STAT 3202: Homework 06

Autumn 2018, OSU

Due: Friday, October 19

Please see the **detailed homework policy document** for information about homework formatting, submission, and grading.

Exercise 1

Before it closed, Ron Swanson was a frequent patron of Charles Mulligan's Steakhouse in Indianapolis, Indiana. Ron enjoyed the experience so much, during each visit he took a picture with his steak.

Ron also weighed each steak he consumed. He has a record of eating six "22 ounce" Charles Mulligan's porterhouse steaks. Ron found that these six steaks weighed

$$22.4 \text{ oz},\ 20.8 \text{ oz},\ 21.6 \text{ oz},\ 20.2 \text{ oz},\ 21.4 \text{ oz},\ 22.0 \text{ oz}$$

Suppose that the weight of "22 ounce" Charles Mulligan's porterhouse steaks follow a $N(\mu, \sigma^2)$ distribution and that Ron's six steaks were a random sample.

Ron is suspicious of this "22 ounce" claim. Use this sample to test

$$H_0 : \mu = 22 \text{ versus } H_1 : \mu < 22$$

Report:

- The **test statistic**
- The **crictical value** when $\alpha = 0.05$.
- The **decision** when $\alpha = 0.05$.

Exercise 2

Let's hope that Exercise 1 fails to reject, and the steaks could really have a mean of 22 ounces. But how variable are they? If the variance is too high, Ron might end up with a really small steak on a particular visit.

Use the sample from Exercise 1 to test

$$H_0 : \sigma = 0.50 \text{ versus } H_1 : \sigma > 0.50$$

Report:

- The **test statistic**
- The **crictical value** when $\alpha = 0.01$.
- The **decision** when $\alpha = 0.01$.

Exercise 3

Last year, ballots in Champaign-Urbana contained the following question to assess public opinion on an issue:

> "Should the State of Illinois legalize and regulate the sale and use of marijuana in a similar fashion as the State of Colorado?"

Suppose that we would like to understand Champaign-Urbana's 2017 opinion on marijuana legalization. To satisfy our curiosity, we obtain a random sample of 120 Champaign-Urbanians and find that 87 support marijuana legalization.

Calculate the **p-value** of the test

$$H_0 : p = 0.70 \text{ versus } H_1 : p > 0.70$$

where p is the true proportion of Champaign-Urbanians that support marijuana legalization.

Do this two ways:

- Using the approximate large-sample z procedure seen in class.
- Using an exact test.

For the exact test, calculate the probability of seeing as many supporters as observed, or more, assuming the null hypothesis is true. (Hint: Use a binomial distribution. Also, consider doing the calculation in `R`.)

Exercise 4

Last year, ballots in Champaign-Urbana contained the following question to assess public opinion on an issue:

> "Should the State of Illinois legalize and regulate the sale and use of marijuana in a similar fashion as the State of Colorado?"

Suppose we obtain a random sample of 80 Champaign voters, of which 55 support marijuana legalization. We also obtain a random sample of 100 Urbana voters, of which 75 support marijuana legalization. Let p_C be the true proportion of Champaign voters who support marijuana legalization and let p_U be the true proportion of Urbana voters who support marijuana legalization.

Perform a test of

$$H_0 : p_U = p_C \text{ versus } H_1 : p_U \neq p_C$$

Report:

- The **test statistic**
- The **p-value**
- The **decision** when $\alpha = 0.05$.

Exercise 5

On January 18, 2015, Clete Blakeman measured the pressure in pounds per square inch (PSI) of 15 footballs during halftime of the AFC Championship game. Of these footballs, 11 were a sample from the New England Patriots. The remaining 4 were a sample from the Indianapolis Colts. The data follows:

```
pats  = c(11.50, 10.85, 11.15, 10.70, 11.10, 11.60, 11.85, 11.10, 10.95, 10.50, 10.90)
colts = c(12.70, 12.75, 12.50, 12.55)
```

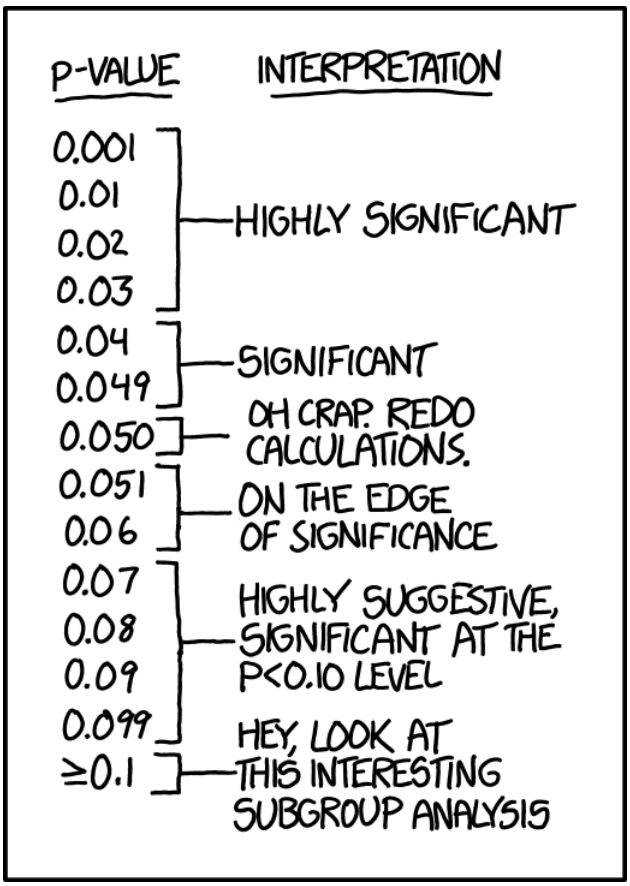
Assume these are both random samples from a normal distribution with equal variances. Use this data to test:

$$H_0 : \mu_P = \mu_C \text{ versus } H_1 : \mu_P \neq \mu_C$$

where μ_P is the mean PSI of the Patriot's footballs and μ_C is the mean PSI of the Colt's footballs.

Report:

- The **test statistic**
- The **p-value**
  - You'll need to use `R` for this calculation. In particular, the `pt()` function.
  - The result will be really, really small because the Patriot's are dirty cheaters!! OK, I shouldn't be so certain. Also this analysis is a little simplified. For actual details, see the Wells Report. (Note that the report contains text messages that use some not so pleasant language.)
- The **decision** when $\alpha = 0.01$.


P-VALUE
INTERPRETATION
0.001
0.01
0.02
0.03
HIGHLY SIGNIFICANT
0.04
0.049
SIGNIFICANT
0.050
OH CRAP. REDO CALCULATIONS.
0.051
0.06
ON THE EDGE OF SIGNIFICANCE
0.07
0.08
0.09
0.099
HIGHLY SUGGESTIVE, SIGNIFICANT AT THE P<0.10 LEVEL
≥0.1
HEY, LOOK AT THIS INTERESTING SUBGROUP ANALYSIS