

Problem 1. (26 points)

For each motor, the present value of the operating cost =
Purchase Price (not considered here) + Present value of (Maintenance +Electricity –Salvage
Value). There are several approaches.

Motor #1:

$$\text{Cost} = 3,000(\text{P/A}, 8\%, 10) + 400(\text{P/G}, 8\%, 10) + 3000(\text{P/A}, 8\%, 10) + 2000(\text{P/A}, 8\%, 5) - 800(\text{P/F}, 8\%, 10)$$

$$\text{Cost} = 6,000(6.7101) + 400(25.9768) + 2000(3.9927) - 800(.4632)$$

$$\text{Cost} = \$58,266$$

Motor #2:

$$\text{Cost} = 2,000(\text{P/A}, 8\%, 10) + 4000(\text{P/F}_1, 8\%, 4\%, 10) - 600(\text{P/F}, 8\%, 10)$$

$$\text{Cost} = 2,000(6.7101) + 4000(7.8590) - 600(.4632)$$

$$\text{Cost} = \$44,578$$

Cheapest Motor: #2

The following factors were used:

$$(\text{P/A}, 8\%, 10) = \frac{(1+i)^n - 1}{i(1+i)^n} = \frac{(1+.08)^{10} - 1}{.08(1+.08)^{10}} = 6.7101$$

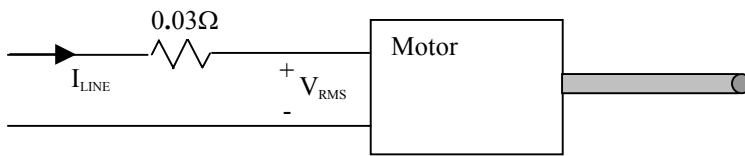
$$(\text{P/A}, 8\%, 5) = \frac{(1+i)^n - 1}{i(1+i)^n} = \frac{(1+.08)^5 - 1}{.08(1+.08)^5} = 4.2124$$

$$(\text{P/G}, 8\%, 10) = \frac{(1+i)^n - (i \cdot n) - 1}{i^2(1+i)^n} = \frac{(1+.08)^{10} - (.8) - 1}{(.08)^2(1+.08)^{10}} = 25.9768$$

$$(\text{P/F}, 8\%, 10) = \frac{1}{(1+i)^n} = \frac{1}{(1+.08)^{10}} = .4632$$

$$(\text{P/F}_1, 8\%, 4\%, 10) = \frac{(1+i)^n - (1+g)^n}{(i-g)(1+i)^n} = \frac{(1.08)^{10} - (1.04)^{10}}{(.08 - .04)(1.08)^{10}} = 7.8590$$

Problem 2. (18 points)



- A. Cost = input power in kilowatts x \$.05/KW-hr x 360 days/year x 12 hours/day

$$\text{Cost} = (40\text{KW}) \times \$.05/\text{KW-hr} \times 300 \text{ days/year} \times 8 \text{ hours /day} = \$4,800/\text{year}$$

- B. $P_{in} = V_T I_L (\text{PF})$

$$I_L = P_{in} / V_T (\text{PF})$$

Line Voltage = 200 volts

$$I_L = 40 \times 10^3 / V_T (\text{PF}) = 250 \text{ amperes}$$

$$P_{line} = I_L^2 R = (250)^2 (.03) = 1,875 \text{ watts}$$

Note: Using the same rate for electricity, the cost would be

$$\text{Cost} = (1.875\text{KW}) \times \$.05/\text{KW-hr} \times 300 \text{ days/year} \times 8 \text{ hours /day} = \$225/\text{year}$$

- C. A rate of 6% nominal, compounded every four months, corresponds to 2% three times per year.

$$A = 20,000(A/P, 2\%, 30)$$

$$(A/P, 2\%, 30) = \frac{i(1+i)^n}{i(1+i)^n - 1} = \frac{.02(1+.02)^{30}}{(1+.02)^{30} - 1} = .04465$$

$$A = 20,000(.04465) = \$1,339.50$$

Problem 3. (8 points)

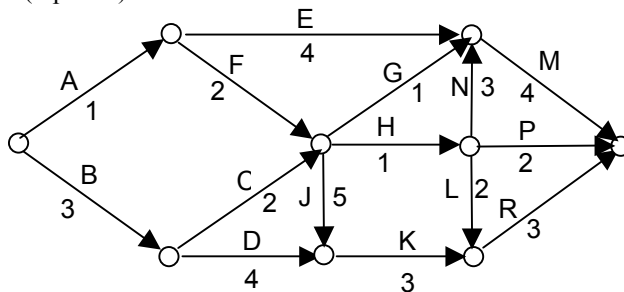
- A. The project completion time for a PERT Chart is assumed to be a normally distributed random variable. This assumption is most closely related to the concept that the individual activity times are uncorrelated random variables, and the central limit theorem applies to the sum. (b)
- B. A utility company sometimes adjusts the cost of power if a purchaser adjusts the load power factor to be less lagging (closer to unity). A plant is normally lagging because of the presence of lagging machinery, and the line is also lagging. A less lagging power factor for the plant would mean lower current for the same real power to the plant. The lower current would produce less power loss in the line, so the power company would be willing to charge a reduced rate. (b)
- C. Recitation #2 discussed the staggered parallel development of a family of microprocessors to produce progressively higher performance machines. (c)
- D. Number of bands = 20,000 (1-Z(x))

$$x = (1,200 - 600) / 400 = 1.5$$

$$\text{Number} = 20,000(1 - Z(1.5)) = 20,000(1 - 0.066807) = 18,664 \text{ bands (e)}$$

Problem 4. (20 points)

- A. (8 points)



Critical Path=longest path=B C J K M

Project Duration=length of critical path=17

- B. (6 points)

(i) Activity H: Latest start = Project duration-length of longest backward path Latest start for Activity H=17-8=9

Earliest start for Activity H=5

Float for Activity H=9-5=4

(ii) Float for Activity K=0, since all activities on the critical path have a float of zero.

C. (6 points) Project duration = 18 months

standard deviation = 6 months.

Probability that the project will require greater than 15 months to complete obtained from tail-end Z distribution.

$$Z = (15 - 18) / 6 = -.5$$

$$P(Z > -.5) = 1 - Z(.5) = 1 - .3085 = .691$$

Probability .691

Problem 5. (9 points)

A. Partitioning is the separating of a design into multiple parts at the same level of abstraction. This separation allows multiple items to be tackled in parallel. Since there are more separate groups, there is less overview, and it, in general, is harder to obtain a globally optimized design, and more interface specifications are required..

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B. Less applies to matters of reduced degree; fewer applies to items that are countable. One would say “fewer students,” as opposed to “less students”, which is incorrect. Either less or fewer may be used to describe time: “fewer than 6 hours” is correct. #1

C. Between is used when there are two persons or items; among is used when there are more than two: between the two students, among the three students. Affect is usually used as a transitive verb, meaning “to influence.” Effect is usually the one used as a noun, meaning the intent, appearance, or the accomplishment.” #1

D. Recycling is the process whereby a discarded product is returned to its basic material components. This is an expensive process. Technology changes would not normally render the materials worthless, because they normally could just be used in another product. #1

Problem 6. (15 points)

- A. For the accelerated cost recovery method of depreciation, the depreciation expense charged is determined by multiplying the unadjusted basis times a percentage. The percentage is determined by law for each class of property. Salvage value and actual working life is irrelevant. It is called accelerated because more of the expense is allocated to the earlier periods, in order to lower income taxes and encourage investment. (False)
- B. The effective rate of interest is always greater than the nominal rate if the compounding period is less than one year. If the compounding rate is one year, then the effective rate is equal to the nominal rate. (False)
- C. A simulation, which is defined as an imitative representation of the functioning of one system or process by means of the functioning of another, is an independent concept from the method of modeling, which could be either mathematical or physical. (False)
- D. The book value is equal to the purchase price minus the accumulated depreciation. The book value therefore decreases with time. For straight line depreciation, the book value becomes equal to the estimated salvage value at the end of the estimated life of the item. There is no defined relation to the market value. (False)
- E. For a series of 20 annual payments such that each payment is 6% greater than the previous payment, then the tenth payment is equal to the first payment times $(1.06)^9$ = first payment times 1.7, less than twice the first payment of the series. (False)