HW # 9: Due Tues 11/5 by 11:59pm ET

● Graded

Student

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Total Points

8.5 / 15 pts

Question 1

Problem 1

3.5 / 9 pts

- ✔ **− 2 pts** part (b): need an np-chart, not a c-chart here, since dealing with number of defective *items*, not total *number of defects*.
- ✔ **− 2 pts** parts (a), (c): values of $\overline{p}$ and n are incorrect
- ✔ **− 1 pt** parts (a), (c): computed UCL disagrees with Minitab's
- ✔ **− 0.5 pts** part (d): method is correct, but value of n and the control limits you're using are incorrect.

Question 2

Problem 2

5 / 6 pts

- ✔ **− 0.5 pts** part (a): UCL in the Mnitab chart is incorrect.
- ✔ **− 0.5 pts** part (b): UCL in the Mnitab chart is incorrect.

Question assigned to the following page: 1

Problem 1. Suppose random samples of size 80 were collected from a normally distributed process that produces bearings for an aerospace company. For each sample, the number of defective bearings is recorded. The data is contained in columns S through T in the `hw_data.xlsx` file.

(a) Use the appropriate formulas to compute the center line and the control limits for a fraction noncon-forming control chart with $\alpha = 0.002$. Then use Minitab to create the control chart (include the chart, and make sure your computed limits agree with Minitab's).

Question assigned to the following page: 1

p is unknown

(a) $\hat{\mu}_{\hat{p}} = \bar{p}$

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

$UCL = \bar{p} + z_{\alpha/2} \cdot \sqrt{\frac{\bar{p}(1-\bar{p})}{n}}$

$CL = \bar{p}$

$LCL = \max\left(\bar{p} - z_{\alpha/2} \cdot \sqrt{\frac{\bar{p}(1-\bar{p})}{n}}, 0\right)$

$z_{0.999} = 3.09 \qquad \bar{p} = 0.2775$

$n = 20$

$UCL = 0.2775 + 3.09 \cdot \sqrt{\frac{0.2775(1-0.2775)}{20}} = 0.5872$

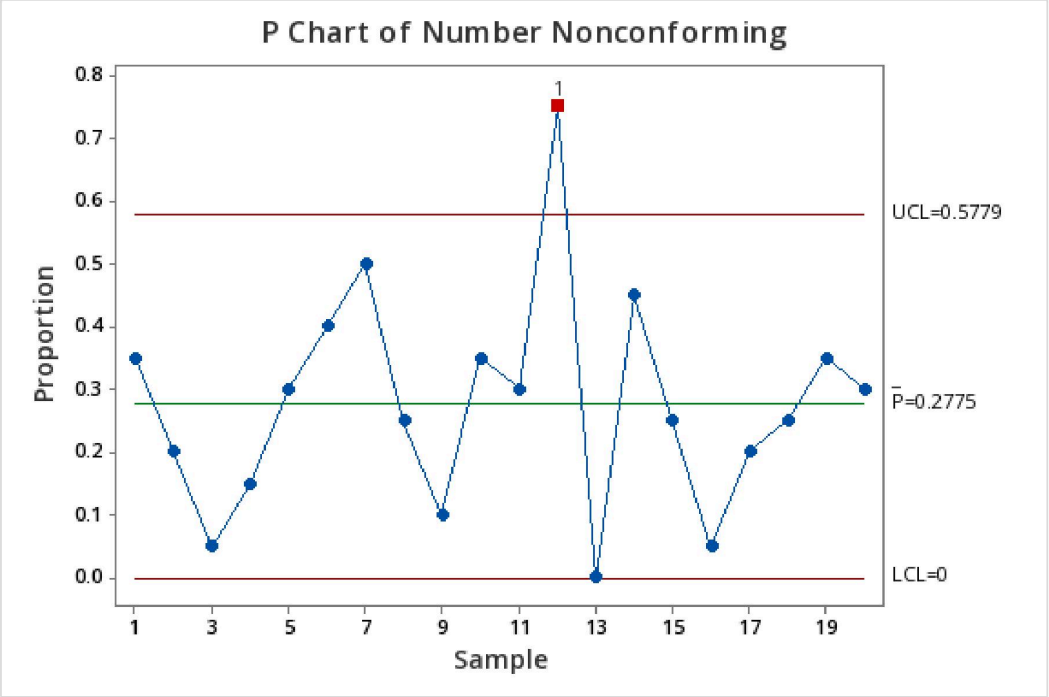
$CL = 0.2775$

$LCL = \max\left(0.2775 - 3.09 \cdot \sqrt{\frac{0.2775(1-0.2775)}{20}}, 0\right) = 0$

$= -0.0322$

blc 0 greater

Question assigned to the following page: 1



(b) Use the appropriate formulas to compute the center line and the control limits for a number noncon-forming control chart with $\alpha = 0.002$. Then use Minitab to create the control chart (include the chart, and make sure your computed limits agree with Minitab's).

Question assigned to the following page: 1

c is Unknown

(b) $\bar{c} = \frac{\sum_{i=1}^{m} x_i}{m}$

$UCL = \bar{c} + L \cdot \sqrt{\bar{c}}$

$CL = \bar{c}$

$LCL = \max(\bar{c} - L \cdot \sqrt{\bar{c}}, 0)$

$\bar{c} = \frac{111}{20} = 5.55$

$z_{0.001} = 3.09$

$UCL = 5.55 + 3.09\sqrt{5.55} = 12.84$

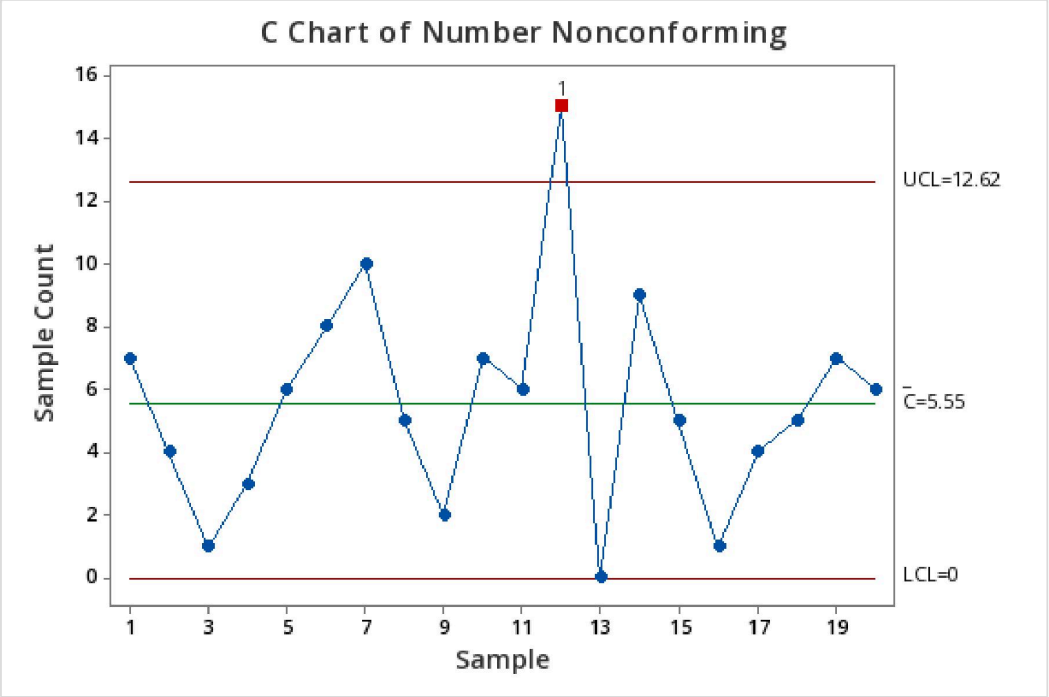
$CL = 5.55$

$LCL = \max(5.55 - 3.09 \cdot \sqrt{5.55}, 0)$

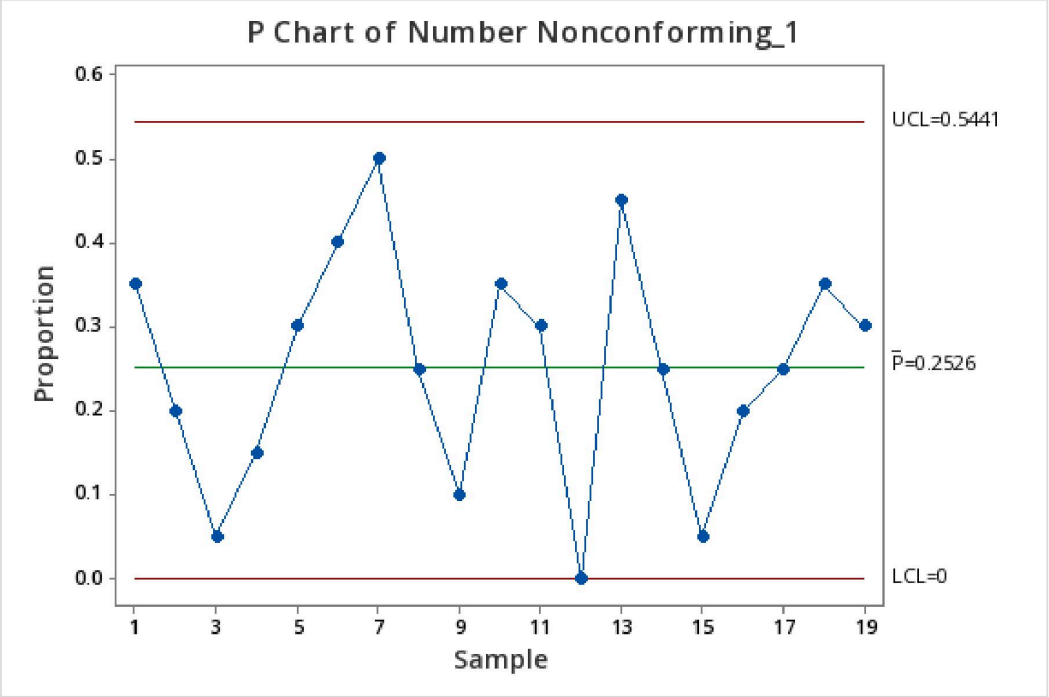
$-1.74 < 0$

use 0

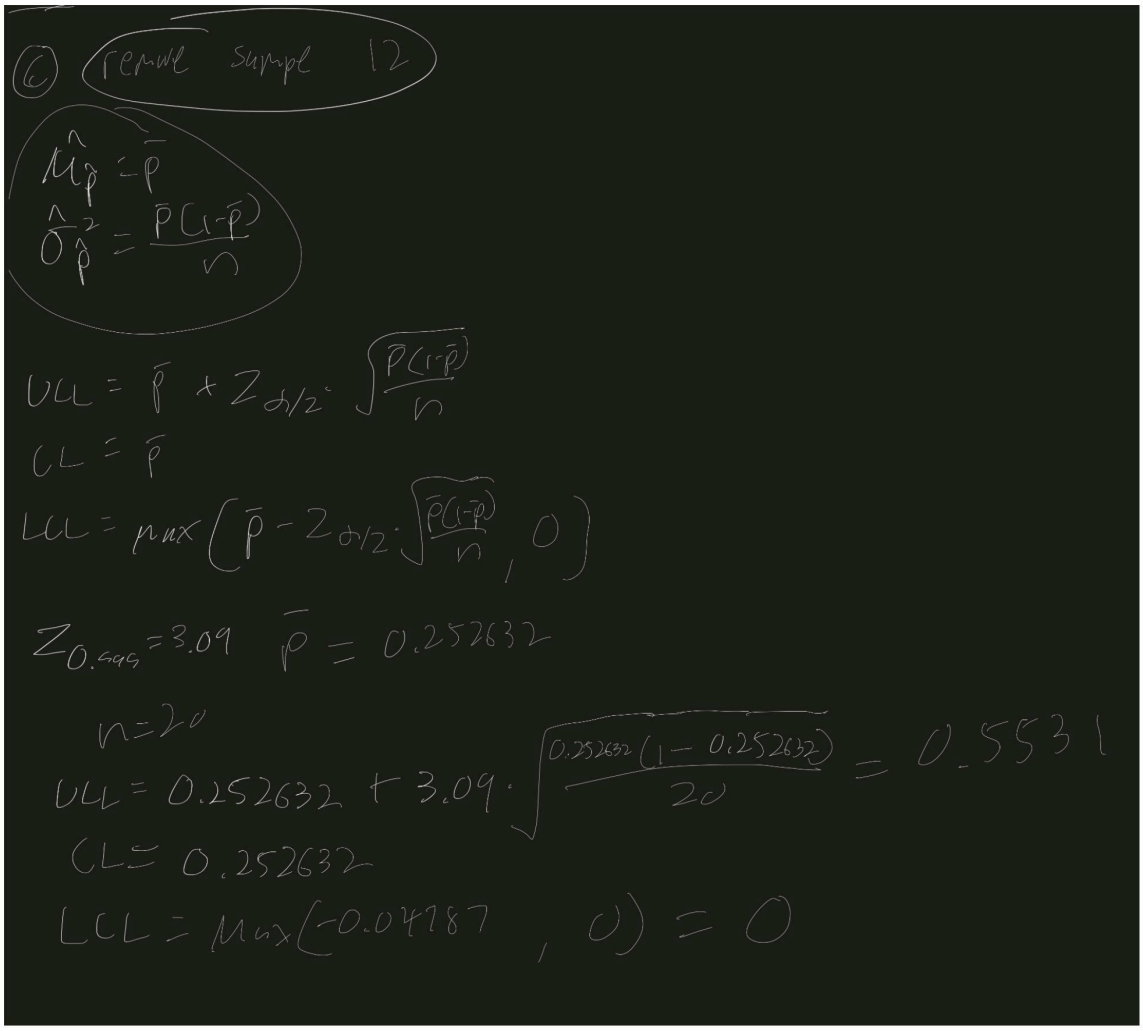
Question assigned to the following page: 1



(c) Assume that assignable causes are found for any out-of-control point(s). Revise the calculations from part (a) and include a new Minitab fraction nonconforming control chart.



Question assigned to the following page: 1



(d) Suppose there is a shift in process fraction nonconforming to $p' = 0.11$. Using the control chart in part (c), determine the β-risk.

Question assigned to the following page: 1

$$\sigma_{\hat{p}} = \sqrt{\frac{p(1-p)}{n}} \qquad p' = 0.11$$

$$= \sqrt{\frac{0.11(1-0.11)}{20}} = 0.07007$$

$$D \sim \text{Binomial}(n, p')$$

$$D_{UCL} = n \cdot UCL = 20 \cdot 0.5531 = 11.062$$

$$D_{LCL} = n \cdot LCL = 20 \cdot 0 = 0$$

$$\beta = P(0 \leq D \leq 11 \mid p' = 0.11)$$

$$\beta = P(D \leq 11) - P(D < 0) = 0.999$$

Question assigned to the following page: 2

(e) What is the probability of detecting the shift described in part (d) on the next sample?
Power = 1 - p
= 1 - 0.999 = 0.001
The probability of detecting the shift on the next sample is 0.001.

Problem 2.
Samples consisting of n = 2 inspection units were collected, and the total number of nonconformities in each sample is recorded. The data is contained in columns U through V in the `Hw_data.xlsx` file.

(a) Use the appropriate formulas to compute the center line and the control limits for a number of nonconformities control chart with L= 2.9. Then use Minitab to create the control chart (include the chart, and make sure your computed limits agree with Minitab's).

Question assigned to the following page: 2

(a) $UCL = \bar{c} + L \cdot \sqrt{\bar{c}}$

$CL = \bar{c}$

$LCL = \max(\bar{c} - L \cdot \sqrt{\bar{c}}, 0)$

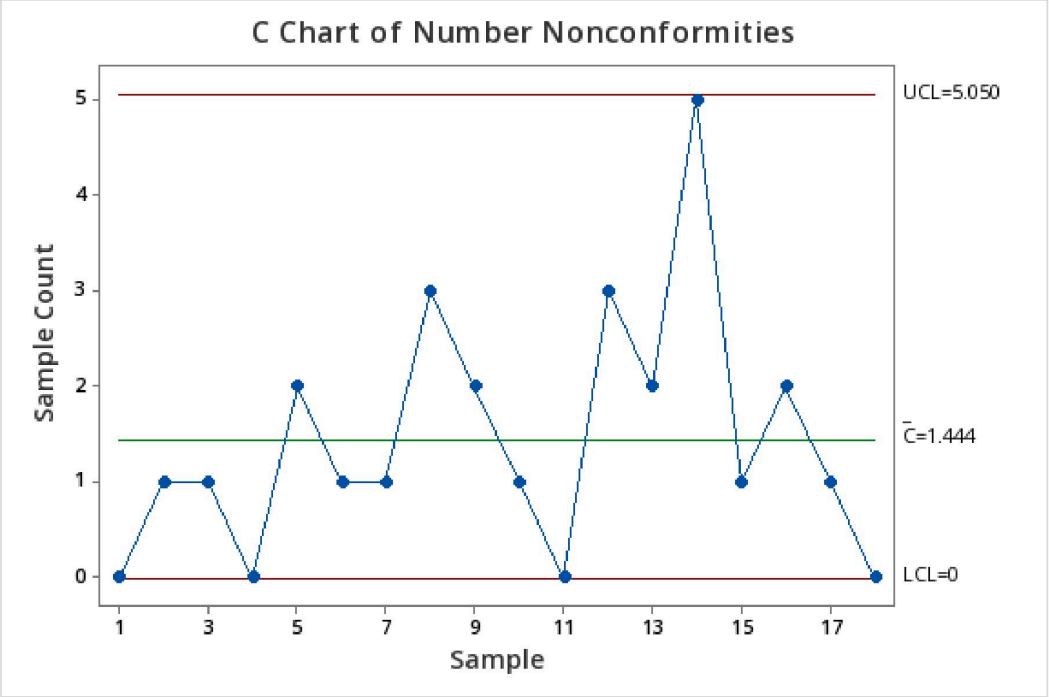
$\bar{c} = 1.44 \qquad L = 2.9$

$UCL = 1.44 + 2.9 \cdot \sqrt{1.44} = 4.92$

$CL = 1.44$

$LCL = \max(-2.04, 0) = 0$

Question assigned to the following page: 2



(b) Use the appropriate formulas to compute the center line and the control limits for a number of nonconformities per unit control chart with L = 2.9. Then use Minitab to create the control chart (include the chart, and make sure your computed limits agree with Minitab's).

Question assigned to the following page: 2

$n=2$

(b) $UCL = \bar{\bar{u}} + L \cdot \sqrt{\frac{\bar{u}}{n}}$

$CL = \bar{u}$

$LCL = \max\left(\bar{\bar{u}} - L \cdot \sqrt{\frac{\bar{u}}{n}}, 0\right)$

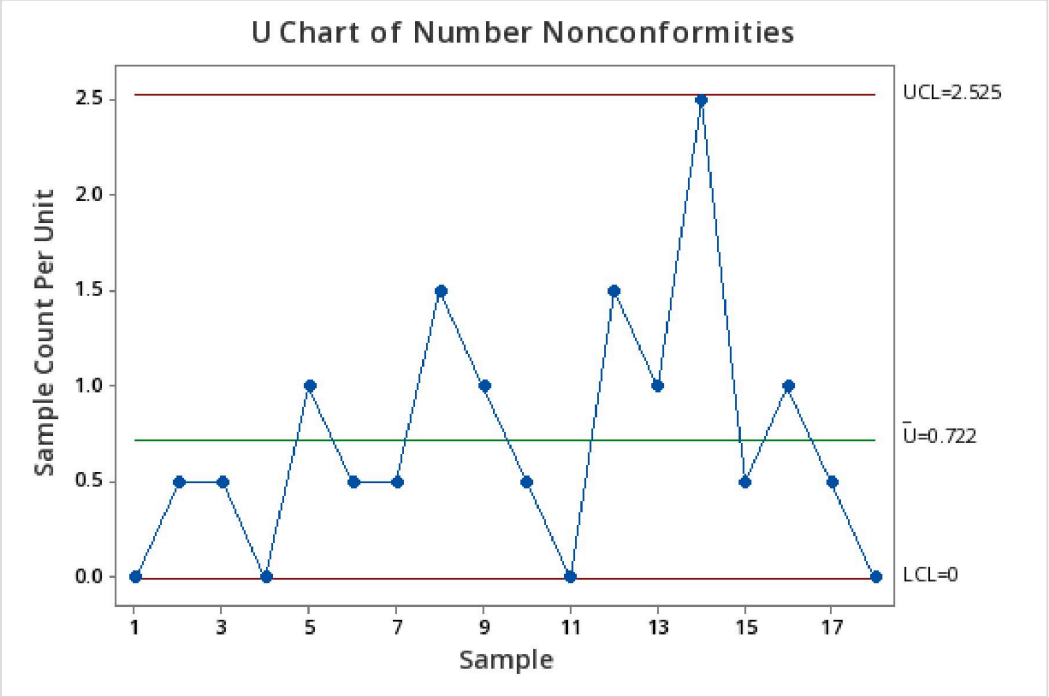
$\bar{u} = \frac{26}{2} = 0.722$

$UCL = 0.722 + 2.9 \cdot \sqrt{\frac{0.722}{2}} = 2.46$

$CL = 0.722$

$LCL = \max(-1.02, 0) = 0$

Question assigned to the following page: 2



(c) What is the connection between the center line and control limits for the c -chart in part(a) and the u-chart in part (b)?

The center line and control limit values are different but otherwise the shape of the control graph looks identical.

The c-chart measures defects per sample while the u-chart measures defects per unit.

The u-chart adjusts for size of the inspection unit in its control limits(this means that the center line and control limits are scaled by n and the c-chart considers the total number of nonconformities per sample.)