STAT 335: Course Aims and Objectives

Learning outcomes

The numbered items below each state a learning aim for the course, and the items that follow indicate the learning outcomes (or objectives) through which that aim could be deemed to have been satisfied. The course commences with a review of relevant material encountered in pre-requisite courses such as STAT 200/241/251 and BIOL 300. Although no learning outcomes are stated here related to ideas met in a pre-requisite course, it is expected that learners can correctly apply those concepts to problems in a quality assurance setting.

Each numbered collection of outcomes corresponds, approximately at least, to a chapter of material in the course notes.

1. Appreciate and apply key methodology of inspection sampling in quality assurance.

   (a) Define and explain the terminology relevant to acceptance sampling schemes, including AQL, LQL, consumer's and producer's risks, OC, ASN.

   (b) Compute probabilities from a Hypergeometric distribution.

   (c) Recognize which Hypergeometric distributions are relevant to evaluating a particular sampling scheme.

   (d) Determine producer's and consumer's risks based on all other relevant information about a sampling scheme, using software if need be.

   (e) Determine whether a sampling scheme meets stipulated requirements based on relevant information about the scheme, using software if need be.

   (f) Compute, with software if need be, and interpret the OC curve for a sampling scheme.

   (g) Explain how the OC for a sampling scheme will vary with changing the lot size, the sample size and the acceptance criterion.

   (h) Explain the principles governing double sampling schemes.

(i) Compute and interpret the expected sample size for a double sampling scheme.

(j) Explain the principles governing sequential sampling schemes.

(k) Derive the criteria governing the decision rules in a sequential sampling scheme.

(l) Compute and interpret approximations to the OC and ASN for a sequential sampling scheme.

(m) Calculate and interpret tolerance limits for a Normal variable with mean μ and variance σ^2, including upper, lower and interval limits, in the cases where one or both of the parameters μ and σ are unknown.

(n) Explain the principles governing sampling schemes when sampling for a continuous variable.

(o) Compute and interpret an approximation to the OC sampling scheme for a continuous variable.

2. Demonstrate an understanding of key concepts in statistical process control, and be able to apply those concepts where appropriate.

   (a) Define and identify common and special causes of variation in a process.

   (b) Recognize possible difficulties when repeatedly sampling from a process.

   (c) Calculate percentages of output falling inside and outside specification limits determined by USL and/or LSL values, assuming a Normal distribution for the output variable.

   (d) Compute and interpret process capability indices C_p and C_{pk}.

   (e) Create and interpret examples of each of Ishikawa's tools in SPC.

   (f) Compare two Pareto charts via a test based on standardized residuals.

3. Create and interpret most common forms of control charts used in modern quality assurance.

(a) Define, construct and interpret various types of Shewhart control charts, including p-charts, np-charts, $\bar{x}$-charts, s-charts and r-charts.

(b) Explain issues regarding estimation of parameters in control charts, and apply common estimation methods for these charts.

(c) Create and interpret upper and lower Page charts, given formulae for the threshold parameters.

(d) Derive the formulae for the threshold parameters for upper and lower Page charts, given the probability distribution for the data.

(e) Create and interpret EWMA charts to detect the change in the mean of a process, given the parameter λ.

(f) Explain the role of the parameter λ in EWMA charts.

(g) Derive and interpret properties of the EWMA chart statistic, in particular its mean and variance.

4. Apply the theory and methodology of one–way and two–way analysis of variance to data collected in a quality assurance context.

   (a) Define and describe the models in one and two–factor ANOVA situations, including all assumptions and constraints.

   (b) Interpret the sums of squares that arise in one and two–way ANOVA.

   (c) Derive and interpret the equations involving sums of squares in ANOVA that give rise to the standard tests.

   (d) Compute statistics from relevant information to carry out standard ANOVA tests in one and two–factor designs, including a multiple–comparison test in one–way ANOVA situations.

   (e) Explain and identify interaction in two–way ANOVA situations.

5. Show an appreciation of factorial designs in quality control, particularly the advantages and construction of such designs.

   (a) Define what is meant by a factorial design, and describe the main features of such a design.

   (b) Describe the advantages of factorial designs, including the advantages over "one–at–a–time" designs.

(c) Compute contrasts to estimate effects in factorial designs, and interpret these estimates.

(d) Compute and interpret the ANOVA table for a factorial design, and if possible determine which effects, if any, could be excluded from the model for the data.

(e) Explain the use of blocking in factorial designs, including the concept of confounding.

(f) Construct block designs for 2^p studies.

(g) Identify the defining contrast(s) and any generalized interaction(s) for a given block design.

(h) Explain the use of fractional factorial designs, including the concept of aliasing.

(i) Construct fractional factorial designs for 2^p studies.

(j) Identify the defining contrast(s) and alias groups for a given fractional factorial design.

(k) Compare different 2^{p-k} designs based on their alias groups.