Valencia College
Division of Engineering, Computer Programming and Technology
EGN 2440 Probability and Statistics for Engineers
Instructor: Kwabena Ofosu, Ph.D., P.E.
Summer 2015

Quiz 4A Name:_____

You will receive credit for showing your steps even if your final answers are incorrect.

A part in an industrial cutting machine loses its cutting capability after a period of time t (in hours) in operation, and must be replaced. Test data suggests that the cumulative distribution function for the time to failure of the cutting part is given by

$$F(t) = 1 - (1 + t/5)^{-3/2}$$

1. What is the probability that the cutting part will survive up to 80 hours in operation? [Hint: Survival function] **(3 points)**

$$S(t) = 1 - F(t) = (1 + t/5)^{-3/2}$$

$$S(80) = (1 + 80/5)^{-3/2} = 0.0143$$

2. What is the average hazard rate (AHR) between 50 and 65 hours of operation? **(3 points)**

$$AHR(t_1, t_2) = \frac{H(t_2) - H(t_1)}{t_2 - t_1} \approx \frac{F(t_2) - F(t_1)}{t_2 - t_1}$$

$$AHR(50, 65) = \frac{F(65) - F(50)}{65 - 50} = \frac{(1 - \frac{65}{5})^{-3/2} - (1 - 50/5)^{-3/2}}{15} = 0.00055$$

3. A manufacturing plant makes a machine part for a defense system that must fit within a specified tolerance. A sample of 40 test specimens yielded an average diameter of 7.5cm with a standard deviation of 0.15cm. Construct a 95% confidence interval for the true mean diameter of the machine parts manufactured at this plant. **(4 points)**

→ Z-table

$$CI = \bar{x} \pm z_{\frac{\alpha}{2}} \frac{s}{\sqrt{n}}, \quad z_{\frac{\alpha}{2}} = z_{0.025} = 1.96$$

$$CI = 7.5 \pm 1.96 \frac{(0.15)}{\sqrt{40}} = 7.5 \pm 0.046$$

$$= [7.454, 7.546]$$

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Quiz 4B Name:_____

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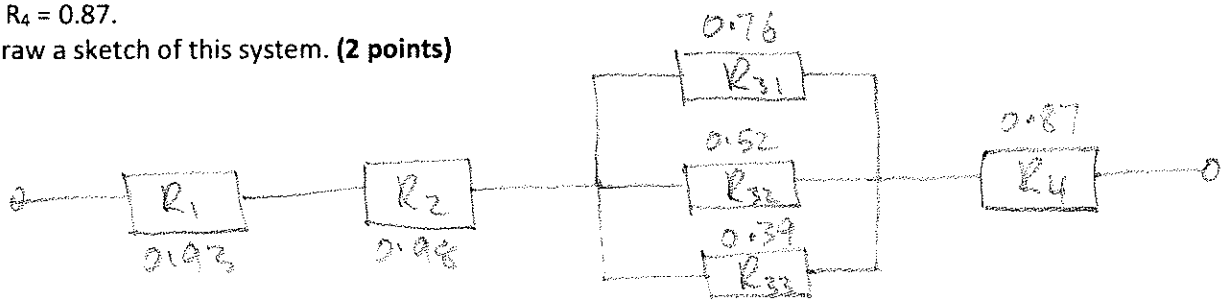
An aerospace engineer designing a new telemetry system, has modeled it as consisting of components R_1, R_2, R_3, and R_4 in series. R_3 actually consists of sub-components R_{31}, R_{32}, and R_{33} connected in parallel. The reliabilities of the components are as follows: R_1, = 0.93, R_2, = 0.98, R_{31}, = 0.76, R_{32}, = 0.52, R_{33} = 0.39, and R_4 = 0.87.

4. Draw a sketch of this system. **(2 points)**



5. The Federal Aviation Authority requires a minimum of 98% overall reliability for such systems to be approved for usage in commercial aircraft. Will this system be approved? **(4 point)**

$R_3 = 1 - (1-0.76)(1-0.52)(1-0.39) = 0.9297$

$R_{system} = (0.93)(0.98)(0.9297)(0.87) = 0.737 \approx 74\%$

$R_{system} <$ FAA requirement, System will not be approved.

A chemical plant manufactures a cleaning product. A process engineer tested a sample 25 standard specimens which yielded a mean concentration of the active ingredient of 38.5g/l and standard deviation of 12g/l. Construct a 95% confidence interval for the true mean concentration of the active ingredient in the cleaning product manufactured by this chemical plant. **(4 point)** → t-table

$CI = \bar{x} \pm t_{\frac{\alpha}{2},\nu} \frac{s}{\sqrt{n}}$, $t_{\frac{\alpha}{2},\nu} = t_{0.025,24} =$

$CI = 38.5 \pm \frac{2.064(12)}{\sqrt{25}} = 38.5 \pm 4.95$

$= [33.5, 43.45]$