
**Statistical methods for
implementation of Six Sigma —
Selected illustrations of distribution
identification studies**

*Méthodes statistiques pour la mise en œuvre du Six Sigma - Exemples
choisis d'études d'identification de la distribution*

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Foreword

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Introduction

Many statistical techniques assume that the data to be analysed come from a given distribution (or population). Such assumptions are crucial to the effectiveness of subsequent statistical inference methods. In the Six Sigma community, when using such statistical methods, one needs to consider whether this assumption is reasonable. More generally, sometimes it is interesting and necessary to find the distribution which generated the data set (or sample) at hand. Identification of the distribution may provide some ways to answer this question. It consists of finding a distribution (or a family of distributions) which provides a good representation of a sample.

The distribution identification within Six Sigma projects should ideally be performed before the end of the Measure phase and can continue throughout the other phases of the DMAIC. From a Six Sigma perspective, the distribution identification can have multiple purposes based on the considered phase. It is used, for example, to characterise a baseline of the process performance, during the Measure or Analyse phase, to characterise the new process during the Improve phase, and to continuously monitor the process performance during the Control phase to ensure that the change is sustained. From a statistical perspective, distribution identification may be helpful to find appropriate statistical techniques for the related data, since many parametric statistical inference methods need certain distributional assumptions.

In general, distribution identification methods may be used as a tool to:

- a) verify that a distribution used historically is still valid for the current data;
- b) choose the appropriate distribution.

The choice of appropriate distribution should be guided by the knowledge of physical phenomena or the business process. It is recommended to start from a tentative theory to avoid just curve fitting.

In practice, there is always certain context or business background which can be used in determining the distribution. For example, under some circumstance, one can expect the measurement error is normally distributed. In reliability fields, the life distributions for certain products are exponential, lognormal, Weibull, or extreme distributions and so on. However, when such knowledge is not available, the possible underlying distribution for the data should also be identified if one wants to use parametric statistical methods. In this case, exploratory data analysis methods should be used to gain a better understanding. Through graphical visualisation methods, one could form a hypothesis on the possible distributions, stratification of the data or other aspects. Once the hypothesis is formed, hypothesis testing, including goodness of fit testing, can be applied to check one's guess. Finally, a suitable distribution may be found for the data.

In some commercial software packages including MINITAB¹⁾, SAS-JMP¹⁾ and Q-DAS¹⁾, although there are buttons for distribution identification, one should take knowledge of context and process related to data into consideration instead of simply relying on the software packages. Otherwise, misleading results can be given.

1) MINITAB is the trade name of a product supplied by Minitab Inc. JMP is the trade name of a product supplied by SAS Institute Inc. Q-DAS is the trade name of a product supplied by Q-DAS GmbH. This information is given for the convenience of users of this document and does not constitute an endorsement by ISO of these products.

