

Question 2 (10 marks)

A bread manufacturer has used statistical process control to ensure that its sandwiches loaves have the proper weight. Based on a previously stable and in-control process, the control limits of X-bar and R-charts are:

X-bar chart: UCL = 16.56, LCL=15.84
R-chart: UCL = 1.141, LCL= 0

Over the past few days, they have taken five random samples of n=4, and the results are as given in Table 2.

Table 2: Sampled data

| Sample | Net weight (gram) | | | |
|--------|-------------------|---------|---------|---------|
| | Loaf #1 | Loaf #2 | Loaf #3 | Loaf #4 |
| 1 | 16.3 | 16.0 | 15.9 | 15.9 |
| 2 | 16.0 | 16.0 | 16.3 | 15.9 |
| 3 | 16.3 | 14.8 | 15.6 | 15.2 |
| 4 | 16.2 | 16.0 | 16.2 | 15.9 |
| 5 | 16.5 | 16.6 | 16.5 | 16.9 |

Is the process still in control? Provide evidence through calculation and control chart plots (both X-bar and R-charts).

Translation:

Sabua pengilang roti menggunakan kawalan proses statistik untuk memastikan roti yang dihasilkan mempunyai berat yang sepatutnya. Berdasarkan data lepas yang dikumpulkan dari proses yang telah stabil, had kawalan bagi carta X-bar dan carta R adalah seperti berikut:

Carta X-bar: UCL = 16.56, LCL=15.84
Carta R: UCL = 1.141, LCL= 0

Bagi tempoh beberapa hari lepas, lima sampel (subkumpulan) bersaiz n=4 telah diambil secara rawak, dan keputusannya adalah seperti Jadual 2.

Jadual 2: Sampel data

| Sample | Berat bersih (gram) | | | |
|--------|---------------------|---------|---------|---------|
| | Roti #1 | Roti #2 | Roti #3 | Roti #4 |
| 1 | 16.3 | 16.0 | 15.9 | 15.9 |
| 2 | 16.0 | 16.0 | 16.3 | 15.9 |
| 3 | 16.3 | 14.8 | 15.6 | 15.2 |
| 4 | 16.2 | 16.0 | 16.2 | 15.9 |
| 5 | 16.5 | 16.6 | 16.5 | 16.9 |

Adakah proses di atas masih dalam kawalan? Buktikan jawapan anda secara kiraan dan plot carta kawalan X-bar dan R.

..... end of question

Solution

Calculate values for x-bar and R --- (5 markah)

Sample: x-bar (for sample 1) = $(16.3+16+15.9+15.9)/4 = 64.1/4 = 16.025$

Values for R: maximum – minimum

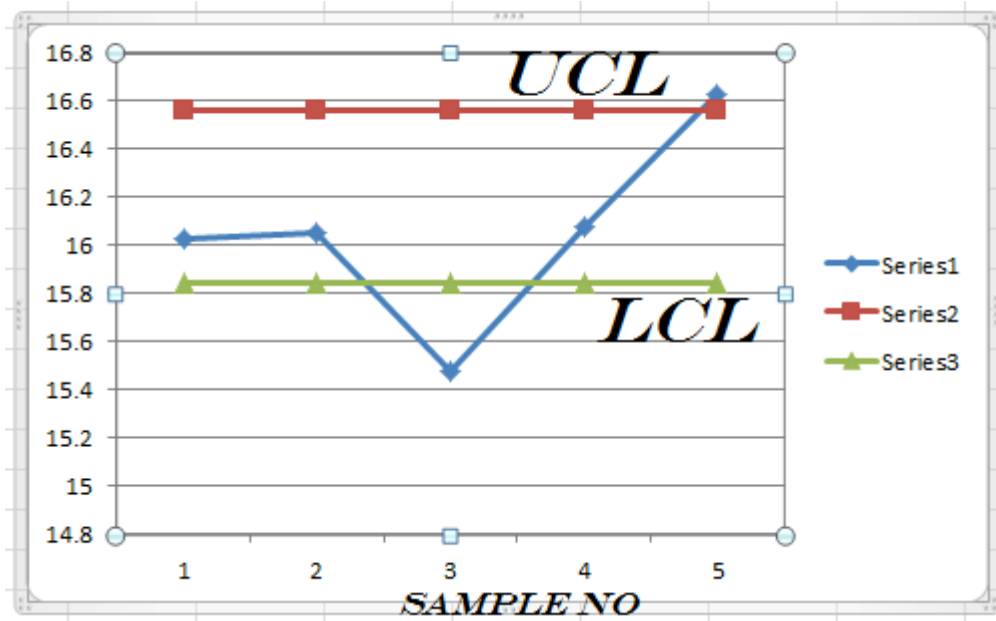
Plot (3 marks)

Interprate (2 marks)

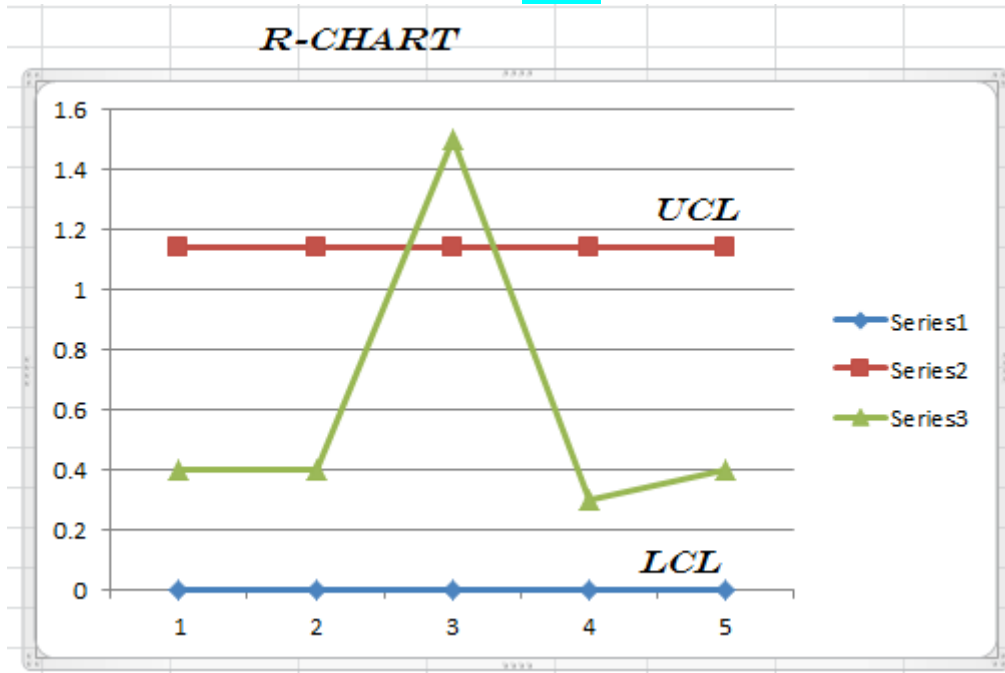
| | Roti #1 | Roti #2 | Roti #3 | Roti #4 | Total | X-bar | R |
|---|---------|---------|---------|---------|-------|--------|-----|
| 1 | 16.3 | 16 | 15.9 | 15.9 | 64.1 | 16.025 | 0.4 |
| 2 | 16 | 16 | 16.3 | 15.9 | 64.2 | 16.05 | 0.4 |
| 3 | 16.3 | 14.8 | 15.6 | 15.2 | 61.9 | 15.475 | 1.5 |
| 4 | 16.2 | 16 | 16.2 | 15.9 | 64.3 | 16.075 | 0.3 |
| 5 | 16.5 | 16.6 | 16.5 | 16.9 | 66.5 | 16.625 | 0.4 |

| | | |
|--------------|--------------|-----------|
| Carta X-bar: | UCL = 16.56, | LCL=15.84 |
| Carta R: | UCL = 1.141, | LCL= 0 |

x-bar chart



R-chart



For x-bar chart, sample no 3 and 5 are outside the control limits.

For R-chart, sample no 3 is out the control limits

Thus, the process is statistically out-of-control (unstable) as shown by x-bar and R charts.