**Colorado Technical University**

 **Course:** MATH366 – Probability and Statistics

#### Unit 10 Part 20 Readings: QC

#### Process Control

The goal of quality control is to: Reduce variation in a product or a service

**Process data** are arranged according to time sequence

They measure characteristics of goods or services resulting from equipment, people, materials, methods, and other business conditions

Process data typically change over time

A process is **statistically stable** (or **within statistical control**) if it has natural

variation, with no patterns, cycles, or any unusual points

Only when a process is statistically stable can we assume the population has a

constant mean, standard deviation, distribution, and other characteristics

**Random variation** is due to chance; it is inherent in any process – it would be

impossible to produce every good or service exactly the same way every time

**Assignable variation** results from causes that can be identified (such as defective

machinery, untrained employees, and so on)

**Control charts** allow us to monitor data over time

These charts allow us to determine whether some process is statistically stable

(or within statistical control)

A control chart is a sequential plot of individual data values over time

The vertical axis is used for the data values

The horizontal axis is used for the time sequence

A control chart of a process characteristic (such as mean or variation) consists of values

plotted sequentially over time, and it includes a **center line** as well as a **lower**

**control limit (LCL)** and an **upper control limit (UCL)**

The centerline represents a central value of the characteristic measurements, whereas

the control limits are boundaries used to separate and identify any points

considered to be unusual

Upper and lower control limits of a control chart are based on the actual behavior of the

process, not the desired behavior

Upper and lower control limits are totally unrelated to any process specifications that

may have been decreed by the manufacturer

### When IS a Process Out of Statistical Control?

1. There is a pattern, trend, or cycle that is obviously not random

2. There is a point lying beyond the upper or lower control limits

3. Run of 8 Rule: There are eight consecutive points all above or all below the

 center line

Control Chart for the range (R-chart): can be used to determine whether the variation

of process data is within statistical control

 Plot the ranges of sequential subgroups (each of size n) of the data

Centerline: r-bar (mean of sample ranges)

Upper Control Limit (UCL): D4  r-bar (where D4 is found in Table 14-2)

Lower Control Limit (LCL): D3  r-bar (where D3 is found in Table 14-2)

**Control Chart for the mean (x-bar chart):** a plot of the sample means used to monitor

the center in a process

 Plot the sample means of sequential subgroups (size n) of the data

Centerline: x̿ denotes the mean of all sample means

The Word hotkey for x̿ is **alt-831**

Upper Control Limit (UCL): x̿ + A2r̄ where A2 is found in the table below

Lower Control Limit (LCL): x̿ – A2r̄ where A2 is found in the table below

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Sample Size | A2 |  | Sample Size | A2 |
| 2 | 1.880 |  | 14 | 0.235 |
| 3 | 1.023 |  | 15 | 0.223 |
| 4 | 0.729 |  | 16 | 0.212 |
| 5 | 0.577 |  | 17 | 0.203 |
| 6 | 0.483 |  | 18 | 0.194 |
| 7 | 0.419 |  | 19 | 0.187 |
| 8 | 0.373 |  | 20 | 0.180 |
| 9 | 0.337 |  | 21 | 0.173 |
| 10 | 0.308 |  | 22 | 0.167 |
| 11 | 0.285 |  | 23 | 0.162 |
| 12 | 0.266 |  | 24 | 0.157 |
| 13 | 0.249 |  | 25 | 0.153 |