NORTHWESTERN UNIVERSITY | SCHOOL OF CONTINUING STUDIES

Handout: Problem Set #4

PREDICT 401: Introduction to Statistical Analysis

1. You are doing an analysis of nurses' salaries in Illinois and want to know whether the average salary of Illinois' nurses is more than $35,000. You select a random sample of 100 Illinois nurses and find an average salary of $38,300 with a standard deviation of $3,000. Test your hypothesis at the .05 level. Be explicit in your work and go through the steps required to test a hypothesis. Drawing pictures would help.

2. The Department of Social Services wishes to evaluate the effect of a new system for handling reported cases of child abuse. Under the old system, it took an average of 15 days for a caseworker to be assigned and to visit the home after someone called in a case of abuse. In a random sample of 50 reported cases of abuse under the new system, the average response time was 13.5 days with a sample standard deviation of 7.0 days. Can we reject the null hypothesis at the .05 level that the new system has not changed response times? Be explicit in your work and go through the steps required to test a hypothesis. Drawing pictures would help.

3. You are the director of research at a large high school. The superintendent asks that you quickly let him know whether the students in the school are outperforming a state mandated cutoff point for standardized test scores.

   a. It would take too long to compile data on all students in your school, so you randomly select 100 students' scores. Their mean is 3 points higher than the cutoff. The standard deviation of their scores is 8 points. You want to be 99% sure of what you tell the superintendent. What do you tell him? Again, show all your work.

   b. What would your answer be if you had been able to randomly select only 25 students (with the same mean and standard deviation as the 100 in part (a))? Make sure to show evidence. Explain why your answer differs/does not differ from your answer in part (a) for a non-statistician audience.

4. You are the parent of a high school boy who wants to be admitted into an Ivy League college. However, to do so, you think that he will need to improve his SAT scores. You like one particular course, called SAT-up. But, before

spending the $1,000 fee for the course, you want evidence that it actually works. You ask the facilitator for SAT-up for the average gain for students in the course. (Here, "gain" = practice SAT score after course minus practice SAT score before the course.) The facilitator says that they don't keep such extensive data, but that they do have gain data for a group of randomly selected students. They give you the data for 100 randomly selected students, which are:

Gain score	% of students
- 100	10
- 50	5
0	15
50	20
100	30
150	15
200	5

a. What is the mean gain of this 100-person sample?

b. What is the standard deviation of gain of this 100-person sample?

c. What is the 90% confidence interval of the gain for students who take the class?

d. What is the 95% confidence interval of the gain for students who take the class?

e. For kids who take the program, do you think that their post-program scores are greater than their pre-program scores? Why/why not?

You are discussing SAT prep courses with another parent who says, "You know, you can get practice tests for free. And research has shown that the average student gains 50 points just by taking practice tests."

f. Assuming that the conclusion of this research that the parent mentions is correct, do you think the program is effective? Would you enroll your child? Explain your answers.

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