FORECASTING

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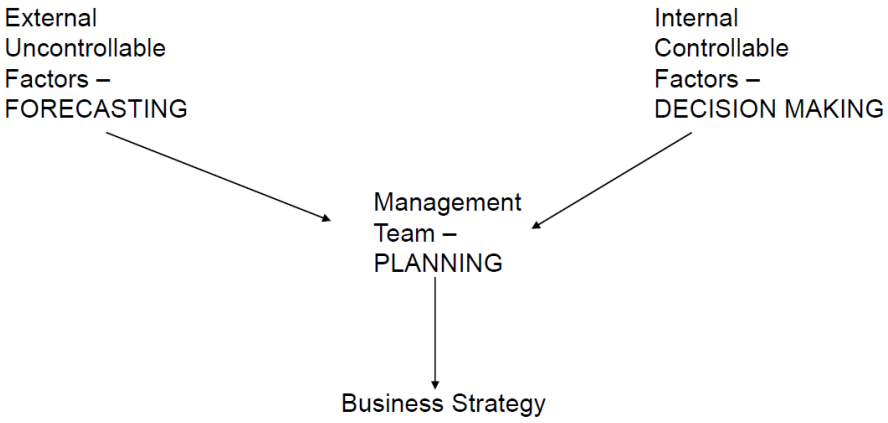
CONTENTS

PART I

PROCESS OF FORECASTING

The Role of Forecasting



STEP 1: PROBLEM DEFINITION

STEP 2: GATHERING DATA

STEP 3: PRELIMINARY (EXPLORATORY) ANALYSIS

STEP 4: CHOOSING AND FITTING MODELS

STEP 5: USING AND EVALUATING THE MODEL

PART II

QUALITATIVE FORECASTING

- Used when little or no historical data are available.
- Used when historical pattern is **NOT** expected to continue in the future.
- Depends on the opinions and knowledge of highly qualified and experienced employees to predict the future outcomes.

1. EXECUTIVE OPINIONS

- Opinions of experts from different departments.
- Pro: Done easily and quickly without the necessity of elaborate statistics.
- Con: Individual opinions can vary from individual to individual

2. DELPHI TECHNIQUE

- Panels of experts are selected and are individually questioned about the upcoming events.
- They do not form a group.
- Pro: Beneficial and very effective for long term forecasting.
- Con: Low reliability.

3. CONSUMER SURVEYS

- Done through telephone contacts, personal interviews or questionnaires.
- Pro: Requires extensive statistical analysis to test regarding the consumer behavior.

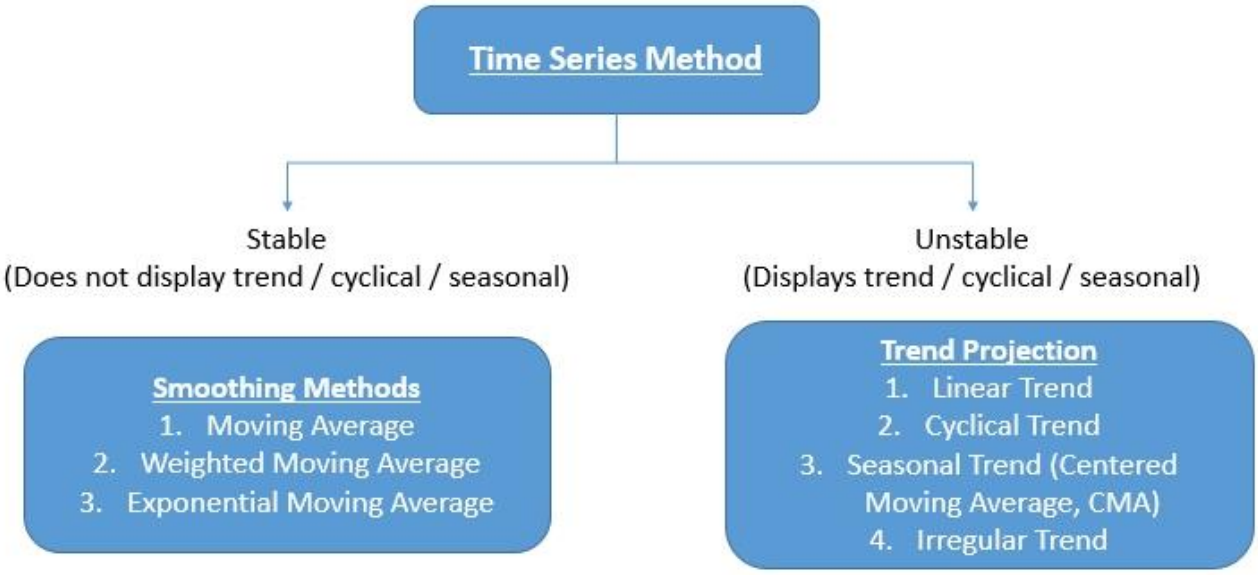
4. SALES FORCE POLLING

- Based on the opinions of salespeople who have steady interactions with the clients.
- Pros: Very simple to use and understand. As they are closest to the customers, they can better predict the requirements of the customers for the future market. Information can be segregated easily into different categories.
- Cons: Can be either optimistic or pessimistic about their predictions and this could lead to inaccurate forecasting.

PART II

QUANTITATIVE FORECASTING

- Quantitative Forecasting = Time Series Method or Causal Method.
- In this article, we only focus on Time Series Method.
- Causal Methods = Regression / Econometrics / Tracking Signals



Time Series method comprises of 2 types:

SMOOTHING METHOD (STABLE)

- Purpose to "smooth out" or "average out" the irregular components of time series.
- Moving Average
- Weighted Moving Average
- Exponential Moving Average

TREND PROJECTION (UNSTABLE)

- Linear trend = Gradual shifting of the time series over a long period of time.
- Cyclical trend = Regular pattern of sequences above and below the trend line.
- Seasonal trend (CMA) = Regular patterns of variability within certain time periods, such as over a year.
- Irregular trend = Short-term, unanticipated and non-recurring factors that affect the values of the time series. One cannot attempt to predict its impact on the time series in advance.

Moving averages often are used to identify movements in stock prices. Daily closing prices (in dollars per share) for SanDisk for August 16, 2002, through September 3, 2002, follow:

Day	Price ($)	Day	Price ($)
August 16	14.45	August 26	16.45
August 19	15.75	August 27	15.60
August 20	16.45	August 28	15.09
August 21	17.40	August 29	16.42
August 22	17.32	August 30	16.21
August 23	15.96	September 3	15.22

Activity 3.1

a) Use a five-day moving average to smooth the time series. Forecast the closing price for September 4, 2002.

Part (a): Explains "5 – Day Moving Average"

Day	Value	5 - Day Moving Average Forecast	Forecast Error	Error2
1	14.45			
2	15.75			
3	16.45			
4	17.40			
5	17.32			
6	15.96	16.27	-0.31	0.10
7	16.45	16.58	-0.13	0.02
8	15.60	16.72	-1.12	1.25
9	15.09	16.55	-1.46	2.12
10	16.42	16.08	0.34	0.11
11	16.21	15.90	0.31	0.09
12	15.22	15.95	-0.73	0.54
13		15.71		
			Total:	4.23

(14.45 + 15.75 + 16.45 + 17.40 + 17.32) / 5 = 16.27

(15.6 + 15.09 + 16.42 + 16.21 +15.22) /5 = 15.71

To calculate Mean Squared Error (MSE):

4.23 (Total Error^2)/ 7 (Number of Forecasts)= 0.60

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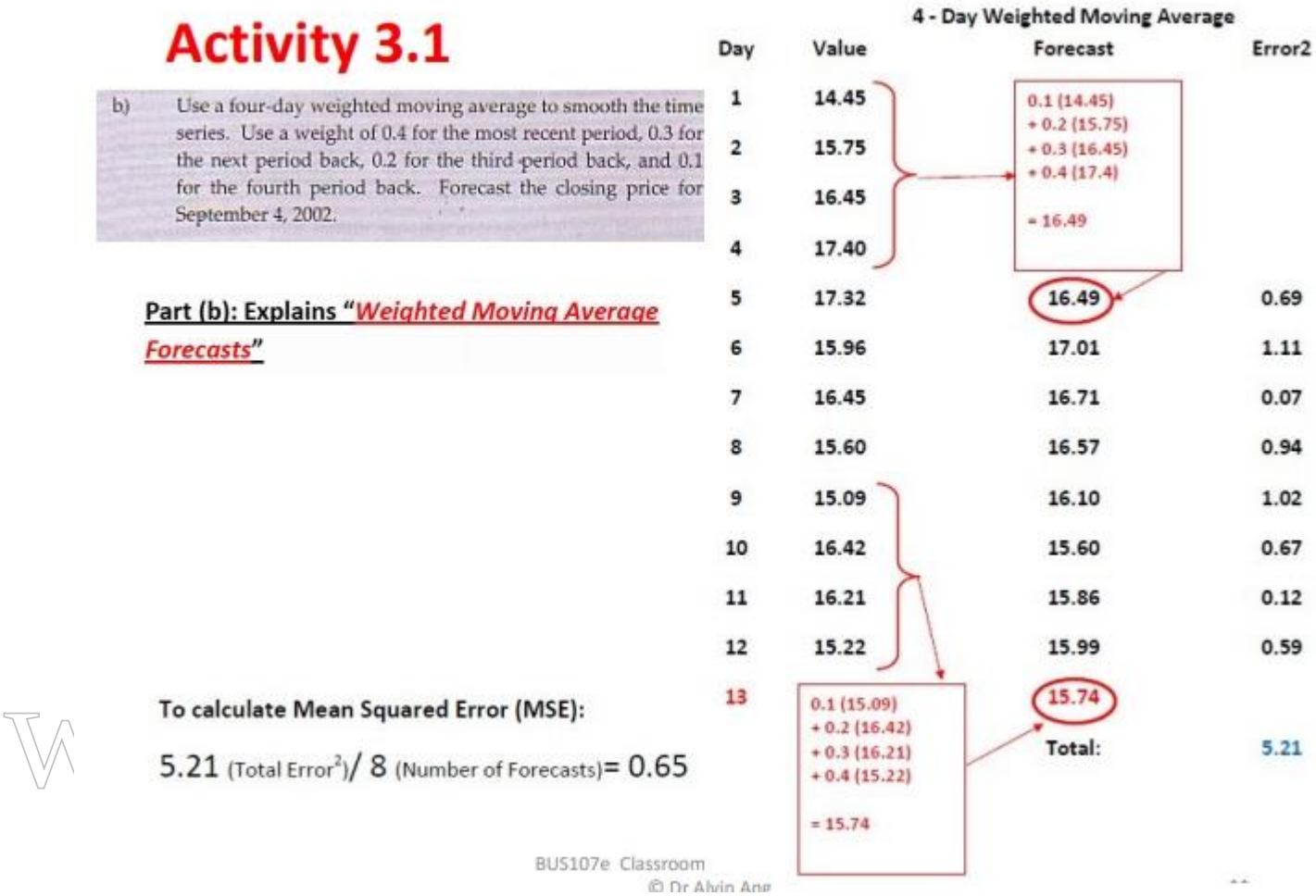
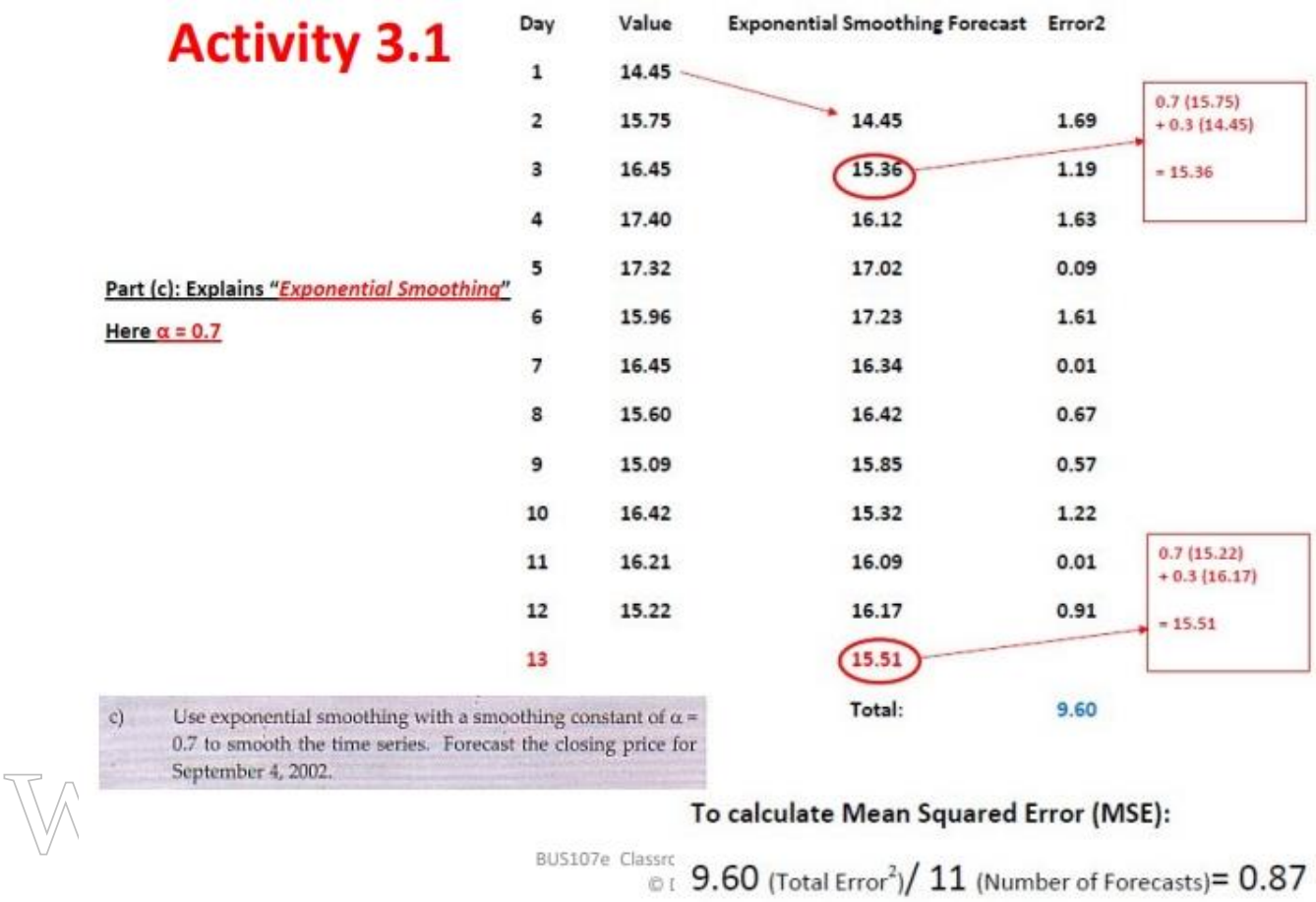
How to Calculate Mean Absolute Deviation (MAD):

$$MAD = \frac{|-0.31|+|-0.13|+|-1.12|+|-1.46|+|0.34|+|0.31|+|-0.73|}{7} = 0.629$$



How to Calculate Mean Absolute Deviation (MAD):

$$MAD = \frac{|0.83| + |-1.05| + |-0.26| + |-0.97| + |-1.01| + |0.82| + |0.35| + |-0.77|}{8} = 0.758$$



Formula for Simple EMA

$$F_{t+1} = \alpha Y_t + (1-\alpha) F_t$$

How to Calculate Mean Absolute Deviation (MAD):

$$MAD = \frac{|1.3| + |1.09| + |1.28| + |0.3| + |-1.27| + |0.11| + |-0.82| + |-0.76| + |1.1| + |0.12| + |-0.95|}{11} = 0.827$$

MSE VS MAD

	Mean Squared Error (MSE)	Mean Absolute Deviation (MAD)
Simple Moving Average (MA)	0.6	0.629
Weighted Moving Average (WMA)	0.65	0.758
Exponential Moving Average (EMA)	0.87	0.827

MA has lowest MSE and MAD.

OTHER TYPES OF FITTING ERROR

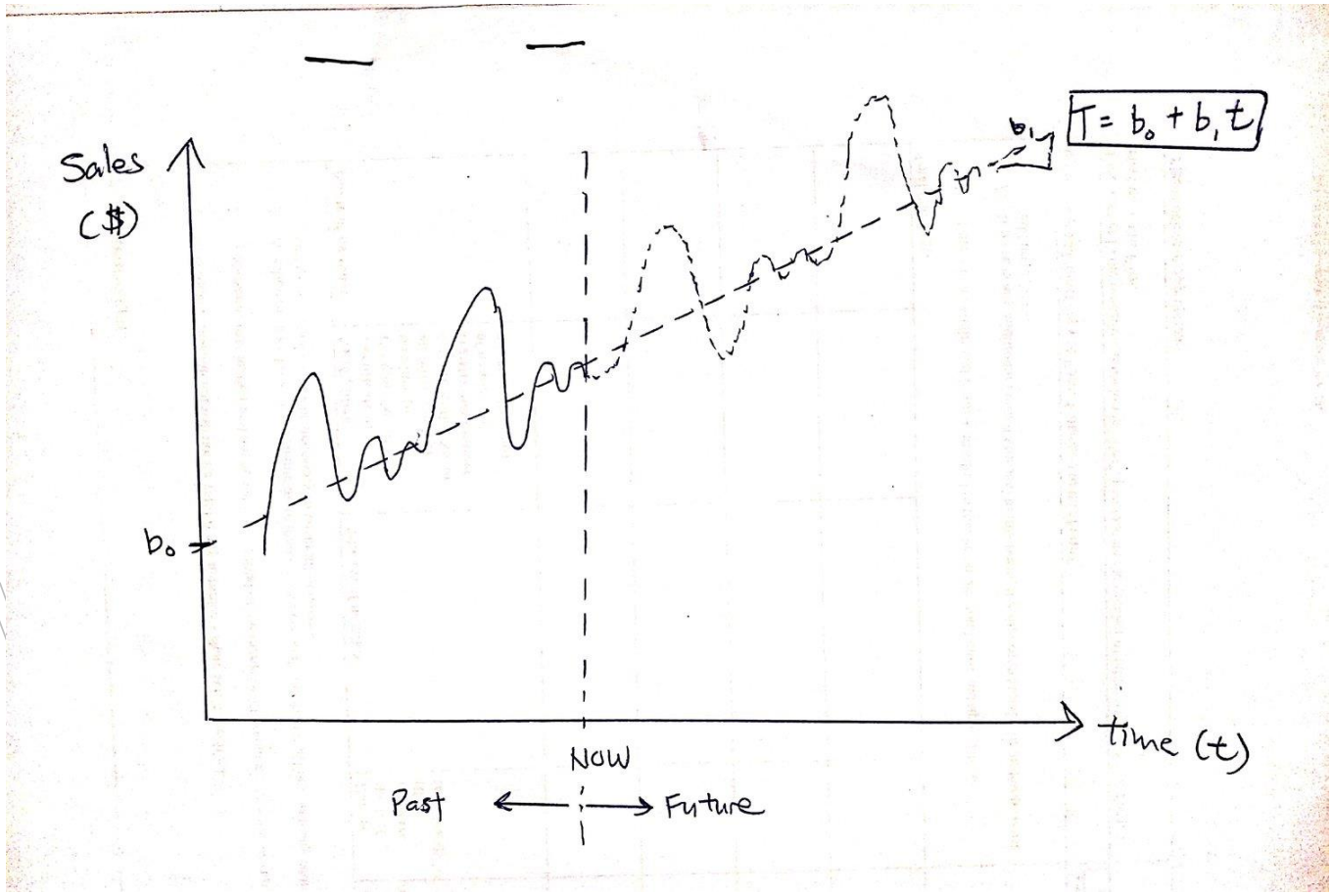
- Root Mean Squared Error (RMSE): $RMSE = \sqrt{\frac{\sum_{t=1}^{n} e_t^2}{n}}$
- Where e_t: Error (= Real Value – Forecasted Value)

- Mean Absolute Percentage Error (MAPE): $MAPE = \frac{\sum_{t=1}^{n} \left| \frac{e_t}{Y_y} \right|}{n} \times 100\%$
- Where Y: Actual Real Value

PART IV

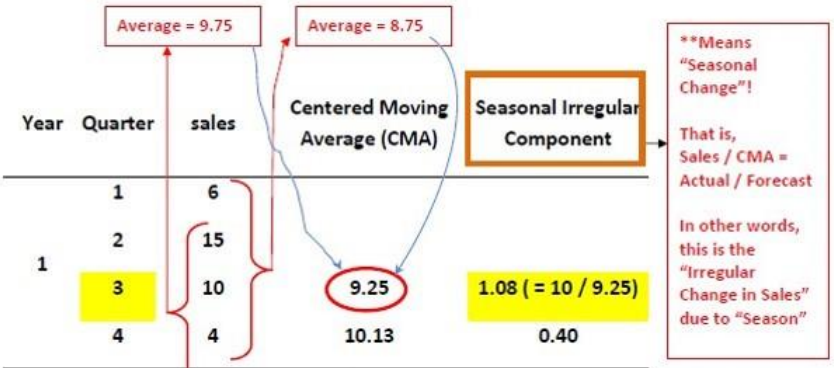
TREND PROJECTION (UNSTABLE)

WHAT WE ARE TRYING TO DO



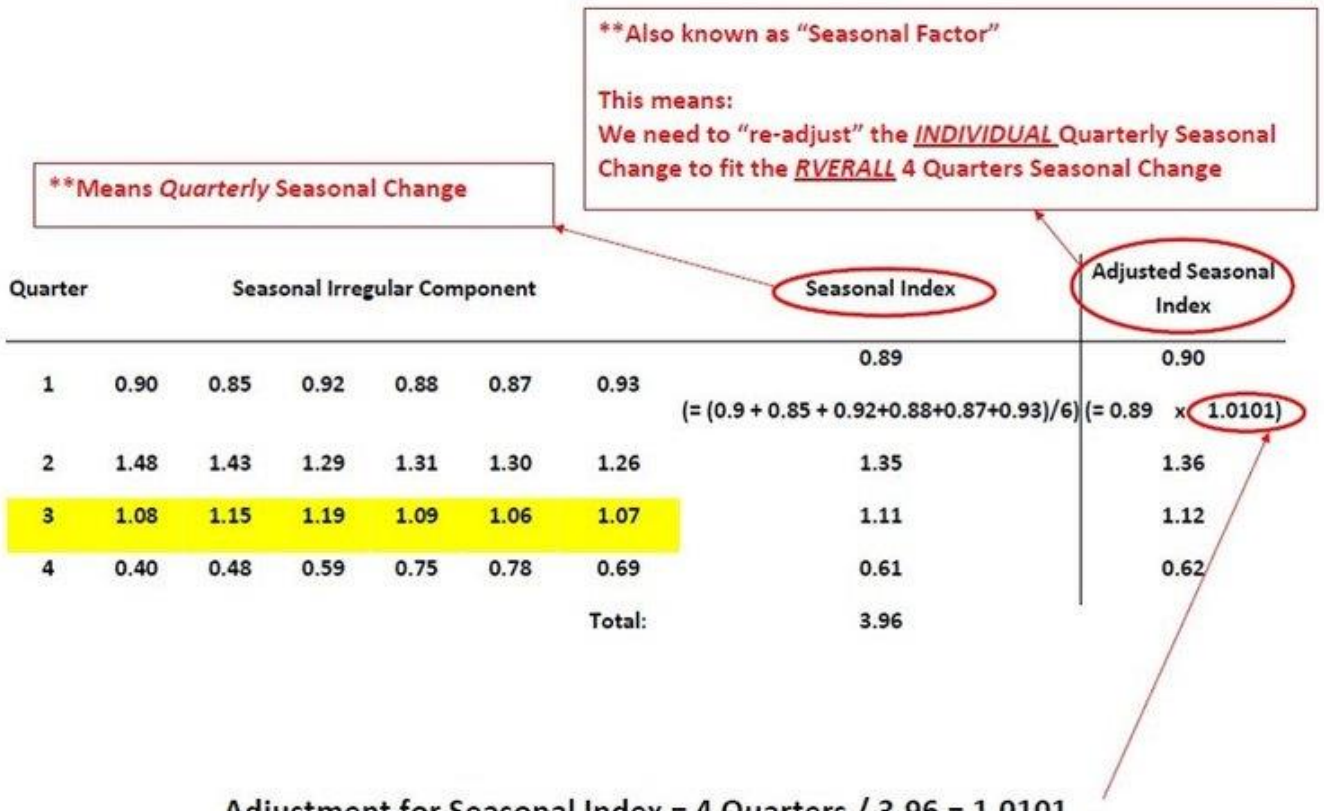
28. Refer to Problem 21. Suppose that the following are the quarterly sales data for the past seven years.

Year	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Total Sales
1	6	15	10	4	35
2	10	18	15	7	50
3	14	26	23	12	75
4	19	28	25	18	90
5	22	34	28	21	105
6	24	36	30	20	110
7	28	40	35	27	130



Year	Quarter	sales	Centered Moving Average (CMA)	Seasonal Irregular Component
1	1	6		
	2	15		
	3	10	9.25	1.08 (= 10 / 9.25)
	4	4	10.13	0.40
2	1	10	11.13	0.90
	2	18	12.13	1.48
	3	15	13.00	1.15
	4	7	14.50	0.48
3	1	14	16.50	0.85
	2	26	18.13	1.43
	3	23	19.38	1.19
	4	12	20.25	0.59
4	1	19	20.75	0.92
	2	28	21.75	1.29
	3	25	22.88	1.09
	4	18	24.00	0.75
5	1	22	25.13	0.88
	2	34	25.88	1.31
	3	28	26.50	1.06
	4	21	27.00	0.78
6	1	24	27.50	0.87
	2	36	27.63	1.30
	3	30	28.00	1.07
	4	20	29.00	0.69
7	1	28	30.13	0.93
	2	40	31.63	1.26
	3	35		
	4	27		

STEP 2: FIND THE SEASONAL INDEX (SI) AND THE ADJUSTED SEASONAL INDEX (ASI)



STEP 3: USE ADJUSTED SEASONAL INDEX (ASI) TO DE-SEASONALIZE THE SALES

Year	Quarter	sales	Seasonal Factor	Deseasonalized Sales
1	1	6	0.90	6.67
	2	15	1.36	11.03
	3	10	1.12	8.93
	4	4	0.62	6.45
2	1	10	0.90	11.11
	2	18	1.36	13.24
	3	15	1.12	13.39
	4	7	0.62	11.29
3	1	14	0.90	15.56
	2	26	1.36	19.12
	3	23	1.12	20.54
	4	12	0.62	19.35
4	1	19	0.90	21.11
	2	28	1.36	20.59
	3	25	1.12	22.32
	4	18	0.62	29.03
5	1	22	0.90	24.44
	2	34	1.36	25.00
	3	28	1.12	25.00
	4	21	0.62	33.87
6	1	24	0.90	26.67
	2	36	1.36	26.47
	3	30	1.12	26.79
	4	20	0.62	32.26
7	1	28	0.90	31.11
	2	40	1.36	29.41
	3	35	1.12	31.25
	4	27	0.62	43.55

27 / 0.62 = 43.55

STEP 4: USE THE DE-SEASONALIZED SALES TO GET THE LINEAR TREND EQUATION

	Year (t)	Numbers Sold (Y)	t2	tY
	1	35	1	35
	2	50	4	100
	3	75	9	225
	4	90	16	360
	5	105	25	525
	6	110	36	660
	7	130	49	910
Total:	28	595	140	2815
Average:	4	85		

MEMORIZE THIS!!!

$$T = b_0 + b_1 t$$

Where:

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

$$b_1 = \frac{\sum tY - \frac{\sum t \sum Y}{n}}{\sum t^2 - \frac{\left(\sum t\right)^2}{n}}$$

$$b_1 = \frac{\sum tY - \frac{\sum t \sum Y}{n}}{\sum t^2 - \frac{\left(\sum t\right)^2}{n}}$$

$$= \frac{2815 - \frac{(28)(595)}{7}}{140 - \frac{28^2}{7}}$$

$$= 15.5357$$

$$b_0 = Y - b_1 t$$

$$= 85 - 15.5357\,(4)$$

$$= 22.857$$

Hence Trend Line Equation:

$$T = b_0 + b_1 t$$

$$T = 22.857 + 15.536t$$

Part (c) - How to forecast when t = 8?

$$T = 22.857 + 15.536\,(8)$$

$$= 147.15$$

STEP 6: MULTIPLY THE ASI INTO THE FUTURE TIME PERIOD TO OBTAIN THE FINAL ANSWER (THE SEASONALIZED FORECASTED SALES VALUE)

- Since from Step 5: T (@ t = 8) = 147.15
- Presume period t = 8 has ASI (aka Seasonal Factor of 0.9)…
- Then the Actual T = 147.15 x 0.9 = 132.44.
- Thus the Actual Sales at t = 8 (which includes Seasonality) = $132.44

ABOUT DR. ALVIN ANG

Dr. Alvin Ang earned his Ph.D., Masters and Bachelor degrees from NTU, Singapore. He is a scientist, entrepreneur, as well as a personal/business advisor. More about him at www.AlvinAng.sg.