Practice Problems for Chapter 8

OpenIntro P.202 #5.15,5.17,5.25; P.214 #6.1,6.5,6.13; P.259 #7.3,7.7

Course Pack P.271 #10.1,10.3; P.302 #10.55,10.57,10.59; P.293 #10.19,10.21,10.23

1. Highway safety engineers test new road signs, hoping that increased reflectivity will make them more visible to drivers. Volunteers drive through a test course with several of the new- and old-style signs and rate which kind shows up the best.

   (a) Is this a one-tailed or two-tailed test? Why? State your hypotheses (in words).

   (b) What is an type I error in this context?

   (c) What is a type II error in this context?

   (d) In this context, what is meant by the power of the test?

2. Determine whether each statement is true or false. If the statement is false, explain why.

   (a) No error is committed when the null hypothesis is rejected.

   (b) When one is conducting a t test for means, the population must be approximately normally distributed.

   (c) The larger the p-value, the stronger the evidence against the null hypothesis.

   (d) The $p - value$ is the probability that the null hypothesis is true.

   (e) A confidence interval for mean μ is computed to be 10 ± 4. This means that there is a 95% probability that μ is between 6 and 14.

   (f) The significance level α is the probability of a Type I error. We reject H_o when the $p - value$ is less than α.

3. (a) Will a 99% confidence interval have a larger or smaller margin of error than a 95% confidence interval calculated from the same data? Explain.

   (b) What happens to a confidence interval if the sample size increases?

   (c) A statistical test is significant at the 5% level. Are such results sometimes, always, or never significant at the 10% level? What about the 1% level? Explain.

   (d) When the value of α is increased, what happens to the probability of committing a type I error?

   (e) When the value of α is increased, what happens to the probability of committing a type II error?

   (f) In hypothesis testing, why can't the hypothesis be proved true?

   (g) Define the p-value, power, and significance level of a test.

4. The hospitalization rate for people who are involved in crashes in midsize cars not equipped with airbags is 7.3%. In a study of airbag effectiveness, it was found that in 905 crashes of midsize cars equipped with airbags, 50 of the crashes resulted in hospitalization of the drivers. At $\alpha = 0.05$ is there enough evidence to suggest that the proportion of hospitalizations is lower than 7.3% for cars equipped with airbags? Choose the p-value from the list below

   (a) 0.20 (b) 0.02 (c) 0.04 (d) 0.08

5. A major credit card company is planning a new offer for their current cardholders. The offer will give double airline miles on purchases for the next six months if the cardholder goes online and registers for the offer. To test effectiveness of the campaign, the company sent out offers to a random sample of 50000 cardholders. Of those, 1184 registered. If the acceptance rate is only 2% or less, the campaign won't be worth the expense. At $\alpha = 0.05$ is the proportion of registrants high enough to start using the new campaign? Use the R output below to find the approximate statistic and p-value to back up your conclusion.

```
> prop.test(1184,50000,p=0.02,alternative="greater")

1-sample proportions test with continuity correction

data:  1184 out of 50000, null probability 0.02
X-squared = 34.359, df = 1, p-value = 2.291e-09
alternative hypothesis: true p is greater than 0.02
95 percent confidence interval:
0.02257725 1.00000000
sample estimates:
p
0.02368
```

6. A survey in an agricultural newsletter reported that 90% of adults drink milk. To verify this, a regional farmers' organization planning a new marketing campaign polls a random sample of 750 adults in the county, of which 657 said that they drink milk. Based on this data, is there evidence at $\alpha = 0.1$ that the value reported in the newsletter was incorrect? Justify your answer using a hypothesis test and confidence interval. You may choose the p-value from the list below.

   (a) 0.016 (b) 0.028 (c) 0.14 (d) 0.54

7. In a rural area, only about 30% of the wells that are drilled find adequate water at a depth of 100m or less. A local man claims to be able to find water by "dowsing" - using a forked stuck to indicate where the well should be drilled. You check with 80 of his customers and find that 27 have wells less than 100m deep. At $\alpha = 0.05$ is there evidence that the the dowsing method is effective? Calculate the p-value using the list below.

```
> pnorm(|statistic|)
[1] 0.7673049
> pt(|statistic|,df)
[1] 0.7662253
```

8. A hypothesis test of $H_o : \mu = 25$ vs $H_a : \mu > 25$ yielded a p-value of 0.0357. Explain in plain language what this result means.

9. In any test of hypothesis, to reject the null hypothesis is to:

   (a) be absolutely certain that the null hypothesis is false.

   (b) be absolutely certain that the null hypothesis is true.

   (c) find significant probabilistic evidence in support of the alternative hypothesis.

   (d) find significant probabilistic evidence in support of the rejection region.

10. A football coach claims that the average weight of all opposing team members is 102 kg. To test the claim, a sample of 50 players is taken from all opposing teams. The mean is found to be 104 kg and standard deviation is 7 kg. Test the coach's claim at $\alpha = 5\%$. (Calculate the p-value using the list below).

```
> pnorm(|statistic|)
[1] 0.9783083
> pt(|statistic|,df)
[1] 0.9755657
```

11. Consumer reports tested several brands of vanilla yogurt and recorded the calories per serving. Use the R output below to answer the following questions. You may assume the data are normally distributed (shown in chapter 7 practice problems). For the mean of calories, identify the hypotheses tested, statistic, and p-value. Then use the p-value to draw conclusions in the context of the problem.

```
> t.test(yogurt,mu=100,alternative="greater")
One Sample t-test

data:  yogurt
t = 4.8374, df = 13, p-value = 0.0001622
alternative hypothesis: true mean is greater than 100
95 percent confidence interval:
136.6759      Inf
sample estimates:
mean of x
157.8571
```