

# **Six Sigma Statistics using Minitab 17**

## **Green Belt Edition**

**09 Control charts  
Answers to Exercise**

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## Exercise 9.12.1

### Control Charts

Data is taken from a process in time order. Check for stability using the appropriate control chart. First use the Assistant and estimate control limits from the data. Once you have done that use the classic menu and test the data for all the available tests for special causes.

Analyse the data in File 09 Control Charts.xlsx worksheet Ex 9.12.1 and answer the questions shown below.

- 1) Is the process stable?
- 2) When using the Assistant on which chart are the stability issues?
- 3) When you use the classic menus and use all the tests for special causes are any additional test activated?

# Set-up I

1. In order to select the appropriate chart look at the data. It is in subgroups and there are 4 data points in each subgroup. As the data is continuous we must use an Xbar R chart to investigate stability.

↓	C1	C2
	Subgroup	Data
1	1	80.284
2	1	94.329
3	1	94.432
4	1	102.018
5	2	101.975

How are your data arranged in the worksheet?

Data are in one column for all subgroups

Data column:

How are your subgroups defined?

☐ Constant size for all subgroups:

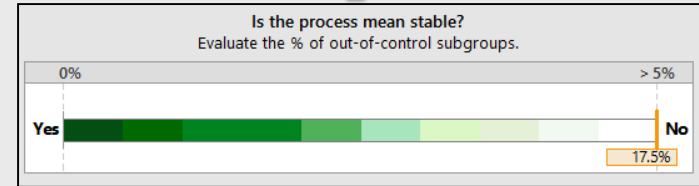
☒ Column of subgroup IDs:

Control limits and center line

How will you determine the control limits and center line?

2. Click Assistant<< Control Charts
3. Click on the button for the Xbar R chart.
4. Complete the menu as shown and then click OK.

# Analysis-I



Starting on the top left of the Summary Report, we can see that the process mean is not stable with 17.5% of subgroups being out of control.

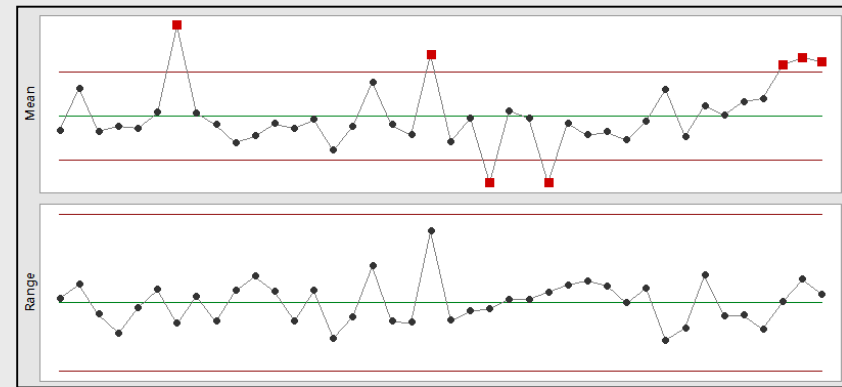






Chart	Test	Out-of-Control Subgroups
Xbar	Test 1: Outside control limits	7, 20, 23, 26, 38-40

The Stability Report shows us the out of control point and we see that all the point on the Xbar chart failed Test 1. The R Chart was in control.

# Analysis-2

Check	Status
Stability	
Amount of Data	
Correlated Data	
Alternative Charts	

The Report Card gives us a warning about stability and about Correlated Data. Correlated data suggests that the data points were not independent of each other.

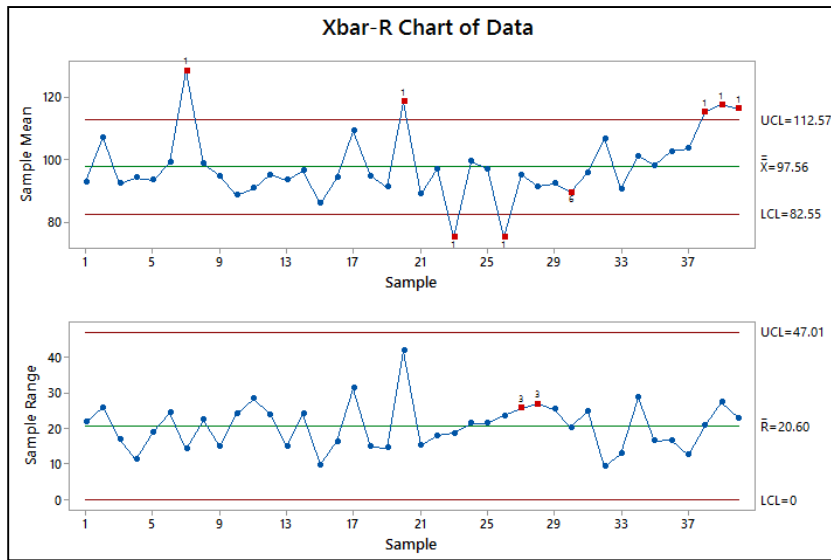
# Set-up 2

All observations for a chart are in one column:	
Data	
Subgroup sizes:	<input type="text" value="Subgroup"/> (enter a number)

5. To produce the control using the classic menus Click Stat<<Control Charts<<Variable Charts for Subgroups <<Xbar-S.
6. Click on the Xbar-R Options button.
7. Click on the Tests tab and then select 'Perform all tests' from the drop-down list.
8. Click OK and OK again to execute the test.

Tests
Perform all tests for special causes ▼

# Analysis-3



Navigate to the new chart. We see that additional points on the R chart have been identified as being out of control. There are also additional points on the Xbar chart and some of the existing points have failed more than one test.

30th Dec 2015

# Analysis-4

## Test Results for Xbar Chart of Data

TEST 1. One point more than 3.00 standard deviations from center line.  
Test Failed at points: 7, 20, 23, 26, 38, 39, 40

TEST 5. 2 out of 3 points more than 2 standard deviations from center line  
Test Failed at points: 39, 40

TEST 6. 4 out of 5 points more than 1 standard deviation from center line  
Test Failed at points: 30, 40

## Test Results for R Chart of Data

TEST 3. 6 points in a row all increasing or all decreasing.  
Test Failed at points: 27, 28

Go to the Session Window to see the breakdown of the test results.