ECE 4000
Quiz #2 Solution

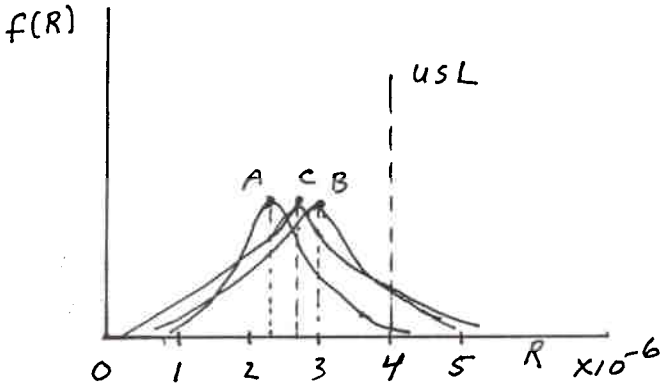
RC
4/10/02

1. Since the mean of A is less than the mean of B, and also the standard deviation of A is less than that of B, then A has less defects than does B. The same situation holds for A versus C. Therefore A has the fewest defects. [see figure]

Fractional number of defects of $A = Z(1.8) =$ .03593, since $\dfrac{4\times10^{-6} - 2.2\times10^{-6}}{10^{-6}} = 1.8$

Expected number of defects $= (.03593)(100{,}000)$

$= 3593$



2. A. Stockholder Equity d – owner's claim on assets
   B. Venture Capital b – cash to fund start-up
   C. Retained Earnings a – net earnings minus dividends
   D. Corporate Bond c – Debt owed by company
   E. Liquidating Value e – Amount available if corp. shuts down

3. $C_p = 1.6 \quad C_{pK} = 1.2 \quad TM = 420 \quad AM = 460$

$$C_{pK} = C_p (1-K)$$

$$1.2 = 1.6 (1-K)$$

$$K = .25$$

$$K = \frac{|AM - TM|}{(USL - LSL)/2} = \frac{2(460-420)}{USL-LSL} = .25$$

$$USL - LSL = 320$$

$$LSL = 420 - 160 = 260$$

$$USL = 420 + 160 = 580$$

$$C_p = \frac{USL - LSL}{6\sigma} = 1.6$$

$$\sigma = 33.3$$

Defects Below LSL = [fraction of total] $Z \frac{460-260}{33.3} = Z(6.0)$

Defects Above LSL = $Z \frac{580-460}{33.3} = Z(3.6)$

4. a First Time Yield = 90%

$$e^{-dpu} = .9$$

$$dpu = -\ln .9 = .105$$

b. Let N = # built

$.1N$ = # defective units

$$.105 = \frac{\#\text{ of Defects (TOTAL)}}{N}$$

$$\frac{\#\text{ of Defects}}{\text{Defective unit}} = \frac{.105N}{.1N} = 1.05$$

c. per unit failure rate = .2 year^{-1}

$$e^{-\lambda t} = e^{-.2(2)} = e^{-.4} = .67 = \text{fraction remaining}$$

d. $P = F_1 \left(P/F_1, i\%, \%, n \right)$

$$P/F_1 = \frac{(1+i)^n - (1+g)^n}{(i-g)(1+i)^n} = \frac{(1.08)^{20} - (1.05)^{20}}{(.08-.05)(1.08)^{20}}$$

$$= 14.3580$$

$$P = 2{,}000\,(14.3580) = \$28{,}716$$

e. Some issues relating to sustainability are: cost of disposal/recycle/reuse
scrap value
environmental pollution due to manufacture/use/disposal
Lifecycle cost
Efficiency

5. A. FE exam: Morning - general
afternoon - general or discipline specific FALSE

B. For strict liability, negligence does not have to be proved. FALSE

C. The Hyatt walkway construction was not in accordance with original design specifications. FALSE

D. The patent application must contain a "preferred embodiment" in sufficient detail that one of ordinary skill in the art could produce a device. The patent application does not require a working model. True

E. The QFD can be used to identify conflicting customer needs and desires. One customer need might result in increasing one engineering characteristic and another need would result in increasing a second engineering characteristic. the two engineering characteristics could be intrinsic conflict. This would appear as a minus in the "rooftop" chart. True

F. Cash flow is equal to net earnings plus non-cash expenses. False

G. A patent application is publically available, and must disclose enough information for the idea to be duplicated by others (See answer D) True

H. $C_p = \frac{USL-LSL}{6\sigma}$. A small value of C_p would mean

That the specification range USL - LSL would be narrow for a given σ, and therefore a large number of defects, or alternately hard to manufacture. False

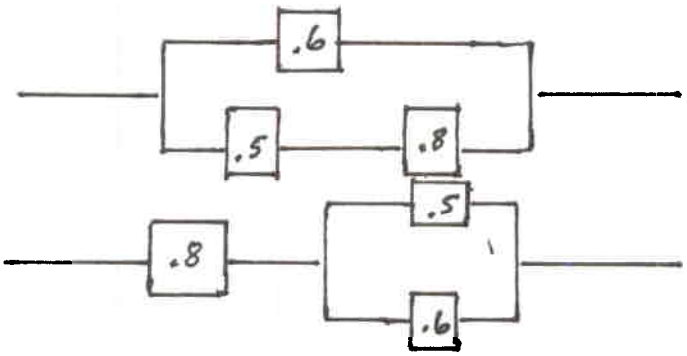
I. Two systems in parallel are always more reliable than either by itself.

$R = 1-(1-R_1)(1-R_2) = R_1 + R_2 - R_1R_2 = R_1 + R_2(1-R_1) > R_1$

for $0 < R_1, R_2 < 1$ False

J. In the bathtub, the per unit failure rate is decreasing during the infant mortality period. False

6. A. #1



Series $R = R_1R_2$

Parallel $R = 1-(1-R_1)(1-R_2)$

$R_1 = 1-(1-.6)(1-.5\times.8) = .76$

$R_2 = .8\{1-(1-.5)(1-.6)\} = .64$

B. Annualized Return of Alt. #1 =

$.6(310{,}000) + .4(280{,}000) - 2\times10^6$ [A/P]

Annualized Return of Alt. #2 =

$.2(300{,}000) + .8(300{,}000) - 2\times10^6$ [A/P]

↑ if 300,000/year for 8 years

ALT. #1, ANNUAL = $298{,}000 - 2\times10^6 [A/P]$

ALT. #2, ANNUAL is greater than

$300{,}000 - 2\times10^6 [A/P]$,

since 600,000 per year for 4 years is greater than 300,000 per year for 8 years. [Money arrives earlier]

∴ Alternative #2 is preferred.

Also, could express ALT. #2 as:

$.2(300{,}000) + .8(600{,}000)(P/A, 6\%, 4)(A/P, 6\%, 8)$

$- 2\times10^6 [A/P] = 327{,}783 - 2\times10^6 [A/P]$