

**STATISTICS 641 - ASSIGNMENT 9**

**DUE DATE: NOON, WEDNESDAY, April 29**

Name \_\_\_\_\_

Email Address \_\_\_\_\_

**Make this cover sheet the first page of your Solutions.**

## STATISTICS 641 - ASSIGNMENT 9

- Due Wednesday, April 29, 2015 at Noon
- Read Handout 13 and Chapters 8, 9, 14.2 in the Textbook

- (P1) (8 points) In each of the following studies, state whether the study uses an independent samples or a matched pairs design:
- (S1) In an evaluation of the efficiency of algorithms, two algorithms are evaluated in terms of CPU times required to complete the same six test problems.
  - (S2) A survey is conducted of 16 year old students from inner city public schools and suburban public schools to compare the proportion who had experimented with marijuana.
  - (S3) A psychologist designs a study to assess whether a visual or audio stimulus produces a more rapid response. A group of 250 undergraduates are randomly assigned to the order in which they are exposed to the two stimuli, audio then visual or vice versa. The response times to the stimuli are then recorded.
  - (S4) The effect of two types of viruses on tobacco leaves was studied by rubbing a preparation containing one of the viruses onto a different half of each of 8 tobacco leavers. The number of lesions counted on the two halves of these leavers were recorded.
- (P2) (12 points) An experiment is run to study the effects of PCB, an industrial contaminant, on the reproductive ability of owls. The shell thickness (mm) of eggs produced by 10 owls exposed to PCB are compared to the shell thickness of eggs produced by 10 owls which did not have PCB exposures.

Owl	1	2	3	4	5	6	7	8	9	10
PCB-Exposed:	3.6	3.2	3.8	3.6	4.1	3.8	4.2	3.4	3.7	3.8
UnExposed:	4.3	4.4	3.6	3.5	4.4	3.5	3.4	3.6	4.1	4.3

- (A) Is there significant( $\alpha = .05$ ) evidence that the PCB exposed owls have thinner egg shells than those of the unexposed owls? Use a t-test in reaching your conclusion and report the p-value.
- (B) Compute the chance that your test committed a Type II error for the following values of  $\theta = \mu_{exposed} - \mu_{unexposed} = 0, -.5\sigma, -\sigma, -1.5\sigma, -2\sigma$ .
- (C) In designing a new study, the researchers want to determine the necessary sample sizes for exposed and unexposed owls such that an  $\alpha = .05$  test will have power of at least 80% to detect a shell thickness difference of more than 0.3 mm. The researchers want to examine three times as many exposed owls as unexposed owls, that is,  $m=3n$ .
- (D) Is there significant( $\alpha = .05$ ) evidence that the PCB exposed owls have thinner egg shells than those of the unexposed owls? Use a Wilcoxon test in reaching your conclusion and report the p-value.
- (E) Is there significant( $\alpha = .05$ ) evidence that the PCB exposed owls have greater variability in egg shell thickness than those of the unexposed owls? Report the p-value of your test.
- (F) Which test, t-test or Wilcoxon, is more appropriate for testing the difference in egg shell thickness?

- (P3) (8 points) In a study of the effect of vitamin B on learning, 12 pairs of children were matched on IQ, age, size, and general health. Within each pair, one child was randomly selected to receive a vitamin B table every day and the other child received a placebo tablet. The following table shows the change in IQ score over the six months of the study.

Pair	1	2	3	4	5	6	7	8	9	10	11	12
Vitamin B	14	26	2	4	-5	14	3	-1	1	6	3	4
Placebo	8	18	-7	-1	2	9	0	-4	13	3	3	3

Is there substantial evidence that a six months treatment with vitamin B increased IQ score? Use  $\alpha = .05$  in applying both the t-test and the Wilcoxon signed rank test for these hypotheses. Which test produces the most reliable conclusion?

- (P4) (10 points) A study evaluated the urinary-thromboglobulin excretion in 12 normal and 12 diabetic patients. The excretions were summarized with a value of 20 or less labeled as "Low" and values above 20 as "High".

	Excretion	
	Low	High
Normal	10	2
Diabetic	4	8

- (A) Set up hypotheses to assess whether there is substantial evidence of a difference in the urinary-thromboglobulin excretion between normal and diabetic patients.  
 (B) At the  $\alpha = .05$  level what can you conclude? Report a p-value for your test.

- (P5) (10 points) A study was conducted to compare two topical anesthetic drugs for use in dentistry. The two drugs were applied on the oral mucous membrane of the two sides of each patient's mouth and after a fixed period of time it was recorded whether or not the membrane remained anesthetized. Data from the 45 patients is recorded below:

		Drug 2 Response	
		Anesthetized	Not Anesthetized
Drug 1	Anesthetized	15	13
Response	Not Anesthetized	3	14

- A. Set up hypotheses to assess whether there is substantial evidence of a difference between the two drugs.  
 B. At the  $\alpha = .05$  level what can you conclude? Report a p-value for your test.

- (P6) (10 points) A genetics experiment on the characteristics of tomato plants provided the following data on the number of offspring expression four phenotypes.

Phenotype	Tall, cut-leaf	Dwarf, cut-leaf	Tall, potato-leaf	Dwarf, potato-leaf	Total
Frequency	926	293	288	104	1611

The researcher wants to determine if there is substantial evidence that the tomato plants deviate from the current theory that the four phenotypes will appear in the proportion 9:3:3:1. Use  $\alpha = .01$ .

- (P7) (20 points) A company is attempting to automate the determination of the amount of the active ingredient, chlorphanimine maleate, in the tablets it produces. Two labs were asked to make 20 determinations on a composite sample which had a nominal dosage level of 4 milligrams. The purpose of the experiment was to study the consistency between labs and the variability of the determination procedure within labs. The data is given in the following table.

	Day									
	1	2	3	4	5	6	7	8	9	10
Lab 1	4.13	4.07	4.04	4.07	4.05	4.04	4.02	4.06	4.10	3.86
Lab 2	3.88	4.02	4.01	4.01	4.04	3.99	4.03	3.97	3.98	4.02

  

	Day									
	11	12	13	14	15	16	17	18	19	20
Lab 1	3.85	4.08	4.11	4.08	4.01	4.02	4.04	3.97	4.00	4.04
Lab 2	3.88	3.91	3.95	3.92	3.97	3.92	3.90	3.89	3.97	3.95

- (A) Do the readings from the labs appear to have a normal distribution? Justify your answer.
- (B) Do the readings from the two labs appear to have the same level of variability? Justify your answer.
- (C) Do the daily determinations within each lab appear to be correlated? Justify your answer.
- (D) Do the readings from the two labs appear to have different average determinations? Justify your answer.
- (E) Provide 95% confidence intervals on the average determinations for both labs.
- (P8) (10 points) A study was conducted to investigate whether there is a relationship between tonsil size and carriers of a particular bacterium, *Streptococcus pyrogenes*. The following table contains the results from 1398 children.

Tonsil Size	Carrier Status		Row
	Carrier	Noncarrier	Total
Normal	19	497	516
Large	29	560	589
Very Large	24	269	293
Column Total	72	1326	1398

Is there significant evidence that tonsil size and carrier status are associated? Use  $\alpha = .05$ .

- (P9) (12 points) The following table gives the racial characteristics of 326 individuals convicted of homicide and whether or not they received the death penalty. Social scientists were interested in the relationship between Defendant's Race and the probability that the defendant would receive the Death Penalty. A possible confounding variable is the Race of the homicide victim

	Victim's Race			
	White		Black	
	Death Penalty		Death Penalty	
	Yes	No	Yes	No
Defendant's Race				
White	19	132	0	9
Black	11	52	6	97

- (A) Test whether there is significant evidence that frequency of receiving the Death Penalty is related to Defendant's Race ignoring the Victim's Race. Use  $\alpha = .05$ .
- (B) For each category of Victim's Race, test whether there is significant evidence that frequency of receiving the Death Penalty is related to Defendant's Race. Use  $\alpha = .05$ .
- (C) Test whether there is significant evidence that frequency of receiving the Death Penalty is related to Defendant's Race after adjusting for the Victim's Race. Use  $\alpha = .05$ .
- (D) Compare your three conclusions and comment on the differences.