DATA ANALYSIS

An App Alternative

New process capability reporting app and how-to business management enrichments

by Forrest W. Breyfogle III

With traditional process capability C_p, C_{pk}, P_p, and P_{pk} indexes reporting, there are basic "elephant in the room" problems. These not-talked-about process capability indexes reporting issues include:

Is the process stable? If the process is unstable, reported process capability indexes values are invalid. How would you know whether a process is stable because a traditional process capability-report-out only provides process capability indexes and no time-series information?

Is the data collection relative to subgrouping appropriately considered and analyzed? C_p and C_{pk} values could be different for data subgrouping vs. no data subgrouping the response from a process.

Are any data non-normality considered appropriately in the reported process capability numbers? Traditional C_p, C_{pk}, P_p and P_{pk} report-outs do not address data non-normality effectively.

How can a process capability statement be determined when there is no specification? A specification is a requirement for traditional process capability reporting. But organizations must understand the capability of a process that does not have an actual specification (for example, the lead-time response from an operation).

How can a statistical process improvement be communicated effectively (and when any change occurred) with process capability indexes reporting to avoid confusion? You cannot achieve this important objective with a traditional process capability report-out, which does not include process tracking over time.

Should a C_p and C_{pk} criteria or P_p and P_{pk} criteria be specified for a process output response? Often, organizations select a C_p and C_{pk} criteria, but determining these values from subgrouped data only reflects the variability within subgroups. Variability between subgroups can be a critical consideration when determining how well a process performs relative to a customer's specification.

What do process capability indexes truly mean relative to the achievement of customer requirements so the report-out leads to the most appropriate actions or nonactions? *Everyone* throughout an organization should easily understand from a report-out how well a process performs relative to customer desires, which traditional C_p, C_{pk}, P_p and P_{pk} reporting does not provide.

How can process capability statements be interpreted and explained to avoid confusion about how good or unsatisfactory a process response is relative to its customer's specs? This determination isn't an easy, if not impossible, desire to complete with traditional process capability indexes reports.

TABLE 1

Operating expense

Month	Expense
1/1/2018	$93,775
2/1/2018	$110,227
3/1/2018	$103,807
4/1/2018	$101,687
5/1/2018	$104,395
6/1/2018	$96,925
7/1/2018	$91,662
8/1/2018	$107,527
9/1/2018	$92,272
10/1/2018	$106,026
11/1/2018	$100,058
12/1/2018	$103,634
1/1/2019	$94,531
2/1/2019	$110,784
3/1/2019	$115,965
4/1/2019	$87,983
5/1/2019	$100,520
6/1/2019	$88,103
7/1/2019	$92,422
8/1/2019	$98,831
9/1/2019	$96,741
10/1/2019	$111,167

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For an attribute response, the reporting of process capability is different from a continuous response output, which can cause much confusion. Process capability indexes C_p, C_{pk}, P_p and P_{pk} are not applicable for a process output attribute pass-fail rate response. Organizations benefit when there is a consistent, easy-to-understand process capability reporting method for continuous and attribute data.

How can the critical concepts of process capability reporting be applied to the reporting of business metrics? Traditional process capability indexes reporting cannot fulfill this desire for many reasons, including business processes need over-time performance tracking and reporting on how well a process performs using words that everyone can understand easily—and all in one chart.

Process capability reporting should have the capability of providing an easy-to-understand predictive statement about expected future process output performance. When a futuristic projection is unsatisfactory, this undesirable anticipation would "pull" for a process improvement effort consideration. Traditional process capability indexes reporting cannot fulfill this beneficial organizational process-tracking-response-output function.

FIGURE 1

30,000-foot-level app report-out of operating expense

Identify the Excel file with data

File input

Browse... Management-2.0-Figure-9.7-Exp

Upload complete

Select the chart type and options

Choose the IEE Chart Type

No Subgroup

Select Plot Column

Expense

Method to determine capability?

Without a Specification

Use Median or Mean in capability?

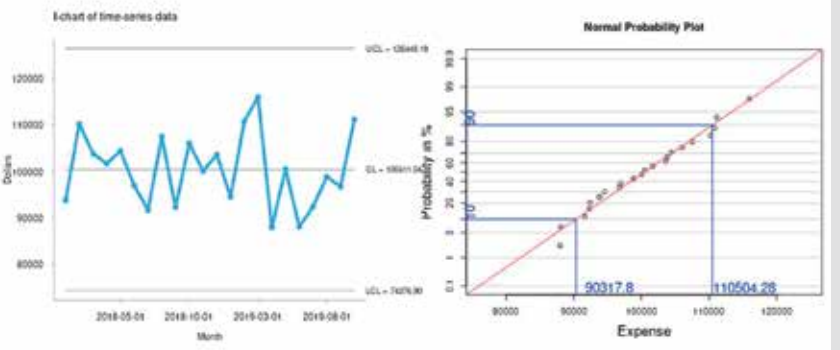
Mean

Stage Column Name

Column to use for I-chart X-axis (may not have repeat values)

Month

Expense



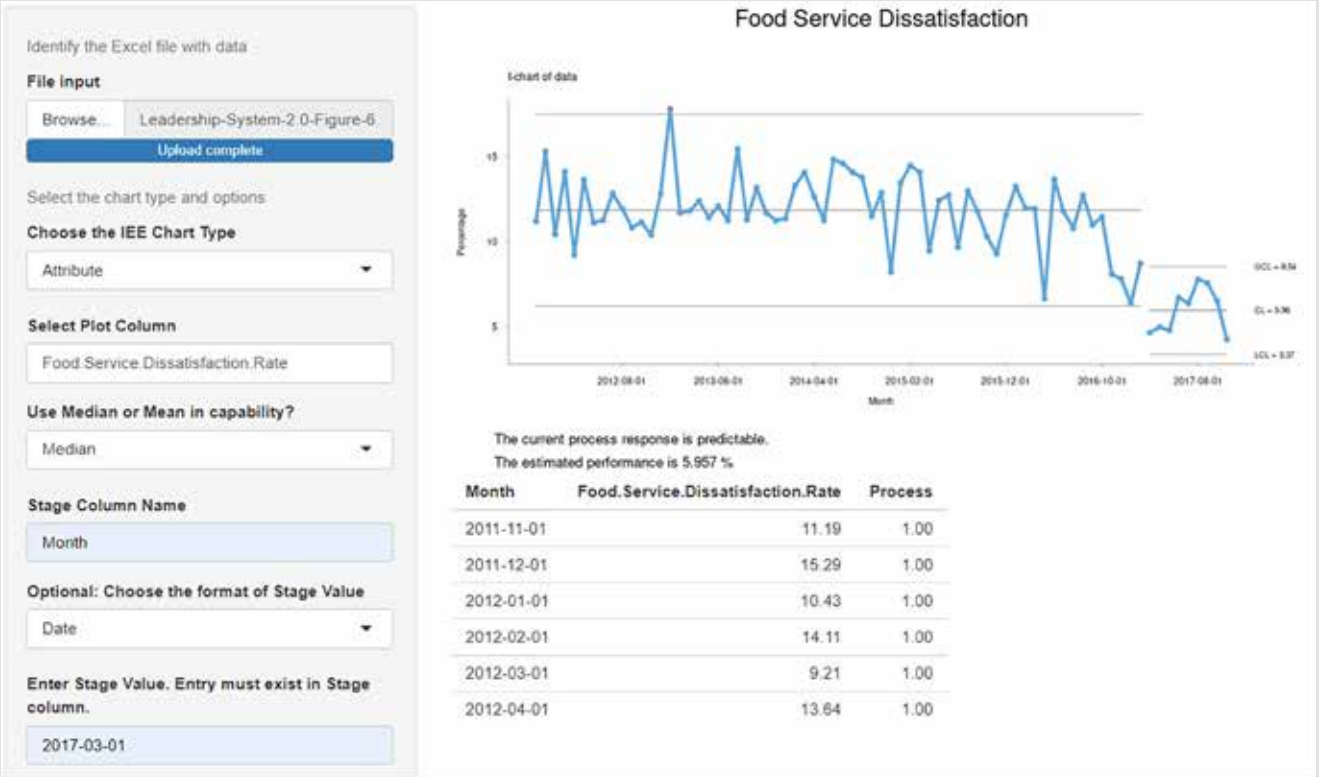
The current process response is predictable.

The estimated mean is 100411.04 with an 80% frequency of occurrence between 90317.8 and 110504.28

Month	Expense
2018-01-01	93774.99
2018-02-01	110227.47
2018-03-01	103807.24
2018-04-01	101687.46
2018-05-01	104394.58
2018-06-01	96924.90

FIGURE 2

30,000-foot-level app report-out of food service dissatisfaction rate



Month	Food.Service.Dissatisfaction.Rate	Process
2011-11-01	11.19	1.00
2011-12-01	15.29	1.00
2012-01-01	10.43	1.00
2012-02-01	14.11	1.00
2012-03-01	9.21	1.00
2012-04-01	13.64	1.00

An alternative to traditional reporting

Many of my previous QP columns and ASQ articles describe the benefits of 30,000-foot-level response output tracking and address all of the previously listed traditional process capability problems.[1] There's now a new stand-alone app (which happens to be free) that can create these 30,000-foot-level charts, does not require any statistical software and is not an Excel add-in.[2] This app can address various process output data formats: no subgrouping, subgrouping and attribute.

Creating a 30,000-foot-level chart is a two-step process:

1. Determine if a process is stable *from a high-level viewpoint*.
2. If a process is stable, report its process capability and performance from this *high-level perspective*.

With 30,000-foot-level reporting, process stability is determined from a high-level point of view using individual charts that consider the variability between subgroups as a source of common cause variability. To illustrate the app's application, consider the continuous response data set in Table 1 (p. 44). Figure 1 (p. 45) is a screenshot showing a snippet of the data set inputs and the app's created 30,000-foot-level chart.

For this continuous response data, there is no specification. Hence, a bottom-of-the-chart reporting from the normal probability plot is an estimated mean and 80% anticipated frequency of occurrence rate (that is, the estimated mean is 100,411 with an 80% frequency of occurrence between 90,317 and 110,504). This reporting is a prediction statement, noting a futuristic prediction statement applies because there are no data points beyond the upper and lower control limits—that is, the process is considered stable.

When there is a process-response specification, a reporting of the estimated percentage nonconformance rate for a stable process would appear at the bottom of the chart instead of an estimated mean or median and expected 80% frequency of occurrence.

READ MORE

Forrest W. Breyfogle III's *Management 2.0: Discovery of Integrated Enterprise Excellence* (Citius Publishing, 2020) discusses in a novel-book format the application of 30,000-foot-level metrics to seven situations. In addition, Breyfogle's *Leadership System 2.0: Implementing Integrated Enterprise Excellence* (Citius Publishing, 2020) provides a discussion for 13 separate 30,000-foot-level reporting situations in a novel-book format.

Concepts described in chapter six of *Leadership System 2.0: Implementing Integrated Excellence* depict a method of integrating 30,000-foot-level metrics reporting throughout a business for the incorporation of an enhanced business process management and management information system, which addresses the objectives of W. Edwards Deming's philosophy, Malcolm Baldrige criteria, Shingo Prize and ISO 9001—at the same time.

With this app, you can save the 30,000-foot-level graph as a PNG file to use elsewhere (for example, a PowerPoint or Word document) with a right-click of a mouse on the chart.

To illustrate the application of this app for an attribute nonconformance rate response and use of the app to address process change, consider the data set in Online Table 1, which can be found on this column's webpage at qualityprogress.com. Figure 2 shows the resulting 30,000-foot-level app-created chart.

With this app, when a process change occurs, there can be a staging of the process response (2017-03-01 date in this example). The metric app determines the estimated prediction rate reported at the bottom of the chart (5.957% in this example) from the data after the staging.

For attribute data, instead of a probability plot to determine process capability, the individuals chart's centerline provides the estimated process capability—if there was no use of a data transformation when creating the individuals chart using the app.

The 30,000-foot-level reporting offers a similar statement at the bottom of a created 30,000-foot-level report-out when a specification exists for continuous response and attribute data. Managers and others throughout an organization can read the bottom-of-the-chart statement to determine whether any action or nonaction is appropriate relative to the stated process-output response.

An action undertaking could be a process improvement effort or address any special cause event signal. If a message at the bottom of the graph indicates stability, but the futuristic expectation statement is undesirable, this unsatisfactory prediction "pulls" to create a process improvement effort consideration.

The Enterprise Performance Reporting System (EPRS)-metrics free app addresses all the previously listed traditional process capability reporting "elephant-in-the-room" issues, including non-normal data.

A click of the mouse

Many of my previous articles describe how organizations can use 30,000-foot-level charts to monitor the stability and capability of business metrics throughout an organization. An Integrated Enterprise Excellence (IEE) value chain accomplishes this, in which the organization's processes are linked to their process-created 30,000-foot-level responses.

This IEE value chain can be clickable throughout an organization and automatically updated (for example, daily) with behind-an-organization-firewall IEE EPRS system software.[3]

Online Figure 1 illustrates the click down of an organizational value chain from the enterprise level (right side of the figure) to "Produce and Deliver Services" (left side of the figure). The figure's left portion top swim lane contains the metrics for this organizational function reported in a 30,000-foot-level response tracking format. In contrast, the bottom swim lane has the associated processes, which have capabilities for further drill-downs. **QP**

WATCH A WEBINAR

In January, Forrest W. Breyfogle III presented on the topic described in this column and provided more details about the techniques highlighted in this article. Access the recording of this ASQ Quality Management Division webinar at https://youtu.be/KHXAIyeF8mg.

EDITOR'S NOTE
References listed in this column can be found on the column's webpage at qualityprogress.com.

Forrest W. Breyfogle III (Forrest@SmarterSolutions.com) is CEO of Smarter Solutions Inc. in Austin, TX, and holds a master of science degree in mechanical engineering from the University of Texas in Austin. An ASQ fellow, Breyfogle has authored or coauthored more than a dozen business management and process improvement books.