The University of Jordan

Quality Control (First Exam 20 8/)

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Name: -- ID: ------------------ Duration: 50 minutes

Q1 (10 pts: 15 min) Please state whether each of the following statements is True/False. Please correct the false part.

- Prevention costs include indirect costs. ------ External failure
- Quality improvement includes the activities that ensure the quality levels of products and services are properly maintained and that customer quality issues are properly resolved. Quality assurance
- Appraisal costs include the costs related to failure identification and analysis. ---failure analysis
- The sample mean measures the scatter and variability in the data. --Sample variance
- The fraction defective by adopting Motorola's 4-sigma is 3.4 ppm. ----6 Sigma
- Features dimension of quality is related to the visual appeal of the product and factors such as style, color, and shape. -aesthetics--.
- Quality characteristics are often evaluated relative to control limits. ---specification
- Control charts help discover the key variables influencing the quality characteristics of interest in the process. -----Designed experiments
- The mean value of a measurement corresponds to the desired value for that quality characteristic. nominal
- Durability is assessed by how willing the service provider was to help correct an error in a bill. responsiveness
- The quality of design implies how well the product conforms to the specifications required by the design. - ---------- conformance
- A product is considered a defect if it has one or more nonconformities that are serious enough to affect the safe or effective use of the product significantly. -defective
- External failure costs include the net loss of labor and overhead resulting from defective products. Internal
- Prevention costs include all costs of adjustment of justified complaints attributable to the nonconforming product. --External failure
- Process add-value time is a direct measure of how efficiently the process is converting the work that is in process into completed products or services. -process cycle time efficiency
- Product durability is a sensory critical-to-quality characteristic. -time orientation
- Appraisal costs cover the cost of reinspection and retesting of products that have undergone rework or other modifications. ---internal failure costs
- The number of bins in Box plots is the square root of sample size. -histogram
- A turning process has an average process rate of 100 units per day; 800 units are waiting for processing. Then, the process cycle efficiency = 8 days. --process cycle time
- The specification chart is a very useful process monitoring technique. ------Control

Q2 (6 pts: 18 min). An industrial engineer inspects a product that is composed of 5 identical and independent components that are arranged sequentially. The probability that any component is nonconforming = 0.2. An engineer inspects the product. Calculate:

(a) The probability that at most one component of the product is nonconforming = 0.7373

$p(x \geq 1) = p(x=0) + p(x=1) =$

$\binom{5}{0} 0.2^0 \times 0.8^5 + \binom{5}{1} 0.2 \times 0.8^4 = 0.7378$ Binomial

(b) The probability that the first nonconforming component is component # 4= 0.1024

$p(x=4) = 0.2^1 \times 0.8^3 = 0.1024$ Geometric

(c) The inspector decides to continue inspecting until finding two nonconforming components. The probability that he/she will inspect exactly 10 components = --------------

$p(x=10) = \binom{9}{1} 0.2^2 \times 0.8^8 = 0.0604$ — Binomial

(d) The surface defects are observed on the product. Defects occur at a mean rate of 0.01 defects per product. The probability that the product contains at most one defect = --------------

$\lambda = 0.01$

$p(x \leq 1) = p(x=0) + p(x=1)$

$= \frac{e^{-\lambda} \cdot \lambda^0}{0!} + \frac{e^{-\lambda} \lambda^1}{1} = 0.99995$ Poisson

Q3 (4.5 pts: 12 min). An industrial engineer inspects a product that is composed of **three** identical and independent components. **Calculate:**

(a) The component's time to failure is modeled by Weibull distribution with shape and scale parameters of 0.25 and 500, respectively. The probability that **the component** fails before 400 hrs = ----------------

$F(400) = 1 - e^{-\left(\frac{400}{500}\right)^{0.25}} = 0.61161$

(b) The component's time to failure is modeled by Exponential distribution with a mean of 500 hours. The probability that the **component** survives 400 hrs = ----------------

$R(400) = e^{-\frac{400}{500}} = 0.4493$

(c) The component's time to failure is modeled by Exponential distribution with a mean of 500 hours. The product components are arranged in a standby configuration. The probability that the **product** fails before 400 hrs = -

$F(400) = 1 - \sum_{x=0}^{2} e^{-\lambda} \left[\frac{(\lambda a)^x}{x!}\right]$

$r = 3$

$\lambda = 1/500$

$a = 400$

$= 1 - e^{-\frac{400}{500}} \left[1 + \frac{400}{500} + \frac{\left(\frac{400}{500}\right)^2}{2}\right]$

$= 0.0474$