Syllabus

I. Course Name: Mathematics Statistics

II. Course description and objective

Content: Descriptive statistics. Point Estimation of Parameters. Confidence Interval. Tests of hypotheses. Simple linear regression. Multiple linear regression. Nonparametric statistics.

III. Compulsory

IV. Bachelor Program, 4th Term, 48 Hours, 5,5 Credits

V. Course content

`Section 1.` Descriptive statistics.
Describing data sets.
Frequency tables and graphs.
Histograms.
Summarizing data sets: sample mean, median, mode, variance, standard deviation, percentils, correlation coefficient.

`Section 2.` Special random variables.
Normal random variables.
Chi-square distribution.
The t-distribution.
The F-distribution.

`Section 3.` Distribution of sampling statistics.
Sampling distributions from a normal population.
Joint distribution of $\overline{X}$ and s^2.

`Section 4.` Point Estimation of Parameters.
General concepts of point estimation.
Methods of point estimation: method of moments, method of maximum likelihood.

`Section 5.` Confidence Interval.
Confidence interval on the mean of a normal distribution (variance is known).
Confidence interval on the mean of a normal distribution (variance is unknown).
Confidence interval on the variance of a normal distribution (mean is known).
Confidence interval on the variance of a normal distribution (mean is unknown).
General method to derive a confidence interval.

`Section 6.` Tests of hypotheses for a single sample.
General procedure for hypothesis testing.
Goodness of fit test when all parameters are specified.
Goodness of fit test when some parameters are unspecified.
Connection between hypothesis tests and confidence intervals.
Tests on the mean of a normal distribution, variance is known (unknown).

Tests on the variance of a normal distribution, mean is known (unknown).
P-values in hypothesis tests.

Section 7. Statistical inference for two samples.
Inference for a difference in means of two normal distributions (variances are known).
Inference for a difference in means of two normal distributions (variances are equal).

Section 8. Simple linear regression.
Empirical models.
Squares estimation of the parameters. Properties of the least squares estimators.
Confidence intervals for parameters of simple linear regression.
Hypothesis tests in simple linear regression.
Weighted least squares estimators.
Prediction of new observations.

Section 9. Multiple linear and polynomial regression.
Multiple linear regression model.
Properties of the least squares estimators.
Confidence intervals in multiple linear regression.
Prediction of new observations.
Polynomial regression models.

Section 10. Analysis of variance.
Multiple comparisons of sample means.
Two-factor analysis of variance: introduction and parameter estimation.
Two-factor analysis of variance: testing hypotheses.

Section 11. Nonparametric statistics.
Sign test.
Wilcoxon signed-rank test.
Sign test for paired samples.
The runs test for randomness.
The MannWhitney U test.

VI. Pre-taken courses
Probability Theory, Mathematical Analysis, Measure Theory and Lebesgue Integral, Complex Analysis, Discrete Mathematics

VII. Form of the final test: examination (four-level evaluation scale)

VIII. Teaching materials and reference books
1. Sheldon M. Ross. *Introduction to Probability and Statistics for Engineers and Scientists*, Academic Press (2004).
2. H. Cramér. *Mathematical methods of statistics*, Princeton University Press (2016).
3. M.B. Lagutin. *Visual mathematical statistics*, Moscow (2009), (in Russian).

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