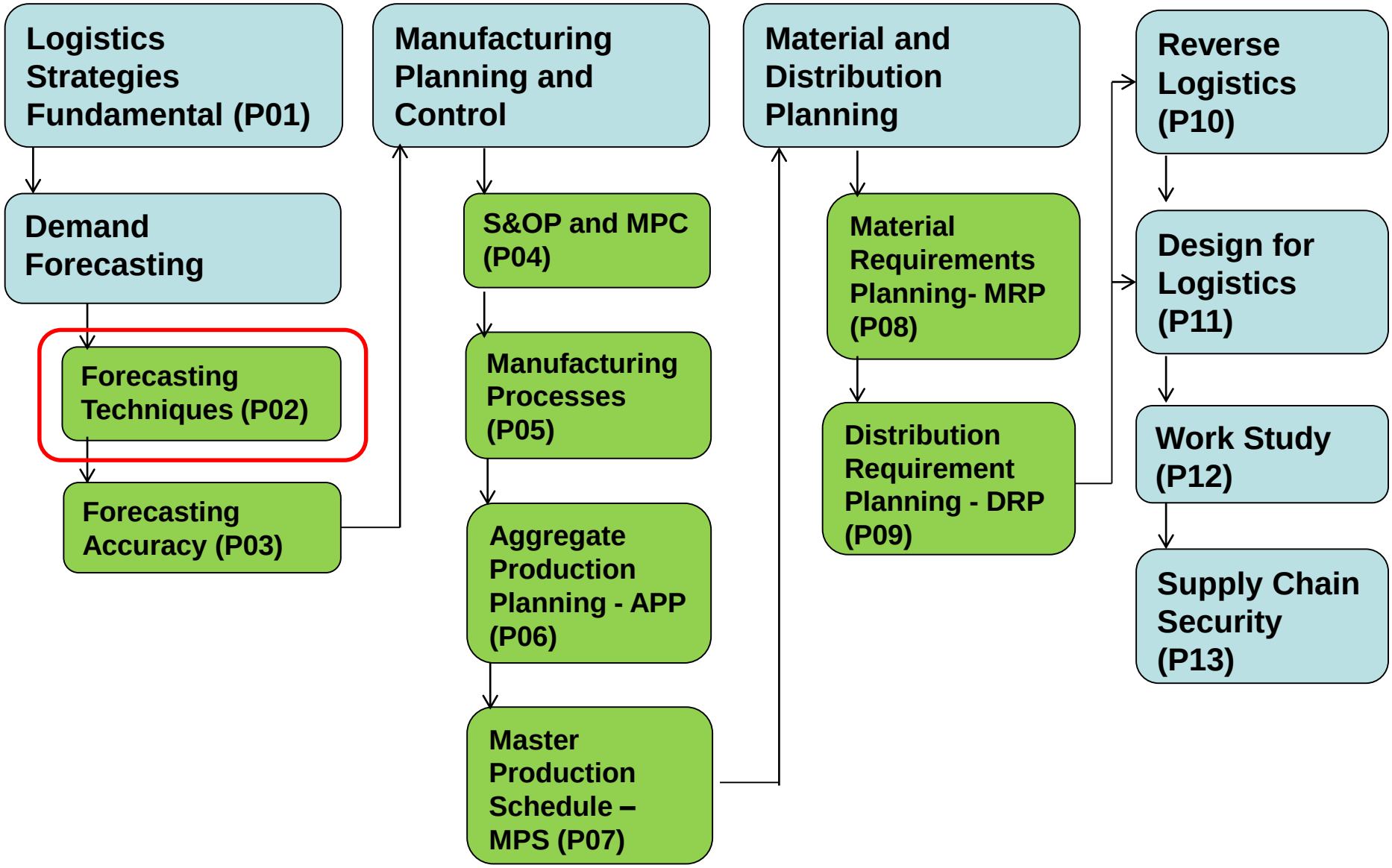
Problem 02
Not too many, Not too few

SCHOOL OF ENGINEERING

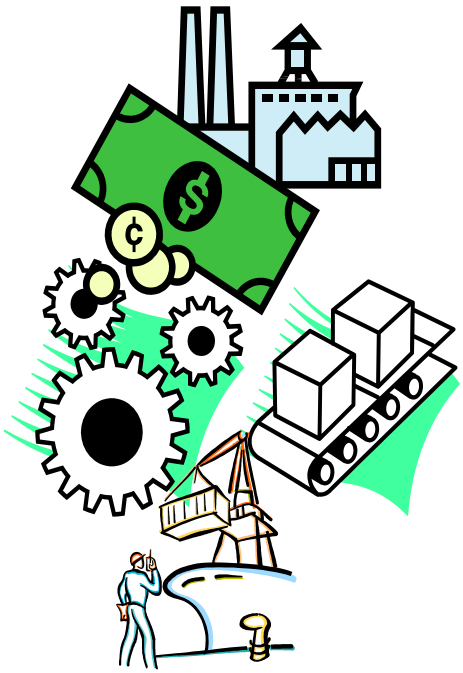
E222 – Logistics Planning and Control

E222 Logistics Planning and Control – Topic Tree



P02 – Not too many, Not too few

- Explain and identify the sources of Demand Variability
- Apply the Qualitative and Quantitative Forecasting Techniques
- Calculate Seasonality



Forecasting

- Forecasting is a necessary part of business planning
  - Some guidelines when deciding how much product likely to sell, therefore need to produce/import
  - Affects decisions & activities throughout an organization (E.g. sales, marketing & logistics)

- Examples of forecasting in business organization
  - **Accounting** - New product/process cost estimates, profit projections, cash management
  - **Finance** – Equipment/ equipment replacement needs, timing and amount of funding/borrowing needs
  - **Human resources** – Hiring activities, including recruitment, interviewing, training, layoff, counseling
  - **Marketing** – Pricing & promotion, e-business, global competition strategies
  - **Management of Information System (MIS)** - New/ revised information systems
  - **Operations** – Schedules, work assignments & workloads, inventory planning
  - **Product/ service design** – Design of new products or services

Features of Forecasts

- **Causal system**

  Forecast techniques generally assume that the same underlying causal system that existed in the past will continue to exist in the future

- **Forecast error**

  Forecasts are rarely perfect; actual results usually differ from predicted values

- **Group forecasts**

  Forecasts for groups of items tend to be more accurate than forecasts for individual items because forecasting errors among items in a group usually have a cancelling effect

- **Accuracy and time**

  Forecast accuracy decreases as the time period covered by the forecast (i.e. the time horizon) increases. Generally, short-term forecasts must deal with fewer uncertainties than long-term forecast

Considerations of Forecasts

A company must be knowledgeable about numerous factors that are related to the demand forecast.

- Past demand
- Lead time of product
- Planned advertising or marketing efforts
- State of the economy
- Planned price discounts
- Actions competitors have taken

Sources of Demand Variability

- **Competition**
  - The most basic fact of life in a market economy

    Competitors' unpredicted innovations can cut into market share; alternatively, competitors' unpredicted problems can suddenly increase demand for your product

- **Seasonality**
  - Demand for many products and services varies with the changing seasons of the year

    E.g. demand for clothing undergoes seasonal variations, demand for snow shovels (winter)

- **Life cycle trends**
  - Demand fluctuates over life cycle of a product

    E.g. Demand builds to a peak before product comes into market (popular books, movies, initial public offerings); or demand build slowly as buyers become gradually aware of product's existence or refinement

Sources of Demand Variability

- **External factors**
  - Factors external to the product & market (e.g. business cycle) tends to stimulate and depress demand across many markets in long-wave terms
- **Promotions**
  - Special pricing, advertising blitzes, “no-interest” financing and other promotional scheme can cause upward fluctuation in demand
  - Demand planning needs to take promotions into account

- **Disasters**
  - Disasters may seem unforeseeable and devastating but planning can mitigate their effect

    E.g. With proper planning, Procter & Gambler (P&G) was able to recover its business operation fully (within 45 days) at New Orleans after hurricane Katrina (Aug, 2005)

Types of Forecasting

- **Qualitative**
  - Based on judgment & intuition (human touch)
  - Advice from most experienced, market-savvy, objective person/ group of experts
  - A rough estimate of likely demand (difficult or impossible to quantify)
- **Quantitative**
  - Rely on historical data
  - Two main types
    - **Intrinsic forecasting:** *Time series models*; focus upon data about demand for the product/service (e.g. past sales data)
    - **Extrinsic forecasting:** *Associative models*; analyze data on conditions thought to be associative with changes in demand for a particular item/ group of items

Qualitative Forecasting Methods

- Personal insight
  - Based upon the insight of most experienced, most knowledgeable, or most senior person available person available
- Sales force consensus estimate
  - Sales & marketing area maintain closest contact with customers, hence they bring expertise to forecasting
- Management estimate
  - Similar to sales force estimate
  - Relies upon a consensus of panel members
  - Depends on forecasting techniques like:

Pyramid forecasting – Begins by aggregating item forecasts for a product group to establish a new group forecast; forecast is then “disaggregated” to generate item forecast consistent with product group plan

Historical analogy - study patterns of demand for a similar product/ service

Qualitative Forecasting Methods

- Market research
  - *"The systematic gathering, recording, and analyzing of data about problems relating to the marketing of goods and services"*

    (APICS Dictionary; 11th Edition)
  - Involves market analysis (e.g. product potential studies), sales analysis (e.g. sales data study) and consumer research (e.g. questionnaires, focus groups)

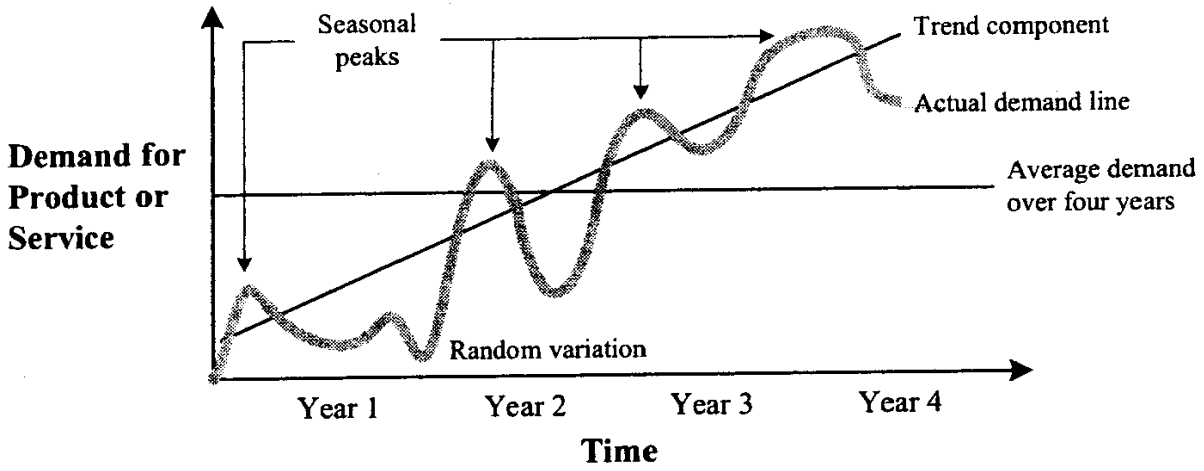
- Delphi method
  - Relies upon a panel of experts (their experience, wisdom, insight and intuition acting in concert)
  - Questionnaires submitted to individual expert for their anonymous response in successive rounds
  - Useful for technological forecasting
  - Frequently used when data are thin or non-existence

Quantitative (Time-Series Forecasting)

- Also known as *Intrinsic forecasting techniques*
- Predicting the future from past historical data
- Based on a sequence of data collected during set intervals of time (hours, days, weeks, months, quarterly etc.)
- Causal variables and qualitative factors are not considered

Time-Series Forecasting

- Time-series forecasting shows combinations of four types of variability
  - ***-Trends:*** A steady movement up or down
  - ***-Seasonality:*** Changes that correlates or changes related to temporal phenomenon
  - ***-Cycles:*** Series of data show alternating cyclical movements, each lasting for years
  - ***-Chance:*** Random variation that can neither be predicted or explained



Time-Series Models

- **Naïve approach**
  - Assumes that demand in the next period will be the same as demand in the last time
  - Rules out all types of fluctuations; a baseline for use to evaluate more sophisticated approaches
- **Moving averages**
- **Weighted moving averages**
- **Exponential smoothing**

Moving Average

$$F_t = \frac{F_{t-N} + F_{t-N+1} + ... + F_{t-1}}{N}$$

Where F_t is the forecast in period t and N is the number of most recent periods used in the forecast.

Example:

$$3Month\ Moving\ Average = \frac{M1 + M2 + M3}{3}$$

Moving Average

- Moving average corrects for chance variation, with longer periods removing more of the randomness **(+)**
- Moving average are not sensitive to trends (NB: The averages of previous numbers cannot predict higher or lower value than period preceding forecast) **(-)**
- Calculations become complex and have to collect more data, as more periods are included in the average **(-)**

Weighted Moving Average

$$F_t = \frac{W_1 F_{t-N} + W_2 F_{t-N+1} + ... + W_N F_{t-1}}{\sum_{1}^{N} W_i}$$

where W_i's are the individual weights

- Greater weights may be placed on more recent data to improve the responsiveness of forecast to changes

Example:

$$3 Month\ Weighted\ Moving\ Average = \frac{(1 \times M1 + 2 \times M2 + 3 \times M3)}{6}$$

Exponential Smoothing

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

OR

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

where:

F_t = new forecast

F_{t-1} = previous forecast

α = smoothing constant ($0 \leq \alpha \leq 1$)

A_{t-1} = previous period's actual demand

Extrinsic Forecasting Techniques

- Also known as *causal techniques*
- Analyze conditions that may cause demand
- May include leading, concurrent or lagging indicators
- Examples: Gross National Product (GNP), steel production, contract awards, automobile production (worldwide)

Seasonality Calculation

- Variation of sales volume with season is typical of many products and services. More products are sold during summer or winter season. Such demand pattern is call **seasonality**
- Seasonality can be represented using the seasonal index associated with a particular demand stream
- The **Seasonal index** is period average demand divided by the average demand for all periods

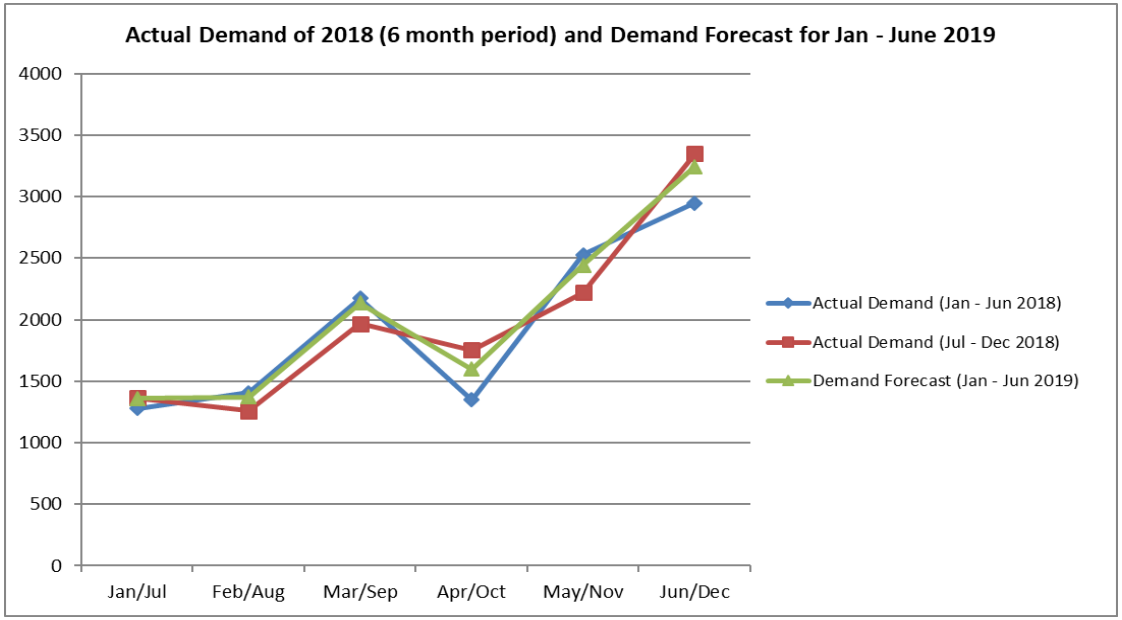
$$Seasonal\ Index = \frac{\text{period average demand}}{\text{average demand for all periods}}$$

- It is best to get more than one cycle's worth of data for seasonality calculations

Seasonal Demand of school shoes

Month	Actual Demand (Jan - Jun 2018)		Actual Demand (Jul - Dec 2018)	Avg	Calculation	Index	Demand Forecast (Jan - Jun 2019)
Jan	1278	Jul	1362	1320	0.6715	0.67	1359
Feb	1405	Aug	1259	1332	0.6776	0.68	1372
Mar	2173	Sep	1969	2071	1.0535	1.05	2133
Apr	1347	Oct	1753	1550	0.7885	0.79	1596
May	2526	Nov	2220	2373	1.2071	1.21	2444
Jun	2950	Dec	3348	3149	1.6019	1.60	3243
Total	11679	Total	11911	Sum of all indexes		6.00	
Average of all period average				1966			

Annual Demand/sales growth = 1.986%



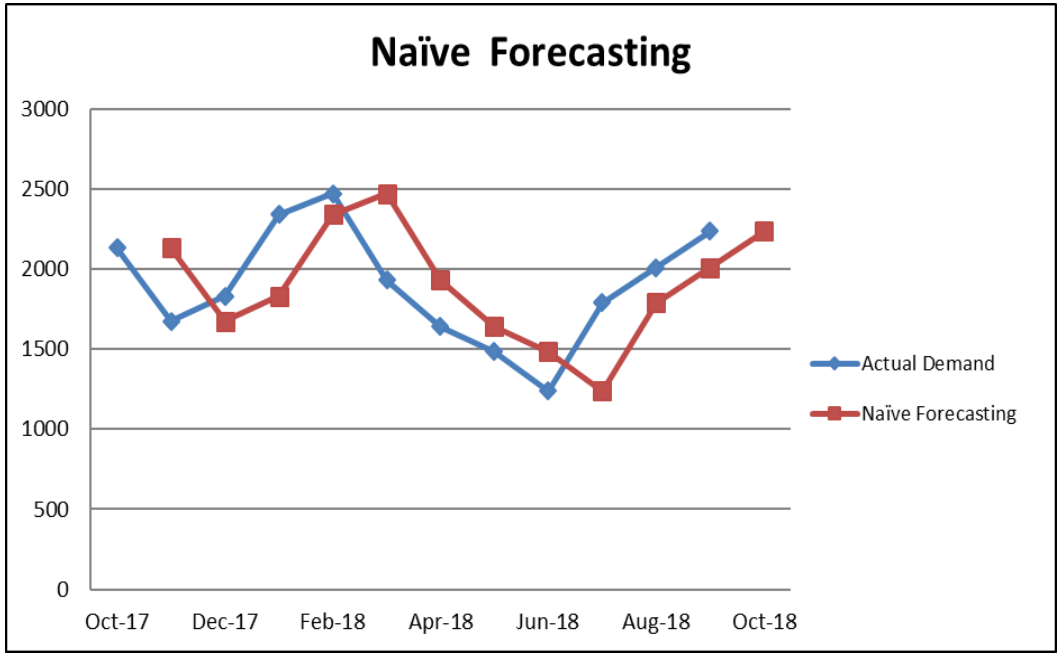
- There is a 6 month seasonal trend as the trend from Jan-Jun 2018 is repeated from Jul-Dec 2018.
- Therefore the seasonal index forecasting can be applied to a 6 month period instead.
- **Annual sales growth = -1.99%** (Based on 1st 6-month sales to 2nd 6-month sales for 2018)
- **The Seasonal Index = Period average demand/average demand for all periods**

P02 :Suggested Solution for….

Today's Problem

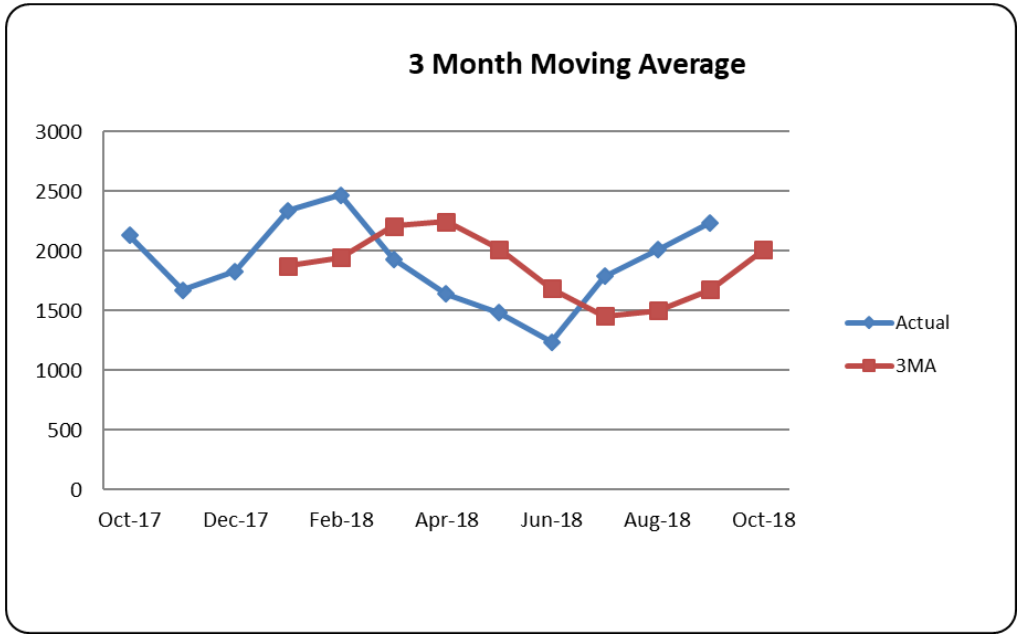
Naive Forecasting

Month-Yr	Actual Demand	Naïve Forecasting
Oct-17	2130	
Nov-17	1675	2130
Dec-17	1829	1675
Jan-18	2338	1829
Feb-18	2468	2338
Mar-18	1932	2468
Apr-18	1640	1932
May-18	1483	1640
Jun-18	1238	1483
Jul-18	1790	1238
Aug-18	2010	1790
Sep-18	2237	2010
Oct-18		2237



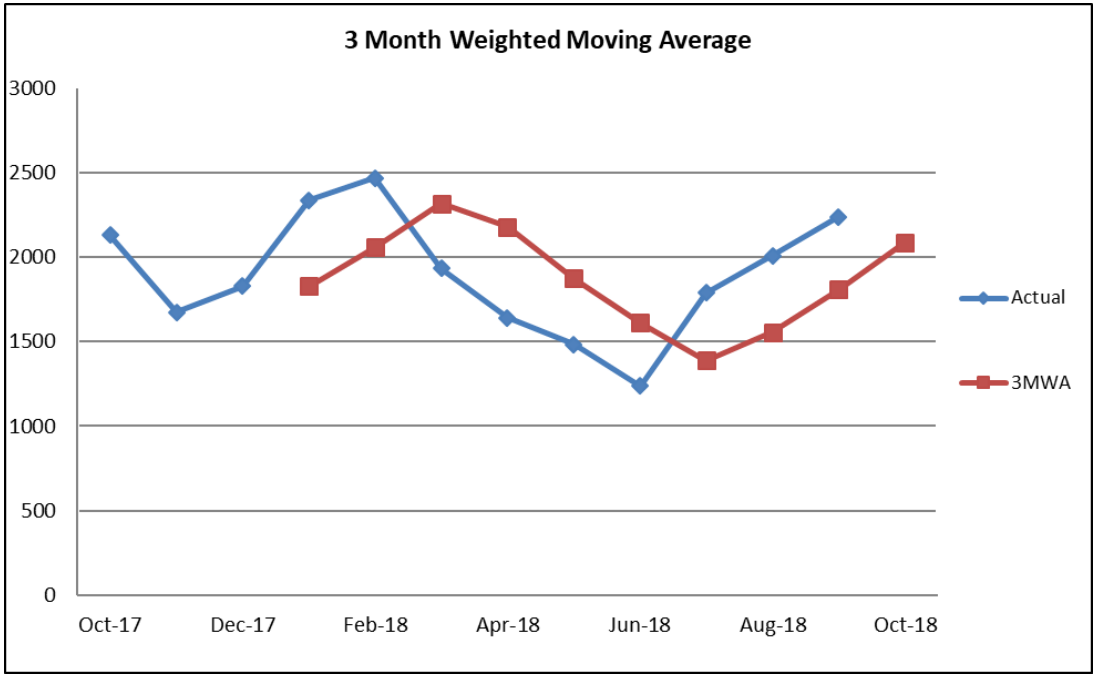
3-Mth Moving Average Forecasting

Month-Yr	Actual Demand	3 Mth Moving Average
Oct-17	2130	
Nov-17	1675	
Dec-17	1829	
Jan-18	2338	1878
Feb-18	2468	1947
Mar-18	1932	2212
Apr-18	1640	2246
May-18	1483	2013
Jun-18	1238	1685
Jul-18	1790	1454
Aug-18	2010	1504
Sep-18	2237	1679
Oct-18		2012



3-Mth Weighted Moving Average Forecasting

Month-Yr	Actual Demand	3 Month Weighted Moving Average
Oct-17	2130	
Nov-17	1675	
Dec-17	1829	
Jan-18	2338	**1828**
Feb-18	2468	**2058**
Mar-18	1932	**2318**
Apr-18	1640	**2178**
May-18	1483	**1875**
Jun-18	1238	**1610**
Jul-18	1790	**1387**
Aug-18	2010	**1555**
Sep-18	2237	**1808**
Oct-18		**2087**

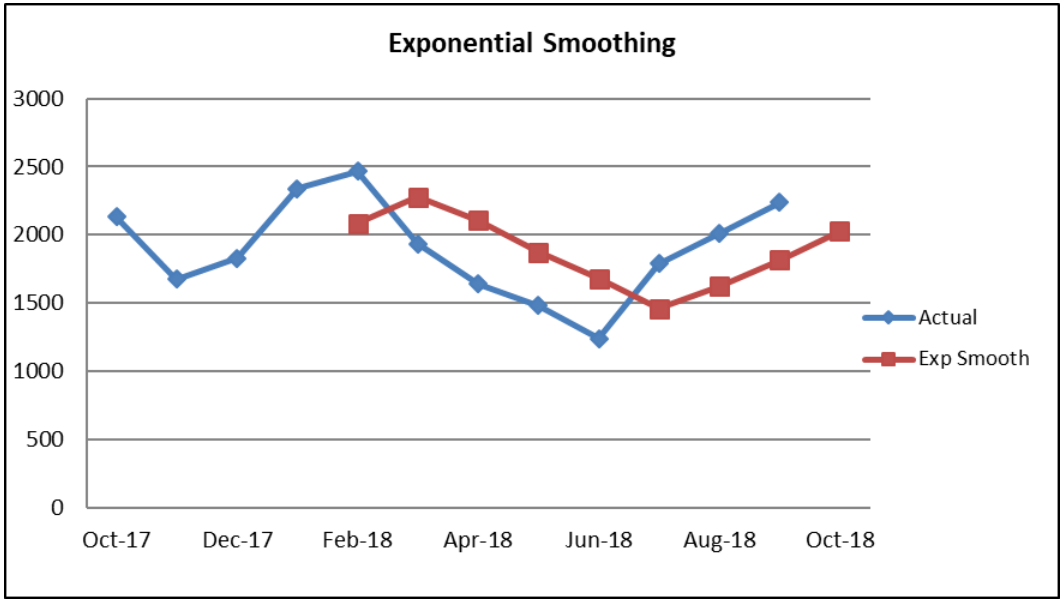


Exponential Smoothing Forecasting

When α= 0.5

•Assumption: The initial forecast used (1828 is the forecast value of 3-month weighted average for Jan 18 (Note: It may also be from naïve, 3MA methods)

Month-Yr	Actual Demand	Exponential Smoothing
Oct-17	2130	
Nov-17	1675	
Dec-17	1829	
Jan-18	2338	
Feb-18	2468	**2083**
Mar-18	1932	**2275**
Apr-18	1640	**2104**
May-18	1483	**1872**
Jun-18	1238	**1677**
Jul-18	1790	**1458**
Aug-18	2010	**1624**
Sep-18	2237	**1817**
Oct-18		**2027**



Recommendations

Veron should

- Take into account the various sources of demand variability when planning for sales, marketing & logistics activities
- Be aware of the **merits & limitations** of different forecasting techniques
- Use a combination of **Qualitative** & **Quantitative** techniques during forecasting
  - ***Example:***
  - Use qualitative techniques (e.g. personal insights, management estimate) for longer range forecast (e.g. 6 months)
    - ✓ Qualitative techniques are especially critical in new products without prior historical sales data
    - ✓ Insights from Market Intelligences and inputs from Business Plan becomes the main sources in gauging the overall market potential
  - Complement longer range forecast with suitable quantitative techniques, when more actual demand data becomes available

Learning Outcomes

- Explain and identify the sources of Demand Variability
- Apply the Qualitative and Quantitative Forecasting Techniques
- Calculate Seasonality