

學號：_____ 姓名：_____

注意事項：

1. 考試中禁止使用電子通訊產品，嚴禁作弊。
2. 計算題最終答案請四捨五入至小數點後第三位。
3. 答案寫在答案卷上，考完後連同題目卷夾在一起交回。

一、計算題 (共計 60 分)

1. (12%) **Construct a 3-sigma \bar{x} bar-chart and R-chart** for the length measurement in centimeters of parts produced based on the following table.

Table-1

Sample #	Observation 1	Observation 2	Observation 3	Observation 4
1	0.486	0.499	0.493	0.511
2	0.499	0.506	0.516	0.494
3	0.496	0.5	0.515	0.488
4	0.495	0.506	0.483	0.487
5	0.472	0.502	0.526	0.469
6	0.473	0.495	0.507	0.493
7	0.495	0.512	0.49	0.471
8	0.525	0.501	0.498	0.474
9	0.497	0.501	0.517	0.506
10	0.495	0.505	0.516	0.511

2. (6%) A metal-cutting operation has a target value of 20 and consistently averages 19.8 with a standard deviation of 0.5. The design engineers have established an upper specification limit of 22 and a lower speculation limit of 18. **What is the process capability index, C_p and C_{pk} ?**
3. The management of a line that fills cereal boxes wants the box filled at 32.2 ounces. When the process is in control, the standard deviation is 0.1 ounces.
 - (a) (5%) Construct the upper and lower control limits for a 3-sigma \bar{X} -bar chart using a sample size of five.
 - (b) (3%) The results from the last 10 samples follow. Is the process in control?

Table-2

Sample	Observation				
	1	2	3	4	5
1	32.07	32.00	32.43	32.50	32.03
2	32.21	32.09	32.17	32.33	32.32
3	32.10	32.41	32.50	32.01	32.19
4	32.20	32.05	32.05	32.08	32.18
5	32.37	32.07	32.20	32.02	32.18
6	32.28	32.26	32.17	32.08	32.41
7	32.22	32.27	32.16	32.26	32.08
8	32.37	32.29	32.07	32.29	32.04
9	32.42	32.15	32.45	32.03	32.15
10	32.03	32.19	32.05	32.35	32.14

4. (8%) The operations manager of the booking services department of Hometown Bank is concerned about the number of wrong customer account numbers recorded by his personnel. Each week a random sample of 2,500 deposits is taken, and the number of incorrect account numbers is recorded. The result for the past 12 weeks are shown in the following table-3. **Is the booking process out of statistical control?** Use three-sigma control limits, which provide a Type I error of 0.26 percent.

Table-3

Sample Number	Wrong Account Number	Sample Number	Wrong Account Number
1	15	7	24
2	12	8	7
3	19	9	10
4	2	10	17
5	19	11	15
6	4	12	3
Total 147			

5. (6%) MKS Inc., produces meter sticks that have a target length of 100 cm with upper and lower speculation limits of 100.05 and 99.95 cm respectively. There existing process produces meter sticks with an average length of 99.97 cm and a standard deviation of 0.015 cm. They are considering the purchase of a new machine that can hold a process output average exactly to target with a standard deviation of 0.02. Which machine will provide a better process capability index?

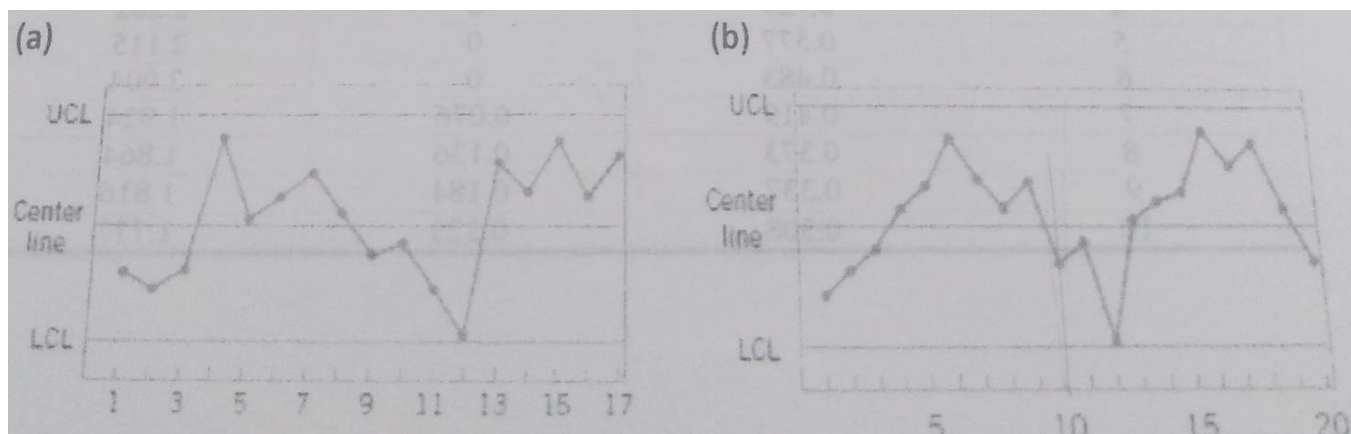
6. Janice Sanders, CEO of Pine Medical Clinic, is concerned over the number of times patients must wait more than 30 minutes beyond their scheduled appointments. She asked her assistant to take random samples of 64 patients to see how many in each sample had to wait more than 30 minutes. Each instance is considered a defect in the clinic process. The table below contains the data for 15 samples.

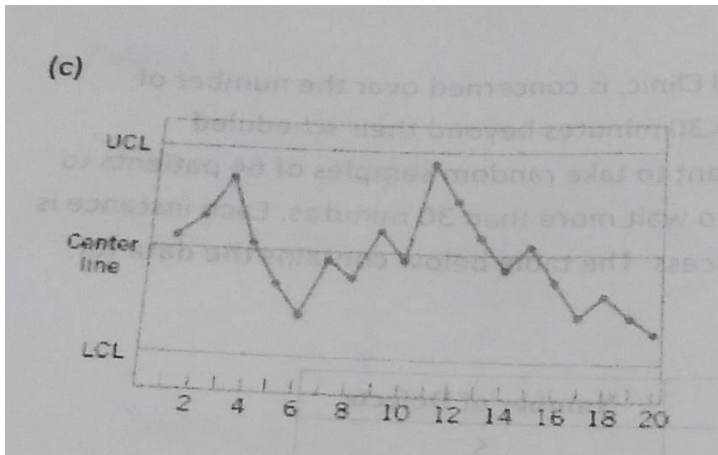
Table-4

Sample	Number of Defects
1	5
2	2
3	1
4	3
5	1
6	5
7	2
8	3
9	6
10	3
11	9
12	9
13	5
14	2
15	3

- (a) (8%) Assuming Janice Sanders is willing to use three-sigma control limits, construct a p-chart.
- (b) (3%) Based on your p-chart and the data in the table, what can you conclude about the waiting time of the patients?

7. (9%) Consider the control chart shown here. Does the pattern appear random? **Why? Give your reasons.**





Reference: Factors for Calculating Three-Sigma Limits for the Control Charts

Size of Sample	Mean Factor, A_2	Lower Range, D_3	Upper Range, D_4
2	1.880	0	3.267
3	1.023	0	2.575
4	0.729	0	2.282
5	0.577	0	2.115
6	0.483	0	2.004
7	0.419	0.076	1.924
8	0.373	0.136	1.864
9	0.337	0.184	1.816
10	0.308	0.223	1.777

品質管制參考圖表

Factors for Calculating Three-Sigma Limits for the \bar{x} Chart and R-Chart

Size of Sample (n)	Factor for UCL and LCL for \bar{x} -bar-Charts A_2	Factor for LCL for R-Charts D_3	Factor for UCL for R-Charts D_4
2	1.880	0	3.267
3	1.023	0	2.575
4	0.729	0	2.282
5	0.577	0	2.115
6	0.483	0	2.004
7	0.419	0.076	1.924
8	0.373	0.136	1.864
9	0.337	0.184	1.816
10	0.308	0.223	1.777

二、名詞解釋 + 簡答題 (5 points each, 40 points total)

1. PDSA, developed by Shewhart, stands for what?
2. What quality tools you might utilize to detect abnormality in a process? List at least three of them.
3. List the four parts of the cost of quality.
4. Please define what ISO 9000 is about.
5. List three of major criteria used by US Baldrige National Quality Program.
6. Please explain four basic process types for manufacturing operation and give each of them a real world example.
7. Which process structure (process pattern) might be the best to describe the current undergraduate required course teaching at university?
8. Please list five key success factors when we studied the Shouldice Hospital case.