Stat Support Activity: T-score Critical Values

Notes on Critical Value T-scores:

- The T-scores and T-distributions were invented by William S. Gossett through his work with the Guinness Brewing Company. Guinness did not allow William to publish his work, so he published under the pseudonym "Student". That is why the T-curves are often called the "Student T Distribution".
- A critical value T-score (T_c) is used to calculate margin of error for population mean average confidence intervals. They are also used in mean average hypothesis tests.
- Like critical value Z-scores, a critical value T-score (T_c) also counts the number of standard errors corresponding to 90%, 95% and 99% confidence levels.
- Critical Value T-scores have a built-in error correction for quantitative data with smaller sample sizes. Each T-score is different and based on the confidence level and degrees of freedom for the data. For one quantitative data set with sample size (n), the degrees of freedom is $n - 1$.
- Generally, Z-score critical values are used when dealing with proportions from categorical data and T-scores are used when dealing with mean averages from quantitative data.

Problems: Use StatKey to calculate T-scores

1.

a) Suppose a quantitative data set has 15 numbers. If the sample size $n = 15$, what is the degrees of freedom?

b) Go to www.lock5stat.com and click on "StatKey". Under "Theoretical Distributions" click on "T". Type in the degrees of freedom you calculated above and push "OK". You will now see the T-distribution (T-curve) corresponding to that degrees of freedom. Click the button that says "Two-Tail". In the middle upper box, you will see 0.950 (95%). The two numbers at the bottom are the critical value T-scores for 95% confidence and this degree of freedom.

T-scores for 95% Confidence = ± ??? How do the T-scores compare with the famous 95% Z-scores ±1.96?

c) Now change the middle upper box to 0.9 (90%). The two numbers at the bottom are the critical value T-scores for 90% confidence and this degree of freedom.

T-scores for 90% Confidence = ± ??? How do the T-scores compare with the famous 90% Z-scores ±1.645?

d) Now change the middle upper box to 0.99 (99%). The two numbers at the bottom are the critical value T-scores for 99% confidence and this degree of freedom.

T-scores for 99% Confidence = ± ??? How do the T-scores compare with the famous 99% Z-scores ±2.576?

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2.

a) Suppose a quantitative data set has 180 numbers. If the sample size $n = 180$, what is the degrees of freedom?

b) Go to www.lock5stat.com and click on "StatKey". Under "Theoretical Distributions" click on "T". Type in the degrees of freedom you calculated above and push "OK". You will now see the T-distribution (T-curve) corresponding to that degrees of freedom. Click the button that says "Two-Tail". In the middle upper box, you will see 0.950 (95%). The two numbers at the bottom are the critical value T-scores for 95% confidence and this degree of freedom.

T-scores for 95% Confidence = ± ??? How do the T-scores compare with the famous 95% Z-scores ±1.96?

c) Now change the middle upper box to 0.9 (90%). The two numbers at the bottom are the critical value T-scores for 90% confidence and this degree of freedom.

T-scores for 90% Confidence = ± ??? How do the T-scores compare with the famous 90% Z-scores ±1.645?

d) Now change the middle upper box to 0.99 (99%). The two numbers at the bottom are the critical value T-scores for 99% confidence and this degree of freedom.

T-scores for 99% Confidence = ± ??? How do the T-scores compare with the famous 99% Z-scores ±2.576?

3.

How do the T-scores compare to the Z-scores when the sample size and degrees of freedom are small?
(Note: This gives a larger margin of error when there is less data.
Remember "Less Random Data" = "More Error".)

4.

How do the T-scores compare to the Z-scores when the sample size and degrees of freedom are larger?
(This is why some say you can only use Z-scores for quantitative data if the sample size is large. It is better to always use T-scores for mean averages with quantitative data and Z-score for proportions with categorical data.)