

ECE 4000
Quiz #2 SOLUTION

RC

July 10, 2002

1. $USL = 4.0 \times 10^{-6} \text{ ohm/m}$

$LSL = -\infty$

BATCH 1 : MEAN = $\bar{R}_1 = 2.2 \times 10^{-6} \text{ ohms}$
STD. DEV. = $\sigma_1 = 1.0 \times 10^{-6} \text{ ohms}$

BATCH 2 : MEAN = $\bar{R}_2 = 3.0 \times 10^{-6} \text{ ohms}$

in BATCH 1 = # in BATCH 2 = 10,000

i) STANDARD NORMAL CURVE VARIABLE:

$$X_1 = \frac{R_1 - \bar{R}_1}{\sigma_1} \quad X_2 = \frac{R_2 - \bar{R}_2}{\sigma_2}$$

$$X_1 \Big|_{USL} = X_2 \Big|_{USL} \Rightarrow \frac{4 - 2.2}{1} = \frac{4 - 3.0}{\sigma_2 \times 10^6}$$

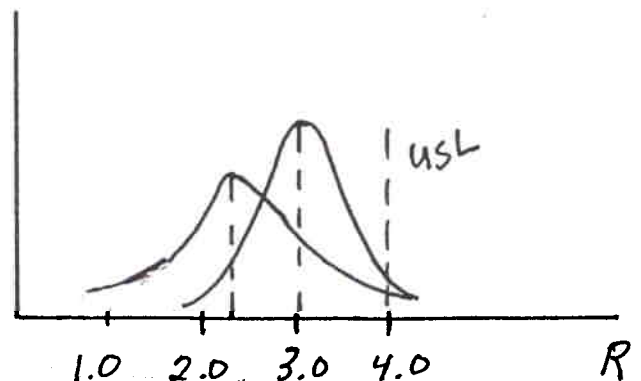
$$\sigma_2 = 5.56 \times 10^{-7} \text{ ohms}$$

ii) PROB ($X > USL$ in terms of UNIT NORMAL)

$$= \text{PROB} \left(X > \frac{4 - 2.2}{1} \right) = \text{PROB} (X > 1.8) = .03593$$

fail, Both BATCHES = 20,000 (.03593)

$$= 718$$



2. Duty-based: No action should violate the obligations to others (b)

Rights-based: No action should violate the rights of others. (c)

Utilitarian: Do the most good for the greatest (a)

Virtue-based: Values are emphasized. (e)

$$3. C_p = \frac{USL - LSL}{6\sigma} = \frac{28 - 16}{6(3)} = \frac{2}{3} = .667$$

$$C_{pk} = C_p(1-k) \quad k = \frac{\text{ACTUAL} - \text{TARGET}}{\frac{USL - LSL}{2}} = \frac{24 - 22}{\frac{28 - 16}{2}}$$

$$k = \frac{1}{3} \quad C_{pk} = \frac{2}{3} \left(1 - \frac{1}{3}\right) = \frac{4}{9} = .444$$

$$\text{Defects Below LSL: } z \left(\frac{24 - 16}{3} \right) = z(2.67)$$

$$\text{Defects Above USL: } z \left(\frac{28 - 24}{3} \right) = z(1.33)$$

$C_p < 1 \Rightarrow$ Process is INCAPABLE

$$4.A. \text{ Per unit failure rate} = 5 \times 10^{-3} \text{ hr}^{-1}$$

$$\text{Number surviving} = N_0 e^{-\lambda t} = 10,000 e^{-5 \times 10^{-3} \times 200} = 6065$$

$$\text{Number Failed} = 10,000 - 6065 = 3935 \quad (b)$$

$$B. \text{ Probability of 3 defects} = \frac{\lambda^k e^{-\lambda}}{k!} = \frac{(1.8)^3 e^{-1.8}}{3!} = 0.161 = 16.1\% \quad (d)$$

$$C. \text{ First Time Yield} = 86\% = .86, \text{ No repair}$$

$$N_{out} = .86 N_{in} = 1000 \quad N_{in} = \frac{1000}{.86} = 1163 \quad (b)$$

D. AN inspection FINDS ALL defects for which The inspection is designed.

Coverage is the fraction of ALL defects of the PARTICULAR type.

Coverage Does not relate To the PROBABILITY of detection for A PARTICULAR type OF defect. (a)

E. Commuter PARKING fees, which could be treated either AS A reduction OF future BENEFITS OR AS AN INCREASE IN PROJECT COSTS, is A TANGIBLE item AND the decision is one of CLASSIFICATION. (c)

F. the four types of CAPITAL, AS defined relating TO SUSTAINABILITY, ARE: HUMAN, FINANCIAL, MANUFACTURED, NATURAL. (a)

5. A. Once one is A licensed Professional Engineer, one MAY UNDERTAKE ASSIGNMENTS only when qualified by education or experience. The exam discipline is NOT the issue. FALSE

B. For STRICT liability, negligence does NOT HAVE TO BE PROVED. FALSE

C. the Hyatt Walkway construction WAS NOT IN ACCORDANCE with the ORIGINAL design specifications FALSE

D. A PATENT IS TO GUARANTEE ROYALTIES OR PREVENT SALE OF A PRODUCT BY A COMPETITOR. IT DOES NOT PREVENT RESEARCH OR DEVELOPMENT. FALSE

E. IF THE FIRST PAYMENT IS \$100, THE SECOND PAYMENT OF AN 8% GEOMETRIC SERIES AND ALSO THE SECOND PAYMENT OF AN \$8 ARITHMETIC GRADIENT SERIES ARE BOTH \$108. THE THIRD PAYMENT OF THE GEOMETRIC SERIES IS $\$108(1.08) = \116.64 , WHILE THE THIRD PAYMENT OF THE ARITHMETIC SERIES IS \$116.00. FOR ALL SUBSEQUENT PAYMENTS, THE GEOMETRIC SERIES TERMS ARE HIGHER THAN THE CORRESPONDING ARITHMETIC SERIES TERMS. THEREFORE THE PRESENT VALUE OF THE GEOMETRIC SERIES IS HIGHER. TRUE

F. A PATENT APPLICATION IS PUBLICALLY AVAILABLE, AND MUST DISCLOSE ENOUGH INFORMATION FOR THE IDEA TO BE DUPLICATED BY OTHERS. THE 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

G. $C_p = \frac{USL - LSL}{6\sigma}$. 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, difficult to manufacture. False

H. 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

I. In the "BATHTUB" model of device reliability, the per unit failure rate is decreasing during the infant mortality period. False

6. Choose annualized viewpoint, since the revenue figures are already annualized.

System Alpha: Approximate Annual return

for lower probability option AS

$$\frac{\$100 + \$500}{2} = \$300$$

2 expected

the Annual Return is then:

$$.8(210) + .2(300) = \$228$$

System Beta: Approximate Annual return

for lower probability option AS

$$\frac{\$400 + \$0}{2} = \$200$$

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The ANNUAL expected return is then:

$$.7(290) + .3(200) = \overset{\$}{263}$$

System Alpha return is overestimated,
since the larger amount (\$500) for the
two year cycle falls in the second year,
AND system Beta return is underestimated,
since the larger amount (\$400) for the
two year cycle falls in the first year.
Therefore choose: System Beta