Name _____ Student ID _____

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

Final Examination: Semester 1	Academic Year: 2004
Date: 5 October 2004	Time: 0900-1200
Subject: 225-491 Problem Solving with Statistical Techniques	Room: R 300

ทุจริตในการสอบ โทษขั้นต่ำ คือ ปรับตกในรายวิชาที่ทุจริต 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 the answer book, 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
1	20
2	30
3	30
4	20

Tests are prepared by
Nikorn Sirivongpaisal

Problem 1: (20 points) Data below are values of the hardness of a steel product and the percentage of ingredient in the raw material used. The data were collected by measuring the hardness of the product corresponding to raw material lots.

% Ingredient	Hardness	% Ingredient	Hardness	% Ingredient	Hardness	% Ingredient	Hardness
0.52	26.2	0.76	28.7	0.45	26.2	0.18	20.1
0.58	25.4	0.40	24.6	0.38	21.9	0.21	23.5
0.66	24.2	0.24	22.4	0.67	25.4	0.45	26.4
0.18	22.7	0.94	31.0	0.37	23.6	0.93	31.8
1.00	30.0	0.94	29.8	1.03	28.4	0.70	27.2
0.71	26.9	0.90	30.3	0.29	23.9	0.41	23.3
0.87	27.0	0.52	25.1	0.70	24.5	0.40	26.4
0.36	25.3	0.45	23.5	0.58	25.1	0.65	26.4
0.62	25.6	0.73	28.4	0.59	26.5	0.63	27.1
0.73	27.3	0.28	23.6	0.20	24.1	0.87	30.5

Use appropriate tool to analyze the relationship between two different sets of data.

Problem 2: (30 points) Assume you are an engineer who is studying the effect of amount of barium to high-temperature ceramic. You conducted an experiment and collected data which are in the following table. Data represent the critical temperatures, in degrees Kelvin.

1.0% Barium	1.5% Barium	2.0% Barium	2.5% Barium
69	76	76	70
70	74	75	72
71	79	76	70
72	77	74	70

What will you conclude your study?

Problem 3: (30 points) Four factors are thought to influence the taste of a soft-drink beverage: type of sweetener (A), ratio of syrup to water (B), carbonation level (C), and temperature (D). Each factor can be run at two levels, producing a 2^4 design. At each run in the design, samples of the beverage are given to a group of testers consisting of 20 people. Each tester assigns the beverage a point score from 1 to 10. The response variable is total score and the results are shown below.

| Treatment Combination	Replicate		Treatment Combination	Replicate	
	I	II		I	II
(1)	159	163	d	164	159
a	168	175	ad	187	189
b	158	163	bd	163	159
ab	166	168	abd	185	191
c	175	178	cd	168	174
ac	179	183	acd	197	199
bc	173	168	bcd	170	174
abc	179	182	abcd	194	198

Analyze the data and draw conclusions. Use $\alpha = 0.05$.

Problem 4: (20 points) Assume you are process control engineer implementing control chart for monitoring a quality characteristic of product. Two situations on the control chart happened and are illustrated below.

Situation 1:
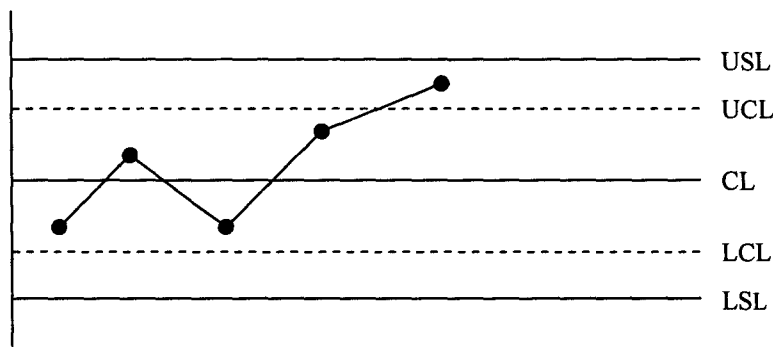
Situation 2:
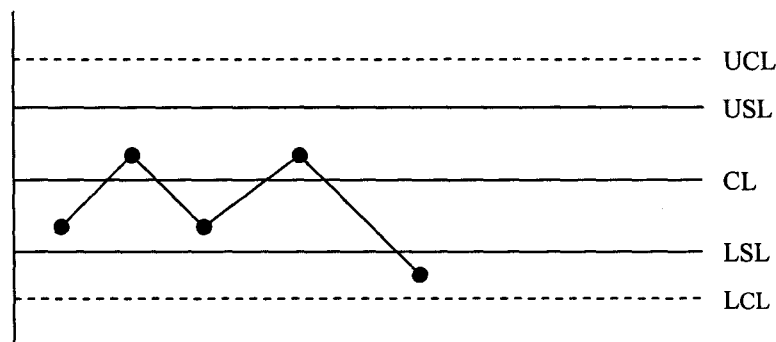
What is your decision in taking action in each situation and explain why you do that?