SNS COLLEGE OF ENGINEERING

Kurumbapalayam (Po), Coimbatore – 641 107

An Autonomous Institution

Accredited by NAAC – UGC with 'A' Grade

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DEPARTMENT OF COMPUTER SCIENCE AND TECHNOLOGY

COURSE NAME : 19OE114 –TOTAL QUALITY MANAGEMENT

III YEAR / VI SEMESTER

Unit 4 - TQM TOOLS & TECHNIQUESII

CONTROL CHARTS

INDEX

- What is a Control Chart ?
- What do these charts do ?
- Its advantages and purposes.
- Types of Control Charts.
- How to plot a certain kind of chart.
- Case Study for a particular product.

CONTROL CHART.

- Control chart is graphical representation of the collected information.

- It pertains to the measured or otherwise judged quality characteristics of the items or samples.

WHAT DO THESE CHARTS DO.

- It detects variations in the processing and warns if there is any departure from the specified tolerance limits.
- It is primarily a diagnostic technique.
- It depicts whether there is any change on the characteristics of items since the start of the production run.

PURPOSE AND ADVANTAGES.

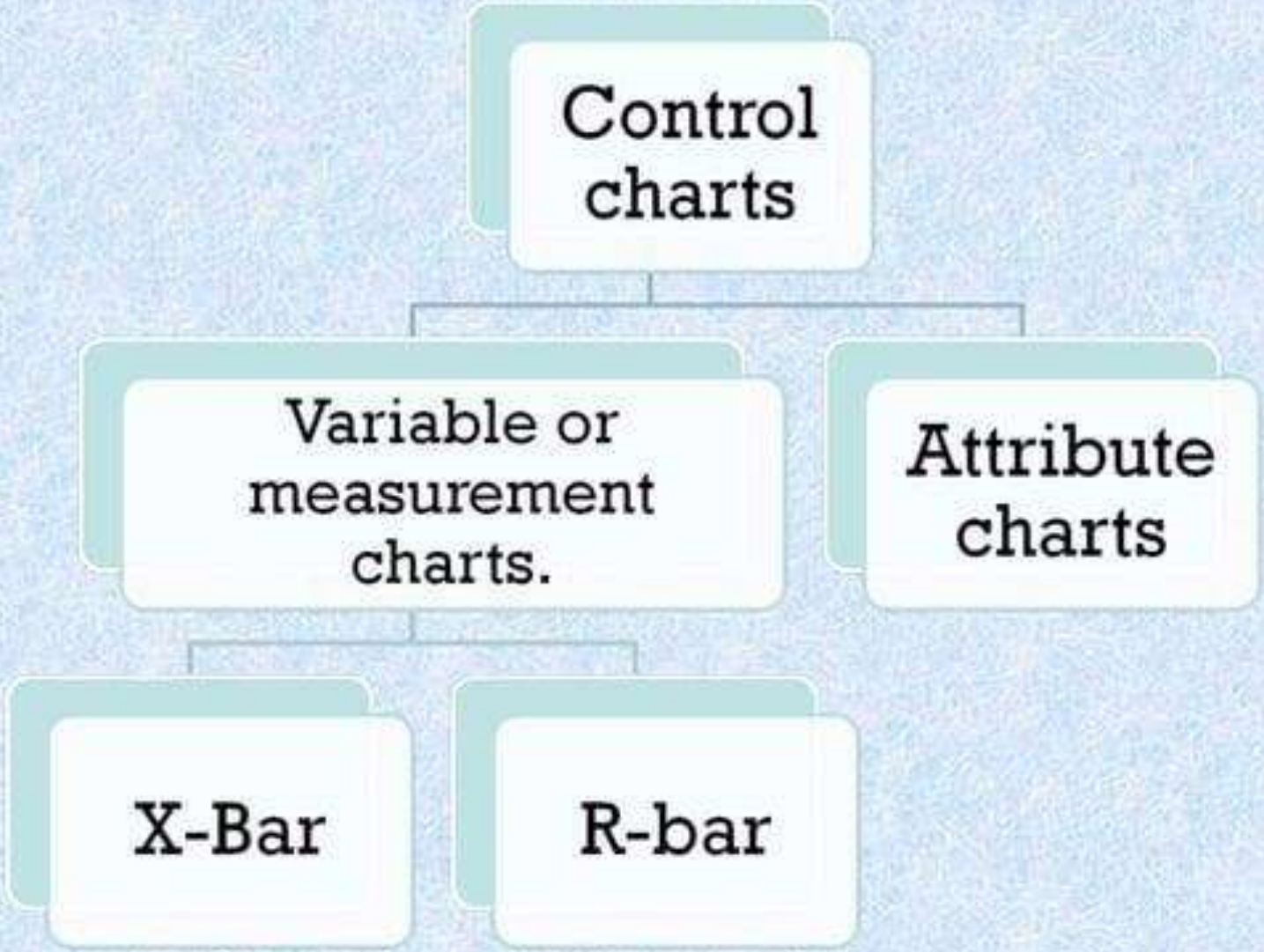
1. A control chart indicates whether a process is in control or out of control.
2. It determines processes variability and detects unusual variations taking place in a process.
3. It ensures product quality level.
4. It warns in time and if the process is rectified in time scrap percentage can be reduced.

PURPOSE AND ADVANTAGES.

5. It provides information about the selection of process and setting of tolerance limits.

6. Control charts build up the reputation of the organization through customer's satisfaction.

TYPES OF CONTROL CHARTS.



COMPARISON OF VARIABLE AND ATTRIBUTE CHART.

1. Variable charts involve the measurement of the job dimensions whereas an attribute chart only differentiates between a defective item and a non-defective item.
2. Variable charts are more detailed and contain more information as compared to attribute charts.
3. Attribute charts is based on 'GO and NO GO' data require comparatively bigger sample size.
4. Variables charts are expensive.

X-BAR CHART.

1. It shows changes in process and is affected by changes in process variability.
2. It is a chart for the measure of central tendency.
3. It shows erratic or cyclic shifts in the process.
4. It detects steady progress changes, like tool wear.
5. It is most commonly used variables chart.

X-BAR CHART.

6. When used along with R-bar chart :
   i. it tells you when to leave the process.
   ii. It secures information in establishing or modifying processes, inspection procedures.
   iii. It controls the quality of incoming material.

7. X-bar and R-bar chart when used together form a powerful instrument for diagnosing quality problems.

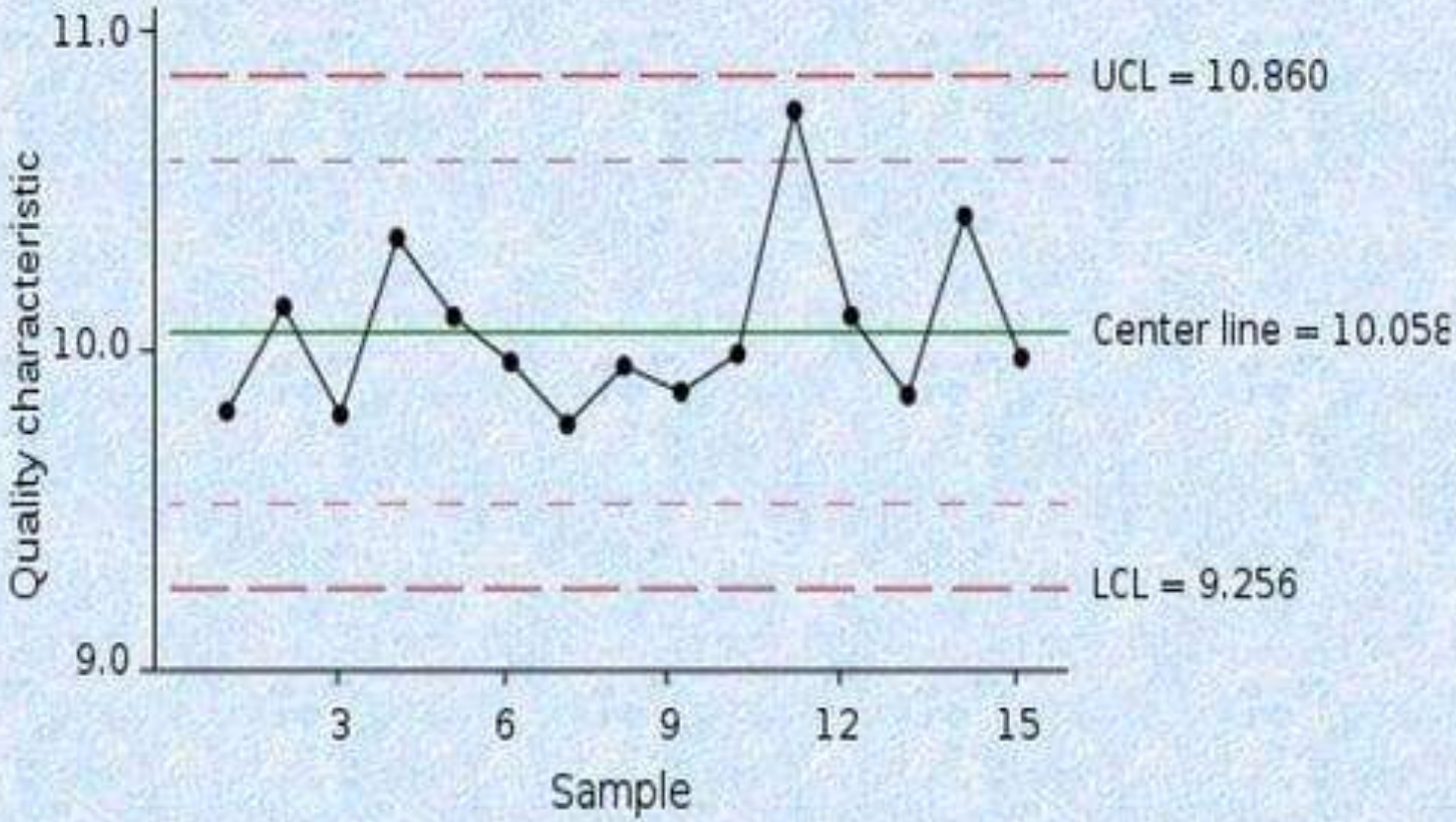
R-BAR CHART.

1. It controls general variability of the process and is affected by changes in process variability.

2. It is a chart for measure of spread.

3. It is used generally along with X-bar chart.

CHART DETAILS



APPROACH

- First Step: Determine what type of data you are working with.
- Second Step: Determine what type of control chart to use with your data set.
- Third Step: Calculate the average and the control limits.

Sample Data

Day	Percent	Day	Percent
1	.056	15	.068
2	.078	16	.038
3	.064	17	.077
4	.023	18	.068
5	.067	19	.053
6	.078	20	.071
7	.067	21	.037
8	.045	22	.052
9	.034	23	.072
10	.045	24	.047
11	.062	25	.042
12	.051	26	.051
13	.070	27	.064
14	.039	28	.071

EXAMPLE

- Now that you have calculated the three important lines for the control chart, plot the data and determine if the process is capable. (i.e. The data falls mostly inside the UCL, and the LCL)

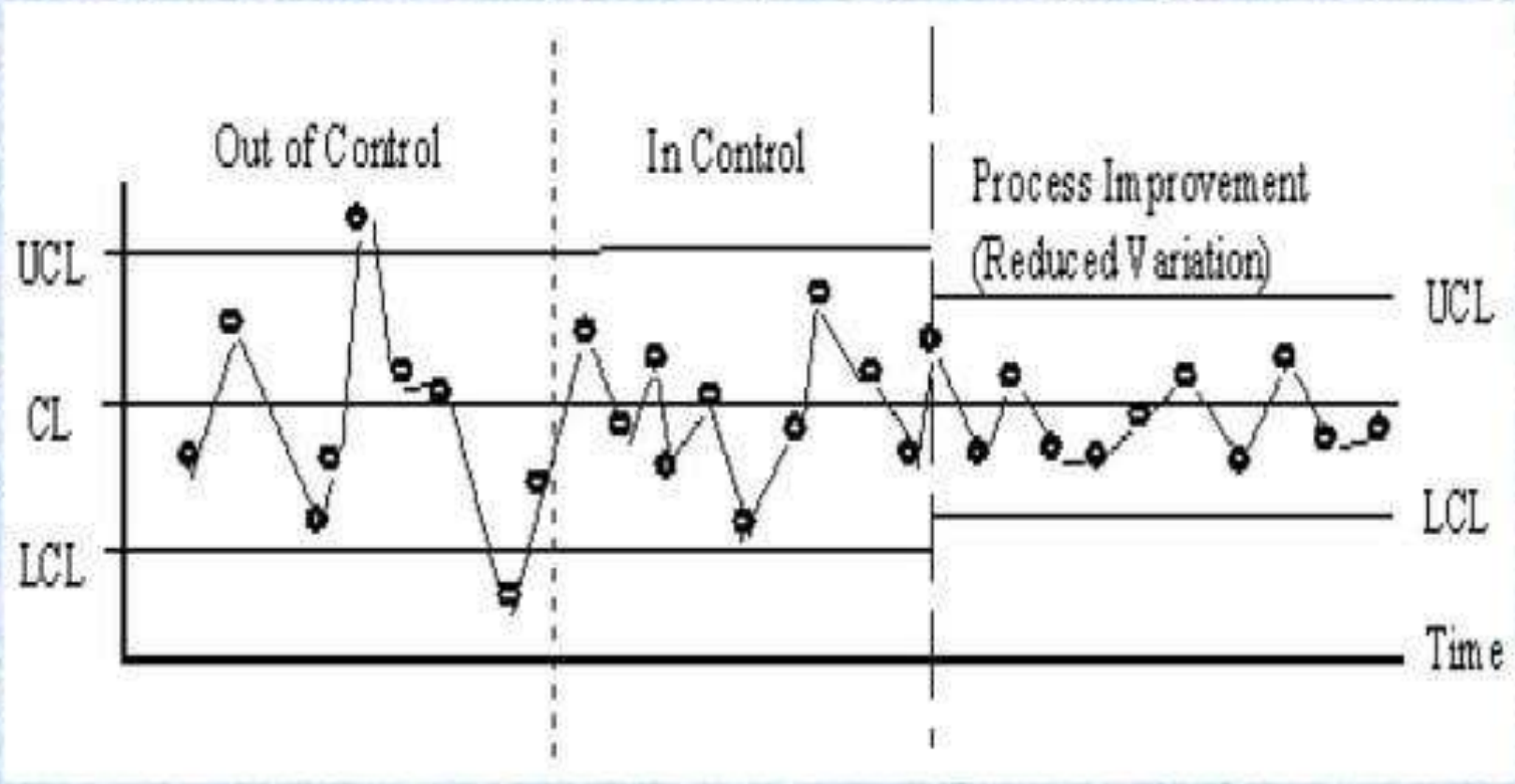
FINAL STEP

- Make a recommendation to your company.
  - The process is capable
  - The process is not capable
    - The following errors were found.
    - The process needs improvement
    - The variations are normal in the system and we must accept them.

CONTROL CHARTS

- The following control chart shows the improvement of a process. The standard deviation decreases as the process becomes more capable.

EXAMPLE OF CONTROL CHARTS



EXAMINE THE PROCESS

- A process is considered to be stable and in a state of control, or under control, when the performance of the process falls within the statistically calculated control limits and exhibits only chance, or common causes.

Case Study On Hospitality Industry Case Study

- By Kent Bauer,
  Information Management Magazine,
  August 1, 2005
- May and June issues of *DM Review*.

Subgroup Sample	Sample Time Frame	Wait Time Samples (in seconds)					
		First	Second	Third	Fourth	Range	x-bar
1	6 – 8 am	1.7	2.5	3.3	2.2	1.6	2.43
2	8 – 10 am	2.5	2.8	1.8	3.0	1.2	2.53
3	10 am - noon	2.8	3.6	2.4	1.8	1.8	2.65
4	Noon – 2 pm	1.9	3.2	3.8	2.6	1.9	2.88
5	2 – 4 pm	3.0	2.5	2.2	2.9	0.8	2.65
6	4 – 6 pm	2.4	3.6	4.1	2.8	1.7	3.23
7	6 – 8 pm	3.1	2.6	4.3	2.8	1.7	3.20
8	8 – 10 pm	4.5	3.5	4.1	4.8	1.3	4.23
	R bar =					1.50	
	x double bar =						2.97

FORMULAS

X-bar

$$\bar{X} = \frac{\sum (X_1 \ldots X_n)}{n}$$

n is the number of observations

$$\bar{\bar{X}} = \frac{\sum (\bar{X}_1 \ldots \bar{X}_k)}{k}$$

k is the number of subgroups

Upper control limit:

$$UCL_x = \bar{\bar{X}} + A_2 * \bar{R}$$

Lower control limit:

$$LCL_x = \bar{\bar{X}} - A_2 * \bar{R}$$

Range

$$Range = X_{max} - X_{min}$$

$$\bar{R} = \frac{\sum (R_1 \ldots R_k)}{k}$$

k is the number of subgroups.

Upper control limit:

$$UCL_R = D_4 * \bar{R}$$

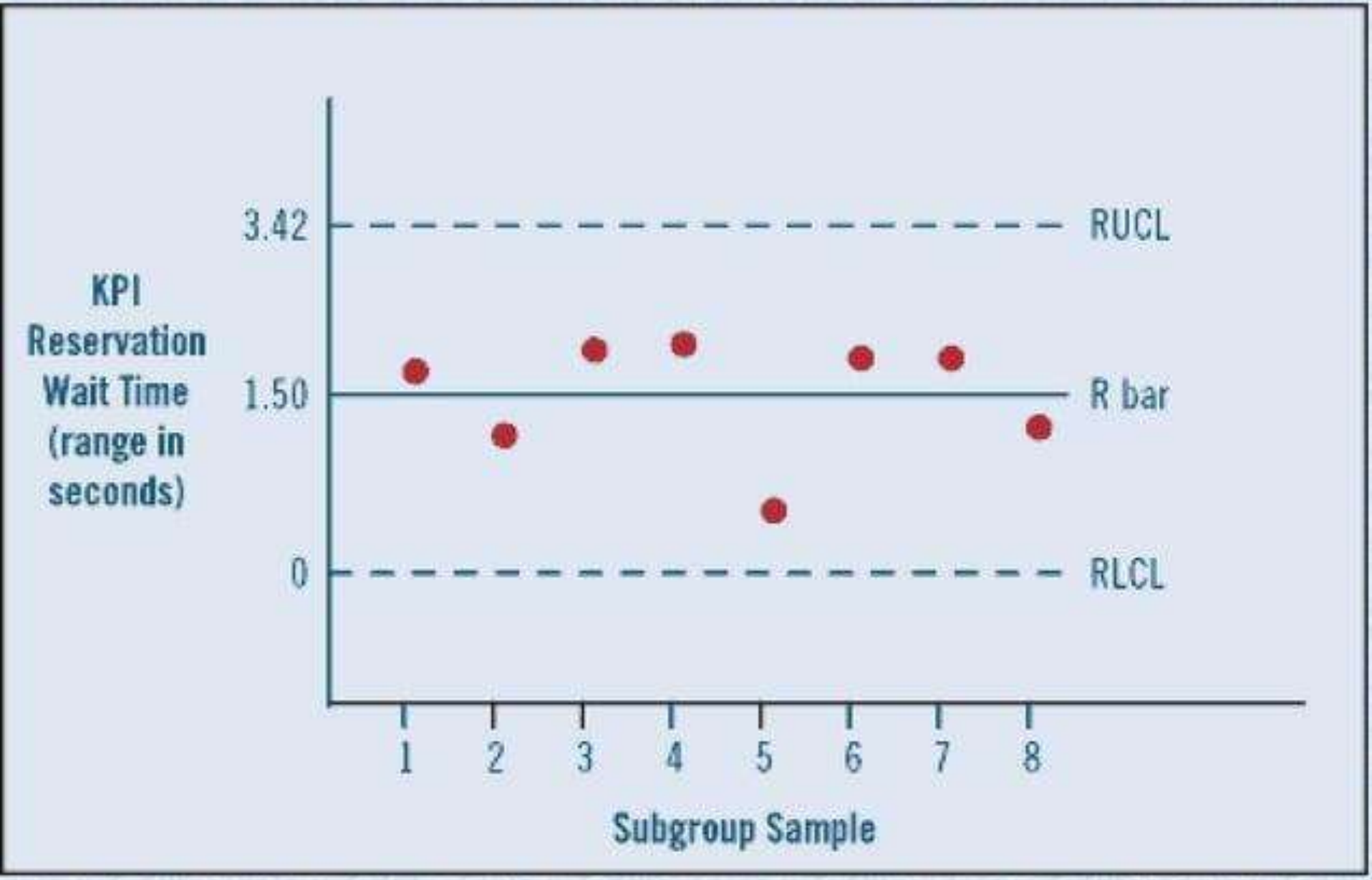
Lower control limit:

$$LCL_R = D_3 * \bar{R}$$

Tabular values for X-bar and range charts

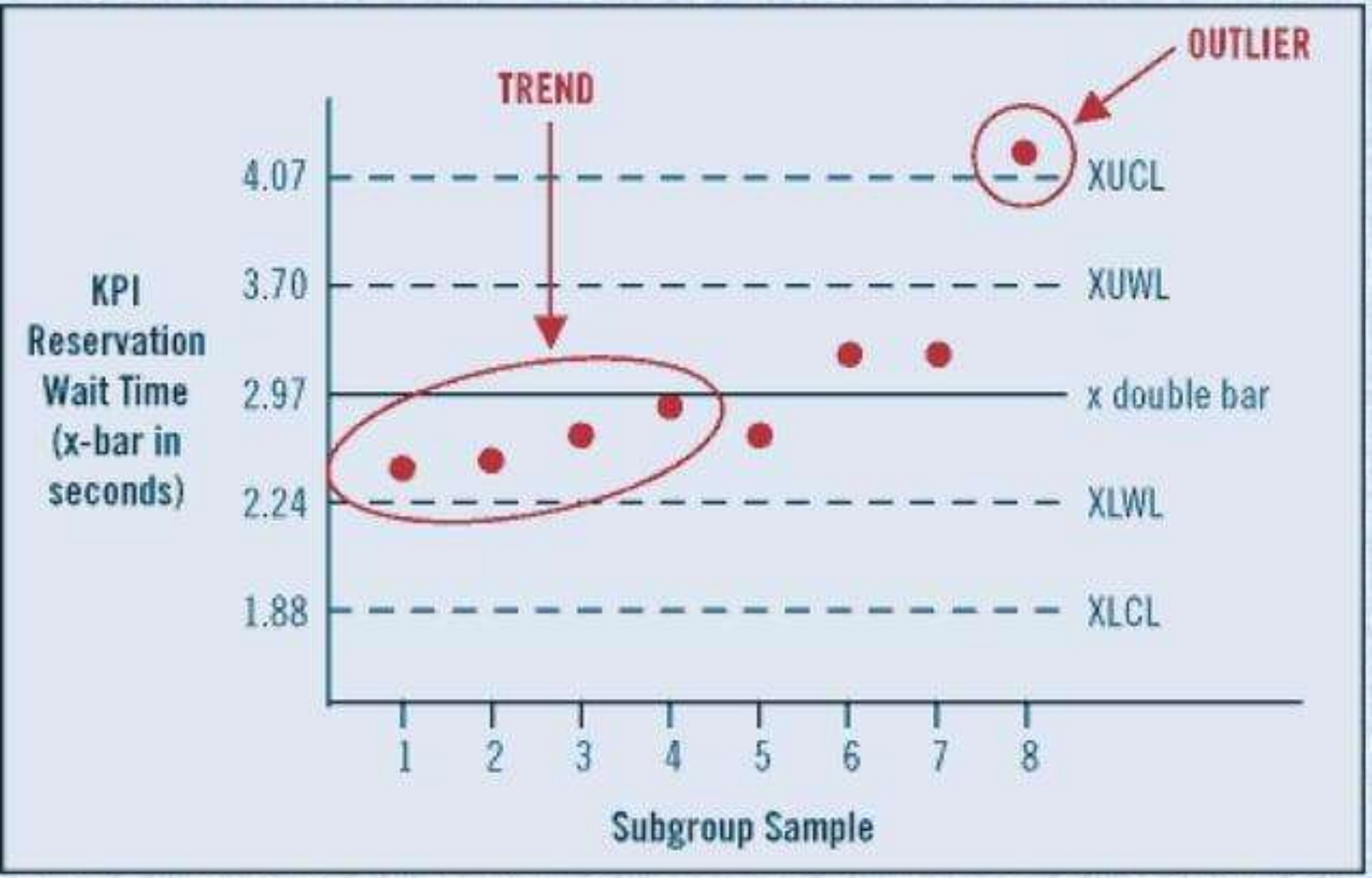
Subgroup Size	A_2	d_2	D_3	D_4
2	1.880	1.128	-----	3.268
3	1.023	1.693	-----	2.574
4	0.729	2.059	-----	2.282
5	0.577	2.326	-----	2.114
6	0.483	2.534	-----	2.004
7	0.419	2.704	0.076	1.924
8	0.373	2.847	0.136	1.864
9	0.337	2.970	0.184	1.816
10	0.308	3.078	0.223	1.777
11	0.285	3.173	0.256	1.744
12	0.266	3.258	0.283	1.717
13	0.249	3.336	0.307	1.693
14	0.235	3.407	0.328	1.672
15	0.223	3.472	0.347	1.653
16	0.212	3.532	0.363	1.637
17	0.203	3.588	0.378	1.622
18	0.194	3.640	0.391	1.608
19	0.187	3.689	0.403	1.597
20	0.180	3.735	0.415	1.585
21	0.173	3.778	0.425	1.575
22	0.167	3.819	0.434	1.566
23	0.162	3.858	0.443	1.557
24	0.157	3.895	0.451	1.548
25	0.153	3.931	0.459	1.541

Bar Chart Type	KPI Control Limit	Description	Formula	Value
X-bar	XUCL	Upper Control Limit	= (x double bar) + (A_2 factor)*(R bar) = (2.97) + (.73)*(1.50)	4.07
	XUWL	Upper Warning Limit	= (x double bar) + (2/3)*(A_2 factor)*(R bar) = (2.97) + (2/3)*(.73)*(1.50)	3.70
	XLWL	Lower Warning Limit	= (x double bar) – (2/3)*(A_2 factor)*(R bar) = (2.97) – (2/3)*(.73)*(1.50)	2.24
	XLCL	Lower Control Limit	=(x double bar) – (A_2 factor)*(R bar) = (2.97) – (.73)*(1.50)	1.88
Range	RUCL	Upper Control Limit	= (R bar)*(D_2 factor) = (1.50)*(2.28)	3.42
	RLCL	Lower Control Limit	= (R bar)*(D_3 factor) = (1.50)*(0)	0.00


KPI
Reservation
Wait Time
(range in
seconds)
3.42
1.50
0
RUCL
R bar
RLCL
1
2
3
4
5
6
7
8
Subgroup Sample

INTERPRET CONTROL CHART RESULTS

- Range chart first to ensure stability of KPI metric process: because no ranges are outside the RLCL or RUCL, the wait time process is in control


OUTLIER
TREND
4.07
XUCL
3.70
XUWL
KPI
Reservation
Wait Time
(x-bar in
seconds)
2.97
x double bar
2.24
XLWL
1.88
XLCL
1
2
3
4
5
6
7
8
Subgroup Sample

Interpret Control Chart Results

- Rule violation 1 - four consecutive data points in a row trending up or down merits a caution. This occurs in subgroups 1 to 4
- Rule violation 2 - one individual data point outside a control limit is a serious problem. This occurs for subgroup 8

THANK YOU