

Name _____ Student ID _____

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

Final Examination: Semester 1

Date: 6 October 2004

Subject: 227-551 Research Methods and Research Statistics

Academic Year: 2004

Time: 0900-1200

Room: A401

ทฤษฎีในการสอบ โทษขั้นต่ำ คือ ปรับตกในรายวิชาที่ทฤษฎี และพักการเรียนหนึ่งภาคการศึกษา

Instructions: Read carefully

1. All materials are allowed.
2. There are 4 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	20	10	10
2	25	-	-
3	30	-	-
4	25	-	-

Tests are prepared by
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Supat

Problem 1: (20 points) An experiment was run to determine whether four specific firing temperatures affect the density of a certain type of brick. The experiment led to the following data.

Temperature (Fahrenheit)	Density						
	100	21.8	21.9	21.7	21.6	21.7	21.5
125	21.7	21.4	21.5	21.5	-	-	-
150	21.9	21.8	21.8	21.6	21.5	-	-
175	21.9	21.7	21.8	21.7	21.6	21.8	-

a) Does the firing temperature affect the density of the bricks? Use $\alpha = 0.05$.

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- b) Use Duncan's multiple range test with $\alpha = 0.05$ to analyze the mean density of the four firing temperatures.

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Problem 2: (25 points) An engineer suspects that the surface finish of metal parts is influenced by the type of paint used and the drying time. He selected three drying times: 20, 25, and 30 minutes and uses six types of paint. Three parts are tested with each combination of paint type and drying time. The data are as follows.

Paint	Drying Time (min)		
	20	25	30
1	74	73	78
2	64	61	85
3	50	44	92
4	92	98	66
5	86	73	45
6	68	88	85

State and test the appropriate hypotheses using the analysis of variance with $\alpha = 0.05$.

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Problem 3: (30 points) The data shown here represent an experiment to study the compressive strength of concrete. The factors are mix(A), time(B), laboratory(C), temperature(D), and drying time(E).

$(1) = 700$	$d = 1000$	$e = 800$	$de = 1900$
$a = 900$	$ad = 1100$	$ae = 1200$	$ade = 1500$
$b = 3400$	$bd = 3000$	$be = 3500$	$bde = 4000$
$ab = 5500$	$abd = 6100$	$abe = 6200$	$abde = 6500$
$c = 600$	$cd = 800$	$ce = 600$	$cde = 1500$
$ac = 1000$	$acd = 1100$	$ace = 1200$	$acde = 2000$
$bc = 3000$	$bcd = 3300$	$bce = 3006$	$bcde = 3400$
$abc = 5300$	$abcd = 6000$	$abce = 5500$	$abcde = 6800$

Which effects appear important? Use $\alpha = 0.01$.

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Scout

Problem 4: (25 points) An chemical engineer experiments to investigate the effect of temperature, gas throughput, and concentration, on the strength of product solution. Two blocks were used with *ABC* confounded. The data are as follows.

Treatment Combination	Replicate 1	Replicate 2
(1)	99	46
<i>a</i>	18	18
<i>b</i>	51	62
<i>ab</i>	52	47
<i>c</i>	108	104
<i>ac</i>	42	22
<i>bc</i>	95	67
<i>abc</i>	35	36

Analyze the data from this experiment.

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