

---

## STAT 110 B, Probability & Statistics for Engineers II UCLA Statistics, Spring 2003

[http://www.stat.ucla.edu/~dinov/courses\\_students.html](http://www.stat.ucla.edu/~dinov/courses_students.html)

---

### HOMEWORK 5

**Due Date: Friday, June 06, 2003, turn in after lecture**

Correct solutions to any six problems carry full credit. See the [HW submission rules](#). On the front page include the [following header](#). You may want to use the online [SOCR resources](#) to complete this assignment.

---

- (HW\_5\_1) [Sec. 10.1, #9] Six samples of each of four types of cereal grain grown in a certain region were analyzed to determine *thiamin content*, resulting in the following data (measured in  $\mu\text{g/g}$ ):

Wheat	5.2	4.5	6.0	6.1	6.7	5.8
Barley	6.5	8.0	6.1	7.5	5.9	5.6
Maize	5.8	4.7	6.4	4.9	6.0	5.2
Oats	8.3	6.1	7.8	7.0	5.5	7.2

- (a) Does the data suggest that at least two of the grains differ with respect to the true average thiamin content? Use  $\alpha = 0.05$  level of significance. Interpret your results.
- (b) What assumptions about the data are made? Do these assumptions seem reasonable here?
- 

- (HW\_5\_2) A first-order linear regression model with 5 explanatory variables was fit to a data set of 29 observations. Complete the following ANOVA table. Interpret the  $p$ -value.

SOURCE	DF	SS	MS	F	p
Regression	___	_____	10	_____	_____
Error	___	20	_____		
Total	___	_____			

- (HW\_5\_3) The article *A Mixed Model Factorial Experiment in Testing Electrical Connectors* in the 1960 volume of the journal *Industrial Quality Control* reported the results of an experiment to assess the effect of the angle of pull on the force required to cause separation in electrical connectors. Four different angles were used and each of five connectors was pulled once at each angle. The forces required are given in the following table:

Angle \ Connector	1	2	3	4	5	Total
0°	45.3	42.2	39.6	36.8	45.8	209.7
2°	44.1	44.1	38.4	38.0	47.2	211.8
4°	42.7	42.7	42.6	42.2	48.9	219.1
6°	43.5	45.8	47.9	37.9	56.4	231.5
Total	175.6	174.8	168.5	154.9	198.3	872.1

- Write down an appropriate model for this experiment.
- Prepare an analysis of variance table and carry out a statistical test of the hypothesis that force required to cause separation is not influenced by angle of pull.
- Carry out a test of the hypothesis that there is no difference between the five connectors used as far as their effect on the force required is concerned.
- Determine which pairs of connectors differ by calculating and using a 5% least significant difference.

- (HW\_5\_4) [Sec. 12.2, #19] The following data is representative of that reported in an article *An Experimental Correlation of Oxides of Nitrogen Emissions from Power boilers Based on Field Data*, with X = burner area liberation rate, and Y = NO<sub>x</sub> emission rate

X	100	125	125	150	150	200	200	250	250	300	300	350	400	400
Y	150	140	180	210	190	320	280	400	430	440	390	600	610	670

- Obtain the least squares estimate of the best linear regression line.
- What is an estimate of the expected NO<sub>x</sub> emission rate when the burner area liberation = 225?
- Estimate the amount by which you expect NO<sub>x</sub> emission rate to change when burn area liberation rate is decreased by 50.
- Would you use the estimated regression line to predict emission rate for a burn area liberation of 500? Explain!

- (HW\_5\_5) [Sec. 14.1, #7] Criminologists have long debated whether there is a relationship between weather conditions and the incidence of violent crime. The article *Is There a Season for Homicide?* (Criminology, 1988, pp. 287-296) classified 1361 homicides according to season as shown in the table below.

Winter	Spring	Summer	Fall
328	334	372	327

Use a Chi-Square ( $\chi^2$ ) test to assess the claim that violent crimes occur at the same rates regardless of season. Use  $\alpha = 1\%$ .

- **(HW\_5\_6)** [Sec. 14.3, #31] A random sample of individuals who drive alone to work in a large metropolitan area was obtained, and each individual was categorized with respect to both size of car and commuting distance. Does the following data suggest that distance and size are related in the population sampled? State the appropriate hypotheses and use level of significance  $\alpha = 0.05$ .

	[0 10]	[10 20]	$\geq 20$
subcompact	6	27	19
compact	8	36	17
midsize	21	45	33
full	14	18	6

- **(HW\_5\_7)** Urinary fluoride concentration (ppm) was measured both for a sample of livestock grazing in a region previously exposed to fluoride pollution, and for a sample grazing in an unpolluted region. Data are presented below:

Polluted (Region 1)	21.3	18.7	23.0	17.1	16.8	20.9	19.7
Unpolluted (Region 2)	14.2	18.3	17.2	18.4	20.0		

Use Wilcoxon rank-sum test (non-parametric equivalent to the two independent sample T-test) to assess whether the true average fluoride concentration for livestock is larger in the polluted region.

- **(HW\_5\_8)** The following data are Nitrogen content analyses performed by two different analysts on six water samples:

Water Sample	1	2	3	4	5	6
Analyst 1	31.4	37.0	44.0	28.8	59.9	37.6
Analyst 2	28.1	37.1	40.6	27.3	58.4	38.9

Use Wilcoxon signed-rank test (non-parametric equivalent to the paired T-test) to assess if there are differences between in the Nitrogen concentrations measured by the two analysts.

- **(HW\_5\_9)** To the data below perform the non-parametric Kruskal-Wallis test, a procedure used in place of the parametric one-way ANOVA when the assumptions for the parametric procedure are

violated. Remember the original data are replaced with ranks and the test statistic is the chi-square. When the number of treatments is two, the Kruskal-Wallis is equivalent to the Wilcoxon rank sum test.

Eleven students were randomly assigned to three different types of therapy in order to reduce hostility levels. Then each students takes a test to evaluate reading comprehension. Is there evidence of a therapy effect on reading comprehension?

Therapy

1	2	3
80	70	63
92	81	76
87	78	70
83	74	