

SPC

Exam 3 - 90 points (though 93 possible with built-in bonus)

Exam 3 NAME: _____

Important Notes:

- It's not necessary to show your work on the multiple choice or true/false questions. The data are in the Minitab worksheet Exam3_DATA.

1. [(a)-(f): +2 each, (g)-(j): +2.5 each] For each of the following, select the most appropriate chart to use.

A. When I walk my dogs daily, I track the number of times that they stop to sniff a mailbox, bush, another dog, etc.

Variable Chart p or np c or u

B. The number of 3-point shots that the RHIT basketball team attempts per game.

Variable Chart p or np c or u

C. The number of parts of this problem that a student correctly answers out of the total (10).

Variable Chart p or np c or u

D. The number of weeds per square foot blocks in my backyard Variable Chart

p or np c or u

E. For each week, the number of weeknights that I go to bed after 2 a.m. Variable

Chart p or np c or u

F. At the Texas Roadhouse restaurant, the time between arriving and being seated.

Variable Chart p or np c or u

G. Texas Roadhouse restaurant sets specification limits for the time customers have to wait to be seated in which the LSL is 1 minute, and the USL is 8 minutes. The daily number of customers who are seated within these specification limits.

Variable Chart p or np c or u

H. Texas Roadhouse restaurant sets specification limits for the time customers have to wait to be seated in which the LSL is 1 minute, and the USL is 8 minutes.

- Each night they create a control chart of individual customer wait times, and they use the MR chart to obtain an estimate for σ .
- With this σ and the specification limits, they determine a value for C_p .
- The restaurant tracks these daily C_p values on a control chart.

Variable Chart p or np c or u

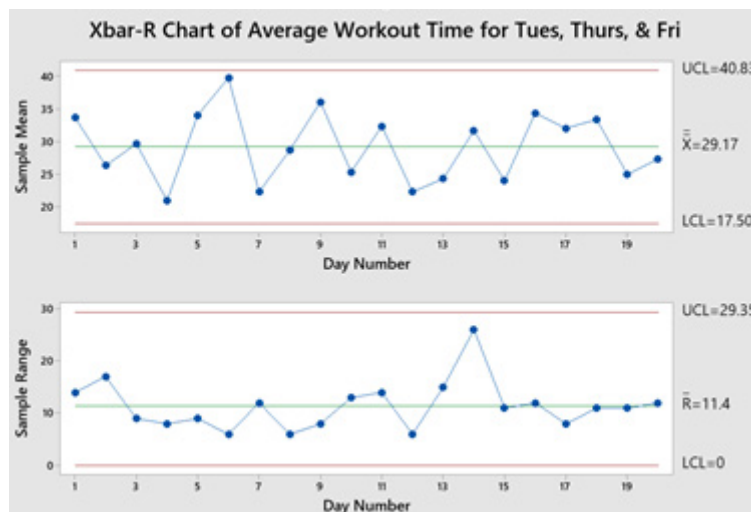
I. At Texas Roadhouse restaurant, they know the number of tables that they serve each night. They track the number or proportion of those tables that only order water as beverages.

Variable Chart p or np c or u

J. The number of RHIT faculty, staff, and students who eat at Texas Roadhouse each week

Variable Chart p or np c or u

2. I exercise with a trainer three mornings a week on Tuesday, Thursday, and Friday. For the most recent 20 weeks, I've averaged my workouts times per week (in minutes) and tracked them on an Xbar-R chart.



I set from specification limits as LSL = 17 minutes to USL = 43. Answer the following correct to 2 decimal places.

A. [+3] Determine the values of $\hat{\mu}$ and $\hat{\sigma}$.

$\hat{\mu}$ $\hat{\sigma}$

B. [+3] The largest spread in my daily workout times happened during which week number?

C. [+3] True or False. Since USL – LSL is greater than UCL – LCL, then $C_p > 1$.
 True False

D. [+5] Determine the value of Cpk.

E. [+3] For every set of 20 weeks, I decide to track the number of days that I exercised more than 30 minutes. What chart would I use to track the number of days that I worked out more than 30 minutes over this 20-day period?

Variable Chart p or np c or u

F. [+2] Provide a value for $\hat{\mu}$ that would cause the Cpk value to be negative, if possible, for this example. If it's not possible, just state, "not possible."

G. [+2] Provide a value for $\hat{\mu}$ that would cause my Cp value to be negative, if possible, for this example. If it's not possible, just state, "not possible."

3. [+3 each] A process for filling yogurt containers is normally distributed and in-control. The process average is 5.43 ounces and the "within" process standard deviation is 0.012 oz. The specification limits set in the factory are 5.25 to 5.4 oz. The capability calculations are Cp = 2.083 and Cpk = -0.833.

Answer True or False regarding the following statements regarding this process.

A. Since the process is close to 6 σ accuracy, the Cpk value is irrelevant.

True False

B. This process must be experiencing Type II Error.

True False

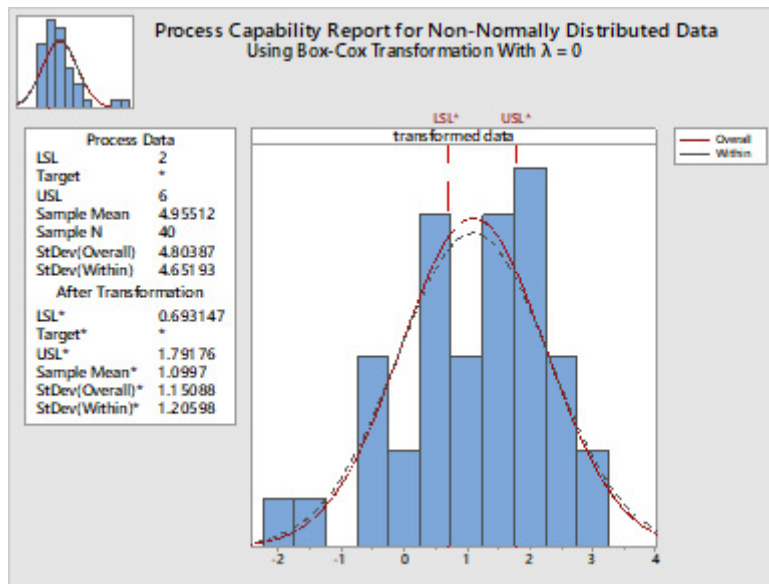
C. The process mean must not be centered on the control chart.

True False

D. The "bell" of the process's normal distribution is below the lower specification limit.

True False

4. We have a process with non-normally distributed data that was transformed to normal in the Process Capability Report below. Compute the following values. The answers have all been rounded correctly to 2 decimal places using the entire values given below (e.g. $LSL^* = 0.693147$, instead of 0.69).



A. [+3] Determine the value of Cp.

- | | | | | | | |
|---------|---------|---------|---------|---------|---------|---------|
| A. 0.04 | B. 0.07 | C. 0.08 | D. 0.10 | E. 0.11 | F. 0.12 | G. 0.14 |
| H. 0.15 | I. 0.16 | J. 0.19 | K. 0.20 | L. 0.28 | M. 0.29 | N. 0.30 |
| O. 0.76 | P. 0.83 | Q. 0.86 | R. 0.91 | S. 0.95 | T. 1.00 | U. 1.10 |

B. [+3] Determine the value of Ppk.

- | | | | | | | |
|---------|---------|---------|---------|---------|---------|---------|
| A. 0.04 | B. 0.07 | C. 0.08 | D. 0.10 | E. 0.11 | F. 0.12 | G. 0.14 |
| H. 0.15 | I. 0.16 | J. 0.19 | K. 0.20 | L. 0.28 | M. 0.29 | N. 0.30 |
| O. 0.76 | P. 0.83 | Q. 0.86 | R. 0.91 | S. 0.95 | T. 1.00 | U. 1.10 |

5. [+3] Which **one** of the following statements is true regarding Control Limits and Specification Limits?

- A. There is no difference between the terms; both are used to indicate if a process is in control.
- B. Control Limits are set by the customers; Specification Limits are derived by the process.
- C. Control Limits are derived by the process; Specification Limits are set by the customer.
- D. Control Limits are typically 3 standard deviations from the mean; Specification Limits are typically 3 standard deviations from the target.

6. The operations manager of a bank's mortgage services department is concerned about the number of errors entered into mortgage applications. Each week, a random application is drawn, and the number of incorrect entries is recorded (e.g. 15, 12, 19, ..., 15, 3). The average errors over this period is 11.33. The data is in the Minitab worksheet for this exam. Provide answers correct to two decimal places.

- A. [+3] Determine the UCL for the most appropriate control chart for tracking this situation. Show your work or state how you determined this value in Minitab.
- B. [+4] If the process is in-control, what's the most exact probability of obtaining a point beyond the UCL? You can provide an approximation for partial credit. Show your work or explain your reasoning.
- C. [+5] Assume that the average number of errors shifts. What's the most exact probability of committing a Type II Error given the mean has shifted to 15? Show your work. You can earn partial credit by providing an approximation.

7. [+4] Assume that the mean number of surface flaws per square meter is 2.8. An inspection operation checks the number of surface flaws per square meter and plots it on the appropriate control chart. What is the upper control limit of the appropriate control chart? Assume the upper control limit is set as a typical 3-sigma control limit.

- A. 4.47
- B. 5.60
- C. 5.70
- D. 7.82
- E. 11.2
- F. We don't have enough information to compute the UCL for the correct control chart.

8. [+5] For a given process and its specification limits, you have computed $Ppk = 0.79$ and $Cpk = 0.8$. Which of the following statements is true about your process? Select **all** the correct choices.
- A. The computations of Ppk and Cpk are incorrect because it should always be the case that Ppk is greater than Cpk .
 - B. The process is not in control.
 - C. The “overall” process standard deviation and the “within” process standard deviation are very close in value.
 - D. This process must be experiencing Type I Error.
 - E. The values of Pp and Cp would be smaller in value to Ppk and Cpk , respectively.
 - F. The process mean must not be centered on the control chart.
 - G. The mean of the process is not centered between the specification limits.
9. With the mailroom opening at 11:30 a.m., I have noticed the wait times for being served can be long. The times are non-normal. In the Minitab worksheet for this exam, I have a column of $n = 35$ wait times.
- A. [+3] Use Minitab to determine one distribution that “fits” the mail time data, where “fits” means the distribution’s p-value is at least 0.05. Make sure the distribution is NOT a transformation (e.g. Box-Cox or Johnson transformation). Write down the name of the distribution. [There is more than one correct answer.]
- B. [+5] Use the distribution that you identified in part (a) to determine its capability indices Pp and Ppk given the specification limits of $LSL = 1$ and $USL = 4$. Just sketch the graph and report the index values.