Psych 315, Winter 2021, Homework 9 Answer Key

Due Friday, March 5th at midnight (PST)

Name ______________________________ ID ____________________

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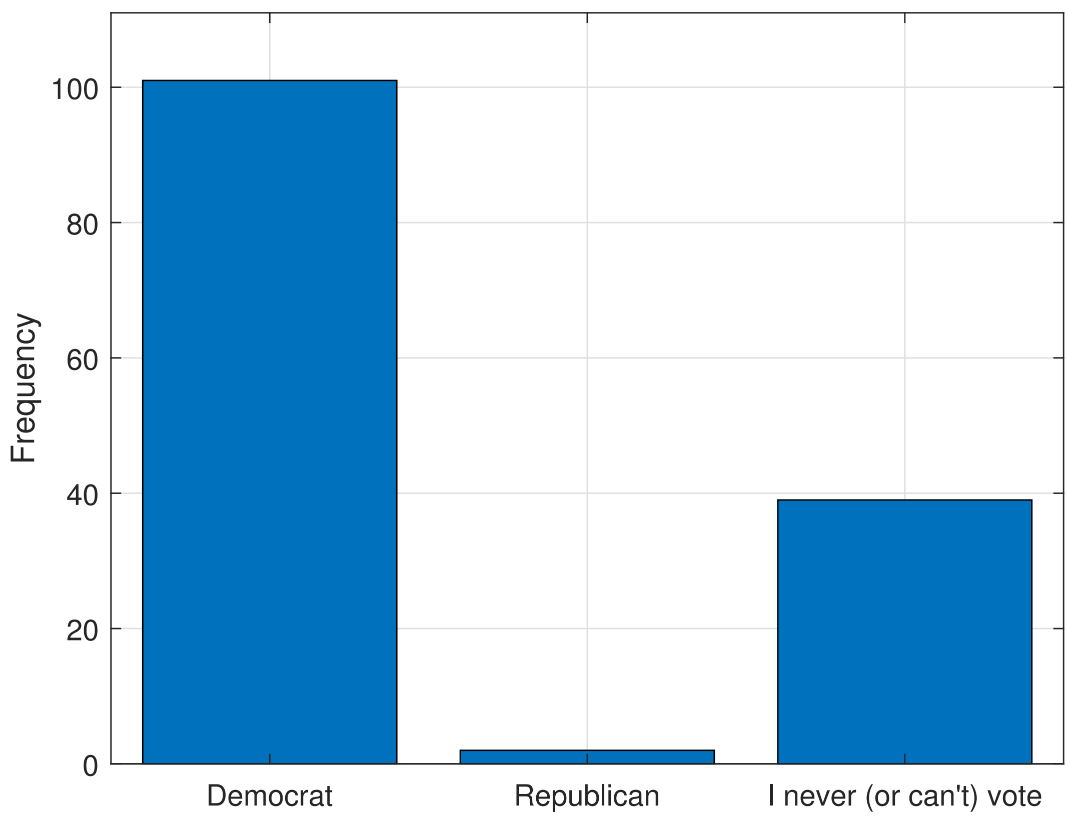
Problem 1: Assume that 50% of the US population votes. Of those who vote, 50% vote Democrat and 50% vote Republican. From our survey, 39 report that they do not (or cannot) vote. Of the students who do vote, 101 students vote Democrat and 2 students vote Republican. Are these observed frequencies significantly different from what you'd expect from a random sample from the US population? We'll run a χ^2 test on frequencies using $\alpha = 0.01$.

a) Make bar graph showing these frequencies:



b) Calculate the expected frequencies for those who vote "Democrat", "Republican" and "I never (or can't) vote".

There are a total of 101 + 2 + 39 = 142 students.
We'd expect 0.25 x 142 = 35.5 to vote Democrat
0.25 x 142 = 35.5 to vote Republican
and 0.5 x 142 = 71 not to vote.

c) Calculate the χ^2 statistic using:

$$\chi^2 = \sum \frac{(fo - fe)^2}{fe}$$

$$\chi 2 = \frac{(101-35.5)^2}{35.5} + \frac{(2-35.5)^2}{35.5} + \frac{(39-71)^2}{71} =$$

$120.8521 + 31.6127 + 14.4225 = 166.8873$

d) Use table I to find the critical value of χ^2

df = (3-1) = 2

$\chi^2_{crit} = 9.21$

e) Make your decision and state your conclusion using APA format

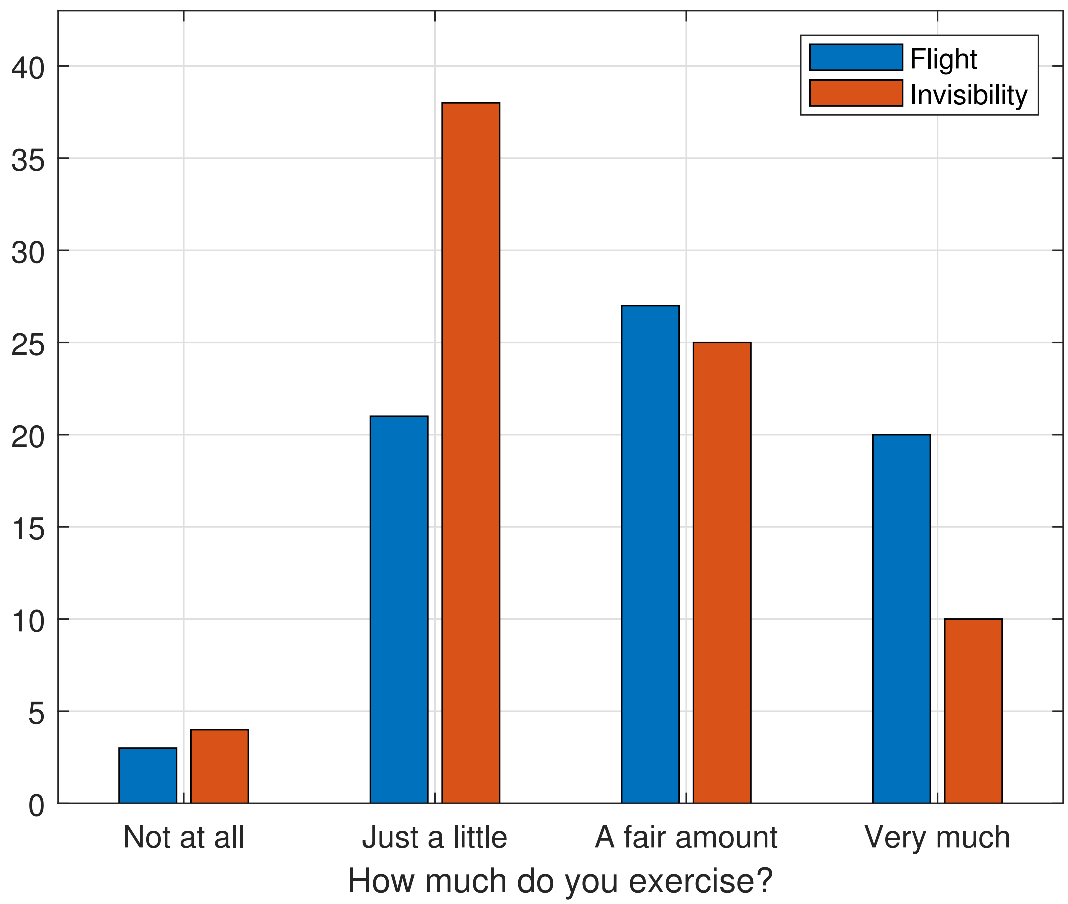
Our observed value of $\chi^2 = 166.89$ is greater than the critical value of 9.21. We reject H_0. The distribution of voting preference in our class is significantly different from the U.S. population, χ^2(2, N=142) = 166.89, $p < 0.01$.

Problem 2 Of the 148 students in our class, the following table shows how much you exercise compared to your choice of superpower.

observed frequencies				
	Not at all	Just a little	A fair amount	Very much
Flight	3	21	27	20
Invisibility	4	38	25	10

We'll use a $\chi 2$ test for independence with $\alpha = 0.05$ to determine if your choice of superpower (flight vs. invisibility) varies with how much exercise you get.

a) Make a bar graph of the observed frequencies



b) Calculate the rows and column sums and the expected frequencies for the null hypothesis

Sums and expected frequencies					
	Not at all	Just a little	A fair amount	Very much	sum
Flight	$\frac{(71)(7)}{148} = 3.3581$	$\frac{(71)(59)}{148} = 28.3041$	$\frac{(71)(52)}{148} = 24.9459$	$\frac{(71)(30)}{148} = 14.3919$	71
Invisibility	$\frac{(77)(7)}{148} = 3.6419$	$\frac{(77)(59)}{148} = 30.6959$	$\frac{(77)(52)}{148} = 27.0541$	$\frac{(77)(30)}{148} = 15.6081$	77
sum	7	59	52	30	148

c) Calculate the χ^2 statistic.

$$\chi 2 = \frac{(3-3.3581)^2}{3.3581} + \frac{(4-3.6419)^2}{3.6419} + \frac{(21-28.3041)^2}{28.3041} + \frac{(38-30.6959)^2}{30.6959} + \frac{(27-24.9459)^2}{24.9459} + \frac{(25-27.0541)^2}{27.0541} + \frac{(20-14.3919)^2}{14.3919} + \frac{(10-15.6081)^2}{15.6081} =$$

$0.0382 + 0.0352 + 1.8849 + 1.738 + 0.1691 + 0.156 + 2.1853 + 2.015 = 8.2217$

d) Use table I to find the critical value of χ^2

df = (2-1)(4-1) = 3

for $\alpha = 0.05$, $\chi^2_{crit} = 7.81$

e) Use the χ^2 calculator in the excel spreadsheet to find the p-value for this test. Make your decision and state your conclusion using APA format.

Our observed value of χ^2 is 8.2217 which is greater than the critical value of 7.81.
We reject H_0.
Your choice of superpower does vary with how much exercise you get,
χ^2(3, N=148) = 8.2217, p = 0.0416.

Problem 3 Use R's 'chisq.test' function on the survey data to conduct the hypothesis test from problem 1. Voter preferences can be found in the field 'vote', and you'll need to pull out just the three categories of 'Democrat' (#1), 'Republican' (#5) and 'I never (or can't) vote' (#2).

Hint: for an example on running chi-squared tests for frequencies see Chi2TestFrequencies.R

```
# HW9_problem3.R
#
# Load in the survey data
survey <-read.csv("http://www.courses.washington.edu/psy315/datasets/Psych315W21survey.csv")
# Make table of voter preferences
fo <- table(survey$vote)  # observed frequencies
# Restrict the table (fo) to Democrats, Republicans, and those who can't vote
fo <- fo[c(1,5,2)]
fe <- c(.25,.25,.5)  # expected frequencies
# run the chi-squared test:
out <- chisq.test(fo,p=fe)
# The chi-squared statistic is:
out$statistic
X-squared
 166.8873

# The degrees of freedom is:
out$parameter
df
 2

# And the p-value is:
out$p.value
[1] 5.766045e-37

# Writing in APA format can be done like this:
sprintf('Chi-Squared(%d,N=%d) = %5.2f, p = %0.20f',out$parameter,sum(fo),out$statistic,out$p.value)
[1] "Chi-Squared(2,N=142) = 166.89, p = 0.00000000000000000000"
```