

UNIT-I

Introduction to Modelling – Types and purposes of business models – Rules for model design–Model layout flow charting – Steps to building a model – Best practice principles of modelling – Documentation – Preparing and presentation of Model results – Model review –Auditing a Model.

Introduction to Modelling:

A financial model is a mathematical representation of the financial operations and financial statements of a company. It is used to forecast future financial performance of the company by making relevant assumptions of how the company would realistic in the coming financial years.

Financial Modeling is the main core element to take the major business decisions in a corporate world. Financial models are the most valuable tools for executing business choices to get perfect solutions. A model can advise you regarding the grade of risk associated with implementing certain decisions. They can also be utilized to devise an effective financial statement that reflects the finances and operations of company. These models help online internet businesses take quick decisions more confidently.

Definition: Financial modelling involves combining key accounting, finance, and business metrics to build an abstract representation, or model, of a company's financial situation. This exercise helps a company visualize its current financial position and predict future financial performance.

Financial modelling can be quite handy in a number of situations. It can help inform investment decisions, securities pricing, and plans for corporate transactions such as mergers, acquisitions, Investment Banking etc. But the most common use of a financial model is for making operational business decisions and performing financial analysis. Executives typically use financial models to make decisions regarding:

- Budgeting and forecasting
- Organic business growth
- Valuing the company
- Raising capital in the form of debt or equity
- Acquiring new assets or other businesses
- Ranking projects
- Distributing the organization's financial resources
- Risk management

Uses of Financial Modelling:

In the finance industry the value of financial modelling is increasing rapidly. Financial modelling acts as an important tool which enables business ideas and risks to be estimated in a cost-effective way. Financial modelling is an action of creating attractive representation of a financial situation of company. Financial Models are mathematical terms aimed at representing the economic performance of a business entity.

Financial Modelling are widely used in Various Sectors like:

- Investment Banks
- Credit Rating Agencies
- Equity Research
- Mutual Funds
- Financial KPOs

- Project Finance companies.

Career opportunities: Financial Modelling is the main component of business decision-making program. The Financial model allows corporate industries to explore the outcome under different scenarios. Some of the skills/areas that you can learn and work in after pursuing financial modelling are:

- Merger and acquisition
- Project finance
- DCF Modelling
- Venture Capital
- IP Valuation- Option Based Method
- IP Valuation- Market Based Method
- Ratio Analysis
- Asset Allocation
- Qualitative Analysis
- Sensitivity Analysis

Financial modelling is the process of estimating the financial performance of a project or business by taking into account all relevant factors, growth and risk assumptions, and interpreting their impact. It enables the user to acquire a concise knowledge of all the variables involved in financial forecasting.

- To show the path to profitability
- To quantify the investment requirement
- To facilitate valuation of the business
- Raising capital (debt and/or equity)
- Budgeting and forecasting (planning for the years ahead)
- Financial statement analysis/ratio analysis

Types of financial models:

- Three Statement Model
- Discounted Cash Flow (DCF) Model
- Merger Model (M&A)
- Initial Public Offering (IPO) Model
- Leveraged Buyout (LBO) Model
- Sum of the Parts Model
- Forecasting Model
- The comparable company analysis (CCA) model
- Option Pricing Model
- Asset and Liability Management

1. Three Statement Model: The three-statement financial model integrates and forecasts a company's three financial statements—the income statement, balance sheet, and cash-flow statement—into the future.

The three-statement model represents the real meat and potatoes when it comes to financial modelling. This model acts as a standard that gives a comprehensive overview of the company's financial history, current standing, and future performance.

2. Discounted Cash Flow (DCF) Model: A financial analyst may turn to the discounted cash flow (DCF) model when they need a way of determining valuation. One of the key attributes of the DCF model is that it calculates current value while taking into account predictions for

how much money something will make in the future.

The DCF model can be used to value an entire company, but you can also use this model to value:

- Shares of a company
- A project or investment within a company
- A cost-saving initiative within a company

3. Merger Model (M&A): The merger and acquisition (M&A) model calculates the impact of a merger or acquisition on the earnings per share (EPS) of the newly formed company. This value can then be compared to the company's current EPS. If the M&A model shows an increase in EPS, then the transaction is considered **accretive**, meaning it should result in growth. But if the M&A model shows a decrease in EPS, the transaction is considered **dilutive**, meaning it will reduce the company's value.

4. The comparable company analysis (CCA) model: It is another way for a business to calculate its value. It's a more basic valuation method than the DCF model.

- The CCA financial model is based on the assumption that similar companies will have similar valuation multiples. It uses metrics from other businesses with similar sizes and operations in the same industry.
- EV/S – Enterprise Value to Sales
- P/E – Price to Earnings
- P/B – Price to Book
- P/S – Price to Sales

5. Initial Public Offering (IPO) Model: The IPO pricing model has several different components that it includes issuing of company shares etc. For example, it will make use of the comparable company analysis, looking at their P/E relative to industry peers.

This model also takes into account previous funding round valuations, and what share price would be attractive to institutional investors that are subscribing to the IPO.

6. Leveraged Buyout (LBO) Model: The leveraged buyout (LBO) model is used to analyse an acquisition that finances the cost mostly with debt. How much debt? Typically, a leveraged buyout is 90% debt and 10% equity. Due to this incredibly high debt-to-equity ratio, the bonds being issued are not investment grade – i.e. junk bonds. Some people consider LBOs to be an incredibly aggressive and risky move, but with great risk comes great reward.

- Key credit metrics in an LBO model include:
- Debt/EBITDA
- Interest Coverage Ratio (EBIT/Interest)
- Debt Service Coverage Ratio (EBITDA – Capex) / (Interest + Principle)
- Fixed Charge Coverage Ratio (EBITDA – Capex – Taxes) / (Interest + Principle)

7. Sum of the Parts Model: The sum-of-the-parts financial model allows large **conglomerate** organizations with many divisions to simplify their valuation. As the name suggests, the sum-of-the-parts model values each business unit, division, or subsidiary separately and then adds them all together.

This can sometimes make it difficult for the FP&A department as they are having to gather financial data from multiple entities and assemble it into a single model.

8. Forecasting Model: Forecasting is one of the most important tasks that the FP&A department takes care of on a regular basis. It is typically used to predict future revenues,

expenses, and capital costs.

- **Straight-Line Model**-It makes use of historical data to estimate what will happen in the future.
- **Moving Average Model**-companies use the moving average model to evaluate performance on a monthly basis and makes use of three-month and five-month moving averages.
- **Linear Regression Model**-This forecasting method is best used to compare the relationship between two different variables. A common example is advertising budget and revenue
- **Time Series Model**-machine learning or specialized software like Tidemark.

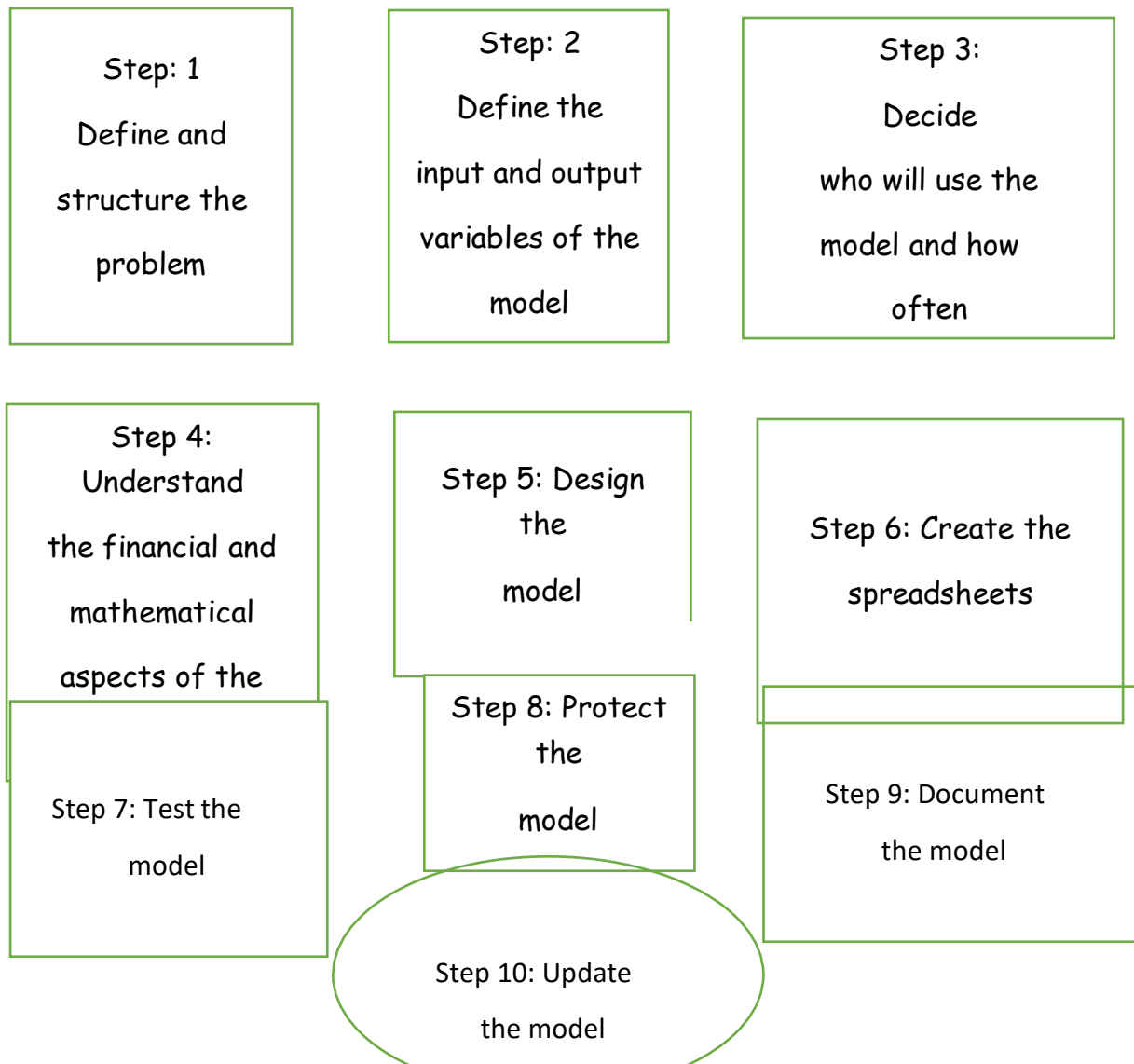
9. Option Pricing Model: Option pricing models are typically used by market makers and securities traders looking to turn a profit or hedge risk. These financial models are used to assign a price (premium) for the options contract based on statistics and probability (i.e. how likely the option will be in-the-money at expiration).

- **In -the- Money- option:** An in-the-money call option means the option holder has the opportunity to buy the security below its current market price.
- **At-the- Money- option:** equal (options contract with a strike price that is identical to the underlying market price.)
- **Out-the -Money -option:** An in-the-money call option means the option holder has the opportunity to buy the security higher its current market price.

10. Asset and Liability Management (ALM): Asset and liability financial models are primarily used by financial institutions (banks and insurance companies) and pension funds (corporate or public) to manage their financial objectives. For example, pension funds must be able to pay pensioners during any economic conditions.

Most pension funds conduct a comprehensive review every three to five years. During this process, they use financial analysis and modelling to adjust their asset and liability management strategies to reduce portfolio sensitivity to economic conditions, interest rate changes, and foreign exchange rates.

Steps to building a model: The building is the process of designing and developing a new financial model with a logical flow and structural compactness to the point that it can transform a given set of assumptions into trustworthy projections that describe and illustrate a deal in a quantitative manner.



Define and structure the problem: the first step of every financial model starts with the historical results of the company. First, load the historical financial statements into Excel, preferably three years. Followed by performing reverse engineering on the assumptions for the historical period, i.e. calculating things like revenue growth rate, gross margins, variable costs, fixed costs, AP days, inventory days, etc. From the past calculations, you can build assumptions to forecast the future period.

Define the input and output variables of the model: It analyses the performance of Excel spreadsheet simulation analysis on supply chain. The spreadsheet was used to model the inventory control issue that developed in order to minimize the total cost of inventory, shortages and transportations for single supplier multi retailer problem who face a stochastic demand

Decide who will use the model and how often: Financial models are used to estimate the valuation of a business or to compare businesses to their peers in the industry. They also are used in strategic planning to test various scenarios, calculate the cost of new projects, decide on budgets, and allocate corporate resources.

Understand the financial and mathematical aspects of the model: Financial models are

activities that prepare a model representing a real-world financial situation. they are intended to be used as decision-making tools. Company executives might use financial models to estimate the costs and project the profits of a proposed new project. Financial analysts use financial models to anticipate the impact of an economic policy change or any other event on a company's stock.

Design the model: Many people are still using spreadsheets for financial modelling. Consider when it may make sense to transition your models to a different tool. Large-scale modelling in spreadsheets may become problematic for a variety of reasons. There are lots of tools available that have been purpose-built for financial modelling that are improvements on the standard spreadsheet tools most modelers use and many offers free trials, so do your homework and choose the right tool.

Create the spreadsheets: Spreadsheets are grid-based files designed to organize information and perform calculations with scalable entries. People all around the world use spreadsheets to create tables for any personal or business need.

Test the model: Nowadays Microsoft Excel is a spreadsheet tool which is used worldwide for performing, financial modelling as it gives more flexibility. With proper analysis of the model the decisions like fund requirement, risk associated, offerings, investment and return analysis can be done.

Protect the model: Protecting Excel data in financial modelling is critical. Users prefer to secure and protect cells that they will not tweak or change while leaving certain cells free to adjust assumptions and inputs. By doing so, users are protected from potential inconsistencies and mistakes that may result from typos and unwanted changes in output cell functions.

Document the model:

- Income statement
- Balance sheet
- cash flow statement
- Supporting Schedule

Update the model or Audit: A model audit is done in order to make sure that spreadsheet errors are corrected. Thus, it needs to be specific with its scope and purpose to ensure that the relevant tasks are completely and correctly carried out.

Best Practices in Financial Modelling: financial modelling best practices in Excel, it is important to note that model building is not an mathematical process in order to minimize errors when building your financial models, be mindful of the following five basic steps:

- Clarify the business problem
- Plan your structure
- Build structural integrity
- Inputs and Assumptions
- Detailed Calculations and Operating Build-up
- Test the model/Formatting Your Model (COLOURS)

Preparing and presentation of Model results:

- Use MS Excel Spread sheet or VBA code
- Use white space instead of gridlines
- Assumptions and drivers
- Income statement
- Balance sheet
- Cash flow statement
- Supporting schedules

- Company Valuation
- Sensitivity analysis
- Charts and graphs

Documentation:

Financial Statement Analysis: The process of critical evaluation of the financial information contained in the financial statements in order to understand and make decisions regarding the operations of the firm is called 'Financial Statement Analysis'.

- Income statement
- Balance sheet
- cash flow statement
- Supporting Schedule

The Income Statement Module is one of the three Module Types in the Financial Statements Module Area. As with all Modules, the Income Statement Module can be used in many different ways to create many different spreadsheet models.

The Income Statement Module could be used to create a spreadsheet model that contains

Balance sheet: The Balance Sheet shows the status of an entity's assets, liabilities and owner's equity at a point in time, usually the close of a month. A Balance Sheet provides a snapshot of the entity's financial position, including the cumulative results of the Income Statement and Cash Flow Statement, at a point in time. A Balance Sheet is also referred to as a „Statement of Financial Position“.

Most balance sheets are arranged according to this equation: Assets =

Liabilities + Shareholders' Equity

Assets:

- Current assets are typically what a company expects to convert into cash within a year's time, such as cash and cash equivalents, prepaid expenses, inventory, marketable securities, and accounts receivable.
- Non-current assets are long-term investments that a company does not expect to convert into cash in the short term, such as land, equipment, patents, trademarks, and intellectual property.

Liabilities:

- Current liabilities are typically those due within one year, which may include accounts payable and other accrued expenses.
- Non-current liabilities are typically those that a company doesn't expect to repay within one year. They are usually long-term obligations, such as leases, bonds payable, or loans

Shareholder's equity: Shareholders' Equity: Shareholders' equity refers generally to the net worth of a company, and reflects the amount of money that would be left over if all assets were sold and liabilities paid. Shareholders' equity belongs to the shareholders, whether they be private or public owners

Shareholders' Equity = Assets - Liabilities

Common line items found in this section of the balance sheet include:

- Common stock
- Preferred stock
- Treasury stock
- Retained earnings

Cash flow statement:

- ✓ Cash comprises cash on hand and demand deposits with banks. Cash equivalents are

short term, highly liquid investments that are readily convertible into known amounts of cash and which are subject to an insignificant risk of changes in value.

- **Cash flows** : cash inflows and cash outflows of cash and cash equivalents.
- Operating activities: Cash, Changes in working capital, Depreciation.
- ❖ Investing activities: Fixed Assets, capital Expenditure, PP&E.

Financing activities: owners' capital (including *preference share capital* in the case of a company) and *borrowings* of the enterprise

Build 3 Statement – Model by Using Excel:

- Income statement
- Balance sheet
- cash flow statement
- Supporting Schedule

The Income Statement Module is one of the three Module Types in the Financial Statements Module Area. As with all Modules, the Income Statement Module can be used in many different ways to create many different spreadsheet models.

Financial Modeling (Three Statement Projection Model)							
Company name : Hinduja Pvt Ltd							
Income Statement	2011	2012	2013	2014	2015	2016	2017
Revenue	74,452	83,492	91,841	1,01,025	1,11,128	1,22,241	1,34,465
Growth%	NA	12%	10%	10%	10%	10%	10%
Cost of Goods Sold	64,440	72,524	79,634	87,675	96,400	1,06,064	1,16,657
% Sales	87%	87%	87%	87%	87%	87%	87%
Gross profit	10,012	10,968	12,208	13,350	14,728	16,177	17,808
% Sales	13%	13%	13%	13%	13%	13%	13%
operating expenses	6389	6545	7,540	8,107	9,021	9,866	10,884
% Sales	9%	8%	8%	8%	8%	8%	8%
operating income(EBIT)	3,623	4,423	4,667	5,243	5,707	6,311	6,924
Intrest ex	518	474	414	340	300	260	220
pre income tax(PBT)	3,105	3,949	4,253	4,903	5,407	6,051	6,704
Income tax Expenses	1,087	1,382	1,276	1,471	1,622	1,815	2,011
Tax rate	NM	NM	30%	30%	30%	30%	30%
Net Income	2,018	2,567	2,977	3,432	3,785	4,236	4,693
Income statement Assumptions							
Operating income	3,623	4,423	4,667	5,243	5,707	6,311	6,924
Depreciation	2,648	2,981	3,273	3,604	3,962	4,359	4,795
Amortization	0	0	0	0	0	0	0

EBITDA	3,623	4,423	4,667	5,243	5,707	6,311	6,924
BALANCE SHEET	2011	2012	2013	2014	2015	2016	2017
Current Assets:							
Cash	1,773	2,000	9,181	9,624	10,826	12,037	13,348
Accounts Reciviables	7,750	8,852	9,649	10,662	11,702	12,887	14,167
Inventory	4,800	5,700	6,095	6,801	7,428	8,200	9,004
Pre paid expenses	456	1,849		-	-	-	-
Total Current Assets:	14,779	18,401	24,925	27,087	29,956	33,123	36,519
Fixed Assets							
PP&E, Net of Accumulated Depreciation	10,913	10,932	11,159	11,556	12,094	12,734	13,440
Total Assets	25,692	29,333	36,085	38,642	42,049	45,858	49,959
Current laibilities:							
Accounts payable	5,665	6,656	7,155	7,962	8,708	9,606	10,551
Line of Credit	792	1,375	-	-	-	-	-
Current Maturities of long term Debt	500	500	500	500	500	500	500
Total current liabilites	6,957	8,531	7,655	8,462	9,208	10,106	11,051
Long term libalities:							
Long term debt, Net of Current maturities	5000	4500	4,000	3,500	3,000	2,500	2,000
Total liabilites	11,957	13,031	11,655	11,962	12,208	12,606	13,051
Common Stock	15	15	15	15	15	15	15
Additional Paid in Capital	5,000	5,000	5,000	5,000	5,000	5,000	5,000
Retained earnings	8,720	11,287	14,264	17,696	21,481	25,717	30,410
Total equity	13,735	16,302	19,279	22,711	26,496	30,732	35,425
Total laibilities & equity	25,692	29,333	30,934	34,673	38,704	43,338	48,476
Check	-	-	5,151	3,970	3,346	2,520	1,483
Balance sheet Assumptions							
AR Days	38	39	38	39	38	38	38
Inventory Days	27	29	28	28	28	28	28
Days AP	32	33	33	33	33	33	33
CASH FLOW STATEMENT	2011	2012	2013	2014	2015	2016	2017
Cash flow operating Activities							
Net Income			2,977	3,432	3,785	4,236	4,693
Add Back Non-Cash items							
Dpreciation			3,273	3,604	3,962	4,359	4,795
Amortization			0	0	0	0	0
Changes in Working Capital							

Accounts Recivables			-797	-1,014	-1,039	-1,185	-1,281
Inventory			-395	-706	-627	-772	-804
Accounts payable			499	807	746	899	945
Net Cash provided by operqtng Activities			5,556	6,124	6,826	7,537	8,348
Cash flow from Investing Activities							
Capital Expenditure -Purchase of PP& E			3500	4000	4500	5000	5500
Net Cash used in Investing Activities			3500	4000	4500	5000	5500
Cash flow from Financing Activities							
Revolving Credit Facility (Line of Credit)			-1,375	-	-	-	-
Long term Debt			-500	-500	-500	-500	-500
Net Cash used in Financiag Activities			-1875	-500	-500	-500	-500
Net Cash Flow /Blance			7,181	9,624	10,826	12,037	13,348
Beginning cash Balance			2,000	0	0	0	0
Opening Cash Balance			9,181	9,624	10,826	12,037	13,348
SUPPORTING SCHEDULES:							
Company Name: Hinduja Pvt Ltd							
Debt Schedule	2011	2012	2013	2014	2015	2016	2017
Cash balance @ Beg of year(end of last year)			2,000	9,181	9,624	10,826	12,037
Plus: Free cash flow from operating and investing			3,681	5,624	6,326	7,037	7,848
Plus: Free cash fow from Financing (before L.O.C)			-500	-500	-500	-500	-500
Less: Minimum Cash Balnce			2000	2000	2000	2000	2000
Total Cash Available or Required from L.O.C			3,181	12,305	13,450	15,363	17,385
Line of Credit	792	1,375	-	-	-	-	-
Debt							
Long term Debt , Net of Current Maturities	5000	4500	4,000	3,500	3,000	2,500	2,000
Current Portion of Long Term Debt	500	500	500	500	500	500	500
Interest Expenses							
Interest Rate on Long term debt			8%	8%	8%	8%	8%
Intrest Rate on Line of Credit			5%	5%	5%	5%	5%
Interest expenses on long term debt			380	340	300	260	220
Interest expenses on line of credit			34	-	-	-	-

Total Interest Expenses			414	340	300	260	220
PP&E Schedule							
Beg: PP&E, Net of			10,932	11,159	11,556	12,094	12,734
Accum. Depreciation							
Plus: Capital Expenditure			3500	4000	4500	5000	5500
Less: Depreciation			3,273	3,604	3,962	4,359	4,795
Depreciation as % of Revenue	4%	4%	4%	4%	4%	4%	4%
END: PP&E, NET OF ACCUM. DEPRECIATION			11,159	11,556	12,094	12,734	13,440

Model review & Auditing a Model: A model audit is an important task in financial auditing that helps ensure that spreadsheet errors are eliminated it also called a model review, it is commonly used by banking organizations in order to make accurate, supportive to lenders and investors.

Scope of a Model Audit: A model audit is done in order to make sure that spreadsheet errors are corrected. Thus, it needs to be specific with its scope and purpose to ensure that the relevant tasks are completely and correctly carried out. The audit's scope includes the following

- The audit should successfully review the logic used in the model underscrutiny.
- An audit should check for the model's consistency in terms of transactions and documentation.
- The audit should make sure that the model is consistent and parallel with GAAP and taxation rules.

Purpose of a Model Audit:

- The audit should be able to yield accurate results and the auditor needs to provide an assurance to the party seeking the audit that such results will be obtained.
- the audit aims to ensure that the financial model used by a business is accurate and that the assumptions contained within it are effective

All 10 types of Financial Models

- It confirms or denies that the financial model does what it is expected to do and that any errors are minimal and will not cause any derail or delay of the business' projects.

Categories:

High-level review

A high-level review provides added confidence to clients about the financial model that they are using. Aside from just correcting errors on a spreadsheet, a special feature of the model audit is that it is keener and more sensitive to spotting errors without checking every single detail of the model in question. It makes the process less time-consuming, while still maintaining a very high accuracy of results, and it includes a check of the model's logic.

Formal model audit: A formal audit is what stakeholders and investors may require even after the completion of an audit and submission of a report saying that the model is good enough to use. Often, they require an audit that is formal and most comprehensive, and the formal audit satisfies this requirement.

Cost and Duration of a Model Audit: The audit is completed usually within one to five weeks, depending on how extensive the review is.

The fee depends on the following factors:

- Scope of the review
- Complexity of the model checked
- Volume and complexity of the documentation to be reviewed
- The seniority of the staff who does the work

How to Conduct a Model Audit: In order to perform the audit, it is important to recognize that a model is produced by using MS Excel spreadsheets and, therefore, contains data, figures, and formulas. The auditors usually conduct a bottom-up review or a cell-by-cell check of every formula. They can also do a “top-down” analysis of the model.

- **Get familiar with its look and feel.** Look through each sheet to see what colour schemes have been used.
- **Run an error check.** Press the Error Checking button on the Formula Auditing section of the Formulas tab in the Ribbon to see at a glance whether there are any Excel errors on the sheet that might cause problems.
- **Check automatic calculations.** Formulas should calculate automatically, but sometimes when a file is very large, or a modeler likes to control the changes manually, the calculation has been set to manual instead of automatic

Important Questions:

1. What is Financial Modelling? Explain how it is helpful in analysing a firm's Financial Position?
2. How do you build a Financial Model?
3. How is Financial Modelling applied to three statement projection model with using Excel?
4. Explain different types of Financial Models with suitable examples?
5. Discuss the best practice principles of modelling and how it is useful in Financial Statement analysis?

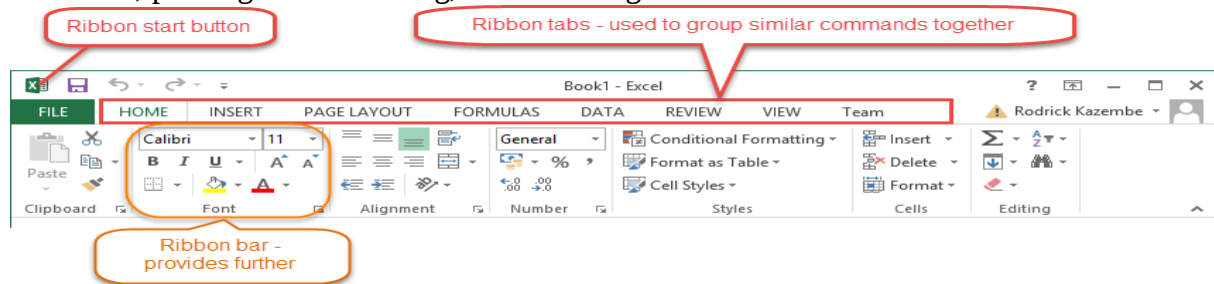
Unit II

Excel functions – Importing and exporting data – Financial functions (PV, FV Rate, NPER, IRR, NPV, MIRR, XNPV, XIRR, effect, nominal, Price) – Lookup and reference functions (Choose, Offset, Match, Indirect, Look up) – Statistical functions – Date and Time functions– What if functions Goal Seek, Solver - PivotTable – Data Analysis – Conditional formatting– Array Formulas - Dynamic named ranges - Working with Charts – Creating dynamic charts.

Introduction:

Excel is a spreadsheet program that is used to record and analyze numerical data. Think of a spreadsheet as a collection of columns and rows that form a table. Alphabetical letters are usually assigned to columns and numbers are usually assigned to rows. The point where a column and a row meet is called a cell. The address of a cell is given by the letter representing the column and the number representing a row. Let's illustrate this using the following image

UNDERSTANDING THE RIBBON: The ribbon provides shortcuts to commands in Excel. A command is an action that the user performs. An example of a command is creating a new document, printing a documenting, etc. The image below shows the ribbon used in Excel



RIBBON COMPONENTS EXPLAINED: Ribbon start button - it is used to access commands i.e. creating new documents, saving existing work, printing, accessing the options for customizing Excel, etc

Ribbon tabs – the tabs are used to group similar commands together. The home tab is used for basic commands such as formatting the data to make it more presentable, sorting and finding specific data within the spreadsheet.

Ribbon bar – the bars are used to group similar commands together. As an example, the Alignment ribbon bar is used to group all the commands that are used to align data together.

UNDERSTANDING THE WORKSHEET (ROWS AND COLUMNS, SHEETS,

WORKBOOKS): A worksheet is a collection of rows and columns. When a row and a column meet, they form a cell. Cells are used to record data. Each cell is uniquely identified using a cell address. Columns are usually labelled with letters while rows are usually numbers.

A workbook is a collection of worksheets. By default, a workbook has three cells in Excel. You can delete or add more sheets to suit your requirements. By default, the sheets are named Sheet1, Sheet2 and so on and so forth. You can rename the sheet names to more meaningful names i.e. Daily Expenses, Monthly Budget, etc

Excel functions:

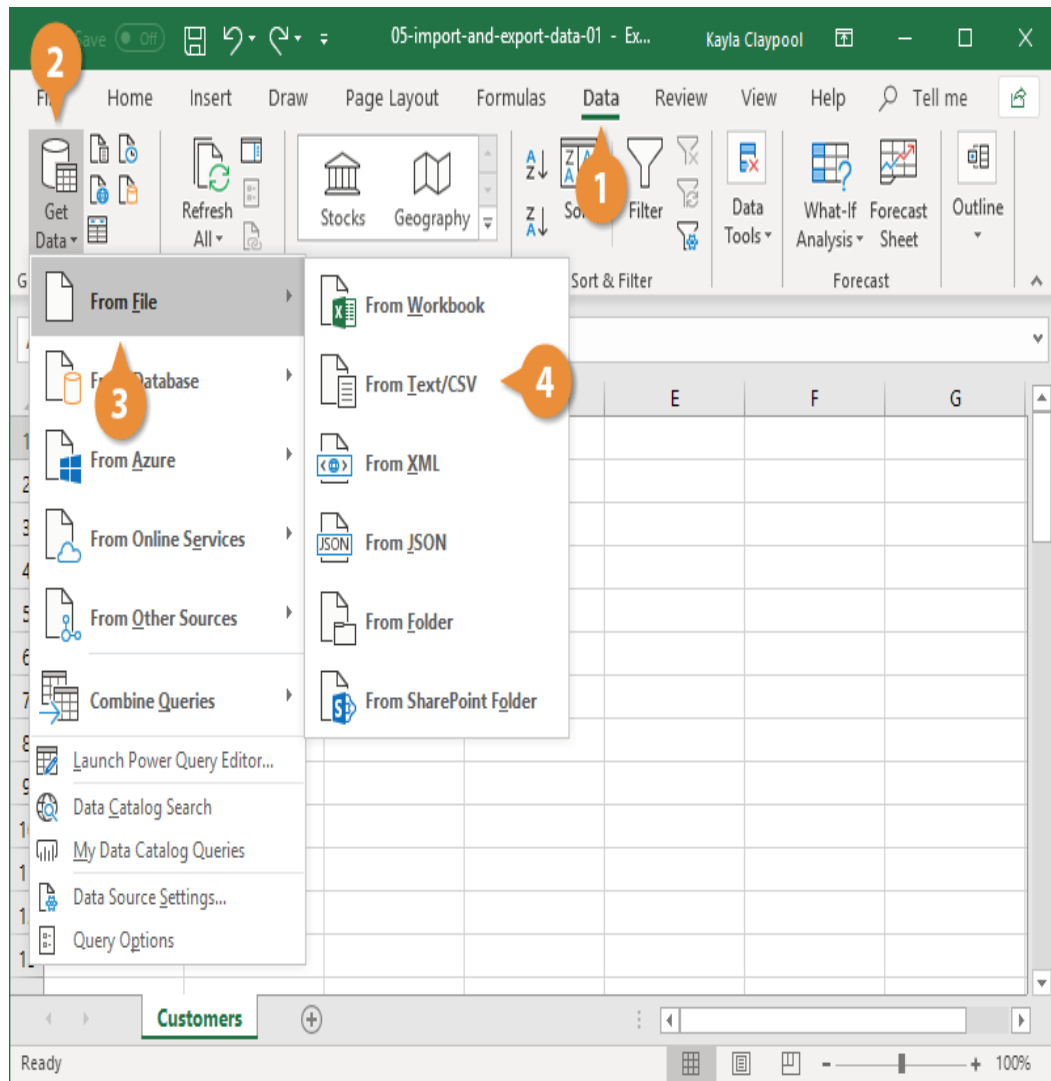
A function in Excel is a formula-based program, that helps perform mathematical, statistical and

logical operations

There are now over 400 functions are available in Excel, and Microsoft keeps adding more with each new version of the software.

The most frequently used functions in Excel are:

Function	What It Does
SUM	Adds up, or sums together, a range of cells.
MIN	Calculates the minimum value of a range of cells.
MAX	Calculates the maximum value of a range of cells.
AVERAGE	Calculates the average value of a range of cells.
ROUND	Rounds a single number to the nearest specified value, usually to a whole number.
ROUNDUP	Rounds up a single number to the nearest specified value, usually to a whole number.
ROUNDDOWN	Rounds down a single number to the nearest specified value, usually to a whole number.
INDEX	Works like the coordinates of a map and returns a single value based on the column and row numbers you input into the function fields.
MATCH	Returns the position of a value in a column or a row. Modelers often combine MATCH with the INDEX function to create a lookup function, which is far more robust and flexible and uses less memory than the LOOKUP functions earlier.
PMT	Calculates the total annual payment of a loan.
IPMT	Calculates the interest component of a loan.
PPMT	Calculates the principal component of a loan.



NPV

Takes into account the time value of money by giving the net present value of future cash flows in today's dollars, based on the investment amount and discount rate.

Importing and exporting data:

Import data:

Excel can import data from external data sources including other files, databases, or web pages.

STEP 1: Click the Data tab on the Ribbon

STEP 2: Click the Get Data button.

STEP 3: Select from File.

STEP 4: Select From Text/CSV.

STEP 5: Select the file you want to import.

Worksheet.csv

File Origin: 1252: Western European (Windows) | Delimiter: Comma | Data Type Detection: Based on first 200 rows

First	Last	Company	City	Packages	Sales
Joel	Nelson	Nincom Soup	Minneapolis	6	6602
Louis	Hay	Video Doctor	Mexico City	7	8246
Anton	Baril	Nincom Soup	Minneapolis	11	13683
Caroline	Jolie	Safrosoft	Paris	12	14108
Daniel	Ruiz	Idéal Base	Paris	6	7367
Gina	Cuellar	SocialU	Minneapolis	6	7456
Joseph	Voyer	Video Doctor	Mexico City	7	8320
Nena	Moran	Hôtel Soleil	Paris	4	4369
Robin	Banks	Nincom Soup	Minneapolis	4	4497
Sofia	Valles	Luna Sea	Mexico City	1	1211
Kerry	Oki	Luna Sea	Mexico City	10	12045
Javier	Solis	Hôtel Soleil	Paris	5	5951
Lucy	Gramm	SocialU	Minneapolis	1	1200
Rachel	Lyons	Hôtel Soleil	Paris	8	9052
Saulo	Diaz	SocialU	Minneapolis	9	10821

File name: 05-import-and-export-data-02.csv | Text Files (*.prn;*.txt;*.csv)

Tools | Import | Cancel

STEP 6: Click Import.

STEP 7: Verify the preview looks correct.

STEP 8: Click Load.

Financial functions (PV, FV Rate, NPER, IRR, NPV, MIRR, XNPV, XIRR, effect, nominal, Price):

PV: The PV function is a widely used financial function in Microsoft Excel. It calculates the present value of a loan or an investment. In financial statement analysis, PV is used to calculate the dollar value of future payments in the presenttime.

Example

Suppose you are buying a refrigerator. The salesperson tells you that the price of the refrigerator is 32000, but you have an option to pay out the amount in 8 years with an interest rate of 13% per annum and yearly payments of 6000. You also have an option to make the payments either at the beginning or end of each year.

You want to know which of these options is beneficial for you. You can use Excel function PV –

PV (rate, nper, pmt, [fv], [type]

To calculate present value with payments at the end of each year, omit type or specify 0 for type.

To calculate present value with payments at the beginning of each year, specify 1 for type.

	A	B	C
1			
2		Price	32000
3		Interest Rate	0.13
4		No. of Payments	8
5		Payment	-6000
6		Payment at end of each year	
7		PV	=PV(C3,C4,C5)
8			
9		Price	32000
10		Interest Rate	0.13
11		No. of Payments	8
12		Payment	-6000
13		Payment at beginning of each year	
14		PV	=PV(C10,C11,C12,,1)

Results:

- ☐ If you make the payment now, you need to pay 32,000 of present value.
- ☐ If you opt for yearly payments with payment at the end of the year, you need to pay

	A	B	C
1			
2		Price	32000
3		Interest Rate	13%
4		No. of Payments	8
5		Payment	-6000
6		Payment at end of each year	
7		PV	28,793
8			
9		Price	32000
10		Interest Rate	13%
11		No. of Payments	8
12		Payment	-6000
13		Payment at beginning of each year	
14		PV	32,536

28, 793 of present value.

- ☐ If you opt for yearly payments with payment at the end of the year, you need to pay 32,536 of present value.

You can clearly see that option 2 is benefited

FV Rate: The FV Function Excel formula is categorized under financial functions. This function helps calculate the future value of an investment. the FV function helps calculate the future value of investments made by a business, assuming periodic, constant payments with a constant interest rate. It is useful in evaluating low-risk investments such as certificates of deposit or fixed rate annuities with low interest rates. It can also be used in relation to interest paid on loans.

NPER: The function helps calculate the number of periods that are required to pay off a loan or reach an investment goal through regular periodic payments andat a fixed interest rate.

IRR: The function is very helpful in financial modelling, as it helps calculate the rate of return an investment would earn based on series of cash flows. It is frequently used by businesses to compare and decide between capital projects

Internal Rate of Return (IRR) of an investment is the rate of interest at which NPV is 0. It is the rate value for which the present values of the positive cash flows exactly compensate the negative ones. When the discount rate is the IRR, the investment is perfectly indifferent, i.e. the investor is neither gaining nor losing money.

Consider the following cash flows, different interest rates and the corresponding NPV values.

	A	B	C	D
1				
2		Cash Flows	Interest Rate	NPV
3		10000	8.00%	(304.95)
4		-5000	8.50%	(242.26)
5		-8500	9.00%	(180.80)
6		2000	9.50%	(120.54)
7			10.00%	(61.47)
8			10.53%	(0.12)
9			11.00%	53.23
10			11.50%	108.91
11			12.00%	163.51

As you can observe between the values of interest rate 10% and 11%, the sign of NPV changes. When you fine-tune the interest rate to 10.53%, NPV is nearly 0. Hence, IRR is 10.53%.

Determining IRR of Cash Flows for a Project

You can calculate IRR of cash flows with Excel function IRR.

	A	B		A	B
1			1		
2		Cash Flows	2		Cash Flows
3		10000	3		10000
4		-5000	4		-5000
5		-8500	5		-8500
6		2000	6		2000
7			7		
8		IRR	8		IRR
9		=IRR(B3:B6)	9		10.53%
10					

The IRR is 10.53% as you had seen in the previous section. For the given cash flows, IRR may –

- ☐ exist and unique
- ☐ exist and multiple
- ☐ not exist

Unique IRR

If IRR exists and is unique, it can be used to choose the best investment among several possibilities.

- ☐ If the first cash flow is negative, it means the investor has the money and wants to invest. Then, the higher the IRR the better, since it represents the interest rate the investor is receiving.
- ☐ If the first cash flow is positive, it means the investor needs money and is looking for a loan, the lower the IRR the better since it represents the interest rate the investor is paying.

To find if an IRR is unique or not, vary the guess value and calculate IRR. If IRR remains constant then it is unique.

	A	B	C	D	E
1					
2		Cash Flows		Guess	IRR
3		10000			=IRR(B3:B6)
4		-5000		0.05	=IRR(\$B\$3:\$B\$6,D4)
5		-8500		0.15	=IRR(\$B\$3:\$B\$6,D5)
6		2000		0.2	=IRR(\$B\$3:\$B\$6,D6)
7				0.25	=IRR(\$B\$3:\$B\$6,D7)
8				0.3	=IRR(\$B\$3:\$B\$6,D8)
9				0.35	=IRR(\$B\$3:\$B\$6,D9)
10				0.4	=IRR(\$B\$3:\$B\$6,D10)
11				0.45	=IRR(\$B\$3:\$B\$6,D11)
12				0.5	=IRR(\$B\$3:\$B\$6,D12)
13				0.55	=IRR(\$B\$3:\$B\$6,D13)

As you observe, the IRR has a unique value for the different guess values.

	A	B	C	D	E
1					
2		Cash Flows		Guess	IRR
3		10000			10.53%
4		-5000		5.00%	10.53%
5		-8500		15.00%	10.53%
6		2000		20.00%	10.53%
7				25.00%	10.53%
8				30.00%	10.53%
9				35.00%	10.53%
10				40.00%	10.53%
11				45.00%	10.53%
12				50.00%	10.53%
13				55.00%	10.53%

NPV: The NPV Function is an Excel Financial function that will calculate the Net Present Value (NPV) for a series of cash flows and a given discount rate. It is

important to understand the Time Value of Money, which is a foundational buildingblock of various Financial Valuation methods.

In financial modelling the NPV function is useful in determining the value of an investment or understanding the feasibility of a project. It should be noted that it's usually more appropriate for analysts to use the XNP function instead of theregular NPV function.

MIRR: The modified internal rate of return (commonly denoted as MIRR) is a financial measure that helps to determine the attractiveness of an investment and that can be used to compare different investments.

Essentially, the modified internal rate of return is a modification of the internalrate of return (IRR) formula, which resolves some issues associated with that financial measure

Consider a case when your finance rate is different from your reinvestment rate. If you calculate Internal Rate of Return with IRR, it assumes same rate for both finance and reinvestment. Further, you might also get multiple IRRs.

For example, consider the cash flows given below –

	A	B	C	D
1				
2		Finance Rate		10%
3		Reinvestment Rate		12%
4				
5			Year	Cash flows
6			0	-1.6
7			1	10
8			2	-10
9				
10			Discount Rate	NPV
11			10%	(\$0.70)
12			25%	\$0.00
13			110%	\$0.43
14			400%	(\$0.00)
15			500%	(\$0.04)

As you observe, NPV is 0 more than once, resulting in multiple IRRs. Further, reinvestment rate is not taken into account. In such cases, you can use modified IRR (MIRR).

	A	B	C	D
1				
2		Finance Rate		0.1
3		Reinvestment Rate		0.12
4				
5			Year	Cash flows
6			0	-1.6
7			1	10
8			2	-10
9				
10			Discount Rate	NPV
11			0.1	=NPV(C11,D6:D8)
12			0.25	=NPV(C12,D6:D8)
13			1.1	=NPV(C13,D6:D8)
14			4	=NPV(C14,D6:D8)
15			5	=NPV(C15,D6:D8)
16				
17		MIRR	=MIRR(D6:D8,D2,D3)	

You will get a result of 7% as shown below –

	A	B	C	D
1				
2		Finance Rate		10%
3		Reinvestment Rate		12%
4				
5			Year	Cash flows
6			0	-1.6
7			1	10
8			2	-10
9				
10			Rate	NPV
11			10%	(\$0.70)
12			25%	\$0.00
13			110%	\$0.43
14			400%	(\$0.00)
15			500%	(\$0.04)
16				
17		MIRR	7%	

Note – Unlike IRR, MIRR will always be unique.

XNPV: The XNPV function in Excel uses specific dates that correspond to each cash flow being discounted in the series, whereas the regular NPV function automatically assumes all the time periods are equal. For this reason, the XNPV function is far more precise and should be used instead of the regular NPV function.

XNPV (Net Present Value of an Investment for Payments or Incomes at Irregular Intervals) Returns the net present value of an investment based on a discount rate and a set of future payments (negative values) and income (positive values). These payments or incomes do not need to occur at regular intervals

XIRR: XIRR stands for the individual rate of return. It's your real investment return. XIRR is a tool for calculating returns on assets where many transactions occur at different times.

XIRR meaning in mutual fund is to calculate returns on investments where there are multiple transactions taking place in different times. Full form of XIRR is Extended Internal Rate of Return.

EFFECT: This function calculates the effective annual interest rate for non-annual compounding loans. Analysts often need to make decisions on which financial loan will be best for a business

NOMINAL: The Excel NOMINAL function is a Financial formula that calculates and returns the nominal annual interest rate, for a given effective annual interest rate and number of compounding periods per year. The nominal annual interest rate is used for calculating financial loans and investments with different compounding terms.

PRICE: The price function is a financial function in Excel. This is mostly used when an investor borrows the money by selling bonds instead of stocks. It requires few more attributes, usually more than other financial function such as settlement, maturity, yield, redemption, and frequency as mandatory attributes

Lookup and reference functions (Choose, Offset, Match, Indirect, Look up): **Choose:** The CHOOSE Function in Excel returns a value from the given data range (array) when the position (index) is specified by the user. This lookup and reference function of Excel is most commonly used to create scenarios in financial models.

Offset: OFFSET will return a range of cells. That is, it will return a specified number of rows and columns from an initial range that was specified.

The OFFSET function can be used to build a dynamic named range for pivot tables or charts to make sure that the source data is always up to date

Match: MATCH is an Excel function used to locate the position of a lookup value in a row, column, or table. It is commonly used with the INDEX function. Learn how to combine INDEX MATCH as a powerful lookup combination

Indirect: The Excel INDIRECT Function returns a reference to a range. The INDIRECT function does not evaluate logical tests or conditions. Also, it will not perform calculations. Basically, this function helps lock the specified cell in a formula.

Look up: The LOOKUP Function is categorized under Excel Lookup and Reference functions. The function performs a rough match lookup either in a one-row or one-column range and returns the corresponding value from another one-row or one-column range.

While doing financial analysis, if we wish to compare two rows or columns, we can use the LOOKUP function. It is designed to handle the simplest cases of vertical and horizontal lookup.

The more advanced versions of the LOOKUP function are :

HLOOKUP: HLOOKUP stands for Horizontal Lookup and can be used to retrieve

information from a table by searching a row for the matching data and outputting from the corresponding column. While VLOOKUP searches for the value in a column, HLOOKUP searches for the value in a row

VLOOKUP: VLOOKUP stands for 'Vertical Lookup'. It is a function that makes Excel search for a certain value in a column (the so called 'table array'), in order to return a value from a different column in the same row. This article will teach you how to use the VLOOKUP function.

Statistical functions:

In Excel, we have a range of statistical functions, we can perform basic mean, median mode to more complex statistical distribution, and probability test. In order to understand statistical Functions, we will divide them into two sets:

- **Basic statistical Function**
- **Intermediate Statistical Function**

COUNT: The COUNT function is used to count the number of cells containing a number. Always remember one thing that it will only count the number.

COUNTA: This function will count everything, it will count the number of the cell containing any kind of information, including numbers, error values, empty text. **COUNTBLANK:** COUNTBLANK function, as the term, suggest it will only count blank or empty cells.

COUNTIFS: COUNTIFS function is the most used function in Excel. The function will work on one or more than one condition in a given range and counts the cell that meets the condition.

Intermediate Statistical Function:

AVERAGE: This function is one of the most used intermediate functions. The function will return the arithmetic mean or an average of the cell in a given range. **AVERAGEIF-** The function will return the arithmetic mean or an average of the cell in a given range that meets the given criteria.

MEDIAN -The MEDIAN function will return the central value of the data. Its syntax is similar to the AVERAGE function.

MODE- The MODE function will return the most frequent value of the cell in a given range.

STANDARD DEVIATION: This function helps us to determine how much observed value deviated or varied from the average. This function is one of the useful functions in Excel

VARIANCE: To understand the VARIANCE function, we first need to know what is variance? Basically, Variance will determine the degree of variation in your dataset. The more data is spread it means the more is variance.

CORRELATION function: CORRELATION function, help to find the relationship between the two variables, this function mostly used by the analyst to study the data. The range of the CORRELATION coefficient lies between -1 to +1.

MAX function: The MAX function will return the largest numeric value within a given set of data or an array.

MIN function: The MIN function will return the smallest numeric value within a given set of data or an array

Date and Time functions:

Function	Description
DATE function	Returns the serial number of a particular date
DATEDIF function	Calculates the number of days, months, or years between two dates. This function is useful in formulas where you need to calculate an age.
DATEVALUE function	Converts a date in the form of text to a serial number
DAY function	Converts a serial number to a day of the month
DAYS function	Returns the number of days between two dates
DAYS360 function	Calculates the number of days between two dates based on a 360-day year
EDATE function	Returns the serial number of the date that is the indicated number of months before or after the start date
MINUTE function	Converts a serial number to a minute
MONTH function	Converts a serial number to a month
NETWORKDAYS function	Returns the number of whole workdays between two dates
NETWORKDAYS.INTL function	Returns the number of whole workdays between two dates using parameters to indicate which and how many days are weekend days
SECOND function	Converts a serial number to a second
TIME function	Returns the serial number of a particular time

TIMEVALUE function	Converts a time in the form of text to a serialnumber
TODAY function	Returns the serial number of today's date
WEEKDAY function	Converts a serial number to a day of the week
WEEKNUM function	Converts a serial number to a number representing where the week falls numericallywith a year
WORKDAY function	Returns the serial number of the date beforeor after a specified number of workdays
WORKDAY.INTL function	Returns the serial number of the date before or after a specified number of workdays using parameters to indicate which and how many days are weekend days
YEAR function	Converts a serial number to a year
YEARFRAC function	Returns the year fraction representing the number of whole days between start date and end date

What if functions Goal Seek:

- ☐ The Goal Seek in excel is a “what-if-analysis” tool that calculates the valueof the input cell (variable) with respect to the desired outcome. In other words, the tool helps answer the question, “what should be the value of theinput in order to attain the given output?”
- ☐ What-If Analysis is one of the most powerful Excel features and one of the least understood. In most general terms, What-If Analysis allows you to test out various scenarios and determine a range of possible outcomes

- **Microsoft Excel comes with three built-in What-If Analysis tools:** Data Tables, Scenarios, and Goal Seek. All three tools are used in “what-if” scenarios to understand how changing certain input values will affect the output value, or the desired outcome. The Goal Seek function is used to understand what input value is needed in order to realistically achieve your set goal.

(Or)

Goal Seek is a What-If Analysis tool that helps you to find the input value that results in a target value that you want. **Goal Seek** requires a formula that uses the input value to give result in the target value. Then, by varying the input value in the formula, Goal Seek tries to arrive at a solution for the input value.

Goal Seek works only with one variable input value. If you have more than one input value to be determined, you have to use the Solver add-in. Refer to the chapter – Optimization with Excel Solver in this tutorial.

Analysis with Goal Seek

Suppose you want to take a loan of 5,000,000 and you want to repay in 25 years. You can pay an EMI of 50000. You want to know at what interest rate you can borrow the loan.

You can use Goal Seek to find the interest rate at which you can borrow the loan as follows

Step 1 – Set up the Excel cells for Goal Seek as given below.

	A	B	C	D
1				
2		Rate per Annum		Interest_Rate
3		No. of Monthly Payments	360	NPER
4		Loan Amount	5000000	Loan_Amount
5		Type	0	Type
6		EMI	=PMT(Interest_Rate/12,NPER,Loan_Amount,0,Type)	EMI
7				

Step 2 – Enter the values in column C corresponding to column D. The cell Interest Rate is kept empty, as you have to retrieve that value. Further, though you know the EMI that you can pay (50000), that value is not included as you have

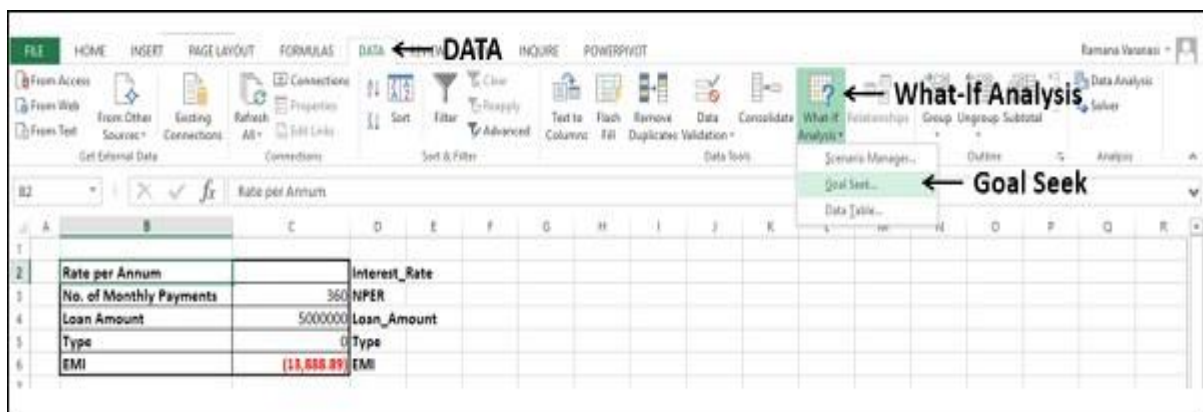
to use the Excel PMT function to arrive at it. Goal Seek requires a formula to find the result. The PMT function is placed in the cell EMI so that it can be used by Goal Seek. Excel computes the EMI with the PMT function. The table now looks like

	A	B	C	D	E
1					
2		Rate per Annum		Interest_Rate	
3		No. of Monthly Payments	360	NPER	
4		Loan Amount	5000000	Loan_Amount	
5		Type	0	Type	
6		EMI	(13,888.89)	EMI	
7					

As the **Interest_Rate** cell is empty, Excel takes that value as 0 and calculates the EMI. You can ignore the result -13,888.89.

Perform the Analysis with Goal Seek as follows:

Step 1 – Go to **DATA > What If Analysis > Goal Seek** on the Ribbon.



The Goal Seek dialog box appears.

Step 2 – Type EMI in the **Set cell** box. This box is the reference for the cell that contains the formula that you want to resolve, in this case the PMT function. It is the cell C6, which you named as EMI.

Step 3 – Type -50000 in the **To value** box. Here, you get the formula result, in this case, the EMI that you want to pay. The number is negative because it represents a payment.

Step 4 – Type Interest_Rate in the **By changing cell** box. This box has the reference of the cell that contains the value you want to adjust, in this case the interest rate. It is cell C2, which you named as Interest_Rate.

Step 5 – This cell that Goal Seek changes, must be referenced by the formula in the cell that you specified in the Set cell box. Click OK.

Goal Seek Dialog Box

Goal Seek ? X

Set cell: EMI

To value: -50000

By changing cell: Interest_Rate

OK Cancel

Goal Seek produces a result, as shown below –

Formula Used $\rightarrow$ =PMT(Interest_Rate/12,NPER,Loan_Amount,0,Type)

Goal Seek Status

Goal Seeking with Cell C6 found a solution.

Target value: -50000

Current value: (50,000.00)

OK Cancel

As you can observe, Goal Seek found the solution using cell C6 (containing the formula) as 12% that is displayed in the cell C2, which is the interest rate. Click OK.

Goal Seek Parameters:

The parameters to be specified in the “Goal Seek” dialog box are stated as follows:

Set cell—In this box, enter the cell reference of the formula to be resolved. This is the target cell or the formula cell.

To value—In this box, enter the desired output to be achieved. This is the value of the “set cell” to be attained.

By changing cell—In this box, enter the reference of the input cell (variable) to be adjusted. This is the cell we want to change in order to impact the “set cell.” **EXAMPLE:**

The following table shows the votes received by the two candidates, A and B, who contested in an election. In the present situation, candidate B is leading by 10,000 votes. It is given that to win the election, 50.01% votes are required. We want to change the voting percentage (column C) of candidate A in such a way that he wins the election. Calculate the total number of votes required by candidate A to win.

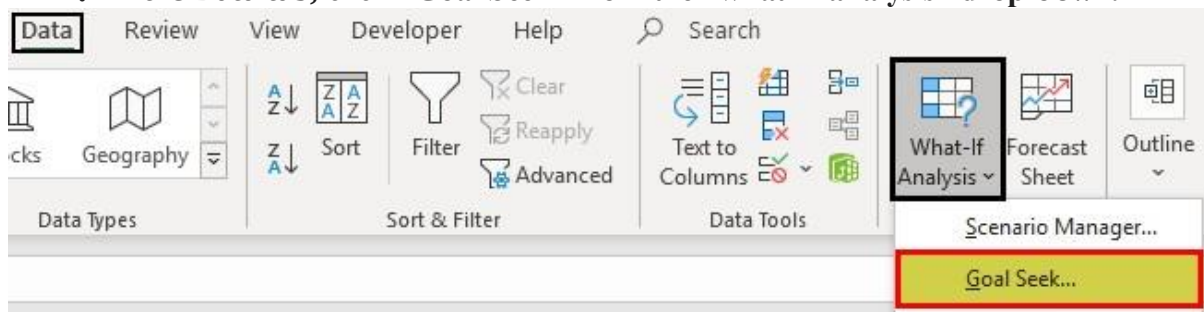
	A	B	C
1	Candidate	Votes	% Votes
2	A	65,000	
3	B	75,000	
4	Total	140,000	
5			

Let us calculate the present voting percentage for both the candidates. This is done by dividing the individual votes received by the total votes. Candidate A has won 46.43% of the total votes. Therefore, he needs only 3.67% votes to win the election.

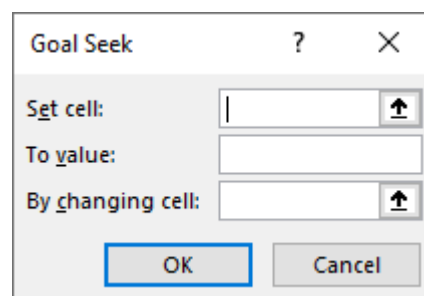
C2				
	A	B	C	D
1	Candidate	Votes	% Votes	
2	A	65,000	46.43%	
3	B	75,000	53.57%	
4	Total	140,000	100.00%	
5				

The steps to use Goal Seek in excel are stated as follows:

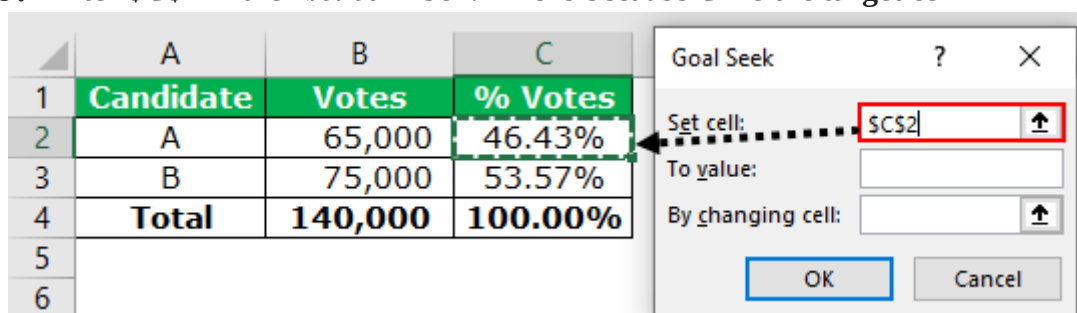
1. In the Data tab, click “Goal Seek” from the “what-if-analysis” drop-down.



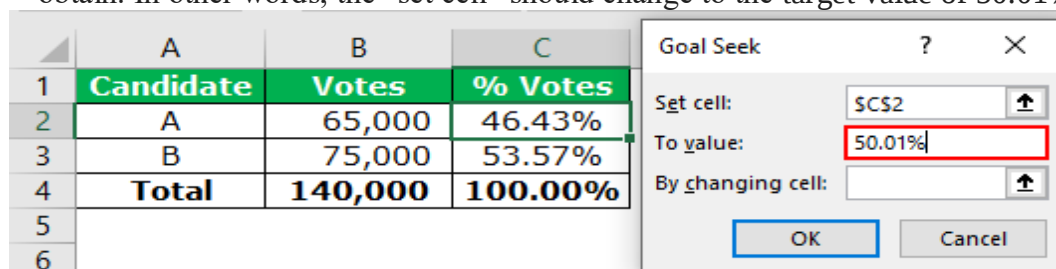
2. The “Goal Seek” excel window appears as shown in the following image



3. Enter \$C\$2 in the “set cell” box. This is because C2 is the target cell



4. Enter 50.01% in the “to value” box. This is the value of the “set cell” that we want to obtain. In other words, the “set cell” should change to the target value of 50.01%.



5. Enter \$B\$2 in the “by changing cell” box. This is the cell we want to change to impact the “set cell” C2. Since all the parameters are set, click “Ok” to get the result.

	A	B	C
1	Candidate	Votes	% Votes
2	A	65,000	46.43%
3	B	75,000	53.57%
4	Total	140,000	100.00%
5			
6			

Goal Seek ? X
Set cell:
To value:
By changing cell:

6. The output is shown in the following image. Candidate A should secure 70,014 votes to win the election. With 70,014 votes, the voting percentage of candidate A will become 50.01%. Click “Ok” to apply the changes.

	A	B	C
1	Candidate	Votes	% Votes
2	A	70,014	50.01%
3	B	75,000	53.57%
4	Total	140,000	100.00%
5			
6			
7			

Goal Seek Status ? X
Goal Seeking with Cell C2 found a solution.

Target value: 0.5001
Current value: 50.01%

The total number of votes and the voting percentage of candidate A has changed. Consequently, the votes and the voting percentage of candidate B also changes.

The votes of candidate B are calculated by subtracting 70,014 from 140,000. The final output is displayed in the following image. Hence, candidate A wins the election.

Example:

Mr. A opens a retail shop and sells goods at an average selling price of \$25 per unit. To meet his operating expenses, he wants to generate monthly revenue of \$250,000.

We want to calculate the quantity of the goods Mr. A should sell to earn the given revenue.

	A	B
1	Unit Price	25
2	Units	-
3	Revenue	??
4		

Step 1: In cell B3, apply the formula unit price*units (B1*B2).

B3			
	A	B	C
1	Unit Price	25	
2	Units	-	
3	Revenue	-	
4			

Step 2: In the Data tab, click “Goal Seek” from the “what-if-analysis” drop-down. The “Goal Seek” window appears as shown in the following image.

	A	B
1	Unit Price	25
2	Units	-
3	Revenue	-
4		
5		
6		

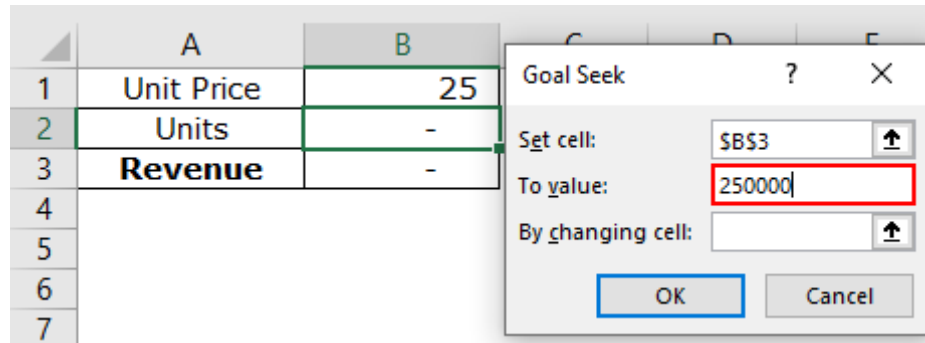
Goal Seek ? X
Set cell:
To value:
By changing cell:
OK Cancel

Step 3: Enter \$B\$3 in the “set cell” box. The target cell is the revenue cell B3.

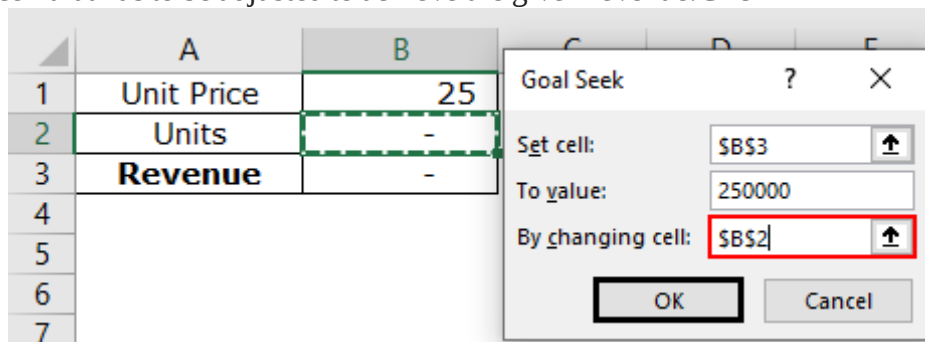
	A	B
1	Unit Price	25
2	Units	-
3	Revenue	-
4		
5		
6		
7		

Goal Seek ? X
Set cell:
To value:
By changing cell:
OK Cancel

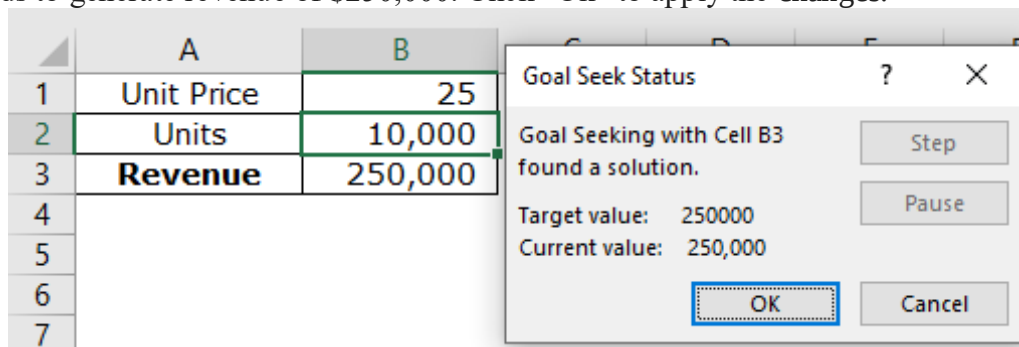
Step 4: Enter 250000 in the “to value” box. This is the value of the “set cell” to be achieved.



Step 5: Enter \$B\$2 in the “by changing cell.” The quantity has to be calculated in cell B2. So, this is the cell that has to be adjusted to achieve the given revenue. Click “Ok.”



Step 6: The output is displayed in the following image. Hence, Mr. A needs to sell 10,000 units of goods to generate revenue of \$250,000. Click “Ok” to apply the changes.



Advantages:

1) Solver can solve formulas (or equations) which use several variables whereas Goal Seek can only be used with a single variable.

- 2) Solver will allow you to vary the values in up to 200 cells whereas Goal Seek only allows you to vary the value in one cell.
- 3) It is possible to save one (or more) models with Solver.

Solver:

Solver is a Microsoft Excel add-in program you can use for what-if analysis. Use Solver to find an optimal (maximum or minimum) value for a formula in one cell —called the objective cell — subject to constraints, or limits, on the values of other formula cells on a worksheet.

Excel Solver is an optimization tool that can be used to determine how the desired outcome can be achieved by changing the assumptions in a model. It is a type of what-if analysis and is particularly useful when trying to determine the “best” outcome, given a set of more than two assumptions

How to Use Excel Solver

The best example of how to use Excel solver is by graphing a situation where there is a non-linear relationship between, for example, the number of salespeople in a company and the profit that they generate. There is a diminishing return on salespeople, so we want to figure out what the optimal number of people to hire is. Put another way, we want to figure out how many salespeople we should hire to get the maximum amount of profit.

Solver is an Excel solution used for What-if analysis. Excel Solver is similar to Goal Seek in that it works backward to achieve a numeric objective by changing variables.

Excel Solver belongs to a special set of commands often referred to as What-if Analysis Tools. It is primarily purposed for simulation and optimization of various business and engineering models.

The Excel Solver add-in is especially useful for solving linear programming problems, aka linear optimization problems, and therefore is sometimes called a *linear programming solver*. Apart from that, it can handle smooth nonlinear and non-smooth problems. Please see Excel Solver algorithms for more details.

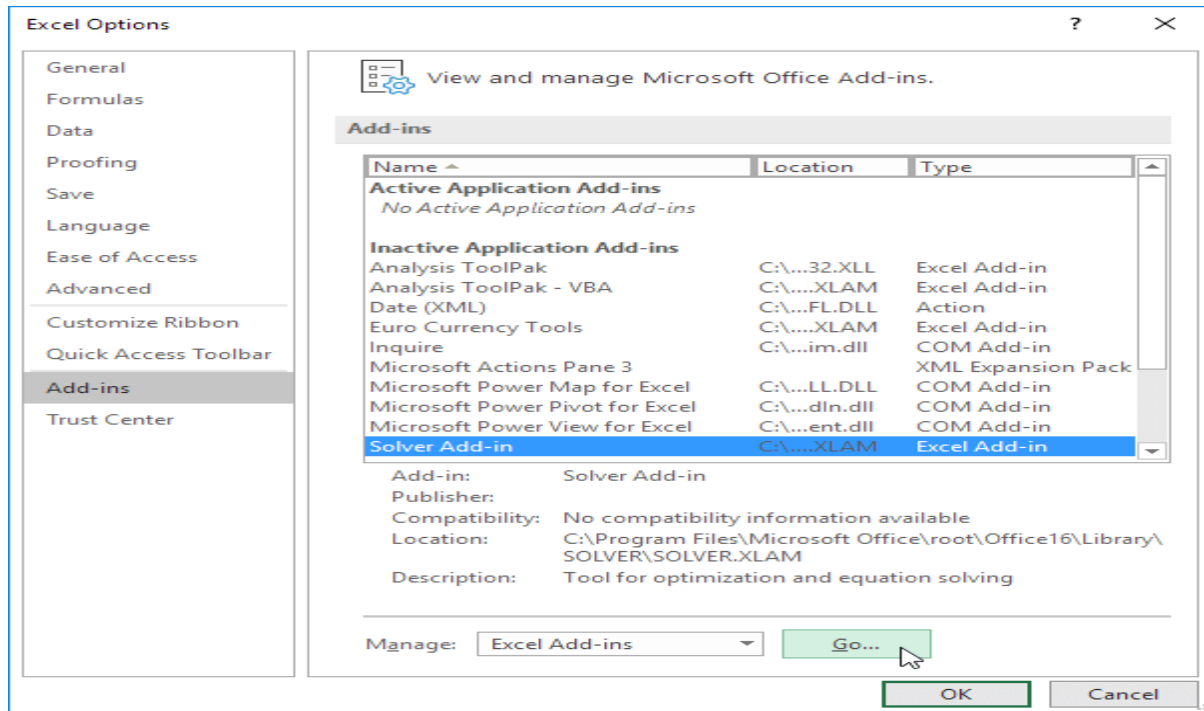
While Solver can't crack every possible problem, it is really helpful when dealing with all kinds of optimization problems where you need to make the best decision. For example, it can help you maximize the return of investment, choose the

optimal budget for your advertising campaign, make the best work schedule for your employees, minimize the delivery costs, and so on.

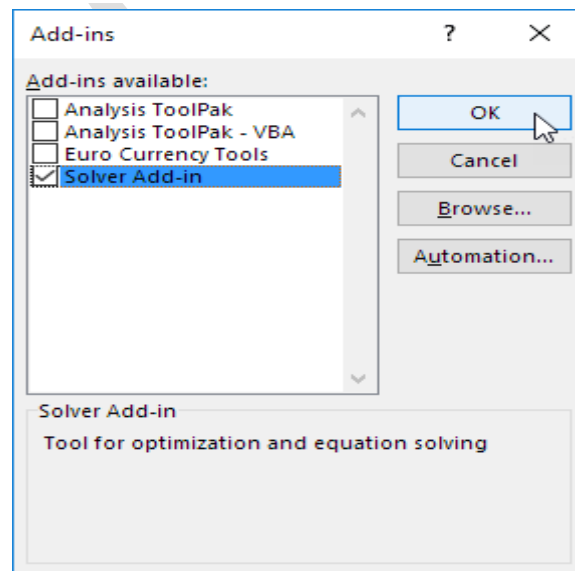
Load the Solver Add-in

To load the solver add-in, execute the following steps.

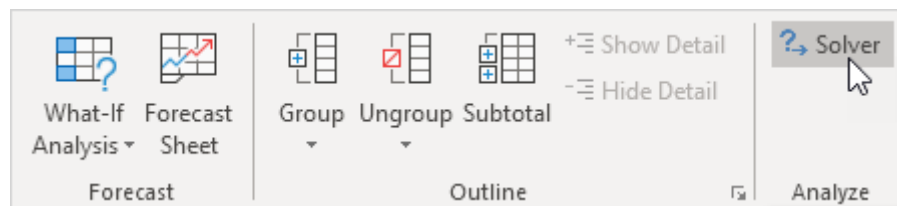
1. On the File tab, click Options.
2. Under Add-ins, select Solver Add-in and click on the Go button.



3. Check Solver Add-in and click OK



4. You can find the Solver on the Data tab, in the Analyze group.



Formulate the Model

The model we are going to solve looks as follows in Excel.

	A	B	C	D	E	F	G	H	I	J
1		Cycle Trader								
2										
3			Bicycles	Mopeds	Child Seats					
4		Unit Profit	100	300	50					
5							Resources		Resources	
6							Used		Available	
7		Capital	300	1200	120		0	≤	93000	
8		Storage	0.5	1	0.5		0	≤	101	
9										
10										
11			Bicycles	Mopeds	Child Seats				Total Profit	
12		Order Size	0	0	0				0	
13										

1. To formulate this linear programming model, answer the following three questions.

- What are the decisions to be made? For this problem, we need Excel to find out how much to order of each product (bicycles, mopeds and child seats).
- What are the constraints on these decisions? The constraints here are that the amount of capital and storage used by the products cannot exceed the limited amount of capital and storage (resources) available. For example, each bicycle uses 300 units of capital and 0.5 unit of storage.
- What is the overall measure of performance for these decisions? The overall measure of performance is the total profit of the three products, so the objective is to maximize this quantity.

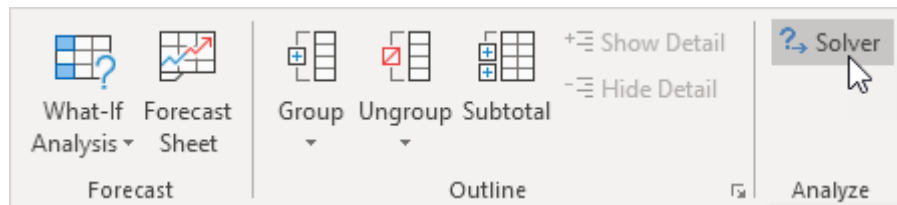
2. To make the model easier to understand, create the following named ranges.

It is not necessary to use trial and error. We shall describe next how the Excel Solver can be used to quickly find the optimal solution.

Solve the Model

To find the optimal solution, execute the following steps.

1. On the Data tab, in the Analyze group, click Solver.

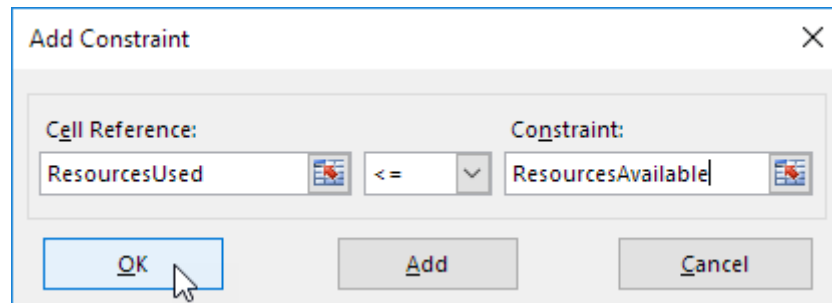


Enter the solver parameters (read on). The result should be consistent with the picture below.

A screenshot of the 'Solver Parameters' dialog box in Excel. The 'Set Objective:' field is set to 'TotalProfit'. The 'To:' section has 'Max' selected. The 'By Changing Variable Cells:' field is set to 'OrderSize'. The 'Subject to the Constraints:' list contains 'ResourcesUsed <= ResourcesAvailable'. The 'Make Unconstrained Variables Non-Negative' checkbox is checked. The 'Select a Solving Method:' dropdown is set to 'Simplex LP'. The 'Solving Method' section provides instructions: 'Select the GRG Nonlinear engine for Solver Problems that are smooth nonlinear. Select the LP Simplex engine for linear Solver Problems, and select the Evolutionary engine for Solver problems that are non-smooth.' The 'Solve' button is highlighted with a blue border.

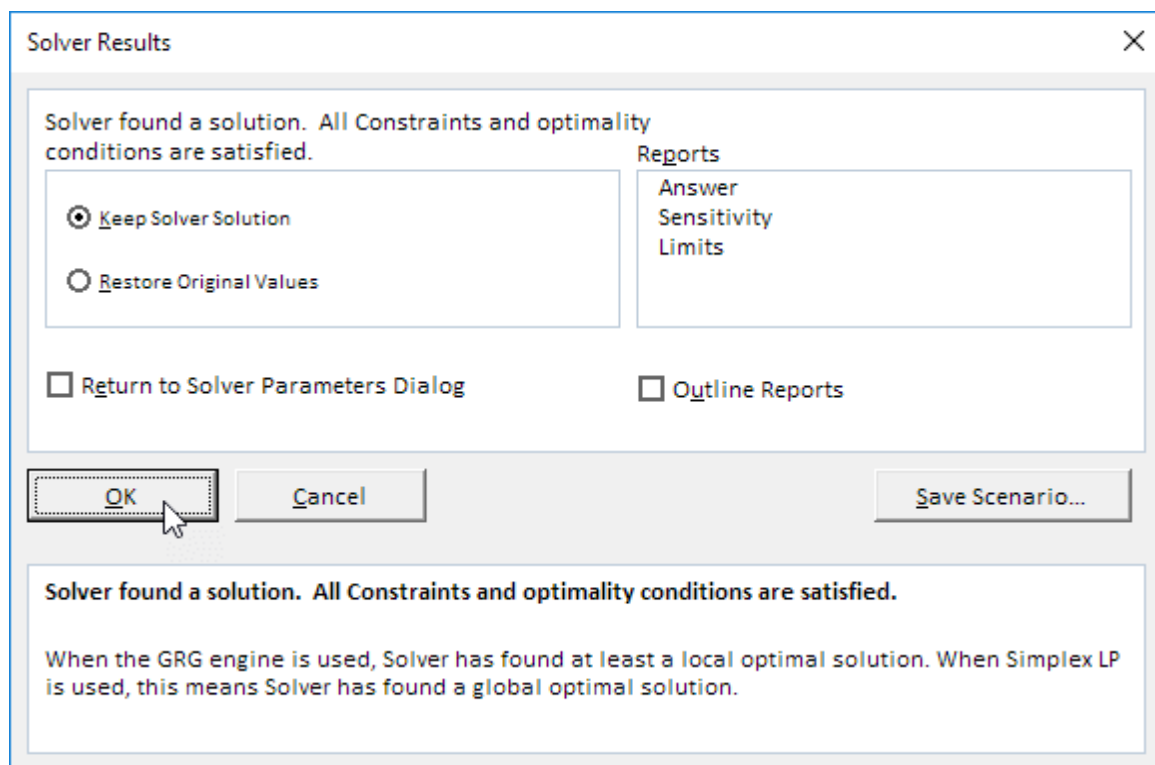
You have the choice of typing the range names or clicking on the cells in the spreadsheet.

2. Enter Total Profit for the Objective.
3. Click Max.
4. Enter OrderSize for the Changing Variable Cells.
5. Click Add to enter the following constraint.



The 'Add Constraint' dialog box is shown. It has a title bar with a close button (X). Inside, there are two input fields: 'Cell Reference:' and 'Constraint:'. The 'Cell Reference:' field contains 'ResourcesUsed' and has a small grid icon to its right. The 'Constraint:' field contains 'ResourcesAvailable' and also has a small grid icon to its right. Between these fields is a dropdown menu showing '<=' with a downward arrow. At the bottom, there are three buttons: 'OK' (highlighted with a mouse cursor), 'Add', and 'Cancel'.

Result:



The 'Solver Results' dialog box is shown. It has a title bar with a close button (X). The main text area says 'Solver found a solution. All Constraints and optimality conditions are satisfied.' Below this, there are two radio buttons: 'Keep Solver Solution' (selected) and 'Restore Original Values'. To the right, there is a 'Reports' section with a list box containing 'Answer', 'Sensitivity', and 'Limits'. Below the radio buttons, there are two checkboxes: 'Return to Solver Parameters Dialog' and 'Outline Reports'. At the bottom, there are three buttons: 'OK' (highlighted with a mouse cursor), 'Cancel', and 'Save Scenario...'. At the very bottom, there is a text box containing the following text: 'Solver found a solution. All Constraints and optimality conditions are satisfied. When the GRG engine is used, Solver has found at least a local optimal solution. When Simplex LP is used, this means Solver has found a global optimal solution.'

The optimal solution:

	A	B	C	D	E	F	G	H	I	J
1		Cycle Trader								
2										
3			Bicycles	Mopeds	Child Seats					
4		Unit Profit	100	300	50					
5							Resources		Resources	
6							Used		Available	
7		Capital	300	1200	120		93000	≤	93000	
8		Storage	0.5	1	0.5		101	≤	101	
9										
10										
11			Bicycles	Mopeds	Child Seats				Total Profit	
12		Order Size	94	54	0				25600	
13										

Conclusion: it is optimal to order 94 bicycles and 54 mopeds. This solution gives the maximum profit of 25600. This solution uses all the resources available.

Pivot Table:

A PivotTable is a powerful tool to calculate, summarize, and analyze data that lets you see comparisons, patterns, and trends in your data.

Advantages:

1. Pivot tables allow you to see how your data works – Pivot tables are one of the many tools out there that can help users get deeper insights into their data. You can create multiple reports on multiple data sets from a single pool of data.
2. Works well with SQL exports – A lot of data we have in our business are often generated from SQL queries. Pivot tables can work with both SQL exports (data downloaded/exported from SQL databases) and directly to SQL servers. This makes it easier for you to harvest data and transfer it directly into a format that you can easily analyze data.
3. Large amounts of data can be segmented – One problem with data analysis is that it gets harder the more data you have. With pivot tables, you can easily segment data no matter how big the whole data set is. This makes analysis much easier and can actually help you spot trends in the data.
4. Creating instant data is possible – When data is loaded into a pivot table, you have the freedom to use it any way you want. You can even program

equations directly into the pivot table or use formulas to create instant data.

Disadvantages:

1. Mastering pivot tables takes time – Sure, creating a pivot table requires a few clicks inside Excel but truly mastering the tool takes time. First-time users of pivot tables might see it as confusing and overwhelming. Only when you have “tamed the beast” can you properly use it for data analysis.
2. Can be time-consuming to use – Depending on how you would like to use your data within the pivot table, using it can actually take some time. This is because the tool itself does not include a robust collection of calculation options. This means the user is required to manually calculate the data or to manually input equations which can take some time
3. There are no automatic updates – Unless you regularly update your pivot table with new data, you are basically relying on old data for your metrics and analytics. This means it will be hard to rely on pivot tables for real-time analytics.
4. Older computers might not be able to handle large data sets – When you are working with a couple of thousand lines of data then any computer will do just fine. But once you hit the tens of thousands mark, old computers might struggle to produce the data that you need. It's also not rare to see computers crash just because they can't handle the amount of data they are processing.

Pivot tables are one of Excel's most powerful features. A pivot table allows you to extract the significance from a large, detailed data set.

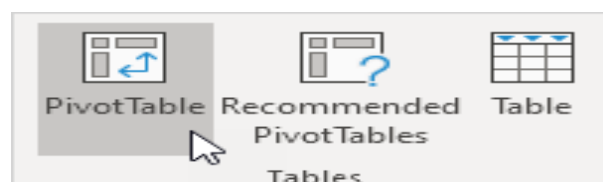
Our data set consists of 213 records and 6 fields. Order ID, Product, Category, Amount, Date and Country.

	A	B	C	D	E	F	G	H
1	Order ID	Product	Category	Amount	Date	Country		
2	1	Carrots	Vegetables	\$4,270	1/6/2016	United States		
3	2	Broccoli	Vegetables	\$8,239	1/7/2016	United Kingdom		
4	3	Banana	Fruit	\$617	1/8/2016	United States		
5	4	Banana	Fruit	\$8,384	1/10/2016	Canada		
6	5	Beans	Vegetables	\$2,626	1/10/2016	Germany		
7	6	Orange	Fruit	\$3,610	1/11/2016	United States		
8	7	Broccoli	Vegetables	\$9,062	1/11/2016	Australia		
9	8	Banana	Fruit	\$6,906	1/16/2016	New Zealand		
10	9	Apple	Fruit	\$2,417	1/16/2016	France		
11	10	Apple	Fruit	\$7,431	1/16/2016	Canada		

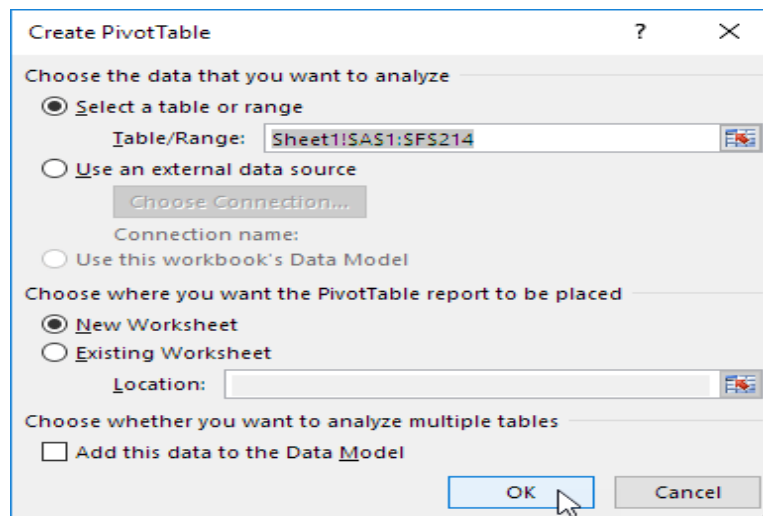
Insert a Pivot Table

To insert a pivot table, execute the following steps.

1. Click any single cell inside the data set.
2. On the Insert tab, in the Tables group, click PivotTable.



3. Click OK.



Drag fields:

The PivotTable Fields pane appears. To get the total amount exported of each product, drag the following fields to the different areas.

1. Product field to the Rows area.
2. Amount field to the Values area.
3. Country field to the Filters area.

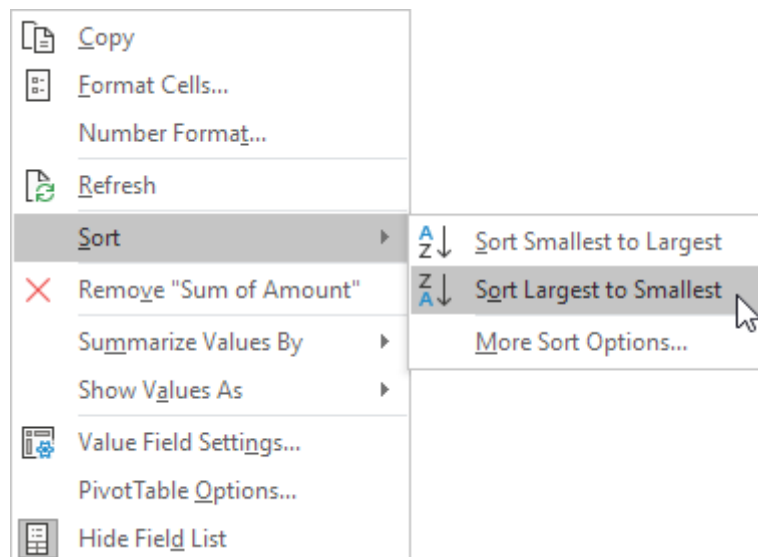
The 'PivotTable Fields' task pane is shown. The 'Choose fields to add to report:' section lists 'Order ID', 'Product', 'Category', 'Amount', 'Date', and 'Country'. 'Product', 'Amount', and 'Country' are checked. The 'Drag fields between areas below:' section shows 'Country' in the 'Filters' area, 'Product' in the 'Rows' area, and 'Sum of Amount' in the 'Values' area. Below the task pane, the resulting PivotTable is displayed.

	A	B	C
1	Country	(All)	
2			
3	Row Labels	Sum of Amount	
4	Apple	191257	
5	Banana	340295	
6	Beans	57281	
7	Broccoli	142439	
8	Carrots	136945	
9	Mango	57079	
10	Orange	104438	
11	Grand Total	1029734	
12			

Sort:

To get Banana at the top of the list, sort the pivot table.

1. Click any cell inside the Sum of Amount column.
2. Right click and click on Sort, Sort Largest to Smallest.



	A	B	C
1	Country	(All) ▼	
2			
3	Row Labels ▼	Sum of Amount	
4	Banana	340295	
5	Apple	191257	
6	Broccoli	142439	
7	Carrots	136945	
8	Orange	104438	
9	Beans	57281	
10	Mango	57079	
11	Grand Total	1029734	
12			

Result:

Filter:

Because we added the Country field to the Filters area, we can filter this pivot table by Country. For example, which products do we export the most to France?

1. Click the filter drop-down and select France.

Result. Apples are our main export product to France.

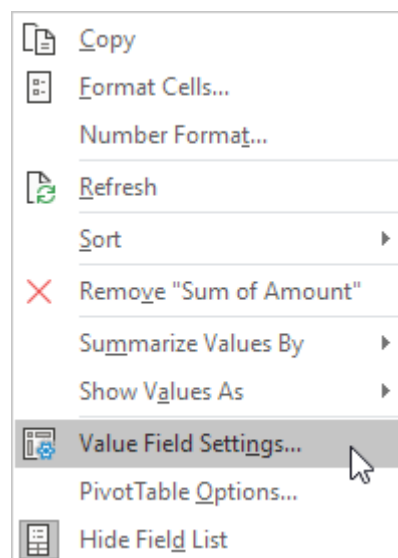
	A	B	C
1	Country	France	
2			
3	Row Labels	Sum of Amount	
4	Apple	80193	
5	Banana	36094	
6	Carrots	9104	
7	Mango	7388	
8	Broccoli	5341	
9	Orange	2256	
10	Beans	680	
11	Grand Total	141056	
12			

Note: you can use the standard filter (triangle next to Row Labels) to only show the amounts of specific products.

Change Summary Calculation

By default, Excel summarizes your data by either summing or counting the items. To change the type of calculation that you want to use, execute the following steps.

1. Click any cell inside the Sum of Amount column.
2. Right click and click on Value Field Settings.



2. Choose the type of calculation you want to use. For example, click Count.

Value Field Settings

Source Name: Amount

Custom Name: Count of Amount

Summarize Values By Show Values As

Summarize value field by

Choose the type of calculation that you want to use to summarize data from the selected field

Sum
Count
Average
Max
Min
Product

Number Format OK Cancel

	A	B	C
1	Country	France	
2			
3	Row Labels	Count of Amount	
4	Apple	16	
5	Banana	7	
6	Carrots	1	
7	Mango	1	
8	Orange	1	
9	Beans	1	
10	Broccoli	1	
11	Grand Total	28	
12			

Two-dimensional Pivot Table

If you drag a field to the Rows area and Columns area, you can create a two-dimensional pivot table. First, insert a pivot table. Next, to get the total amount exported to each country, of each product, drag the following fields to the different areas.

1. Country field to the Rows area.
2. Product field to the Columns area.

3. Amount field to the Values area.
4. Category field to the Filters area.

PivotTable Fields

Choose fields to add to report:

☐ Order ID

☒ **Product**

☒ **Category**

☒ **Amount**

☐ Date

☒ **Country**

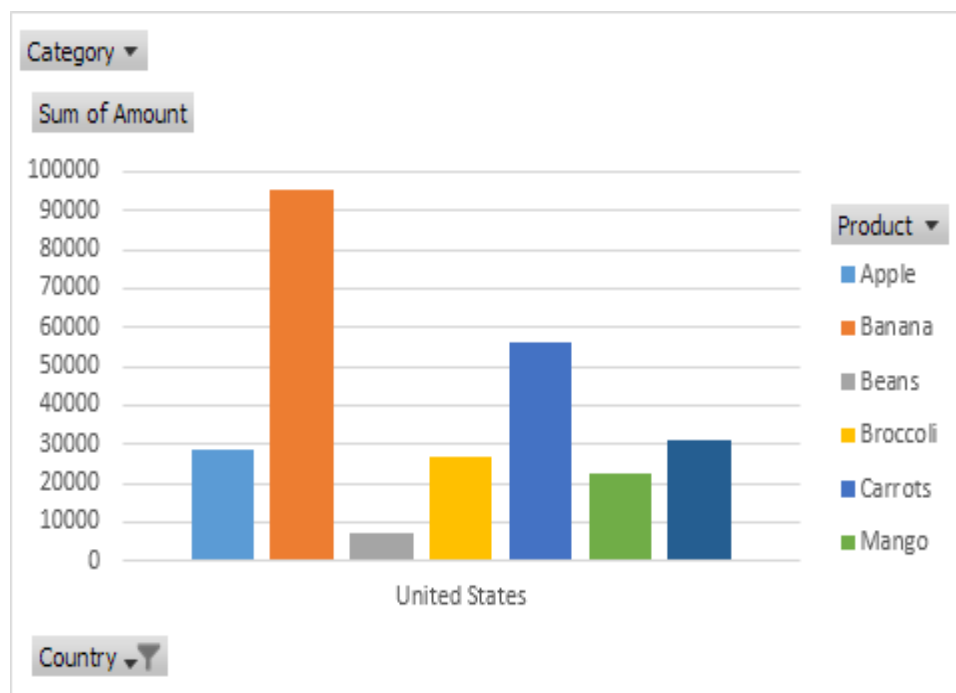
Drag fields between areas below:

Filters Category	Columns Product
Rows Country	Values Sum of Amou...

Below you can find the two-dimensional pivot table.

[illegible]

to easily compare these numbers, create a pivot chart and apply a filter. Maybe this is one step too far for you at this stage, but it shows you one of the many other powerful pivot table features Excel has to offer.



Data Analysis:

Microsoft Excel is one of the most popular applications for data analysis. Equipped with built-in pivot tables, they are without a doubt the most sought-after analytic tool available. It is an all-in-one data management software that allows you to easily import, explore, clean, analyze, and visualize your data. In this article, we will discuss the various methods of data analysis in Excel.

- ☐ Data Analysis with Excel is a comprehensive tutorial that provides a good insight into the latest and advanced features available in Microsoft Excel. It explains in detail how to perform various data analysis functions using the features available in MS-Excel. The tutorial has plenty of screenshots that explain how to use a particular feature, in a step-by-step manner.
- ☐ Data Analysis is a process of inspecting, cleaning, transforming and modelling data with the goal of discovering useful information, suggesting conclusions and supporting decision-making

Types of Data Analysis

Several data analysis techniques exist encompassing various domains such as business, science, social science, etc. with a variety of names. The major data analysis approaches are –

- ☐ Data Mining
- ☐ Business Intelligence
- ☐ Statistical Analysis
- ☐ Predictive Analytics
- ☐ Text Analytics

Data Mining: Data Mining is the analysis of large quantities of data to extract previously unknown, interesting patterns of data, unusual data and the dependencies. Note that the goal is the extraction of patterns and knowledge from large amounts of data and not the extraction of data itself.

Data mining analysis involves computer science methods at the intersection of the artificial intelligence, machine learning, statistics, and database systems.

Business Intelligence: Business Intelligence techniques and tools are for acquisition and transformation of large amounts of unstructured business data to help identify, develop and create new strategic business opportunities.

Statistical Analysis: Statistics is the study of collection, analysis, interpretation, presentation, and organization of data.

In data analysis, two main statistical methodologies are used –

Descriptive statistics –

In descriptive statistics, data from the entire population or a sample is summarized with numerical descriptors such as –

- ☐ Mean, Standard Deviation for Continuous Data
- ☐ Frequency, Percentage for Categorical Data

Inferential statistics – It uses patterns in the sample data to draw inferences about the represented population or accounting for randomness. These inferences can be –

- ☐ answering yes/no questions about the data (hypothesis testing)
- ☐ estimating numerical characteristics of the data (estimation)

- describing associations within the data (correlation)
- modelling relationships within the data (E.g. regression analysis) **Predictive**

Analytics: Predictive Analytics use statistical models to analyze current and historical data for forecasting (predictions) about future or otherwise unknown events. In business, predictive analytics is used to identify risks and opportunities that aid in decision-making.

Text Analytics: Text Analytics, also referred to as Text Mining or as Text Data Mining is the process of deriving high-quality information from text. Text mining usually involves the process of structuring the input text, deriving patterns within the structured data using means such as statistical pattern learning, and finally evaluation and interpretation of the output.

Data Analysis Process:

Data Analysis is defined by the statistician John Tukey in 1961 as "Procedures for analysing data, techniques for interpreting the results of such procedures, ways of planning the gathering of data to make its analysis easier, more precise or more accurate, and all the machinery and results of (mathematical) statistics which apply to analyzing data."

Thus, data analysis is a process for obtaining large, unstructured data from various sources and converting it into information that is useful for –

- Answering questions
- Test hypotheses
- Decision-making
- Disproving theories

Data Analysis with Excel

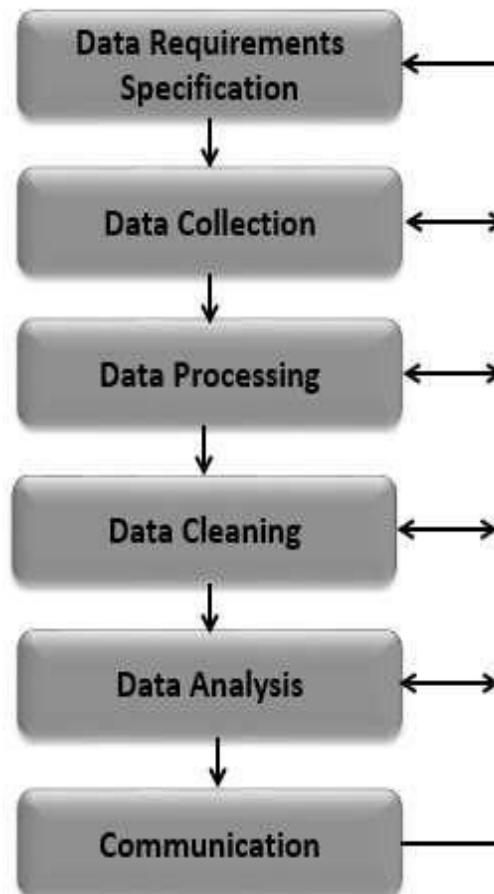
Microsoft Excel provides several means and ways to analyze and interpret data. The data can be from various sources. The data can be converted and formatted in several ways. It can be analyzed with the relevant Excel commands, functions and tools - encompassing Conditional Formatting, Ranges, Tables, Text functions, Date functions, Time functions, financial functions, Subtotals, Quick Analysis, Formula Auditing, Inquire Tool, What-if Analysis, Solvers, Data Model, PowerPivot, PowerView, PowerMap, etc.

Data Analysis is a process of collecting, transforming, cleaning, and modelling data with the goal of discovering the required information. The results so obtained are

communicated, suggesting conclusions, and supporting decision-making. Data visualization is at times used to portray the data for the ease of discovering the useful patterns in the data. The terms Data Modelling and Data Analysis mean the same.

Data Analysis Process consists of the following phases that are iterative in nature –

- ☐ Data Requirements Specification
- ☐ Data Collection
- ☐ Data Processing
- ☐ Data Cleaning
- ☐ Data Analysis
- ☐ Communication



Data Requirements Specification: The data required for analysis is based on a question or an experiment. Based on the requirements of those directing the analysis, the data necessary as inputs to the analysis is identified (e.g., Population of people). Specific variables regarding a population (e.g., Age and Income) may be specified and obtained. Data may be numerical or categorical.

Data Collection: Data Collection is the process of gathering information on targeted variables identified as data requirements. The emphasis is on ensuring accurate and honest collection of data. Data Collection ensures that data gathered is accurate such that the related decisions are valid. Data Collection provides both a baseline to measure and a target to improve.

Data Processing: The data that is collected must be processed or organized for analysis. This includes structuring the data as required for the relevant Analysis Tools. For example, the data might have to be placed into rows and columns in a table within a Spreadsheet or Statistical Application. A Data Model might have to be created.

Data Cleaning: The processed and organized data may be incomplete, contain duplicates, or contain errors. Data Cleaning is the process of preventing and correcting these errors. There are several types of Data Cleaning that depend on the type of data. For example, while cleaning the financial data, certain totals might be compared against reliable published numbers or defined thresholds. Likewise, quantitative data methods can be used for outlier detection that would be subsequently excluded in analysis.

Data Analysis: Data that is processed, organized and cleaned would be ready for the analysis. Various data analysis techniques are available to understand, interpret, and derive conclusions based on the requirements. Data Visualization may also be used to examine the data in graphical format, to obtain additional insight regarding the messages within the data.

Communication: The results of the data analysis are to be reported in a format as required by the users to support their decisions and further action. The feedback from the users might result in additional analysis.

Conditional formatting: In Microsoft Excel, you can use Conditional Formatting for data visualization. You have to specify formatting for a cell range based on the contents of the cell range. The cells that meet the specified conditions would be formatted as you have defined.

MS Excel 2010 Conditional Formatting feature enables you to format a range of values so that the values outside certain limits, are automatically formatted.

Highlight Cells Rules

To highlight cells that are greater than a value, execute the following steps.

1. Select the range A1:A10.
4. Enter the value 80 and select a formatting style.
5. Click OK.

Result. Excel highlights the cells that are greater than 80.

Note: you can also use this category (see step 3) to highlight cells that are less than a value, between two values, equal to a value, cells that contain specific text, dates (today, last week, next month, etc.), duplicates or unique values.

Clear Rules

To clear a conditional formatting rule, execute the following steps.

1. Select the range A1:A10.

Top/Bottom Rules

To highlight cells that are above average, execute the following steps.

1. Select the range A1:A10.
2. On the Home tab, in the Styles group, click Conditional Formatting.
3. Click Top/Bottom Rules, Above Average.
4. Select a formatting style.
5. Click OK.

Note: you can also use this category (see step 3) to highlight the top n items, the top n percent, the bottom n items, the bottom n percent or cells that are below average.

Conditional Formatting with Formulas

Take your Excel skills to the next level and use a formula to determine which cells to format. Formulas that apply conditional formatting must evaluate to TRUE or FALSE.

1. Select the range A1:E5.
2. On the Home tab, in the Styles group, click Conditional Formatting.
3. Click New Rule.

Result. Excel highlights all odd numbers.

Explanation: always write the formula for the upper-left cell in the selected range. Excel automatically copies the formula to the other cells. Thus, cell A2 contains the formula =ISODD(A2), cell A3 contains the formula =ISODD(A3), etc.

7. Select the range A2:D7.

Result. Excel highlights all USA orders.

Explanation: we fixed the reference to column C by placing a \$ symbol in front of the column letter (\$C2). As a result, cell B2, C2 and cell D2 also contain the formula =\$C2="USA", cell A3, B3, C3 and D3 contain the formula =\$C3="USA", etc.

Advantages of Conditional formatting:

Conditional formatting is a way of formatting cells in the spreadsheet software Microsoft Excel. It allows cells within a particular spreadsheet to be formatted automatically in accordance to what is in the cell. For example, if there is a figure that is negative in a cell, the cell color would automatically turn to red, positive numbers may turn the cell green and so on. So what are the advantages of conditional formatting

Updates occur in real time: The spreadsheet will have the ability to format itself as you are working on it in real time. This means that anything you do within the spreadsheet will be brought to your attention quicker if the cells were to change their format. For example, if you have entered the same data into the spreadsheet twice, you could set up conditional formatting to change this cell to red. That way you are constantly up to date with everything that is going on in your spreadsheet.

Stops you from wasting time: If all of this formatting is happening on its own, this leaves you with a lot more time to complete the more important tasks. You will have more free time to spend analyzing the spreadsheet thoroughly or indeed to do whatever else you want to do with your spare time now that the formatting is complete.

More in-depth analysis: The conditional formatting can allow you to control data in your spreadsheet in a way that will help you analyze the data in a much deeper way. This will give you a much better understanding of your statistics in the long run.

Array Formulas:

Before we start on array functions and formulas, let's figure out what the term "array" means. Essentially, an **array** is a collection of items. The items can be text or numbers and they can reside in a single row or column, or in multiple rows and columns.

For example, if you put your weekly grocery list into an Excel array format, it would look like:

{"Milk", "Eggs", "Butter", "Corn flakes"}

Then, if you select cells A1 through D1, enter the above array preceded by an equal sign (=) in the formula bar and press **CTRL + SHIFT + ENTER**, you will get the following result:

What is an array formula in Excel?

The difference between an array formula and a regular formula is that an array formula processes several values instead of just one. In other words, an array formula in Excel evaluates all individual values in an array and performs multiple calculations on one or several items according to the conditions expressed in the formula.

Simple example of Excel array formula

Suppose you have some items in column B, their prices in column C, and you want to calculate the grand total of all sales.

Of course, nothing prevents you from calculating subtotals in each row first with something as simple as **=B2*C2** and then sum those values:

However, an array formula can spare you those extra key strokes since it gets Excel to store intermediate results in memory rather than in an additional column. So, all it takes is a single array formula and 2 quick steps:

Select an empty cell and enter the following formula in it:

=SUM(B2:B6*C2:C6)

Press the keyboard shortcut **CTRL + SHIFT + ENTER** to complete the array formula.

Once you do this, Microsoft Excel surrounds the formula with {curly braces}, which is a visual indication of an array formula.

What the formula does is multiply the values in each individual row of the specified array (cells B2 through C6), add the sub-totals together, and output the grand total:

Why use array formulas in Excel?

Excel array formulas are the handiest tool to perform sophisticated calculations and do complex tasks. A single array formula can replace literally hundreds of usual formulas. Array formulas are very good for tasks such as:

- Sum numbers that meet certain conditions, for example sum N largest or smallest values in a range.
- Sum every other row, or every Nth row or column, as demonstrated in this example.
- Count the number of all or certain characters in a specified range. Here is an array formula that counts all chars, and another one that counts any given characters.

Example 1. A single-cell array formula

Suppose you have two columns listing the number of items sold in 2 different months, say columns B and C, and you want to find the maximum sales increase.

Normally, you would add an additional column, say column D, that calculates the sales change for each product using a formula like `=C2-B2`, and then find the maximum value in that additional column `=MAX(D:D)`.

An array formula does not need an additional column since it perfectly stores intermediate results in memory. So, you just enter the following formula and press **Ctrl + Shift + Enter**:

`=MAX(C2:C6-B2:B6)`

Example 2. A multi-cell array formula in Excel

In the previous SUM example, suppose you have to pay 10% tax from each sale and you want to calculate the tax amount for each product with one formula.

Select the range of cell in some blank column, say D2:D6, and enter the following formula in the formula bar:

`=B2:B6 * C2:C6 * 0.1`

Once you press **Ctrl + Shift + Enter**, Excel will place an instance of your array formula in each cell of the selected range, and you will get the following result:

Example 3. Using an Excel array function to return a multi-cell array

As already mentioned, Microsoft Excel provides a few so called "array functions" that are specially designed to work with multi-cell arrays. TRANSPOSE is one of such functions and we are going to utilize it to transpose the above table, i.e. convert rows to columns.

- Select an empty range of cells where you want to output the transposed table. Since we are converting rows to columns, be sure to select the same number of rows and columns as your source table has columns and rows, respectively. In this example, we are selecting 6 columns and 4 rows.
- Press **F2** to enter the edit mode.
- Enter the array function `=TRANSPOSE(array)` and press **Ctrl + Shift + Enter**. In our example, the formula is `=TRANSPOSE($A$1:$D$6)`. The result is going to look similar to this:

this is how you use an array function in Excel. To learn the nuts and bolts of TRANSPOSE, please check out this tutorial: [How to transpose in Excel - convert rows to columns](#).

Dynamic named ranges:

How to use the OFFSET formula with a defined name

To do this, follow these steps, as appropriate for the version of Excel that you are running.

Microsoft Office Excel 2007, Microsoft Excel 2010 and Microsoft Excel 2013

1. On the *Formula* tab, in the *Defined Names* group, click **Define Name**. Or, press **Ctrl + F3** to open the Excel Name Manager, and click the **New...** button.
2. Either way, the *New Name* dialogue box will open, where you specify the following details:
 - In the *Name* box, type the name for your dynamic range.
 - In the *Scope* dropdown, set the name's scope. *Workbook* (default) is recommended in most cases.
 - In the *Refers to* box, enter either `OFFSET COUNTA` or `INDEX COUNTA` formula.

3. Click OK. Done!

In the following screenshot, we define a dynamic named range items that accommodates all cells with data in column A, except for the header row:

Working with Charts :

A chart is a tool you can use in Excel to communicate data graphically. Charts allow your audience to see the meaning behind the numbers, and they make showing comparisons and trends much easier. In this lesson, you'll learn how to insert charts and modify them so they communicate information effectively. **Charts**

Excel workbooks can contain **a lot of data**, and this data can often be difficult to interpret. For example, where are the highest and lowest values? Are the numbers increasing or decreasing?

The answers to questions like these can become much clearer when data is represented as a **chart**. Excel has various types of charts, so you can choose one that most effectively represents your data.

A simple chart in Excel can say more than a sheet full of numbers. As you'll see, creating charts is very easy.

Create a Chart

To create a line chart, execute the following steps.

1. Select the range A1:D7.

Result:

Note: enter a title by clicking on Chart Title. For example, Wildlife Population.

Change Chart Type

You can easily change to a different type of chart at any time.

1. Select the chart.
2. On the Design tab, in the Type group, click Change Chart Type.
4. Click OK.

Result:

Switch Row/Column

If you want to display the animals (instead of the months) on the horizontal axis, execute the following steps.

1. Select the chart.
2. On the Design tab, in the Data group, click Switch Row/Column.

Result:

Legend Position

To move the legend to the right side of the chart, execute the following steps.

1. Select the chart.
2. Click the + button on the right side of the chart, click the arrow next to Legend and click Right.

Result:

Data Labels

You can use data labels to focus your readers' attention on a single data series or data point.

1. Select the chart.
2. Click a green bar to select the Jun data series.
3. Hold down CTRL and use your arrow keys to select the population of Dolphins in June (tiny green bar).
4. Click the + button on the right side of the chart and click the check box next to Data Labels.

Result:

Creating dynamic charts:

How to Create a Dynamic Chart Range in Excel?

There are two ways to create a dynamic chart range in Excel:

- ☐ Using Excel Table
- ☐ Using Formulas

In most of the cases, using Excel Table is the best way to create dynamic ranges in Excel.

Let's see how each of these methods work.

Using Excel Table

Using Excel Table is the best way to create dynamic ranges as it updates automatically when a new data point is added to it.

Excel Table feature was introduced in Excel 2007 version of Windows and if you're versions prior to it, you won't be able to use it (see the next section on creating dynamic chart range using formulas).

In the example below, you can see that as soon as I add new data, the Excel Table expands to include this data as a part of the table (note that the border and formatting expand to include it in the table).

Now, we need to use this Excel table while creating the charts.

Here are the exact steps to create a dynamic line chart using the Excel table: Select the entire Excel table.

Go to the Insert tab

In the Charts Group, select 'Line with Markers' chart.

- ☐ The above steps would insert a line chart which would automatically update when you add more data to the Excel table.
- ☐ Note that while adding new data automatically updates the chart, deleting data would not completely remove the data points. For example, if you remove 2 data points, the chart will show some empty space on the right. To correct this, drag the blue mark at the bottom right of the Excel table to remove the deleted data points from the table (as shown below).

Using Excel Formulas

As I mentioned, using Excel table is the best way to create dynamic chart ranges. However, if you can't use Excel table for some reason (possibly if you are using Excel 2003), there is another (slightly complicated) way to create dynamic chart ranges using Excel formulas and named ranges.

Suppose you have the data set as shown below:

to create a dynamic chart range from this data, we need to:

Create two dynamic named ranges using the OFFSET formula (one each for 'Values' and 'Months' column). Adding/deleting a data point would automatically update these named ranges.

Insert a chart that uses the named ranges as a data source.

Step 1 – Creating Dynamic Named Ranges

Below are the steps to create dynamic named ranges: Go to the 'Formulas' Tab

Click on 'Name Manager'

In the Name Manager dialog box, specify the name as **Chart Values** and enter the following formula in Refers to part:

- ☐ Click OK.
- ☐ In the Name Manager dialog box, click on New.
- ☐ In the Name Manager dialog box, specify the name as **Chart Months** and enter the following formula in Refers to part: `=OFFSET(Formula!$A$2,,,COUNTIF(Formula!$A$2:$A$100,"<>"))`
- ☐ Click Ok.
- ☐ Click Close.

The above steps have created two named ranges in the Workbook – Chart Value and ChartMonth (these refer to the values and months range in the data set respectively). If you go and update the value column by adding one more data point, the Chart Value named range would now automatically update to show the additional data point in it. The magic is done by the OFFSET function here.

In the 'Chart Value' named range formula, we have specified B2 as the reference point. OFFSET formula starts there and extends to cover all the filled cells in the column. The Same logic works in the ChartMonth named range formula as well. Step 2 – Create a Chart Using these Named Ranges

Now all you need to do is insert a chart that will use the named ranges as the data source. Here are the steps to insert a chart and use dynamic chart ranges:

Go to the Insert tab

With the chart selected, go to the Design tab

Click on Select Data

In the 'Select Data Source' dialog box, click on the Add button in 'Legend Entries(Series)'

In the Series value field, enter =Formula! Chart Values (note that you need to specify the worksheet name before the named range for this to work).

- ☐ Click OK.
- ☐ Click on the Edit button in the 'Horizontal (Category) Axis Labels'.

In the 'Axis Labels' dialog box, enter =Formula! Chart Months

- ☐ Click Ok.

That's it! Now your chart is using a dynamic range and will update when you add/delete data points in the chart.

Important Questions (Unit1 & 2):

1. What is Financial Modelling? Explain how it is helpful in analysing a firms' Financial Position?
2. How do you build a Financial Model?
3. How is Financial Modelling applied to three statement projection model with using Excel?
4. Explain different types of Financial Models with suitable examples?
5. Discuss the best practice principles of modelling and how it is useful in Financial Statement analysis?
6. What are different types of Finance Functions applied in Modelling with using Excel?
7. What are different types of Look up and reference Functions applied in Modelling with using Excel?
8. What are different types of Statistical Functions applied in Modelling with using Excel?
9. What are different types of Array formulas applied in Modelling with using Excel?
10. How do you create Pivot table and discuss its Advantages and disadvantages?
11. What is Goal seek analysis? and explain how it is useful in Modelling?
12. What is Data Analysis? And explain its types, process?

Case Study:

Yes Bank confident of Fortis fetching good valuation

Fortis Healthcare, is one of the best hospitals in India, which provide all kinds of medical treatment and surgeries by experience surgeons at affordable price. Yes, Bank is the single largest shareholder of this hospital. Yes, Bank exuded confidence of a sound resolution with a good valuation and thus help drive out of the management crisis plaguing one of the largest corporate hospital chains in the country.

In February 2018, Yes Bank, which was the largest lender to the hospital, had acquired a 17.31 per cent stake by invoking nearly 9 crore pledged share. Later in mid-March, it sold 2.17 per cent of its Stake, thereby, bringing down its shareholding to 15.14 per cent as of March 2018.

Still, this makes the city-based private lender the single largest shareholder in the New Delhi headquartered corporate hospital chain. Yes Bank has acquired 8,97,81,906 equity shares having nominal value of Rs 10 per share of the company pursuant to invocation of pledge on the said equity shares subsequent to default by promoter group companies in the credit facility provided by the bank. Yes Bank faces problem in the valuation of the Fortis Health Care, as it the performing asset for Yes Bank. Does the Yes bank able to resolve the problem?

They were not focusing on the quality of the bidders as Fortis is a prime healthcare asset in the country which is a major concern area. Yes Bank as a major shareholder was not active in the valuation process of the Fortis Hospital chain but only good in transparency which may lead to improvement. Improper Bidding will be affecting the small and big investors and impact the valuation of a company.

1. Does YES Bank fetch good valuation to Fortis Health Care.
2. What impact the transparency and full disclosure plays in valuation of a company.

Financial Functions

[PMT](#) | [RATE](#) | [NPER](#) | [PV](#) | [FV](#)

To illustrate Excel's most popular **financial functions**, we consider a **loan** with monthly payments, an annual interest rate of 6%, a 20-year duration, a present value of \$150,000 (amount borrowed) and a future value of 0 (that's what you hope to achieve when you pay off a loan).

We make monthly payments, so we use $6\%/12 = 0.5\%$ for Rate and $20 \times 12 = 240$ for Nper (total number of periods). If we make annual payments on the same loan, we use 6% for Rate and 20 for Nper.

PMT

Select cell A2 and insert the **PMT function**.

COUNTIF : X ✓ fx =PMT(						
	A	B	C	D	E	F
1	PMT	Rate	Nper	Pv	Fv	
2	=PMT(	0.50%	240	\$150,000	0	
3	PMT(rate, nper, pv, [fv], [type])					
4						

Note: the last two arguments are optional. For loans, Fv can be omitted (the future value of a loan equals 0, however, it's included here for clarification). If Type is omitted, it is assumed that payments are due at the end of the period.

Result. The monthly payment equals \$1,074.65.

A2 : X ✓ fx =PMT(B2,C2,D2,E2)						
	A	B	C	D	E	F
1	PMT	Rate	Nper	Pv	Fv	
2	(\$1,074.65)	0.50%	240	\$150,000	0	
3						

Tip: when working with financial functions in Excel, always ask yourself the question, am I making a payment (negative) or am I receiving money (positive)? We pay off a loan of \$150,000 (positive, we received that amount) and we make monthly payments of \$1,074.65 (negative, we pay). Visit our page about the PMT function for many more examples.

RATE

If Rate is the only unknown variable, we can use the RATE function to calculate the interest rate.

B2 : X ✓ fx =RATE(C2,A2,D2,E2)						
	A	B	C	D	E	F
1	Pmt	RATE	Nper	Pv	Fv	
2	(\$1,074.65)	0.50%	240	\$150,000	0	
3						

NPER

Or the NPER function. If we make monthly payments of \$1,074.65 on a 20-year loan, with an annual interest rate of 6%, it takes 240 months to pay off this loan.

C2 ✕ ✓ fx =NPER(B2,A2,D2,E2)						
	A	B	C	D	E	F
1	Pmt	Rate	NPER	Pv	Fv	
2	(\$1,074.65)	0.50%	240	\$150,000	0	
3						

We already knew this, but we can change the monthly payment now to see how this affects the total number of periods.

C2 ✕ ✓ fx =NPER(B2,A2,D2,E2)						
	A	B	C	D	E	F
1	Pmt	Rate	NPER	Pv	Fv	
2	(\$2,074.65)	0.50%	89.95316057	\$150,000	0	
3						

Conclusion: if we make monthly payments of \$2,074.65, it takes less than 90 months to pay off this loan.

PV

Or the PV (Present Value) function. If we make monthly payments of \$1,074.65 on a 20-year loan, with an annual interest rate of 6%, how much can we borrow? You already know the answer.

D2 ✕ ✓ fx =PV(B2,C2,A2,E2)						
	A	B	C	D	E	F
1	Pmt	Rate	Nper	PV	Fv	
2	(\$1,074.65)	0.50%	240	\$150,000	0	
3						

FV

And we finish this chapter with the FV (Future Value) function. If we make monthly payments of \$1,074.65 on a 20-year loan, with an annual interest rate of 6%, do we pay off this loan? Yes.

E2 ✕ ✓ fx =FV(B2,C2,A2,D2)						
	A	B	C	D	E	F
1	Pmt	Rate	Nper	Pv	FV	
2	(\$1,074.65)	0.50%	240	\$150,000	0	
3						

But, if we make monthly payments of only \$1,000.00, we still have debt after 20 years.

E2 ✕ ✓ fx =FV(B2,C2,A2,D2)						
	A	B	C	D	E	F
1	Pmt	Rate	Nper	Pv	FV	
2	(\$1,000.00)	0.50%	240	\$150,000	(\$34,489.78)	
3						

Top of Form

Unit III

Financial Analysis Techniques - Ratio analysis, Du point Analysis – Cash budgeting – Master budgeting - Break-even analysis – Profit planning - Loan amortization - Capital Budgeting Decisions – Sensitivity analysis – Scenario Analysis with Scenario Manager – Computing rates of returns, averages and variances of financial data.

Ratio Analysis

Ratio: It is the quantitative relation between two amounts showing the number of times one value contains or is contained within the other. Accounting Ratio: It means ratio calculated on the basis of accounting information.

Ratio analysis: A ratio analysis is a quantitative analysis of information contained in a company's financial statements. Ratio analysis is used to evaluate various aspects of a company's operating and financial performance such as its efficiency, liquidity, profitability and solvency.

Objective of Ratio Analysis:

To assess the earning capacity, financial soundness and operating efficiency of an enterprise.

To simplify the accounting information.

To help in comparative analysis.

Ratios are categorized into following basic categories:

Liquidity Ratios

Solvency Ratios

Activity or Turnover Ratios

Profitability Ratios

Liquidity Ratios:

These ratios measure the paying capacity of the entity to meet its short-term financial obligations. These includes: Current Ratio and Quick Ratio/Liquid Ratio/Acid Test Ratio.

Current Ratio/Working Capital Ratio:

Current Ratio =
$$\frac{\text{current assets}}{\text{Current liabilities}}$$

Current Assets = (Current Investments + Inventories + Trade Receivable + Cash & Cash Equivalents + Short-Term Loans & Advances + Other Current Assets)

Current Liabilities = (Short-term Borrowings + Trade Payables + Other Current Liabilities + Short-term Provisions)

This Ratio Shows short-term financial soundness of the business. Higher ratio means better capacity to meet its current obligation. The ideal *Current Ratio* Is 2:1. In case it is very high it shows the idleness of funds.

Quick Ratio/Liquid Ratio/Acid Test Ratio:

Quick Ratio/Liquid Ratio/Acid Test Ratio =
$$\frac{\text{liquid assets}}{\text{Current liabilities}}$$

Liquid/Quick Assets = (Current Assets - Inventories – Prepaid Expenses)

Current Liabilities = (Short-term Borrowings + Trade Payables + Other Current Liabilities + Short-term Provisions)

This Ratio is a fairly stringent measure of liquidity. It is based on those current assets which are highly liquid, i.e., can be converted into cash and cash equivalents quickly. Quick Ratio of 1:1 is considered as ideal. Higher the Quick Ratio better the short-term financial position.

Solvency Ratios:

These ratios measure the long-term financial position of the enterprise. These includes: Debt to Equity Ratio; Total Asset to Debt Ratio; Proprietary Ratio; Interest Coverage Ratio; Debt Service Coverage Ratio and Capital Gearing Ratio.

Debt to Equity Ratio:

$$\text{Debt to Equity Ratio} = \frac{\text{debts}}{\text{Equity}}$$

Debt = Long-term Borrowings (i.e., *Debenture* + *Mortgage public deposits*)
+ Long-term Provisions

Equity = Share Capital + Reserve and Surplus

Or

= Non-current Assets + Working Capital – Non-current Liabilities

This Ratio assesses the long-term financial position and soundness of enterprises. In general, lower the Debt to Equity Ratio higher the degree of protection enjoyed by the lenders.

Total Asset to Debt Ratio:

$$\text{Total Assets to Debt Ratio} = \frac{\text{total assets}}{\text{debts}}$$

Total Assets = Non-Current Assets + Current Assets + Inventories + Trade Receivables + Cash & Cash Equivalent + Short-term Loans & Advances + Other Current Assets

Debt = Long-term Borrowings (i.e., *Debenture* + *Mortgage public deposits*)
+ Long-term Provisions

This Ratio measures the safety margin available to lenders of long-term debts. It measures the extent to which debt is being covered by Assets.

Proprietary Ratio:

$$\text{Proprietary Ratio} = \frac{\text{Shareholder's Fund/Equity}}{\text{Total assets}}$$

Shareholder's Fund/Equity = Share Capital + Reserve and Surplus

Or

= Non-current Assets + Working Capital – Non-current Liabilities

Total Assets = Non-Current Assets + Current Assets + Inventories + Trade Receivables + Cash & Cash Equivalent + Short-term Loans & Advances + Other Current Assets

This Ratio shows the extent to which total assets have been financed by the proprietor. Higher the Ratio, higher the safety margin for lenders & creditors.

Interest Coverage Ratio:

$$\text{Interest Coverage Ratio} = \frac{\text{EBIT}}{\text{INTEREST ON LONG TERM DEBT}}$$

EBIT = Profit After Tax + Tax + Interest

Interest on L.T. Debt = Interest on Debenture + Interest on L.T. Loan

This Ratio shows how many times the interest charges are covered by the profits available to pay interest. Higher the Ratio, more secure the lender is in respect of payment of interest regularly.

Debt Service Coverage Ratio:

$$\text{Debt Service Coverage Ratio} = \frac{\text{Profit After Tax Before Int(PATBI)}}{\text{Interest on L.T. Loans \& Debts + Installments}}$$

PATBI = Profit After Tax + Interest

This is a measure of the cash flow available to pay current debt obligations. The ratio states net operating income as a multiple of debt obligations due within one year, including interest, principal, sinking-fund and lease payments.

Capital Gearing Ratio:

$$\text{Capital Gearing Ratio} = \frac{\text{Equity Share Capital}}{\text{Funds Bearing Fixed Payments}}$$

Equity Share Capital = Share Capital + Reserve and Surplus

FBFP = L.T. Loans + L.T. Debts + Preference Share Capital

The gearing ratio is a measure of financial risk and expresses the amount of a company's debt in terms of its equity. A company with a gearing ratio of 2.0 would have twice as much debt as equity.

Activity or Turnover Ratios:

These ratios are used to indicate the efficiency with which Assets and Resources of the firm are being utilized. These includes: Inventory Turnover Ratio; Debtor Turnover ratio; Creditor Turnover ratio; Fixed Asset Turnover Ratio and Working Capital Turnover Ratio.

Inventory Turnover Ratio:

$$\text{Inventory Turnover Ratio} = \frac{\text{Sales}}{\text{Average Stock}}$$

$$\text{Average Stock} = \frac{\text{Sales} + \text{Credit Sales} - \text{Returns}}{2}$$

Inventory turnover is a ratio showing how many times a company has sold and replaced inventory during a given period.

Debtor Turnover ratio:

$$\text{Debtor Turnover ratio} = \frac{\text{Net Credit Sales}}{\text{Average Trade Receivable}}$$

$$\text{Avg Trade Receivable} = \frac{\text{Net Credit Sales} + \text{Credit Sales} - \text{Returns}}{365}$$

$$\text{Avg. Collection Period} = \frac{365}{\text{DTR}}$$

The receivables turnover ratio is an accounting measure used to quantify a firm's effectiveness in extending credit sales and in collecting debts on those credit sales. Normally

higher the debtors turnover ratio better it is. Higher turnover signifies speedy and effective collection. Lower turnover indicates sluggish and inefficient collection leading to the doubts that receivables might contain significant doubtful debts. Receivables collection period is expressed in number of days. It should be compared with the period of credit allowed by the management to the customers as a matter of policy. Such comparison will help to decide whether receivables collection management is efficient or inefficient.

Creditor Turnover ratio:

$$\text{Creditor Turnover ratio} = \frac{\text{Net Credit Purchases}}{\text{Average Trade Payables}}$$

$$\text{Net Credit Purchases} = \text{Credit Purchases} - \text{Returns}$$

$$\text{Avg Trade Payables} = \frac{(\text{Opening Trade Payables} + \text{Closing Trade Payable})}{2}$$

$$\text{Avg. Payment Period} = \frac{365 \text{ DAYS}}{\text{CTR}}$$

It indicates the speed with which the payments are made to the trade creditors. Shorter average payment period or higher payable turnover ratio may indicate less period of credit enjoyed by the business it may be due to the fact that either business has better liquidity position; believe in availing cash discount and consequently enjoys better credit standing in the market or business credit rating among suppliers is not good and therefore they do not allow reasonable period of credit.

Fixed Asset Turnover Ratio:

$$\text{Fixed Asset Turnover Ratio} = \frac{\text{Sales}}{\text{Net Fixed Assets}}$$

$$\text{Sales} = \text{Cash Sales} + \text{Credit Sales} - \text{Returns}$$

$$\text{Net Fixed Assets} = \text{Fixed Assets} - \text{Accumulated Depreciation}$$

This Ratio indicates the efficiency with which the firm is utilizing its investment in Fixed Assets.

Working Capital Turnover Ratio:

$$\text{Working Capital Turnover Ratio} = \frac{\text{Sales}}{\text{Working Capital}}$$

$$\text{Sales} = \text{Cash Sales} + \text{Credit Sales} - \text{Returns}$$

$$\text{Cost of Sales} = \text{Sales} + \text{Closing Stock} - \text{Gross Profit}$$

Or

$$= \text{Opening Stock} + \text{Net Purchases} + \text{Direct Expenses} - \text{Closing Stock}$$

$$\text{Working Capital} = \text{Current Assets} - \text{Current Liabilities}$$

The working capital turnover ratio measures how well a company is utilizing its working capital to support a given level of sales. A high turnover ratio indicates that management is being extremely efficient in using a firm's short-term assets and liabilities to support sales. Conversely, a low ratio indicates that a business is investing in too many accounts receivable and inventory assets to support its sales, which could eventually lead to an excessive amount of bad debts and obsolete inventory.

Profitability Turnover Ratios:

These ratios show the Profitability or efficiency of the enterprise. These includes: Gross Profit Ratio; Net Profit Ratio; Operating Ratio; Operating Profit Ratio; Return on Investment; Return on Equity; Earnings Per Share (EPS); Dividend Payout Ratio and Price Earnings Ratio.

Gross Profit Ratio:

$$\text{Gross Profit Ratio} = \frac{\text{Gross Profit} \times 100}{\text{SALES}}$$

Gross Profit = Net Sales – Cost of Goods Sold

Net Sales = Sales – Returns

It shows whether Sales Prices are adequate or not. It also indicates the extent to which Sales Prices may be reduced without resulting losses.

Net Profit Ratio:

$$\text{Net Profit Ratio} = \frac{\text{net profit}}{\text{sales}} \times 100$$

Net Profit = Net Operating Profit + Non-Operating Income – Non-Operating Expenses Or
= Gross Profit – All Expenses + All Incomes

Net Sales = Sales – Returns

It reveals the remaining profit after all costs of production, administration, and financing have been deducted from sales, and income taxes recognized.

Operating Profit Ratio

$$\text{Operating Profit Ratio} = \frac{\text{Operating Profit} \times 100}{\text{sales}}$$

Operating Profit = Gross Profit – (Office and administrative expenses + Selling and distribution expenses)

Net Sales = Sales – Returns

This ratio helps in determining the ability of the management in running the business.

Operating Ratio:

$$\text{Operating Ratio} = \frac{\text{Cost of Goods Sold} + \text{Operating Expenses}}{\text{sales}} \times 100$$

Cost of Goods Sold = Opening Stock + Net Purchases + Direct Expenses – Closing Stock

Operating Expenses = Office and administrative expenses + Selling and distribution expenses

Net Sales = Sales – Returns

Operating Ratio is a yardstick to measure the efficiency with which a business is operated.

Operating ratio plus operating profit ratio is 100. The two ratios are obviously interrelated. For example, if the operating profit ratio is 20%, it means that the operating ratio is 80%. A rise in the operating ratio indicates a decline in the efficiency. Lower the operating ratio, the better is the position because greater is the profitability and management efficiency of the concern. The higher the ratio, the less favorable is the situation, because there will be smaller margin of profit available for the purpose of payment of dividend and creation of reserves.

Return on Equity(ROE):

$$\text{Return on Equity} = \frac{\text{Profit After Interest \& (PAT)}}{\text{Shareholder's Fund}} \times 100$$

PAT = EBIT – Tax – Interest

Shareholder's Fund = Share Capital + Reserve and Surplus

It measures the ability of a firm to generate profits from its shareholders investments in the company. In other words, the return on equity ratio shows how much profit each Rupee of common stockholders' equity generates.

Earning Per Share(EPS):

$$\text{Earnings Per Share} = \frac{\text{PAT} - \text{Preference Dividend}}{\text{No. of Equity Shareholders}}$$

No. of Equity Shareholders

It is a market prospect ratio that measures the amount of net income earned per share of stock outstanding. In other words, this is the amount of money each share of stock would receive if all the profits were distributed to the outstanding shares at the end of the year.

Dividend Payout Ratio:

$$\text{Dividend Payout Ratio} = \frac{\text{Dividend Per Share}}{\text{Earnings Per Share}}$$

Earnings Per Share

It measures the percentage of net income that is distributed to shareholders in the form of dividends during the year. In other words, this ratio shows the portion of profits the company decides to keep to fund operations and the portion of profits that is given to its shareholders.

Price Earnings Ratio:

$$\text{Price Earnings Ratio} = \frac{\text{Market Price Per Share}}{\text{Earnings Per Share}}$$

Earnings Per Share

It is a market prospect ratio that calculates the market value of a stock relative to its earnings by comparing the market price per share by the earnings per share. In other words, the price earnings ratio shows what the market is willing to pay for a stock based on its current earnings.

Advantages of Ratios Analysis:

Ratio analysis is an important and age-old technique of financial analysis. The following are some of the advantages / Benefits of ratio analysis:

1. Simplifies financial statements:

It simplifies the comprehension of financial statements. Ratios tell the whole story of changes in the financial condition of the business

2. Facilitates inter-firm comparison:

It provides data for inter-firm comparison. Ratios highlight the factors associated with with successful and unsuccessful firm. They also reveal strong firms and weak firms, overvalued and undervalued firms.

3. Helps in planning:

It helps in planning and forecasting. Ratios can assist management, in its basic functions of forecasting. Planning, co-ordination, control and communications.

4. Makes inter-firm comparison possible:

Ratios analysis also makes possible comparison of the performance of different divisions of the firm. The ratios are helpful in deciding about their efficiency or otherwise in the past and likely performance in the future.

5. Help in investment decisions:

It helps in investment decisions in the case of investors and lending decisions in the case of bankers etc.

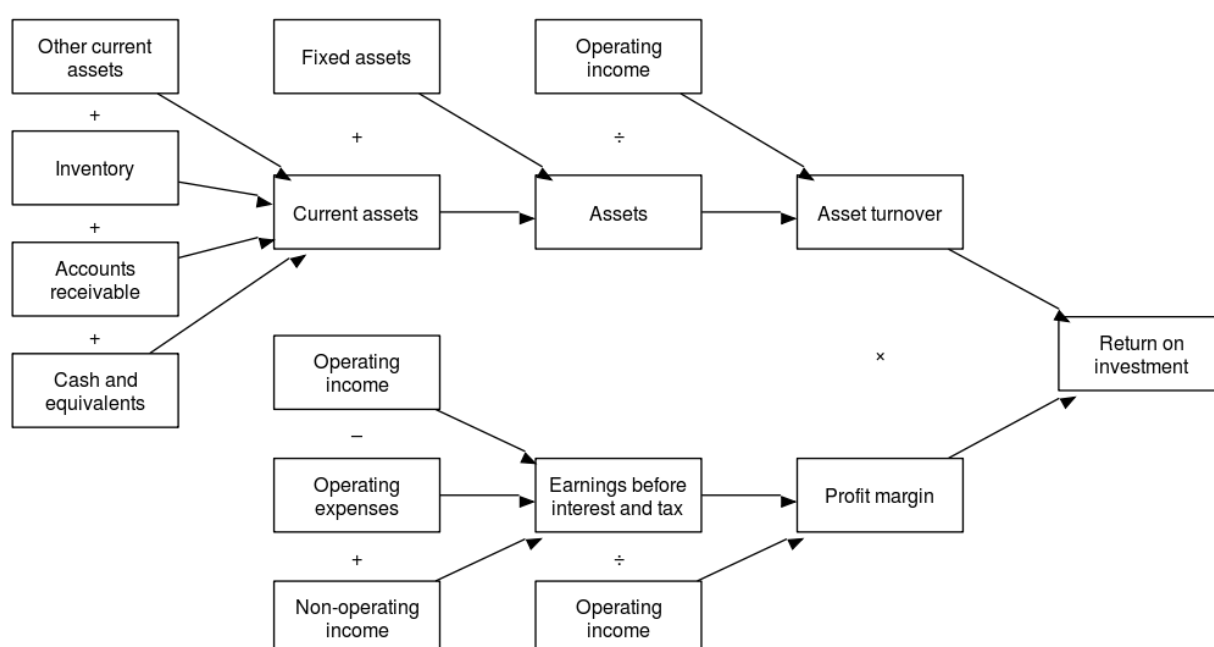
What Is the DuPont Analysis?

The DuPont analysis (also known as the [DuPont identity](#) or DuPont model) is a framework for analyzing fundamental performance popularized by the DuPont Corporation. DuPont analysis is [a useful technique](#) used to decompose the different drivers of [return on equity \(ROE\)](#). The decomposition of ROE allows [investors](#) to focus on the key metrics of financial performance individually to identify strengths and weaknesses.

DuPont analysis (also known as the DuPont identity, DuPont equation, DuPont framework, DuPont model or the DuPont method) is an expression which breaks ROE ([return on equity](#)) into three parts.

The name comes from the [DuPont](#) company that began using this formula in the 1920s. DuPont explosives salesman [Donaldson Brown](#) invented the formula in an internal efficiency report in 1912 ✓

DuPont Model



Basic formula

ROE = (Profit margin)*(Asset turnover)*(Equity multiplier) = ([Net profit/Sales](#))*([Sales/Average Total Assets](#))*([Average Total Assets/Average Equity](#)) = (Net Profit/Equity) Or

Profit/Sales*Sales/Assets=Profit/Assets*Assets/Equity Or ROS*AT=ROA*Leverage=ROE

Profitability (measured by [profit margin](#))

Asset efficiency (measured by [asset turnover](#))

[Financial leverage](#) (measured by [equity multiplier](#))

ROE analysis

The DuPont analysis breaks down ROE (that is, the returns that investors receive from a single dollar of equity) into three distinct elements. This analysis enables the analyst to understand the source of superior (or inferior) return by comparison with companies in similar industries (or between industries).

The DuPont analysis is less useful for industries such as investment banking, in which the underlying elements are not meaningful. Variations of the DuPont analysis have been developed for industries where the elements are weakly meaningful. ^{[[citation needed](#)]}

Examples

High margin industries

Some industries, such as fashion, may derive a substantial portion of their competitive advantage from selling at a higher margin, rather than higher sales. For high-end fashion brands, increasing sales without sacrificing margin may be critical. The DuPont analysis allows analysts to determine which of the elements is dominant in any change of ROE.

High turnover industries

Certain types of retail operations, particularly stores, may have very low profit margins on sales, and relatively moderate leverage. In contrast, though, groceries may have very high turnover, selling a significant multiple of their assets per year. The ROE of such firms may be particularly dependent on performance of this metric, and hence asset turnover may be studied extremely carefully for signs of under-, or, over-performance. For example, [same-store sales](#) of many retailers is considered important as an indication that the firm is deriving greater profits from existing stores (rather than showing improved performance by continually opening stores).

High leverage industries

Some sectors, such as the financial sector, rely on high leverage to generate acceptable ROE. Other industries would see high levels of leverage as unacceptably risky. DuPont analysis enables third parties that rely primarily on their financial statements to compare leverage among similar companies.

ROA and ROE ratio

The return on assets (ROA) ratio developed by DuPont for its own use is now used by many firms to evaluate how effectively assets are used. It measures the combined effects of profit margins and asset turnover.^[2]

$$ROA = \frac{\text{Net Income}}{\text{Revenue}} \times \frac{\text{Revenue}}{\text{Average Total Assets}} = \frac{\text{Net income}}{\text{Average Total Assets}}$$

The return on equity (ROE) ratio is a measure of the rate of return to stockholders. Decomposing the ROE into various factors influencing company performance is often called the DuPont system.

$$ROE = \frac{\text{Net Income}}{\text{Average Total Equity}} = \frac{\text{Net Income}}{\text{Pretax Income}} \times \frac{\text{Pretax Income}}{\text{EBIT}} \times \frac{\text{EBIT}}{\text{Revenue}} \times \frac{\text{Revenue}}{\text{Average Total Assets}} \times \frac{\text{Average Total Assets}}{\text{Average Total Equity}}$$

Where

Net Income = net income after taxes

Equity = shareholders' equity

EBIT = [Earnings before interest and taxes](#)

Pretax Income is often reported as Earnings Before Taxes or EBT

This decomposition presents various ratios used in [fundamental analysis](#).

The company's [tax](#) burden is (Net income ÷ Pretax profit). This is the proportion of the company's profits retained after paying income taxes. [NI/EBT]

The company's interest burden is (Pretax income ÷ EBIT). This will be 1.00 for a firm with no [debt](#) or financial leverage. [EBT/EBIT]

The company's operating income margin or [return on sales](#) (ROS) is (EBIT ÷ Revenue). This is the operating income per dollar of sales. [EBIT/Revenue]

The company's [asset turnover](#) (ATO) is (Revenue ÷ Average Total Assets).

The company's equity multiplier is (Average Total Assets ÷ Average Total Equity). This is a measure of financial leverage.

CASH BUDGET –

A Cash Budget is a projected cash transaction in future that is utilized in controlling actual receipts and payments by mending for the variances. It starts with a given 'Cash Balance'

which may be either big or small. But the said balance is, in any case, desired to be 'the optimum balance'. The sign of optimality for a given cash balance is obviously its ability to produce the highest rate of return for the minimum cost for mainly the said cash balance.

The main aim of Cash Budget is to ascertain whether there is excess or deficit of cash. It involves different steps.

The First element is selection of time period to be covered which is known as planning horizon. This coverage will differ from firm to firm depending upon its nature and degree of accuracy.

The Second element is the factors affecting the cash flows. Non cash items such as, depreciation are excluded from Cash Budget. The cash flow is affected by two factors operating and financial. The operating category includes cash flow generated by operations of the firm and are known as operating cash flows. The other category is known as financial cash flow.

Operating Cash Flow contains the following.

INFLOW

1. Cash Sales
2. Collection from Debtors
3. Sale of Assets

OUTFLOW

1. Cash Purchases
2. Payment to Creditors
3. Purchase of Assets.
4. Operating Expenses Paid

b) Financial Cash Flow contains the following.

INFLOW

1. Loans taken
2. Sale of Investments
3. Issue of Shares
4. Interest, Dividend, Rent Received.

OUTFLOW

1. Repayment of Loan
2. Purchase of Investment
3. Redemption of Shares
4. Interest, Dividend, Rent Paid

METHODS OF PREPARATION OF CASH BUDGET

Methods used for cash forecasting – There are two recognized ways of preparing a cash forecasting.

1 The Receipt & Payment Method.

2 The Income Statement Cash Flow Method (Adjusted Profit & Loss method)

1 THE RECEIPT AND PAYMENT METHOD –

Under this method, all expected cash receipts and payments during the period; under consideration are taken into account. The expected cash balance of a week or month will be equivalent to the difference between total expected Cash Receipts including opening balance, if any, and total expected Cash Payment during that period. The budget is generally prepared from various plans.

Cash Receipts from Customers, based on sales forecast, the term of sale, lag in payment etc. are generally taken into consideration. Cash Receipts from other sources, such as dividend on trade investments, rent, issue of capital, sale of; investment and fixed assets etc.

Cash requirements for materials, wages and salaries and overhead expenses based on purchasing, personnel and overhead budgets. The policy of the business with regard to the payment of supplier's accounts, the term of cash discount, the lag in payment of wages etc. are given due consideration.

Cash requirements for capital expenditure as per capital expenditure budget.

Cash requirement for other purposes, such as payment of dividend, income tax, fines, penalties etc.

ADJUSTED PROFIT AND LOSS ACCOUNT:

This method is based on cash and non-cash transactions. This method estimates closing cash balance by converting profit into cash. The hypothesis of this method is that the earning of profit brings equal amount of cash into the business. The net profit shown by profit and loss account does not signify the actual cash flow into the business. This also leads to another assumption, that is the business will remain static, i.e. there will be no wearing out or increase of assets and changes of working capital so that the total cash on hand for the business would be equal to the profit earned.

Model of Cash Budget

Particular	January	February	March
Opening Balance	-	-	-
Add: Receipts:			
Cash Sales	-	-	-
Receipts from Debtors	-	-	-
Interest and Dividend	-	-	-
Sale of fixed assets	-	-	-
Sale of Investments	-	-	-
Bank Loan	-	-	-
Issue Shares & Debenture	-	-	-
Others	-	-	-
Total Receipts (A)	-	-	-
Less: Payments			
Cash Purchases	-	-	-
Payment to creditors	-	-	-
Salaries & wages	-	-	-
Administrative expenses	-	-	-
Selling expenses	-	-	-
Dividend payable	-	-	-
Purchase of Fixed Assets	-	-	-
Repayment of Loan	-	-	-
Payment of taxes	-	-	-
Total Payments (B)	-	-	-
Closing Balance (A - B)	-	-	-

MASTER BUDGET –

It is defined as summary budget which includes different functional budgets and which is finally approved adopted and employed. It is defined as a budget which summarises all functional budgets when all functional budgets are prepared they are summarized to produce. Profit & Loss Account and Profit & Loss Appropriation Account.

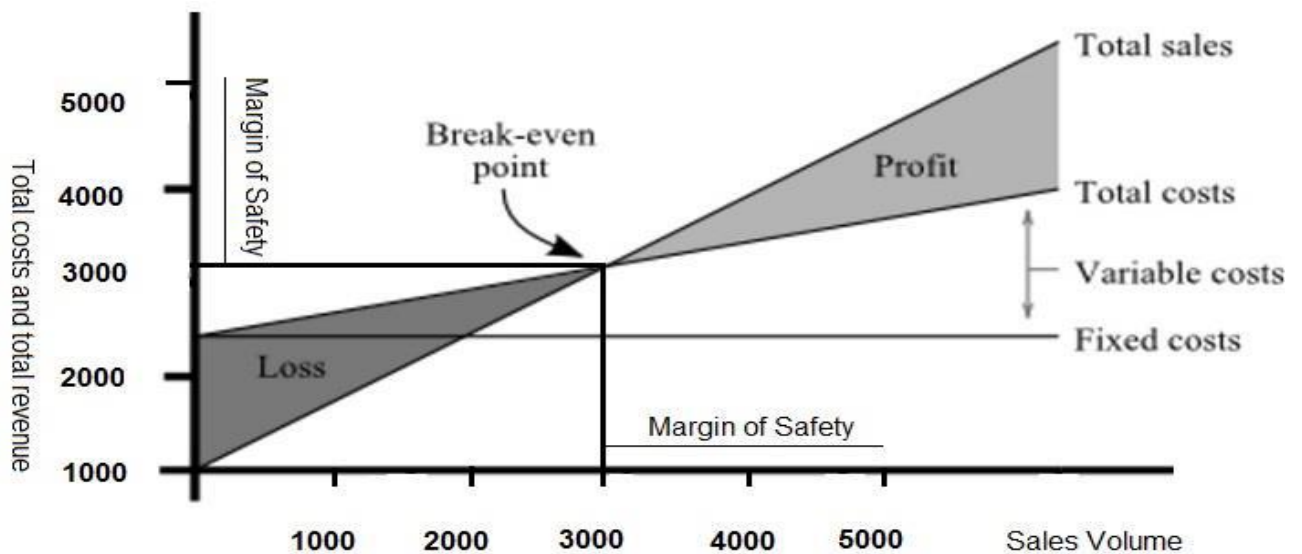
Balance Sheet. Master Budget takes the form of budgeted Profit & Loss Account and Balance Sheet.

It is overall business plan and familiar to financial statements. The only difference is that the accountant here deals with expected future data rather than historical data. The budget committee will prepare the master budget based on the functional budget. Once it is approved by the committee it becomes the target for the firm during the budget period.

BREAK EVEN ANALYSIS:

Break-even analyses help business owners determine when they'll begin to turn a profit and help them price their products with that in mind. It provides a dynamic overview of the relationships among revenues, costs and profits. However, typical variable and fixed costs differ widely among industries. This is why comparison of break-even points is generally most meaningful among companies within the same industry, and the definition of a "high" or "low" break-even point should be made within this context. A break-even analysis is a

calculation of the point at which revenues equal expenses. In securities trading, the break-even point is the point at which gains equal losses.



Break even analysis is defined as “No profit or No Loss” it denotes the minimum volume of production to be undertaken to avoid losses.

It points out how much minimum is to be produced to see the profits.

It is a technique for profit planning and control and therefore is considered as available marginal tool.

Break even analysis is defined as analysis of cost and their possible impacts on revenues and value of the firm. A firm is said to attain BEP when its total revenue is equal to total cost.

DETERMINANTS OF BEP:

BEP in units = $\frac{\text{Fixed cost}}{\text{Contribution (margin) per unit}}$

Contribution margin per unit = selling price per unit – variable cost per unit.
 $\text{Fixed cost} \times \text{sales}$

2. BEP in sales = $\frac{\text{Fixed cost} \times \text{sales}}{\text{Sales} - \text{Variable cost}}$

3. Total cost = fixed cost + variable cost

4. Profit = Contribution – fixed cost

5. Margin of safety (in units) = No. of units sold – BEP in units

6. BEA = P/V ratio

7. P/V ratio = $\frac{\text{Contribution}}{\text{Sales}}$

8. Margin of safety = $\frac{\text{Profit}}{\text{P/V ratio}}$
 $\frac{\text{Fixed cost} + \text{Targeted profit}}{\text{P/V ratio}}$

9. Volume of sales attain profit = $\frac{\text{Fixed cost} + \text{Targeted profit}}{\text{Contribution per margin}}$
 $\frac{\text{Profit}}{\text{P/V ratio}}$

10. Margin of safety = $\frac{\text{Profit}}{\text{P/V ratio}}$

Illustration 1:

The P/V ratio of Bharat Pharmaceuticals Ltd is 50% and the margin of safety is 40%.

Calculate the break-even point and the net profit if the sales volume is Rs. 1, 00,000.

Solution:

(ii) Calculation of Sales at Break-even Point.

	Rs.
Sales	1,00,000
Less margin of safety—40%	<u>40,000</u>
Sales at Break-even point	<u>60,000</u>

(iii) Calculation of Contribution at Break-even Sales

Sales at BEP × P/V ratio

∴ Rs. 60,000 × 50%

∴ Rs. 30,000.

(iv) Calculation of Fixed Costs.

	Rs.
Sales at BEP	60,000
Less contribution at BEP	<u>30,000</u>
Fixed costs	<u>30,000</u>

(v) Calculation of Profit

	Rs.
Contribution on total sales	50,000
Less fixed costs	<u>30,000</u>
Profit	<u>20,000</u>

Managerial Uses of Break-Even Analysis:

1. Product planning: it helps the firm in planning its new product development. Decisions regarding removal or addition of new products in their product line.
2. Activity planning: the firm decides the expansion of production capacity.
3. Profit planning: this helps the firm to plan about their profit well in advance and at the same time it helps to identify the quantity to be sold to achieve the targeted profit.
4. Target capacity: the targeted sales quantity helps to decide the purchase, inventory and management.
5. Price and cost decision: Decision regarding how much the price of the commodity should be reduced or increased to cover their cost of production.

What is profit planning?

Whether your business is run from your dining room table, a small office, or a large manufacturing plant, you should be using profit planning. A profit plan not only looks at how your business will earn a profit today but also creates a plan for future profits.

Profit planning doesn't have to be complicated, but it does need to be put into writing and carried out accordingly. Profit planning helps you set business goals while creating a plan for reaching those goals. The profit plan for a small business will initially be very simple but will grow in complexity as the business grows.

A profit plan is always created as part of a larger plan, such as a master budget or a strategic plan, and should include the following information:

Target market

Product or service pricing

Staffing

Marketing and advertising

Collection processes

Business investment
Operating expenses

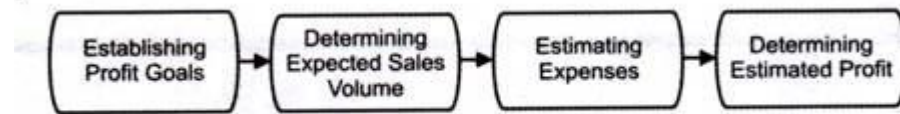


Figure-6: Process of Profit Planning

Profit planning typically takes four steps. Source: economicsdiscussion.net.

Why profit planning is important for your business

What is your goal for your business? Do you want to break even your first year and continue to grow year after year, or would you rather start strong and sustain your profits in the coming years? Profit planning answers those questions and a lot more, allowing you to carefully plan out not just how much profit you'd like to earn, but the steps necessary to achieve those goals.

As an integral part of the planning process, profit planning should always be part of any business plan or forecast you create for your business and not just the number left over after expenses have been subtracted from revenues. By planning for profit intentionally, rather than by default, you're more likely to build profit levels each year.

For example, you manufacture and sell coffee mugs for \$10. For your first year in business, your goal is to earn a \$2 profit for every coffee mug you sell. By planning for profit first, you now know that only \$8 per cup sold is available for all of the other expenses involved in selling your coffee cups. And because you know that, you can plan your expenses accordingly, including materials, labor, selling costs, and even a business emergency fund. Profit is the most important part of your business. It should always come first. These are just a few of the reasons why.

It helps business owners achieve their goals

If you don't plan for profit, how will you know if you've achieved your goals? In your head you may be thinking, "I want to earn \$50,000 a year in profit," but in reality, you have no idea how you're going to make that happen. Before you can earn your \$50,000 profit, you'll have to create a method for achieving that goal. That's what profit planning does.

Assists with future decisions

Profit planning can be used to achieve both short-term and long-term objectives. For example, you start a business in January of 2021, with the modest goal of earning \$40,000 in profit your first year in business. However, as your brand becomes better known and your sales techniques improve, you expect your profit in 2022 to double to \$80,000.

While these are achievable goals, profit planning provides the details you need to give you the best shot at achieving them by taking into account details such as increased materials costs and labor costs.

Provides a baseline to measure against

It's important to establish a baseline to measure success against. In our earlier example, we talked about the business owner that wanted to earn \$50,000 a year but didn't have a plan in place. Do you think that a business owner would feel successful if they earned \$25,000 their first year?

Probably not. Establishing a baseline, and continuing to measure against that baseline as your business grows will allow you to make adjustments along the way, giving your business a better shot at success.

Benefits of profit planning

Simply wanting to earn a profit is not an achievable goal. Profit planning provides you with a way to set and achieve your goals. There are a lot of benefits to profit planning. The following are just a few.

It allows you to set a target and create a roadmap to that target

The most important thing about profit planning is that it allows you to create a target profit and then build a detailed plan around it. For example, if your target profit for the year is \$100,000, you can then devise a strategy around achieving that goal by answering the following questions:

How many items/units/services will I need to sell to achieve my goal?

Do I plan on reinvesting profits?

What are my maximum costs?

How much should I charge for my products and services?

How many salespeople will I need to achieve my goals?

Are there any places where I need to reduce expenses?

Where do I want my [gross profit margin](#) to be?

Once these questions have been answered, you're well on your way to creating a sound [business budget](#) to go along with your profit plan.

Select Reporting Month

Month 01

FULL YEAR	Budget		Actual		Difference
Operating Revenue	\$	50,000.00	\$	156,000.00	\$ 106,000.00
Non-Operating Revenue	\$	50,000.00	\$	5,250.00	\$ (44,750.00)
Total Revenue	\$	1,875,000.00	\$	161,250.00	\$ (1,713,750.00)
Total Expenses	\$	1,425,250.00	\$	114,734.34	\$ (1,310,515.66)
Profit	\$	449,750.00	\$	46,515.66	\$ (403,234.34)

YEAR TO DATE	Budget		Actual		Difference
Operating Revenue	\$	152,083.33	\$	156,000.00	\$ 3,916.67
Non-Operating Revenue	\$	4,166.67	\$	5,250.00	\$ 1,083.33
Total Revenue	\$	156,250.00	\$	161,250.00	\$ 5,000.00
Total Expenses	\$	118,770.83	\$	114,734.34	\$ (4,036.49)
Profit	\$	37,479.17	\$	46,515.66	\$ 9,036.49

MONTH	Budget		Actual		Difference
Operating Revenue	\$	152,083.33	\$	156,000.00	\$ 3,916.67
Non-Operating Revenue	\$	4,166.67	\$	5,250.00	\$ 1,083.33
Total Revenue	\$	156,250.00	\$	161,250.00	\$ 5,000.00
Total Expenses	\$	118,770.83	\$	114,734.34	\$ (4,036.49)
Profit	\$	37,479.17	\$	46,515.66	\$ 9,036.49

Profit planning should always be part of any budget you create.

It strengthens the business overall

A profit plan is designed to be used with other financial projections such as a business plan, financial forecast, or organizational budget. When you create a detailed profit plan, you can compare progress each accounting period to see just how close or how far away you are from your initial targeted profit, and more importantly, take corrective action to get back on track.

It provides owners, managers, and employees with clear objectives

It's only fair that all key employees are on the same page about the strategic goals of your business. It's difficult to hold an employee responsible for underselling if they have no idea

or input into your profit-planning process. Bringing your employees into the process provides them with a key stake in the outcomes and also gives them a much clearer picture of expectations.

4 best practices for profit planning

If you're a new business owner, chances are that you've created a rudimentary business plan and didn't pay a lot of attention to profit; it was just what was left over after your expenses were subtracted from your revenue. But detailed profit planning is important, even for smaller businesses. So let's get started planning today, using some of these best practices.

1. Create a profit plan as part of a business plan

A profit plan should always be part of a business plan or strategic plan. Planning for profit is impossible without using a complete budget approach for profit planning, which includes expense budgeting and estimating production levels.

2. Use a cash flow forecast to map out goals

Once profit planning and expense budgeting are complete, create a [cash flow forecast](#) that provides the details of your plan. Not only does this give key players a guide to use, but it can also help you see where your projections are off, allowing you to make changes when needed.

3. Plan for profit first

Always define the profit level you wish to achieve and then plan your expenses around it, instead of the other way around. While this sounds simple, in reality, many business owners estimate revenue and expenses, with [operating profit](#) anything that's left over. By determining the profit that you wish to make and by planning for it properly, you're much more likely to achieve your goals.

4. Hold yourself (and others) accountable

Having a strategic plan in place that includes a detailed plan for profit helps to hold you, your managers, and your employees accountable. It's impossible to achieve a goal without knowing what goal it is you wish to achieve. Be as detailed as you can, and rely on your team to make it happen.

Loan Amortization Schedule

This example teaches you how to create a loan amortization schedule in Excel.

1. We use the [PMT function](#) to calculate the monthly payment on a loan with an annual interest rate of 5%, a 2-year duration and a present value (amount borrowed) of \$20,000. We use [named ranges](#) for the input cells.

=PMT(AnnualInterestRate/PaymentsPerYear,Years*PaymentsPerYear,Amount)						
	A	B	C	D	E	F
1	Annual Interest Rate	5.00%				
2	Years	2				
3	Payments Per Year	12				
4	Amount	\$20,000				
5						
6	Payment Number	Payment	Principal	Interest	Balance	
7	1	(\$877.43)				
8						

2. Use the PPMT function to calculate the principal part of the payment. The second argument specifies the payment number.

=PPMT(AnnualInterestRate/PaymentsPerYear,A7,Years*PaymentsPerYear,Amount)

	A	B	C	D	E	F
1	Annual Interest Rate	5.00%				
2	Years	2				
3	Payments Per Year	12				
4	Amount	\$20,000				
5						
6	Payment Number	Payment	Principal	Interest	Balance	
7	1	(\$877.43)	(\$794.09)			
8						

3. Use the IPMT function to calculate the interest part of the payment. The second argument specifies the payment number.

=IPMT(AnnualInterestRate/PaymentsPerYear,A7,Years*PaymentsPerYear,Amount)

	A	B	C	D	E	F
1	Annual Interest Rate	5.00%				
2	Years	2				
3	Payments Per Year	12				
4	Amount	\$20,000				
5						
6	Payment Number	Payment	Principal	Interest	Balance	
7	1	(\$877.43)	(\$794.09)	(\$83.33)		
8						

4. Update the balance.

=Amount+C7

	A	B	C	D	E	F
1	Annual Interest Rate	5.00%				
2	Years	2				
3	Payments Per Year	12				
4	Amount	\$20,000				
5						
6	Payment Number	Payment	Principal	Interest	Balance	
7	1	(\$877.43)	(\$794.09)	(\$83.33)	\$19,205.91	
8						

5. Select the range A7:E7 (first payment) and drag it down one row. Change the balance formula.

=E7+C8						
	A	B	C	D	E	F
1	Annual Interest Rate	5.00%				
2	Years	2				
3	Payments Per Year	12				
4	Amount	\$20,000				
5						
6	Payment Number	Payment	Principal	Interest	Balance	
7	1	(\$877.43)	(\$794.09)	(\$83.33)	\$19,205.91	
8	2	(\$877.43)	(\$797.40)	(\$80.02)	\$18,408.50	
9						

6. Select the range A8:E8 (second payment) and drag it down to row 30.

2						
	A	B	C	D	E	F
1	Annual Interest Rate	5.00%				
2	Years	2				
3	Payments Per Year	12				
4	Amount	\$20,000				
5						
6	Payment Number	Payment	Principal	Interest	Balance	
7	1	(\$877.43)	(\$794.09)	(\$83.33)	\$19,205.91	
8	2	(\$877.43)	(\$797.40)	(\$80.02)	\$18,408.50	
9	3	(\$877.43)	(\$800.73)	(\$76.70)	\$17,607.78	
10	4	(\$877.43)	(\$804.06)	(\$73.37)	\$16,803.71	
11	5	(\$877.43)	(\$807.41)	(\$70.02)	\$15,996.30	
12	6	(\$877.43)	(\$810.78)	(\$66.65)	\$15,185.53	
13	7	(\$877.43)	(\$814.15)	(\$63.27)	\$14,371.37	
14	8	(\$877.43)	(\$817.55)	(\$59.88)	\$13,553.82	
15	9	(\$877.43)	(\$820.95)	(\$56.47)	\$12,732.87	
16	10	(\$877.43)	(\$824.37)	(\$53.05)	\$11,908.50	
17	11	(\$877.43)	(\$827.81)	(\$49.62)	\$11,080.69	
18	12	(\$877.43)	(\$831.26)	(\$46.17)	\$10,249.43	
19	13	(\$877.43)	(\$834.72)	(\$42.71)	\$9,414.71	
20	14	(\$877.43)	(\$838.20)	(\$39.23)	\$8,576.51	
21	15	(\$877.43)	(\$841.69)	(\$35.74)	\$7,734.81	
22	16	(\$877.43)	(\$845.20)	(\$32.23)	\$6,889.62	
23	17	(\$877.43)	(\$848.72)	(\$28.71)	\$6,040.89	
24	18	(\$877.43)	(\$852.26)	(\$25.17)	\$5,188.64	
25	19	(\$877.43)	(\$855.81)	(\$21.62)	\$4,332.83	
26	20	(\$877.43)	(\$859.37)	(\$18.05)	\$3,473.45	
27	21	(\$877.43)	(\$862.96)	(\$14.47)	\$2,610.50	
28	22	(\$877.43)	(\$866.55)	(\$10.88)	\$1,743.95	
29	23	(\$877.43)	(\$870.16)	(\$7.27)	\$873.79	
30	24	(\$877.43)	(\$873.79)	(\$3.64)	(\$0.00)	
31						
32						

It takes 24 months to pay off this loan. See how the principal part increases and the interest part decreases with each payment.

Capital Budgeting Techniques?

Capital budgeting technique is the company's process of analyzing the decision of investment/projects by taking into account the investment to be made and expenditure to be incurred and maximizing the profit by considering following factors like availability of funds, the economic value of the project, taxation, capital return, and accounting methods.

List of Top 5 Capital Budgeting Techniques (with examples)

[Profitability index](#)

Payback period

Net present value

[Internal rate of return](#)

Modified rate of return

Let us discuss this one by one in detail along with examples –

#1 – Profitability Index

Profitability Index is one of the essential techniques, and it signifies a relationship between the investment of the project and the payoff of the project.

The [formula of profitability index](#) given by:-

Profitability Index = PV of future cash flows / PV of initial investment

Where PV is the present value.

It is mainly used for ranking projects. According to the rank of the project, a suitable project is chosen for investment.

#2 – Payback Period

This method of capital budgeting helps to find a profitable project. The [payback period is calculated](#) by dividing the initial investment by the annual cash flows. But the main drawback is it ignores the time value of money. By the [time value of money](#), we mean that money is more today than the same amount in the future. So if we payback to an investor tomorrow, it includes an [opportunity cost](#). As already mentioned, the payback period disregards the time value of money.

It is calculated by how many years it is required to recover the amount of investment done. Shorter paybacks are more attractive than more extended payback periods. Let's calculate the payback period for the below investment:-

Example

For example, there is an initial investment of ₹1000 in a project, and it generates a cash flow of ₹ 300 for the next five years.

Year	0	1	2	3	4	5
Cash flow	-1000	300	300	300	300	300
Cumulative cash flow	-1000	-700	-400	-100	200	500

Therefore the payback period is calculated as below:

B6		=B2-(B3/B4)	
	A	B	
1			
2	no. of years	5	
3	cumulative cash flow	500	
4	cash flow	300	
5			
6	Payback period	3.33	
7			

Payback period= no. of years - (cumulative cash flow/cash flow)

Payback period = no. of years – (cumulative cash flow/cash flow)

Payback period = 5- (500/300)

= 3.33 years

Therefore it will take 3.33 years to recover the investment.

#3 – Net Present Value

Net Present Value is the difference between the present value of incoming cash flow and the outgoing cash flow over a particular time. It is used to analyze the profitability of a project.

The formula for the calculation of NPV is as below:-

NPV = [Cash Flow / (1+i)ⁿ] – Initial Investment

Here i is the discount rate, and n is the number of years.

Example

Let us see an example to discuss it.

Let us assume the discount rate is 10%

B6

✕

✓

f_x

=B4+C4/(1+B1)^1+D4/(1+B1)^2+E4/(1+B1)^3+F4/(1+B1)^4+G4/(1+B1)^5

	A	B	C	D	E	F	G	H
1	Discount Rate	10%						
2								
3	Year	0	1	2	3	4	5	
4	Cashflow	-1000	200	300	400	600	700	
5								
6	NPV	574.731						
7								

NPV = [Cash Flow / (1+i)ⁿ] - Initial Investment

NPV = [Cash Flow / (1+i)ⁿ] - Initial Investment

$$\text{NPV} = -1000 + 200/(1+0.1)^1 + 300/(1+0.1)^2 + 400/(1+0.1)^3 + 600/(1+0.1)^4 + 700/(1+0.1)^5$$

$$= 574.731$$

We can also calculate it by [basic excel formulas](#).

There is an in-built excel formula of “NPV” which can be used. The discounting rate and the series of cash flows from the 1st year to the last year are considered arguments. We should not include the year zero cash flow in the formula. We should later subtract it.

=IRR (Cash flow from 0 to 5th year)

= 26 %

Therefore in both ways, we get **26 %** as the internal rate of return.

#5 – Modified Internal Rate of return

The main drawback of the internal rate of return that it assumes that the amount will be reinvested at the IRR itself, which is not the case. [MIRR](#) solves this problem and reflects the profitability in a more accurate manner.

The formula is as below:-

$$\text{MIRR} = \frac{\text{FV}(\text{Positive cash flows} * \text{Cost of capital}) / \text{PV}(\text{Initial outlays} * \text{Financing cost})^{1/n-1}}$$

Where,

N = the number of periods

FVCF = the future value of positive cash flow at the cost of capital

PVCF = the present value of [negative cash flows](#) at the financing cost of the company.

Example

We can calculate MIRR for the below example:

Let us assume the [cost of capital](#) at 12%. In MIRR, we need to consider the reinvested rate, which we assume as 14%. In Excel, we can calculate as the below formulae

B7

✕

✓

fx

=MIRR(B5:G5,B1,14%)

	A	B	C	D	E	F	G	H
1	Cost of capital	12%						
2	Reinvestment Rate	14%						
3								
4	Year	0	1	2	3	4	5	
5	Cashflow	-1000	200	300	400	600	700	
6								
7	MIRR	22%						
8								

MIRR= (cash flows from year 0 to 4th year, cost of capital rate, reinvestment rate)

MIRR= (cash flows from year 0 to 4th year, cost of capital rate, reinvestment rate)

MIRR= (-1000: 600, 12%, 14%)

MIRR= 22%

A [MIRR in excel](#) is a better estimation than an internal rate of return.

SCENARIO MANAGER IN EXCEL?

Scenario Manager in Excel is used to compare data side by side and also swap multiple sets of data within a worksheet. In simple words when you have multiple variables and you want to see their effect on the final result, and also want to estimate between two or more desired budgets you can use Scenario Manager. It is built-in functionality in excel and can be spotted under the head [What-If Analysis](#). It allows users to change input values up to a maximum of 32 cells.

Let's take an example of Event Management who wish to host an event. An important step is to decide the venue as it plays a major role in determining expenditure, revenues, profit, or loss. You can create various scenarios consisting of different venues and then compare them.

Scenario Manager in Excel –

Example #1

A simple example could be your monthly family budget. You will spend on food, travel, entertainment, clothes, etc.... and see how these affect your overall budget.

Step 1: Create a below table shows your list of expenses and income sources.

	A	B	C
1	Particulars	Amt	
2	Income from Salary	50,000	
3	Income from wife	25,000	
4	Income from Other Source	15,000	
5	Total Income	90,000	
6			
7	Expenses	Amt	
8	Rent	18,000	
9	Electricity Bill	2,500	
10	Mobile Bill	1,250	
11	Internet Bill	1,500	
12	Water Bill	1,200	
13	Clothes	15,000	
14	Fuel	10,000	
15	Food	15,000	
16	Personal Loan	20,000	
17	Total Expenses	84,450	
18			
19	Income Left	5,550	
20			

In cell **B5**, you have total income.

B5	:	X	✓	<i>f_x</i>	=SUM(B2:B4)
	A	B			
1	Particulars	Amt			
2	Income from Salary	50,000			
3	Income from wife	25,000			
4	Income from Other Source	15,000			
5	Total Income	90,000			
6					

In cell **B17**, you have total expenses for the month.

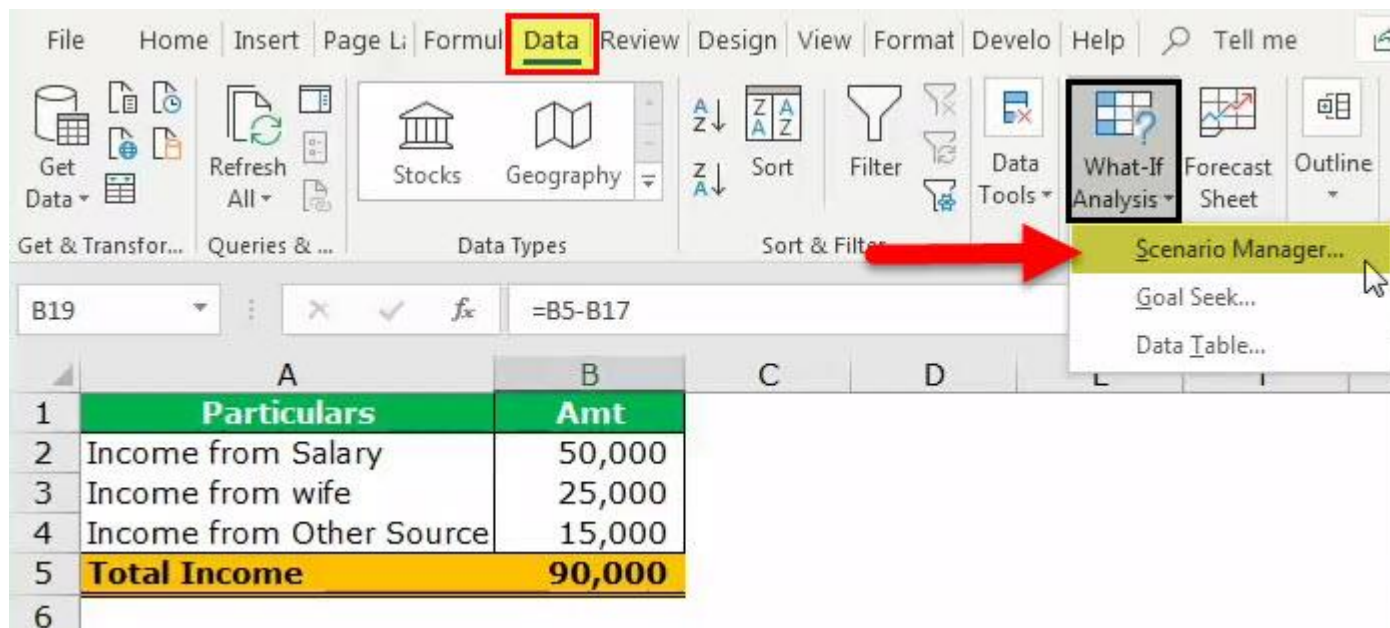
B17		$\times$	$\checkmark$	f_x	=SUM(B8:B16)
	A			B	
7	Expenses			Amt	
8	Rent			18,000	
9	Electricity Bill			2,500	
10	Mobile Bill			1,250	
11	Internet Bill			1,500	
12	Water Bill			1,200	
13	Clothes			15,000	
14	Fuel			10,000	
15	Food			15,000	
16	Personal Loan			20,000	
17	Total Expenses			84,450	
18					

In cell **B19**, total money left.

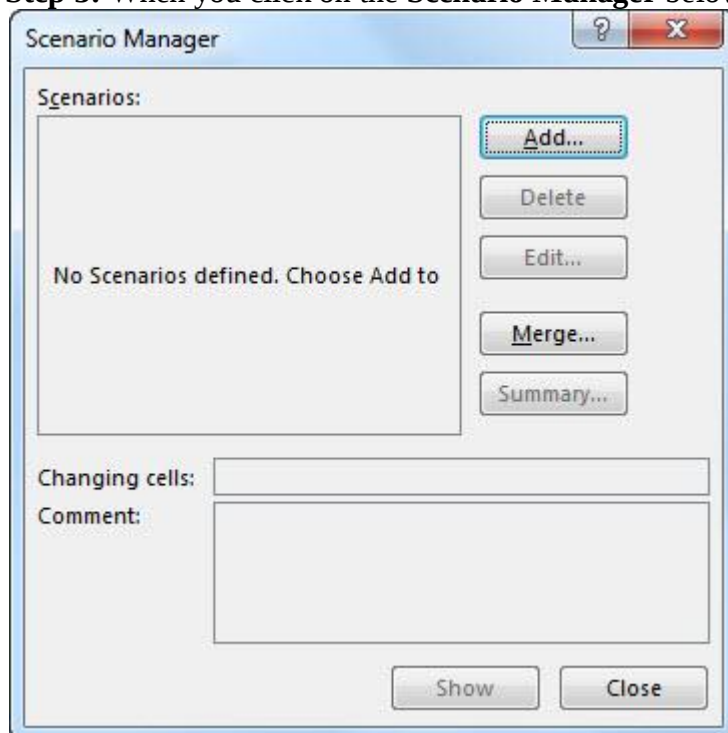
B19		$\times$	$\checkmark$	f_x	=B5-B17
	A			B	
7	Expenses			Amt	
8	Rent			18,000	
9	Electricity Bill			2,500	
10	Mobile Bill			1,250	
11	Internet Bill			1,500	
12	Water Bill			1,200	
13	Clothes			15,000	
14	Fuel			10,000	
15	Food			15,000	
16	Personal Loan			20,000	
17	Total Expenses			84,450	
18					
19	Income Left			5,550	
20					

You are ending up with only 5,550 after all the expenses. So, you need to cut down your cost to save more for the future...

Step 2: From the top of Excel, click the Data menu > On the Data menu, locate the Data Tools panel > Click on the what-if-Analysis item and select the Scenario Manager in excel from the menu.



Step 3: When you click on the **Scenario Manager** below, the dialogue box will open.



Step 4: You need to create a new scenario. So click on the **Add** button. Then you will get the below dialogue box.

Add Scenario

Scenario name:

Changing cells:

C10

Ctrl+click cells to select non-adjacent changing cells.

Comment:

Created by Sales on 11/15/2018

Protection

☒ Prevent changes

☐ Hide

OK Cancel

By default, it shows the cell C10, which means that it is the currently active cell. First, type the Scenario Name in the box as the **Actual Budget**.

Add Scenario

Scenario name:

Actual Budget

Changing cells:

C10

Ctrl+click cells to select non-adjacent changing cells.

Comment:

Created by Sales on 11/15/2018

Protection

☒ Prevent changes

☐ Hide

OK Cancel

Now, you need to enter which cells your excel sheet will be changing. In this first scenario, nothing will be changing because this is my actual budget for the month. Still, we need to specify the cells will be changing.

Now try to reduce your Food expenses and Clothes expenses. These are in the cells **B15 & B13**, respectively. Now your add scenario dialogue box should look like this.

	A	B	C	D	E	F	G
1	Particulars	Amt	Add Scenario Scenario name: Actual Budget Changing cells: \$B\$15,\$B\$13 Ctrl+click cells to select non-adjacent changing cells. Comment: Created by Family Head Protection ☒ Prevent changes ☐ Hide OKCancel				
2	Income from Salary	50,000					
3	Income from wife	25,000					
4	Income from Other Source	15,000					
5	Total Income	90,000					
6							
7	Expenses	Amt					
8	Rent	18,000					
9	Electricity Bill	2,500					
10	Mobile Bill	1,250					
11	Internet Bill	1,500					
12	Water Bill	1,200					
13	Clothes	15,000					
14	Fuel	10,000					
15	Food	15,000					
16	Personal Loan	20,000					
17	Total Expenses	84,450					
18							
19	Income Left	5,550					
20							

Click, OK, and Excel will ask you for some values. Since we do not want any changes to this scenario, just click OK.

Scenario Values

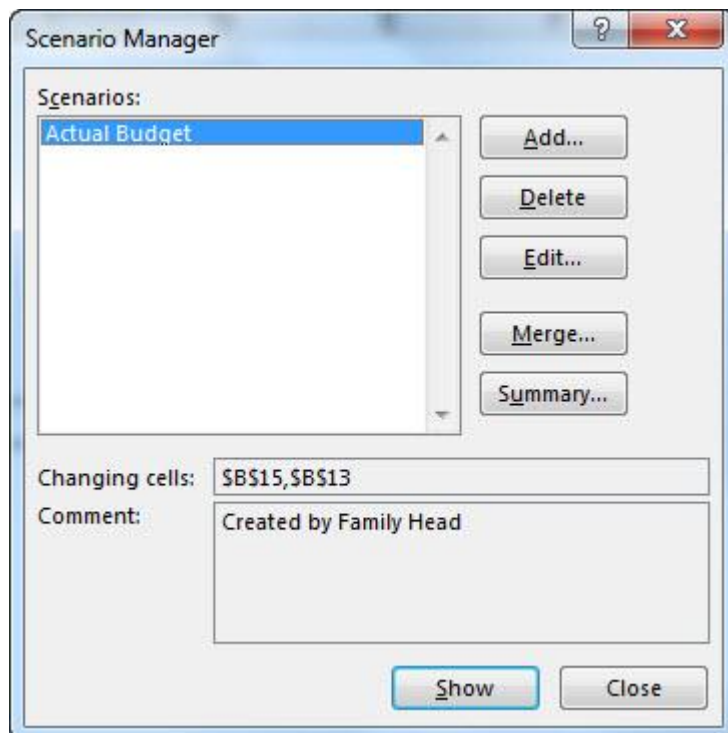
Enter values for each of the changing cells.

1: \$B\$15 15000

2: \$B\$13 15000

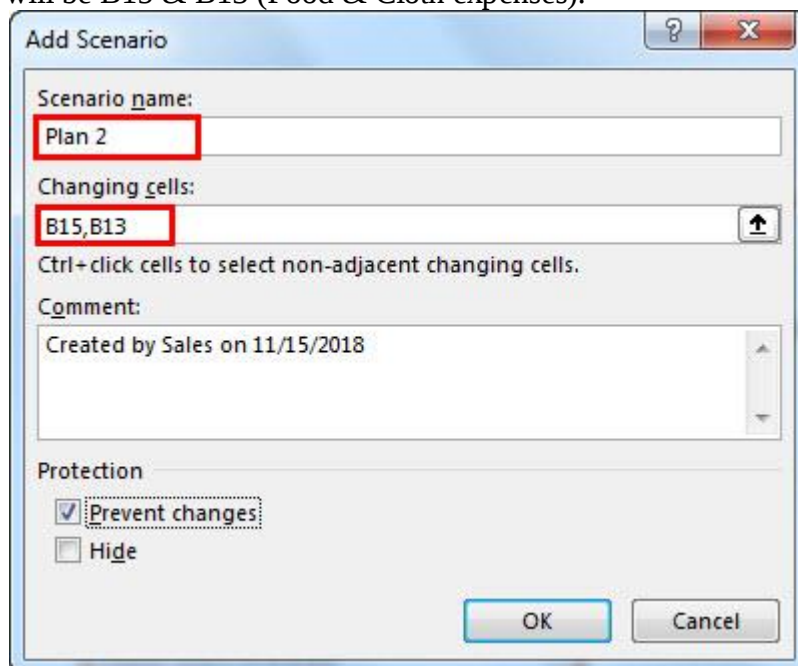
Add OK Cancel

Now, you will be taken back to the Scenario Manager Box. Now the window will look like this.

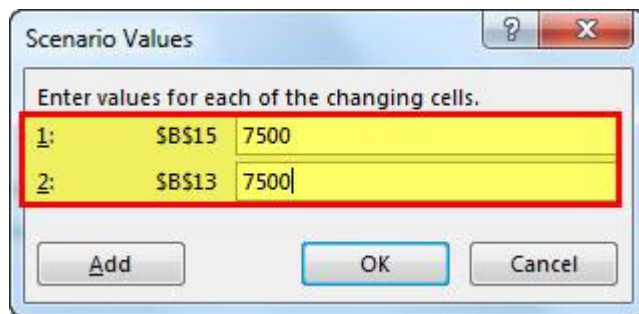


Now, one scenario is done and dusted. Create a second scenario, and this where you need to make changes to your Food & Clothes expenses.

Click the **Add** button one more time and give a scenario name as **“Plan 2”**. Changing the cell will be B15 & B13 (Food & Cloth expenses).



Now, below Scenario Values dialogue box opens again. This time, we do want to change the values. Enter the same ones as in the image below:



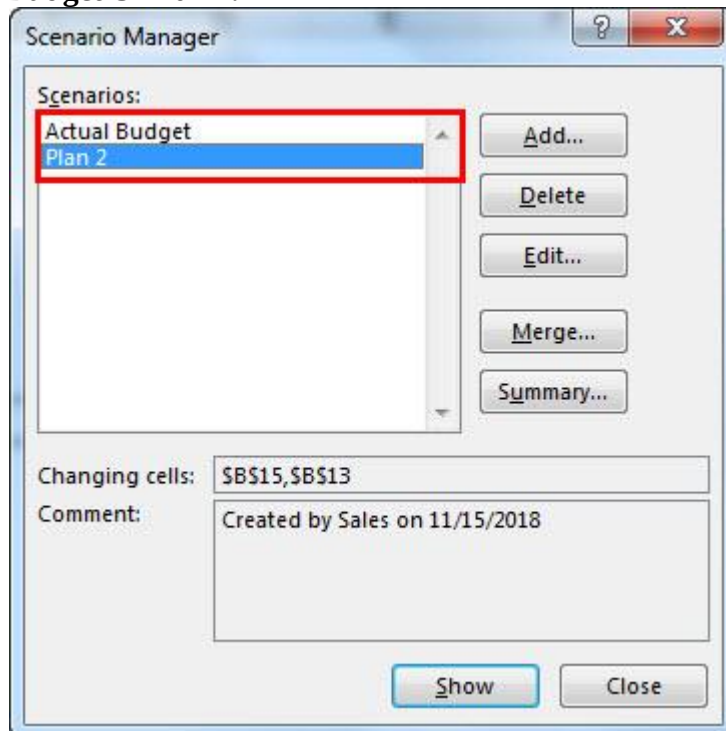
Scenario Values

Enter values for each of the changing cells.

1:	\$B\$15	7500
2:	\$B\$13	7500

Buttons: Add, OK, Cancel

These are the new values for our new scenario, **Plan 2**. Click OK, and now you are back to the Scenario Manager window. Now we already have two scenarios named after **Actual Budget & Plan 2**.



Scenario Manager

Scenarios:

- Actual Budget
- Plan 2

Buttons: Add..., Delete, Edit..., Merge..., Summary...

Changing cells: \$B\$15,\$B\$13

Comment: Created by Sales on 11/15/2018

Buttons: Show, Close

Click the **Add** button one more time and give a scenario name as “**Plan 3**”. Changing the cell will be B15 & B13 (Food & Cloth expenses).

Add Scenario

Scenario name:

Changing cells:

Ctrl+click cells to select non-adjacent changing cells.

Comment:

Protection

☒ Prevent changes
☐ Hide

Now, below Scenario Values dialogue box opens again. This time, we do want to change the values. Enter the same ones as in the image below:

Scenario Values

Enter values for each of the changing cells.

1:	\$B\$15	10000
2:	\$B\$13	10000

These are the new values for our new scenario, **Plan 3**. Click OK, and now you are back to the Scenario Manager window. Now you have three scenarios named after **Actual Budget**, **Plan 2**, and **Plan 3**.

Scenario Manager

Scenarios:

- Actual Budget
- Plan 2
- Plan 3

Buttons: Add..., Delete, Edit..., Merge..., Summary...

Changing cells: \$B\$15,\$B\$13

Comment: Created by Family Head

Buttons: Show, Close

As you can see, we have our Actual Budget, Plan 1 and Plan 2. With Plan 2 selected, click the Show button at the bottom. The values in your excel sheet will change, and the new budget will be calculated. The image below shows what it looks like.

	A	B
1	Particulars	Amt
2	Income from Salary	50,000
3	Income from wife	25,000
4	Income from Other Source	15,000
5	Total Income	90,000
6		
7	Expenses	Amt
8	Rent	18,000
9	Electricity Bill	2,500
10	Mobile Bill	1,250
11	Internet Bill	1,500
12	Water Bill	1,200
13	Clothes	10,000
14	Fuel	10,000
15	Food	10,000
16	Personal Loan	20,000
17	Total Expenses	74,450
18		
19	Income Left	15,550
20		

Scenario Manager

Scenarios:

- Actual Budget
- Plan 2
- Plan 3

Buttons: Add..., Delete, Edit..., Merge..., Summary...

Changing cells: \$B\$15,\$B\$13

Comment: Created by Family Head

Buttons: Show, Close

Click on the **Actual Budget**, then click on **the Show** button to see the differences. Initial values will be displayed.

	A	B
1	Particulars	Amt
2	Income from Salary	50,000
3	Income from wife	25,000
4	Income from Other Source	15,000
5	Total Income	90,000
6		
7	Expenses	Amt
8	Rent	18,000
9	Electricity Bill	2,500
10	Mobile Bill	1,250
11	Internet Bill	1,500
12	Water Bill	1,200
13	Clothes	15,000
14	Fuel	10,000
15	Food	15,000
16	Personal Loan	20,000
17	Total Expenses	84,450
18		
19	Income Left	5,550
20		

Scenario Manager

Scenarios:

- Actual Budget
- Plan 2
- Plan 3

Buttons: Add..., Delete, Edit..., Merge..., Summary...

Changing cells: \$B\$15,\$B\$13

Comment: Created by Family Head

Buttons: Show, Close

Do the same for Plan 2 to look at the changes.

	A	B
1	Particulars	Amt
2	Income from Salary	50,000
3	Income from wife	25,000
4	Income from Other Source	15,000
5	Total Income	90,000
6		
7	Expenses	Amt
8	Rent	18,000
9	Electricity Bill	2,500
10	Mobile Bill	1,250
11	Internet Bill	1,500
12	Water Bill	1,200
13	Clothes	7,500
14	Fuel	10,000
15	Food	7,500
16	Personal Loan	20,000
17	Total Expenses	69,450
18		
19	Income Left	20,550
20		

Scenario Manager

Scenarios:

- Actual Budget
- Plan 2
- Plan 3

Buttons: Add..., Delete, Edit..., Merge..., Summary...

Changing cells: \$B\$15,\$B\$13

Comment: Created by Sales on 11/15/2018

Buttons: Show, Close

So Scenario Manager in Excel allows you to set different values and allows you to identify the significant changes from them.

How to Create a Summary Report in Excel?

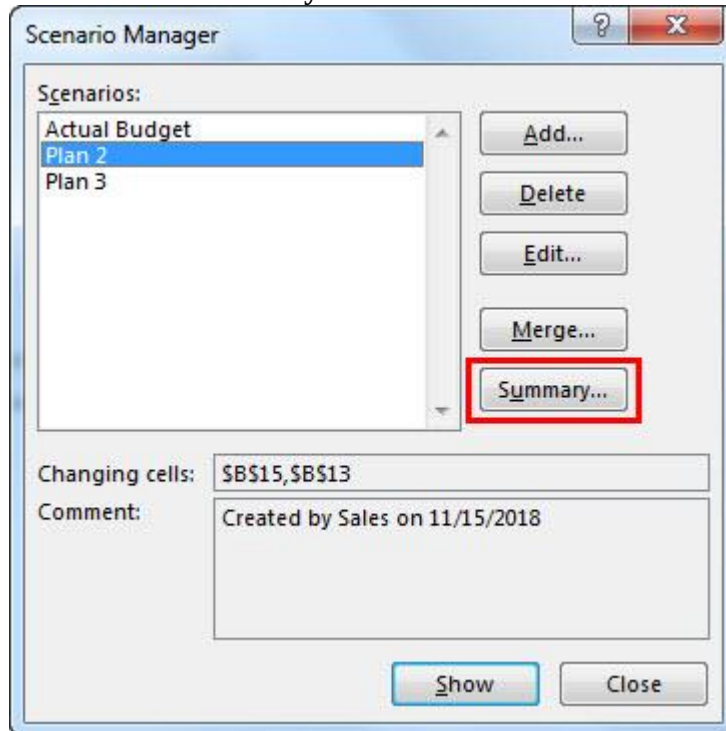
After we are done with adding different scenarios, we can create a summary report in excel from this scenario manager in excel. To create a summary report in excel, follow the below steps.

Click on the **Data** tab from the Excel menu bar.

Click on **What-If-Analysis**.

Under the what-if-analysis, click **Scenario Manager in Excel**.

Now click on **Summary**.



Click ok to create the summary report in excel.

B19					
	A	B	C	D	E
1	Particulars	Amt			
2	Income from Salary	50,000			
3	Income from wife	25,000			
4	Income from Other Source	15,000			
5	Total Income	90,000			
6					
7	Expenses	Amt			
8	Rent	18,000			
9	Electricity Bill	2,500			
10	Mobile Bill	1,250			
11	Internet Bill	1,500			
12	Water Bill	1,200			
13	Clothes	7,500			
14	Fuel	10,000			
15	Food	7,500			
16	Personal Loan	20,000			
17	Total Expenses	69,450			
18					
19	Income Left	20,550			
20					

Scenario Summary

Report type

☒ Scenario summary
 ☐ Scenario PivotTable report

Result cells:

B13,B15,B19

OK

Cancel

It will create the summary in the new sheet, as shown in the below image.

	A	B	C	D	E	F	G	H
1								
2								
3								
5								
6								
7								
8								
9								
10								
11								
12								
13								
14								
15								

Scenario Summary					
	Current Values:	Actual Budget	Plan 2	Plan 3	
Changing Cells:					
\$B\$15	7,500	15,000	7,500	10,000	
\$B\$13	7,500	15,000	7,500	10,000	
Result Cells:					
\$B\$13	7,500	15,000	7,500	10,000	
\$B\$15	7,500	15,000	7,500	10,000	
\$B\$19	20,550	5,550	20,550	15,550	

Notes: Current Values column represents values of changing cells at time Scenario Summary Report was created. Changing cells for each scenario are highlighted in gray.

It shows the change in savings in three different scenarios. In the first scenario, the savings was 5,550. In the second scenario, savings are increased to 20,550 due to cost cut down in Food & Clothes section, and finally, the third scenario shows the other scenario.

All right, now we exercised a simple Family Budget Planner. It looks good enough to understand. Perhaps this is enough to convince your family to change their lifestyle.

Scenario manager in Excel is a great tool when you need to do [sensitivity analysis](#). You can create the summary report in excel instantly to compare one plan with the other and decide the best alternative plan to get a better outcome.

Scenarios

A scenario is a set of values that Excel saves and can substitute automatically on your worksheet. You can create and save different groups of values as scenarios on a worksheet and then switch between these scenarios to view the different results.

For example, you can have several different budget scenarios that compare various possible income levels and expenses. You can also have different loan scenarios from different sources that compare various possible interest rates and loan tenures.

If the information that you want to use in scenarios is from different sources, you can collect the information in separate workbooks, and then merge the scenarios from the different workbooks into one.

After you have all the scenarios you need, you can create a scenario summary report –

That incorporates information from all the scenarios.

That lets you compare the scenarios side-by-side.

Scenario Manager

Scenario Manager is one of the What-if Analysis tools in Excel.

To create an analysis report with Scenario Manager, you have to follow these steps –

Step 1 – Define the set of initial values and identify the input cells that you want to vary, called the changing cells.

Step 2 – Create each scenario, name the scenario and enter the value for each changing input cell for that scenario.

Step 3 – Select the output cells, called the result cells that you want to track. These cells contain formulas in the initial set of values. The formulas use the changing input cells.

The Scenario Manager creates a report containing the input and the output values for each scenario.

Consider the previous example of loan. Now, proceed as follows –

Define a cell for Loan Amount.

This input value is constant for all the scenarios.

Name the cell Loan_Amount.

Specify the value as 5,000,000.

Define the cells for Interest Rate, No. of payments and Type (Payment at the beginning or end of the month).

These input values will be changing across the scenarios.

Name the cells Interest_Rate, NPER and Type.

Specify the initial values for the analysis in these cells as 12%, 360 and 0 respectively.

Define the cell for the EMI.

This is the result value.

Name the cell EMI.

Place the formula in this cell as –

=PMT (Interest_Rate/12, NPER, Loan_Amount, 0, Type)

Your worksheet looks as shown below –

	A	B	C	D
1				
2		Loan Amount	5000000	Loan_Amount
3		Rate per Annum	0.12	Interest_Rate
4		No. of Monthly Payments	360	NPER
5		Type	0	Type
6		EMI	=PMT(Interest_Rate/12,NPER,Loan_Amount,0,Type)	EMI
7				

As you can see that the input cells and the result cells are in column C with the names as given in column D.

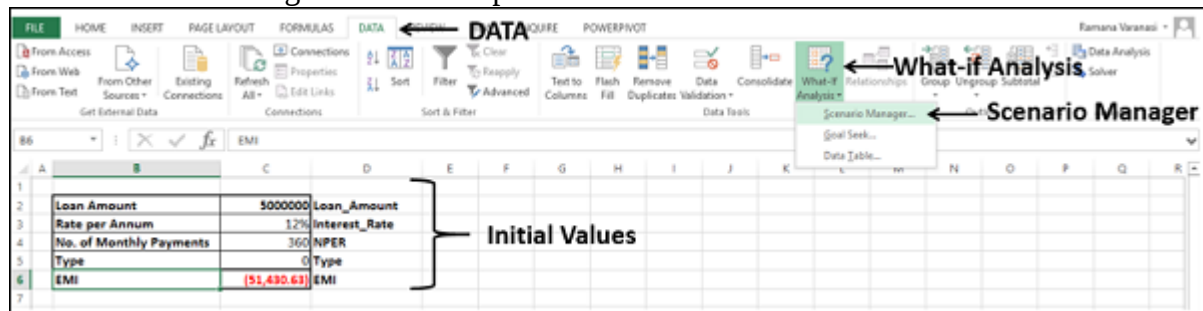
Creating Scenarios

After setting up the initial values for the Scenarios, you can create the scenarios using Scenario Manager as follows –

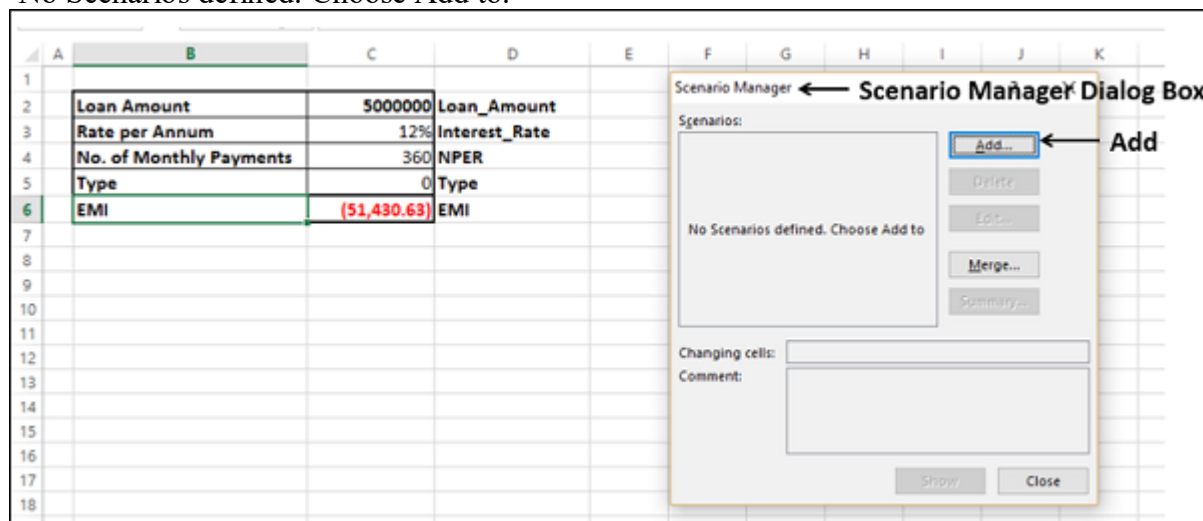
Click the DATA tab on the Ribbon.

Click What-if Analysis in the Data Tools group.

Select Scenario Manager from the dropdown list.



The Scenario Manager Dialog box appears. You can observe that it contains a message – “No Scenarios defined. Choose Add to.”



You need to create scenarios for each set of changing values in the Scenario Manager. It is good to have the first scenario defined with initial values, as it enables you to switch back to initial values whenever you want while displaying different scenarios.

Create the first scenario with the initial values as follows –

Click the Add button in the Scenario Manager Dialog box.

The Add Scenario dialog box appears.

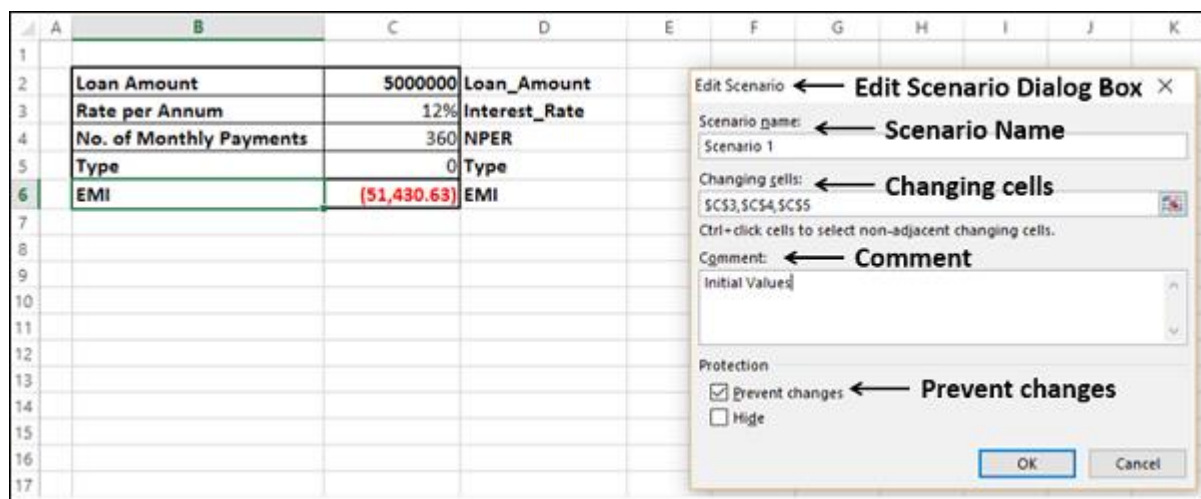
Under Scenario Name, type Scenario 1.

Under Changing Cells, enter the references for the cells i.e. C3, C4 and C5 with the Ctrl key pressed.

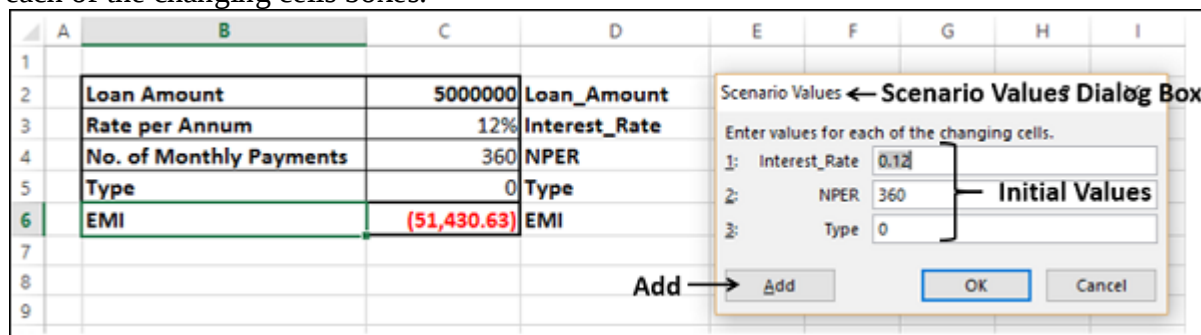
The name of the dialog box changes to Edit Scenario.

Edit the text in the Comment as – Initial Values box.

Select the option Prevent changes under Protection and then click OK.



The Scenario Values dialog box appears. The initial values that you have defined appear in each of the changing cells boxes.



Scenario 1 with the initial values is created.

Create three more scenarios with varying values in the changing cells as follows –

Click the Add button in the Scenario Values dialog box.

Add Scenario dialog box appears. Note that C3, C4, C5 appear in the Changing cells box.

In the Scenario Name box, type Scenario 2.

Edit the text in the Comment as – Different Interest Rate.

Select Prevent changes under Protection and click OK.

Add Scenario ← **Add Scenario Dialog Box** ? X

Scenario name: ← **Scenario Name**
 Scenario 2

Changing cells: ← **Changing cells**
 C3,C4,C5

Ctrl+click cells to select non-adjacent changing cells.

Comment: ← **Comment**
 Different Interest Rate

Protection

☒ Prevent changes ← **Prevent changes**
☐ Hide

OK Cancel

The Scenario Values dialog box appears. The initial values appear in the changing cells. Change the value of Interest_Rate to 0.13 and click Add.

Scenario Values ← **Scenario Values Dialog Box** X

Enter values for each of the changing cells.

1: Interest_Rate 0.13 ← **Changed Value**

2: NPER 360

3: Type 0

Add ↓

Add OK Cancel

The Add Scenario dialog box appears. Note that C3, C4, C5 appear in the box under changing cells.

In the Scenario Name box, type Scenario 3.

Edit the text in the Comment box as – Different no. of Payments.

Select Prevent changes under Protection and click OK.

Add Scenario ← **Add Scenario Dialog Box** ? X

Scenario name: ← **Scenario Name**
 Scenario 3

Changing cells: ← **Changing cells**
 C3,C4,C5

Ctrl+click cells to select non-adjacent changing cells.

Comment: ← **Comment**
 Different no. of Payments

Protection

☒ Prevent changes ← **Prevent changes**
☐ Hide

OK Cancel

The Scenario Values dialog box appears. The initial values appear in the changing cells. Change the value of NPER to 300 and click Add.

Scenario Values ← **Scenario Values Dialog Box** X

Enter values for each of the changing cells.

1: Interest_Rate 0.12

2: NPER 300 ← Changed Value

3: Type 0

Add ↓

Add OK Cancel

The Add Scenario dialog box appears. Note that C3, C4, C5 appear in the Changing cells box.

In the Scenario Name box, type Scenario 4.

Edit the text in the Comment box as – Different Type of Payment.

Select Prevent changes under Protection and click OK.

Add Scenario ← **Add Scenario Dialog Box** ? X

Scenario name: ← **Scenario Name**
 Scenario 4

Changing cells: ← **Changing cells**
 C3,C4,C5

Ctrl+click cells to select non-adjacent changing cells.

Comment: ← **Comment**
 Different Type of Payment

Protection

☒ Prevent changes ← **Prevent changes**
☐ Hide

OK Cancel

The Scenario Values dialog box appears. The initial values appear in the changing cells. Change the value of Type to 1. Click OK as you have added all the scenarios that you wanted to add.

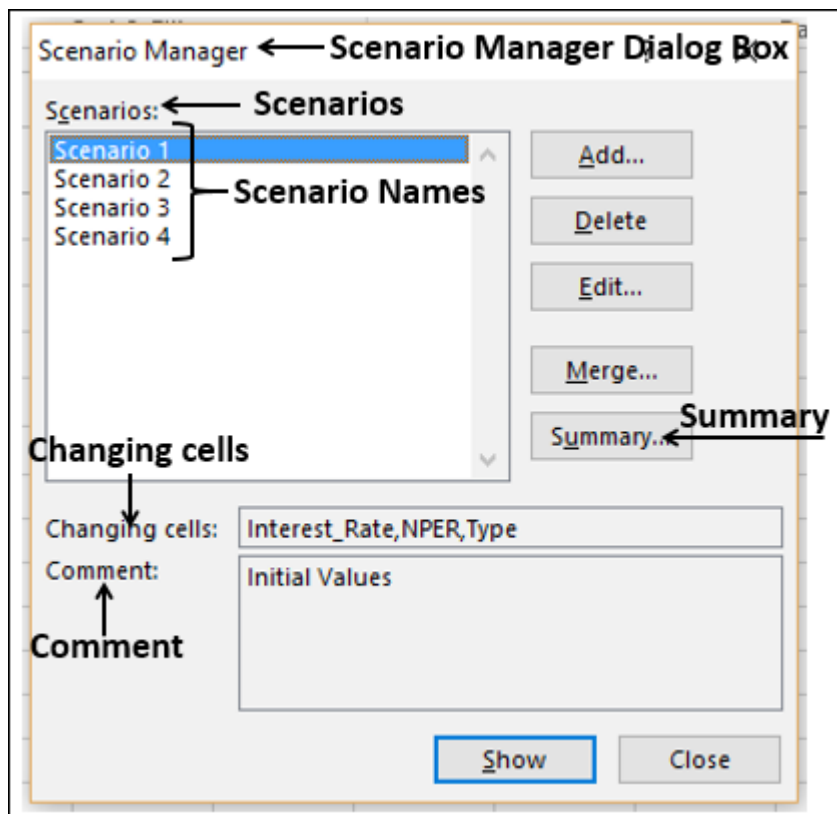
Scenario Values ← **Scenario Values Dialog Box** X

Enter values for each of the changing cells.

1:	Interest_Rate	0.12
2:	NPER	360
3:	Type	1 ← Changed Value

Add OK Cancel

The Scenario Manager dialog box appears. In the box under Scenarios, You will find the names of all the scenarios that you have created. Click Scenario 1. As you are aware, Scenario 1 contains the initial values.



Now, click Summary. The Scenario Summary dialog box appears.

Scenario Summary Reports

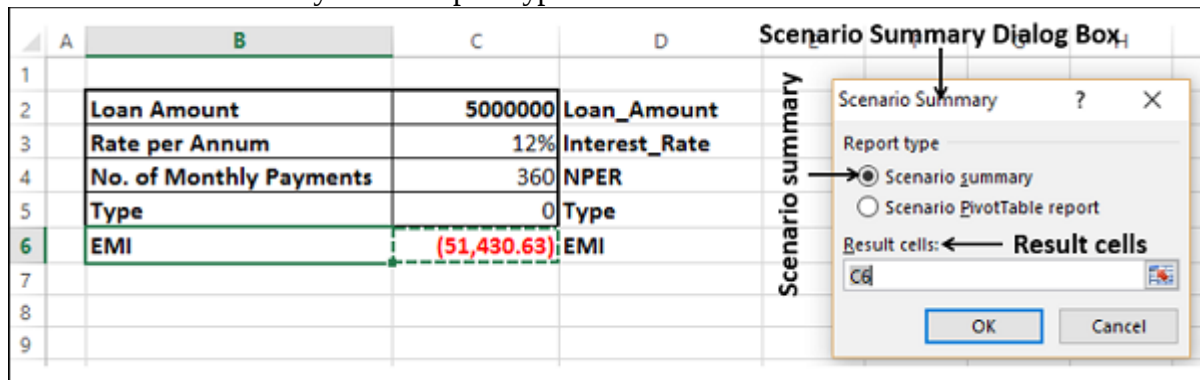
Excel provides two types of Scenario Summary reports –

Scenario summary.

Scenario PivotTable report.

In the Scenario Summary dialog box, you can find these two Report types.

Select Scenario summary under Report type.



Scenario Summary

In the Result cells box, select the cell C6 (Here, we had put the PMT function). Click OK.

Scenario Summary report appears in a new worksheet. The worksheet is named as Scenario Summary.

Scenario Summary		Current Values	Scenario 1	Scenario 2	Scenario 3	Scenario 4
Changing Cells:						
Interest_Rate		12%	12%	13%	12%	12%
NPER		360	360	360	300	360
Type		0	0	0	0	1
Result Cells:						
EMI		(51,430.63)	(51,430.63)	(55,309.98)	(52,661.21)	(50,921.42)
Notes: Current Values column represents values of changing cells at time Scenario Summary Report was created. Changing cells for each scenario are highlighted in gray.						

You can observe the following in the Scenario Summary report –

Changing Cells – Enlists all the cells used as changing cells. As you have named the cells, Interest_Rate, NPER and Type, these appear to make the report meaningful. Otherwise, only cell references will be listed.

Result Cells – Displays the result cell specified, i.e. EMI.

Current Values – It is the first column and enlists the values of that scenario which is selected in the Scenario Manager Dialog box before creating the summary report.

For all the scenarios you have created, the changing cells will be highlighted in gray.

In the EMI row, the result values for each scenario will be displayed.

You can make the report more meaningful by displaying the comments that you added while creating the scenarios.

Click the + button to the left of the row containing the scenario names. The comments for the scenarios appear in the row under the scenario names.

Scenario Summary		Current Values	Scenario 1	Scenario 2	Scenario 3	Scenario 4
Comments		Initial Values	Different Interest Rate	Different no. of Payments	Different Type of Payment	
Changing Cells:						
Interest_Rate		12%	12%	13%	12%	12%
NPER		360	360	360	300	360
Type		0	0	0	0	1
Result Cells:						
EMI		(51,430.63)	(51,430.63)	(55,309.98)	(52,661.21)	(50,921.42)
Notes: Current Values column represents values of changing cells at time Scenario Summary Report was created. Changing cells for each scenario are highlighted in gray.						

Scenarios from Different Sources

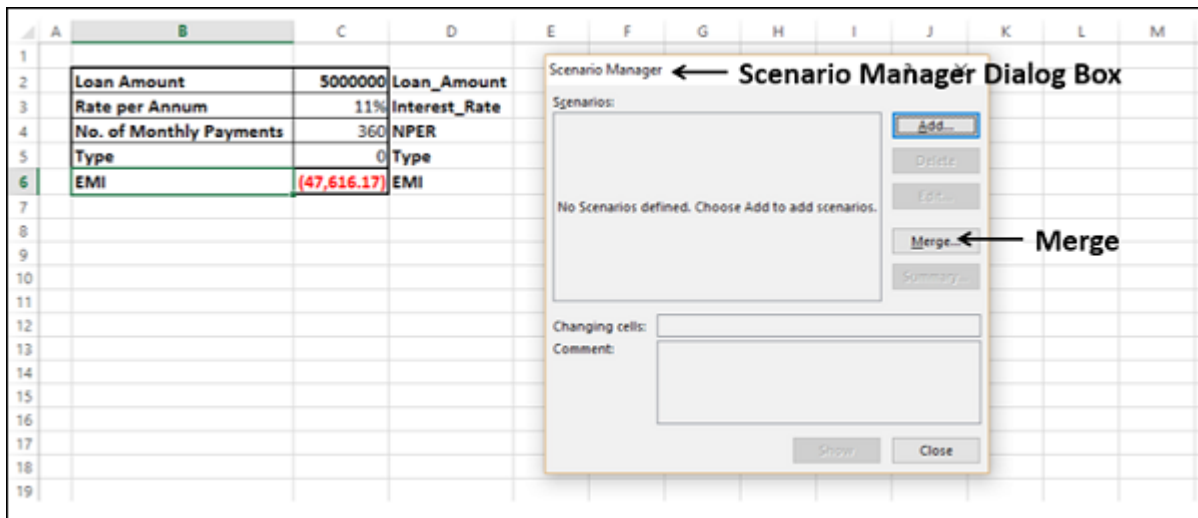
Suppose you get the scenarios from three different sources and you need to prepare the Scenario summary report in a Master workbook. You can do this by merging the scenarios from different workbooks into the Master workbook. Follow the steps given below –

Assume that the scenarios are in the workbooks, Bank1_Scenarios, Bank2_Scenarios and Bank3_Scenarios. Open the three workbooks.

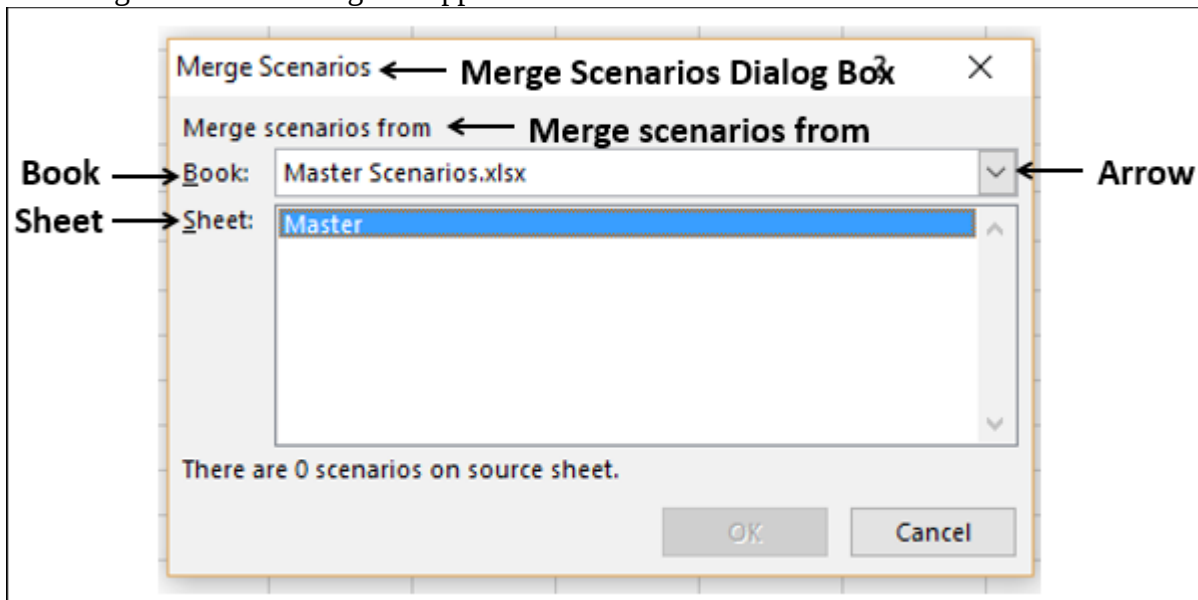
Open the Master workbook, in which you have the initial values.

Click DATA > What-if Analysis > Scenario Manager in the Master workbook.

The Scenario Manager Dialog box appears.



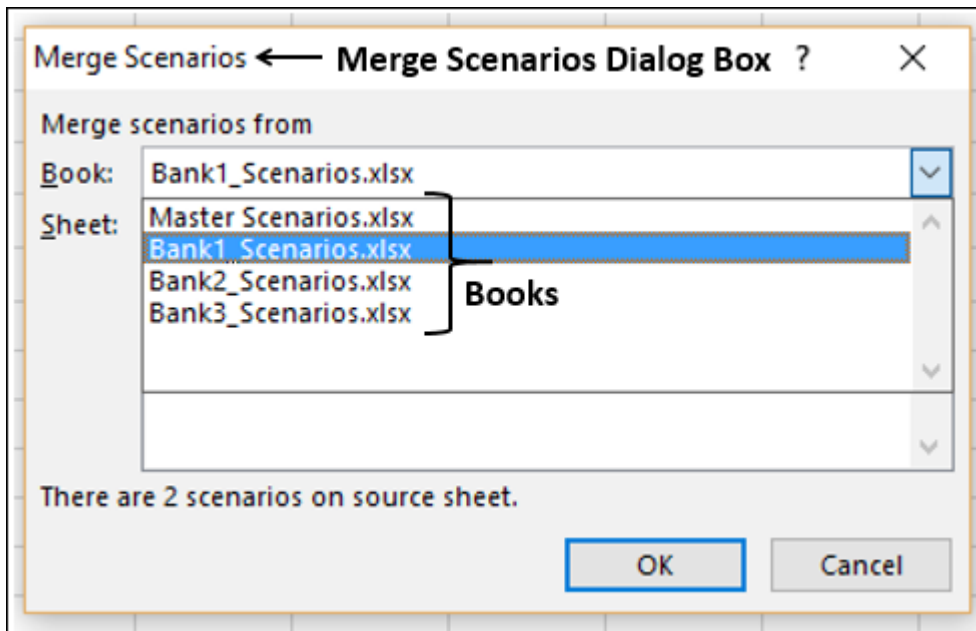
As you can observe, there are no scenarios as you have not yet added any. Click Merge. The Merge Scenarios dialog box appears.



As you can see, under Merge scenarios from, you have two boxes –
Book
Sheet

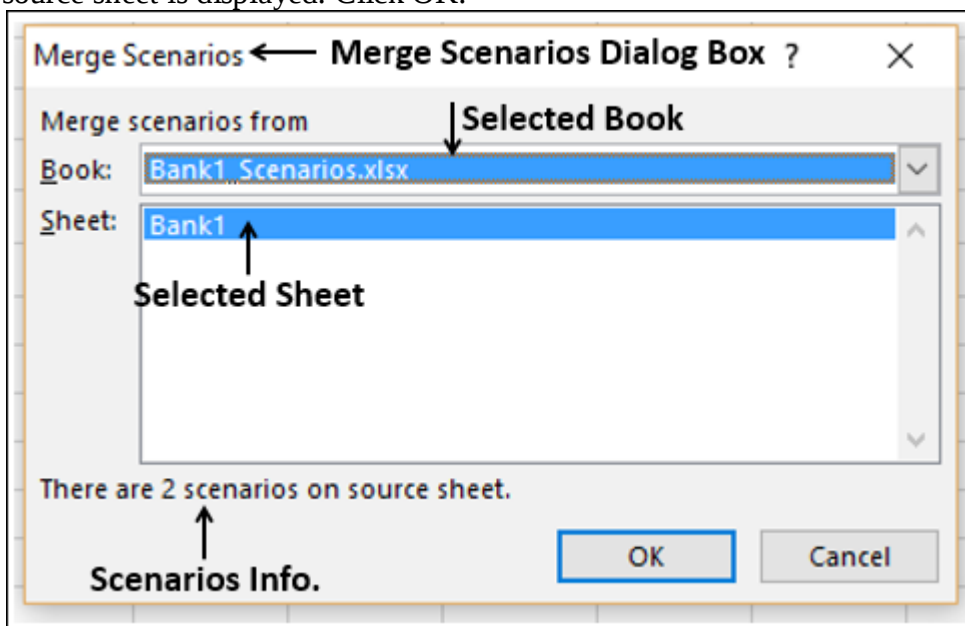
You can select specific worksheet from a specific workbook that contains the scenarios, which you want to add to your results. Click the drop-down arrow of Book to see the workbooks.

Note – The corresponding workbooks should be open to appear in this list.

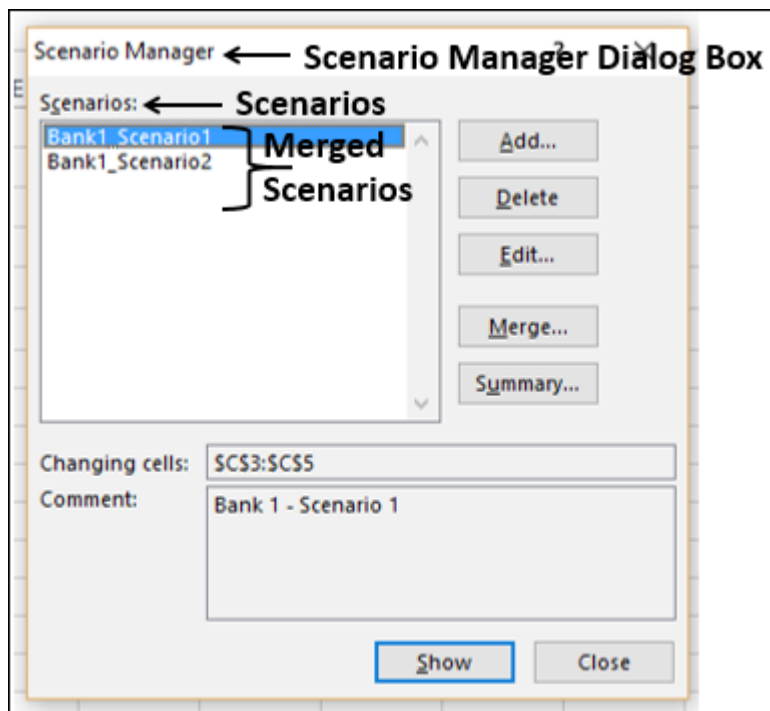


Select the book – Bank1_Scenarios.

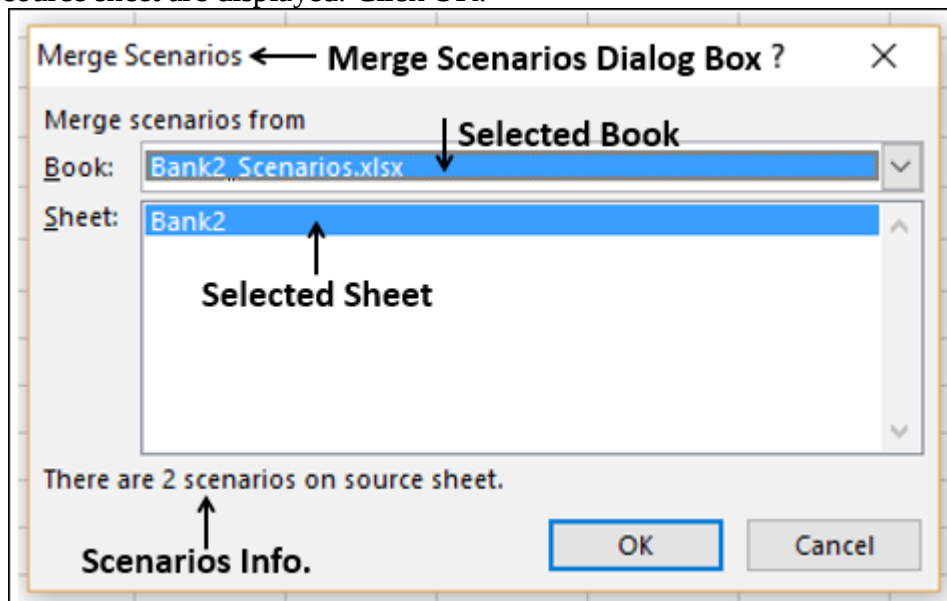
Bank1 sheet is displayed. At the bottom of the dialog box, the number of scenarios found on source sheet is displayed. Click OK.



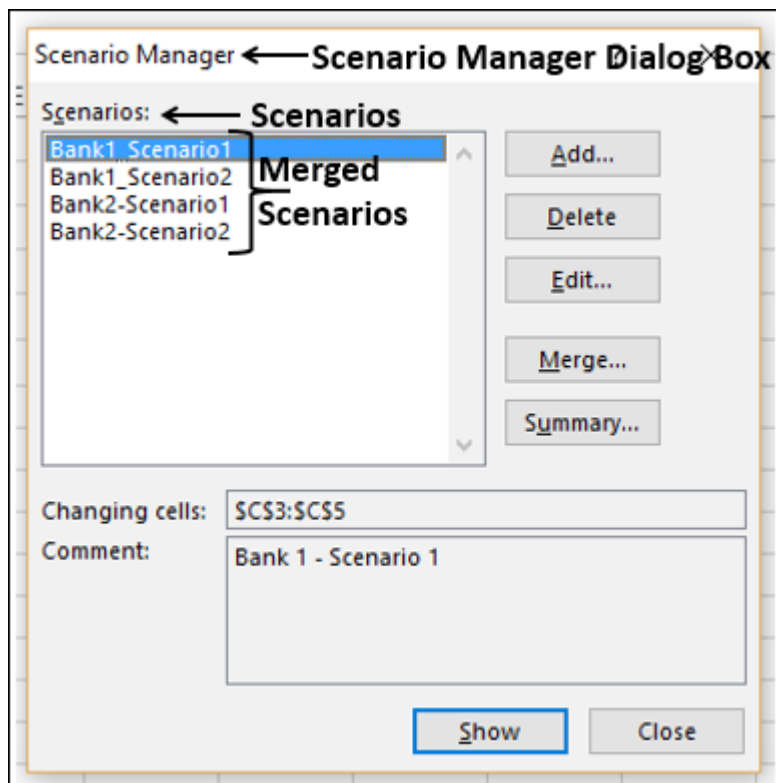
The Scenario Manager dialog box appears. The two scenarios that were merged into the Master workbook will be listed under Scenarios.



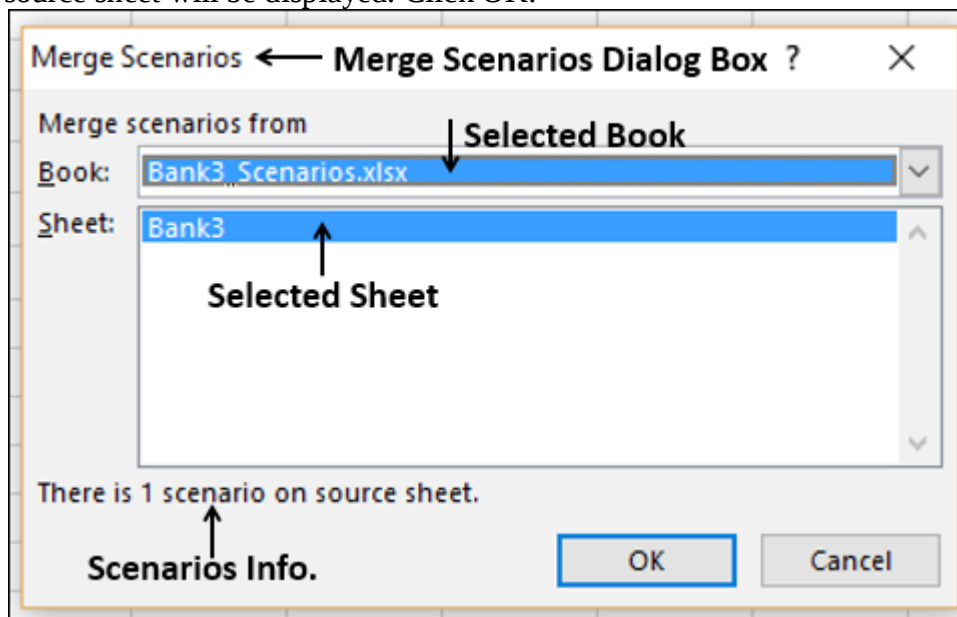
Click the Merge button. The Merge Scenarios dialog box appears. Now, select Bank2_Scenarios from the drop-down list in the Book box. Bank2 sheet is displayed. At the bottom of the dialog box, the number of scenarios found on source sheet are displayed. Click OK.



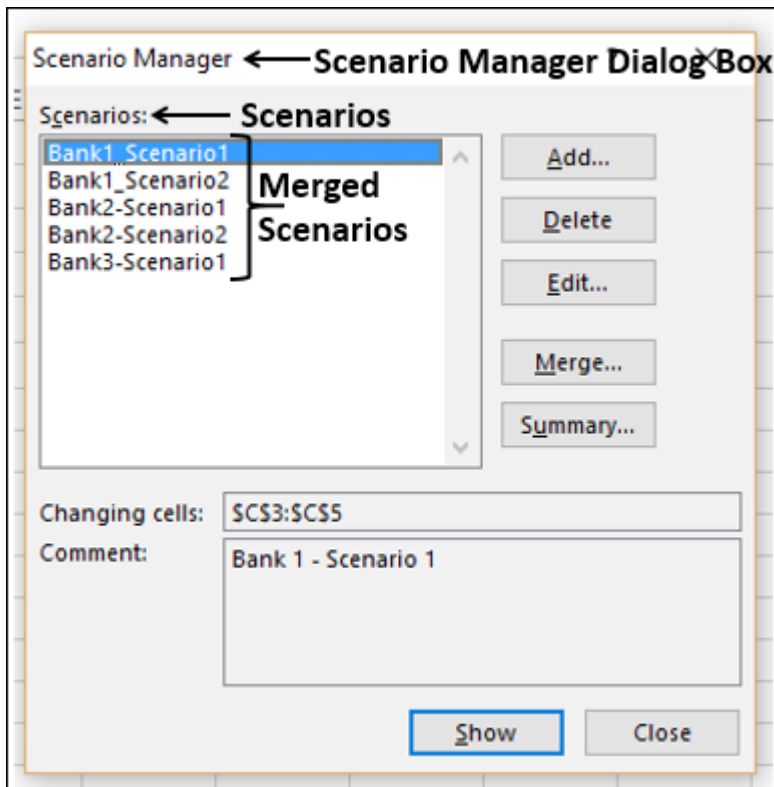
The Scenario Manager Dialog box appears. The four scenarios that were merged into the Master workbook are listed under Scenarios.



Click the Merge button. The Merge Scenarios dialog box appears. Now, select Bank3_Scenarios from the drop-down list in the Book box. Bank3 sheet is displayed. At the bottom of the dialog box, the number of scenarios found on source sheet will be displayed. Click OK.



The Scenario Manager Dialog box appears. The five scenarios that were merged into the Master workbook will be listed under Scenarios.

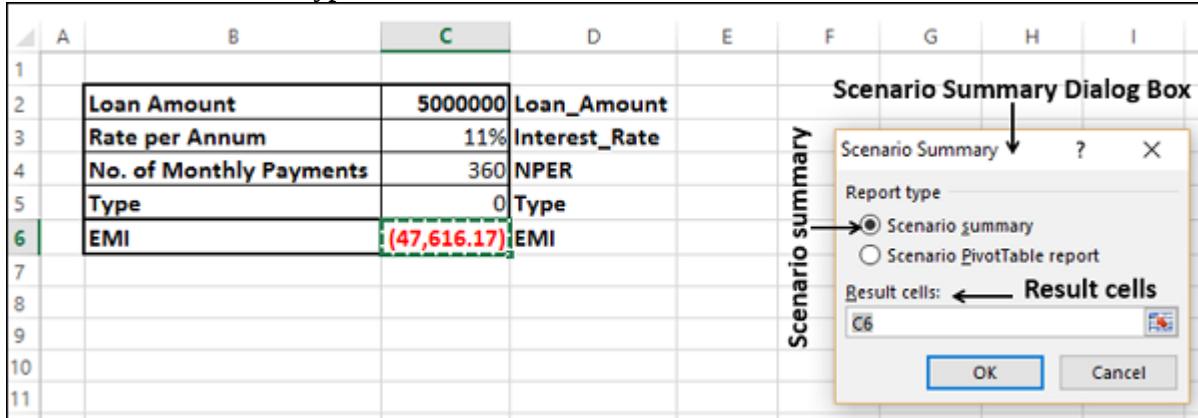


Now, you have all the required scenarios to produce the Scenario summary report.

Click the Summary button. The Scenario Summary dialog box appears.

Select Scenario summary.

In the Result cells box, type C6 and click OK.



The Scenario summary report appears on a new worksheet in the Master workbook.

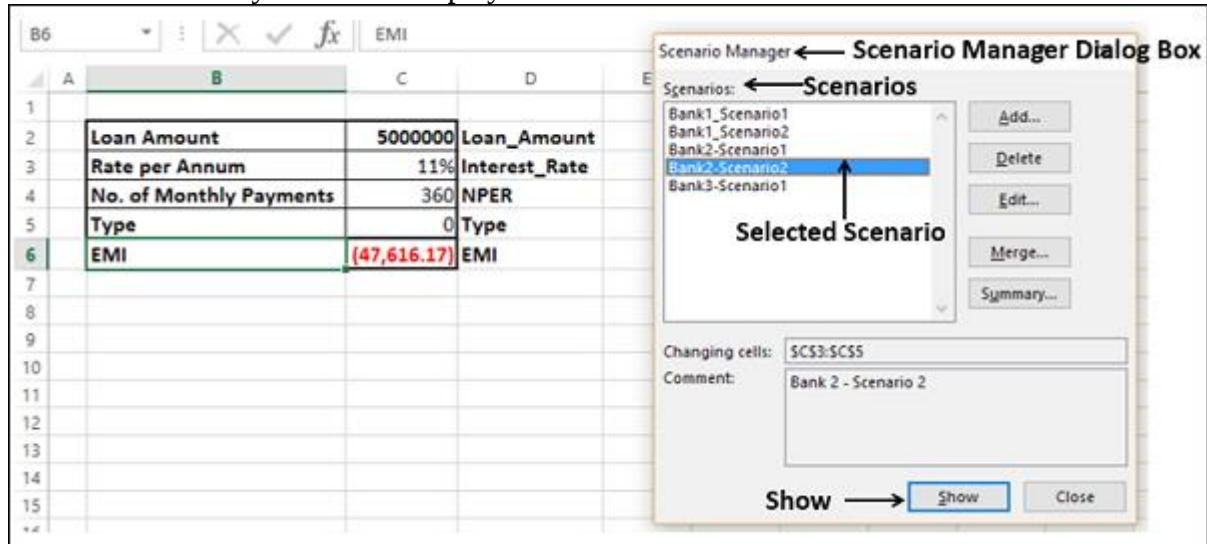
Scenario Summary						
Current Values: Bank1_Scenario1 Bank1_Scenario2 Bank2_Scenario1 Bank2_Scenario2 Bank3_Scenario1						
Changing Cells:						
Interest_Rate	11%	10%	10%	9%	10%	12%
NPER	360	360	360	360	360	360
Type	0	0	0	0	0	0
Result Cells:						
EMI	(47,616.17)	(43,141.43)	(44,248.51)	(41,678.39)	(43,509.55)	(50,278.96)
Notes: Current Values column represents values of changing cells at time Scenario Summary Report was created. Changing cells for each scenario are highlighted in gray.						

Displaying Scenarios

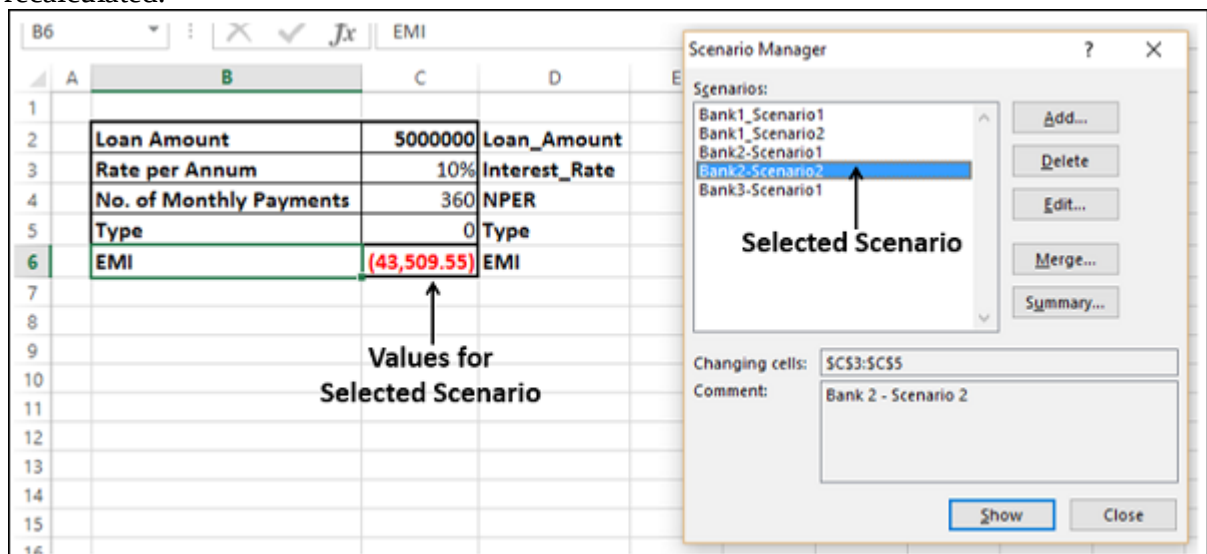
Suppose you are presenting your scenarios and you would like to dynamically switch from one scenario to another and display the set of input values and result values of the corresponding scenario.

Click DATA > What-if Analysis > Scenario Manager from the Data Tools group. The Scenario Manager Dialog box appears. The list of scenarios appear.

Select the scenario you want to display. Click Show.



The values on the worksheet are updated to that of the selected scenario. The result values are recalculated.



What is Sensitivity Analysis?

Sensitivity Analysis is a tool used in [financial modeling](#) to analyze how the different values of a set of independent variables affect a specific dependent variable under certain specific conditions. In general, sensitivity analysis is used in a wide range of fields, ranging from biology and geography to economics and engineering.

It is especially useful in the study and analysis of a “Black Box Process” where the output is an opaque function of several inputs. An opaque function or process is one which, for some reason, can’t be studied and analyzed. For example, climate models in geography are usually very complex. As a result, the exact relationship between the inputs and outputs are not well understood.

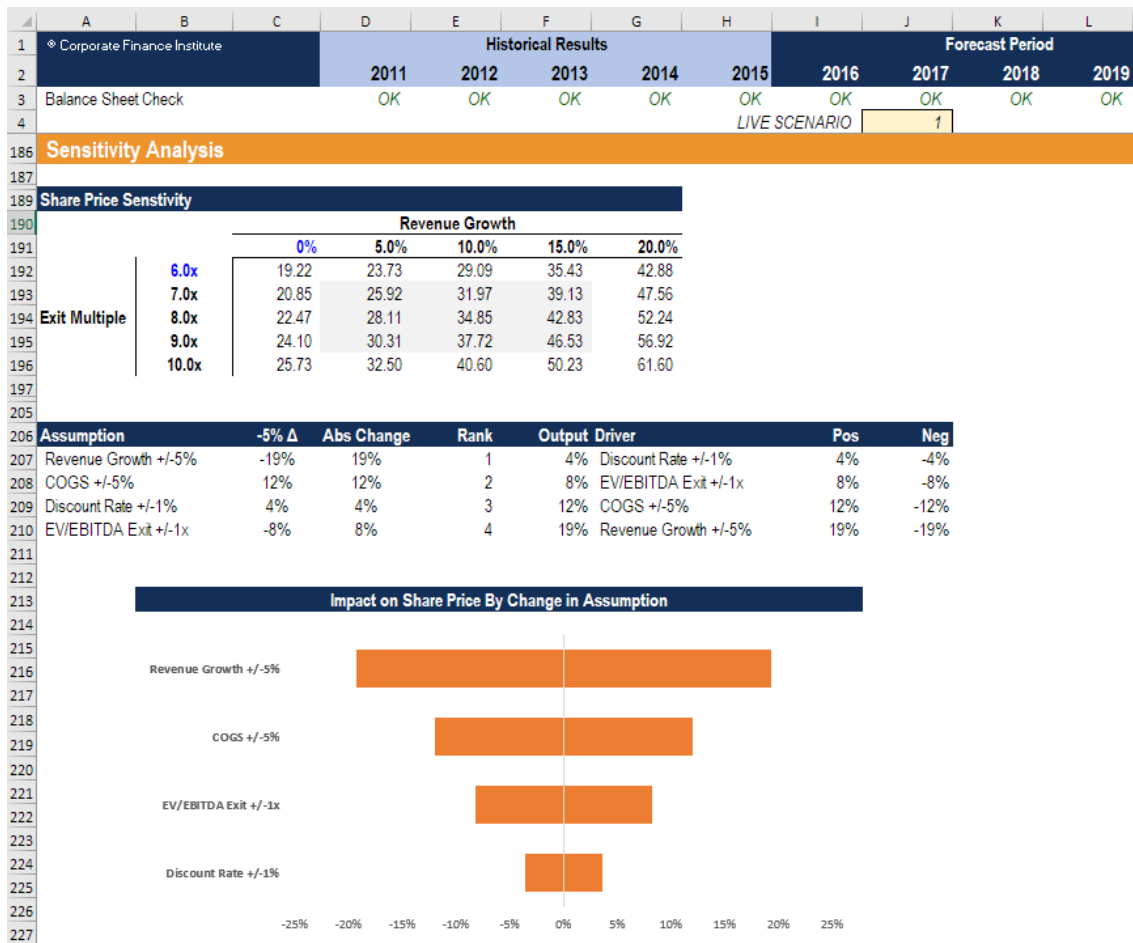


Image from CFI's [Scenario & Sensitivity Analysis in Excel Course](#)

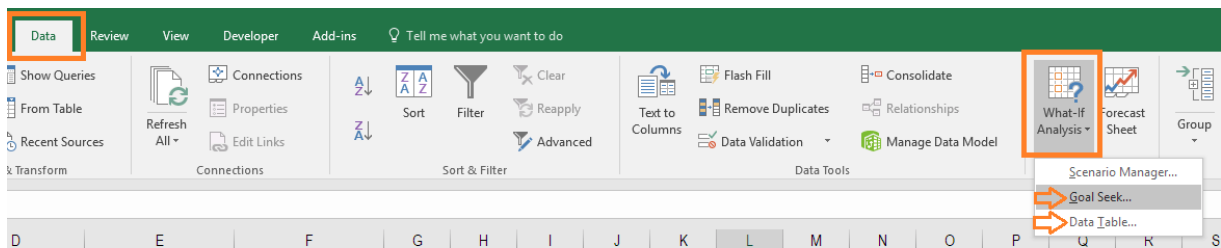
What-If Analysis

A Financial Sensitivity Analysis, also known as a What-If analysis or a What-If simulation exercise, is most commonly used by [financial analysts](#) to predict the outcome of a specific action when performed under certain conditions.

Financial Sensitivity Analysis is done within defined boundaries that are determined by the set of independent (input) variables.

For example, sensitivity analysis can be used to study the effect of a change in interest rates on bond prices if the interest rates increased by 1%. The “What-If” question would be: “**What** would happen to the price of a bond **If** interest rates went up by 1%?”. This question can be answered with sensitivity analysis.

The analysis is performed in Excel, under the Data section of the ribbon and the “What-if Analysis” button, which contains both “Goal Seek” and “Data Table”. These functions are both taught step-by-step in our [free Excel Crash Course](#).



Sensitivity Analysis Example

John is in charge of sales for HOLIDAY CO, a business that sells Christmas decorations at a shopping mall. John knows that the holiday season is approaching and that the mall will be crowded. He wants to find out whether an increase in customer traffic at the mall will raise the total [sales revenue](#) of HOLIDAY CO and, if so, then by how much.

The average price of a packet of Christmas decorations is \$20. During the previous year's holiday season, HOLIDAY CO sold 500 packs of Christmas decorations, resulting in total sales of \$10,000.

After carrying out a Financial Sensitivity Analysis, John determines that a 10% increase in customer traffic at the mall results in a 7% increase in the number of sales.

Using this information, John can predict how much money company XYZ will generate if customer traffic increases by 20%, 40%, or 100%. Based on John's Financial Sensitivity Analysis, such increases in traffic will result in an increase in revenue of 14%, 28%, and 70%, respectively.

	A	B	C	D	E	F	G
1							
2							
3		Mall Traffic Growth	Unit Price	Sales Volume	Revenue	Rev. Increase	
4		0.0%	\$20	500	\$10,000	na	
5		10.0%	\$20	535	\$10,700	7%	
6		20.0%	\$20	570	\$11,400	14%	
7		30.0%	\$20	605	\$12,100	21%	
8		40.0%	\$20	640	\$12,800	28%	
9		50.0%	\$20	675	\$13,500	35%	
10		60.0%	\$20	710	\$14,200	42%	
11		70.0%	\$20	745	\$14,900	49%	
12		80.0%	\$20	780	\$15,600	56%	
13		90.0%	\$20	815	\$16,300	63%	
14		100.0%	\$20	850	\$17,000	70%	

Computing rates of returns, averages and variances of financial data

stock's historical variance measures the difference between the stock's returns for different periods and its average return. A stock with a lower variance typically generates returns that are closer to its average. A stock with a higher variance can generate returns that are much higher or lower than expected, which increases uncertainty and increases the risk of losing money.

Let's go over how to calculate the historical variance of stock returns as we work through an example step by step.

Step 1: Select the period and measurement period over which you wish to calculate the variance

There are two things you need to determine before you start the calculation:

What is your time unit: daily, monthly, or annual returns?

You're calculating historical variance. What is your "history" -- i.e., what is the time period for which you want to calculate the variance: 30 days, six months, 30 years, and so on?

The choice of time unit and your measurement period will depend on your goal in calculating the variance in the first place.

Discussing these choices is well beyond the scope of this article, so for the purpose of the following example, we'll start with our data set as a given. We'll calculate the historical monthly variance of the S&P 500 Total Return Index over a five-year period from August 2010 through July 2015 -- that's 60 observations (5 years x 12 months).

Here's the formula for variance:

$$\sigma_H^2 = \sum_{t=1}^n \frac{(R_t - \overline{R_t})^2}{n-1}$$

Wow, that looks *really* complicated. Let's start with a translation in English: The variance of historical returns is equal to the sum of squared deviations of returns from the average ($\overline{R}$) divided by the number of observations (n) minus 1. (The large Greek letter sigma is the mathematical notation for a sum.)

That still sounds very complicated, which is why we're going to work through an example, and because no one in this day and age would calculate a variance by hand, we'll use Microsoft Excel.

The following screenshot of our Excel spreadsheet shows our starting data set. Column B, from Rows 3 through 62, contains our monthly return series for the S&P 500 Total Return Index for the period from August 2010 through July 2015:

	A	B
1	S&P 500 TR Index	
2	MONTH	MONTHLY RETURNS
3	Aug-2010	(4.51%)
4	Sep-2010	8.92%
	Oct-2010	3.80%

BREAK IN THE DATA: THE FULL SERIES IS NOT DISPLAYED IN THIS PICTURE

5		
60	May-2015	1.29%
61	Jun-2015	(1.94%)
62	Jul-2015	2.10%
63		

The first thing we need to do is calculate the average return over the period. Mathematically, the formula for the average return is as follows:

Step 2: Calculate the average return

The first thing we need to do is calculate the average return over the period. Mathematically, the formula for the average return is as follows:

Average return = (1 / n) x (sum of all the returns in the observation period)

Here, n is the total number of observations.

We calculate the average using Excel's "Average" function. The result, 1.32%, is in cell C65. (The exact Excel formula we use is displayed in the cell immediately to the right.)

	A	B	C	D
1		S&P 500 TR Index		
2	MONTH	MONTHLY RETURNS		
3	Aug-2010	(4.51%)		
4	Sep-2010	8.92%		
	Oct-2010	3.80%		
5		BREAK IN THE DATA: THE FULL SERIES IS NOT DISPLAYED IN THIS PICTURE		
60	May-2015	1.29%		
61	Jun-2015	(1.94%)		
62	Jul-2015	2.10%		
63				
64				
65		AVERAGE RETURN	1.32%	=AVERAGE(B3:B62)

This step occurs in column C:

Step 3: Calculate the difference between each of the individual returns and the average return

	A	B	C	D
1		S&P 500 TR Index		
2	MONTH	MONTHLY RETURNS	DIFFERENCE FROM AVERAGE	
3	Aug-2010	(4.51%)	(5.83%)	=B3-C\$65
4	Sep-2010	8.92%	7.61%	
	Oct-2010	3.80%	2.49%	
5		BREAK IN THE DATA: THE FULL SERIES IS NOT DISPLAYED IN THIS PICTURE		
60	May-2015	1.29%	(0.03%)	
61	Jun-2015	(1.94%)	(3.25%)	
62	Jul-2015	2.10%	0.78%	
63				
64				
65		AVERAGE RETURN	1.32%	=AVERAGE(B3:B62)

For example, for August 2010 (row 3), the difference between the monthly return is $-4.51\% - 1.32\% = -5.83\%$, which is the figure found in Cell C3. (The Excel formula we used to obtain that figure is shown immediately to the right.)

For example, for August 2010 (row 3), the difference between the monthly return is $-4.51\% - 1.32\% = -5.83\%$, which is the figure found in Cell C3. (The Excel formula we used to obtain that figure is shown immediately to the right.)

Step 4: Calculate the square of the differences and add them all up

In column D, we square the differences we just obtained:

	A	B	C	D	
1		S&P 500 TR Index			
2	MONTH	MONTHLY RETURNS	DIFFERENCE FROM AVERAGE	SQUARED DIFFERENCE	
3	Aug-2010	(4.51%)	(5.83%)	0.34%	=C3^2
4	Sep-2010	8.92%	7.61%	0.58%	
	Oct-2010	3.80%	2.49%	0.06%	
5	BREAK IN THE DATA: THE FULL SERIES IS NOT DISPLAYED IN THIS PICTURE				
60	May-2015	1.29%	(0.03%)	0.00%	
61	Jun-2015	(1.94%)	(3.25%)	0.11%	
62	Jul-2015	2.10%	0.78%	0.01%	
63					
64					
65	AVERAGE RETURN		1.32%	=AVERAGE(B3:B62)	
66	SUM OF SQUARED DIFFERENCES		6.77%	=SUM(D3:D62)	

For example, for August 2010 (row 3), the difference squared is equal to: $-5.83\% \wedge 2 = 0.34\%$, which is the figure displayed in Cell D3. (The Excel formula we used to obtain that figure is shown immediately to the right.)

For example, for August 2010 (row 3), the difference squared is equal to: $-5.83\% \wedge 2 = 0.34\%$, which is the figure displayed in Cell D3. (The Excel formula we used to obtain that figure is shown immediately to the right.)

We then add up all the squared differences using Excel's "Sum" function. The result, 6.77%, is in C66.

Step 5: Divide the sum of squared differences by $n - 1$

We're almost home!

Cell C67 below contains the number of observations (i.e., the number of months). Just below that, in Cell C68, we finally obtain the variance. The formula we use for the variance is displayed immediately to the right and shows that we divide the sum of squared differences (Cell C66) by the number of months (Cell C67) less 1.

	A	B	C	D
1		S&P 500 TR Index		
2	MONTH	MONTHLY RETURNS	DIFFERENCE FROM AVERAGE	SQUARED DIFFERENCE
3	Aug-2010	(4.51%)	(5.83%)	0.34%
4	Sep-2010	8.92%	7.61%	0.58%
	Oct-2010	3.80%	2.49%	0.06%
	BREAK IN THE DATA: THE FULL SERIES IS NOT DISPLAYED IN THIS PICTURE			
5				
60	May-2015	1.29%	(0.03%)	0.00%
61	Jun-2015	(1.94%)	(3.25%)	0.11%
62	Jul-2015	2.10%	0.78%	0.01%
63				
64				
65	AVERAGE RETURN		1.32%	=AVERAGE(B3:B62)
66	SUM OF SQUARED DIFFERENCES		6.77%	=SUM(D3:D62)
67	NUMBER OF DATA POINTS		60	=COUNT(D3:D62)
68	VARIANCE		0.1148%	=C66/(C67-1)

The variance is 0.1148% (Cell C68).

You can confirm with a calculator that:

variance = $6.77\% / 59 = 0.1147\%$. (The difference is due to rounding errors.)

Is there an easier way to do this?

Yes, there is! Excel has a variance function, "VAR," which calculates the variance of a set of numbers directly, eliminating the need for all those intermediary steps, which *are* pretty tiresome. The result is in Cell C70 below:

	A	B	C	D
1		S&P 500 TR Index		
2	MONTH	MONTHLY RETURNS	DIFFERENCE FROM AVERAGE	SQUARED DIFFERENCE
3	Aug-2010	(4.51%)	(5.83%)	0.34%
4	Sep-2010	8.92%	7.61%	0.58%
	Oct-2010	3.80%	2.49%	0.06%
	BREAK IN THE DATA: THE FULL SERIES IS NOT DISPLAYED IN THIS PICTURE			
5				
60	May-2015	1.29%	(0.03%)	0.00%
61	Jun-2015	(1.94%)	(3.25%)	0.11%
62	Jul-2015	2.10%	0.78%	0.01%
63				
64				
65	AVERAGE RETURN		1.32%	=AVERAGE(B3:B62)
66	SUM OF SQUARED DIFFERENCES		6.77%	=SUM(D3:D62)
67	NUMBER OF DATA POINTS		60	=COUNT(D3:D62)
68	VARIANCE		0.1148%	=C66/(C67-1)
69				
70		VARIANCE (USING EXCEL FORMULA)	0.1148%	=VAR(B3:B62)

Note that the result matches the one we derived independently, which is comforting.

UNIT IV

Estimating demand curves – revenue management – Computing marketing metrics – Take rate, Churn, Customer satisfaction – customer life time value – cost per click – Transaction conversion rate – bounce rate

Estimating the demand curve

The demand curve $D(p)$ of a product is always changing and depends on actors like seasonality, competitive pressure, and the state of the economy.

A related concept is the price elasticity which is the percentage decrease in demand when the price of the product goes up by 1 percent. When elasticity is greater than 1 percent, demand is price elastic – a price cut increases revenue. When elasticity is less than 1 percent, a price cut decreases demand.

Products like coffee, stocks and high-end restaurants are elastic goods. Products like gasoline, electricity, water and cell phone plans are inelastic.

To estimate the demand curve, we'll run some experiments (or market research surveys) with three price points. The highest and lowest price points that seem reasonable, and the mid-way point. With these three price points, we can fit a quadratic curve to estimate a demand curve:

where a , b and c are the coefficients of the quadratic curve. The three data points will solve the quadratic curve exactly for the three coefficients.

An example with mobile in-app purchases

Let's take a concrete example: consider a mobile game that monetizes through in-app purchases. Though the product here is a digital good and doesn't have a real cost of production, for the sake of argument let's assume that it costs \$0.50 in hosting and server costs.

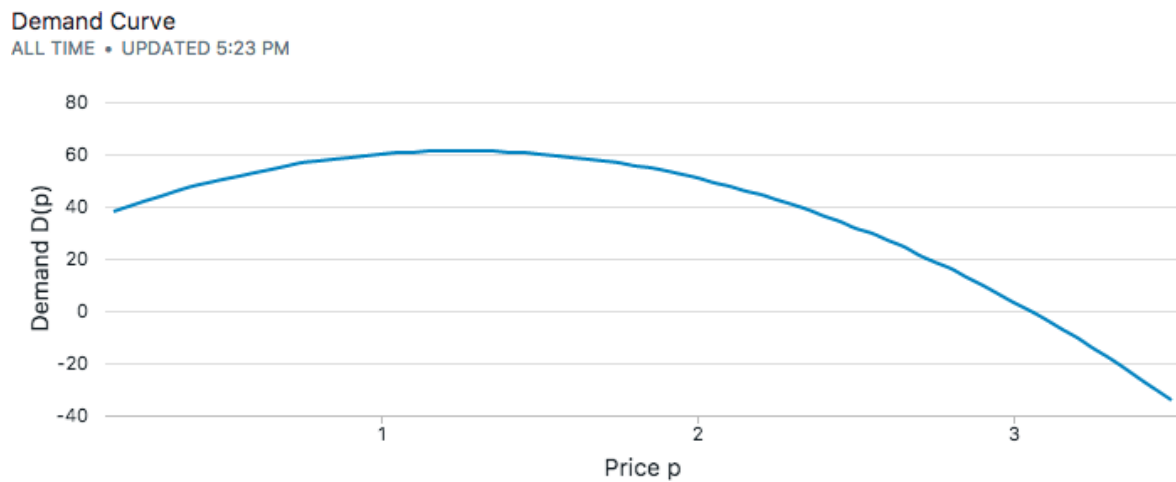
From experience and looking at other similar apps in the app store, it's reasonable to charge between \$0.99 and \$2.99 for it. We then design an experiment to show a percentage of users the product for \$0.99, \$1.99 and \$2.99 in order to collect data – assuming everything else stays constant. We have the following demand for the product:

	price	demand
low price	\$0.99	60
mid-price	\$1.99	51
high price	\$2.99	20

Plugging the three data points into the quadratic equation, we can solve for the coefficients a , b and c .

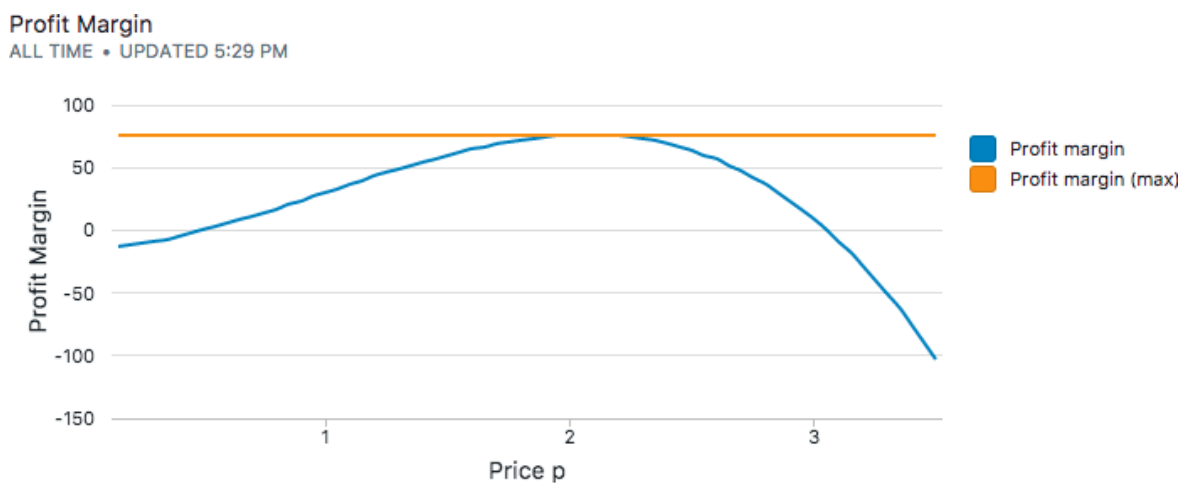
coefficient	value
a	-18.98
b	47.57
c	31.50

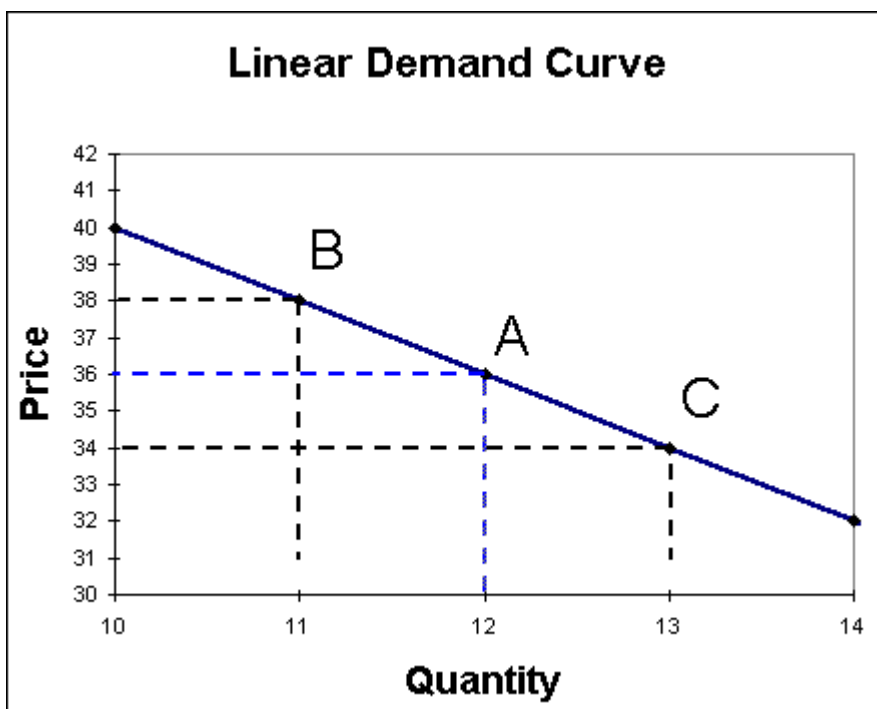
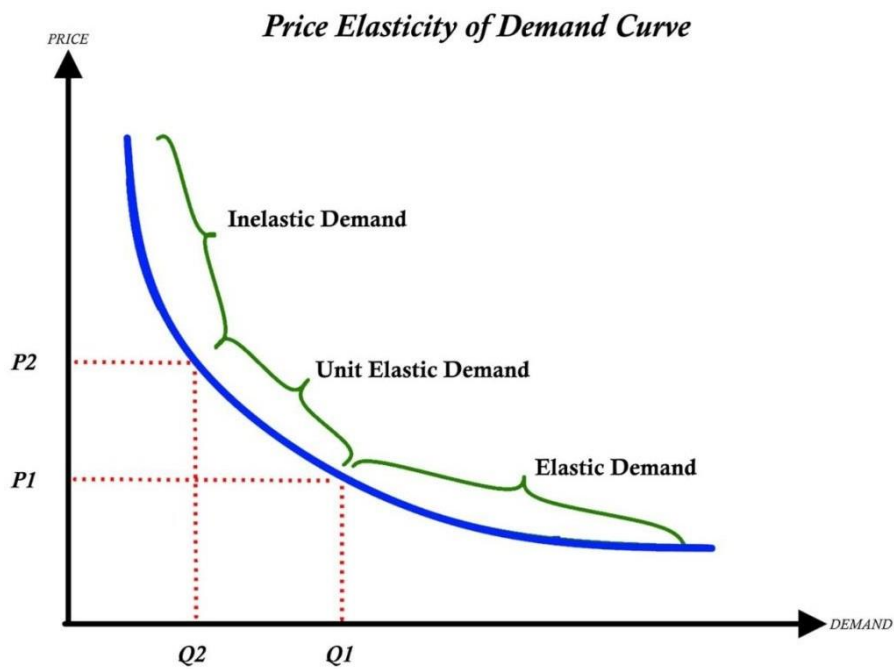
Thus, the demand curve is:



We'll now maximize the profit curve to figure out what the price needs to be.

3. Pricing that maximizes profits





Revenue Management:

Companies predominantly use revenue management in industries characterized by fixed capacity and costs and products or services that expire. These industries include travel, hospitality, and event-related retailing.

Revenue management has permeated other industries, including the SaaS sector, despite its origin in travel and hospitality. Its methodology has quickly proven itself in maximizing profits for the industry.

Revenue management is the use of optimized pricing to enhance revenues. The intent is only to increase revenues when doing so will also increase profits. When properly conceived, revenue management establishes the optimum price for each customer.

Revenue Management Best Practices Possible tactics for enhancing revenue levels include the actions noted below.

Add Distribution Channels: A business can sell its products through different distribution channels in order to reach out to different groups of customers, possibly selling at different price points in each distribution channel. For example, a cruise line could sell at a reduced price through a discount travel service, while selling at full price through its own website.

Institute Dynamic Pricing: A company can adjust its prices continually, based on ongoing changes in its estimates of demand and the remaining amount of supply on hand. Airlines routinely engage in dynamic pricing, so that the passengers on a flight may pay widely differing amounts for essentially the same seats. Hotels also employ dynamic pricing; for example, they raise room rates when there are major events in town that they know will increase the demand for rooms.

Selectively Implement Overbooking: When a business has a fixed capacity and there is a risk of order cancellation, the company can overbook customer orders. The airline, hotel, and restaurant industries routinely engage in overbooking. Doing so can annoy customers when they find that there is no available capacity, so organizations have to be careful about the level of overbooking in which they choose to engage.

Initiate Promotions: A business can engage in various promotions, using such tools as rebates and coupons, to discount prices for targeted sales periods. For example, a retailer can use coupons to drive sales during what might otherwise be a slow sales period. Or, promotions may be used at the beginning of a selling season in order to sell more goods at full price.

Offer Bundling: A firm can offer a set of related products to its customers for a discounted price. For example, a travel business could offer a vacation bundle that includes airfare, a hotel room, and a rental car. This approach locks up all related purchases that a customer might want to make, thereby maximizing the seller's revenue.

Offer Cross-Selling: Present customers with an option to make additional purchases that complement their initial purchase. For example, a hotel can offer its customers breakfast for an extra \$20, while a bookstore might offer its customers a leather bookmark for an extra \$2. As long as the cross-selling relates to products that customers believe to be useful, they may view cross-selling as an added benefit.

Offer Up-Selling: Many businesses try to sell higher-priced versions of the products in which customers have initially expressed an interest. This is quite common in car dealerships, where the sales staff routinely tries to draw the attention of customers to more expensive models. Similarly, a hotel might offer its customers an upgrade to a suite from its standard room. Up-selling can result in substantial increases in profits, especially when the products to which customers are being directed have a higher profit margin than what they were originally interested in buying.

Employ Rate Fences: In order to keep full-price customers from taking advantage of discount deals that are intended for more price-sensitive customers, revenue management can also include the use of rate fences, which are rules or restrictions that allow customers to segment themselves into certain rate categories based on their needs, behaviour, or willingness to pay. For example, a common rate fence used by hotels is to offer a low price, but only if payment is made several months in advance. Since businesspeople are rarely able to plan that far in advance, they are effectively excluded from these deals. Similarly, higher-priced business class plane tickets allow their purchasers to reschedule flights for free, while this option is not available when lower-cost seats are purchased in the economy section.

Invest in Branding: Use enhanced product quality and expanded marketing programs to increase customer appreciation for and awareness of the company's brands. Doing so makes it more likely that customers will want to purchase its products, even if the company's price points are somewhat higher than those of the competition. Branding only works if substantial investments are made in it for an extended period of time, and the firm's products are sufficiently distinctive.

Set Up a Loyalty Program: A classic revenue management technique is to set up a customer loyalty program. By encouraging customers to buy directly from the company, the firm can avoid selling to wholesalers and retailers at lower margins. This approach also allows the company to market directly to its end customers and interact with them, which may result in new ideas regarding how to better service customers.

Sell Direct: A company can set up a direct sales channel, rather than selling through wholesalers and retailers. A common approach is to set up an Internet store, while rolling out physical stores may also work (though the capital cost is higher). The advantage of selling direct is that the company does not have to give away a portion of its margins, as is the case when selling through other parties. However, there are also costs associated with selling direct, which can offset some or all of the profits generated.

Incremental Cost Analysis: Revenue management also takes into account the incremental costs associated with each sale. For example, when a hotel sells its excess supply of rooms through several aggregator websites, it makes sense to direct most of the excess supply to whichever of the sites charges the smallest commission.

Revenue management KPIs: Top metrics to follow

After formulating your revenue management process and strategies, you need to track their performance and success. The following revenue management key performance indicators (KPIs) are available for SaaS companies:

Customer lifetime value (CLTV)

You can determine your customer lifetime value using the equation below:

CLTV = average revenue per account/net monthly recurring revenue churn × 100
A steady or increasing CLTV indicates successful revenue management. A rising CLTV shows that you are retaining customers longer who are buying more.

Average cost per acquisition (ACPA)

Average cost per acquisition measures if a SaaS company is spending its money in the right places and keeping its acquisition strategy up-to-date. Aim for organic acquisition channels to lower your costs as your brand awareness grows.

Monthly & annual recurring revenue (MRR/ARR) : These two holistic KPIs indicate how your business is performing. They are excellent for showing business growth and progress, especially when aligned alongside other KPIs.

MRR = total customer revenue within one month

ARR = $MRR \times 12$

ARR gives an annual prediction even if a business has only collected data for a few months.

Customer & revenue churn rate (CRR/RCR)

Customer churn rate sets benchmarks that businesses should aim to beat.

CCR = difference between the number of users at the start and end of a selected period divided by the number of users present at the start of the period

RCR = The net revenue lost from customers within a period/ the total revenue at the start of the period
Revenue churn rate goes hand-in-hand with CCR unless you have flexible, monthly pricing plans. In this case, you may realize you are losing revenue but not clients because they are going for cheaper plans. Fortunately, you can try and upsell them or adjust your plans to generate more revenue.

Revenue management process in 5 steps

SaaS companies should collect data and use it for forecasting to help predict the future performance of products and services and make adjustments to maximize revenue. Below is the revenue management process in detail:

Data collection and recording: Companies should base their revenue management systems on the collection and recording of data to enable decision making, translating into price and distribution strategies. Therefore, all the information the company obtains relating to its customers and purchasing habits is essential for revenue managers—for example, subscription dates, cancellations, plans, etc.

Historical data analysis: Interpreting and analysing historical data is the basis for producing sales forecasts and pricing and distribution strategies. Revenue managers have the complicated task of focusing on market segmentation. The analysis allows SaaS companies to identify patterns and exploit them to increase their bottom line.

Evaluation of seasonal trends: When preparing the sales forecast, precision is critical in obtaining a demand measurement, including seasonal trends characterized by activity peaks and troughs. In turn, forecasting enables companies to react when faced with low demand periods. It also allows them to design different rate levels and select optimal distribution channels.

Market trends analysis: It's an analysis of past and prevailing market behaviour plus dominant patterns of consumers and the market. To analyse market trends, keep track of industry publications and influencers, listen to your customers, absorb up-to-date industry trends and research, and utilize available digital tools and analytics.

Competitor research: Competitor research and analysis should include competitors' pricing, features, market share, differentiators, marketing, location, strengths, weaknesses, and customer reviews.

Marketing Metrics

A marketing report is clear and most effective when it presents a handful of important marketing metrics. So you've heard. But the question is: what are the most important, must-track marketing metrics?

If you look at your pool of marketing metrics, it'd appear that each number is essential – like your marketing report would be incomplete without all the numbers. But by looking closer, you'll be able to pick out the most important, results-proving metrics that will make your Marketing Reporting more efficient.

SEO Metrics

These marketing metrics give an idea of how well your SEO efforts are reaping. Some essential figures to monitor include:

Organic traffic: how many visitors are coming to your page via search.

Conversion metrics: Email signups, Form submissions, and Phone calls (all self-explanatory).

Backlinks and Referring domains: the links other sites are giving to your content and the sites that are linking to you, respectively.

Domain authority (DA): how authoritative your site is.

Page speed: how fast your page loads.

Content Marketing Metrics

Consumption metrics: Page views, Average time on page, and Unique visitors meaning people viewing your pages, how much time they're spending on your pages, and how many new visitors (vs. returning visitors) your pages are attracting.

Retention: Page per visit, which tells how many pages someone visits on your site and Bounce rate, the measure of people leaving your page after clicking through it.

Engagement: Comments and Session duration (time spent per visit).

Leads: Leads generated or people interested in your service/product.

Social Media Metrics

While there are a ton of social marketing metrics to track, several are vanity metrics such as likes. Some of the most important social metrics to keep an eye on, however, include:

Awareness metrics: Reach and Impressions which denote how far your posts are going and how many people are seeing them, respectively.

Engagement metrics: Mentions and Comments that relate to people tagging you on social and commenting on your posts, respectively.

Customer care metrics: Response Time and Rate, which is the average time it takes your representative to answer your audience's message and the average number of queries answered, respectively.

ROI: Link Clicks, Referrals, and Conversions. These show how many people are clicking your links, how many people social is sending to your website, and how many of those people on social complete a specific action, respectively.

Email Marketing Metrics

When reporting on your email campaigns, always include these email marketing metrics:

Open rates: how many people are opening your emails.

Click-through rates: how many people are clicking the links you share in your emails.

Number of unsubscribes: a measure of how many are leaving your list.

Bounce rates: it shows how many on your list didn't receive your email.

Conversion rate: these measures how many people are clicking your email links and completing a specific action.

List growth rate: the rate at which subscribers are joining your list.

Engagement rate: an estimate of when subscribers are opening, clicking, and replying to your emails.

Paid Marketing Metrics

Paid marketing metrics largely depend on your goals from ad campaigns. Here's a rough idea of some essential metrics to keep an eye on:

Clicks: how many clicks you're getting on your ads.

Conversion: how many people are taking a specific step.

Conversion rate: the rate at which people are converting.

Cost per conversion: how much does each conversion cost.

Click-through rate (CTR): the number of clicks on your ads divided by the impressions your ads generated.

Customer Lifetime Value

"It's important to look at the long-term as a marketing professional, especially the value of your customers in the long run," insists Jack Wang of Amazing Beauty Hair. This is why Wang thinks it's essential to mention Customer Lifetime Value in every marketing report.

"It will help you establish your VIPs, who will be there for you no matter what. That's an advantage to have, especially during uncertain times like the ongoing pandemic."

KNB Communications' Crissibeth Cooper agrees: "In an ideal world, LTV: CAC (lifetime value of a customer vs the cost per acquisition of customer) would be included in every marketing report. Oftentimes these numbers are difficult to obtain because they require calculations to be done. They're high-level numbers so they probably won't be calculated often.

However, every report being sent to the CEO or other executives who care about the bottom line, dollars, and cents, appreciate receiving this ratio because it can tell them a lot about the process of customer acquisition and where funds should be spent or diverted from.

If the ratio is very low, you are spending too much on marketing and/or not using your marketing dollars effectively. If the ratio is way too high, you are not spending enough on marketing and you could be growing faster if you invested more money into marketing.”

Response Time

“Hands down, a crucial metric in marketing reports is the response time to customers,” notes Lilius’s Osiris Parikh

“This is a crucial metric that examines how quickly a sales or marketing team is answering questions and engaging with customers. Unlike being on hold in a call center, there should be no reason a customer is not able to get a question answered quickly.

This can be broken down by company average and individual staff to gauge effectiveness and seek improvement.”

Return On Investment

“ROI or time spent are important metrics for most marketing reports,” suggests 45/RPM’s Noriko Harada.

“ROI is important because it reveals the impact of all marketing efforts on the business and if those efforts are effective. Time spent is important because no matter how many clicks you have on one website if they don’t spend time on the site, it is worthless. So, knowing the time a consumer spends on a website gives insight on the success of the website.”

On top of that, “some campaigns may drive in a lot of business, other campaigns may not, but the true sign of success is how much you earned in relation to what you spent,” adds Melanie Musson of CarInsuranceComparison.com

Visitor Queue’s Nick Hollinger agrees, “I think a universally important one that needs to be included in every marketing report is ROI. **The job of a marketer is to use channels and tools to have a positive impact on the company. If you aren’t measuring that positive impact, how can you justify you’re doing a good job?**”

Total Profit Added

“The most important marketing metric across all of our campaigns is total profit added,” recommends Helen White from House of.

“We’re not simply looking at return on investment (ROI) but more importantly **how much value does a campaign drive for the business by accounting for factors such as cost and time invested to determine how profitable a campaign was.**

It's a more holistic measurement of success rather than simply looking at the ROI from a purely spend/return perspective which doesn't quantify the true realities of the total cost incurred to the business," explains White.

Referrals: Another important marketing metric to include in your marketing report is referrals. Mavens & Moguls' Paige Arnof-Fenn writes, "for my business the most important metric is how much repeat business and referrals I get from my clients. Most of my business comes from referral and word of mouth so keeping current clients happy is my top priority."

Customer Engagement

"One important marketing metric that a brand should include in every marketing report is customer engagement," says Jacknife Design's Michael Kelar

"This can be measured in multiple ways such as activity and usage of a product or service, social media interactions, website traffic, time spent on site, newsletter open rates or brand recall.

Customer engagement is ultimately a way to gauge brand awareness and how effective a brand is at not only reaching its audience but resonating with them. Collecting this data allows a brand to optimize its high performing tactics/channels and invest in improving its less engaging ones—enhancing the overall customer experience at every touchpoint."

Take rate

2.66%)

Taking a cut for services is a key profit driver for many companies.

Long before e-commerce began, intermediaries have charged money to link buyers and sellers of goods and services. For e-commerce businesses such as , **eBay (EBAY -2.92%)**, and **PayPal (PYPL -3.77%)**, the take rate refers to the percentage of the value of the transactions they facilitate that they get to keep as revenue.

How much an e-commerce company is able to charge as a take rate depends on the strength of its underlying network of users and the degree of competition within the industry. As Amazon, eBay, and PayPal have found, building up an internal ecosystem to keep users within reach can be a key driver in keeping take rates up and boosting profits as much as possible.

What take rates look like in online marketplaces

For online marketplaces like what Amazon and eBay offer, the take rate refers to the fees and commissions that the companies collect on sales by third-party sellers. For eBay, those fees typically take the form of initial listing fees for offering goods and services on its marketplace in the first place, as well as final value fees that the e-commerce specialist collects after a successful sale.

The key issue with take rate in online marketplaces is the tug-of-war between maximizing profit and keeping customers within the network. eBay has traditionally sought to move its

take rate higher, boosting final value fees and taking a bigger piece of its sellers' sales. Yet as it has done so, eBay has opened the door to competing marketplace services, and the rise of companies like **Etsy** has shown that raising take rates too high can enable competitors to undercut based on price and lure cost-sensitive users away.

In assessing the health of Amazon, eBay, and other marketplaces, it's valuable to look at gross merchandise volume and segment profitability. Volume growth is important to ensure that the network is healthy, but the ratio of profits to volume is directly proportional to the take rate, and growth in profits is necessary to show that the company is finding the optimal take rate to balance income and revenue.

What take rates look like for payment networks

Meanwhile, the take rate concept is similar for payment services providers like PayPal. Payment services providers typically take a percentage of every transaction in exchange for facilitating the movement of funds from the buyer to the seller. For instance, if a buyer spends \$100 on a product, a payment services company might pay the seller \$97, keeping the remaining \$3 as a fee. This would work out to a take rate of 3%.

As with online marketplaces, competitive pressures define how payment providers can optimize take rates. PayPal's net take rate actually depends significantly on the choice of funding source that customers make, because if customers use a debit or credit card, then PayPal has to bear the costs that the card network company charges. PayPal actually takes that into account with certain transactions, charging no fee on personal payments funded with existing PayPal balances or from a bank account, but charging 2.9% plus a \$0.30 transaction fee if the payment is funded through a debit or credit card. However, for purchase payments, the seller pays 2.9% plus \$0.30 per transaction regardless of the funding source -- meaning that PayPal gets to keep extra profit if buyers use a bank account rather than a card.

What take rates look like for website analytics

Finally, take rate has a different meaning for marketing activity, including that done through e-commerce. Take rate reflects the fact that a great deal of internet marketing happens in multiple stages, where the first goal is to get a customer to click on an ad, and the next is to convince that customer to buy a product. The take rate in this case refers to the percentage of customers who click on the ad, in contrast to the conversion rate, or percentage of customers who not only took the ad but actually bought the product.

In general, a high take rate is good, but it's essential that conversion rates be strong as well. For marketers, a high take rate and a low conversion rate can be the worst of all worlds in e-commerce. Often, marketing costs are based on the number of people clicking through, and it's then up to the company to convince those people to buy a product. By contrast, a lower take rate can be better if it doesn't hurt conversions, because it will cost less to drive the same amount of final sales.

Churn Rate

Churn rate, also referred to as attrition rate, measures the number of individuals or units leaving a group over a specified time period. The term is used in many contexts, including in business, human resources, and IT.

Most notably, churn rate is referred to as the proportion of contractual (or subscribed) customers who terminate their contractual relationships/subscriptions with a company in a given timeframe. In this context, the term is primarily associated with companies operating on a subscription basis.

Importance of Measuring Churn Rate

Churn rate is one of the most critical business metrics for the companies using a subscription-based business model. For example, a high churn rate or a churn rate constantly increasing over time can be detrimental to a company's profitability and limit its growth potential. Thus, the ability to predict the churn rate is essential for the company's success. Many companies rely on predictive analytics that allows creating models that forecast churn rates.

In order to decrease the churn rate, companies utilize different methods and strategies. Generally, the strategies are focused on improvements in customer retention and satisfaction by establishing proactive communication with customers, obtaining constant customer feedback on the company's performance, and improving the company's operations.

What is Customer Churn Rate?

Customer churn rate (also known as customer attrition rate) measures the proportion of contractual customers of a company who cease their subscriptions over a defined time period. Customer churn rate is one of the important business metrics for companies providing some services (such as SaaS companies) or those operating on a subscription-based model.

Companies can use two variations of customer churn rate: voluntary churn and involuntary churn. Voluntary churn rate indicates the proportion of customers who decide to cease their subscriptions as a result of their own decisions (e.g., dissatisfaction with the company's services). On the other hand, involuntary churn rate is a proportion of customers who terminate their subscriptions due to some unavoidable circumstances (e.g., relocation).

Generally, companies are primarily concerned with voluntary churn that is directly related to their core business operations.

Formula for Customer Churn Rate

The customer churn rate is calculated by dividing the number of customers left in a given period by the total number of customers at the beginning of a given period. Mathematically, it can be expressed using the following formula:

$$\text{Customer Churn Rate} = \frac{\text{No. of Customers Churned in a Period}}{\text{No. of Customers at the Beginning of a Period}} \times 100$$

What is Employee Churn Rate?

In human resources, churn rate is referred to as a proportion of employees who leave a company in a given period of time. In this context, the churn rate is frequently referred to as employee attrition rate or employee turnover rate.

Employee churn rate indicates how frequently the company's employees quit their jobs within a given period. Note that employee churn rates can significantly vary among

companies and industries. For example, a consulting company is likely to see a significantly lower churn rate than a fast-food restaurant.

Generally, companies aim to either maintain churn rates corresponding to the industry average or lower than the industry average.

Formula for Employee Churn Rate

Customer satisfaction

Employee churn rate is calculated by dividing the total number of employees who resigned within a period by the total number of employees in that period. The mathematical formula is given below:

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Customer satisfaction should be the main focus of an organization because customers drive business. Collecting customer satisfaction data can help your company determine what is working well with your products, services and internal processes, and what you need to improve or change completely. In this article, you will learn what customer satisfaction is, how to measure it effectively and why it's important for the success of your business.

Customer satisfaction (often abbreviated as CSAT) is a measurement of how happy (or unhappy) customers are with a company's products, services or experience.

Customer satisfaction consists of a customer's perceived quality, value and expectations of your company and what you offer. This data can reveal major insights into how customers relate to your brand and how they will interact with your brand in the future.

Customers include anyone a company provides products, services or experiences. For example, a car dealership's customers are individual buyers and a hospital's customers are patients. Many businesses are actually both providers and customers. For instance, a hospital is a provider for patients by offering healthcare and a provider for insurance companies by releasing data on patients, but hospitals are also customers of insurance companies, which pay hospitals for their services.

How can we get customer service data?

The most common way for companies to receive customer service data is to analyze their Customer Satisfaction Score. This score is generated with a customer satisfaction survey using a Likert scale. In this survey, customers are asked to evaluate statements about their perceptions and expectations of your business, product or service. Question categories might include product usage, demographics, satisfaction scale, open-text for long-form responses and longevity questions that ask customers if they can be contacted again in the future. The satisfaction scale is typically set on a scale of 1-3, 1-5, or 1-10. All customer rating responses are then averaged to get the CSAT score.

While the CSAT is a comprehensive way to get customer feedback, there are additional metrics you can establish to gather more data. They include:

□	Net promoter score:	This score evaluates customer loyalty by measuring the likelihood that a customer will refer you to someone. Referrals are important for company longevity.
Customer effort score: This score measures the effort customers had to use to get their issues solved. The lower the score the more efficient customer service is and the happier customers are.		
Social media monitoring: Monitoring what your followers are saying on social media helps you evaluate how customers feel about your company and what they are saying to their closest family and friends about it.		
Measuring complaints: This is the measurement of the number of complaints received for products or services sold or survey responses, per 100, 1000, or up to		
		1,000,000 units. Lowering this score means you are proactively reducing customer dissatisfaction.

Why is customer satisfaction important?

Great customer satisfaction and high customer retention are strongly linked. Customer retention powers sales and helps businesses maintain sustainability. While metrics like sales and shares show important details on how well a company is performing at a specific time, customer satisfaction scores are one of the best indicators to reveal how a company will perform in the future.

Here are some specific ways knowing your CSAT can help your business:

CSAT identifies your unsatisfied customers

Identifying and addressing unhappy customers is crucial to the success of any business. Negative customer reviews, or word-of-mouth warnings to friends and family based on bad experiences, can adversely impact a company's longevity. Asking for feedback through surveys, and acting on any unfavorable responses by addressing problems and making adjustments, shows that customers are your top priority. When you show unhappy customers you care about them, they have a higher chance of coming back.

CSAT identifies your happy customer

Prioritization of customer success is an important aspect to growing your business. To determine if customers are happy, you'll need to measure and analyze their satisfaction rates. Your satisfied customers are important because they will maintain loyalty and increase referrals. You can create customer advocacy programs for these customers to encourage them to bring in more referrals and advertise on your business's behalf.

CSAT forecasts help you prioritize.

Customer metrics help you focus your priorities. Customer satisfaction data allows your teams to assess what areas they need to work on to improve the health of your customer base. Customer success teams, sales, production and marketing are all involved in making your customers' experiences excellent.

CSAT powers internal processes

Customer satisfaction data gives you powerful insights into who is consuming your product or service. These metrics can be very advantageous when used correctly. By learning more about your customer base and who is satisfied with your product, you can adjust your marketing plans, sales techniques and other internal operations.

CSAT attracts new leads

Customer reviews are one of the most persuasive ways to attract new customers. Greater customer satisfaction leads to an increase in positive reviews. These strong testimonials attract more potential customers to your business than a marketing campaign because people trust their peers.

6. CSAT sells.

Customer satisfaction is a selling point for sales teams. High customer satisfaction scores are a compelling highlight to make during a pitch to new leads. Additionally, sales teams can analyse happy customer reviews to note which parts of your service or product they should mention as unique advantages over competitors.

7. CSAT guides product updates

Negative reviews can actually be very beneficial for product development. When an unsatisfied customer relays their problems with a product or service, it opens up an opportunity to fix a problem that could affect many other customers in the future. This is especially important for businesses that regularly update software where bugs must be fixed immediately.

Customer Lifetime Value

Keeping your customers happy and coming back for more is an essential strategy for any business. Still, many companies are short-sighted and focus on one-off purchases from new buyers rather than repeat purchases from existing customers.

Hanging on to repeat customers and nurturing that relationship can be extremely lucrative, considering that repeat customers generally spend 67% more than new customers.

One metric in particular can help companies understand the value of existing buyers: customer lifetime value.

Customer lifetime value (CLV) is the amount a customer can be expected to spend on a company's services or products during their entire relationship or **lifetime**.

CLV is essentially calculated as follows:

Average Value of a Sale (x) Number of Transactions (x) Retention Time Period (x) Profit Margin

Customer lifetime value (CLV), also called lifetime value (LTV), refers to the profit margin that a company can expect to earn during its business relationship with a customer.

Keeping this metric in mind helps companies take a longer view and shift their focus from simple transactions to the extended value of repeat business.

Of course, it's crucial to find new customers so that your company can grow, but for your business model to be sustainable, it's also imperative to bolster the lifetime value of existing customers.

Unfortunately, many companies dismiss, ignore or underappreciate this metric because it can be tricky to define and calculate. What's more, data shows that 44% of companies are focused on acquiring new customers while just 18% are committed to retention. If you're in the latter group, it's time to step it up and really focus on the customer lifetime value.

Keep in mind that just a 5% increase in customer retention can boost your profits by more than 25%, so it's clearly well worth the effort.

Why Is Customer Lifetime Value Important?

Customer lifetime value (CLV) is a crucial metric as it allows companies to understand the value of retained customers. If the success rate of selling to an existing customer is 60-70% and to a new customer is 5-20%, it makes a ton of sense for companies to try to increase their CLV any way they can.

Let's take a look at the five most significant reasons why CLV is so important.

It can help boost profit: Increasing customer retention rates by just 5% has been shown to increase profits by 25% to 95%. This, at least in part, is because existing customers are 50% more likely to try out new products and statistics show they spend 31% more than new customers.

Thus, repeat customers increase your average CLV because customer retention can improve not only the number of sales per order but also sales over time. Since you spend only once to acquire a customer and customer retention costs less than the acquisition cost, your customer lifetime value can increase and translate into more profit.

It can lower customer acquisition costs (CAC): Companies that interact with and nurture their customers will enjoy higher profit margins and lower CAC. It's actually an expensive proposition for companies to go out and constantly try to find new customers. If acquiring a new customer can cost between 5% and 25% more than hanging onto an existing one, it makes all the sense in the world to take care of your current ones.

It can help you maintain a steady cash flow: If you're getting repeat sales from existing customers, that will create a very nice, regular cash flow. When you know you have money coming in, it's easier to reinvest it back into your business. When you know people will be coming back for more, you know you have a steady flow of cash to work with.

It can increase customer loyalty and retention: CLV allows companies to identify their most valuable customers and offer them personalized rewards and incentives. At the same time, you can build strong relationships with new customers and retain them through stellar customer support, attractive loyalty programs, and other lucrative incentives to win their loyalty and long-term business. When you have repeat customers, you get more sales, good reviews, and referrals.

It can allow you to target your ideal customers: Understanding customer lifetime value can give you a better idea of what kind of customers spend the most money on your business. It allows you to segment your audience according to their CLV. Then you can use look-alike modelling to adapt your acquisition strategy to the target audience matching your customers with the highest CLV. From there, you can work to increase your customer lifetime value further.

Customer Lifetime Value Formula

There are multiple ways to calculate CLV. We're going to look at two possibilities here, one using the ARPU and churn that we mentioned above and one using other metrics. The formula you use will depend mainly on the data you have available.

The first method is to divide ARPU by the churn rate:

Customer lifetime value = $\text{ARPU} / \text{Churn Rate}$

A second method for calculating CLV is by using the following formula:

Customer Lifetime Value = Average Value of a Sale x Number of Transactions x Retention Period x Profit Margin

Keep reading for some real examples.

Example CLV Calculation

Let's look at two examples so we can understand CLV better.

You already know your company has a churn rate of 10% and an ARPU of \$30. Using the first formula, we get:

$$30 / 0.10 = \$300$$

The average customer lifetime value for your company would be \$300. Let's use the other formula.

Your company sells menswear. The average sale is \$75, and the average customer shops with you 4 times per year for 3 years. You know that your profit margin is 20% after taking into account overhead, the cost of goods sold, marketing expenses, and administrative costs.

Using our formula, CLV would be calculated as follows:

$$\$75 \times 4 \times 3 \times 20\% = \$180$$

Your company's average customer lifetime value is \$180, and you can now use this information to predict cash flow. You can also figure out how many customers you'll need to acquire and retain if you're going to achieve your target profitability.

Cost per click: Pay-per-click is one of the many tactics that you can use to strengthen your marketing campaign. It's important to track the cost of each marketing tactic you deploy throughout your campaign, so you meet budgetary requirements and evaluate the performance of your team effectively. However, it's also feasible for the accounting department to know the cost of your paid search campaign to see if it's an indicator of the marketing team's success.

Cost per click, formally known as pay per click, measures how much you get paid when a user clicks on your advertisement displayed within a search engine. In other words, the cost per click gets measured by how many users have an interaction with your brand in the form of ads. Since you'll be getting paid by the advertiser for your ad's performance, you need to make sure that the ad redirects to your landing page that solicits the user to respond to your call-to-action (CTA). Some of the ad types you can use include text, image, video, social media and shopping.

Increases the chance of boosting profits

A lead searches for what they want to buy on a search engine to find the lowest price and highest quality, so placing your ad with the highest searched result creates interest and

improves the probability of your target audience to go to your website, along with ending up in the buying process. You'll need to check the functionality of your website for it to navigate your customers through the buying stage smoothly.

Easy to manage spending costs

You can make a quick decision on when to start and stop campaigns, so you'll know how much you paid through the duration your ads ran on the search engine and make adjustments to your ads campaign to be within budget. Also, you can run an ad campaign for as long as you want and you have no upfront cost, which can have enormous growth potential.

Accessible performance metrics

You can see the performance of your ads as the user clicks on them, which can determine how much you want to spend for the quarter or the year depending on your marketing budget. You can also find out who's clicking on your ads, and you have the option of adjusting your keywords and adding a promotion that incentivizes leads to go to your website.

Improves exposure opportunities

You can attract your target audiences and new audiences to your product with quality ad campaigns, and cost per click campaigns present you the opportunity to apply remarketing tools that can drive the user back to your website based on their search history. The association with your brand and the search gives familiarity with the user, so they'll know to search for your company again in case they want to make a purchase.

How to calculate cost per click

Take a look at the steps to calculate cost per click for your business:

1. Identify the ad campaign you're calculating.
2. Determine the total cost per click.
3. Find out the number of users click on the ad.
4. Divide the cost per click by the number of clicks to get your calculation.

1. Identify the ad campaign you're calculating

It's advised that you run multiple ad campaigns using different keywords to see which one is the most searchable. This way, you'll know the numbers behind your brand's impact and you can note the demographics that showed up on your searches, which can lead to a separate marketing campaign if you can see a different target audience consistently interacting with your website.

Determine the total cost per click

The average price per click shows up when you search for available keywords that you want to use for your ad campaign. The cost can vary depending on the number of companies bidding for the keyword. It notes the competition you'll have with others in using it.

However, we want to look out for the total cost of each click to begin finding the average amount for the campaign. We'll say that the total cost per click is \$19.90 to make this calculation.

Find out the number of users click on the ad

Monitor the number of users that clicked on your ad on a daily, weekly, monthly and even annual basis to check on the progress you have with engaging with your target audience. Ad reports can be handed out to marketing managers and be a factor in the marketing budget allocated by the executive team for the following year. We'll say that a weekly ad campaign with a \$19.00 cost per click received 20 clicks.

Divide the cost per click by the number of clicks to get your calculation

The last step is to divide your total cost per click over the number of clicks you received for the campaign. The number can either be a decimal or a whole number, which symbolizes the total that comes out to be less or more than \$1 per click. Using the example from above, the average cost per click is \$.95 per click.

Conversion Rate

The conversion rate is an online marketing KPI measuring the ratio of a website's visitors to conversions. A conversion doesn't necessarily have to be a sale or transaction, but could also include successful downloads or newsletter sign-ups. Conversion rate optimization is a central aspect of online marketing and search engine optimization, as an improved conversion rate can have a significant impact on lead generation, and therefore sales and revenue.

Conversion Rate Definition

The conversion rate describes the relationship between visits/clicks on a website to conversions. A conversion is the process of a potential customer becoming an actual customer. Conversions can consist of purchases or downloads.

How to Calculate the Conversion Rate

The conversion rate can be calculated in two ways. One method of calculating the conversion rate includes all recorded visits to a website, therefore including automated page impressions by bots, and repeated page impressions from the same user. This calculation is less accurate, unless a logfile analysis is used so that visits by search engine bots can be excluded.

Conversion Rate = (Number of Conversions x 100%) / (Number of Visits) Here's an example: A marketing professional sells eBooks on their website. In the first week after the sales launch, the website gains 100,000 page views and his eBook is downloaded a total 100 times which means:

Conversion Rate = $(100 \times 100\%) / 100000 = 0.1\%$

For a more accurate calculation of the conversion rate, the page views in the formula need to be replaced by unique visitors or sessions, meaning a visitor is only counted once even if they visit the site multiple times. Cookies are usually used to identify visitors, making it possible to exclude multiple visits by the same user.

More accurate conversion rate = (number of conversions x 100) / (number of unique visitors)

For this calculation, a particular period of time is selected and only one conversion per unique visitor per day is calculated. The total number of page views doesn't matter for the calculation.

Bounce rate

In internet marketing/business terminology, bounce rate is associated with the analysis of traffic to a company's webpage. The rate (always a percentage) indicates the percentage of visitors that come to the site and leave versus those who come and view multiple pages.

Formula for Bounce Rate

The formula for calculating bounce rate is given below:

$$\text{Bounce Rate} = \frac{\text{Total One-Page Visits}}{\text{Total Website Visits}}$$

There are a number of different aspects to consider when making a website that will keep users around to check out more than one page. At the top of the list are:

Effective communication

With any website, the primary objective is to pass along the most pertinent information about the company and what is being sold or offered. Effectively communicating things such as contact information, all available products/services, prices, etc., is critical if the company wants to get visitors to view more than one page, thereby making the company more successful.

Aesthetics

Stimulating colours and interesting graphics, organized in a neat and orderly way, are far more likely to attract and keep viewers. The key is to make sure that in the aim to be aesthetically pleasing that the site doesn't become overburdened with too many flashy, confusing graphics, texts, or colours.

User accessibility

Neither the two other aspects on this list – nor any of the other aspects for a successful website – matter if the site isn't user-friendly. Fast loading speeds, clearly labelled links, and even things such as audio clips to read out the names of the links, are all important. Enabling viewers to easily find and access whatever part of the site they're interested in encourages them to stick around.

A Good Bounce Rate

There are a number of variables that determine what a good or bad bounce rate is. They include the industry, business type, products/services sold, and how saturated the marketplace is for companies in the industry or that sell the same or similar goods/services.

The way to determine the best rate for a certain company is to research the standard-to-average rates for similar companies or companies within the same market space that seem to be making a decent profit.

Again, what is a good or ideal rate for one type of company in a given city may be completely different for a similar company in a different area. However, the rule of thumb with bounce rates is as follows:

Anything below 20%: An extraordinarily low bounce rate!

20% – 40%: The ideal goal range for pretty much every company
41% – 75%: The range that most sites actually fall into

75%+: The danger zone for bounce rates

UNIT V

Forecasting – time series and exponential smoothing – purchase order processing – production order quantity model – acceptance sampling – material requirement planning – Quality control charts – Lot sizing methods – Project management

Exponential Smoothing for Time Series Forecasting

Exponential smoothing is a forecasting method for univariate time series data. This method produces forecasts that are weighted averages of past observations where the weights of older observations exponentially decrease. Forms of exponential smoothing extend the analysis to model data with trends and seasonal components.

Statisticians began developing exponential smoothing back in the 1950s. Since then, it has enjoyed a very successful presence among analysts as a quick way to generate accurate forecasts in diverse fields, particularly in industry. It's also used in signal processing to smooth signals by filtering high-frequency noise.

In this post, I show you how to use various exponential smoothing methods, including those that can model trends and seasonality. These methods include simple, double, and triple (Holt-Winters) exponential smoothing. Additionally, I help you specify parameter values to improve your models. We'll work through example data sets and make forecasts!

Benefits of Exponential Smoothing

By adjusting parameter values, analysts can change how quickly older observations lose their importance in the calculations. Consequently, analysts can tweak the relative importance of new observations to older observations to meet their subject area's requirements.

In contrast, the moving average method weights all past observations equally when they fall within the moving average window and it gives observations outside the window zero weight. Like the Box-Jenkins ARIMA methodology, statisticians refer to exponential smoothing as an ETS model because it models error, trend, and seasonality in time series data.

Time Series Analysis Introduction

Time series analysis tracks characteristics of a process at regular time intervals. It's a fundamental method for understanding how a metric change over time and forecasting future values. Analysts use time series methods in a wide variety of contexts.

Area	Examples
Business	Manufacturing output, sales, prices
Economics	GDP, stock market, and other indicators
Social Sciences	Population trends, political changes
Medicine	Disease, birth, and death rates
Physical Sciences	Climate and environmental changes

In this post, I cover the basics of time series analysis. I'll define this type of data, explain what we can learn from it, and touch on more advanced methods that I will explore in future

posts. For this introduction, I focus on using time series plots to highlight what you can learn from these data.

Time Series Data

A time series is a set of measurements that occur at regular time intervals. For this type of analysis, you can think of time as the independent variable, and the goal is to model changes in a characteristic (the dependent variable).

For example, you might measure the following:

Hourly consumption of energy

Daily sales

Quarterly profits

Annual changes in a country's population

Each of these examples tracks a single metric at regular time points. Use subject-area knowledge to choose the appropriate time interval that allows you to answer your research questions.

Compared to Panel Data

Panel data contain observations of multiple characteristics measured over time for the same set of subjects, such as people, businesses, or countries.

For panel data, you need a time value and an additional characteristic to identify a particular observation. For example, if you have panel data that tracks sales for a group of companies over time, you'll need a time value and a company identifier to find an individual observation.

Time series data are a sub-type of the broader class of panel data. These series only track a single characteristic. Consequently, you only need the time value. For example, for the annual number of breast cancer cases time series, you just need to know the year to identify the observation.

Compared to Cross-Sectional Data

Cross-sectional data describes a set of people, items, companies, etc. at a single point in time. The goal is to determine the differences between the subjects at one time. For example, a cross-sectional study might assess wages by education level to understand the impact of education. Time does not play a role in this type of analysis.

Goals of Time Series Analysis

Time series analysis seeks to understand patterns in changes over time. Statisticians refer to these patterns as the components of a time series and they include trends, cycles, and irregular movements. When these components exist in a time series, the model must account for these patterns to generate accurate forecasts, such as future sales, GDP, and global temperatures.

In addition to these patterns, time series models typically incorporate the fact that time flows in one direction. Past events can influence future observations but not the other way around. Additionally, events close together in time often have a stronger association than more distant

observations. While these ideas are obvious to us, statisticians had to build them into how these models work.

Like all data, time series data contain random fluctuations. This randomness can obscure the underlying patterns. Smoothing techniques cancel out these fluctuations to more clearly unveil the trends and cycles. In other posts, I cover the modelling and smoothing techniques.

Simple Exponential Smoothing (SES)

Use simple exponential smoothing for univariate time series data that do not have a trend or seasonal cycle. Analysts also refer to it as single exponential smoothing. It's the simplest form of exponential smoothing and a great place to start!

Simple exponential smoothing estimates only the level component. Think of the level component as the typical value or average. This method updates the level component for each observation. Because it models one component, it uses only one weighting parameter, alpha (α). This value determines the degree of smoothing by changing how quickly the level component adjusts to the most recent data.

Alpha values can range from 0 to 1, inclusive. Lower values produce smoother fitted lines because they give more weight to past observations, averaging out fluctuations over time. Higher values create a more jagged line because they weigh current data more highly, which reduces the degree of averaging by the older data.

Double Exponential Smoothing (DES)

Double exponential smoothing can model trend components and level components for univariate times series data. Trends are slopes in the data. This method models dynamic gradients because it updates the trend component for each observation. To model trends, DES includes an additional parameter, beta (β^*). Double exponential smoothing is also known as Holt's Method.

As with alpha, beta can be between 0 and 1, inclusive. Higher values place more weight on recent observations, allowing the trend component to react more quickly to changes in the trend.

Forecasts for this method change at a constant rate equal to the final value of the trend component. A popular extension for this method adds a dampening component to the forecasts, causing the forecasts to level out over time to avoid overly optimistic long-term forecasts.

In the example below, we're using double exponential smoothing to model monthly computer sales. As you can see in the chart, the time series data have a trend. I've allowed the software to estimate the level (0.599) and trend (0.131) smoothing constants from the data to optimize the fit.

The forecasts (green diamonds) increase at a rate equal to the final trend estimate. Notice how the prediction intervals widen with subsequent forecasts.

Triple Exponential Smoothing (Holt-Winters Method)

Triple exponential smoothing can model seasonality, trend, and level components for univariate time series data. Seasonal cycles are patterns in the data that occur over a standard number of observations. Triple exponential smoothing is also known as Holt-Winters Exponential Smoothing.

This method adds in the gamma (γ) parameter to account for the seasonal component. For this method, you must specify the period for the seasonal cycle. For example, these lengths include the following: weekly (7), monthly (12), or quarterly (4).

In triple exponential smoothing, seasonality can be multiplicative or additive. Multiplicative seasonality has a pattern where the magnitude increases when the data increase. Additive seasonality reflects a seasonal pattern that has a constant scale even as the observations change.

In the example below, we're using triple exponential smoothing to model daily food sales. The time series plot displays an upward trend and a weekly seasonality.

Purchase order process: In today's global workforce, a slow purchase order process can cripple your business. Manual purchase order processing and archaic systems hamper the purchase order process and do more harm than good. Relying on a manual purchase order process with emails and spreadsheets is like using a bank account with no ATM access. A great way to overcome this challenge is by automating your procurement process. Digitalization makes clunky processes work like a charm. Still not convinced? Here's a free e-book that talks about the importance of procurement automation.

In the technological era, it would be wise to take advantage of a cloud-based solution like Kiss Flow for purchase orders. Because it would help you to track POs end-to-end. But before we delve deeper into a procurement system for successful PO management, let's take a look at the current state of purchase order management, and figure out its major flaws.

Purchase order process flow

The purchase order process consists of several compliance checkpoints and approval/input tasks to ensure timely PO processing. Here are the most common purchase order process steps:

Create a purchase order

Send out multiple requests for quotation (RFQ)

Analyse and select a vendor

Negotiate contract and send PO

Receive goods/services

Receive and check invoice (3-Way Matching)

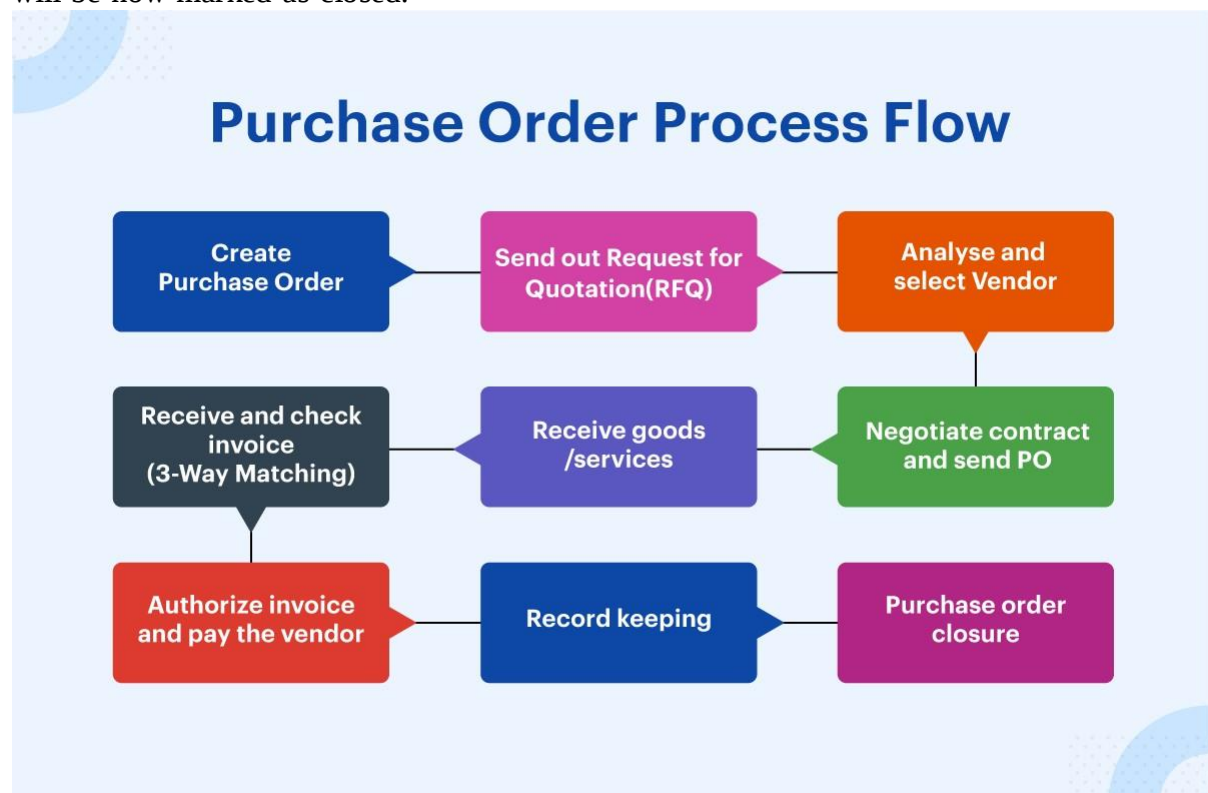
Authorize invoice and pay the vendor

Record keeping

Purchase order closure

Example:

To understand a PO process, consider this real-life example. Jeni, an HR Manager is looking out for new laptops to onboard new joiners. She creates a PR, which auto flips and becomes a PO, thanks to procurement software like Kiss flow. The purchase order has information on the number of laptops, the specifications, and the time she needs them. Based on the PO, a Request for Quote (RFQ) is sent to the suppliers to get the quotes. Based on the quotes received, their quality, and estimated delivery time, a vendor is selected. Post selection of the vendor, he/she is contracted and the PO is shared. The vendor delivers the laptops requested, Jeni receives them and verifies the products. Post this, Sathish, Accounts Manager from the Finance team performs 3-way matching with the help of Kiss flow Procurement Cloud and then pays the vendor if there aren't any discrepancies. The records for the transaction are kept safe, and the PO will be now marked as closed.



The pain points of manual purchase order processes

Manual purchase orders are costly, inefficient, and time-consuming to maintain. There are too many documents required to process a single purchase order.

Acquiring, storing, and sending them through the approval loop while ensuring they don't get lost or damaged along the way is extremely tedious.

According to a recent APQC study, manual PO processing can cost organizations as much as \$506.52 per purchase order. A great way to reduce this cost is by automating your procurement process. We have broken this down into simple actionable steps and put them together in our free e-book.

Here are some of the disadvantages of a manual purchase order process:

Lacks visibility

Spikes organizational expense

Drags PO processing cycle

Depends on human intervention

Has process bottlenecks and compliance issues

Involves an endless loop of emails and people

Is cumbersome, inaccurate, and error-prone

Benefits of a digital PO system

Here are six reasons why every organization needs a procurement solution with a purchase order management system. Digital purchase order systems can:

Enhance efficiency in PO management, with no lost or delayed POs

Improve PO processing speed

Accelerate purchase order approvals

Streamline order and stock management

Improve the vendor-buyer relationship

Prevent procurement fraud

Production Order Quantity Model Definition:

An economic order quantity technique applied to production orders.

Production Order Quantity Model Explanation:

A generation arranging model with stochastic interest, consistent faulty rate and limit imperative is created to examine the generation issue of a chocolate milk producer. The model is demonstrated to have an ideal arrangement under the given conditions. An ideal creation plan is set up for the firm, which is demonstrated to be better than the present generation plan. The affectability investigation performed on the ideal arrangement gives helpful bits of knowledge on the stock control and limit prerequisite choices of the firm. The distinction

between these two techniques is that the EPQ model accept the organization will deliver its very own amount or the parts will be transported to the organization while they are being created, in this manner the requests are accessible or gotten in a steady way while the items are being created. While the EOQ model accept the request amount arrives total and following requesting, implying that the parts are created by another organization and are prepared to be sent when the request is put.

Production Order Quantity Model

When annual data are used the equation becomes

$$Q^* = \sqrt{\frac{2DS}{H \left(1 - \frac{\text{annual demand rate}}{\text{annual production rate}} \right)}}$$

Economic Order Quantity Model

(Figure 15-3)

1. Enter the problem name in B3.

2. Enter the problem information in F6:F9.

	A	B	C	D	E	F	G	H	I
1	INVENTORY ANALYSIS - ECONOMIC ORDER QUANTITY MODEL								
2									
3	PROBLEM:	House of Fine Wines and Liquors - Tres Equis Beer							
4									
5	Parameter Values:								
6		Fixed Cost per Order: k =				\$ 10.00			
7		Annual Number of Items Demanded: A =				5,200			
8		Unit Cost of Procuring an Item: c =				\$ 2.00			
9		Annual Holding Cost per Dollar Value: h =				\$ 0.20			
10									
11	Decision Variables:								
12		Order Quantity: Q =				100			
13									
14	Results:								
15		Total Annual Relevant Cost: TC =				\$ 540.00	15	=(F7/F12)*F6+F9*F8*(F12/2)	
16		Time Between Orders (years): T =				0.0192	16	=F12/F7	

Optimal order quantity

Optimal total annual relevant cost and time between orders

Optimal total annual relevant cost and time between orders

Optimal order quantity

Production Order Quantity Model

- ◆ Consider one product at a time.
- ◆ Produce Q units in a production run; then switch and produce other products.
- ◆ Later produce Q more units in 2nd production run (Q units of product of interest).
- ◆ Later produce Q more units in 3rd production run, etc.

Production Order Quantity Model

Q = Number of pieces per order p = Daily production rate
 H = Holding cost per unit per year d = Daily demand/usage rate
 t = Length of the production run in days

$$\left(\begin{array}{c} \text{Annual inventory} \\ \text{holding cost} \end{array} \right) = (\text{Average inventory level}) \times \left(\begin{array}{c} \text{Holding cost} \\ \text{per unit per year} \end{array} \right)$$

$$\left(\begin{array}{c} \text{Annual inventory} \\ \text{level} \end{array} \right) = (\text{Maximum inventory level})/2$$

$$\left(\begin{array}{c} \text{Maximum} \\ \text{inventory level} \end{array} \right) = \left(\begin{array}{c} \text{Total produced during} \\ \text{the production run} \end{array} \right) - \left(\begin{array}{c} \text{Total used during} \\ \text{the production run} \end{array} \right)$$

$$= pt - dt$$

Quality control

Quality control charts depict measures of quality for processes or for products. They show the deviation, if any, from the set, ideal standards or specifications for a product or a process.

The Importance of Quality Control Quality control is an extremely important activity for any business that is engaged in manufacturing products. If a company's products are produced with uneven quality, it can negatively impact the company's sales.

For example, consider a company that makes and sells bottled beverages. Now think about what might happen if a production machine that affixes the caps to the bottles gets a little bit

out of whack, so that it begins affixing approximately one-third of the bottle caps in such a way that it becomes nearly impossible, or at least extremely difficult, for consumers to remove the cap from the bottle. It doesn't take too many instances of an occurrence such as that before the company begins to lose a lot of customers.

Therefore, companies set rigorous specification standards for both manufacturing processes and for the finished products that they produce. They then set in place quality control procedures. One of the procedures is commonly to take random samples and create quality control charts that reveal how much deviation exists from the specification standards for a product.

Understanding Quality Control Charts

Quality control charts can be created and used to examine either a single variable or multiple variables related to the desired quality of a product or process. For example, a toy manufacturing company may wish to use quality control charts to monitor

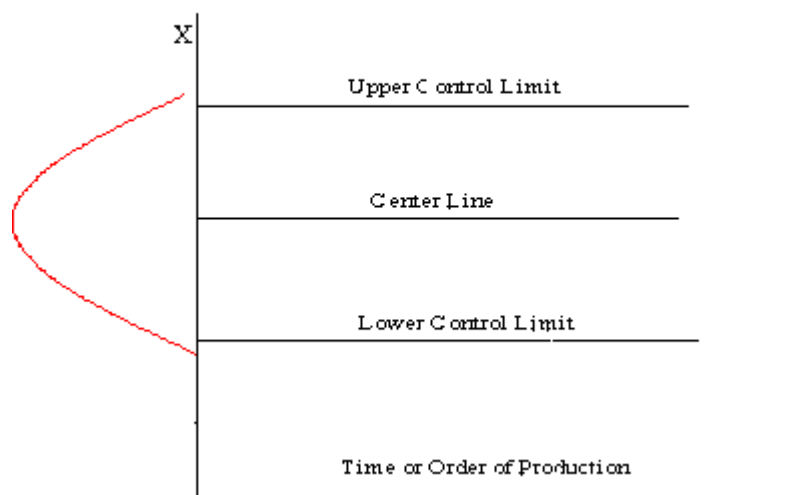
- (1) the smoothness of the edges of the toy and
- (2) the fit of the toy's packaging.

A quality control examination will use random samples of the population to be examined, comparing actual specifications found in the collected samples to the stated, ideal specifications. Typically, a quality control chart will show a centre line that represents the ideal specification for whatever quality variable is being studied. The chart will also usually include upper and lower quality control lines that represent acceptable, relatively insignificant levels of deviation from the desired specification. Plotted on the chart will be the results of random samples drawn for the quality control study.

As long as the samples show deviations that are only within the range bordered by the upper and lower quality control lines, then that indicates good quality control, that products are being produced with the desired level of uniform quality. It is referred to as being "in control."

However, if the results show many samples with plot points above or below the upper or lower quality control lines, respectively, it indicates significant variation in product or process quality that needs to be addressed. Wide variations from specifications indicate being "out of control."

Theoretical Basis for a Control Chart



Uses of Quality Control Charts

While the use of quality control charts is most frequently associated with manufacturing processes and manufactured products, they can be applied to many other things as well. Following are some other potential applications for the use of quality control charts.

Employee Retention Rates

Finding, hiring, and training new employees is an expensive and time-consuming process for a company. Therefore, it is to a company's advantage to retain good employees as long as possible. A quality control chart can be constructed that compares a company's actual employee turnover rate to its desired rate. If the chart reveals an excessively high turnover rate, then the company can do further investigation to find the cause(s) of the high turnover rate, and then make changes designed to reduce the rate.

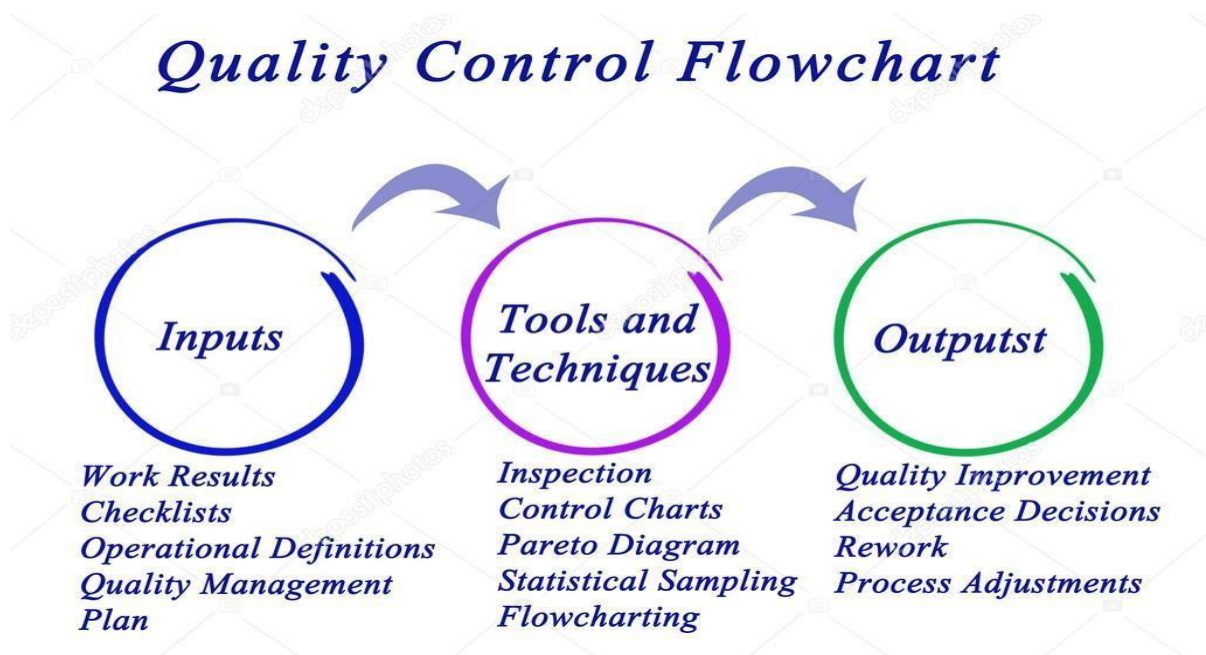
Returns on Investments

Quality control can also be applied to examine returns on your investments, checking the extent to which individual investments in your portfolio either outperform or underperform compared to your expected investment returns.

Wide variations in investment results, either up or down, may indicate that your current investment portfolio carries a higher degree of risk than the risk level that you are comfortable with. Outperforming and underperforming investments can also be examined for common characteristics that may help you identify future investments that offer a higher probability of obtaining maximum profits.

E-commerce websites

Quality control charts can be used to monitor the processes and functionality of an e-commerce website. For example, anyone engaged in such a business would do well to monitor the number of instances where there is some type of glitch in the website's operation that causes a customer to abandon the process of making a purchase. By monitoring the quality of the website's operational performance, any problems or issues that arise can be quickly addressed before they lead to a substantial decline in revenues.



Acceptance sampling

Let's imagine that a consumer receives some lots of products from a supplier. A sample of parts from the lot is taken and the number of defective items counted, if there is. If the number of defective items is low, the entire lot will be accepted, but if the number of defective items is high, the entire lot is rejected. Deciding on accepting a good-quality lot and rejecting a poor-quality lot is referred to in quality as acceptance sampling.

Acceptance sampling is a statistical technique utilized in quality control, allowing a manufacturer to determine the quality level of a batch of products from a specific production run by selecting a predetermined number for testing. The quality of the sample selected during sampling becomes the quality level for the entire group of products.

The primary objective of acceptance sampling is to determine the quality level of a batch with a specified degree of statistical certainty without having to test every single unit of that batch. After completing the sampling exercise or testing, the manufacturer decides whether to accept a lot or reject it based on how many of the predetermined number of samples passed or failed the test.

The concept of acceptance sampling was originally applied by the U.S. military to the testing of bullets during World War II and became very popular throughout that time and beyond. The concept was developed by Harold Dodge, a veteran of the Bell Laboratories quality assurance department, who was acting as a consultant to the Secretary of War.

Why Sampling?

Random sampling is conducted for the following reason:

Sensitive of Products: Comprehensive testing might damage the product or make it unfit for sale in some way. An example is testing a food or pharmaceutical products. This is an especially important point to consider when testing method is a destructive one.

Cost & Time: Inspecting too many products at a reasonable cost or within a reasonable timeframe poses another challenge. Much time is spent in the course of testing and more inspectors might be needed which amounts to more cost.

Cumbersomeness of Lot Size: It is practically unrealistic to test every single product of a particular lot of very large size at the same time due to the level of cumbersomeness of the batch which makes handling quite difficult.

Acceptance Sampling Methods

The following are two methods listed below:

Singular Sampling: This is the simplest which involves testing a single unit at random, per say X units produced (sometimes called an (n, c) plan). The acceptance is thereafter evaluated based on the number of defective units say, C , found in the sample size, say, N .

Multiple Sampling: This method involves multiple sampling, which relies on several such (N, C) evaluations. This method of sampling is more costly, but may be more accurate.

When Acceptance Sampling should be used

Since acceptance sampling relies on statistical inference made from a small sample, thus not as accurate as more comprehensive measures of quality control, it should only be used when so many products are made that are impractical to test a large percentage of its units; or when inspection of a unit would result in its destruction or render it unusable.

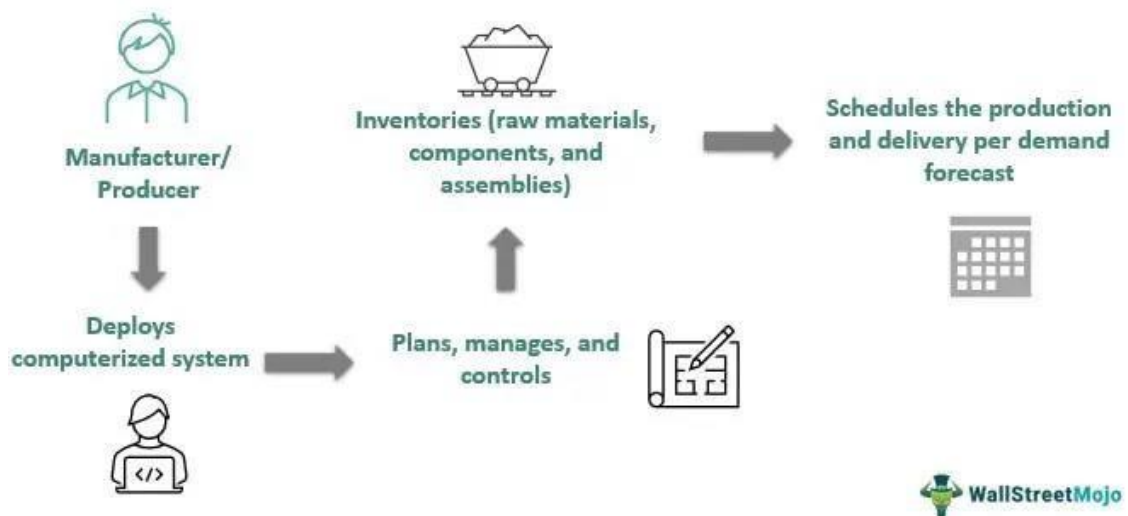
Material Requirements Planning

Material requirements planning or MRP is a computerized system that allows manufacturers to plan, manage, and control their inventories more efficiently. It, thus, helps them schedule

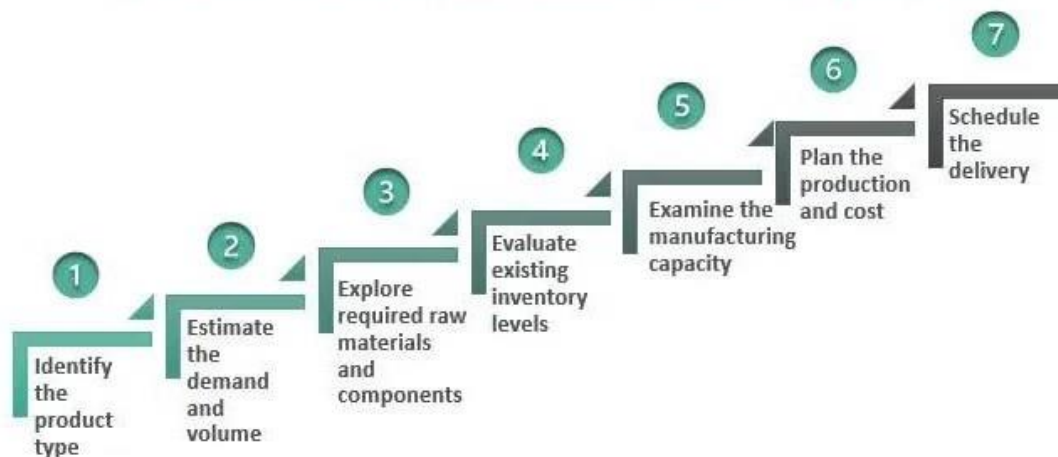
the manufacturing per bills of materials and deliver the right product at the right time and the best possible price.

This manufacturing decision-making process compares existing raw materials and components required to produce goods with the production capacity based on the demand forecasts. Besides helping understand inventory levels, the system lets producers optimize labor requirements. Its purpose is to enhance the productivity of a business and reduce superfluous inventory while maintaining the supply-demand cycle.

What Is Material Requirements Planning?



Material Requirements Planning Steps



Examining existing inventory levels and the manufacturing capacity of a unit is critical to production. The first stage in the process is to determine what to manufacture to develop the inventory. MRP then examines the current market demand to determine the volume. The next step is to figure out quantities of raw materials and components required to produce finished goods. Finally, the unit plans the production (based on the bill of materials), cost, and delivery of products. Overall, it leads to efficient production and inventory optimization while satisfying the demand.

MRP Inputs, Objectives, And Benefits

Material Requirement Planning Examples

Let us consider the following material requirements planning examples to get an in-depth insight into the concept:

Example #1

Sharon, the proprietor of a clothing store, creates and sells a wide range of clothes. In a short time, her shop became well-known among the local ladies. However, when she began accepting online orders, operating the store became more difficult. Despite her best efforts, she could not deliver the products on time as she struggled to keep track of the demands. As a result, she produced more similar clothes based on the variety of demand resulting in excess production and further losses.

Her friend Lisa, who was more into using technology to solve business challenges, suggested using the material requirements planning system. Sharon did so and prepared a bill of materials to understand the type, quantity, and delivery time. The computerized system did all computations and let her know how to maintain the demand and supply chain.

Example #2

MRP enables firms to make well-informed decisions about inventory management, production planning, and delivery of finished goods. Using an outdated system, however, may cause manufacturing issues during supply chain disruptions.

For instance, the COVID-19 epidemic halted the import of raw materials and components, affecting the manufacture of products worldwide. As a result, manufacturers have little choice but to switch to advanced software or integrate modern functions to deal with such incidents. One method is to optimize raw material management and leverage diverse systems to cut costs while developing responsive supply chains.

Pros and Cons

Here are a few advantages and disadvantages of the material requirements planning process:

Pros

- Assesses the volume beforehand
- Balances the demand and supply chain
- Enhances the productivity
- Guarantees customer satisfaction
- Helps in product customization
- Maintains inventory levels
- Turns complex manufacturing processes into simple
- Minimizes overhead costs
- Delivers products on time
- Prevents wastage of inventories and stocks
- Provides a time estimate for production and distribution
- Reduces lead times

Cons

- Expensive to deploy and complicated to use
- Incorrect data can provide inaccurate demand estimate
- Needs proper training and regular maintenance
- Requires accurate data
- Wrong inputs can delay production and shipment

What are the basic steps of MRP?

The basic steps of MRP are as follows:

- Determining the product type
- Calculating demand and setting volume
- Identifying required raw materials and components
- Checking existing inventory levels
- Examining the manufacturing capacity
- Planning production
- Scheduling delivery

How does MRP help?

MRP assists the producer in analysing several parameters to develop demand forecasts. It enables a company to understand the type and quantity of a specific product, estimate inventory, schedule manufacturing, and ensure that finished goods arrive at the appropriate location at the right time and at the lowest possible cost to meet the market demand.

Lot sizing procedures: The material planner (who is the person in charge of placing the order) must decide how large the order should be, as placing numerous orders each month could be very costly as well as inventory holding costs. Their decision should be made to find an appropriate trade-off between the costs to find a viable financial solution. This optimization problem is called “lot sizing”. As more and more constraints are added to the

equation such as quality control or perishability, it becomes quite thorny. In this article, we will present how lot sizing is done as of today and review the lot sizing techniques available to industrial companies to plan their purchases of raw materials and components.

Material Requirements Planning: the first step before computing lot sizes

Determining adequate lot sizes is needed to maintain acceptable inventory and service levels. Minimum order quantities demanded by suppliers often blow-up inventory levels especially for items with long inventory turn cycles. To determine the lot size that will minimize the costs, industrial companies use Materials Requirements Planning (MRP).

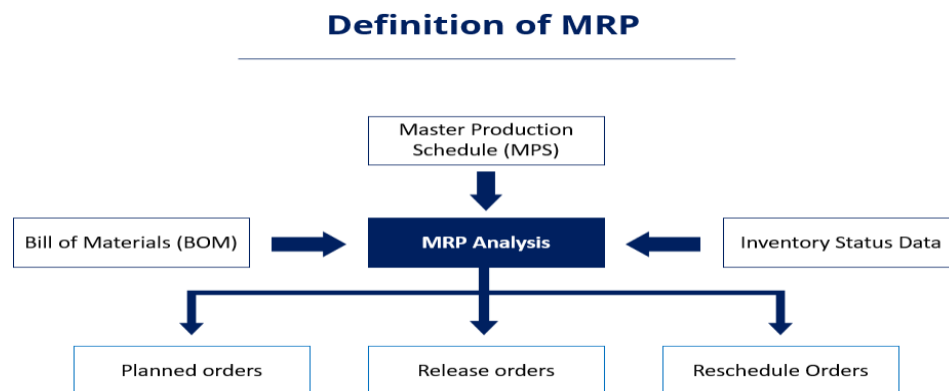
Materials Requirements Planning (MRP) is a software-based solution used by every Enterprise Resources Planned (ERP) system whose purpose is to:

Ensure the availability of materials, components, and products for planned production and for customer delivery, Maintain the lowest possible levels of inventory, Plan production, delivery schedules, and purchasing activities.

MRP is especially suited for manufacturing environments where the demand of many materials and components depends on products with external requirements.

Demand for end products is independent.

Demand for components depends on end products, which is why we call it dependent demand



The three major inputs of an MRP system are:

the master production schedule, which expresses how much of each material is required and when it is required the product structure records, also known as the Bill of Material Records (BOM), contains information on every item or assembly required to produce the end products the inventory status records which contains the status of all materials in inventory After running the Material Requirements Planning, industrial companies know the following:

What items are required for the production

How many of them are required?

When are they required (i.e. when they will be consumed in production)

However, they must now decide when to order what quantity of the desired material in order to minimize costs, which is when lot sizing comes into the equation.

2. What are the different methods applied to determine optimal lot size?

The different lot sizing techniques implemented across industrial companies can be categorized into static, periodic, or dynamic. Static lot sizing consists of placing a fixed order quantity or ordering exactly the amount that is needed to cover forecasted demand. Periodic lot sizing groups together the requirements that lie in a determined period. For dynamic lot sizing, the cumulative forecasted demand throughout the entire time horizon is taken into account to determine the optimal order quantities. As time progresses and the production requirements for the new time horizon adjusts, the previously developed planned orders might be adapted.

Static lot sizing procedures

Static lot sizing methods consist of ordering a fixed quantity or the exact number of requirements for the date needed.

Fixed Order Quantity: This method involves ordering a fixed quantity when the reorder point is reached. The quantity often depends on the supplier-specific constraints.

Economic Order Quantity: This formula was developed in 1913 by Ford W. Harris which results in an order quantity that minimizes the total holding costs and ordering costs.

The formula is the following: $Q = \sqrt{2DS/H}$ where:

Q = Quantity to be ordered

D = Demand in units (typically on an annual basis) S = Order cost (per purchase order)

H = Holding costs (per unit, per year)

Lot for Lot (L4L): It consists of ordering the exact amount that matches the net requirement for each period.

Single Lot: It entails ordering the total requirement for the defined period in one go.

Static lot sizing procedures are easy to automate but do not provide much flexibility as a high demand variability could result in high inventory holding costs. The Lot for Lot procedure stands out as an exception as inventory is minimized which on the other hand results in extremely high ordering costs.

Periodic Lot sizing procedures

Periodic lot sizing groups several requirements within a time interval together to form a lot. Periodic lot sizing procedures are effective when used with cheap items when inventory costs is low.

Period of Supply (POS): A period of supply such as 3 weeks is specified, for which the net requirements across that period are ordered together each time.

Period Order Quantity: It consists of applying the EOQ model to a subset of the entire period under consideration at a time, where the demand is translated into the average requirement of each subset period.

Dynamic lot sizing procedures

Dynamic lot sizing considers the effect of cumulative needs across time to determine the best order quantities. As time advances and new production requirements for inbound materials are known, previously developed planned orders may end up changing. This could also be the result of forecast variability.

In the examples for each technique provided at the end of this article, we oversimplify the situation for ease of comprehension, by assuming perfectly forecasted requirements which in reality is often not the case.

Least Unit Cost (LUC): An order size is determined such that the demand for the next “n” periods will be met, where “n” minimizes the average cost per unit.

Least Total Cost (LTC): In this heuristic technique the optimal solution corresponds to the order plan where the order costs approximate the carrying costs.

Part Period Balancing (PPB): This method represents a variation of the LTC approach. It converts the ordering cost to its equivalent in part periods, “the economic part period (EPP)”, by dividing the ordering cost by the cost of carrying one unit for one period. When “the cumulative parts period” which corresponds to the excess inventory x the number of weeks that it is carried, exceeds the EPP, we take it as the optimal lot size.

Silver Meal (SM): Silver and Meal developed this heuristic in 1973, which determines the average cost per period. It first considers a lot that covers the demand for a period and calculates the costs. It then increases the lot size to cover the requirements for another period and calculates the average cost for that period. One period is added at a time until the average cost per period increases, after which the process stops.

3. How lot sizing optimization should be done today?

Many could think it would make more sense to only apply dynamic lot sizing procedures as static and periodic procedures allow a lower level of flexibility resulting in unnecessary high levels of inventory or too many orders.

Still, many industrial companies continue to use static and periodic lot sizing techniques like EOQ because of their simplicity to implement, although supplier constraints such as

minimum order quantities or rounding values are not considered in the original formula. This implies that an optimum is difficult to reach, especially in terms of costs, resulting in financial hidden losses tied in the order planning processes (Nydick 1989).

For dynamic lot sizing techniques, every method could perform well depending on the environment and type of material (Collier 1980). Some methods still managed to stand out as academic studies have shown that the Silver Meal (SM) represents the best trade-off between cost-effectiveness and robustness (Jeunet 2000) and the Wagner Whitin (WW) algorithm performs best for the dynamic lot sizing problem and is often used as a benchmark for simpler heuristic techniques (Baciarello 2013, Beck 2015).

However, if these methods perform well in academic studies, there are some clear real-world limitations, as for example, the Silver-Meal is not easily expandable to include real-life constraints such as minimum order quantities or multiple quantity discounts (Benton 1996). Furthermore, the Wagner Whitin (WW) algorithm is not used in practice as it is not available on ERP systems due to its complexity and difficulty to implement (Bahl 2009).

Given the increased adoption of data analytics into business decision-making, the problem has to be solved algorithmically in order to realize substantial savings as it allows for more flexibility to integrate all the constraints relative to the complex lot sizing problem (Kulkarni 2019). The UMSOPQVAD provides good results integrating most supplier constraints but requires a high level of data requirement in order to perform well and does not consider material perishability

Project management

Project management is the use of specific knowledge, skills, tools and techniques to deliver something of value to people. The development of software for an improved business process, the construction of a building, the relief effort after a natural disaster, the expansion of sales into a new geographic market—these are all examples of projects.

All projects are a temporary effort to create value through a unique product, service or result. All projects have a beginning and an end. They have a team, a budget, a schedule and a set of expectations the team needs to meet. Each project is unique and differs from routine operations—the ongoing activities of an organization—because projects reach a conclusion once the goal is achieved.

The changing nature of work due to technological advances, globalization and other factors means that, increasingly, work is organized around projects with teams being brought together based on the skills needed for specific tasks.

THE 5 STAGES OF THE PROJECT PLANNING PROCESS

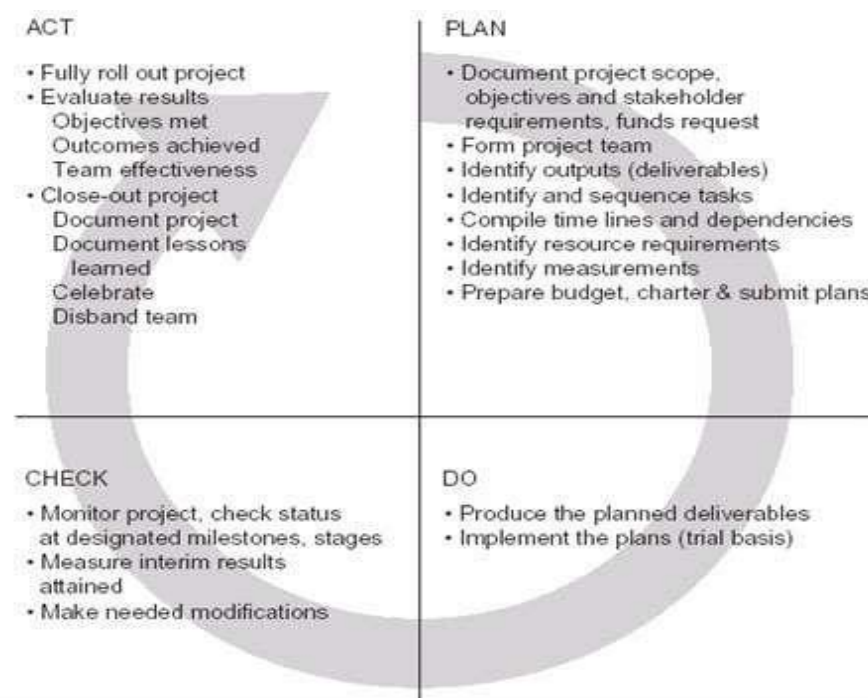
The life cycle of a project has five stages.

Stage 1: Visualizing, selling, and initiating the project

An effective way to get buy-in for a project or idea is to link it to what is important to the person or group you are approaching and demonstrate that you are openly soliciting their input. By doing so, they can help shape the concept.

Stage 2: Planning the project

Assuming the project concept and feasibility have been determined, the plan-do-check-act (PDCA) cycle (see figure below) is directly applicable to project planning and management.



Stage 3: Designing the processes and outputs (deliverables)

When the project is approved, the project team may proceed with the content design along with the persons or items needed to implement the project.

The design process includes defining:

- Measurements
- The monitoring method
- Status reporting protocols
- Evaluation criteria
- Design of the ultimate processes and outputs
- Implementation schedules

Stage 4: Implementing and tracking the project

The project design team may also implement the project, possibly with the help of additional personnel. A trial or test implementation may be used to check out the project design and outputs to determine if they meet the project objectives.

Result.
Excel
calculates
the

Using the planned reporting methods, the implementation team monitors the project and reports on its status to appropriate interested parties at designated project milestones. Interim results may also be communicated to interested parties. The implementation team makes any course corrections and trade-offs that may be necessary and are approved.

Stage 5: Evaluating and closing out the project

The implementation team officially closes the project when the scheduled tasks have been completed.

Usually evaluations are done to determine:

- Objectives met versus objectives planned
- Actual tasks and events scheduled versus planned
- Resources used versus planned resource usage
- Costs versus budget
- Organizational outcomes achieved versus planned outcomes; any unplanned outcomes
- Effectiveness of project planning team (optional)
- Effectiveness of implementation team (optional)
- Team's compilation of project documents, evaluations, and lessons learned

The project is then officially closed out. Participants are recognized for their contributions, and the team disbands.

For some projects, many organizations find value in a post-implementation assessment of the outcomes achieved from implementing the project. This may occur several months after project completion.

PROJECT OUTPUTS VS. OUTCOMES

Frequently the project management terms “outputs” and “outcomes” are used as if their meanings were interchangeable; however, they are not.

Outputs are defined as what the project produces. Project outputs may be an improved process, installation of a new machine, a benchmarking study, etc. Outputsof the project team process itself may be project plans and supporting documents, status reports, and the like.

Outcomes are defined as the effects that the implementation of the project has on theoverall organization and should support the strategic direction of the organization. Outcomes may consist of measurable improvements in customer satisfaction, profits or cost containment, improved market position and market penetration, etc. For ease of understanding, outcomes are usually expressed as dollar values.