Control Chart

Problem
How to monitor defects?

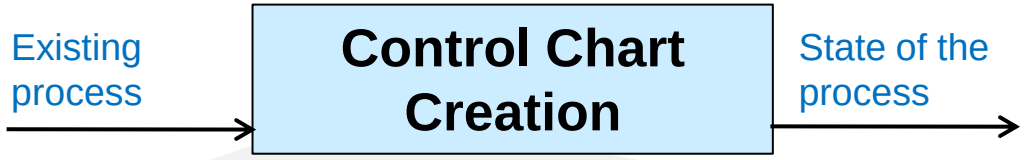
Difficulty
Some training required

1. A **Control Chart** shows how a process evolves over time. It is used to monitor, control, and/or improve a process.
2. A **Control Chart** includes a
   - center line (average)

   and the data boundaries
   - Lower Control Line (LCL)
   - Upper Control Line (UCL)
3. The LCL and UCL are three standard deviations from the center line (below and above).
4. There are 4 process states, see table below right.

There are 7 control chart types

1. **Discrete data**: c, np, p, u
2. **Continuous data**: Individual Moving Range (I-MR), average-range (Xbar-R), and average-sigma (Xbar-S).



1. Determine which of 7 types of control chart to use (see example). The choice depends on
   A. data type, whether it is continuous or discrete
   B. sample size and whether or not it is constant
   C. type of analysis to be performed
2. Collect the data
3. Perform needed computations
4. Plot the results of the computation
5. Analyze the plots for large variance or patterns.

State	In statistical control?	Data between LCL and UCL?	Process meets customer specifications?
Ideal	Yes	all	NA
Threshold	Yes	most	NA
Brink of Chaos	No	NA	Yes
Out of Control	No	NA	No

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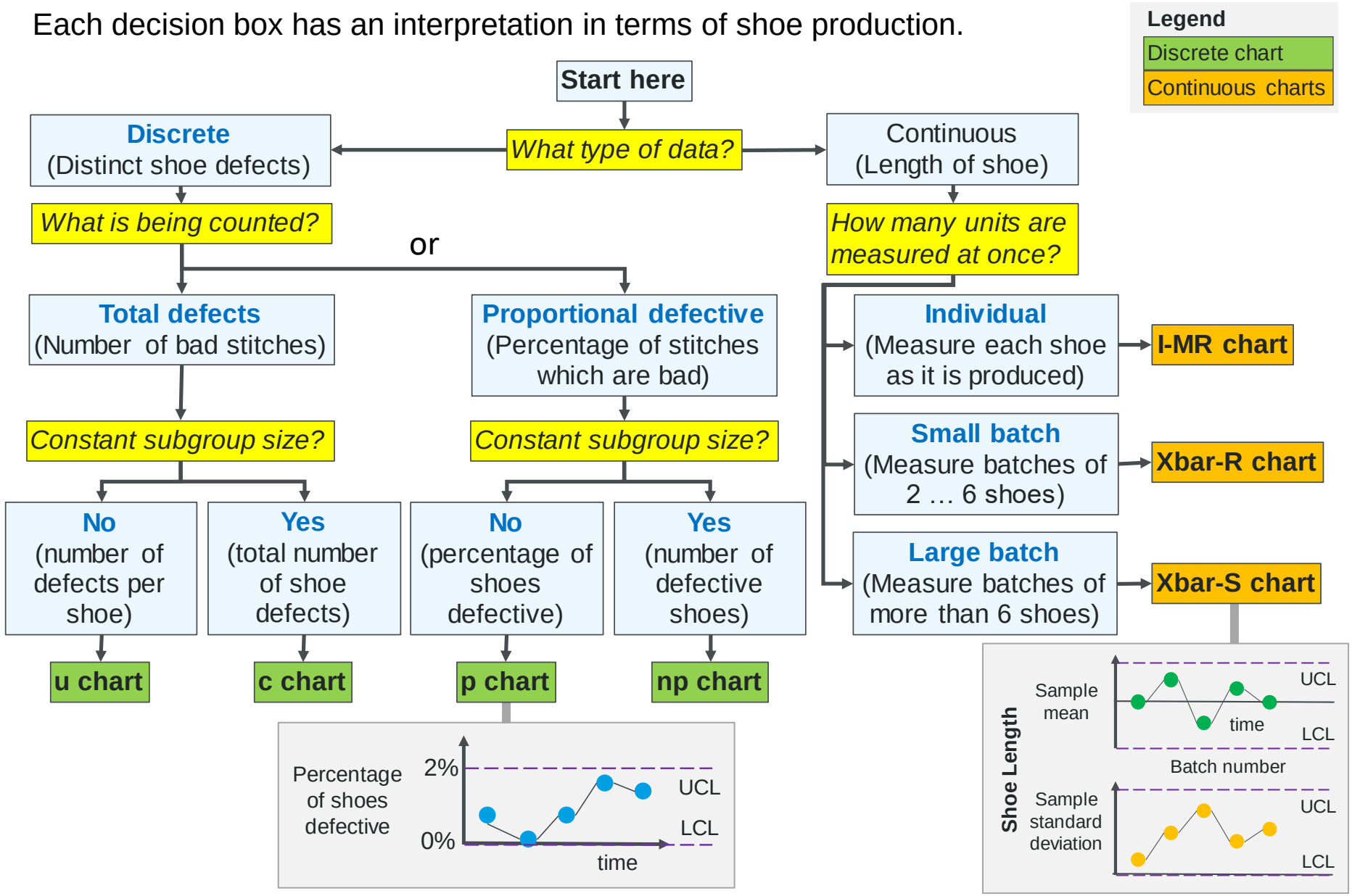
Control Chart – Example – Shoe Production

Each decision box has an interpretation in terms of shoe production.



Control Chart – Notes

Slide 1

1. The control chart (also called a *Shewhart chart* or a *process behavior chart*) was invented by Walter A. Shewhart.
2. Control charts show the Voice of the Process (VoP); see the 6in6 on Voice of the Customer.
3. A process in statistical control has consistent performance; it does not necessarily meet customer expectations. See the 6in6 on Statistical Process Control (SPC).
4. While analysis formulas are easy to find and use, using a statistical software package is recommended.
5. Control Chart guidelines
   A. While customers create specification limits, the UCL and LCL are computed. Specification values are *never* shown on a control chart.
   B. For an unchanging process, the UCL and LCL values are not changed.
   C. If a computed LCL value is negative, replace it with the value zero.
   D. Ensure that enough data is collected to make decisions; software packages will indicate when not enough data has been obtained.

Slide 2

1. This example shows what the 7 different types of control charts represent.
2. The example is for shoe production and indicates the different types of defects that might be interest:
   A. variation in a continuous value (such as shoe length), or
   B. variation in a discrete value (such as number of bad stiches per shoe, or the number of defective shoes).
3. For discreet data, a single chart is created. For continuous data, two charts are created.