

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

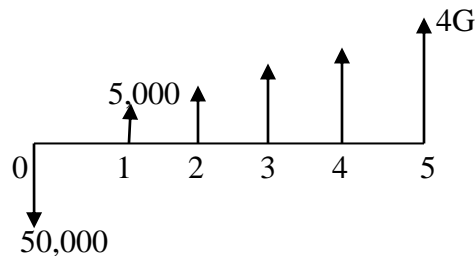
1. Suppose you deposit \$1,000 in a bank savings account that pays interest at a rate of 10% compounded annually. Assume that you don't withdraw the interest earned at the end of each period (one year), but let it accumulate. How much would you have at the end of year 3? (Example 3.1)
2. In 1626, Peter 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. Find present equivalent from the cash flow given if interest rate is 11% per year using uniform gradient method. (PU, 2014/F)

End of Year	Cash Flow
1	400
2	600
3	800
4	1,000
5	1,200
6	1,400

24. Find the value of  $G$  if  $i=12\%$  (PU/2014/S)



25. A father deposits a sum of Rs. 100,000 in a bank account for his son's education who will be admitted to a professional course after 5 years. The bank has 12% interest per year compounded monthly. Find the future amount of the deposited money at the time of admitting his son in the professional course. (PU, 2014)
26. Suppose that the parents of a young child to make annual deposits into a saving account, with the first deposit being on the child's fifth birthday and the last deposit being the child's fifteenth birthday. Then starting on the child's eighteenth birthday, the withdrawal will be Rs. 20,000 and will increase by Rs. 4,000 every year till the child's twenty first birthday. If the effective interest rate is 8% during this period of time, what are the annual deposits in years five through fifteen? Also show the cash flow diagram in detail. (PU, 2005/S)
27. What is the future equivalent of Rs. 50,000 per year that follows continuously for 8 years if the nominal interest rate is 12% and compounded continuously. (PU/2005/Spring)
28. Calculate the future worth of the following cash flows deposited at 8% compounded continuously for 5 years.
- Rs. 50,000 at the beginning of each year.
  - Rs. 50,000 the end of each year. (PU, 2017/F)
29. Suppose that one has a bank loan of Rs. 10,000, which is to be repaid in equal end of the month installments for 5 years with nominal interest rate of 12% compounded monthly. What is the amount of each payment? (PU, 2009/F)
30. A man aged 40 years now had Rs. 5,00,000 from bank for his studies at the age of 20 years. Interest was charged 11% per year compounded quarterly. He wished to pay in semi-annual equal installment with the first installment 5 year after receiving the loan. He has just cleared his loan now. What amount did he pay in each installment? (PU, 2012/F; 2016/S)

31. Sarita wants to deposit Rs. 15,000 in every year into a bank at interest rate of 12% per year compounded semi annually. What will be the maturity amount after 5 years? (PU, 2013/F)
32. How much do you need to deposit now in a savings account that earns 8% interest compounded continuously so that you can withdraw Rs. 1000 at the end of each quarter for five years?
33. Suppose a farmer want to save money semi-annually in a financial company for the engineering education of his daughter of 2 years old. How much money does he need to save per period if she will need Rs. 20,00,000 when her age will be 18 years old. The company compounded the money semi-annually and interest rate is 12%. (PU, 2019/F)
34. 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?
35. 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?
36. 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?
37. How many deposits of Rs. 5,000 each should make per month so that the final accumulated amount will be Rs. 100,000 if the bank interest rate is 12% per year? (PU, 2014)
38. If you have Rs. 10,00,000 loan from a bank, how much rupees should you pay as installment per two month for five years bank interest rate is 12% per year.(PU, 2018/F)
39. How many deposits of Rs. 25,000 each should Mr. A made each month so that the final accumulated amount will be Rs. 10,000,000 if interest rate is 12% per year.
40. Hari wants to deposit an amount P now such that he can withdraw an equal amount of Rs. 2,000 each year for the first 5 years and then Rs. 3,000 for the following 3 years. Calculate what P amount is if the interest earned is 6% per year. Draw Cash flow diagram. (PU, 2009/F; 2008/F)
41. Suppose you deposit Rs. 100,000 in fixed deposit account of Nabil Bank 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.
42. Find present equivalent from cash flow given if interest rate is 11% per year using uniform gradient method. (PU, 2011/F)

EOY	1	2	3	4	5	6
Cash Flow	-40000	-50000	-60000	-70000	-80000	-100000

{Hints:  $P = -[40,000(P/A, 11\%, 5) + 10,000(P/G, 10\%, 5) + 100,000(P/F, 11\%, 6)]$ }

43. Suppose you make Rs. 5000 monthly deposits to a retirement plan that pays interest at a rate of 10% compounded quarterly. Compute the balance at the end of 10 years.
44. 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?
45. 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.)
46. 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)
47. 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.

48. 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?
49. 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)
50. 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.
51. 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).
52. 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 benefits 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. 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)
5. 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)

6. 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)
7. 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.
8. 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).
9. Consider an investment project with the following cash flow. Compute the IRR for this investment and determine its acceptability at  $MARR = 10\%$  and draw also an investment balance diagram. (PU, 2009/F)

End of Year	Net cash flows
0	-22,000
1	-1,000
2	0
3	8,000
4	3,000
5	15,000

10. 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 10<sup>th</sup> 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%
11. Find the both types of payback period of the project with the following cash flow status: (PU, 2007/F)

EOY	0	1	2	3	4	5	6	7
Cash Flow (Rs.)	-1500	200	400	450	450	600	900	1100

12. Calculate simple and discounted payback periods assuming  $MARR = 15\%$ . (PU, 2015/S)

EOY	0	1	2	3	4	5	6
Cash Flow (Rs.)	-85000	15000	25000	35000	45000	45000	35000

13. An investment of Rs. 10,000 can be made in a project that will produce uniform annual revenue of Rs. 5,310 for five years and then have a market (salvage) value of Rs. 2,000.

The company is willing to accept an project that will earn 10% per year or more on all invested capital. Show whether this is a desirable investment by using the present worth and annual worth method. (PU, 2006/S)

14. Evaluate IRR of the following project. Identify whether the projects is feasible or not? Also draw investment Balance Diagram. (PU, 2014/S; 2005/F; 2007/S; 2008/F; 2010/F; 2011/F; 2014/F)

Initial investment	Rs.5,00,000
Annual Revenues	Rs.1,20,000
Annual cost	Rs.30,000
Useful life year	10 years
MARR	10%

15. Select the best project by using IRR method when MARR is 8%. Use incremental analysis if necessary. (PU, 2019/S)

Year	Project A	Project B
Initial Investment	3,00,000	5,00,000
Annual Revenue	1,50,000	1,75,000
Life	6	6
Salvage Value	70,000	1,00,000

16. From the following set of mutually exclusive projects chose best alternative using incremental BC ratio method. (PU, 2005/F)

Alternatives	Annual Benefits (Rs.)	Annual Cost (Rs.)
A	900	600
B	1600	800
C	1660	850
D	1200	900
E	1725	1050
F	1975	1100

17. Evaluate IRR of the following project and identify whether the project is feasible or not.

Initial investment	=Rs. 5,00,000
Annual revenue	=Rs. 2,30,000
Annual cost	=Rs. 45,000
Useful life	=8 yrs
Repair and maintenance cost at 4 <sup>th</sup> and 6 <sup>th</sup> year	=Rs. 30,000
MARR	=10% per year

Also draw investment balance diagram.

18. 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%.

19. Calculate IRR and ERR of following cash flow, Why these values are different. (PU, 2018/F)

Year	0	1	2	3	4	5
Cash flow	-1100	250	-300	400	500	600

20. Find both types of BCR using FW formulation where initial investment is 500000; annual income is Rs. 100000 and decrease by Rs. 10000 per year; annual cost is Rs. 20000 and

increases by Rs. 2000 per year; useful life is 10 years and salvage value is Rs. 150000.  
MARR=11. (PU, 2018/Fall)

21. Calculate PW of the following two mutually exclusive projects by using repeatability assumption when MARR is 10% per year. (PU, 2014)

	A	B
Initial Cost Rs.	400,000	600,000
Annual Revenue Rs.	30,000	35,000
Annual O&M Rs.	3,000	4,000
Useful life, Years	3	9
Market Value Rs.	4,000	7,000

22. Use repeatability assumption to select the best project from the following three projects.

Project	A	B	C
Initial Investment	2000	3000	4000
Annual Revenue	1000	1200	1500
Useful Life, Years	3	5	7
Salvage Value	20% of initial investment		

23. Capitalized Worth Method: Assume infinite project life; recommend one of the following mutually exclusive projects.

Project	A	B
Initial investment	Rs. 50,000	Rs. 120,000
Annual Cost	9,000	6,000
Salvage Value	10,000	10,000
Useful Life	10 years	25 years
MARR	15%	

24. From the following information select the best project using co-terminated assumption.  
Useful life = 5 years. (PU, 2019/F)

Items	X	Y	Z
Initial Investment	50000	40000	30000
Annual Revenue	20000	15000	14000
Annual Expenses	15000	12000	8000
Useful Life	5 years	7 years	9 years
Salvage Value	1000	500	0
MARR	10%	10%	10%

25. The following are five proposed projects being considered by an engineer in an integrate system for a company. The interrelationships among the projects and the respective cash flows for the coming budgeting period are as shown.

Project A1 and Project A2: Mutually exclusive and independent of B set.

Project B1 and Project B2: Mutually exclusive and contingent on the acceptance of A2.

Project C: Contingent on the acceptance of B1

	Project				
	A1	A2	B1	B2	C
Initial cost	Rs. 50,000	Rs. 30,000	Rs. 14,000	Rs. 15,000	Rs. 10,000
Annual Benefit	20,000	12,000	4,000	5,000	6,000



26. Assume MARR is 8% per year and all the equipments are having useful life of four years. Determine what combination of projects is best if the capital to be invested is (i) unlimited and (ii) limited to Rs. 48,000. (PU, 2005/S)

27. Following are two mutually exclusive alternatives.

	Machine X	Machine Y
Initial Cost	Rs. 2,000	Rs. 7,000
Uniform annual benefit	Rs. 950	Rs. 1,200
Salvage value	Rs. 500	Rs. 1,500
Useful life	5 years	10 years

Assuming 10% interest rate, which machine should be bought? Use conventional and modified benefit cost ratio method. (PU, 2007/F) (Hint: Use Incremental BC ratio)

28. Following are the two independent projects. Determine which project is worthy by using BC ratio. Assume MARR = 10%. (PU, 2015/S) (Hints: Compute BC ratio of both projects. Do not use incremental BC as they are independent projects).

	Project A	Project B
I	350,000	450,000
AR	150,000	175,000
O&M	30,000	40,000
S	50,000	75,000
N (year)	4	5

29. Three mutually exclusive public works projects are currently under consideration. Their respective cost and benefit are included in the table below. If life for each project is 50 years and nominal interest rate is 10% choose best alternative using BC ratio. (PU, 2007/S; 2009/F) (Hints: Use incremental BC ratio)

	A	B	C
Capital Investment	Rs. 8,500	Rs. 10,000	Rs. 12,000
Annual O & M Cost	750	725	700
Salvage Value	1,250	1,750	2,000
Annual Benefit	2,150	2,265	2,500

30. Compare following projects by using repeatability & Co-terminated assumption when MARR = 12% per year. Use PW, AW and FW formulation.

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

- 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.
- From the following information, compute the breakeven salvage value of the project B?

	Project A	Project B
Initial cost	Rs. 1,000	Rs. 2,000
Annual benefit	150	250
Life	10 yrs	10 yrs
Salvage Value	100	?

MARR	3.5%	3.5%
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3. From the following information of micro hydro project, determine how many years it needs to be operated for breakeven point.

Initial cost	Rs. 150,000
Annual maintenance cost	Rs. 5,000
Annual energy generated at full load	10 MW
Values of energy generated	Rs. 5/Kwhr
Salvage Value	Rs. 50,000
MARR	10%

4. From the following information, find that how many hours/year would the motors have to be operated at full load for annual costs to be equal if MARR is 15%?

	<b>Motor A</b>	<b>Motor B</b>
Purchase cost	Rs. 125000	Rs. 160,000
Efficiency	74%	92%
Life	10 yrs	10 yrs
Maintenance Cost	Rs. 5,000/year	Rs. 2500/year

5. Annual tax and insurance: 1.5% of investment for both motors and electricity cost Rs. 5/KW hr. Power of both motors =100hp. (PU, 2005/F; 2008/S; 2008/F; 2009/S; 2011/F)
6. Perform sensitivity analysis of following project over a range of -10% to +30% in initial investment, -10 to +10% in useful life and -20% to +20% in MARR. Draw sensitivity diagram and decide most sensitive parameter. (PU, 2018/F)

Initial Cost	Annual Income	Useful Life	Salvage Value	MARR
20 crore	3 crore	30 years	0	10%

7. Perform sensitivity analysis of the parameters over the range of  $\pm 20\%$  in
- Initial investment
  - Annual revenue
  - Useful life

If  $I = 11,500$ ;  $AR = 3,000$ ;  $N = 6$  years;  $S = 1,000$ ;  $MARR = 10\%$

8. From the following information, conduct scenario analysis based on FW formulation. Assume  $I=1,25,000$ ,  $MARR=12.5\%$ , and life of project is 5 years. Also give your remarks based on results of different scenarios. (PU, 2018/S)

<b>Variable Considered</b>	<b>Worst Case Scenario</b>	<b>Most Likely Scenario</b>	<b>Best Case Scenario</b>
Annual Sales	76,800	1,00,000	127,200
Annual Variable Cost	27,200	30,000	28,800
Annual Fixed Cost	11,000	10,000	8,000
Salvage Value	30,000	40,000	50,000

9. From the following information, calculate NPW for each scenario by assuming  $I=1,25,000$ ,  $MARR=15\%$ , and life of project is 5 years.

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

