System reliability and statistical quality control - 6 CFU, a. a. 2010/2011

**Elements of probability theory:** random experiments, sample space, events and operations on events. Probability. Conditional probability. Independent events. Bayes' theorem.

**Random variables:** probability distribution, distribution function, mean and variance, standard deviation, discrete uniform, binomial, geometric, Pascal, negative binomial, Poisson, hypergeometric random variables. Continuous random variables, density function, random variable uniformly continuous, Gaussian, exponential. How to use Matlab to calculate the laws of probability and their main.

**Vectors of random variables:** Joint probability distribution and marginal probability distribution with their properties; joint and marginal density function and its properties: the Gaussian case. Independent random variables, covariance and correlation; convolutions. The moment generating function and its role in the characterization of summation of random variables. Central limit theorem. Transformations of random variables: the chi-squared distribution, the T-student distribution, the Fisher distribution. The multinomial random variable. Applications: random sample, multivariate random samples.


Design of the production process: ANOVA (analysis of variance) with one factor. The mathematical model. Decomposition of the total variability in factor variability and error variability. Notched box-plots. Compare the level means by using Matlab. Residue analysis to validate the model. ANOVA with fixed effects and random effects. Block ANOVA and two-factors ANOVA without replication. Two-factors ANOVA with replication. Fisher exact test. The interactions between two factors. OFAT approach: to vary one factor at a time. Factorial experiments: response variable. Main effect of one factor, the effect of a factor response variable. \(2^k\) factorial designs: a study of the cases \(k = 2\) and \(k = 3\). Geometric interpretation. Evaluate the effects of interactions between factors. Graph of interactions. Tests on the interactions of factors. Using ANOVAN function in Matlab. Orthogonal factorial designs. Reduction of an orthogonal plan. Taguchi’s robust design. Loss function NB (normal is better), HB (high is better), LB (low is better). Evaluation of the loss function when the performance is random. Function signal / noise. Crossed plans.

Recommended texts.
- Murray R. Spiegel, 2/ed Statistics, Schaum Series