30,000-foot-level Charting: Multiple Samples in Subgroups

By Forrest W. Breyfogle III

Time-series data that have multiple subgroup samples can be monitored over time for stability and then, when a process is stable, provide a prediction statement.

Consider that the data in Table 1 were collected using an infrequent subgrouping/sampling plan, which is consistent with a 30,000-foot-level charting methodology[1], and there were specification limits of 95 and 105 for the processôresponse.

Traditionally an $\bar{x}$ and R control chart methodology would be used to track this type of data over time; however, there are issues with this approach as described in X-bar and R Control Chart: Issues and Resolution.

Day	Sample One	Sample Two	Sample Three	Sample Four	Sample Five
1	102.7	102.2	102.7	103.3	103.6
2	108.2	108.8	106.7	106.6	109.1
3	101.9	103.0	100.6	101.4	101.3
4	103.9	105.5	104.3	104.5	104.5
5	97.2	99.0	96.5	94.9	96.5
6	94.4	93.0	93.0	95.2	93.6
7	104.7	103.6	103.7	104.7	104.5
8	102.5	102.7	101.2	100.6	103.1
9	101.9	103.1	101.0	101.2	101.4
10	95.0	95.3	95.3	94.4	94.2

From Table 12.1, *Integrated Enterprise Excellence Volume III - Improvement Project Execution: A Management and Black Belt Guide for Going Beyond Lean Six Sigma and the Balanced Scorecard*, Forrest W. Breyfogle III, Bridgeway Books/Citius Publishing, Austin, TX, 2008.

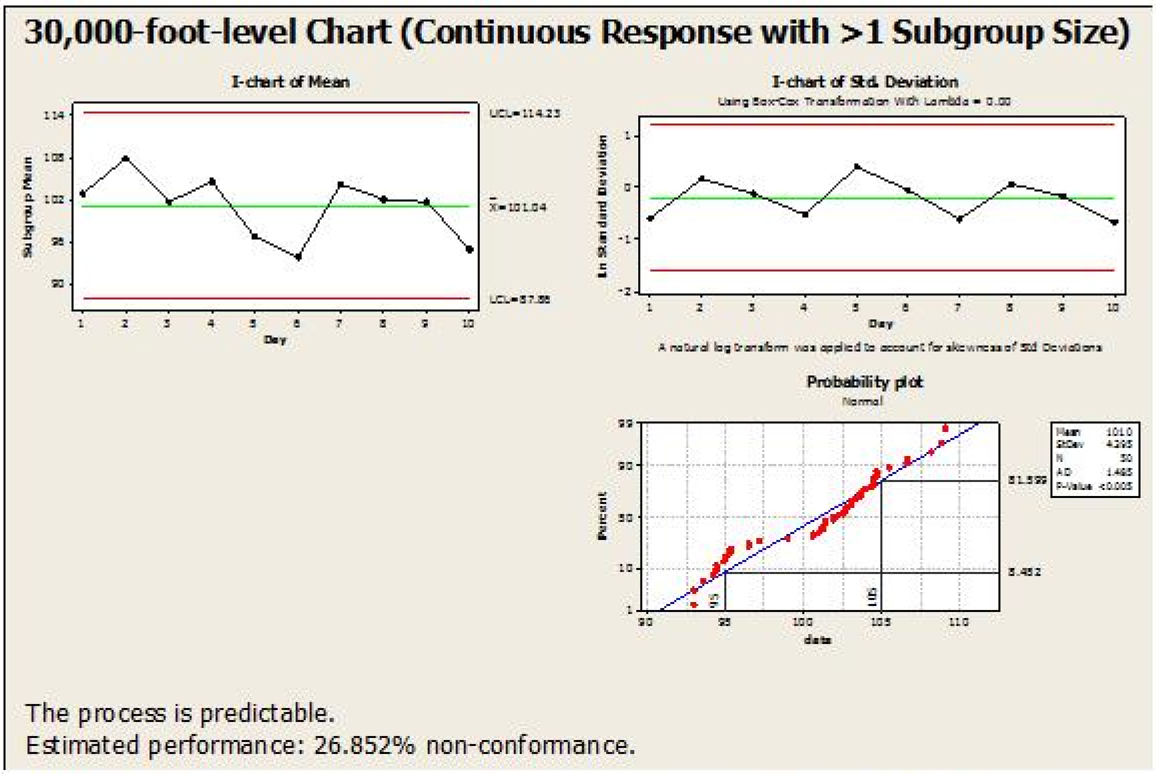
Table 1: Time series Data

These Table 1 data could be the completion time for five randomly-selected daily procedural transactions in an insurance company, hospital, or one-shift manufacturing facility. In the following analyses, focus will be given initially to the assessment of process stability and then, if stable, its process capability relative to customer specifications of 95 to 105.

Figure 1 provides a 30,000-foot-level chart of the response. From the individuals control charts of the mean and log of within subgroup standard deviation shown on the top of the report-out, the process is concluded to have a recent region of stability. This conclusion is made since there are no trends or data points outside the statistically -determined upper and lower control limits (UCL and LCL).

Since the process is considered to have a recent region of stability, it is concluded that the process is predictable. The up-and-down variability shown over time is from common-cause variability. The probability plot at the lower right side of the chart was created from all the raw data during the recent region of stability and provides a process-performance statement relative to the specification limits of 72 and 78. From this plot, a process capability/performance metric estimate of 26.853% non-conformance [(100-81.599) + 8.452 = 26.853] can be made.

Conclusions about this process and its performance relative to predictability and a prediction statement are described at the bottom of the 30,000-foot-level chart in this figure. These statements are written in terms that written in terms that everyone can understand.



Modified from Figure 12.9, *Integrated Enterprise Excellence Volume III - Improvement Project Execution: A Management and Black Belt Guide for Going Beyond Lean Six Sigma and the Balanced Scorecard*, Forrest W. Breyfogle III, Bridgeway Books/Citius Publishing, Austin, TX, 2008.

Figure 2: 30,000-foot-level Chart[2]

Reference X-bar and R Control Chart: Issues and Resolution for a more detailed explanation of the methodology summarized in this paper.

Summary

The estimated unacceptability rate can be expected in the future unless something changes. To improve a processô common-cause level of performance when reported at the 30,000-foot-level, the process needs to be enhanced; e.g., through a Lean Six Sigma improvement project.

30,000-foot-level Charting Applications

The described 30,000-foot-level charting technique has many applications, as described in 30,000-foot-level Performance Reporting Applications.

References

1. Forrest W. Breyfogle III, *Integrated Enterprise Excellence Volume III - Improvement Project Execution: A Management and Black Belt Guide for Going Beyond Lean Six Sigma and the Balanced Scorecard*, Bridgeway Books/Citius Publishing, 2008
2. Figure created using Enterprise Performance Reporting System (EPRS) Software

About the Author
Forrest Breyfogle, III
Integrated Enterprise Excellence

In a professional career spanning over a quarter century, Forrest Breyfogle has established himself as a leading edge thinker, a prolific author, an innovative consultant, a world-class educator, and a successful business executive. His work is documented in eleven books and over ninety articles on the topic of quality improvement.

A professional engineer, Forrest is also a member of the board of advisors for the University of Texas Center for Performance Excellence. He is the founder and CEO of Smarter Solutions, Inc., an Austin, Texas based consulting firm offering business measurement and improvement consultation and education to a distinguished list of clients worldwide, including BAMA, CIGNA, Dell, HP, IBM, Oracle Packaging, Sherwin Williams, Cameron, TIMET, and TATA. He served his country on active duty in the US Army for 2 years, and has played an active leadership role in professional and educational organizations. Forrest received the prestigious Crosby Medal from the American Society for Quality (ASQ) in 2004 for his book, *Implementing Six Sigma* (second edition). This award is presented annually by the American Society for Quality to the individual who has authored a distinguished book contributing significantly to the extension of the philosophy and application of the principles, methods, or techniques of quality management. Mr. Breyfogle was named Quality Professional of the Year for 2011 by Quality Magazine and in 2012 was awarded alumni of the year by Missouri University of Science and Technology.

He is a widely recognized authority in the field of management improvement and is a frequent speaker before professional associations and businesses. His earlier work in the field of management science has been widely acclaimed. A previous book, *Implementing Six Sigma*, sold over 40,000 copies and still ranks among the top Amazon books in Applied Mathematics/Engineering Statistics and Industrial Engineering /Quality Control.

He founded Smarter Solutions in 1992 after a 24-year career at IBM. The associates of Smarter Solutions specialize in helping companies throughout the world improve their bottom line and customer satisfaction through the implementation of techniques that are beyond traditional Lean Six Sigma and the balanced scorecard methodologies. His latest and most extensive work has been in the documentation of a new system of enterprise management, the Integrated Enterprise Excellence (IEE) system, in a series of four books. IEE provides a detailed roadmap that builds on and integrates the best practices of earlier disciplines like Six Sigma, Lean, TQM , PDCA, DOE, and TPS combined with innovative analytical tools to produce improvements at the highest level of an enterprise.

In addition to assisting hundreds of major clients in the wise implementation of improvement systems worldwide, Forrest has also developed over 300 hours of classroom instruction used to train executives, managers, and Black Belt practitioners to plan for, implement, and manage IEE systems. He also leads formal seminars and workshops worldwide.

Forrest Breyfogle
forrest@smartersolutions.com
512-918-0280 x401
www.smartersolutions.com