

Supply Chain Management

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MGM 660

Lecture 6



Demand forecasting in a supply chain

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Learning Objectives

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- 1. Understand the role of forecasting for both an enterprise and a supply chain.**
 - 2. Identify the components of a demand forecast.**
 - 3. Forecast demand in a supply chain given historical demand data using time-series methodologies.**
 - 4. Analyze demand forecasts to estimate forecast error.**

Role of Forecasting in a Supply Chain

- **Demand forecasts** form the basis of all supply chain planning.
- **All push processes** in the supply chain are performed in anticipation of customer demand, whereas all **pull processes** are performed in response to customer demand.
- **For push processes**, a manager must plan the level of activity, be it production, transportation, or any other planned activity.
- **For pull processes**, a manager must plan the level of available capacity and inventory, but not the actual amount to be executed.
- **In both instances**, the first step a manager must take is to forecast what customer demand will be.

Role of Forecasting in a Supply Chain

- The forecast of demand forms the basis for all strategic and planning decisions in a supply chain.
- When all stages of a supply chain work together to produce a collaborative forecast, however, the forecast tends to be much more accurate.
- The resulting forecast accuracy enables supply chains to be both more responsive and more efficient in serving their customers.
- Long-term forecasts are usually less accurate than short-term forecasts.
- Leaders in many supply chains, from electronics manufacturers to packaged-goods retailers, have improved their ability to match supply and demand by moving toward collaborative forecasting.

Role of Forecasting in a Supply Chain

- **Example** : Consider the value of collaborative forecasting for Coca-Cola and its bottlers.
- Coca-Cola decides on the timing of promotions based on the demand forecast over the coming quarter.
- Promotion decisions are then incorporated into an updated demand forecast.
- The updated forecast is essential for the bottlers to plan their capacity and production decisions.
- A bottler operating without an updated forecast based on the promotion is unlikely to have sufficient supply available for Coca-Cola, thus hurting supply chain profits.

Characteristics of Forecasts

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

Components and Methods

- Companies must identify the factors that influence future demand and then ascertain the relationship between these factors and future demand including the following:
 - Past demand
 - Lead time of product replenishment
 - Planned advertising or marketing efforts
 - Planned price discounts
 - State of the economy
 - Actions that competitors have taken

Components and Methods

- A company must understand such factors before it can select an appropriate forecasting methodology.

For example,

- Historically a firm may have experienced low demand for chicken noodle soup in July and high demand in December and January.
- If the firm decides to discount the product in July, the situation is likely to change, with some of the future demand shifting to the month of July.
- The firm should make its forecast taking this factor into consideration.

Components and Methods

1. Qualitative

- Primarily subjective
- Rely on judgment

2. Time Series

- Use historical demand only
- Best with stable demand

3. Causal

- Relationship between demand and some other factor

4. Simulation

- Imitate consumer choices that give rise to demand

Components and Methods

Qualitative:

- Qualitative forecasting methods are primarily subjective and rely on human judgment.
- They are most appropriate when little historical data are available or when experts have market intelligence that may affect the forecast.
- Such methods may also be necessary to forecast demand several years into the future in a new industry.

Components and Methods

Time series:

- Time-series forecasting methods use historical demand to make a forecast.
- They are based on the assumption that past demand history is a good indicator of future demand.
- These methods are most appropriate when the basic demand pattern does not vary significantly from one year to the next.
- These are the simplest methods to implement and can serve as a good starting point for a demand forecast.

Components and Methods

Causal:

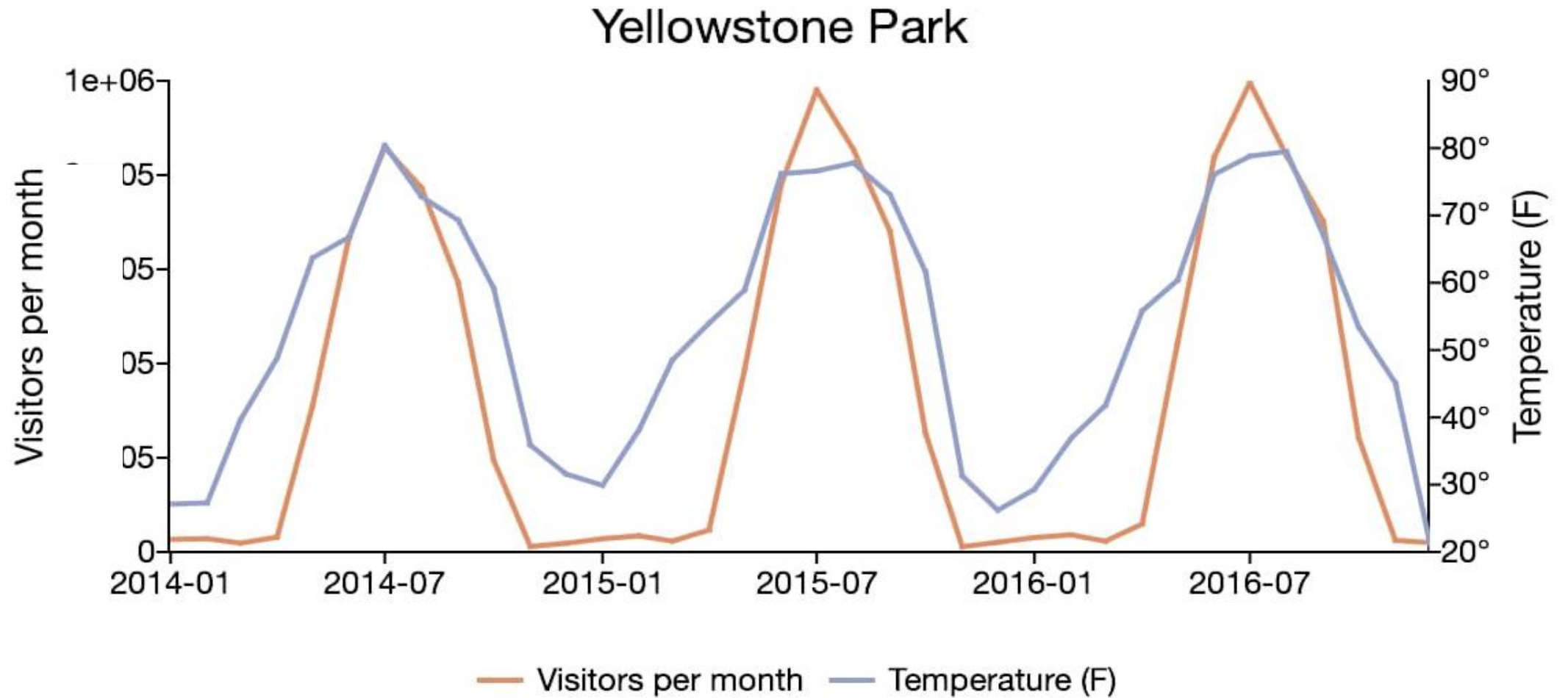
- Causal forecasting methods assume that the demand forecast is highly correlated with certain factors in the environment (the state of the economy, interest rates, etc.).
- Causal forecasting methods find this correlation between demand and environmental factors and use estimates of what environmental factors will be to forecast future demand.
- **For example**, product pricing is strongly correlated with demand. Companies can thus use causal methods to determine the impact of price promotions on demand.

Components and Methods

Simulation:

- Simulation forecasting methods imitate the consumer choices that give rise to demand to arrive at a forecast.
- Using simulation, a firm can combine time-series and causal methods to answer such questions as: What will be the impact of a price promotion?
- What will be the impact of a competitor opening a store nearby?
- Airlines simulate customer buying behavior to forecast demand for higher-fare seats when no seats are available at lower fares.

Time Series Analysis



Basic Approach

The following five points are important for an organization to forecast effectively:

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.

Basic Approach

- **Understand the Objective of Forecasting**
- Every forecast supports decisions that are based on it, so an important first step is to identify these decisions clearly.
- **Examples** of such decisions include how much of a particular product to make, how much to inventory, and how much to order.
- All parties affected by a supply chain decision should be aware of the link between the decision and the forecast.

Basic Approach

- **Understand the Objective of Forecasting**
- **For example**, Walmart's plans to discount detergent during the month of July must be shared with the manufacturer, the transporter, and others involved in filling demand, as they all must make decisions that are affected by the forecast of demand.
- All parties should come up with a common forecast for the promotion and a shared plan of action based on the forecast.
- Failure to make these decisions jointly may result in either too much or too little product in various stages of the supply chain.

Basic Approach

- **Integrate Demand Planning and Forecasting Throughout the Supply Chain**
- A company should link its forecast to all planning activities throughout the supply chain.
- These include capacity planning, production planning, promotion planning, and purchasing, among others.
- In one unfortunately common scenario, a retailer develops forecasts based on promotional activities, whereas a manufacturer, unaware of these promotions, develops a different forecast for its production planning based on historical orders.

Basic Approach

- **Integrate Demand Planning and Forecasting Throughout the Supply Chain**
- This leads to a mismatch between supply and demand, resulting in poor customer service.
- To accomplish integration, it is a good idea for a firm to have a cross-functional team, with members from each affected function responsible for forecasting demand—and an even better idea is to have members of different companies in the supply chain working together to create a forecast.

Basic Approach

- **Identify Major Factors That Influence the Demand Forecast**
- Next, a firm must identify demand, supply, and product-related phenomena that influence the demand forecast. On the demand side, a company must ascertain whether demand is growing or declining or has a seasonal pattern. These estimates must be based on demand, not on sales data.
- **For example**, a supermarket promoted a certain brand of cereal in July 2014. As a result, the demand for this cereal was high, whereas the demand for other, comparable cereal brands was low in July. The supermarket should not use the sales data from 2014 to estimate that demand for this brand will be high in July 2015, because this will occur only if the same brand is promoted again in July 2015 and other brands respond as they did the previous year.

Basic Approach

- **Identify Major Factors That Influence the Demand Forecast**
- When making the demand forecast, the supermarket must understand what the demand would have been in the absence of promotion activity and how demand is affected by promotions and competitor actions. A combination of these pieces of information will allow the supermarket to forecast demand for July 2015, given the promotion activity planned for that year.
- On the supply side, a company must consider the available supply sources to decide on the accuracy of the forecast desired. If alternate supply sources with short lead times are available, a highly accurate forecast may not be especially important. However, if only a single supplier with a long lead time is available, an accurate forecast will have great value.

Basic Approach

- **Forecast at the Appropriate Level of Aggregation**
- Given that aggregate forecasts are more accurate than disaggregate forecasts, it is important to forecast at a level of aggregation that is appropriate, given the supply chain decision that is driven by the forecast.
- Consider a buyer at a retail chain who is forecasting to select an order size for shirts.
- One approach is to ask each store manager the precise number of shirts needed and add up all the requests to get an order size with the supplier.

Basic Approach

- **The advantage** of this approach is that it uses local market intelligence that each store manager has. **The problem** with this approach is that it makes store managers forecast well before demand arises at a time when their forecasts are unlikely to be accurate.
- A better approach may be to forecast demand at the aggregate level when ordering with the supplier and ask each store manager to forecast only when the shirts are to be allocated across the stores. In this case, the long lead time forecast (supplier order) is aggregate, thus lowering error. The disaggregate store-level forecast is made close to the sales season, when local market intelligence is likely to be most effective.

Basic Approach

- **Establish Performance and Error Measures for the Forecast**
 - Companies should establish clear performance measures to evaluate the accuracy and timeliness of the forecast.
 - These measures should be linked to the objectives of the business decisions based on these forecasts.
 - Consider a mail-order company that uses a forecast to place orders with its suppliers, which take two months to send in the orders.

Basic Approach

- **Establish Performance and Error Measures for the Forecast**
 - The mail-order company must ensure that the forecast is created at least two months before the start of the sales season because of the two-month lead time for replenishment.
 - At the end of the sales season, the company must compare actual demand to forecasted demand to estimate the accuracy of the forecast.
 - Then plans for decreasing future forecast errors or responding to the observed forecast errors can be put into place.

Measures of Forecast Error

- As mentioned earlier, every instance of demand has a random component. A good forecasting method should capture the systematic component of demand but not the random component. The random component manifests itself in the form of a forecast error.
- Forecast errors contain valuable information and must be analyzed carefully for two reasons:

Basic Approach

1. **Managers use error analysis to determine whether the current forecasting method is predicting the systematic component of demand accurately.**

For example, if a forecasting method consistently produces a positive error, the forecasting method is overestimating the systematic component and should be corrected.

2. All contingency plans must account for forecast error.

Consider a mail-order company with two suppliers.

- The first is in the Far East and has a lead time of two months.
- The second is local and can fill orders with one week's notice.
- The local supplier is more expensive than the Far East supplier.
- The mail-order company wants to contract a certain amount of contingency capacity with the local supplier to be used if the demand exceeds the quantity the Far East supplier provides.
- The decision regarding the quantity of local capacity to contract is closely linked to the size of the forecast error with a two-month lead time.

The Role of IT in Forecasting

- **Forecasting module** is core supply chain software can be used to best determine forecasting methods for the firm and by product categories and markets Real time updates help firms respond quickly to changes in marketplace
Facilitate demand planning

The Role of IT in Forecasting

- There is a natural role for IT in forecasting, given the large amount of data involved, the frequency with which forecasting is performed, and the importance of getting the highest quality results possible.
- A good forecasting package provides forecasts across a wide range of products that are updated in real time by incorporating any new demand information.
- This helps firms respond quickly to changes in the marketplace and avoid the costs of a delayed reaction.
- Good demand planning modules link not only to customer orders but often directly to customer sales information as well, thus incorporating the most current data into the demand forecast

The Role of IT in Forecasting

- A positive outcome of the investment in ERP systems has been a significant improvement in supply chain transparency and data integration, thus allowing potentially better forecasts.
- Although this technical improvement can help produce better forecasts, firms must develop the organizational capabilities required to take advantage of this improvement.
- Besides providing a rich library of forecasting methodologies, a good demand planning module should provide support in helping select the right forecasting model for the given demand pattern.
- This has become particularly important as the available library of forecasting methodologies has grown.

Risk Management

- Errors in forecasting can cause significant misallocation of resources in inventory, facilities, transportation, sourcing, pricing, and information management
- Common factors are long lead times, seasonality, short product life cycles, few customers and lumpy demand, and when orders placed by intermediaries in a supply chain
- Mitigation strategies – increasing the responsiveness of the supply chain and utilizing opportunities for pooling of demand

Forecasting In Practice

- Collaborate in building forecasts
- Share only the data that truly provide value
- Be sure to distinguish between demand and sales

Forecasting In Practice

- **Collaborate in building forecasts.**
- Collaboration with one's supply chain partners can often create a much more accurate forecast.
- It takes an investment of time and effort to build the relationships with one's partners to begin sharing information and creating collaborative forecasts.
- However, the supply chain benefits of collaboration are often an order of magnitude greater than the cost

Forecasting In Practice

- **Share only the data that truly provide value.**
- The value of data depends on where one sits in the supply chain.
- A retailer finds point-of-sale data to be quite valuable in measuring the performance of its stores.
- However, a manufacturer selling to a distributor that, in turn, sells to retailers does not need all the point-of-sale detail.
- The manufacturer finds aggregate demand data to be quite valuable, with marginally more value coming from detailed point-of-sale data.
- Keeping the data shared to what is truly required decreases investment in IT and improves the chances of successful collaboration.

Forecasting In Practice

- **Be sure to distinguish between demand and sales.**
- Often, companies make the mistake of looking at historical sales and assuming that this is what the historical demand was.
- To get true demand, however, adjustments need to be made for unmet demand due to stockouts, competitor actions, pricing, and promotions.
- Failure to do so results in forecasts that do not represent the current reality.

Summary of Learning Objectives

- 1. Understand the role of forecasting for both an enterprise and a supply chain.**
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Essential Reference

Chopra, S., & Meindl, P. (2016). Global Edition.
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Chapter Seven.



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Thank You

