Corporate Finance: The Core

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Solution Manual

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Chapter 1
The Corporation

1-1. A corporation is a legal entity separate from its owners. This means ownership shares in the corporation can be freely traded. None of the other organizational forms share this characteristic.

1-2. Owners' liability is limited to the amount they invested in the firm. Stockholders are not responsible for any encumbrances of the firm; in particular, they cannot be required to pay back any debts the incurred by the firm.

1-3. Corporations and limited liability companies. Limited partnerships provide limited liability for the limited partners, but not for the general partners.

1-4. Advantages: Limited liability, liquidity, infinite life
Disadvantages: Double taxation, separation of ownership and control

1-5. C corporations much pay corporate income taxes; S corporations do not pay corporate taxes but must pass through the income to shareholders to whom it is taxable. S corporations are also limited to 75 shareholders and cannot have corporate or foreign stockholders.

1-6. First the corporation pays the taxes. After taxes, $\$2 \times (1-0.4) = \$1.20$ is left to pay dividends. Once the dividend is paid, personal tax on this must be paid leaving $\$1.20 \times (1-0.3) = \$0.84$. So after all the taxes are paid, you are left with 84¢.

1-7. An S corporation does not pay corporate income tax. So it distributes $2 to its stockholders. These stockholders must then pay personal income tax on the distribution. So they are left with $\$2 \times (1-0.3) = \$1.40$.

1-8. Shareholders can:

i. Ensure that employees are paid with company stock and/or stock options.

ii. Ensure that underperforming managers are fired.

iii. Write contracts that ensure that the interests of the managers and shareholders are closely aligned.

iv. Mount hostile takeovers.

1-9. The shares of a public corporation are traded on an exchange (or "over the counter" in an electronic trading system) while the shares of a private corporation are not traded on a public exchange.

1-10. Investors always buy at the ask and sell at the bid. Since ask prices always exceed bid prices, investors "lose" this difference. It is one of the costs of transacting. Since the market makers take the other side of the trade, they make this difference.

1-11. You would buy at $28.70 and sell for $28.69.

Chapter 2

Introduction to Financial Statement Analysis

2-1. In a firm's 10-K filing, four financial statements can be found: the balance sheet, the income statement, the statement of cash flows, and the statement of stockholders' equity. Financial statements in form 10-K are required to be audited by a neutral third party, who checks and ensures that the financial statements are prepared according to GAAP and that the information contained is reliable.

2-2. Users of financial statements include present and potential investors, financial analysts, and other interested outside parties (such as lenders, suppliers and other trade creditors, and customers). Financial managers within the firm also use the financial statements when making financial decisions.

Investors. Investors are concerned with the risk inherent in and return provided by their investments. Bondholders use the firm's financial statements to assess the ability of the company to make its debt payments. Stockholders use the statements to assess the firm's profitability and ability to make future dividend payments.

Financial analysts. Financial analysts gather financial information, analyze it, and make recommendations. They read financial statements to determine a firm's value and project future earnings, so that they can provide guidance to businesses and individuals to help them with their investment decisions.

Managers. Managers use financial statement to look at trends in their own business, and to compare their own results with that of competitors.

2-3. Each method will help find the same SEC filings. Yahoo finance also provides some analysis such as charts and key statistics.

2-4.

a. Long-term liabilities would decrease by $20 million, and cash would decrease by the same amount. The book value of equity would be unchanged.

b. Inventory would decrease by $5 million, as would the book value of equity.

c. Long-term assets would increase by $10 million, cash would decrease by $5 million, and long-term liabilities would increase by $5 million. There would be no change to the book value of equity.

d. Accounts receivable would decrease by $3 million, as would the book value of equity.

e. This event would not affect the balance sheet.

f. This event would not affect the balance sheet.

2-5. Global Conglomerate's book value of equity increased by $1 million from 2004 to 2005. An increase in book value does not necessarily indicate an increase in Global's share price. The market value of a stock does not depend on the historical cost of the firm's assets, but on investors' expectation of the firm's future performance. There are many events that may affect Global's future profitability, and hence its share price, that do not show up on the balance sheet.

2-6.

a. Market Capitalization = 10.6 billion ? $36 = $381.6 billion

Market-to-book ratio = $\frac{381.6}{113} = 3.38$

b. Book debt-equity ratio = $\frac{370}{113} = 3.27$

Market debt-equity ratio = $\frac{370}{381.6} = 0.97$

c. Enterprise value = $381.6 + 370 - 13 = 738.6$

2-7.

a. At the start of 2005, Peet's had cash and cash equivalents of $11.356 million.

b. Peet's total assets were $127.889 million.

c. Peet's total liabilities were $18.762 million, and it had no debt.

d. The book value of Peet's equity was $109.127 million.

2-8.

a. Peet's revenues for 2004 were $145.683 million.

Increase in revenues = $\frac{145,683}{119,816} - 1 = 21.59\%$

b. Operating margin (2004) = $\frac{13,133}{145,683} = 9.01\%$

Operating margin (2003) = $\frac{7,496}{119,816} = 6.26\%$

Net profit margin (2004) = $\frac{8,785}{145,683} = 6.03\%$

Net profit margin (2003) = $\frac{5,178}{119,816} = 4.32\%$

c. Both margins increased compared with the year before. The diluted earnings per share in 2004 was $0.63. The number of shares used in calculation of diluted EPS was13.951 million.

2-9.

a. Revenues in 2006 = 1.15 × 186.7 = $214.705 million.

EBIT = 4.50% × 214.705 = $9.66 million (there is no other income).

b. Net Income = EBIT – Interest Expenses – Taxes = (9.66 – 7.7) × (1 – 26%) = $1.45 million.

c. Share price = (P/E Ratio in 2005) ? (EPS in 2006) = 25.2 ? $\left(\frac{1.45}{3.6}\right)$ = $10.15

2-10.

a. A \$10 million operating expense would be immediately expensed, increasing operating expenses by \$10 million. This would lead to a reduction in taxes of 35% × \$10 million = \$3.5 million. Thus, earnings would decline by 10 – 3.5 = \$6.5 million. There would be no effect on next year's earnings.

b. Capital expenses do not affect earnings directly. However, the depreciation of \$2 million would appear each year as an operating expense. With a reduction in taxes of 2 × 35% = \$0.7 million, earnings would be lower by 2 – 0.7 = \$1.3 million for each of the next 5 years.

2-11.

a. If Quisco develops the product in house, its earnings would fall by \$500 × (1 – 35%) = \$325 million. With no change to the number of shares outstanding, its EPS would decrease by $\$0.05 = \frac{\$325}{6500}$ to \$0.75. (Assume the new product would not change this year's revenues.)

b. If Quisco acquires the technology for \$900 million worth of its stock, it will issue \$900 / 18 = 50 million new shares. Since earnings without this transaction are \$0.80 × 6.5 billion = \$5.2 billion, its EPS with the purchase is $\frac{5.2}{6.55} = \$0.794$.

c. Acquiring the technology would have a smaller impact on earnings. But this method is not cheaper. Developing it in house is less costly and provides an immediate tax benefit. The earnings impact is not a good measure of the expense. In addition, note that because the acquisition permanently increases the number of shares outstanding, it will reduce Quisco's earnings per share in future years as well.

2-12.

a. Market capitalization-to-revenue ratio

$$= \frac{2.3}{18.9} = 0.12 \text{ for American Airlines}$$

$$= \frac{5.2}{13.6} = 0.38 \text{ for British Airways}$$

b. Enterprise value-to-revenue ratio

$$= \frac{(2.3 + 14.3 - 3.1)}{18.9} = 0.71 \text{ for American Airlines}$$

$$= \frac{(5.2 + 8.0 - 2.9)}{13.6} = 0.76 \text{ for British Airways}$$

c. The market capitalization to revenue ratio cannot be meaningfully compared when the firms have different amounts of leverage, as market capitalization measures only the value of the firm's equity. The enterprise value to revenue ratio is therefore more useful when firm's leverage is quite different, as it is here.

2-13.

a. Net cash provided by operating activities was $18.337 million in 2004.

b. Depreciation and amortization expenses were $6.899 million in 2004.

c. Net cash used in new property and equipment was $38.984 million in 2004.

d. Net cash provided by financing activities was $1.740 million, in which $1.647 million was raised from the sale of its stock.

2-14. A firm can have positive net income but still run out of cash. For example, to expand its current production, a profitable company may spend more on investment activities than it generates from operating activities and financing activities. Net cash flow for that period would be negative, although its net income is positive. It could also run out of cash it spends a lot on financing activities, perhaps by paying off other maturing long-term debt, repurchasing share, or paying dividends.

2-15.

a. Heinz's cumulative earnings over these four quarters was $753 million. Its cumulative cash flows from operating activities was $1.19 billion.

b. Fraction of cash from operating activities used for investment over the 4 quarters:

	27-Apr-05	26-Jan-05	27-Oct-04	28-Jul-04	4 quarters
Operating Activities	654,647	126,584	221,578	186,180	1,188,989
Investing Activities	–138,922	–72,601	–18,063	–34,468	–264,054
CFI/CFO	21.22%	57.35%	8.15%	18.51%	22.21%

c. Fraction of cash from operating activities used for financing over the 4 quarters:

	27-Apr-05	26-Jan-05	27-Oct-04	28-Jul-04	4 quarters
Operating Activities	654,647	126,584	221,578	186,180	1,188,989
Financing Activities	–210,683	–518,856	–160,954	–160,392	–1,050,885
CFF/CFO	32.18%	410%	72.64%	86.15%	88.38%

2-16.

a. Revenues: increase by $5 million

b. Earnings: increase by $3 million

c. Receivables: increase by $4 million

d. Inventory: decrease by $2 million

e. Cash: increase by $3 million (earnings) – $4 million (receivables) + $2 million (inventory) = $1 million (cash).

2-17.

a. Earnings for the next 4 years would have to deduct the depreciation expense. After taxes, this would lead to a decline of $10 \times (1 - 40\%) = \$6$ million each year for the next 4 years.

b. Cash flow for the next four years: less \$36 million (–6 + 10 – 40) this year, and add \$4 million (–6 + 10) for three following years.

2-18.

a. The book value of Clorox's equity decreased by \$2.101 billion compared with that at the end of previous quarter, and was negative.

b. Because the book value of equity is negative in this case, Clorox's market-to-book ratio and its book debt-equity ratio are not meaningful. Its market debt-equity ratio may be used in comparison.

c. Information from the statement of cash flows helped explain that the decrease of book value of equity resulted from an increase in debt that was used to repurchase \$2.110 billion worth of the firm's shares.

d. Negative book value of equity does not necessarily mean the firm is unprofitable. Loss in gross profit is only one possible cause. If a firm borrows to repurchase shares or invest in intangible assets (such as R&D), it can have a negative book value of equity.

2-19.

a. Peet's net income in 2004 after deducting fair value of options granted to employees was \$4.502 million, compared with reported net income of \$8.785 million. (Note 2)

b. Peet's inventory of raw materials at the end of 2004 was \$7.416 million. (Note 3)

c. The fair value of Peet's marketable securities at the end of 2004 was \$52.057 million. (Note 5)

d. As note 11 in 10-K report stated, "The Company leases its Emeryville, California coffee roasting plant, distribution center, administrative offices, and warehouse, its retail stores and certain equipment..." The minimum lease payments due in 2005 are \$7.537 million.

e. Peet's granted 576,754 shares of stock options in 2004. (Note 10)

f. Sales from whole bean coffee, tea, and related products was \$86.270 million or 59.22%, and from beverages and pastries was \$59.413 million or 40.78%. (Note 13)

2-20.

a. Deloitte & Touche LLP audited these financial statements.

b. Peet's Chief Executive Officer, Chief Financial Officer, and board of directors certified the financial statements.

2-21. By reclassifying \$3.85 billion operating expenses as capital expenditures, Worldcom increased its net income but lowered its cash flow for that period. If a firm could legitimately choose how to classify an expense, expensing as much as possible in a profitable period rather than capitalizing them will save more on taxes, which results in higher cash flows, and thus is better for the firm's investors.

Chapter 3
Arbitrage and Financial Decision Making

3-1. The benefit of the rebate is that Honda will sell more vehicles and earn a profit on each additional vehicle sold:

Benefit = Profit of \$6,000 per vehicle × 15,000 additional vehicles sold = \$90 million.

The cost of the rebate is that Honda will make less on the vehicles it would have sold:

Cost = Loss of \$2,000 per vehicle × 40,000 vehicles that would have sold without rebate = \$80 million.

Thus, Benefit – Cost = \$90 million – \$80 million = \$10 million, and offering the rebate looks attractive.

(Alternatively, we could view it in terms of total, rather than incremental, profits. The benefit as \$6000/vehicle × 55,000 sold = \$330 million, and the cost is \$8,000/vehicle × 40,000 sold = \$320 million.)

3-2. Czech buyer's offer = 2,000,000 CZK / (25.50 CZK/USD) = 78,431.37 USD

Thai supplier's offer = 3,000,000 THB / (41.25 THB/USD) = 72,727.27 USD

The value of the deal is \$78,431 – 72,727 = \$5704 today.

3-3.

a. Stock bonus = 100 × \$63 = \$6,300

Cash bonus = \$5,000

Since you can sell (or buy) the stock for \$6,300 in cash today, its value is \$6,300 which is better than the cash bonus.

b. Because you could buy the stock today for \$6,300 if you wanted to, the value of the stock bonus cannot be more than \$6,300. But if you are not allowed to sell the company's stock for the next year, its value to you could be less than \$6,300. Its value will depend on what you expect the stock to be worth in one year, as well as how you feel about the risk involved. You might decide that it is better to take the \$5,000 in cash then wait for the uncertain value of the stock in one year.

3-4.

a. Having \$200 today is equivalent to having 200 × 1.04 = \$208 in one year.

b. Having \$200 in one year is equivalent to having 200 / 1.04 = \$192.31 today.

c. Because money today is worth more than money in the future, \$200 today is preferred to \$200 in one year. This answer is correct even if you don't need the money today, because by investing the \$200 you receive today at the current interest rate, you will have more than \$200 in one year.

3-5. Cost = \$1 million today

Benefit = ? 14 million in one year

$$= ?\ 14 \text{ million in one year} \div \left(\frac{?\ .02 \text{ in one year}}{?\ \text{today}}\right) = ?\ 11.76 \text{ million today}$$

$$= ?\ 11.76 \text{ million today} \div \left(\frac{110}{\$\ \text{today}}\right) = \$1.016 \text{ million today}$$

NPV = \$1.016 million – \$1 million = \$16,000

The NPV is positive, so it is a good investment opportunity.

3-6.

a. $NPV = PV_{\text{Benefits}} - PV_{\text{Costs}}$

$$PV_{\text{Benefits}} = \$20 \text{ million in one year } ?\ \left(\frac{\$1.10 \text{ in one year}}{\$\ \text{today}}\right)$$

$$= \$18.18 \text{ million}$$

$$PV_{\text{This year's cost}} = \$10 \text{ million today}$$

$$PV_{\text{Next year's cost}} = \$5 \text{ million in one year } ?\ \left(\frac{\$1.10 \text{ in one year}}{\$\ \text{today}}\right)$$

$$= \$4.55 \text{ million today}$$

$$NPV = 18.18 - 10 - 4.55 = \$3.63 \text{ million today}$$

b. The firm can borrow \$18.18 million today, and pay it back with 10% interest using the \$20 million it will receive from the government (18.18 × 1.10 = 20). The firm can use \$10 million of the 18.18 million to cover its costs today, and save \$4.55 million in the bank earn 10% interest to cover its cost of 4.55 × 1.10 = \$5 million next year.

This leaves 18.18 – 10 – 4.55 = \$3.63 million in cash for the firm today.

3-7.

a. $$NPV_A = -10 + \frac{20}{1.1} = \$8.18$$

$$NPV_B = 5 + \frac{5}{1.1} = \$9.55$$

$$NPV_C = 20 - \frac{10}{1.1} = \$10.91$$

b. If only one of the projects can be chosen, project C is the best choice because it has the highest NPV.

c. If two of the projects can be chosen, projects B and C are the best choice because they offer a higher total NPV than any other combinations.

3-8.

a. Supplier 1: $PV_{Costs} = 100{,}000 + \$10 \text{ ? } \dfrac{10{,}000}{1.06} = \$194{,}339.62$

Supplier 2: $PV_{Costs} = 21 \text{ ? } \dfrac{10{,}000}{1.06} = \$198{,}113.21$

Costs are lower under the first supplier's offer, so it is better choice.

b. The firm can borrow \$100,000 at 6% from a bank for one year to make the initial payment to the first supplier. One year later, the firm will pay back the bank \$106,000 (100,000 × 1.06) and the first supplier \$100,000 (10 × 10,000), for a total of \$206,000. This amount is less than the \$210,000 (21 × 10,000) the second supplier asked for.

3-9.

a. Take a loan from Bank One at 5.5% and save the money in Bank Enn at 6%.

b. Bank One would experience a surge in the demand for loans, while Bank Enn would receive a surge in deposits.

c. Bank One would increase the interest rate, and/or Bank Enn would decrease its rate.

3-10. There is exchange rate risk. Engaging in such transactions may incur a loss if the value of the dollar falls relative to the yen. Because a profit is not guaranteed, this strategy is not an arbitrage opportunity.

3-11. We can trade one share of Nokia stock for \$17.96 per share in the U.S. and €14.78 per share in Helsinki. By the Law of One Price, these two competitive prices must be the same at the current exchange rate. Therefore, the exchange rate must be:

$$\frac{\$17.96/\text{share of Nokia}}{€14.78/\text{share of Nokia}} = \$1.215/€ \text{ today.}$$

3-12. $PV_{\text{Cash Flows of A}} = 500 + \dfrac{500}{1.05} = \$976.19$

$PV_{\text{Cash Flows of B}} = \dfrac{1000}{1.05} = \$952.38$

$PV_{\text{Cash Flows of C}} = \$1{,}000$

While the total cash flows paid by each security is the same (\$1000), securities A and B are worth less than \$1000 because some or all of the money is received in the future.

3-13.

a. We can value the portfolio by summing the value of the securities in it:
Price per share of ETF = 2 × \$28 + 1 × \$40 + 3 × \$14 = \$138

b. If the ETF currently trades for \$120, an arbitrage opportunity is available. To take advantage of it, one should buy ETF for \$120, sell two shares of HP, sell one share of S, and sell three shares of F. Total profit for such transaction is \$18.

c. If the ETF trades for \$150, an arbitrage opportunity is also available. It can be realized by buying two shares of HP, one share of S, and three shares of F, and selling one share of the ETF for \$150. Total profit would be \$12.

3-14.

a. This security has the same cash flows as a portfolio of one share of B1 and one share of B2. Therefore, its no-arbitrage price is 94 + 85 = \$179.

b. This security has the same cash flows as a portfolio of one share of B1 and five shares of B2. Therefore, its no-arbitrage price is 94 + 5 × 85 = \$519

c. There is an arbitrage opportunity because the no-arbitrage price should be \$132 (94 / 2 + 85). One should buy two shares of the security at \$130/share and sell one share of B1 and two shares of B2. Total profit would be \$4 (94 + 85 × 2 – 130 × 2).

3-15. The PV of the security's cash flow is (\$150 in one year)/(1 + *r*), where *r* is the one-year risk-free interest rate. If there are no arbitrage opportunities, this PV equals the security's price of \$140 today.

Therefore,

$$\$140 \text{ today} = \frac{(\$150 \text{ in one year})}{(1+r)}$$

Rearranging:

$$\frac{(\$150 \text{ in one year})}{\$140 \text{ today}} = (1+r) = \$1.0714 \text{ in one year / \$ today, so } r = 7.14\%$$

3-16.

a. $$\text{NPV}_A = -20,000 + \frac{30,000}{1.1} = \$7,272.73$$

$$\text{NPV}_B = -10,000 + \frac{25,000}{1.1} = \$12,727.27$$

$$\text{NPV}_C = -60,000 + \frac{80,000}{1.1} = \$12,727.27$$

All projects have positive NPV, and Xia has enough cash, so Xia should take all of them.

b. Total value today = Cash + NPV(projects) = 100,000 + 7,272.73 + 12,727.27 + 12,727,27 = \$132,727.27

c. After taking the projects, Xia will have 100,000 – 20,000 – 30,000 – 60,000 = \$10,000 in cash left to invest at 10%. Thus, Xia's cash flows in one year = 30,000 + 25,000 + 80,000 + 10,000 × 1.1 = \$146,000.

$$\text{Value of Xia today} = \frac{146,000}{1.1} = \$132,727.27$$

The same as calculated in b.

d. Unused cash = 100,000 – 20,000 – 30,000 – 60,000 = $10,000

Cash flows today = $10,000

Cash flows in one year = 30,000 + 25,000 + 80,000 = $135,000

Value of Xia today = $10{,}000 + \frac{135{,}000}{1.1} = \$132{,}727.27$

e. Results form b, c and d are the same because all methods value Xia's assets today. Whether Xia pays out cash now or invests it at the risk-free rate, investors get the same value today. The point is that firms cannot increase its value by doing what investors can do by themselves (and is the essence of the separation principle).

3-17.

a. $A + B$ pays $\$600$ in both cases (i.e., it its risk free).

b. Market price $= 231 + 346 = 577$. Expected return is $\frac{(600-577)}{577} = 4.0\%$ risk-free interest rate.

3-18.

a. $C = 3A + B$

b. Price of $C = 3 \times 231 + 346 = 1039$

c. Expected payoff is $\frac{600}{2} + \frac{1,800}{2} = 1,200$. Expected return $= \frac{1,200 - 1,039}{1,039} = 15.5\%$.

Risk premium $= 15.5 - 4 = 11.5\%$

d. Return when strong $= \frac{1,800 - 1,039}{1,039} = 73\%$, return when weak $= \frac{600 - 1039}{1039} = -42\%$.

Difference $= 73 - (-42) = 115\%$

e. Price of C given 10% risk premium $= \frac{1,200}{1.14} = \$1,053$.

Buy $3A + B$ for 1039, sell C for 1053, and earn a profit of $1,053 - 1,039 = \$14$.

3-19.

a. Half as variable $\Rightarrow$ half the risk premium of market $\Rightarrow$ risk premium is 3%

b. Market price $= \frac{\$80}{1 + 4\% + 3\%} = \frac{\$80}{1.07} = \$74.77$

3-20.

a There is an arbitrage opportunity. One would buy from the NASDAQ dealer at $27.95 and sell to NYSE dealer at $28.00, making profit of $0.05 per share.

b. There is no arbitrage opportunity.

c. To eliminate any arbitrage opportunity, the highest bid price should be lower then the lowest ask price.

3-21. We can buy Citigroup stock by buying the portfolio and selling the bond. The cost of buying Citigroup stock in this way is:

–132.25 (buy portfolio at ask) + 91.75 (sell bond at bid) = -40.50

So, if we can sell Citigroup stock for more than 40.50, we can earn an arbitrage profit by buying the portfolio, selling the bond, and selling Citigroup stock.

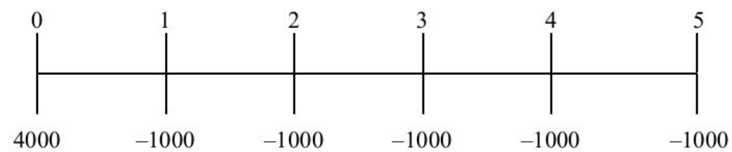
We can also sell Citigroup stock by selling the portfolio and buying the bond. We would earn:

+131.65 (sell portfolio at bid) – 91.95 (buy bond at ask) = 39.70

If we can buy Citigroup for less than 39.70, then again there is an arbitrage opportunity. Thus, no arbitrage implies that the competitive price of Citigroup stock can be between 39.70 and 40.50.

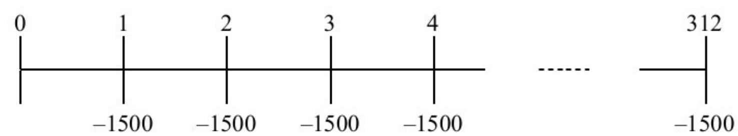
Chapter 4
The Time Value of Money

4-1.



From the bank's perspective the timeline is the same except all the signs are reversed.

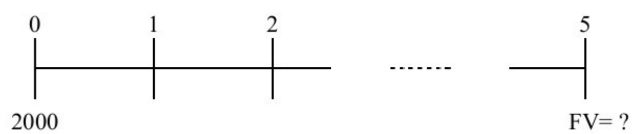
4-2.



From the bank's perspective the timeline would be identical except with opposite signs.

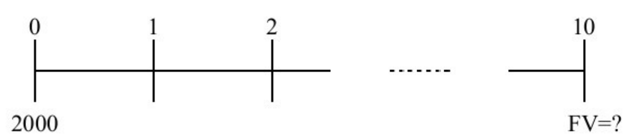
4-3.

a. Timeline:



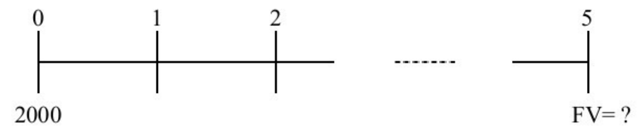
$FV_5 = 2{,}000 \times 1.05^5 = 2{,}552.56$

b. Timeline:



$FV_{10} = 2{,}000 \times 1.05^{10} = 3{,}257.79$

c. Timeline:

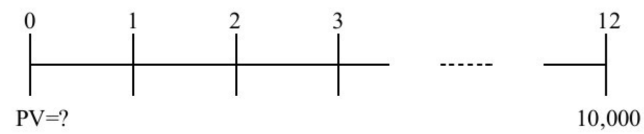


$FV_5 = 2,000 \times 1.1^5 = 3,221.02$

d. Because in the last 5 years you get interest on the interest earned in the first 5 years as well as interest on the original $2,000.

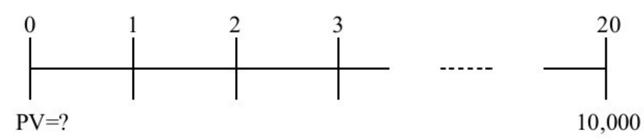
4-4.

a. Timeline:



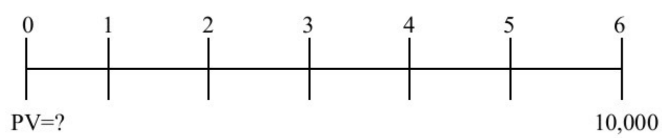
$$PV = \frac{10,000}{1.04^{12}} = 6,245.97$$

b. Timeline:



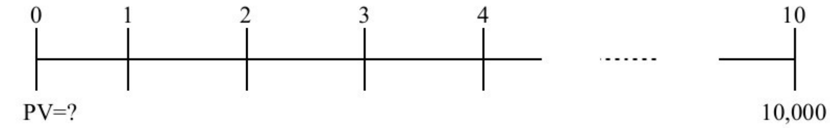
$$PV = \frac{10,000}{1.08^{20}} = 2,145.48$$

c. Timeline:



$$PV = \frac{10,000}{1.02^6} = 8,879.71$$

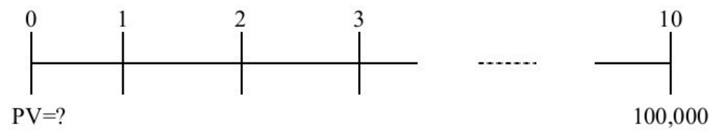
4-5. Timeline:



$$PV = \frac{10,000}{1.07^{10}} = 5,083.49$$

So the 10,000 in 10 years is preferable because it is worth more.

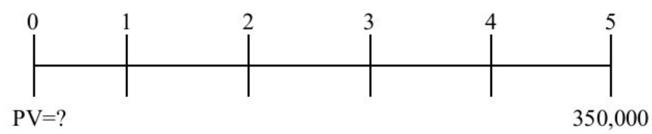
4-6. Timeline:



$$PV = \frac{100,000}{1.03^{10}} = 74,409.39$$

4-7.

Timeline: Same for all parts



a. $PV = \frac{350,000}{1.0^5} = 350,000$

So you should take the 350,000

b. $PV = \frac{350,000}{1.08^5} = 238,204$

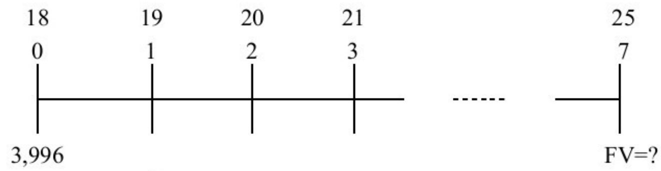
You should take the 250,000.

c. $PV = \frac{350,000}{1.2^5} = 140,657$

You should take the 250,000.

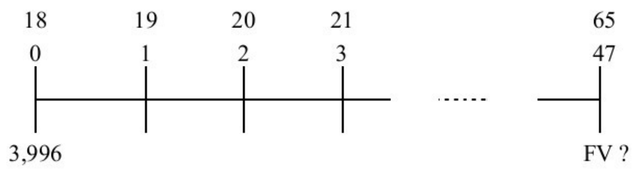
4-8.

a. Timeline:



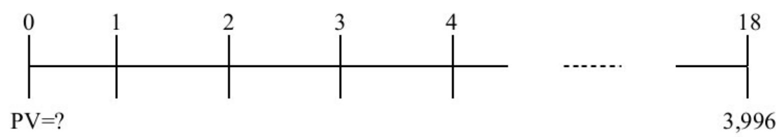
$$\text{FV} = 3,996(1.08)^7$$
$$= 6,848.44$$

b. Timeline:



$$\text{FV} = 3,996(1.08)^{47} = 148,779$$

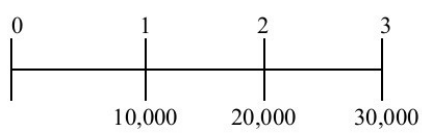
c. Timeline:



$$\text{PV} = \frac{3,996}{1.08^{18}} = 1,000$$

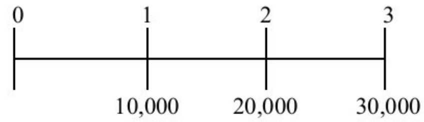
4-9.

a. Timeline:



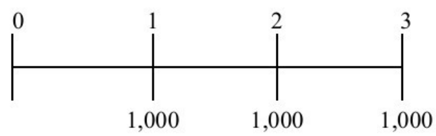
$$\text{PV} = \frac{10,000}{1.035} + \frac{20,000}{1.035^2} + \frac{30,000}{1.035^3}$$
$$= 9,662 + 18,670 + 27,058 = 55,390$$

b. Timeline:



$$\text{FV} = 55,390 \times 1.035^3$$
$$= 61,412$$

4-10. Timeline:



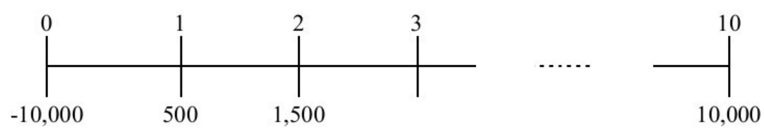
First, calculate the present value of the cash flows:

$$\text{PV} = \frac{1,000}{1.05} + \frac{1,000}{1.05^2} + \frac{1,000}{1.05^3} = 952 + 907 + 864 = 2,723$$

Once you know the present value of the cash flows, compute the future value (of this present value) at date 3.

$$\text{FV}_3 = 2,723 \times 1.05^3 = 3,152$$

4-11. Timeline:



a. $\text{NPV} = -10,000 + \frac{500}{1.06} + \frac{1,500}{1.06^2} + \frac{10,000}{1.06^{10}} = -10,000 + 471.70 + 1,334.99 + 5,583.95 = -2,609.36$

Since the NPV < 0, don't take it.

b. $\text{NPV} = -10,000 + \frac{500}{1.02} + \frac{1,500}{1.02^2} + \frac{10,000}{1.02^{10}} = -10,000 + 490.20 + 1,441.75 + 8,203.48 = 135.43$

Since the NPV > 0, take it.

4-12. Timeline:

0	1	2	3
–1,000	4,000	–1,000	4,000

$$\text{NPV} = -1,000 + \frac{4,000}{(1.02)} - \frac{1,000}{(1.02)^2} + \frac{4,000}{(1.02)^3}$$
$$= -1,000 + 3,921.57 - 961.17 + 3,769.29 = 5,729.69$$

Yes, make the investment.

4-13. Timeline:

0	1	2	3	…
–1,000	100	100	100	

To decide whether to build the machine you need to calculate the NPV. The cash flows the machine generates are a perpetuity, so by the PV of a perpetuity formula:

$$\text{PV} = \frac{100}{0.095} = 1,052.63$$

So the $\text{NPV} = 1,052.63 - 1,000 = 52.63$. He should build it.

4-14. Timeline:

0	1	2	3	…
–1,000		100	100	

To decide whether to build the machine you need to calculate the NPV: The cash flows the machine generates are a perpetuity with first payment at date 2. Computing the PV at date 1 gives

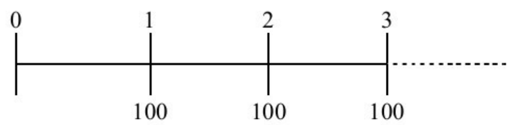
$$\text{PV}_1 = \frac{100}{0.095} = 1,052.63$$

So the value today is

$$\text{PV}_0 = \frac{1,052.63}{1.095} = 961.31 \quad \text{So the NPV} = 961.31 - 1,000 = -38.69$$

He should not build the machine

4-15. Timeline:

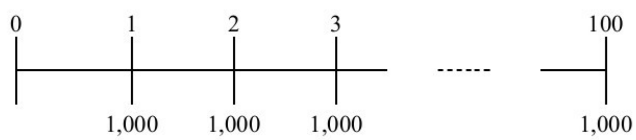


a. The value of the bond is equal to the present value of the cash flows. By the perpetuity formula:

$$PV = \frac{100}{0.04} = £2,500$$

b. The value of the bond is equal to the present value of the cash flows. The cash flows are the perpetuity plus the payment that will be received immediately.
PV = 100/0.04 + 100 = £2,600

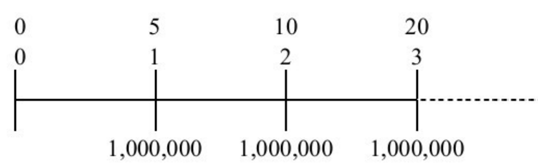
4-16. Timeline:



The cash flows are a 100 year annuity, so by the annuity formula:

$$PV = \frac{1,000}{0.07}\left(1 - \frac{1}{1.07^{100}}\right) = 14,269.25$$

4-17. Timeline:



First we need the 5-year interest rate. If the annual interest rate is 8% per year and you invest $1 for 5 years you will have, by the 2nd rule of time travel, $(1.08)^5 = 1.46932808$. So the 5 year interest rate is 46.93%. The cash flows are a perpetuity, so:

$$PV = \frac{1,000,000}{0.46932808} = 2,130,833$$

4-18.

a. Timeline:

12	13	14	15	-----	30
0	1	2	3	-----	18
	1,200	1,200	1,200		1,200

To pay off the mortgage you must repay the remaining balance. The remaining balance is equal to the present value of the remaining payments. The remaining payments are an 18 year annuity, so:

$$\begin{aligned} PV &= \frac{1,200}{0.06}\left(1-\frac{1}{1.06^{18}}\right) \\ &= 12,993.12 \end{aligned}$$

b. Timeline:

21	22	23	24	-----	30
0	1	2	3	-----	10
	1,200	1,200	1,200		1,200

To pay off the mortgage you must repay the remaining balance. The remaining balance is equal to the present value of the remaining payments. The remaining payments are a 10 year annuity, so:

$$PV = \frac{1,200}{0.06}\left(1-\frac{1}{1.06^{10}}\right) = 8,832.10$$

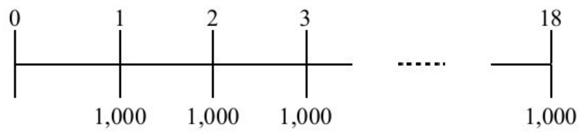
c. Timeline:

12	13	14	15	-----	30
0	1	2	3	-----	18
1,200	1,200	1,200	1,200		1,200

If you decide to pay off the mortgage immediately before the 12th payment, you will have to pay exactly what you paid in part (a) as well as the 12th payment itself:

$$12,993.12 \; + \; 1,200 = 14,193.12$$

4-19. Timeline:



We first calculate the present value of the deposits at date 0. The deposits are an 18 year annuity:

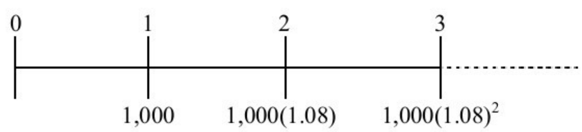
$$\text{PV} = \frac{1,000}{0.03}\left(1 - \frac{1}{1.03^{18}}\right) = 13,753.51$$

Now, we calculate the future value of this amount:

$$\text{FV} = 13,753.51(1.03)^{18} = 23,414.43$$

4-20.

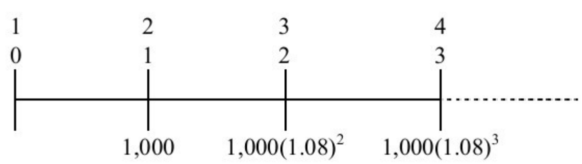
a. Timeline:



Using the formula for the PV of a growing perpetuity gives:

$$\text{PV} = \left(\frac{1,000}{0.12 - 0.08}\right) = 25,000$$

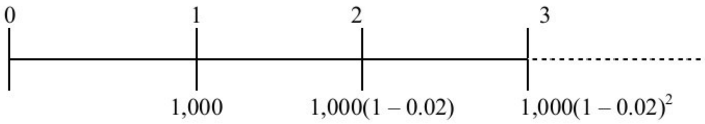
b. Timeline:



Using the formula for the PV of a growing perpetuity gives:

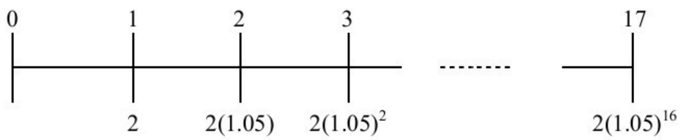
$$\text{PV} = \frac{1,000(1.08)}{0.12 - 0.08} = 27,000$$

4-21. Timeline:



We must value a growing perpetuity with a <u>negative</u> growth rate of -0.02: $\text{PV} = \dfrac{1,000}{0.05 - -0.02} = \$14,285.71$

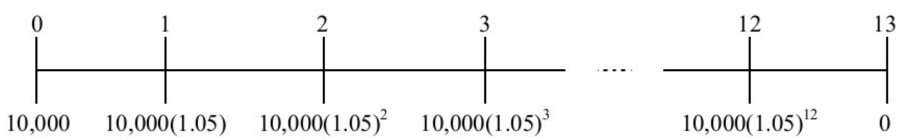
4-22. Timeline:



This is a 17-year growing annuity. By the growing annuity formula we have

$$\text{PV} = \frac{2,000,000}{0.1 - 0.05}\left(1 - \left(\frac{1.05}{1.1}\right)^{17}\right) = 21,861,455.80$$

4-23. Timeline:



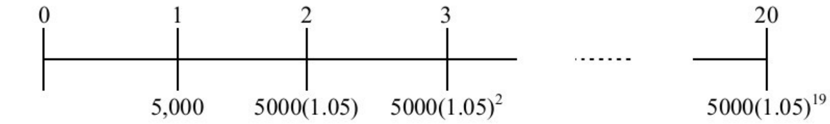
This problem consist of 2 parts: today's tuition payment of $10,000 and a 12-year growing annuity with first payment of 10,000(1.05). However we cannot use the growing annuity formula because in this case r = g. We can just calculate the present values of the payments and add them up:

$$\begin{aligned}\text{PV}_{\text{GA}} &= \frac{10,000(1.05)}{(1.05)} + \frac{10,000(1.05)^2}{(1.05)^2} + \frac{10,000(1.05)^3}{(1.05)^3} + \cdots + \frac{10,000(1.05)^{12}}{(1.05)^{12}} \\ &= 10,000 + 10,000 + 10,000 + \cdots + 10,000 = 10,000 \times 12 \\ &= 120,000\end{aligned}$$

Adding the initial tuition payment gives:

$$120,000 + 10,000 = 130,000$$

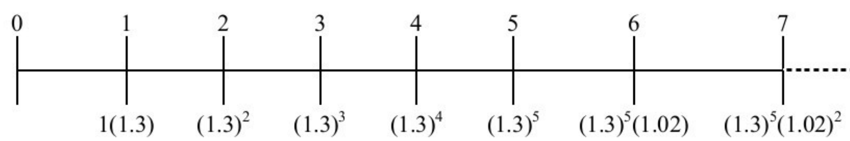
4-24. Timeline:



This value is equal to the PV of a 20-year annuity with a first payment of \$5,000. However we cannot use the growing annuity formula because in this case r = g. So instead we can just find the present values of the payments and add them up:

$$\begin{aligned}PV_{GA} &= \frac{5,000}{(1.05)} + \frac{5,000(1.05)}{(1.05)^2} + \frac{5,000(1.05)^2}{(1.05)^3} + \cdots + \frac{5,000(1.05)^{19}}{(1.05)^{20}} \\ &= \frac{5,000}{1.05} + \frac{5,000}{1.05} + \frac{5,000}{1.05} + \cdots + \frac{5,000}{1.05} = \frac{5,000}{1.05} \times 20 = 95,238\end{aligned}$$

4-25. Timeline:



This problem consists of two parts:
(1) A growing annuity for 5 years
(2) A growing perpetuity after 5 years

First we find the PV of (1)

$$PV_{GA} = \frac{1.3}{0.08-0.3}\left(1-\left(\frac{1.3}{1.08}\right)^5\right) = \$9.02 \text{ million}$$

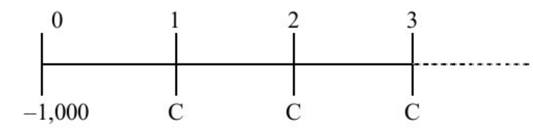
Now we calculate the PV of (2). The value at <u>date 5</u> of the growing perpetuity is

$$PV_5 = \frac{(1.3)^5(1.02)}{0.08-0.02} = \$63.12 \text{ million} \Rightarrow PV_0 = \frac{63.12}{(1.08)^5} = \$42.96 \text{ million}$$

Adding the present value of (1) and (2) together gives the PV value of future earnings:

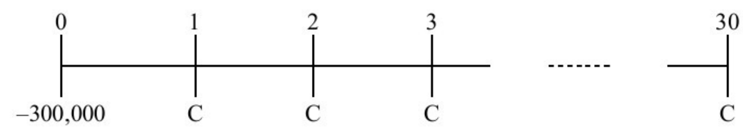
$\$9.02 + \$42.96 = \$51.98$ million

4-26. Timeline:



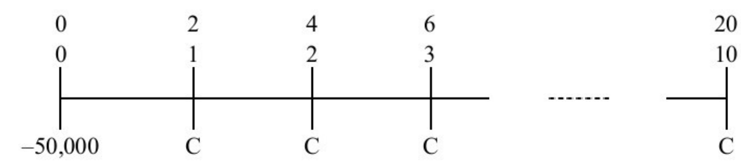
$$P = \frac{C}{r} \Rightarrow C = P \times r = 1,000 \times 0.05 = \$50$$

4-27. Timeline: (From the perspective of the bank)



$$C = \frac{300,000}{\frac{1}{0.07}\left(1 - \frac{1}{1.07^{30}}\right)} = \$24,176$$

4-28. Timeline:



This cash flow stream is an annuity. First, calculate the 2-year interest rate: the 1-year rate is 4%, and \$1 today will be worth $(1.04)^2 = 1.0816$ in 2 years, so the 2-year interest rate is 8.16%. Using the equation for an annuity payment:

$$C = \frac{50,000}{\frac{1}{0.0816}\left(1 - \frac{1}{(1.0816)^{10}}\right)} = \$7,505.34$$

4-29. Timeline: (where X is the balloon payment.)

0	1	2	3	…	30
–300,000	23,500	23,500	23,500		23,500 + X

The present value of the loan payments must be equal to the amount borrowed:

$$300,000 = \frac{23,500}{0.07}\left(1 - \frac{1}{1.07^{30}}\right) + \frac{X}{(1.07)^{30}}$$

Solving for X:

$$X = \left[300,000 - \frac{23,500}{0.07}\left(1 - \frac{1}{1.07^{30}}\right)\right](1.07)^{30} = \$63,848$$

4-30. Timeline:

30	31	32	33	…	65
0	1	2	3		35
C	C	C	C		C

FV = \$2 million

The PV of the cash flows must equal the PV of \$2 million in 35 years. The cash flows consist of a 35-year annuity, plus the contribution today, so the PV is:

$$PV = \frac{C}{0.05}\left(1 - \frac{1}{(1.05)^{35}}\right) + C$$

The PV of \$2 million in 35 years is

$$\frac{2,000,000}{(1.05)^{35}} = \$362,580.57$$

Setting these equal gives:

$$\frac{C}{0.05}\left(1 - \frac{1}{(1.05)^{35}}\right) + C = 362,580.57$$

$$\Rightarrow C = \frac{362,580.57}{\frac{1}{0.05}\left(1 - \frac{1}{(1.05)^{35}}\right) + 1} = \$20,868.91$$

4-31. Timeline:

30	31	32	33	……	65
0	1	2	3		35
C	C(1.07)	$C(1.07)^2$	$C(1.07)^3$		$C(1.07)^{35}$

FV = 2 million

The PV of the cash flows must equal the PV of $2 million in 35 years. The cash flow consists of a 35 year growing annuity, plus the contribution today. So the PV is:

$$PV = \frac{C(1.07)}{0.05 - 0.07}\left(1 - \left(\frac{1.07}{1.05}\right)^{35}\right) + C$$

The PV of $2 million in 35 years is:

$$\frac{2,000,000}{(1.05)^{35}} = \$362,580.57$$

Setting these equal gives:

$$\frac{C(1.07)}{0.05 - 0.07}\left(1 - \left(\frac{1.07}{1.05}\right)^{35}\right) + C = 362,580.57$$

Solving for C

$$C = \frac{362,580.57}{\frac{1.07}{0.05 - 0.07}\left(1 - \left(\frac{1.07}{1.05}\right)^{35}\right) + 1} = \$7,102.11$$

4-32. Timeline:

0	1
–5,000	6,000

IRR is the r that solves:

$$\frac{6,000}{I + r} = 5,000 = \frac{6,000}{5,000} - 1 = 20\%$$

4-33. Timeline:

0	1	2	3	4
–32,500	10,000	10,000	10,000	10,000

The PV of the car payments is a 4-year annuity:

$$PV = \frac{10,000}{r}\left(1 - \frac{1}{(1+r)^4}\right)$$

Setting the NPV of the cash flow stream equal to zero and solving for r gives the IRR:

$$NPV = 0 = -32,500 + \frac{10,000}{r}\left(1 - \frac{1}{(1+r)^4}\right) \Rightarrow \frac{10,000}{r}\left(1 - \frac{1}{(1+r)^4}\right) = 32,500$$

To find r we either need to guess or use the annuity calculator. You can check and see that r = 8.85581% solves this equation. So the IRR is 8.86%.

4-34. Timeline:

0	1	2	3	…
–1,000	100	100	100	

The payments are a perpetuity, so

$$PV = \frac{100}{r}$$

Setting the NPV of the cash flow stream equal to zero and solving for r gives the IRR:

$$NPV = 0 = \frac{100}{r} - 1,000 \Rightarrow r = \frac{100}{1,000} = 10\%$$

So the IRR is 10%

4-35. Timeline:

2	3	.....	9	10	.....	15	16	.....	24
0	1		7	8		13	14		22
–79.50			47.45			32.85			23.90

The PV of the cash flows generated by storing the cheese is:

$$PV = \frac{47.45}{(1+r)^7} + \frac{32.85}{(1+r)^{13}} + \frac{23.90}{(1+r)^{22}}$$

The IRR is the r that sets the NPV equal to zero:

$$NPV = 0 = -79.50 + \frac{47.45}{(1+r)^7} + \frac{32.85}{(1+r)^{13}} + \frac{23.90}{(1+r)^{22}}$$

By iteration or by using a spreadsheet (see 4.35.xls). The r that solves this equation is r=2.28918% so the IRR is 2.29% per month.

4-36. Timeline:

0	1	2	3	....	N
–200,000	25,000	25,000	25,000		25,000

She breaks even when the NPV of the cash flows is zero. The value of N that solves this is:

$$NPV = -200,000 + \frac{25,000}{0.05}\left(1 - \frac{1}{(1.05)^N}\right) = 0$$

$$\Rightarrow 1 - \frac{1}{(1.05)^N} = \frac{200,000 \times 0.05}{25,000} = 0.4$$

$$\frac{1}{(1.05)^N} = 0.6 \Rightarrow (1.05)^N = \frac{1}{0.6}$$

$$\log(1.05)^N = \log\left(\frac{1}{0.6}\right)$$

$$N \log(1.05) = -\log(0.6)$$

$$N = \frac{-\log(0.6)}{\log(1.05)}$$

$$= 10.5$$

So if she lives 10.5 or more years she comes out ahead.

4-37. Timeline:

0	1	2	....	N
-10,000,000	1,000,000 – 50,000	1,000,000 - 50,000(1.05)		1,000,000 50,000$(1.05)^{N-1}$

The plant will shut down when:

$$1{,}000{,}000 - 50{,}000(1.05)^{N-1} < 0$$

$$(1.05)^{N-1} > \frac{1{,}000{,}000}{50{,}000} = 20$$

$$(N-1)\log(1.05) > \log(20)$$

$$N > \frac{\log(20)}{\log(1.05)} + 1 = 62.4$$

So the last year of production will be in year 62.

The cash flows consist of two pieces, the 62 year annuity of the \$1,000,000 and the growing annuity.

The PV of the annuity is

$$PV_A = \frac{1{,}000{,}000}{0.06}\left(1 - \frac{1}{(1.06)^{62}}\right) = 16{,}217{,}006$$

The PV of the growing annuity is

$$PV_{GA} = \frac{-50{,}000}{0.06 - 0.05}\left(1 - \left(\frac{1.05}{1.06}\right)^{62}\right) = -2{,}221{,}932$$

So the PV of all the cash flows is

$$PV = 16{,}217{,}006 - 2{,}221{,}932 = \$13{,}995{,}074$$

So the $NPV = 13{,}995{,}07 - 10{,}000{,}000 = \$3{,}995{,}074$ and you should build it.

4-38. Timeline:

30	31	32	…	65	66	67	…	100
0	1	2	…	35	36	37	…	70
	–C	–C		–C	100	100		100

The present value of the costs must equal the PV of the benefits. So begin by dividing the problem into two parts, the costs and the benefits.

Costs: The costs are the contributions, a 35-year annuity with the first payment in one year:

$$PV_{costs} = \frac{C}{0.07}\left(1 - \frac{1}{(1.07)^{35}}\right)$$

Benefits: The benefits are the payouts after retirement, a 35-year annuity paying $100,000 per year with the first payment 36 years from today. The value of this annuity in year 35 is:

$$PV_{35} = \frac{100,000}{0.07}\left(1 - \frac{1}{(1.07)^{35}}\right)$$

The value today is just the discounted value in 35 years:

$$PV_{benefits} = \frac{PV_{35}}{(1.07)^{35}} = \frac{100,000}{0.07(1.07)^{35}}\left(1 - \frac{1}{(1.07)^{35}}\right) = 121,272$$

Since the PV of the costs must equal the PV of the benefits (or equivalently the NPV of the cash flow must be zero):

$$121,272 = \frac{C}{0.07}\left(1 - \frac{1}{(1.07)^{35}}\right)$$

Solving for C gives:

$$C = \frac{121,272 \times 0.07}{\left(1 - \frac{1}{(1.07)^{35}}\right)} = 9,366.29$$

4-39. Timeline: (f = Fraction of your salary that you contribute)

30	31	32	.....	65	66	67	.....	100
0	1	2		35	36	37		70
	75f	75(1.02)f		$75(1.02)^{34}$f	100	100		100

The present value of the costs must equal the PV of the benefits. So begin by dividing the problem into two parts, the costs and the benefits.

<u>Costs</u>: The costs are the contributions, a 35-year growing annuity with the first payment in one year. The PV of this is

$$PV_{costs} = \frac{75,000f}{0.07-0.02}\left(1-\left(\frac{1.02}{1.07}\right)^{35}\right)$$

<u>Benefits</u>: The benefits are the payouts after retirement, a 35-year annuity paying \$100,000 per year with the first payment 36 years from today. The value of this annuity <u>in year 35</u> is

$$PV_{35} = \frac{100,000}{0.07}\left(1-\frac{1}{(1.07)^{35}}\right)$$

The value today is just the discounted value in 35 years.

$$PV_{benefits} = \frac{PV_{35}}{(1.07)^{35}} = \frac{100,000}{0.07(1.07)^{35}}\left(1-\frac{1}{(1.07)^{35}}\right) = 121,272$$

Since the PV of the costs must equal the PV of the benefits (or equivalently the NPV of the cash flows must be zero):

$$121,272 = \frac{75,000f}{0.07-0.02}\left(1-\left(\frac{1.02}{1.07}\right)^{35}\right)$$

Solving for f, the fraction of your salary that you would like to contribute:

$$f = \frac{121,272\times(0.07-0.02)}{75,000\left(1-\left(\frac{1.02}{1.07}\right)^{35}\right)} = 9.948\%$$

So you would contribute approximately 10% of your salary. This amounts to \$7,500 in the first year, which is lower than the plan in the prior problem.

Chapter 5

Interest Rates

5-1.

a. Since 6 months is $\frac{6}{24} = \frac{1}{4}$ of 2 years, using our rule $(1+0.2)^{\frac{1}{4}} = 1.0466$
So the equivalent 6 month rate is 4.66%

b. Since one year is half of 2 years $(1.2)^{\frac{1}{2}} = 1.0954$
So the equivalent 1 year rate is 9.54%

c. Since one month is $\frac{1}{24}$ of 2 years, using our rule $(1+0.2)^{\frac{1}{24}} = 1.00763$
So the equivalent 1 month rate is 0.763%

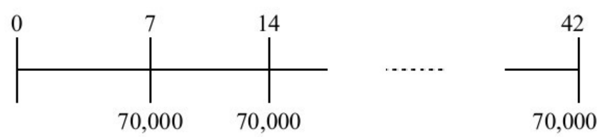
5-2. If you deposit \$1 into a bank account that pays 5% per year for 3 years you will have $(1.05)^3 = 1.15763$ after 3 years

a. If the account pays $2\frac{1}{2}\%$ per 6 months then you will have $(1.025)^6 = 1.15969$ after 3 years, so you prefer $2\frac{1}{2}\%$ every 6 months

b. If the account pays $7\frac{1}{2}\%$ per 18 months then you will have $(1.075)^2 = 1.15563$ after 3 years, so you prefer 5% per year

c. If the account pays $\frac{1}{2}\%$ per month then you will have $(1.005)^{36} = 1.19668$ after 3 years, so you prefer $\frac{1}{2}\%$ every month

5-3. Timeline:



Because $(1.06)^7 = 1.50363$, the equivalent discount rate for a 7-year period is 50.363%.

Using the annuity formula

$$PV = \frac{70,000}{0.50363}\left(1 - \frac{1}{(1.50363)^6}\right) = \$126,964$$

5-4. For a \$1 invested in an account with 10% APR with monthly compounding you will have

$$\left(1+\frac{0.1}{12}\right)^{12} = \$1.10471$$

So the EAR is 10.471%

For a \$1 invested in an account with 10% APR with annual compounding you will have

$$\left(1+0.1\right) = \$1.10$$

So the EAR is 10%

For a \$1 invested in an account with 9% APR with daily compounding you will have

$$\left(1+\frac{0.09}{365}\right)^{365} = 1.09416$$

So the EAR is 9.416%

5-5. Using the formula for converting from an EAR to an APR quote

$$\left(1+\frac{\text{APR}}{\text{k}}\right)^{\text{k}} = 1.05$$

Solving for the APR

$$\text{APR} = \left(\left(1.05\right)^{\frac{1}{\text{k}}} - 1\right)\text{k}$$

With annual payments k = 1, so APR = 5%

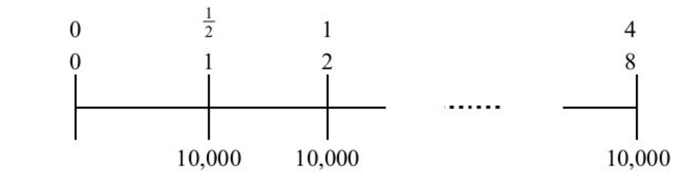
With semiannual payments k = 2, so APR = 4.939%

With monthly payments k = 12, so APR = 4.889%

5-6. Using the PV of an annuity formula with N = 10 payments and C = \$100 with r = 4.067% per 6 month interval, since there is an 8% APR with monthly compounding: 8% / 12 = 0.6667% per month, or (1.006667)^6 – 1 = 4.067% per 6 months.

$$\text{PV} = 100 \times \frac{1}{.04067}\left(1-\frac{1}{1.04067^{10}}\right) = \$808.39$$

5-7. Timeline:



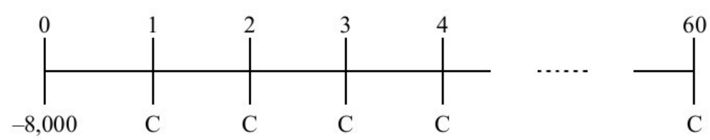
4% APR (semiannual) implies a semiannual discount rate of $\frac{4\%}{2} = 2\%$

So, $$\text{PV} = \frac{10,000}{0.02}\left(1 - \frac{1}{(1.02)^8}\right)$$
$$= \$73,254.81$$

5-8. Using the formula for computing the discount rate from an APR quote:

$$\text{Discount Rate} = \frac{5}{12} = 0.41667\%$$

5-9. Timeline:



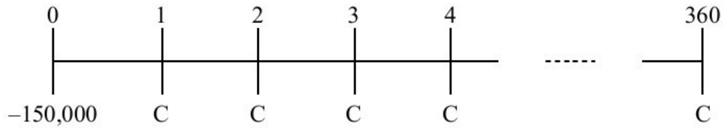
5.99 APR monthly implies a discount rate of

$$\frac{5.99}{12} = 0.499167\%$$

Using the formula for computing a loan payment

$$C = \frac{8,000}{\frac{1}{0.00499167}\left(1 - \frac{1}{(1.00499167)^{60}}\right)} = \$154.63$$

5-10. Timeline:



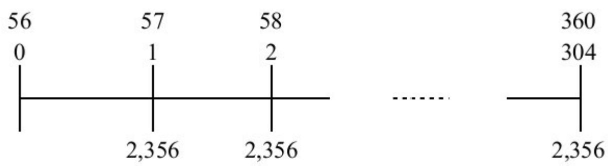
$$(1+0.05375)^{\frac{1}{12}} = 1.0043725$$

So $5\frac{3}{8}\%$ EAR implies a discount rate of 0.43725%

Using the formula for computing a loan payment

$$C = \frac{150,000}{\frac{1}{0.0043725}\left(1-\frac{1}{(1.0043725)^{360}}\right)} = \$828.02$$

5-11. Timeline:



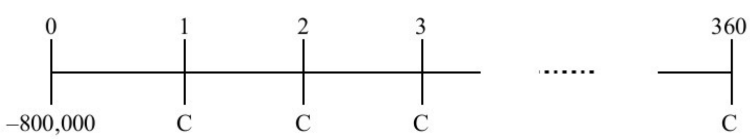
To find out what is owed compute the PV of the remaining payments using the loan interest rate to compute the discount rate:

$$\text{Discount Rate} = \frac{6.375}{12} = 0.53125\%$$

$$PV = \frac{2,356}{0.0053125}\left(1-\frac{1}{(1.0053125)^{304}}\right) = \$354,900$$

5-12. First we need to compute the original loan payment

Timeline #1:



$5\frac{1}{4}\%$ APR (monthly) implies a discount rate of $\frac{5.25}{12} = 0.4375\%$

Using the formula for a loan payment

$$C = \frac{800,000 \times 0.004375}{\left(1 - \frac{1}{(1.004375)^{360}}\right)} = \$4,417.63$$

Now we can compute the PV of continuing to make these payments

The timeline is

Timeline #2:

222	223	224	225	……	360
0	1	2	3	……	138
	4,417.63	4,417.63	4,417.63		4,417.63

Using the formula for the PV of an annuity

$$PV = \frac{4,417.63}{0.004375}\left(1 - \frac{1}{(1.004375)^{138}}\right) = \$456,931.41$$

So, you would keep \$1,000,000 - \$456,931 = \$543,069.

5-13.

a. APR of 6% = 0.5% per month. Payment = $\dfrac{500,000}{\frac{1}{.005}\left(1 - \frac{1}{1.005^{360}}\right)} = \$2997.75$.

Total annual payments = 2997.75 × 12 = \$35,973.

Loan balance at the end of 1 year $= \$2997.75 \times \frac{1}{.005}\left(1 - \frac{1}{1.005^{348}}\right) = \$493,860$.

Therefore, 500,000 – 493,860 = \$6140 in principal repaid in first year, and 35,973 – 6140 = \$29833 in interest paid in first year.

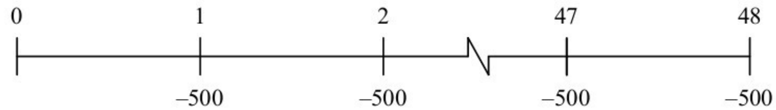
b. Loan balance in 19 years (or 360 – 19×12 = 132 remaining pmts) is

$\$2997.75 \times \frac{1}{.005}\left(1 - \frac{1}{1.005^{132}}\right) = \$289,162$.

Loan balance in 20 years = $\$2997.75 \times \frac{1}{.005}\left(1 - \frac{1}{1.005^{120}}\right) = \$270,018$.

Therefore, 289,162 – 270,018 = \$19,144 in principal repaid, and \$35,973 – 19,144 = \$16,829 in interest repaid.

5-14. We begin with the timeline of our required payments



(1) Let's compute our remaining balance on the student loan. As we pointed out earlier, the remaining balance equals the present value of the remaining payments. The loan interest rate is 9% APR, or 9% / 12 = 0.75% per month, so the present value of the payments is

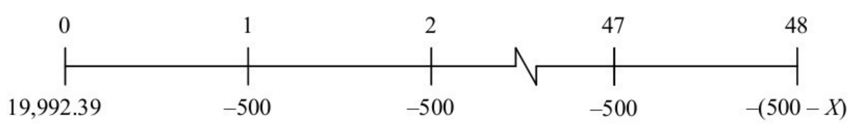
$$PV = \frac{500}{0.0075}\left(1 - \frac{1}{1.0075^{48}}\right) = \$20,092.39$$

Using the annuity spreadsheet to compute the present value, we get the same number:

N	I	PV	PMT	FV
48	0.75 %	20,092.39	–500	0

Thus, your remaining balance is $20,092.39.

If you prepay an extra $100 today, your will lower your remaining balance to $20,092.39 – 100 = $19,992.39. Though your balance is reduced, your required monthly payment does not change. Instead, you will pay off the loan faster; that is, it will reduce the payments you need to make at the very end of the loan. How much smaller will the final payment be? With the extra payment, the timeline changes:



That is, we will pay off by paying $500 per month for 47 months, and some smaller amount, $500 – *X*, in the last month. To solve for *X,* recall that the PV of the remaining cash flows equals the outstanding balance when the loan interest rate is used as the discount rate:

$$19,992.39 = \frac{500}{0.0075}\left(1 - \frac{1}{(1+0.0075)^{48}}\right) - \frac{X}{1.0075^{48}}$$

Solving for X gives

$$19,992.39 = 20,092.39 - \frac{X}{1.0075^{48}}$$

$$X = \$143.14$$

So the final payment will be lower by $143.14.

You can also use the annuity spreadsheet to determine this solution. If you prepay $100 today, and make payments of $500 for 48 months, then your final balance at the end will be a credit of $143.14:

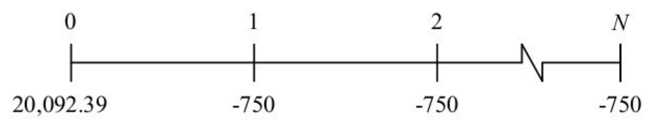
N	I	PV	PMT	FV
48	0.75 %	19,992.39	-500	143.14

(2) The extra payment effectively lets us exchange $100 today for $143.14 in four years. We claimed that the return on this investment should be the loan interest rate. Let's see if this is the case:

$\$100 \times (1.0075)^{48} = \$143.14$, so it is.

Thus, you earn a 9% APR (the rate on the loan).

5-15. The timeline in this case is:



and we want to determine the number of monthly payments N that we will need to make. That is, we need to determine what length annuity with a monthly payment of $750 has the same present value as the loan balance, using the loan interest rate as the discount rate. As we did in Chapter 4, we set the outstanding balance equal to the present value of the loan payments and solve for N:

$$\frac{750}{0.0075}\left(1-\frac{1}{1.0075^N}\right) = 20,092.39$$

$$\left(1-\frac{1}{1.0075^N}\right) = \frac{20,092.39 \times 0.0075}{750} = 0.200924$$

$$\frac{1}{1.0075^N} = 1 - 0.200924 = 0.799076$$

$$1.0075^N = 1.25145$$

$$N = \frac{\text{Log}(1.25145)}{\text{Log}(1.0075)} = 30.02$$

We can also use the annuity spreadsheet to solve for N:

N	I	PV	PMT	FV
30.02	0.75 %	20,092.39	–750	0

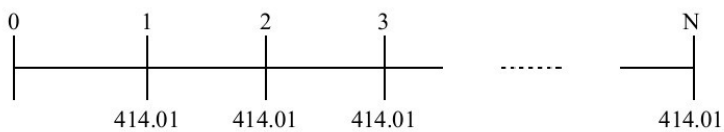
So, by prepaying the loan, we will pay off the loan in about 30 months or 2 ½ years, rather than the four years originally scheduled. Because N of 30.02 is larger than 30, we could either increase the 30th payment by a small amount or make a very small 31st payment. We can use the annuity spreadsheet to determine the remaining balance after 30 payments:

N	I	PV	PMT	FV
30	0.75 %	20,092.39	–750	–13.86

If we make a final payment of \$750.00 + \$13.86 = \$763.86, the loan will be paid off in 30 months.

5-16. From the solution to problem 5.10 the monthly payment on the mortgage is \$828.02. So if we make $\frac{828.02}{2} = \$414.01$ every 2 weeks the timeline is

Timeline:



Now since there are 26 weeks in a year

$$(1.05375)^{\frac{1}{26}} = 1.002016$$

So, the discount rate is 0.2016%.

To compute N we set the PV of the loan payments equal to the outstanding balance

$$150,000 = \frac{441.01}{0.002016}\left(1 - \frac{1}{(1.002016)^N}\right)$$

And Solve for N

$$1 - \left(\frac{1}{1.002016}\right)^N = \frac{150,000 \times 0.002016}{441.01} = 0.7303$$

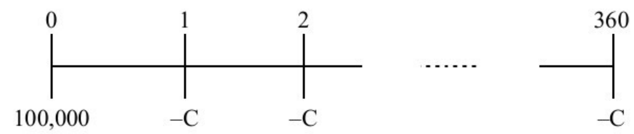
$$\left(\frac{1}{1.002016}\right)^N = 0.2697$$

$$N = \frac{\log(0.2697)}{\log\left(\frac{1}{1.002016}\right)} = 650.79$$

So it will take 651 payments to pay off the mortgage. Since the payments occur every two weeks this will take $651 \times 2 = 1302$ weeks or approximately 25 years. (It is shorter because there are approximately 2 extra payments every year.)

5-17. The principle balance does not matter, so just pick 100,000. Begin by computing the monthly payment. The discount rate is $12\%/12 = 1\%$

Timeline #1:

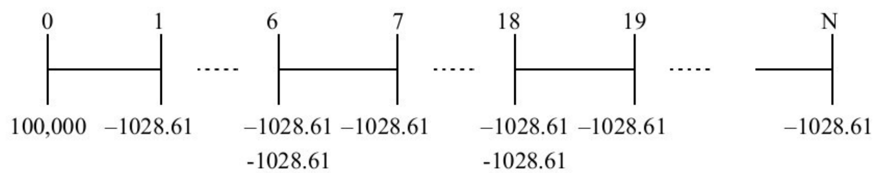


Using the formula for the loan payment

$$C = \frac{100,000 \times 0.01}{\left(1 - \frac{1}{1.01^{360}}\right)} = \$1,028.61$$

Next we write out the cash flows with the extra payment:

Timeline #2:



The cash flow consists of 2 annuities.

i. The original payments. The PV of these payments is

$$PV_{org} = \frac{1,028.61}{0.01}\left(1 - \left(\frac{1}{1.01}\right)^N\right)$$

ii. The extra payment every Christmas. There are m such payments, where m is the number of <u>*years*</u> you keep the loan. (For the moment we will not worry about the possibility that m is not a whole number.) Since the time period between payments is 1 year, we first have to compute the discount rate

$$(1.01)^{12} = 1.12683$$

So the discount rate is 12.683%

Now the present value of the extra payments in month 6 consist of the remaining m-1 payments (an annuity) and the payment in month 6. So the PV is

$$PV_6 = \frac{1,028.61}{0.12683}\left(1 - \frac{1}{(1.12683)^{m-1}}\right) + 1,028.61$$

To get the value today we must discount these cash flows to month zero. Recall that the monthly discount rate is 1%. So the value today of the extra payment is:

$$PV_{extra} = \frac{PV_6}{(1.01)^6} = \frac{1,028.61}{0.12683(1.01)^6}\left(1-\frac{1}{(1.12683)^{m-1}}\right)+\frac{1,028.61}{(1.01)^6}$$

To find out how long it will take to repay the loan, we need to determine the number of years until the value of our loan payments has a present value at the loan rate equal to the amount we borrowed. Because the number of monthly payments $N = 12\times m$, we can write this as the following expression which we need to solve for m:

$$100,000 = PV_{org} + PV_{extra}$$

$$100,000 = \frac{1,028.61}{0.01}\left(1-\left(\frac{1}{1.01}\right)^{12m}\right)+\frac{1,028.61}{0.12683(1.01)^6}\left(1-\frac{1}{(1.12683)^{m-1}}\right)+\frac{1,028.61}{(1.01)^6}$$

The only way to find m is to iterate (guess). The answer is $m = 19.04$ years, or approximately 19 years. In fact, after exactly 19 years the PV of the payments is

$$PV = \frac{1,028.61}{0.01}\left(1-\left(\frac{1}{1.01}\right)^{228}\right)+\frac{1,028.61}{0.12683(1.01)^6}\left(1-\frac{1}{(1.12683)^{18}}\right)+\frac{1,028.61}{(1.01)^6} = \$99,939$$

Since you initially borrowed \$100,000 the PV of what you still owe at the end of 19 years is \$100,000 – \$99,939 = \$61. The future value of this in 19 years and one month is

$$61\times(1.01)^{229} = \$596$$

So, you will have a partial payment of \$596 in the first month of the 19th year. Because the mortgage will take about 19 years to pay off this way -- which is close to $\frac{2}{3}$ of its life of 30 years -- your friend is right.

5-18. You can use any money that you don't spend on the car to pay down your credit card debt. Paying down the loan is equivalent to an investment earning the loan rate of 15% APR. Thus, your opportunity cost of capital is 15% APR (monthly) and so the discount rate is 15 / 12 = 1.25% per month. Computing the present value of option (ii) at this discount rate, we find

$$PV(ii) = -5000+(-500)\times\frac{1}{.0125}\left(1-\frac{1}{1.0125^{30}}\right) = -5000-12,444 = -\$17,444$$

You are better off taking the loan from the dealer and using any extra money to pay down your credit card debt.

5-19.

a. First we calculate the outstanding balance of the mortgage. There are 25 × 12 = 300 months remaining on the loan, so the timeline is

Timeline #1:

0	1	2	...	300
	1,402	1,402		1,402

To determine the outstanding balance we discount at the original rate, i.e., $\frac{10}{12} = 0.8333\%$

$$PV = \frac{1402}{0.008333}\left(1 - \frac{1}{(1.008333)^{300}}\right) = \$154,286.22$$

Next we calculate the loan payment on the new mortgage

Timeline #2:

0	1	2	......	360
154,286.22	–C	–C		–C

The discount rate on the new loan is the new loan rate: $\frac{6.625}{12} = 0.5521\%$

Using the formula for the loan payment:

$$C = \frac{154,286.22 \times 0.005521}{\left(1 - \left(\frac{1}{1.005521}\right)^{360}\right)} = \$987.93$$

b. $$C = \frac{154,286.22 \times 0.005521}{\left(1 - \left(\frac{1}{1.005521}\right)^{300}\right)} = \$1,053.85$$

c. $\text{PV} = \dfrac{1402}{0.005521}\left(1 - \dfrac{1}{(1.005521)^N}\right) = \$154,286.22 \Rightarrow N = 170$ months (you can use trial and error or the annuity calculator to solve for N).

d. $\text{PV} = \dfrac{1402}{0.005521}\left(1 - \dfrac{1}{(1.005521)^{300}}\right) = \$205,255$

$\Rightarrow$ you can keep $205,259 - 154,286 = \$50,969$
(Note: results may differ slightly due to rounding.)

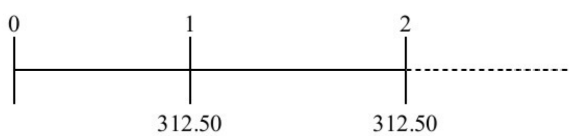
5-20. The discount rate on the original card is

$$\frac{15}{12} = 1.25\%$$

Assuming that your current monthly payment is the interest that accrues, it equals:

$$\$25,000 \times \frac{0.15}{12} = \$312.50$$

Timeline:



This is a perpetuity. So the amount you can borrow at the new interest rate is this cash flow discounted at the new discount rate. The new discount rate is $\dfrac{12}{12} = 1\%$

$$\text{So, PV} = \frac{312.50}{0.01} = \$31,250$$

So by switching credit cards you are able to spend an extra $31,250 - 25,000 = \$6,250$
You do not have to pay taxes on this amount of new borrowing, so this is your <u>after-tax</u> benefit of switching cards

5-21. $r_r = \dfrac{r - i}{1 + i} = \dfrac{7.85\% - 12.3\%}{1.123} = -3.96\%$

The purchasing power of your savings declined by 3.96% over the year.

5-22. $1 + r_r = \dfrac{1 + r}{1 + i}$ implies $1 + r = (1 + r_r)(1 + i) = (1.03)(1.05) = 1.0815$.

Therefore, a nominal rate of 8.15% is required.

5-23. By holding cash, an investor earns a nominal interest rate of 0%. Since an investor can always earn at least 0%, the nominal interest rate cannot be negative. The real interest rate can be negative, however. It is negative whenever the rate of inflation exceeds the nominal interest rate.

5-24.

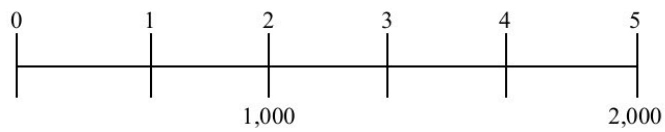
a. NPV = –100,000 + 150,000 / 1.05^5 = \$17,529.

b. NPV = –100,000 + 150,000 / 1.10^5 = –\$6862

c. The answer is the IRR of the investment. IRR = (150,000 / 100,000)1/5 – 1 = 8.45%

5-25.

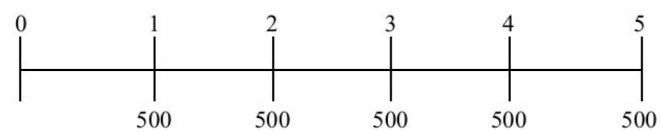
a. Timeline:



Since the opportunity cost of capital is different for investments of different maturities, we must use the cost of capital associated with each cash flow as the discount rate for that cash flow:

$$PV = \frac{1,000}{(1.0241)^2} + \frac{2,000}{(1.0332)^5} = \$2,652.15$$

b. Timeline:

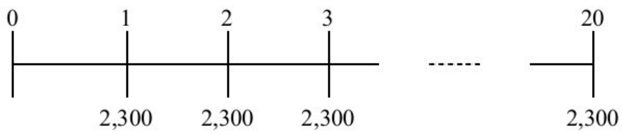


Since the opportunity cost of capital is different for investments of different maturities, we must use the cost of capital associated with each cash flow as the discount rate for that cash flow. Unfortunately we do not have a rate for a 4 year cash flow, so we linearly interpolate:

$$r_4 = \frac{1}{2}(2.74) + \frac{1}{2}(3.32) = 3.03$$

$$PV = \frac{500}{1.0199} + \frac{500}{(1.0241)^2} + \frac{500}{(1.0274)^3} + \frac{500}{(1.0303)^4} + \frac{500}{(1.0332)^5} = \$2,296.43$$

c. Timeline:



Since the opportunity cot of capital is different for investments of different maturities, we must use the cost of capital associated with each cash flow as the discount rate for that cash flow. Unfortunately we do not have a rate for a number of years, so we linearly interpolate:

$$\begin{aligned}
r_4 &= \frac{1}{2}(2.74) + \frac{1}{2}(3.32) \\
&= 3.03 \\
r_6 &= \frac{1}{2}(3.32) + \frac{1}{2}(3.76) \\
&= 3.54 \\
r_8 &= \frac{2}{3}(3.76) + \frac{1}{3}(4.13) \\
&= 3.883 \\
r_9 &= \frac{1}{3}(3.76) + \frac{2}{3}(4.13) \\
&= 4.0067 \\
r_{11} &= \frac{9}{10}(4.13) + \frac{1}{10}(4.93) \\
&= 4.21 \\
r_{12} &= \frac{8}{10}(4.13) + \frac{2}{10}(4.93) \\
&= 4.29 \\
r_{13} &= 4.37 \\
r_{14} &= 4.45 \\
r_{15} &= 4.53 \\
r_{16} &= 4.61 \\
r_{17} &= 4.64 \\
r_{18} &= 4.77 \\
r_{19} &= 4.85
\end{aligned}$$

$$\begin{aligned}
PV &= \frac{2,300}{1+r_1} + \frac{2,300}{(1+r_2)^2} + \frac{2,300}{(1+r_3)^3} + \ldots + \frac{2,300}{(1+r_{20})^{20}} \\
&= \frac{2,300}{1.0199} + \frac{2,300}{1.0241} + \frac{2,300}{1.0274} + \ldots + \frac{2,300}{(1.0493)^{20}} \\
&= \$30,636.56
\end{aligned}$$

5-26. PV = 100 / 1.0199 + 100 / 1.0241^2 + 100 / 1.0274^3 =$285.61.

To determine the single discount rate that would compute the value correctly, we solve the following for r:

PV = 285.61 = 100/(1 + r) + 100 / $(1 + r)^2$ + 100/$(1 + r)^3$ = $285.61.

This is just an IRR calculation. Using trial and error or the annuity calculator, r = 2.50%. Note that this rate is between the 1, 2, and 3-yr rates given.

5-27. The yield curve is increasing. This is often a sign that investors expect interest rates to rise in the future.

5-28.

a. The 1-year interest rate is 6%. If rates fall next year to 5%, then if you reinvest at this rate over two years you would earn (1.06)(1.05) = 1.113 per dollar invested. This amount corresponds to an EAR of $(1.113)^{1/2}$ – 1 = 5.50% per year for two years. Thus, the two-year rate that is consistent with these expectations is 5.50%.

b. We can apply the same logic for future years:

Year	Future Interest Rates	FV from reinvesting	EAR
1	6%	1.0600	6.00%
2	5%	1.1130	5.50%
3	2%	1.1353	4.32%
4	3%	1.1693	3.99%
5	4%	1.2161	3.99%
6	5%	1.2769	4.16%
7	6%	1.3535	4.42%
8	6%	1.4347	4.62%
9	6%	1.5208	4.77%
10	6%	1.6121	4.89%

c. We can plot the yield curve using the EAR's in (b), note that the 10-yr rate is below the 1-yr rate (yield curve is inverted).

5-29. We can use the interest rates each company must pay on a 5-year loan as the discount rate.

PV for GM = 700 / 1.0822^5 = $471.59 < $500 today, so take the money now.

PV for JP Morgan = 700 / 1.0544^5 = $537.12 > $500 today, so take the promise.

5-30. After-tax rate = 4%(1 – .30) = 2.8%, which is less than your tax-free investment with pays 3%.

5-31. After-tax cost of home equity loan is 8%(1 – .25) = 6%, which is cheaper than the dealer's loan (for which interest is not tax-deductible). Thus, the home equity loan is cheaper. (Note that this could also be done in terms of EARs.)

5-32. Using the formula to convert an APR to an EAR:

$$\left(1+\frac{0.06}{12}\right)^{12}=1.06168$$

So the home equity loan as an EAR 6.168%. Now since the rate on a tax deductible loan is a before tax rate, we must convert this to an after tax rate to compare it

$$6.168\times(1\text{-}0.15)=5.243\%$$

Since the student loan has a larger after tax rate, you are better off using the home equity loan.

5-33.

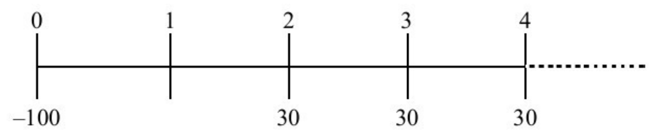
a. The regular savings account pays 5.5% EAR, or 5.5%(1 – .35) = 3.575% after-tax. The money-market account pays $(1 + 5.25\%/365)^{365} - 1 = 5.39\%$ or 5.39%(1 – .35) = 3.50% after-tax. Therefore, the regular savings account pays a higher rate.

b. Your friend should pay off the credit card loans and the car loan, since they have after-tax costs of 14.9% APR and 4.8% APR respectively, which exceed the rate earned on savings. The home equity loan should not be repaid, as its EAR = $(1 + 5\%/12)^{12} - 1 = 5.12\%$, for an after-tax rate of only 5.125(1 – .35) = 3.33% which is below the rate earned on savings.

5-34. 8% is the appropriate cost of capital for a new risk-free investment, since you could earn 8% without risk by paying off your existing loan and avoiding interest charges.

Chapter 6
Investment Decision Rules

6-1. Timeline:



$$\text{NPV}=\left(\frac{1}{1.08}\right)\frac{30}{0.08}\text{-}100\text{=\$247.22 million}$$

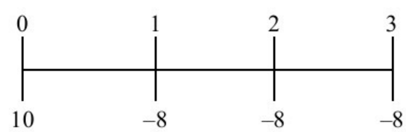
The IRR solves

$$\left(\frac{1}{1+r}\right)\frac{30}{r}-100=0 \Rightarrow r=24.16\%$$

So, the cost of capital can be underestimated by 16.16% without changing the decision.

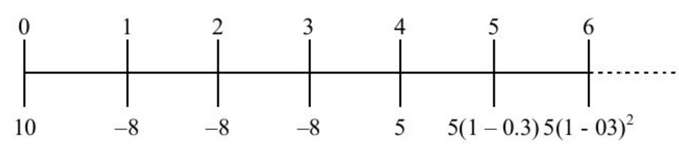
6-2.

a. Timeline:



$$\text{NPV}=10-\frac{8}{0.1}\left(1-\frac{1}{(1.1)^3}\right)=-\$9.895\text{ million}$$

b. Timeline:



First calculate the PV of the royalties at year 3. The royalties are a declining perpetuity:

$$PV_5=\frac{5}{0.1-(-0.3)}=\frac{5}{0.4}=12.5\text{ million}$$

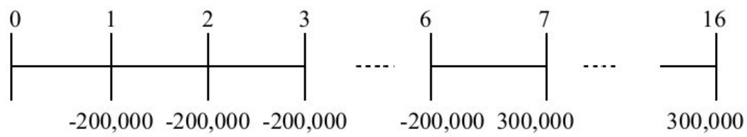
So the value today is

$$PV_{\text{royalties}} = \frac{12.5}{(1.1)^3} = 9.391$$

Now add this to the NPV from part a), $NPV = -9.895 + 9.391 = -\$503,381$.

6-3.

a. Timeline:



$$NPV = -\frac{200,000}{r}\left(1-\frac{1}{(1+r)^6}\right)+\left(\frac{1}{(1+r)^6}\right)\frac{300,000}{r}\left(1-\frac{1}{(1+r)^{10}}\right)$$

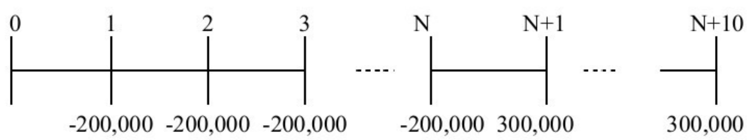
i. $$= -\frac{200,000}{0.1}\left(1-\frac{1}{(1.1)^6}\right)+\left(\frac{1}{(1.1)^6}\right)\frac{300,000}{0.1}\left(1-\frac{1}{(1.1)^{10}}\right)$$

$$= \$169,482$$

NPV>0, so the company should take the project.

ii. Setting the NPV = 0 and solving for r (using a spreadsheet) the answer is IRR = 12.66%. So if the estimate is too low by 2.66%, the decision will change from accept to reject.

iii. The new timeline is



$$NPV = -\frac{200,000}{r}\left(1-\frac{1}{(1+r)^N}\right)+\left(\frac{1}{(1+r)^N}\right)\frac{300,000}{r}\left(1-\frac{1}{(1+r)^{10}}\right)$$

Setting the NPV = 0 and solving for N gives

$$N = \frac{\log\left(\dfrac{500,000-\left(\dfrac{300,000}{(1+r)^{10}}\right)}{200,000}\right)}{\log(1+r)} = \frac{\log\left(2.5-\dfrac{1.5}{1.1^{10}}\right)}{\log(1.1)} = 6.85 \text{ years}$$

b.

i. Timeline:

0	1	2	3	-----	6	7	-----	16
	-200,000	-200,000	-200,000		-200,000	300,000		300,000

$$\begin{aligned} NPV &= -\frac{200{,}000}{r}\left(1-\frac{1}{(1+r)^6}\right)+\left(\frac{1}{(1+r)^6}\right)\frac{300{,}000}{r}\left(1-\frac{1}{(1+r)^{10}}\right) \\ &= -\frac{200{,}000}{0.14}\left(1-\frac{1}{(1.14)^6}\right)+\left(\frac{1}{(1.14)^6}\right)\frac{300{,}000}{0.14}\left(1-\frac{1}{(1.14)^{10}}\right) \\ &= -\$64.816 \end{aligned}$$

ii. Since the IRR still has not changed it is still 12.66%, so if the estimate is too <u>high</u> by 1.34%, the decision will change

iii. Setting the NPV = 0 and solving for N gives:

$$\begin{aligned} NPV &= -\frac{200{,}000}{.14}\left(1-\frac{1}{(1.14)^6}\right)+\left(\frac{1}{(1.14)^6}\right)\frac{300{,}000}{.14}\left(1-\frac{1}{(1.14)^N}\right)=0 \\ &= -777{,}733.5 + 976{,}256.9\left(1-\frac{1}{(1.14)^N}\right)=0 \\ &= 198{,}523.4 = \frac{976{,}256.9}{(1.14)^N} = 0 \Rightarrow (1.14)^N = 4.9176 \\ &\Rightarrow N\log(1.14) = \log(4.9176) \Rightarrow 0.131N = 1.5928 \Rightarrow N = 12.16 \text{ years} \end{aligned}$$

6-4. 5000 / 500 = 10 months.

6-5. Timeline:

0	1	2	3	4	------------
–100		30	30	30	

$$NPV = \left(\frac{1}{1.08}\right)\frac{30}{0.08} - 100 = \$247.22 \text{ million}$$

The IRR solves

$$\left(\frac{1}{1+r}\right)\frac{30}{r} - 100 = 0 \Rightarrow r = 24.16\%$$

Since the IRR exceeds the 8% discount rate the IRR gives the same answer as the NPV rule.

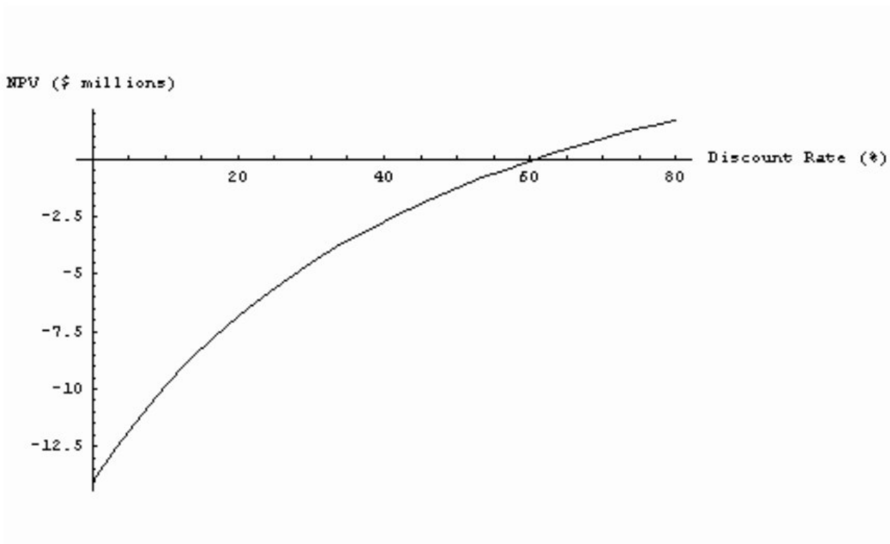
6-6. Timeline:

0	1	2	3
10	–8	–8	–8

IRR is the r that solves

$$\text{NPV} = 0 = 10 - \frac{8}{r}\left(1 - \frac{1}{(1+r)^3}\right)$$

To determine how many solutions this equation has, plot the NPV as a function of r



From the plot there is one IRR of 60.74%

Since the IRR is much greater than the discount rate the IRR rule says write the book. Since this is a negative NPV project (from 6.2a) the IRR gives the wrong answer.

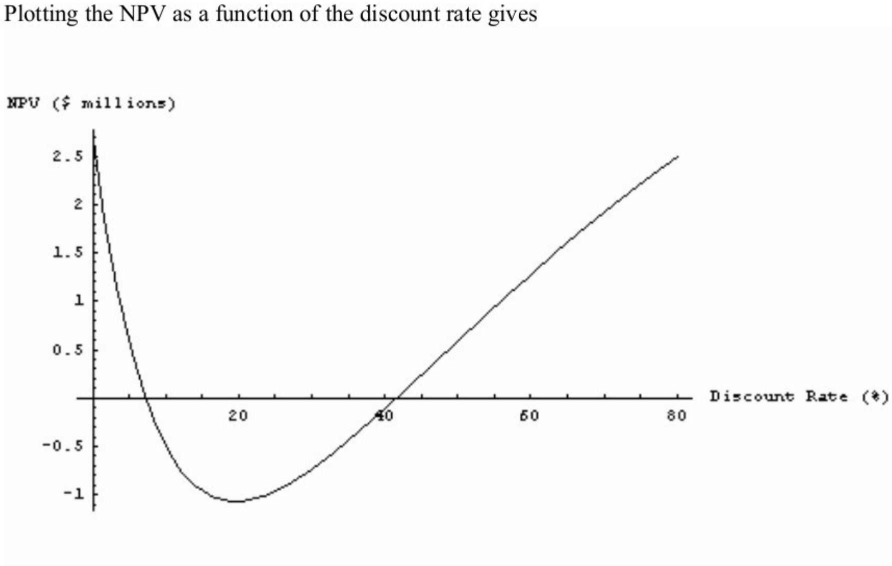
6-7. Timeline:

0	1	2	3	4	5	6	...
10	–8	–8	–8	5	5(1 – 0.3)	$5(1.03)^2$	

From 6.2(b) the NPV of these cash flows is

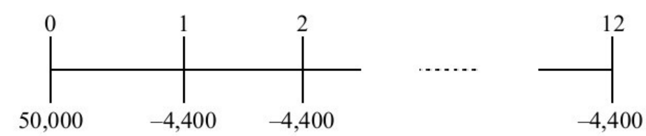
$$\text{NPV} = 10 - \frac{8}{r}\left(1 - \frac{1}{(1+r)^3}\right) + \frac{1}{(1+r)^3}\left(\frac{5}{r+0.3}\right)$$

Plotting the NPV as a function of the discount rate gives



The plot shows that there are 2 IRRs – 7.165% and 41.568%. The IRR does give an answer in this case, so it does <u>not</u> work

6-8. The timeline of this investment opportunity is:



Computing the NPV of the cash flow stream

$$\text{NPV} = 50{,}000 - \frac{4{,}400}{r}\left(1 - \frac{1}{(1+r)^{12}}\right)$$

To compute the IRR, we set the NPV equal to zero and solve for *r*. Using the annuity spreadsheet gives

N	I	PV	PMT	FV
12	0.8484%	50,000	–4,400	0

The monthly IRR is 0.8484, so since

$$(1.008484)^{12} = 1.106696$$

0.8484% monthly corresponds to an EAR of 10.67%. Smith's cost of capital is 15%, so according to the IRR rule, she should turn down this opportunity.

Let's see what the NPV rule says. If you invest at an EAR of 15%, then after one month you will have

$$(1.15)^{1/12} = 1.011715$$

so the monthly discount rate is 1.1715%. Computing the NPV using this discount rate gives

$$\text{NPV} = 50,000 - \frac{4,400}{0.011715}\left(1 - \frac{1}{(1.011715)^{12}}\right) = \$1010.06$$

Which is positive, so the correct decision is to accept the deal. Smith can also be relatively confident in this decision. Based on the difference between the IRR and the cost of capital, her cost of capital would have to be 15 – 10.67 = 4.33% *lower* to reverse the decision

6-9.

a. Timeline:

0	1	2	……	10	11	12	………
–5	1 – 0.1	1 – 0.1		1 – 0.1	0.1	0.1	

The PV of the profits is

$$\text{PV}_{\text{profits}} = \frac{1}{r}\left(1 - \frac{1}{(1+r)^{10}}\right)$$

The PV of the support costs is

$$\text{PV}_{\text{support}} = \frac{0.1}{r}$$

$$\text{NPV} = -5 + \text{PV}_{\text{profits}} + \text{PV}_{\text{support}} = -5 + \frac{1}{r}\left(1 - \left(\frac{1}{(1+r)^{10}}\right)\right) - \frac{0.1}{r}$$

r = 5.438761% then NPV = $721,162

r = 2.745784% then NPV = 0

r = 10.879183% then NPV = 0

b. From the answer to part (a) there are 2 IRRs: 2.745784% and 10.879183%

c. The IRR rule says nothing in this case because there are 2 IRRs

6-10. The timeline of this investment opportunity is:

0	1	2	……	10	11	12	………
–120	20	20		20	–2	–2	

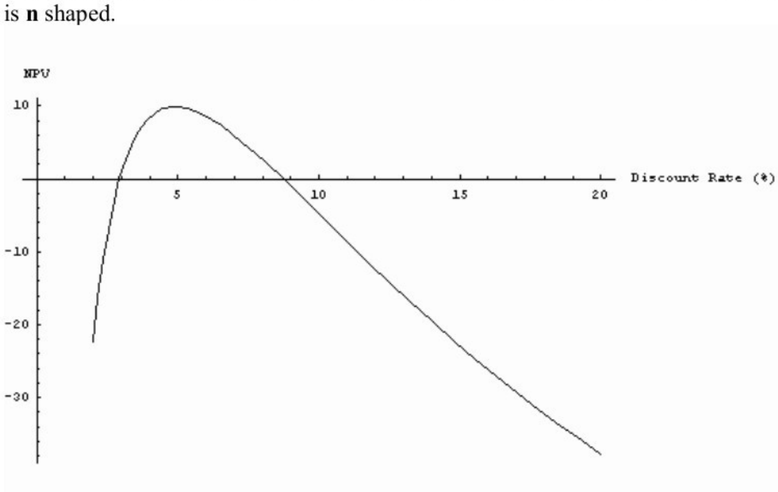
Computing the NPV of the cash flow stream:

$$\text{NPV} = -120 + \frac{20}{r}\left(1 - \frac{1}{(1+r)^{10}}\right) - \frac{2}{r(1+r)^{10}}$$

You can verify that $r = 0.02924$ or 0.08723 gives an NPV of zero. There are two IRRs, so you cannot apply the IRR rule. Let's see what the NPV rule says. Using the cost of capital of 8% gives

$$\text{NPV} = -120 + \frac{20}{r}\left(1 - \frac{1}{(1+r)^{10}}\right) - \frac{2}{r(1+r)^{10}} = 2.621791$$

So the investment has a positive NPV of $2,621,791. In this case the NPV as a function of the discount rate is **n** shaped.



If the opportunity cost of capital is *between* 2.93% and 8.72%, the investment should be undertaken.

6-11. Timeline:

0	1	2	3	.....	20	21	22
–250	20	20	20		20	–5	–5

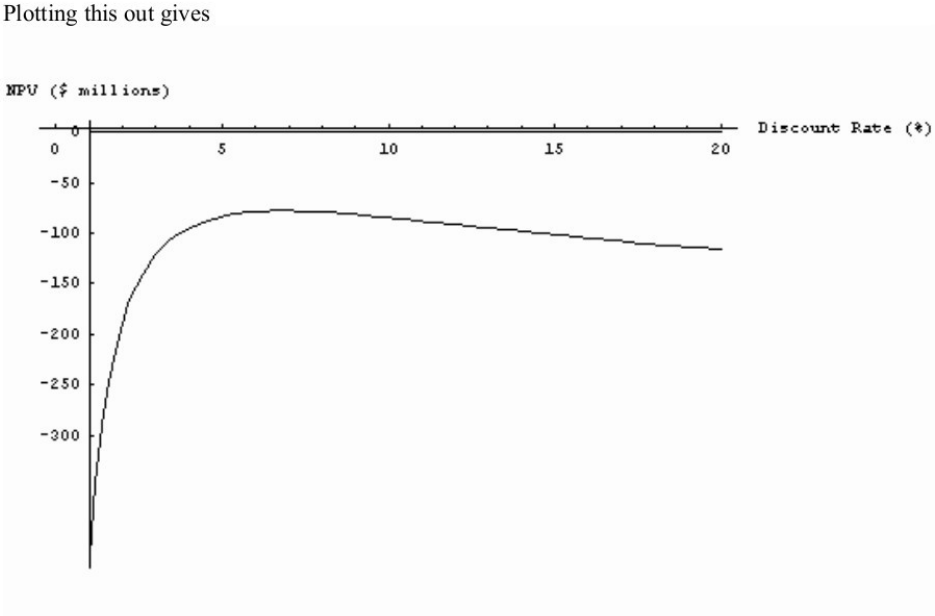
$$PV_{\text{operating profits}} = \frac{20}{r}\left(1 - \frac{1}{(1+r)^{20}}\right)$$

In year 20, the PV of the stabilizations costs are $PV_{20} = \frac{5}{r}$

So the PV today is $PV_{\text{stabilization costs}} = \frac{1}{(1+r)^{20}}\left(\frac{5}{r}\right)$

$$\text{NPV} = -250 + \frac{20}{r}\left(1 - \frac{1}{(1+r)^{20}}\right) - \frac{1}{(1+r)^{20}}\left(\frac{5}{r}\right)$$

Plotting this out gives



So no IRR exists.

6-12. Timeline:

	0	1	2	3	4
	–100		30	30	30
EVA		–100r	30 – 100r	30 – 100r	30 – 100r

In the first year there are no profits but capital is still being tied up, so we still need to take this cost into account. So the EVA at date 1 is

EVA_1 = -100r

After that the EVA is

EVA_N = 30 – 100r

At date 1 the PV of all future EVAs is

$$PV_1 = \frac{30 - 100r}{r}$$

So the PV of this today is

$$PV_f = \left(\frac{30 - 100r}{r}\right)\left(\frac{1}{1 + r}\right) = \frac{30 - 100(0.08)}{0.08}\frac{1}{1.08} = 254.63 \text{ million}$$

The PV of the EVA at date 1 is

$$PV_{\text{date 1}} = \frac{-100r}{1 + r} = \frac{-100(0.08)}{1.08} = -7.41$$

So the PV of all future EVAs is

$$PV = PV_f + PF_{\text{date 1}} = 254.13 - 7.41 = \$247.22 \text{ million}$$

The EVA rule gives the same answer as the NPV rule.

6-13. Timeline:

	0	1	2	3	......	21
Cash Flow	–100		15	15		15 + 10
EVA		–100r	15 – 100r	15 – 100r		15 – 100r - (100 – 10)

EVA in year 1 is –100r because there is cash generated, but capital is still tied up. The PV is

$$PV_{\text{Year 1 EVA}} = \frac{-100r}{1 + r} = \frac{-100(0.12)}{1.12} = -10.714$$

EVA in year 2–20 is

15 – 100r

Calculate the PV in year 1 gives

$$\frac{15 - 100r}{r}\left(1 - \frac{1}{(1 + r)^{19}}\right)$$

So the PV today is

$$PV_{\text{Y2-20 EVA}} = \left(\frac{1}{1 + r}\right)\frac{15 - 100r}{r}\left(1 - \frac{1}{(1 + r)^{19}}\right) = \left(\frac{1}{1.12}\right)\frac{15 - 100(0.12)}{0.12}\left(1 - \frac{1}{(1.12)^{19}}\right) = 19.73$$

EVA in year 21, when the capital is used is

15 – 100r – (100 – 10)

So the PV of this today is

$$PV_{\text{Year 21 EVA}} = \frac{15 - 100r - (100 - 10)}{(1+r)^{21}} = \frac{15 - 100(0.12) - 90}{(1.12)^{21}} = -8.053$$

PV of the EVAs is

$PV = PV_{\text{Year 1 EVA}} + PV_{\text{Y2-20 EVA}} + PV_{\text{Year 21 EVA}} = 0.963$. Take the project.

The NPV is

$$NPV = -100 + \frac{15}{r(1+r)}\left(1 - \frac{1}{(1+r)^{20}}\right) + \frac{10}{(1+r)^{21}} = 0.963$$

So the two rules agree.

6-14. Timeline:

0	1	2	3	4	5	6
–10	0	5	2	2	2	2

It will take 5 years to pay back the initial investment so the payback period is 5 years. You will not make the movie.

$$NPV = -10 + \frac{5}{(1+r)^2} + \frac{2}{r}\left(1 - \frac{1}{(1+r)^4}\right)\frac{1}{(1+r)^2} = -10 + \frac{5}{(1.1)^2} + \frac{2}{0.1(1.1)^2}\left(1 - \frac{1}{(1.1)^4}\right) = \text{-\$628,322}$$

So the NPV agrees with the payback rule in this case

6-15. Compute the IRR by plotting the NPV as a function of the discount rate and marking the IRR where the graph crosses the x axes. Give your boss this plot rather than the single IRR number.

6-16.

a. Timeline:

	0	1	2	3
A	–10	2	2	2
B	–10	1.5	1.5(1.02)	$1.5(1.02)^2$

$$NPV_A = \frac{2}{r} - 10$$

Setting $NPV_A = 0$ and solving for r

$IRR_A = 20\%$

$$NPV_B = \frac{1.5}{r - 0.02} - 10$$

Setting $NPV_B = 0$ and solving for r

$$\frac{1.5}{r - 0.02} = 10 \Rightarrow r - 0.02 = 0.15 \Rightarrow r = 17\%. \text{ So, } IRR_B = 17\%$$

Based on the IRR you always pick project A

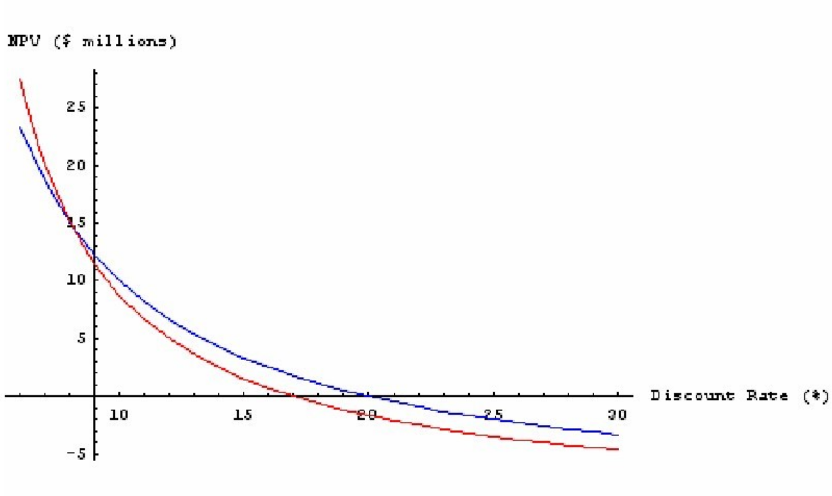
b. Substituting r = 0.07 into the NPV formulas derived in part (a) gives

NPV_A = \$18.5714 million

NPV_B = \$20 million

So the NPV says take B

c. Here is a plot of NPV of both projects as a function of the discount rate. The NPV rule selects A (and so agrees with the IRR rule) for all discount rates to the right of the point where the curves cross.



$$\begin{aligned}
NPV_A &= NPV_B \\
\frac{2}{r} &= \frac{1.5}{r - 0.02} \\
\frac{r}{2} &= \frac{r - 0.02}{1.5} \\
1.5r &= 2r - 0.04 \\
0.5r &= 0.04 \\
r &= 0.08
\end{aligned}$$

So the IRR rule will give the correct answer for discount rates greater than 8%

6-17. Timeline:

	0	1	2	3	
A	–10	2	2	2	
B	–10	1.5	1.5(1.02)	$1.5(1.02)^2$	

To calculate the incremental IRR subtract A from B

0	1.5 – 2	1.5(1.02)–2	$1.5(1.02)^2$–2	⋯

$$\text{NPV} = \frac{1.5}{r - 0.02} - \frac{2}{r} = 0$$

$$\frac{2}{r} = \frac{1.5}{r - 0.02}$$

$$\frac{r}{2} = \frac{r - 0.02}{1.5}$$

$$1.5r = 2r - 0.04$$

$$0.5r = 0.04$$

$$r = 0.08$$

So the incremental IRR is 8%. This rate is above the cost of capital so we should take B

6-18. Timeline:

	0	1	2
Playhouse	–30	15	20
Fort	–80	39	52

Subtract the Playhouse cash flows from the Fort

–50	24	32

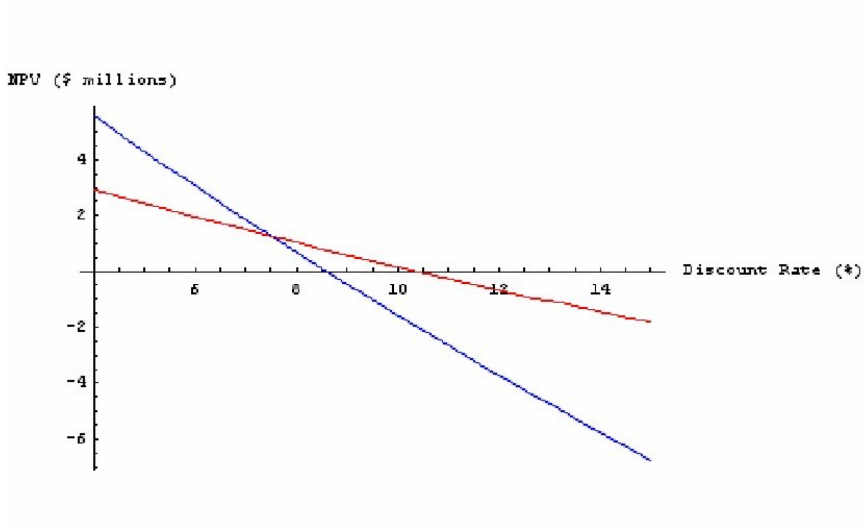
$$\text{NPV} = -50 + \frac{24}{1+r} + \frac{32}{(1+r)^2}$$

Solving for r

$$r = \frac{-2(50) + 24 + \sqrt{24^2 + 4(50)(32)}}{2(50)}$$

$$= 7.522\%$$

Since the incremental IRR of 7.522% is <u>less</u> than the cost of capital of 8% you should take the Playhouse



6-19.

Project	NPV	Profitability Index
Parkside Acres	91,765	.18
Real Property Estates	120,523	.15
Lost Lake Properties	40,392	.06
Overlook	80,131	.53

The PI implies that Overlook and Parkside Acres should be selected. Note that $150,000 of the capital budget is unused. The alternative investment opportunities that meet the resource constraint are: (i) Real Property Estates alone, (ii) Lost Lake and Overlook, or (ii) Parkside and Overlook. All of these alternatives generate lower NPVs, so in this case the PI rule gives the correct answer, although as the text explains, this need not always be the case when the complete budget is not used by taking the projects in order.

** Note – this problem, as presented in the text, contains some complexities that will be replaced in the second edition. We recommend you make use of the new problem 6-21 below as a replacement.

6-20.

Project	PI	NPV/Headcount
I	1.01	5.1
II	1.27	6.3
III	1.47	5.5
IV	1.25	8.3
V	2.01	6.0

a. The PI rule selects projects V, III, II. These are also the optimal projects to undertake (as the budget is used up fully taking the projects in order).

b. The PI rule selects IV and II alone, because the project with the next highest PI (that is NPV/Headcount), V, cannot be undertaken without violating the resource constraint. However, this choice of projects does not maximize NPV. Orchid should also take on III and I. This solution is better than taking V and I (which is also affordable), and shows that it may be optimal to skip some projects in the PI ranking if they will not fit within the budget (and there is unused budget remaining).

** Note – this problem, as presented in the text, contains some complexities that will be replaced in the second edition. We recommend you make use of the new problem 6-21 below as a replacement

6-21 ADDITIONAL RESOURCE in 2nd printing of Solutions Manual

Because problems 6-19 and 6-20 as currently given in the text contain additional complexities, we will replace them with the following problem in the next edition, which is more insightful.

New problem:

6-21. Kaimalino Properties (KP) is evaluating six real estate investments. Management plans to buy the properties today and sell them five years from today. The following table summarizes the initial cost and the expected sale price for each property, as well as the appropriate discount rate based on the risk of each venture.

Project	Cost Today	Discount Rate	Expected Sale Price in Year 5
Mountain Ridge	$ 3,000,000	15%	$ 18,000,000
Ocean Park Estates	15,000,000	15%	$ 75,500,000
Lakeview	9,000,000	15%	$ 50,000,000
Seabreeze	6,000,000	8%	$ 35,500,000
Green Hills	3,000,000	8%	$ 10,000,000
West Ranch	9,000,000	8%	$ 46,500,000

KP has a total capital budget of $18,000,000 to invest in properties.

a) What is the IRR of each investment?

b) What is the NPV of each investment?

c) Given its budget of $18,000,000, which properties should KP choose?

d) Explain why the profitably index method could not be used if KP's budget were $12,000,000 instead. Which properties should KP choose in this case?

Solution:

a) We can compute the IRR for each as IRR = $(\text{Sale Price/Cost})^{1/5} - 1$. See spreadsheet below.

b) We can compute the NPV for each as NPV = Sale Price/$(1+r)^5$ – Cost . See spreadsheet below.

c) We can rank projects according to their profitability index = NPV/Cost, as shown below. Thus, KP should invest in Seabreeze, West Ranch, and Mountain Ridge. (Note that ranking projects according to their IRR would not maximize KP's total NPV, and so would not lead to the correct selection.)

Project	Cost Today	Discount Rate	Expected Sale Price in Year 5		IRR	NPV	Profitability Index
Mountain Ridge	$ 3,000,000	15%	$ 18,000,000		43.1%	$ 5,949,181	1.98
Ocean Park Estates	15,000,000	15%	$ 75,500,000		38.2%	22,536,844	1.50
Lakeview	9,000,000	15%	$ 50,000,000		40.9%	15,858,837	1.76
Seabreeze	6,000,000	8%	$ 35,500,000		42.7%	18,160,703	3.03
Green Hills	3,000,000	8%	$ 10,000,000		27.2%	3,805,832	1.27
West Ranch	9,000,000	8%	$ 46,500,000		38.9%	22,647,119	2.52

Chapter 7
Fundamentals of Capital Budgeting

7-1.

a. Sales of new pizza – lost sales of original = 20 – 0.40(20) = $12 million

b. Sales of new pizza – lost sales of original pizza from customers who would not have switched brands = 20 – 0.50(0.40)(20) = $16 million

7-2.

	Year	1	2
Incremental Earnings Forecast ($000s)			
1	Sales of Mini Mochi Munch	9,000	7,000
2	Other Sales	2,000	2,000
3	Cost of Goods Sold	(7,350)	(6,050)
4	**Gross Profit**	3,650	2,950
5	Selling, General & Admin.	(5,000)	-
6	Depreciation	-	-
7	**EBIT**	(1,350)	2,950
8	Income tax at 35%	473	(1,033)
9	**Unlevered Net Income**	**(878)**	**1,918**

7-3.

a. No, this is a sunk cost and will not be included directly. (But see (f) below.)

b. Yes, this is a cost of opening the new store.

c. Yes, this loss of sales at the existing store should be deducted from the sales at the new store to determine the incremental increase in sales that opening the new store will generate for HBS.

d. No, this is a sunk cost.

e. This is a capital expenditure associated with opening the new store. These costs will therefore increase HBS's depreciation expenses.

f. Yes, this is an opportunity cost of opening the new store. (By opening the new store, HBS forgoes the after-tax proceeds it could have earned by selling the property. This loss is equal to the sale price less the taxes owed on the capital gain from the sale, which is the difference between the sale price and the book value of the property. The book value equals the initial cost of the property less accumulated depreciation.)

g. While these financing costs will affect HBS's actual earnings, for capital budgeting purposes we calculate the incremental earnings without including financing costs to determine the project's unlevered net income.

7-4.

a. Change in EBIT = Gross profit with price drop – Gross profit without price drop
= 25,000 × (300 – 200) – 20,000 ×(350 – 200)
= - $500,000

b. Change in EBIT from Ink Cartridge sales = 25,000 × $75 × 0.70 – 20,000 × $75 × 0.70 = $262,500

Therefore, incremental change in EBIT for the next 3 years is

Year 1: $262,500 – 500,000 = -$237,500

Year 2: $262,500

Year 3: $262,500

7-5.

		Year0	Year1	Year2	Year3	Year4	Year5
1	Cash		6	12	15	15	15
2	Accounts Receivable		21	22	24	24	24
3	Inventory		5	7	10	12	13
4	Accounts Payable		18	22	24	25	30
5	Net working capital (1+2+3-4)	0	14	19	25	26	22
6	Increase in NWC		14	5	6	1	-4

7-6. *Solution: Note – we have assumed any incremental cost of goods sold is included as part of operating expenses.*

a.

	Year	1	2
Incremental Earnings Forecast ($000s)			
1	Sales	125.0	160.0
2	Operating Expenses	(40.0)	(60.0)
3	Depreciation	(25.0)	(36.0)
4	**EBIT**	60.0	64.0
5	Income tax at 35%	(21.0)	(22.4)
6	**Unlevered Net Income**	**39.0**	**41.6**

b.

Free Cash Flow ($000s)		**1**	**2**
7	Plus: Depreciation	25.0	36.0
8	Less: Capital Expenditures	(30.0)	(40.0)
9	Less: Increases in NWC	(5.0)	(8.0)
10	**Free Cash Flow**	**29.0**	**29.6**

7-7.

a. Free Cash Flows are:

	0	1	2	…	9	10
= Net income		4,875	4,875		4,875	4,875
+ Overhead (after tax at 35%)		650	650		650	650
+ Depreciation		2,500	2,500		2,500	2,500
– Capex	25,000					
– Inc. in NWC	10,000					–10000
FCF	–35,000	8,025	8,025	…	8,025	18,025

b. $\text{NPV} = -35 + 8.025 \times \frac{1}{.14}\left(1 - \frac{1}{1.14^9}\right) + \frac{18.025}{1.14^{10}} = 9.56$

7-8. FCF = Unlevered Net Income + Depreciation – CapEx – Increase in NWC= 250 + 100 – 200 – 10 = $140 million.

7-9.

a. $15 million / 5 years = $3 million per year

b. $3 million × 35% = $1.05 million per year

c.

Year	0	1	2	3	4	5
MACRS Depreciation						
Equipment Cost	15,000					
MACRS Depreciation Rate	20.00%	32.00%	19.20%	11.52%	11.52%	5.76%
Depreciation Expense	3,000	4,800	2,880	1,728	1,728	864
Depreciation Tax Shield (at 35% tax rate)	1,050	1,680	1,008	605	605	302

d. In both cases, its total depreciation tax shield is the same. But with MACRS, it receives the depreciation tax shields sooner—thus, MACRS depreciation leads to a higher NPV of Markov's FCF.

e. If the tax rate will increase substantially, than Markov may be better off claiming higher depreciation expenses in later years, since the tax benefit at that time will be greater.

7-10. The expected cash flow in year 5 is 240,000 × 1.03 = 247,200. We can value the cash flows in year 5 and beyond as a growing perpetuity:

Continuation Value in Year 4 = 247,200/(0.14 – 0.03) = $2,247,273

We can then compute the value of the division by discounting the FCF in years 1 through 4, together with the continuation value:

$$\text{NPV} = \frac{-185,000}{1.14} + \frac{-12,000}{1.14^2} + \frac{99,000}{1.14^3} + \frac{240,000 + 2,247,273}{1.14^4} = \$1,367,973$$

7-11.

a. FCF in year 6 = 110 × 1.02 = 112.2

Continuation Value in year 5 = 112.2 / (12% – 2%) = $1,122.

b. We can estimate the continuation value as follows:

Continuation Value in year 5 = (Earnings in year 5) × (P/E ratio in year 5)

= $50 × 30 = $1500.

c. We can estimate the continuation value as follows:

Continuation Value in year 5 = (Book value in year 5) × (M/B ratio in year 5)

= $400 × 4 = $1600.

7-12. Replacing the machine increases EBITDA by 40,000 – 20,000 = 20,000. Depreciation expenses rises by $15,000 – $10,000 = $5,000. Therefore, FCF will increase by (20,000) × (1-0.45) + (0.45)(5,000) = $13,250 in years 1 through 10.

In year 0, the initial cost of the machine is $150,000. Because the current machine has a book value of $110,000 – 10,000 (one year of depreciation) = $100,000, selling it for $50,000 generates a capital gain of 50,000 – 100,000 = –50,000. This loss produces tax savings of 0.45 × 50,000 = $22,500, so that the after-tax proceeds from the sales including this tax savings is $72,500. Thus, the FCF in year 0 from replacement is –150,000 + 72,500 = -$77,500.

NPV of replacement = $–77,500 + 13,250 \times (1 / .10)(1 - 1 / 1.10^{10})$ = $3916. There is a small profit from replacing the machine.

7-13. We can use Eq. 7.5 to evaluate the free cash flows associated with each alternative. Note that we only need to include the components of free cash flows that vary across each alternative. For example, since NWC is the same for each alternative, we can ignore it.

The spreadsheet below computes the relevant FCF from each alternative. Note that each alternative has a negative NPV—this represents the PV of the costs of each alternative. We should choose the one with the highest NPV (lowest cost), which in this case is purchasing the existing machine.

a. See spreadsheet

b. See spreadsheet

		0	1	2	3	4	5	6	7	8	9	10
Rent Machine												
1	Rent		(50,000)	(50,000)	(50,000)	(50,000)	(50,000)	(50,000)	(50,000)	(50,000)	(50,000)	(50,000)
2	**FCF(rent)**		(32,500)	(32,500)	(32,500)	(32,500)	(32,500)	(32,500)	(32,500)	(32,500)	(32,500)	(32,500)
3	**NPV at 8%**	**(218,078)**										
Purchase Current Machine												
4	Maintenance		(20,000)	(20,000)	(20,000)	(20,000)	(20,000)	(20,000)	(20,000)	(20,000)	(20,000)	(20,000)
5	Depreciation		21,429	21,429	21,429	21,429	21,429	21,429	21,429	-	-	-
6	Capital Expenditures	(150,000)										
7	**FCF(purchase current)**	(150,000)	(5,500)	(5,500)	(5,500)	(5,500)	(5,500)	(5,500)	(5,500)	(13,000)	(13,000)	(13,000)
8	**NPV at 8%**	**(198,183)**										
Purchase Advanced Machine												
9	Maintenance		(15,000)	(15,000)	(15,000)	(15,000)	(15,000)	(15,000)	(15,000)	(15,000)	(15,000)	(15,000)
10	Other Costs	(35,000)	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000
11	Depreciation		35,714	35,714	35,714	35,714	35,714	35,714	35,714	-	-	-
12	Capital Expenditures	(250,000)										
13	**FCF(purchase advanced)**	(272,750)	9,250	9,250	9,250	9,250	9,250	9,250	9,250	(3,250)	(3,250)	(3,250)
14	**NPV at 8%**	**(229,478)**										

7-14.

	Year	0	1	2	3	4	5	6	7	8	9	10
Free Cash Flow Forecast ($ millions)												
1	Sales	—	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
2	Manufacturing	—	(35.0)	(35.0)	(35.0)	(35.0)	(35.0)	(35.0)	(35.0)	(35.0)	(35.0)	(35.0)
3	Marketing Expenses	—	(10.0)	(10.0)	(10.0)	(10.0)	(10.0)	(10.0)	(10.0)	(10.0)	(10.0)	(10.0)
4	Depreciation	—	(15.0)	(15.0)	(15.0)	(15.0)	(15.0)	(15.0)	(15.0)	(15.0)	(15.0)	(15.0)
5	EBIT	—	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0
6	Income tax at 35%	—	(14.0)	(14.0)	(14.0)	(14.0)	(14.0)	(14.0)	(14.0)	(14.0)	(14.0)	(14.0)
7	**Unlevered Net Income**	—	26.0	26.0	26.0	26.0	26.0	26.0	26.0	26.0	26.0	26.0
8	Depreciation	—	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0
9	Inc. in NWC	—	(5.0)	(5.0)	(5.0)	(5.0)	(5.0)	(5.0)	(5.0)	(5.0)	(5.0)	(5.0)
10	Capital Expenditures	(150.0)	—	—	—	—	—	—	—	—	—	—
11	Continuation value	—	—	—	—	—	—	—	—	—	—	12.0
12	**Free Cash Flow**	(150.0)	36.0	36.0	36.0	36.0	36.0	36.0	36.0	36.0	36.0	48.0
13	**NPV at 12%**	**57.3**	—	—	—	—	—	—	—	—	—	—

a. The NPV of the estimate free cash flow is

$$\text{NPV} = -150 + 36 \times \frac{1}{0.12}\left(1 - \frac{1}{1.12^9}\right) + \frac{48}{1.12^{10}} = \$57.3 \text{ million}$$

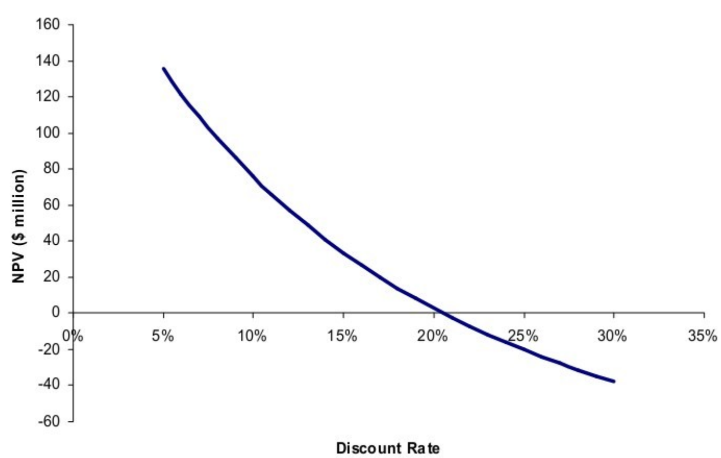
b.

Initial Sales	90	100	110
NPV	20.5	57.3	94.0

c.

Growth Rate	0%	2%	5%
NPV	57.3	72.5	98.1

d. NPV is positive for discount rates below the IRR of 20.6%



7-15.

a. See spreadsheet

b. See spreadsheet

c. See spreadsheet

d. See data tables in spreadsheet

e. See data tables in spreadsheet

f. See spreadsheet—need additional sales of $11.384 million in years 3-10 for larger machine to have a higher NPV than XC-750.

Incremental Effects
(with vs. without XC-750)

Year	0	1	2	3	4	5	6	7	8	9	10	11
Sales Revenues	-5,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	
Cost of Goods Sold	3,500	-7,000	-7,000	-7,000	-7,000	-7,000	-7,000	-7,000	-7,000	-7,000	-7,000	
S, G & A Expenses		-2,000	-2,000	-2,000	-2,000	-2,000	-2,000	-2,000	-2,000	-2,000	-2,000	
Depreciation		-275	-275	-275	-275	-275	-275	-275	-275	-275	-275	
EBIT	-1,500	725	725	725	725	725	725	725	725	725	725	
Taxes at 35%	525	-254	-254	-254	-254	-254	-254	-254	-254	-254	-254	
Unlevered Net Income	-975	471	471	471	471	471	471	471	471	471	471	
Depreciation		275	275	275	275	275	275	275	275	275	275	
Capital Expenditures	-2,750											
Add. To Net Work. Cap.	-600	-1,200	0	0	0	0	0	0	0	0	1,000	800
FCF	-4,325	-454	746	746	746	746	746	746	746	746	1,746	800
Cost of Capital	10.00%											
PV(FCF)	-4,325	-413	617	561	510	463	421	383	348	316	673	280
NPV	-164.6											

Net Working Capital Calculation

Year	0	1	2	3	4	5	6	7	8	9	10	11
Receivables at 15%	-750	1500	1500	1500	1500	1500	1500	1500	1500	1500	1500	0
Payables at 10%	350	-700	-700	-700	-700	-700	-700	-700	-700	-700	-700	0
Inventory	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	0	0
NWC	600	1800	1800	1800	1800	1800	1800	1800	1800	1800	800	0

Sensitivity Analysis: New Sales

New Sales (000s)	8	9	10	10.143	11	12
NPV	-2472	-1318	-165	0	989	2142

Sensitivity Analysis: Cost of Goods Sold

COGS	67%	68%	69.545%	69%	70%	71%

Incremental Effects
(with vs. without XC-900)

Year	0	1	2	3	4	5	6	7	8	9	10	11
Sales Revenues	-5,000	10,000	10,000	11,384	11,384	11,384	11,384	11,384	11,384	11,384	11,384	
Cost of Goods Sold	3,500	-7,000	-7,000	-7,969	-7,969	-7,969	-7,969	-7,969	-7,969	-7,969	-7,969	
S, G & A Expenses		-2,000	-2,000	-2,000	-2,000	-2,000	-2,000	-2,000	-2,000	-2,000	-2,000	
Depreciation		-400	-400	-400	-400	-400	-400	-400	-400	-400	-400	
EBIT	-1,500	600	600	1,015	1,015	1,015	1,015	1,015	1,015	1,015	1,015	
Taxes at 35%	525	-210	-210	-355	-355	-355	-355	-355	-355	-355	-355	
Unlevered Net Income	-975	390	390	660	660	660	660	660	660	660	660	
Depreciation		400	400	400	400	400	400	400	400	400	400	
Capital Expenditures	-4,000											
Add. To Net Work. Cap.	-600	-1,200	0	-111	0	0	0	0	0	0	1,000	911
FCF	-5,575	-410	790	949	1,060	1,060	1,060	1,060	1,060	1,060	2,060	911
Cost of Capital	10.00%											
PV(FCF)	-5,575	-373	653	713	724	658	598	544	494	450	794	319
NPV	0.0											

Net Working Capital Calculation

Year	0	1	2	3	4	5	6	7	8	9	10	11
Receivables at 15%	-750	1500	1500	1708	1708	1708	1708	1708	1708	1708	1708	0
Payables at 10%	350	-700	-700	-797	-797	-797	-797	-797	-797	-797	-797	0
Inventory	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	0	0
NWC	600	1800	1800	1911	1911	1911	1911	1911	1911	1911	911	0

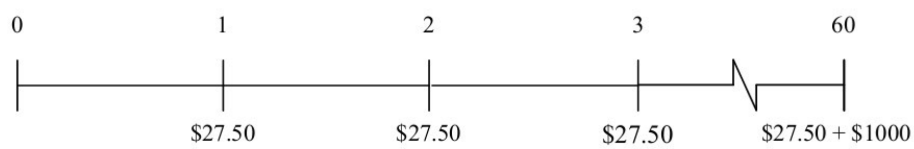
Chapter 8
Valuing Bonds

8-1.

a. The coupon payment is:

$$CPN = \frac{\text{Coupon Rate} \times \text{Face Value}}{\text{Number of Coupons per Year}} = \frac{0.055 \times \$1000}{2} = \$27.50$$

b. The timeline for the cash flows for this bond is (the unit of time on this timeline is six-month periods):



$P = 100/(1.055)^2 = \$89.85$

8-2.

a. The maturity is 10 years.

b. (20/1000) * 2 = 4% so the coupon rate is 4%.

c. The face value is $1000.

8-3.

a. Use the following equation:

$$1 + YTM_n = \left(\frac{FV_n}{P}\right)^{1/n}$$

$$1 + YTM_1 = \left(\frac{100}{95.51}\right)^{1/1} \Rightarrow YTM_1 = 4.70\%$$

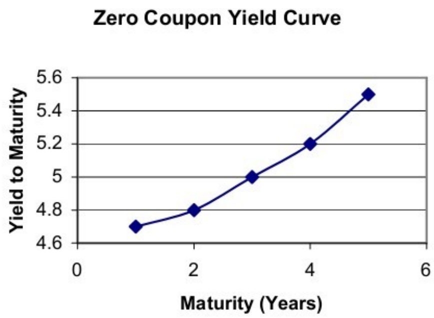
$$1 + YTM_1 = \left(\frac{100}{91.05}\right)^{1/2} \Rightarrow YTM_1 = 4.80\%$$

$$1 + YTM_3 = \left(\frac{100}{86.38}\right)^{1/3} \Rightarrow YTM_3 = 5.00\%$$

$$1 + YTM_4 = \left(\frac{100}{81.65}\right)^{1/4} \Rightarrow YTM_4 = 5.20\%$$

$$1 + YTM_5 = \left(\frac{100}{76.51}\right)^{1/5} \Rightarrow YTM_5 = 5.50\%$$

b. The yield curve is



c. The yield curve is upward sloping

8-4.

a. $P = 100(1.055)^2 = \$89.85$

b. $P = 100/(1.0595)^4 = \$79.36$

c. 6.05%

8-5.

a. $$\$1{,}034.74 = \frac{40}{(1+\frac{\text{YTM}}{2})} + \frac{40}{(1+\frac{\text{YTM}}{2})^2} + \cdots + \frac{40+1000}{(1+\frac{\text{YTM}}{2})^{20}} \Rightarrow \text{YTM} = 7.5\%$$

Using the annuity spreadsheet:

	NPER	Rate	PV	PMT	FV	Excel Formula
Given:	20		-1,034.74	40	1,000	
Solve For Rate:		3.75%				=RATE(20,40,-1034.74,1000)

Therefore, YTM = 3.75% × 2 = 7.50%

b. $$\text{PV} = \frac{40}{(1+\frac{.09}{2})} + \frac{40}{(1+\frac{.09}{2})^2} + \text{L} + \frac{40+1000}{(1+\frac{.09}{2})^{20}} = \$934.96.$$

Using the spreadsheet
With a 9% YTM = 4.5% per 6 months, the new price is $934.96

	NPER	Rate	PV	PMT	FV	Excel Formula
Given:	20	4.50%		40	1,000	
Solve For PV:			(934.96)			=PV(0.045,20,40,1000)

8-6.

$$900 = \frac{C}{(1+.06)} + \frac{C}{(1+.06)^2} + \cdots + \frac{C+1000}{(1+.06)^5} \Rightarrow C = \$36.26, \text{ so the coupon rate is } 3.626\%$$

We can use the annuity spreadsheet to solve for the payment:

	NPER	Rate	PV	PMT	FV	Excel Formula
Given:	5	6.00%	-900.00		1,000	
Solve For PMT:				36.26		=PMT(0.06,5,-900,1000)

Therefore, the coupon rate is 3.626%

8-7. Bond A trades at a discount. Bond D trades at par. Bonds B and C trade at a premium.

8-8. Bonds trading at a discount generate a return from both receiving the coupons and from receiving a face value that exceeds the price paid for the bond. As a result, the yield to maturity of discount bonds exceeds the coupon rate.

8-9.

a. Because the yield to maturity is less than the coupon rate, the bond is trading at a premium.

b. $$\frac{40}{(1+.035)} + \frac{40}{(1+.035)^2} + \cdots + \frac{40+1000}{(1+.035)^{14}} = \$1,054.60$$

	NPER	Rate	PV	PMT	FV	Excel Formula
Given:	14	3.50%		40	1,000	
Solve For PV:			(1,054.60)			=PV(0.035,14,40,1000)

8-10.

a. When it was issued, the price of the bond was

$$P = \frac{70}{(1+.06)} + \ldots + \frac{70+1000}{(1+.06)^{10}} = \$1073.60$$

b. Before the first coupon payment, the price of the bond is

$$P = 70 + \frac{70}{(1+.06)} \ldots + \frac{70+1000}{(1+.06)^9} = \$1138.02$$

c. After the first coupon payment, the price of the bond will be

$$P = \frac{70}{(1+.06)} \ldots + \frac{70+1000}{(1+.06)^9} = \$1068.02$$

8-11.

a. First, we compute the initial price of the bond by discounting its 10 annual coupons of $6 and final face value of $100 at the 5% yield to maturity:

	NPER	Rate	PV	PMT	FV	Excel Formula
Given:	10	5.00%		6	100	
Solve For PV:			(107.72)			= PV(0.05,10,6,100)

Thus, the initial price of the bond = $107.72. (Note that the bond trades above par, as its coupon rate exceeds its yield).

Next we compute the price at which the bond is sold, which is the present value of the bonds cash flows when only 6 years remain until maturity:

	NPER	Rate	PV	PMT	FV	Excel Formula
Given:	6	5.00%		6	100	
Solve For PV:			(105.08)			= PV(0.05,6,6,100)

Therefore, the bond was sold for a price of $105.08. The cash flows from the investment are therefore as shown in the following timeline:

Year	**0**	**1**	**2**	**3**	**4**
Purchase Bond	-$107.72				
Receive Coupons		$6	$6	$6	$6
Sell Bond					$105.08
Cash Flows	-$107.72	$6.00	$6.00	$6.00	$111.08

b. We can compute the IRR of the investment using the annuity spreadsheet. The PV is the purchase price, the PMT is the coupon amount, and the FV is the sale price. The length of the investment N = 4 years. We then calculate the IRR of investment = 5%. Because the YTM was the same at the time of purchase and sale, the IRR of the investment matches the YTM.

	NPER	Rate	PV	PMT	FV	Excel Formula
Given:	4		–107.72	6	105.08	
Solve For Rate:		5.00%				= RATE(4,6,-107.72,105.08)

8-12.

a. We can compute the price of each bond at each YTM using Eq. 8.5. For example, with a 6% YTM, the price of bond A per $100 face value is

$$\text{P(bond A, 6\% YTM)} = \frac{100}{1.06^{15}} = \$41.73$$

The price of bond D is

$$\text{P(bond D, 6\% YTM)} = 8 \times \frac{1}{.06}\left(1 - \frac{1}{1.06^{10}}\right) + \frac{100}{1.06^{10}} = \$114.72$$

One can also use the Excel formula to compute the price: –PV(YTM, NPER, PMT, FV).

Once we compute the price of each bond for each YTM, we can compute the % price change as

$$\text{Percent change} = \frac{(\text{Price at 5\% YTM}) - (\text{Price at 6\% YTM})}{(\text{Price at 6\% YTM})}$$

The results are shown in the table below:

Bond	Coupon Rate (annual payments)	Maturity (years)	Price at 6% YTM	Price at 5% YTM	Percentage Change
A	0%	15	$41.73	$48.10	15.3%
B	0%	10	$55.84	$61.39	9.9%
C	4%	15	$80.58	$89.62	11.2%
D	8%	10	$114.72	$123.17	7.4%

b. Bond A is most sensitive, because it has the longest maturity and no coupons. Bond D is the least sensitive. Intuitively, higher coupon rates and a shorter maturity typically lower a bond's interest rate sensitivity.

8-13.

a. Purchase price = 100 / 1.06^{30} = 17.41. Sale price = 100 / 1.06^{25} = 23.30. Return = $(23.30 / 17.41)^{1/5} - 1$ = 6.00%. I.e., since YTM is the same at purchase and sale, IRR = YTM.

b. Purchase price = 100 / 1.06^{30} = 17.41. Sale price = 100 / 1.07^{25} = 18.42. Return = $(18.42 / 17.41)^{1/5} - 1$ = 1.13%. I.e., since YTM rises, IRR < initial YTM.

c. Purchase price = 100 / 1.06^{30} = 17.41. Sale price = 100 / 1.05^{25} = 29.53. Return = $(29.53 / 17.41)^{1/5} - 1$ = 11.15%. I.e., since YTM falls, IRR > initial YTM.

d. Even without default, if you sell prior to maturity, you are exposed to the risk that the YTM may change.

8-14. $$P = \frac{CPN}{1+YTM_1} + \frac{CPN}{(1+YTM_2)^2} + \ldots + \frac{CPN+FV}{(1+YTM_N)^N} = \frac{60}{(1+.04)} + \frac{60+1000}{(1+.043)^2} = \$1032.09$$

This bond trades at a premium. The coupon of the bond is greater than each of the zero coupon yields, so the coupon will also be greater than the yield to maturity on this bond. Therefore it trades at a premium

8-15. The price of the zero-coupon bond is

$$P = \frac{FV}{(1+YTM_N)^N} = \frac{1000}{(1+0.048)^5} = \$791.03$$

8-16. The price of the bond is

$$P = \frac{CPN}{1+YTM_1} + \frac{CPN}{(1+YTM_2)^2} + \ldots + \frac{CPN+FV}{(1+YTM_N)^N} = \frac{40}{(1+.04)} + \frac{40}{(1+.043)^2} + \frac{40+1000}{(1+.045)^3} = \$986.58$$

The yield to maturity is

$$P = \frac{CPN}{1+YTM} + \frac{CPN}{(1+YTM)^2} + ... + \frac{CPN + FV}{(1+YTM)^N}$$

$$\$986.58 = \frac{40}{(1+YTM)} + \frac{40}{(1+YTM)^2} + \frac{40+1000}{(1+YTM)^3} \Rightarrow YTM = 4.488\%$$

8-17. The maturity must be one year. If the maturity were longer than one year, there would be an arbitrage opportunity

8-18. Solve the following equation:

$$1000 = CPN\left(\frac{1}{(1+.04)} + \frac{1}{(1+.043)^2} + \frac{1}{(1+.045)^3} + \frac{1}{(1+.047)^4}\right) + \frac{1000}{(1+.047)^4}$$

$$CPN = \$46.76$$

Therefore, the par coupon rate is 4.676%.

8-19.

a. The bond is trading at a premium because its yield to maturity is a weighted average of the yields of the zero coupon bonds. This implied that its yield is below 5%, the coupon rate.

b. To compute the yield, first compute the price.

$$P = \frac{CPN}{1+YTM_1} + \frac{CPN}{(1+YTM_2)^2} + ... + \frac{CPN+FV}{(1+YTM_N)^N}$$
$$= \frac{50}{(1+.04)} + \frac{50}{(1+.043)^2} + \frac{50}{(1+.045)^3} + \frac{50}{(1+.047)^4} + \frac{50+1000}{(1+.048)^5} = \$1010.05$$

The yield to maturity is:

$$P = \frac{CPN}{1+YTM} + \frac{CPN}{(1+YTM)^2} + ... + \frac{CPN+FV}{(1+YTM)^N}$$
$$1010.05 = \frac{50}{(1+YTM)} + ... + \frac{50+1000}{(1+YTM)^N} \Rightarrow YTM = 4.77\%$$

c. If the yield increased to 5.2%, the new price would be:

$$P = \frac{CPN}{1+YTM} + \frac{CPN}{(1+YTM)^2} + ... + \frac{CPN+FV}{(1+YTM)^N}$$
$$= \frac{50}{(1+.052)} + ... + \frac{50+1000}{(1+.052)^N} = \$991.39$$

8-20. First, figure out if the price of the coupon bond is consistent with the zero coupon yields implied by the other securities:

$$970.87 = \frac{1000}{(1+YTM_1)} \quad \rightarrow \quad YTM_1 = 3.0\%$$

$$938.95 = \frac{1000}{(1+YTM_2)^2} \quad \rightarrow \quad YTM_2 = 3.2\%$$

$$904.56 = \frac{1000}{(1+YTM_3)^3} \quad \rightarrow \quad YTM_3 = 3.4\%$$

According to these zero coupon yields, the price of the coupon bond should be:

$$\frac{100}{(1+.03)} + \frac{100}{(1+.032)^2} + \frac{100+1000}{(1+.034)^3} = \$1186.00$$

The price of the coupon bond is too low, so there is an arbitrage opportunity. To take advantage of it:

	Today	1 Year	2 Years	3 Years
Buy 10 Coupon Bonds	−11835.00	+1000	+1000	+11,000
Short Sell 1 One-Year Zero	+970.87	−1000		
Short Sell 1 Two-Year Zero	+938.95		−1000	
Short Sell 11 Three-Year Zeros	+9950.16			−11,000
Net Cash Flow	24.98	0	0	0

8-21. To determine whether these bonds present an arbitrage opportunity, check whether the pricing is internally consistent. Calculate the spot rates implied by Bonds A, B and D (the zero coupon bonds), and use this to check Bond C. (You may alternatively compute the spot rates from Bonds A, B and C, and check Bond D, or some other combination.)

$$934.58 = \frac{1000}{(1+\text{YTM}_1)} \Rightarrow \text{YTM}_1 = 7.0\%$$

$$881.66 = \frac{1000}{(1+\text{YTM}_2)^2} \Rightarrow \text{YTM}_2 = 6.5\%$$

$$839.62 = \frac{1000}{(1+\text{YTM}_3)^3} \Rightarrow \text{YTM}_3 = 6.0\%$$

Given the spot rates implied by Bonds A, B and D, the price of Bond C should be \$1,105.21. Its price really is \$1,118.21, so it is overpriced by \$13 per bond. YES, there is an arbitrage opportunity.

To take advantage of this opportunity, you want to (short) Sell Bond C (since it is overpriced). To match future cash flows, one strategy is to sell 10 Bond Cs (it is not the only effective strategy; any multiple of this strategy is also arbitrage). This complete strategy is summarized:

	Today	1 Year	2Years	3Years
Sell Bond C	11,182.10	–1,000	–1,000	–11,000
Buy Bond A	–934.58	1,000	0	0
Buy Bond B	–881.66	0	1,000	0
Buy 11 Bond D	–9,235.82	0	0	11,000
Net Cash Flow	130.04	0	0	0

Notice that your arbitrage profit equals 10 times the mispricing on each bond (subject to rounding error).

8-22.

a. We can construct a two-year zero coupon bond using the one and two-year coupon bonds as follows:

	Cash Flow in Year: 1	2	3	4
Two-year coupon bond ($1000 Face Value)	100	1,100		
Less: One-year bond ($100 Face Value)	(100)			
Two-year zero ($1100 Face Value)	-	1,100		

Now,

$$\text{Price(2-year coupon bond)} = \frac{100}{1.03908} + \frac{1100}{1.03908^2} = \$1115.05$$

$$\text{Price(1-year bond)} = \frac{100}{1.02} = \$98.04$$

By the Law of One Price:

Price(2 year zero) = Price(2 year coupon bond) – Price(One-year bond)
= 1115.05 – 98.04 = $1017.01

Given this price per $1100 face value, the YTM for the 2-year zero is (Eq. 8.3)

$$\text{YTM}(2) = \left(\frac{1100}{1017.01}\right)^{1/2} - 1 = 4.000\%$$

b. We already know YTM(1) = 2%, YTM(2) = 4%. We can construct a 3-year zero as follows:

	Cash Flow in Year: 1	2	3	4
Three-year coupon bond ($1000 face value)	60	60	1,060	
Less: one-year zero ($60 face value)	(60)			
Less: two-year zero ($60 face value)	-	(60)		
Three-year zero ($1060 face value)	-	-	1,060	

Now,

$$\text{Price(3-year coupon bond)} = \frac{60}{1.0584} + \frac{60}{1.0584^2} + \frac{1060}{1.0584^3} = \$1004.29$$

By the Law of One Price:

Price(3-year zero) = Price(3-year coupon bond) – Price(One-year zero) – Price(Two-year zero)
= Price(3-year coupon bond) – PV(coupons in years 1 and 2)
= 1004.29 – 60 / 1.02 – 60 / 1.04^2 = \$889.99

Solving for the YTM:

$$\text{YTM}(3) = \left(\frac{1060}{889.99}\right)^{1/3} - 1 = 6.000\%$$

Finally, we can do the same for the 4-year zero:

	Cash Flow in Year:			
	1	**2**	**3**	**4**
Four-year coupon bond (\$1000 face value)	120	120	120	1,120
Less: one-year zero (\$120 face value)	(120)			
Less: two-year zero (\$120 face value)	—	(120)		
Less: three-year zero (\$120 face value)	—	—	(120)	
Four-year zero (\$1120 face value)	—	—	—	1,120

Now,

$$\text{Price(4-year coupon bond)} = \frac{120}{1.05783} + \frac{120}{1.05783^2} + \frac{120}{1.05783^3} + \frac{1120}{1.05783^4} = \$1216.50$$

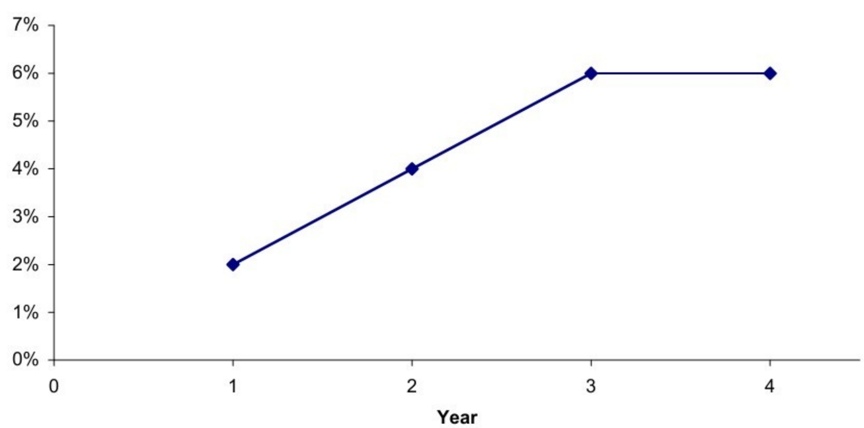
By the Law of One Price:

Price(4-year zero) = Price(4-year coupon bond) – PV(coupons in years 1–3)
= 1216.50 – 120 / 1.02 – 120 / 1.04^2 – 120 / 1.06^3 = \$887.15

Solving for the YTM:

$$\text{YTM}(4) = \left(\frac{1120}{887.15}\right)^{1/4} - 1 = 6.000\%$$

Thus, we have computed the zero coupon yield curve as



8-23. The yield to maturity of a corporate bond is based on the promised payments of the bond. But there is some chance the corporation will default and pay less. Thus, the bond's expected return is typically less than its YTM.

Corporate bonds have credit risk, the risk that the borrower will default and not pay all specified payments. As a result, investors pay less for bonds with credit risk than they would for an otherwise identical default-free bond. Because the YTM for a bond is calculated using the promised cash flows, the yields of bonds with credit risk will be higher than that of otherwise identical default-free bonds. However, the YTM of a defaultable bond is always higher than the expected return of investing in the bond because it is calculated using the promised cash flows rather than the expected cash flows.

8-24.

a. The price of this bond will be

$$P = \frac{100}{1+.032} = 96.899$$

b. The credit spread on AAA-rated corporate bonds is 0.032 – 0.031 = 0.1%

c. The credit spread on B-rated corporate bonds is 0.049 – 0.031 = 1.8%

d. The credit spread increases as the bond rating falls, because lower rated bonds are riskier.

8-25.

a. When originally issued, the price of the bonds was

$$P = \frac{70}{(1+0.065)} + \ldots + \frac{70+1000}{(1+.065)^{30}} = \$1065.29$$

b. If the bond is downgraded, its price will fall to

$$P = \frac{70}{(1+0.069)} + \ldots + \frac{70+1000}{(1+.069)^{30}} = \$1012.53$$

8-26.

a. The price will be

$$P = \frac{65}{(1+.063)} + \ldots + \frac{65+1000}{(1+.063)^{5}} = \$1008.36$$

b. Each bond will raise \$1008.36, so the firm must issue: $\frac{\$10,000,000}{\$1008.36} = 9917.13 \Rightarrow 9918 \text{ bonds}$.

This will correspond to a principle amount of $9918 \times \$1000 = \$9,918,000$.

c. For the bonds to sell at par, the coupon must equal the yield. Since the coupon is 6.5%, the yield must also be 6.5%, or A-rated.

d. First, compute the yield on these bonds:

$$959.54 = \frac{65}{(1+\text{YTM})} + \ldots + \frac{65+1000}{(1+\text{YTM})^5} \Rightarrow \text{YTM} = 7.5\%$$

Given a yield of 7.5%, it is likely these bonds are BB rated. Yes, BB-rated bonds are junk bonds.

8-27.

a. $$P = \frac{35}{(1+.0325)} + \ldots + \frac{35 + 1000}{(1+.0325)^{10}} = \$1{,}021.06 = 102.1\%$$

b. $$P = \frac{35}{(1+.041)} + \ldots + \frac{35 + 1000}{(1+.041)^{10}} = \$951.58 = 95.2\%$$

c. 0. 17

Appendix

A.1. From Eq 8A.2,

$$f_2 = \frac{(1+\text{YTM}_2)^2}{(1+\text{YTM}_1)} - 1 = \frac{1.055^2}{1.04} - 1 = 7.02\%$$

A.2. From Eq 8A.2,

$$f_3 = \frac{(1+\text{YTM}_3)^3}{(1+\text{YTM}_2)^2} - 1 = \frac{1.055^3}{1.055^2} - 1 = 5.50\%$$

When the yield curve is flat (spot rates are equal), the forward rate is equal to the spot rate.

A.3. From Eq 8A.2,

$$f_5 = \frac{(1+\text{YTM}_5)^5}{(1+\text{YTM}_4)^4} - 1 = \frac{1.045^5}{1.050^4} - 1 = 2.52\%$$

When the yield curve is flat (spot rates are equal), the forward rate is equal to the spot rate.

A.4. Call this rate f1,5. If we invest for one-year at YTM1, and then for the 4 years from year 1 to 5 at rate f1,5, after five years we would earn

$$(1 + \text{YTM}_1)(1 + f_{1,5})^4$$

with no risk. No arbitrage means this must equal that amount we would earn investing at the current five year spot rate:

$$(1 + \text{YTM}_1)(1 + f_{1,5})^4 = (1 + \text{YTM}_5)^5$$

Therefore, $$(1+f_{1,5})^4 = \frac{(1+\text{YTM}_5)^5}{1+\text{YTM}_1} = \frac{1.045^5}{1.04} = 1.19825$$

and so: $f_{1,5} = 1.19825^{1/4} - 1 = 4.625\%$

A.5. We can invest for 3 years with risk by investing for one year at 5%, and then locking in a rate of 4% for the second year and 3% for the third year. The return from this strategy must equal the return from investing in a 3 year zero coupon bond (see Eq 8A.3):

$(1 + YTM_3)^3 = (1.05)(1.04)(1.03) = 1.12476$

Therefore: $YTM_3 = 1.12476^{1/3} - 1 = 3.997\%$

Chapter 9
Valuing Stocks

9-1.

a. $P(0) = 2.80 / 1.10 + (3.00 + 52.00) / 1.10^2 = \$48.00$

b. $P(1) = (3.00 + 52.00) / 1.10 = \$50.00$

c. $P(0) = (2.80 + 50.00) / 1.10 = \$48.00$

9-2. Dividend Yield = 0.88 / 22.00 = 4%

Capital gain rate = (23.54 – 22.00) / 22.00 = 7%

Total expected return = r_E = 4% + 7% = 11%

9-3. With simplifying assumption (as was made in the chapter) that dividends are paid at the end of the year, then the stock pays a total of \$2.00 in dividends per year. Valuing this dividend as a perpetuity, we have, $P = \$2.00 / 0.15 = \$13.33$

Alternatively, if the dividends are paid quarterly, we can value them as a perpetuity using a quarterly discount rate of $(1.15)^{\frac{1}{4}} - 1 = 3.556\%$ (see Eq. 5.1) then, $P = \$0.5010.03556 = \$14.06$.

9-4. P = 1.50 / (11% – 6%) = \$30

9-5.

a. Eq 9.7 implies r_E = Div Yld + g , so 8% – 1.5% = g = 6.5%

b. With constant dividend growth, share price is also expected to grow at rate g = 6.5% (or we can solve this from Eq 9.2)

9-6.

a. Eq 9.12: g = retention rate × return on new invest = (2/5) × 15% = 6%

b. P = 3 / (12% – 6%) = \$50

c. g = (1/5) × 15% = 3%, P = 4 / (12% – 3%) = \$44.44. No, projects are positive NPV (return exceeds cost of capital), so don't raise dividend.

9-7. Estimate r_E: r_E = Div Yield + g = 4 / 50 + 3% = 11%

New Price: P = 2.50/(11% – 5%) = \$41.67

In this case, cutting the dividend to expand is not positive NPV.

9-8. Value if the first 5 dividend payments

$$PV_{1-5} = \frac{0.65}{(0.08-0.12)}\left(1-\left(\frac{1.12}{1.08}\right)^5\right) = \$3.24$$

Value on date 5 of the rest of the dividend payments

$$PV_5 = \frac{0.65(1.12)^4\, 1.02}{0.08-0.02} = 17.39$$

Discounting this value to the present gives

$$PV_0 = \frac{17.39}{(1.08)^5} = \$11.83$$

So the value of Gillette is: $P = PV_{1-5} + PV_0 = 3.24 + 11.83 = \$15.07$

9-9. PV of the first 5 dividends

$$PV_{\text{first }5} = \frac{0.96(1.11)}{0.085-0.11}\left(1-\left(\frac{1.11}{1.085}\right)^5\right) = 5.14217$$

PV of the remaining dividends in year 5

$$PV_{\text{remaining in year }5} = \frac{0.96(1.11)^5(1.052)}{0.085-0.052} = 51.5689$$

Discounting back to the present

$$PV_{\text{remaining}} = \frac{51.5689}{(1.085)^5} = 34.2957$$

Thus the price of Colgate is

$$P = PV_{\text{first }5} + PV_{\text{remaining}} = 39.4378$$

9-10.

$$P_0 = \overbrace{\frac{Div_1}{r-g_1}\left(1-\left(\frac{1+g_1}{1+r}\right)^n\right)}^{\text{n-year, constant growth annuity}} + \overbrace{\left(\frac{1+g_1}{1+r}\right)^n \frac{Div_1}{r-g_2}}^{\text{PV of terminal value}}$$

$$= \underbrace{\frac{Div_1}{r-g_1}}_{\text{constant growth perpetuity}} + \underbrace{\left(\frac{1+g_1}{1+r}\right)^n\left(\frac{Div_1}{r-g_2} - \frac{Div_1}{r-g_1}\right)}_{\text{present value of difference of perpetuities in year n}}$$

9-11. See the spreadsheet for Halliford's dividend forecast:

	Year	0	1	2	3	4	5	6
Earnings								
1	EPS Growth Rate (vs. prior yr)			25%	25%	12.5%	12.5%	5%
2	EPS		\$3.00	\$3.75	\$4.69	\$5.27	\$5.93	\$6.23
Dividends								
3	Retention Ratio		100%	100%	50%	50%	20%	20%
4	Dividend Payout Ratio		0%	0%	50%	50%	80%	80%
5	Div (2 × 4)		—	—	\$2.34	\$2.64	\$4.75	\$4.98

From year 5 on, dividends grow at constant rate of 5%. Therefore,

$P(4) = 4.75/(10\% - 5\%) = \$95$.

Then: $P(0) = 2.34 / 1.10^3 + (2.64 + 95) / 1.10^4 = \$68.45$

9-12. Total payout next year = 5 billion × 1.08 = \$5.4 billion

Equity Value = 5.4 / (12% – 8%) = \$135 billion

Share price = 135 / 6 = \$22.50

9-13.

a. Earnings growth = EPS growth = dividend growth = 4%. Thus, $P = 3 / (10\% - 4\%) = \$50$.

b. Using the total payout model, $P = 3/(10\% - 4\%) = \$50$

c. $g = r_E - \text{Div Yield} = 10\% - 1/50 = 8\%$

9-14.

a. $V(4) = 82 / (14\% - 4\%) = \$820$

$V(0) = 53 / 1.14 + 68/1.14^2 + 78 / 1.14^3 + (75 + 820) / 1.14^4 = \$681$

b. $P = (681 + 0 - 300)/40 = \$9.53$

9-15.

a. $V(3) = 33.3 / (10\% - 5\%) = 666$

$V(0) = 25.3 / 1.10 + 24.6 / 1.10^2 + (30.8 + 666) / 1.10^3 = 567$

$P(0) = (567 + 40 - 120) / 60 = \$8.11$

b. Free cash flows change as follows:

	Year	0	1	2	3	4	5
Earnings Forecast ($000s)			8%	10%	6%	5%	5%
1	Sales	433.00	468.00	516.00	546.96	574.31	603.02
2	Cost of Goods Sold		(327.60)	(361.20)	(382.87)	(402.02)	(422.12)
3	**Gross Profit**		140.40	154.80	164.09	172.29	180.91
4	Selling, General & Admin.		(93.60)	(103.20)	(109.39)	(114.86)	(120.60)
6	Depreciation		(7.00)	(7.50)	(9.00)	(9.45)	(9.92)
7	**EBIT**		39.80	44.10	45.70	47.98	50.38
8	Income tax at 40%		(15.92)	(17.64)	(18.28)	(19.19)	(20.15)
9	**Unlevered Net Income**		23.88	26.46	27.42	28.79	30.23
Free Cash Flow ($000s)							
10	Plus: Depreciation		7.00	7.50	9.00	9.45	9.92
11	Less: Capital Expenditures		(7.70)	(10.00)	(9.90)	(10.40)	(10.91)
12	Less: Increases in NWC		(6.30)	(8.64)	(5.57)	(4.92)	(5.17)
13	**Free Cash Flow**		**16.88**	**15.32**	**20.94**	**22.92**	**24.07**

Hence V(3) = 458, and V(0) = 388. Thus, P(0) = $5.13

c. New FCF:

	Year	0	1	2	3	4	5
Earnings Forecast ($000s)			8%	10%	6%	5%	5%
1	Sales	433.00	468.00	516.00	546.96	574.31	603.02
2	Cost of Goods Sold		(313.56)	(345.72)	(366.46)	(384.79)	(404.03)
3	**Gross Profit**		154.44	170.28	180.50	189.52	199.00
4	Selling, General & Admin.		(74.88)	(82.56)	(87.51)	(91.89)	(96.48)
6	Depreciation		(7.00)	(7.50)	(9.00)	(9.45)	(9.92)
7	**EBIT**		72.56	80.22	83.98	88.18	92.59
8	Income tax at 40%		(29.02)	(32.09)	(33.59)	(35.27)	(37.04)
9	**Unlevered Net Income**		43.54	48.13	50.39	52.91	55.55
Free Cash Flow ($000s)							
10	Plus: Depreciation		7.00	7.50	9.00	9.45	9.92
11	Less: Capital Expenditures		(7.70)	(10.00)	(9.90)	(10.40)	(10.91)
12	Less: Increases in NWC		(6.30)	(8.64)	(5.57)	(4.92)	(5.17)
13	**Free Cash Flow**		**36.54**	**36.99**	**43.92**	**47.04**	**49.39**

Now V(3) = 941, V(0) = 804, P(0) = $12.07

d. Inc. in NWC in yr1 = 12% Sales(1) – 18% Sales(0)

Inc in NWC in later years = 12% × change in sales

New FCF:

		Year	0	1	2	3	4	5
Earnings Forecast ($000s)				8%	10%	6%	5%	5%
1	Sales		433.00	468.00	516.00	546.96	574.31	603.02
2	Cost of Goods Sold			(313.56)	(345.72)	(366.46)	(384.79)	(404.03)
3	**Gross Profit**			154.44	170.28	180.50	189.52	199.00
4	Selling, General & Admin.			(93.60)	(103.20)	(109.39)	(114.86)	(120.60)
6	Depreciation			(7.00)	(7.50)	(9.00)	(9.45)	(9.92)
7	**EBIT**			53.84	59.58	62.10	65.21	68.47
8	Income tax at 40%			(21.54)	(23.83)	(24.84)	(26.08)	(27.39)
9	**Unlevered Net Income**			32.30	35.75	37.26	39.13	41.08
Free Cash Flow ($000s)								
10	Plus: Depreciation			7.00	7.50	9.00	9.45	9.92
11	Less: Capital Expenditures			(7.70)	(10.00)	(9.90)	(10.40)	(10.91)
12	Less: Increases in NWC			21.78	(5.76)	(3.72)	(3.28)	(3.45)
13	**Free Cash Flow**			**53.38**	**27.49**	**32.65**	**34.90**	**36.64**

Now V(3) = 698, V(0) = 620, P(0) = $9.00

9-16.

a. $25.38 – $27.41

b. $23.76 – $29.02

c. $28.09 – $23.60

d. By changing parameters you get prices from 20.57 to 32.19.

9-17.

a. Share price = Average P/E × KCP EPS = 15.01 × $1.65 = $24.77

b. Minimum = 8.66 × $1.65 = $14.29, Maximum = 22.62 × $1.65 = $37.32

c. 2.84 × $12.05 = $34.22

d. 1.12 × $12.05 = $13.50, 8.11 × $12.05 = $97.73

9-18.

a. Estimated enterprise value for KCP = Average EV/Sales × KCP Sales = 1.06 × $518 million = $549 million. Equity Value = EV – Debt + Cash = $549 – 3 + 100 = $646 million. Share price = Equity Value / Shares = $646/ 21 = $30.77

b. $16.21 – $58.64

c. Est. enterprise value for KCP = Average EV/EBITDA × KCP EBITDA = 8.49 × $55.6 million = $472 million. Share Price = ($472 – 3 + 100)/21 = $27.10

d. $22.25 – $33.08

9-19.

a. Using EV/EBITDA: EV = 55.6 × 9.73 = 541 million, P = (541 + 100 – 3) / 21 = $30.38

Using P/E: P = 1.65 × 18.4 = $30.36

Thus, KCP appears to be trading at a "discount" relative to Fossil.

b. Using EV/EBITDA: EV = 55.6 × 7.19 = 400 million, P = (400 + 100 – 3) / 21 = $23.67

Using P/E: P = 1.65 × 17.2 = $28.38

Thus, KCP appears to be trading at a "premium" relative to Tommy Hilfiger using EV/EBITDA, but at a slight discount using P/E.

9-20. All the multiples show a great deal of variation, suggesting that profitability and growth varies widely across firms. This makes the use of multiples problematic. In particular, for several firms, earnings and EBIT are negative, and for Nissan, book value is negative, making these ratios meaningless.

In this case, EV/Sales is probably the most useful multiple. The one big outlier is GM, but this is probably because its EV is over-estimated, since the debt component is based on book value of debt, and the market value of GM's debt has dropped substantially recently (GM's debt was downgraded to junk in 2005).

9-21.

a. P = 1.24 / (8% – 7%) = $124

b. Based on the market price, our growth forecast is probably too high. Growth rate consistent with market price is g = r_E – div yield = 8% – 1.24 / 43= 5.12%, which is more reasonable.

9-22.

a. PV(change in FCF) = –180 / 1.13 – 60 / 1.13^2 = -206
Change in V = –206, so if debt value does not change, P drops by 206 / 35 =$5.89 per share.

b. If this is public information, in an efficient market share price will drop immediately to reflect the news, and no trading profit is possible.

9-23.

a. Market seems to assess a somewhat greater than 50% chance of success

b. Yes, if they have better information than other investors

c. Market may be illiquid – no one wants to trade if they know Kliner has better info. Kliner's trades will move prices significantly, limiting profits.

Chapter 10
Capital Markets and the Pricing of Risk

10-1.

a. $E[R] = -0.25(0.1) - 0.1(0.2) + 0.1(0.25) + 0.25(0.3) = 5.5\%$

b. $$\begin{aligned}\text{Variance}[R] &= (-0.25-0.055)^2 \times 0.1 + (-0.1-0.055)^2 \times 0.2 \\ &+ (0.1-0.055)^2 \times 0.25 + (0.25-0.055)^2 \times 0.3 \\ &= 2.6\%\end{aligned}$$

Standard Deviation $= \sqrt{0.026} = 16.13\%$

10-2.

a. $E[R] = -1(0.4) - 0.75(0.2) - 0.5(0.2) - 0.25(0.1) + 10(0.1) = 32.5\%$

b. $$\begin{aligned}\text{Variance}[R] &= (-1-0.325)^2\ 0.4 + (-0.75-0.325)^2\ 0.2 + (-0.5-0.325)^2\ 0.2 \\ &+ (-0.25-0.325)^2\ 0.1 + (10-0.325)^2\ 0.1 \\ &= 10.46\end{aligned}$$

Standard Deviation $= \sqrt{10.46} = 3.235 = 323.5\%$

10-3. Startup has a higher expected return, but is riskier. It is impossible to say which stock I would prefer. It depends on risk performances and what other stocks I'm holding.

10-4. Return from 1/2/03 $\rightarrow$ 2/5/03

$$R_1 = \frac{30.67 + 0.17}{33.88} - 1 = -0.08973$$

Return from 2/5 $\rightarrow$ 5/14

$$R_2 = \frac{29.49 + 0.17}{30.67} - 1 = -0.03293$$

Return from 514 $\rightarrow$ 8/13

$$R_3 = \frac{32.38 + 0.17}{29.49} - 1 = 0.10376$$

Return from 8/13 $\rightarrow$ 11/12

$$R_4 = \frac{39.07 + 0.17}{32.38} - 1 = 0.21186$$

Return from 11/12 $\rightarrow$ ½

$$R_5 = \frac{41.99}{39.07} - 1 = 0.07474$$

Return for the year is:

$$(1+R_1)(1+R_2)(1+R_3)(1+R_4)(1+R_5) - 1 = 26.55\%$$

10-5.

Ford Motor Co (F)

Month	Stock Price	Dividend	Return	1+R
Aug-97	43.000		0.05199	1.05199
Jul-97	40.875	0.420	0.08671	1.08671
Jun-97	38.000		0.01333	1.01333
May-97	37.500		0.07914	1.07914
Apr-97	34.750	0.420	0.12096	1.12096
Mar-97	31.375		-0.04563	0.95437
Feb-97	32.875		0.02335	1.02335
Jan-97	32.125	0.385	0.00806	1.00806
Dec-96	32.250		-0.01527	0.98473
Nov-96	32.750		0.04800	1.04800
Oct-96	31.250	0.385	0.01232	1.01232
Sep-96	31.250		-0.06716	0.93284
Aug-96	33.500		0.03475	1.03475
Jul-96	32.375	0.385	0.01189	1.01189
Jun-96	32.375		-0.11301	0.88699
May-96	36.500		0.01742	1.01742
Apr-96	35.875	0.350	0.05382	1.05382
Mar-96	34.375		0.10000	1.10000
Feb-96	31.250		0.05932	1.05932
Jan-96	29.500	0.350	0.03377	1.03377
Dec-95	28.875		0.02212	1.02212
Nov-95	28.250		-0.01739	0.98261
Oct-95	28.750	0.350	-0.06506	0.93494
Sep-95	31.125		0.01220	1.01220
Aug-95	30.750		0.06034	1.06034
Jul-95	29.000	0.310	-0.01479	0.98521
Jun-95	29.750		0.01709	1.01709
May-95	29.250		0.07834	1.07834
Apr-95	27.125	0.310	0.02084	1.02084
Mar-95	26.875		0.02871	1.02871
Feb-95	26.125		0.03465	1.03465
Jan-95	25.250	0.260	-0.08484	0.91516
Dec-94	27.875		0.02765	1.02765
Nov-94	27.125		-0.08051	0.91949
Oct-94	29.500	0.260	0.07243	1.07243
Sep-94	27.750		-0.05128	0.94872
Aug-94	29.250			

Total Return (product of 1+R's)	1.67893
Equivalent Monthly return = (Total Return)^(1/36)-1 =	1.45%

10-6.

Ford Motor Co (F)

Month	Stock Price	Dividend	Return
Aug-97	43.000		0.05199
Jul-97	40.875	0.420	0.08671
Jun-97	38.000		0.01333
May-97	37.500		0.07914
Apr-97	34.750	0.420	0.12096
Mar-97	31.375		-0.04563
Feb-97	32.875		0.02335
Jan-97	32.125	0.385	0.00806
Dec-96	32.250		-0.01527
Nov-96	32.750		0.04800
Oct-96	31.250	0.385	0.01232
Sep-96	31.250		-0.06716
Aug-96	33.500		0.03475
Jul-96	32.375	0.385	0.01189
Jun-96	32.375		-0.11301
May-96	36.500		0.01742
Apr-96	35.875	0.350	0.05382
Mar-96	34.375		0.10000
Feb-96	31.250		0.05932
Jan-96	29.500	0.350	0.03377
Dec-95	28.875		0.02212
Nov-95	28.250		-0.01739
Oct-95	28.750	0.350	-0.06506
Sep-95	31.125		0.01220
Aug-95	30.750		0.06034
Jul-95	29.000	0.310	-0.01479
Jun-95	29.750		0.01709
May-95	29.250		0.07834
Apr-95	27.125	0.310	0.02084
Mar-95	26.875		0.02871
Feb-95	26.125		0.03465
Jan-95	25.250	0.260	-0.08484
Dec-94	27.875		0.02765
Nov-94	27.125		-0.08051
Oct-94	29.500	0.260	0.07243
Sep-94	27.750		-0.05128
Aug-94	29.250		

Average Monthly Return	1.60%
Std Dev of Monthly Return	5.46%

a. Average Return over this period: 1.60%

b. Standard Deviation over the Period: 5.46%

10-7. Both numbers are useful. The realized return (in problem 10.5) tells you what you actually made if you hold the stock over this period. The average return (problem 10.6) over the period can be used as an estimate of the monthly expected return. If you use this estimate, then this is what you expect to make on the stock in the next month.

10-8.

Ford Motor Co (F)

Month	Stock Price	Dividend	Return
Aug-97	43.000		0.05199
Jul-97	40.875	0.420	0.08671
Jun-97	38.000		0.01333
May-97	37.500		0.07914
Apr-97	34.750	0.420	0.12096
Mar-97	31.375		-0.04563
Feb-97	32.875		0.02335
Jan-97	32.125	0.385	0.00806
Dec-96	32.250		-0.01527
Nov-96	32.750		0.04800
Oct-96	31.250	0.385	0.01232
Sep-96	31.250		-0.06716
Aug-96	33.500		0.03475
Jul-96	32.375	0.385	0.01189
Jun-96	32.375		-0.11301
May-96	36.500		0.01742
Apr-96	35.875	0.350	0.05382
Mar-96	34.375		0.10000
Feb-96	31.250		0.05932
Jan-96	29.500	0.350	0.03377
Dec-95	28.875		0.02212
Nov-95	28.250		-0.01739
Oct-95	28.750	0.350	-0.06506
Sep-95	31.125		0.01220
Aug-95	30.750		0.06034
Jul-95	29.000	0.310	-0.01479
Jun-95	29.750		0.01709
May-95	29.250		0.07834
Apr-95	27.125	0.310	0.02084
Mar-95	26.875		0.02871
Feb-95	26.125		0.03465
Jan-95	25.250	0.260	-0.08484
Dec-94	27.875		0.02765
Nov-94	27.125		-0.08051
Oct-94	29.500	0.260	0.07243
Sep-94	27.750		-0.05128
Aug-94	29.250		

Average Monthly Return	1.60%	
Std Dev of Monthly Return	5.46%	
Std Error of Estimate = (Std Dev)/sqrt(36) =	0.91%	
95% Confidence Interval of average monthly return	-0.22%	3.41%

10-9. For large portfolios there is a relationship between returns and volatility—portfolios with higher returns have higher volatilities. For stocks, no clear relation exists.

10-10. The expected payoffs are the same, but bank A is less risky.

10-11.

a. Expected payoff is the same for both banks

Bank B = \$100 million × 0.95 = \$95 imllion

Bank A = (\$1 million × 0.95) × 100 = \$95 million

b. Bank B

$\text{Variance} = (100-95)^2\ 0.95 + (0-95)^2\ 0.05 = 475$

$\text{Standard Deviation} = \sqrt{475} = 21.79$

Bank A

$\text{Variance of each loan} = (1-0.95)^2\ 0.95(0-0.95)^2\ 0.05 = 0.0475$

$\text{Standard Deviation of each loan} = \sqrt{0.0475} = 0.2179$

Now the bank has 100 loans that are all independent of each other so the standard deviation of the average loan is

$$\frac{0.2179}{\sqrt{100}} = 0.02179$$

But the bank has 100 such loans so the standard deviation of the portfolio is
$100 \times 0.02179 = 2.179$

Which is much lower than Bank B

10-12. A risk-averse investor would choose the economy in which stock returns are independent because this risk can be diversified away in a large portfolio.

10-13.

a. $E[R] = 0.15(0.6) - 0.1(0.4) = 0.05$

$\text{Standard Deviation} = \sqrt{(0.15-0.05)^2\ 0.6 + (-0.1-0.05)^2\ 0.4} = 0.12247$

Because all S firms in the portfolio move together there is no diversification benefit. So the standard deviation of the portfolio is the same as the standard deviation of the stocks—12.25%

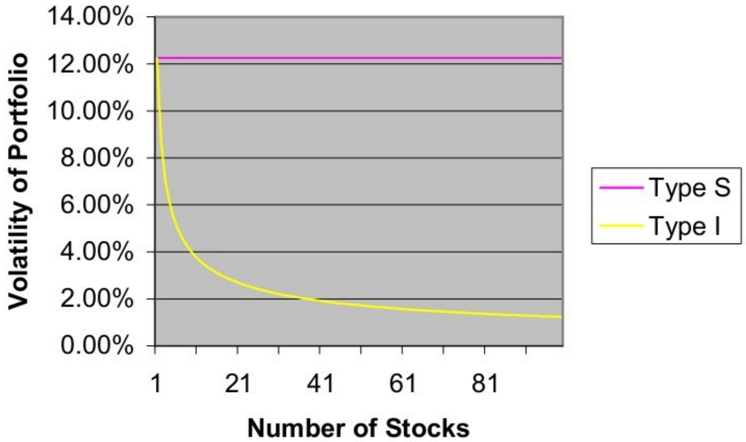
b. $E[R] = 0.15(0.6) - 0.1(0.4) = 0.05$

$\text{Standard Deviation} = \sqrt{(0.15-0.05)^2\ 0.6 + (-0.1-0.05)^2\ 0.4} = 0.12247$

Type I stocks move independently. Hence the standard deviation of the portfolio is

$$\text{SD}(\text{Portfolio of 20 Type I stocks}) = \frac{0.12247}{\sqrt{20}} = 2.74\%$$

10-14.



Expected return of a stock	0.05
Standard Deviation of a stock	0.122474

Number of Stocks	Type S	Type I
1	12.25%	12.25%
2	12.25%	8.66%
3	12.25%	7.07%
4	12.25%	6.12%
5	12.25%	5.48%
6	12.25%	5.00%
7	12.25%	4.63%
8	12.25%	4.33%
9	12.25%	4.08%
10	12.25%	3.87%
11	12.25%	3.69%
12	12.25%	3.54%
13	12.25%	3.40%
14	12.25%	3.27%
15	12.25%	3.16%
16	12.25%	3.06%
17	12.25%	2.97%
18	12.25%	2.89%
19	12.25%	2.81%
20	12.25%	2.74%
21	12.25%	2.67%
22	12.25%	2.61%
23	12.25%	2.55%
24	12.25%	2.50%
25	12.25%	2.45%
26	12.25%	2.40%
27	12.25%	2.36%
28	12.25%	2.31%

(Continues)

(Continued)

Number of Stocks	Type S	Type I
29	12.25%	2.27%
30	12.25%	2.24%
31	12.25%	2.20%
32	12.25%	2.17%
33	12.25%	2.13%
34	12.25%	2.10%
35	12.25%	2.07%
36	12.25%	2.04%
37	12.25%	2.01%
38	12.25%	1.99%
39	12.25%	1.96%
40	12.25%	1.94%
41	12.25%	1.91%
42	12.25%	1.89%
43	12.25%	1.87%
44	12.25%	1.85%
45	12.25%	1.83%
46	12.25%	1.81%
47	12.25%	1.79%
48	12.25%	1.77%
49	12.25%	1.75%
50	12.25%	1.73%
51	12.25%	1.71%
52	12.25%	1.70%
53	12.25%	1.68%
54	12.25%	1.67%
55	12.25%	1.65%
56	12.25%	1.64%
57	12.25%	1.62%
58	12.25%	1.61%
59	12.25%	1.59%
60	12.25%	1.58%
61	12.25%	1.57%
62	12.25%	1.56%
63	12.25%	1.54%
64	12.25%	1.53%
65	12.25%	1.52%
66	12.25%	1.51%
67	12.25%	1.50%
68	12.25%	1.49%
69	12.25%	1.47%
70	12.25%	1.46%
71	12.25%	1.45%
72	12.25%	1.44%
73	12.25%	1.43%
74	12.25%	1.42%
75	12.25%	1.41%

(Continues)

(Continued)

Number of Stocks	Type S	Type I
76	12.25%	1.40%
77	12.25%	1.40%
78	12.25%	1.39%
79	12.25%	1.38%
80	12.25%	1.37%
81	12.25%	1.36%
82	12.25%	1.35%
83	12.25%	1.34%
84	12.25%	1.34%
85	12.25%	1.33%
86	12.25%	1.32%
87	12.25%	1.31%
88	12.25%	1.31%
89	12.25%	1.30%
90	12.25%	1.29%
91	12.25%	1.28%
92	12.25%	1.28%
93	12.25%	1.27%
94	12.25%	1.26%
95	12.25%	1.26%
96	12.25%	1.25%
97	12.25%	1.24%
98	12.25%	1.24%
99	12.25%	1.23%

10-15. Investors can costlessly remove diversifiable risk from their portfolio by diversifying. They therefore do not demand a risk premium for it.

10-16.

a. Diversifiable Risk

b. Systematic Risk

c. Diversifiable Risk

d. Diversifiable Risk

10-17. An efficient portfolio is any portfolio that only contains systemic risk—it contains no diversifiable risk.

10-18. Beta measures the amount of systemic risk in a stock

10-19.

a. $\text{Beta} = \dfrac{\text{D Stock}}{\text{D Market}} = \dfrac{43-(-17)}{30-(-10)} = \dfrac{60}{40} = 1.5$

b. $\text{Beta} = \dfrac{\text{D Stock}}{\text{D Market}} = \dfrac{-18-22}{30-(-10)} = \dfrac{-40}{40} = -1$

c. A firm that moves independently has no systemic risk so Beta = 0

10-20.

A. $E[R_M]$ = ½ (30%) + ½ (-10%) = 10%

i.. E[R] = 4% + 1.5 (10% - 4%) = 13%
ii. Actual Expected return =
(43% - 17%) / 2 = 13%

B i. . E[R] = 4% - 1(10% - 4%) = -2%
ii. Actual l expected Return =
(-22% + 18%) / 2 = -2%

10-21.

a. $E\left[R_{Heinz}\right] = r_f + b_{cs}\left(E\left[R_m\right] - r_f\right) = 4 + 0.37(6) = 6.22\%$

b. $E\left[R_c\right] = 4 + 2.28(6) = 17.68\%$

c. $E\left[R_{GE}\right] = 4 + 0.85(6) = 9.1\%$

10-22. $\text{Cost of Capital} = r_f + b\left(E\left[R_m\right] - r_f\right) = 5 + 1.2(6.5) = 12.8\%$

10-23.

a. This statement is inconsistent with both.

b. This statement is consistent with both.

c. This statement is inconsistent with the CAPM but not necessarily with efficient capital markets.

Chapter 11
Optimal Portfolio Choice

11-1.

a. Let n_i be the number of share in stock I, then

$$n_G = \frac{200,000 \times 0.5}{25} = 4,000$$

$$n_M = \frac{200,000 \times 0.25}{80} = 625$$

$$n_V = \frac{200,000 \times 0.25}{2} = 25,000$$

The new value of the portfolio is

$$\begin{aligned} p &= 30n_G + 60n_M + 3n_v \\ &= \$232,500 \end{aligned}$$

b. $\text{Return} = \frac{232,500}{200,000} - 1 = 16.25\%$

c. The portfolio weight are the fraction of value invested in each stock

$$\text{GoldFinger: } \frac{n_G \times 30}{232,500} = 51.61\%$$

$$\text{Moosehead: } \frac{n_M \times 60}{232,500} = 16.13\%$$

$$\text{Venture: } \frac{n_V \times 3}{232,500} = 32.26\%$$

11-2. Both calculations of expected return of a portfolio give the same answer.

11-3. If the price of one stock goes up, the other stock price always goes up as well.

11-4.

a.

$$\overline{R}_A = \frac{-10 + 20 + 5 - 5 + 2 + 9}{6} = 3.5\%$$

$$\overline{R}_B = \frac{21 + 30 + 7 - 3 - 8 + 25}{6}$$

$$= 12\%$$

$$\text{Variance of A} = \frac{1}{5}\begin{bmatrix} (-0.1 - 0.035)^2 + \\ (0.2 - 0.08)^2 + (0.05 - 0.035)^2 + \\ (-0.05 - 0.035)^2 + (0.02 - 0.035)^2 \\ +(0.09 - 0.035)^2 \end{bmatrix}$$

$$= 0.01123$$

$$\text{Volatility of A} = \text{SD}(R_A) = \sqrt{\text{Variance of A}} = \sqrt{.01123} = 10.60\%$$

$$\text{Variance of B} = \frac{1}{5}\begin{bmatrix} (0.21 - 0.12)^2 + (0.3 - 0.12)^2 + \\ (0.07 - 0.12)^2 + (-0.03 - 0.12)^2 + \\ (-0.08 - 0.12)^2 + (0.25 - 0.12)^2 \end{bmatrix}$$

$$= 0.02448$$

$$\text{Volatility of B} = \text{SD}(R_B) = \sqrt{\text{Variance of B}} = \sqrt{.02448} = 15.65\%$$

b.

$$\text{Covariance} = \frac{1}{5}\begin{bmatrix} (-0.1 - 0.035)(0.21 - 0.4) + \\ (0.2 - 0.035)(0.3 - 0.12) + \\ (0.05 - 0.035)(0.07 - 0.12) + \\ (-0.05 - 0.035)(-0.03 - 0.12) + \\ (0.02 - 0.035)(-0.08 - 0.12) + \\ (0.09 - 0.035)(0.25 - 0.12) \end{bmatrix}$$

$$= 0.00794$$

c. $$\text{Correlation} = \frac{\text{Covariance}}{\text{SD}(R_A)\text{SD}(R_B)}$$

$$= 0.479$$

11-5.

a. The mean for KO is 2.02%; the mean for XOM is 0.79%.
The standard deviation (i.e., volatility) for KO is 8.24%; the standard deviation for XOM is 4.25%.

b. The covariance is 0.00213.

c. The correlation is 60.83%.

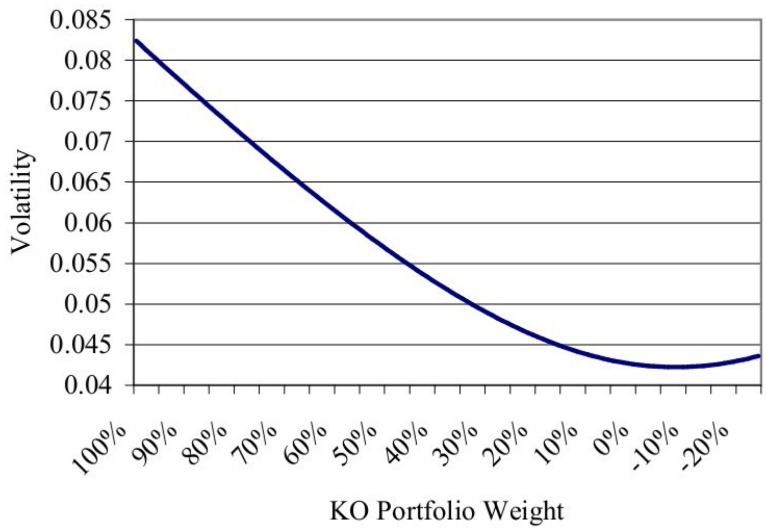
11-6. covariance $= \text{con} \times SD(R_D) \times SD(R_{AA}) = 0.69 \times 0.5 \times 0.72 = 0.2484$

11-7. Variance $= (0.7)^2\, 0.01123 + (0.3)^2\, 0.02448 + 2(0.7)(0.3)0.00794 = 0.011$

Standard Deviation $= \sqrt{0.011} = 10.5\%$

11-8. All three methods result have the same result: The standard deviation (i.e., volatility) is 5.90%.

11-9.



(see spreadsheet application)

11-10. First calculate the standard deviation of each stock and multiply this by the stock's portfolio weight and by the stock's correlation with the whole portfolio. The sum of these products is the portfolio's volatility.

11-11. Volatility of a very large portfolio is

$$\sqrt{\text{average covariance}}$$
$$= \sqrt{(0.4)(0.5)(0.5)}$$
$$= 31.62\%$$

11-12.

a. If the two stocks are perfectly negatively correlated, they fluctuate due to the same risks, but in opposite directions. Because Intel is twice as volatile as Coke, we will need to hold twice as much Coke stock as Intel in order to offset Intel's risk. That is, our portfolio should be 2/3 Coke and 1/3 Intel.

We can check this using Eq. 11.9:

$$\begin{aligned}\mathrm{Var}(R_P) &= (2/3)^2 SD(R_{Coke})^2 + (1/3)^2 SD(R_{Intel})^2 + 2(2/3)(1/3)\mathrm{Corr}(R_{Coke}, R_{Intel})SD(R_{Coke})SD(R_{Intel}) \\ &= (2/3)^2(0.25^2) + (1/3)^2(0.50^2) + 2(2/3)(1/3)(-1)(.25)(.50) \\ &= 0\end{aligned}$$

b. From Eq. 11.3, the expect return of the portfolio is

$$\begin{aligned}E[R_P] &= (2/3)E[R_{Coke}] + (1/3)E[R_{Intel}] \\ &= (2/3)6\% + (1/3)26\% \\ &= 12.67\%\end{aligned}$$

Because this portfolio has no risk, the risk-free interest rate must also be 12.67%.

11-13. In this case, the portfolio weights are $x_j = x_w = 0.50$. From Eq. 11.3,

$$\begin{aligned}E[R_P] &= x_j E[R_j] + x_w E[R_w] \\ &= 0.50(7\%) + 0.50(10\%) \\ &= 8.5\%\end{aligned}$$

We can use Eq. 11.9

$$\begin{aligned}SD(R_P) &= \sqrt{x_j^2 SD(R_j)^2 + x_w^2 SD(R_w)^2 + 2x_j x_w \mathrm{Corr}(R_j, R_w)SD(R_j)SD(R_w)} \\ &= \sqrt{.50^2(.16^2) + .50^2(.20)^2 + 2(.50)(.50)(.22)(.16)(.20)} \\ &= 14.1\%\end{aligned}$$

11-14. In this case, the total investment is \$10,000 – 2,000 = \$8,000, so the portfolio weights are $x_j = 10,000 / 8,000 = 1.25$, $x_w = -2,000 / 8,000 = -0.25$. From Eq. 11.3,

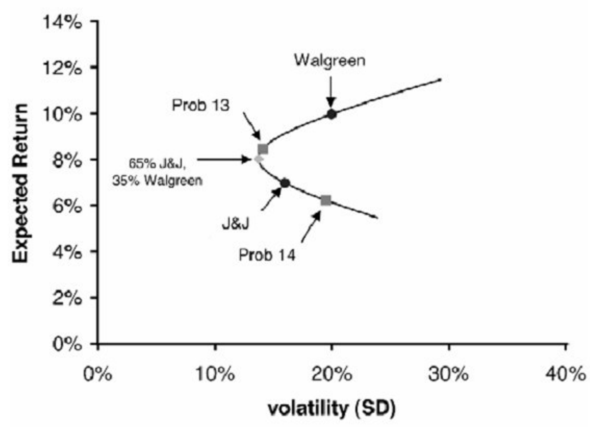
$$\begin{aligned}E[R_P] &= x_j E[R_j] + x_w E[R_w] \\ &= 1.25(7\%) - 0.25(10\%) \\ &= 6.25\%\end{aligned}$$

We can use Eq. 11.9

$$\begin{aligned}SD(R_P) &= \sqrt{x_j^2 SD(R_j)^2 + x_w^2 SD(R_w)^2 + 2x_j x_w \mathrm{Corr}(R_j, R_w)SD(R_j)SD(R_w)} \\ &= \sqrt{1.25^2(.16^2) + (-0.25)^2(.20)^2 + 2(1.25)(-0.25)(.22)(.16)(.20)} \\ &= 19.5\%\end{aligned}$$

11-15. The set of efficient portfolio's is approximately those portfolios with no more than 65% invested in J&J (this is the portfolio with the lowest possible volatility, as shown in the chart).

x(J&J)	x(Walgreen)	SD	ER
-50%	150%	29.30%	11.50%
-40%	140%	27.32%	11.20%
-30%	130%	25.38%	10.90%
-20%	120%	23.50%	10.60%
-10%	110%	21.70%	10.30%
0%	100%	20.00%	10.00%
10%	90%	18.42%	9.70%
20%	80%	16.99%	9.40%
30%	70%	15.77%	9.10%
40%	60%	14.79%	8.80%
50%	50%	14.11%	8.50%
60%	40%	13.78%	8.20%
65%	**35%**	**13.75%**	**8.05%**
70%	30%	13.82%	7.90%
80%	20%	14.23%	7.60%
90%	10%	14.97%	7.30%
100%	0%	16.00%	7.00%
110%	-10%	17.27%	6.70%
120%	-20%	18.73%	6.40%
130%	-30%	20.34%	6.10%
140%	-40%	22.07%	5.80%
150%	-50%	23.88%	5.50%



11-16.

a. $x = \dfrac{115{,}000}{100{,}000} = 1.15$

$E[R] = r_f + x\left(E[R_j] - r\right) = 4\% + 1.15(11\%) = 16.65\%$

$\text{Volatility} = x\ SD[R_j] = 1.15\ 25\% = 28.75\%$

b. $R = \dfrac{115{,}000(1.25) - 15{,}000(1.04)}{100{,}000} - 1 = 28.15\%$

c. $R = \dfrac{115{,}000(0.80) - 15{,}000(1.04)}{100{,}000} - 1 = -23.6\%$

11-17. Investors who want to maximize their expected return for a given level of volatility will pick portfolios which maximize their Sharpe ratio. The set of portfolios that do this is a combination of a risk free asset a single portfolio of risk assets --- the tangential portfolio.

11-18. $$\text{Required Return} = 4\% + 0.2 \times \frac{80\%}{25\%}(8\%) = 9.12\%$$

You should add some of the venture fund to your portfolio because it has an expected return that exceeds the required return.

11-19. Your current portfolio is not efficient.

11-20. $$\beta_K^{sp} = 0.15 \times \frac{30\%}{15\%} = 0.3$$

$$\text{Required Return} = 4\% + 0.3(6\%) = 5.8\%$$

Chapter 12
The Capital Asset Pricing Model

12-1. All investors will want to maximize their Sharpe ratios by picking efficient portfolios. When a riskless asset exists this means that all investors will pick the same efficient portfolio, and because the sum of all investors' portfolios is the market portfolio this efficient portfolio must be the market portfolio.

12-2.

a. Under the CAPM assumptions the market is efficient, that is, a leveraged position in the market has the highest expected return of any portfolio for a given volatility and the lowest volatility for a given expected return. By holding a leveraged position in the market portfolio you can achieve an expected return of

$$E\left[R_p\right] = r_f + x\left(E\left[R_m\right] - r_f\right) = 5\% + x \times 5\%$$

Setting this equal to 12% gives $12 = 5 + 5x \Rightarrow x = 1.4$

So the portfolio with the lowest volatility that has the same return as Microsoft has $\$15,000 \times 1.4 = \$21,000$ in the market portfolio and borrows $\$21,000 - \$15,000 = \$6,000$, that is -$6,000 in the in force asset.

b. A leveraged portion in the market has volatility η

$$SD\left(R_p\right) = xSD\left(R_m\right) = x \times 18\%$$

Setting this equal to the volatility of Microsoft gives

$$40\% = x \times 18\%$$

$$x = \frac{40}{18} = 2.222$$

So the portfolio with the highest expected return that has the same volatility as Microsoft has $\$15,000 \times 2.2 = \$33,000$ in the market portfolio and borrows $33,000 - 15,000 = \$18,333.33$, that is – $18,333.33 in the in force asset.

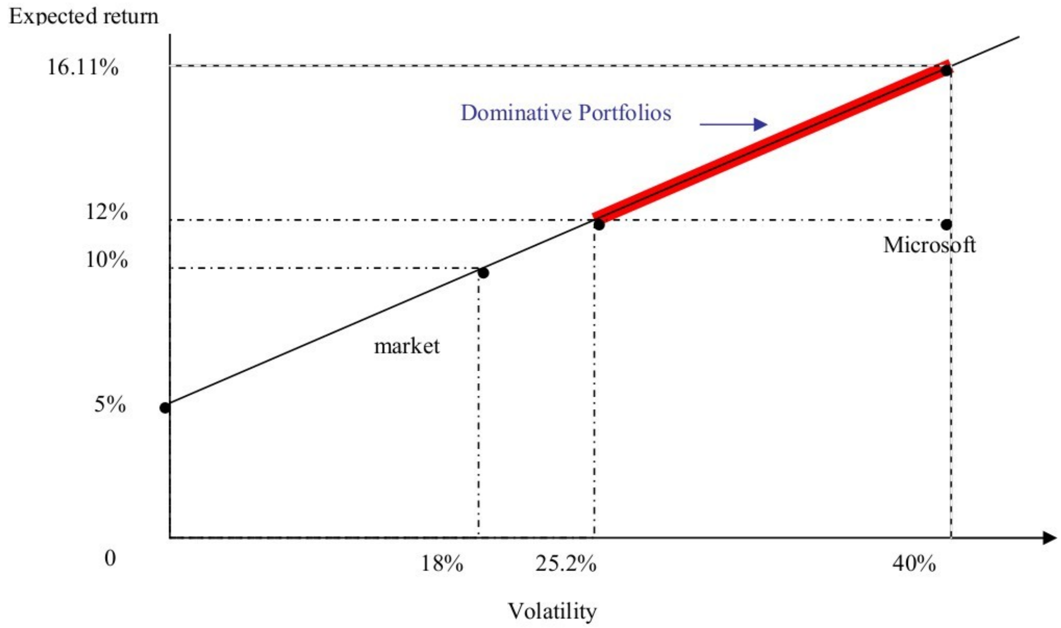
12-3. $SD\left(R_p\right) = xSD\left[R_m\right] = 1.4 \times 18 = 25.2\%$

Note that this is considerably lower than Microsoft's volatility.

12-4. $E\left[R_p\right] = r_f + x\left(E\left[R_m\right] - r_f\right) = 5\% + 2.222 \times 5\% = 16.11\%$

Note that this is considerably higher than Microsoft's expected return.

12-5.



12-6.

a. $\beta_{JJ} = 0.06 \times \dfrac{0.2}{0.16} = 0.075$

b. $E[R_{JJ}] = 0.04 + 0.075(0.1 - 0.04) = 4.45\%$

12-7. The sign of the risk premium of a negative beta stock is negative; assuming the market risk premium is positive, the risk premium has the same sign as beta.

12-8. $\beta = (0.6)(2.16) + (0.4)(0.69) = 1.572$

$E[R] = 4 + (1.572)(10 - 4) \ = 13.432\%$

12-9. The risk premium of a zero beta stock is zero. If you substitute a zero beta stock with a risk free asset the expected return of the portfolio will remain the same but the volatility will go up.

12-10. Total value of the market $= 10 \times 10 + 20 \times 12 + 8 \times 3 + 50 \times 1 + 45 \times 20 = \$1.314$ billion

Stock	Portfolio Weight
A	$\frac{10 \times 10}{1314} = 7.61\%$
B	$\frac{20 \times 12}{1314} = 18.26\%$
C	$\frac{8 \times 3}{1314} = 1.83\%$
D	$\frac{50}{1314} = 3.81\%$
E	$\frac{45 \times 20}{1314} = 68.49\%$

12-11. Total value of all 4 stock $= 13 \times 1000 + 22 \times 1.25 + 43 \times 30 + 5 \times 10 = \$14,367.5$ billion

Stock	Portfolio Weight
Golden Seas	$\frac{13 \times 1000}{14367.5} = 90.48\%$
Jacobs and Jacobs	$\frac{22 \times 1.25}{14367.5} = 0.19\%$
MAG	$\frac{43 \times 30}{14367.5} = 8.98\%$
PDJB	$\frac{5 \times 10}{14367.5} = 0.35\%$

12-12. The portfolio weight of the stock that went up remains no change.

12-13. The beta of Nike is 0.47605.

12-14.

a. The alpha of Nike is 1.56. (See spreadsheet application.)

b. The confidence interval is –1.15 to 4.28. The p-value is 0.25, so it is not significant.

12-15. No investors will hold a levered position in the market portfolio.

12-16. The market portfolio will be efficient.

12-17. Either investors believe they are earning a positive alpha but are not or investors care about things other than expected return and volatility.

12-18. Method 1: Use the past average returns.
Method 2: Use the implied discount rate from a constant growth model calibrated to current prices.

12-19. There are at least three reasons why an empirical test of the CAPM might indicate that the model does not work: (1) the proxy portfolio for the market portfolio is not correct; (2) beta is measured with error; (3) expected returns are measured with error.

Chapter 13
Alternative Models of Systematic Risk

13-1. The size effect is the empirical observation that firms with lower market capitalizations on average have higher average returns.

13-2. If returns are predictable it is possible to construct a positive alpha trading strategy.

13-3. Either the CAPM does not capture a risk factor investors care about, or investors are ignoring the opportunity to earn higher expected returns without taking on any extra risk.

13-4. You buy stocks that have done well in the past and sell stocks that have done poorly.

13-5. If the market portfolio is efficient, then all stocks have zero alphas, and you could not construct any strategy that has a positive alpha.

13-6. Firms with higher expected returns will have lower market values, and firms with high dividend yields will have high expected returns.

13-7.

a.

Firm	Dividend	Cost of Capital	Market value
S1	10	8%	$125.00
S2	10	12%	$83.33
S3	10	14%	$71.43
B1	100	8%	$1,250.00
B2	100	12%	$833.33
B3	100	14%	$714.29

b.

Firm	Market Value	Cost of Capital	Self financing weights
S1	$125.00	8%	1
S2	$83.33	12%	
S3	$71.43	14%	(1.00)
B1	$1,250.00	8%	1
B2	$833.33	12%	
B3	$714.29	14%	(1.00)
		E[R] (S firms)	–6.00%
		E[R] (B firms)	–6.00%

c.

Firm	Market Value	Cost of Capital	Self financing weights
B1	$1,250.00	8%	1
B2	$833.33	12%	
B3	$714.29	14%	
S1	$125.00	8%	
S2	$83.33	12%	
S3	$71.43	14%	(1.00)
		E[R] (All firms)	-6.00%

Firms will lower costs of capital tend to be higher in this sort, but the ranking is not perfect.

d.

Firm	Market Value	Dividend yield/Cost of Capital	Self financing weights
S1	$125.00	8%	(1.00)
B1	$1,250.00	8%	
S2	$83.33	12%	
B2	$833.33	12%	
S3	$71.43	14%	
B3	$714.29	14%	1.00
		E[R] (All firms)	6.00%

Because the dividend yield equals the cost of capital, the sort ranks firms perfectly (in contrast to parts b and c) — firms with higher dividend yields have higher costs of capital.

13-8. Because the proxy portfolio is not highly correlated with the market portfolio, it will not capture some components of systematic risk. The alphas reflect the risk components that the proxy portfolio is not capturing.

13-9. Employees are already partially invested in their company due to their human capital. Their optimal diversification strategy should take this into account, and thus should underweight their own company stock.

13-10. We start with this regression:

$$R_s - r_f = \alpha_s + \beta_s^{F1}\left(R_{F1} - r_f\right) + \beta_s^{F2}\left(R_{F2} - r_f\right) + \beta_s^{F3}\left(R_{F3} - r_f\right) + \varepsilon_s$$

We define portfolio P as:

$$R_P = R_s - \beta_s^{F1}R_{F1} - \beta_s^{F2}R_{F2} - \beta_s^{F3}R_{F3} + \left(\beta_s^{F1} + \beta_s^{F2} + \beta_s^{F3}\right)r_f$$
$$= R_s - \beta_s^{F1}\left(R_{F1} - r_f\right) - \beta_s^{F2}\left(R_{F2} - r_f\right) - \beta_s^{F3}\left(R_{F3} - r_f\right)$$

Substituting the first formula into the second gives:

$$R_P = r_f + \alpha_s + \varepsilon_s$$

The efficient portfolio is given by:

$$R_{eff} = x_1 R_{F1} + x_2 R_{F2} + x_3 R_{F3}$$

So:

$$\begin{aligned}&Cov(R_{eff}, \varepsilon_s) = Cov(x_1 R_{F1} + x_2 R_{F2} + x_3 R_{F3}, \varepsilon_s)\\ &= x_1 Cov(R_{F1}, \varepsilon_s) + x_2 Cov(R_{F2}, \varepsilon_s) + x_3 Cov(R_{F3}, \varepsilon_s)\\ &= 0\end{aligned}$$

Therefore:

$E[R_P] = r_f$ and $\alpha_S = 0$

We end with:

$$E[R_s] = r_f + \beta_s^{F1}\left(E[R_{F1}] - r_f\right) + \beta_s^{F2}\left(E[R_{F2}] - r_f\right) + \beta_s^{F3}\left(E[R_{F3}] - r_f\right)$$

13-11.

	Factor	**GE**
MKT	0.64	0.747
SMB	0.17	–0.478
HML	0.53	–0.232
PR1YR	0.76	–0.147

Risk Premium (monthly)	0.16%
RP annual	1.95%

13-12.

	Factor	**XOM**
MKT	0.64	0.243
SMB	0.17	0.125
HML	0.53	0.144
PR1YR	0.76	–0.185

Risk Premium (monthly)	0.11%
RP annual	1.35%
R_f	6.00%
Cost of capital	7.35%

13-13.

	Factor	**MSFT**
MKT	0.64	1.068
SMB	0.17	–0.374
HML	0.53	–0.814
PR1YR	0.76	–0.226

Risk Premium (monthly)	0.02%
RP annual	0.20%
R_f	5.50%
Cost of capital	5.70%

13-14. A firm's characteristics change as the firm evolves. This changes the weight of each characteristic in the firm's expected return calculation thereby changing the firm's beta.

13-15. Characteristic variable model: sensitivity of each firm to a characteristic; Factor model: factor portfolio returns

Chapter 14
Capital Structure in a Perfect Market

14-1.

a. $E\left[C(1)\right] = \frac{1}{2}(130{,}000 + 180{,}000) = 155{,}000,$

$NPV = \frac{155{,}000}{1.20} - 100{,}000 = 129{,}167 - 100{,}000 = \$29{,}167$

b. Equity value $= PV\left(C(1)\right) = \frac{155{,}000}{1.20} = 129{,}167$

c. Debt payments $= 100{,}000$, equity receives 20,000 or 70,000.

Initial value, by MM, is $129{,}167 - 100{,}000 = \$29{,}167$.

14-2.

a. Total value of equity $= 2 \times \$2m = \$4m$

b. MM says total value of firm is still \$4 million. \$1 million of debt implies total value of equity is \$3 million. Therefore, 33% of equity must be sold to raise \$1 million.

c. In (a), 50% × \$4M = \$2M. In (b), 2/3 × \$3M = \$2M. Thus, in a perfect market the choice of capital structure does not affect the value to the entrepreneur.

14-3.

a. E[Value in one year] $= 0.8(50) + 0.2(20) = 44$. E $= \frac{44}{1.10} = \$40\text{m}$.

b. D $= \frac{20}{1.05} = 19.048$. Therefore, $E = 40 - 19.048 = \$20.952m$.

c. Without leverage, r$= \frac{44}{40} - 1 = 10\%$, with leverage, r$= \frac{44-20}{20.952} - 1 = 14.55\%$.

d. Without leverage, r$= \frac{20}{40} - 1 = -50\%$, with leverage, r$= \frac{0}{20.952} - 1 = -100\%$.

14-4.

a.

	ABC		XYZ	
FCF	Debt Payments	Equity Dividends	Debt Payments	Equity Dividends
\$800	0	800	500	300
\$1,000	0	1000	500	500

b. Unlevered Equity = Debt + Levered Equity. Buy 10% of XYZ debt and 10% of XYZ Equity, get 50 + (30,50) = (80,100)

c. Levered Equity = Unlevered Equity + Borrowing. Borrow \$500, buy 10% of ABC, receive (80,100) – 50 = (30, 50)

14-5.

a. V(alpha) = 10 × 22 = 220m = V(omega) = D + E ⇒ E = 220 – 60 = 160m ⇒ p = \$8 per share.

b. Omega is overpriced. Sell 20 Omega, Buy 10 alpha and borrow 60. Initial = 220 – 220 + 60 = 60. Assumes we can trade shares at current prices & Assumes we can borrow at same terms as Omega (or own Omega debt and can sell at same price).

14-6.

a. Assets = cash + non-cash, Liabilities = equity + options. non-cash assets = equity + options – cash = 12 × 5 + 8 – 5 = 63 billion

b. Equity = 60 – 5 =55. Repurchase $\frac{5b}{12} = 0.417b$ shares ⇒ 4.583 b shares remain.

Per share value $= \frac{55}{4.583} = \$12$.

14-7.

a.

i. A = 50 cash + 700 non-cash
L = 750 equity

ii. A = 350 cash + 700 non-cash
L = 750 equity + 100 short-term debt + 100 long-term debt + 100 preferred stock

iii. A = 700 non-cash
L = 400 equity + 100 short-term debt + 100 long-term debt + 100 preferred stock

b. Repurchase $\frac{350}{7.50} = 46.67$ shares ⇒ 53.33 remain. Value is $\frac{400}{53.33} = 7.50$

14-8. Any leverage raises the equity cost of capital. In fact, risk-free leverage raises it the most (because it does not share any of the risk).

14-9.

a. E = 1000 – 750 = 250. CF = (1400,900) – 500 (1.05) = (612.5,112.5)

b. R_e = (145%, – 55%), E[Re] = 45%, Risk premium = 45% – 5% = 40%

c. Return sensitivity = 145% – (-55%) = 200%. This sensitivity is 4x the sensitivity of unlevered equity (50%). Its risk premium is also 4x that of unlevered equity (40% vs. 10%).

d. $\frac{750}{250} = 3\text{x}$

e. 25%(45%)+75%(5%) = 15%

14-10.

a. $r_e = r_u + d/e(r_u - r_d) = 12\% + 0.50(12\% - 6\%) = 15\%$

b. $r_e = 12\% + 1.50(12\% - 8\%) = 18\%$

c. Returns are higher because risk is higher—the return fairly compensates for the risk. There is no free lunch.

14-11.

a. $wacc = \frac{2(15\%)}{3} + \frac{6\%}{3} = 12\% = r_u$.

b.

i. $r_e = r_u + d/e\left(r_u - r_d\right) = 12 + \frac{150(12-6)}{150} = 18\%$

ii. if r_d is higher, r_e is lower. The debt will share some of the risk.

14-12. $wacc = r_u = 10\% = \frac{1}{1.6}13\% + \frac{0.6}{1.6}x \Rightarrow 1.6(10) - 13 = 3 = 0.6x \Rightarrow x = 5\%$

14-13. $r_u = wacc = \frac{1}{2}(11) + \frac{1}{2}(5) = 8\%$. $r_e = 8\% + \frac{200}{150}(8\% - 5\%) = 12\%$

14-14. Indell increases its net debt by \$40 million (\$30 million in new debt + \$10 million in cash paid out). Therefore, the value of its equity decreases to 120 – 40 = \$80 million.

If the debt is risk-free:

$$b_e = b_u\left(1 + \frac{D}{E}\right) = \frac{b_u(E+D)}{E} = b_u \times \frac{EV}{E},$$

where D is net debt, and EV is enterprise value . The only change in the equation is the value of equity. Therefore

$$b_e^{'} = b_e\frac{E}{E'} = 1.50\frac{120}{80} = 2.25$$

14-15.

a. $b_e = b_u\left(1+d/e\right) = 1.2\left(1+\frac{40}{60}\right) = 2$

b. $r_e = r_f + b\left(r_m - r_f\right) \Rightarrow r_m - r_f = \frac{12.5-5}{1.2} = 6.25 \Rightarrow r_e = 5+2\left(6.25\right) = 17.5\%$ from the CAPM, or

$r_e = r_u + d/e\left(r_u - r_d\right) = 12.5 + \frac{40\left(12.5-5\right)}{60} = 17.5$

c. $p = 14\left(1.50\right) = \$21$. Borrow 40%(21) = 8.4, interest = 5%(8.4) = 0.42. Earnings = 1.50 – 0.42 = 1.08, per share $= \frac{1.08}{0.60} = 1.80$

No benefit; risk is higher. The stock price does not change.

d. $PE = \frac{21}{1.80} = 11.67$. It falls due to higher risk.

14-16.

a. Issue $\frac{180}{90} = 2$ million new shares $\Rightarrow$ 12 million shares outstanding.

New EPS $= \frac{24}{12} = \$2.00$ per share.

b. Interest on new debt $= 180 \times 5\% = \$9$ million. The interest expense will reduce earnings to 24 – 9 = \$15 million. With 10 million shares outstanding, $EPS = \frac{15}{10} = \$1.50$ per share.

c. By MM, share price is \$90 in either case. PE ratio with equity issue is $\frac{90}{2} = 45$.

PE ratio with debt is $\frac{\$90}{1.50} = 60$.

The higher PE ratio is justified because with leverage, EPS will grow at a faster rate.

14-17.

a. Assets = 850m. New shares = 110. $\Rightarrow price = \frac{850}{110} = \$7.73$

b. Cost = 100(8.50 – 7.73) = 77 m = 10(7.73). Issuing equity at below market price is costly.

Chapter 15

Debt and Taxes

15-1.

a. Net Income = EBIT − Interest − Taxes $= (325 - 125) \times (1 - 0.40) = \$120$ million.

b. Net income + Interest = 120 + 125 = $245 million

c. Net income = EBIT − Taxes $= 325 \times (1 - 0.40) = \$195$ million. This is $245 - 195 = \$50$ million lower than part (b).

d. Interest tax shield $= 125 \times 40\% = \$50$ million

15-2.

a. Net income will fall by the after-tax interest expense to $\$20.750 - 1 \times (1 - 0.35) = \$20.10$ million.

b. Free cash flow is not affected by interest expenses.

15-3.

a. Net income $= 1000 \times (1 - 40\%) = \$600$. Thus, equity holders receive dividends of $600 per year with no risk. $E = \dfrac{600}{5\%} = \$12,000$

b. Net income $= (1000 - 500) \times (1 - 0.40) = \$300 \Rightarrow E = \dfrac{300}{5\%} = \$6000$. Debt holders receive interest of $500 per year $\Rightarrow$ D = $10,000

c. With leverage = 6,000 + 10,000 = $16,000
Without leverage = $12,000
Difference = 16,000 – 12,000 = $4000

d. $\dfrac{4,000}{10,000} = 40\% =$ corporate tax rate

15-4.

Year	0	1	2	3	4	5
Debt	35	28	21	14	7	0
Interest		2.8	2.24	1.68	1.12	0.56
Tax Shield		1.12	0.896	0.672	0.448	0.224

15-5.

Year	0	1	2	3	4	5
Debt	100	75	50	25	0	0
Interest		10	7.5	5	2.5	0
Tax Shield		4	3	2	1	0
PV	\$8.30					

15-6.

a. Interest tax shield $= \$10 \times 6\% \times 35\% = \$0.21$ million

b. PV(Interest tax shield) $= \dfrac{\$0.21}{0.06} = \$3.5$ million

c. Interest tax shield = \$10 × 5% × 35% = \$0.175 million. PV $= \dfrac{\$0.175}{0.05} = \$3.5$ million.

15-7. Interest tax shield in year 1 = \$30 × 6.5% × 40% = \$0.78 million. As the outstanding balance declines, so will the interest tax shield. Therefore, we can value the interest tax shield as a growing perpetuity with a growth rate of g = -5% and r = 6.5%:

$$PV = \frac{\$0.78}{6.5\% + 5\%} = \$6.78 \text{ million}$$

15-8.

a. $E = \$15 \times 30 = \$450$ million. D = \$150 million.

$$\text{Pretax WACC} = \frac{450}{600}10\% + \frac{150}{600}5\% = 8.75\%$$

b. $$\text{WACC} = \frac{450}{600}10\% + \frac{150}{600}5\%\left(1 - 35\%\right) = 8.3125\%$$

15-9. $\dfrac{D}{E+D} = \dfrac{0.65}{1.65} = 0.394$.

Therefore, WACC = Pretax WACC – .394(7%)(.40) = Pretax WACC – 1.10%

So, it lowers it by 1.1%.

15-10.

a. $\text{WACC} = \frac{1}{1.85}12\% + \frac{0.85}{1.85}7\%(1-0.40) = 8.42\%$

$V^L = E + D = 220 \times 1.85 = 407 = \frac{\text{FCF}}{\text{WACC} - g} = \frac{10}{0.0842 - g}$

$g = 0.0842 - \frac{10}{407} = 5.96\%$

b. $\text{pretax WACC} = \frac{1}{1.85}12\% + \frac{0.85}{1.85}7\% = 9.70\%$

$V^U = \frac{\text{FCF}}{\text{pretax WACC} - g} = \frac{10}{0.0970 - 0.0596} = \$267 \text{ million}$

$\text{PV}(\text{Interest Tax Shield}) = 407 - 267 = \$140 \text{ million}$

15-11.

a. $V^L = E + D = 140 = \frac{\text{FCF}}{\text{WACC} - g} = \frac{7}{\text{WACC} - 3\%}$. Therefore WACC = 8%.

b. $\text{Pre-tax WACC} = \text{WACC} + \frac{D}{E+D} r_D \tau_C = 8\% + \frac{40}{140}(7.5\%)(0.35) = 8.75\%$

$V^U = \frac{\text{FCF}}{\text{pretax WACC} - g} = \frac{7}{0.0875 - 0.03} = \$122 \text{ million}$

$\text{PV}(\text{Interest Tax Shield}) = V^L - V^U = 140 - 122 = \$18 \text{ million}$

15-12.

a. $V^U = \frac{5}{0.15} = \$33.33 \text{ million}$

b. $V^L = V^U + \tau_C D = 33.33 + 0.35 \times 19.05 = \$40 \text{ million}$

15-13.

a. Assets = Equity = \$7.50 × 20 = \$150 million

b. Assets = 150 (existing) + 50 (cash) + 40% × 50 (tax shield) = \$220 million

c. E = Assets – Debt = 220 – 50 = \$170 million. Share price $= \frac{\$170 \text{ million}}{20} = \$8.50$.

Kurz will repurchase $\frac{50}{8.50} = 5.882$ million shares.

d. Assets = 150 (existing) + 40% × 50 (tax shield) = \$170 million

Debt = \$50 million

E = A – D = 170 – 50 = \$120 million

Share price $= \frac{\$120}{20 - 5.882} = \$8.50/\text{share}$.

15-14.

a. $\text{Share price} = \frac{25}{10} = \$2.50$ per share

b. Just before the share repurchase:

$$\text{Assets} = 25(\text{existing}) + 10(\text{cash}) + 35\% \times 10(\text{tax shield}) = \$38.5 \text{ billion}$$

$$E = 38.5 - 10 = 28.5 \text{疍hare price} = \frac{28.5}{10} = \$2.85 / \text{share}$$

Therefore, shareholders will not sell for \$2.75 per share.

c. Assets = 25 (existing) + 35% × 10 (tax shield) = \$28.5 billion

E = 28.5 – 10 = 18.5 billion

$$\text{Shares} = 10 - \frac{10}{3} = 6.667 \text{ billion. Share price} = \frac{18.5}{6.667} = \$2.775 \text{ share.}$$

d. From (b), fair value of the shares prior to repurchase is \$2.85. At this price, Rally will have $10 - \frac{10}{2.85} = 6.49$ million shares outstanding, which will be worth $\frac{18.5}{6.49} = \$2.85$ after the repurchase. Therefore, shares will be willing to sell at this price.

15-15.

a. \$15 × (1 – .333) = \$10 million each year

b. Given a corporate tax rate of 40%, an interest expense of \$15 million per year reduces net income by 15(1 – .4) = \$9 million after corporate taxes.

c. \$9 million dividend cut ⇒ \$9 × (1 – .15) = \$7.65 million per year.

d. Interest taxes = .333 × 15 = \$5 million

Less corporate taxes = .40 × 15 = \$6 million

Less dividend taxes = .15 × 9 = \$1.35 million

⇒ Govt tax revenues change by 5 – 6 – 1.35 = \$2.35 million

(Note this equals (a) – (c)).

e. $$\tau^* = 1 - \frac{(1-0.40)(1-0.15)}{1-0.333} = 23.5\%$$

15-16.

a. $PV = \tau_C D = 35\% \times 100 = \$35$ million.

b. $$\tau^* = 1 - \frac{(1-0.35)(1-0.20)}{1-0.40} = 13.33\%$$

$PV = \tau_C D = 13.33\% \times 100 = \$13.33$ million

15-17.

a. Investors receive 6% × (1 – .35) = 3.9% after-tax from risk-free debt. They must earn the same after-tax return from risk-free preferred stock. Therefore, the cost of capital for preferred stock is $\dfrac{3.9\%}{1-0.15\%} = 4.59\%$.

b. After-tax debt cost of capital = 6% × (1 – .40) = 3.60% is cheaper than the 4.59% cost of capital for preferred stock.

c. $\tau^* = 1 - \dfrac{(1-0.40)(1-0.15)}{1-0.35} = 21.54\%$

4.59% × (1 – .2154) = 3.60%

15-18. $\tau^* = 1 - \dfrac{(1-\tau_C)(1-\tau_e)}{1-\tau_i} > 0$ if and only if $1-\tau_C < \dfrac{1-\tau_i}{1-\tau_e}$ or equivalently:

$\tau_C > 1 - \dfrac{1-\tau_i}{1-\tau_e} = 1 - \dfrac{0.65}{0.90} = 27.8\%$.

Thus, there is a tax advantage of debt as long as the marginal corporate tax rate is above 27.8%.

15-19. Net income of \$4.5 million $\Rightarrow \dfrac{4.5}{1-0.35} = \$6.923$ million in taxable income.

Therefore, Arundel can increase its interest expenses by \$6.923 million, which corresponds to debt of:

$\dfrac{6.923}{0.08} = \$86.5$ million.

15-20.

a. $\text{FCF} = \text{EBIT} \times (1-\tau) + \text{Dep} - \text{Capex} - \Delta\text{NWC} = 15 \times (1-0.35) + 3 - 6 = 6.75$

$E = \dfrac{6.75}{10\% - 8.5\%} = \$450 \text{ million}$

b. Interest expense of \$15 million $\Rightarrow$ debt of $\dfrac{15}{0.08} = \$187.5$ million.

c. No. The most they should borrow is 187.5 million—there is no interest tax shield from borrowing more.

15-21.

a. $\tau^* = 1 - \frac{(1-\tau_C)(1-\tau_e)}{1-\tau_i} = 1 - \frac{(1-0.35)(1-0.15)}{1-0.35} = 15\%$

b. For interest expenses over \$20 million, net income is negative so $\tau_C = 0$.

Therefore, $\tau^* = 1 - \frac{(1-\tau_C)(1-\tau_e)}{1-\tau_i} = 1 - \frac{(1-0)(1-0.15)}{1-0.35} = -31\%$

c. For interest expenses between \$10 million and \$15 million, there is a $\frac{2}{3}$ chance that net income will be positive. Therefore, the expected corporate tax savings is $\frac{2}{3} \times 35\% = 23.3\%$. Thus,

$\tau^* = 1 - \frac{(1-\tau_C)(1-\tau_e)}{1-\tau_i} = 1 - \frac{(1-0.23)(1-0.15)}{1-0.35} = -0.3\%$.

d. There is a tax advantage up to an interest expense of \$10 million.

Chapter 16

Financial Distress, Managerial Incentives, and Information

16-1.

a. $0.25 \times \dfrac{150 + 135 + 95 + 80}{1.05} = \$109.52 \text{ million}$

b. $0.25 \times \dfrac{100 + 100 + 95 + 80}{1.05} = \$89.28 \text{ million}$

c. $\text{YTM} = \dfrac{100}{89.29} - 1 = 12\%$

expected return = 5%

d. $\text{equity} = 0.25 \times \dfrac{50 + 35 + 0 + 0}{1.05} = \$20.24 \text{ million}$

total value = 89.28 +20.24 = \$109.52 million

16-2.

a. $\dfrac{81 - 36}{10} = \$4.5/\text{share}$

b. $\dfrac{36}{4.5} = 8 \text{ million shares}$

c. $\dfrac{81}{18} = \$4.5/\text{share}$

16-3. No. Some of these losses are due to declines in the value of the assets that would have occurred whether or not the firm defaulted. Only the incremental losses that arise from the bankruptcy process are bankruptcy costs.

16-4.

a. Intuit Inc. – its customers will care about their ability to receive upgrades to their software.

b. Allstate Corporation – its customers rely on the firm being able to pay future claims.

16-5.

a. Office building—there are many alternate users who would be likely to value the property similarly.

b. Raw materials—they are easier to reuse.

c. Patent rights—they would be easier to sell to another firm.

16-6.

a. $0.25 \times \dfrac{150+135+95+80}{1.05} = \$109.52 \text{ million}$

b. $0.25 \times \dfrac{100+100+95 \times 0.75+80 \times 0.75}{1.05} = \$78.87 \text{ million}$

c. $\text{YTM} = \dfrac{100}{78.87} - 1 = 26.79\%$

expected return = 5%

d. $\text{equity} = 0.25 \times \dfrac{50+35+0+0}{1.05} = \$20.24 \text{ million}$

$\text{total value } = 0.25 \times \dfrac{150+135+95 \times 0.75+80 \times 0.75}{1.05} = \$99.11 \text{ million}$

(or 78.87 + 20.24 = $99.11 million)

e. $\dfrac{109.52}{10} = \$10.95/\text{share}$

f. $\dfrac{99.11}{10} = \$9.91/\text{share}$ Bankruptcy cost lowers share price.

Note that Gladstone will raise $78.87 million from the debt, and repurchase $\dfrac{78.87}{9.91} = 7.96$ million shares.

Its equity will be worth $20.24 million, for a share price of $\dfrac{20.24}{10-7.96} = \$9.91$ after the transaction is completed.

16-7.

a. $\dfrac{10}{0.08} - 50 = \$75 \text{ million}$

b. $\dfrac{75}{5} = \$15/\text{share}$

c. $\dfrac{75+0.4 \times 50}{5} = \$19/\text{share}$

d. $\dfrac{\frac{9}{0.08} - 50 + 0.4 \times 50}{5} = \$16/\text{share}$

16-8.

a. The same price, \$5.50/share, because financial transactions do not create value.

b. $0.3 \times \frac{20}{10} + 5.5 = \$6.10 / \text{share}$

c. $(6.1 - 5.75) \times 10 = \$3.5$ million

16-9.

a. $r = 5\% + 1.1 \times (15\% - 5\%) = 16\%$

$$V = \frac{16}{0.16} = \$100 \text{ million}$$

b. $r = 5\% + 1.1 \times (15\% - 5\%) = 16\%$

$$V = \frac{15}{0.16} + 0.35 \times 40 = \$107.75 \text{ million}$$

16-10. According to tradeoff theory, tax shield adds value while financial distress costs reduce a firm's value. The financial distress costs for a real estate investment are likely to be low, because the property can generally be easily resold for its full market value. In contrast, corporations generally face much higher costs of financial distress. As a result, corporations choose to have lower leverage.

16-11. If Dynron has no debt or if in all scenarios Dynron can pay the debt in full, equity holders will only consider the project's NPV in making the decision. If Dynron is heavily leveraged, equity holders will also gain from the increased risk of the new investment.

16-12.

a. equity $= 0$

$$\text{debt} = \frac{10}{1.1} = \$9.09 \text{ million}$$

b. $\text{NPV} = \frac{25}{1.1} - 20 = \$2.73$ million

c. $\text{debt} = \frac{15}{1.1} = \$13.64$ million

$$\text{equity} = \frac{35 - 15}{1.1} = \$18.18 \text{ million}$$

d. Equity holders will not be willing to accept the deal, because for them it is a negative NPV investment ($18.18 - 20 < 0$).

16-13.

a. E(A) = \$75 million

E(B) = 0.5 × 140 = \$70 million

E(C) = 0.1 × 300 + 0.9 × 40 = \$66 million

Project A has the highest expected payoff.

b. E(A) = 75 – 40 = \$35 million

E(B) = 0.5 × (140 – 40) = \$50 million

E(C) = 0.1 × (300 –40) + 0.9 × (40 – 40) = \$26 million

Project B has the highest expected payoff for equity holders.

c. E(A) =\$0 million

E(B) = 0.5 × (140 – 110) = \$15 million

E(C) = 0.1 × (300 –110) = \$19 million

Project C has the highest expected payoff for equity holders.

d. With \$40 million in debt, management will choose project B, which has an expected payoff for the firm that is 75 – 70 = \$5 million less than project A. Thus, the expected agency cost is \$5 million.

With \$110 million in debt, management will choose project C, resulting in an expected agency cost of 75 – 66 = \$9 million.

16-14.

a. Market value of firm Assets $= 30/(2/3) = \$45$ million. With debt of \$20 million, equity is worth 45 – 20 = 25, so you will need to sell $\frac{10}{25} = 40\%$ of the equity.

b. Given debt D, equity is worth 45 – D. Selling 50% of equity, together with debt must raise \$30 million: $5 \times (45 - D) + D = 30$. Solve for D = \$15 million.

16-15.

a. In addition to tax benefits of leverage, debt financing can benefit Empire by reducing wasteful investment.

b. Net income will fall by $1 × 0.65 = $0.65

Because 10% of net income will be wasted, dividends and share repurchases will fall by $0.65 × (1 – .10) = $0.585

c. Pay $1 in interest, give up $0.585 in dividends and share repurchases ⇒ Increase of 1 – 0.585 = $0.415 per $1 of interest.

16-16.

a. Without personal spending, there is a1% chance of bankruptcy.

With $10 million personal spending, there is a 7% chance—so the probability of bankruptcy, increased by 6%.

b. Debt between $90 and $100 million will provide the CEO with the biggest incentive not to proceed with personal spending because by doing so the chance of bankruptcy would increase by 38%.

16-17.

a. $\frac{50+100+150}{3} = \$100$ million

b.

i. Empire building: value = 100 – 5 = $95 million

ii. Value = $100 million

iii. Empire building and increased risk: value = .5(50) + .1(100) + .4(150) – 5 = $90 million

iv. Increased risk: value = $95 million

c. Because the tax benefits are paid as a dividend, the manager will empire build or increase risk as determined in part (b). We can therefore determine the expected value with leverage by adding the expected tax benefit to the value calculated in part (b):

i. $95 + 10%(44) = $99.4 million

ii. $100 + 10%(49) = $104.9 million

iii. $\$90+10\%(0.5\times 45+0.5\times 90)=\$96.75$ million

iv. $95 + 10%(.5 × 50 + .5 × 99) = $102.45 million

Therefore, $49 million in debt is optimal; even though there is a tax benefit, the firm's optimal leverage is limited due to agency costs.

16-18.

a. Tobacco firms

high optimal debt level—high free cash flow, low growth opportunities

b. Accounting firms

low optimal debt level—high distress costs

c. Mature restaurant chains

high optimal debt level—stable cash flows, low growth, low distress costs

d. Lumber companies

high optimal debt level—stable cash flows, low growth, low distress costs

e. Cell phone manufacturers

low optimal debt level—high growth opportunities, high distress costs

16-19. Unlevered Value $= \dfrac{90}{0.10} = \$900$.

Levered Value with Raider = 900 + 40%(750) = $1.2 billion

To prevent successful raid, current management must have a levered value of at least $\dfrac{\$1.2 \text{ billion}}{1.20} = \$1 \text{ billion}$.

Thus, the minimum tax shield is $1 billion – 900 million = $100 million, which requires $\dfrac{100}{0.40} = \$250$ million in debt.

16-20.

a.

i. Borrowing has a net cost of $20 million, or $\dfrac{\$20}{100} = \$0.20$ per share. Selling $\dfrac{500}{13.50} = 37$ million shares at a premium of $1 per share has a benefit of $37 million, or $\dfrac{37}{137} = \$0.27$ per share. (I.e.

$$\left(\frac{12.50 \times 100 + 500}{100 + \dfrac{500}{13.50}} = 12.77 = 12.50 + 0.27. \right)$$ Therefore, issue equity.

ii. Borrowing has a net cost of $20 million, or $\dfrac{\$20}{100} = \$0.20$ per share. Selling $\dfrac{500}{13.50} = 37$ million shares at a discount of $1 per share has a cost of $37 million, or $\dfrac{37}{137} = \$0.27$ per share. Therefore, issue debt.

b. If IST issues equity, investors would conclude IST is overpriced, and the share price would decline to \$12.50.

c. If IST issues debt, investors would conclude IST is undervalued, and the share price would rise to \$14.50.

d. If there are no costs from issuing debt, then equity is only issued if it is over-priced. But knowing this, investors would only buy equity at the lowest possible value for the firm. Because there would be no benefit to issuing equity, all firms would issue debt.

16-21. If the firm must pay 10% more than the target firm was worth, but can do the purchase using shares that were over-valued by more than 10%, in the long run the firm will gain from the acquisition.

16-22.

a. NPV of expansion $= 20 \times \frac{0.65}{0.1} - 50 = \$80$ million

Equity value $= \frac{500+80}{10} = \$58/\text{share}$

b. NPV of expansion $= 4 \times \frac{0.65}{0.1} - 50 = -\$24$ million

share price $= \frac{500-24}{10} = \$47.6/\text{share}$

new shares $= \frac{50}{47.6} = 1.05$ million shares

c. share price $= \frac{500+50+80}{11.05} = \$57/\text{share}$

The share price is now lower than the answer from part (a), because in part (a), share price is fairly valued, while here shares issued in part (b) are undervalued. New shareholders' gain of $(57-47.6)\times 1.05 = \$10$ million = old shareholders' loss of (58 – 57) × 10.

d. Tax shield = 35%(50) = \$17.5 million

Share price $= \frac{500+50+80+17.50-50}{10} = \$59.75$ per share.

Gain of \$2.75 per share compared to case (c). \$1 = avoid issuing undervalued equity, and \$1.75 from interest tax shield.

Chapter 17

Payout Policy

17-1.

a. March 29

b. March 30

17-2. There are 3 mechanisms: 1) In an open market repurchase the firm repurchases the shares in the open market. This is the most common mechanism in the U.S. 2) In a tender offer the firm announces the intention to all shareholders to repurchase a fixed number of shares for a fixed price, conditional on shareholders agreeing to tender their shares. If not enough shares are tendered, the deal can be cancelled. 3) A targeted repurchase is similar to a tender offer except it is not open to all shareholders, only specific shareholder can tender their shares in a targeted repurchase.

17-3.

a. The dividend payoff is $250/$500 = $0.50 on a per share basis. In a perfect capital market the price of the shares will drop by this amount to $14.50.

b. $15

c. Both are the same.

17-4. If you sell 0.5/15 of one share you receive $0.50 and your remaining shares will be worth $14.50, leaving you in the same position as if the firm had paid a dividend.

17-5. Because the payoff of the option depends upon Oracle's future stock price, you would prefer that Oracle use share repurchases, as it avoids the price drop that occurs when the stock price goes ex-dividend.

17-6.

a. P=$1.60/0.12=$13.33

b. P=$2/0.12=$16.67

17-7. 58.33% in 1981 and 37.5% in 1982.

17-8. 1988, 1989, or 1990.

17-9.

a. The price drop was $2.63/$$3.08 = 85.39% of the dividend amount, implying an effective tax rate of 14.61%.

b. I

17-10. d., Corporations

17-11. Dividend capture theory states that investors with high effective dividend tax rates sell to investors with low effective dividend tax rates just before the dividend payment. The price drop therefore reflects the tax rate of the low effective dividend tax rate individuals.

17-12.

a. The value of Kay will remain the same.

b. The value of Kay will fall by $100 million.

c. It will neither benefit nor hurt investors.

17-13.

a. The value of Kay will rise by $35 million.

b. The value of Kay will fall by $100 million.

c. It will benefit investors.

17-14. Assuming investors pay a 15% tax on dividends but no capital gains taxes nor taxes on interest income, and Kay does not pay corporate taxes:

a. The value of Kay will remain the same.

b. The value of Kay will fall by $85 million.

c. It will neither benefit nor hurt investors.

17-15.

a. 13.33%

b. –12.667%

17-16.

a. By increasing dividends managers signal that they believe that future earnings will be high enough to maintain the new dividend payment.

b. Raising dividends signals that the firm does not have any positive NPV investment opportunities, which is bad news.

17-17. By choosing to do a share repurchase management credibly signal that they believe the stock is undervalued.

17-18.

a. Because Enterprise Value = Equity + Debt – Cash, AMC's equity value is

Equity = EV + Cash = \$500 million.

Therefore,

Share price = (\$500 million) / (10 million shares) = \$50 per share.

b. AMC repurchases \$100 million / (\$50 per share) = 2 million shares. With 8 million remaining share outstanding (and no excess cash) its share price if its EV goes up to \$600 million is

Share price = \$600 / 8 = \$75 per share

And if EV goes down to \$200 million:

Share price = \$200 / 8 = \$25 per share

c. If EV rises to \$600 million prior to repurchase, given its \$100 million in cash and 10 million shares outstanding, AMC's share price will rise to:

Share price = (600 + 100) / 10 = \$70 per share

If EV falls to \$200 million:

Share price = (200 + 100) / 10 = \$30 per share

The share price after the repurchase will be also be \$70 or \$30, since the share repurchase itself does not change the stock price.

Note: the difference in the outcomes for (a) vs (b) arise because by hold cash (a risk-free asset) AMC reduces the volatility of its share price.

d. If management expects good news to come out, they would prefer to do the repurchase first, so that the stock price would rise to \$75 rather than \$70. On the other hand, if they expect bad news to come out, they would prefer to do the repurchase after the news comes out, for a stock price of \$30 rather than \$25. (Intuitively, management prefers to do a repurchase if the stock is undervalued – they expect good news to come out – but not when it is overvalued because they expect bad news to come out.)

e. Based on (d), we expect managers to do a share repurchase before good news comes out and after any bad news has already come out. Therefore, if investors believe managers are better informed about the firm's future prospects, and that they are timing their share repurchases accordingly, a share repurchase announcement would lead to an increase in the stock price.

17-19.

a. With a 20% stock dividend, an investor holding 100 shares receives 20 additional shares. However, since the total value of the firm's shares is unchanged, the stock price should fall to:

Share price = \$20 × 100 / 120 = \$20 / 1.20 = \$16.67 per share

b. A 3:2 stock split means for every 2 shares currently held, the investor receives a third share. This split is therefore equivalent to a 50% stock dividend. The share price will fall to:

Share price = $20 × 2/3 = $20/ 1.50 = $13.33 per share

c. A 1:3 reverse split implies that every 3 shares will turn into 1 share. Therefore, the stock price will rise to:

Share price = $20 × 3 / 1 = $60 per share

17-20. Companies use stock splits to keep their stock prices in a range that reduces investor transaction costs

17-21. To avoid being delisted from an exchange because the price of the stock has fallen below the minimum required to stay listed.

17-22. The value of the dividend paid per Adaptec share was (0.1646 shares of Roxio) × ($14.23 per share of Roxio) = $2.34 per share. Therefore, ignoring tax effects or other news that might come out, we would expect Adaptec's stock price to fall to $10.55 – 2.34 = $8.21 per share once it goes ex-dividend. (Note: In fact, Adaptec stock opened on Monday May 14, 2001 – the next trading day – at a price of $8.45 per share.)

Chapter 18

Capital Budgeting and Valuation with Leverage

18-1. Explain whether each of the following projects is likely to have risk similar to the average risk of the firm:

a. While there may be some differences, the market risk of the cash flows from this new product is likely to be similar to Clorox's other household products. Therefore, assuming it has the same risk as the average risk of the firm is reasonable.

b. A real estate investment likely has very different market risk than Google's other investments in internet search technology and advertising. It would not be appropriate to assume this investment as risk equal to the average risk of the firm.

c. An expansion in the same line of business is likely to have risk equal to the average risk of the business.

d. The theme park will likely be sensitive to the growth of the Chinese economy. It's market risk may be very different from GE's other division, and from the company as a whole. It would not be appropriate to assume this investment as risk equal to the average risk of the firm.

18-2. E = 665 million × \$74.77 = \$49.7 billion, D = \$25 billion, D/E = 25/49.722 = 0.503.

E = 700 million × \$83.00 = \$58.1 billion. Constant D/E implies D = 58.1 × 0.503 = \$29.2 billion.

18-3. Intel's debt is a tiny fraction of its total value. Indeed, Intel has more cash than debt, so its net debt is negative. Intel is also very profitable – at an interest rate of 6%, interest on Intel's debt is only \$132 million per year, which is less than 1.5% of its EBIT. Thus, the risk the Intel will default on its debt is extremely small. This risk will remain extremely small even if Intel borrows an additional \$1 billion. Thus, adding debt will not really change the likelihood of financial distress for Intel (which is nearly zero), and thus will also not lead to agency conflicts. As a result, the most important financial friction for such a debt increase is the tax savings Intel would receive from the interest tax shield. A secondary issue may be the signaling impact of the transaction – borrowing to do a share repurchase is usually interpreted as a positive signal that management may view the shares to be under-priced.

18-4. We can compute the levered value of the plant using the WACC method. Goodyear's WACC is

$$r_{wacc} = \frac{1}{1+2.6}8.5\% + \frac{2.6}{1+2.6}7\%(1-0.35) = 5.65\%$$

Therefore, $V^L = \dfrac{1.5}{0.0565-0.025} = \$47.6$ million

A divestiture would be profitable if Goodyear received more than \$47.6 million after tax.

18-5.

a. $r_{wacc} = \frac{10.8}{14.4}10\% + \frac{14.4 - 10.8}{14.4}6.1\%(1 - 0.35) = 8.49\%$

b. Using the WACC method, the levered value of the project at date 0 is

$$V^L = \frac{50}{1.0849} + \frac{100}{1.0849^2} + \frac{70}{1.0849^3} = 185.86$$

Given a cost of 100 to initiate, the project's NPV is 185.86 – 100 = 85.86.

c. Lucent's debt-to-value ratio is d = (14.4 – 10.8) / 14.4 = 0.25. The project's debt capacity is equal to d times the levered value of its remaining cash flows at each date:

Year	0	1	2	3
FCF	–100	50	100	70
VL	185.86	151.64	64.52	0
D = d*VL	46.47	37.91	16.13	0.00

18-6.

a. We don't know Acort's equity cost of capital, so we cannot calculate WACC directly. However, we can compute it indirectly by estimating the discount rate that is consistent with Acort's market value. First, E = 10 × 40 = $400 million. The market value of Acort's debt is

$$D = 10 \times \frac{1}{0.06}\left(1 - \frac{1}{1.06^4}\right) + \frac{100}{1.06^4} = \$113.86 \text{ million}$$

Therefore, Acort's enterprise value is E + D = 400 + 113.86 = 513.86.

Acort's FCF = EBIT×(1 – τ_C) + Dep – Capex – Inc in NWC

FCF = 106 × (1 – 0.40) = 63.6

Because Acort is not expected to grow,

$$V^L = 513.86 = \frac{63.6}{r_{wacc}} \text{ and so } r_{wacc} = \frac{63.6}{513.86} = 12.38\%$$

b. Using $r_{wacc} = \frac{E}{E+D}r_E + \frac{D}{D+E}r_D(1 - \tau_c)$,

$$12.38\% = \frac{400}{513.86}r_E + \frac{113.86}{513.86}6\%(1 - 0.40)$$

solving for r_E:

$$r_E = \frac{513.86}{400}\left[12.38\% - \frac{113.86}{513.86}6\%(1 - 0.40)\right] = 14.88\%$$

18-7.

a. $r_{wacc} = \frac{1}{1+2.6}8.5\% + \frac{2.6}{1+2.6}7\%(1-0.35) = 5.65\%$

b. Because Goodyear maintains a target leverage ratio, we can use Eq. 18.6:

$$r_U = \frac{1}{1+2.6}8.5\% + \frac{2.6}{1+2.6}7\% = 7.42\%$$

c. Goodyear's equity cost of capital exceeds its unlevered cost of capital because leverage makes equity riskier than the overall firm. Goodyear's WACC is less than its unlevered cost of capital because the WACC includes the benefit of the interest tax shield.

18-8.

a. WACC = (1 / 1.4)(11.3%) + (.4 / 1.4)(5%)(1 – .35) = 9%

V^L = 0.75 / (9% – 4%) = $15 million

NPV = -10 + 15 = $5 million

b. Debt-to-Value ratio is (0.4) / (1.4) = 28.57%

Therefore Debt is 28.57% × $15 million = $4.29 million

c. Discounting at r_u gives unlevered value. r_u = (1 / 1.4)11.3% + (.4 / 1.4)5% = 9.5%

V^u = 0.75 / (9.5% – 4%) = $13.64 million

Tax shield value is therefore 15 – 13.64 = 1.36 million

Alternatively, initial debt is $4.29 million, for a tax shield in the first year of 4.29 × 5% × 0.35 = 0.075 million. Then PV(ITS) = 0.075 / (9.5% – 4%) = 1.36 million.

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18-9.

a. $r_U = \frac{10.8}{14.4}10\% + \frac{14.4-10.8}{14.4}6.1\% = 9.025\%$

b. $V^U = \frac{50}{1.09025} + \frac{100}{1.09025^2} + \frac{70}{1.09025^3} = 184.01$

c. Using the results from problem 5(c):

Year	0	1	2	3
FCF	–100	50	100	70
VL	185.86	151.64	64.52	0
D = d*VL	46.47	37.91	16.13	0.00
Interest		2.83	2.31	0.98
Tax Shield		0.99	0.81	0.34

The present value of the interest tax shield is

$$PV(ITS) = \frac{0.99}{1.09025} + \frac{0.81}{1.09025^2} + \frac{0.34}{1.09025^3} = 1.85$$

d. $V^L = APV = 184.01 + 1.85 = 185.86$

This matches the answer in problem 5.

18-10.

a. Using the debt capacity calculated in problem 5, we can compute FCFE by adjusting FCF for after-tax interest expense ($D*r_D*(1 - tc)$) and net increases in debt ($D_t - D_{t-1}$):

Year	0	1	2	3
D	46.47	37.91	16.13	0.00
FCF	-$100.00	$50.00	$100.00	$70.00
After-tax Interest Exp.	$0.00	-$1.84	-$1.50	-$0.64
Inc. in Debt	$46.47	-$8.55	-$21.78	-$16.13
FCFE	-$53.53	$39.60	$76.72	$53.23

b. $NPV = -53.53 + \frac{39.60}{1.10} + \frac{76.72}{1.10^2} + \frac{53.23}{1.10^3} = \$85.86$

18-11.

a. AMC has unlevered FCF of $\$2,000 \times 0.6 = \$1,200$.

From the CAPM, AMC's unlevered cost of capital is $5\% + 1.11 \times (11\% - 5\%) = 11.66\%$.

Discounting the FCF as a growing perpetuity tells us that the value of the firm, assuming growth of 3%, is:

$$\text{V(All Equity)} = \frac{\$1,200}{0.1166 - 0.03} = \$13,857$$

b. Since the debt is risk-free, the interest rate paid on it must equal the risk-free rate of 5% (or else there would be an arbitrage opportunity). The firm has $5,000 of debt next year. The interest payment will be 5% of that, or $250. If the debt grows by 3% per year, so will the interest payments.

c. The expected value of next year's tax shield will be $250 × 40% = $100, and it will grow (with the growth of the debt) at a rate of 3%. But the exact amount of the tax shield is uncertain, since AMC may add new debt or repay some debt during the year, depending on their cash flows. This makes the actual amount of the tax shield risky (even though the debt itself is not). Since the beta of the tax shield due to debt is 1.11, the appropriate discount rate is 5% + 1.11 (11% – 5%) = 11.67%. We can now use the growing perpetuity formula and conclude that

$$\text{PV(Interest Tax Shields)} = \frac{\$100}{0.1166 - 0.03} = \$1,155.$$

d. The APV tells us that the value of a firm with debt equals the sum of the value of an all equity firm and the tax shield. From previous work (parts (a) and (c)), we get:

$\text{V(AMC)} = \$13,857 + \$1,155 = \$15,012$

The market value of the equity is therefore V – D = $15,012 - $5000 = $10,012.

e. Next year's FCF is $\$2{,}000 \times 0.6 = \$1{,}200$. It is expected to grow at 3%, so the WACC must satisfy:

$$V(AMC) = \frac{\$1{,}200}{r_{wacc} - 0.03} = \$15{,}000,$$

Solving for the WACC, we get WACC = 11 %

f. By definition, $r_{wacc} = \frac{E}{V} \times r_E + \frac{D}{V} \times r_D \times (1 - \tau_c)$.

The return on the debt is 5%; the value of the debt is $5,000, the value of the firm is $15,000 and therefore the value of the equity is $15,000-$5,000 = $10,000. Plugging into the above expression, we get:

$$11\% = \frac{\$10{,}000}{\$15{,}000} \times r_E + \frac{\$5{,}000}{\$15{,}000} \times 5\% \times (1 - 0.4) \Rightarrow r_E = 15\%$$

g. From the CAPM, β_E must satisfy $15\% = 5\% + \beta_E(11\% - 5\%)$, so we conclude $\beta_E = 1.66$.

The relationship holds since ($10,000/$15,000) × 1.66 = 1.11, and the beta of the debt equals 0.

h. The debt is expected to increase to $\$5{,}000 \times (1 + 0.03) = \$5{,}150$; so the equity holders will get $150 due to the increase in debt. These proceeds will increase by 3% annually. (The second year debt will be $\$5{,}000 \times (1 + 0.03)^2 = \$5{,}304.5$, with an increase in debt of $154.5, 3% higher than the $150 proceeds of year 1.) The expected FCF to equity at the end of the first year is therefore EBIT – Interest – Taxes + Debt proceeds, or

FCFE = (2000 – 250) × (1 – .40) + 150 = $1200

This cash flow is expected to grow at 3% per year. Thus, another way to compute the value of equity is to discount these cash flows directly at the MCR for the equity of 15% (from (f)):

$$E = \frac{FCFE}{r_E - g} = \frac{1200}{15\% - 3\%} = 10{,}000.$$

This is the same value we computed in (d), using the APV.

18-12.

a. E = $50 × 2.5 B = $125 B

D = 0.20 × 125 B = $25 B

V^L = E +D = $150 B

From CAPM: Equity Cost of Capital = 4% + 0.5(10% – 4%) = 7%

WACC = (125 / 150) 7% + (25 / 150) 4.2% (1 – 35%) = 6.29%

$V^L = FCF/(r_{wacc} - g) \Rightarrow g = r_{wacc} - FCF/V = 6.29\% - 6/150 = 2.29\%$

b. Initial Unlevered cost of capital (Eq. 18.6) = (125 / 150) 7% + (25 / 150) 4.2% = 6.53%

New Equity cost of capital (Eq. 18.10) = 6.53% + (.5)(6.53% – 4.5%) = 7.55%

New WACC = (1 / 1.5) 7.55% + (.5 / 1.5) 4.5% (1 – 35%) = 6.01%

$V^L = FCF / (r_{wacc} - g) = 6.0 / (6.01\% - 2.29\%) = 161.29$

This is a gain of 161.29 – 150 = $11.29 B or 11.29/2.5 = $4.52 per share

Thus, share price rises to $54.52/share

18-13.

a. From Eq. 14.9, UAL Asset beta = (1/2) 1.5 + (1/2) 0.3 = 0.90

We can use this for AMR's asset beta.

To derive the equity beta, since AMR's debt is risk free we have (Eq. 14.10):

Equity Beta = Asset Beta × (1 + D/E) = 0.9 × 1.30 = 1.17

From the SML

$r_e = 5\% + 1.17(11\% - 5\%) = 12.02\%$

Alternatively, given an asset or unlevered beta of 0.90 for AMR, we have (from SML):

$r_u = 5\% + 0.90(11\% - 5\%) = 10.4\%$

Then we can solve for r_e using Eq. 18.10:

$r_e = 10.4\% + 0.30\ (10.4\% - 5\%) = 12.02\%$

b. Since D/E ratio is stable, we can value AMR using the WACC approach.

WACC = (1/1.3) 12.02% + (.3/1.3) 5% (1 – 40%) = 9.94%

Levered value of AMR (as a constant growth perpetuity):

$D + E = V^L = FCF/(r_{wacc} - g) = 15\ /\ (9.94\% - 4\%) = \$252.52$ million

$E = (E\ /\ (D + E)) \times V^L = 252.52\ /\ 1.3 = \$194.25$ million

Share price = 194.25 / 10 = $19.43

18-14.

a. Before Change: From the SML, $r_E = 5\% + 1.50 \times 6\% = 14\%$

Since the firm has no leverage, $r_{wacc} = r_U = r_E = 14\%$

After the change, from Eq. 18.10:

$r_E = 14\% + 0.30(14\% - 6.5\%) = 16.25\%$

Since the firm has D/E of 0.30, the WACC formula is

$$\begin{aligned} r_{wacc} &= \frac{E}{D+E}R_E + \frac{D}{D+E}R_D(1-T_C) \\ &= \frac{1}{1.3}16.25 + \frac{.3}{1.3}6.5(1-.35) \\ &= 13.475\% \end{aligned}$$

We can also use Eq. 18.11: rwacc = 14% – (.3 / 1.3)(.35)(6.5%) = 13.475%

b. We can compare Remex's value with and without leverage. Without leverage (and no expected growth),

$$V^U = \frac{FCF}{r_U} = \frac{25}{14\%} = \$178.57 \text{ million}$$

With leverage (and no expected growth):

$$V^L = \frac{FCF}{r_{wacc}} = \frac{25}{13.475\%} = \$185.53 \text{ million}$$

Therefore, PV(ITS) = $V^L - V^U$ = 185.53 – 178.57 = $6.96 million

18-15.

a. Unlevered value $V^U = FCF / (r_U - g) = 2.5 / (10\% - 4\%) = \$41.67$ million

b. From Eq. 18.14, $V^L = (1 + \tau_c k) V^U = (1 + 0.40 \times 0.20)\ 41.67 = \$45$ million

c. Interest = 20%(FCF) = 20%(2.5) = \$0.5 million = $r_D D = 0.05 D$

Therefore, D = 0.5 / 0.05 = \$10 million

d. Debt-to-value $d = D / V^L = 10 / 45 = 0.2222$.

From Eq. 18.11, $r_{wacc} = 10\% - (0.2222)(0.40)5\% = 9.556\%$

e. Using the WACC method, $V^L = 2.5 / (9.556\% - 4\%) = \$45$ million

18-16.

a. First,

Interest Payment = Interest Rate (5%) × Prior period debt

From the tax calculation in the spreadsheet, we can see that the tax rate is 2.4/6 = 40%. Therefore,
Interest Tax shield = Interest Payment × Tax Rate (40%)

Because the tax shields are predetermined, we can discount them using the 5% debt cost of capital.

$$\text{PV(ITS)} = \frac{0.40(0.05)(80)}{1.05} + \frac{0.40(0.05)(80)}{1.05^2} + \frac{0.40(0.05)(60)}{1.05^3} + \frac{0.40(0.05)(40)}{1.05^4}$$
$$= \$4.67 \text{ million}$$

	Year 0	Year 1	Year 2	Year 3	Year 4
Debt	80	80	60	40	0
Interest at 5.0%		4	4	3	2
Tax shield 40.0%		1.6	1.6	1.2	0.8
PV 5.0%	\$4.67				

b. We can use Eq. 7.5:

$$FCF = EBIT \times (1 - T_c) + \text{Depreciation} - \text{CapEx} - \Delta NWC$$

	0	1	2	3	4
EBIT		10	10	10	10
Taxes		-4	-4	-4	-4
Unlevered Net Income		6	6	6	6
Depreciation		25	25	25	25
Cap Ex	-100				
Additions to NWC	-20				20
FCF	-120	31	31	31	51

Alternatively, we can use Eq. 18.9:

$$FCF = FCFE + Int \times (1 - T_C) - \text{ Net New Debt}$$

	Year 0	Year 1	Year 2	Year 3	Year 4
FCFE	-40	28.6	8.6	9.2	9.8
+ After-tax Interest		2.4	2.4	1.8	1.2
- Net New Debt	-80	0	20	20	40
FCF	-120	31	31	31	51

c. With predetermined debt levels, the APV method is easiest.

Step 1: Determine r_U. Assuming the company has maintained a historical D/E ratio of 0.20, we can approximate its unlevered cost of capital using Eq. 18.6:

$$r_U = (1 / 1.2)\ 11\% + (.2 / 1.2)\ 5\% = 10\%$$

Step 2: Compute NPV of FCF without leverage

$$\text{NPV} = -120 + \frac{31}{1.10} + \frac{31}{1.10^2} + \frac{31}{1.10^3} + \frac{51}{1.10^4} = -8.1$$

Step 3: Compute APV

$$APV = NPV + PV(ITS) = -8.1 + 4.7 = -3.4$$

So the project actually has negative value.

18-17.

a. First we compute the FCF:

$$FCF_0 = -600 \text{ (Capex)} - 50 \text{ (Inc in NWC)} = -650$$

Using Eq. 7.6:

$$FCF_{1-9} = 145 \times (1 - 0.35) + 0.35 \times 60 = 115.25$$

After-tax Salvage Value = 300 × (1 – 0.35) = 195

$$FCF_{10} = 145 \times (1 - 0.35) + 0.35 \times 60 + 50 \text{ (Inc in NWC)} + 195 \text{ (salvage)}$$
$$= 360.25$$

From the CAPM, $r_U = 5\% + 1.67(11\% - 5\%) = 15\%$

Therefore,

$$\text{NPV} = -650 + 115.25 \times \frac{1}{.15}\left(1 - \frac{1}{1.15^9}\right) + \frac{360.25}{1.15^{10}} = -11.0$$

Without leverage, project NPV is -$11 million.

b. Because the debt level is predetermined, we can use the APV approach. Because the bonds initially trade at par, the interest payments are the 9% coupon payments of the bond. Assuming annual coupons:

$$PV(ITS) = 400 \times 0.09 \times 0.35 \times \frac{1}{.09}\left(1 - \frac{1}{1.09^{10}}\right) = \$80.9 \text{ million}$$

Therefore,

APV = NPV + PV(ITS) = –11 + 81 = \$70 million

Note that this project is only profitable as a result of the tax benefits of leverage.

18-18.

a. Because the debt is permanent, the value of the tax shield is 35% × D. From that we must deduct the 5% issuance cost, and the PV of distress and agency costs to determine the net benefit of leverage.

Debt Amount (\$M):	0	10	20	30	40	50
PV of Expected Distress and Agency Costs (\$M):	0.0	–0.3	–1.8	–4.3	–7.5	–11.3
Tax Benefit less Issuance Cost (30%):	0.0	+3.0	+6.0	+9.0	+12.0	+15.0
Net Benefit:	0.0	+2.7	+4.2	+4.7	+4.5	+3.7

Based on this information, the greatest net benefit occurs for debt = \$30 million

b. Value of assets goes up from \$100M to \$104.7 M. Thus, the share price should rise to \$26.175.

18-19.

a. With permanent debt the APV method is simplest. NPV(unlevered) = –150 + 20 / 0.10 = \$50 million. PV(ITS) = τ_c × D = 35% × 100 = \$35 million. Thus, the NPV with leverage is APV = NPV + PV(ITS) = 50 + 35 = \$85 million.

b. Financing costs = 2% × 100 + 5% × 50 = \$4.5 million. (We assume these amounts are after-tax.)

Underpricing cost = (5 / 40) × 50 = \$6.25 million.

APV = 85 – 4.5 – 6.25 = 74.25 million

18-20.

a. We use Eq. 18.6 with the true debt cost:

$$r_u = \frac{E}{E+D} r_E + \frac{D}{E+D} r_D = 0.50 \times 10\% + 0.50 \times 6.50\% = 8.25\%$$

b. The unlevered value is the PV of the FCF discounted at r_U:

$$V^U = 18 \times \frac{1}{.0825}\left(1 - \frac{1}{1.0825^4}\right) = \$59.29 \text{ million}$$

The amount of the interest tax shield each period is that same as computed in Table 18.5 in the text, but now we discount at $r_u = 8.25\%$:

$$PV(ITS) = \frac{0.73}{1.0825} + \frac{0.57}{1.0825^2} + \frac{0.39}{1.0825^3} + \frac{0.20}{1.0825^4} = \$1.62 \text{ million}$$

c. The loan guarantee reduces the interest paid from 6.5% to 6% each year. Thus, the savings in year t is $0.5\% \times D_{t-1}$. The value of the loan guarantee is the present value of this savings. Because the debt amount D will vary with the value of the project over time, we discount the savings at rate r_U.

$$NPV(Loan) = \frac{.005 \times 30.62}{1.0825} + \frac{.005 \times 23.71}{1.0825^2} + \frac{.005 \times 16.32}{1.0825^3} + \frac{.005 \times 8.43}{1.0825^4} = \$0.34 \text{ million}$$

d. $APV = V^U + PV(ITS) + NPV(Loan) = 59.29 + 1.62 + 0.34 = \$61.25$ million

Note that this is the same value we originally computed using the WACC method, where we used the firm's actual borrowing cost rather than the true rate it would have received.

18-21.

a. $r_{wacc} = r_u - d\tau_c(r_D) = 9\% - (.5/1.5)(0.40)5\% = 8.333\%$

b.
$$\begin{aligned} r_{wacc} &= r_u - d\tau_c(r_D + \phi(r_u - r_D)) \\ &= 9\% - (.5/1.5)(0.40)\left(5\% + \frac{.05}{1.05}(9\% - 5\%)\right) = 8.308\% \end{aligned}$$

Alternatively, from Eq. 18.17:

$$\begin{aligned} r_{wacc} &= r_u - d\tau_c r_D \frac{1 + r_u}{1 + r_D} \\ &= 9\% - (.5/1.5)(0.40)5\% \frac{1.09}{1.05} = 8.308\% \end{aligned}$$

c. In case (a), $V^L = 10/(.08333 + .02) = \$96.78$ million .

In case (b), $V^L = 10/(.08308 + .02) = \$97.01$ million .

Note the minor difference in the two cases. Case (b) is higher because the tax shields are less risky when debt is fixed over the year.

18-22.

a. $V^U = 10.9 / 10\% = \$109$ million. $PV(ITS) = 0.40 \times \$40$ million $= \$16$ million.

$V^L = APV = 109 + 16 = \$125$ million, so $E = 125 - 40 = \$85$ million.

b.
$$\begin{aligned} r_{wacc} &= r_u - d\tau_c(r_D + \phi(r_u - r_D)) = r_u - d\tau_c(r_D + r_u - r_D) \\ &= r_u - d\tau_c r_u \\ &= 10\% - (40/125)(0.40)10\% = 8.72\% \end{aligned}$$

Using the WACC method, $V^L = 10.9 / 8.72\% = \$125$ million, so $E = 125 - 40 = \$85$ million.

c. If XL's debt cost of capital is 5%, what is XL's equity cost of capital?

From Eq. 18.20:

$$r_E = r_u + \frac{D^s}{E}(r_u - r_D)$$
$$= 10\% + \frac{40-16}{125-40}(10\% - 5\%) = 11.412\%$$

d. FCFE = FCF – After-tax Interest + Net new debt = 10.9 – 5%(1 – 0.40)40 = 9.7

E = 9.7 / 0.11412 = \$85 million.

18-23.

a. Note that this answer actually uses the APV method instead of the WACC method.

We compute V^U at each date by discounting the project's <u>future</u> FCF at rate r_U = 12%.

($V_t^U = NPV(r_U, FCF_{t+1} : FCF_T)$):

Year	**0**	**1**	**2**	**3**
FCF	-50	40	20	25
$\mathbf{V^u}$	\$69.45	\$37.79	\$22.32	

Then we compute the value of the future interest tax shields at each date by discounting at rate rD = 8%:

Year	**0**	**1**	**2**	**3**
D	50	30	15	0
interest at 8%		4	2.4	1.2
tax shield at 40%		1.6	0.96	0.48
PV(ITS)	\$2.69	\$1.30	\$0.44	

Finally, we compute V^L = APV = V^U + PV(ITS):

Year	**0**	**1**	**2**	**3**
$\mathbf{V^u}$	\$69.45	\$37.79	\$22.32	
PV(ITS)	\$2.69	\$1.30	\$0.44	
$\mathbf{V^L}$	\$72.14	\$39.09	\$22.77	

Given the initial investment of \$50, the project's NPV is 72.14 – 50 =\$22.14.

b. We can compute the WACC at each date using Eq. 18.21. The debt-to-value ratio, d, is given by D / V^L. The debt persistence ϕ is given by $T^s/(\tau_c D)$, where T^s =PV(ITS) (since all tax shields are predetermined):

Year	0	1	2	3
D	50	30	15	0
V^L	\$72.14	\$39.09	\$22.77	
$d = D/V^L$	69%	77%	66%	
T^s = PV(ITS)	\$2.69	\$1.30	\$0.44	
T^s/t_cD	13.4%	10.8%	7.4%	
r_{wacc}	9.63%	9.41%	9.81%	

Note that the WACC changes over time, decreasing from date 0 to 1, and increasing from date 1 to 2. The WACC fluctuates because the leverage ratio of the project changes over time (as does the persistence of the debt).

c. We can compute the levered value of the project by discounting the FCF using the WACC at each date:

$$V_2^L = \frac{FCF_3}{1+r_{wacc}(2)} = \frac{25}{1.0981} = \$22.77$$

$$V_1^L = \frac{FCF_2 + V_2^L}{1+r_{wacc}(1)} = \frac{20+22.77}{1.0941} = \$39.09$$

$$V_0^L = \frac{FCF_1 + V_1^L}{1+r_{wacc}(0)} = \frac{40+39.09}{1.0963} = \$72.14$$

Note that these results coincide with part (a).

d. We can compute the project's equity cost of capital using Eq. 18.20. Note that $D^s = D - T^s = D - PV(ITS)$:

Year	0	1	2	3
$D^s = D - T^s$	\$47.31	\$28.70	\$14.56	
$E = V^L - D$	\$22.14	\$9.09	\$7.77	
D^s/E	2.14	3.16	1.87	
r_E	20.55%	24.63%	19.50%	

Note the equity cost of capital rises and then falls with the project's effective debt-equity ratio, D^s/E.

e) We first compute FCFE at each date by deducting the after-tax interest expenses (equivalently, deducting interest and adding back the tax shield) and adding net increases in debt:

Year	0	1	2	3
FCF	-50	40	20	25
- Interest		-4	-2.4	-1.2
+ Tax shield		1.6	0.96	0.48
+ Inc. in Debt	50	-20	-15	-15
FCFE	0	17.6	3.56	9.28
E	22.14	9.09	7.77	

Then, we compute the equity value of the project by discounting FCFE using r_E at each date:

$$E_2 = \frac{FCFE_3}{1+r_E(2)} = \frac{9.28}{1.1950} = \$7.77$$

$$E_1 = \frac{FCFE_2 + E_2}{1+r_E(1)} = \frac{3.56+7.77}{1.2463} = \$9.09$$

$$E_0 = \frac{FCFE_1 + E_1}{1+r_E(0)} = \frac{17.60+9.09}{1.2055} = \$22.14$$

These values for equity match those computed earlier, and match the project's initial NPV.

Note that to use the WACC or FTE methods here, we relied on V^L computed in the APV method. We could also solve for the value using the WACC or FTE methods directly using the techniques in appendix 18A.3.

18-24.

a. From Eq. 18.25, $\tau* = 1 - (1 - 0.40)(1 - 0.20) / (1 - 0.40) = 20\%$.

Using the APV method, $V^L = V^U + \tau c\, D = 100 + 0.20 \times 50 = \$110$ million

b. With a constant debt-to-value ratio, the WACC approach is easiest. We need to determine Gartner's WACC with this new leverage policy. To compute the WACC, we need to determine the new equity cost of capital using Eq. 18.24:

$$r_U = \frac{E}{E+D^s} r_E + \frac{D^s}{E+D^s} r_D^*$$

Because Gartner initially has no leverage, $r_U = r_E = 10\%$. Next, $r_D* = r_D (1 - \tau i)/(1 - \tau e) = 6.67\%(1 - 0.40) / (1 - 0.20) = 5.00\%$. With a constant debt-to-value ratio, $T^s = 0$ and $D^s / (E + D^s) = D /(E + D) = 50\%$. Thus,

$$10\% = 0.50 r_E + 0.50(5\%)$$

implying that r_E rises to 15%. Therefore, Gartner's WACC is

$$r_{wacc} = \frac{E}{E+D} r_E + \frac{D}{E+D} r_D (1-\tau_c) = 0.50(15\%) + 0.50(6.67\%)(1-0.40) = 9.50\%$$

We also need to estimate Gartner's FCF. Based on its current market cap,

$100 = FCF / (10\% - 3\%)$ implies $FCF = \$7$ million.

Therefore, with the new leverage,

$V^L = 7 / (9.50\% - 3\%) = \$\ 107.69$ million

18-25.

a. $r_{wacc} = \frac{E}{E+D} r_E + \frac{D}{E+D} r_D (1-\tau_c) = (1/1.5)(12\%) + (.5/1.5)(6\%)(1-0.35) = 9.3\%$

b. From Eq. 18.6:

$$r_U = \frac{E}{E+D} r_E + \frac{D}{E+D} r_D = (1/1.5)(12\%) + (.5/1.5)(6\%) = 10\%$$

From Eq. 18.11:

$$r_{wacc} = r_U - d\tau_c r_D = 10\% - (2/3)(.35)6\% = 8.6\%$$

c. Given their initial capital structure, we would estimate Revtek's unlevered cost of capital as (using Eq. 18.24)

$$r_U = \frac{E}{E+D} r_E + \frac{D}{E+D} r_D^* = (1/1.5)(12\%) + (.5/1.5)(4.235\%) = 9.41\%$$

We can also use Eq. 18.24 to calculate r_E with higher leverage:

$$9.41\% = (1/3)r_E + (2/3)4.235\% \text{ so that } r_E = 19.76$$

Then,

$$r_{wacc} = \frac{E}{E+D} r_E + \frac{D}{E+D} r_D (1-\tau_c) = (1/3)(19.76\%) + (2/3)(6\%)(1-0.35) = 9.19\%$$

d. When investors pay higher taxes on interest income than equity income, the tax benefit of leverage is reduced. Thus, for the same increase in leverage, the decline in the WACC is smaller in the presence of investor taxes.

Chapter 19
Valuation and Financial Modeling: A Case Study

19-1. Ideko's 2005 sales are $75 million.

Find the highest and lowest EBITDA values across all three firms and the industry as a whole:

	EBITDA/Sales (%)	EBITDA ($ mil)
Oakley	17.0	12.75
Luxcottica	18.5	13.875
Nike	15.9	11.925
Industry	12.1	9.075

This implies an EBITDA range of $9.075 to $13.875 million.

19-2. First compute the projected annual market share:

		Growth/Yr	2005	2006	2007	2008	2009	2010
Sales Data								
1	Market Size (000 units)	5.0%	10,000	10,500	11,025	11,576	12,155	12,763
2	Market Share	0.5%	10.0%	10.5%	11.0%	11.5%	12.0%	12.5%
3	Ave. Sales Price ($/unit)	2.0%	75.00	76.50	78.03	79.59	81.18	82.81

Using these projections, calculate the projected annual production volume:

		2005	2006	2007	2008	2009	2010
Production Volume (000 units)							
1	Market Size	10,000	10,500	11,025	11,576	12,155	12,763
2	Market Share	10.0%	10.5%	11.0%	11.5%	12.0%	12.5%
3	Production Volume (1x2)	1,000	1,103	1,213	1,331	1,459	1,595

Based on these estimates, it will take to 2010 before current capacity will be exceeded and an expansion becomes necessary.

19-3.

			2005	2006	2007	2008	2009	2010
Debt & Interest Table ($000s)								
1	Outstanding Debt		100,000	100,000	100,000	100,000	100,000	115,000
2	Interest on Term Loan	6.80%		(6,800)	(6,800)	(6,800)	(6,800)	(6,800)
3	Interest Tax Shield			2,380	2,380	2,380	2,380	2,380

19-4.

	Year	2005	2006	2007	2008	2009	2010
INCOME STATEMENT ($000s)							
1	Sales	75,000	84,341	94,631	105,956	118,413	132,105
2	Cost of Goods Sold						
3	Raw Materials	(16,000)	(17,816)	(19,794)	(21,946)	(24,285)	(26,828)
4	Direct Labor Costs	(18,000)	(20,639)	(23,611)	(26,955)	(30,715)	(34,938)
5	**Gross Profit**	41,000	45,886	51,226	57,056	63,413	70,339
6	Sales & Marketing	(11,250)	(13,916)	(17,034)	(20,662)	(23,683)	(26,421)
7	Administration	(13,500)	(12,651)	(14,195)	(14,834)	(15,394)	(17,174)
8	**EBITDA**	16,250	19,319	19,998	21,560	24,337	26,745
9	Depreciation	(5,500)	(5,450)	(5,405)	(5,365)	(5,328)	(6,795)
10	**EBIT**	10,750	13,869	14,593	16,196	19,009	19,949
11	Interest Expense (net)	(75)	(6,800)	(6,800)	(6,800)	(6,800)	(6,800)
12	**Pretax Income**	10,675	7,069	7,793	9,396	12,209	13,149
13	Income Tax	(3,736)	(2,474)	(2,728)	(3,289)	(4,273)	(4,602)
14	**Net Income**	**6,939**	**4,595**	**5,065**	**6,107**	**7,936**	**8,547**

19-5.

	Year	2005	2006	2007	2008	2009	2010
Working Capital ($000s)							
Assets							
1	Accounts Receivable	18,493	13,864	15,556	17,418	19,465	21,716
2	Raw Materials	1,973	1,464	1,627	1,804	1,996	2,205
3	Finished Goods	4,192	4,741	5,351	6,029	6,781	7,615
4	Minimum Cash Balance	6,164	6,932	7,778	8,709	9,733	10,858
5	Total Current Assets	30,822	27,002	30,312	33,959	37,975	42,394
Liabilities							
6	Wages Payable	1,295	1,368	1,554	1,717	1,895	2,142
7	Other Accounts Payable	3,360	3,912	4,540	5,253	5,914	6,565
8	Total Current Liabilities	4,654	5,280	6,094	6,970	7,809	8,706
Net Working Capital		26,168	21,722	24,218	26,989	30,166	33,687
9	Increase in Net Working Capital		(4,446)	2,496	2,771	3,177	3,521

19-6.

	Year	2005	2006	2007	2008	2009	2010
Working Capital ($000s)							
Assets							
1	Accounts Receivable	18,493	20,796	23,334	26,126	29,198	32,574
2	Raw Materials	1,973	2,197	2,440	2,706	2,994	3,308
3	Finished Goods	4,192	4,741	5,351	6,029	6,781	7,615
4	Minimum Cash Balance	6,164	6,932	7,778	8,709	9,733	10,858
5	Total Current Assets	30,822	34,666	38,903	43,569	48,705	54,354
Liabilities							
6	Wages Payable	1,295	1,368	1,554	1,717	1,895	2,142
7	Other Accounts Payable	3,360	3,912	4,540	5,253	5,914	6,565
8	Total Current Liabilities	4,654	5,280	6,094	6,970	7,809	8,706
Net Working Capital		26,168	29,386	32,809	36,599	40,897	45,648
9	Increase in Net Working Capital		3,218	3,423	3,790	4,297	4,751

19-7.

		Year 2005	2006	2007	2008	2009	2010
Free Cash Flow ($000s)							
1	**Net Income**		4,595	5,065	6,107	7,936	8,547
2	Plus: After-Tax Interest Expense		4,420	4,420	4,420	4,420	4,420
3	**Unlevered Net Income**		9,015	9,485	10,527	12,356	12,967
4	Plus: Depreciation		5,450	5,405	5,365	5,328	6,795
5	Less: Increases in NWC		4,446	(2,496)	(2,771)	(3,177)	(3,521)
6	Less: Capital Expenditures		(5,000)	(5,000)	(5,000)	(5,000)	(20,000)
7	**Free Cash Flow of Firm**		13,911	7,394	8,121	9,507	(3,759)
8	Plus: Net Borrowing		-	-	-	-	15,000
9	Less: After-Tax Interest Expense		(4,420)	(4,420)	(4,420)	(4,420)	(4,420)
10	**Free Cash Flow to Equity**		9,491	2,974	3,701	5,087	6,821

19-8.

		Year 2005	2006	2007	2008	2009	2010
Free Cash Flow ($000s)							
1	**Net Income**		4,595	5,065	6,107	7,936	8,547
2	Plus: After-Tax Interest Expense		4,420	4,420	4,420	4,420	4,420
3	**Unlevered Net Income**		9,015	9,485	10,527	12,356	12,967
4	Plus: Depreciation		5,450	5,405	5,365	5,328	6,795
5	Less: Increases in NWC		(3,218)	(3,423)	(3,790)	(4,297)	(4,751)
6	Less: Capital Expenditures		(5,000)	(5,000)	(5,000)	(5,000)	(20,000)
7	**Free Cash Flow of Firm**		6,246	6,467	7,102	8,387	(4,989)
8	Plus: Net Borrowing		-	-	-	-	15,000
9	Less: After-Tax Interest Expense		(4,420)	(4,420)	(4,420)	(4,420)	(4,420)
10	**Free Cash Flow to Equity**		1,826	2,047	2,682	3,967	5,591

19-9.

		Year	2005	2006	2007	2008	2009	2010
BALANCE SHEET ($000s)								
Assets								
1	Cash & Cash Equivalents		6,164	6,932	7,778	8,709	9,733	10,858
2	Accounts Receivable		18,493	13,864	15,556	17,418	19,465	21,716
3	Inventories		6,164	6,205	6,978	7,833	8,777	9,820
4	**Total Current Assets**		30,822	27,002	30,312	33,959	37,975	42,394
5	Property, Plant and Equipment		49,500	49,050	48,645	48,281	47,952	61,157
6	Goodwill		72,332	72,332	72,332	72,332	72,332	72,332
7	**Total Assets**		152,654	148,384	151,289	154,572	158,259	175,883
Liabilities								
8	Accounts Payable		4,654	5,280	6,094	6,970	7,809	8,706
9	Debt		100,000	100,000	100,000	100,000	100,000	115,000
10	**Total Liabilities**		104,654	105,280	106,094	106,970	107,809	123,706
Stockholders' Equity								
11	Starting Stockholders' Equity			48,000	43,104	45,195	47,601	50,451
12	Net Income			4,595	5,065	6,107	7,936	8,547
13	Dividends		(2,000)	(9,491)	(2,974)	(3,701)	(5,087)	(6,821)
14	Capital Contributions		50,000	-	-	-	-	-
15	**Stockholders' Equity**		48,000	43,104	45,195	47,601	50,451	52,177
16	**Total Liabilities & Equity**		152,654	148,384	151,289	154,572	158,259	175,883

		Year	2005	2006	2007	2008	2009	2010
STATEMENT OF CASH FLOWS ($000s)								
1	**Net Income**			4,595	5,065	6,107	7,936	8,547
2	Depreciation			5,450	5,405	5,365	5,328	6,795
3	Changes in Working Capital							
4	Accounts Receivable			4,629	(1,691)	(1,862)	(2,048)	(2,251)
5	Inventory			(41)	(773)	(854)	(944)	(1,043)
6	Accounts Payable			626	814	876	838	898
7	**Cash from Operating Activities**			15,259	8,820	9,632	11,110	12,946
8	Capital Expenditures			(5,000)	(5,000)	(5,000)	(5,000)	(20,000)
9	Other Investment			-	-	-	-	-
10	**Cash from Investing Activities**			(5,000)	(5,000)	(5,000)	(5,000)	(20,000)
11	Net Borrowing			-	-	-	-	15,000
12	Dividends			(9,491)	(2,974)	(3,701)	(5,087)	(6,821)
13	Capital Contributions			-	-	-	-	-
14	**Cash from Financing Activities**			(9,491)	(2,974)	(3,701)	(5,087)	8,179
15	**Change in Cash & Cash Equivalents**			768	846	931	1,024	1,125

19-10.

	Year	2005	2006	2007	2008	2009	2010
BALANCE SHEET ($000s)							
Assets							
1	Cash & Cash Equivalents	6,164	6,932	7,778	8,709	9,733	10,858
2	Accounts Receivable	18,493	20,796	23,334	26,126	29,198	32,574
3	Inventories	6,164	6,938	7,792	8,734	9,775	10,922
4	**Total Current Assets**	30,822	34,666	38,903	43,569	48,705	54,354
5	Property, Plant and Equipment	49,500	49,050	48,645	48,281	47,952	61,157
6	Goodwill	72,332	72,332	72,332	72,332	72,332	72,332
7	**Total Assets**	152,654	156,048	159,880	164,182	168,990	187,844
Liabilities							
8	Accounts Payable	4,654	5,280	6,094	6,970	7,809	8,706
9	Debt	100,000	100,000	100,000	100,000	100,000	115,000
10	**Total Liabilities**	104,654	105,280	106,094	106,970	107,809	123,706
Stockholders' Equity							
11	Starting Stockholders' Equity		48,000	50,768	53,786	57,212	61,181
12	Net Income		4,595	5,065	6,107	7,936	8,547
13	Dividends	(2,000)	(1,826)	(2,047)	(2,682)	(3,967)	(5,591)
14	Capital Contributions	50,000	-	-	-	-	-
15	**Stockholders' Equity**	48,000	50,768	53,786	57,212	61,181	64,137
16	**Total Liabilities & Equity**	152,654	156,048	159,880	164,182	168,990	187,844

	Year	2005	2006	2007	2008	2009	2010
STATEMENT OF CASH FLOWS ($000s)							
1	**Net Income**		4,595	5,065	6,107	7,936	8,547
2	Depreciation		5,450	5,405	5,365	5,328	6,795
3	Changes in Working Capital						
4	Accounts Receivable		(2,303)	(2,537)	(2,793)	(3,072)	(3,376)
5	Inventory		(773)	(854)	(943)	(1,040)	(1,148)
6	Accounts Payable		626	814	876	838	898
7	**Cash from Operating Activities**		7,594	7,893	8,613	9,990	11,717
8	Capital Expenditures		(5,000)	(5,000)	(5,000)	(5,000)	(20,000)
9	Other Investment		-	-	-	-	-
10	**Cash from Investing Activities**		(5,000)	(5,000)	(5,000)	(5,000)	(20,000)
11	Net Borrowing		-	-	-	-	15,000
12	Dividends		(1,826)	(2,047)	(2,682)	(3,967)	(5,591)
13	Capital Contributions		-	-	-	-	-
14	**Cash from Financing Activities**		(1,826)	(2,047)	(2,682)	(3,967)	9,409
15	**Change in Cash & Cash Equivalents**		768	846	931	1,024	1,125

19-11. $r_u = r_f + \beta_u \left(E\left[R_{mkt}\right] - r_f\right) = 4\% + 1.1(5\%) = 9.5\%$

19-12. $r_u = r_f + \beta_u \left(E\left[R_{mkt}\right] - r_f\right) = 5\% + 1.2(6\%) = 12.2\%$

19-13.

Continuation Value: Multiples Approach ($000s)				
1	EBITDA in 2010	26,745	**Common Multiples**	
2	EBITDA multiple	9.1x	EV/Sales	1.8x
3	**Cont. Enterprise Value**	**243,377**	P/E (levered)	15.0x
4	Debt	(115,000)	P/E (unlevered)	18.8x
5	**Cont. Equity Value**	**128,377**		

19-14. It does not affect the answer because the working capital savings do not affect EBITDA or debt levels.

Continuation Value: Multiples Approach ($000s)				
1	EBITDA in 2010	26,745	**Common Multiples**	
2	EBITDA multiple	9.1x	EV/Sales	1.8x
3	**Cont. Enterprise Value**	**243,377**	P/E (levered)	15.0x
4	Debt	(115,000)	P/E (unlevered)	18.8x
5	**Cont. Equity Value**	**128,377**		

19-15. Approximately 5.6%.

Continuation Value: DCF and EBITDA Multiple ($000s)				
1	Long-term growth rate	5.60%	Target D/(E+D)	40.0%
2			Projected WACC	9.05%
Free Cash Flow in 2011				
3	Unlevered Net Income	13,693	**Cont. Enterprise Value**	**243,098**
4	Less: Inc. in NWC	(1,886)		
5	Less: Inc. in Fixed Assets	(3,425)	**Implied EBITDA Multiple**	**9.1x**
6	Free Cash Flow	8,382		

19-16. Approximately 6.05%.

Continuation Value: DCF and EBITDA Multiple ($000s)				
1	Long-term growth rate	6.05%	Target D/(E+D)	40.0%
2			Projected WACC	9.05%
Free Cash Flow in 2011				
3	Unlevered Net Income	13,752	**Cont. Enterprise Value**	**243,161**
4	Less: Inc. in NWC	(2,762)		
5	Less: Inc. in Fixed Assets	(3,700)	**Implied EBITDA Multiple**	**9.1x**
6	Free Cash Flow	7,290		

19-17. The equity value is \$90 million so the NPV of the deal is 90 – 53=\$37 million.

		Year	2005	2006	2007	2008	2009	2010
APV Method (\$ millions)								
1	Free Cash Flow			13,911	7,394	8,121	9,507	(3,759)
2	**Unlevered Value V^u**		**180,136**	**184,238**	**195,268**	**206,674**	**217,835**	**243,377**
3	Interest Tax Shield			2,380	2,380	2,380	2,380	2,380
4	**Tax Shield Value T^s**		**9,811**	**8,098**	**6,269**	**4,315**	**2,228**	**-**
5	**APV: $V^L = V^u + T^s$**		**189,946**	**192,336**	**201,537**	**210,989**	**220,063**	**243,377**
6	Debt		(100,000)	(100,000)	(100,000)	(100,000)	(100,000)	(115,000)
7	**Equity Value**		**89,946**	**92,336**	**101,537**	**110,989**	**120,063**	**128,377**

19-18. The equity value is \$80 million so the NPV of the deal is 90 – 53=\$27 million.

		Year	2005	2006	2007	2008	2009	2010
APV Method (\$ millions)								
1	Free Cash Flow			6,246	6,467	7,102	8,387	(4,989)
2	**Unlevered Value V^u**		**170,107**	**180,872**	**192,492**	**204,639**	**216,717**	**243,377**
3	Interest Tax Shield			2,380	2,380	2,380	2,380	2,380
4	**Tax Shield Value T^s**		**9,811**	**8,098**	**6,269**	**4,315**	**2,228**	**-**
5	**APV: $V^L = V^u + T^s$**		**179,918**	**188,970**	**198,760**	**208,954**	**218,945**	**243,377**
6	Debt		(100,000)	(100,000)	(100,000)	(100,000)	(100,000)	(115,000)
7	**Equity Value**		**79,918**	**88,970**	**98,760**	**108,954**	**118,945**	**128,377**

19-19. The value of the savings in working capital management is the difference between the value with and without the savings—approximately \$10 million.

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