Industrial Management and Engineering Economy

For 5th year Mechanical & industrial Engineering students

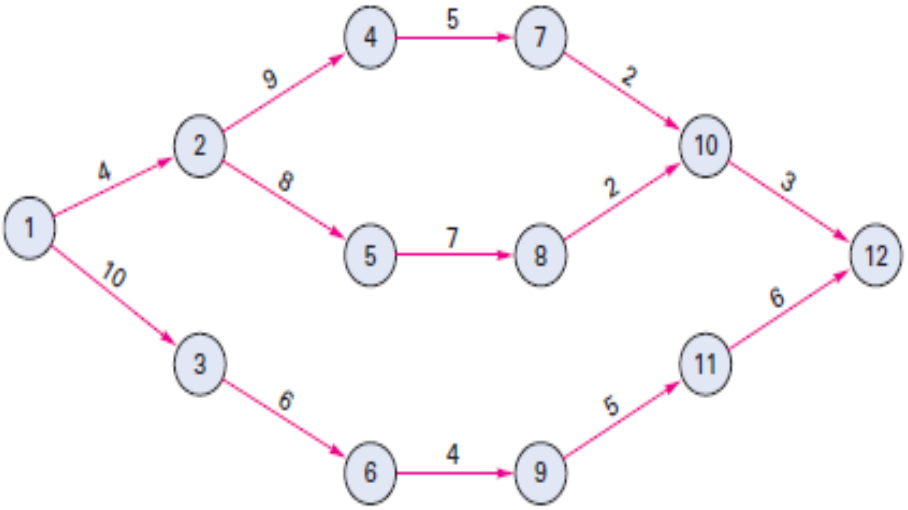
Individual Assignment 3

1. An electrification project in debre markos district has to pass through six substations. The duration and the precedence order of these substations are given below:

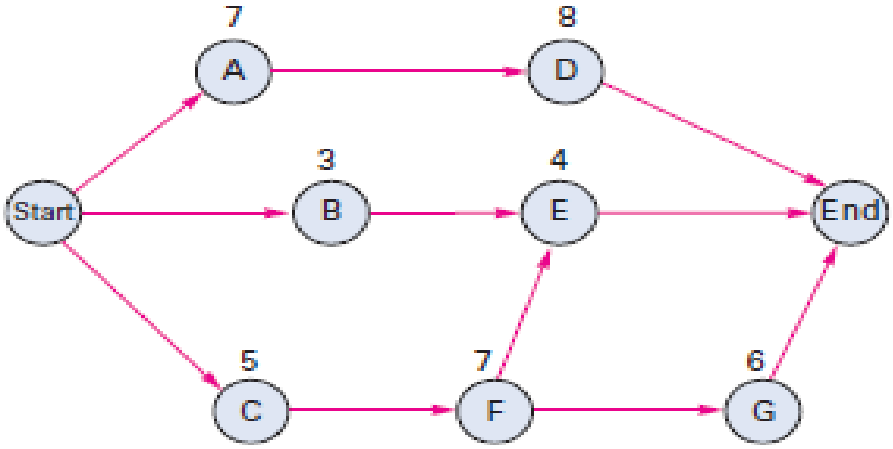
Substation	(Activity) predecessor	Activity duration (in days)
A	-	14
B	A	16
C	A	18
D	B	15
E	C	17
F	D, E	15

(a) Construct the network diagram for the project.
(b) Determine:
   i. The forward passes (ES & EF) for each task.
   ii. The backward passes (LS & LF) for each task.
   iii. The slack time for each task; and hence the critical path.

2. For each of the following network diagrams, determine both the critical path and the expected project duration. The numbers on the arrows represent expected activity times.
   a. AOA diagram



b. AON diagram

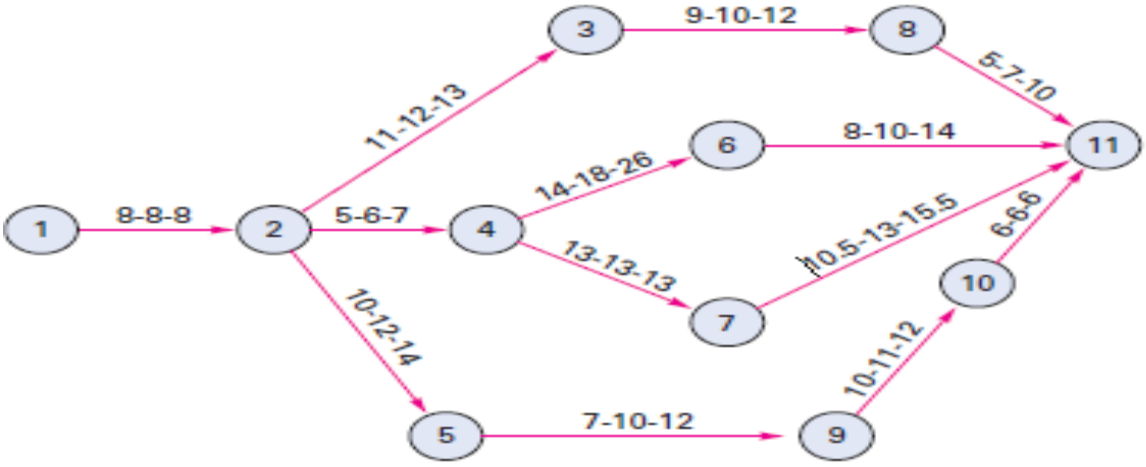


3. The following precedence diagram reflects three time estimates in weeks for each activity. Determine:

a. The expected completion time for each path and its variance.

b. The probability that the project will require more than 49 weeks.

c. The probability that the project can be completed in 46 weeks or less.



4. A small project consists of 7 activities whose three time estimates are given below:

Activity	Activity's name	Time estimates (in days)		
		t_o	t_m	t_p
1-2	H	3	3	12
1-3	I	3	6	9
1-4	J	6	6	15
2-5	K	3	3	3
3-5	L	6	15	24
4-6	M	6	15	21
5-6	N	9	15	27

(a) Find the expected duration and variance for each activity.

(b) Draw a network diagram.

(c) What is the critical project length (duration)?

(d) Calculate the variance and standard deviation of the project length.

5. Assume you are a manager of a big hydroelectric power station. For the expansion of the substations, you borrowed 80,000birr at the beginning of year 1 and 120,000birr at the beginning of year 2 from development bank of Ethiopia. The agreement made to discharge the debt is by making **two equal payments**, one at the end of year 4 and one at the beginning of year 7. If the interest rate of the loans is 8% for the first 3 years and 10% thereafter, what will be the amount of each payment?
6. A new machine is expected to cost $60,000 and have a life of 5 years. Maintenance costs will be $15,000 the first year, $17,000 the second year, $19,000 the third year, $21,000 the fourth year, and $23,000 the fifth year. To pay for the machine, how much should be budgeted and deposited in a fund that earns

   (a) 5% per year, compounded annually?

   (b) 13% per year, compounded quarterly?

7. Assume you are an employee of an electric power industry and the sum of 100,000 birr will be required 10 years hence to buy a home. To ensure its viability, you have to deposit each year some amount of money in a bank from your yearly salary. If the bank's interest is 5%, what equal amount of money you must deposit at the end of each year?
8. You have just graduated from university & plan to begin a retirement fund. It is your desire to withdraw money every year for 30 years starting 25 years from now. The fund earns 7% interest. What uniform annual amount will you be able to withdraw when you retire in 25 years if you deposit $1,000 per year for the 1st 20 years starting one year hence?

Additional practical exercises (not to be submitted)

1. The sum of $ 5000 will be required 10 years hence. To ensure its availability, a sum of money will be deposited in a reserve fund at the present time. If the fund will earn interest at the rate of 4% for the first three years & 6% thereafter, what sum must be deposited?
2. A new machine is expected to cost $6000 and have a life of 5 years. Maintenance costs will be $1500 the first year, $1700 the second year, $1900 the third year, $2100 the fourth year, and $2300 the fifth year. To pay for the machine, how much should be budgeted and deposited in a fund that earns

   (a) 1% per year, compounded annually?

   (b) 9% per year, compounded quarterly?

3. Your engineering firm needs a rapid prototyping machine. The company gives you two options. In Option 1 you purchase the machine outright for $50,000, pay a maintenance contract of $1,000 per year, and expect to be able to resell the machine after 10 years at a salvage value of $10,000. In Option 2, you lease the machine at $7,000 per year and pay no maintenance, but receive no salvage. Assume that in both options you will be able to take in $8,000 per year in income from this machine. Also assume that an additional option is not to buy the machine at all, but to put the money in the bank at 5% interest. Which option will be best for the firm?
4. Assume you are an employee of a chemical processing factory and the sum of 100,000 birr will be required 10 years hence to buy a home. To ensure its viability, you have to deposit each year some amount of money in a bank from your yearly salary. If the bank's interest is 5%, what equal amount of money you must deposit at the end of each year?
5. A company is considering the two available types of equipment for performing a manufacturing operation: standard and semiautomatic machine. The comparative data are given below:

Item	Standard machine	Semiautomatic machine
purchase price, $	12,000	18,000
Salvage value(@end of 4yrs), $	2000	5,000
Labour cost per year, $	12,000	6,000
Annual operating cost, $	1000	800
Estimated Life, years	4	4

All the costs incurred during a year can be assumed to occur at the end of the year. The prevailing interest rate for money is 5%. Using the present worth cost of- method; determine which machine is to be preferred (economical) & show all payments & receipts using cash flow diagram.

6. Two alternative assets have the cost data as follow:

Item	Asset I	Asset I
First cost, $	95,000	63,000
Salvage value, $	6,000	5,000
Annual maintenance cost, $	9,200	12,500
Estimated Life, years	8	5

Which asset is preferable / economical? Apply interest rate of 11.5%.

7. Ato kebede loaned for Ato Yohennese, the sum of $ 15,000 at the beginning of year 1, $45,000 at the beginning of year 2 and $ 54,000 at the beginning of year 4. The loans are to be discharged by a single payment made at the end of year 6. If the interest rate of the loans is 8% per annum, what sum must Ato Yohennese pay?
8. Valley Rendering, Inc. is considering the purchase of a new flotation system for recovering more grease. The company can finance a $150,000 system at 5% per year compound interest or 5.5% per year simple interest.
    a. If the total amount owed is due in a single payment at the end of 3 years, which interest rate should the company select?
    b. How much is the difference in interest between the two schemes?