

Name _____ Student ID _____

Prince of Songkla University
Department of Industrial Engineering, Faculty of Engineering

Mid Term Examination: Semester 1
Date: 2 August 2004
Subject: 227-551 Research Methods and Research Statistics

Academic Year: 2004
Time: 13.30 – 16.30
Room: A 400

ทฤษฎีในการสอบ โทษขั้นต่ำ คือ ปรับตกในรายวิชาที่ทฤษฎี และพักการเรียนหนึ่งภาคการศึกษา

Instructions: Read carefully

1. All materials are allowed.
2. There are 5 problems, do all of them. Also show your work clearly and legibly.
3. Answer the questions in this test paper, only.
4. You must write your name and your student ID in every page of the test.
5. Total score is 100 points.

Distribution of Score

Problem	Points	(a)	(b)
1	25	-	-
2	15	-	-
3	20	15	5
4	20	10	10
5	20	-	-

Tests are prepared by
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Supapa

Problem 1: (25 points) The concentration of ingredient in a liquid detergent is thought to be affected by the type of catalyst used in the process. Ten observations of concentration are taken with each catalyst, and the data are shown below.

Sample	1	2	3	4	5	6	7	8	9	10
Catalyst 1	57.9	66.2	65.4	65.4	65.2	62.6	67.6	63.7	67.2	71.0
Catalyst 2	66.4	71.7	70.3	69.3	64.8	69.6	68.6	69.4	65.3	68.8

It is important for manager to show that there is no difference in mean concentration of ingredient in a liquid detergent by using two types of catalyst. Suppose you are an engineer in this plant, what will you do to convince your manager?



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Problem 2: (15 points) Two different analytical tests can be used to determine the impurity level in steel alloys. Eight specimens are tested using both methods, and the results are shown in the following table. Is there sufficient evidence to conclude that both tests give the same mean impurity level?

Specimen	1	2	3	4	5	6	7	8
Test 1	1.2	1.3	1.5	1.4	1.7	1.8	1.4	1.3
Test 2	1.4	1.7	1.5	1.3	2.0	2.1	1.7	1.6



Problem 3: (20 points) An experiment to determine the effect of air gaps on percentage retained strength of asphalt. For purposes of the experiment, air gaps are controlled at three levels: low (2-4%), medium (4-6%), and high (6-8%). The data are shown in the following table.

Air Gaps	Retained Strength (%)							
Low	106	90	103	90	79	88	92	95
Medium	80	69	94	91	70	83	87	83
High	78	80	62	69	76	85	69	85

- (a) Do the different levels of air gaps significantly affect mean retained strength? Use $\alpha = 0.01$.



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(b) Find the P – value for this test in part (a)?



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Problem 4: (20 points) From problem 3, do the following problems.

(a) Use Tukey's test to compare pairs of treatment mean. Use $\alpha = 0.01$.

(b) Construct a set of orthogonal contrasts and test, assuming that at the outset of the experiment you suspected the percentage retained strength of air gaps at low level to be different from the other two.



Problem 5: (20 points) An experiment was performed to determine the effect of four different chemicals on the strength of a fabric. These chemicals are used as part of the permanent press finishing process. Five fabric samples were selected. The data are shown in the following table.

Chemical type	Fabric Sample				
	1	2	3	4	5
1	1.3	1.6	0.5	1.2	1.1
2	2.2	2.4	0.4	2.0	1.8
3	1.8	1.7	0.6	1.5	1.3
4	3.9	4.4	2.0	4.1	3.4

Would you suggest what design that an experimenter should use between “completely randomized design” and “randomized complete block design”? **You have to show the reason to support your suggestion why you choose what design.**

