PRINCE OF SONGKLA UNIVERSITY
FACULTY OF ENGINEERING

Final Examination: Semester 1 Academic Year: 2005
Date: 14th October, 2005 Time: 9:00-12:00
Subject: 226-541 Research Methodology Room: R300
Instructor: Boonsiri Limsakul

ทุตจริตในการสอบ โทษขั้นต่ำปรับตกในรายวิชานั้น และพักการเรียน 1 ภาคการศึกษา

Direction

- There are 4 set of problems for this exam.
- Score for each question is as following.
  Question 1 – 20 marks
  Question 2 – 20 marks
  Question 3 – 10 marks
  Question 4 – 30 marks
- All materials, books, and calculator are allowed.
- Write your name, student ID, and department on every page of test material.

Student Name_____ Student ID_____

Question No.	Full Score	Assigned Score
1	20	
2	20	
3	10	
4	30	

ชื่อ_____ สกุล_____รหัสนักศึกษา_____ภาควิชา_____ชั้นปี____

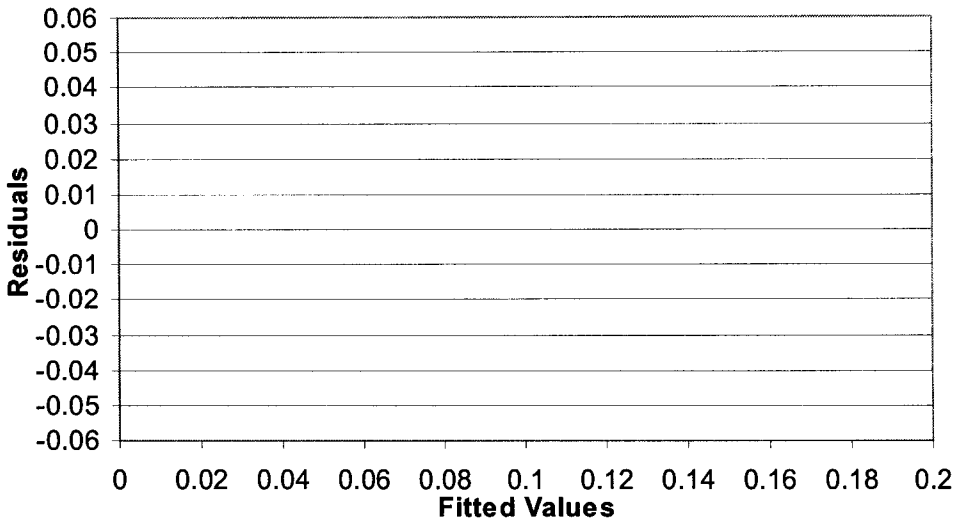
1. Four different feed rates were investigated in an experiment on a CNC machine producing a component part used in an aircraft auxiliary power unit. The manufacturing engineer in charge of experiment knows that a critical part dimension of interest may be affected by the feed rate. However, prior experience has indicated that only dispersion effected are likely to be present. That is, changing the feed rate does not affect the average dimension (in 10^{-3} mm.). The data are shown below. Assume that all runs were made in random order. Testing at $\alpha = 0.05$

Feed Rate	Production Run				
(inche/minute)	1	2	3	4	5
10	0.09	0.1	0.13	0.08	0.07
12	0.06	0.09	0.12	0.07	0.12
14	0.11	0.08	0.08	0.05	0.06
16	0.19	0.13	0.15	0.2	0.11

1.1 Does the feed rate have any effect on the standard deviation of this critical dimension?

ชื่อ_____ สกุล_____รหัสนักศึกษา_____ภาควิชา_____ชั้นปี____

1.2 Use the residuals from this experiment to investigate model adequacy. Are there any problems with experimental validity base? (Base only on residual versus fitted values).



ชื่อ_____ สกุล_____รหัสนักศึกษา_____ภาควิชา_____ชั้นปี____

2. The effective life of insulating fluids at an accelerated load of 35 kV is being studied. Test data have been obtained for four types of fluids. The results were as follows: Testing at $\alpha = 0.05$

Fluid Type	Life (in hours) at 35 kV Load				
1	17.6	18.9	16.3	17.4	20.1
2	16.9	15.3	18.6	17.1	19.5
3	21.4	23.6	19.4	18.5	20.5
4	19.3	21.1	16.9	17.5	18.3

2.1 Is there any indication that the fluids differ?

ชื่อ_____ สกุล_____รหัสนักศึกษา_____ภาควิชา_____ชั้นปี____

2.2 Using Duncan's multiple range test which fluid would you select, given that the objective is long life?

ชื่อ_____ สกุล_____รหัสนักศึกษา_____ภาควิชา_____ชั้นปี____

3. Three different washing solutions are being compared to study their effectiveness in reading bacteria growth in five-gallon milk containers. The analysis is done in a laboratory, and only three trials can be run on any day. Because days could represent a potential source of variability, the experimenter decides to use a randomized block design. Observations are taken for four days, and the data are shown below. Analyze the data and draw conclusions. Testing at $\alpha = 0.05$

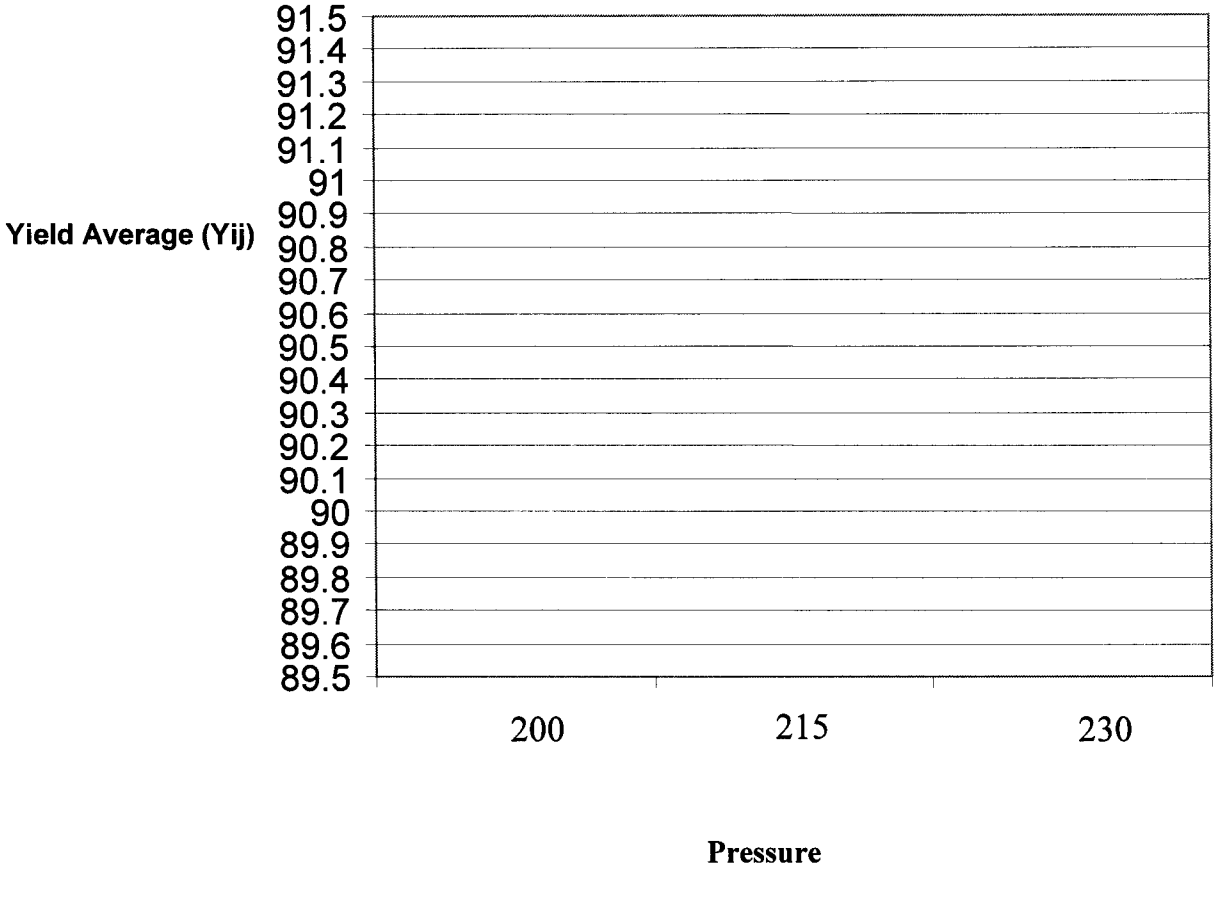
Solution	Days			
	1	2	3	4
1	13	22	18	39
2	16	24	17	44
3	5	4	1	22

4. The yield of chemical process is being studied. The two most important variables are thought to be the pressure and the temperature. Three levels of each factor are selected, and a factorial experiment with two replicates is performed. The yield data follow: Testing at $\alpha = 0.05$

Temperature	Pressure		
	200	215	230
Low	90.4	90.7	90.2
	90.2	90.6	90.4
Medium	90.1	90.5	89.9
	90.3	90.6	90.1
High	90.5	90.8	90.4
	90.7	90.9	90.1

4.1 Analyze the data and draw conclusion.

4.2 Plot average yield of both temperature and pressure for supporting/not supporting of interaction.



4.3 Under which conditions would you operate this process, if our target is to obtain the highest yield?