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Statistics Package Exercise: Calculating Confidence Intervals for μ When σ is Known

Learning Objective: Explain what a confidence interval represents and determine how changes in sample size and confidence level affect the precision of the confidence interval.

Learning Objective: Find confidence intervals for the population mean and the population proportion (when certain conditions are met), and perform sample size calculations.

The purpose of this activity is to learn how to use statistical software for calculating confidence intervals for μ (when σ is known). Software is particularly useful when all you have are the raw data (no summary has been calculated), which is what you encounter in practice. In all the examples and activities we looked at so far, the sample mean is given (rather than the whole data set), in which case it will often take you less time to calculate the confidence interval by hand than to launch a software program and ask it to do the calculation for you.

Background: Some studies suggest that women having their first baby at age 35 or older are at increased risk of having a baby with a low birth weight. A medical researcher wanted to estimate μ, the mean weight of newborns who are the first child for women over the age of 35. To this end, the researcher chose a random sample of 125 women ages 35 and older who were pregnant with their first child and followed them through the pregnancy. The datafile linked below contains the birth weight (in

grams) of the 125 newborns (women pregnant with more than one child were excluded from the study). From past research, it is assumed that the weight of newborns has a standard deviation of σ = 500 grams. We will estimate μ with a 99% confidence interval.

- R
- StatCrunch
- TI Calculator
- Minitab
- Excel

R Instructions

To open R with the data set preloaded, right-click here and choose "Save Target As" to download the file to your computer. Then find the downloaded file and double-click it to open it in R.

The data have been loaded into the data frame

```
birthweight
```

. Enter the command

```
birthweight
```

to see the data. The variable name in the data frame is also

```
birthweight
```

.

In R, there is no specific command to calculate a z-based confidence interval. We will use other functions in R to calculate the components of the confidence interval.

First, we will reassign the variable of interest to the variable name

```
x
```

.

- ```
  x=birthweight$birthweight
  ```

Now we will calculate the necessary sample statistics, such as the sample mean,

$\bar{x}$

, the sample size,
  ```

`n`

, and the

`z`

critical value:

1. Set your Confidence Level,

   `C`

   , and

   `z`

   critical value,

   `z`

   :

   - `C=0.99`
   - `z=qnorm((1+C)/2)`

2. Set your Population Standard Deviation,

   `σ`

   :

   - `σ=500`

3. Calculate the sample mean,

   `xbar`

   , and sample size,

```
n
```

:

- ```
  n=length(x)
  ```
- ```
  xbar=mean(x)
  ```

Now we can construct the confidence interval.

- Lower Bound:
- ```
  xbar-z*(σ/sqrt(n))
  ```
- Upper Bound:
- ```
  xbar+z*(σ/sqrt(n))
  ```

To calculate a confidence interval with a different confidence level, simply modify the confidence level

```
C
```

value and rerun each step of the code. To calculate a confidence interval for a new variable, simply reassign

```
x
```

and

```
σ
```

and set

```
C
```

to the appropriate confidence level and rerun each step of the code.

Learn By Doing (1/1 point)

What is the 99% confidence interval for μ? Interpret it in context.

Your Answer:

(2996.165, 3226.555)

99% of babies will have a weight between 2996.165 pounds and 3226.555 pounds.

Our Answer:
RStatCrunch TI CalculatorMinitabExcel R R gives us: Thus, we are 99% confident that the mean birth weight of first babies born to mothers who are 35 or older is between 2,996 and 3,227 grams. StatCrunch The 99% confidence interval is (2996.17, 3226.55). Thus, we are 99% confident that the mean birth weight of first babies born to mothers who are 35 or older is between 2,996 and 3,227 grams. TI Calculator If you enter: and choose CALCULATE, then press ENTER, you should see: Thus, we are 99% confident that the mean birth weight of first babies born to mothers who are 35 or older is between 2,996 and 3,227 grams. Comments: 1. Note that in the output, the TI Calculator also calculates the sample standard deviation, Sx. Even though this quantity is not needed for calculating the confidence interval, it is quite encouraging to see that the sample standard deviation is 501.32, since this means that our assumption of σ = 500 is quite reasonable. 2. When calculating the confidence interval for the population mean, the TI offers the choice of DATA or STATS. If you choose STATS, you'd see: Note that you'd enter x-bar and n rather than List: and Freq: Minitab Here is the Minitab output: Thus, we are 99% confident that the mean birth weight of first babies born to mothers who are 35 or older is between 2,996 and 3,227 grams. Comments: 1. Note that in the output, Minitab also calculates the sample standard deviation, s, (under StDev) and another quantity denoted by "SE Mean" (which we will discuss in the course shortly). Even though these quantities are not needed for calculating the confidence interval, it is quite encouraging to see that the sample standard deviation is 501.32, since this means that our assumption of σ = 500 is quite reasonable. 2. If you go back for a minute to the dialog box (Stat → Basic statistics → 1 Sample Z) you'll notice that there is also the option to give Minitab "Summarized data" instead of the raw data. (i.e., the sample size (n) and mean (x-bar)). As we mentioned earlier in this activity, in cases like these, it would be easier to simply use the formula ourselves, but it is noteworthy that the option in Minitab exists. Excel Excel tells us that the mean is 3,111, and the margin of error is 115. Thus, we are 99% confident that the mean birth weight of first babies born to mothers who are 35 or older is between 2,996 and 3,226 grams.

Resubmit Reset

Learn By Doing (1/1 point)

The mean birth weight in the general population is known to be roughly 3,450 grams. Based on this figure and the confidence interval you found in the previous question, what can you conclude?

Your Answer:

Since our sample were only of mothers who aged 35 and older when they were pregnant with their first child, their population -- i.e. mothers aged 35+ when pregnant -- will probably have a baby whose weight is below the "normal" value of 3450.

orig answer: Our sample was a bad one. (LOL that was a really shitty answer; my apologies, in case anyone is still reading this.)

Our Answer:

Since our 99% confidence interval (which provides a set of plausible values for μ) all lies below 3,450, we can conclude (with 99% certainty) that the mean birth weight of babies who are the first child born to mothers who are 35 or older is lower than the mean birth weight in the general population.

Resubmit Reset