

Chapter 7.

Demand Forecasting in a Supply Chain

2021

Manhattan, Kansas



Learning Objectives

- Understand the role of forecasting for both an enterprise and a supply chain.
- Identify the components of a demand forecast.
- Forecast demand using time-series methodologies given historical demand data in a supply chain.
- Understand demand forecasts to estimate forecast error.
- The role of software tools in forecasting



Forecasting in a Supply Chain

Role of Forecasting in a Supply Chain

The basis for all planning decisions in a supply chain

Used for both push and pull processes

- Production scheduling, inventory, aggregate planning
- Sales force allocation, promotions, new production introduction
- Plant/equipment investment, budgetary planning
- Workforce planning, hiring, layoffs

All of these decisions are interrelated

Characteristics of Forecasts

- Forecasts are always inaccurate and should thus include both the expected value of the forecast and a measure of forecast error
- Long-term forecasts are usually less accurate than short-term forecasts
- Aggregate forecasts are usually more accurate than disaggregate forecasts
- In general, the farther up the supply chain a company is (or the farther it is from the consumer), the greater the distortion of information it receives is



Components and Methods

Components and Methods

Companies must identify the factors that influence future demand and then ascertain the relationship between these factors and future demand

- Past demand
- Lead time of product replenishment
- Planned advertising or marketing efforts (increase)
- Planned price discounts (increase)
- State of the economy
- Actions that competitors have taken (decrease)

Components and Methods

Qualitative

- Primarily subjective
- Rely on judgment
-

Time series

- Use historical demand only
- Best with stable demand

Causal

- Relationship between demand and some other factor

Simulation

- Imitate consumer choices that give rise to demand

Components and Methods

Observed demand (O) = systematic component (S) + random component (R)

Systematic component – expected value of demand

- Level (current deseasonalized demand)
- Trend (growth or decline in demand)
- Seasonality (predictable seasonal fluctuation)

Random component – part of forecast that deviates from systematic component

Forecast error – difference between forecast and actual demand

Basic Approach for Forecasting Process

1. Understand the objective of forecasting.
2. Integrate demand planning and forecasting throughout the supply chain.
3. Identify the major factors that influence the demand forecast.
4. Forecast at the appropriate level of aggregation.
5. Establish performance and error measures for the forecast.



Time-Series Forecasting Methods and Models

Time-Series Forecasting Methods

Three ways to calculate the systematic component

- Multiplicative

$$S = \text{level} \times \text{trend} \times \text{seasonal factor}$$

- Additive

$$S = \text{level} + \text{trend} + \text{seasonal fact}$$

- Mixed

$$S = (\text{level} + \text{trend}) \times \text{seasonal factor}$$

Static Model

Systematic component = (level + trend) \leftrightarrow seasonal factor

$$F_{t+l} = [L + (t + l)T]S_{t+l}$$

where

L = Estimate of level at $t = 0$

T = Estimate of trend

S_t = Estimate of seasonal factor for Period t

D_t = Actual demand observed in Period t

F_t = Forecast of demand for Period t

Adaptive Model

$$F_{t+1} = (L_t + lT_t)S_{t+1}$$

where

L_t = estimate of level at the end of Period t

T_t = estimate of trend at the end of Period t

S_t = estimate of seasonal factor for Period t

F_t = forecast of demand for Period t (made Period $t - 1$ or earlier)

D_t = actual demand observed in Period t

$E_t = F_t - D_t$ = forecast error in Period t

Summary of Forecasting Methods in the Adaptive Model and When they are Applicable

Forecasting Method	Applicability
Moving average	No trend or seasonality
Simple exponential smoothing	No trend or seasonality
Holt's model	Trend but no seasonality
Winter's model	Trend and seasonality



Measures of Forecast Error

Measures of Forecast Error

- Every instance of demand has a random component
- A good forecasting method should capture the systematic component of demand but not the random component which manifests itself in the form of forecast error

Measures of Forecast Error

Forecast error contains valuable info and should be measured:

- To determine whether the current forecasting method is predicting the systematic component of demand accurately
- All contingency plans must account for forecast error

Measures of Forecast Error

The MSE, MAD, and MAPE are used to estimate the size of the forecast error

The bias and TS are used to estimate if the forecast consistently over or under forecasts or if demand has deviated significantly from historical norms



The Role of Software Tools in Forecasting

The Role of Software Tools in Forecasting

Given the repetitive nature of time-series forecasting methods, they can be easily modeled in Microsoft Excel, R, STATA, Python.

Excel is effective when learning forecasting or to quickly decide what forecasting model to use



BUILD YOUR OWN MODEL ACCORDINGLY TO
THE FACTORS THAT AFFECT THE DEMAND OF
YOUR PRODUCT.



AGEC 632: Agribusiness Logistics

2021

Manhattan, Kansas