Introduction to Materials Management

Chapter 8 - Forecasting

Demand Management

- Recognize and manage demand for all products
- Includes:
  - Forecasting
  - Order promising
  - Making delivery promises
  - Interfacing between planning, control and the marketplace

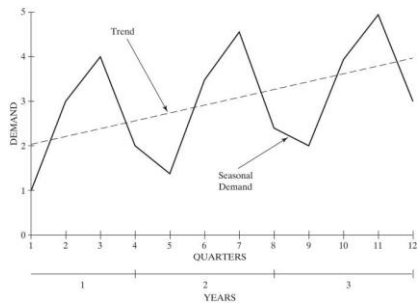
Demand Forecasting

- A projection of past information and/or experience into expectation of demand in the future. Levels of detail may include:
  - Individual products
  - Product families
  - Product categories
  - Market sectors
  - Resources

Typical Demand Patterns

- Trend (upward or downward, linear or non-linear)
- Cyclicality
- Seasonality (a special form of cyclicality)
- Random variations

Demand Over Time Example



Basic Principles of Forecasting

- Forecasts are usually incorrect – most demand is dependent on so many variables it is impossible to capture the impact of all.
- Forecasts tend to be more accurate
  - For families or groups of products
  - For time periods closer to the present
- Every forecast should include and estimate of error

If forecasting is generally incorrect, why do it?

- Planning has to start with some projection of anticipated demand
- The key to planning with forecasting data:
  - How wrong is the forecast likely to be (need forecast error)?
  - How will the plan accommodate for the expected error?

Some Forecasting Techniques

- Qualitative – based on judgment, intuition, and informed opinions
- Quantitative
  - Extrinsic – based on external indicators that relate to demand
  - Intrinsic – the use of historical data to create forecast

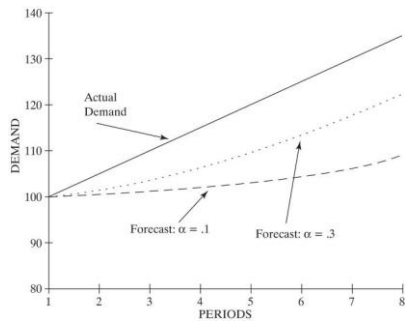
Simple Moving Average

- Take the average demand for a defined number of past periods
- Forecast will lag behind
  - Trends
  - Seasonality or other cyclicality

Exponential Smoothing

- Basic Formula:
  New Forecast =
  (α)(Latest Demand) + (1 - α)Previous Forecast
- α is a smoothing constant, always between 0 and 1 in value

Impact of The Value of α

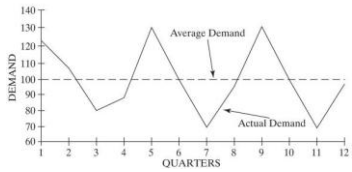


Seasonal Index

- For each season, can compute a seasonal index:
  Seasonal Index = (Period average demand)/(Average Demand for all periods)
- Index can be used as a multiplier for future seasons

Example – Given the following sales history

Year	Quarter				
	1	2	3	4	Total
1	122	108	81	90	401
2	130	100	73	96	399
3	132	98	71	99	400
Average	128	102	75	95	400



Calculating Seasonal Indices

- Average quarterly demand = 100 units
- Seasonal indices
  - Quarter 1: 128/100 = 1.28
  - Quarter 2: 102/100 = 1.02
  - Quarter 3: 75/100 = 0.75
  - Quarter 4: 95/100 = 0.95

Applying Seasonal Indices

- Suppose the same company forecast an annual demand of 420 units next year
- The average quarterly demand = 105 units. Applying seasonal indices:
  - Quarter 1: 1.28 x 105 = 134.4 units
  - Quarter 2: 1.20 x 105 = 107.1 units
  - Quarter 3: 0.75 x 105 = 78.75 units
  - Quarter 4: 0.95 x 105 = 99.75 units

Rules for forecasting with seasonality

- Use only deseasonalized data to forecast
  - Deseasonalized demand = (actual seasonal demand)/(seasonal index)
- Base forecast is deseasonalized demand
- Calculate seasonal forecasts by applying seasonal indices to base forecast

Forecast Errors

- Basic rule – assume the forecast is incorrect. The key issue: "How incorrect is it and what do we do about it?"
- The error can be used to:
  - Evaluate and possibly change forecasting methodology
  - Apply buffer stock or capacity to account for possible error

Forecast Bias

- Systematic error in which the actual demand is consistently above or below the forecasted demand
- When exists, evaluate forecast to improve accuracy

Example – given the following demand history

Month	Forecast	Actual	Error (A-F)
1	100	106	6
2	100	93	-7
3	100	102	2
4	100	101	1
5	100	95	-5
Total	500	497	-3

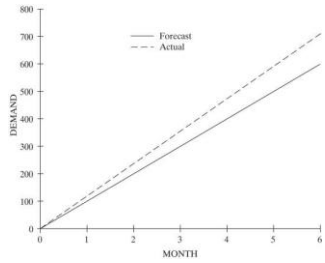
The conclusion from the table

- Over the five months shown, the forecast projected demand of 3 units more than was actually demanded
- We can conclude that for this data the forecasting method was *biased* toward over projecting actual demand

Shown graphically, given the following data

Month	Forecast		Actual	
	Monthly	Cumulative	Monthly	Cumulative
1	100	100	110	110
2	100	200	125	235
3	100	300	120	355
4	100	400	125	480
5	100	500	130	610
6	100	600	110	720
Total	600	600	720	720

The resulting graph shows the bias



Mean Absolute Deviation (MAD)

- MAD = (Sum of absolute deviations)/(Number of deviations)
- A positive number that indicates the average value of forecast error during the time of evaluation

MAD Example – Given the following data

Month	Forecast	Actual	Variation (error)
1	100	105	5
2	100	94	– 6
3	100	98	– 2
4	100	104	4
5	100	103	3
6	100	96	– 4
Total	600	600	0

MAD Example, continued

- Note there is no bias over the six months shown
- The MAD
  - Sum of absolute deviations = 5+6+2+4+3+4 = 24
  - MAD = 24/6 = 4
- This means while the forecast method showed no bias, it was in error by an average of 4 units per month

Tracking signal

- Used to monitor the quality of the forecast
- One simple method:
  - Tracking signal = (sum of the forecast errors)/(MAD)

Example:

Period	Forecast	Actual	Deviation	Cumulative Deviation	Tracking Signal
				5	2.5
1	100	96			
2	100	98			
3	100	104			
4	100	110			

The MAD for the item is 2 and the company uses a tracking signal of + or – 4 to determine if the forecasting method should be reviewed

Filling in the table:

Period	Forecast	Actual	Deviation	Cumulative Deviation	Tracking Signal
				5	2.5
1	100	96	– 4	1	0.5
2	100	98	– 2	– 1	– 0.5
3	100	104	4	3	1.5
4	100	110	10	13	6.5

The forecasting method should be reviewed.
The tracking signal of 6.5 violates the tracking signal rule of + or - 4