
UNIVERSITI SAINS MALAYSIA

Second Semester Examination
Academic Session 2007/2008

April 2008

MSG 262 – Quality Control
[Kawalan Mutu]

Duration : 3 hours
[Masa : 3 jam]

Please check that this examination paper consists of THIRTEEN pages of printed material before you begin the examination.

[Sila pastikan bahawa kertas peperiksaan ini mengandungi TIGA BELAS muka surat yang bercetak sebelum anda memulakan peperiksaan ini.]

Instructions: Answer **all four** [4] questions.

Arahan: Jawab **semua empat** [4] soalan.]

1. (a) Write short notes on the topics below:
- (i) Quality systems
 - (ii) Root Cause Analysis
 - (iii) PDCA
 - (iv) Kaizen
 - (v) World class quality

[100 marks]

2. (a) What is Quality Control (QC)? Give two examples to illustrate the concept of QC.

[30 marks]

- (b) Recap the industrial visit to Robert Bosch Sdn. Bhd. Do you think this multinational company is serious about quality control? Justify your answer.

[30 marks]

- (c) Mr. Bachik, the leader of a QC Circle, is in charge of the production process for moulded plastic products. From March this year, they started a new production line to manufacture product XX. The process of operation for this new line was, however, different from that of the earlier ones and there were many product defects. The process of operation was also unstable and it was becoming a serious problem. Mr. Bachik's QC Circle then decided to have their project aim 'Reduce the number of defects of new product XX'. First, they carried out a survey to see how many defects there were from March 1 to March 31. They found out that there were 188 defective products out of a total production of 2,163 products. The types of defects are shown in Table 2c.

Table 2c. Types and Number of Defects and Cost per defect.

Type of Defect	No. of Defects	Cost per Defect (RM)
Swelling	13	8
Wrinkles	55	1
Chipping	23	20
Warping	20	40
Cracks	29	50
Mixing of foreign materials	41	10
Others	7	10
Total	188	-

Which SPC tool would Mr. Bachik's QC Circle use to achieve the aim of their project? What are their findings? [40 marks]

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1. (a) Tuliskan nota pendek tentang tajuk-tajuk di bawah:
- (i) Sistem Kualiti
 - (ii) Analisis Sebab Punca
 - (iii) PDCA
 - (iv) Kaizen
 - (v) Kualiti kelas dunia

[100 markah]

2. (a) Apakah Kawalan Mutu? Beri dua contoh untuk mengilustrasikan konsep Kawalan Mutu?

[30 markah]

- (b) Ingat kembali lawatan industri ke Robert Bosch Sdn. Bhd, Adakah anda berpendapat bahawa syarikat multinasional ini mementingkan kawalan mutu? Berikan alasan-alasan anda.

[30 markah]

- (c) Encik Bachik, ketua Bulatan Kawalan Mutu, bertanggungjawab untuk proses membuat produk plastik. Mulai Mac tahun ini, mereka memulakan satu baris pengeluaran baru untuk mengeluarkan produk XX. Proses operasi baris baru ini berlainan daripada baris-baris lama dan terdapat banyak produk cacat. Proses operasi juga tidak stabil dan ini menjadi masalah yang serius. Bulatan Kawalan Mutu Encik Bachik memutuskan bahawa tujuan projek mereka ialah 'mengurangkan bilangan kecacatan produk XX'. Pertama, mereka menjalankan suatu kajian untuk mengetahui bilangan kecacatan dari Mac 1 hingga Mac 31. Mereka mendapati 188 produk cacat daripada jumlah 2,163 produk. Jenis kecacatan ditunjukkan dalam Jadual 2c.

Jadual 2c. Jenis dan Bilangan Kecacatan dan Kos secacat.

Jenis Kecacatan	Bilangan Kecacatan	Kos secacat (RM)
Bengkak	13	8
Kedut-kedut	55	1
Serpihan	23	20
Ledingan	20	40
Pecah	29	50
Bahan asing tercampur	41	10
Lain-lain	7	10
Jumlah	188	-

Apakah alat SPC yang Bulatan Kawalan Mutu Encik Bachik gunakan untuk mencapai tujuan projek mereka? Apakah keputusan mereka?

[40 markah]

3. (a) What is process flow analysis? Give an example to illustrate a process flow analysis. Why is it necessary to carry out a process flow analysis? [20 marks]
- (b) How are histograms used in SPC? Sketch and comment on the various scenarios of the stability of a process. [20 marks]
- (c) An aluminium spacer ring outer diameter (OD) used in equipment cabinets had a tolerance of ± 0.008 inch. The quality of the part was difficult to control, and the operators frequently adjusted the process. The average of the maximum and minimum OD was used to monitor the process. However, it was realized that significant within-part OD variability existed. The data in Table 3c were collected by measuring the minimum and maximum OD of five consecutive parts approximately every hour the machine was running. The data are coded so 1 = 0.001 inch.

Table 3c. Minimum and Maximum OD Measurements.

Subgroup	Min/Max	Min/Max	Min/Max	Min/Max	Min/Max
1	-2 -1	-3 -2	-2 -1	-1 0	-4 0
2	0 1	0 1	0 2	0 1	-1 1
3	1 3	1 2	1 3	0 3	0 3
4	-1 2	-1 0	-2 0	-2 0	-2 0
5	1 2	-1 0	-1 2	-2 2	-2 0
6	-2 2	-2 1	-3 2	-2 2	-2 1
7	-2 1	0 3	-3 2	0 2	-2 2
8	-1 2	0 2	-2 1	0 3	-2 2
9	-1 1	-3 -1	-2 1	-2 0	-2 0
10	-1 0	-3 1	-2 2	-2 1	-2 1
11	-1 2	-3 3	-2 0	-2 1	-2 0
12	-1 1	-2 1	-1 2	-3 2	-2 0
13	-5 0	-7 -1	-5 -2	-5 -3	-5 -2
14	-5 -2	-7 -2	-6 -1	-5 -1	-5 -3
15	-2 0	-3 1	-3 0	-5 1	-4 1
16	-4 2	-3 0	-3 -1	-5 3	-4 0
17	-5 2	-4 0	-2 0	-3 1	-4 1
18	-2 -1	-3 -1	-4 0	-2 -1	-4 0
19	-3 4	-1 4	0 2	-2 4	-4 4
20	-1 2	0 3	-2 3	-1 2	-1 2
21	-2 2	-1 1	-1 2	-2 -2	-2 2
22	1 6	2 6	2 6	1 7	1 6
23	-1 4	0 5	-1 4	0 3	2 5
24	-1 3	-2 4	-2 3	-3 5	-3 4
25	0 4	-1 4	1 3	1 2	0 2

...5/-

3. (a) *Apakah analisis aliran proses? Berikan satu contoh untuk menunjukkan analisis aliran proses. Mengapakah perlu analisis aliran proses dilaksanakan?*

[20 markah]

- (b) *Bagaimanakah histogram digunakan dalam SPC? Lakar dan komen tentang berbagai senario kestabilan bagi suatu proses.*

[20 markah]

- (c) *Garis-pusat luar (OD) bagi suatu bulatan 'aluminium spacer' yang digunakan dalam kabinet peralatan mempunyai toleransi ± 0.008 inci. Mutu bahagiannya adalah susah dikawal, dan operator sering mengubahsuai prosesnya. Walau bagaimana pun, disedari bahawa serakan OD dalam-bahagian wujud. Data di dalam Jadual 3c dikutip dengan menyukat minimum dan maksimum OD bagi lima bahagian berturutan bagi setiap jam mesin dijalankan. Data dikodkan supaya $1 = 0.001$ inci.*

Jadual 3c. Minimum dan Maksimum Ukuran OD.

Subkumpulan	Min/Max	Min/Max	Min/Max	Min/Max	Min/Max
1	-2 -1	-3 -2	-2 -1	-1 0	-4 0
2	0 1	0 1	0 2	0 1	-1 1
3	1 3	1 2	1 3	0 3	0 3
4	-1 2	-1 0	-2 0	-2 0	-2 0
5	1 2	-1 0	-1 2	-2 2	-2 0
6	-2 2	-2 1	-3 2	-2 2	-2 1
7	-2 1	0 3	-3 2	0 2	-2 2
8	-1 2	0 2	-2 1	0 3	-2 2
9	-1 1	-3 -1	-2 1	-2 0	-2 0
10	-1 0	-3 1	-2 2	-2 1	-2 1
11	-1 2	-3 3	-2 0	-2 1	-2 0
12	-1 1	-2 1	-1 2	-3 2	-2 0
13	-5 0	-7 -1	-5 -2	-5 -3	-5 -2
14	-5 -2	-7 -2	-6 -1	-5 -1	-5 -3
15	-2 0	-3 1	-3 0	-5 1	-4 1
16	-4 2	-3 0	-3 -1	-5 3	-4 0
17	-5 2	-4 0	-2 0	-3 1	-4 1
18	-2 -1	-3 -1	-4 0	-2 -1	-4 0
19	-3 4	-1 4	0 2	-2 4	-4 4
20	-1 2	0 3	-2 3	-1 2	-1 2
21	-2 2	-1 1	-1 2	-2 -2	-2 2
22	1 6	2 6	2 6	1 7	1 6
23	-1 4	0 5	-1 4	0 3	2 5
24	-1 3	-2 4	-2 3	-3 5	-3 4
25	0 4	-1 4	1 3	1 2	0 2

...6/-

Construct the control charts for four cases: (a) Average of Min/Max OD; (b) Max OD; (c) Min OD; and (d) Difference (Max OD – Min OD), using the computed values in the table below.

Measurement	LCL	\bar{X}	UCL	\bar{R}	LCL
Average OD	-1.0	-0.2	0.6	1.3	2.8
Max OD	0.3	1.5	2.7	2.0	4.2
Min OD	-3.1	-1.9	-0.7	2.1	4.5
Difference OD	1.5	3.3	5.1	3.1	6.6

Interpret the patterns on the control charts. What can you conclude about the process?

[60 marks]

Bina carta-carta kawalan untuk empat kes: (a) Purata Min/Max OD; (b) Max OD; (c) Min OD; dan (d) Beza (Max OD – Min OD), dengan menggunakan nilai-nilai yang dihitung dalam jadual di bawah.

Sukatan	LCL	$\bar{\bar{X}}$	UCL	\bar{R}	LCL
Purata OD	-1.0	-0.2	0.6	1.3	2.8
Max OD	0.3	1.5	2.7	2.0	4.2
Min OD	-3.1	-1.9	-0.7	2.1	4.5
Beza OD	1.5	3.3	5.1	3.1	6.6

Tafsir pola-pola di atas carta-carta kawalan. Apakah kesimpulan anda tentang proses yang dipertimbangkan?

[60 markah]

4. (a) Special Plastics Sdn. Bhd. has been making blank credit cards for a number of years. They use p charts to keep track the number of nonconforming cards that are created each time a batch of blank cards is run. Use the data in Table 4a to construct a fraction nonconforming (p) chart.

Table 4a. Data Sheet: Credit cards.

Sample No.	Sample Size, n	No. of nonconforming units, np	Fraction nonconforming, p
1	500	20	
2	500	21	
3	500	19	
4	500	15	
5	500	18	
6	500	20	
7	500	19	
8	500	28	
9	500	17	
10	500	20	
11	500	19	
12	500	18	
13	500	10	
14	500	11	
15	500	10	
16	500	9	
17	500	10	
18	500	11	
19	500	9	
20	500	8	

After constructing the p chart, interpret the chart. What is your conclusion? If a special cause exists, what should Special Plastics Sdn. Bhd. do? Can they use the same p chart again? If no, what should they use?

[40 marks]

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4. (a) *Special Plastics Sdn. Bhd.* telah membuat kad kredit kosong untuk beberapa tahun. Mereka menggunakan carta p untuk memantau bilangan kad yang cacat setiap kali satu kumpulan kad kosong dibuat. Gunakan data dalam Jadual 4a untuk membina satu carta pecahan kecacatan (p).

Jadual 4a. Helaian Data: Kad Kredit.

No. Sampel	Saiz Sampel, n	Bilangan unit kecacatan, np	Pecahan kecacatan, p
1	500	20	
2	500	21	
3	500	19	
4	500	15	
5	500	18	
6	500	20	
7	500	19	
8	500	28	
9	500	17	
10	500	20	
11	500	19	
12	500	18	
13	500	10	
14	500	11	
15	500	10	
16	500	9	
17	500	10	
18	500	11	
19	500	9	
20	500	8	

Setelah membina carta p , tafsirkan carta. Apakah kesimpulan anda? Jika wujud punca khas, apakah syarikat *Special Plastics Khas Sdn. Bhd.* harus buat? Bolehkah mereka menggunakan carta p yang sama? Jika tidak, apakah yang harus mereka gunakan?

[40 markah]

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- (b) What are memory control charts? How are they different from the Shewhart control charts? Give an example for each type of memory control chart.

[30 marks]

- (c) We are encouraged to ask questions in problem-solving. The five Ws and the one H are commonly asked in SPC. State the five Ws and the one H. Then apply these questions to Process Capability Analysis. What are your answers?

Consider input of 500 measurements in subgroups of five from a certain process. The capability indices based on previous performance when this process is operating under stable conditions are $C_p = 1.6$ and $C_{pk} = 1.6$. The histogram and $\bar{X} - R$ control charts are displayed in Figure 4.1; Figure 4.2 and Figure 4.3, respectively.

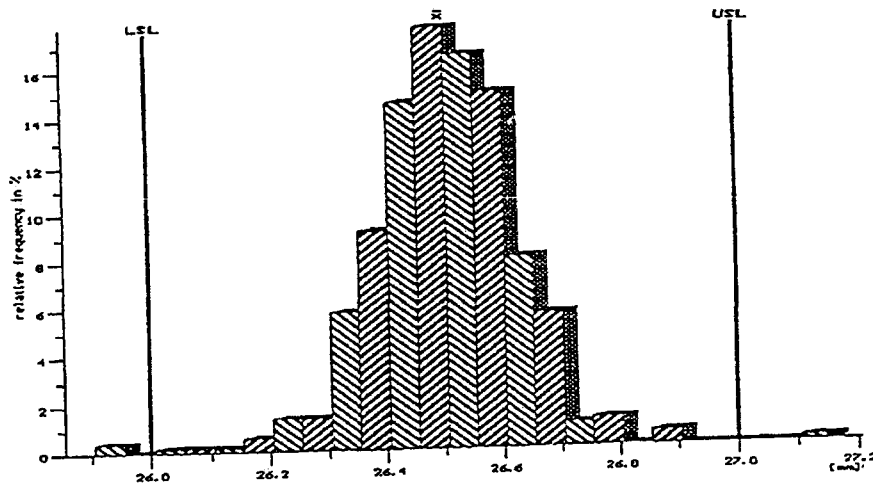


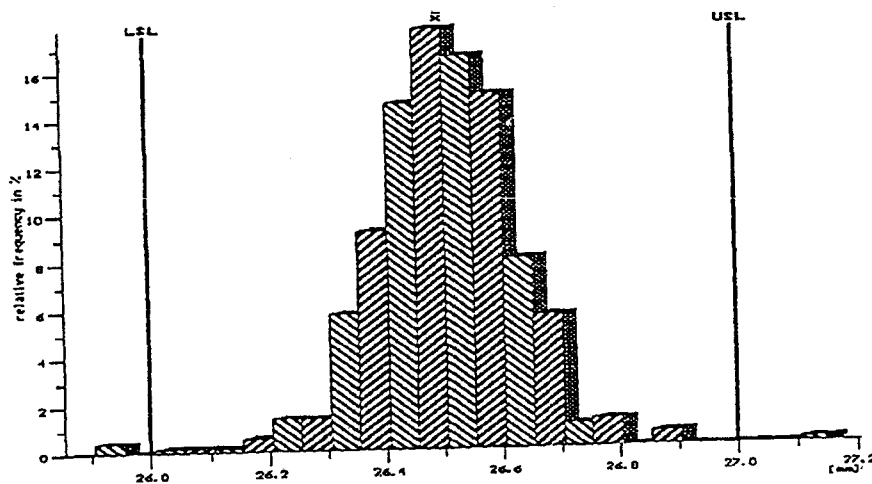
Figure 4.1. Histogram

- (b) *Apakah carta-carta kawalan memori? Bagaimanakah carta ini berbeza daripada carta-carta kawalan Shewhart? Beri satu contoh bagi setiap jenis carta kawalan memori.*

[30 markah]

- (c) *Kita digalakkan menanya soalan-soalan dalam penyelesaian masalah. Lima W dan satu H biasa ditanya dalam SPC. Nyatakan soalan-soalan lima W dan satu H. Kemudian gunakan soalan-soalan ini dalam Analisis Keupayaan Proses. Apakah jawapan-jawapan anda?*

Pertimbangkan input bagi 500 ukuran dalam subkumpulan bersaiz 5 dari sesuatu proses. Indeks-indeks keupayaan yang berdasarkan prestasi dulu apabila proses ini beroperasi dalam keadaan stabil ialah $C_p = 1.6$ dan $C_{pk} = 1.6$. Histogram dan carta kawalan $\bar{X} - R$ masing-masing dipamerkan dalam Rajah 3.1, Rajah 3.2 dan Rajah 3.3.



Rajah 4.1. Histogram

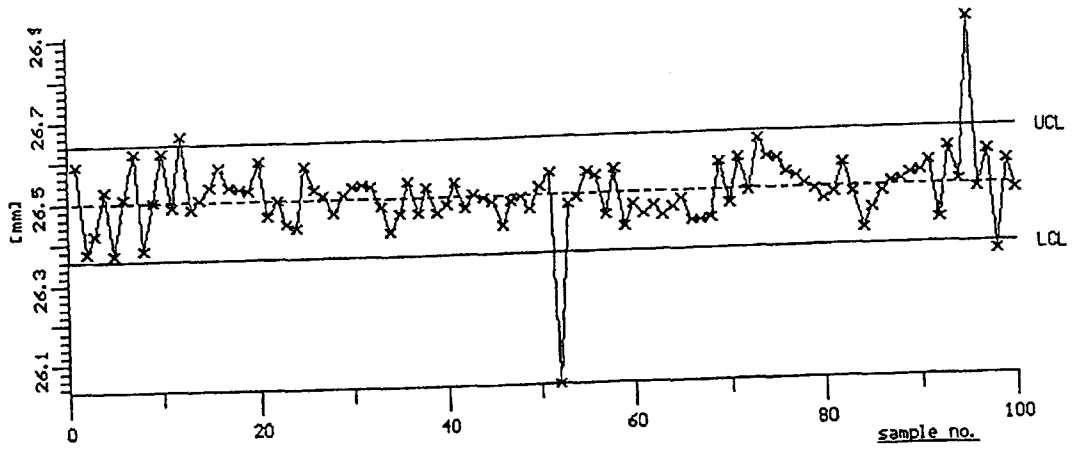


Figure 4.2. \bar{X} control chart

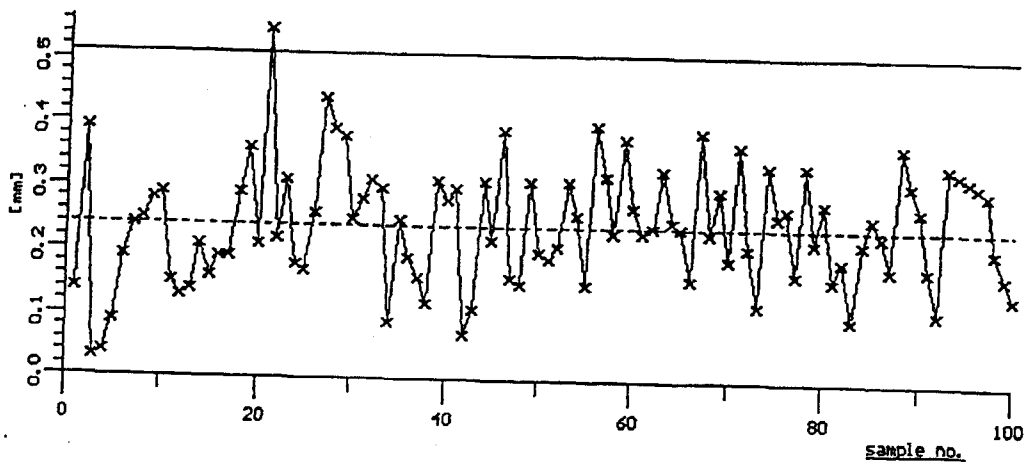
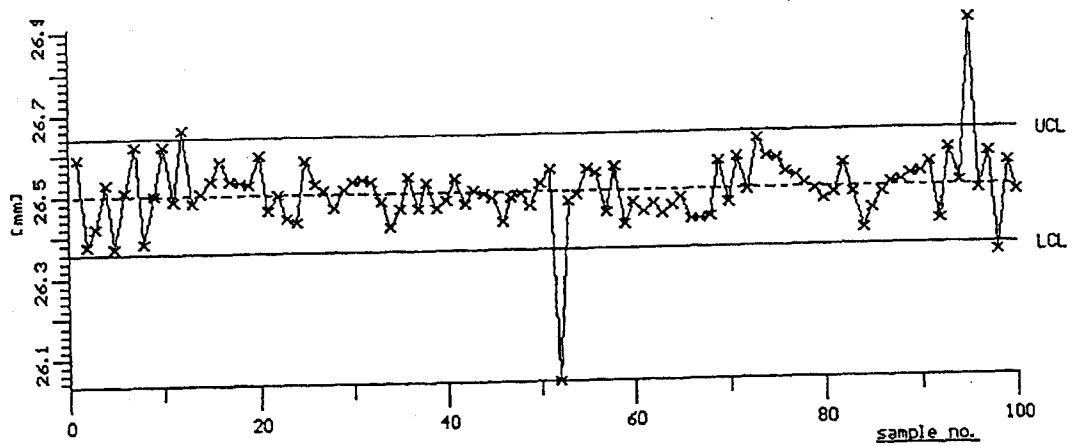


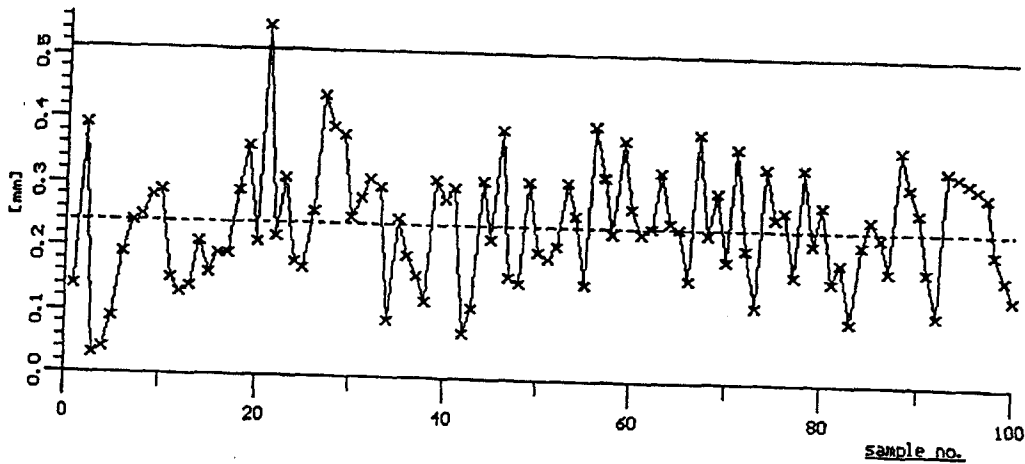
Figure 4.3. R control chart

Comment on the results in these figures. Is the process capable or not based on these results?

[30 marks]



Rajah 4.2. Carta kawalan \bar{X}



Rajah 4.3. Carta kawalan R

Komen tentang keputusan-keputusan dalam ketiga-tiga rajah ini. Adakah proses ini berupaya atau tidak berdasarkan keputusan-keputusan tadi?

[30 markah]