Nonparametric Predictive Inference for Acceptance Sampling with Destructive Tests

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Abstract

Coolen [2] presented lower and upper probabilities for prediction of Bernoulli random quantities, which followed from an assumed underlying model similar to Bayes' original representation, yet without a prior distribution. In this approach, future outcomes of random quantities are related to observations by Hill's assumption $A_{(n)}$ [4]. The results by Coolen [2] form part of a wider statistical methodology called 'Nonparametric Predictive Inference' [1]. In the research reported here, we have studied an application of these lower and upper probabilities, full details are presented elsewhere [3].

An important scenario in quality and reliability applications is acceptance sampling, where items from a production process are tested in order to decide on whether or not to accept a batch of items. A specific form of such testing appears when the test result is simply whether or not a tested unit functions, which is known as 'attribute acceptance sampling'. We explicitly consider destructive testing, meaning that the tested unit cannot be used again, and corresponding attribute acceptance sampling is considered from nonparametric predictive perspective, with the inferences explicitly in terms of the untested units in the batch which are required for use after testing. It is considered what can be derived in this theory, with only few assumptions used, and with inferences in terms of lower and upper probabilities for the event that the batch will satisfy a suitable reliability criterion in the process after testing. Results for single-stage sampling are summarized, and two-stage sampling is discussed. Generally, many items need to be tested and no strong guidance on choice of test numbers can be given before some actual testing has taken place, which is a consequence of using only few modelling assumptions and no information in addition to the test data.

Keywords. acceptance sampling; lower and upper probability; Nonparametric Predictive Inference; imprecise probabilities; interval probability.

References

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