CREDIT AND INVENTORY MANAGEMENT

In April 2004, retailing giant Wal-Mart Stores began using radio-frequency identification (RFID) tags on cases and pallets in a small group of stores in the Dallas area. These high-tech tags are replacing bar codes because they can be read from a distance. Wal-Mart originally required 100 suppliers use RFID tags, but by 2007 that number was expected to grow to the 600 largest suppliers. RFID tag sales are expected to grow from about $1 billion in 2003 to about $4.6 billion in 2007, even though the tags cost less than 20 cents each. So why the rapid growth in a high-tech bar code? Look no further than Wal-Mart for the answer. The company is expected to save billions each year when RFIDs are fully implemented across the company. Specifically, it will save

$6.7 billion in labor costs by eliminating the need to scan each pallet individually, $600 million by reducing out-of-stock items, $575 million by reducing theft, $300 million with better tracking, and $180 million by reducing inventory. The total cost savings for Wal-Mart is estimated at $8.35 *billion* per year! As this example suggests, proper management of inventory can have a significant impact on the profitability of a company and the value investors place on it.

PART 7

Short-Term Financial Planning and Management

21.1 Credit and Receivables

When a firm sells goods and services, it can demand cash on or before the delivery date or it can extend credit to customers and allow some delay in payment. The next few sections provide an idea of what is involved in the firm's decision to grant credit to its customers. Granting credit is making an investment in a customer—an investment tied to the sale of a product or service.

Why do firms grant credit? Not all do, but the practice is extremely common. The obvious reason is that offering credit is a way of stimulating sales. The costs associated with granting credit are not trivial. First, there is the chance that the customer will not pay. Second, the firm has to bear the costs of carrying the receivables. The credit policy decision thus involves a trade-off between the benefits of increased sales and the costs of granting credit.

From an accounting perspective, when credit is granted, an account receivable is created. Such receivables include credit to other firms, called *trade credit,* and credit granted consumers, called *consumer credit.* About one-sixth of all the assets of U.S. industrial firms are in the form of accounts receivable, so receivables obviously represent a major investment of financial resources by U.S. businesses.

COMPONENTS OF CREDIT POLICY

If a firm decides to grant credit to its customers, then it must establish procedures for extending credit and collecting. In particular, the firm will have to deal with the following components of credit policy:

1. **Terms of sale**: The terms of sale establish how the firm proposes to sell its goods and services. A basic decision is whether the firm will require cash or will extend credit. If the firm does grant credit to a customer, the terms of sale will specify (perhaps implicitly) the credit period, the cash discount and discount period, and the type of credit instrument.
2. **Credit analysis**: In granting credit, a firm determines how much effort to expend trying to distinguish between customers who will pay and customers who will not pay. Firms use a number of devices and procedures to determine the probability that customers will not pay; put together, these are called credit analysis.
3. **Collection policy**: After credit has been granted, the firm has the potential problem of collecting the cash, for which it must establish a collection policy.

In the next several sections, we will discuss these components of credit policy that collectively make up the decision to grant credit.

THE CASH FLOWS FROM GRANTING CREDIT

In a previous chapter, we described the accounts receivable period as the time it takes to collect on a sale. There are several events that occur during this period. These events are the cash flows associated with granting credit, and they can be illustrated with a cash flow diagram:

terms of sale
The conditions under which a firm sells its goods and services for cash or credit.

credit analysis
The process of determining the probability that customers will not pay.

collection policy
The procedures followed by a firm in collecting accounts receivable.

These companies assist businesses with working capital management: www.treasury.pncbank.com *and* www.treasurystrat.com/corp.

The Cash Flows of Granting Credit

As our time line indicates, the typical sequence of events when a firm grants credit is as follows: (1) The credit sale is made, (2) the customer sends a check to the firm, (3) the firm deposits the check, and (4) the firm's account is credited for the amount of the check.

Based on our discussion in the previous chapter, it is apparent that one of the factors influencing the receivables period is float. Thus, one way to reduce the receivables period is to speed up the check mailing, processing, and clearing. Because we cover this subject elsewhere, we will ignore float in the subsequent discussion and focus on what is likely to be the major determinant of the receivables period: credit policy.

THE INVESTMENT IN RECEIVABLES

The investment in accounts receivable for any firm depends on the amount of credit sales and the average collection period. For example, if a firm's average collection period, ACP, is 30 days, then at any given time, there will be 30 days' worth of sales outstanding. If credit sales run $1,000 per day, the firm's accounts receivable will then be equal to 30 days $\times$ $1,000 per day $=$ $30,000, on average.

As our example illustrates, a firm's receivables generally will be equal to its average daily sales multiplied by its average collection period, or ACP:

$$\text{Accounts receivable} = \text{Average daily sales} \times \text{ACP} \qquad \text{[21.1]}$$

Thus, a firm's investment in accounts receivable depends on factors that influence credit sales and collections.

We have seen the average collection period in various places, including Chapter 3 and Chapter 19. Recall that we use the terms *days' sales in receivables, receivables period,* and *average collection period* interchangeably to refer to the length of time it takes for the firm to collect on a sale.

> ### Concept Questions
>
> **21.1a** What are the basic components of credit policy?
> **21.1b** What are the basic components of the terms of sale if a firm chooses to sell on credit?

Terms of the Sale   21.2

As we described previously, the terms of a sale are made up of three distinct elements:

1. The period for which credit is granted (the credit period).
2. The cash discount and the discount period.
3. The type of credit instrument.

Within a given industry, the terms of sale are usually fairly standard, but these terms vary quite a bit across industries. In many cases, the terms of sale are remarkably archaic and literally date to previous centuries. Organized systems of trade credit that resemble current practice can be easily traced to the great fairs of medieval Europe, and they almost surely existed long before then.

THE BASIC FORM

The easiest way to understand the terms of sale is to consider an example. Terms such as 2/10, net 60 are common. This means that customers have 60 days from the invoice date (discussed a bit later) to pay the full amount; however, if payment is made within 10 days, a 2 percent cash discount can be taken.

Consider a buyer who places an order for $1,000, and assume that the terms of the sale are 2/10, net 60. The buyer has the option of paying $1,000 × (1 − .02) = $980 in 10 days, or paying the full $1,000 in 60 days. If the terms are stated as just net 30, then the customer has 30 days from the invoice date to pay the entire $1,000, and no discount is offered for early payment.

In general, credit terms are interpreted in the following way:

<take this discount off the invoice price> / <if you pay in this many days>,

<else pay the full invoice amount in this many days>

For more about the credit process for small businesses, see www.newyorkfed.org/education/addpub/credit.html.

Thus, 5/10, net 45 means take a 5 percent discount from the full price if you pay within 10 days, or else pay the full amount in 45 days.

THE CREDIT PERIOD

credit period
The length of time for which credit is granted.

The **credit period** is the basic length of time for which credit is granted. The credit period varies widely from industry to industry, but it is almost always between 30 and 120 days. If a cash discount is offered, then the credit period has two components: the net credit period and the cash discount period.

The net credit period is the length of time the customer has to pay. The cash discount period is the time during which the discount is available. With 2/10, net 30, for example, the net credit period is 30 days and the cash discount period is 10 days.

invoice
A bill for goods or services provided by the seller to the purchaser.

The Invoice Date   The invoice date is the beginning of the credit period. An **invoice** is a written account of merchandise shipped to the buyer. For individual items, by convention, the invoice date is usually the shipping date or the billing date, *not* the date on which the buyer receives the goods or the bill.

Many other arrangements exist. For example, the terms of sale might be ROG, for *receipt of goods.* In this case, the credit period starts when the customer receives the order. This might be used when the customer is in a remote location.

With EOM dating, all sales made during a particular month are assumed to be made at the end of that month. This is useful when a buyer makes purchases throughout the month, but the seller bills only once a month.

For example, terms of 2/10th, EOM tell the buyer to take a 2 percent discount if payment is made by the 10th of the month; otherwise the full amount is due. Confusingly, the end of the month is sometimes taken to be the 25th day of the month. MOM, for middle of month, is another variation.

Seasonal dating is sometimes used to encourage sales of seasonal products during the off-season. A product sold primarily in the summer (suntan oil?) can be shipped in January with credit terms of 2/10, net 30. However, the invoice might be dated May 1 so that the credit period actually begins at that time. This practice encourages buyers to order early.

Length of the Credit Period   Several factors influence the length of the credit period. Two important ones are the *buyer's* inventory period and operating cycle. All else equal, the shorter these are, the shorter the credit period will be.

From Chapter 19, the operating cycle has two components: the inventory period and the receivables period. The buyer's inventory period is the time it takes the buyer to acquire inventory (from us), process it, and sell it. The buyer's receivables period is the time it then takes the buyer to collect on the sale. Note that the credit period we offer is effectively the buyer's payables period.

By extending credit, we finance a portion of our buyer's operating cycle and thereby shorten that buyer's cash cycle (see Figure 19.1). If our credit period exceeds the buyer's inventory period, then we are financing not only the buyer's inventory purchases, but part of the buyer's receivables as well.

Furthermore, if our credit period exceeds our buyer's operating cycle, then we are effectively providing financing for aspects of our customer's business beyond the immediate purchase and sale of our merchandise. The reason is that the buyer effectively has a loan from us even after the merchandise is resold, and the buyer can use that credit for other purposes. For this reason, the length of the buyer's operating cycle is often cited as an appropriate upper limit to the credit period.

There are a number of other factors that influence the credit period. Many of these also influence our customer's operating cycles; so, once again, these are related subjects. Among the most important are these:

1. *Perishability and collateral value*: Perishable items have relatively rapid turnover and relatively low collateral value. Credit periods are thus shorter for such goods. For example, a food wholesaler selling fresh fruit and produce might use net seven days. Alternatively, jewelry might be sold for 5/30, net four months.

2. *Consumer demand*: Products that are well established generally have more rapid turnover. Newer or slow-moving products will often have longer credit periods associated with them to entice buyers. Also, as we have seen, sellers may choose to extend much longer credit periods for off-season sales (when customer demand is low).

3. *Cost, profitability, and standardization*: Relatively inexpensive goods tend to have shorter credit periods. The same is true for relatively standardized goods and raw materials. These all tend to have lower markups and higher turnover rates, both of which lead to shorter credit periods. However, there are exceptions. Auto dealers, for example, generally pay for cars as they are received.

4. *Credit risk*: The greater the credit risk of the buyer, the shorter the credit period is likely to be (if credit is granted at all).

5. *Size of the account*: If an account is small, the credit period may be shorter because small accounts cost more to manage, and the customers are less important.

6. *Competition*: When the seller is in a highly competitive market, longer credit periods may be offered as a way of attracting customers.

7. *Customer type*: A single seller might offer different credit terms to different buyers. A food wholesaler, for example, might supply groceries, bakeries, and restaurants. Each group would probably have different credit terms. More generally, sellers often have both wholesale and retail customers, and they frequently quote different terms to the two types.

CASH DISCOUNTS

As we have seen, **cash discounts** are often part of the terms of sale. The practice of granting discounts for cash purchases in the United States dates to the Civil War and is widespread today. One reason discounts are offered is to speed up the collection of receivables.

cash discount
A discount given to induce prompt payment. Also, *sales discount.*

This will have the effect of reducing the amount of credit being offered, and the firm must trade this off against the cost of the discount.

Notice that when a cash discount is offered, the credit is essentially free during the discount period. The buyer pays for the credit only after the discount expires. With 2/10, net 30, a rational buyer either pays in 10 days to make the greatest possible use of the free credit or pays in 30 days to get the longest possible use of the money in exchange for giving up the discount. By giving up the discount, the buyer effectively gets $30 - 10 = 20$ days' credit.

Another reason for cash discounts is that they are a way of charging higher prices to customers that have had credit extended to them. In this sense, cash discounts are a convenient way of charging for the credit granted to customers.

Visit the National Association of Credit Management at www.nacm.org.

Cost of the Credit   In our examples, it might seem that the discounts are rather small. With 2/10, net 30, for example, early payment gets the buyer only a 2 percent discount. Does this provide a significant incentive for early payment? The answer is yes because the implicit interest rate is extremely high.

To see why the discount is important, we will calculate the cost to the buyer of not paying early. To do this, we will find the interest rate that the buyer is effectively paying for the trade credit. Suppose the order is for $1,000. The buyer can pay $980 in 10 days or wait another 20 days and pay $1,000. It's obvious that the buyer is effectively borrowing $980 for 20 days and that the buyer pays $20 in interest on the "loan." What's the interest rate?

This interest is ordinary discount interest, which we discussed in Chapter 5. With $20 in interest on $980 borrowed, the rate is $20/980 = 2.0408\%$. This is relatively low, but remember that this is the rate per 20-day period. There are $365/20 = 18.25$ such periods in a year; so, by not taking the discount, the buyer is paying an effective annual rate (EAR) of:

$$\text{EAR} = 1.020408^{18.25} - 1 = 44.6\%$$

From the buyer's point of view, this is an expensive source of financing!

Given that the interest rate is so high here, it is unlikely that the seller benefits from early payment. Ignoring the possibility of default by the buyer, the decision of a customer to forgo the discount almost surely works to the seller's advantage.

Trade Discounts   In some circumstances, the discount is not really an incentive for early payment but is instead a *trade discount,* a discount routinely given to some type of buyer. For example, with our 2/10th, EOM terms, the buyer takes a 2 percent discount if the invoice is paid by the 10th, but the bill is considered due on the 10th, and overdue after that. Thus, the credit period and the discount period are effectively the same, and there is no reward for paying before the due date.

The Cash Discount and the ACP   To the extent that a cash discount encourages customers to pay early, it will shorten the receivables period and, all other things being equal, reduce the firm's investment in receivables.

For example, suppose a firm currently has terms of net 30 and an average collection period (ACP) of 30 days. If it offers terms of 2/10, net 30, then perhaps 50 percent of its customers (in terms of volume of purchases) will pay in 10 days. The remaining customers will still take an average of 30 days to pay. What will the new ACP be? If the firm's annual sales are $15 million (before discounts), what will happen to the investment in receivables?

If half of the customers take 10 days to pay and half take 30, then the new average collection period will be:

$$\text{New ACP} = .50 \times 10 \text{ days} + .50 \times 30 \text{ days} = 20 \text{ days}$$

The ACP thus falls from 30 days to 20 days. Average daily sales are $15 million/365 = $41,096 per day. Receivables will thus fall by $41,096 × 10 = $410,960.

CREDIT INSTRUMENTS

The **credit instrument** is the basic evidence of indebtedness. Most trade credit is offered on *open account.* This means that the only formal instrument of credit is the invoice, which is sent with the shipment of goods and which the customer signs as evidence that the goods have been received. Afterward, the firm and its customers record the exchange on their books of account.

At times, the firm may require that the customer sign a *promissory note.* This is a basic IOU and might be used when the order is large, when there is no cash discount involved, or when the firm anticipates a problem in collections. Promissory notes are not common, but they can eliminate possible controversies later about the existence of debt.

One problem with promissory notes is that they are signed after delivery of the goods. One way to obtain a credit commitment from a customer before the goods are delivered is to arrange a *commercial draft.* Typically, the firm draws up a commercial draft calling for the customer to pay a specific amount by a specified date. The draft is then sent to the customer's bank with the shipping invoices.

If immediate payment is required on the draft, it is called a *sight draft.* If immediate payment is not required, then the draft is a *time draft.* When the draft is presented and the buyer "accepts" it, meaning that the buyer promises to pay it in the future, then it is called a *trade acceptance* and is sent back to the selling firm. The seller can then keep the acceptance or sell it to someone else. If a bank accepts the draft, meaning that the bank is guaranteeing payment, then the draft becomes a *banker's acceptance.* This arrangement is common in international trade, and banker's acceptances are actively traded in the money market.

A firm can also use a conditional sales contract as a credit instrument. With such an arrangement, the firm retains legal ownership of the goods until the customer has completed payment. Conditional sales contracts usually are paid in installments and have an interest cost built into them.

credit instrument
The evidence of indebtedness.

Concept Questions

21.2a What considerations enter the determination of the terms of sale?

21.2b Explain what terms of "3/45, net 90" mean. What is the effective interest rate?

Analyzing Credit Policy 21.3

In this section, we take a closer look at the factors that influence the decision to grant credit. Granting credit makes sense only if the NPV from doing so is positive. We thus need to look at the NPV of the decision to grant credit.

CREDIT POLICY EFFECTS

In evaluating credit policy, there are five basic factors to consider:

1. *Revenue effects*: If the firm grants credit, then there will be a delay in revenue collections as some customers take advantage of the credit offered and pay later. However, the firm may be able to charge a higher price if it grants credit and it may be able to increase the quantity sold. Total revenues may thus increase.

2. *Cost effects*: Although the firm may experience delayed revenues if it grants credit, it will still incur the costs of sales immediately. Whether the firm sells for cash or credit, it will still have to acquire or produce the merchandise (and pay for it).

3. *The cost of debt*: When the firm grants credit, it must arrange to finance the resulting receivables. As a result, the firm's cost of short-term borrowing is a factor in the decision to grant credit.[1]

4. *The probability of nonpayment*: If the firm grants credit, some percentage of the credit buyers will not pay. This can't happen, of course, if the firm sells for cash.

5. *The cash discount*: When the firm offers a cash discount as part of its credit terms, some customers will choose to pay early to take advantage of the discount.

EVALUATING A PROPOSED CREDIT POLICY

To illustrate how credit policy can be analyzed, we will start with a relatively simple case. Locust Software has been in existence for two years, and it is one of several successful firms that develop computer programs. Currently, Locust sells for cash only.

Locust is evaluating a request from some major customers to change its current policy to net one month (30 days). To analyze this proposal, we define the following:

P = Price per unit

v = Variable cost per unit

Q = Current quantity sold per month

Q' = Quantity sold under new policy

R = Monthly required return

For now, we ignore discounts and the possibility of default. Also, we ignore taxes because they don't affect our conclusions.

NPV of Switching Policies   To illustrate the NPV of switching credit policies, suppose we have the following for Locust:

P = $49

v = $20

Q = 100

Q' = 110

If the required return, R, is 2 percent per month, should Locust make the switch?

Currently, Locust has monthly sales of $P \times Q$ = $4,900. Variable costs each month are $v \times Q$ = $2,000, so the monthly cash flow from this activity is:

$$\text{Cash flow with old policy} = (P - v)Q$$
$$= (\$49 - 20) \times 100 \qquad \text{[21.2]}$$
$$= \$2,900$$

This is not the total cash flow for Locust, of course, but it is all that we need to look at because fixed costs and other components of cash flow are the same whether or not the switch is made.

---

[1]The cost of short-term debt is not necessarily the required return on receivables, although it is commonly assumed to be. As always, the required return on an investment depends on the risk of the investment, not the source of the financing. The *buyer's* cost of short-term debt is closer in spirit to the correct rate. We will maintain the implicit assumption that the seller and the buyer have the same short-term debt cost. In any case, the time periods in credit decisions are relatively short, so a relatively small error in the discount rate will not have a large effect on our estimated NPV.

If Locust does switch to net 30 days on sales, then the quantity sold will rise to $Q' = 110$. Monthly revenues will increase to $P \times Q'$, and costs will be $v \times Q'$. The monthly cash flow under the new policy will thus be:

$$\text{Cash flow with new policy} = (P - v)\, Q'$$
$$= (\$49 - 20) \times 110 \qquad \text{[21.3]}$$
$$= \$3,190$$

Going back to Chapter 10, we know that the relevant incremental cash flow is the difference between the new and old cash flows:

$$\text{Incremental cash inflow} = (P - v)(Q' - Q)$$
$$= (\$49 - 20) \times (110 - 100)$$
$$= \$290$$

This says that the benefit each month of changing policies is equal to the gross profit per unit sold, $P - v = \$29$, multiplied by the increase in sales, $Q' - Q = 10$. The present value of the future incremental cash flows is thus:

$$PV = [(P - v)(Q' - Q)]/R \qquad \text{[21.4]}$$

For Locust, this present value works out to be:

$$PV = (\$29 \times 10)/.02 = \$14,500$$

Notice that we have treated the monthly cash flow as a perpetuity because the same benefit will be realized each month forever.

Now that we know the benefit of switching, what's the cost? There are two components to consider. First, because the quantity sold will rise from Q to Q', Locust will have to produce $Q' - Q$ more units at a cost of $v(Q' - Q) = \$20 \times (110 - 100) = \$200$. Second, the sales that would have been collected this month under the current policy ($P \times Q = \$4,900$) will not be collected. Under the new policy, the sales made this month won't be collected until 30 days later. The cost of the switch is the sum of these two components:

$$\text{Cost of switching} = PQ + v(Q' - Q) \qquad \text{[21.5]}$$

For Locust, this cost would be $\$4,900 + 200 = \$5,100$.

Putting it all together, we see that the NPV of the switch is:

$$\text{NPV of switching} = -[PQ + v(Q' - Q)] + [(P - v)(Q' - Q)]/R \qquad \text{[21.6]}$$

For Locust, the cost of switching is $\$5,100$. As we saw earlier, the benefit is $\$290$ per month, forever. At 2 percent per month, the NPV is:

$$NPV = -\$5,100 + 290/.02$$
$$= -\$5,100 + 14,500$$
$$= \$9,400$$

Therefore, the switch is very profitable.

We'd Rather Fight Than Switch	EXAMPLE 21.1

Suppose a company is considering a switch from all cash to net 30, but the quantity sold is not expected to change. What is the NPV of the switch? Explain.

In this case, $Q' - Q$ is zero, so the NPV is just $-PQ$. What this says is that the effect of the switch is simply to postpone one month's collections forever, with no benefit from doing so.

A Break-Even Application   Based on our discussion thus far, the key variable for Locust is $Q' - Q$, the increase in unit sales. The projected increase of 10 units is only an estimate, so there is some forecasting risk. Under the circumstances, it's natural to wonder what increase in unit sales is necessary to break even.

Earlier, the NPV of the switch was defined as:

$$NPV = -[PQ + v(Q' - Q)] + [(P - v)(Q' - Q)]/R$$

We can calculate the break-even point explicitly by setting the NPV equal to zero and solving for $(Q' - Q)$:

$$NPV = 0 = -[PQ + v(Q' - Q)] + [(P - v)(Q' - Q)]/R$$
$$Q' - Q = PQ/[(P - v)/R - v] \qquad [21.7]$$

For Locust, the break-even sales increase is thus:

$$Q' - Q = \$4,900/(29/.02 - 20)$$
$$= 3.43 \text{ units}$$

This tells us that the switch is a good idea as long as Locust is confident that it can sell at least 3.43 more units per month.

Concept Questions

21.3a What are the important effects to consider in a decision to offer credit?

21.3b Explain how to estimate the NPV of a credit policy switch.

21.4 Optimal Credit Policy

So far, we've discussed how to compute net present values for a switch in credit policy. We have not discussed the optimal amount of credit or the optimal credit policy. In principle, the optimal amount of credit is determined by the point at which the incremental cash flows from increased sales are exactly equal to the incremental costs of carrying the increase in investment in accounts receivable.

For business reports on credit, visit www.creditworthy.com.

THE TOTAL CREDIT COST CURVE

The trade-off between granting credit and not granting credit isn't hard to identify, but it is difficult to quantify precisely. As a result, we can only describe an optimal credit policy.

To begin, the carrying costs associated with granting credit come in three forms:

1. The required return on receivables.
2. The losses from bad debts.
3. The costs of managing credit and credit collections.

We have already discussed the first and second of these. The third cost, the cost of managing credit, consists of the expenses associated with running the credit department. Firms that don't grant credit have no such department and no such expense. These three costs will all increase as credit policy is relaxed.

If a firm has a very restrictive credit policy, then all of the associated costs will be low. In this case, the firm will have a "shortage" of credit, so there will be an opportunity cost.

Carrying costs are the cash flows that must be incurred when credit
is granted. They are positively related to the amount of credit extended.

Opportunity costs are the lost sales resulting from refusing credit.
These costs go down when credit is granted.
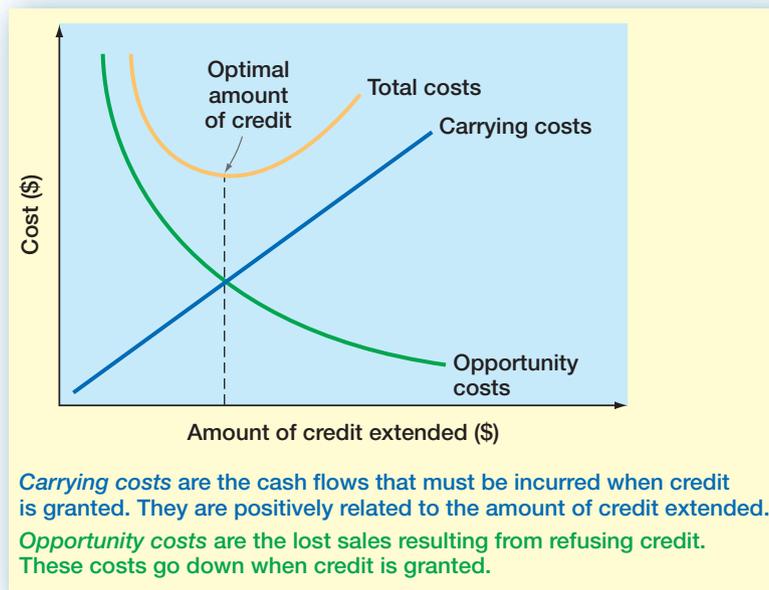
This opportunity cost is the extra potential profit from credit sales that are lost because
credit is refused. This forgone benefit comes from two sources: the increase in quantity
sold, Q' minus Q, and (potentially) a higher price. The opportunity costs go down as credit
policy is relaxed.

The sum of the carrying costs and the opportunity costs of a particular credit policy is
called the total **credit cost curve**. We have drawn such a curve in Figure 21.1. As Figure 21.1
illustrates, there is a point where the total credit cost is minimized. This point corresponds to
the optimal amount of credit or, equivalently, the optimal investment in receivables.

If the firm extends more credit than this minimum, the additional net cash flow from new
customers will not cover the carrying costs of the investment in receivables. If the level of
receivables is below this amount, then the firm is forgoing valuable profit opportunities.

In general, the costs and benefits from extending credit will depend on characteristics
of particular firms and industries. All other things being equal, for example, it is likely that
firms with (1) excess capacity, (2) low variable operating costs, and (3) repeat customers
will extend credit more liberally than other firms. See if you can explain why each of these
characteristics contributes to a more liberal credit policy.

credit cost curve
A graphical representation
of the sum of the carrying
costs and the opportunity
costs of a credit policy.

ORGANIZING THE CREDIT FUNCTION

Firms that grant credit have the expense of running a credit department. In practice, firms
often choose to contract out all or part of the credit function to a factor, an insurance com-
pany, or a captive finance company. Chapter 19 discusses factoring, an arrangement in
which the firm sells its receivables. Depending on the specific arrangement, the factor may
have full responsibility for credit checking, authorization, and collection. Smaller firms may
find such an arrangement cheaper than running a credit department.

Firms that manage internal credit operations are self-insured against default. An alter-
native is to buy credit insurance through an insurance company. The insurance company
offers coverage up to a preset dollar limit for accounts. As you would expect, accounts with
a higher credit rating merit higher insurance limits. This type of insurance is particularly
important for exporters, and government insurance is available for certain types of exports.

captive finance company
A wholly owned subsidiary that handles the credit function for the parent company.

Large firms often extend credit through a **captive finance company**, which is simply a wholly owned subsidiary that handles the credit function for the parent company. Ford Motor Credit (FMC) is a well-known example. Ford sells to car dealers, who in turn sell to customers. FMC finances the dealer's inventory of cars and also finances customers who buy the cars.

Why would a firm choose to set up a separate company to handle the credit function? There are a number of reasons, but a primary one is to separate the production and financing of the firm's products for management, financing, and reporting. For example, the finance subsidiary can borrow in its own name, using its receivables as collateral, and the subsidiary often carries a better credit rating than the parent. This may allow the firm to achieve a lower overall cost of debt than could be obtained if production and financing were commingled.

Concept Questions

21.4a What are the carrying costs of granting credit?

21.4b What are the opportunity costs of not granting credit?

21.4c What is a captive finance subsidiary?

21.5 Credit Analysis

Thus far, we have focused on establishing credit terms. Once a firm decides to grant credit to its customers, it must then establish guidelines for determining who will and who will not be allowed to buy on credit. *Credit analysis* refers to the process of deciding whether or not to extend credit to a particular customer. It usually involves two steps: gathering relevant information and determining creditworthiness.

Credit analysis is important simply because potential losses on receivables can be substantial. Companies report the amount of receivables they expect not to collect on their balance sheets. In 2006, IBM reported that $477 million of accounts receivable were doubtful, and GE reported a staggering $4.5 billion as an allowance for losses.

WHEN SHOULD CREDIT BE GRANTED?

Imagine that a firm is trying to decide whether or not to grant credit to a customer. This decision can get complicated. For example, note that the answer depends on what will happen if credit is refused. Will the customer simply pay cash? Or will the customer not make the purchase at all? To avoid being bogged down by this and other difficulties, we will use some special cases to illustrate the key points.

A One-Time Sale   We start by considering the simplest case. A new customer wishes to buy one unit on credit at a price of P per unit. If credit is refused, the customer will not make the purchase.

Furthermore, we assume that, if credit is granted, then, in one month, the customer will either pay up or default. The probability of the second of these events is π. In this case, the probability (π) can be interpreted as the percentage of *new* customers who will not pay. Our business does not have repeat customers, so this is strictly a one-time sale. Finally, the required return on receivables is R per month, and the variable cost is v per unit.

The analysis here is straightforward. If the firm refuses credit, then the incremental cash flow is zero. If it grants credit, then it spends v (the variable cost) this month and expects to

collect $(1 - \pi)P$ next month. The NPV of granting credit is:

$$NPV = -v + (1 - \pi)P/(1 + R) \qquad [21.8]$$

For example, for Locust Software, this NPV is:

$$NPV = -\$20 + (1 - \pi) \times 49/1.02$$

With, say, a 20 percent rate of default, this works out to be:

$$NPV = -\$20 + .80 \times 49/1.02 = \$18.43$$

Therefore, credit should be granted. Notice that we have divided by $(1 + R)$ here instead of by R because we now assume that this is a one-time transaction.

Our example illustrates an important point. In granting credit to a new customer, a firm risks its variable cost (v). It stands to gain the full price (P). For a new customer, then, credit may be granted even if the default probability is high. For example, the break-even probability in this case can be determined by setting the NPV equal to zero and solving for π:

$$NPV = 0 = -\$20 + (1 - \pi) \times 49/1.02$$
$$1 - \pi = \$20/49 \times 1.02$$
$$\pi = 58.4\%$$

Locust should extend credit as long as there is a $1 - .584 = 41.6\%$ chance or better of collecting. This explains why firms with higher markups tend to have looser credit terms.

This percentage (58.4%) is the maximum acceptable default probability for a *new* customer. If a returning, cash-paying customer wanted to switch to a credit basis, the analysis would be different, and the maximum acceptable default probability would be much lower.

The important difference is that, if we extend credit to a returning customer, we risk the total sales price (P), because this is what we collect if we don't extend credit. If we extend credit to a new customer, we risk only our variable cost.

Repeat Business   A second, very important factor to keep in mind is the possibility of repeat business. We can illustrate this by extending our one-time sale example. We make one important assumption: A new customer who does not default the first time around will remain a customer forever and never default.

If the firm grants credit, it spends v this month. Next month, it gets nothing if the customer defaults, or it gets P if the customer pays. If the customer pays, then the customer will buy another unit on credit and the firm will spend v again. The net cash inflow for the month is thus $P - v$. In every subsequent month, this same $P - v$ will occur as the customer pays for the previous month's order and places a new one.

It follows from our discussion that, in one month, the firm will receive $0 with probability π. With probability $(1 - \pi)$, however, the firm will have a permanent new customer. The value of a new customer is equal to the present value of $(P - v)$ every month forever:

$$PV = (P - v)/R$$

The NPV of extending credit is therefore:

$$NPV = -v + (1 - \pi)(P - v)/R \qquad [21.9]$$

For Locust, this is:

$$NPV = -\$20 + (1 - \pi) \times (49 - 20)/.02$$
$$= -\$20 + (1 - \pi) \times 1,450$$

Even if the probability of default is 90 percent, the NPV is:

$$NPV = -\$20 + .10 \times 1,450 = \$125$$

Locust should extend credit unless default is a virtual certainty. The reason is that it costs only $20 to find out who is a good customer and who is not. A good customer is worth $1,450, however, so Locust can afford quite a few defaults.

Our repeat business example probably exaggerates the acceptable default probability, but it does illustrate that it will often turn out that the best way to do credit analysis is simply to extend credit to almost anyone. It also points out that the possibility of repeat business is a crucial consideration. In such cases, the important thing is to control the amount of credit initially offered to any one customer so that the possible loss is limited. The amount can be increased with time. Most often, the best predictor of whether or not someone will pay in the future is whether or not they have paid in the past.

CREDIT INFORMATION

Web-surfing students should peruse the Dun & Bradstreet home page. This major supplier of credit information can be found at www.dnb.com.

If a firm wants credit information about customers, there are a number of sources. Information sources commonly used to assess creditworthiness include the following:

1. *Financial statements*: A firm can ask a customer to supply financial statements such as balance sheets and income statements. Minimum standards and rules of thumb based on financial ratios like the ones we discussed in Chapter 3 can then be used as a basis for extending or refusing credit.

2. *Credit reports about the customer's payment history with other firms*: Quite a few organizations sell information about the credit strength and credit history of business firms. The best-known and largest firm of this type is Dun & Bradstreet, which provides subscribers with credit reports on individual firms. Experian is another well-known credit-reporting firm. Ratings and information are available for a huge number of firms, including very small ones. Equifax, Transunion, and Experian are the major suppliers of consumer credit information.

3. *Banks*: Banks will generally provide some assistance to their business customers in acquiring information about the creditworthiness of other firms.

4. *The customer's payment history with the firm*: The most obvious way to obtain information about the likelihood of customers not paying is to examine whether they have settled past obligations (and how quickly).

five *Cs* of credit
The five basic credit factors to be evaluated: character, capacity, capital, collateral, and conditions.

CREDIT EVALUATION AND SCORING

There are no magical formulas for assessing the probability that a customer will not pay. In very general terms, the classic **five *Cs* of credit** are the basic factors to be evaluated:

1. *Character*: The customer's willingness to meet credit obligations.
2. *Capacity*: The customer's ability to meet credit obligations out of operating cash flows.
3. *Capital*: The customer's financial reserves.
4. *Collateral*: An asset pledged in the case of default.
5. *Conditions*: General economic conditions in the customer's line of business.

credit scoring
The process of quantifying the probability of default when granting consumer credit.

Credit scoring is the process of calculating a numerical rating for a customer based on information collected; credit is then granted or refused based on the result. For example, a firm might rate a customer on a scale of 1 (very poor) to 10 (very good) on each of the five *C*s of credit using all the information available about the customer. A credit score could then be calculated by totaling these ratings. Based on experience, a firm might choose to grant credit only to customers with a score above, say, 30.

Firms such as credit card issuers have developed statistical models for credit scoring. Usually, all of the legally relevant and observable characteristics of a large pool of customers are studied to find their historic relation to defaults. Based on the results, it is possible to determine the variables that best predict whether a customer will pay and then calculate a credit score based on those variables.

Because credit-scoring models and procedures determine who is and who is not creditworthy, it is not surprising that they have been the subject of government regulation. In particular, the kinds of background and demographic information that can be used in the credit decision are limited.

> **Concept Questions**
>
> **21.5a** What is credit analysis?
> **21.5b** What are the five *C*s of credit?

Collection Policy

<div align="right">

21.6

</div>

Collection policy is the final element in credit policy. Collection policy involves monitoring receivables to spot trouble and obtaining payment on past-due accounts.

MONITORING RECEIVABLES

To keep track of payments by customers, most firms will monitor outstanding accounts. First of all, a firm will normally keep track of its average collection period (ACP) through time. If a firm is in a seasonal business, the ACP will fluctuate during the year; but unexpected increases in the ACP are a cause for concern. Either customers in general are taking longer to pay, or some percentage of accounts receivable are seriously overdue.

To see just how important timely collection of receivables is to investors, consider the case of Art Technology Group (ATG), a company that provides Internet customer relationship management and e-commerce software. In late 2000, ATG announced an unusual sale of accounts receivable to a bank. The sale helped lower ATG's reported September days' sales outstanding, an important indicator of receivables management. However, after this information became public, investors became concerned about the quality of the firm's sales, and ATG's stock sank 18 percent.

The **aging schedule** is a second basic tool for monitoring receivables. To prepare one, the credit department classifies accounts by age.[2] Suppose a firm has $100,000 in receivables. Some of these accounts are only a few days old, but others have been outstanding for quite some time. The following is an example of an aging schedule:

aging schedule
A compilation of accounts receivable by the age of each account.

Aging Schedule		
Age of Account	**Amount**	**Percentage of Total Value of Accounts Receivable**
0–10 days	$ 50,000	50%
11–60 days	25,000	25
61–80 days	20,000	20
Over 80 days	5,000	5
	$100,000	100%

---

[2]Aging schedules are used elsewhere in business such as inventory tracking.

If this firm has a credit period of 60 days, then 25 percent of its accounts are late. Whether or not this is serious depends on the nature of the firm's collections and customers. It is often the case that accounts beyond a certain age are almost never collected. Monitoring the age of accounts is very important in such cases.

Firms with seasonal sales will find the percentages on the aging schedule changing during the year. For example, if sales in the current month are very high, then total receivables will also increase sharply. This means that the older accounts, as a percentage of total receivables, become smaller and might appear less important. Some firms have refined the aging schedule so that they have an idea of how it should change with peaks and valleys in their sales.

COLLECTION EFFORT

A firm usually goes through the following sequence of procedures for customers whose payments are overdue:

1. It sends out a delinquency letter informing the customer of the past-due status of the account.
2. It makes a telephone call to the customer.
3. It employs a collection agency.
4. It takes legal action against the customer.

At times, a firm may refuse to grant additional credit to customers until arrearages are cleared up. This may antagonize a normally good customer, which points to a potential conflict between the collections department and the sales department.

In probably the worst case, the customer files for bankruptcy. When this happens, the credit-granting firm is just another unsecured creditor. The firm can simply wait, or it can sell its receivable. For example, when FoxMeyer Health filed for bankruptcy in August 1996, it owed $20 million to Bristol-Myers Squibb for drug purchases. Once FoxMeyer filed for bankruptcy, Bristol-Myers tried to sell its receivable at a discount. The purchaser would then have been the creditor in the bankruptcy proceedings and would have gotten paid when the bankruptcy was settled. Similar trade claims against FoxMeyer initially traded as high as 49 cents on the dollar, but settled to about 20 cents less than a month later. Thus, if Bristol-Myers had cashed out at that price, it would have sold its $20 million claim for about $4 million, a hefty discount. Of course, Bristol-Myers would have gotten the money immediately rather than waiting for an uncertain future amount.

> **Concept Questions**
>
> **21.6a** What tools can a manager use to monitor receivables?
> **21.6b** What is an aging schedule?

21.7 Inventory Management

Like receivables, inventories represent a significant investment for many firms. For a typical manufacturing operation, inventories will often exceed 15 percent of assets. For a retailer, inventories could represent more than 25 percent of assets. From our discussion in Chapter 19, we know that a firm's operating cycle is made up of its inventory period and

its receivables period. This is one reason for considering credit and inventory policy in the same chapter. Beyond this, both credit policy and inventory policy are used to drive sales, and the two must be coordinated to ensure that the process of acquiring inventory, selling it, and collecting on the sale proceeds smoothly. For example, changes in credit policy designed to stimulate sales must be accompanied by planning for adequate inventory.

THE FINANCIAL MANAGER AND INVENTORY POLICY

Despite the size of a typical firm's investment in inventories, the financial manager of a firm will not normally have primary control over inventory management. Instead, other functional areas such as purchasing, production, and marketing will usually share decision-making authority regarding inventory. Inventory management has become an increasingly important specialty in its own right, and financial management will often only have input into the decision. For this reason, we will just survey some basics of inventory and inventory policy.

INVENTORY TYPES

Visit the Society for Inventory Management Benchmarking Analysis at www.simba.org.

For a manufacturer, inventory is normally classified into one of three categories. The first category is *raw material.* This is whatever the firm uses as a starting point in its production process. Raw materials might be something as basic as iron ore for a steel manufacturer or something as sophisticated as disk drives for a computer manufacturer.

The second type of inventory is *work-in-progress,* which is just what the name suggests—unfinished product. How big this portion of inventory is depends in large part on the length of the production process. For an airframe manufacturer, for example, work-in-progress can be substantial. The third and final type of inventory is *finished goods*—that is, products ready to ship or sell.

Keep in mind three things concerning inventory types. First, the names for the different types can be a little misleading because one company's raw materials can be another's finished goods. For example, going back to our steel manufacturer, iron ore would be a raw material, and steel would be the final product. An auto body panel stamping operation will have steel as its raw material and auto body panels as its finished goods, and an automobile assembler will have body panels as raw materials and automobiles as finished products.

The second thing to keep in mind is that the various types of inventory can be quite different in terms of their liquidity. Raw materials that are commodity-like or relatively standardized can be easy to convert to cash. Work-in-progress, on the other hand, can be quite illiquid and have little more than scrap value. As always, the liquidity of finished goods depends on the nature of the product.

Finally, a very important distinction between finished goods and other types of inventories is that the demand for an inventory item that becomes a part of another item is usually termed *derived* or *dependent demand* because the firm's need for these inventory types depends on its need for finished items. In contrast, the firm's demand for finished goods is not derived from demand for other inventory items, so it is sometimes said to be *independent.*

INVENTORY COSTS

As we discussed in Chapter 19, two basic types of costs are associated with current assets in general and with inventory in particular. The first of these is *carrying costs.* Here, carrying costs represent all of the direct and opportunity costs of keeping inventory on hand. These include:

1. Storage and tracking costs.
2. Insurance and taxes.

3. Losses due to obsolescence, deterioration, or theft.
4. The opportunity cost of capital on the invested amount.

The sum of these costs can be substantial, ranging roughly from 20 to 40 percent of inventory value per year.

The other type of costs associated with inventory is *shortage costs.* Shortage costs are costs associated with having inadequate inventory on hand. The two components of shortage costs are restocking costs and costs related to safety reserves. Depending on the firm's business, restocking or order costs are either the costs of placing an order with suppliers or the costs of setting up a production run. The costs related to safety reserves are opportunity losses such as lost sales and loss of customer goodwill that result from having inadequate inventory.

A basic trade-off exists in inventory management because carrying costs increase with inventory levels, whereas shortage or restocking costs decline with inventory levels. The basic goal of inventory management is thus to minimize the sum of these two costs. We consider ways to reach this goal in the next section.

Just to give you an idea of how important it is to balance carrying costs with shortage costs, consider the case of restaurant chain Applebee's. In 2003, the company ran out of its signature riblets for its all-you-can-eat promotion. So, in 2004, the company found additional suppliers and increased its inventory. In regrettable planning, the company began promoting its honey barbecue ribs, which were a big hit. At the same time, it removed riblets from its appetizer sampler and dropped pictures of the riblets from the menu. The result was far more riblets in stock than could be sold; so, in July 2004, the company wrote off $2.3 million in riblet inventory (and probably took a lot of ribbing from the competition).

Concept Questions

21.7a What are the different types of inventory?

21.7b What are three things to remember when examining inventory types?

21.7c What is the basic goal of inventory management?

21.8 Inventory Management Techniques

As we described earlier, the goal of inventory management is usually framed as cost minimization. Three techniques are discussed in this section, ranging from the relatively simple to the very complex.

THE ABC APPROACH

The ABC approach is a simple approach to inventory management in which the basic idea is to divide inventory into three (or more) groups. The underlying rationale is that a small portion of inventory in terms of quantity might represent a large portion in terms of inventory value. For example, this situation would exist for a manufacturer that uses some relatively expensive, high-tech components and some relatively inexpensive basic materials in producing its products.

Figure 21.2 illustrates an ABC comparison of items in terms of the percentage of inventory value represented by each group versus the percentage of items represented. As Figure 21.2 shows, the A Group constitutes only 10 percent of inventory by item count,
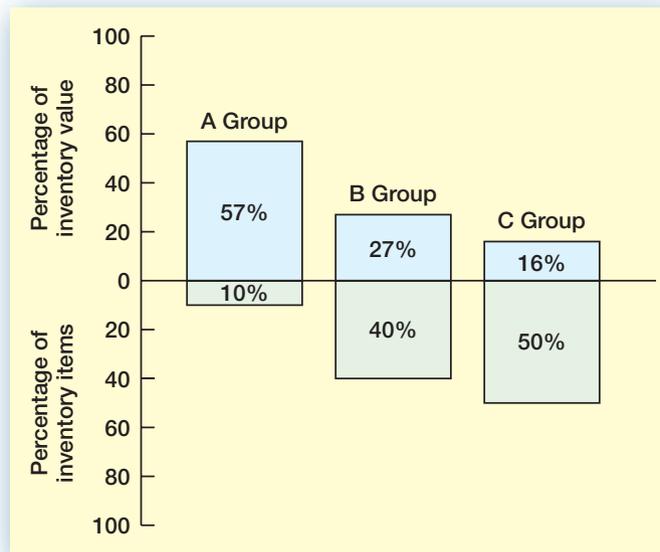
FIGURE 21.2

ABC Inventory Analysis

but it represents over half of the value of inventory. The A Group items are thus monitored closely, and inventory levels are kept relatively low. At the other end, basic inventory items, such as nuts and bolts, also exist; but, because these are crucial and inexpensive, large quantities are ordered and kept on hand. These would be C Group items. The B Group is made up of in-between items.

THE ECONOMIC ORDER QUANTITY MODEL

The economic order quantity (EOQ) model is the best-known approach for explicitly establishing an optimal inventory level. The basic idea is illustrated in Figure 21.3, which plots the various costs associated with holding inventory (on the vertical axis) against inventory levels (on the horizontal axis). As shown, inventory carrying costs rise and restocking costs decrease as inventory levels increase. From our general discussion in Chapter 19 and our discussion of the total credit cost curve in this chapter, the general shape of the total inventory cost curve is familiar. With the EOQ model, we will attempt to specifically locate the minimum total cost point, Q^*.

In our discussion that follows, an important point to keep in mind is that the actual cost of the inventory itself is not included. The reason is that the *total* amount of inventory the firm needs in a given year is dictated by sales. What we are analyzing here is how much the firm should have on hand at any particular time. More precisely, we are trying to determine what order size the firm should use when it restocks its inventory.

Inventory Depletion To develop the EOQ, we will assume that the firm's inventory is sold off at a steady rate until it hits zero. At that point, the firm restocks its inventory back to some optimal level. For example, suppose the Eyssell Corporation starts out today with 3,600 units of a particular item in inventory. Annual sales of this item are 46,800 units, which is about 900 per week. If Eyssell sells off 900 units of inventory each week, all the available inventory will be sold after four weeks, and Eyssell will restock by ordering (or manufacturing) another 3,600 and start over. This selling and restocking process produces a sawtooth pattern for inventory holdings; this pattern is illustrated in Figure 21.4. As the figure shows, Eyssell always starts with 3,600 units in inventory and ends up at zero. On average, then, inventory is half of 3,600, or 1,800 units.

FIGURE 21.3

Costs of Holding
Inventory
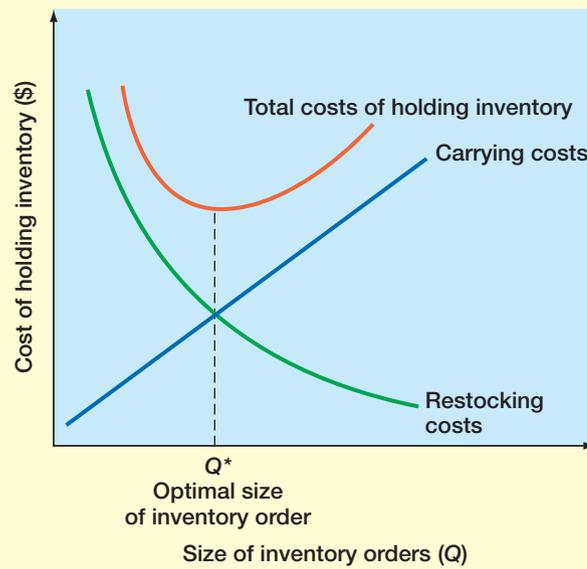
Restocking costs are greatest when the firm holds a small quantity of inventory.
Carrying costs are greatest when there is a large quantity of inventory on hand.
Total costs are the sum of the carrying and restocking costs.

FIGURE 21.4

Inventory Holdings for the
Eyssell Corporation
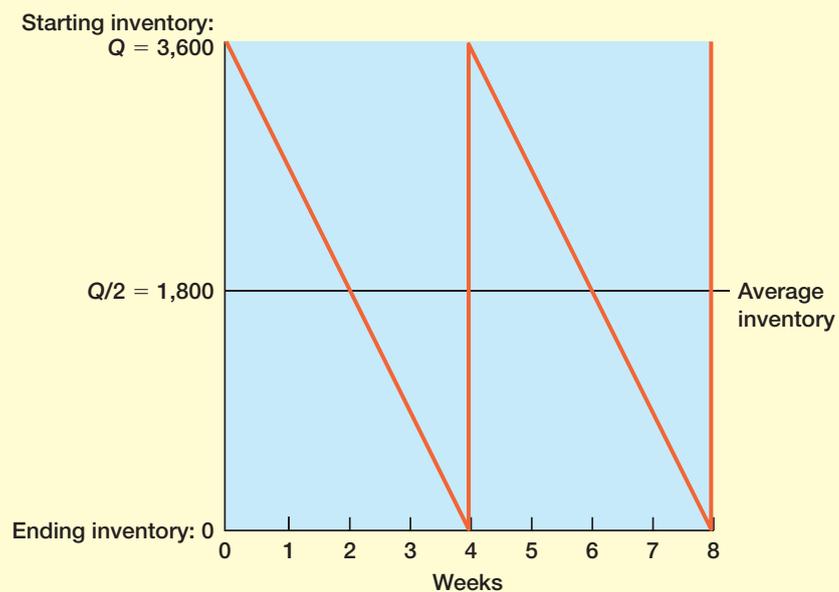
The Eyssell Corporation starts with inventory of 3,600 units. The quantity
drops to zero by the end of the fourth week. The average inventory is
$Q/2 = 3,600/2 = 1,800$ over the period.

The Carrying Costs   As Figure 21.3 illustrates, carrying costs are normally assumed to be directly proportional to inventory levels. Suppose we let Q be the quantity of inventory that Eyssell orders each time (3,600 units); we will call this the *restocking quantity*. Average inventory would then just be $Q/2$, or 1,800 units. If we let CC be the carrying cost per unit per year, Eyssell's total carrying costs will be:

$$\text{Total carrying costs} = \text{Average inventory} \times \text{Carrying costs per unit}$$
$$= (Q/2) \times \text{CC}$$

[21.10]

In Eyssell's case, if carrying costs were $.75 per unit per year, total carrying costs would be the average inventory of 1,800 multiplied by $.75, or $1,350 per year.

The Shortage Costs   For now, we will focus only on the restocking costs. In essence, we will assume that the firm never actually runs short on inventory, so that costs relating to safety reserves are not important. We will return to this issue later.

Restocking costs are normally assumed to be fixed. In other words, every time we place an order, fixed costs are associated with that order (remember that the cost of the inventory itself is not considered here). Suppose we let T be the firm's total unit sales per year. If the firm orders Q units each time, then it will need to place a total of T/Q orders. For Eyssell, annual sales are 46,800, and the order size is 3,600. Eyssell thus places a total of $46,800/3,600 = 13$ orders per year. If the fixed cost per order is F, the total restocking cost for the year would be:

$$\text{Total restocking cost} = \text{Fixed cost per order} \times \text{Number of orders}$$
$$= F \times (T/Q)$$

[21.11]

For Eyssell, order costs might be $50 per order, so the total restocking cost for 13 orders would be $50 \times 13 = 650 per year.

The Total Costs   The total costs associated with holding inventory are the sum of the carrying costs and the restocking costs:

$$\text{Total costs} = \text{Carrying costs} + \text{Restocking costs}$$
$$= (Q/2) \times \text{CC} + F \times (T/Q)$$

[21.12]

Our goal is to find the value of Q, the restocking quantity, that minimizes this cost. To see how we might go about this, we can calculate total costs for some different values of Q. For the Eyssell Corporation, we had carrying costs (CC) of $.75 per unit per year, fixed costs (F) of $50 per order, and total unit sales (T) of 46,800 units. With these numbers, here are some possible total costs (check some of these for practice):

Restocking Quantity (Q)	Carrying Costs (Q/2 × CC)	+	Restocking Costs (F × T/Q)	=	Total Costs
500	$ 187.5		$4,680.0		$4,867.5
1,000	375.0		2,340.0		2,715.0
1,500	562.5		1,560.0		2,122.5
2,000	750.0		1,170.0		1,920.0
2,500	**937.5**		**936.0**		**1,873.5**
3,000	1,125.0		780.0		1,905.0
3,500	1,312.5		668.6		1,981.1

Inspecting the numbers, we see that total costs start out at almost $5,000 and decline to just under $1,900. The cost-minimizing quantity is about 2,500.

To find the cost-minimizing quantity, we can look back at Figure 21.3. What we notice is that the minimum point occurs right where the two lines cross. At this point, carrying costs and restocking costs are the same. For the particular types of costs we have assumed here, this will always be true; so we can find the minimum point just by setting these costs equal to each other and solving for Q^*:

$$\text{Carrying costs} = \text{Restocking costs}$$
$$(Q^*/2) \times \text{CC} = F \times (T/Q^*) \qquad\qquad \text{[21.13]}$$

With a little algebra, we get:

$$Q^{*2} = \frac{2T \times F}{\text{CC}} \qquad\qquad \text{[21.14]}$$

To solve for Q^*, we take the square root of both sides to find:

$$Q^* = \sqrt{\frac{2T \times F}{\text{CC}}} \qquad\qquad \text{[21.15]}$$

economic order quantity (EOQ)
The restocking quantity that minimizes the total inventory costs.

This reorder quantity, which minimizes the total inventory cost, is called the **economic order quantity (EOQ)**. For the Eyssell Corporation, the EOQ is:

$$Q^* = \sqrt{\frac{2T \times F}{\text{CC}}}$$
$$= \sqrt{\frac{(2 \times 46{,}800) \times \$50}{.75}}$$
$$= \sqrt{6{,}240{,}000}$$
$$= 2{,}498 \text{ units}$$

Thus, for Eyssell, the economic order quantity is 2,498 units. At this level, verify that the restocking costs and carrying costs are both $936.75.

EXAMPLE 21.2 | **Carrying Costs**

Thiewes Shoes begins each period with 100 pairs of hiking boots in stock. This stock is depleted each period and reordered. If the carrying cost per pair of boots per year is $3, what are the total carrying costs for the hiking boots?

Inventories always start at 100 items and end up at zero, so average inventory is 50 items. At an annual cost of $3 per item, total carrying costs are $150.

EXAMPLE 21.3 | **Restocking Costs**

In Example 21.2, suppose Thiewes sells a total of 600 pairs of boots in a year. How many times per year does Thiewes restock? Suppose the restocking cost is $20 per order. What are total restocking costs?

Thiewes orders 100 items each time. Total sales are 600 items per year, so Thiewes restocks six times per year, or about every two months. The restocking costs would be 6 orders $\times$ $20 per order = $120.

EXAMPLE 21.4 | **The EOQ**

Based on our previous two examples, what size orders should Thiewes place to minimize costs? How often will Thiewes restock? What are the total carrying and restocking costs? The total costs?

(continued)

We know that the total number of pairs of boots ordered for the year (T) is 600. The restocking cost (F) is $20 per order, and the carrying cost (CC) is $3. We can calculate the EOQ for Thiewes as follows:

$$
\begin{aligned}
\text{EOQ} &= \sqrt{\frac{2T \times F}{\text{CC}}} \\
&= \sqrt{\frac{(2 \times 600) \times \$20}{3}} \\
&= \sqrt{8,000} \\
&= 89.44 \text{ units}
\end{aligned}
$$

Because Thiewes sells 600 pairs per year, it will restock $600/89.44 = 6.71$ times. The total restocking costs will be $\$20 \times 6.71 = \$134.16$. Average inventory will be $89.44/2 = 44.72$. The carrying costs will be $\$3 \times 44.72 = \$134.16$, the same as the restocking costs. The total costs are thus $268.33.

EXTENSIONS TO THE EOQ MODEL

Thus far, we have assumed that a company will let its inventory run down to zero and then reorder. In reality, a company will wish to reorder before its inventory goes to zero, for two reasons. First, by always having at least some inventory on hand, the firm minimizes the risk of a stockout and the resulting losses of sales and customers. Second, when a firm does reorder, there will be some time lag before the inventory arrives. Thus, to finish our discussion of the EOQ, we consider two extensions: safety stocks and reordering points.

Safety Stocks   A *safety stock* is the minimum level of inventory that a firm keeps on hand. Inventories are reordered whenever the level of inventory falls to the safety stock level. The top of Figure 21.5 illustrates how a safety stock can be incorporated into an EOQ model. Notice that adding a safety stock simply means that the firm does not run its inventory all the way down to zero. Other than this, the situation here is identical to that described in our earlier discussion of the EOQ.

Reorder Points   To allow for delivery time, a firm will place orders before inventories reach a critical level. The *reorder points* are the times at which the firm will actually place its inventory orders. These points are illustrated in the middle of Figure 21.5. As shown, the reorder points simply occur some fixed number of days (or weeks or months) before inventories are projected to reach zero.

One of the reasons that a firm will keep a safety stock is to allow for uncertain delivery times. We can therefore combine our reorder point and safety stock discussions in the bottom part of Figure 21.5. The result is a generalized EOQ model in which the firm orders in advance of anticipated needs and also keeps a safety stock of inventory.

MANAGING DERIVED-DEMAND INVENTORIES

The third type of inventory management technique is used to manage derived-demand inventories. As we described earlier, demand for some inventory types is derived from or dependent on other inventory needs. A good example is given by the auto manufacturing industry, in which the demand for finished products depends on consumer demand, marketing programs, and other factors related to projected unit sales. The demand for inventory items such as tires, batteries, headlights, and other components is then completely determined by the number of autos planned. Materials requirements planning and just-in-time inventory management are two methods for managing demand-dependent inventories.

FIGURE 21.5

Safety Stocks and
Reorder Points

A. Safety stocks

With a safety stock, the firm reorders when inventory reaches a minimum level.

B. Reorder points

When there are lags in delivery or production times, the firm reorders when inventory reaches the reorder point.

C. Combined reorder points and safety stocks

By combining safety stocks and reorder points, the firm maintains a buffer against unforeseen events.
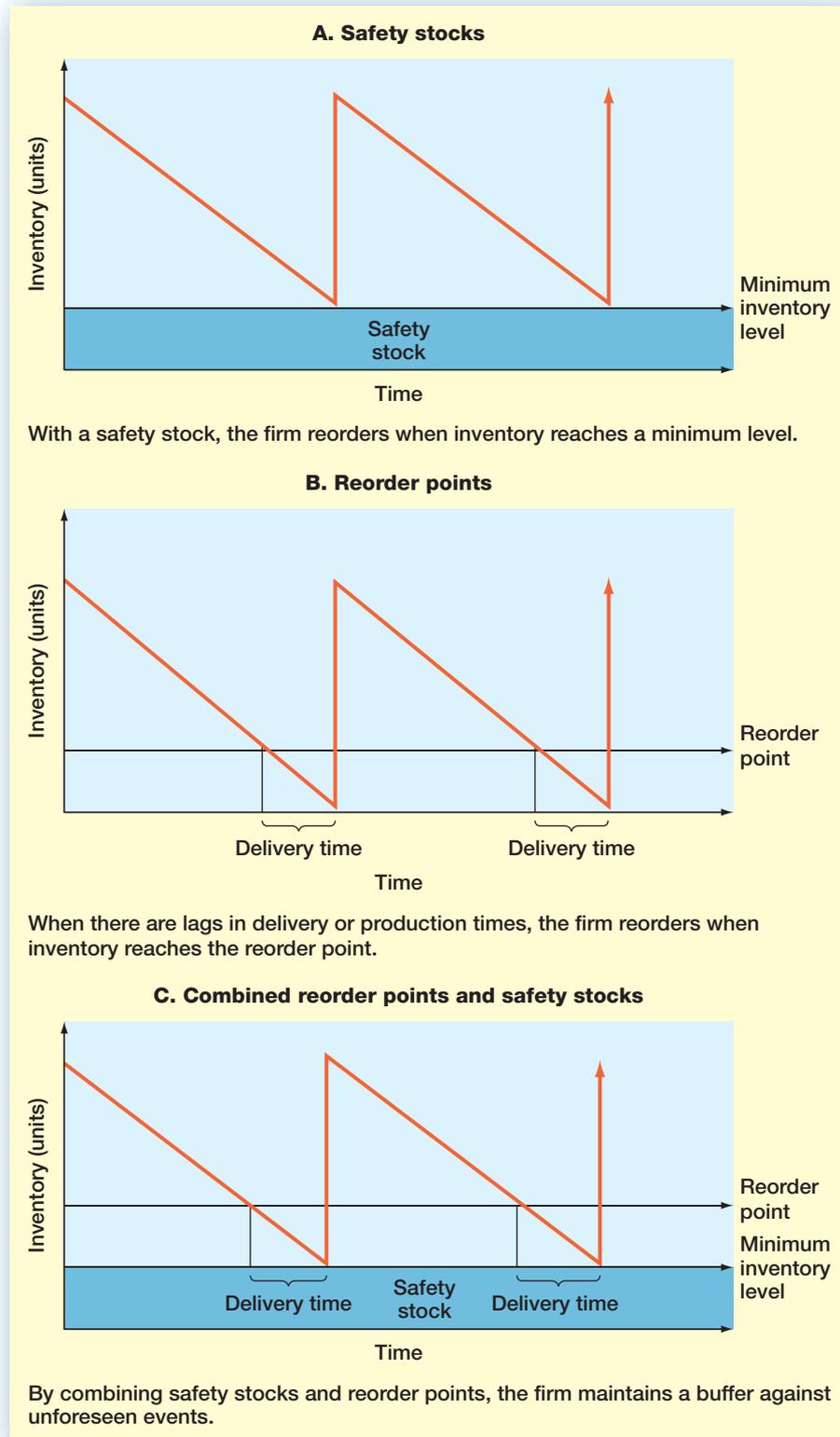
Materials Requirements Planning   Production and inventory specialists have developed computer-based systems for ordering and/or scheduling production of demand-dependent types of inventories. These systems fall under the general heading of **materials requirements planning (MRP)**. The basic idea behind MRP is that, once finished goods inventory levels are set, it is possible to determine what levels of work-in-progress inventories must exist to meet the need for finished goods. From there, it is possible to calculate the quantity of raw materials that must be on hand. This ability to schedule backward from finished goods inventories stems from the dependent nature of work-in-progress and raw materials inventories. MRP is particularly important for complicated products for which a variety of components are needed to create the finished product.

Just-in-Time Inventory   **Just-in-time (JIT) inventory** is a modern approach to managing dependent inventories. The goal of JIT is to minimize such inventories, thereby maximizing turnover. The approach began in Japan, and it is a fundamental part of Japanese manufacturing philosophy. As the name suggests, the basic goal of JIT is to have only enough inventory on hand to meet immediate production needs.

The result of the JIT system is that inventories are reordered and restocked frequently. Making such a system work and avoiding shortages requires a high degree of cooperation among suppliers. Japanese manufacturers often have a relatively small, tightly integrated group of suppliers with whom they work closely to achieve the needed coordination. These suppliers are a part of a large manufacturer's (such as Toyota's) industrial group, or *keiretsu*. Each large manufacturer tends to have its own *keiretsu*. It also helps to have suppliers located nearby, a situation that is common in Japan.

The *kanban* is an integral part of a JIT inventory system, and JIT systems are sometimes called *kanban systems*. The literal meaning of *kanban* is "card" or "sign"; but, broadly speaking, a kanban is a signal to a supplier to send more inventory. For example, a kanban can literally be a card attached to a bin of parts. When a worker pulls that bin, the card is detached and routed back to the supplier, who then supplies a replacement bin.

A JIT inventory system is an important part of a larger production planning process. A full discussion of it would necessarily shift our focus away from finance to production and operations management, so we will leave it here.

materials requirements planning (MRP)
A set of procedures used to determine inventory levels for demand-dependent inventory types such as work-in-progress and raw materials.

just-in-time (JIT) inventory
A system for managing demand-dependent inventories that minimizes inventory holdings.

Concept Questions

21.8a What does the EOQ model determine for the firm?

21.8b Which cost component of the EOQ model does JIT inventory minimize?

Summary and Conclusions   **21.9**

This chapter has covered the basics of credit and inventory policy. The major topics we discussed include these:

1. *The components of credit policy*: We discussed the terms of sale, credit analysis, and collection policy. Under the general subject of terms of sale, the credit period, the cash discount and discount period, and the credit instrument were described.

2. *Credit policy analysis*: We developed the cash flows from the decision to grant credit and showed how the credit decision can be analyzed in an NPV setting. The NPV of granting credit depends on five factors: revenue effects, cost effects, the cost of debt, the probability of nonpayment, and the cash discount.

3. *Optimal credit policy*: The optimal amount of credit the firm should offer depends on the competitive conditions under which the firm operates. These conditions will determine the carrying costs associated with granting credit and the opportunity costs of the lost sales resulting from refusing to offer credit. The optimal credit policy minimizes the sum of these two costs.

4. *Credit analysis*: We looked at the decision to grant credit to a particular customer. We saw that two considerations are very important: the cost relative to the selling price and the possibility of repeat business.

5. *Collection policy*: Collection policy determines the method of monitoring the age of accounts receivable and dealing with past-due accounts. We described how an aging schedule can be prepared and the procedures a firm might use to collect on past-due accounts.

6. *Inventory types*: We described the different inventory types and how they differ in terms of liquidity and demand.

7. *Inventory costs*: The two basic inventory costs are carrying and restocking costs; we discussed how inventory management involves a trade-off between these two costs.

8. *Inventory management techniques*: We described the ABC approach and the EOQ model approach to inventory management. We also briefly touched on materials requirements planning (MRP) and just-in-time (JIT) inventory management.

CHAPTER REVIEW AND SELF-TEST PROBLEMS

21.1 Credit Policy The Cold Fusion Corp. (manufacturer of the Mr. Fusion home power plant) is considering a new credit policy. The current policy is cash only. The new policy would involve extending credit for one period. Based on the following information, determine if a switch is advisable. The interest rate is 2.0 percent per period:

	Current Policy	New Policy
Price per unit	$ 175	$ 175
Cost per unit	$ 130	$ 130
Sales per period in units	1,000	1,100

21.2 Credit Where Credit Is Due You are trying to decide whether or not to extend credit to a particular customer. Your variable cost is $15 per unit; the selling price is $22. This customer wants to buy 1,000 units today and pay in 30 days. You think there is a 15 percent chance of default. The required return is 3 percent per 30 days. Should you extend credit? Assume that this is a one-time sale and that the customer will not buy if credit is not extended.

21.3 The EOQ Annondale Manufacturing starts each period with 10,000 "Long John" golf clubs in stock. This stock is depleted each month and reordered. If the carrying cost per golf club is $1, and the fixed order cost is $5, is Annondale following an economically advisable strategy?

ANSWERS TO CHAPTER REVIEW AND SELF-TEST PROBLEMS

21.1 If the switch is made, an extra 100 units per period will be sold at a gross profit of $175 − 130 = $45 each. The total benefit is thus $45 × 100 = $4,500 per period. At 2.0 percent per period forever, the PV is $4,500/.02 = $225,000.

The cost of the switch is equal to this period's revenue of $175 × 1,000 units = $175,000 plus the cost of producing the extra 100 units: 100 × $130 = $13,000. The total cost is thus $188,000, and the NPV is $225,000 − 188,000 = $37,000. The switch should be made.

21.2 If the customer pays in 30 days, then you will collect $22 × 1,000 = $22,000. There's only an 85 percent chance of collecting this; so you expect to get $22,000 × .85 = $18,700 in 30 days. The present value of this is $18,700/1.03 = $18,155.34. Your cost is $15 × 1,000 = $15,000; so the NPV is $18,155.34 − 15,000 = $3,155.34. Credit should be extended.

21.3 We can answer by first calculating Annondale's carrying and restocking costs. The average inventory is 5,000 clubs, and, because the carrying costs are $1 per club, total carrying costs are $5,000. Annondale restocks every month at a fixed order cost of $5, so the total restocking costs are $60. What we see is that carrying costs are large relative to reorder costs, so Annondale is carrying too much inventory.

To determine the optimal inventory policy, we can use the EOQ model. Because Annondale orders 10,000 golf clubs 12 times per year, total needs (T) are 120,000 golf clubs. The fixed order cost is $5, and the carrying cost per unit (CC) is $1. The EOQ is therefore:

$$
\begin{aligned}
EOQ &= \sqrt{\frac{2T \times F}{CC}} \\
&= \sqrt{\frac{(2 \times 120,000) \times \$5}{1}} \\
&= \sqrt{1,200,000} \\
&= 1,095.45 \text{ units}
\end{aligned}
$$

We can check this by noting that the average inventory is about 550 clubs, so the carrying cost is $550. Annondale will have to reorder 120,000/1,095.45 = 109.54 ≈ 110 times. The fixed order cost is $5, so the total restocking cost is also $550.

CONCEPTS REVIEW AND CRITICAL THINKING QUESTIONS

1. **Credit Instruments** Describe each of the following:
   a. Sight draft.
   b. Time draft.
   c. Banker's acceptance.
   d. Promissory note.
   e. Trade acceptance.

2. **Trade Credit Forms** In what form is trade credit most commonly offered? What is the credit instrument in this case?

3. **Receivables Costs** What costs are associated with carrying receivables? What costs are associated with not granting credit? What do we call the sum of the costs for different levels of receivables?

4. **Five *C*s of Credit** What are the five *C*s of credit? Explain why each is important.

5. **Credit Period Length** What are some of the factors that determine the length of the credit period? Why is the length of the buyer's operating cycle often considered an upper bound on the length of the credit period?

6. **Credit Period Length** In each of the following pairings, indicate which firm would probably have a longer credit period and explain your reasoning.

   a. Firm A sells a miracle cure for baldness; Firm B sells toupees.
   b. Firm A specializes in products for landlords; Firm B specializes in products for renters.
   c. Firm A sells to customers with an inventory turnover of 10 times; Firm B sells to customers with an inventory turnover of 20 times.
   d. Firm A sells fresh fruit; Firm B sells canned fruit.
   e. Firm A sells and installs carpeting; Firm B sells rugs.

7. **Inventory Types** What are the different inventory types? How do the types differ? Why are some types said to have dependent demand whereas other types are said to have independent demand?

8. **Just-in-Time Inventory** If a company moves to a JIT inventory management system, what will happen to inventory turnover? What will happen to total asset turnover? What will happen to return on equity (ROE)? (*Hint:* Remember the Du Pont equation from Chapter 3.)

9. **Inventory Costs** If a company's inventory carrying costs are $5 million per year and its fixed order costs are $8 million per year, do you think the firm keeps too much inventory on hand or too little? Why?

10. **Inventory Period** At least part of Dell's corporate profits can be traced to its inventory management. Using just-in-time inventory, Dell typically maintains an inventory of three to four days' sales. Competitors such as Hewlett-Packard and IBM have attempted to match Dell's inventory policies, but lag far behind. In an industry where the price of PC components continues to decline, Dell clearly has a competitive advantage. Why would you say that it is to Dell's advantage to have such a short inventory period? If doing this is valuable, why don't all other PC manufacturers switch to Dell's approach?

QUESTIONS AND PROBLEMS ■M™

1. **Cash Discounts** You place an order for 300 units of inventory at a unit price of $115. The supplier offers terms of 1/10, net 30.

   a. How long do you have to pay before the account is overdue? If you take the full period, how much should you remit?
   b. What is the discount being offered? How quickly must you pay to get the discount? If you do take the discount, how much should you remit?
   c. If you don't take the discount, how much interest are you paying implicitly? How many days' credit are you receiving?

2. **Size of Accounts Receivable** The Wind Surfer Corporation has annual sales of $57 million. The average collection period is 39 days. What is the average investment in accounts receivable as shown on the balance sheet?

3. **ACP and Accounts Receivable** Kyoto Joe, Inc., sells earnings forecasts for Japanese securities. Its credit terms are 2/10, net 30. Based on experience, 70 percent of all customers will take the discount.
    a. What is the average collection period for Kyoto Joe?
    b. If Kyoto Joe sells 1,500 forecasts every month at a price of $1,900 each, what is its average balance sheet amount in accounts receivable?

4. **Size of Accounts Receivable** Wave Runner, Inc., has weekly credit sales of $23,000, and the average collection period is 32 days. The cost of production is 80 percent of the selling price. What is the average accounts receivable figure?

5. **Terms of Sale** A firm offers terms of 2/10, net 35. What effective annual interest rate does the firm earn when a customer does not take the discount? Without doing any calculations, explain what will happen to this effective rate if:
    a. The discount is changed to 3 percent.
    b. The credit period is increased to 60 days.
    c. The discount period is increased to 15 days.

6. **ACP and Receivables Turnover** Music City, Inc., has an average collection period of 42 days. Its average daily investment in receivables is $43,000. What are annual credit sales? What is the receivables turnover?

7. **Size of Accounts Receivable** Essence of Skunk Fragrances, Ltd., sells 4,500 units of its perfume collection each year at a price per unit of $400. All sales are on credit with terms of 2/10, net 40. The discount is taken by 60 percent of the customers. What is the amount of the company's accounts receivable? In reaction to sales by its main competitor, Sewage Spray, Essence of Skunk is considering a change in its credit policy to terms of 4/10, net 30 to preserve its market share. How will this change in policy affect accounts receivable?

8. **Size of Accounts Receivable** The Turn It Up Corporation sells on credit terms of net 30. Its accounts are, on average, 7 days past due. If annual credit sales are $8 million, what is the company's balance sheet amount in accounts receivable?

9. **Evaluating Credit Policy** Air Spares is a wholesaler that stocks engine components and test equipment for the commercial aircraft industry. A new customer has placed an order for eight high-bypass turbine engines, which increase fuel economy. The variable cost is $1.4 million per unit, and the credit price is $1.65 million each. Credit is extended for one period, and based on historical experience, payment for about 1 out of every 200 such orders is never collected. The required return is 2.5 percent per period.
    a. Assuming that this is a one-time order, should it be filled? The customer will not buy if credit is not extended.
    b. What is the break-even probability of default in part (a)?
    c. Suppose that customers who don't default become repeat customers and place the same order every period forever. Further assume that repeat customers never default. Should the order be filled? What is the break-even probability of default?
    d. Describe in general terms why credit terms will be more liberal when repeat orders are a possibility.

10. **Credit Policy Evaluation** Quest, Inc., is considering a change in its cash-only sales policy. The new terms of sale would be net one month. Based on the following information, determine if Quest should proceed or not. Describe the buildup of receivables in this case. The required return is 1.5 percent per month.

Visit us at www.mhhe.com/rwj

	Current Policy	New Policy
Price per unit	$ 780	$ 780
Cost per unit	$ 475	$ 475
Unit sales per month	1,420	1,505

11. **EOQ** Redan Manufacturing uses 2,500 switch assemblies per week and then reorders another 2,500. If the relevant carrying cost per switch assembly is $10, and the fixed order cost is $2,400, is Redan's inventory policy optimal? Why or why not?

12. **EOQ** The Trektronics store begins each week with 450 phasers in stock. This stock is depleted each week and reordered. If the carrying cost per phaser is $37 per year and the fixed order cost is $125, what is the total carrying cost? What is the restocking cost? Should Trektronics increase or decrease its order size? Describe an optimal inventory policy for Trektronics in terms of order size and order frequency.

13. **EOQ Derivation** Prove that when carrying costs and restocking costs are as described in the chapter, the EOQ must occur at the point where the carrying costs and restocking costs are equal.

14. **Credit Policy Evaluation** The Dilana Corporation is considering a change in its cash-only policy. The new terms would be net one period. Based on the following information, determine if Dilana should proceed or not. The required return is 3 percent per period.

	Current Policy	New Policy
Price per unit	$ 82	$ 84
Cost per unit	$ 43	$ 43
Unit sales per month	4,150	4,380

15. **Credit Policy Evaluation** Happy Times currently has an all-cash credit policy. It is considering making a change in the credit policy by going to terms of net 30 days. Based on the following information, what do you recommend? The required return is 2 percent per month.

	Current Policy	New Policy
Price per unit	$ 330	$ 334
Cost per unit	$ 260	$ 265
Unit sales per month	1,250	1,310

16. **Credit Policy** The Silver Spokes Bicycle Shop has decided to offer credit to its customers during the spring selling season. Sales are expected to be 400 bicycles. The average cost to the shop of a bicycle is $280. The owner knows that only 97 percent of the customers will be able to make their payments. To identify the remaining 3 percent, she is considering subscribing to a credit agency. The initial charge for this service is $500, with an additional charge of $4 per individual report. Should she subscribe to the agency?

17. **Break-Even Quantity** In Problem 14, what is the break-even quantity for the new credit policy?

18. **Credit Markup** In Problem 14, what is the break-even price per unit that should be charged under the new credit policy? Assume that the sales figure under the new policy is 4,200 units and all other values remain the same.

19. **Credit Markup** In Problem 15, what is the break-even price per unit under the new credit policy? Assume all other values remain the same.

20. **Safety Stocks and Order Points** Saché, Inc., expects to sell 700 of its designer suits every week. The store is open seven days a week and expects to sell the same number of suits every day. The company has an EOQ of 500 suits and a safety stock of 100 suits. Once an order is placed, it takes three days for Saché to get the suits in. How many orders does the company place per year? Assume that it is Monday morning before the store opens, and a shipment of suits has just arrived. When will Saché place its next order?

Credit Policy at Howlett Industries

Sterling Wyatt, the president of Howlett Industries, has been exploring ways of improving the company's financial performance. Howlett manufactures and sells office equipment to retailers. The company's growth has been relatively slow in recent years, but with an expansion in the economy, it appears that sales may increase more rapidly in the future. Sterling has asked Andrew Preston, the company's treasurer, to examine Howlett's credit policy to see if a change can help increase profitability.

The company currently has a policy of net 30. As with any credit sales, default rates are always of concern. Because of

credit period to net 45, and the third option is a combination of the relaxed credit policy and the extension of the credit period to net 45. On the positive side, each of the three policies under consideration would increase sales. The three policies have the drawbacks that default rates would increase, the administrative costs of managing the firm's receivables would increase, and the receivables period would increase. The effect of the credit policy change would impact all four of these variables in different degrees. Andrew has prepared the following table outlining the effect on each of these variables:

	Annual Sales (Millions)	Default Rate (% of Sales)	Administrative Costs (% of Sales)	Receivables Period
Current Policy	$120	1.5%	2.1%	38 days
Option 1	140	2.4	3.1	41 days
Option 2	137	1.7	2.3	51 days
Option 3	150	2.1	2.9	49 days

Howlett's screening and collection process, the default rate on credit is currently only 1.7 percent. Andrew has examined the company's credit policy in relation to other vendors, and he has found three available options.

The first option is to relax the company's decision on when to grant credit. The second option is to increase the

Howlett's variable costs of production are 45 percent of sales, and the relevant interest rate is a 6 percent effective annual rate. Which credit policy should the company use? Also, notice that in option 3, the default rate and administrative costs are above those in option 2. Is this plausible? Why or why not?

More about Credit Policy Analysis   **21A**

This appendix takes a closer look at credit policy analysis by investigating some alternative approaches and by examining the effect of cash discounts and the possibility of nonpayment.

TWO ALTERNATIVE APPROACHES

From our chapter discussion, we know how to analyze the NPV of a proposed credit policy switch. We now discuss two alternative approaches: the one-shot approach and the accounts receivable approach. These are common means of analysis; our goal is to show

that these two and our NPV approach are all the same. Afterward, we will use whichever of the three is most convenient.

The One-Shot Approach   Looking back at our example for Locust Software (in Section 21.3), we see that if the switch is not made, Locust will have a net cash flow this month of $(P - v)Q = \$29 \times 100 = \$2,900$. If the switch is made, Locust will invest $vQ' = \$20 \times 110 = \$2,200$ this month and will receive $PQ' = \$49 \times 110 = \$5,390$ next month. Suppose we ignore all other months and cash flows and view this as a one-shot investment. Is Locust better off with $2,900 in cash this month, or should Locust invest the $2,200 to get $5,390 next month?

The present value of the $5,390 to be received next month is $\$5,390/1.02 = \$5,284.31$; the cost is $2,200, so the net benefit is $\$5,284.31 - 2,200 = \$3,084.31$. If we compare this to the net cash flow of $2,900 under the current policy, then we see that Locust should switch. The NPV is $\$3,084.31 - 2,900 = \$184.31$.

In effect, Locust can repeat this one-shot investment every month and thereby generate an NPV of $184.31 every month (including the current one). The PV of this series of NPVs is:

$$\text{Present value} = \$184.31 + 184.31/.02 = \$9,400$$

This PV is the same as our answer in Section 21.3.

The Accounts Receivable Approach   Our second approach is the one that is most commonly discussed and is very useful. By extending credit, the firm increases its cash flow through increased gross profits. However, the firm must increase its investment in receivables and bear the carrying cost of doing so. The accounts receivable approach focuses on the expense of the incremental investment in receivables as compared to the increased gross profit.

As we have seen, the monthly benefit from extending credit is given by the gross profit per unit $(P - v)$ multiplied by the increase in quantity sold $(Q' - Q)$. For Locust, this benefit is $(\$49 - 20) \times (110 - 100) = \$290$ per month.

If Locust makes the switch, then receivables will rise from zero (because there are currently no credit sales) to PQ', so Locust must invest in receivables. The necessary investment has two components. The first part is what Locust would have collected under the old policy (PQ). Locust must carry this amount in receivables each month because collections are delayed by 30 days.

The second part is related to the increase in receivables that results from the increase in sales. Because unit sales increase from Q to Q', Locust must produce the latter quantity today even though it won't collect for 30 days. The actual cost to Locust of producing the extra quantity is equal to v per unit, so the investment necessary to provide the extra quantity sold is $v(Q' - Q)$.

In sum, if Locust switches, its investment in receivables will be equal to the $P \times Q$ in revenues plus an additional $v(Q' - Q)$ in production costs:

$$\text{Incremental investment in receivables} = PQ + v(Q' - Q)$$

The required return on this investment (the carrying cost of the receivables) is R per month; so, for Locust, the accounts receivable carrying cost is:

$$
\begin{aligned}
\text{Carrying cost} &= [PQ + v(Q' - Q)] \times R \\
&= (\$4,900 + 200) \times .02 \\
&= \$102 \text{ per month}
\end{aligned}
$$

Because the monthly benefit is $290 and the cost per month is only $102, the net benefit is $290 − 102 = $188 per month. Locust earns this $188 every month, so the PV of the switch is:

Present value = $188/.02
              = $9,400

Again, this is the same figure we previously calculated.

One of the advantages of looking at the accounts receivable approach is that it helps us interpret our earlier NPV calculation. As we have seen, the investment in receivables necessary to make the switch is $PQ + v(Q' − Q)$. If you take a look back at our original NPV calculation, you'll see that this is precisely what we had as the cost to Locust of making the switch. Our earlier NPV calculation thus amounts to a comparison of the incremental investment in receivables to the PV of the increased future cash flows.

Notice one final thing. The increase in accounts receivable is PQ', and this amount corresponds to the amount of receivables shown on the balance sheet. However, the incremental investment in receivables is $PQ + v(Q' − Q)$. It is straightforward to verify that this second quantity is smaller by $(P − v)(Q' − Q)$. This difference is the gross profit on the new sales, which Locust does not actually have to put up in order to switch credit policies.

Put another way, whenever we extend credit to a new customer who would not otherwise buy, all we risk is our cost, not the full sales price. This is the same issue that we discussed in Section 21.5.

Extra Credit	**EXAMPLE 21A.1**

Looking back at Locust Software, determine the NPV of the switch if the quantity sold is projected to increase by only 5 units instead of 10. What will be the investment in receivables? What is the carrying cost? What is the monthly net benefit from switching?

If the switch is made, Locust gives up $P \times Q$ = $4,900 today. An extra five units have to be produced at a cost of $20 each, so the cost of switching is $4,900 + 5 \times 20 = $5,000. The benefit each month of selling the extra five units is $5 \times ($49 − 20) = $145. The NPV of the switch is −$5,000 + 145/.02 = $2,250, so the switch is still profitable.

The $5,000 cost of switching can be interpreted as the investment in receivables. At 2 percent per month, the carrying cost is .02 × $5,000 = $100. Because the benefit each month is $145, the net benefit from switching is $45 per month ($145 − 100). Notice that the PV of $45 per month forever at 2 percent is $45/.02 = $2,250, as we calculated.

DISCOUNTS AND DEFAULT RISK

We now take a look at cash discounts, default risk, and the relationship between the two. To get started, we define the following:

π = Percentage of credit sales that go uncollected

d = Percentage discount allowed for cash customers

P' = Credit price (the no-discount price)

Notice that the cash price, P, is equal to the credit price, P', multiplied by $(1 − d)$: $P = P'(1 − d)$, or, equivalently, $P' = P/(1 − d)$.

The situation at Locust is now a little more complicated. If a switch is made from the current policy of no credit, then the benefit from the switch will come from both the higher price (P') and, potentially, the increased quantity sold (Q').

Furthermore, in our previous case, it was reasonable to assume that all customers took the credit, because it was free. Now, not all customers will take the credit because a discount is offered. In addition, of the customers who do take the credit offered, a certain percentage (π) will not pay.

To simplify the discussion that follows, we will assume that the quantity sold (Q) is not affected by the switch. This assumption isn't crucial, but it does cut down on the work (see Problem 5 at the end of the appendix). We will also assume that all customers take the credit terms. This assumption isn't crucial either. It actually doesn't matter what percentage of the customers take the offered credit.[3]

NPV of the Credit Decision   Currently, Locust sells Q units at a price of $P = \$49$. Locust is considering a new policy that involves 30 days' credit and an increase in price to $P' = \$50$ on credit sales. The cash price will remain at $49, so Locust is effectively allowing a discount of $(\$50 - 49)/50 = 2\%$ for cash.

What is the NPV to Locust of extending credit? To answer, note that Locust is already receiving $(P - v)Q$ every month. With the new, higher price, this will rise to $(P' - v)Q$, assuming that everybody pays. However, because π percent of sales will not be collected, Locust will collect on only $(1 - \pi) \times P'Q$; so net receipts will be $[(1 - \pi)P' - v] \times Q$.

The net effect of the switch for Locust is thus the difference between the cash flows under the new policy and those under the old policy:

Net incremental cash flow $= [(1 - \pi)P' - v] \times Q - (P - v) \times Q$

Because $P = P' \times (1 - d)$, this simplifies to:[4]

$$\text{Net incremental cash flow} = P'Q \times (d - \pi) \qquad \text{[21A.1]}$$

If Locust makes the switch, the cost in terms of the investment in receivables is just $P \times Q$ because $Q = Q'$. The NPV of the switch is thus:

$$\text{NPV} = -PQ + P'Q \times (d - \pi)/R \qquad \text{[21A.2]}$$

For example, suppose that, based on industry experience, the percentage of "deadbeats" (π) is expected to be 1 percent. What is the NPV of changing credit terms for Locust? We can plug in the relevant numbers as follows:

$$
\begin{aligned}
\text{NPV} &= -PQ + P'Q \times (d - \pi)/R \\
&= -\$49 \times 100 + 50 \times 100 \times (.02 - .01)/.02 \\
&= -\$2,400
\end{aligned}
$$

Because the NPV of the change is negative, Locust shouldn't switch.

In our expression for NPV, the key elements are the cash discount percentage (d) and the default rate (π). One thing we see immediately is that, if the percentage of sales that goes uncollected exceeds the discount percentage, then $d - \pi$ is negative. Obviously,

---

[3]The reason is that all customers are offered the same terms. If the NPV of offering credit is $100, assuming that all customers switch, then it will be $50 if only 50 percent of our customers switch. The hidden assumption is that the default rate is a constant percentage of credit sales.

[4]To see this, note that the net incremental cash flow is:

Net incremental cash flow $= [(1 - \pi)P' - v] \times Q - (P - v) \times Q$
$$= [(1 - \pi)P' - P] \times Q$$

Because $P = P' \times (1 - d)$, this can be written as:

Net incremental cash flow $= [(1 - \pi)P' - (1 - d)P'] \times Q$
$$= P'Q \times (d - \pi)$$

the NPV of the switch would then be negative as well. More generally, our result tells us that the decision to grant credit here is a trade-off between getting a higher price, thereby increasing sales revenues, and not collecting on some fraction of those sales.

With this in mind, note that $P'Q \times (d - \pi)$ is the increase in sales less the portion of that increase that won't be collected. This is the incremental cash inflow from the switch in credit policy. If d is 5 percent and π is 2 percent, for example, then, loosely speaking, revenues are increasing by 5 percent because of the higher price, but collections rise by only 3 percent because the default rate is 2 percent. Unless $d > \pi$, we will actually have a decrease in cash inflows from the switch.

A Break-Even Application   Because the discount percentage (d) is controlled by the firm, the key unknown in this case is the default rate (π). What is the break-even default rate for Locust Software?

We can answer by finding the default rate that makes the NPV equal to zero:

$$NPV = 0 = -PQ + P'Q \times (d - \pi)/R$$

Rearranging things a bit, we have:

$$PR = P'(d - \pi)$$
$$\pi = d - R \times (1 - d)$$

For Locust, the break-even default rate works out to be:

$$\pi = .02 - .02 \times (.98)$$
$$= .0004$$
$$= .04\%$$

This is quite small because the implicit interest rate Locust will be charging its credit customers (2 percent discount interest per month, or about $.02/.98 = 2.0408\%$) is only slightly greater than the required return of 2 percent per month. As a result, there's not much room for defaults if the switch is going to make sense.

Concept Questions

21A.1a What is the incremental investment that a firm must make in receivables if credit is extended?

21A.1b Describe the trade-off between the default rate and the cash discount.

APPENDIX REVIEW AND SELF-TEST PROBLEMS

21A.1 **Credit Policy** Rework Chapter Review and Self-Test Problem 21.1 using the one-shot and accounts receivable approaches. As before, the required return is 2.0 percent per period, and there will be no defaults. Here is the basic information:

	Current Policy	New Policy
Price per unit	$ 175	$ 175
Cost per unit	$ 130	$ 130
Sales per period in units	1,000	1,100

21A.2 **Discounts and Default Risk** The De Long Corporation is considering a change in credit policy. The current policy is cash only, and sales per period are 2,000 units

at a price of $110. If credit is offered, the new price will be $120 per unit, and the credit will be extended for one period. Unit sales are not expected to change, and all customers are expected to take the credit. De Long anticipates that 4 percent of its customers will default. If the required return is 2 percent per period, is the change a good idea? What if only half the customers take the offered credit?

ANSWERS TO APPENDIX REVIEW AND SELF-TEST PROBLEMS

21A.1 As we saw earlier, if the switch is made, an extra 100 units per period will be sold at a gross profit of $175 − 130 = $45 each. The total benefit is thus $45 × 100 = $4,500 per period. At 2.0 percent per period forever, the PV is $4,500/.02 = $225,000.

The cost of the switch is equal to this period's revenue of $175 × 1,000 units = $175,000 plus the cost of producing the extra 100 units, 100 × $130 = $13,000. The total cost is thus $188,000, and the NPV is $225,000 − 188,000 = $37,000. The switch should be made.

For the accounts receivable approach, we interpret the $188,000 cost as the investment in receivables. At 2.0 percent per period, the carrying cost is $188,000 × .02 = $3,760 per period. The benefit per period we calculated as $4,500; so the net gain per period is $4,500 − 3,760 = $740. At 2.0 percent per period, the PV of this is $740/.02 = $37,000.

Finally, for the one-shot approach, if credit is not granted, the firm will generate ($175 − 130) × 1,000 = $45,000 this period. If credit is extended, the firm will invest $130 × 1,100 = $143,000 today and receive $175 × 1,100 = $192,500 in one period. The NPV of this second option is $192,500/1.02 − 143,000 = $45,725.49. The firm is $45,725.49 − 45,000 = $725.49 better off today and in each future period because of granting credit. The PV of this stream is $725.49 + 725.49/.02 = $37,000 (allowing for a rounding error).

21A.2 The costs per period are the same whether or not credit is offered; so we can ignore the production costs. The firm currently has sales of, and collects, $110 × 2,000 = $220,000 per period. If credit is offered, sales will rise to $120 × 2,000 = $240,000.

Defaults will be 4 percent of sales, so the cash inflow under the new policy will be .96 × $240,000 = $230,400. This amounts to an extra $10,400 every period. At 2 percent per period, the PV is $10,400/.02 = $520,000. If the switch is made, De Long will give up this month's revenues of $220,000; so the NPV of the switch is $300,000. If only half of the customers take the credit, then the NPV is half as large: $150,000. So, regardless of what percentage of customers take the credit, the NPV is positive. Thus, the change is a good idea.

QUESTIONS AND PROBLEMS

BASIC
(Questions 1–5)

1. **Evaluating Credit Policy** Bismark Co. is in the process of considering a change in its terms of sale. The current policy is cash only; the new policy will involve one period's credit. Sales are 50,000 units per period at a price of $525 per unit. If credit is offered, the new price will be $547. Unit sales are not expected to change, and all customers are expected to take the credit. Bismark estimates that 2.5 percent

of credit sales will be uncollectible. If the required return is 2 percent per period, is the change a good idea?

2. **Credit Policy Evaluation** The Johnson Company sells 3,000 pairs of running shoes per month at a cash price of $88 per pair. The firm is considering a new policy that involves 30 days' credit and an increase in price to $90.72 per pair on credit sales. The cash price will remain at $88, and the new policy is not expected to affect the quantity sold. The discount period will be 20 days. The required return is 1 percent per month.

   a. How would the new credit terms be quoted?

   b. What investment in receivables is required under the new policy?

   c. Explain why the variable cost of manufacturing the shoes is not relevant here.

   d. If the default rate is anticipated to be 10 percent, should the switch be made? What is the break-even credit price? The break-even cash discount?

3. **Credit Analysis** Silicon Wafers, Inc. (SWI), is debating whether or not to extend credit to a particular customer. SWI's products, primarily used in the manufacture of semiconductors, currently sell for $1,340 per unit. The variable cost is $910 per unit. The order under consideration is for 12 units today; payment is promised in 30 days.

   a. If there is a 20 percent chance of default, should SWI fill the order? The required return is 2 percent per month. This is a one-time sale, and the customer will not buy if credit is not extended.

   b. What is the break-even probability in part (a)?

   c. This part is a little harder. In general terms, how do you think your answer to part (a) will be affected if the customer will purchase the merchandise for cash if the credit is refused? The cash price is $1,310 per unit.

4. **Credit Analysis** Consider the following information about two alternative credit strategies:

	Refuse Credit	Grant Credit
Price per unit	$ 63	$ 68
Cost per unit	$ 29	$ 31
Quantity sold per quarter	6,200	6,900
Probability of payment	1.0	.90

The higher cost per unit reflects the expense associated with credit orders, and the higher price per unit reflects the existence of a cash discount. The credit period will be 90 days, and the cost of debt is .75 percent per month.

   a. Based on this information, should credit be granted?

   b. In part (a), what does the credit price per unit have to be to break even?

   c. In part (a), suppose we can obtain a credit report for $2 per customer. Assuming that each customer buys one unit and that the credit report correctly identifies all customers who will not pay, should credit be extended?

5. **NPV of Credit Policy Switch** Suppose a corporation currently sells Q units per month for a cash-only price of P. Under a new credit policy that allows one month's credit, the quantity sold will be Q' and the price per unit will be P'. Defaults will be π percent of credit sales. The variable cost is v per unit and is not expected to change. The percentage of customers who will take the credit is α, and the required return is R per month. What is the NPV of the decision to switch? Interpret the various parts of your answer.