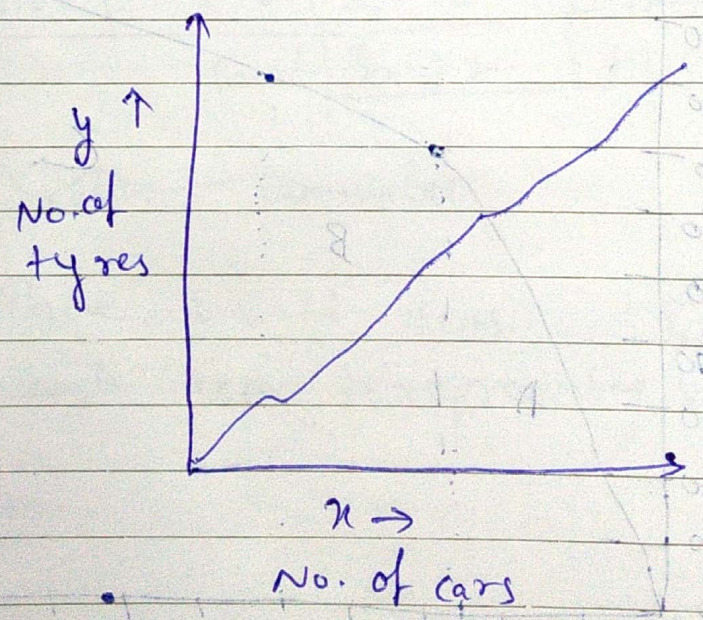
Forecasting

forecasting can be termed as prediction or Projection of future sale or demand of a product. it is a projection based upon past data and the art of human judgement, the survival of any organisation depends upon how well they can project the demand in future.

Types of demand Variation

1) Trend Variation



it shows a long term upward or downward movement in the demand of the product for a long time.

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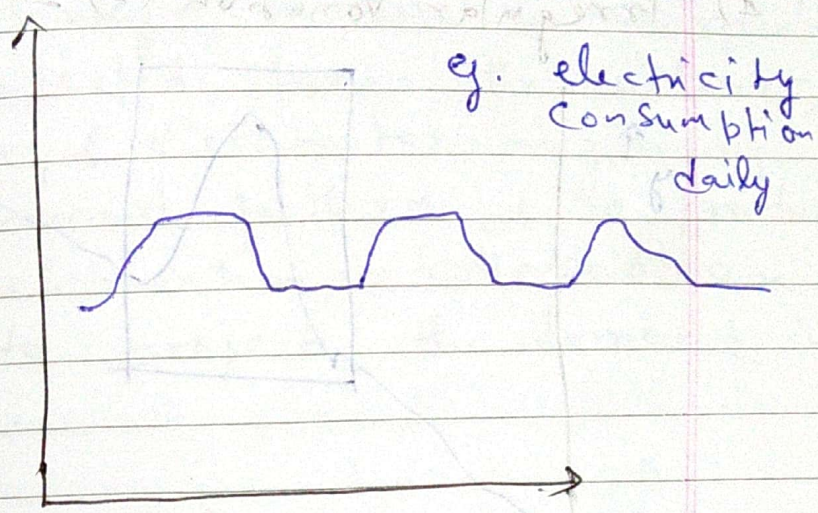
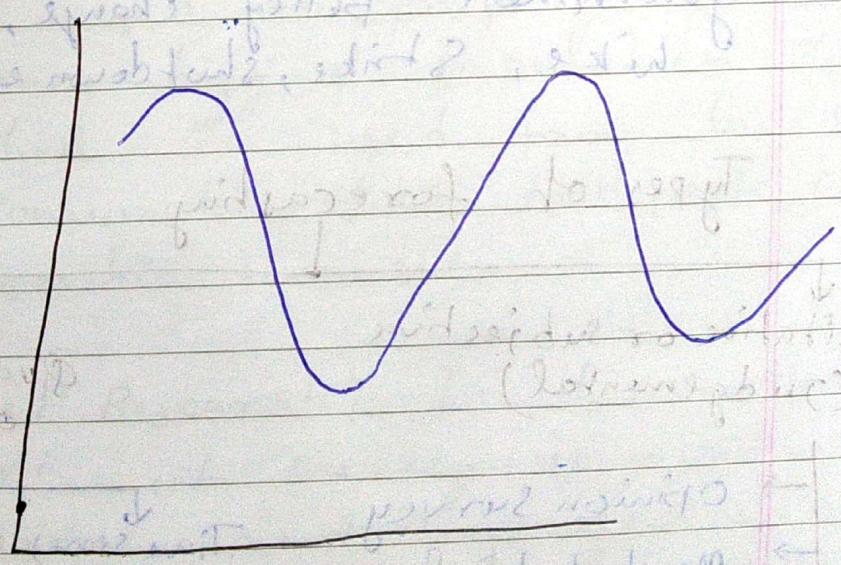
2) Seasonal variation



it shows a short term regular variation related to a particular time of a day or day of a week.

3) Cyclic variation.



it shows a wave like demand variation for a longer period normally for more than a year.

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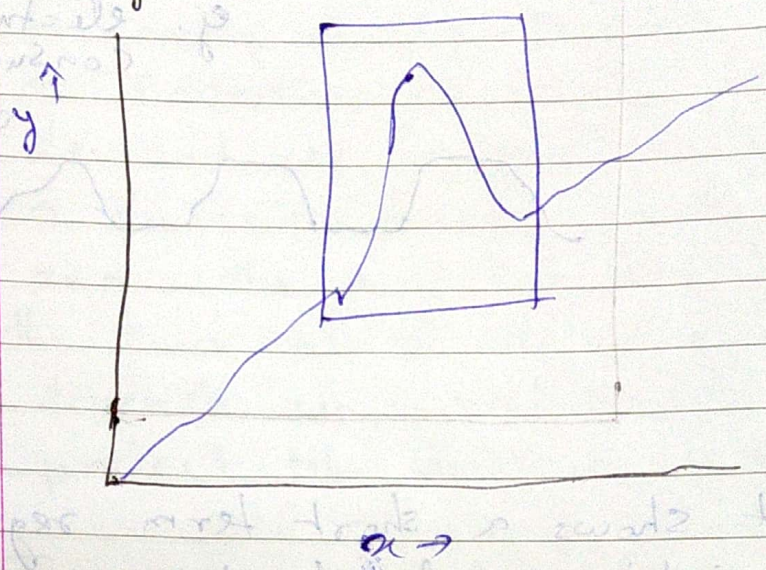
4) Irregular Variation (I) :-



These variations are caused by unusual circumstances which are not reflective of normal behaviour. these may be due to government policy change, price hike, Strike, shutdown etc.

Types of forecasting

- Qualitative or subjective (Judgemental)
  - Opinion Survey
  - Market trial
  - Market Research
  - Delphi technique
- Quantitative or Objective
  - Time series
    - past average
    - Moving average
    - weighted moving avg.
    - Exponential smoothing
  - Casual or Econometric
    - Correlation
    - Regression

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Opinion Survey :- In this method opinions are collected from the customer, retailer, & distributor regarding the demand pattern of a product. The informations collected are used to project the demand in future.

Market trial :-

This method is normally used for new product & in that case product is introduced b/w a limited population in the form of free samples. The Response from the limited population is used to project the demand from bigger population. This method is used for low cost consumable like toothpaste, chocolate cosmetic items etc.

Market Research :- In this method the work of survey is assigned to external marketing agencies and purpose of research is to collect information regarding the demand of a product. The details about various factor which influence the demand

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like customer income, occupation, age, location, quality & quantity etc. are related to get the forecast.

Delphi technique

In this Method a panel of experts are asked sequencial questions in which the response to one question is used to produce next question it is step by step procedure in which information available to some experts is made available to others and the final forecast is obtained by common opinion of all the experts

Time series Method

In this method past data are arranged in chronological order as dependent variable and time as independent variable based upon these past data we need to forecast the demand in future.

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(i) past average:-

forecast is given by average or mean value of the actual demand data for the ~~per~~ previous period.

(ii) Moving average Method:-

Year	Demand	forecast	n = no. of period for moving avg.
2006	180		
2007	240		
2008	160		
2009	180	$\frac{180+240+160}{3}$	$f_{2009} = \frac{180+240+160}{3}$
2010	270	$\frac{240+160+180}{3}$	
2011	310	$\frac{160+180+270}{3}$	
2012	250	$\frac{180+270+310}{3}$	
		$\frac{270+310+250}{3}$	

this method uses past data & calculate rolling average for certain fixed period. fresh average is computed at the end of each period by adding the actual demand data for most recent period & deleting the data for the older period.

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Weighted moving average Method

WMA → $f_{2010} = 0.4 \times 280 + 0.3 \times 160 + 0.2 \times 240 + 0.1 \times 180$

→ most recent value will be given most weight

This method gives unequal weight to each demand data in such a manner that summation of all weights always equals to one. The most recent data is given the highest weight & weight assigned to older data is least.

Sum of Digit Method

n = no. of period of WMA

1) find the sum of n natural no.

$$\Sigma n = \frac{n(n+1)}{2}$$

2) Arrange in the decreasing order of weight as

$$\frac{n}{\Sigma n}, \frac{n-1}{\Sigma n}, \frac{n-2}{\Sigma n} \cdots \frac{1}{\Sigma n}$$

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Q. for the following data, forecast the demand for each of the ~~following~~ time period using simple moving average for $n=3$ period & weighted moving average = 4 periods. Also find the forecast for the 9th, 10th, 11th period

S.No.	Demand	SMA $n=3$	WMA $n=4$
1	180		
2	120		
3	150		
4	240	150	$\frac{4}{10}$
5	60	170	$\frac{4}{10} \times 240 + \frac{3}{10} \times 150 + \frac{2}{10} \times 120 + \frac{1}{10} \times 180 = 183$
6	210	150	138
7	300	170	165
8	240	190	219
9		250	234
		250	
		250	

forecast for 9th period

$$\frac{4}{10} \times 240 + \frac{3}{10} \times 150 + \frac{2}{10} \times 120 + \frac{1}{10} \times 180$$

$$= 183$$

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Exponential smoothing

This method require the actual demand data & the forecasted value for the current period to give the next forecast. This method gives weight to all the previous data & the pattern of weight assigned is exponentially decreasing order. the most recent data is given the highest weight & the weight assigned to the older data decreases exponentially.

General form

$$f_t = \alpha D_{t-1} + \alpha(1-\alpha) D_{t-2} + \alpha(1-\alpha)^2 D_{t-3} + \cdots + \infty$$

$$f_t = \alpha D_{t-1} + (1-\alpha) f_{t-1}$$

Or

$$f_t = F_{t-1} + \alpha (D_{t-1} - f_{t-1})$$

Error $= e_i = D_i - f_i$

$$\boxed{F_t = F_{t-1} + \alpha e_{t-1}}$$

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9. The sale of car in a showroom in 4 consecutive ~~month~~ month are 70, 68, 82, 95 with a smoothing constant 0.4. find the forecast for next month.

Month	Demand	f	e_i
1	70	70	0
2	68	70	-2
3	85	69.2	12.8
4	95	74.32	20.68
		82.59	

Ans

forecast Error

1) Mean Absolute Deviation (MAD)

S.No.	Demand	f	e_i
1	100	130	-30
2	120	110	+10
3	140	120	+20
			60

$$M = \sum_{i=1}^{n} \frac{|D_i - f_i|}{n}$$

→ Mean forecast Error

This measure the forecast error with regard to direction & shows any tendency of over or under forecast. +ve value indicates underestimated forecasting -ve value indicates over estimated forecasting

$$BIAS = MFE = \frac{\sum_{i=1}^{n} (D_i - f_i)}{n}$$

~~BIAS =~~

→ Mean Square Error

$$MSE = \frac{\sum_{i=1}^{n} (D_i - f_i)^2}{n}$$

$$\sigma = \sqrt{MSE}$$

→ Mean Absolute percentage error.

$$MAPE = \frac{\sum_{i=1}^{n} \left| \frac{D_i - f_i}{D_i} \times 100 \right|}{n}$$

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Q. The Demand for a luxury car has been shown below the experts forecasted sale of 100 car for the month of march with smoothing constant of 0.15. find the forecast for the month of August. Also calculate MAD, MAPE, MSE & Bias.

Month	Demand	~~forecast~~
March	150	
April	200	
May	100	
june	50	
july	150	
Aug		

Month	Demand	forecast	e_i	e_i^2	$\frac{e_i}{D_i} \times 100$
Mar	150	100	50		
April	200	107.5	92.5		
May	100	121.375	-21.375		
june	50	118.16	-68.168		
july	150	107.94	42.006		
~~Ag~~ Aug		114.25			

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1) $MAD = \frac{\Sigma |e_i|}{n} = \frac{274.1}{5} = 54.82$

2) $MSE = \frac{\Sigma e_i^2}{n} = 3585.56$

3) $MAPE = \frac{\Sigma \left| \frac{e_i}{D_i} \times 100 \right|}{n} = 53.01$

4) $BIAS = \frac{\Sigma e_i}{n} = 19.0$

CASUAL or ECONOMETRIC

In this forecaster tries to establish cause & effect relation between demand of a product at any other variable on which demand is dependent. Objective is to establish relation such that the change in one variable become useful for the prediction of other

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Correlation

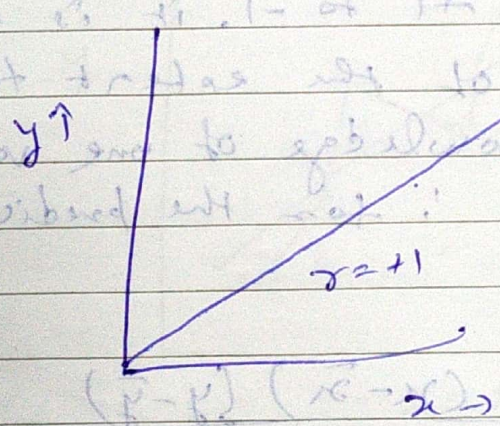
$r \boxed{+1 \text{ to } -1}$

r = correlation coefficient

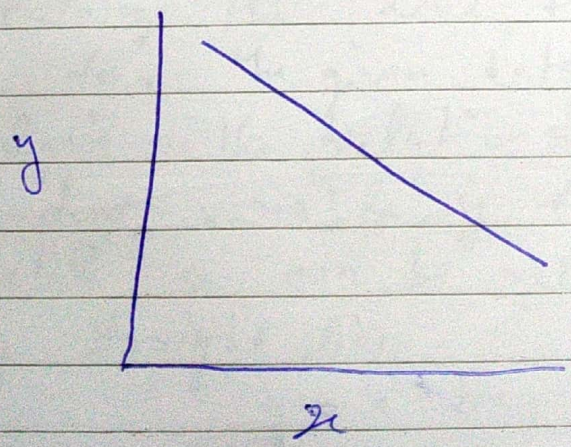
x, y

$r = +0.65$	$r = -0.7$
x 100 ↑	x 100 ↑
y 65 ↑	y 70 ↓

when $r = +1$



2) when $r = -1$



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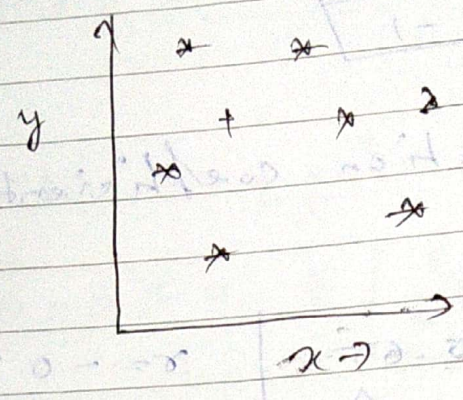
when $r = 0$



Correlation coefficient tells degree of closeness b/w two variable & its value ranges from +1 to -1. it is an indicator of the extent to which knowledge of one variable is useful for the prediction of other.

$$r = \frac{\Sigma (x-\bar{x})(y-\bar{y})}{\sqrt{\Sigma (x-\bar{x})^2 \cdot \Sigma (y-\bar{y})^2}}$$

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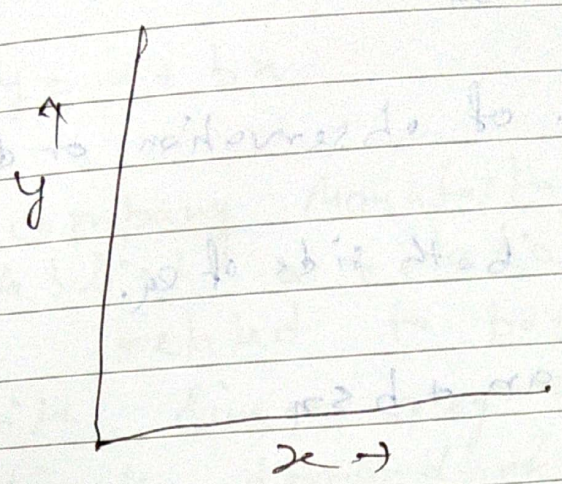
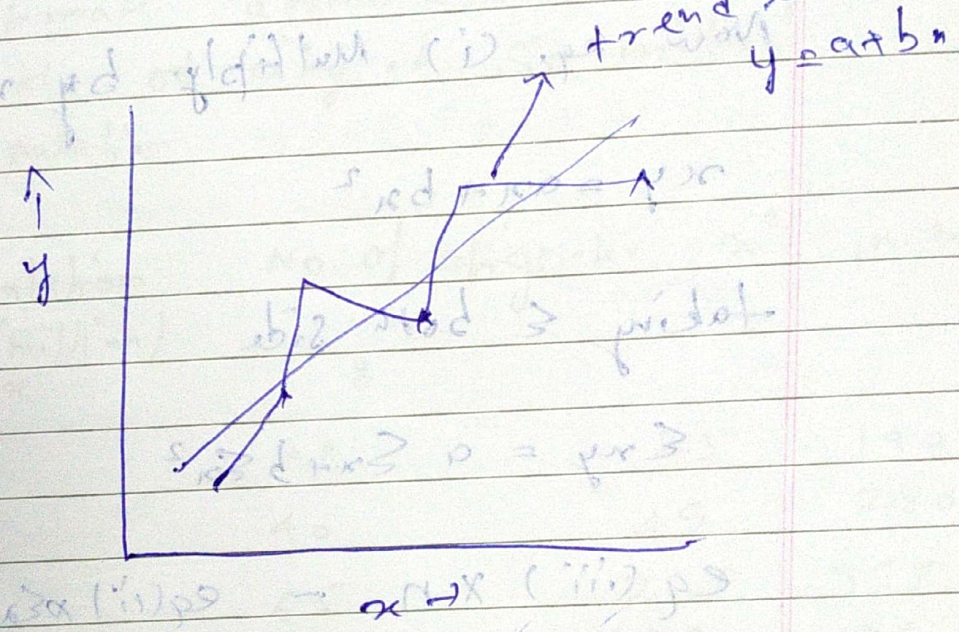
2) Regression or linear Regression Analysis





it is a mathematical technich of obtaining the line for the best fit for the given data in regression analysis; the relationship b/w the dependent variable y & some independent variable x can be represented by straight line

$$y = a + bx$$

where a is the intercept on y axis & b is the slope of line

$y = a + bx$

n = no. of observation or data given

taking Σ both side of eq.

$\Sigma y = an + b\Sigma x$

Now eq. (i) Multiply by x

$xy = ax + bx^2$

taking Σ both side

$\Sigma xy = a\Sigma x + b\Sigma x^2$

eq (iii) $\times n$ − eq(ii) $\times \Sigma x$

$n\Sigma xy = an\Sigma x + bn\Sigma x^2$

$-\Sigma x . \Sigma y = a . n . \Sigma x + b(\Sigma x)^2$

$$b = \frac{n\Sigma xy - \Sigma x . \Sigma y}{n\Sigma x^2 - (\Sigma x)^2}$$

Q.

$$a = \frac{\Sigma y - b\Sigma x}{n}$$

$$y = a + bx$$

Q. A company Manufacturing refrigerator establish a relation that sale is related to population of city with linear regression eq. & estimate demand of refrigerator with ~~of~~ city of 50 million population

Population in (million) x	No. of Refrigerator y	x^2	$x.y$
5	28	25	140
7	40	49	280
15	65	225	975
22	80	484	1760
27	96	729	2592
36	130	1296	4680
	439	2808	10427

$$y = a + bx$$

$$\Sigma y = an + b\Sigma x$$

$$\Sigma xy = a\Sigma x + b\Sigma x^2$$

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$439 = a \cdot 6 + b \cdot 112$

$6a + 112b = 439$

$112a + 2808b = 10427$

$b = 3.11$

$a = 15.07$

$y = 15.07 + 3.11x$

$y = 15.07 + 3.11 \times 50$

$y = 170.67.$

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