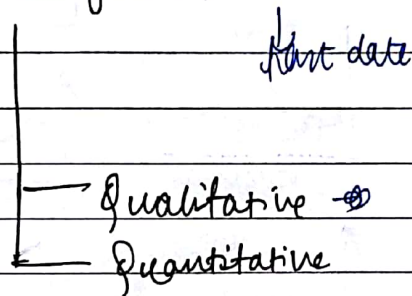


- Q1. What is production & operation management.
- Q2. Draw a schematic diagram.
- Q3. What is Cobb-Douglas?
- Q4. What are the main activities in production & operation management?
- Q5. What are the 3 func<sup>ns</sup> of production management?
- Q6. What are the different types of production systems? Explain each.
- Q7. What is the diff b/w production and productivity?

## # Forecasting $\approx$ prediction



### Qualitative

Relies on subject opinions from one or more experts

### Quantitative

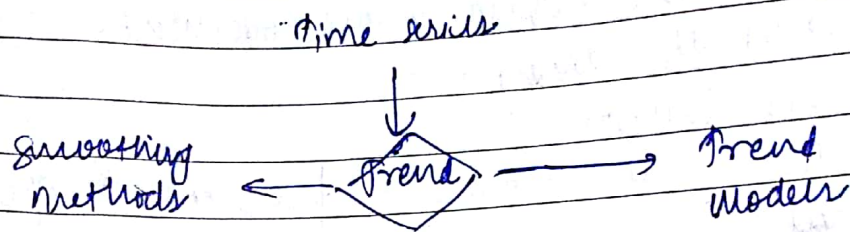
Relies on data & analytical techniques

### Qualitative forecast

- Grass root : going to customer directly
- Market research :
- Panel consensus
- Historical analogy : check for similar product from past
- Delphi method : experts located at diff places ~~disjointly~~ and provide feedback disjointly. Average is taken from multiple rounds to make a prediction.

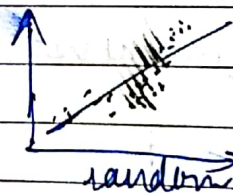
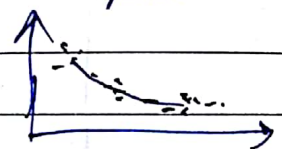
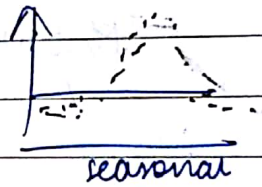
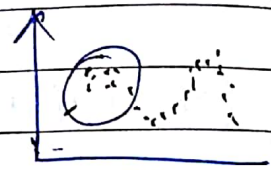
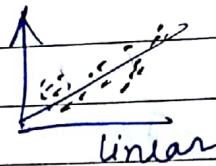
### Quantitative forecast

- Time series : trends
- Causal : regression
- Simulation : Monte-Carlo



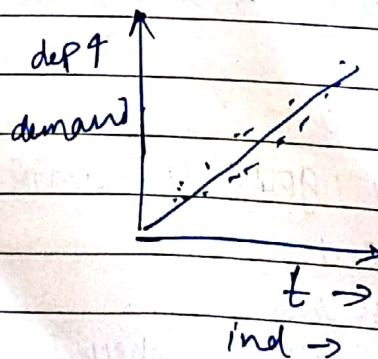
What to consider when looking at past demand data?

Trends  
Seasonality  
Cyclical elements  
Autocorrelation  
Random variation



Trend projection

Method of least square method may be used to determine a trend line.



The best line is that which minimizes the error  
Predicted line is

$$Y = a + bX$$

So the error is

$$e_i = y_i - \hat{y}_i$$



## Measures of forecast accuracy

- Mean squared error (MSE)  
The average of the squares ~

- MAD (Mean absolute deviation)

## Mean forecast error (MFE)

MFE = Mean absolute deviation

It is the average absolute error in the observation

$$\sum_{j=1}^n \frac{|A_j - F_j|}{n}$$

## Trend projection

Using the method of least squares.

$$Y_t = b_0 + b_1 t$$

$\downarrow$  trend forecast       $\downarrow$  trend line projection for time 0 (constant)       $\rightarrow$  slope of the trend line

$$b_1 = \frac{n \sum t Y_t - \sum t \sum Y_t}{n \sum t^2 - (\sum t)^2}$$

and  $b_0 = \bar{Y} - b_1 \bar{t}$

- Q. The no. of plumbing jobs performed by a plumbing service in the last 9 months are as follows -

Month	Jobs
March	853
April	987
May	849
June	874
July	896

August 409  
 September 399  
 October 412  
 November 408  
~~December~~

Forecast the no. of jobs performed will perform in december.

t	Month	Jobs ( $y_t$ )	$t \cdot (y_t)$	$t^2$
1	March	357	353	1
2		387	774	4
3		342	1026	9
4		374	1496	16
5		396	1980	25
6		409	2454	36
7		399	2793	49
8		412	3296	64
9	Nov	408	3672	81
<u>45</u>		<u>3480</u>	<u>17844</u>	<u>285</u>

$$b_1 = \frac{n \sum t y_t - \sum t \sum y_t}{\sum t^2 - (\sum t)^2}$$

$$= \frac{9 \times 17844 - 45 \times 3480}{9 \times 285 - (45)^2}$$

$$= \frac{160596 - 156600}{2565 - 2025}$$

$$= \frac{3996}{540} = 7.4$$

$$b_0 = \bar{y} - b_1 \bar{t} = 386.67 - 7.4 \times 5 = 349.67$$



$$\therefore Y_t = 849.67 + 7.4t$$

$$\therefore \text{For dec} = Y_{10} = 423.67$$

Q. Least square

Year	Time period (x)	Electrical power demand (MW) y	$x^2$	$xy$
2006	1	74	1	74
2007	2	79	4	158
2008	3	80	9	240
2009	4	90	16	360
2010	5	105	25	525
2011	6	142	36	852
2012	7	122	49	854
	28	692	140	3063

$$b_1 = \frac{n \sum xy - \sum x \sum y}{n \sum x^2 - (\sum x)^2}$$

$$= \frac{21441 - 19376}{980 - 784}$$

$$= \frac{2065}{196} = 10.53$$

$$b_0 = \bar{y} - b_1 \bar{x}$$

$$= 98.8 - 10.53 \times 4$$

$$= 56.68$$

$$Y = 56.68 + 10.53t$$

$$\therefore Y_8 = 140.92$$

$$Y_9 = 151.45$$

## Financial management

### National income accounting

$$GDP = C + \overset{\text{investment}}{\underset{\uparrow}{I}} + G + NX$$

Gross domestic product  $\downarrow$  consumption  $\downarrow$  govt  $\rightarrow$  exports - imports

### GNP - Gross national product

unlike GDP, we include NRI's earnings & profit of Indian companies abroad

$$C + I + G + NX + Y$$

$\downarrow$   
 earnings of NRIs - earning of  
 firms in India.

### Goals of financial mgmt

maximize wealth of company's shareholders.  
 maintain balanced financial health.

building market goodwill through attractive  
 returns to the investors at an  
 acceptable level.