Inferences Based on Two Samples

1. Exposure to dust at work can lead to lung disease later in life. One study measured the workplace exposure of tunnel construction workers. Part of the study compared 115 drill and blast workers with 220 outdoor concrete workers. Total dust exposure was measured in milligram years per cubic meter ($mg.y/m^3$). This part of the study aims to see if there is a difference in the dust exposure between these two groups of workers.

a. Determine the appropriate test statistics to use and specify its distribution.

b. Formulate the appropriate null and alternative hypotheses.

c. If the mean exposure for the drill and blast workers was 18.0 $mg.y/m^3$ with a standard deviation of 7.8 $mg.y/m^3$ and for the outdoor concrete workers, the corresponding values were 6.5 $mg.y/m^3$ and 3.4 $mg.y/m^3$, test the null hypothesis $H_0 : \mu_1 = \mu_2$ versus the alternative hypothesis you specified in part (b) using $\alpha = 0.01$

d. Construct a 99% confidence interval for $\mu_1 - \mu_2$.

2. Does increasing the amount of calcium in our diet reduce blood pressure? A randomized comparative experiment gave one group of 10 men a calcium supplement for 12 weeks. The control group of 11 men received a placebo that appeared identical to the calcium supplement. The experiment was double-blind. The table below gives the <u>decrease</u> in the blood pressure for each subject.

Calcium	7	-4	18	17	-3	-5	1	10	11	-2	
Placebo	-1	12	-1	-3	3	-5	5	2	-11	-1	-3

a. Assume $\sigma_1 = \sigma_2$.

i. Determine the appropriate test statistics to use and specify its distribution.

ii. Construct and interpret the 95% confidence interval for the true mean difference between the test scores for the new method and the standard method.

iii. Formulate the appropriate null and alternative hypotheses.

iv. Conduct a complete test of significance using $\alpha = 0.05$.

b. Assume $\sigma_1 \neq \sigma_2$.

i. Determine the appropriate test statistics to use and specify its distribution.

ii. Construct and interpret the 95% confidence interval for the true mean difference between the test scores for the new method and the standard method.

iii. Formulate the appropriate null and alternative hypotheses.

iv. Conduct a complete test of significance using $\alpha = 0.05$.

3. To determine the effectiveness of an industrial safety program, the following data was collected (over a period of one year) on the average weekly loss of worker-hours due to accidents in 12 plants "before and after" the program was put into operations.

Plants	1	2	3	4	5	6	7	8	9	10	11	12
Before	37	45	12	72	54	34	26	13	39	125	79	26
After	28	46	18	59	43	29	24	15	35	120	75	24

a. Explain why the standard two-sample independent t-test is not appropriate for this study. How can we use this data? [4]

b. Formulate the most appropriate null and alternative hypotheses to test whether the safety program is effective. [3]

c. Specify the appropriate test statistic for this analysis. What is its distribution? [4]

d. Using a level of significance of $\alpha = 0.05$, define your rejection rule. [3]

e. Does the data provide sufficient evidence to say that the safety program is effective? Provide all necessary results to support your answer. [5]

4. In a winter of an epidemic flu, babies were surveyed by a well-known pharmaceutical company to determine if the company's new medicine was effective after two days. Among 120 babies who had the flu and were given the medicine, 29 were cured within two days. Among 280 babies who had the flu but were not given the medicine, 56 were cured within two days.

a. Formulate the most appropriate null and alternative hypotheses. Define clearly the parameters you use in your hypotheses. [4]

b. Specify the most appropriate test statistic and define your rejection rule using a level of significance of $\alpha = 0.05$. [4]

c. Test the company's claim of the effectiveness of the medicine. Write a practical conclusion. [9]

d. Compute the p-value of this sample. [5]

e. Construct and interpret a 99% confidence interval for $(p_1 - p_2)$. [9]

Homework problems:

1. Due Monday, 4/14/08
Sec 9.2: (pp. 447-453) # 5, 6, 7, 10, 12, 14.
Supp.: (pp. 499-507) # 105.

2. Due Tuesday, 4/15/08
Sec 9.3: (pp. 464-468) # 36, 37, 41.
Sec 9.4: (pp. 476-479) # 54, 55, 57, 59, 60.
Supp.: (pp. 499-507) # 108, 109, 123.