Basics of Engineering Economy 3rd edition Blank Solutions Manual

SKU: 9781259875984-SOLUTIONS

Solutions to end-of-chapter problems

Basics of Engineering Economy, 3rd edition

Leland Blank and Anthony Tarquin

Chapter 1
Foundations of Engineering Economy

1.1 In an economic analysis of alternatives, list three items that are typically included as part of the evaluation.

Purchase cost, useful life, maintenance & operating costs, salvage value, inflation rate, and interest rate.

1.2 What is the name of the alternative that represents the *status quo*?

The alternative that represents the status quo is called the *do-nothing alternative*.

1.3 What is the primary evaluation criterion used in engineering economic analysis?

The primary evaluation criterion is cost.

1.4 List three evaluation criteria besides initial cost that might be used for selecting the best automobile to purchase.

Fuel rating, crash protection, acceleration, body styling, color, environmental impacts, and resale value.

1.5 Identify the following factors as either economic (tangible) or noneconomic (intangible); first cost, leadership, taxes, salvage value, morale, inflation, profit, acceptance by others, interest rate.

First cost: *economic*; leadership: *non-economic*; taxes: *economic*; salvage value: *economic*; morale: *non-economic*; inflation: e*conomic*; profit: *economic*; acceptance by others: *non-economic*; interest rate: *economic*.

1.6 Identify the following factors as either tangible or intangible: sustainability, installation cost, transportation cost, simplicity, resale value, rate of return, dependability, deflation rate, and ethics.

Sustainability: *intangible*; installation cost: *tangible*; transportation cost: *tangible*; simplicity: *intangible*; resale value: *tangible*; rate of return: *tangible*; dependability: *intangible*; deflation rate: *tangible*; ethics: *intangible*.

Copyright 2021 © McGraw-Hill Education. All rights reserved. No reproduction or distribution without the prior written consent of McGraw-Hill Education.

Basics of Engineering Economy 3rd edition Blank Solutions Manual

1.7 What is meant by the term *time value of money*?

Time value of money means that there is a certain worth in having money, and that worth changes as a function of time.

1.8 Interest is a manifestation of what general concept in engineering economy?

Interest is a manifestation of the time value of money.

1.9 Of the fundamental dimensions length, mass, time, and electric charge, which one is the most important in economic analysis? Why?

The most important fundamental dimension in economic analysis is *time* because of time value of money.

1.10 Identify at least five areas of personal finances wherein you might use economic analysis in the future.

Examples are: house purchase; car purchase, credit card (which ones to use); personal loans (and their rate of interest and repayment schedule); investment decisions of all types; when to sell a house or car.

1.11 In economic calculations, how is the time value of money recognized?

The time value of money recognized through payment of interest

1.12 A small Voice over Internet Protocol (VoIP) provider borrowed $2 million for new equipment and repaid the principal of the loan plus $275,000 interest after 1 year. What was the interest rate on the loan?

Interest rate = (275,000/2,000,000)*100
= 13.75%

1.13 In order to reduce so-called back-office costs, such as payroll and insurance costs, by $45 million per year, trucking giant Yellow Corp. agreed to purchase rival Roadway LLC for $966 million in cash. If the savings are realized as planned, what is the rate of return on the investment?

Rate of return = (45/966)*100
= 4.7%

1.14 A small analytical laboratory borrowed $40,000 (the original amount or the principal) at an interest rate of 8% per year to purchase a used Agilent gas chromatograph. If the lab repays the loan plus interest in 1 year, how much must it pay at the end of the year?

Copyright 2021 © McGraw-Hill Education. All rights reserved. No reproduction or distribution without the prior written consent of McGraw-Hill Education.

Basics of Engineering Economy 3rd edition Blank Solutions Manual

Amount due in one year = 40,000 + 40,000(0.08)
= 40,000 + 3,200
= $43,200

1.15 If the amount due now on a loan taken 1 year ago at an interest rate of 10% per year is $18,000, what was the principal of the loan?

Amount due = principal + (principal)(interest rate)
18,000 = P + (P)(0.10)
1.1P = 18,000
P = $16,363.64

1.16 If you expect to receive an inheritance of $100,000 one year from now, how much money would you be able to borrow *now* at an interest rate of 8% per year if you pledge the total amount of the inheritance against the loan?

Future amount = principal + (principal)(interest rate)
100,000 = P + (P)(0.08)
1.08P = 100,000
P = $92,592.59

1.17 Assume you just invested $130,000 in a high-rise condo venture in downtown Austin, one of the top 10 hottest real estate markets in the country. The developers promise a rate of return of 21% per year for as long as you have your money invested. (*a*) How much interest will you receive at the end of 1 year, and (*b*) what is the total amount you will have after 1 year?

(a) Interest = (principal)(interest rate)
= 130,000*0.21
= $27,300

(b) Total amount = Principal + Interest
= 130,000 + 27,300
= $157,300

1.18 Emerson Processing borrowed $900,000 for installing energy-efficient lighting and safety equipment in its manufacturing facilities. The terms of the loan were such that the company would pay *interest only* at the end of each year for 4 years, after which the company would have to pay the annual interest and entire loan principal after 5 years. If the interest rate on the loan was 12% per year and the company paid only the interest for 4 years, (*a*) what was the amount of each of the four interest payments, and (*b*) what was the amount of the final payment at the end of year 5?

(a) Amt paid first four years = 900,000(0.12)
= $108,000

Copyright 2021 © McGraw-Hill Education. All rights reserved. No reproduction or distribution without the prior written consent of McGraw-Hill Education.

Basics of Engineering Economy 3rd edition Blank Solutions Manual

(b) Final payment = 900,000 + 900,000(0.12)
= $1,008,000

1.19 A start-up chemical company has an average cost of capital of 15% per year. Additionally, it has a long-term goal of making at least a 20% per year rate of return on all investments; however, because of market opportunity the ROR can be reduced for the current project by 3%. If the company acquired $50 million in venture capital, how much did it have to earn in the first year?

Expected MARR = 20% + 15% – 3% = 32%
Earnings = 50,000,000(0.32)
= $16,000,000

1.20 Bradley Instruments borrowed $3,500,000 from a private equity firm for expansion of its manufacturing facility for making carbon monoxide monitors/controllers. The company repaid the loan after 1 year with a single payment of $3,885,000. What was the interest rate on the loan?

interest rate = [(3,885,000 – 3,500,000)/3,500,000](100)
= 11% per year

1.21 A friend of yours borrowed $550 for video game purchases and repaid the principal of the loan plus $75 interest after 1 year. (*a*) What was the interest rate on the loan? (*b*) During the same year, you borrowed $8000 for lawn mowing equipment to make money on the side and paid it off in 1 year for a total of $8600. How does your interest rate compare to that of your friend?

(a) Interest rate = (75/550)(100)
= 13.64%

(b) Interest rate = (600/8000)(100)
= 7.5%

You paid slightly more than ½ as much as your friend.

1.22 A design-build engineering firm completed a pipeline project wherein the company realized a profit of $2.3 million in year 1 and $750,000 in year 2. If the amount of money the company had invested was $6 million both years, what was the rate of return on the investment for each year?

Year 1, ROR = (2.3/6)(100) = 38.3%

Year 2, ROR = (0.75/6)(100) = 12.5%

Copyright 2021 © McGraw-Hill Education. All rights reserved. No reproduction or distribution without the prior written consent of McGraw-Hill Education.

Basics of Engineering Economy 3rd edition Blank Solutions Manual

1.23 Which of the following 1-year investments has the highest rate of return: $12,500 that yields $1125 in interest, $56,000 that yields $6160 in interest, or $95,000 that yields $7600 in interest?

ROR = (1125/12,500)(100) = 9%
ROR = (6160/56,000)(100) = 11%
ROR = (7600/95,000)(100) = 8%

Therefore, the $56,000 investment has the highest rate of return

1.24 A new engineering graduate who started a consulting business borrowed money for 1 year to furnish the office. The amount of the loan was $23,800, and it had an interest rate of 10% per year. However, because the new graduate hadn't built up a credit history, the bank made him buy loan default insurance for 5% of the loan amount. In addition, the bank charged a loan setup fee of $300. What was the effective interest rate the engineer paid for the loan?

Interest on loan = 23,800(0.10) = $2,380
Default insurance = 23,800(0.05) = $1190
Set-up fee = $300
Total amount paid = 2380 + 1190 + 300
= $3870
Effective interest rate = (3870/23,800)(100)
= 16.3%

1.25 How many years does it take for an investment of $280,000 to total at least $425,000 if the return is 15% per year (*a*) only on the original amount each year, and (*b*) on the total accumulated amount each year?

(a) Interest paid each year = 280,000(0.15) = $42,000
Amt. at end of year 1 = 280,000 + 42,000 = $322,000 < $425,000
Amt. at end of year 2 = 280,000 + 84,000 = $364,000 < $425,000
Amt. at end of year 3 = 280,000 + 126,000 = $406,000 < $425,000
Amt. at end of year 4 = 280,000 + 168,000 = $448,000 > $425,000

Time = 4 years

(b) Amt. at end of year 1 = 280,000(1.15) = $322,000 < $425,000
Amt. at end of year 2 = 322,000(1.15) = $370,300 < $425,000
Amt. at end of year 3 = 370,300(1.15) = $425,845 > $425,000

Time = 3 years

Copyright 2021 © McGraw-Hill Education. All rights reserved. No reproduction or distribution without the prior written consent of McGraw-Hill Education.

Basics of Engineering Economy 3rd edition Blank Solutions Manual

1.26 At an interest rate of 15% per year, an investment of $100,000 one year ago is equivalent to how much now?

Amt. now is F = 100,000 + 100,000(0.15)
= $115,000

1.27 As a principal in the consulting firm where you have worked for 20 years, you have accumulated 5000 shares of company stock. One year ago, each share of stock was worth $40. The company has offered to buy back your shares for $225,000. At what rate of return would the firm's offer be equivalent to the worth of the stock last year?

Let i = ROR

5000(40)(1 + i) = 225,000
1 + i = 225,000/200,000
1 + i = 1.125
i = 0.125 (12.5% per year)

1.28 At an interest rate of 8% per year, $10,000 today is equivalent to how much (*a*) 1 year from now, and (*b*) 1 year ago?

(a) Equivalent future amount = 10,000 + 10,000(0.08)
= 10,000(1 + 0.08)
= $10,800

(b) Equivalent past amount = 10,000/1.08
= $9259.26

1.29 A medium-size consulting engineering firm is trying to decide whether it should replace its office furniture now or wait and do it 1 year from now. If it waits 1 year, the cost is expected to be $16,000. At an interest rate of 10% per year, what is the equivalent cost now?

Equivalent cost now = 16,000/1.10
= $14,545.45

1.30 A design-build engineering company that usually gives year-end bonuses in the amount of $8000 to each employee is having cash flow problems. The company said that although it could not give bonuses this year, it would give each individual two bonuses next year; the regular one of $8000 plus an amount equivalent to the $8000 they would have gotten this year. If the interest rate is 6% per year, what will be the total amount of bonus money an employee should receive next year?

Total bonus next year = 8,000 + 8,000(0.06)
= $16,480

Copyright 2021 © McGraw-Hill Education. All rights reserved. No reproduction or distribution without the prior written consent of McGraw-Hill Education.

Basics of Engineering Economy 3rd edition Blank Solutions Manual

1.31 University tuition and fees can be paid using one of two plans:
Early-bird: Pay total amount due *one year in advance* and get a 10% discount
On-time: Pay total amount due when classes start
If the cost of tuition is $18,000 per year, determine (*a*) the tuition if paid in advance, and (*b*) the equivalent amount of the early-bird savings compared to on-time payment.

(a) Early bird: payment = 18,000 – 18,000(0.10)
= $16,200

(b) Equivalent future is F = 16,200(1 + 0.10)
= $17,820
Savings = 18,000 – 17,820
= $180

1.32 An engineer told you that a project is economically acceptable when its rate of return equals or exceeds the corporation's cost of capital. Is this correct? Explain your answer.

The engineer is correct, if the MARR is exactly equal to the cost of capital. The engineer is wrong, if a return greater than zero is required. Usually, the inequality ROR ≥ MARR > cost of capital is used, and the MARR is established higher than the cost of capital so that profit, risk and other factors are considered.

1.33 The MARR is not calculated like an ROR. What is the MARR used for in economic analysis?

The MARR is used to make accept/reject decisions on projects and alternative selections.

1.34 Dawn is preparing a home office to perform subcontract projects for midsized architect firms. She plans to use $15,000 of her own funds which currently generate a return of 4% per year. The remainder of financing will be provided by a $10,000 bank loan carrying a 9% per year interest rate. She hopes to realize a return of 3% above the average cost of capital to establish her office, and she realizes that the factors of inflation and risk should also be considered. Her decision is to add another 2% per year to compensate for these elements. What is the MARR she should use when evaluating projects?

Fraction of equity capital = 15,000/25,000 = 0.60
Fraction of debt capital = 10,000/25,000 = 0.40

WACC = 0.60(4%) + 0.40(9%)
= 6%

MARR = WACC + return above WACC + risk and inflation add-on
= 6% + 3% + 2%
= 11% per year

Copyright 2021 © McGraw-Hill Education. All rights reserved. No reproduction or distribution without the prior written consent of McGraw-Hill Education.

Basics of Engineering Economy 3rd edition Blank Solutions Manual

1.35 Determine the WACC, MARR, and estimated ROR for the following situation at Himalayan Air, Inc., which owns and operates oxygen bars across the United States and Europe. The management plans a second major expansion of outlets with a hoped-for return of 20% above cost of capital the first year of full operation. The first was very successful with an excess revenue of $7 million on a $20 million investment during the first year, leading to an ROR of 35%. Being more conservative due to market competition, the return on the new expansion is estimated at 80% of the previously observed ROR. This expansion will be funded using a 50-50 debt-equity mix. The equity funds currently return 6% per year and the debt financing will cost 9.7% per year. Is the expansion ROR expected to exceed the MARR?

$$\begin{aligned} \text{WACC} &= 0.50(6\%) + 0.50(9.7\%) \\ &= 7.85\% \end{aligned}$$

$$\text{MARR} = 7.85\% + 20\% = 27.85\%$$

Estimated expansion ROR = 0.8(35%) = 28%

Conclusion: Since 28% > 27.85%, the expansion is barely expected to meet the MARR criterion. Any over-estimate in the ROR will make the expansion financial questionable.

1.36 In an effort to increase its customer base, a company set the project MARR at exactly the WACC. If equity capital costs 9% per year and debt capital costs 11.75% for the project, what is the equitydebt percentage mix of capital required to make the WACC = 10%?

Let X = percent equity capital

$$\begin{aligned} \text{WACC} = 10\% &= X(9\%) + (1 - X)(11.75\%) \\ (9 - 11.75)X &= 10 - 11.75 \\ X &= 1.75/2.75 \\ &= 0.636 \qquad (63.6\%) \end{aligned}$$

Mix is 63.6% equity and 36.4% debt capital

1.37 Will and Ben Ice Cream plan to build a new mixing plant to serve customers in Mexico. Because the company is in good financial shape with equity funds returning 11% per year, the bank will charge an interest rate of 8% per year for the loan. An MARR that is 5% over the WACC is required to proceed with the project, which sets the MARR at 14%. What percentage of debt financing can the company assume to meet its MARR requirement?

Let X = percent debt capital

$$\text{WACC} = 14 - 5 = 9\%$$

Copyright 2021 © McGraw-Hill Education. All rights reserved. No reproduction or distribution without the prior written consent of McGraw-Hill Education.

Basics of Engineering Economy 3rd edition Blank Solutions Manual

$$\text{WACC} = 9\% = X(8\%) + (1 - X)(11\%)$$
$$(8 - 11)X = 9 - 11$$
$$X = 0.667 \qquad (66.7\%)$$

Mix is 66.7% debt and 33.3% equity capital

1.38 Raydeck International set aside a lump sum investment 4 years ago in order to finance a plant expansion now. The money returned 10% per year simple interest. How much did the company set aside if the investment is now worth $850,000?

$$F = \text{principal} + \text{interest}$$
$$= P + Pni$$

$$850{,}000 = P + P(4)(0.10)$$
$$1.4P = 850{,}000$$
$$P = \$607{,}143$$

1.39 Dynamic Data LLC, a company that customizes software for construction cost estimates, repaid a loan obtained 3 years ago at 7% per year simple interest. If the amount that Dynamic Data repaid was $120,000, calculate the principal of the loan.

$$F = P + Pni$$
$$120{,}000 = P + P(3)(0.07)$$
$$1.21P = 120{,}000$$
$$P = \$99{,}173.55$$

1.40 The Aberdeen Fixed Rate Fund pays a dividend of 10% per year simple interest. If you invest $240,000 today, what total amount will you have accumulated at the end of 3 years?

$$F = 240{,}000 + 240{,}000(0.10)(3)$$
$$= \$312{,}000$$

1.41 If EP Electronics sets aside $1,000,000 now into a contingency fund, how much will the company have in 2 years if it doesn't use any of the money and the account grows at a rate of 10% per year?

$$F_1 = 1{,}000{,}000 + 1{,}000{,}000(0.10)$$
$$= 1{,}100{,}000$$

$$F_2 = 1{,}100{,}000 + 1{,}100{,}000(0.10)$$
$$= \$1{,}210{,}000$$

or

$$F_2 = 1{,}000{,}000(1.10)^2$$
$$= \$1{,}210{,}000$$

Copyright 2021 © McGraw-Hill Education. All rights reserved. No reproduction or distribution without the prior written consent of McGraw-Hill Education.

Basics of Engineering Economy 3rd edition Blank Solutions Manual

1.42 Rambus Diagnostics has extra funds to invest for future capital expansion. If the selected investment pays simple interest, what interest rate would be required for the amount to grow from $60,000 to $90,000 in 5 years?

$$90{,}000 = 60{,}000 + 60{,}000(5)(i)$$
$$300{,}000\, i = 30{,}000$$
$$i = 0.10 \quad (10\% \text{ per year})$$

1.43 You plan to place your savings into a high-yield account at your company's Employee Credit Union. How long will it take to double your money at 5% per year simple interest?

$$2P = P + P(0.05)(n)$$
$$P = P(0.05)(n)$$
$$n = 20 \text{ years}$$

1.44 If your money earns compound interest at a generous 20% per year, how long will it take $50,000 to accumulate to at least $85,000? Solve using two methods: (*a*) year-by-year accumulated total, and (*b*) Equation [1.6].

(a) Amount Year 1 = 50,000 + 50,000(0.20) = $60,000 < $85,000
Amount Year 2 = 60,000 + 60,000(0.20) = $72,000 < $85,000
Amount Year 3 = 72,000 + 72,000(0.20) = $86,400 > $85,000

Time = 3 years

$$85{,}000 = 50{,}000(1.20)^n$$
$$1.70 = 1.20^n$$
$$\log 1.70 = n \log 1.20$$
$$0.23045 = n(0.07918)$$
$$n = 2.9 \text{ years}$$

1.45 In order to finance a new product line, a company that makes high-temperature ball bearings borrowed $1.8 million at 10% per year compound interest. If the company repaid the loan in a lump sum amount after 2 years, what was (*a*) the amount of the payment, and (*b*) the amount and percentage of interest based on the original principal?

(a) Payment = $1{,}800{,}000(1 + 0.10)^2$
= $2,178,000

(b) Interest = 2,178,000 – 1,800,000
= $378,000

Percent of principal = (378,000/1,800,000)(100)
= 21%

Copyright 2021 © McGraw-Hill Education. All rights reserved. No reproduction or distribution without the prior written consent of McGraw-Hill Education.

Basics of Engineering Economy 3rd edition Blank Solutions Manual

1.46 Fill in the missing values (A through D) for a loan of $10,000 if the interest rate is compounded at 10% per year.

End of Year	Interest for Year	Amount Owed After Interest	End-of-Year Payment	Amount Owed After Payment
0	—	—	—	10,000
1	1000	11,000	2000	9000
2	900	9900	2000	**A**
3	**B**	**C**	2000	**D**

Follow calculations in Example 1.8

A is 9900 – 2000 = $7900
B is 7900(0.10) = $790
C is 7900 + 790 = $8690
D is 8690 – 2000 = $6690

1.47 Companies frequently borrow money under an arrangement that requires them to make periodic payments of "interest only" and then pay the principal all at once at the end of the loan period. If Cisco International borrowed $500,000 (identified as loan A) at 10% per year simple interest and another $500,000 (identified as loan B) at 10% per year compound interest and paid *only the interest* at the end of *each year* for 3 years on both loans, (*a*) on which loan did the company pay more interest, and (*b*) what was the difference in interest paid between the two loans?

(a) Loan A: interest/year = 500,000(0.10) = $50,000
Loan B: interest/year = 500,000(0.10) = $50,000

The same amount of interest was be paid on each loan

(b) There was no difference paid between the two loans

1.48 The NFL should update its online security systems now at a cost of $5 million to avert cyberattacks by hackers. However, since there has been no breach thus far, the tendency is to put off the upgrade and take the risk. If these costs are being inflated at 12% per year, estimate the cost (*a*) next year, and (*b*) 2 years from now.

(a) Cost next year = 5,000,000(1.12) = $5,600,000

(b) Cost two years from now can be found using either of two relations.

Method 1: Cost in 2 years = 5,600,000(1.12)
= $6,272,000

or

Method 2: Cost in 2 years = $5{,}000{,}000(1.12)^2$

Copyright 2021 © McGraw-Hill Education. All rights reserved. No reproduction or distribution without the prior written consent of McGraw-Hill Education.

Basics of Engineering Economy 3rd edition Blank Solutions Manual

1.49 Suppose you want to purchase a Dodge Ram 1500 pickup that costs $32,000 now, but you don't have the money. If the cost increases by 5% per year, and you plan to buy it for cash in 5 years, estimate the future cost using two methods: (*a*) based on Equation [1.7], and (*b*) the increased percentage shown in Figure 1.3.

(a) Cost in 5 years = $32{,}000(1 + 0.05)^5$
= 32,000(1.276)
= $40,832

(b) Cost in 5 years = 32,000 + 32,000(0.28)
= $40,960

1.50 You and your sister went shopping today for jeans. The pair she bought costs $49.95 and is identical to a pair you purchased 2 years ago for $37.87. (*a*) Determine the numerical and percentage increase in cost. (*b*) Determine the annual inflation rate of the cost increase and compare your result to the increase indicated in Figure 1.3 (upper).

(a) Numerical increase = 49.95 – 37.87 = $12.08
Percentage increase = (12.08/37.87)(100) = 32%

(b) Use Equation [1.7]

Increase in cost: $(1 + f)^2 - 1 = 0.32$
$1 + f = 1.32^{0.5}$
f = 0.1489 (14.89% per year)

Figure 1.3 indicates a cost increase of 32% when f = 15% per year, which is the same as 14.89%, rounded up.

1.51 An arc welder with AI software onboard costs $4500 today, $3750 last year, and $3400 one year prior to that. Determine the 1-year rate of inflation for each year.

Last year: 4500 = 3750(1 + f)
1 + f = 1.20
f = 0.20 (20%)

Year before: 3750 = 3400(1 + f)
1 + f = 1.103
f = 0.103 (10.3%)

1.52 When the yield on a U.S. Treasury Bill, considered a "safe" investment, is 3% per year, investors expect the inflation rate to be approximately what value?

When the yield is 3% per year on U.S. government bonds, investors expect the inflation rate to be near zero.

Copyright 2021 © McGraw-Hill Education. All rights reserved. No reproduction or distribution without the prior written consent of McGraw-Hill Education.

Basics of Engineering Economy 3rd edition Blank Solutions Manual

1.53 You have the $1200 to cover the discounted sales price of your favorite Shimano mountain bike, but no safe storage area if you owned it today. The projected cost increase each year is 5%. Determine the purchasing power of your $1200 if you wait (*a*) 2 years, and (*b*) 5 years to spend it.

Based on Figure 1.3

(a) 2-year reduction in PP is 9%

PP = 1200(1 – 0.09) = $1092

(b) 5-year reduction in PP is 22%

PP = 1200(1 – 0.22) = $936

Based on Equation [1.8]

(a) $PP = 1200/(1.05)^2$

= $1088

(b) $PP = 1200/(1.05)^5$

= $940

1.54 Assume you received $500 for your birthday today and placed it in your no-interest checking account for safe keeping. Determine the purchasing power 3 years in the future if (a) $f = 3.5\%$ per year, and (*b*) $f = 10\%$ per year. (Round answers to the nearest dollar.) (*c*) How much more dollar purchasing power was lost with the higher inflation rate?

(a) $PP_3 = 500/(1.035)^3$

= 500/1.1087

= $451

(b) $PP_3 = 500/(1.10)^3$

= 500/1.3310

= $376

(c) Additional lost PP = 451 – 376 = $75

1.55 McDougal's LTD is a food products wholesaler operating in Costa Rica and Mexico where the inflation rate has historically averaged 3% and 5% per year, respectively. The company maintains a cash amount of $500,000 in each country's banks in case of emergency needs. (*a*) Use Figure 1.3 to estimate the purchasing power after 1 year and 2 years of the $500,000 in each country. (*b*) (Spreadsheet exercise) If assigned by the instructor, use a spreadsheet and the approach of Example 1.9 to plot the purchasing power over a 10-year period for both inflation rates.

(a) Costa Rica: PP after 1 and 2 years at f = 3% per year

$PP_1 = 500{,}000(1 - 0.03) = \$485{,}000$

$PP_2 = 500{,}000(1 - 0.06) = \$470{,}000$

Mexico: PP after 1 and 2 years at f = 5% per year

$PP_1 = 500{,}000(1 - 0.05) = \$475{,}000$

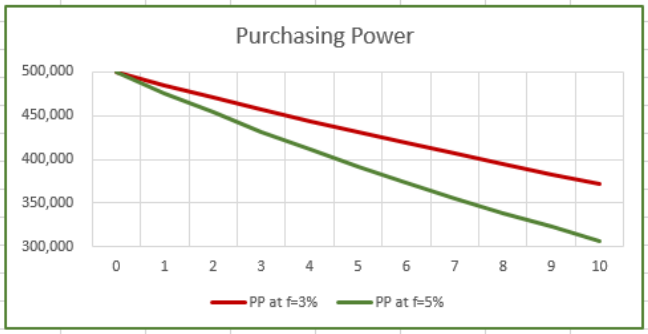
$PP_2 = 500{,}000(1 - 0.09) = \$455{,}000$

Copyright 2021 © McGraw-Hill Education. All rights reserved. No reproduction or distribution without the prior written consent of McGraw-Hill Education.

Basics of Engineering Economy 3rd edition Blank Solutions Manual

(b) (Spreadsheet exercise)
Develop the relations = 500000/(1 + f)^n where f = 0.03 and 0.05, respectively and n = 0, 1,…, 10; then insert a line chart of the PP results. The chart should look something like the one below.

Year	PP at f=3%	PP at f=5%
0	500,000	500,000
1	485,437	476,190
2	471,298	453,515
3	457,571	431,919
4	444,244	411,351
5	431,304	391,763
6	418,742	373,108
7	406,546	355,341
8	394,705	338,420
9	383,208	322,304
10	372,047	306,957



1.56 Continental Airlines operates in and out of many countries. Country A has a low inflation rate of 3% per year while country B has a high rate of 30% per year. A $1 million fund is maintained in each country for emergency purchases to repair disabled aircraft. (*a*) Use a formula to determine the purchasing power after 2, 4, and 5 years if the funds are not utilized. (*b*) (Spreadsheet exercise) Use a spreadsheet to plot the diminishing purchasing power curves, if assigned by your instructor. (*c*) With the dramatic effect of 30% inflation, if you were president of Continental Airlines, how would you manage this situation?

(a) Country A with f = 3%

$PP_2 = 1{,}000{,}000/(1.03)^2 = \$942{,}596$
$PP_4 = 1{,}000{,}000/(1.03)^4 = \$888{,}487$
$PP_5 = 1{,}000{,}000/(1.03)^5 = \$862{,}609$

Country B with f = 30%

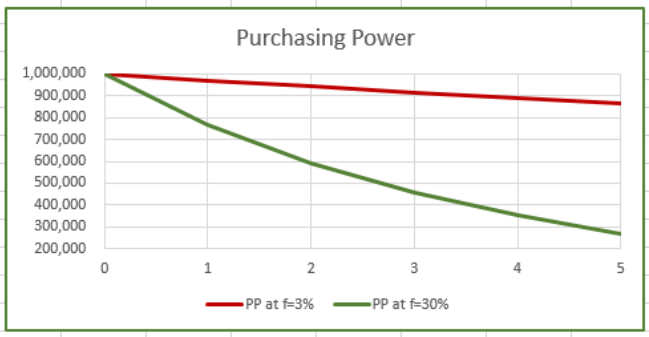
$PP_2 = 1{,}000{,}000/(1.30)^2 = \$591{,}716$
$PP_4 = 1{,}000{,}000/(1.30)^4 = \$350{,}128$
$PP_5 = 1{,}000{,}000/(1.30)^5 = \$269{,}329$

(b) (Spreadsheet exercise)
Develop the relations = 1000000/(1 + f)^n where f = 0.03 and 0.30, respectively and n = 0, 1, …, 5; then insert a line chart of the PP results. The chart should look something like the one below.

Copyright 2021 © McGraw-Hill Education. All rights reserved. No reproduction or distribution without the prior written consent of McGraw-Hill Education.

Basics of Engineering Economy 3rd edition Blank Solutions Manual

	Year	PP at f=3%	PP at f=30%
1	0	1,000,000	1,000,000
2	1	970,874	769,231
3	2	942,596	591,716
4	3	915,142	455,166
5	4	888,487	350,128
6	5	862,609	269,329



(c) No answer is provided since it is meant to be a discussion question.

1.57 Every engineering economy problem will involve at least how many symbols?

It will involve at least four symbols.

1.58 Thompson Mechanical Products is planning to set aside $150,000 now for possibly replacing its large synchronous refiner motors whenever it becomes necessary. If the replacement isn't needed for 7 years, how much will the company have in its investment set-aside account if it achieves a rate of return of 11% per year?

P = $150,000; F = ?; i = 11%; n = 7

1.59 Atlas Long-Haul Transportation is considering the installation of Valutemp temperature loggers in all of its refrigerated trucks for monitoring temperatures during transit. If the systems will reduce insurance claims by $100,000 two years from now, how much should the company be willing to spend now, if it uses an MARR of 12% per year?

P = ?; F = $100,000; i = 12%; n = 2

1.60 Determine the amount of money FrostBank might loan a housing developer who will repay the loan 2 years from now by selling eight lots at $240,000 each. Assume the bank's interest rate is 10% per year.

P = ?; F = 8(240,000) = $1,920,000; n = 2; i = 0.10

1.61 Bodine Electric, based in Des Moines, Iowa, USA, makes gear motors with a three-stage, selectively hardened gearing cluster that is permanently lubricated. If the company borrows $20 million for a new distribution facility in Europe, how much must it pay back each year to repay the loan in six equal annual payments at an interest rate of 10% per year?

P = $20,000,000; A = ?; n = 6; i = 0.10

Copyright 2021 © McGraw-Hill Education. All rights reserved. No reproduction or distribution without the prior written consent of McGraw-Hill Education.

Basics of Engineering Economy 3rd edition Blank Solutions Manual

1.62 DubaiWorks manufactures angular contact ball bearings for pumps that operate in harsh environments. The company invested $2.4 million in a process that resulted in net profits of $760,000 per year for 5 consecutive years. What rate of return did the company make?

P = $2,400,000; A = $760,000: n = 5; i = ?

1.63 How many years will it take for your investment to be 1.5 times as much as what you deposit now, if the return is 5% per year?

P = P; F = 1.5P; i = 5%; n = ?

1.64 Vision Technologies, Inc. is a small company that uses ultra-wideband technology to develop devices that can detect objects (including people) inside of buildings, behind walls, or below ground. The company expects to spend $100,000 per year for labor and $125,000 per year for supplies before a product can be marketed. What is the total equivalent future amount of the company's expenses at the end of 3 years at 15% per year interest?

A = $225,000; n = 3; i = 15% per year; F = ?

1.65 Fifteen years ago your grandfather invested $10,000 in a stock fund to pay for your college education. Each year thereafter, he deposited $3000 into the fund. If the investments grew at a rate of 8% per year over the 15 years, how much is in the fund now?

P = $10,000; A = $3,000; i = 0.08; n = 15; F = ?

1.66 What does the term *end-of-period convention* mean? What does it not mean?

End-of-period-convention means end-of-interest period. It does not mean end of the calendar year.

1.67 Identify the following as cash inflows or outflows to a commercial air carrier: fuel cost, pension plan contributions, fares, maintenance, freight revenue, cargo revenue, extra-bag charges, cost of snacks, web-based advertising, landing fees, and seat-preference fees.

Fuel cost - *outflow*, pension plan contributions - *outflow*, passenger fares - *inflow,* maintenance - *outflow*, freight revenue - *inflow,* cargo revenue - *inflow*, extra-bag charges – *inflow*, snacks - *outflow*, web-based advertising - *outflow*, landing fees - *outflow*, seat preference fees – *inflow*

1.68 Identify the following as cash inflows or outflows to a privately owned water company: well drilling, maintenance, water sales, accounting, government grants, issuance of bonds, energy cost, pension plan contributions, heavy equipment purchases, used-equipment sales, stormwater fees, and discharge permit revenues.

Copyright 2021 © McGraw-Hill Education. All rights reserved. No reproduction or distribution without the prior written consent of McGraw-Hill Education.

Basics of Engineering Economy 3rd edition Blank Solutions Manual

Well drilling: *outflow*; maintenance: *outflow*; water sales: *inflow*; accounting: *outflow*; government grants: *inflow*; issuance of bonds: *inflow*; energy cost: *outflow*; pension plan contributions: *outflow*; heavy equipment purchases: *outflow*; used-equipment sales: *inflow*; stormwater fees: *inflow*; discharge permit revenues: *inflow*.

1.69 Many credit unions use semiannual interest periods to pay interest on customer savings accounts. For a credit union that uses June 30 and December 31 as its semiannual interest periods, determine the end-of-interest period *total deposit amounts* that will be recorded for the cash flows shown below.

Month	**Deposit, $**
Jan	50
Feb	70
Mar	—
Apr	120
May	20
June	—
July	150
Aug	90
Sept	—
Oct	—
Nov	40
Dec	110

End-of-period amount for June = 50 + 70 + 120 + 20
= $260
End-of-period amount for Dec = 150 + 90 + 40 + 110
= $390

1.70 List three different types of cost estimation and give an example of each type different than those mentioned in this chapter.

Product – motorcycle; Project – bridge upgrade; operation – delivery truck, driver and fork lift; system – develop and implement a pension program for all employees.

1.71 Identify the type of cost estimation that is associated with each of the following: new suspension bridge, bicycle manufacturing, identity theft deterrent by a nationwide bank corporation, monthly lubrication of heat-sensitive bearings, writing a textbook on engineering economy, 3-D printer.

New suspension bridge - *project*, bicycle manufacturing - *product*, identity theft deterrent by a nationwide bank corporation - *system*, monthly lubrication of heat-sensitive bearings - *operation*, writing a textbook on engineering economy - *project*, 3d printer - *product.*

Copyright 2021 © McGraw-Hill Education. All rights reserved. No reproduction or distribution without the prior written consent of McGraw-Hill Education.

Basics of Engineering Economy 3rd edition Blank Solutions Manual

1.72 Construct a cash flow diagram for the following cash flows: $25,000 outflow at time zero, $9000 per year inflow in years 1 through 5 at an interest rate of 10% per year, and an unknown future amount in year 5.

Assuming down is negative: down arrow of $25,000 in year 0; up arrows in the amount of $9000 in years 1 through 5; i = 10% per year; arrow in year 5 identified as F=? (either direction).

1.73 Construct a cash flow diagram to find the present worth in year 0 for the following series at i = 15% per year.

Year	Cash Flow, $
0	−19,000
1–4	+8,100

Assuming down is negative: up arrow in year 0 identified as P = ?; down arrow of $19,000 in year 0; up arrows in the amount of $8100 in years 1 through 4; i = 15% per year.

1.74 Construct a cash flow diagram to find the rate of return on an investment of $60,000 made today and accumulated to an amount of $95,000 in 5 years.

Assuming down is negative: down arrow of $60,000 in year 0; up arrow of $95,000 in year 5; i = ?

1.75 Write the engineering economy symbol that is displayed when each of the following spreadsheet functions are entered.
a. PV
b. PMT
c. NPER
d. IRR
e. FV
f. RATE

(a) PV is P; (b) PMT is A; (c) NPER is n; (d) IRR is i; (e) FV is F; (f) RATE is i

1.76 State the purpose for each of the following built-in spreadsheet functions.
a. PV(*i*%,*n*,*A*,*F*)
b. FV(*i*%,*n*,*A*,*P*)
c. RATE(*n*,*A*,*P*,*F*)
d. IRR(first_cell:last_cell)
e. PMT(*i*%,*n*,*P*,*F*)
f. NPER(*i*%,*A*,*P*,*F*)

(a) PV(i%,n,A,F) finds the present value P
(b) FV(i%,n,A,P) finds the future value F
(c) RATE(n,A,P,F) finds the compound interest rate i for equal periodic payments A

Copyright 2021 © McGraw-Hill Education. All rights reserved. No reproduction or distribution without the prior written consent of McGraw-Hill Education.

Basics of Engineering Economy 3rd edition Blank Solutions Manual

(d) IRR(first_cell:last_cell) finds the compound interest rate i
(e) PMT(i%,n,P,F) finds the equal periodic payment A
(f) NPER(i%,A,P,F) finds the number of periods n

1.77 For the following spreadsheet functions, (*a*) write the values of the engineering economy symbols *P*, *F*, *A*, *i*, and *n*, using a ? for the symbol that is to be determined, and (*b*) state whether the displayed answer will have a positive sign, a negative sign, or it can't be determined from the entries.
1. = FV(8%,10,3000,8000)
2. = PMT(12%,20,−16000)
3. = PV(9%,15,−1000,600)
4. = NPER(10%,−290,12000)
5. = FV(5%,5,500,−2000)

(a) (1) F = ?; i = 8%; n = 10; A = $3000; P = $8000
(2) A = ?; i = 12%; n = 20; P = $–16,000; F = 0
(3) P = ?; i = 9%; n = 15; A = $–1000; F = $600
(4) n = ?; i = 10%; A = $–290; P = 0; F = $12,000
(5) F = ?; i = 5%; n = 5; A = $500; P = $–2000

(b) (1) negative
(2) positive
(3) positive
(4) positive (years)
(5) can't determine if 5% per year will cover the 5 withdrawals of $500

1.78 In a built-in spreadsheet function, if a certain parameter does not apply, under what circumstances can it be left blank, and when must a comma be entered in its place?

For built-in spreadsheet functions, a parameter that does not apply can be left blank when it is not an interior one. For example, if no F is involved when using the PMT function, it can be left blank because it is an end parameter. When the parameter involved is an interior one (like P in the PMT function), a comma must be entered in its position.

1.79 Emily and Madison both invest $1000 at 10% per year for 4 years. Emily receives simple interest and Madison gets compound interest. Use a spreadsheet and cell reference formats to develop relations that show a total of $64 more interest for Madison at the end of the 4 years. Assume no withdrawals or further deposits are made during the 4 years.

Spreadsheet shows relations only in cell reference format. Cell E10 will indicate $64 more than cell C10.

Copyright 2021 © McGraw-Hill Education. All rights reserved. No reproduction or distribution without the prior written consent of McGraw-Hill Education.

Basics of Engineering Economy 3rd edition Blank Solutions Manual

	A	B	C	D	E
1	Initial amount =	1000		i =	0.1
2					
3		Simple		Compound	
4	Year	Interest, $	Total, $	Interest, $	Total, $
5	0		= B1		= B1
6	1	= B1*E1	= C5 + B6	= $E5 * E1	= E5 + D6
7	2	= B1*E1	= C6 + B7	= $E6 * E1	= E6 + D7
8	3	= B1*E1	= C7 + B8	= $E7 * E1	= E7 + D8
9	4	= B1*E1	= C8 + B9	= $E8 * E1	= E8 + D9
10	Total	=SUM(B6:B9)	= C9	=SUM(D6:D9)	= E9

1.80 Assume you pay the reduced amount of $4750 for a corporate stock that has a market value of $5000. The stock pays an annual dividend of 4% of its market value. Since this is primarily a dividendpaying stock, you estimate that you will sell the stock 10 years from now at the current $5000 market value. Develop spreadsheet functions that display the following results:

a. Total amount of the dividends paid to you.

b. Equivalent future worth after 10 years of the dividends at $i = 6\%$ per year.

c. Present worth now (year 0) of the original purchase price, dividends and proceeds when the stock is sold after 10 years, if $i = 6\%$ per year. Observe the sign on the result and explain what it means to you financially.

d. Rate of return on this entire investment over a 10-year period. (*Note:* The answer displayed here should confirm your response to the question in part c.)

(a) The function = 10*0.04*5000 displays the total dividends of $2000

(b) The function = – FV(6%,10,200) displays an F of $2636.16

(c) The function = – PV(6%,10,200,5000) – 4750 displays a P of $–486.01. This means you did not make 6% on the investment.

(d) The function = RATE(10,200,-4750,5000) displays a i value of 4.64%, which verifies that the return is less than 6% per year.

1.81 A Harley-Davidson bike you hope to own in the future costs $12,000 today. If the inflation rate is expected to be 4.5% per year, determine the estimated cost using a spreadsheet function for each of the next 5 years.

Use the FV function with i = f. Enter the year numbers 1-5 in cells A2 through A6 and develop the functions = – FV(4.5%,year_cell,12000) where 'year_cell' is a reference to the cell containing the year numbers 1-5. To the nearest dollar, the displays should be: $12,540; $13,104; $13,694; $14,310; and $14,954.

Copyright 2021 © McGraw-Hill Education. All rights reserved. No reproduction or distribution without the prior written consent of McGraw-Hill Education.

Basics of Engineering Economy 3rd edition Blank Solutions Manual

1.82 Explain the relation between a common moral and a personal moral.

A common moral is a fundamental belief held by virtually all people. A personal moral is the translation of a common moral into that which an individual believes and uses as guidance for their own decisions and actions.

1.83 What is one primary use of a *code of ethics* for a specific discipline of professional practice?

A code of ethics can be used as an evaluation measure for the decision and actions of an individual who works in the discipline that honors the code.

1.84 Yesterday, Carol, an engineer with Hancock Enterprises, was at lunch with several work friends. Joe, a person Carol has known for a year or so from similar lunches, proudly mentioned that he got a free flight and tickets to a major league playoff game two weeks from now in a distant city. Joe happened to also mention the company: it is Dryer. Carol is aware that Dryer is one of the prime bidders on a major contract to be evaluated by Hancock next month. Upon inquiry, Carol learned that both she and Joe are on the bid evaluation committee. Carol suspects that someone in Dryer has offered Joe the tickets as a consideration for Joe's favorable evaluation of their bid.

a. Carol has determined that she could do one of several things about the situation: recommend to Joe directly that he refuse the tickets; show Joe the NSPE Code of Ethics for Engineers and let him make his own decision; go to Joe's supervisor and tell her of the situation; go to her supervisor and inform him of her suspicion; write an e-mail to Joe with a copy to Carol's supervisor recommending that Joe consider the ethical dilemma involved for him; do nothing. Considering only these actions, select one you think is the best and explain why you chose it.

b. Identify other options for Carol's response at this time and determine if one of them is better than her options outlined above.

(a) Assuming that Carol's supervisor is a trustworthy and ethical person himself, going to her supervisor and informing him of her suspicion is probably the best of these options. This puts Carol on record (verbally) as questioning something she heard at an informal gathering.

(b) Another good option is to go to Joe one-on-one and inform him of her concern about what she heard him say at lunch. Joe may not be aware he is on the bid evaluation team and the potential ethical consequences if he accepts the free tickets from Dryer.

1.85 Stefanie is a design engineer with an international railroad locomotive manufacturing company in the state of Illinois. Management wants to return some of the engineering design work to the United States rather than export all of it to India, where their primary design work has been completed for the last decade. This transfer will employ more people locally and could improve the economic conditions for families in and around Illinois.

Stefanie and her design team were selected as a test case to determine the quality and speed of the design work they could demonstrate on a more fuel-efficient diesel

Copyright 2021 © McGraw-Hill Education. All rights reserved. No reproduction or distribution without the prior written consent of McGraw-Hill Education.

Basics of Engineering Economy 3rd edition Blank Solutions Manual

locomotive. None of her team members or she has done such a significant design job themselves, because their jobs had previously entailed only the interface with the subcontracted engineers in India. One of her team members had a great design idea on a key element that will improve fuel efficiency by approximately 15%. She told Stefanie it came from one of the Indiangenerated documents, but that it would probably be okay for the team to use it and remain silent as to its origin, since it was quite clear the U.S. management was about to cancel the foreign contract. Though reluctant at first, Stefanie did go forward with a design that included the efficiency improvement and made no mention of the origin of the idea during the oral presentation or documentation delivery. As a result, the Indian contract was canceled and full design responsibility was transferred to Stefanie's group.

Consult the NSPE Code of Ethics for Engineers and identify sections that are points of concern about Stefanie's decisions and actions.

Many sections could be identified; however, III.9.a and b are likely the most applicable. Some others are: I.2 and 5, and II.2.a and b.

1.86 All of the following are examples of cash outflows except:
a. Asset salvage value
b. Income taxes
c. Operating cost of asset
d. First cost of asset

Answer is (a)

1.87 An example of an intangible factor is:
a. Taxes
b. Cost of materials
c. Morale
d. Rent

Answer is (c)

1.88 At an interest rate of 10% per year, the equivalent amount of $10,000 *one year ago* is closest to:
a. $8264
b. $9095
c. $11,000
d. $12,000

Amount one year ago = 10,000/(1+ 0.10) = $9090.90
Answer is (b)

Copyright 2021 © McGraw-Hill Education. All rights reserved. No reproduction or distribution without the prior written consent of McGraw-Hill Education.

Basics of Engineering Economy 3rd edition Blank Solutions Manual

1.89 In most engineering economy studies, the best alternative is the one that:
a. Will last the longest time
b. Is most politically correct
c. Is easiest to implement
d. Has the lowest cost

Answer is (d)

1.90 The time it would take for a given sum of money to double at 4% per year *simple* interest is closest to:
a. 30 years
b. 25 years
c. 20 years
d. 10 years

$2P = P + P(n)(0.04)$
$1 = 0.04n$
$n = 25$
Answer is (b)

1.91 The compound interest rate per year at which amounts of $1000 one year ago and $1345.60 one year hence are equivalent is closest to:
a. 8.5% per year
b. 10.8% per year
c. 20.2% per year
d. None of the above

Move both cash flows to year 0 and solve for i

$1000(1 + i) = 1345.60/(1 + i)$
$(1 + i)^2 = 1345.60/1000$
$(1 + i) = 1.16$
$i = 0.16 \quad (16\%)$
Answer is (d)

1.92 The simple interest rate per year that will accumulate the same amount of money in 2 years as a compound interest rate of 20% per year is closest to:
a. 20.5%
b. 21%
c. 22%
d. 25%

For compound interest at 20%, in 2 years $F = P(1.20)(1.20) = 1.44P$

For simple interest, $F = P + Pni = P(1 + ni) = P(1 + 2i)$

Copyright 2021 © McGraw-Hill Education. All rights reserved. No reproduction or distribution without the prior written consent of McGraw-Hill Education.

Basics of Engineering Economy 3rd edition Blank Solutions Manual

Equate the two relations.

$$P(1 + 2i) = 1.44P$$
$$(1 + 2i) = 1.44$$
$$i = 0.22 \qquad (22\%)$$

Answer is (c)

1.93 A company that utilizes carbon fiber 3-D printing wants to have money available two years from now to add new equipment. The company currently has $650,000 in a capital account and it plans to deposit $200,000 now and another $200,000 one year from now. The total amount available in two years, provided it returns a compounded rate of 15% per year, is closest to:

a. $1,354,125
b. $1,324,125
c. $1,325,500
d. $1,050,000

Amount available = total principal in year 0 + interest for 2 years + principal added year 1 + interest for 1 year

$$= 850{,}000(1+0.15)^2 + 200{,}000\,(1+0.15)$$
$$= 1{,}124{,}125 + 230{,}000$$
$$= \$1{,}354{,}125$$

Answer is (a)

1.94 If inflation has been steady at 3.2% per year for 4 years, the reduction in purchasing power over the 4 years is closest to:

a. 6%
b. 12%
c. 14%
d. 22%

Purchasing power reduction $= [1 - 1/(1.032)^4](100)$

$$= [1 - 0.8816](100)$$
$$= 0.1184 \qquad (11.84\%)$$

Answer is (b)

1.95 For the spreadsheet built-in function PV(*i*%,*n*,*A*,*F*), the only parameter that can be completely omitted is:

a. *i*%
b. *n*
c. *A*
d. *F*

Only a parameter at the end of the string can be omitted without an entry or comma; it is F in the PV function.
Answer is (d).

Copyright 2021 © McGraw-Hill Education. All rights reserved. No reproduction or distribution without the prior written consent of McGraw-Hill Education.

Basics of Engineering Economy 3rd edition Blank Solutions Manual