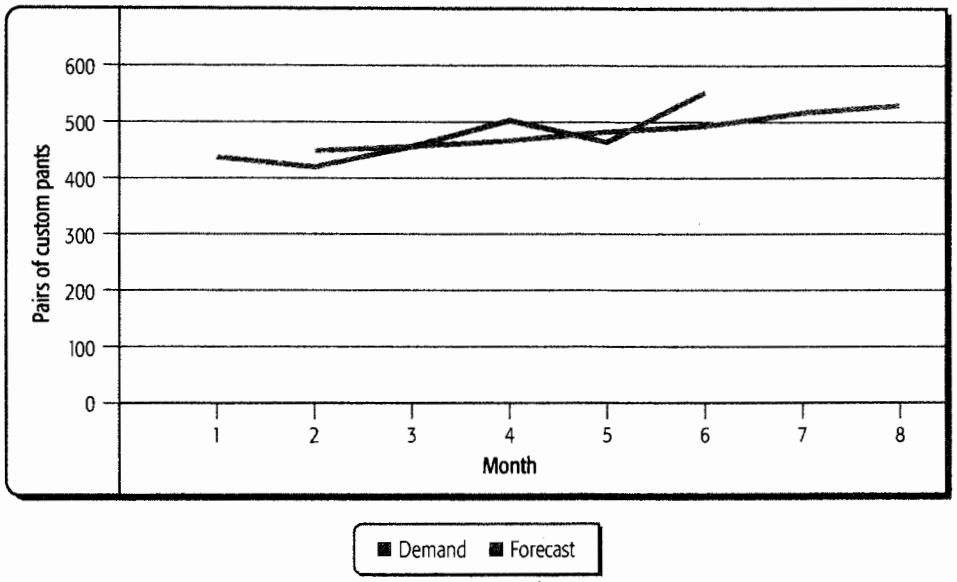

FIGURE 5.13 Graph of Demand versus Forecast

SOLVED PROBLEM 3

Seasonal Forecasting

7-Day Dry Cleaners is situated in a major city and is open seven days per week. The cleaner experiences a very seasonal demand, as it varies fairly regularly by day of the week. Use the data in Table 5.16 for the number of customers on each day for the last two weeks to forecast demand for Thursday and Friday of week 3. The data consist of both trend and seasonal components. The forecast with trend component is calculated using the formula $F_t = 421 + 3t$.

TABLE 5.16 Two Weeks of Customer Data for 7-Day Dry Cleaners

	Week 1	Week 2
Monday	500	490
Tuesday	440	400
Wednesday	400	410
Thursday	350	330
Friday	550	600
Saturday	320	400
Sunday	240	317
Total	2,800	2,947
Average	400	421

SOLUTION

1. Calculate the seasonal indices by dividing each day's demand by the average daily demand.

$$\text{Thursday, Week 1: } \frac{350}{400} = 0.88 \qquad \text{Week 2: } \frac{330}{421} = 0.78$$

$$\text{Friday, Week 1: } \frac{550}{400} = 1.38 \qquad \text{Week 2: } \frac{600}{421} = 1.43$$

2. The next step is to take the average of the seasonal indices for each day for the two weeks.

$$\text{Thursday: } \frac{0.88 + 0.78}{2} = 0.83$$

$$\text{Friday: } \frac{1.38 + 1.43}{2} = 1.405$$

3. The last step is to multiply the trend forecast by the seasonal index.

   Thursday: Trend forecast—Thursday is the fourth day; use the trend equation $F_t = 421 + 3t$.

$$F_t = 421 + 3t = 421 + 3 * 4 = 433$$

   Combine the trend forecast and the seasonal index.

$$F_{\text{Th}} = 433 * 0.83 = 359.39$$

   Friday: Trend forecast—Friday is the fifth day.

$$F_t = 421 + 3t = 421 + 3 * 5 = 436$$
$$F_{\text{Fri}} = 436 * 1.405 = 612.58$$

Table 5.17 shows forecasts using this method for each day of week 3.

TABLE 5.17 Forecasts for 7-Day Dry Cleaners

	Week 1	Week 2	Forecast
Monday	500	490	511.75
Tuesday	440	400	437.70
Wednesday	400	410	424.38
Thursday	350	330	359.14
Friday	550	600	612.58
Saturday	320	400	384.15
Sunday	240	317	299.01
Total	2,800	2,947	
Average	400	421	

SOLVED PROBLEM 4

Comparing Forecast Methods Based on Forecast Error

Quantum Electronics employs two forecasting methods for its Gamestation 19 product: an exponential smoothing with $\alpha = 0.6$ and a trend-adjusted exponential smoothing with $\alpha = 0.25$ and $\beta = 0.10$. Calculate CFE, MSE, MAD, and MAPE for the data given in Table 5.18. Based on the scores for these forecast error measures, recommend which of the two forecasting methods should be employed.

9. Smallville Bus System provides public transportation to the residents of Smallville. The maintenance department manages 1,000 buses and faces annual demand for 2,166 tires. The order cost is $50 per order, and the holding cost is $6 per tire. The lead time for an order is 2 weeks, and the standard deviation of demand is 7 tires per week.
   a. What is the optimal order quantity of tires?
   b. What is the optimal number of orders per year?
   c. What is the reorder point if Smallville desires a cycle-service level of 50 percent?
   d. What value of z should be used if Smallville wishes to achieve a cycle-service level of 92 percent?
   e. What should the reorder point be? How much safety stock of tires does this provide?
10. Arnie's Air Conditioners, Inc., manufactures a variety of heating and cooling equipment. The SuperCool model is one of the higher-demand items and is of particular interest because its manufactured cost is $600. Demand for the SuperCool is relatively constant, and demand data for the past 12 weeks is given here. The lead time to manufacture one order of SuperCool is 4 weeks. The holding cost percentage for Arnie's is 16 percent. The setup cost is $20 per order. The company operates 52 weeks per year.

$$\text{Average Demand} = 120 \text{ units/week}$$
$$\sigma_1 = 15 \text{ units/week}$$

   a. Design a continuous review inventory management system for the SuperCool model and calculate the appropriate parameters to control two things: (1) *when* to order and (2) *how much* to order. Assume that Arnie's Air Conditioners wants to maintain an 86 percent cycle-service level.
   b. What effect would increasing the cycle-service level to 94 percent have on customer service and inventory levels? Calculate the change in *numerical* terms, if appropriate.
   c. What effect(s) would a decrease in the lead time from 4 weeks to 2 weeks have, assuming that the company maintains the 86 percent cycle-service level of part *a*?
11. Artists' Advantage sells painting supplies. The most basic brush for watercolors, the T100, sells 2,080 per year. The order cost is $30 per order, and the holding cost is $3.00 per box. The lead time for an order is 3 weeks, and the standard deviation of demand is 6 boxes per week.
   a. What is the optimal order quantity of brushes?
   b. What is the optimal number of orders per year?
   c. Compute the period that most closely matches this EOQ.
   d. What value of z should be used if A1 wishes to achieve a cycle-service level of 98 percent?
   e. Using the period from part *c*, compute the target inventory level T. How much safety stock of brushes does this provide? How does this compare to the safety stock if a continuous review system is used?

CASE STUDY

Dano's Drugstore

Margaret Dano opened her drugstore in 1951 on a busy street corner in a small suburb of Chicago. Originally, the store provided drugs and various other small items primarily to residents of the town. Over the course of decades, the store expanded as the suburbs of Chicago expanded. By 1996, the store had tripled from its original size, occupying 5,000 square feet of space. In the course of this expansion, the store increased its product range, so that in addition to the pharmacy, it offered other items such as snack food, dental care items, suntan lotion, and bug spray. The total breadth of the product line encompassed more than 10,000 items.

As the drugstore grew, managing inventory represented a significant challenge. Margaret has tried numerous systems over the past few years, but most of these have not been very successful. The average item has 75 days' worth of inventory, yet the fill rate of all customer orders is approximately 90 percent. Any item that is out of stock will be backordered (with a rain check provided) upon customer request. In approximately 50 percent of the cases where an item is out of stock, the customer simply buys the item from a competing drugstore. Margaret realizes that the current inventory methods are not working well. In addition, she realizes that her background as a pharmacist may not have properly prepared her for managing the inventory for thousands of items. Furthermore, Margaret would like to take a less active role in her business and spend her winters in Florida. Therefore, she has hired you as a consultant to evaluate and improve the inventory methods for Dano's.

Dano's Drugstore is currently affiliated with a major national drugstore chain that supplies all of the items that Dano's sells. Supplies are delivered weekly in a single shipment on Wednesday afternoon. Dano's must finalize its order by 9:00 a.m. Tuesday morning. The warehouse/service center that Dano's Drugstore orders from has close to a 100 percent fill rate; therefore, it is safe to assume that any orders placed on Tuesday morning will be delivered on Wednesday afternoon. Your initial assignment is to develop an inventory system for three items: (1) Tylenol aspirin caplets, (2) Milky Way candy bars, and (3) Raid rat poison. Demand data for the previous year for each of these three products is given in Exhibits 1 through 3.

The three products sell for $5.99 (Tylenol), $0.75 (Milky Way), and $9.99 (Raid). The profit margins on the three products are 30 percent, 40 percent, and 20 percent, respectively. The cost of placing any order, including stocking the order in the storeroom and on the store's display shelves, is estimated to be $3.

Dano's Drugstore has averaged a 15 percent annual return on assets over the past four years. Margaret has a revolving line of credit at the local bank that allows Dano's to borrow money at 10 percent. Currently, the drugstore has a loan in the amount of $145,000 outstanding. Annual rent for the store is $84,000, insurance is $24,000 per year, and maintenance expenses are approximately $20,000.

The current order policies for each of the three "test" units are as follows:

Tylenol Caplets	Milky Way	Raid Rat
$Q = 600$	$Q = 200$	Order 100 if inventory < 30
P = every 9 weeks	$R = 200$	If forecast > 50, order forecast number for next week

EXHIBIT 1 **Tylenol Aspirin Caplets—Demand for Past Year**

Week	Actual Demand	Week	Actual Demand	Week	Actual Demand	Week	Actual Demand
1	60	14	59	27	64	40	58
2	62	15	59	28	65	41	67
3	58	16	44	29	57	42	68
4	56	17	54	30	68	43	52
5	54	18	60	31	55	44	75
6	68	19	60	32	61	45	55
7	57	20	62	33	61	46	54
8	64	21	62	34	49	47	53
9	62	22	74	35	59	48	61
10	52	23	54	36	61	49	63
11	48	24	62	37	61	50	64
12	72	25	58	38	57	51	60
13	63	26	64	39	65	52	61

EXHIBIT 2 **Milky Way Candy Bars—Demand for Past Year**

Week	Actual Demand	Week	Actual Demand	Week	Actual Demand	Week	Actual Demand
1	150	14	162	27	141	40	145
2	120	15	184	28	159	41	171
3	165	16	151	29	139	42	153
4	121	17	137	30	136	43	147
5	131	18	157	31	168	44	146
6	185	19	128	32	152	45	161
7	144	20	190	33	129	46	153
8	165	21	150	34	152	47	132
9	133	22	150	35	152	48	148
10	157	23	99	36	115	49	159
11	168	24	105	37	160	50	146
12	152	25	174	38	162	51	167
13	145	26	170	39	165	52	163

(*continued*)

EXHIBIT 3 **Raid Rat Spray—Forecasted versus Actual Demand for Past Year**

Week	Forecasted Demand	Actual Demand	Week	Forecasted Demand	Actual Demand	Week	Forecasted Demand	Actual Demand	Week	Forecasted Demand	Actual Demand
1	14	10	14	33	12	27	33	17	40	500	630
2	10	12	15	12	18	28	17	22	41	630	480
3	12	25	16	18	15	29	22	30	42	480	200
4	25	18	17	15	8	30	30	19	43	200	21
5	18	16	18	8	22	31	19	22	44	21	15
6	16	9	19	22	25	32	22	11	45	15	18
7	9	22	20	25	14	33	11	17	46	18	17
8	22	24	21	14	21	34	17	25	47	17	22
9	24	17	22	21	17	35	25	19	48	22	26
10	17	14	23	17	8	36	19	44	49	26	33
11	14	27	24	8	7	37	44	95	50	33	15
12	27	28	25	7	44	38	95	220	51	15	14
13	28	33	26	44	33	39	220	500	52	14	17

QUESTIONS

1. What factors should be considered when developing inventory systems for the 10,000 items carried by Dano's? What are the key differences between items that would affect how their inventory is managed? For example, how should prescription drugs be handled differently from over-the-counter items? Or how do seasonal products differ from more stable products?
2. Develop an inventory system for Tylenol caplets and for Milky Way candy bars. Hint: You will need to choose an appropriate cycle-service level and an appropriate holding cost for each item.
3. Discuss the characteristics of Raid rat spray that might suggest that it should have a different type of inventory system. What factors should be considered in developing a system for Raid?
4. Compare the annual costs for your plan for Tylenol and Milky Way relative to the costs under the current plan. You may want to consider ordering, holding, and stockout costs.