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When, Why and How Shewhart Control Chart Constants need to be changed?

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Shewhart Control Charts (ShCCs) are part and parcel of stability and capability analysis of any process. They have long since been known and widely used all over the World. The performance of ShCCs depends critically on the values of control limits which in turn depend on the values of so-called control chart constants that are considered invariable (for any given sample size) in all SPC literature for practitioners (standards, guides, handbooks, etc.).

On the other hand, many researchers proved that for non-normal distribution functions (DF) the control limits may notably differ from standard values. However, there have not been even discussion about changing the values of ShCCs constants yet. Meanwhile, this is, obviously, the simplest (for practitioners) way to take the effect of non-normality into consideration.

Firstly, we discuss what specific change of the chart constants should be taken into account. Secondly, we simulated different DFs lying in different places of the well-known (β_1-β_2) plane and calculated (by direct simulation) the values of the bias correction factors (d_2, d_3, d_4) which are the basis for all chart constants. Our results agree very well with the previous data, but the further analysis showed that the impact of non-normality on the ShCCs construction and interpretation in no way can't be neglected. Thirdly, we suggest rejecting the prevalent belief of constancy of the control chart constants and explain when and how they should be changed.

Keywords

Shewhart control chart control chart constants non-normality

Special/invited session

Primary authors: SHPER, Vladimir; SHEREMETYEVA, Svetlana (NUST MISiS)

Presenter: SHPER, Vladimir

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