Economics 30330: Statistics for Economics
Problem Set 8
University of Notre Dame
Instructor: Julio Garín
Spring 2012

Due Date: Beginning of class on Wednesday, May 2nd. Please complete the assignment in the allotted space. You may work in groups, but you need to turn in your own work.

Hypothesis Testing (80 Points)

1. Consider the following hypothesis test:

$$H_0 : \mu \geq 20$$

$$H_0 : \mu < 20$$

A sample of 40 provided a sample mean of 19.4. The population standard deviation is 2.

(a) Create a 95% confidence interval for the mean.

(b) What is the p-value?

(c) At $\alpha = 0.01$, what is your conclusion?

(d) What is the rejection rule using the critical value? What is your conclusion?

2. Consider the following hypothesis test:

$$H_0 : \mu = 15$$

$$H_0 : \mu \neq 15$$

A sample of 50 provided a sample mean of 14.5. The population standard deviation is 3.

(a) Create a 95% confidence interval for the mean.

(b) What is the p-value?

(c) At $\alpha = 0.01$, what is your conclusion?

(d) What is the rejection rule using the critical value? What is your conclusion?

3. Wall Street securities firms paid out record year-end bonuses of $125,000 per employee for 2005 (*Fortune*, February 6, 2006). Suppose we would like to take a sample of employees at the Garín & Munnich securities firm to see whether the mean year-end bonus is different from the reported mean of $125,000 for the population.

   (a) State the null and alternative hypotheses you would use to test whether the year-end bonuses paid by Garín & Munnich were different from the population mean.

   (b) Suppose a sample of 40 Garín & Munnich employees showed a sample mean year-end bonus of $118,000. Assume a population standard deviation of $30,000 and compute the p-value.

   (c) With $\alpha = 0.05$ as the level of significance, what is your conclusion?

   (d) Repeat the preceding hypothesis test using the critical value.

4. During the 2004 election year, new polling results were reported daily. In an IBD/TIPP poll of 910 adults, 503 respondents reported that they were optimistic about the national outlook, and President Bush's leadership index jumped 4.7 points to 55.3 (*Investor's Business Daily* January 14, 2004).

   (a) What is the sample proportion of respondents who are optimistic about the national outlook?

   (b) A campaign manager wants to claim that this poll indicates that the majority of adults are optimistic about the national outlook. Construct a hypothesis test so that the rejection of the null hypothesis will permit the conclusion that the proportion optimistic is greater than 50%.

   (c) Compute the p-value and explain to the manager what it means about the level of significance of the results.

5. In a survey of 1,200 high school seniors in 1992, 27% answered yes to the question: Have you smoked at least one cigarette in the past 30 days? In a 1997 survey of 1100 students, 35% answered yes to the same question.

   (a) Construct a 95% confidence interval for the change in the fraction of high school seniors who smoke.

   (b) Using a t-test, test null hypothesis that the fraction of high school seniors who smoked in the past 30 days has not changed over the 1992-1997 period.

6. Listed below are sample characteristics from a 1987 survey that examines average hourly wage rates for union and non-union workers.

   - Nonunion: $\bar{x}_n = 11.47; \quad n_n = 1206; \quad s_n = 6.58$
   - Union: $\bar{x}_u = 12.19; \quad n_u = 376; \quad s_u = 4.77$:

   (a) What is the average difference in hourly wages between union and nonunion workers?

   (b) Construct a 95% confidence interval around this difference.

   (c) Test the null hypothesis that there is no difference in wages across the two groups.

7. In a survey of 700 undergraduates (350 females and 350 males), 48% of males reported an episode of binge drinking in the past year (five or more drinks in a row on one occasion), whereas only 40% of females reported binge drinking.

   (a) What is the point estimate of the difference between the two population proportions?

   (b) Construct a 95% confidence interval on the difference in binge drinking rates between males and females.

   (c) Can you reject the null hypothesis that at the 95% confidence level males and females have the same binge drinking rates?

   (d) How does your answer change if you increase the confidence interval to 99%?

(e) What are the types of errors you can commit in this particular example? Explain.

(f) What is the p-value for this example?

8. Economists Joe Price and Justin Wolfers studied discrimination among NBA referees in a recent paper and argued that more personal fouls were awarded against players when they are officiated by an opposite-race officiating crew than when officiated by an own-race refereeing crew.[1] Specifically, using a sample of 266,984 observations, they find that a player earns 0.197 fewer fouls per 48 minutes played when facing three referees of his own race than when facing three opposite race referees. In other words, $\hat{\beta}_1 = .197$, with a standard error of 0.061, as shown in row 1, column 1 of Table 4 (see next page). [2]

(a) What is $\hat{\beta}_1$ measuring?

(b) What is the null hypothesis that the authors are testing? (Write out the equations and explain in your words).

(c) Using the estimate of $\hat{\beta}_1$ and its standard error, create a 95% confidence interval for $\hat{\beta}_1$. (Note that the number of observations is listed in the footnote of the table).

(d) What is the p-value?

(e) At $\alpha = 0.01$, what is your conclusion about discrimination among NBA referees?

[1] The paper is available at http://bpp.wharton.upenn.edu/jwolfers/Papers/NBARace.pdf.
[2] For now, just ignore the stars in the table.

TABLE IV

EFFECTS OF OPPOSITE-RACE REFEREES ON FOUL RATES

	Dependent variable: foul rate (= 48 × fouls/minutes) (mean = 4.43; SD = 3.34)		
Independent variables	(1)	(2)	(3)
Black player × %white refs	0.197**	0.203**	0.181**
	(0.061)	(0.072)	(0.080)
	Control variables		
Age	−0.728***	−0.729***	
	(0.047)	(0.049)	
All-Star	−0.383***	−0.429***	
	(0.026)	(0.063)	
Starting five	−0.988**	−1.004**	−0.775***
	(0.016)	(0.040)	(0.044)
Home team	−0.125***	−0.213***	
	(0.012)	(0.033)	
Attendance (1,000s)	0.008***	0.004	
	(0.002)	(0.005)	
Out of contention	−0.127**	−0.136*	
	(0.027)	(0.071)	
Black coach	−0.107***	−0.080**	
	(0.017)	(0.040)	
R^2	.18	.18	.28
	Other controls		
Referee, year, and player fixed effects	√	√	√
Player characteristics × %white refs		√	√
Full set of fixed effects			√