Q1 (7 PTS) Please circle the correct ...

In ---------, the control chart is used to monitor the process by comparing the sample statistic for each successive sample as it is drawn from the process to the control limits.

a. Phase I b. Phase II c. Online monitoring d. probability distribution

---------- is a graphical method for determining whether sample data conform to a hypothesized distribution based on a subjective visual examination of the data.

a. Phase I b. Box-plot c. probability plot d. probability distribution

---------- approach is used when the primary purpose of the control chart is for acceptance sampling.

a. Consecutive sampling b. control chart c. probability plot d. acceptance sampling

An ---------is a flowchart or text-based description of the sequence of activities that must take place following the occurrence of an activating event.

a. OCAP b. Phase II c. value stream mapping d. Flow chart

The -------- is simply a frequency distribution of attribute data arranged by category.

a. Histogram b. Parto chart c. concentration diagram d. probability plot

The existence of -------- causes results in a random pattern in the control chart.

a. assignable b. chance c. DOE d. defects

The 2-sigma control limits are called the --------- limits.

a. Action b. warning c. sample d. specification

The control charts only detect ----------.

a. assignable b. chance c. online d. specifications

The --------- is used to display the relationship between two variables.

a. Stem and leaf b. Parto chart c. concentration diagram d. Scatter diagram

The cost of checking the conformance of the product throughout its various stages of manufacturing are -------costs.

a. prevention b. production c. appraisal d. internal failure

Customers obviously want products that perform satisfactorily over a long period of time. This emphasizes the ---------- dimension of manufactured products.

a. durability b. conforming c. reliability d. responsiveness

The smallest allowable value for a quality characteristic is called the ----------

a. USL b. UCL c. LCL d. LSL

-------- are nonconformities that are serious enough to significantly affect the safe or effective use of the product.

a. Nonconforming b. Nonconformity c. Defective d. Defect

-------- time is the amount of time actually spent in the process that transforms the form, fit, or function of the product or service that results in something for which the customer is willing to pay.

a. Lead b. Value-add c. Nonvalue-add d. Cycle

2 (15 PTS) Please solve the following questions, show your calculations and final answer.

(a) The weight of a component is normally distributed with a mean and a standard deviation of 121 and 9, respectively. If a sample of 4 components is randomly selected. The probability that **the average weight** is larger than 130 = 0.02275

$X \sim (121, (9)^2)$ $n = 4$

$P(\bar{X} > 130) \rightarrow P\left(Z > \frac{130 - 121}{9/\sqrt{4}}\right) = P(Z > 2) = P(Z \leq -2)$

$= 0.02275$

(b) The time-to-failure of an electrical battery is well-modeled by the Exponential distribution with a variance = 10000 hour^2. The probability that the battery survives 120 hours = 0.3012

$\alpha^2 = 10000\ hr^2$ $\alpha = 100$

$a^2 = \frac{1}{\lambda^2}$ $\lambda = 0.01$

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

$P(X > 120) = e^{-\lambda a} = e^{-(0.01 \times 120)}$

$= 0.3012$

$= 1 - \left[\binom{3}{2} R^2 (1-R)^1 + \binom{3}{3} (R)^3 (1-R)^0\right]$

(c) Using part b, an electronic panel requires at least 2 out of 3 batteries operating to operate. **The probability that the panel fails before 120 hours**= 0.34

$P(X < 120)$ $(a = 120, \lambda = 0.01)$

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

$1 - e^{-(0.01 \times 120)}\left[1 + 120(0.01) + \frac{((0.01)(120))^2}{2}\right]$

$1 - 0.66$

$= 0.34$

(d) An electronic device has a time-to-failure modeled by Weibull distribution with a mean of 2400 hours. If the shape parameter = 0.25. **The device life** of the battery at which the reliability of the device is 0.431324 = 50

$\mu = 2400$

$\beta = 0.25$

$2400 = B\left(\frac{1}{B}\right)!$

$2400 = B(24)$

$B = 100$

$R(a) = \exp\left[-\left(\frac{a}{100}\right)^{0.25}\right]$

$e^{-\left(\frac{a}{100}\right)^{0.25}} = 0.431324$

$R(a) = 0.431324$

(e) A quality control engineer decides to establish a control chart to monitor the sample fraction of nonconforming units. The probability that a unit is nonconforming is 0.1. The sample size is 100. The UCL = 0.22. **The sigma level** = 4

$\hat{p}$ Binomial $UCL = 0.22$

$p = 0.1$

$n = 100$

$0.22 = 0.1 + L(0.03)$

$0.12 = L(0.03)$

$L = 4$ sigma level

$E(\hat{p}) = 0.1$

$\sigma^2_{\hat{p}} = \frac{p(1-p)}{n}$

$\sigma = \sqrt{\frac{0.1(0.9)}{100}} = 0.03$

$\Phi\left(\frac{a}{100}\right)^{0.25} = 0.8413$

$\frac{a}{100} = 0.5$

$a = 50$

(f) An electronic device contains 100 components. The probability of a nonconforming component = 0.1. The inspector has decided to continue the inspection till finding two nonconforming components in 50 components. The probability that the inspector will inspect **more than 50 components** = ~~0.11165~~

$p = 0.1$
$r = 2$
$n = 50$

$P(X > 50)$ it will become Binomial

$n = 50$
$x = 2$

$= P(X=0) + P(X=1) + P(X=2)$
$= 5.15 \times 10^{-3} + 0.0286 + 0.0779$
$= 0.11165$

(g) An electronic **panel** is composed of three identical components each with a time-to-failure modeled by an exponential distribution with a mean = 100 hours. The components are arranged in a standby redundant configuration. The probability that the **panel** will survive 100 hours = ~~0.919699~~

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

$r = 3$

$\lambda = 0.01$

$R(100) = e^{-\lambda a}\left[1 + (\lambda a) + \frac{(\lambda a)^2}{2}\right]$

$= e^{-1}\left[1 + 1 + \frac{(1)^3}{2}\right]$

$= 0.919699$

(h) A quality engineer wants to establish a control chart to monitor the average thickness ($\bar{X}$) which is normally distributed with mean and variance of 100 and 9, respectively. Twenty samples, each sample consisting of 9 units, were randomly selected. **The 2-sigma upper control limit** of the appropriate control chart = ~~106~~

$\bar{X} \sim (100, (3)^2)$
$\mu \quad \sigma$

$m = 20$
$n = 9$
$L = 2$

$UCL = 100 + 2\left(\frac{3}{\sqrt{9}}\right)$
$= 106$

(i) A quality engineer to monitor the number of nonconformities in a unit. The standard deviation of the distribution is defects/unit. **The 3-sigma upper control limit** of the appropriate control chart *(round up)* = ~~10~~

Poisson

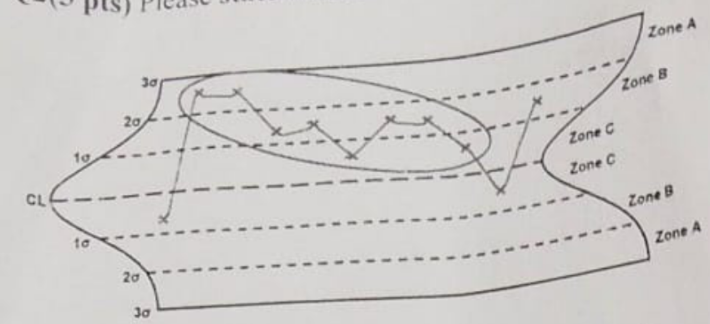
$\alpha = 2$

$\alpha^2 = \lambda$

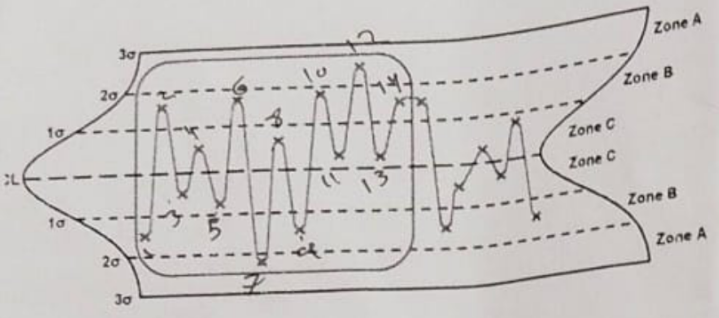
$\lambda = 4$ def/unit $= \mu$

$UCL = 4 + (3)(2)$
$= 10$

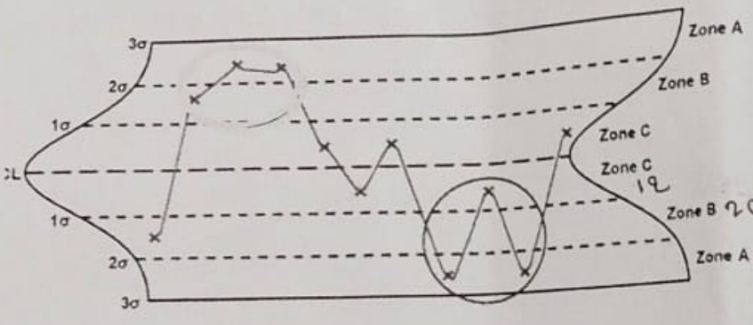
Q2(5 pts) Please state whether each of the control charts is in control or out-of-control (Based on sensitizing



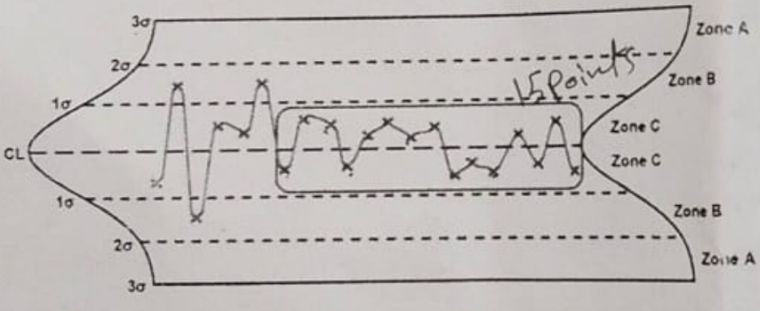
out of control Rule: 4



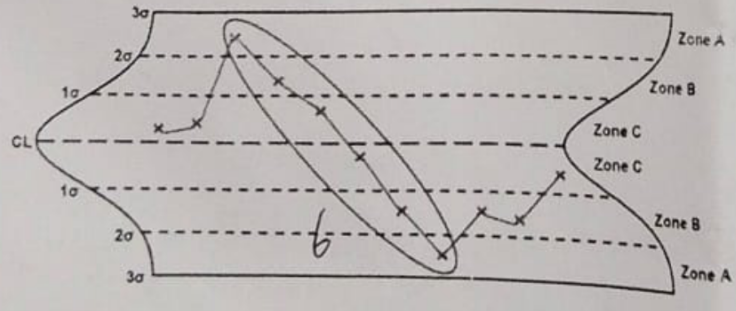
out of control Rule: 7



out of control Rule: 2



out of control Rule: 6



out of control Rule: 5