

Chapter 6: Demand Forecasting

◆ 1. Introduction to Demand Forecasting

- Forecasting is essential due to **uncertainty and risk**.
- Two types:
 - **Macro forecasts:** economy-wide predictions.
 - **Micro forecasts:** firm-specific or product-specific.
- **Techniques range** from naïve to sophisticated, qualitative to quantitative.
- Performed **internally by firms** or **outsourced to consulting firms**.
- Different techniques suit:
 - **Short-term** (e.g., barometric forecasts)
 - **Long-term** (e.g., input-output method)

◆ Factors Affecting Choice of Technique:

- **Cost vs. benefit** of forecasting
- **Lead time** for decision-making
- **Forecast horizon** (short/long-term)
- **Accuracy** needed
- **Data quality/availability**
- **Complexity** of forecasted relationships



◆ 2. Qualitative Forecasting Methods

Useful when:

- No quantitative data are available
- Supplementing quantitative forecasts
- Forecasting **new product demand**

◆ A. Survey Techniques:

- Business investment plans
- Expected sales/inventory changes
- Consumer expenditure plans

◆ B. Opinion Polls:

- Executive opinions (Delphi method)
- Sales force expectations
- Consumer intentions

✓ **Strength:** Useful in anticipating spending

✗ **Weakness:** May be biased, affected by events, not liked due to privacy/time pressure

◆ 3. Naïve Forecasting – Time Series Analysis

Assumes past patterns continue into the future.

◆ Four Components of Time Series:

1. **Secular Trend** – long-run growth or decline
2. **Cyclical Fluctuations** – economic cycles
3. **Seasonal Variations** – regular seasonal changes
4. **Irregular Variations** – random, unpredictable factors

◆ 4. Trend Projection Techniques

◆ A. Linear Trend Equation:

$$S_t = S_0 + bt$$

- S_t : sales at time t
- S_0 : sales at base time
- b : constant absolute growth



◆ B. Constant Growth Rate:

$$S_t = S_0(1 + g)^t$$

- g : constant growth rate
- **Log Transformation:**

$$\ln S_t = \ln S_0 + t \cdot \ln(1 + g)$$

◆ 5. Seasonal Variations – Ratio to Trend Method

◆ Formula:

$$\text{Adjusted Forecast} = \text{Trend Forecast} \times \text{Seasonal Adjustment}$$

◆ Example:

- Trend for 2004 Q1:

$$11.90 + (0.394)(17) = 18.60$$

- Seasonal Adjustment: 0.8869

$$18.60 \times 0.8869 = 16.50$$

◆ 6. Dummy Variable Method for Seasonality

Use **dummy variables** to capture seasonal effects:

$$S_t = a + b_1D_1 + b_2D_2 + b_3D_3 + ct$$

- D_1 : 1 if Q1, 0 otherwise
- D_2 : 1 if Q2, 0 otherwise
- D_3 : 1 if Q3, 0 otherwise
- Q4 is the **base quarter**

◆ Example:

$$S_t = 12.75 - 2.375D_1 + 1.75D_2 - 2.125D_3 + 0.375t$$

- $R^2 = 0.99 \rightarrow$ very accurate fit

◆ 7. Limitations of Time Series Analysis

- Assumes **past trends repeat**
- Cannot predict **turning points**
- Doesn't examine **underlying causes**
- Best used **with other methods**

◆ 8. Smoothing Techniques

◆ A. Moving Averages

Forecast = Average of previous w values

- Larger w = more smoothing
- Works best for random variation

◆ B. Exponential Smoothing

$$F_t = wA_{t-1} + (1 - w)F_{t-1}$$

- F_t : forecast for time t
- A_{t-1} : actual at time $t-1$
- w : smoothing constant ($0 < w < 1$)
- Recent values get more weight

◆ C. RMSE – Accuracy Check

$$\text{Root Mean Square Error (RMSE)} = \sqrt{\frac{\sum(A_t - F_t)^2}{n}}$$

- Used to compare forecasting methods



◆ 9. Barometric Methods (Leading Indicators)

Use economic indicators to predict future trends:

◆ Types:

- **Leading indicators:** change before economy does
- **Coincident indicators:** change with the economy
- **Lagging indicators:** change after the economy

◆ Composite Index:

- Weighted average of multiple leading indicators
- Interpreted by % change

◆ Diffusion Index:

$$\text{Diffusion Index} = \frac{\text{Number of indicators increasing}}{\text{Total indicators}}$$

✓ **Strength:** Predicts direction

✗ **Weakness:** Uncertain magnitude, variable lead times

◆ 10. Forecasting Rule of Thumb

- If Leading Index declines 3 times in a row, a recession is likely
- Predicted all recessions since 1948
- ⚠ Sometimes gives false alarms
- Difficult to identify the best indicators for all industries

✓ Summary Table of Key Formulas:

Method	Formula	Purpose
Linear Trend	$S_t = S_0 + bt$	Project absolute growth
Constant Growth Rate	$S_t = S_0(1 + g)^t$	Project percentage growth
Log Growth Estimation	$\ln S_t = \ln S_0 + t \ln(1 + g)$	Estimate growth rate
Adjusted Forecast	Trend \times Seasonal Factor	Include seasonality
Exponential Smoothing	$F_t = wA_{t-1} + (1 - w)F_{t-1}$	Smooth random variation
RMSE	$\sqrt{\frac{\sum(A_t - F_t)^2}{n}}$	Accuracy measure
Diffusion Index	$\frac{\text{Number Increasing}}{\text{Total}}$	Track movement in multiple indicators