The German Tank Problem

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Activity overview

Students will develop an understanding of sampling distributions by exploring the methods used to estimate the number of German tanks in existence during WWII

Concepts

Sampling distributions, bias, Central Limit Theorem, confidence intervals, p-values and significance levels.

Teacher preparation

Read Activity GermanTankover.doc

Classroom management tips

Students should be familiar with sending and receiving data before the activity.

TI-Nspire Applications

Tanks.tns
Sampdist.tns
StudentSample.tns
Mathematicians.tns
Spies.tns

Step-by-step directions

Step-by-step activity directions with screenshots, sample data, etc. as needed. Screenshots should be created using the TI-Nspire handheld and resized to 70% for best visibility.

Send ½ of the class the spies.tns file and the other ½ the class the mathematicians.tns file. Have the students work on their problem for approximately 10 minutes.

Class discussion: see GermanTanks.doc
Today we know that the actual number of tanks in the German forces was 342. Let's test our methods of estimation by creating a sampling distribution (a collection of many samples of 10 tanks from this population of 342)

Begin by creating a Spreadsheet page. Fill column one with the numbers 1 - 342 to represent our population of tanks.

Label column A popTanks. In the diamond row enter the formula: seq(x,x,1,342) to create the tank population.

	A poptanks	B	C	D
◆	=seq(x,x,1,342)			
1	1			
2	2			
3	3			
4	4			
5	5			
6	6			
7	7			
8	8			

Column B will hold the random samples. Name Column B tankSample. In the diamond row enter the formula: randsample(popTank, 10)

	A poptanks	B tanksample	C	D
◆	=seq(x,x,1,342)	=randsamp(popta		
1	1	69		
2	2	341		
3	3	117		
4	4	16		
5	5	251		
6	6	139		
7	7	177		
8	8	51		
9	9	311		
10	10	323		

The students will need to do 1 variable statistics on the sample data. Have them highlight column B: menu: Statistics: 1) stat calculations; 1)1 variable statistics.

A poptanks	B tanksample	C	D
=seq(x,x,1,342)	=randsamp(popta		=OneVar(b[],
1	69	Title	One-Varia...
2	341	$\bar{x}$	179.5
3	117	Σx	1795
4	16	Σx^2	452289
5	251	sx := sn-...	120.225
6	139	$\sigma x := \sigma_{n-1}x$	114.055
7	177	n	10
8	51	MinX	16
9	311	Q_1X	69
10	323	MedianX	158
11		Q_3X	311

The student groups should use column E to enter their method of estimation. I will use Max + Min. (Note each group should use their method of estimation from the previous activity)

Name Column E estimate. Enter = d8+ d12 in the FIRST row of Column E.

D	E
=OneVar(b[],	
One-Varia...	=d8+d12
179.5	
1795.	
452289.	

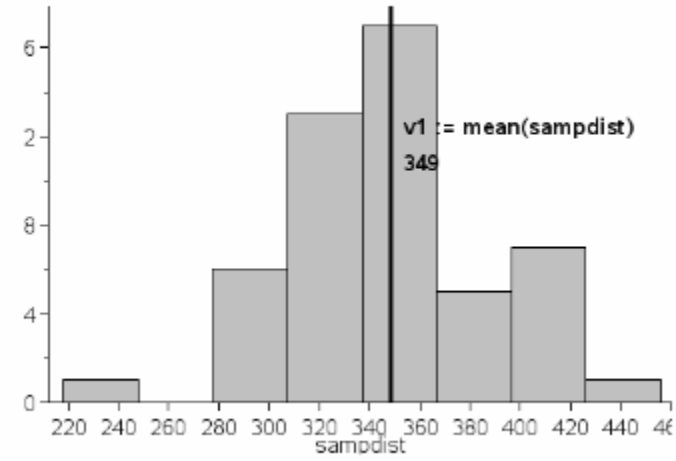
Another member of the group will enter the values into a different calculator: I prefer the student to use a TI-84 that is connected to the navigator so that we can screen capture all the histograms for comparison. If you do not have a navigator have the students use a different TInpire and enter the data into a list and spreadsheet page.

B tanksample	C	D	E
=randsamp(popta		=OneVar(b[],	
69	Title	One-Varia...	357.
341	$\bar{x}$	179.5	
117	Σx	1795.	

The students can click on the diamond row of Column B TWO TIMES and a new sample will fill the column. Make sure the recorder adds the new “estimate” into the other list and repeat 50 times. Name the list ‘sampdist’

After students collect 50 samples have them create a data and statistics page and plot the sampling distribution.

Under the tools menu choose plot value: type Mean(sampdist).



Assessment and evaluation

- *After students have completed the graphs put all the estimates on the board. If you have a navigator set up screen capture all of the histograms for comparison. This leads to a very good discussion about bias and variability.*