16

USING STATISTICS FOR QUALITY CONTROL

QUESTION 1.

In the box below explain what 'statistical process control' is and what 'acceptance sampling' is.

Statistical process control is:
Acceptance sampling is:

QUESTION 2.

Write down two possible causes of quality variation in a manufacturing process and give an example of each:

1. _____
   _____ is one example.
2. _____
   _____is one example.

Complete the following table:

Decision	Process in control	Process out of control
Accept	H_0 = true	Type II error
Change process		

Complete the following:

A Type I error occurs when _____

A Type II error occurs when _____

QUESTION 3.

Complete the following: The UCL (upper control limit) is given by $\mu + 3\sigma$ and the LCL (lower control limit) is given by $\mu - 3\sigma$. If the mean of the sample falls between these limits there is a _____ % probability the mean is within acceptable/unacceptable (delete as appropriate) limits and therefore we consider the process to be in/out of (delete as appropriate) control.

QUESTION 4.

You have been asked to advise the Production Manager of a manufacturing company whether a particular process is operating in statistical control. The company manufactures drive shafts. The Quality Control department have taken 10 samples comprising of 100 drive shafts each. Each sample is independent from the other and the drive shafts are selected at random. The table below shows the results of the sampling.

Sample ID	1	2	3	4	5	6	7	8	9	10
Sample range	0.5	0.2	0.3	0.8	0.4	0.1	0.2	0.6	0.3	0.4

The CL (Control Limit) $\bar{\bar{x}} = 0.38$

The value of the mean range across the samples, $\bar{R} =$
The value of A_2 in the formula UCL $= \bar{\bar{x}} + A_2\bar{R}$ is 0.308

The UCL = _____

The LCL = _____

Complete the following sentence:

Providing the individual sample means are within the _____ and the _____, the process is said to be in statistical control. If a particular sample mean was outside of this range it would be out of control and _____ _____ would be necessary.

QUESTION 5.

You have been commissioned to investigate the number of readmissions to a local hospital. The management team are concerned that patients may be being discharged too early so that the clinical teams meet their targets for discharges.
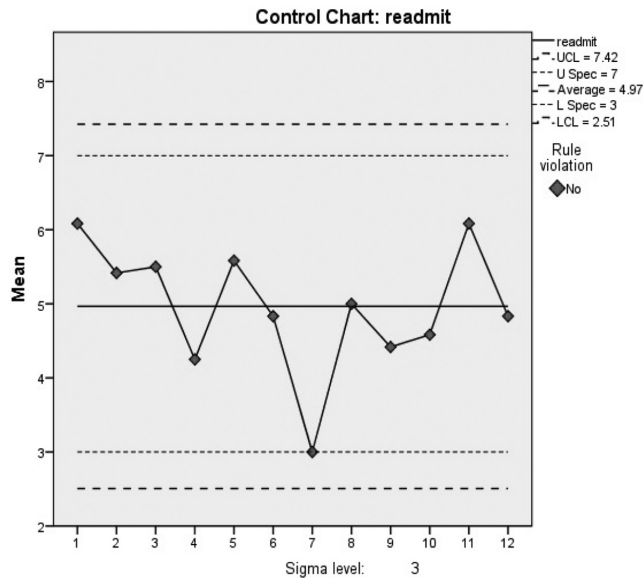   The table below shows the data collected over the past 12 months.

Month no.	1	2	3	4	5	6	7	8	9	10	11	12
Mean readmissions	6.08	5.42	5.5	4.25	5.58	4.83	3.00	5.00	4.42	4.58	6.08	4.83

In order to do the analysis you need to select an appropriate control chart.

In the box below state the type of chart you would use to monitor the readmissions and explain why you made this choice.

<div style="background-color:#cfc3b0; height:60px;"></div>

The figure below shows a control chart from the readmissions data.

Control Chart: readmit

Legend:
- readmit
- -UCL = 7.42
- U Spec = 7
- Average = 4.97
- L Spec = 3
- -LCL = 2.51

Rule violation
◆ No

Sigma level: 3

Complete the following statements:

The calculated UCL = _____
The specified UCL = _____
The calculated LCL = _____
The specified LCL = _____

In the box below interpret the chart in terms of the monthly variations. For example, could there be a reason why the readmissions for July were less than for any other month, etc.?

<div style="background-color:#cfc3b0; height:80px;"></div>

The control chart below shows the range of the data about the mean.

Complete the following:

The solid centre line represents the _____ of the sample _____.

The control limits reflect the expected amount of variation in the sample ranges when only _____ causes of _____ are present.

The chart indicates for October, November and December there is no variation in the range. This could indicate the _____ of a problem therefore further _____ are necessary to make a judgement. In order to make a judgement a _____ chart could be used.

Control Chart: readmit
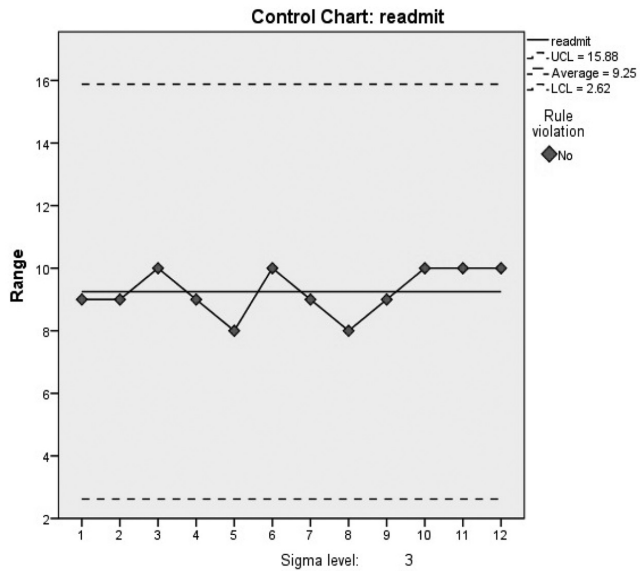
You decide also to look at the readmissions by ward. The figure below shows the control chart for this activity.

Control Chart: readmit
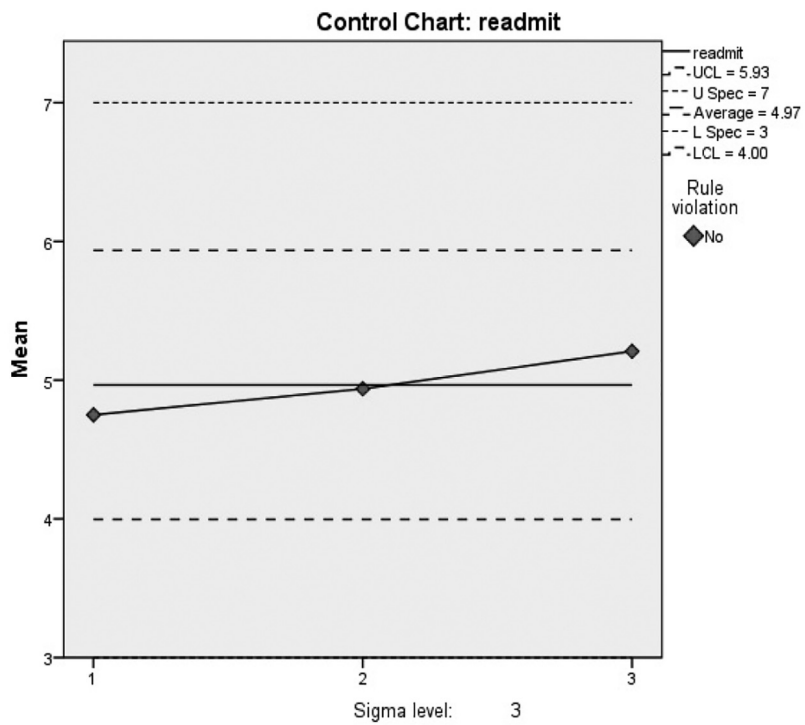
In the box below interpret what the chart is telling you.

For the final part of your analysis you decide to look at the proportion of non-conforming wards. The figure below shows the *p* control chart for this activity.

Control Chart: readmit
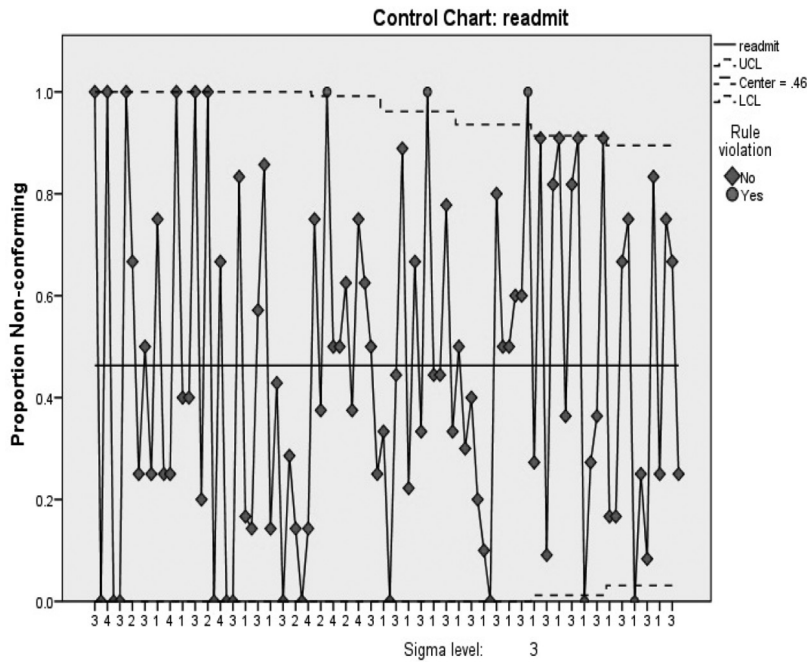
The chart indicates that on 5 occasions there were non-conformities which are tabulated below

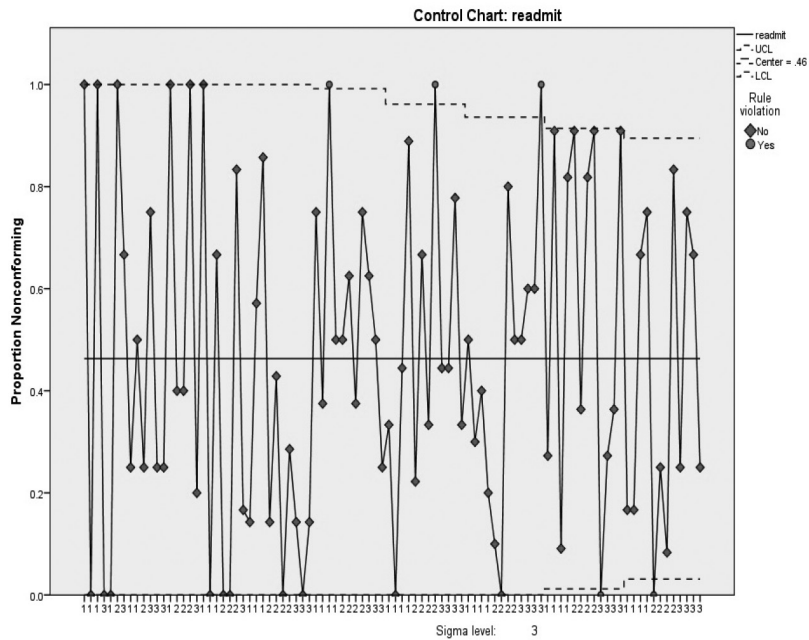| Ward	Violations for points
4	Greater than +3σ
3	Greater than +3σ
3	Greater than +3σ
1	Less than −3σ
1	Less than −3σ

Complete the following:

The readmissions for ward 3 on 1 occasion were greater than 3σ which means readmissions _____ above the _____.

Ward 4 had _____ violations.

Ward 1 had 2 violations below the −3σ limit which means on these occasions the number of readmissions was acceptable/unacceptable (delete as appropriate).

Finally, you decide to look at the shift non-conformities. The figure below shows the results of your analysis.

Control Chart: readmit

Shift	Violations for points
1	Greater than +3σ
2	Greater than +3σ
3	Greater than +3σ
3	Less than −3σ
2	Less than −3σ

In the box below, comment on the control chart and the associated rule violations table. In particular discuss any areas that could potentially be a cause for concern.

MINI PROJECT

In question 5 you carried out an investigation into the readmissions data for a local hospital. Your final task is to write a report about the investigation in which you should outline the investigation and the methods you used and the reasons for choosing particular charts. As usual, your target audience are not statistically savvy, so you have to use plain English to inform them of what the data is saying. The final section of your report should contain conclusions and any recommendations you think the management should consider.

And finally...

You have completed the final chapter; well done. Hopefully you feel your knowledge and skills with statistics falls within the range of +2σ to +3σ.