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:
Present Cost= 4,000(P/A, 8%, 10)+ 3000(P/A, 8%, 10) +3000 (P/A,8%,5) (P/F,8%,5) - 600(P/F,8%,10)
Present Cost= 7,000(6.7101)+3000(3.9927)(.6806)-600(.4632)=54,845
Annual Cost=54,845(A/P,8%,10)=58,266(.1490)
Annual Cost=$8,172

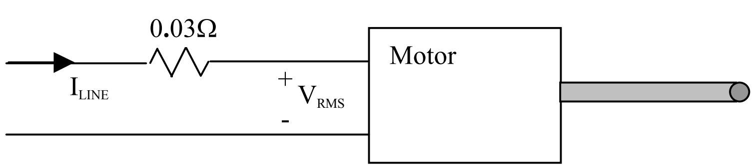
Motor #2:
Present Cost= 6,000(P/A, 8%, 10)-400(P/G, 8%, 10)+3000(P/F_1, 8%, 4%, 10)-800(P/F,8%,10)
Present Cost= 6,000(6.7101)-400(25.9768)+3000(7.8590)-800(.4632)
Annual Cost=$53,076(A/P,8%,10)=53,076(.1490)
Annual Cost=$7,908

Cheapest Motor: #2

The factors were obtained from the table supplied except for the P/F_1,calculated below :

$$((P/F_1, 8\%,4\%,10)= \frac{(1+i)^n-(1+g)^n}{(i-g)\ (1+i)^n} = \frac{(1.08)^{10}-(1.04)^{10}}{(.08-.04)(1.08)^{10}} = 7.8590$$

Problem 2. (18 points)



A. Cost = input power in kilowatts x $.06/KW-hr x 300 days/year x 8 hours/day

Cost =(60KW) x $.06/KW-hr x 300 days/year x 8 hours /day = $8,640/year

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

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

Line Voltage= 220 volts

$I_L = 60x10^3 /220(.8) = 340.9$ amperes

$P_{line} = I_L^2 R=(340.9)^2(.03)=3,487$ watts

Using the same rate for electricity, the cost would be

Cost =(3.486KW) x $.06/KW-hr x 300 days/year x 8 hours /day = $502/year

C. For 9 equal annual payments of amount A_1, the first occurring immediately, at an interest rate of 6%.

$40,000=A_1+ A_1$ (P/A,6%,8)

A_1=40,000/(1+6.2098)=$5,548

Problem 3. (8 points)

A. The primary advantage of Gantt charts over CPM diagrams for project scheduling is that Gantt charts clearly show the chronological relations completion time among the various activities; CPM diagrams more clearly show the logical precedence relations. (a)

B. The roof top of the Quality Function Deployment Diagram indicates primarily the tradeoffs and correlations among the engineering characteristics. The central rectangular part relates the customer desires to the engineering attributes. (c)

C. Recitation #2 discussed the staggered parallel development of a family of microprocessors to produce progressively higher performance machines. (c)

D. If a manufacturing process has an average defect rate of 1.4 defects per unit, then the probability that a particular unit will have less than two defects is equal to the probability that it has zero defects plus the probability that it has one defect.

P(<2)=P(0)+P(1).

Prob { k defects } = $(dpu^k / k!)\, e^{-dpu}$

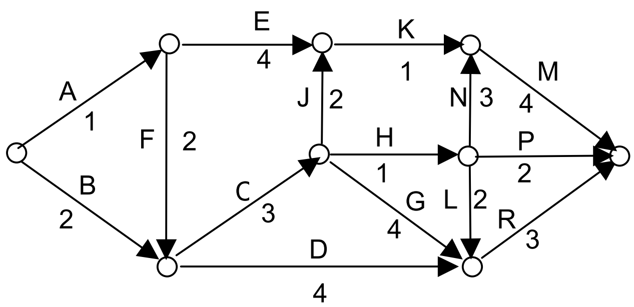
Prob { 0 defects } = $(dpu^0 / 0!)\, e^{-dpu} = e^{-1.4}$=24.7%

Prob { 1 defects } = $(dpu^1 / 1!)\, e^{-dpu} = 1.4e^{-1.4}$=34.5%

P(<2)=P(0)+P(1)=24.7%+34.5%=59.2% Version #1 (b) Version #2 (d)

Problem 4. (20 points)

A. (8 points)



Critical Path=longest path=A F C H N M

Project Duration=length of critical path=14

B. (6 points)

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

(ii)Activity J: Latest start = Project duration -length of longest backward pathLatest start for Activity H=14-7=7

Earliest start for Activity J=6

Float for Activity H=7-6=1

Problem 5. (9 points)

Specification: R > 6. Three batches of 100,000 fasteners

Version #1

Batch A: mean= 6.5×10^6 ohms

Standard deviation $=1.5\times10^6$ ohms

Batch B: mean=7.2×10^6 ohms

Standard deviation=10^6 ohms

Batch C: mean=8.5×10^6 ohms

Standard deviation=2.5×10^6 ohms

Version #2

Batch A: mean= 7.2×10^6 ohms

Standard deviation $=10^6$ ohms

Batch B: mean=8.5×10^6 ohms

Standard deviation=2.5×10^6 ohms

Batch C: mean=6.5×10^6 ohms

Standard deviation=1.5×10^6 ohms

Version #1
Fraction of expected defects, A= Z((6.5-6)/1.5)=Z(.33)
Fraction of expected defects, B= Z((7.2-6)/1)=Z(1.2)
Fraction of expected defects, C= Z((8.5-6)/2.5)=Z(1)

B has the lower fraction

Number of expected defects, B=Z(1.2)(100,000)=.11507(100,000)=11,507

Version #2
Fraction of expected defects, A= Z((7.2-6)/1)=Z(1.2)
Fraction of expected defects, B= Z((8.5-6)/2.5)=Z(1)
Fraction of expected defects, C= Z((6.5-6)/1.5)=Z(.33)

A has the lower fraction

Number of expected defects, A= Z(1.2)(100,000)=.11507(100,000)=11,507

Problem 6. (15 points)

Version #1

A. The effective rate of interest is always greater than the nominal rate if the compounding period is less than one year, for a positive, non-zero rate. If the compounding rate is one year, then the effective rate is equal to the nominal rate. In nearly all cases of practical interest, the compounding period is less than one year. (True)

B. 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)

C. The term biennial only means occurring every two years; the term semiannual only means occurring twice a year. Therefore regular semiannual payments occur four times more often than do regular biennial payments. (True)

D. For the Payback Period method of project comparison, one merely determines the amount of time required to recoup the original investment, without regard for the time-value of money. One does not use the P?/F factor (False)

E. In group decision–making, the number of possible communication interactions is not linearly proportional to the number of group members. If th e group has N members, each member can interact with N-1 others. By considering each member, there are N(N-1)/2 possible interactions, with the 2 in the denominator preventing double counting. For large N, the leading term is N2/2. (False)

Version #2

A. See C. above.

B. See D. above.

C. See B. above.

D. See A. above.

E. See E. above.