# Problem Set For Point Estimates & Confidence Intervals:

**1. A ______________ is a type of estimation that uses a single value, oftentimes a sample statistic, to infer information about the population parameter as a single value or point.**

A. point estimate
B. confidence level
C. interval estimate
D. Sample Statistic

**2. An _________________ is a type of estimation that uses a range (or interval) of values, based on sampling information, to "capture" or "cover" the true population parameter being inferred.**

A. point estimate
B. confidence level
C. interval estimate
D. significant level

**3. An ___________________ is one who's expected value is equal to the population parameter being estimated.**

A. sample statistic
B. efficient estimator
C. confidence interval
*D.* unbiased estimator

**4. Identify all of the statements below that are true:**

A. The standard error is computed solely from sample attributes
B. The standard error is a measure of central tendency
C. There are two types of estimates, Point Estimates & Interval Estimates
D. The Expected Value of the sample mean distribution is analogous to the standard deviation in that it is a reflection of the dispersion of sample mean values

**5. Identify all of the statements below that are false:**

A. Alpha risk is also called your significance level

B. The confidence level of your interval estimate is based on your beta risk

C. When we say that we have 95% confidence in our interval estimate, we mean that 95% of the overall population falls within the confidence interval.

D. If the sample size is less than 30, the z-score should be used

**6. The likelihood that the interval estimate contains the true population parameter is given by the ____________**

A. Confidence Level

B. Significance Level

C. Alpha Risk

D. Standard Error

E. Point Estimate

**7. A "high quality" estimator (point estimate / interval estimate) has which of the two following properties:**

A. unbiased

B. efficient

C. Low alpha risk

D. Low beta risk

**8. The confidence interval for the population mean, when the population variance is known, is based on which of the following items:**

A. The Point Estimate

B. The Critical Chi-Squared Value

C. The Margin of Error

D. The Sample Median

E. The Confidence Level

F. The Sample Proportion

G. The Sample Standard Deviation

**9. What is the critical t-value for a sample of 15 and a 2-sided confidence interval that's associated with a 5% alpha risk.**

A. t-crit = 2.131

B. t-crit = 2.145

C. t-crit = 1.753

D. t-crit = 1.761

**10. What is the critical t-value for a sample of 4 and a 2-sided confidence interval that's associated with a 1% alpha risk.**

A. t-crit = 3.747

B. t-crit = 4.604

C. t-crit = 4.541

D. t-crit = 5.841

**11. What is the critical t-value for a sample of 10 and a 2-sided confidence interval that's associated with a 10% alpha risk.**

A. t-crit = 1.833

B. t-crit = 1.383

C. t-crit = 1.812

D. t-crit = 1.372

**12. What is the critical z-value associated with a 2-sided confidence interval that's associated with a 10% alpha risk.**

A. z-score = 1.29

B. z-score = 1.96

C. z-score = 1.78

**D. z-score = 1.65**

**13. What is the critical z-value associated with a 2-sided confidence interval that's associated with a 1% alpha risk.**

A. z-score = 2.58

B. z-score = 2.33

C. z-score = 1.96

D. z-score = 3.09

**14. What is the critical z-value associated with a 2-sided confidence interval that's associated with a 20% alpha risk.**

**A. z-score = 1.29**

B. z-score = 1.65

C. z-score = 1.72

D. z-score = 1.34

**15. For a sample size of 10, and a 2-sided confidence interval, identify the appropriate lower-tail & upper-tail chi-squared critical values associated with a 5% alpha risk.**

A. lower-tail chi-squared = 2.700

B. lower-tail chi-squared = 3.247

C. lower-tail chi-squared = 16.919

D. Upper-tail chi-squared = 19.023

E. Upper-tail chi-squared = 20.483

F. Upper-tail chi-squared = 3.940

**16. For a sample size of 4, and a 2-sided confidence interval, identify the appropriate lower-tail & upper-tail chi-squared critical values associated with a 20% alpha risk.**

A. lower-tail chi-squared = 1.064

B. lower-tail chi-squared = 0.581

C. lower-tail chi-squared = 7.815

D. Upper-tail chi-squared = 0.711

E. Upper-tail chi-squared = 7.779

F. Upper-tail chi-squared = 6.251

**17. For a sample size of 16, and a 2-sided confidence interval, identify the appropriate lower-tail & upper-tail chi-squared critical values associated with a 10% alpha risk.**

A. lower-tail chi-squared = 26.296

B. lower-tail chi-squared = 7.962

C. lower-tail chi-squared = 7.261

D. Upper-tail chi-squared = 24.996

E. Upper-tail chi-squared = 22.307

F. Upper-tail chi-squared = 8.547

**18. Identify the statement below that is correct for the following data set: 2, 4, 6, 6, 4, 2**

A. Mean = 4, Median = 4
B. Mean = 6, Median = 4
C. Mean = 6, Median = 6
D. Mean = 4, Median = 6

**19. Identify the statement below that is correct for the following data set: 1.5, 2.1, 1.8, 2.4, 2.3, 1.7**

A. Mean = 1.9, Median = 1.80
B. Mean = 1.9, Median = 2.10
C. Mean = 2.0, Median = 1.95
D. Mean = 2.0, Median = 1.80

**20. Calculate the point estimate for the sample mean using the following 5 sample data points: 116, 123, 133, 127, 119**

A. Sample Mean = 123.4
B. Sample Mean = 123.6
C. Sample Mean = 123.5
D. Sample Mean = 123.8

**21. Find the sample standard deviation for the following sample data set:**

**2, 4, 6, 6, 4, 2**

A. Sample Standard Deviation = 3.20
B. Sample Standard Deviation = 2.16
C. Sample Standard Deviation = 1.79
D. Sample Standard Deviation = 1.47

**22. Find the sample standard deviation for the following sample data set:**

**1.5, 2.1, 1.8, 2.4, 2.3, 1.7**

A. Sample Standard Deviation = 0.36
B. Sample Standard Deviation = 0.13
C. Sample Standard Deviation = 0.64
D. Sample Standard Deviation = 0.41

**23. You're attempting to estimate the weight of the population of men in the U.S. You've sampled 1,000 men and found the mean value to be 175 lbs and the sample standard deviation to be 10 lbs.**

**What is the standard error of the sample mean distribution:**

A. 10 lbs
B. 0.32 lbs
C. 0.10 lbs
D. 100 lbs

**24. You've taken a sample of 25 units from a population, and you're measuring the length of the part. If the mean value is 1.65in, and the standard deviation is 0.25in.**

**What is the standard error of the sample mean distribution:**

A. 0.25 lbs
B. 0.05 lbs
C. 0.0025 lbs
**D.** 0.10 lbs

**25. You've sampled 60 units from the latest production lot to measure the width of the product. The sample mean is 6.75in and the population standard deviation is known to be 0.75in.**

**Calculate the 95% confidence interval for the population mean:**

A. 6.75 $\pm$ 0.219
B. 6.75 $\pm$ 1.470
C. 6.75 $\pm$ 0.024
D. 6.75 $\pm$ 0.189

**26. You've sampled 50 units from the latest production lot to measure the outer diameter of the product. The sample mean is 0.51in and the population standard deviation is known to be 0.07in.**

**Calculate the 95% confidence interval:**

A. 0.491 - 0.529
B. 0.487 - 0.532
C. 0.369 - 0.651
D. 0.507 - 0.513

**27. You've measure 8 units from the latest production lot to measure the length of the parts. You calculate the sample mean to be 16.5in, and the sample standard deviation to be 1.5in.**

**Calculate the 90% confidence interval for the population mean.**

**A.** 16.5 $\pm$ 1.00
**B.** 16.5 $\pm$ 1.03
**C.** 16.5 $\pm$ 1.20
**D.** 16.5 $\pm$ 0.36

**28. You've measure 15 units from the latest production lot to measure the weight of the parts. You calculate the sample mean to be 3.5lbs, and the sample standard deviation to be 0.40lbs.**

**Calculate the 95% confidence interval for the population mean.**

**A.** 3.28 - 3.72
**B.** 3.27 - 3.73
**C.** 3.29 - 3.70
**D.** 3.45 - 3.55

**29. You've taken a random sample of 10 units from the latest production lot, and measured the overall height of the part. You calculate the sample mean to be 17.55 in, and the sample standard deviation to be 1.0 in.**

**Calculate the 90% confidence interval for the population standard deviation.**

**A.** $0.688 < \sigma < 1.825$
**B.** $0.768 < \sigma < 1.734$
**C.** $0.729 < \sigma < 1.645$
**D.** $0.532 < \sigma < 2.706$

**30. You've measure 15 units from the latest production lot to measure the weight of the parts. You calculate the sample mean to be 3.5lbs, and the sample standard deviation to be 0.40lbs.**

**Calculate the 95% confidence interval for the population standard deviation.**

**A.** $0.086 < \sigma < 0.397$
**B.** $0.285 < \sigma < 0.598$
**C.** $0.303 < \sigma < 0.653$
**D.** **$0.293 < \sigma < 0.630$**

**31. You've measure 8 units from the latest production lot to measure the length of the parts. You calculate the sample mean to be 16.5in, and the sample standard deviation to be 1.5 in.**

**Calculate the 80% confidence interval for the population standard deviation.**

**A.** $1.224 < \sigma < 2.521$
**B.** $1.145 < \sigma < 2.358$
**C.** $1.086 < \sigma < 2.124$
**D.** $1.310 < \sigma < 5.559$

**32. You've surveyed 500 individuals from your city to determine how many of them will be voting for a certain candidate in an upcoming election, 265 said they would.**

**Find the 95% confidence interval for the population proportion who will vote for your your candidate.**

**A.** $0.486 < p < 0.574$
**B.** $0.482 < p < 0.578$
**C.** $0.448 < p < 0.612$
**D.** $0.517 < p < 0.543$

**33. You've surveyed 100 individuals from your organization to see how many of them would say they are "satisfied" with the current management team. 43 said yes. Find the 90% confidence interval for the true population proportion.**

**A.** $0.430 \pm 0.049$
**B.** $0.430 \pm 0.097$
**C.** $0.430 \pm 0.082$
**D.** $0.430 \pm 0.053$

**34. You've sampled 20 units from the last production lot and found that 3 of them are non-conforming. Find the 95% confidence interval for the true population proportion of defective products.**

**A.** $0.070 < p < 0.229$
**B.** $0.000 < p < 0.306$
**C.** $-0.006 < p < 0.306$
**D.** $0.018 < p < 0.282$

**35. You've sampled 100 units from the last production lot and found that 8 of them are non-conforming. Find the 90% confidence interval for the true population proportion of defective products.**

**A.** $0.080 \pm 0.047$
**B.** $0.080 \pm 0.049$
**C.** $0.080 \pm 0.053$
**D.** $0.080 \pm 0.045$

## Problem Set Solution:

1. **A Point Estimate is a type of estimation that uses a single value, oftentimes a sample statistic, to infer information about the population parameter as a single value or point.**

2. **An Interval Estimate is a type of estimation that uses a range (or interval) of values, based on sampling information, to "capture" or "cover" the true population parameter being inferred.**

3. **An unbiased estimate is one who's expected value is equal to the population parameter being estimated.**

4. **Identify all of the statements below that are true:**

A. The **standard error** is computed solely from sample attributes - ***True***, *The standard error can be computed from a knowledge of sample attributes - sample size and sample statistics.*

B. The **standard error** is a measure of ~~**central tendency**~~ **variability** - **False**

C. There are two types of estimates, **Point Estimates** & **Interval Estimates** - **True**

D. The ~~**Expected Value**~~ **Standard Error** of the sample mean distribution is analogous to the standard deviation in that it is a reflection of the dispersion of sample mean values - **False**

5. **Identify all of the statements below that are false:**

A. Alpha risk is also called your significance level - **True**.

B. The confidence level of your interval estimate is based on your ~~**beta**~~ **alpha** risk -**False**

C. When we say that we have 95% confidence in our interval estimate, we mean that 95% of the overall population falls within the confidence interval. - **False**, *The confidence level is the probability that your confidence interval truly captures the population parameter being estimated.*

D. If the sample size is less than 30, the ~~**z-score**~~ **t-distribution** should be used. - **False**

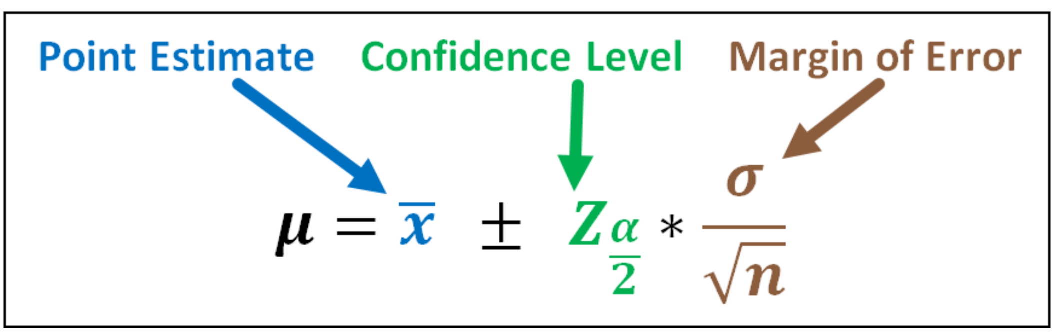
6. **The likelihood that the interval estimate contains the true population parameter is given by the Confidence Level**

7. **A "high quality" estimator (point estimate / interval estimate) has which of the two following properties:**

- **unbiased**
- **efficient**
- ~~Low alpha risk~~
- ~~Low beta risk~~

8. **The confidence interval for the population mean, when the population variance is known, is based on which of the following items:**

- **The Point Estimate**
- **The Margin of Error**
- **The Confidence Level**
- ~~**The Critical Chi-Squared Value**~~
- ~~**The Sample Median**~~
- ~~**The Sample Standard Deviation**~~
- ~~**The Sample Proportion**~~




$$\mu = \bar{x} \pm Z_{\frac{\alpha}{2}} * \frac{\sigma}{\sqrt{n}}$$

9. **What is the critical t-value for a sample of 15 and a 2-sided confidence interval that's associated with a 5% alpha risk.**

[NIST T-distribution Critical Values](),

- ~~t-crit = 2.131~~
- **t-crit = 2.145**
- ~~t-crit = 1.753~~
- ~~t-crit = 1.761~~

A sample size of 15 means that there are 14 degrees of freedom.

With an alpha risk of 5% and a 2-sided confidence interval, we're looking in the column of 0.975 where we find our critical t-value to be 2.145.

**Critical values of Student's *t* distribution with *ν* degrees of freedom**

Probability less than the critical value ($t_{1-\alpha,\nu}$)

| ν | 0.90 | 0.95 | 0.975 | 0.99 | 0.995 | 0.999 |
|---|---|---|---|---|---|---|
| 1. | 3.078 | 6.314 | 12.[illegible]06 | 31.821 | 63.657 | 318.313 |
| 2. | 1.886 | 2.920 | 4.[illegible]03 | 6.965 | 9.925 | 22.327 |
| 3. | 1.638 | 2.353 | 3.[illegible]82 | 4.541 | 5.841 | 10.215 |
| 4. | 1.533 | 2.132 | 2.[illegible]76 | 3.747 | 4.604 | 7.173 |
| 5. | 1.476 | 2.015 | 2.[illegible]71 | 3.365 | 4.032 | 5.893 |
| 6. | 1.440 | 1.943 | 2.[illegible]47 | 3.143 | 3.707 | 5.208 |
| 7. | 1.415 | 1.895 | 2.[illegible]65 | 2.998 | 3.499 | 4.782 |
| 8. | 1.397 | 1.860 | 2.[illegible]06 | 2.896 | 3.355 | 4.499 |
| 9. | 1.383 | 1.833 | 2.[illegible]62 | 2.821 | 3.250 | 4.296 |
| 10. | 1.372 | 1.812 | 2.[illegible]28 | 2.764 | 3.169 | 4.143 |
| 11. | 1.363 | 1.796 | 2.[illegible]01 | 2.718 | 3.106 | 4.024 |
| 12. | 1.356 | 1.782 | 2[illegible]79 | 2.681 | 3.055 | 3.929 |
| 13. | 1.350 | 1.771 | 2.[illegible]60 | 2.650 | 3.012 | 3.852 |
| 14. | [illegible] | [illegible] | 2.145 | 2.624 | 2.977 | 3.787 |
| 15. | 1.341 | 1.753 | 2.131 | 2.602 | 2.947 | 3.733 |

**10. What is the critical t-value for a sample of 4 and a 2-sided confidence interval that's associated with a 1% alpha risk.**

[NIST T-distribution Critical Values](),

- ~~t-crit = 3.747~~
- ~~t-crit = 4.604~~
- ~~t-crit = 4.541~~
- **t-crit = 5.841**

A sample size of 4 means that there are 3 degrees of freedom.

With an alpha risk of 1% and a 2-sided confidence interval, we're looking in the column of 0.995 and find our critical t-value to be 5.841.

**Critical values of Student's *t* distribution with *ν* degrees of freedom**

Probability less than the critical value ($t_{1-\alpha, \nu}$)

| ν | 0.90 | 0.95 | 0.975 | 0.99 | 0.995 | 0.999 |
|---|---|---|---|---|---|---|
| 1. | 3.078 | 6.314 | 12.706 | 31.821 | [illegible] | 318.313 |
| 2. | 1.886 | 2.920 | 4.303 | 6.965 | [illegible] | 22.327 |
| 3. | [illegible] | [illegible] | [illegible] | [illegible] | 5.841 | 10.215 |
| 4. | 1.533 | 2.132 | 2.776 | 3.747 | 4.604 | 7.173 |

**11. What is the critical t-value for a sample of 10 and a 2-sided confidence interval that's associated with a 10% alpha risk.**

NIST T-distribution Critical Values,

- **t-crit = 1.833**
- ~~t-crit = 1.383~~
- ~~t-crit = 1.812~~
- ~~t-crit = 1.372~~

**Critical values of Student's *t* distribution with *ν* degrees of freedom**

Probability less than the critical value ($t_{1-\alpha,\nu}$)

| ν | 0.90 | 0.95 | 0.975 | 0.99 | 0.995 | 0.999 |
|---|---|---|---|---|---|---|
| 1. | 3.078 | [illegible] | 12.706 | 31.821 | 63.657 | 318.313 |
| 2. | 1.886 | [illegible] | 4.303 | 6.965 | 9.925 | 22.327 |
| 3. | 1.638 | [illegible] | 3.182 | 4.541 | 5.841 | 10.215 |
| 4. | 1.533 | [illegible] | 2.776 | 3.747 | 4.604 | 7.173 |
| 5. | 1.476 | [illegible] | 2.571 | 3.365 | 4.032 | 5.893 |
| 6. | 1.440 | [illegible] | 2.447 | 3.143 | 3.707 | 5.208 |
| 7. | 1.415 | [illegible] | 2.365 | 2.998 | 3.499 | 4.782 |
| 8. | 1.397 | [illegible] | 2.306 | 2.896 | 3.355 | 4.499 |
| 9. | [illegible] | 1.833 | 2.262 | 2.821 | 3.250 | 4.296 |
| 10. | 1.372 | 1.812 | 2.228 | 2.764 | 3.169 | 4.143 |

A sample size of 10 means that there are 9 degrees of freedom. With an alpha risk of 10% that's associated with a 2-sided confidence interval, we're looking in the column of 0.95 and we find our critical t-value to equal 1.833.

12. **What is the critical z-value associated with a 2-sided confidence interval that's associated with a 10% alpha risk.**

[NIST Z-Table for Normal Distribution]

- ~~z-score = 1.29~~
- ~~z-score = 1.96~~
- **z-score = 1.65**
- ~~z-score = 1.78~~

Because it's a 2-sided distribution with at the 10% significance level, we're looking for the z-score that's associated with the area under the curve of 0.450 (0.450 = 0.500 - 0.050).

This would capture 45% on the left half & right half of the distribution, leaving the remaining 10% of the alpha risk in the rejection area of the tails of the distribution.

**The z-score associated with 0.450 probability is z = 1.65**

Area under the Normal Curve from 0 to X

| X | 0.00 | 0.01 | 0.02 | 0.03 | 0.04 | 0.05 | 0.06 | 0.07 |
|---|---|---|---|---|---|---|---|---|
| 0.0 | 0.00000 | 0.00399 | 0.00798 | 0.01197 | 0.01595 | 0.[illegible]1994 | 0.02392 | 0.02790 |
| 0.1 | 0.03983 | 0.04380 | 0.04776 | 0.05172 | 0.05567 | 0.[illegible]5962 | 0.06356 | 0.06749 |
| 0.2 | 0.07926 | 0.08317 | 0.08706 | 0.09095 | 0.09483 | 0.[illegible]9871 | 0.10257 | 0.10642 |
| 0.3 | 0.11791 | 0.12172 | 0.12552 | 0.12930 | 0.13307 | 0.[illegible]3683 | 0.14058 | 0.14431 |
| 0.4 | 0.15542 | 0.15910 | 0.16276 | 0.16640 | 0.17003 | 0.[illegible]7364 | 0.17724 | 0.18082 |
| 0.5 | 0.19146 | 0.19497 | 0.19847 | 0.20194 | 0.20540 | 0.[illegible]0884 | 0.21226 | 0.21566 |
| 0.6 | 0.22575 | 0.22907 | 0.23237 | 0.23565 | 0.23891 | 0.[illegible]4215 | 0.24537 | 0.24857 |
| 0.7 | 0.25804 | 0.26115 | 0.26424 | 0.26730 | 0.27035 | 0.[illegible]7337 | 0.27637 | 0.27935 |
| 0.8 | 0.28814 | 0.29103 | 0.29389 | 0.29673 | 0.29955 | 0.[illegible]0234 | 0.30511 | 0.30785 |
| 0.9 | 0.31594 | 0.31859 | 0.32121 | 0.32381 | 0.32639 | 0.[illegible]2894 | 0.33147 | 0.33398 |
| 1.0 | 0.34134 | 0.34375 | 0.34614 | 0.34849 | 0.35083 | 0.[illegible]5314 | 0.35543 | 0.35769 |
| 1.1 | 0.36433 | 0.36650 | 0.36864 | 0.37076 | 0.37286 | 0.[illegible]7493 | 0.37698 | 0.37900 |
| 1.2 | 0.38493 | 0.38686 | 0.38877 | 0.39065 | 0.39251 | 0.[illegible]9435 | 0.39617 | 0.39796 |
| 1.3 | 0.40320 | 0.40490 | 0.40658 | 0.40824 | 0.40988 | 0.[illegible]1149 | 0.41308 | 0.41466 |
| 1.4 | 0.41924 | 0.42073 | 0.42220 | 0.42364 | 0.42507 | 0.[illegible]2647 | 0.42785 | 0.42922 |
| 1.5 | 0.43319 | 0.43448 | 0.43574 | 0.43699 | 0.43822 | 0.[illegible]3943 | 0.44062 | 0.44179 |
| 1.6 | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | 0.45053 | 0.45154 | 0.45254 |
| 1.7 | 0.45543 | 0.45637 | 0.45728 | 0.45818 | 0.45907 | 0.45994 | 0.46080 | 0.46164 |

13. **What is the critical z-value associated with a 2-sided confidence interval that's associated with a 1% alpha risk.** [NIST Z-Table for Normal Distribution]

- ~~z-score = 2.33~~
- **z-score = 2.58**
- ~~z-score = 1.96~~
- ~~z-score = 3.09~~

Because it's a 2-sided distribution, we're looking for the z-score that's associated with the area under the curve of 0.495.

This would capture 49.5% on the left half & right half of the distribution, leaving the remaining 1% of the alpha risk in the rejection area of the tails of the distribution.

**The z-score associated with 0.495 probability is z = 2.58**

Area under the Normal Curve from 0 to X

| X | 0.00 | 0.01 | 0.02 | 0.03 | 0.04 | 0.05 | 0.06 | 0.07 | 0.08 | 0.09 |
|---|---|---|---|---|---|---|---|---|---|---|
| 0.0 | 0.00000 | 0.00399 | 0.00798 | 0.01197 | 0.01595 | 0.01994 | 0.02392 | 0.02790 | 0.[illegible]188 | 0.03586 |
| 0.1 | 0.03983 | 0.04380 | 0.04776 | 0.05172 | 0.05567 | 0.05962 | 0.06356 | 0.06749 | 0.[illegible]142 | 0.07535 |
| 0.2 | 0.07926 | 0.08317 | 0.08706 | 0.09095 | 0.09483 | 0.09871 | 0.10257 | 0.10642 | 0.[illegible]026 | 0.11409 |
| 0.3 | 0.11791 | 0.12172 | 0.12552 | 0.12930 | 0.13307 | 0.13683 | 0.14058 | 0.14431 | 0.[illegible]803 | 0.15173 |
| 0.4 | 0.15542 | 0.15910 | 0.16276 | 0.16640 | 0.17003 | 0.17364 | 0.17724 | 0.18082 | 0.[illegible]439 | 0.18793 |
| 0.5 | 0.19146 | 0.19497 | 0.19847 | 0.20194 | 0.20540 | 0.20884 | 0.21226 | 0.21566 | 0.[illegible]904 | 0.22240 |
| 0.6 | 0.22575 | 0.22907 | 0.23237 | 0.23565 | 0.23891 | 0.24215 | 0.24537 | 0.24857 | 0.[illegible]175 | 0.25490 |
| 0.7 | 0.25804 | 0.26115 | 0.26424 | 0.26730 | 0.27035 | 0.27337 | 0.27637 | 0.27935 | 0.[illegible]230 | 0.28524 |
| 0.8 | 0.28814 | 0.29103 | 0.29389 | 0.29673 | 0.29955 | 0.30234 | 0.30511 | 0.30785 | 0.[illegible]057 | 0.31327 |
| 0.9 | 0.31594 | 0.31859 | 0.32121 | 0.32381 | 0.32639 | 0.32894 | 0.33147 | 0.33398 | 0.[illegible]646 | 0.33891 |
| 1.0 | 0.34134 | 0.34375 | 0.34614 | 0.34849 | 0.35083 | 0.35314 | 0.35543 | 0.35769 | 0.[illegible]993 | 0.36214 |
| 1.1 | 0.36433 | 0.36650 | 0.36864 | 0.37076 | 0.37286 | 0.37493 | 0.37698 | 0.37900 | 0.[illegible]100 | 0.38298 |
| 1.2 | 0.38493 | 0.38686 | 0.38877 | 0.39065 | 0.39251 | 0.39435 | 0.39617 | 0.39796 | 0.[illegible]973 | 0.40147 |
| 1.3 | 0.40320 | 0.40490 | 0.40658 | 0.40824 | 0.40988 | 0.41149 | 0.41308 | 0.41466 | 0.[illegible]621 | 0.41774 |
| 1.4 | 0.41924 | 0.42073 | 0.42220 | 0.42364 | 0.42507 | 0.42647 | 0.42785 | 0.42922 | 0.[illegible]056 | 0.43189 |
| 1.5 | 0.43319 | 0.43448 | 0.43574 | 0.43699 | 0.43822 | 0.43943 | 0.44062 | 0.44179 | 0.[illegible]295 | 0.44408 |
| 1.6 | 0.44520 | 0.44630 | 0.44738 | 0.44845 | 0.44950 | 0.45053 | 0.45154 | 0.45254 | 0.[illegible]352 | 0.45449 |
| 1.7 | 0.45543 | 0.45637 | 0.45728 | 0.45818 | 0.45907 | 0.45994 | 0.46080 | 0.46164 | 0.[illegible]246 | 0.46327 |
| 1.8 | 0.46407 | 0.46485 | 0.46562 | 0.46638 | 0.46712 | 0.46784 | 0.46856 | 0.46926 | 0.[illegible]995 | 0.47062 |
| 1.9 | 0.47128 | 0.47193 | 0.47257 | 0.47320 | 0.47381 | 0.47441 | 0.47500 | 0.47558 | 0.[illegible]615 | 0.47670 |
| 2.0 | 0.47725 | 0.47778 | 0.47831 | 0.47882 | 0.47932 | 0.47982 | 0.48030 | 0.48077 | 0.[illegible]124 | 0.48169 |
| 2.1 | 0.48214 | 0.48257 | 0.48300 | 0.48341 | 0.48382 | 0.48422 | 0.48461 | 0.48500 | 0.[illegible]537 | 0.48574 |
| 2.2 | 0.48610 | 0.48645 | 0.48679 | 0.48713 | 0.48745 | 0.48778 | 0.48809 | 0.48840 | 0.[illegible]870 | 0.48899 |
| 2.3 | 0.48928 | 0.48956 | 0.48983 | 0.49010 | 0.49036 | 0.49061 | 0.49086 | 0.49111 | 0.[illegible]134 | 0.49158 |
| 2.4 | 0.49180 | 0.49202 | 0.49224 | 0.49245 | 0.49266 | 0.49286 | 0.49305 | 0.49324 | 0.[illegible]343 | 0.49361 |
| 2.5 | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | 0.49506 | 0.49520 |
| 2.6 | 0.49534 | 0.49547 | 0.49560 | 0.49573 | 0.49585 | 0.49598 | 0.49609 | 0.49621 | 0.49632 | 0.49643 |

**14. What is the critical z-value associated with a 2-sided confidence interval that's associated with a 20% alpha risk.**

[NIST Z-Table for Normal Distribution]

- **z-score = 1.29**
- ~~z-score = 1.65~~
- ~~z-score = 1.72~~
- ~~z-score = 1.34~~

Because it's a 2-sided distribution, we're looking for the z-score that's associated with the area under the curve of 0.400.

This would capture 40% on the left half & right half of the distribution, leaving the remaining 20% of the alpha risk in the rejection area of the tails of the distribution.

The z-score associated with 0.400 probability is z = 1.29

Area under the Normal Curve from 0 to X

| X | 0.00 | 0.04 | 0.05 | 0.06 | 0.07 | 0.08 | 0.09 |
|---|---|---|---|---|---|---|---|
| 0.0 | 0.00000 | 0.01595 | 0.01994 | 0.02392 | 0.02790 | 0.03188 | 0.0[illegible]586 |
| 0.1 | 0.03983 | 0.05567 | 0.05962 | 0.06356 | 0.06749 | 0.07142 | 0.0[illegible]535 |
| 0.2 | 0.07926 | 0.09483 | 0.09871 | 0.10257 | 0.10642 | 0.11026 | 0.1[illegible]409 |
| 0.3 | 0.11791 | 0.13307 | 0.13683 | 0.14058 | 0.14431 | 0.14803 | 0.1[illegible]173 |
| 0.4 | 0.15542 | 0.17003 | 0.17364 | 0.17724 | 0.18082 | 0.18439 | 0.1[illegible]793 |
| 0.5 | 0.19146 | 0.20540 | 0.20884 | 0.21226 | 0.21566 | 0.21904 | 0.2[illegible]240 |
| 0.6 | 0.22575 | 0.23891 | 0.24215 | 0.24537 | 0.24857 | 0.25175 | 0.2[illegible]490 |
| 0.7 | 0.25804 | 0.27035 | 0.27337 | 0.27637 | 0.27935 | 0.28230 | 0.2[illegible]524 |
| 0.8 | 0.28814 | 0.29955 | 0.30234 | 0.30511 | 0.30785 | 0.31057 | 0.3[illegible]327 |
| 0.9 | 0.31594 | 0.32639 | 0.32894 | 0.33147 | 0.33398 | 0.33646 | 0.3[illegible]891 |
| 1.0 | 0.34134 | 0.35083 | 0.35314 | 0.35543 | 0.35769 | 0.35993 | 0.3[illegible]214 |
| 1.1 | 0.36433 | 0.37286 | 0.37493 | 0.37698 | 0.37900 | 0.38100 | 0.3[illegible]298 |
| 1.2 | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | 0.40147 |
| 1.3 | 0.40320 | 0.40988 | 0.41149 | 0.41308 | 0.41466 | 0.41621 | 0.41774 |
| 1.4 | 0.41924 | 0.42507 | 0.42647 | 0.42785 | 0.42922 | 0.43056 | 0.43189 |

15. **For a sample size of 10, and a 2-sided confidence interval, identify the appropriate lower-tail & upper-tail chi-squared critical values associated with a 5% alpha risk.**

    NIST Chi-Squared Critical Values

- **lower-tail chi-squared = 2.700**
- ~~lower-tail chi-squared = 3.247~~
- ~~lower-tail chi-squared = 16.919~~
- **Upper-tail chi-squared = 19.023**
- ~~Upper-tail chi-squared = 20.483~~
- ~~Upper-tail chi-squared = 3.940~~

The degrees of freedom in this sample is 9 (10 - 1), and the 2-sided confidence interval and 5% alpha risk is split in half between the upper and lower tail, so we're looking in the 0.025 column and 0.975 column for our critical chi-squared value.

The upper tail is the intersection of 0.975 and 9 degrees of freedom = 19.023.

The lower tail is the intersection of 0.025 and 9 degrees of freedom = 2.700.

16. **For a sample size of 4, and a 2-sided confidence interval, identify the appropriate lower-tail & upper-tail chi-squared critical values associated with a 20% alpha risk.**

    NIST Chi-Squared Critical Values,

- ~~lower-tail chi-squared = 1.064~~
- **lower-tail chi-squared = 0.581**
- ~~lower-tail chi-squared = 7.815~~
- ~~Upper-tail chi-squared = 0.711~~
- ~~Upper-tail chi-squared = 7.779~~
- **Upper-tail chi-squared = 6.251**

The degrees of freedom in this sample is 3 (4 - 1), and the 2-sided confidence interval and 20% alpha risk is split in half between the upper and lower tail, so we're looking in the 0.10 column and 0.90 column for our critical chi-squared value.

The upper tail is the intersection of 0.90 and 3 degrees of freedom = 6.521.

The lower tail is the intersection of 0.10 and 3 degrees of freedom = 0.581

17. **For a sample size of 16, and a 2-sided confidence interval, identify the appropriate lower-tail & upper-tail chi-squared critical values associated with a 10% alpha risk.**

[NIST T-distribution Critical Values](), [NIST Chi-Squared Critical Values](), [NIST Z-Table for Normal Distribution]()

- ~~lower-tail chi-squared = 26.296~~
- ~~lower-tail chi-squared = 7.962~~
- **lower-tail chi-squared = 7.261**
- **Upper-tail chi-squared = 24.996**
- ~~Upper-tail chi-squared = 22.307~~
- ~~Upper-tail chi-squared = 8.547~~

The degrees of freedom in this sample is 15 (16 - 1), and the 2-sided confidence interval and 10% alpha risk is split in half between the upper and lower tail, so we're looking in the 0.05 column and 0.95 column for our critical chi-squared value.

The upper tail is the intersection of 0.95 and 15 degrees of freedom = 24.996.

The lower tail is the intersection of 0.05 and 15 degrees of freedom = 7.261

**18. Identify the statement below that is correct for the following data set: 2, 4, 6, 6, 4, 2**

$$\textit{Sample Mean}: \ \bar{X} = \frac{\sum x}{n} = \frac{2+4+6+6+4+2}{6} = 4$$

**Median: ~~2, 2~~, 4, 4, ~~6, 6~~,** The middle value (Median) is **4.**

- **Mean = 4, Median = 4**
- ~~Mean = 6, Median = 4~~
- ~~Mean = 6, Median = 6~~
- ~~Mean = 4, Median = 6~~

**19. Identify the statement below that is correct for the following data set: 1.5, 2.1, 1.8, 2.4, 2.3, 1.7**

$$\textit{Sample Mean}: \ \bar{X} = \frac{\sum x}{n} = \frac{1.6+2.1+1.9+2.4+2.3+1.7}{6} = 2.0$$

**Median: ~~1.5, 1.7~~, 1.8, 2.1, ~~2.3, 2.4~~ =** $\frac{1.8+2.1}{2} = 1.95$

- ~~Mean = 1.9, Median = 1.80~~
- ~~Mean = 1.9, Median = 2.10~~
- **Mean = 2.0, Median = 1.95**
- ~~Mean = 2.0, Median = 1.80~~

**20. Calculate the point estimate for the sample mean using the following 5 sample data points: 116, 123, 133, 127, 119**

$$\textit{Sample Mean}: \ \bar{X} = \frac{\sum x}{n} = \frac{116+123+133+127+119}{5} = 123.6$$

- ~~Sample Mean = 123.4~~
- **Sample Mean = 123.6**
- ~~Sample Mean = 123.5~~
- ~~Sample Mean = 123.8~~

21. **Find the sample standard deviation for the following sample data set: 2, 4, 6, 6, 4, 2**

| $x_i$ | $(x_i - \bar{x})$ | $(x_i - \bar{x})^2$ |
|---|---|---|
| **2** | (2 - 4) = -2 | 4 |
| **4** | (4 - 4) = 0 | 0 |
| **6** | (6 - 4) = 2 | 4 |
| **6** | (6 - 4) = 2 | 4 |
| **4** | (4 - 4) = 0 | 0 |
| **2** | (2 - 4) = -2 | 4 |
| | | **16** |

$$\textit{Sample Standard Deviation}: \; s = \sqrt{\frac{\sum(x_i - \bar{x})^2}{n-1}} = \sqrt{\frac{16}{6-1}} = 1.79$$

- ~~Sample Standard Deviation = 3.20~~
- ~~Sample Standard Deviation = 2.16~~
- **Sample Standard Deviation = 1.79**
- ~~Sample Standard Deviation = 1.47~~

22. **Find the sample standard deviation for the following sample data set: 1.5, 2.1, 1.8, 2.4, 2.3, 1.7**

| $x_i$ | $(x_i - \bar{x})$ | $(x_i - \bar{x})^2$ |
|---|---|---|
| **1.5** | (1.5 - 2.0) = -0.5 | 0.25 |
| **2.1** | (2.1 - 2.0) = 0.1 | 0.01 |
| **1.8** | (1.8 - 2.0) = -0.2 | 0.04 |
| **2.4** | (2.4 - 2.0) = 0.4 | 0.16 |
| **2.3** | (2.3 - 2.0) = 0.3 | 0.09 |
| **1.7** | (1.7 - 2.0) = -0.3 | 0.09 |
| | | **0.64** |

$$\textit{Sample Standard Deviation}: \; s = \sqrt{\frac{\sum(x_i - \bar{x})^2}{n-1}} = \sqrt{\frac{0.64}{6-1}} = 0.36$$

- ~~Sample Standard Deviation = 0.36~~
- **Sample Standard Deviation = 0.13**
- ~~Sample Standard Deviation = 0.64~~
- ~~Sample Standard Deviation = 0.41~~

**23. You're attempting to estimate the weight of the population of men in the U.S. You've sampled 1,000 men and found the mean value to be 175 lbs and the sample standard deviation to be 10 lbs.**

**What is the standard error of the sample mean distribution:**

- 10 lbs
- 0.32 lbs
- 0.10 lbs
- 100 lbs

$$\textit{Standard Error of The Sample Mean}: S.E. = \sqrt{\frac{\sigma^2}{n}} = \frac{\sigma}{\sqrt{n}}$$

$$S.E. = \frac{\sigma}{\sqrt{n}} = \frac{10}{\sqrt{1000}} = 0.32$$

**24. You've taken a sample of 25 units from a population, and you're measuring the length of the part. If the mean value is 1.65in, and the standard deviation is 0.25in.**

**What is the standard error of the sample mean distribution:**

- 0.25 lbs
- **0.05 lbs**
- 0.0025 lbs
- 0.10 lbs

$$\textit{Standard Error of The Sample Mean}: S.E. = \sqrt{\frac{\sigma^2}{n}} = \frac{\sigma}{\sqrt{n}}$$

$$S.E. = \frac{\sigma}{\sqrt{n}} = \frac{0.25}{\sqrt{25}} = 0.05$$

**25. You've sampled 60 units from the latest production lot to measure the width of the product. The sample mean is 6.75in and the population standard deviation is known to be 0.75in. Calculate the 95% confidence interval for the population mean:**

- ~~6.75 ± 0.219~~
- ~~6.75 ± 1.470~~
- ~~6.75 ± 0.024~~
- **6.75 ± 0.189**

Ok, we know after reading the question:

n = 60, σ = 0.75in, α = 0.05, x-bar = 6.75in

Because we've sampled more than 30 units and the population standard deviation is known, we can use the Z-score approach to this confidence interval problem.

We need to find the Z-score associated with the 95% confidence interval using the NIST Z-Table, we find Z = 1.96.

$$\textit{Interval Estimate of Population Mean (known variance)} : \bar{x} \pm Z_{\frac{\alpha}{2}} * \frac{\sigma}{\sqrt{n}}$$

$$\textit{Interval Estimate} : 6.75 \pm 1.96 * \frac{0.75}{\sqrt{60}}$$

$$\textit{Interval Estimate} : 6.75 \pm 0.189$$

**26. You've sampled 50 units from the latest production lot to measure the outer diameter of the product. The sample mean is 0.51in and the population standard deviation is known to be 0.07in. Calculate the 95% confidence interval:**

- **0.491 - 0.529**
- ~~0.487 - 0.532~~
- ~~0.369 - 0.651~~
- ~~0.507 - 0.513~~

Ok, we know after reading the question: n = 50, σ = 0.07in, α = 0.05, x-bar = 0.51in.

Because we've sampled more than 30 units and the population standard deviation is known, we can use the Z-score approach to this confidence interval problem.

We need to find the Z-score associated with the 95% confidence interval using the NIST Z-Table, we find Z = 1.96.

$$\textit{Interval Estimate of Population Mean (known variance)} : \bar{x} \pm Z_{\frac{\alpha}{2}} * \frac{\sigma}{\sqrt{n}}$$

$$\textit{Interval Estimate} : 0.51 \pm 1.96 * \frac{0.07}{\sqrt{50}}$$

$$\textit{Interval Estimate} : 0.51 \pm 0.019$$

$$95\% \textit{ Confidence Interval} : 0.491 - 0.529$$

27. **You've measure 8 units from the latest production lot to measure the length of the parts. You calculate the sample mean to be 16.5in, and the sample standard deviation to be 1.5 in.**

    **Calculate the 90% confidence interval for the population mean.**

- **16.5 ± 1.00**
- ~~16.5 ± 1.03~~
- ~~16.5 ± 1.20~~
- ~~16.5 ± 0.36~~

Because we've only sampled 8 units and we only know the sample standard deviation (not the population standard deviation), we must use the t-distribution to create this confidence interval.

Ok, let's see what we know after reading the problem statement: n = 8, s = 1.5in, α = 0.10, x-bar = 16.5in

Before we can plug this into our equation we need to find the t-score associated with the 90% confidence interval.

With n = 8, we can calculate our degrees of freedom (n - 1) to be 7.

Since this confidence interval is two-sided, we will split our alpha risk (10%) in half (5% or 0.05) to lookup the critical t-value of 0.950 (1 - α/2) at d.f. = 7 in the NIST t-distribution table at 1.895.

$$\textit{Interval Estimate of Population Mean (unknown variance)}: \; \bar{x} \pm t_{\frac{\alpha}{2}} * \frac{s}{\sqrt{n}}$$

$$\bar{x} = 16.5 \text{ in}, \; n = 8, \; s = 1.5 \text{ in}, \; t_{\frac{\alpha}{2}} = 1.895$$

$$90\% \; \textit{Confidence Interval}: 16.5 \pm 1.895 * \frac{1.5}{\sqrt{8}} =$$

$$90\% \; \textit{Confidence Interval}: 16.5 \pm 1.00$$

28. **You've measure 15 units from the latest production lot to measure the weight of the parts. You calculate the sample mean to be 3.5lbs, and the sample standard deviation to be 0.40lbs.**

    **Calculate the 95% confidence interval for the population mean.**

- **3.28 - 3.72**
- ~~3.27 - 3.73~~
- ~~3.29 - 3.70~~
- ~~3.45 - 3.55~~

Because we've only sampled 15 units and we only know the sample standard deviation (not the population standard deviation), we must use the t-distribution to create this confidence interval.

Ok, let's see what we know after reading the problem statement: n = 15, s = 0.40lbs, α = 0.05, x-bar = 3.5lbs

Before we can plug this into our equation we need to find the t-score associated with the 95% confidence interval.

With n = 15, we can calculate our degrees of freedom (n - 1) to be 14.

Since this confidence interval is two-sided, we will split our alpha risk (5%) in half (2.5% or 0.025) to lookup the critical t-value of 0.975 (1 - α/2) at d.f. = 14 in the NIST t-distribution table at 2.145.

$$Interval\ Estimate\ of\ Population\ Mean\ (unknown\ variance):\ \bar{x} \pm t_{\frac{\alpha}{2}} * \frac{s}{\sqrt{n}}$$

$$\bar{x} = 3.5\text{lbs},\ n = 15,\ s = 0.40\text{lbs},\ t_{\frac{\alpha}{2}} = 2.145$$

$$95\%\ Confidence\ Interval: 3.5 \pm 2.145 * \frac{0.40}{\sqrt{15}}$$

$$95\%\ Confidence\ Interval: 3.5 \pm 0.22$$

$$95\%\ Confidence\ Interval: 3.28 - 3.72$$

29. **You've taken a random sample of 10 units from the latest production lot, and measured the overall height of the part. You calculate the sample mean to be 17.55 in, and the sample standard deviation to be 1.0 in.**

    **Calculate the 90% confidence interval for the population standard deviation.**

- ~~0.688 < σ < 1.825~~
- ~~0.768 < σ < 1.734~~
- **0.729 < σ < 1.645**
- ~~0.532 < σ < 2.706~~

Ok, let's see what we know after reading the problem statement: **n = 10, s = 1.0 in, α = 0.10, x-bar = 17.55in**

First we must find our critical chi-squared values from the NIST Chi-Squared Table associated with our alpha risk (10%), sample size (10), and degrees of freedom (9):

$$\textit{Confidence Interval for Standard Deviation}: \sqrt{\frac{(n-1)s^2}{X^2_{1-\alpha/2}}} < \sigma < \sqrt{\frac{(n-1)s^2}{X^2_{\alpha/2}}}$$

$$X^2_{\alpha/2} = X^2_{.10/2} = X^2_{.05}$$

$$X^2_{1-\alpha/2} = X^2_{1-.10/2} = X^2_{1-.05} = X^2_{.95}$$

$$X^2_{.05,9} = 3.325 \quad \& \quad X^2_{.95,9} = 16.919$$

Now we can complete the equation using these chi-squared values along with the sample size, and sample standard deviation to calculate our interval.

$$\textit{Confidence Interval for Standard Deviation}: \sqrt{\frac{(n-1)s^2}{X^2_{1-\alpha/2}}} < \sigma < \sqrt{\frac{(n-1)s^2}{X^2_{\alpha/2}}}$$

$$\sqrt{\frac{(10-1)1^2}{16.919}} < \sigma < \sqrt{\frac{(10-1)1^2}{3.325}}$$

$$0.729 < \sigma < 1.645$$

30. **You've measure 15 units from the latest production lot to measure the weight of the parts. You calculate the sample mean to be 3.5lbs, and the sample standard deviation to be 0.40lbs.**

    **Calculate the 95% confidence interval for the population standard deviation.**

- ~~0.086 < σ < 0.397~~
- ~~0.285 < σ < 0.598~~
- ~~0.303 < σ < 0.653~~
- **0.293 < σ < 0.630**

Ok, let's see what we know after reading the problem statement: **n = 15, s = 0.40 lbs, α = 0.05, x-bar = 3.5lbs**

First we must find our critical chi-squared values with the NIST Chi-Squared Table associated with our alpha risk (5%), sample size (15), and degrees of freedom (14):

$$\textit{Confidence Interval for Standard Deviation}: \sqrt{\frac{(n-1)s^2}{X^2_{1-\alpha/2}}} < \sigma < \sqrt{\frac{(n-1)s^2}{X^2_{\alpha/2}}}$$

$$X^2_{\alpha/2} = X^2_{.05/2} = X^2_{.025}$$

$$X^2_{1-\alpha/2} = X^2_{1-.05/2} = X^2_{1-.025} = X^2_{.975}$$

$$X^2_{.025,14} = 5.629 \quad \& \quad X^2_{.975,14} = 26.119$$

Now we can complete the equation using these chi-squared values along with the sample size, and sample standard deviation to calculate our interval.

$$\textit{Confidence Interval for Standard Deviation}: \sqrt{\frac{(n-1)s^2}{X^2_{1-\alpha/2}}} < \sigma < \sqrt{\frac{(n-1)s^2}{X^2_{\alpha/2}}}$$

$$\sqrt{\frac{(15-1)0.40^2}{26.119}} < \sigma < \sqrt{\frac{(15-1)04.40^2}{5.629}}$$

$$0.293 < \sigma < 0.630$$

**31. You've measure 8 units from the latest production lot to measure the length of the parts. You calculate the sample mean to be 16.5in, and the sample standard deviation to be 1.5 in.**

**Calculate the 80% confidence interval for the population standard deviation.**

- ~~1.224 < σ < 2.521~~
- **1.145 < σ < 2.358**
- ~~1.086 < σ < 2.124~~
- ~~1.310 < σ < 5.559~~

Ok, let's see what we know after reading the problem statement: **n = 8, s = 1.5in, α = 0.20, x-bar = 16.5in**

First we must find our critical chi-squared values with the NIST Chi-Squared Table associated with our alpha risk, sample size (8), degrees of freedom (7):

$$\textit{Confidence Interval for Standard Deviation}: \sqrt{\frac{(n-1)s^2}{X^2_{1-\alpha/2}}} < \sigma < \sqrt{\frac{(n-1)s^2}{X^2_{\alpha/2}}}$$

$$X^2_{\alpha/2} = X^2_{.20/2} = X^2_{.10}$$

$$X^2_{1-\alpha/2} = X^2_{1-.20/2} = X^2_{1-.10} = X^2_{.90}$$

$$X^2_{.90,7} = 12.017 \qquad \& \qquad X^2_{.10,7} = 2.833$$

Now we can complete the equation using these chi-squared values along with the sample size, and sample standard deviation to calculate our interval.

$$\textit{Confidence Interval for Standard Deviation}: \sqrt{\frac{(n-1)s^2}{X^2_{1-\alpha/2}}} < \sigma < \sqrt{\frac{(n-1)s^2}{X^2_{\alpha/2}}}$$

$$\sqrt{\frac{(8-1)1.5^2}{12.017}} < \sigma < \sqrt{\frac{(8-1)1.5^2}{2.833}}$$

$$1.145 < \sigma < 2.358$$

32. **You've surveyed 500 individuals from your city to determine how many of them will be voting for a certain candidate in an upcoming election, 265 said they would.**

**Find the 95% confidence interval for the population proportion who will vote for your candidate.**

- **0.486 < p < 0.574**
- ~~0.482 < p < 0.578~~
- ~~0.448 < p < 0.612~~
- ~~0.517 < p < 0.543~~

First we can calculate the **sample proportion, p** using **n = 500, and 265 "yes" votes**:

$$Sample\ Proportion: p = \frac{265}{500} = 0.530$$

Then we can look up our Z-score at the 5% alpha risk: $Z_{\frac{\alpha}{2}} = Z_{\frac{0.05}{2}} = Z_{.025} = 1.96$

$$Confidence\ Interval\ (Proportion): p \pm Z_{\frac{\alpha}{2}}\sqrt{\frac{p*(1-p)}{n}}$$

$$Confidence\ Interval: 0.530 \pm 1.96\sqrt{\frac{0.530*(1-0.530)}{500}}$$

$$Confidence\ Interval: 0.530 \pm 1.96\sqrt{.02232}$$

$$Confidence\ Interval: 0.530 \pm 0.044$$

$$Confidence\ Interval\ for\ Population\ Proportion: 0.486 < p < 0.574$$

33. **You've surveyed 100 individuals from your organization to see how many of them would say they are "satisfied" with the current management team. 43 said yes.**

    **Find the 90% confidence interval for the true population proportion.**

- ~~0.430 ± 0.049~~
- ~~0.430 ± 0.097~~
- **0.430 ± 0.082**
- ~~0.430 ± 0.053~~

First we can calculate the **sample proportion, p** using **n = 100,** and the number of "Yes" votes (43):

$$\boldsymbol{Sample\ Proportion: p = \frac{43}{100} = 0.430}$$

Then we can look up our Z-score at the 10% alpha risk: $\boldsymbol{Z_{\frac{\alpha}{2}} = Z_{\frac{0.10}{2}} = Z_{.050} = 1.65}$

$$\boldsymbol{Confidence\ Interval\ (Proportion): p \pm Z_{\frac{\alpha}{2}}\sqrt{\frac{p*(1-p)}{n}}}$$

$$\boldsymbol{Confidence\ Interval: 0.430 \pm 1.65\sqrt{\frac{0.430*(1-0.430)}{100}}}$$

$$\boldsymbol{Confidence\ Interval: 0.430 \pm 1.65\sqrt{.0025}}$$

$$\boldsymbol{Confidence\ Interval: 0.430 \pm 0.082}$$

34. **You've sampled 20 units from the last production lot and found that 3 of them are non-conforming.**

    **Find the 95% confidence interval for the true population proportion of defective products.**

- ~~0.070 < p < 0.229~~
- **0.000 < p < 0.306**
- ~~-0.006 < p < 0.306~~
- ~~0.018 < p < 0.282~~

First we can calculate the sample proportion, p using n = 20, and the number of non-conformances (3):

$$\textit{Sample Proportion}: p = \frac{3}{20} = 0.150$$

**Then we can look up our Z-score at the 5% alpha risk:** $Z_{\frac{\alpha}{2}} = Z_{\frac{0.05}{2}} = Z_{.025} = 1.96$

$$\textit{Confidence Interval (Proportion)}: p \pm Z_{\frac{\alpha}{2}}\sqrt{\frac{p*(1-p)}{n}}$$

$$\textit{Confidence Interval}: 0.150 \pm 1.96\sqrt{\frac{0.150*(1-0.150)}{20}}$$

$$\textit{Confidence Interval}: 0.150 \pm 1.96\sqrt{.0064}$$

$$\textit{Confidence Interval}: 0.150 \pm 0.156$$

$$\textit{Confidence Interval for Population Proportion}: 0.000 < p < 0.306$$

**The negative value for the lower side of the confidence interval is adjusted to zero as it is impossible to have a negative proportion of defects.**

**35. You've sampled 100 units from the last production lot and found that 8 of them are non-conforming.**

**Find the 90% confidence interval for the true population proportion of defective products.**

- ~~0.080 ± 0.047~~
- ~~0.080 ± 0.049~~
- ~~0.080 ± 0.053~~
- **0.080 ± 0.045**

First we can calculate the **sample proportion, p** using **n = 100**, and the **number of non-conformances (8)**:

$$\textit{Sample Proportion}: p = \frac{8}{100} = 0.080$$

Then we can look up our Z-score at the 10% alpha risk: $Z_{\frac{\alpha}{2}} = Z_{\frac{0.10}{2}} = Z_{.050} = 1.65$

$$\textit{Confidence Interval (Proportion)}: p \pm Z_{\frac{\alpha}{2}}\sqrt{\frac{p*(1-p)}{n}}$$

$$\textit{Confidence Interval}: 0.080 \pm 1.65\sqrt{\frac{0.080*(1-0.080)}{100}}$$

$$\textit{Confidence Interval}: 0.080 \pm 1.65\sqrt{.000736}$$

$$\textit{Confidence Interval}: 0.080 \pm 0.045$$