Practice Exam for Statistical Process Control

1. **Identify all the statements below regarding control charts that are True:**
   - The X-bar chart often has a lower control limit of zero.
   - The I-MR chart is the only control chart that can be used with both discrete and variable data.
   - Approximately half of the data points on a control chart should be above the centerline
   - The p chart and NP chart are created based on the binomial distribution as they trend defective items.

2. **Identify all the statements below regarding control charts that are False:**
   - Prior to determining if a process is in control, you must first confirm that the process is capable of meeting specification.
   - Control charts are robust enough that data can be re-arranged on the X-axis and will still detect when a process is out of statistical control.
   - Unlike other control charts, pre-control charts are not statistically based.
   - Attribute control charts are less sensitive than variable control charts to changes in your process

3. **Identify all the statements below regarding control charts that are True:**
   - A control chart is constructed based on acceptance sampling requirements
   - If a process is in statistical control it will never produce a unit outside of the control limits.
   - The key concept of rational subgrouping is that the variability within a sample should be minimized resulting in a homogenous sample.
   - Variable control charts work in pairs. One controls for the central tendency of the process while the other controls for the variation within the process

4. **Identify all the statements below regarding control charts that are False:**
   - For a process to be stable over time, the process capability must be greater than 1.0
   - The average sample standard deviation (s-bar) is an unbiased estimate of the population standard deviation
   - The primary benefit of a control is to help you identify when your process is being influenced by special causes of variation.
   - The I-MR chart is the only control chart that can be used with non-normal data

5. **Identify all the statements below regarding control charts that are True:**
   - One of the benefits of a pre-control chart is that it provides information on how to bring a process back into statistical control.
   - A unit can be defective, but cannot have multiple defects
   - Control limits create the boundaries between common cause variation and special cause variation.
   - The control limits on a control chart mimic the 5% alpha risk of a hypothesis test thus the control limits are 2σ from the mean to capture 95% of the process variation.

6. **Identify all the statements below regarding control charts that are False:**
   - The primary objective of SPC is to remove all defective units from a production lot prior to shipment to the customer.
   - Having data outside the control limits is the only criteria to confirm that a process is out of statistical control.
   - A defective unit can have multiple defects
   - The X-bar and R chart should be used for attribute data whose sample size is between 2 – 9.

7. **What tool below is best suited to help identify special cause variation within your process:**
   - Pareto Chart
   - Gantt Chart
   - Control Chart
   - Flow Diagram
   - Scatter Diagram

8. **A control chart showed a data point outside the control limit however no action was taken - what is this an example of:**
   - Common cause variation
   - special cause variation
   - The re-sampling fallacy
   - Under Adjustment
   - Over Adjustment

9. **Which Quality Guru is often credited with introducing the first control chart**
    - W. Edwards Deming
    - Walter Shewhart
    - Joseph M. Juran
    - Kaoru Ishikawa

10. **Which probability distribution is used to construct the c-chart:**
    - The Normal Distribution
    - The Exponential Distribution
    - The Poisson Distribution
    - The Binomial Distribution

11. **What type of variation occurs when a process is in control:**
    - Variable
    - Attribute
    - Common Casue
    - Special Cause
    - None of the above

12. **Fill in the blank: A _____ is defined as a collection of units that are all produced under the same conditions.**
    - Rational Subgroup
    - Proper Sample Size
    - Heterogenous Sample
    - Acceptance Sample
    - Discrete Control Chart
    - X-bar Chart

13. **What type of control chart would be used to monitor the number of defects for a process with a variable sample size:**
    - P Chart
    - NP Chart
    - C Chart
    - U Chart

14. **What type of control chart would be used to monitor the number of defectives for a process with a constant sample size:**
    - P Chart
    - NP Chart
    - C Chart
    - U Chart

15. **Your process uses a tool to form a critical dimension, and this tool has cracked, causing a change in the critical dimension. This an example of:**
    - Common cause variation
    - Special Cause variation
    - A lack of process capability
    - An unstable, but capable process

16. **At the Fancy Pants corporation, an X-bar and R chart is used to monitor the length of pants during a production run where n=4 units are measured in each sample.**

    X-double bar is 24, R-bar is 3, n = 4.

    During the latest sample of 4 units the following values were measured (25, 28, 26, 27), what is the conclusion from this sample:

    - Both the average and range charts are within the statistical control limits
    - Both the average and range charts are out of the statistical control limits
    - The range is within control, however the average is out of statistical control
    - The average value is within control, however the range is out of statistical control

17. **What type of control chart would be used to monitor the number of defects for a process with a constant sample size:**
    - P Chart
    - NP Chart
    - C Chart
    - U Chart

18. **What factor determines which variable control chart should be used:**
    - Defects v. defectives
    - The accuracy of the measurement system being used
    - The acceptance sampling plan associated with your product
    - The number of units sampled within each subgroup

19. **The Acme Brick company measures the weight of bricks coming off the production line. 15 bricks are measured per sub-group. Which of the following control charts is most appropriate?**
    - X-bar and R chart
    - X-bar and S Chart
    - P Chart
    - C Chart

20. **A p-chart monitors what type of attribute:**
    - The number of defective items in a subgroup
    - The number of defects in a subgroup
    - The percentage of defects in a subgroup
    - The percentage of defectives in a subgroup

21. **The Space Force Company would like to monitor a dimensional characteristic of their product however the testing is destructive in nature and expensive.**

    What type of control chart would be most appropriate to monitor this production process:
    - I-MR Chart
    - X-bar and R Chart
    - X-bar and S Chart
    - C-chart
    - NP Chart

22. **Every month, the same 20 reports are submitted to the local finance department. When an error occurs, the report is sent back for revision.**

    The finance department wants to monitor the number of reports rejected the first time each month. Which of the following control charts would be most appropriate?

    - I-MR Chart
    - X-bar and R Chart
    - X-bar and S Chart
    - P-Chart
    - NP-Chart
    - U Chart

23. **The Fake News Media Corporate collected data on the number of fake news stories published every day and constructed a p-chart.**

    A sample of 100 articles are inspected every day, however this can vary. The average percentage of fake news stories (defectives) was calculated as 0.106.

    On a particular day 200 articles were inspected, and 47 fake news reports were observed. What is the conclusion of this day:

    - The sample is in statistical control and this is a normal level of fake news
    - The sample is out of statistical control and there's a lot of fake news going around

24. Using the following data points from these 5 sub-groups, calculate R-bar:

Sub-group	Sample 1	Sample 2	Sample 3
1	12	15	16
2	14	12	13
3	10	13	13
4	14	16	16
5	14	12	16

- 2
- 3
- 4
- 5
- 6

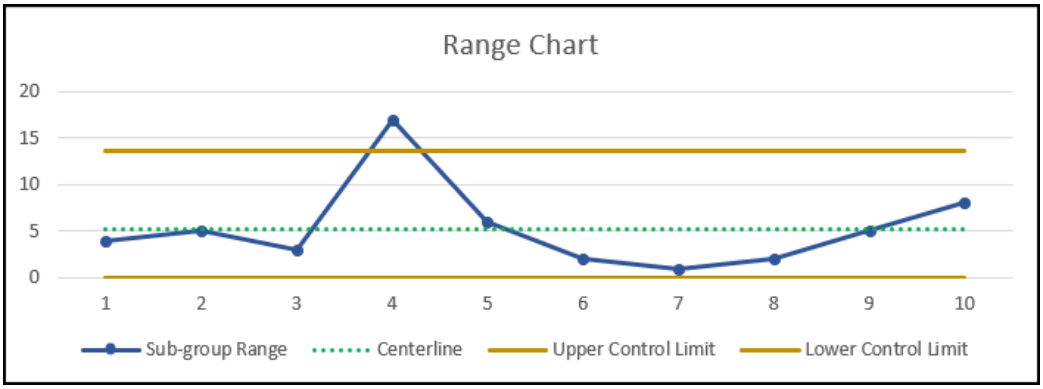
25. What is the UCL for a p-chart when the average daily inspection quantity is 50, and the historical percentage of defectives is 0.05?

- 0.21
- 0.09
- 0.29
- 0.14
- 0.17

26. The Intelligent Radio Company manufactures smart radios and wants to control for the common defects associated with their manufacturing process. Which of the following control charts is most appropriate?

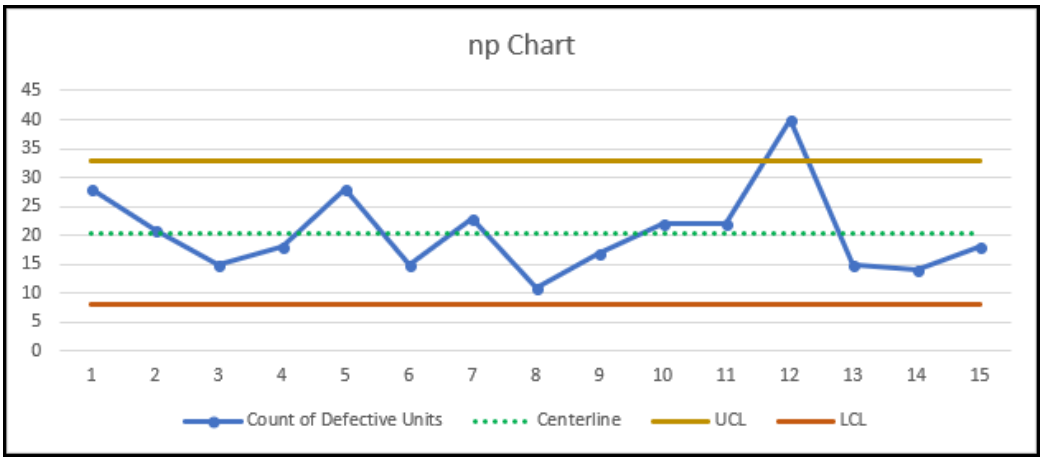
- U chart
- NP Chart
- P Chart
- X-bar and R Chart

27. Consider the following Range chart. What conclusion can be drawn:



- The product is out of specifications
- The product is in specifications
- The process is out of specifications
- The process is in specification
- The process is out of control
- The process is in control

28. Consider the following NP Chart. What conclusion can be drawn:



- The product is out of specifications
- The product is in specifications
- The process is out of specifications
- The process is in specification
- The process is out of control
- The process is in control

29. **A manufacturer has a product line that only produces parts once a quarter and the company would like to monitor the process. Which of the following tools is most appropriate?**
    - Pre Control
    - X-bar and S Chart
    - I-MR chart
    - P Chart
    - Short Run SPC

30. **A manufacturer wants to improve the way they start up their process to ensure that the product is within specifications. Which tool would you recommend:**
    - Short Run SPC
    - An X-bar and R Chart
    - Pre-Control Chart
    - Process Capability Analysis

31. **Which of the following control charts is most sensitive to changes in the process:**
    - I-MR Chart
    - P Chart
    - C Chart
    - X-bar and R Chart

32. **Pencil Makers Incorporated uses an x-bar and R chart of n=5 to monitor the length of pencils coming off the production line.**

    The inspector takes two samples, measures the length and plots their values on the X-bar chart as both data points are outside of the upper control limit and decides to stop the process. What does this mean:

    - Only the process range is out of statistical control
    - Only the process average is out of statistical control
    - Both the average and range are out of statistical control
    - Nothing, the inspector is not executing the control chart appropriately

33. **You're constructing an NP chart, where you've sampled from 25 subgroups, each with 100 samples, and found a total of 145 defective units. Calculate the UCL for this process.**
    - Not Enough Information Provided
    - 5.8
    - 0.058
    - 7.0
    - 12.8
    - 14.5

34. **You're manufacturing a widget and using an X-bar and R chart to control the critical feature of the product. Your normal process has the following attributes:**

    X-double bar is 225, R-bar is 12, n = 8.

    Identify the upper and lower control limits for the range chart:

    - 0
    - 220.52
    - 229.48
    - 1.63
    - 5.73
    - 18.23
    - 22.37

35. **You're manufacturing a widget and using an X-bar and R chart to control the critical feature of the product. Your normal process has the following attributes:**

    X-double bar is 225, R-bar is 12, n = 8.

    Identify the upper and lower control limits for the X-bar chart:

    - 0
    - 220.52
    - 229.48
    - 1.63
    - 233.14
    - 218.71
    - 22.37

36. You manufacture a widget and use a c chart to monitor the number of defects associated with your process. Your sample size is constant and on average you find 7 defects per sample.

Identify the upper and lower control limits for the c chart:

- 0
- 2
- 4
- 10
- 12
- 15

37. You manufacture a widget and use an x-bar and s chart to monitor your process where you sample 15 units in each subgroup.

What factor should be used to calculate the upper control limits of the X-bar chart?

- 0.975
- 0.789
- 0.680
- 0.428
- 1.572
- 0.972

38. You manufacture a widget and use an x-bar and S chart to monitor your process, where you sample 5 units in each subgroup, and s-bar = 4.2.

Estimate the population standard deviation for this process.

- 4.2
- 2.1
- 8.4
- 3.9
- 4.5

39. You manufacture a widget and use an x-bar and R chart to monitor your process, where you sample 3 units in each subgroup, and R-bar = 16.0.

Estimate the population standard deviation for this process.

- 16.0
- 9.5
- 27.1
- 13.2

40. What is the LCL for a p-chart when the average daily inspection quantity is 125, and the historical percentage of defectives is 0.10?

- 0.00
- 0.02
- 0.10
- 0.18
- 0.20

Problem Set Solution:

1. **Identify all the statements below regarding control charts that are True:**
   - The X-bar chart often has a lower control limit of zero – **False, depending on the sample size, the range chart can sometimes have an LCL of zero, but the x-bar chart does not necessarily often have an LCL of zero.**
   - The I-MR chart is the only control chart that can be used with both discrete and variable data. – **False, the I-MR chart only works with variable data.**
   - Approximately half of the data points on a control chart should be above the centerline **- True**
   - The p chart and NP chart are created based on the binomial distribution as they trend defective items. **- True**

2. **Identify all the statements below regarding control charts that are False:**
   - Prior to determining if a process is in control, you must first confirm that the process is capable of meeting specification **–False, capability is not required prior to process control**
   - Control charts are robust enough that data can be re-arranged on the X-axis and will still detect when a process is out of statistical control. – **False, The x-axis of a control chart must be arranged in the original time sequence that the data was collected.**
   - Unlike other control charts, pre-control charts are not statistically based. **- True**
   - Attribute control charts are less sensitive than variable control charts to changes in your process **- True**

3. **Identify all the statements below regarding control charts that are True:**
   - A control chart is constructed based on acceptance sampling requirements – **False, these two concepts are not related**
   - If a process is in statistical control it will never produce a unit outside of the control limits. – **False, a process can be stable, but not capable, and still produce parts that are out of specification.**
   - The key concept of rational subgrouping is that the variability within a sample should be minimized resulting in a homogenous sample **- True**
   - Variable control charts work in pairs. One controls for the central tendency of the process while the other controls for the variation within the process **- True**

4. **Identify all the statements below regarding control charts that are False:**
   - For a process to be stable over time, the process capability must be greater than 1.0 – **False, process capability is not required for process stability**
   - The average sample standard deviation (s-bar) is an unbiased estimate of the population standard deviation – **False, the population standard deviation can be calculated as s-bar divided by the factor C_4.**
   - The primary benefit of a control is to help you identify when your process is being influenced by special causes of variation. **- True**
   - The I-MR chart is the only control chart that can be used with non-normal data – **False, the I-MR chart is heavily dependent on the assumption of a normally distributed population**

5. **Identify all the statements below regarding control charts that are True:**
   - One of the benefits of a pre-control chart is that it provides information on how to bring a process back into statistical control. **False, a pre-control chart might identify that your process is not centered, but it does not indicate how to bring the process back into control.**
   - A unit can be defective, but cannot have multiple defects – **False, a defective CAN have multiple defects.**
   - Control limits create the boundaries between common cause variation and special cause variation **- True**
   - The control limits on a control chart mimic the 5% alpha risk of a hypothesis test thus the control limits are 2σ from the mean to capture 95% of the process variation. – **False, the control limits capture 3σ, and thus capture >99% of the process variation**

6. **Identify all the statements below regarding control charts that are False:**
   - The primary objective of SPC is to remove all defective units from a production lot prior to shipment to the customer. **False – SPC is only meant to detect when a process is out of control, it is not meant as a screening tool to remove all defective units from a production lot.**
   - Having data outside the control limits is the only criteria to confirm that a process is out of statistical control. - **False, there are other criteria and rules that exist that would indicate that a process is out of control**
   - A defective unit can have multiple defects **- True**
   - The X-bar and R chart should be used for ~~**attribute**~~ **variable** data whose sample size is between 2 – 9. – **False**

7. **What tool below is best suited to help identify special cause variation within your process:**
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8. **A control chart showed a data point outside the control limit however no action was taken - what is this an example of:**
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12. **Fill in the blank: A _____ is defined as a collection of units that are all produced under the same conditions.**
   - **Rational Subgroup**
   - Proper Sample Size
   - Heterogenous Sample
   - Acceptance Sample
   - Discrete Control Chart
   - X-bar Chart

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   - C Chart
   - **U Chart**

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X-double bar is 24, R-bar is 3, n = 4.

During the latest sample of 4 units the following values were measured (25, 28, 26, 27), what is the conclusion from this sample:

- Both the average and range charts are within the statistical control limits
- Both the average and range charts are out of the statistical control limits
- **The range is within control, however the average is out of statistical control**
- The average value is within control, however the range is out of statistical control

First, we must calculate the average and range associated with this latest sample of 4 units (25, 28, 26, 27).

The range is 3, and the average is 26.5.

Now we must calculate our control limits for our process.

$$\boldsymbol{UCL_{\bar{X}}} = \bar{\bar{X}} + A_2\bar{R} = 24 + 0.729 * 3 = 26.19$$

$$\boldsymbol{LCL_{\bar{X}}} = \bar{\bar{X}} - A_2\bar{R} = 24 - 0.729 * 3 = 21.81$$

$$\boldsymbol{UCL_R} = D_4\bar{R} = 2.282 * 3 = 6.846$$

$$\boldsymbol{LCL_R} = D_3\bar{R} = 0 * 3 = 0$$

Now we can compare our values (Range = 3, Average = 26.5) against the control limits.

The measured range of 3 is within the control limits, however the average value (26.5) is greater than the upper control limit (26.19).

17. What type of control chart would be used to monitor the number of defects for a process with a constant sample size:

- P Chart
- NP Chart
- **C Chart**
- U Chart

18. **What factor determines which variable control chart should be used:**
    - Defects v. defectives
    - The accuracy of the measurement system being used
    - The acceptance sampling plan associated with your product
    - **The number of units sampled within each subgroup**

19. **The Acme Brick company measures the weight of bricks coming off the production line. 15 bricks are measured per sub-group. Which of the following control charts is most appropriate?**
    - X-bar and R chart
    - **X-bar and S Chart**
    - P Chart
    - C Chart

20. **A p-chart monitors what type of attribute:**
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    - The number of defects in a subgroup
    - The percentage of defects in a subgroup
    - **The percentage of defectives in a subgroup**

21. **The Space Force Company would like to monitor a dimensional characteristic of their product however the testing is destructive in nature and expensive.**

    What type of control chart would be most appropriate to monitor this production process:
    - **I-MR Chart**
    - X-bar and R Chart
    - X-bar and S Chart
    - C-chart
    - NP Chart

22. Every month, the same 20 reports are submitted to the local finance department. When an error occurs, the report is sent back for revision.

The finance department wants to monitor the number of reports rejected the first time each month. Which of the following control charts would be most appropriate?

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- X-bar and R Chart
- X-bar and S Chart
- P-Chart
- **NP-Chart**
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A sample of 100 articles are inspected every day, however this can vary. The average percentage of fake news stories (defectives) was calculated as 0.106.

On a particular day, 200 articles were inspected and 47 fake news reports were observed. What is the conclusion of this day:

- The sample is in statistical control and this is a normal level of fake news
- **The sample is out of statistical control and there's a lot of fake news going around**

First, we must calculate the percentage of defectives found in the inspection. We found 47 defectives (Fake news articles) in a sample of 200.

Thus, our percentage defective is 0.235.

Now we must use our historical data to calculate the control limits for this process

$$UCL_{\bar{p}} = \bar{p} + 3\sqrt{\frac{\bar{p}(1-\bar{p})}{\bar{n}}} = 0.106 + 3\sqrt{\frac{0.106(1-0.106)}{200}} = 0.1713$$

$$LCL_{\bar{p}} = \bar{p} - 3\sqrt{\frac{\bar{p}(1-\bar{p})}{\bar{n}}} = 0.106 - 3\sqrt{\frac{0.106(1-0.106)}{200}} = 0.041$$

Our measured percentage defective is greater than the upper control limit, thus we can confirm that on this day, the process is out of control and there is a lot of fake news going around.

24. Using the following data points from these 5 sub-groups, calculate R-bar:

Sub-group	Sample 1	Sample 2	Sample 3
1	12	15	16
2	14	12	13
3	10	13	13
4	14	16	16
5	14	12	16

- 2
- **3**
- 4
- 5
- 6

First, we must solve for the Range value for each sub-group, shown in the far-right hand column. Then we must take the average value of the 5 sub-group ranges to find the average range value of 3 (R-bar).

Sub-group	Sample 1	Sample 2	Sample 3	Range
1	12	15	16	4
2	14	12	13	2
3	10	13	13	3
4	14	16	16	2
5	14	12	16	4
				3 R-Bar

25. What is the UCL for a p-chart when the average daily inspection quantity is 50, and the historical percentage of defectives is 0.05?

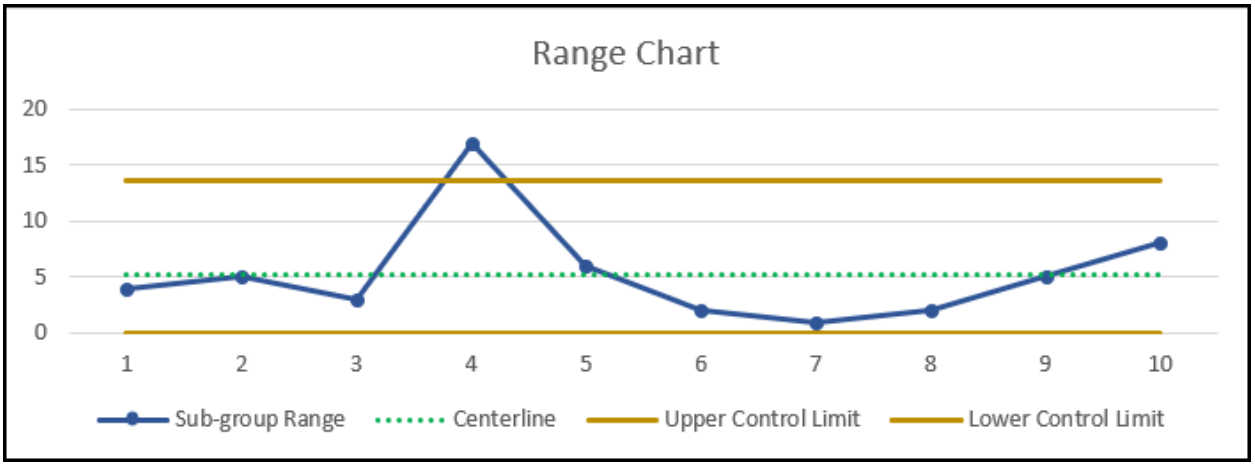
- 0.21
- 0.09
- 0.29
- **0.14**
- 0.17

$$UCL_{\bar{p}} = \bar{p} + 3\sqrt{\frac{\bar{p}(1-\bar{p})}{\bar{n}}} = 0.05 + 3\sqrt{\frac{0.05(1-0.05)}{50}} = 0.05 + 3\sqrt{0.00095} = 0.142$$

26. The Intelligent Radio Company manufactures smart radios and wants to control for the common defects associated with their manufacturing process. Which of the following control charts is most appropriate?

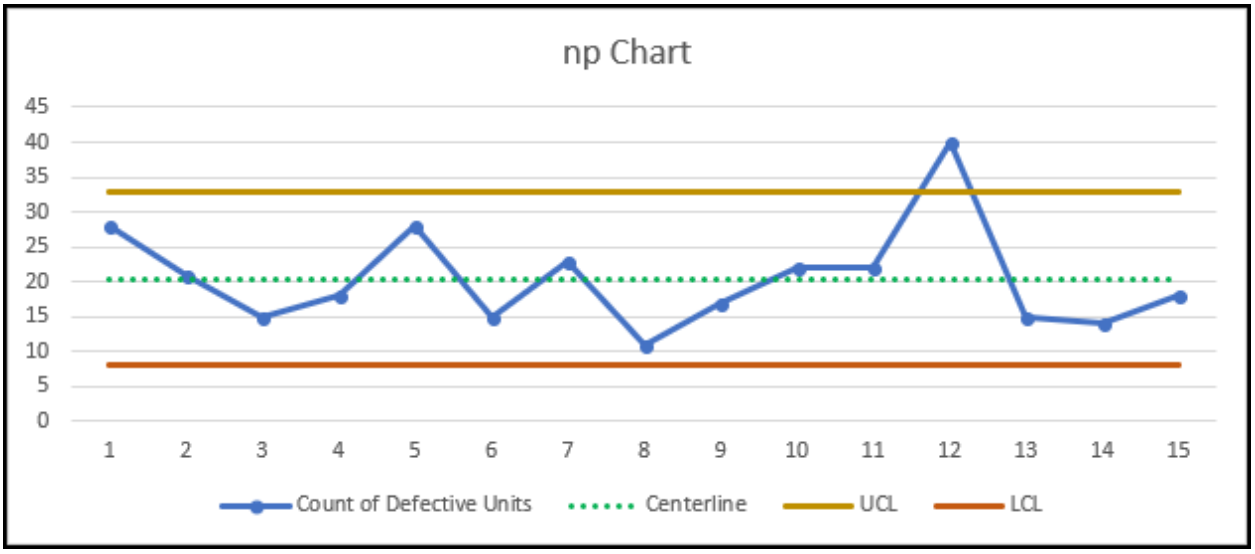
- **U chart**
- NP Chart
- P Chart
- X-bar and R Chart

27. Consider the following Range chart. What conclusion can be drawn:



- The product is out of specifications
- The product is in specifications
- The process is out of specifications
- The process is in specification
- **The process is out of control**
- The process is in control

28. Consider the following NP Chart. What conclusion can be drawn:



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- The process is out of specifications
- The process is in specification
- **The process is out of control**
- The process is in control

29. A manufacturer has a particular product line that only produces parts once a quarter and the company would like to monitor the process. Which of the following tools is most appropriate:

- Pre Control
- X-bar and S Chart
- I-MR chart
- P Chart
- **Short Run SPC**

30. A manufacturer wants to improve the way they start up their process to ensure that the product is within specifications. Which tool would you recommend:

- Short Run SPC
- An X-bar and R Chart
- **Pre-Control Chart**
- Process Capability Analysis

31. **Which of the following control charts is most sensitive to changes in the process:**
    - I-MR Chart
    - P Chart
    - C Chart
    - **X-bar and R Chart**

32. **Pencil Makers Incorporated uses an x-bar and R chart of n=5 to monitor the length of pencils coming off the production line.**

    The inspector takes two samples, measures the length and plots their values on the X-bar chart as both data points are outside of the upper control limit and decides to stop the process. What does this mean:

    - Only the process range is out of statistical control
    - Only the process average is out of statistical control
    - Both the average and range are out of statistical control
    - **Nothing, the inspector is not executing the control chart appropriately**

33. **You're constructing an NP chart, where you've sampled from 25 subgroups, each with 100 samples, and found a total of 145 defective units. Calculate the UCL for this process.**
    - Not Enough Information Provided
    - 5.8
    - 0.058
    - 7.0
    - **12.8**
    - 14.5

$$\bar{p} = \%\,Defective = \frac{\sum np}{\sum n} = \frac{Sum\ of\ All\ Defectives}{Sum\ of\ Subgroup\ Quantity} = \frac{145}{2500} = 0.058$$

$$n\bar{p}\ Centerline = \frac{\sum np}{k} = \frac{Sum\ of\ All\ Defectives}{\#\ of\ subgroups} = \frac{145}{25} = 5.8$$

$$UCL_{np} = n\bar{p} + 3\sqrt{n\bar{p}(1-\bar{p})} = 5.8 + 3\sqrt{5.8(1-0.058)} = 5.8 + 7.0 = 12.8$$

34. You're manufacturing a widget and using an X-bar and R chart to control the critical feature of the product. Your normal process has the following attributes:

X-double bar is 225, R-bar is 12, n = 8.

Identify the upper and lower control limits for the range chart:

- 0
- 220.52
- 229.48
- **1.63**
- 5.73
- 18.23
- **22.37**

Let's calculate our control limits for this control chart

$$\boldsymbol{UCL_R} = D_4\bar{R} = 1.864 * 12 = 22.37$$

$$\boldsymbol{LCL_R} = D_3\bar{R} = 0.136 * 12 = 1.63$$

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- 0
- **220.52**
- **229.48**
- 1.63
- 233.14
- 218.71
- 22.37

Let's calculate our control limits for this control chart

$$\boldsymbol{UCL_{\bar{X}}} = \bar{\bar{X}} + A_2\bar{R} = 225 + 0.373 * 12 = 229.48$$

$$\boldsymbol{LCL_{\bar{X}}} = \bar{\bar{X}} - A_2\bar{R} = 225 - 0.373 * 12 = 220.52$$

36. You manufacture a widget and use a c chart to monitor the number of defects associated with your process. Your sample size is constant and on average you find 7 defects per sample.

Identify the upper and lower control limits for the c chart:

- **0**
- 2
- 4
- 10
- 12
- **15**

Below are the calculations of the control limits for the c chart:

$$UCL_c = \bar{c} + 3\sqrt{\bar{c}} = 7 + 3\sqrt{7} = 14.94$$

$$UCL_c = \bar{c} - 3\sqrt{\bar{c}} = 7 - 3\sqrt{7} = -0.94 = 0$$

37. You manufacture a widget and use an x-bar and s chart to monitor your process where you sample 15 units in each subgroup.

What factor should be used to calculate the upper control limits of the X-bar chart?

- 0.975
- **0.789**
- 0.680
- 0.428
- 1.572
- 0.972

38. You manufacture a widget and use an x-bar and S chart to monitor your process, where you sample 5 units in each subgroup, and s-bar = 4.2.

Estimate the population standard deviation for this process.

- 4.2
- 2.1
- 8.4
- 3.9
- **4.5**

We divide S-bar by the factor c_4, which is based on the n=5 sample size.

$$\textbf{\textit{Population Standard Deviation}} = \hat{\sigma} = \frac{\bar{s}}{C_4} = \frac{4.2}{0.9400} = 4.5$$

39. You manufacture a widget and use an x-bar and R chart to monitor your process, where you sample 3 units in each subgroup, and R-bar = 16.0.

Estimate the population standard deviation for this process.

- 16.0
- **9.5**
- 27.1
- 13.2

We divide R-bar by the factor d_2, which is based on the n=3 sample size.

$$\textbf{\textit{Population Standard Deviation}} = \hat{\sigma} = \frac{\bar{R}}{d_2} = \frac{16}{1.693} = 9.5$$

40. What is the LCL for a p-chart when the average daily inspection quantity is 125, and the historical percentage of defectives is 0.10?

- 0.00
- **0.02**
- 0.10
- 0.18
- 0.20

$$LCL_{\bar{p}} = \bar{p} - 3\sqrt{\frac{\bar{p}(1-\bar{p})}{\bar{n}}}$$

$$LCL_{\bar{p}} = 0.10 - 3\sqrt{\frac{0.10(1-0.10)}{125}} = 0.10 - 3\sqrt{0.00072} = 0.019 = 0.02$$