

Modified chain sampling plans for variables inspection

Stijn Luca

Ghent University,
Department of Data Analysis and Mathematical Modelling
Ghent, Belgium

An acceptance quality control system utilize sampling plans to maintain and improve existing levels of quality in a production process. The purpose of acceptance sampling is to develop decision rules to accept or reject production lots based on sample data and to protect against irregular degradation of the quality of a supplier's process. When testing is destructive or expensive, dependent sampling procedures cumulate results from several preceding lots. This chaining of past lot results reduces the required size of the samples.

Modified chain sampling plans are a particular case of dependent sampling plans that chain past lot results when the current lot is free from nonconforming units while it rejects the current lot when a nonconforming unit is found. This is in contrast with existing dependent procedures that only chain past lot results when defective units are found in the current lot. The modified procedure was first proposed by Govindaraju [1] in case of attributes inspection based on a Poisson model. It was shown that the use of quality history when the lot is free from nonconforming units can lead to a reduction in sample size. Recently, the approach was extended to variables inspection where the measurements were assumed to be drawn from a normal distribution with known variance [2].

In this work, the modified procedure for variables inspection will be extended in case the variance is unknown. Firstly, an overview of existing modified procedures is given. Secondly, the operating procedure is extended to the case of variables inspection where the standard deviation is not known. A Bayesian update-process is proposed to estimate the unknown standard deviation in an incremental manner based on the measurements from the lots. Furthermore, an interpretation is given to the parameters of a modified chain sampling plan in terms of consumer's risk and expected average run length.

Search procedures for a two-point design of modified chain sampling plans will be used to compare the sample sizes required by a modified procedure with those required by a single sampling and a multiple dependent state sampling procedure.

The proposed approach is illustrated on a case study from food industry where destructive tests on eggs are performed on incoming shipments. A modified chain sampling procedure is applied that can result in a reduce of drop-out during a peeling process of cooked eggs when compared to a multiple dependent state or a single sampling plan.

[1] K. Govindaraju and C. Lai, A modified ChSP-1 chain sampling plan, MChSP-1, with very small sample sizes, *American Journal of Mathematical and Management Sciences* 18 (1998), pp. 343–358.

[2] Luca S.. Modified chain sampling plans for lot inspection by variables and attributes. *Journal of Applied Statistics*. 2018;45(8):1447-1464.