

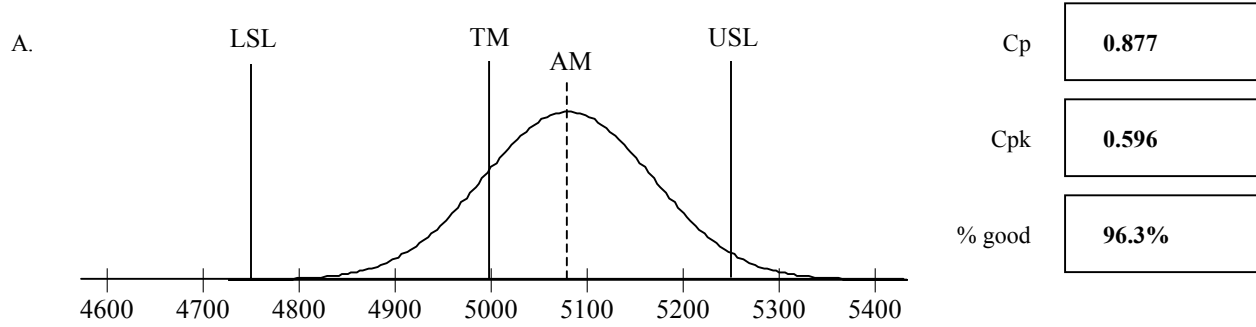
Problem 1. (28 points)

- A. **b**
- B. **a**
- C. **b**
- D. **c** $\lambda = 1/\text{MTTF} = 1/\text{yr} \Rightarrow N_S = N_0 e^{-\lambda(0.5\text{yr})} = 1000 e^{-0.5} = 606.5$
- E. **$1 - (1 - R_A R_B) (1 - R_C)$**
- F. **d**
- G. **c** $0.7 = R(100) = e^{-\lambda(100)} \Rightarrow \lambda = 0.003567 \Rightarrow F(250) = 1 - R(250) = 1 - e^{-\lambda(250)} = 0.59$

Problem 2. (18 points)

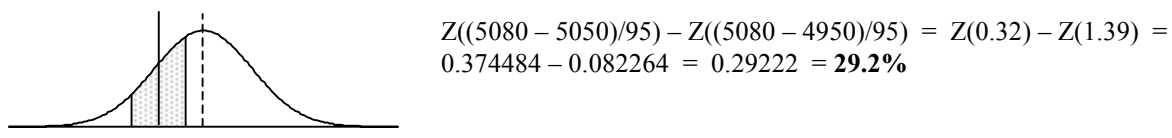
- A1) $5000 (\text{dpu} + 1) = 5000 (2.1 + 1) = 5000 (3.1) = \mathbf{15,500}$
- A2) $0 \text{ defects} \Rightarrow \text{FTY} = e^{-\text{dpu}} \Rightarrow 5000 (e^{-2.1}) = 5000 (0.1225) = \mathbf{612.3}$
- B1) $0 \text{ def} \Rightarrow 1 \text{ test}; 1+ \text{ def} \Rightarrow 2 \text{ tests}; 5000 (2 - \text{FTY}) = 5000 (2 - e^{-\text{dpu}}) = 5000 (1.8775) = \mathbf{9387.7}$
- B2) $5000 (\text{FTY}) = 5000 (e^{-\text{dpu}}) = 5000 (0.1225) = \mathbf{612.3}$
- C1) $0 \text{ defects} \Rightarrow \text{FTY} = e^{-\text{dpu}} = 0.1225 \Rightarrow 5000 / \text{FTY} = 5000/0.1225 = \mathbf{40,830.8}$
- C2) $\text{Prob} \{3 \text{ defects}\} = (\text{dpu}^3/3!) e^{-\text{dpu}} = (2.1^3/6)(0.1225) = 0.189 = \mathbf{18.9\%}$

Problem 3. (22 points)



$C_p = (\text{USL} - \text{LSL}) / (6 \sigma) = (5250 - 4750) / (6 (95)) = 500 / 570 = \mathbf{0.877}$
 $k = |\text{AM} - \text{TM}| / (0.5 (\text{USL} - \text{LSL})) = (5080 - 5000) / (0.5 (5250 - 4750)) = 80/250 = 0.32$
 $C_{pk} = C_p (1 - k) = 0.877 (1 - 0.32) = \mathbf{0.596}$
 Above: $Z((5250 - 5080)/95) = Z(1.79) = 0.036727$; Below: $Z((5080 - 4750)/95) = Z(3.47) = 0.000260$
 Good = $1 - \text{above} - \text{below} = 1 - 0.036727 - 0.000260 = 0.963013 \Rightarrow \mathbf{96.3\%}$

- B. $5000 \pm 1\% \Rightarrow \text{LSL} = 4950, \text{USL} = 5050$. Note that both of these are below the actual mean. Thus, the desired result is most easily obtained as the difference between the two “tail” values.



- C. $C_p = 1.150 = (USL - LSL)/(6\sigma) \Rightarrow USL - LSL = 6.9\sigma \Rightarrow LSL = -3.45\sigma, USL = 3.45\sigma$
 $C_{pk} = C_p(1 - k) \Rightarrow k = 1 - (C_{pk} / C_p) = 1 - (1.063 / 1.150) = 0.0756$
 $k = 0.0756 = |AM - TM| / (0.5(USL - LSL)) = |AM - 0| / (0.5(6.9\sigma)) = |AM| / (3.45\sigma)$
 $|AM| = 0.0756(3.45\sigma) = \pm 0.261\sigma$
Defects below = $Z(3.45 + 0.26) = Z(3.71) = 0.000104$
Defects above = $Z(3.45 - 0.26) = Z(3.19) = 0.000711$
Defects = $.000104 + .000711 = .000815 \Rightarrow DPMO = 1000000 (.000815) = 815$

Problem 4. (20 points)

- A. $t_{exp} = (t_o + 4t_m + t_p) / 6$
 $t_A = \{1.3 + 4(2.4) + 3.1\} / 6 = 2.33$
 $t_B = \{2.6 + 4(4.2) + 4.6\} / 6 = 4.00$
 $t_C = \{2.0 + 4(3.2) + 4.2\} / 6 = 3.17$
 $t_D = \{3.4 + 4(4.2) + 4.8\} / 6 = 4.17$
 $t_E = \{1.3 + 4(2.5) + 3.7\} / 6 = 2.50$
Critical Path = Longest Path = **A C E**
Expected Project Duration = Length of Critical Path = $2.33 + 3.17 + 2.50 = 8.00$
- B. Float = Latest Start - Earliest Start; Latest Start = Duration - Length of Longest Backward Path
 $LS(B) = 8.00 - 6.50 = 1.5$; $ES(B) = 0$; Float B = $8.00 - 6.50 = 1.50$
Activity C is on the critical path, so Float C = **0.00**
- C. Variance = $\sigma^2 = 0.384 \text{ month}^2 \Rightarrow \sigma = 0.6197 \text{ month}$
 $\Pr \{< 9 \text{ months}\} = 1 - \Pr \{> 9 \text{ months}\} = 1 - Z((9 - 8) / 0.6197) = 1 - Z(1.614) = 1 - .053 = 0.947 = 94.7\%$

Problem 5. (12 points)

- A. Possible answers include self-regulation, peer review and discipline, requires skills and judgment that is not routine or mechanized, requires extensive formal training or education, commitment to serve the public good, professional organization to set standards and codes of practice, and licensure.
- B. Possible answers include providing continuing education and training, setting standards, defining educational requirements and accreditation, peer review, and publication on research and practices.
- C. Many possible answers in terms of how specific aspects of the codes of ethics compare to the various moral theories. In order to receive maximum points, you generally were expected to point out that the moral theories are intended to be applicable to a wide range of human activities and that the various codes of ethics deal directly with engineering, including specific required and prohibited actions.