QUESTIONS:

1. **A/An __________________ 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.**
   - Point estimate
   - Confidence level
   - Interval estimate
   - Sample Statistic

2. **A/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.**
   - Point estimate
   - Confidence level
   - Interval estimate
   - Significant level

3. **Calculate the point estimate for the sample mean using the following 5 sample data points: 119, 121, 132, 125, 129**
   - 129
   - 125.2
   - 123.5
   - 124

4. **You're attempting to estimate the weight of the population of men in the U.S. You've sampled 2,000 men and found the mean value to be 180 lbs and the sample standard deviation to be 9 lbs. What is the standard error of the sample mean distribution?**
   - 9 lbs
   - 0.20 lbs
   - 0.07 lbs
   - 1.8 lbs

5. **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

6. **You've sampled 75 units from the latest production lot to measure the width of the product. The sample mean is 8.15in and the population standard deviation is known to be 0.92in. Calculate the 95% confidence interval for the population mean:**
   - 8.15 $\pm$ 0.920
   - 8.15 $\pm$ 0.175
   - 8.15 $\pm$ 0.106
   - 8.15 $\pm$ 0.208

7. **Calculate C_{pk} for the following Parameters: (USL = 15, LSL = 10, μ = 13, σ = 1.25)**
   - 0.53
   - 0.67
   - 0.80
   - 1.0

8. **You've sampled 15 units from the latest production lot to measure the weight of the parts. You calculate the sample mean to be 4.3lbs, and the sample standard deviation to be 0.68lbs. Calculate the 95% confidence interval for the population mean.**
   - 3.92 – 4.68
   - 3.96 – 4.64
   - 3.99 – 4.61
   - 3.62 – 4.98

9. **You're working to define the scope of your green belt project. Initially, you wanted to reduce scrap on the production line, however many different defects are occurring. You've decided to focus on the most important defect type. What tool could be used to help you focus your project?**
   - Check Sheet
   - Scatter Plot
   - Cause and Effect Diagram
   - Pareto Chart

10. **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

SOLUTIONS:

1. **A/An __________________ 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.**
    - **Point estimate**
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    - **Interval estimate**
    - Significant level

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    - 129
    - **125.2**
    - 123.5
    - 124

$$Sample\ Mean:\ \bar{X} = \frac{\sum x}{n} = \frac{119 + 121 + 132 + 125 + 129}{5} = \mathbf{125.2}$$

4. **You're attempting to estimate the weight of the population of men in the U.S. You've sampled 2,000 men and found the mean value to be 180 lbs and the sample standard deviation to be 9 lbs. What is the standard error of the sample mean distribution?**
    - 9 lbs
    - **0.20 lbs**
    - 0.07 lbs
    - 1.8 lbs

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

$$S.E. = \frac{\sigma}{\sqrt{n}} = \frac{9}{\sqrt{2000}} = \mathbf{0.20}$$

5. **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

6. **You've sampled 75 units from the latest production lot to measure the width of the product. The sample mean is 8.15in and the population standard deviation is known to be 0.92in. Calculate the 95% confidence interval for the population mean:**
    - 8.15 $\pm$ 0.920
    - 8.15 $\pm$ 0.175
    - 8.15 $\pm$ 0.106
    - **8.15 $\pm$ 0.208**

    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.

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

$$Interval\ Estimate : 8.15 \pm 1.96 * \frac{0.92}{\sqrt{75}} = \mathbf{8.15\ \pm 0.208}$$

7. Calculate Cpk for the following Parameters: (USL = 15, LSL = 10, μ = 13, σ = 1.25)

- **0.53**
- 0.67
- 0.80
- 1.0

$$C_{pk} = Min\left(C_{p,Lower}, C_{p,Upper}\right) = Min\left(\frac{USL - \tilde{x}}{3s}, \frac{\tilde{x} - LSL}{3s}\right)$$

$$C_{pk} = Min\left(\frac{15 - 13}{3 * 1.25}, \frac{13 - 10}{3 * 1.25}\right) = Min\left(\frac{2}{3.75}, \frac{3}{3.75}\right) = Min(0.53, 0.80) = \mathbf{0.53}$$

8. You've sampled 15 units from the latest production lot to measure the weight of the parts. You calculate the sample mean to be 4.3lbs, and the sample standard deviation to be 0.68lbs. Calculate the 95% confidence interval for the population mean.

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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.

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

$$95\%\ Confidence\ Interval: 4.3 \pm 2.145 * \frac{0.68}{\sqrt{15}}$$

$$95\%\ Confidence\ Interval: 4.3 \pm 0.38$$

$$95\%\ Confidence\ Interval: \mathbf{3.92 - 4.68}$$

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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

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**.