22.4UC2 — Numerical Computation and Statistics in Engineering

The Numerical Computation part of this module is taught by Changhai Wang (one hour per week), the Statistics part is given by Carsten Butz (two hours per week). This handout solely describes the Statistics part. *The course outline below gives only a rough overview of the topics covered. It may change at any time.*

Week 1: Statistics, an introduction

Statistics.

Overview, data analysis and simulation, aims, qualitative versus quantitative data, outliers, data presentation and data collection.

Basic probability theory.

Objective versus subjective probability, joint probability, addition rule, conditional probability, counting.

Week 2: Probability distributions

Discrete probability distributions.

Random variables, expected value, Binomial distribution, hyper-geometric distribution.

Continuous probability distributions.

Density functions, uniform distribution, normal distribution, gamma distribution.

Week 3: Sampling

Sampling.

Sampling distribution of the mean, sampling distribution of the proportion, sampling size.

Week 4: Estimation

Estimation.

Confidence interval estimation, simple queuing systems.

Week 5: Hypothesis testing

Hypothesis testing (quantitative).

Testing procedure, null hypothesis, alternative hypothesis, type I and type II errors, testing for the mean.

Hypothesis testing (qualitative).

Testing for a proportion, chi-square test.

Week 6: Linear regression and correlation

Linear regression and correlation.

Linear regression, scatter diagrams, standard error of estimate, correlation analysis, confidence interval estimation, multiple and stepwise regression, Pearson's coefficient, least squares.

Week 7: Case study - Random numbers

Random number generation.

Properties, generation and tests for pseudo-random number sequences, tests for random numbers.

Random variate generation.

Inverse transform technique, direct transform for the normal distribution, acceptance-rejection.

Week8: Simulation

Simulation.

Background, uses of simulation, models with one or two servers

Week 9: Review