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Quality Management of Software and Systems (WS15/16)

Problem Set 2

Due: in exercise, 09.12.2015

Please come well prepared to the tutorial. We'll only discuss problems that you made at home and whereby any questions occurred. If you encounter any problems, please feel free to ask.

Problem 1: SPC

a) The execution time of a time-critical routine is measured to see if it varies only statistically or if there are systematic influences. Develop the X-chart, including control and warning levels at +/- 3s and +/- 2s, respectively. Assume the cause for outliers is found and fixed. Repeat the analysis until no outliers occur:

no.	1	2	3	4	5	6	7	8	9	10	11	12	13	14
time (ms)	7,6	8,0	8,1	8,2	7,2	17,1	8,2	7,7	6,7	8,1	7,3	8,4	14,9	6,9

b) During the production of steel rods, 25 samples of size four are extracted from the production. Calculate the mean values and the range of each sample, as well as the overall mean value and range. Use this data to calculate the warning and control levels and indicate which measures are between warning and control levels and which are outside control levels.

Hint: The standard deviation can be calculated using $\sigma = \frac{\bar{R}}{d_n\sqrt{n}}$ with n the size of each sample and d_n a constant found in the following table:

n	2	3	4	5	6	7	8	9	10	11	12
$\boldsymbol{d_n}$	1,128	1,69	2,059	2,326	2,534	2,704	2,847	2,97	3,078	3,173	3,258

Sample	**Rod Length (in mm)**				**Sample**	**Rod Length (in mm)**			
1	144	146	154	146	**14**	144	160	150	149
2	151	150	134	153	**15**	150	146	148	157
3	145	139	143	152	**16**	147	144	148	149
4	154	146	152	148	**17**	155	150	153	148
5	157	153	155	157	**18**	157	148	149	153
6	157	150	145	147	**19**	153	155	149	151
7	149	144	137	155	**20**	155	142	150	150
8	151	157	159	155	**21**	146	156	148	160
9	158	150	149	156	**22**	159	161	156	160
10	145	148	152	154	**23**	143	156	151	151
11	151	150	154	153	**24**	151	152	157	149
12	155	145	152	148	**25**	154	140	157	151
13	152	146	152	142					

c) Calculate the warning and control levels analogue to exercise b) for the following data. You can use the same formula and table to calculate the standard deviation as in exercise b). Additionally, try to give a statement to the measured values and the underlying process.

Sample	Measures (in dB)					Sample	Measures (in dB)				
1	11,1	9,4	11,2	10,4	10,1	**11**	10,6	9,9	10,7	10,2	11,4
2	9,6	10,8	10,1	10,8	11,0	**12**	10,8	10,2	10,5	8,4	9,9
3	9,7	10,0	10,0	9,8	10,4	**13**	10,7	10,7	10,8	8,6	11,4
4	10,7	8,4	10,2	9,4	11,0	**14**	11,3	11,4	10,4	10,6	11,1
5	12,4	10,0	10,7	10,1	11,3	**15**	11,4	11,2	11,4	10,1	11,6
6	10,1	10,2	10,2	11,2	10,1	**16**	10,1	10,1	9,7	9,8	10,5
7	11	11,5	11,8	11,0	11,3	**17**	10,7	12,8	11,2	11,2	11,3
8	11,2	10,0	10,9	10,5	10,9	**18**	11,9	11,9	11,6	12,4	11,4
9	10,6	10,4	10,5	10,5	10,9	**19**	10,8	12,1	11,8	9,4	11,6
10	8,3	10,2	9,8	9,5	9,8	**20**	12,4	11,1	10,8	11,0	11,9

Problem 2: Cause and Effect Diagram

a) *Copyking*, a copier manufacturer, is currently writing the manual for their latest product. The last chapter should deal with malfunctions. Develop a Cause-and-Effect Diagram for the problem: no or wrong copies!

Develop a Cause-and-Effect diagram for the following problems:

b) Car cannot be launched.

Problem 3: Pareto Analysis

a) Let's assume a library with some problems: The library has a rusting fire sprinkling system, causing 70688 € per failure. Additionally, the air conditioning is defect, causing a 78959 € per failure. The roof, where the rain comes through, causes only 7390 €, as only part of the books are destroyed. At the reception, the new operating system "Astala" crashes regularly, causing 838 € per crash, as an external technician is needed. Last but not least, thieves frequently visit the library, because it is known that the alarm system is not operating. A book has an average value of 79 €. The following frequencies have been reported for the individual failures:

Fire sprinkling system	1
Air conditioning	1
Roof	4
Astala	142
Theft	112
Sum	260

b) Peter has a little time management problem. He has only 18 days left until he leaves for holidays. Until then, he has to finish his master's degree. Therefore, he needs 7h for the lecture "Quality Management", 44h for the lecture "Java is not only coffee", 41 "Dynamic programming" needs 41h, and "Data Mining for Beginners" needs 31h. Unfortunately, his master thesis also needs completion. He analyzes his day and discovers that he sleeps 7h per day and stays 5h at university. The remaining time can be spent to the aforementioned tasks. Additionally, the examination office told him the allotment for the final mark:

Thesis	4%
Quality Management	5%
Java is not only coffee	10%
Dynamic Programming	12%
Data Mining for beginners	5%

Which topic should Peter handle first?

c) A manufacturer sells alarm clocks. During the final control failures occur, requiring a costly network. Analyze the causes using a Pareto-Analysis.

Failure	**Costs**	**Quantity**
Missing Power Cable	7 €	7
Broken lever	35 €	2
Defect display	60 €	5
Loose screws	3 €	23
Wrong manual	5 €	18
Scratches	20 €	13
Everything else	15 €	7

d) A bicycle vendor receives pre-assembled bikes from his distributor. Unfortunately, most bikes require additional work, before they could be sold. Which problem should the distributor address first?

Problem	**Time needed**	**Quantity**
Light defect	0,5 h	35
Loose spokes	0,3 h	9
Spikes not correctly mounted	0,3 h	7
No canvas (flat tube after pumping)	0,5 h	5
Fork stem to short	3,0 h	3
Screws askew	0,3 h	3
Brake cable too short (can't turn handle bar completely)	0,6 h	10
Creaks in the bottom bracket	1,0 h	49
Suspension looses oil	0,6 h	20
Paintwork damage	0,5 h	2