UNIVERSITÄT BONN
RHEINISCHE FRIEDRICH-WILHELMS-UNIVERSITÄT

Institute of Geodesy and Geoinformation
Theoretical Geodesy Group

UNIVERSITÄT BONN · IGG-TG · J.M. Brockmann · Nußallee 17 · 53115 Bonn

Prof. Dr. techn. W.-D. Schuh

Dr.-Ing. Jan Martin Brockmann
Research Assistant

Nußallee 17
53115 Bonn
Tel.: 0228/73-7423
Fax: 0228/73-6486
brockmann@geod.uni-bonn.de

Sekretariat: C. van Eckeren
Tel.: 0228/73-2626
vaneckeren@geod.uni-bonn.de

www.tg.uni-bonn.de/

Bonn, October 6, 2017

Statistics and Adjustment Theory

1st semester (M.Sc. GE), 1 L, 1 Es

WS 2017/18

Learning objectives:

Acquisition of advanced knowledge about concepts in statistics, parameter estimation and hypothesis testing. Problem-solving abilities in order to independently solve practical adjustment problems shall be available after the module. In addition the ability to independently interpret the quality and reliability of adjustment results is aspired.

Learning content (preliminary draft, regularly adopted):

1. **Motivation and Introduction**
2. **Concept of Random Variables**
3. **Uncertainty Modeling and Variance Propagation**
   - Covariance matrices
   - Covariance functions
   - Law of error propagation
4. **Least Squares Adjustment**
   - Motivation
   - Stochastic approach
   - Best Linear Unbiased Estimator (BLUE)
   - Gauss-Markov Model with constraints on parameters
5. **Confidence Regions and Hypothesis Testing**
   - Distributions
   - Confidence regions
   - Test of variances
   - Test of parameters
6. **Selected Topics of Parameter Estimation**

Teaching method:

- Audio-visually supported lecture
- Integrated module with lectures and exercise
- Course material is shared via E-campus platform
- Exercises are solved supported by a programming language

Exercise supervision:

Dr.-Ing. Jan Martin Brockmann; Karen Backs, B.Sc.; Cordula Knauf, B.Sc.; David Witte, B.Sc.;

Exam:

Course work: Accepted exercises (see below)
Exam: Written exam 2 h (marked)

References to support self-studies, draft list:

[1] Å. Björck. *Numerical Methods for Least Squares Problems*. SIAM, Society for Industrial and Applied Mathematics, Philadelphia, 1998.

[2] Ian Gladwell, Warren Ferguson, and James Nagy. *Introduction to Scientific Computing Using Matlab*. August 2011.

[3] Karl-Rudolf Koch. *Parameter Estimation and Hypothesis Testing in Linear Models*. Springer Berlin Heidelberg, Berlin, Heidelberg, 2 edition, 1999. ISBN 978-3-642-08461-4 978-3-662-03976-2. URL `http://link.springer.com/10.1007/978-3-662-03976-2`.

[4] E. Kreyszig. *Advanced Engineering Mathematics*. John Wiley & Sons, 10 edition, 2011. ISBN 978-0-470-45836-5.

[5] P. Meissl. Least Squares Adjustment A modern Approach. Technical Report 43, Geodätische Institute der Technischen Universität Graz, A-8010 Graz, Steyrergasse 30, 1982. URL `ftp://skylab.itg.uni-bonn.de/schuh/Separata_Meissl/Meissl_1982_Least_Squares_Adjustment_A_Modern_Approach.pdf`.

[6] W. H. Press, A. Teukolsky, W. T. Vetterling, and B. P. Flannery. *Numerical Recipes: The Art of Scientific Computing*. Cambridge University Press, New York, NY, USA, 3rd edition, 2007. ISBN 0-521-88068-8 978-0-521-88068-8.

Regulations for acceptance of exercises (successful course work)

1 During the entire semester, about seven exercises sheets are provided. The tasks on each sheet have to be dealt with (obligatory). Documented solutions have to be uploaded digitally (e.g. scanned) to the E-campus platform (closing date provided for every exercise sheet).
2 Tutors look over the individual solutions and provide (general) feedback.
3 Solutions are discussed in the next practical lesson. Contributions to the discussion are expected from the students.
4 Results are used to identify deficits.
5 One special exercise sheet (announced separately) has to be solved correctly. It is a kind of mock exam. It will be checked in detail. 75 % of the achievable points have to be collected. One resubmission is possible.
6 If all exercise sheets are submitted and more than 75 % of the mock exam's points are achieved, the course work is successfully approved (prerequisite to attend the exam).