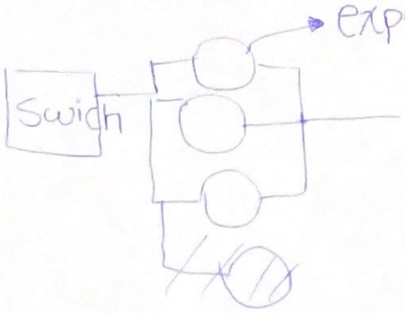
فرح عمر عبدالله

02225244



$\mu = 100h$

$\mu = \frac{1}{\lambda}$

$100 = \frac{1}{\lambda}$

$\boxed{\lambda = 10^{-2}}$

$r = 3$

Q:- prob that $\lambda = 10^{-2}$

exp → (1) Compon fails 100h

$1 - e^{-\lambda a}$

$1 - e^{-10^{-2} 100}$

$\boxed{0.6321}$

gamma → (2) system survives 100h $r = 3$ $\lambda = 10^{-2}$

$e^{-\lambda a} \sum_{0}^{2} \frac{(\lambda a)^K}{K!}$

$e^{-10^{-2} 100} \left(1 + \frac{\lambda a}{1} + \frac{(\lambda a)^2}{2}\right)$

$\boxed{= 0.9197}$

2

20.5

The University of Jordan

Quality Control (First Exam 20 8/) **Instructor: Prof. Abbas Al-Refaie**

Name: FARAH OMAR AR PAIAH **ID:** 0225211 **Duration: 50 minutes**

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

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- Prevention costs include (indirect) costs. reputation 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. internal failures
- 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 limits
- Control charts help discover the key variables influencing the quality characteristics of interest in the process. Design of experiment
- The mean value of a measurement corresponds to the desired value for that quality characteristic. Target / Nominal
- Durability is assessed by how willing the service provider was to help correct an error in a bill. Serviceability (responsiveness)
- The quality of design implies how well the product conforms to the specifications required by the design. - Conformance to specifications
- 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. scrap internal failure
- 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 effeciency
- 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 $\frac{800 \text{ unit}}{100 \text{ unit/day}}$
- The specification chart is a very useful process monitoring technique. Control

5 components

P = 0.2

10.5

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 = 0.73728

$P(X \le 1) \leftrightarrow \binom{5}{0}0.2^0 0.8^5 + \binom{5}{1}0.2^1 0.8^4 = 0.73728$ Binomial

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

geometric

$0.2^1 0.8^3 = 0.1024$

6

(c) The inspector decides to continue inspecting until finding two nonconforming components. The probability that he/she will inspect exactly 10 components = 0.0604 Answer on the back

$r = 2$ $x = 10$ $P(X = 10) = \binom{9}{1}0.2^2 0.8^8 = 0.0604$?

1 2 3 4 5 6 7 8 9 10

(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 = 0.99995

Possion

$\mu = 0.01 = \lambda$

$P(X \le 1) \leftrightarrow \frac{e^{-0.01}0.01^0}{0!} + \frac{e^{-0.01}0.01^1}{1!} = 0.99995$

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 = 0.6116

$\beta = 0.25$ $\alpha = 400$ $\theta = 500$

$P(\text{fail before } 400) = 1 - \exp\left(\frac{400}{500}\right)^{0.25} = 0.6116$

4.5

(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 = 0.4493

$\mu = 500 = 1/\lambda$ $\lambda = 1/500$ $a = 400$

$P(\text{com survives } 400 \text{ hr}) = e^{-1/500\,400} = 0.4493$

(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 = -

$r = 3$

$\lambda = 1/500$

gamma

$P(\text{product to fail}) = 1 - e^{-1/500\,400}\sum_{0}^{2}\frac{(1/500\,400)^K}{K!}$

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

$= 0.0474$

The University of Jordan

الجامعة الاردنية

Paper-based :Form Questions Cover Sheet		
	Policy Number	SUJ-02-01-04A
	Issue Number and Date	2/3/24/2022/2963 5/12/2022
	Number and Date of Revision or Modification	
	Deans Council Approval Decision Number	3/ 4/24/2023
	The Date of the Deans Council Approval Decision	23/1/2023
	Number of Pages	01

School	Engineering			Department	Industrial Engineering
Course Name	Statistical Quality Control			Course No.	0906358
Academic Year	2023/2024	Semester	summer	Exam Type	Midterm
Exam Date	4/8/2024			Exam Time	11:00-12:15

الرقم الجامعي: 0225244			اسم الطالب(بالعربي): فتح عمر عبد الله
الرقم المتسلسل:	وقت المحاضرة: 11:00-12:15	رقم الشعبة: 1	اسم المدرس: ا.د عباس الرفاعي

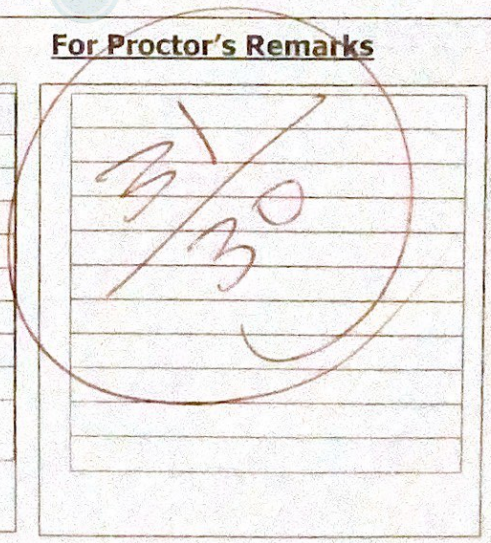
Important Instructions

- This is a closed (opened) book exam. all related material must be placed away from your desk.
- Cell phone use is prohibited for any purpose. Your cell phone must be turned off and placed off of the desk. Cell phones may not be accessed during the exam. Failure to comply may be treated as a violation of the Honor Code.
- Headphones of any kind are not permitted.
- This exam is (90) minutes long.
- Make sure that you have (3) pages including this page.
- This exam has (no) essay questions. Read each question carefully before answering.
- Calculators can be used but **can *not*** be shared.
- When you finish, you must:
  - Check that you have written your information in the spaces provided.
  - Give the exam package (all papers) to the proctor before you leave.

For Teacher's Use Only

No.	ILO	SO	DL	Mark	Weight
1					
2					
3					
4					
5					
6					
7					
8					
Total					

For Proctor's Remarks



KPI: Key Performance Indicator, ILO: Intended Learning Outcomes, SO: Student Outcomes, DL: Difficulty Level (1. Easy, 2. Average, 3. Hard, 4. Very Hard)

10

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

- The costs incurred in selecting the right supplier of raw materials are treated as internal failure costs. prevention
- In the Pareto chart, 80% of the improvement is gained by eliminating 20 % of the causes. True
- The random sampling approach to rational subgroups is used to detect process shifts. Consecutive/ Snapshot
- The control charts prevent unnecessary process adjustments. True
- 14 points in a row alternating up and down in the chart indicates an out-of-control condition. True
- A histogram is simply a frequency distribution of attribute data arranged by category. pareto chart
- Liability is an example of internal failure costs. external failure
- The defects concentration is a formal tool frequently useful in unlayering potential causes. Cause and effect diagram
- The boxplot is a useful tool for identifying a potential relationship between two variables. Scatter diagram
- Eight consecutive points plotted on one side of the centerline indicate an out-of-control state. True
- In phase II, the control charts will be used for monitoring future production. True
- The control chart will only detect assignable causes. True
- The control chart is in control when the plotted points exhibit a random pattern of behavior. True
- The three-sigma limits are called action limits. True
- The costs related to materials used in retesting reworked units are appraisal costs. internal failure

Q*2 (15 pts: 35 min). Three key characteristics of an electronic display have been monitored for quality improvement. Suppose that:

(a: 4 pts) The displays' weight is normally distributed with a mean of 132 gm and a variance of 16. The specifications are at least 130 gm. If a sample of size 4 displays is randomly collected

- The probability that a display is conforming relative to weight = 0.69146

4

Not the Average

weight $\sim N(132, 16)$

$n = 4$

$\sigma = 4$

130

reject

$Z = \frac{130 - 132}{4} = -0.5$

Conforming

$\rightarrow 1 - \Phi(-0.5)$

$= \Phi(0.5) = 0.69146$

- The probability of finding at most one nonconforming displays out of 5 relative to weight = 0.5107

binomial

$P(X \leq 1)$

non Conforming from $n = 5$

$P = 0.30854$

of non Conforming

0.5107

$\rightarrow 0 \binom{5}{0} 0.30854^0 \, 0.69146^5$

$\rightarrow 1 \binom{5}{1} 0.30854^1 \, 0.69146^4$

12

(b: 3 pts) The displays' time to failure is modeled by a **Weibull** distribution with mean and scale parameters of 1200 and 200 hr, respectively. If the probability that the **display** survives a given time t is 0.62884. The time t = 19.96 hr

$\mu = 1200 = \theta\left(\frac{1}{\beta}\right)! = 200\left(\frac{1}{\beta}\right)!$ Survives $(t) = 0.62884$

$\theta = 200$ $\quad 6 = \left(\frac{1}{\beta}\right)!$ $\quad 0.62884 = \exp\left(-\left(\frac{t}{200}\right)^{1/3}\right)$

$3 = \frac{1}{\beta}$ $\quad 3$ $\quad t = 19.96$

$\beta = 1/3$

(c: 3 pts) A lot size of 15 displays contains 4 nonconforming displays. A sample of 5 displays are selected randomly without replacement from the lot. The probability of finding at most one nonconforming display in the sample = 0.5934

$N = 15 \quad D = 4$

$n = 5 \quad x \le 1 \rightarrow 0 \rightarrow 1$

$\frac{\binom{4}{0}\binom{11}{5}}{\binom{15}{5}} = 0.5934$

$\frac{\binom{4}{1}\binom{11}{4}}{\binom{15}{5}}$ 3

(d: 2 pts) An industrial engineer monitors the average thickness of an electronic display. Twenty samples of size 100 displays are selected then the number of nonconforming displays in each sample is counted. The probability that a display is nonconforming is 0.1. The 4-sigma lower control limit of the control chart for monitoring the number of nonconforming displays = -2

Average thickness $\quad$ binomial

$m = 20 \quad p = 0.1 \quad \mu = np = 100\ 0.1 = 10$

$n = 100 \quad LCL = 10 - 4 * 3 \quad 2 \quad \sigma = \sqrt{np(1-p)} = 3$

$= -2$

(e: 2 pts) An industrial engineer monitors the number of nonconformities on an electronic display. Twenty displays were selected and then the number of defects on each display were counted. If nonconformities occur at a mean rate of 0.002 per display. The **4-sigma lower control limit of the control chart for monitoring nonconformities on electronic display** = -0.1769

poisson $\quad \mu = 0.002 = \lambda$

$m = 20 \quad \sigma^2 = 0.002 \quad 2 \quad LCL = 0.002 - 4 * \sqrt{0.002}$

$\sigma = \sqrt{0.002} \quad = -0.1769$

(e: 2 pts) The tensile strength of a mechanical component is a critical-to-quality characteristic. Twenty samples; each of size= 16 components, were selected. The tensile strength is normally distributed with a mean and a standard deviation of 100 and 16, respectively. The lower control limit of the control chart for monitoring **the average tensile strength** = 88

$m = 20 \quad T \sim N(100, 16^2) \quad 2 \quad \mu = 100$

$n = 16 \quad \sigma_{\bar{x}} = \frac{16}{\sqrt{16}} = 4$

$LCL = 100 - 3 * 4$

$= 88$