MTH 3210 Lab 3 (Takehome)

Can be handed in Tue., Apr. 30

1 Part A: Confidence Interval for μ

1.1 Change in Blood Pressure Data Set

If a random sample is drawn from a N(μ, σ) distribution, then a $\boldsymbol{(1-\alpha)100\%}$ ***confidence interval*** for $\boldsymbol{\mu}$ is

$$\bar{X} \pm t_{\alpha/2}\frac{S}{\sqrt{n}},$$

where $\boldsymbol{t_{\alpha/2}}$ is the $\boldsymbol{(1-\alpha/2)100}$***th percentile*** of the t distribution with $n-1$ degrees of freedom.

(The confidence interval is also (approximately) valid if the sample is from a *non-normal* distribution *as long as* n *is large.*)

A study was designed to see if increased dietary calcium intake reduces blood pressure. Ten men were given a calcium supplement for 12 weeks. Blood pressure was measured before and after the twelve-week period. The changes in blood pressure for the ten subjects are below:

-7, -5, -5, -17, 8, 5, -1, -10, -11, 2

A **negative** value means the blood pressure **decreased**.

1. Use `c()` create a vector that stores the data.
2. Check the assumption that the sample is from a *normal* distribution by looking at a histogram of the data (using `hist()` after storing the data as a vector).
3. The function `qt()` will return percentiles (or *quantiles*) of a t distribution. It takes arguments:

`p`	the probability to the left of the desired t distribution percentile.
`df`	the degrees of freedom of the t distribution.

   For example, to obtain $\boldsymbol{t_{0.025}}$ (the **97.5th percentile**) from the t distribution with **nine** degrees of freedom, we type:

   ```
   qt(p = 0.975, df = 9)

   ## [1] 2.262157
   ```

   Compute the critical values $\boldsymbol{t_{0.005}}$, $\boldsymbol{t_{0.025}}$, and $\boldsymbol{t_{0.05}}$ from the t distribution with **nine** degrees of freedom.

4. The `t.test()` function takes a data vector `x` and computes a ***95% one-sample t confidence interval*** (and carries out a *one-sample t test*) for a population mean μ. Among its arguments are:

`x`	a data vector.
`alternative`	the direction for the alternative hypothesis, one of `"two.sided"`, `"less"`, or `"greater"`.
`mu`	the null hypothesized value for the unknown population mean, with default value 0.
`conf.level`	the confidence level for a confidence interval for the unknown population mean, with default value 0.95.

The optional argument, `conf.level`, can be used to change the level of confidence. For example, the **90%** confidence interval, based on data in a vector called `my.data`, would be computed by typing:

```
t.test(x = my.data, conf.level = 0.90)
```

Use `t.test()` to compute **90%**, **95%**, and **99%** confidence intervals for the true (unknown) mean change in blood pressure μ.

2 Part B: Confidence Interval for a Population Proportion p

2.1 Political Poll Results

If a random sample is from a population of *successes* and *failures*, then a $(1-\alpha)100\%$ ***confidence interval*** for the population **proportion** of successes p is

$$\hat{P} \pm z_{\alpha/2}\sqrt{\frac{\hat{P}(1-\hat{P})}{n}},$$

where $z_{\alpha/2}$ is the $(1-\alpha/2)100$***th percentile*** the N(0, 1) distribution.

(A slightly more accurate version of the CI, called the ***score CI***, is given in the textbook.)

A November 18, 2015, online CNN article had the headline ”Poll: Clinton trails GOP rivals in Colorado.”

The headline referred to a Quinnipiac poll which found that ”Dr. Ben Carson tops Democratic front-runner Hillary Clinton **52 - 38** percent in a general election matchup.”

Referring to its survey methodology, Quinnipiac states ”This RDD (Random Digital Dialing) telephone survey was conducted from November 11 - 15, 2015 throughout the state of Colorado. Responses are reported for **1,262** self-identified registered voters.”

1. The function `prop.test()` takes arguments

`x`	the number of successes in the sample.
`n`	the sample size.
`conf.level`	the confidence level for a confidence interval for the unknown population proportion, with default value 0.95.

It returns the ***sample proportion*** $\hat{P}$ along with a ***95% confidence interval for p***.

Assume that **656** (52%) of the **1,262** respondents support Carson, and use `prop.test()` to compute a ***95% confidence interval*** for the true (unknown) population **proportion** $\boldsymbol{p}$ that supports him.