Population Mean: σ unknown
ID: 12388

Time required
15 minutes

Activity Overview
In this short activity, students will calculate confidence intervals to estimate the true population mean when the standard deviation of the population is not known. Students will be introduced to the t distribution.

Topic: Statistical Inference
- *t distributions*
- *normal distribution*
- *calculating confidence intervals*

Teacher Preparation and Notes
- *This can be used as a stand alone lesson on t distributions. Homework problems are included. The student worksheet is needed if students are to work individually.*
- *Self-check questions are part of the .tns file to allow students to solidify the concepts learned and to check for understanding.*
- *After completing this activity, students will be able to complete free response questions such as AP Stats 2006, Q4.*
- ***To download the student and solution TI-Nspire documents (.tns files) and student worksheet, go to education.ti.com/exchange and enter "12388" in the keyword search box.***

Associated Materials
- *PopMean_Student.doc*
- *PopMean.tns*
- *PopMean_Soln.tns*

Suggested Related Activities
To download any activity listed, go to education.ti.com/exchange and enter the number in the Keyword search box.
- *Estimating a Population Proportion (TI-Nspire technology) — 9986*
- *t Distributions (TI-Nspire technology) — 9618*

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Problem 1 – Pre-requisites

The worksheet introduces students to the assumptions needed to use the *t* distribution. Explain to them that when using the *t* distribution, degrees of freedom are used. The definition for *degrees of freedom* for a collection of sample data is the number of sample values that can vary after certain restrictions have been imposed on all data values.

Students will investigate, by graphing, the relationship between a normal distribution and the *t* distribution. They need to enter the functions by directly typing in the function entry line. Have students change the thickness of **f2(*x*)** using the **Attributes** tool. This will enable them to distinguish one graph from another as they increase *n*.

They should see that as the sample size increases the *t* distribution more closely resembles the normal distribution. This means that the estimation of the population mean is more accurate as *n* increases.

Self-check questions allow students to verify their understanding of the material, deciding which distribution is most appropriate. Discuss with students why they choose the distribution they did. For each self-check question, students should be able to justify their decision.

3 **a.** *t* distribution since *n* > 30.

    b. *t* distribution since population is normal.

    c. Normal distribution since σ is known.

    d. None of the methods learned yet since *n* < 30, it is skewed, and σ is not known

Problem 2 – Estimating the interval

On the worksheet, students are given the formula for calculating the interval and more specifically the error, *E*. They will find a 95% confidence interval where *n* = 25, $\overline{x}$ = 15, and *s* = 0.5. Step by step instructions are given on the worksheet.

After students use the **Inverse t** command to calculate the *t*-value, they should compare this value with the one found using a *t* Distribution chart.
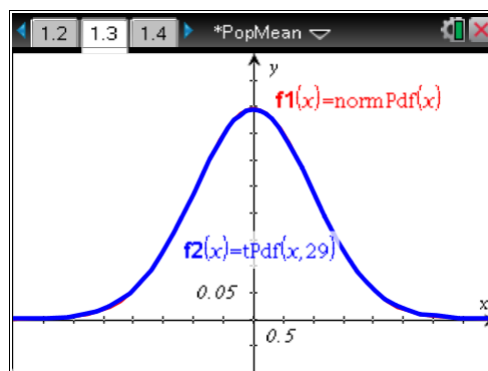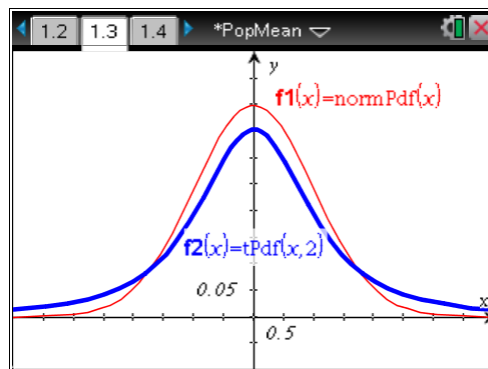
To take the absolute value of the *t*-value, students can enter the command **abs(ans)** or use the absolute value template ([◻|◻|]) and type **ans** in between the lines. Discourage students from entering the number as they see it on the previous line, since it has been rounded.

To store a number, press [ctrl] [var] followed by the letter.

After all students are finished computing the interval in Question 4, show students how to use the built-in command, **tInterval**, to find the intervals faster. On the *Calculator* page, choose **MENU > Statistics > Confidence Intervals > t Interval**. Fill in the boxes with the appropriate responses. The Data Input Method is Stats since we do not have any data with this problem.

It is important to emphasize that students need to understand under what conditions each type of confidence interval can be used. They must know the assumptions for each test.

Extension – Using Data

The data on the page 3.2 gives the normal average January minimum temperature in degrees Fahrenheit of 56 cities.

Students will use the data to construct three confidence intervals. They can use the first method from Problem 2, by finding E. For this method, they would also have to find the sample mean either using the **One-Variable Statistics** command or entering a formula in the spreadsheet. Or students can use the second method using the **t Interval** command. This time, since they are given data, they need to select **Data** for the Data Input Method.

It is obvious from looking at the results that as the percentage increases, so does the size of the interval. Why? Relate to the normal distribution curve and the percentages.

1. (23.5, 29.5)

2. (22.9, 30.1)

3. (21.7, 31.3)