

Chapter 3: Time Value of Money (Chan S. Park, Chapter 3 & 4)

1. Suppose you deposit \$1,000 in a bank savings account that pays interest at a rate of 10% compounded annually. Assume that you don't withdraw the interest earned at the end of each period (one year), but let it accumulate. How much would you have at the end of year 3? (Example 3.1)
2. In 1626, Peter Minuit of the Dutch West India Company paid \$24 to purchase Manhattan Island in New York from the Indians. In retrospect, if Minuit had invested the \$24 in a savings account that earned 8% interest, how much would it be worth in 2007? (Example 3.2)
3. Suppose you are offered the alternative of receiving either \$3,000 at the end of five years or P dollars today. There is no question that the \$3,000 will be paid in full (no risk). Because you have no current need for the money, you would deposit the P dollars in an account that pays 8% interest. What value of P would make you indifferent to your choice between P dollars today and the promise of \$3,000 at the end of five years? (Example 3.3)
4. In Example 3.3, we determined that, given an interest rate of 8% per year, receiving \$2,042 today is equivalent to receiving \$3,000 in five years. Are these cash flows equivalent at an interest rate of 10%? (Example 3.5)
5. Suppose that you borrow \$1,000 from a bank for three years at 10% annual interest. The bank offers two options: (1) repaying the interest charges for each year at the end of that year and repaying the principal at the end of year 3 or (2) repaying the loan all at once (\$1,331) (including both interest and principal) at the end of year 3. Determine whether these options are equivalent, assuming that the appropriate interest rate for the comparison is 10%. (Example 3.6)
6. If you had \$2,000 now and invested it at 10%, how much would it be worth in eight years (Example 3.7)?
7. Suppose that \$1,000 is to be received in five years. At an annual interest rate of 12%, what is the present worth of this amount? (Example 3.8)
8. Suppose you buy a share for \$10 and sell it for \$20. Then your profit is \$10. If that happens within a year, your rate of return is an impressive 100%. If it takes five years, what would be the average annual rate of return on your investment? (Example 3.9)
9. You have just purchased 100 shares of General Electric stock at \$60 per share. You will sell the stock when its market price has doubled. If you expect the stock price to increase 20% per year, how long do you anticipate waiting before selling the stock (Example 3.10)?
10. Wilson Technology, a growing machine shop, wishes to set aside money now to invest over the next four years in automating its customer service department. The company can earn 10% on a lump sum deposited now, and it wishes to withdraw the money in the following increments:
 - **Year 1:** \$25,000, to purchase a computer and database software designed for customer service use;
 - **Year 2:** \$3,000, to purchase additional hardware to accommodate anticipated growth in use of the system;
 - **Year 3:** No expenses; and
 - **Year 4:** \$5,000, to purchase software upgrades.How much money must be deposited now to cover the anticipated payments over the next 4 years?
11. Suppose you make an annual contribution of \$3,000 to your savings account at the end of each year for 10 years. If the account earns 7% interest annually, how much can be withdrawn at the end of 10 years (Example 3.13)?
12. In Example 3.13, the first deposit of the 10-deposit series was made at the end of period 1 and the remaining nine deposits were made at the end of each following period. Suppose that all deposits were made at the beginning of each period instead. How would you compute the balance at the end of period 10?
13. To help you reach a \$5,000 goal five years from now, your father offers to give you \$500 now. You plan to get a part-time job and make five additional deposits, one at the end of each year. (The first deposit is made at the end of the first year.) If all your money is deposited in a bank that pays 7% interest, how large must your annual deposit be? (Example 3.15)
14. Consider three investment plans at an annual interest rate of 9.38% (Figure 3.22):
 - **Investor A.** Invest \$2,000 per year for the first 10 years of your career. At the end of 10 years, make no further investments, but reinvest the amount accumulated at the end of 10 years for the next 31 years.
 - **Investor B.** Do nothing for the first 10 years. Then start investing \$2,000 per year for the next 31 years.
 - **Investor C.** Invest \$2,000 per year for the entire 41 years.

Note that all investments are made at the *beginning* of each year; the first deposit will be made at the beginning of age 25 ($n = 0$) and you want to calculate the balance at the age of 65 ($n = 41$)

15. BioGen Company, a small biotechnology firm, has borrowed \$250,000 to purchase laboratory equipment for gene splicing. The loan carries an interest rate of 8% per year and is to be repaid in equal installments over the next six years. Compute the amount of the annual installment. (Example 3.17)
16. Suppose that BioGen wants to negotiate with the bank to defer the first loan repayment until the end of year 2 (but still desires to make six equal installments at 8% interest). If the bank wishes to earn the same profit, what should be the annual installment, also known as **deferred annuity**. (Example 3.18)
17. A textile mill has just purchased a lift truck that has a useful life of five years. The engineer estimates that maintenance costs for the truck during the first year will be \$1,000. As the truck ages, maintenance costs are expected to increase at a rate of \$250 per year over the remaining life. Assume that the maintenance costs occur at the end of each year. The firm wants to set up a maintenance account that earns 12% annual interest. All future maintenance expenses will be paid out of this account. How much does the firm have to deposit in the account now? (Example 20)
18. John and Barbara have just opened two savings accounts at their credit union. The accounts earn 10% annual interest. John wants to deposit \$1,000 in his account at the end of the first year and increase this amount by \$300 for each of the next five years. Barbara wants to deposit an equal amount each year for the next six years. What should be the size of Barbara's annual deposit so that the two accounts will have equal balances at the end of six years (Figure 3.31)?
19. Suppose that you make a series of annual deposits into a bank account that pays 10% interest. The initial deposit at the end of the first year is \$1,200. The deposit amounts decline by \$200 in each of the next four years. How much would you have immediately after the fifth deposit?
20. The two cash flows in Figure 3.38 are equivalent at an interest rate of 12% compounded annually. Determine the unknown value C .
21. A couple with a newborn daughter wants to save for their child's college expenses in advance. The couple can establish a college fund that pays 7% annual interest. Assuming that the child enters college at age 18, the parents estimate that an amount of \$40,000 per year (actual dollars) will be required to support the child's college expenses for 4 years. Determine the equal annual amounts the couple must save until they send their child to college. (Assume that the first deposit will be made on the child's first birthday and the last deposit on the child's 18th birthday. The first withdrawal will be made at the beginning of the freshman year, which also is the child's 18th birthday.)
22. You deposit \$5,000 in a savings account that earns 8% simple interest per year. What is the minimum number of years you must wait to double your balance? Suppose instead that you deposit the \$5,000 in another savings account that earns 7% interest compounded yearly. How many years will it take now to double your balance?
23. A man wants to have \$20,000 for his daughter's education after five years. How much should he deposit now at saving account which provides 10% interest compounded annually?
24. You are considering investing \$3,000 at an interest rate of 8% compounded annually for five years or investing the \$3,000 at 9% per year simple interest for five years. Which option is better?
25. Suppose that you are obtaining a personal loan from your uncle in the amount of \$20,000 (now) to be repaid in two years to cover some of your college expenses. If your uncle usually earns 8% interest (annually) on his money, which is invested in various sources, what minimum lump-sum payment two years from now would make your uncle happy?
26. If \$1,500 is invested now, \$1,800 two years from now, and \$2,000 four years from now at an interest rate of 6% compounded annually, what will be the total amount in 15 years?
27. You are considering to deposit \$4,000 at a nominal interest rate of 12% for five years. Find the maturity of the deposit when the interest is compounding quarterly. (Use quarterly interest rate with total no of quarters to calculate or use yearly effective interest rate.)
28. Find the effective interest rate per *quarter* at a nominal rate of 8% compounded (a) quarterly, (b) monthly, (c) weekly, (d) daily, and (e) continuously. (Example 4.3)
29. Suppose you make equal quarterly deposits of \$1,500 into a fund that pays interest at a rate of 6% compounded monthly, as shown in Figure 4.4. Find the balance at the end of year 2.
30. A series of equal quarterly receipts of \$500 extends over a period of five years as shown in Figure 4.5. What is the present worth of this quarterly payment series at 8% interest compounded continuously?
31. Suppose you make \$500 monthly deposits to a tax-deferred retirement plan that pays interest at a rate of 10% compounded quarterly. Compute the balance at the end of 10 years. (Example 4.7)

32. Consider a situation in which money flows daily. Suppose you own a retail shop and generate \$200 cash each day. You establish a special business account and deposit your daily cash flows in an account for 15 months. The account earns an interest rate of 6%. Compare the accumulated cash values at the end of 15 months, assuming
 - (a) Daily compounding and
 - (b) Continuous compounding.
33. Suppose you deposit \$2,000 in an individual retirement account (IRA) that pays interest at 6% compounded monthly for the first two years and 9% compounded monthly for the next three years. Determine the balance at the end of five years (Figure 4.12).
34. Suppose you secure a home improvement loan in the amount of \$5,000 from a local bank. The loan officer computes your monthly payment as follows:

Contract amount = \$5,000
 Contract period = 24 months,
 Annual percentage rate = 12%,
 Monthly installments = \$235.37.

Figure 4.14 is the cash flow diagram. Construct the loan payment schedule by showing the remaining balance, interest payment, and principal payment at the end of each period over the life of the loan.

Chapter 4 & 5: Basic Methods of Engineering Economics Studies and Comparative Analysis of Alternatives (CS Park Chapter: 5, 6 & 7)

1. Autonumerics Company has just bought a new spindle machine at a cost of \$105,000 to replace one that had a salvage value of \$20,000. The projected annual after-tax savings via improved efficiency, which will exceed the investment cost, are as given in example 5.3. Find:
 - a. Conventional Payback Period (Example 5.3)
 - b. Discounted Payback Period (Table 5.2)
2. Consider the investment cash flows associated with the computer process control project discussed in Example 5.1. If the firm's MARR is 15%, compute the NPW of this project. Is the project acceptable?
3. Tiger Machine Tool Company is considering acquiring a new metal-cutting machine. The required initial investment of \$75,000 and the projected cash benefits³ over the project's three-year life are as given in example 5.5. You have been asked by the president of the company to evaluate the economic merit of the acquisition. The firm's MARR is known to be 15%. Find NPW.
4. Consider the project cash flows in Example 5.5. Compute the NFW at the end of year 3 at $i = 15\%$.
5. An engineering school has just completed a new engineering complex worth \$50 million. A campaign targeting alumni is planned to raise funds for future maintenance costs, which are estimated at \$2 million per year. Any unforeseen costs above \$2 million per year would be obtained by raising tuition. Assuming that the school can create a trust fund that earns 8% interest annually, how much has to be raised now to cover the perpetual string of \$2 million in annual costs? (Capitalized Worth Method)
6. Consider a machine that costs \$20,000 and has a five-year useful life. At the end of the five years, it can be sold for \$4,000 after tax adjustment. The annual operating and maintenance (O&M) costs are about \$500. If the firm could earn an after-tax revenue of \$5,000 per year with this machine, should it be purchased at an interest rate of 10%? (Example 6.4)
7. Consider the investment in the metal-cutting machine of Example 5.5. Recall that this three-year investment was expected to generate an NPW of \$3,553. Suppose that the machine will be operated for 2,000 hours per year. Compute the equivalent savings per machine hour at $i = 15\%$. (Example 6.5)
8. Sunbelt Corporation, an investment company, is considering building a 50-unit apartment complex in a growing area near Tucson, Arizona. Since the long-term growth potential of the town is excellent, it is believed that the company could average 85% full occupancy for the complex each year. If the following financial data are reasonably accurate estimates, determine the minimum monthly rent that should be charged if a 15% rate of return is desired:
 - Land investment cost = \$1,000,000
 - Building investment cost = \$2,500,000
 - Annual upkeep cost = \$150,000
 - Property taxes and insurance = 5% of total initial investment
 - Study period = 25 years
 - Salvage value = Only land cost can be recovered in full.
 Find: Minimum monthly rental charge.

9. Consider two investment projects with the cash flow transactions given in Example 7.3. Compute the rate of return for each project.
10. The Imperial Chemical Company is considering purchasing a chemical analysis machine worth \$13,000. Although the purchase of this machine will not produce any increase in sales revenues, it will result in a reduction of labor costs. In order to operate the machine properly, it must be calibrated each year. The machine has an expected life of six years, after which it will have no salvage value. The following table summarizes the annual savings in labor cost and the annual maintenance cost in calibration over six years given in example 7.4. Find the rate of return for this project. (Trial and Error Method).
11. Gandaki College of Engineering and Sciences (GCES) is considering to purchase a new photocopy machine costing Rs. 1,00,000 having salvage value of Rs. 25,000 at 10th year that needs Rs. 5,000 electricity cost per year where MARR 10% per year. a) Find PW, AW & FW, b) Find IRR & Decide investment on photocopy, c) Find both types of B/C ratio by PW formulation, d) Find simple & discounted payback period, e) MIRR, if reinvestment rate is 20%
12. Nepal College of Information Technology (NCIT) is considering to purchase a new generator costing of Rs. 4,00,000 having salvage value Rs. 1,00,000 at the end of 5th year. The use of generator will increase Rs.1,50,000 that needs fuel cost of Rs. 30,000 per year. Find the following when MARR = 10%.
i. PW, AW & FW; ii. IRR. Also develop investment balance diagram and table; iii. B\C ratio by PW formulation (Both Methods); iv. Simple & discounted payback period ; v. MIRR, if reinvestment rate is 20%.
13. Compare following projects by using repeatability & Co-terminated assumption when MARR = 12% per year. Use PW, AW and FW formulation. (See same example from Damodhar Adhikari, Example 4.14).

Items	Project A	Project B
I	1,50,000	2,00,000
AR	90,000	1,00,000
AE	20,000	22,000
S	50,000	1,00,000
N	2 years	4 years

Chapter 6: Risk Analysis

1. Find break-even output level and current profitability position from the following information. Also plot BEP chart. Total cost = 12,00,000; Variable cost = 4,00,000; Total income = 15,00,000 at production of 5,000 units. (See similar example in Damodar Adhikari book, 6.15)
2. Perform sensitivity analysis of the parameters over the range of $\pm 20\%$ in
 - i) Initial investment
 - ii) Annual revenue
 - iii) Useful life
 If I = 11,500; AR = 3,000; N = 6 years; S = 1,000; MARR = 10%
(See similar example in Damodar Adhikari book, 6.16)
3. From the following information, calculate NPW for each scenario by assuming I=1,25,000, MARR=15%, and life of project is 5 years.
(See same example in Damodar Adhikari book, 6.17)

Variable Considered	Worst Case Scenario	Most Likely Scenario	Best Case Scenario
Unit Demand/Year	1,600	2,000	2,400
Unit Price (Rs.)	48	50	53
Variable Cost (Rs.)/Unit	17	15	12
Fixed Cost (Rs)/Year	11,000	10,000	8,000
Salvage Value	30,000	40,000	50,000