

## M&IS 34060—Operations Management Excel Exercises—SPC

### Introduction

The problems in this exercise are chosen to test your abilities to implement a spreadsheet decision model for statistical process control, SPC.

When developing your spreadsheet, keep in mind the following ideas related to good spreadsheet design practices and hints.

- 1) Formulas should never have constants (e.g., A<sub>2</sub>, D<sub>3</sub>, D<sub>4</sub>, etc.) entered in them directly. Enter references to cells that contain the constants so changes can be easily implemented.
- 2) Formulas should be entered once and copied, if possible. Use Absolute and Relative cell addresses to help here. Remember, A<sub>2</sub> is a relative address but \$A\$2 is an absolute address.
- 3) Use functions such as =Average() to calculate sample averages.
- 4) To find the ranges, there is no =Range() function that I am aware of in Excel. However, if you recall that Range = Max – Min, you can use the =Max() and =Min() functions.
- 5) The data file is available on the class website at the [quality1 file link](#). Sheets have been created with the data and space you will need to work each part.

### Excel Exercises

*The problems in this Excel Exercise are adapted from the Heizer/Render OM textbook.*

**PART (1)** You are a purchasing agent for West Battery Corp., which has been receiving complaints from corporate customers that the 9-volt batteries you have recently sourced in China are not lasting as long as the ones your company supplied before. You are concerned because you recommended switching battery vendors, and got a bonus for the savings, believing the batteries had an average life of 50 hours, about 10% longer than the previous ones. Subsequently, you were able to charge more for the longer lasting battery.

You review the data you used to make this decision as indicated in the table below. You decide to see if the process is in-control and averaging the 50 hours you assumed before. Furthermore, you believe the process will show a lower control limit of at least 45 hours, representing your previous lower specification.

Data has been collected over a 25 hour period as represented in the table below.

What are the control limits, centerlines, and is the process in-control?

*Tip—when you setup your spreadsheet, leave space for 30 hours of data. Only the first 25 hours will be used in your formulas for control limits but for graphing in Problem 2, you are going to add hours 26 – 30.*

**West Battery Data—Battery Lifetimes (in hours)**

*NOTE—this file is on the class website as the “Quality 1” file link; therefore you can cut and paste this table into Excel.*

Hour	Observation (battery)				
	1	2	3	4	5
1	51	50	49	50	50
2	45	47	70	46	36
3	50	35	48	39	47
4	55	70	50	30	51
5	49	38	64	36	47
6	59	62	40	54	64
7	36	33	49	48	56
8	50	67	53	43	40
9	44	52	46	47	44
10	70	45	50	47	41
11	57	54	62	45	36
12	56	54	47	42	62
13	40	70	58	45	44
14	52	58	40	52	46
15	57	42	52	58	59
16	62	49	42	33	55
17	40	39	49	59	48
18	64	50	42	57	50
19	58	53	52	48	50
20	60	50	41	41	50
21	52	47	48	58	40
22	55	40	56	49	45
23	52	48	50	50	65
24	50	49	56	51	51
25	51	48	51	53	62

**THE ABOVE TABLE IS USED FOR PART (1) AND AGAIN IN PART (2)**

**PART (2)** Afterwards, you find data from the next five hours shown below. How is this data used (or combined) with the data and control charts you calculated above? Are control limits recalculated? Does the process appear to be in-control now?

Hour	Observation (battery)				
	1	2	3	4	5
26	48	52	39	57	61
27	45	56	48	43	66
28	63	49	50	45	53
29	57	70	45	52	61
30	44	38	46	55	52

**PART (3)** What is the difference between a process being “in-control” and being “capable”?

What is the implication of this issue for your situation above? If you made the recommendation in Part 1, why is your career in jeopardy?

**PART (4)** Can you use the spreadsheet to calculate the capability index Cpk for the first 25 hours of data assuming only the lower specification limit is of concern? Use the Memory Jogger II for formulas and guidance as there is a section on process capability. Your challenge is to try to do this on your own without my help. *Tip—process capability has its own section but it does use a value from the “Table of Constants” section under control charts.*

**PART (5)** On the worksheet titled “Part 5” in the quality1.xls file is another opportunity to do a capability study on a process. In this case, both the upper and lower spec limits are relevant. Consider the following information...

Consistency in the length of time it takes to complete orders is an important indicator of customer satisfaction and efficiency. If it takes too long, customers are dissatisfied. Done too quickly and unnecessary resources were probably used, raising costs.

Data on a sample of four orders each day over a 40 day period was collected. The process completion target is 360 minutes, with a lower spec limit (LSL) of 270 minutes and an USL of 430 minutes.

Given this information, does the process appear “capable” of meeting specifications?

**PART (6)** A manufacturer of pants wants to monitor its production process to maintain high quality. To this end, the company decided to obtain a sample of 100 jeans per day and record the number of defective pairs. They did this for 20 days, with the data listed below.

Assuming most of the variation in the process (e.g., 99% or more) is due to inherent variation, construct an appropriate control chart to monitor this situation.

Day	# Defective Jeans	% Defective Jeans
1	6	0.06
2	0	0
3	4	0.04
4	10	0.1
5	6	0.06
6	4	0.04
7	12	0.12
8	10	0.1
9	8	0.08
10	10	0.1
11	12	0.12
12	10	0.1
13	14	0.14
14	8	0.08
15	6	0.06
16	16	0.16
17	12	0.12
18	14	0.14
19	20	0.2
20	18	.18
	<b>200</b>	

**PART (7)** A restaurant uses surveys to monitor customer satisfaction. The survey measures a large number of factors related to the food (taste, presentation, temperature, etc.) and service (promptness, accuracy, courteousness, etc.). A low rating (below the middle point) in any of these categories is considered a defect. Therefore, each order can have multiple defects. The results below represent 20 surveys over the course of the month.

If approximately 95.5% of the variability in the process is considered inherent, use a control chart and calculate appropriate control limits.

<b>Survey</b>	<b># of defects</b>
1	4
2	6
3	10
4	3
5	6
6	7
7	8
8	5
9	2
10	5
11	9
12	4
13	3
14	4
15	13
16	9
17	10
18	11
19	15
20	12
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## Solution Video Links

There are two solution video formats below. The streaming version is interactive and you should try these first for the best experience. If the streaming version does not work for you, use the MP4 version instead.

### Streaming Version

[EE SPC Part 1](#)

[EE SPC Part 2 and 3](#)

[EE SPC Part 4](#)

[EE SPC Part 5](#)

[EE SPC Part 6](#)

[EE SPC Part 7](#)

### MP4 Version

[EE SPC Part 1](#)

[EE SPC Part 2 and 3](#)

[EE SPC Part 4](#)

[EE SPC Part 5](#)

[EE SPC Part 6](#)

[EE SPC Part 7](#)