QUESTIONS:

1. **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?**
   - t-crit = 2.131
   - t-crit = 2.145
   - t-crit = 1.753
   - t-crit = 1.761

2. **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?**
   - t-crit = 3.747
   - t-crit = 4.604
   - t-crit = 4.541
   - t-crit = 5.841

3. **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?**
   - t-crit = 1.833
   - t-crit = 1.383
   - t-crit = 1.812
   - t-crit = 1.372

4. **What is the critical z-value associated with a 2-sided confidence interval that's associated with a 10% alpha risk?**
   - z-score = 1.29
   - z-score = 1.96
   - z-score = 1.78
   - z-score = 1.65

5. **What is the critical z-value associated with a 2-sided confidence interval that's associated with a 1% alpha risk?**
   - z-score = 2.58
   - z-score = 2.33
   - z-score = 1.96
   - z-score = 3.09

6. **What is the critical z-value associated with a 2-sided confidence interval that's associated with a 20% alpha risk?**
   - z-score = 1.28
   - z-score = 1.65
   - z-score = 1.72
   - z-score = 1.34

7. **For a sample size of 10, and a 2-sided confidence interval, identify the appropriate upper-tail chi-squared critical values associated with a 5% alpha risk.**
   - Upper-tail chi-squared = 21.666
   - Upper-tail chi-squared = 19.023
   - Upper-tail chi-squared = 20.483
   - Upper-tail chi-squared = 16.919

8. **For a sample size of 4, and a 2-sided confidence interval, identify the appropriate lower-tail chi-squared critical values associated with a 20% alpha risk.**
   - lower-tail chi-squared = 1.064
   - lower-tail chi-squared = 0.584
   - lower-tail chi-squared = 0.115
   - lower-tail chi-squared = 0.024

9. **For a sample size of 16, and a 2-sided confidence interval, identify the appropriate lower-tail chi-squared critical values associated with a 10% alpha risk.**
   - lower-tail chi-squared = 8.547
   - lower-tail chi-squared = 7.962
   - lower-tail chi-squared = 7.261
   - lower-tail chi-squared = 6.671

10. **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 $\pm$ 0.219
    - 6.75 $\pm$ 1.470
    - 6.75 $\pm$ 0.024
    - 6.75 $\pm$ 0.189

11. **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

12. **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.**
    - 16.5 ± 1.00
    - 16.5 ± 1.03
    - 16.5 ± 1.20
    - 16.5 ± 0.36

13. **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

14. **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.**
    - $0.688 < \sigma < 1.825$
    - $0.768 < \sigma < 1.734$
    - $0.729 < \sigma < 1.645$
    - $0.532 < \sigma < 2.706$

15. **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.**
    - $0.086 < \sigma < 0.397$
    - $0.285 < \sigma < 0.598$
    - $0.303 < \sigma < 0.653$
    - $0.293 < \sigma < 0.630$

16. **You've measured 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.**
    - $1.224 < \sigma < 2.521$
    - $1.145 < \sigma < 2.358$
    - $1.086 < \sigma < 2.124$
    - $1.310 < \sigma < 5.559$

17. 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.

- $0.486 < p < 0.574$
- $0.482 < p < 0.578$
- $0.448 < p < 0.612$
- $0.517 < p < 0.543$

18. 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

19. 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.

- $0.070 < p < 0.229$
- $0.000 < p < 0.306$
- $-0.006 < p < 0.306$
- $0.018 < p < 0.282$

20. 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

SOLUTIONS:

1. **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?**
   - 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 the Student T's Distribution at Various Degrees of Freedom and Alpha Levels (α)

df (v)	α = 0.1	α = 0.05	α = 0.025	α = 0.01	α = 0.005	α = 0.001
1	3.078	6.314	12.706	31.821	63.657	318.309
2	1.886	2.920	4.303	6.965	9.925	22.327
3	1.638	2.353	3.182	4.541	5.841	10.215
4	1.533	2.132	2.776	3.747	4.604	7.173
5	1.476	2.015	2.571	3.365	4.032	5.893
6	1.440	1.943	2.447	3.143	3.707	5.208
7	1.415	1.895	2.365	2.998	3.499	4.785
8	1.397	1.860	2.306	2.896	3.355	4.501
9	1.383	1.833	2.262	2.821	3.250	4.297
10	1.372	1.812	2.228	2.764	3.169	4.144
11	1.363	1.796	2.201	2.718	3.106	4.025
12	1.356	1.782	2.179	2.681	3.055	3.930
13	1.350	1.771	2.160	2.650	3.012	3.852
14	1.345	1.761	2.145	2.624	2.977	3.787
15	1.341	1.753	2.131	2.602	2.947	3.733

2. **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?**
   - 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 the Student T's Distribution at Various Degrees of Freedom and Alpha Levels (α)

df (v)	α = 0.1	α = 0.05	α = 0.025	α = 0.01	α = 0.005	α = 0.001
1	3.078	6.314	12.706	31.821	63.657	318.309
2	1.886	2.920	4.303	6.965	9.925	22.327
3	1.638	2.353	3.182	4.541	5.841	10.215
4	1.533	2.132	2.776	3.747	4.604	7.173

3. 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?

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

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.

Critical Values of the Student T's Distribution at Various Degrees of Freedom and Alpha Levels (α)

df (v)	α = 0.1	α = 0.05	α = 0.025	α = 0.01	α = 0.005	α = 0.001
1	3.078	6.314	12.706	31.821	63.657	318.309
2	1.886	2.920	4.303	6.965	9.925	22.327
3	1.638	2.353	3.182	4.541	5.841	10.215
4	1.533	2.132	2.776	3.747	4.604	7.173
5	1.476	2.015	2.571	3.365	4.032	5.893
6	1.440	1.943	2.447	3.143	3.707	5.208
7	1.415	1.895	2.365	2.998	3.499	4.785
8	1.397	1.860	2.306	2.896	3.355	4.501
9	1.383	1.833	2.262	2.821	3.250	4.297
10	1.372	1.812	2.228	2.764	3.169	4.144

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

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

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	0.08	0.09
0.0	0.00000	0.00399	0.00798	0.01197	0.01595	[illegible]	0.02392	0.02790	0.03188	0.03586
0.1	0.03983	0.04380	0.04776	0.05172	0.05567	[illegible]	0.06356	0.06749	0.07142	0.07535
0.2	0.07926	0.08317	0.08706	0.09095	0.09483	[illegible]	0.10257	0.10642	0.11026	0.11409
0.3	0.11791	0.12172	0.12552	0.12930	0.13307	[illegible]	0.14058	0.14431	0.14803	0.15173
0.4	0.15542	0.15910	0.16276	0.16640	0.17003	[illegible]	0.17724	0.18082	0.18439	0.18793
0.5	0.19146	0.19497	0.19847	0.20194	0.20540	[illegible]	0.21226	0.21566	0.21904	0.22240
0.6	0.22575	0.22907	0.23237	0.23565	0.23891	[illegible]	0.24537	0.24857	0.25175	0.25490
0.7	0.25804	0.26115	0.26424	0.26730	0.27035	[illegible]	0.27637	0.27935	0.28230	0.28524
0.8	0.28814	0.29103	0.29389	0.29673	0.29955	[illegible]	0.30511	0.30785	0.31057	0.31327
0.9	0.31594	0.31859	0.32121	0.32381	0.32639	[illegible]	0.33147	0.33398	0.33646	0.33891
1.0	0.34134	0.34375	0.34614	0.34849	0.35083	[illegible]	0.35543	0.35769	0.35993	0.36214
1.1	0.36433	0.36650	0.36864	0.37076	0.37286	[illegible]	0.37698	0.37900	0.38100	0.38298
1.2	0.38493	0.38686	0.38877	0.39065	0.39251	[illegible]	0.39617	0.39796	0.39973	0.40147
1.3	0.40320	0.40490	0.40658	0.40824	0.40988	[illegible]	0.41309	0.41466	0.41621	0.41774
1.4	0.41924	0.42073	0.42220	0.42364	0.42507	[illegible]	0.42785	0.42922	0.43056	0.43189
1.5	0.43319	0.43448	0.43574	0.43699	0.43822	[illegible]	0.44062	0.44179	0.44295	0.44408
1.6	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.45053	0.45154	0.45254	0.45352	0.45449
1.7	0.45543	0.45637	0.45728	0.45818	0.45907	0.45994	0.46080	0.46164	0.46246	0.46327
1.8	0.46407	0.46485	0.46562	0.46638	0.46712	0.46784	0.46856	0.46926	0.46995	0.47062

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

- **z-score = 2.58**
- z-score = 2.33
- 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	0.03188	0.03586
0.1	0.03983	0.04380	0.04776	0.05172	0.05567	0.05962	0.06356	0.06749	0.07142	0.07535
2.2	0.48610	0.48645	0.48679	0.48713	0.48745	0.48778	0.48809	0.48840	0.48870	0.48899
2.3	0.48928	0.48956	0.48983	0.49010	0.49036	0.49061	0.49086	0.49111	0.49134	0.49158
2.4	0.49180	0.49202	0.49224	0.49245	0.49266	0.49286	0.49305	0.49324	0.49343	0.49361
2.5	0.49379	0.49396	0.49413	0.49430	0.49446	0.49461	0.49477	0.49492	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
2.7	0.49653	0.49664	0.49674	0.49683	0.49693	0.49702	0.49711	0.49720	0.49728	0.49736

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

- **z-score = 1.28**
- 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 = 1.28**

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	0.03188	0.03586
0.1	0.03983	0.04380	0.04776	0.05172	0.05567	0.05962	0.06356	0.06749	0.07142	0.07535
0.2	0.07926	0.08317	0.08706	0.09095	0.09483	0.09871	0.10257	0.10642	0.11026	0.11409
0.3	0.11791	0.12172	0.12552	0.12930	0.13307	0.13683	0.14058	0.14431	0.14803	0.15173
0.4	0.15542	0.15910	0.16276	0.16640	0.17003	0.17364	0.17724	0.18082	0.18439	0.18793
0.5	0.19146	0.19497	0.19847	0.20194	0.20540	0.20884	0.21226	0.21566	0.21904	0.22240
0.6	0.22575	0.22907	0.23237	0.23565	0.23891	0.24215	0.24537	0.24857	0.25175	0.25490
0.7	0.25804	0.26115	0.26424	0.26730	0.27035	0.27337	0.27637	0.27935	0.28230	0.28524
0.8	0.28814	0.29103	0.29389	0.29673	0.29955	0.30234	0.30511	0.30785	0.31057	0.31327
0.9	0.31594	0.31859	0.32121	0.32381	0.32639	0.32894	0.33147	0.33398	0.33646	0.33891
1.0	0.34134	0.34375	0.34614	0.34849	0.35083	0.35314	0.35543	0.35769	0.35993	0.36214
1.1	0.36433	0.36650	0.36864	0.37076	0.37286	0.37493	0.37698	0.37900	0.38100	0.38298
1.2	0.38493	0.38686	0.38877	0.39065	0.39251	0.39435	0.39617	0.39796	0.39973	0.40147
1.3	0.40320	0.40490	0.40658	0.40824	0.40988	0.41149	0.41309	0.41466	0.41621	0.41774
1.4	0.41924	0.42073	0.42220	0.42364	0.42507	0.42647	0.42785	0.42922	0.43056	0.43189

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

- Upper-tail chi-squared = 21.666
- **Upper-tail chi-squared = 19.023**
- Upper-tail chi-squared = 20.483
- Upper-tail chi-squared = 16.919

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.

Right-Tail Critical Value of the Chi-Squared (X^2) Distribution

df (v)	0.900	0.950	0.975	0.990	0.995	0.999
1	2.706	3.841	5.024	6.635	7.879	10.828
2	4.605	5.991	7.378	9.210	10.597	13.816
3	6.251	7.815	9.348	11.345	12.838	16.266
4	7.779	9.488	11.143	13.277	14.860	18.467
5	9.236	11.070	12.833	15.086	16.750	20.515
6	10.645	12.592	14.449	16.812	18.548	22.458
7	12.017	14.067	16.013	18.475	20.278	24.322
8	13.362	15.507	17.535	20.090	21.955	26.124
9	14.684	16.919	19.023	21.666	23.589	27.877
10	15.987	18.307	20.483	23.209	25.188	29.588

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

- lower-tail chi-squared = 1.064
- **lower-tail chi-squared = 0.584**
- lower-tail chi-squared = 0.115
- lower-tail chi-squared = 0.024

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 lower tail is the intersection of 0.10 and 3 degrees of freedom = 0.584

Left-Tail Critical Value of the Chi-Squared (X^2) Distribution

df (v)	0.001	0.005	0.010	0.025	0.050	0.100
1	0.000	0.000	0.000	0.001	0.004	0.016
2	0.002	0.010	0.020	0.051	0.103	0.211
3	0.024	0.072	0.115	0.216	0.352	0.584
4	0.091	0.207	0.297	0.484	0.711	1.064
5	0.210	0.412	0.554	0.831	1.145	1.610

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

- lower-tail chi-squared = 8.547
- lower-tail chi-squared = 7.962
- **lower-tail chi-squared = 7.261**
- lower-tail chi-squared = 6.671

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

Left-Tail Critical Value of the Chi-Squared (X^2) Distribution

df (v)	0.001	0.005	0.010	0.025	0.050	0.100
1	0.000	0.000	0.000	0.001	0.004	0.016
2	0.002	0.010	0.020	0.051	0.103	0.211
14	3.041	4.075	4.660	5.629	6.571	7.790
15	3.483	4.601	5.229	6.262	7.261	8.547
16	3.942	5.142	5.812	6.908	7.962	9.312

10. 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 $\pm$ 0.219
- 6.75 $\pm$ 1.470
- 6.75 $\pm$ 0.024
- **6.75 $\pm$ 0.189**

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 Z-Table, we find Z = 1.96.

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

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

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

11. 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

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

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

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

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

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

12. 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 $\pm$ 1.00**
- 16.5 $\pm$ 1.03
- 16.5 $\pm$ 1.20
- 16.5 $\pm$ 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. Before we can plug this into our equation, we need to find the t-score associated with the 90% confidence interval.

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 t-distribution table at 1.895.

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

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

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

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

13. 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.

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 t-distribution table at 2.145.

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

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

$$95\%\ \textit{Confidence Interval}: 3.5 \pm 0.22$$

$$95\%\ \textit{Confidence Interval}: 3.28 - 3.72$$

14. 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

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

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

$$X^2_{\alpha/2} = X^2_{.10/2} = X^2_{.05} = 3.325$$

$$X^2_{1-\alpha/2} = X^2_{1-.10/2} = X^2_{1-.05} = X^2_{.95} = 16.919$$

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

$$0.729 < \sigma < 1.645$$

15. 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**

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

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

$$X^2_{\alpha/2} = X^2_{.05/2} = X^2_{.025,14} = 5.629$$

$$X^2_{1-\alpha/2} = X^2_{1-.05/2} = X^2_{1-.025} = X^2_{.975,14} = 26.166$$

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

$$0.293 < \sigma < 0.630$$

16. You've measured 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

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

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

$$X^2_{\alpha/2} = X^2_{.20/2} = X^2_{.10,7} = 2.833$$

$$X^2_{1-\alpha/2} = X^2_{1-.20/2} = X^2_{1-.10} = X^2_{.90,7} = 12.017$$

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

$$1.145 < \sigma < 2.358$$

17. 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**:

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

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

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

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

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

$$\textit{Confidence Interval}: 0.530 \pm 0.044$$

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

18. 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 $\pm$ 0.049
- 0.430 $\pm$ 0.097
- **0.430 $\pm$ 0.082**
- 0.430 $\pm$ 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: $\boldsymbol{Z_{\frac{\alpha}{2}} = Z_{\frac{0.10}{2}} = Z_{.050} = 1.65}$

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

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

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

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

19. 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):

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

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

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

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

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

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

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

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.

20. 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 $\pm$ 0.047
- 0.080 $\pm$ 0.049
- 0.080 $\pm$ 0.053
- **0.080 $\pm$ 0.045**

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

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

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

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

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

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

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