



# SNS College of Technology

Coimbatore - 35



19BAZ782 – Analytics for Everyone

Unit IV – Predictive Analytics I

# Topic...Guess...???

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**1<sup>st</sup> Indian Institution to Implement Design Thinking Curriculum**  
Redesigning Common Mind and Business Towards Excellence



# Recall



- Cyclical
- Seasonal
- Trend
- Irregular



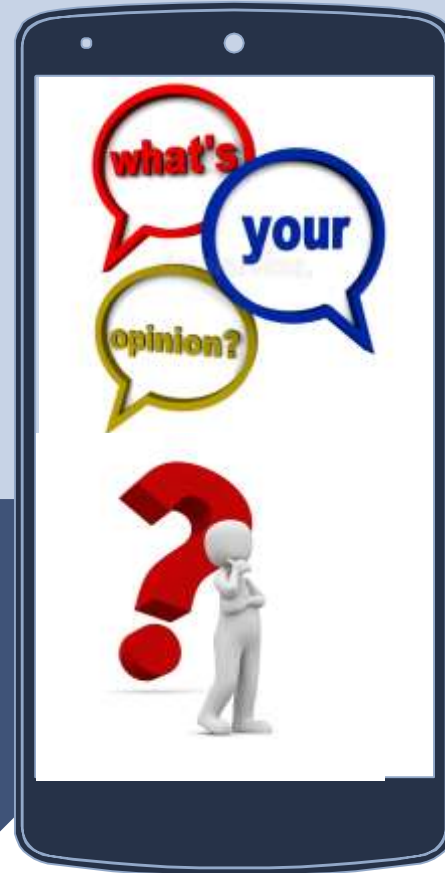
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# Guess the topic...???

$\begin{array}{r} 3 \\ +6 \\ \hline \end{array}$	$\begin{array}{r} 3 \\ +7 \\ \hline \end{array}$	$\begin{array}{r} 3 \\ +8 \\ \hline \end{array}$	$\begin{array}{r} 3 \\ +9 \\ \hline \end{array}$	$\begin{array}{r} 3 \\ +10 \\ \hline \end{array}$
$\begin{array}{r} 4 \\ +3 \\ \hline \end{array}$	$\begin{array}{r} 5 \\ +3 \\ \hline \end{array}$	$\begin{array}{r} 6 \\ +3 \\ \hline \end{array}$	$\begin{array}{r} 7 \\ +3 \\ \hline \end{array}$	$\begin{array}{r} 8 \\ +3 \\ \hline \end{array}$





# Forecasting



# Additive Model



- Addition of Trend, Seasonality, Cyclical, random

$$Y_t = \overset{\text{Trend}}{\widehat{T}_t} + \overset{\text{Seasonality}}{\widehat{S}_t} + \overset{\text{Cyclical}}{\widehat{C}_t} + \overset{\text{Random}}{\widehat{R}_t}$$



# Multiplicative Model



- Multiplication of Trend, Seasonality, Cyclical, random

$$Y_t = \overset{\text{Trend}}{\widehat{T}_t} \times \overset{\text{Seasonality}}{\widehat{S}_t} \times \overset{\text{Cyclical}}{\widehat{C}_t} \times \overset{\text{Random}}{\widehat{R}_t}$$



# When to use...?

- Additive: Seasonality is independent of trend / known sample
- Multiplicative: Seasonality is dependent of trend/unknown sample





# Time Series Technique

- Moving average [Simple/Weighted]
- Exponential Smoothing
- Auto regression model [AR Model]
- Auto Regression Integrated Moving Average [ARIMA]







# Moving Average

$$F_{t+1} = \frac{A_t + A_{t-1} + A_{t-2} + \dots + A_{t-n+1}}{n}$$

$F_{t+1}$  = Forecast for the upcoming period, t+1

$n$  = Number of periods to be averaged

$A_t$  = Actual occurrence in period t

$$F_{t+1} = w_1 A_t + w_2 A_{t-1} + w_3 A_{t-2} + \dots + w_n A_{t-n+1}$$



# Weighted MVA

Month	Sales (000)	Weighted Moving Average
1	4	NA
2	6	NA
3	5	NA
4	?	$31/6 = 5.167$
5	?	
6	?	

Month	Sales (000)	Weighted Moving Average
1	4	NA
2	6	NA
3	5	NA
4	3	$31/6 = 5.167$
5	7	$25/6 = 4.167$
6		$32/6 = 5.333$



# Measure of Aggregate Error

Mean absolute error <b>MAE</b>	$MAE = \frac{1}{n} \sum_{t=1}^n  E_t $
Mean absolute percentage error <b>MAPE</b>	$MAPE = \frac{1}{n} \sum_{t=1}^n \left  \frac{E_t}{Y_t} \right $
Mean squared error <b>MSE</b>	$MSE = \frac{1}{n} \sum_{t=1}^n E_t^2$
Root mean squared error <b>RMSE</b>	$RMSE = \sqrt{\frac{1}{n} \sum_{t=1}^n E_t^2}$

n = No of errors

$E_t$  = Absolute errors  $|x_i - x|$

$Y_t$  = Actual



# Cont...

## Mean Absolute Error

$$MAE = \frac{1}{n} \sum_{i=1}^n |x_i - x|$$

$n$  = the number of errors,  
 $|x_i - x|$  = the absolute errors.

## Mean Absolute Percentage Error

$$\left( \frac{1}{n} \sum \frac{|Actual - Forecast|}{|Actual|} \right) * 100$$

Month	Actual	Forecast	Absolute Percent Error
1	112.3	124.7	11.0%
2	108.4	103.7	4.3%
3	148.9	116.6	21.7%
4	117.4	78.5	33.1%
<b>MAPE</b>			<b>17.6%</b>



# Cont...

## Mean Squared Error

Height (X)	Weight (Y)	Estimated (Y)	Error (Y-Y)	Error Squared
43	41	43.6	-2.6	6.76
44	45	44.4	0.6	0.36
45	49	45.2	3.8	14.44
46	47	46	1	1
47	44	46.8	-2.8	7.84

Regression line =  $y=9.2+0.8x$

Add all of the squared errors up:  
 $6.76 + 0.36 + 14.44 + 1 + 7.84 = 30.4.$

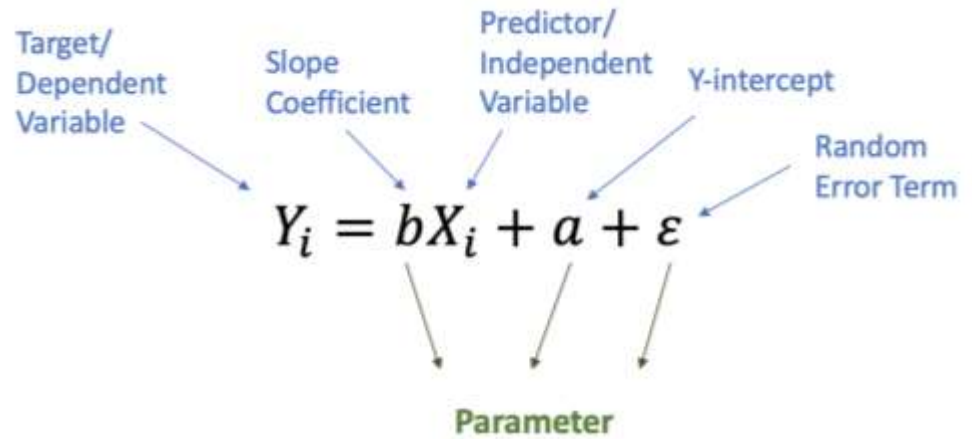
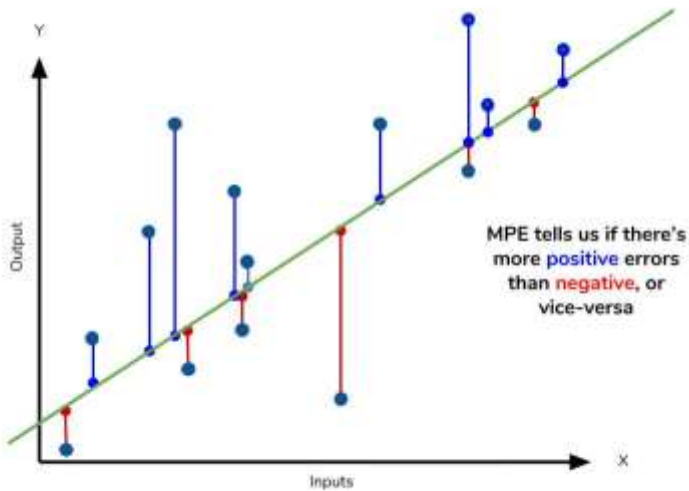
Find the mean squared error:  
 $30.4 / 5 = 6.08.$

## Root Mean Squared Error

$$RMSE = \sqrt{\frac{\sum_{i=1}^n (\hat{y}_i - y_i)^2}{n}}$$



# Regression Equation





# Summary

- Forecasting
- Additive Model
- Multiplicative Model
- Time series technique
- Errors in regression

SUMMARY





# Reference

- <https://online.stat.psu.edu/stat510/lesson/5/5.1>
- <https://support.minitab.com/en-us/minitab/19/help-and-how-to/statistical-modeling/time-series/supporting-topics/time-series-models/additive-and-multiplicative-models/>
- <https://www.statisticshowto.com/probability-and-statistics/regression-analysis/>
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*Thank  
you*