Chapter 3
The Decision Usefulness Approach
to Financial Reporting

Figure 3.1 Organization of Chapter 3

3.1 OVERVIEW

In Chapter 2, we concluded that the present value model faces some severe problems in practice. It is doubtful that a complete set of financial statements on this basis is feasible. This inability to value the whole firm on a present value or market value basis means that a theoretically well-defined concept of net income does not exist in the complex real world in which accountants operate.

In this chapter we will begin our study of how to tackle this problem. In the previous chapter, we noted that some accountants argue that historical cost accounting provides a foundation from which to predict future firm performance. Others, including standard setters, feel that current values better predict performance.

Regardless of which view we take, all accountants agree that financial statements should be useful. This leads to an important concept in accounting—the concept of decision usefulness. To properly understand this concept, we need to consider other theories (that is, other than the present value model) from economics and finance. This is because we cannot make financial statements more useful until we know what usefulness means. We also need a precise definition of information. Decision theories and capital market theories assist in conceptualizing the meaning of useful financial statement information.

The main purpose of this chapter is to introduce you to some of these theories and to discuss their relevance to accounting. As we shall see, major accounting standard-setting bodies have picked up on these theories to such an extent that they underlie many of the accounting standards and pronouncements issued by these bodies.

Figure 3.1 outlines the organization of this chapter.

3.2 THE DECISION USEFULNESS APPROACH

As we can infer from Section 2.6, the decision usefulness approach to accounting theory takes the view that “if we can’t prepare theoretically correct financial statements, at least we can try to make financial statements more useful.” First enunciated in 1966, and reinforced by the influential 1973 report of the Trubridge Commission, this simple observation has had major implications for accounting theory and practice. In particular, we must now pay much closer attention than we did in Chapter 2 to financial statement users and their decision needs, since under non-ideal conditions it is not possible to read the value of the firm directly from the financial statements.

Decision usefulness is contrasted with another view of the role of financial reporting, namely stewardship, whereby the role is to report on management’s success, or lack thereof, in managing the firm’s resources. This role is more past-oriented than the role of helping investors predict future firm performance that we discussed in Chapter 2. Of course, motivating managers’ performance is also future-oriented in the sense that knowing that past and current performance is monitored will, hopefully, encourage managers to plan for the future. We regard each role as equally important. In this chapter, we begin our discussion of decision usefulness. Discussion of the second role begins in Chapter 8.

In adopting the decision usefulness approach, two major questions must be addressed. First, who are the users of financial statements? Clearly, there are many users. It is helpful to categorize them into broad groups, such as equity and debt investors, managers, unions, standard setters, and governments. These groups are called constituencies of accounting.

Second, what are the decision problems of financial statement users? By understanding these decision problems, accountants will be better prepared to meet the information needs of the various constituencies. Financial statements can then be prepared with these information needs in mind. In other words, tailoring financial statement information to the specific needs of the users of these statements will lead to improved decision-making. In this way, the financial statements are made more useful.
3.3 SINGLE-PERSON DECISION THEORY

Single-person decision theory takes the viewpoint of an individual who must make a decision under conditions of uncertainty. It recognizes that state probabilities are no longer objective, as they are under ideal conditions, and sets out a formal procedure whereby the individual can make the best decision by selecting from a set of alternatives. This procedure allows additional information to be obtained to revise the decision-maker's subjective assessment of the probabilities of what might happen after the decision is made (i.e., the probabilities of states of nature). Decision theory is relevant to accounting because financial statements provide additional information that is useful for many decisions, as illustrated in Example 3.1.
time. They are called prior probabilities. He could base these probabilities on an analysis of X Ltd.'s past financial statements, plus other news to date about the company. Instead, or in addition, he could study the current market price of X Ltd.'s shares. If share price is low, it would indicate an unfavourable market evaluation of X's future prospects, and Bill might also take this into account when assessing his state probabilities.

Bill is risk-averse. Let us assume that the amount of utility, or satisfaction, he derives from a payoff is equal to the square root of the amount of the payoff. Thus, if he receives a payoff of $1,600, his utility is 40. This assumption of risk aversion is not necessary to our example. We could just as easily assume Bill was risk-neutral and evaluate the expected dollar amounts of the various payoffs. However, investors are generally risk-averse, so we will work in utilities rather than dollars. Section 3.4 considers risk aversion in greater detail.

In view of our discussion of ethical issues in Section 1.5, a complete evaluation of the utility of an act requires Bill to evaluate any effects of his decision on others. Here, however, Bill’s decision is relatively self-contained. That is, whether he buys the shares or the bonds will have little or no effect on anyone else. Consequently, we evaluate his utility in terms of its effect on his own wealth. In other decision problems, for example, whether to buy the shares of a firm that is a heavy polluter, Bill may reduce the utility of his payoffs to recognize the adverse social effects of a decision to buy.

Bill also leaves out of his decision other events that could affect his payoff but are deemed so unlikely that they are not worth considering. For example, an earthquake could seriously affect X Ltd.’s operations. However, since earthquakes are a rare event in X Ltd.’s areas of operation, Bill ignores this possibility. This is called “cutting the decision tree down to size.”

Figure 3.2 gives a decision tree diagram for this decision problem. The numbers in parentheses in the middle column of the figure are the probabilities of the states, the second column from the right shows the dollar amounts of the payoffs, and the rightmost column gives Bill’s utility for each amount.

The decision theory tells us that, if he must decide now, Bill should choose the act with the highest expected utility. We will denote the expected utility of act $a_1$ by $EU(a_1)$, and so on.

$EU(a_1) = (0.30 \times 40) + (0.70 \times 0) = 12$

$EU(a_2) = 1.00 \times 15 = 15$

Therefore, it appears that Bill should choose $a_2$ and buy the bonds. However, Bill has another alternative: to obtain more information before deciding. Accordingly, let’s assume that he decides to become more informed. The annual report of X Ltd. is to be released within the next few days, and Bill decides to wait for it, since it provides ready available evidence about the state of the firm. When the annual report comes, Bill notes that net income is quite high and the firm’s net current assets and debt-to-equity ratio are improved from last year. In effect, the current financial statements show “good news” (GN).5

<table>
<thead>
<tr>
<th>Act</th>
<th>State (Probability)</th>
<th>Payoff (Utility)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>High performance (0.30)</td>
<td>$1,600 (40)</td>
</tr>
<tr>
<td>$a_1$</td>
<td>Low performance (0.70)</td>
<td>$50 (0)</td>
</tr>
<tr>
<td>Invest $10,000</td>
<td>Performance high or low (1.00)</td>
<td>$225 (15)</td>
</tr>
</tbody>
</table>

On the basis of extensive experience in financial statement preparation and analysis and his familiarity with GAAP, Bill knows that if X Ltd. really is a high-state firm, there is an 80% probability that the current year’s financial statements will show GN and 20% probability that they will show bad news (BN). Denote these conditional probabilities by $Pr(GN|H) = 0.80$ and $Pr(BN|H) = 0.20$, respectively. Note that even if the firm is in the high state, there is still a 20% probability that the financial statements show BN. This is because accounting standards do not generate complete relevance and reliability. For example, the 20% value of $Pr(BN|H)$ may be due to accounting standards designed to prevent premature revenue recognition. Then, expected profit from a major new X Ltd. contract may not be included in current earnings even though it is relevant information about future payoffs. Alternatively, or in addition, BN may be reported by a high-state firm to disguise high profits. Such firms may wish to smooth earnings to a sustainable level, or reduce the likelihood of attracting competitors. Since accounting standards give firms some flexibility to choose different accounting policies, such behaviour need not violate GAAP.

Bill also knows that if X Ltd. is a low-state firm, it is still possible that the financial statements show GN. Again, this is because accounting standards are not completely relevant and reliable. Assume that if X Ltd. really is in a low state, the probability that the current year’s financial statements will show GN is 10%, giving a 90% probability that they will show BN. Denote these conditional probabilities by $Pr(GN|L) = 0.10$ and $Pr(BN|L) = 0.90$, respectively.

Now, armed with the GN evidence from the current financial statements and the above conditional probabilities, Bill can use Bayes’ theorem to calculate his posterior state probabilities (that is, posterior to the financial statement evidence). The posterior probability of the high-performance state is:

$$Pr(H|GN) = \frac{Pr(H) Pr(GN|H)}{Pr(H) Pr(GN|H) + Pr(L) Pr(GN|L)}$$

$$= \frac{0.30 \times 0.80}{(0.30 \times 0.80) + (0.70 \times 0.10)}$$

$$= 0.77$$
where:

\[ P(H|GN) \] is the (posterior) probability of the high state given the good-news financial statement
\[ P(H) \] is the prior probability of the high state
\[ P(GN|H) \] is the probability that the financial statements show good news given that the firm is in the high state
\[ P(L) \] is the prior probability of the low state
\[ P(GN|L) \] is the probability that the financial statements show good news given that the firm is in the low state

Then, Bill’s posterior probability \[ P(L|GN) \] of X Ltd. being in the low-performance state is \[ 1.00 - 0.77 = 0.23 \]. Recall that if the state is high, the payoff from Bill’s share investment will be high (\$1,600), and if it is low, the payoff will be low (\$0).

Bill can now calculate the expected utility of each act on the basis of his posterior probabilities:

\[ EU(\alpha_1|GN) = (0.77 \times 40) + (0.23 \times 0) = 30.8 \]
\[ EU(\alpha_2|GN) = 1.00 \times 15 = 15 \]

Thus, the GN current financial statement information has caused Bill’s optimal decision to change to \( \alpha_2 \)—he should buy the shares of X Ltd.

### 3.3.2 The Information System

It is important to understand why financial statement information is useful here. To be useful, it must help predict future investment returns. Under non-ideal conditions, the financial statements do not show expected future firm performance directly. Nevertheless, financial statements will still be useful to investors to the extent that the good or bad news they contain will persist into the future. Think of a regression, from current good or bad news in the financial statements to future expected firm performance to future expected investment returns.

To return to our example, the good news was that current earnings and liquidity were high. This information enabled Bill to predict high future X Ltd. performance with probability 0.77, and this is also the probability of the high payoff on his investment. Of course, such information is a double-edged sword. Had the financial statements contained bad news, Bill’s probability of high payoff would have been lowered just as surely as it was raised by good news.

We conclude that financial statements can still be useful to investors even though they do not report directly on future cash flows by means of present value-based calculations. Here, it is the lack of ideal conditions that gives the financial statements their information content—recall that there was really no information in net income in Examples 2.1 and 2.2. While Examples 2.2 and 3.1 both allow for uncertainty, the fundamental difference between them is that state probabilities were objective in Example 2.2 but subjective in Example 3.1. This opens a role for information to help the decision-maker update subjective state probabilities and predict investment returns.

The heart of the linkage between current financial statement information and future firm performance is the conditional probabilities \[ P(GN|H) \] and \[ P(BN|L) \]. These probabilities are called an information system, which can be summarized by a table such as Table 3.2. Recall that, in our example, the probability that the current financial statements of X Ltd. show good news, conditional on the firm being in the high performance state, is 0.80. The probability they show bad news conditional on the low performance state is 0.90. The probabilities add to 1 across the table. The 0.80 and 0.90 probabilities are called main diagonal probabilities; the others are called off-main diagonal probabilities.

<table>
<thead>
<tr>
<th>Current Financial Statement Evidence</th>
<th>GN</th>
<th>BN</th>
</tr>
</thead>
<tbody>
<tr>
<td>State</td>
<td></td>
<td></td>
</tr>
<tr>
<td>High</td>
<td>0.80</td>
<td>0.20</td>
</tr>
<tr>
<td>Low</td>
<td>0.10</td>
<td>0.90</td>
</tr>
</tbody>
</table>

An information system is a table giving, conditioned on each state of nature, the objective probability of each possible financial statement evidence item.

Note that financial statements are not perfect, or “true”—this would be the case only under ideal conditions. Given the underlying GAAP, there is a 20% probability that even if X Ltd. is in the high state its financial statements would show BN, and a 10% probability that if it is in the low state the financial statements would show GN. This weakening of the relationship between current financial statement information and future firm performance is sometimes described as noise or as low earnings quality in the financial statements. Nevertheless, the information system is informative, since it enables Bill to update his prior probabilities to reflect what he now knows, thereby affecting his decision. For cases of fully informative and non-informative information systems, see Question 1 at the end of this chapter.

It should be noted that the information system concept is decision-specific. The system in Table 3.2 is geared to a decision whether or not to buy a firm’s shares. Other decisions would involve a different table. For example, a decision to evaluate manager stewardship could define states of nature as “high manager performance” or “low manager performance.” The analysis of the financial statements would then be oriented to investigating the extent to which net income reflects manager performance.

Financial statements that are highly informative, and the information system that underlies them, are often called transparent, precise, or high quality, since they convey lots of information to investors. In this book, we shall often use the term “informative” to refer to financial statement quality since it is a more primitive concept. However, we shall
also use the other terms, particularly in relation to earnings, since various measures of earnings informativeness are used to evaluate the usefulness of reported net income.

The extent of informativeness for investment decisions depends on the relevance and reliability of the financial statements. For example, suppose a new accounting standard required X Ltd. to switch to value-in-use from historical cost for its capital assets. The resulting increase in relevance would increase the main diagonal probabilities of the information system and lower the off-main diagonal ones, since value-in-use is a better predictor of future firm performance than historical cost. However, switching to value-in-use would also decrease reliability. Value-in-use has to be estimated, creating the possibility of error and manager bias. This would have the opposite effect on the information system probabilities. Thus, a move to value-in-use accounting will increase informativeness only if its greater relevance outweighs the decrease in reliability.

However, if it were possible to increase relevance without sacrificing reliability or vice versa, the result would be to increase financial statement usefulness. One way to accomplish this would be to present supplementary current value information, as in RRA. This increases relevance for investors who want to use supplemental information in their decisions. However, the financial statements proper are still available for those who want the somewhat greater reliability of historical cost accounting for oil and gas operations.

Informativeness also depends on the extent to which financial reporting is conservative. Recall from our discussion in Section 1.2 that conservatism is defined as requiring a higher standard of verification to record gains than to record losses. That is, the accountant wants to record gains until there is objective evidence of their realization, but records unrealized losses by writing assets down (or liabilities up) when a loss in value occurs. In Section 1.2, we used ceiling tests and the lower of cost or market rule for inventories as examples. Recognition of unrealized losses but not unrealized gains raises the information system probability of BN/low state relative to the probability of GN/high state, assuming reasonable reliability. Table 3.2 includes some conservatism, since the BN/low state probability (0.90) is greater than the GN/high state (0.80).8

The concept of informativeness of an information system is useful in understanding the role of information in decision-making. The higher the main diagonal probabilities relative to the off-main diagonal ones, the more informative the system. Consequently, the more informative an information system, the more decision useful it is. It enables better predictions of relevant states of nature and resulting payoffs. In an investment context, these payoffs are returns on investments.

While thinking of financial statements as a table of conditional probabilities may take some getting used to, the information system is one of the most powerful and useful concepts in financial accounting theory. This is because it captures the information content of financial statements, thereby determining their usefulness for decision-making. Furthermore, many practical accounting problems can be framed in terms of their impact on the information system. For example, we pointed out above that if a move to value-in-use accounting for capital assets is to be decision useful, the increase in relevance (which increases the main diagonal probabilities) must outweigh any decrease in reliability (which decreases them). Similar reasoning can be applied to other new or proposed accounting standards. Standards requiring fair value accounting for financial instruments, for example, are subject to similar tradeoffs. Since most financial reporting debates can be cast in terms of relevance versus reliability, the information system provides a useful framework for thinking about effects of these debates on decision usefulness.

How does Bill know what the information system probabilities are? One response is simply to assume they are known. We made this assumption in Example 3.1 and Table 3.2. This is an example of rational expectations—investors are assumed to quickly form accurate estimates of unknown, underlying parameters, in this case the information system probabilities.9 This assumption is common in much theoretical economics and accounting research.

As a practical matter, one approach to forming accurate estimates is by sampling. Bill could take a sample of recent financial statements of X Ltd. and similar firms, possibly including previous periods' statements as well, recording the number of times GN is followed by high performance, and similarly for BN. If GAAP does not change over the sample period, these frequencies will equal the probabilities in Table 3.2, for a large enough sample.10

A different approach to evaluating information system informativeness was taken by Easton and Zawacki (1989) (EZ). They examined Value Line analysts’ revisions of future quarterly earnings forecasts following the GN or BN in firms’ current quarterly earnings. That is, analysts are viewed as rational investors who use financial statement earnings information to revise their beliefs about future firm performance, similar to Bill Cautious in Example 3.1. Future quarterly earnings are analogous to the states of nature in Table 3.2 (Value Line predicts future firm performance in terms of earnings), and the GN or BN in current quarterly earnings constitutes the financial statement evidence in that table. Value Line provides forecasts for a large number of firms, and these forecasts are revised quarterly.

For a sample of 150 large U.S. corporations followed by Value Line over the period 1975–1980, EZ found that for every $1 of GN or BN in reported earnings, the Value Line analysts increased or decreased next quarter’s earnings forecast by about 34 cents on average. This implies that the information systems underlying the sample firms’ financial statements are informative, that is, analysts use current financial statement information to revise their beliefs about future firm performance. EZ called the effect of current financial statement information on analysts’ next quarter earnings forecasts a “revision coefficient.” This coefficient is a proxy for the average earnings quality of their sample firms; that is, it reflects the magnitude of the information system probabilities.

EZ also found that the higher a firm’s revision coefficient is (recall that the 34 cents above is an average), the stronger was the effect of the GN or BN in current earnings on the market price of the firm’s shares. This is consistent with investors accepting the analysts’ evaluation of the information system, bidding shares price up or down more strongly the higher the quality of the system.
The definition should really be interpreted net of cost. An information source may have the potential to affect an individual's decision but, if it is too costly, it is not information since it will not be used. It can be argued, however, that financial statements are a cost-effective information source (at least for investors, who do not pay for their preparation) since they are readily available and reasonably well understood by investors.

Finally, it should be emphasized that an individual's receipt of information and subsequent belief revision is really a continuous process. We can think of the individual as using Bayes' theorem every time a new information item comes along. Example 3.1 concentrated on belief revision following receipt of the annual report, but obviously there are many other information sources, such as analyst forecasts, quarterly reports, media, web sites, speeches and announcements, statistical reports, etc. that can also affect decisions.

Thus, the accountant faces competition. Hopefully, by supplying useful tradeoffs between relevance and reliability, financial statements will continue their role as an important source of information.

3.3.4 Summary

Decision theory is important because it helps us to understand why information is such a powerful commodity—it can affect the actions taken by investors. Accountants, who prepare much of the information required by investors, need to understand this powerful role.

3.4 THE RATIONAL, RISK-AVERSE INVESTOR

In decision theory, the concept of a rational individual simply means that in making decisions, the chosen act is the one that yields the highest expected utility. This implies that the individual may search for additional information relating to the decision, using it to revise state probabilities by means of Bayes' theorem.

We emphasize that the decision theory described above is a model of rational decision-making. Whether individuals actually make decisions this way is difficult to say. Nevertheless, in thinking about questions of decision usefulness, it is helpful to assume that they do. As we will discuss in Section 6.2, we do not mean to imply that all individuals make decisions as the theory suggests, but only that the theory captures the average behavior of investors who want to make good investment decisions. Alternatively, we can argue that if investors want to make good decisions this is how they should proceed. If individuals do not make decisions in some rational, predictable manner it is difficult for accountants, or anyone else, to know what information they find useful. At any rate, implications of the theory have been subjected to much empirical testing, as we shall see in Chapter 5. To the extent that predictions of the theory are confirmed empirically, our confidence that the decision theory model is a reasonable one is strengthened.
It is also usually assumed that rational investors are risk-averse. To see the intuition underlying this concept, think of yourself as an investor who is asked to flip a fair coin with your university or college instructor—suppose the coin is a penny. You would probably be willing to flip for pennies, if for no other reason than to humour the instructor. If the ante were raised, you would probably be willing to flip for dimes, quarters, even dollars. However, there would come a point where you would refuse—say, flipping for $100,000. (If you didn’t refuse, the instructor would.)

Remind yourself that the expected payoff of flipping a fair coin is zero, regardless of the amount at stake, since you have a 50% chance of winning and a 50% chance of losing in all cases. Thus, your increasing nervousness as the stakes are raised means that another effect, beyond the expected value of the gamble, is operating. This is risk aversion.

Note also that risk-averse individuals trade off expected return and risk. For example, if the coin was biased in your favour—say you have a 75% chance of winning—you would probably be willing to flip for higher stakes than if the coin was fair. In effect, you are now willing to bear more risk in exchange for a higher expected value—the expected payoff of your gamble is now $0.50 per dollar rather than 0.

To model risk aversion, decision theorists use the device of a utility function, which relates payoff amounts to the decision-maker’s utility for those amounts.

To portray a utility function, consider Figure 3.3. The solid line shows the utility function of Bill Cautious in Example 3.1. Bill’s utility function is:

$$U(x) = \sqrt{x}, x \geq 0$$

where $x$ is the amount of the payoff. Note that the utility function of a risk-averse individual is concave.

Based on his prior probabilities, Bill’s expected payoff for act $a_i$ is $(0.3 \times 1,600) + (0.7 \times 0) = 480$. The expected utility of the payoff is at point C on the dotted line joining A and B. This expected utility of $(0.3 \times 40) + (0.7 \times 0) = 12$ is less than the utility of 15 for the risk-free investment at point D on Figure 3.3. Consequently, Bill’s rational decision is to choose the risk-free investment, if he were to act on the basis of his prior probabilities. This is the case even though the expected payoff of the risky investment ($480$) is greater than the risk-free payoff ($225$). This demonstrates that Bill is averse to risk.

To see how Bill’s decision may change if the risky investment were less risky, assume that the possible payoffs are now $200 (with probability 0.7) and $1,133.33 (with probability 0.3) instead of the earlier $0 and $1,600. You should verify that the expected payoff is still $480 but the expected utility rises to 20. Then Bill’s rational decision is to buy the risky investment. The reduction in risk raises expected utility, even though the expected payoff has not changed.

Despite the intuitive appeal of risk aversion, it is sometimes assumed that decision-makers are risk-neutral. This means that they evaluate risky investments strictly in terms of expected payoff—risk itself does not matter per se. We made this assumption in Example 2.2. Figure 3.4 shows the utility function of a risk-neutral decision-maker. A typical risk-neutral utility function is $U(x) = bx$, where $b$ is the slope of the line. Here, utility is simply a linear function of the payoff.

Risk neutrality may be a reasonable assumption when the payoffs are small. However, risk aversion is the more realistic assumption in most cases. The concept of risk aversion is important to accountants, because it means that investors need information concerning the risk, as well as the expected value, of future returns.
3.5 THE PRINCIPLE OF PORTFOLIO DIVERSIFICATION

In Section 3.4, we stated that individual investors are typically assumed to be risk-averse. Consequently, for a given expected payoff from investments, the rational investor wants the lowest possible risk or, equivalently, for a given risk, will want the highest possible expected payoff. In effect, the investor adopts a tradeoff between risk and return; greater risk will be borne only if expected return is higher and vice versa.

One way investors can lower risk for a given expected return is to adopt a strategy of diversification, that is, to invest in a portfolio of securities. The principle of portfolio diversification shows us that some, but not all, risk can be eliminated by appropriate investment strategy. This principle has important implications for the nature of the risk information that investors need. The risk reported on by many common accounting-based risk measures, such as debt to equity, times interest earned (ratio of net income before interest and taxes to interest expense), or the current ratio, can be reduced or eliminated a priori by appropriate diversification.

Before illustrating the diversification principle, we return briefly to our risk-averse investor. Note that before we can calculate an individual's expected utility for different investment acts, we need to know what that individual's utility function looks like. For example, Bill Caution's utility function in Example 3.1 was \( U(x) = \sqrt{x}, x \geq 0 \). With this utility function and payoff probabilities, Bill's expected utilities for different acts were calculated and compared.

One might reasonably ask, "How do we know what an individual's utility function is?" To avoid this question, we shall now assume mean-variance utility:

\[
U_i(a) = f(x_i, \sigma_i^2)
\]

where symbol \( a \) represents an investment act. For example, investment act \( a \) could be an investment in a riskless government bond, or in a firm's shares, as in Example 3.1. Alternatively, it could be an investment in a portfolio of securities.

The equation states that the utility of an investment act \( a \) to investor \( i \) is a function \( f \) of the expected rate of return from that act \( x_i \) and the risk as measured by its variance \( \sigma_i^2 \). We assume that \( f \) is increasing in \( x_i \) and decreasing in \( \sigma_i^2 \). A specific example of a mean variance utility function is:

\[
U_i(a) = 2x_i - \sigma_i^2
\]

which can be seen to increase in \( x_i \) and decrease in \( \sigma_i^2 \). Individuals will have different tradeoffs between expected rate of return and risk—for example, a more risk-averse investor might have \( -2\sigma_i^2 \) rather than \( -\sigma_i^2 \) as shown above. It is not true in general that the utility of an act depends only on its mean and variance. However, investigation of this is beyond our scope.

The significance of a mean-variance utility assumption to accountants is that it makes investors' decision needs more explicit—all investors need information about the expected values and risks from investments, regardless of the specific forms of their utility functions. Without such an assumption, specific knowledge of investors' utility functions would be needed to fully deduce their information requirements.

With this background in mind, we now illustrate the principle of portfolio diversification by means of two examples.

Suppose that Toni Delfino, a risk-averse investor has $200 to invest and is considering investing all of it in the shares of firm A currently trading for $20. Assume that Toni assesses a 0.74 probability14 that the shares will increase in market value to $22 over the coming period and a 0.26 probability that they will decrease to $17. Assume also that A will pay a dividend of $1 per share at the end of the period. (We could also make the dividend uncertain, but this would just add complexity without affecting the point to be made.)

Example 3.2
The Principle of Portfolio Diversification (Part 1)

As in our decision theory Example 3.1, Toni's subjective probabilities could be posterior to her analysis of firm A's financial statements and the resulting application of Bayes' theorem. Alternatively, they could be her prior probabilities based on whatever other information is at her disposal. For present purposes, the extent to which Toni may have become informed does not matter. The important point is that she has assessed probabilities.

The payoffs from Toni's proposed investment are as follows:

- If shares increase: $22 \times 10$ shares + $10$ dividend = $230
- If shares decrease: $17 \times 10$ shares + $10$ dividend = $180

Table 3.3 shows the calculation of the expected rate of return and variance of this investment. Henceforth, we will work with the rate of return. As can be seen from Table 3.3, this just involves dividing net returns by the amount of original investment ($200). The division by original investment is a standardization device—rates of return can be directly compared across securities while amounts of returns cannot. Also, rate of return fits in nicely with the assumption of mean-variance utility, which is in terms of the expected value and variance of rate of return.

The variance of return is 0.0120. The variance of an investment return serves as a measure of its riskiness. Since Toni is risk-averse, increasing riskiness will lower her utility, other things equal.

\textsuperscript{1}Sections 3.5, 3.6, and 3.7 can be ignored with little loss of continuity. However, diversification and beta are referred to frequently in subsequent chapters. Readers with no previous exposure to these concepts should read at least Sections 3.5 and 3.7.1.
Four possible payoffs now exist from the portfolio: both shares increase in market value, one share increases and the other decreases, or both shares decrease. The amounts of the payoffs and their assumed probabilities are as follows in Table 3.4:

<table>
<thead>
<tr>
<th>Table 3.4 Payoffs and Their Probabilities</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
</tr>
<tr>
<td>-----</td>
</tr>
<tr>
<td>132</td>
</tr>
<tr>
<td>132</td>
</tr>
<tr>
<td>102</td>
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<tr>
<td>102</td>
</tr>
</tbody>
</table>

Recall that six shares of firm A and eight shares of firm B are held, and that the high payoff is $22 per share for firm A and $10.50 for firm B, plus a $1 dividend from each share. This gives the $230 payoff on the first line of the table. The other payoffs are similarly calculated.

Now let us consider more closely the probabilities we have assumed for the four possible payoffs. The returns from shares of firm A and firm B are correlated in our example. To see this, consider the first row in Table 3.4 with a total payoff of $230. This payoff will be realized if both shares A and B realize their high-payoff values. On the basis of our assumption the probabilities of the individual payoffs of shares A and B, the probabilities of these two payoffs, when each share is considered separately, are 0.74 for A and 0.6750 for B. If the payoffs of shares A and B were independent, the probability of both shares realizing their high payoffs would be 0.74 × 0.6750 = 0.4995.

However, in any economy, there are states of nature, also called factors, which affect the returns of all shares, such as levels of interest rates, foreign exchange rates, the level of economic activity, and so on. These are called market-wide or economy-wide factors. Their presence means that if the return on one share is high, it is more likely that the returns on most other shares in the economy will also be high—more likely, that is, than would be the case if the returns on shares were independent. Thus, we have assumed that the probability that both shares A and B realize their high payoffs is 0.5742, greater than the 0.4995 that we would obtain under independence, to reflect these underlying common factors.

Similar reasoning applies to the last row of Table 3.4 with a payoff of $184. Here we have assumed that the joint probability of both firm A and firm B realizing their low payoffs is 0.1592, greater than the (0.26 × 0.3250 = 0.0845) probability under independence. If market-wide state realizations are such that they work against high returns (i.e., if the economy is performing poorly), then the probability that both shares realize low payoffs is greater than what would be expected under independence.

---

### Example 3.3

**The Principle of Portfolio Diversification (Part 2)**

It turns out that Toni would not be rational to accept the above investment—a more attractive investment can be found. It is possible to find another investment decision that has the same expected return but lower risk. This is because of the principle of portfolio diversification.

To illustrate, assume that shares of firm B are also traded on the market, with a current market value of $10. These shares also pay a dividend of $1. Assume there is a 0.6750 probability that firm B's shares will increase in market value to $10.50 at the end of the period, and a 0.3250 probability that they will decrease to $8.50.

Now suppose that Toni decides to invest $200 in six shares of firm A at $20 and eight shares of firm B at $10. We must calculate Toni's expected utility for the portfolio consisting of six shares of firm A and eight shares of firm B. Notice that the same amount ($200) is invested, but that it is now spread over two different securities.

Assume that Toni's utility function is:

$$ U(a) = 2X_a - \sigma_a^2 $$

as given above. Then, her utility for this investment is:

$$ (2 \times 0.0850) - 0.0120 = 0.1580 $$

Toni now has to decide whether to take this investment act. If she feels that this utility is not sufficiently high, further research would be necessary to find a more attractive investment, or some other use for the $200 of capital.
### Table 3.5 Calculating Expected Rate of Return and Variance

<table>
<thead>
<tr>
<th>Payoff</th>
<th>Rate of Return</th>
<th>Probability</th>
<th>Expected Rate of Return</th>
<th>Variance</th>
</tr>
</thead>
<tbody>
<tr>
<td>$230</td>
<td>$230 - 200</td>
<td>0.15</td>
<td>0.0861</td>
<td>0.0024</td>
</tr>
<tr>
<td>$214</td>
<td>$214 - 200</td>
<td>0.07</td>
<td>0.0116</td>
<td>0.0000</td>
</tr>
<tr>
<td>$200</td>
<td>$200 - 200</td>
<td>0.00</td>
<td>0.0000</td>
<td>0.0000</td>
</tr>
<tr>
<td>$184</td>
<td>$184 - 200</td>
<td>-0.08</td>
<td>-0.0122</td>
<td>0.0043</td>
</tr>
</tbody>
</table>

\[
n = 0.0650 \\
\sigma^2 = 0.0074
\]

### 3.5.1 Summary

Risk-averse investors can take advantage of the principle of portfolio diversification to reduce their risk, by investing in a portfolio of securities. This is because realizations of firm-specific states of nature tend to cancel out across securities, leaving economy-wide factors as the main contributors to portfolio risk.

While individual attitudes to risk may differ, we can see investors' decision needs with particular clarity if we assume mean-variance utility. Then, regardless of the degree of risk aversion, we know that utility increases in expected rate of return and decreases in variance of the portfolio.

### 3.6 THE OPTIMAL INVESTMENT DECISION

If a portfolio of two shares is better than one, then a three-share portfolio should be better than two, and so on. Indeed, this is the case and, assuming there are no transaction costs such as brokerage fees, Toni should continue buying until the portfolio includes some of every security traded on the market. This is called “holding the market portfolio.” Note again that the total amount invested remains at $200, but is spread over a greater number of securities.

Be sure you understand why the same amount invested in a portfolio can yield lower risk than it were invested in a single firm for the same expected rate of return. To repeat, when more than one risky investment is held, the firm-specific risks tend to cancel out. If one share realizes a low return, there is always the chance that another share will realize a high return.16 The larger the number of different firms' shares in the portfolio, the more this effect can operate. As a result, the riskiness of returns is reduced, which we have illustrated above by means of our variance calculations. Of course, in the presence of economy-wide risk, there is not a complete cancelling out. At a minimum, that is, when the market portfolio is held, the economy-wide factors will remain to contribute to portfolio risk. Such non-observable risk is called systematic risk.17

Conceptually, the market portfolio includes all assets available for investment in the economy. As a practical matter, the market portfolio is usually taken as all the securities traded on a major stock exchange. The return on the market portfolio can then be proxied by the return on a market index for that exchange, such as the Dow Jones Industrial Average index of the New York Stock Exchange, the S&P/TSX Composite Index, etc.

Now return to our investor, Toni Delicieux. Toni decides to buy the market portfolio after hearing about the benefits of diversification. Her first task is to assess the expected return and variance of the market portfolio. She subjectively assesses a 0.8 probability that the S&P/TSX Composite Index will increase by 10% for the coming period and a 0.2 probability that it will increase by 2%. Then, denoting the expected return and

---

16This section can be omitted without loss of continuity.
variance of the market portfolio by \( \bar{x}_m \) and \( \sigma^2_m \) respectively:

\[
\bar{x}_m = (0.10 \times 0.5) + (0.0250 \times 0.2) = 0.0850 \\
\sigma^2_m = [(0.10 - 0.0850)^2 \times 0.5] + [(0.0250 - 0.0850)^2 \times 0.2] \\
= 0.0002 + 0.0007 \\
= 0.0009
\]

This gives Toni a utility of

\[
2\bar{x}_m - \sigma^2_m = 0.1700 - 0.0009 \\
= 0.1691
\]

which is greater than the 0.1626 utility of the two-share portfolio in Example 3.3.

The question now is, is this Toni's optimal investment decision? The answer is probably not. If Toni were quite risk-averse, she might prefer a portfolio with lower risk than 0.0009, and would be willing to have a lower expected return as a result.

One strategy she might follow would be to sell some of the high-risk stocks in her portfolio. But, if she does this, she is no longer holding the market portfolio, so some of the benefits of diversification are lost. How can Toni adjust portfolio risk to her desired level without losing the benefits of diversification?

The answer lies in the risk-free asset. If a risk-free asset, such as treasury bills yielding, say, 4%, is available, an investor could sell some of the market portfolio (that is, sell some of each security, so that the market portfolio is still held but total investment in it is lower) and use the proceeds to buy the risk-free asset. This strategy is depicted in Figure 3.5 as a move from M, where only the market portfolio is held, to Y. Risk is lower at Y, but so is expected return, compared to M. However, if the investor is quite risk-averse this could raise utility.

Conversely, if Toni were less risk-averse, she may prefer to borrow at the risk-free rate and buy more of the market portfolio, thereby moving to Z, with higher expected return and risk.

In this way, each investor can secure a desired risk–return tradeoff while continuing to enjoy the maximum risk-reduction effects of diversification.

To illustrate, suppose that Toni borrows $100 at a rate of 0.04 and buys an additional $100 of the market portfolio. Toni now has $300 of market portfolio, on which she expects to earn 0.0850, and owes $100 at 4% interest. But her own investment is still $200. Consequently, her expected return is now

\[
\bar{x}_a = \left( \frac{300}{200} \times 0.0850 \right) - \left( \frac{100}{200} \times 0.0400 \right) \\
= (0.1275 - 0.0200) \\
= 0.1075
\]

The variance of her return also increases, since she now has $300 at risk on an investment of $200. There is no variance attached to the $100 borrowed, of course, since interest and principal payments are fixed. The variance of her return is now

\[
\sigma^2_a = \left( \frac{300}{200} \right)^2 \times 0.0009 \\
= 0.0020
\]

yielding utility of \((2 \times 0.1075) - 0.0020 = 0.2130\). This yields Toni a higher utility than simply holding the market portfolio (0.1691). Toni will continue to borrow until the amount borrowed and reinvested yields an \( \bar{x}_a \) and \( \sigma^2_a \) that maximizes her utility. In fact, if she can borrow all she wants at 4%, she would borrow $9,800, which would yield her utility of 2.33.

3.6.1 Summary

When transaction costs are ignored, a risk-averse investor's optimal investment decision is to buy that combination of market portfolio and risk-free asset that yields the best tradeoff between expected return and risk. This tradeoff is individual-specific—it depends on the investor's utility function. Some investors may wish to reduce their investment in the market portfolio and buy the risk-free asset with the proceeds. Others may wish to borrow at the risk-free rate and increase their investment. Either way, all investors can enjoy the full benefits of diversification while at the same time attaining their optimal risk–return tradeoff.

3.7 PORTFOLIO RISK

3.7.1 Calculating and Interpreting Beta

The principle of diversification leads to an important risk measure of a security in the theory of investment. This is beta, which measures the co-movement between changes in the price of a security and changes in the market value of the market portfolio. To illustrate,
we will calculate the betas of shares of firms A and B in Example 3.3, in relation to the
market portfolio M given in Section 3.6.

Beta is an important and useful concept in financial accounting. As we shall see in
Chapter 5, a stock's beta is a crucial component of empirical studies of the usefulness to
investors of financial accounting information. Also, it is a "launching pad" for reporting
on firm risk. Reporting on risk is discussed in Section 7.2. Consequently, an understand-
ing of what a stock's beta is and what it tells us about firm risk is an important part of an
accountant's knowledge base.

Example 3.4
Calculating Beta

The beta of A shares, denoted by $\beta_A$, is given by

$$\beta_A = \frac{\text{Cov}(A, M)}{\text{Var}(M)}$$

where Cov(A, M) is the covariance of the returns on A with the returns on the market
portfolio M. In effect, $\beta_A$ measures how strongly the return on A varies as the market
varies. For example, a high-beta security would undergo wide swings in rate of return as
market conditions change. Shares of airlines and aircraft manufacturers are examples,
since these industries are sensitive to economic conditions. Shares of electric utilities and
fast food firms would be low-beta, since the returns of such firms are less subject to the
state of the economy.

Division by Var(M) is simply a standardization device, to express Cov(A, M) in units of
market variance. For example, if the returns on the Toronto and New York Stock
Exchanges have different variances, standardization by the variance of returns on the
respective exchanges makes betas of Canadian and U.S. firms more comparable.

To calculate the beta of security A, assume that the conditional payoff probabilities
of A are as follows:

- When return on M is high:
  Probability that return on A is high = 0.90
  Probability that return on A is low = 0.10

- When return on M is low:
  Probability that return on A is high = 0.10
  Probability that return on A is low = 0.90

These probabilities could be estimated by examining past data on the returns on A
shares in relation to the returns on M. Cov(A, M) is calculated in Table 3.6.

In the first row of the table, the values 0.15 and 0.0850 are the high return and the
expected return respectively of A (see Table 3.3). Similarly 0.10 and 0.0850 are the high

\begin{table}[h]
\centering
\begin{tabular}{|c|c|c|}
\hline
\textbf{Returns} & \textbf{Joint} & \\
\hline
\textbf{A} & \textbf{M} & \\
\hline
High & High & \((0.15 - 0.0850)(0.10 - 0.0850) \times 0.72 = 0.0007\) \\
High & Low & \((0.15 - 0.0850)(0.0250 - 0.0850) \times 0.02 = -0.0001\) \\
Low & High & \((-0.10 - 0.0850)(0.10 - 0.0850) \times 0.08 = -0.0002\) \\
Low & Low & \((-0.10 - 0.0850)(0.0250 - 0.0850) \times 0.18 = 0.0020\) \\
\hline
\end{tabular}
\end{table}

return and the expected return of M (see Section 3.6). The joint probability that both A
and M pay off high is

$$\text{Prob} (A \text{ high and } M \text{ high}) = \text{Prob} (M \text{ high}) \times \text{Prob} (A \text{ high} | M \text{ high})$$

$$= 0.8 \times 0.9 = 0.72$$

You should verify the remaining rows in the table.

Then, recalling from Section 3.6 that $\sigma_M^2 = \text{Var}(M) = 0.0009$, we obtain

$$\beta_A = \frac{0.0024}{0.0009} = 2.6667$$

For security B in Example 3.3, assume that the conditional payoff probabilities are as
follows:

- When return on M is high:
  Probability that return on B is high = 0.7917
  Probability that return on B is low = 0.2083

- When return on M is low:
  Probability that return on B is high = 0.2083
  Probability that return on B is low = 0.7917

Then, similar calculations give

$$\beta_B = \frac{0.0014}{0.0009} = 1.5556$$

You should verify this calculation.\(^{16}\)

Since $\beta_B$ is lower than $\beta_A$, an investor who buys only B shares is more insulated from
the ups and downs of the stock market than if he/she buys only A shares. This is the sense
in which a low-beta security has low risk.\(^{19}\)
3.7.2 Portfolio Expected Value and Variance

Since risk-averse investors with mean-variance utility functions need to know the expected value and variance of their investment portfolios, we give here formulae for their calculation. In the process, we shall see that beta measures the amount of systematic risk contributed by a security to a portfolio.

The expected value of return on a portfolio \( P \) is calculated as a weighted average of the expected returns on the securities in the portfolio:

\[
\bar{x}_p = k_1 \bar{x}_1 + k_2 \bar{x}_2 + \ldots + k_n \bar{x}_n
\]

where \( \bar{x}_p \) is the expected return on \( P \), \( \bar{x}_i \) is the expected return on security \( i \), etc., \( k_i \) is the proportion of total portfolio investment in security \( i \), etc., and there are \( n \) securities in the portfolio.

In Example 3.3, \( n = 2 \), \( k_1 = \frac{120}{200} = 0.6 \), \( k_2 = (1 - k_1) = 0.4 \), and the expected returns on the two securities \( A \) and \( B \) in Tom's portfolio were both 0.0850. Then, the formula gives:

\[
\bar{x}_{A+B} = (0.6 \times 0.0850) + (0.4 \times 0.0850) = 0.0850
\]

which, of course, agrees with the direct calculation in Table 3.5.

For the variance of portfolio return, we have the following standard formula for the variance of a sum of random variables:

\[
Var(P) = \sigma_p^2 = k_1 \sigma_1^2 + k_2 \sigma_2^2 + \ldots + k_n \sigma_n^2 + 2k_1k_2 \text{Cov}(x_1,x_2) + 2k_1k_3 \text{Cov}(x_1,x_3) + \ldots + 2k_{n-1}k_n \text{Cov}(x_{n-1},x_n)
\]

That is, the variance of \( P \) is the weighted sum of the variances of the individual securities in \( P \) plus the weighted sum of covariances of all the pairs of securities in \( P \).

In Example 3.3, the formula reduces to:

\[
Var(A + B) = k_1^2 Var(A) + (1 - k_1)^2 Var(B) + 2k_1(1 - k_1) \text{Cov}(A,B)
\]

The main point here is that portfolio variance depends not only on the variances of the component securities, but also, if the security returns are correlated, on the covariance between them (if the returns on \( A \) and \( B \) are uncorrelated, \( \text{Cov}(A,B) = 0 \)).

In an investment context, the returns on \( A \) and \( B \) are most definitely correlated because of economy-wide factors. In fact, we have assumed that economy-wide factors are the only source of correlation between security returns. Then, we can write the covariance between \( A \) and \( B \) in terms of their covariances with the market portfolio \( M \):

\[
\text{Cov}(A,B) = \frac{\text{Cov}(A,M) \text{Cov}(B,M)}{Var(M)} = Var(M) \beta_A \beta_B
\]

The portfolio variance becomes:

\[
Var(A + B) = 0.6^2 Var(A) + 0.4^2 Var(B) + 2 \times 0.6 \times 0.4 \times Var(M) \beta_A \beta_B
\]

\[
= (0.36 \times 0.0120) + (0.16 \times 0.0088) + (0.48 \times 0.0099 \times 2.6667 \times 1.5556)
\]

\[
= 0.0043 + 0.0014 + 0.0017
\]

\[
= 0.0074
\]

which agrees with the direct calculation in Table 3.5. Thus, we see that securities \( A \) and \( B \) contribute systematic risk of 0.0017 to the portfolio variance of 0.0074, or about 23%.

3.7.3 Portfolio Risk as the Number of Securities Increases

A contribution to risk of 23% may not seem like much, but this results from the presence of only two securities in the portfolio. Consider what happens as the number of securities in the portfolio increases. Let there now be \( n \) securities in portfolio \( P \). To simplify a bit, we will assume that an equal amount is invested in each security, so that the proportion of each security in \( P \) is \( 1/n \) of the total amount invested. Then

\[
Var(P) = \frac{1}{n^2} \sigma_1^2 + \frac{1}{n^2} \sigma_2^2 + \ldots + \frac{1}{n^2} \sigma_n^2 + \frac{1}{n^2} \text{Cov}(x_1,x_2) + \frac{1}{n^2} \text{Cov}(x_1,x_3) + \ldots + \frac{1}{n^2} \text{Cov}(x_{n-1},x_n)
\]

\[
= \frac{1}{n^2} \left[ \sigma_1^2 + \sigma_2^2 + \ldots + \sigma_n^2 + \frac{1}{n} \text{Var}(M) \beta_1 \beta_1 + \beta_1 \beta_2 + \ldots + \beta_{n-1} \beta_n \right]
\]

There are \( n \) variance terms in the formula. However, the number of covariance terms goes up quite quickly relative to \( n \). In fact, there are \( n(n - 1)/2 \) covariance terms. For example, if \( n = 10 \), there are 10 variance terms but 45 covariance terms.

This means that, even for portfolios that contain a modest number of securities, most of the risk is systematic risk, from the covariance terms. For example, for \( n = 10 \), the coefficient of the variance terms is only 1/100, so that the variances of the 10 securities contribute only 10% of their average variance to the portfolio variance. However, while the coefficient of the systematic risk terms is only 2/100, there are 45 terms, so the covariances contribute fully 90% of their average covariance to the portfolio variance. In other words, most of the benefits of diversification can be attained with only a few securities in the portfolio.

This is fortunate, since brokerage and other transactions costs would prevent most investors from buying the market portfolio.

Note that we have made a rational expectations assumption that the investor knows the expected returns and risk of the securities being considered for the portfolio, analogous to our assumption in Section 3.3.2 that the information system probabilities were known. As a practical matter, these items are not known with complete accuracy. This creates a more specialized role for financial reporting relative to its rather abstract role in Example 3.1 of supplying GN or BN. That is, useful information is information that helps investors assess securities' expected returns and betas.
3.7.4 Summary

When transactions costs are not ignored, a risk-averse investor's optimal investment decision is to buy relatively few securities, rather than the market portfolio. In this way, most of the benefits of diversification can be attained, at reasonable cost.

Information about securities' expected returns and betas is useful to such investors. This enables them to assess the expected return and riskiness of various portfolios that they may be considering. They can then choose the portfolio that gives them their most preferred risk-return tradeoff, subject to the level of transactions costs that they are willing to bear.

3.8 THE REACTION OF PROFESSIONAL ACCOUNTING BODIES TO THE DECISION USEFULNESS APPROACH

Major professional accounting bodies have adopted the decision usefulness approach. For example, according to the draft IASB/FASB Conceptual Framework (2008), the objective of financial statements is to provide financial information that is "useful to present and potential equity investors, lenders, and other creditors in making decisions in their capacity as capital providers."22

Note that this objective implies that it is the investor who makes the decision, and that the role of financial reporting is to supply useful information for this purpose. 'This is the essence of the decision usefulness approach that we outlined in Section 3.2. In particular, the Framework implies that it is not the accountant's role to make investors' decisions for them.

A variety of constituencies is included in this most general objective, namely present and potential equity investors, lenders, and other creditors. These constituencies are referred to in the Framework as the primary user group. Their use of financial information is oriented to making investment decisions. By recognizing a responsibility to report to all capital providers, the Framework adopts the entity view of financial reporting. That is, financial reports reflect the perspective of the entity, rather than simply the perspective of the entity's shareholders.23

The question then arises: what types of information do capital providers need? The Framework goes on to state that the primary user group needs information about the amount, timing, and uncertainty of the firm's future cash flows. This is consistent with our discussion of investor needs in Sections 3.2-3.7. In particular, the reference to uncertainty implies that investors are assumed to be risk-averse—as we pointed out in Section 3.4. If they were risk-neutral they would not care about uncertainty.

Thus, we see that the primary decision addressed in the Framework is the investment decision in firms' shares or debt. Specifically, cash flows are payoffs, similar to those in the payoff table (Table 3.1) of Example 3.1. These investment decisions apply to potential investors as well as present ones. This means that financial statements must communicate useful information to the market, not just to existing investors in the firm.

Note also that the information objective is future-oriented—it calls for information about "future" payoffs from investments. While the terms are somewhat different from those used in our earlier discussion of the investment decision, the basic objective of the Framework clearly implies that investors want future-oriented information. More specifically, this is information that helps them to assess the expected returns and risk of their investments.

How can financial statements be useful in predicting future returns? For this, it is necessary to establish some linkage between current and past firm performance and future prospects. Without such linkage, the decision-oriented objectives of the Framework would not be attainable.

We can see the linkage clearly, however, by drawing on the decision theory model. In particular, refer to the information system (Table 3.2) for Example 3.1. The table provides a probabilistic relationship between current financial statement information (GN or BN) and the future-oriented states of nature (high or low performance), that will determine future investment payoffs. In effect, current financial statement information and future returns are linked via the conditional probabilities of the information system.

Consistent with the information system linkage, the Framework states (comments in brackets added):

Information about an entity's economic resources and the claims on them . . . i.e., the balance sheet can provide a user of the entity's financial reports with a good deal of insight into the amount, timing and uncertainty of its future cash flows.

Information about effects of transactions and other events and circumstances that change an entity's economic resources and the claims on them i.e., the income statement helps the user of the entity's financial reports to assess the amount, timing and uncertainty of its future cash flows.

While these arguments suggest that the two financial statements work together, the Framework views the balance sheet as paramount. In its basis for conclusions, we have

... in measuring performance, an entity first identifies and measures its economic resources and claims on them . . . then calculates the net changes in economic resources and claims . . .

These arguments enable the Framework to maintain that even though the financial statements report on current firm financial position and performance, this information can be useful to forward-looking investors. The Framework also states (comments in brackets added):

Information in financial reports about an entity's economic resources and claims i.e., the balance sheet and changes in resources and claims (the income statement) provides a better basis for assessing . . . future prospects than information solely about the entity's current cash receipts and payments.

Here, the Framework envisages future firm performance in terms of future cash flows, and argues that the financial statements enable a better prediction of future cash flows than current cash flows themselves. This may seem surprising. Nevertheless, several researchers, for example, Kim and Krosz (2005), have documented this statement empirically. For a
large sample of U.S. firms over 1974–2000, they report that the ability of current earnings to predict next period’s operating cash flows exceeds that of current operating cash flows.

In Section 2.5.1, we described accruals as a device to match costs and revenues. Consistent with its view that the balance sheet is the primary statement, the Framework highlights somewhat different accruals role, namely to anticipate future cash flows and thus future firm performance. For example, an account receivable (an accrual) anticipates the sales proceeds to be received next period, and current net income includes this amount. Current cash flows (zero, for this particular sale) would not predict next period’s cash receipts from this sale very well. Note that a goal of predicting future cash flows (i.e., positive and negative) implies a rejection of conservatism by the Framework. Conservation emphasizes anticipation of only negative cash flows.

Kim and Kross also find that the ability of earnings to predict next period’s operating cash flows increased over 1974–2000. Furthermore, Ball and Shivakumar (2000), in a study over 1987–2003, find that the ability of earnings to predict future cash flows increases substantially for years in which the firm is performing poorly, compared to years of good performance. This latter finding suggests that practice has moved towards increasing use of accruals to anticipate unrealized losses while avoiding anticipation of unrealized gains. Since accruals to anticipate unrealized losses predict future cash flow reductions, the combination of these two findings provides empirical evidence of increasing conservatism. This may seem strange, in view of standard setters’ movements towards current value accounting. In Section 6.7 we will suggest reasons that conservatism, even though it is rejected by the Framework, can increase financial statement usefulness for investors.

The Framework goes on to consider the characteristics that are necessary if the financial statement information is to be useful for investor decision-making. This is another crucial and delicate aspect of the whole conceptual framework—how can financial statement information be presented so as to be of maximum use to investors in predicting future returns? Once again, the answer lies in the concepts of relevance and reliability.

In Chapter 2, we defined relevant financial statements as those that give information to investors about the firm’s future economic prospects. The Framework definition is consistent with ours:

Information is relevant if it is capable of making a difference in the decisions made by users...

Clearly, if information helps investors to evaluate future economic prospects, it can make a difference in users’ decisions. The definition is also consistent with the definition of information in decision theory. Recall that information is evidence which has the potential to change individual decisions. In effect, evidence is not really information unless it is capable of affecting user decisions. This role of information comes across with particular clarity in Bayes’s theorem, which provides a vehicle for investors to update their prior beliefs about relevant states of nature on the basis of new information.

Thus, we can say that under the ideal conditions of Chapter 2, relevant financial statement information consists of (the discounted present values of) expected future payoffs. Under less-than-ideal conditions, relevant financial statement information consists of information that helps investors form their own expectations of future payoffs. By extending the definition of relevance to include information that can help investors form their own payoff estimates, the scope for information to be relevant is greatly enlarged.

Reliability is another desirable information characteristic. In Section 2.2, we defined reliable information as information that faithfully represents what it is intended to represent. The Framework definition is equivalent to ours:

To be useful in financial reporting, information must be a faithful representation of what it purports to represent.

The Framework goes on to point out that to be a faithful representation, information must be complete (i.e., nothing in the valuation or description of an item that affects its faithful representation is left out), free from material error, and neutral, where neutral information is free from any bias which may affect its interpretation by the user.

The Framework does not specifically state that relevance and reliability have to be traded off. Given our conclusion in Section 2.4.4 that a tradeoff is necessary, this may seem surprising. Presumably, given the primacy of the balance sheet in the Framework, its designers feel that relevance is the primary information characteristic. However, the Framework does state

Together, relevance and representational faithfulness make financial reporting information decision useful.

This seems a rather imprecise, even grudging, admission that a tradeoff is necessary.

The Framework goes on to explore other desirable characteristics of useful financial statement information. One of these is timeliness, which is best thought of as a constraint on relevance and reliability. That is, as new events occur along, a delay in information release reduces both its ability to predict future state realizations and its faithful representation. Other desirable characteristics are comparability, verifiability, and understandability.

3.8.1 Summary

The Framework operationalizes the decision usefulness approach by developing the characteristics that accounting information should have in order to be useful. In essence, accounting information should provide an informative information system that links current financial statements with future state realizations and payoffs. To be useful for investment decision purposes, the financial statements need not involve a direct prediction of future firm payoffs. Rather, if the information has certain desirable characteristics, such as relevance and reliability, it can be an informative input to help investors form their own predictions of these payoffs. For maximum usefulness, the accountant must seek an appropriate tradeoff between these characteristics.
3.9 CONCLUSIONS ON DECISION USEFULNESS

Following from the pioneering ASOBAT and Trueblood Committee reports, the decision usefulness approach to financial reporting implies that accountants need to understand the decision problems of financial statement users. Single-person decision theory and its specialization to the portfolio investment decision provide an understanding of the needs of rational, risk-averse investors. This theory tells us that such investors need information to help them assess securities' expected returns and the riskiness of these returns. In the theory of investment, beta is an important risk measure, being the standardised variance of a security's return with the return on the market portfolio. This variance risk is the main component of the riskiness of a diversified portfolio, even if the portfolio contains only relatively few securities.

Financial statements are an important and cost-effective source of information for investors, even though they do not report directly on future investment payoffs. They provide an information system that can help investors to predict future firm performance, which, in turn, predicts future investment returns. To enhance this predictive role, accountants need to find the most useful tradeoff between relevance and reliability.

Major accounting standard-setting bodies such as the IASB and FASB have adopted the decision usefulness approach. This is evidenced by their conceptual framework, which shows a clear recognition of the role of financial reporting in providing useful information for investors.

Questions and Problems

1. Refer to Table 3.2, the information system table for Example 3.1. Prepare a similar table for a perfect, or fully informative, information system, that is, an information system that perfectly reveals the true state of nature. Do the same for a non-informative information system, that is, one that reveals nothing about the true state.

Use the probabilities from the two tables you have prepared to revise state probabilities by means of Bayes' theorem, using the prior probabilities and GH message given in Example 3.1. Comment on the results.

2. What would a utility function of a risk-taking investor look like? What sort of portfolio would such an individual be likely to invest in? What information would the investor need?

3. An investor's utility function is

\[ U(a) = \frac{1}{2} \bar{x}^2 - 16\sigma^2 \]

Calculate Toni's utility at point Z on Figure 3.5 and compare it with her utility at point M. Which act does Toni prefer? Explain.

4. What is the beta of
   a. The market portfolio
   b. The risk-free asset
   c. Portfolio A + B in Example 3.3 and Section 3.7?

5. Calculate Toni's utility at point Z on Figure 3.5 and compare it with her utility at point M. Which act does Toni prefer? Explain.

6. Explain why most of the benefits of diversification can be attained with only a relatively few securities in the portfolio. Assume that an equal amount is invested in each security. Does the riskiness of the return on a diversified portfolio approach zero as the number of securities in the portfolio gets larger? Explain.

7. The IASB/FASB draft joint Conceptual Framework states:

   Information about effects of transactions and other events and circumstances that change an entity's economic resources and the claims on them i.e., the income statement, helps the user of the entity's financial reports to assess the amount, timing and uncertainty of its future cash flows.

   Why do you think the FASB Standard setters argue that information about earnings based on accrual accounting provides a better prediction of the firm's present and continuing ability to generate favourable cash flows than information limited to the financial effects of cash receipts and payments?

8. In Section 3.8, the text refers to the study of Kim and Cross, who report that the ability of current earnings to predict next period's operating cash flow exceeds that of current operating cash flows. Give an explanation for this result.

9. Verify the statement made at the end of Section 3.6 that if Toni Difelice can borrow all she wants at 4% she would borrow $9,800, yielding utility of 2.33.

10. Give some reasons why the off-main diagonal probabilities of an information system such as that depicted in Table 3.2 are non-zero. Use the concepts of relevance and reliability in your answer. Explain why an information system is more useful the lower the off-main diagonal probabilities are.

11. Decision usefulness is an important accounting concept:

   a. State the decision usefulness approach to accounting theory.
   b. What two questions arise once the decision usefulness approach is adopted?
   c. What primary constituency of financial statement users has been adopted by the draft joint IASB/FASB Framework as a guide to the reporting of decision-useful financial information? What information does this constituency need?
   d. What characteristics does financial accounting information need if it is to be useful to the constituency identified in part c?
   e. Explain why information about the riskiness of securities is useful to investors.
12. Mr. Smart is an investor with $15,000 to invest. He has narrowed his choice down to two possible investments:
- Mutual fund
- Common shares in Byyme Corporation

Figure 3.6 gives a decision tree for Mr. Smart's situation. Mr. Smart is risk-averse. The amount of utility he derives from a payoff is

\[ \text{Utility} = 2 \ln(\text{payoff}) \]

Because of a planned major purchase, Mr. Smart intends to sell his investment one year later. The payoffs represent the proceeds from the sale of the investment and receipt of any dividends, net of initial investment. The probabilities represent Mr. Smart's prior probabilities about the state of the economy (good or bad) over the coming year.

Required

a. Calculate Mr. Smart's expected utility for each action, and indicate which action he would choose if he acted on the basis of his prior information.

b. Now, suppose Mr. Smart decides that he would like to obtain more information about the state of the economy rather than simply accepting that it is just as likely to be good as bad. He decides to take a sample of current annual reports of major corporations. Every annual report shows that its firm is doing well, with increased profits over the previous year. The probability that there would be such healthy profits if the state of the economy actually was good is 0.75. The probability of such healthy profits is only 0.10 if the state of the economy actually was bad.

Use Bayes' theorem to calculate Mr. Smart's posterior probabilities of the high and low states of the economy. Will he change his decision?

Note: Round your calculations to two decimal places.

**Figure 3.6 Decision Tree for Mr. Smart's Problem**

<table>
<thead>
<tr>
<th>Action</th>
<th>State</th>
<th>Probability</th>
<th>Net Payoff</th>
</tr>
</thead>
<tbody>
<tr>
<td>Buy common</td>
<td>Good</td>
<td>0.60</td>
<td>$8,000</td>
</tr>
<tr>
<td>Buy common</td>
<td>Bad</td>
<td>0.50</td>
<td>$1,000</td>
</tr>
<tr>
<td>Invest $15,000</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Buy mutual</td>
<td>Good</td>
<td>0.50</td>
<td>$5,000</td>
</tr>
<tr>
<td>Buy mutual</td>
<td>Bad</td>
<td>0.50</td>
<td>$2,000</td>
</tr>
</tbody>
</table>

13. John Save plans to invest $5,000 in one of the following instruments:
- Bonds of J Ltd., yielding 12%
- Canada Savings Bonds, yielding 8%

On the basis of his knowledge of current economic conditions and the outlook for the industry of J Ltd., John assesses the prior probability that J Ltd. will go bankrupt as 0.05. If this happens, John will lose both principal and interest and receive no money at the end of the year. If J Ltd. does not go bankrupt, John plans to sell the bonds, plus interest, at the end of one year.

Of course, the probability that the Canada Savings Bonds will fail to pay off is zero. John also plans to sell these, plus interest, one year later.

John is risk-averse and decides to choose the investment that yields the highest expected utility. Assume that John's utility for an amount of $x$ is given by $V(x)$, where $x$ is the gross payoff.

Required

a. On the basis of his prior probabilities, which investment should John choose?

b. Rather than choosing on the basis of his prior probabilities, assume that John decides to analyze the current financial statements of J Ltd. These financial statements can look "good" (G) or "bad" (B). After his analysis, John realizes that the statements look good. On the basis of his extensive understanding of financial statement analysis, he knows that the probability that the financial statements would look good given that the firm was actually heading for bankruptcy is 0.10, that is

\[ \text{Prob}(G \mid S_1) = 0.10 \]

where $S_1$ denotes the state of heading for bankruptcy.

Similarly, John knows that

\[ \text{Prob}(G \mid S_2) = 0.80 \]

where $S_2$ denotes the state of not heading for bankruptcy.

Which investment should John now take? Explain why. Use Bayes' theorem.

14. Consider the common stock of A Ltd. and the common stock of B Ltd. These two common stocks have the same expected return and the same variance of return.

You are a risk-averse investor and have a fixed sum of money to invest. You are considering the following two choices:

a. Investing all of the money in common stock of A Ltd.

b. Investing in a portfolio with the investment equally distributed between common stock of A Ltd. and common stock of B Ltd.

Required

Discuss whether you would choose alternative a or b or whether you are indifferent between them. Explain your choice.
15. "It is possible to reduce risk in a portfolio by diversification."

Required
a. Do you agree with this statement? Explain why or why not.
b. Can the risk of a portfolio be reduced to zero by diversification? Explain.
c. Why is beta the most relevant measure of risk in a diversified portfolio?

16. Marie has $1,000 that she wishes to invest for one year. She has narrowed her choices down to one of the following two actions:
   a. Buy bonds of Risky Mining Ltd. These pay 14.4% interest, unless Risky goes bankrupt, in which case Marie will lose her principal and interest.
   b. Buy Canada Savings Bonds, paying 6.4% interest.

Marie assesses her prior probability of Risky Mining Ltd. going bankrupt as 0.40. Marie's utility for money is given by the square root of the amount of her gross payoff. That is, if she buys the Canada Savings Bonds her gross payoff is $1,064, etc. Marie is a rational decision-maker.

Required
a. Based on her prior probabilities, which action should Marie take? Show your calculations.
b. Before making a final decision, Marie decides she needs more information. She obtains Risky Mining's current financial statements and examines its debt-to-equity ratio. This ratio can be either "HI" or "LO." Upon calculating the ratio, Marie observes that it is LO. On the basis of her prior experience in bond investments, Marie knows the following conditional probabilities:

<table>
<thead>
<tr>
<th>Future State</th>
<th>Debt-to-Equity Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>NB (Not Bankrupt)</td>
<td>LO 0.50 0.50</td>
</tr>
<tr>
<td>B (Bankrupt)</td>
<td>HI 0.05 0.95</td>
</tr>
</tbody>
</table>

Which action should Marie now take? Show your calculations, taken to two decimal places.

c. A new accounting standard requires that Risky Mining Ltd.'s pension liabilities must now be measured in the financial statements at their expected discounted present values (i.e., value-in-use), instead of the previous pay-as-you-go accounting under which pension expense was based on amounts paid out for pensions during the period with no balance sheet liability recorded.

Evaluate the likely impact of the new standard on the main diagonal probabilities of the information system in part b.

17. A rational investor has $1,000 to invest. She is contemplating investing the full amount in shares of Company A (a1) or investing it in a risk-free government bond (a2).

The investor identifies two states of nature:
State H: Company A has high future performance.
State L: Company A has low future performance.

On the basis of her prior information about Company A, the investor assesses the following subjective prior probabilities:
State H: 0.2
State L: 0.8

The following is the payoff table for these two investments. Payoffs are not of (i.e., they exclude) the original investment.

<table>
<thead>
<tr>
<th>Act</th>
<th>State</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>H</td>
</tr>
<tr>
<td>a1</td>
<td>$324</td>
</tr>
<tr>
<td>a2</td>
<td>$36</td>
</tr>
</tbody>
</table>

The investor is risk-averse, with utility equal to the square root of the net dollar payoff.

Required
a. On the basis of her prior probabilities, which action should the investor take? Show calculations.
b. Instead of acting now, the investor decides to obtain more information about Company A by careful reading of its annual report. The investor, who is an expert in financial accounting and reporting standards, knows that the company's financial statements are expressed in the following information system:

<table>
<thead>
<tr>
<th>Current Annual Report Evidence</th>
<th>GOOD</th>
<th>BAD</th>
</tr>
</thead>
<tbody>
<tr>
<td>State</td>
<td></td>
<td></td>
</tr>
<tr>
<td>H</td>
<td>0.6</td>
<td>0.4</td>
</tr>
<tr>
<td>L</td>
<td>0.1</td>
<td>0.9</td>
</tr>
</tbody>
</table>

Good evidence means that a company reports increased profits and adequate working capital. Bad evidence means that the company's profits are down and working capital is low. Upon reading the current annual report, the investor finds it is Good. Which act should the investor take now? Show calculations.

c. Assume that the accounting standards are revised to require fair value accounting for major asset classes. Evaluate, in words, the impact of this revision on the quality of the information system.

18. Ajay is a rational, risk-averse investor with $5,000 to invest for one year. He has decided to invest this amount in a high-technology firm and has narrowed his choice down to either AB Ltd. or XY Ltd. AB is a highly speculative firm with good prospects but no established products. XY is a well-established firm with stable performance. The payoffs (net of
amount invested) for each firm depend on its next year’s performance, as follows:

<table>
<thead>
<tr>
<th></th>
<th>Return</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>AB Ltd.</td>
</tr>
<tr>
<td>High</td>
<td>$1,089</td>
</tr>
<tr>
<td>Low</td>
<td>$0</td>
</tr>
</tbody>
</table>

For each firm, Ajay assesses prior probabilities of 0.5 for the high- and low-performance states. His utility for his investment return is equal to the square root of the amount of net payoff received.

Required:

a. On the basis of his prior probabilities, should Ajay invest in AB Ltd. (a₁) or XY Ltd. (a₂)? Show calculations.

b. XY Ltd. has just released its annual report. Ajay decides to analyze it before investing. His analysis shows “good news” (GN). He consults Al, an expert in financial reporting standards, who is quite critical of the quality of current GAAP. Al advises that, based on current GAAP, the information system for firms’ annual reports is as follows:

<table>
<thead>
<tr>
<th>Next Year’s Performance</th>
<th>Financial Statement Information</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>GN</td>
</tr>
<tr>
<td>High</td>
<td>0.6</td>
</tr>
<tr>
<td>Low</td>
<td>0.5</td>
</tr>
</tbody>
</table>

The annual report of AB Ltd. is not due for some time, and nothing else has happened to cause Ajay to change his prior probabilities of AB’s next year performance. Which investment should Ajay make now? Show calculations.

c. Concerned by several recent financial reporting failures, the regulatory authorities decide to act. They quickly introduce several new accounting standards, including tighter controls over revenue recognition and greater conservatism in asset valuation. New corporate governance regulations and restrictions on the ability of auditors to engage in non-audit services for their clients are also implemented. Al advises Ajay that the information system for annual reports following these new standards and regulations is as follows:

<table>
<thead>
<tr>
<th>Next Year’s Performance</th>
<th>Financial Statement Information</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>GN</td>
</tr>
<tr>
<td>High</td>
<td>0.8</td>
</tr>
<tr>
<td>Low</td>
<td>0.2</td>
</tr>
</tbody>
</table>

Al advises Ajay to ignore the information system in part b and instead use this one to revise his prior probabilities of XY Ltd.’s next year’s performance based on the GN in its annual report. AB Ltd. still has not reported and Ajay’s prior probabilities of its performance are unchanged. Which act should Ajay now take? Show calculations.

19. You are an expert on financial statement analysis and the quality of financial reporting, with extensive experience in rational investing. You determine that the current quality of financial reporting is summarized in the following information system:

<table>
<thead>
<tr>
<th>State of Nature</th>
<th>GN</th>
<th>BN</th>
</tr>
</thead>
<tbody>
<tr>
<td>High</td>
<td>0.8</td>
<td>0.2</td>
</tr>
<tr>
<td>Low</td>
<td>0.1</td>
<td>0.9</td>
</tr>
</tbody>
</table>

The states of nature refer to future firm performance. GN (good news) and BN (bad news) summarize the information content of current financial statements.

You are a shareholder of CG Ltd., which has just released its quarterly financial report. You analyze this report, and decide that it shows GN. Your decision problem is to sell your shares now (a₁) or hold them for another quarter (a₂).

Your prior probability of the high state is 0.7. The current market value of your CG Ltd. shares is $811. If CG is in the high state, your payoff will be $100 if you sell at the end of the next quarter. If CG is in the low state, your payoff will be $36. You are risk-averse, with utility equal to the square root of your payoff.

Required:

a. What information is included in your prior probabilities? Are they subjective or objective? Why?

b. Are the information system probabilities subjective or objective? What determines these probabilities?

c. Should you sell or hold your CG shares? Show calculations.

20. Bill plans to invest $50,000 in the shares of Company Q (act a₁) or the same amount in shares of Company W (act a₂) for 1 year.

- Bill, who is a rational investor, identifies two states of nature:
  - State H: The company expects high future cash flows.
  - State L: The company expects low future cash flows.

- On the basis of his information to date about each firm, Bill assesses the following subjective prior state probabilities (i.e., the same probabilities for each company):
  - State H: 0.8
  - State L: 0.2

The following is the payoff table for these two investments. Payoffs are net of (i.e., they exclude) the original investment.
Bill is risk-averse, with utility equal to the square root of the amount of payoff received.

Required
a. On the basis of his prior probabilities, which act should Bill take? Show calculations.
b. Instead of acting now, Bill decides to obtain more information by careful reading of each company's Management Discussion and Analysis (MD&A), from their latest annual reports. He plans to focus on their discussions of risks and uncertainties, in conjunction with their discussions of future prospects. He knows that careful evaluation of the quality of these discussions will provide inside evidence of the companies' future cash flow expectations. That is, companies with high expectations will tend to provide better disclosure.

Bill knows, however, that MD&A is not a perfect predictor. Some firms that expect high future performance may disguise their optimism by poor disclosure, to reduce the likelihood that new competitors will be attracted to the industry. Conversely, some firms that expect low future performance may provide excellent disclosure. They do this to reduce investor concerns about estimation risk, thereby reducing the "hit" to their share price when the poor performance prospects become known.

Bill, who is an expert on GAAP and current MD&A guidelines, knows that these possibilities are summarized by the following information system.

<table>
<thead>
<tr>
<th>Current MD&amp;A Evidence</th>
<th>State</th>
<th>Good disclosure</th>
<th>Poor disclosure</th>
</tr>
</thead>
<tbody>
<tr>
<td>H</td>
<td></td>
<td>0.8</td>
<td>0.2</td>
</tr>
<tr>
<td>L</td>
<td></td>
<td>0.3</td>
<td>0.7</td>
</tr>
</tbody>
</table>

Upon reading the current MD&As, Bill finds that Company Q has good disclosure and Company W has poor disclosure.

Which act, a1 or a2, should Bill take now? Show calculations.

c. Bill tells you about his decision. You respond by suggesting that he should perhaps have bought some of both Company Q and Company W shares. Explain why you make this suggestion. Calculations not required.

21. The following problem is designed to encourage your consideration of Bayes' theorem. It shows how unaided judgment about probabilities can often be far off the mark. The problem is adapted from one appearing in an article in The Economist, "Getting the goat," February 20, 1999, p. 32. This article discusses how people who guess at probabilities can frequently be wrong.

A disease is present in the population at the rate of one person per thousand. A test for the disease becomes available. The drug company that is marketing the test randomly selects you to take the test. You agree, and the test results are positive. If the disease is present, the test always shows a positive result. However, the test has a 5% probability of showing a positive result when in fact the disease is not present. What is the probability that you have the disease?

Notes
1. As mentioned in Section 1.2, decision usefulness was the focus of the 1966 AAA monograph, A Statement of Basic Accounting Theory (ASOBAT).
2. The Trueblood Commission was a study group of the American Institute of Certified Public Accountants, which, in its 1973 report, Objectives of Financial Statements, accepted the decision usefulness approach of ASOBAT. The significance of this acceptance is that the AICPA is a professional accounting body, whereas the AAA is an association of academicians.
3. For a formal development of the concepts of decision theory, including utility theory, the information system, and the value of information, see Laffont (1989), especially Chapters 1, 2, and 4. See also Denski (1972), especially Chapters 1 to 3. For an excellent intuitive development of the theory, see Raffi (1988).
4. We define utility here in terms of the net payoff. Conceptually, utility should be defined in terms of the investor's total wealth. However, we opt for the simplest presentation in this example. Note also that the payoff for square root utility must be positive. If a negative (net) payoff is possible, we could work with gross payoffs or assume some other measure of utility, such as the log of the payoff.
5. A possible alternative would be to diversify, that is, to buy some of each type of security. We will rule this out for now by assuming that the brokerage fees for buying small amounts are prohibitive.
6. Evaluation of the information in financial statements requires complete and careful analysis. For example, suppose earnings are up this year but sales are down. On closer inspection, the reason for the higher earnings may be some non-operating items, such as gains on sale of land, or cost-cutting due to declining market share. Alternatively, the earnings may be higher due to some temporary but temporary favorable events of a one-time nature, such as a fire at a competitor's factory. In both cases, Bill may interpret higher earnings as bad news. Note that full disclosure is necessary here.
7. While the decision-maker's prior and posterior probabilities are subjective, the information system probabilities are objective. As explained below, these objective probabilities are determined by the quality of the GAAP financial statements. For the distinction between objective and subjective probabilities, see the discussion in Example 2.2.
8. This type of conservatism is called conditional conservatism by Beaver and Ryan (2005), since write-downs are conditional on a loss in value actually taking place.

Historical cost accounting also introduces conservatism into the information system. For example, probable capital investments are recorded at historical cost rather than current value, and inventories are carried at cost until objective evidence of realization is achieved. This recognition lag for good news in the financial statements lowers the probability of GAAP-based accruals. Beaver and Ryan call this type of conservatism unconditional conservatism, since assets are valued at less than their current value even though a loss in value has not taken place. Both types of conservatism are discussed in Section 6.7.
9. The rational expectations assumption should not be interpreted as literally true. Rather, it is intended to capture the end result (in this case, the correct values of information system probabilities) as individuals learn the unknown parameters values through experience, and assuming these values stay constant.

Note that this assumption does not extend to the states of nature. If Bill knows for sure which state X Ltd. is in, there is no need to gather information.

Also, a rational expectations assumption with respect to the information system is not necessary. Bill could assess a joint prior probability distribution on the states of nature and the information system probabilities, where the state of nature is interpreted as the mean of the distribution of future firm performance, and the information system is interpreted as the variance. Observation of X Ltd.'s financial statements over time can then be interpreted as a sample providing information about both mean and variance. With each observation, Bill updates his prior probabilities of both. Our assumption that the information system is known is primarily for simplicity.
10. Case must be taken in classifying firms as GN or BN, however, since firms differ in their innate characteristics such as size, capital structure, volatility of environment, and the presence of intangibles. For example, GAAP requires that all research costs be written off currently. Thus the financial statements of high research intensity firms may appear to show BN when actually they imply GN. In effect, firms' financial statements may differ in their informativeness about future firm performance even if the financial statements of both firms are consistent with GAAP.

11. Strictly speaking, choosing the act that maximizes expected utility is a consequence of rationality, not rationality itself. Savage (1954) defines a set of axioms of rational behavior under uncertainty with subjective probabilities. If an individual acts according to these axioms, it can be shown that that individual will prefer one act to another if and only if its expected utility is higher than the other, where the expectation is with respect to the individual’s subjective state probabilities. See, for example, Laffont (1988, pp. 14–17) for a demonstration.

12. For a formal development and analysis of risk aversion, see Pratt (1964), in Laffont (1988), Chapter 2.

13. The expected payoff is:

\[0.7 \times 200 + 0.3 \times 1,133.33 = 480\]

Expected utility is:

\[0.7 \times \sqrt{200} + 0.3 \times \sqrt{1,133.33} = 0.7 \times 14.14 + 0.3 \times 33.66 = 9.90 + 10.10 = 20\]

14. Note that we have suppressed the set of states of nature in this example. That is, Toni assesses payoff probabilities directly, rather than working through states. Thus, instead of saying “the probability that firm A is in high-performance state is 0.74 and if A really is in this state the payoff will be 200,” we simply say “the probability of the $200 payoff is 0.74.” This simplification has certain analytical advantages and is frequently used.

15. This argument assumes that the only source of correlation between returns on firms’ shares is market-wide factors. In effect, we have partitioned states of nature that can affect share returns into two components—economy-wide and firm-specific. This is a simplification, since, for example, industry-wide factors could introduce additional returns correlation. However, the simplification is a widely used one and is sufficient for our purposes. It leads to an important measure of share riskiness (beta), which we will discuss shortly.

16. The risk we are referring to here is extra risk. That is, the investor is in the process of an investment decision and is looking ahead. This is not to say that if a firm in the portfolio realizes, say, a low return because some unfortunate firm-specific risk factor has happened, the investor will not be angry at that firm’s performance.

17. This is not to say that economy-wide risk is insignificant in a diversified portfolio. The drastic fall in share prices following the 2002–2008 market meltdowns (Section 1.3) illustrates the effects of economy-wide risk.

18. The expected return of B is:

\[0.6750 \times \frac{92 - 80}{80} + 0.3250 \times \frac{76 - 80}{80}\]

\[= 0.6750 \times 0.15 + 0.3250 \times -0.05 = 0.0850\]

(See Example 3.3.)

\[
\begin{array}{|c|c|c|}
\hline
\text{Returns} & \text{B} & \text{M} \\
\hline
\text{Joint Probabilities} & \text{High} & \text{Low} \\
\hline
\text{High} & (0.15 + 0.085)(0.10 - 0.085) & 0.6333 = 0.0006 \\
\text{Low} & (0.15 + 0.085)(0.25 - 0.085) & 0.0417 = 0.0002 \\
\hline
\text{Low} & (-0.05 + 0.085)(0.10 - 0.085) & 0.1667 = 0.0003 \\
\text{Low} & (-0.05 + 0.085)(0.25 - 0.085) & 0.1583 = 0.0013 \\
\hline
\text{Cov}(B, M) = 0.0014 \\
\hline
\end{array}
\]

The joint probability of B high and M high is given by 0.8 \times 0.7917 = 0.6333. You should now verify the remaining lines.

19. Note that A shares have the same expected return as B shares (0.085), but higher risk since \( \beta_A = 2.0667 \) while \( \beta_B = 1.5596 \). Then, it might seem that Toni should buy only B shares. However, this is not the case—Toni will still hold both A and B shares in her portfolio. If she invests all of her $200 in B, her expected return is 0.085 and variance of return is 0.0008 (see Note 20), giving expected utility of 0.1612, which is less than expected utility of 0.1625 from holding both A and B. In this case, the benefits of diversification outweigh the fact that B shares by themselves have lower risk.

20. \text{Var}(B) = 0.075 \times 0.15 - 0.0850^2 + 0.3250 \times (-0.05 - 0.0850)^2 = 0.0009 + 0.0009 = 0.0008

21. An alternative to buying the market portfolio is to invest in an index fund. This is a fund that tracks the rate of return on a stock market index. This attains the benefits of full diversification but with lower transactions costs. However, unless he/she buys every stock in the index, the manager of such a fund would be more interested in stocks’ unexpected returns and betas.

22. Statement of Financial Accounting Concepts No. 1 (1978) (SFAC1), the original conceptual framework, is also consistent with the decision usefulness approach. A difference from the IASC/FASB Framework, however, is its use of the term “rational” decisions, providing additional linkage with the theory of “rational” decision-making. Removal of the term “rational” in the first Framework is presumably due to theory and evidence suggesting that individuals may not be as fully “rational” as the theory assumes. We shall review this theory and evidence in Chapter 6, where we suggest that much of this evidence of non-rational behaviour can equally well be explained in a manner consistent with rationality.

23. The entity view contends with the proprietorship view, under which the income statement is geared to the firm’s common shareholders.