Module title	**Design and Analysis of Experiments**
Code	D2
Degree Programme	Master of Science in Life Sciences
Workload	3 ECTS (90 student working hours) - Lessons contact (total 42 of which 28 central teaching): 32 h - Self-study: 58 h
Module Coordinator	**Name**: Dr. Christoph Kopp **Phone**: +41 (0)31 910 21 20 **Email**: christoph.kopp@bfh.ch **Address**: Berner Fachhochschule, HAFL, Länggasse 85, 3052 Zollikofen
Lecturers	Dr. Christoph Kopp, BFH
Entry requirements	Attending the module "Handling and Visualizing Data" is required. Prior to this module, additional preparatory reading, graded hand-in exercises and a self-test will be made available to facilitate student preparation for the module. Students are advised to start five weeks before the module with the preparatory work.
Learning outcomes and competences	After completing the module, students will be able to: • apply the basics of statistical inference (estimation, testing, confidence regions) in the course setting, • make use of the basics of the Design of Experiments such as randomization and blocking, • identify common and important types of experimental designs with respective advantages and disadvantages (power, cost/workload), • choose an appropriate design in a given research setting, • calculate the power/required sample size for a given design, based on prior information, • perform a correct statistical analysis of different types of designs, including unbalanced data sets, • perform post hoc tests, • interpret the model and report the findings scientifically.
Module contents	• Introduction to statistical inference (population and sample, statistical hypothesis testing, confidence regions) • Experiments and other methods (i.e. observational studies); the place of a single experiment in a research plan • General principles of experimental design (blocking, randomization), how to translate research questions in statistical terms • Important particular experimental designs (e.g. fully randomized designs, randomized block designs; incomplete designs; factorial designs, fractional factorial designs; split-plot designs); when to use which design (feasibility, compare efficiency, power and sample size calculations) • Statistical analysis of all the particular designs that were introduced (including interpretation of e.g. block effects or interaction effects, adapted to the design) • Post hoc tests (also for ordinal factors) e.g. to compare subsets of treatments to each other

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- Interpretation and visualization of the results; scientific reporting of the results, back-translation from statistical terminology to the original research question

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<tr><td>Teaching / learning methods</td><td>
This module has the following structure:
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<tr><td>Week</td><td><1</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td><td>>7</td></tr>
<tr><td>Central</td><td></td><td></td><td>8L</td><td></td><td>8L</td><td></td><td>8L</td><td>4L</td><td></td></tr>
<tr><td>Local</td><td></td><td>2L</td><td></td><td>4L</td><td></td><td>4L</td><td></td><td>4L</td><td></td></tr>
<tr><td>Self-study</td><td>10h</td><td colspan="7">38h</td><td>10h</td></tr>
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In the weeks before module start, students are expected to do preparatory work to prepare themselves for the module: preparations for the statistical topics as well as a minor brush-up of the course software R.

The students receive preparatory as well as follow-up <u>self-study</u> work for each course day (regardless of whether it is a central or local day). The self-study consists e.g. of preparatory reading/videos, follow up exercises, examining case studies, etc.

<u>Central</u> teaching is a blend of classical lectures with more interactive teaching approaches. Each central course day starts with a learning team block. Students are given self-study preparatory work that they work on individually. In class, the students discuss the open questions they have regarding the preparatory work in small learning teams. They try to answer these questions together and record the remaining questions for the plenary. The remaining questions are answered in the plenary by the lecturer.
The learning team block is followed by classical lectures to introduce new topics. These lectures are interspersed with large group activation methods and small group exercise sessions.
Each central course day finishes with an exercise session in which students work on the exercises and have the opportunity to ask questions and get individual support.

<u>Local</u> coaching consists of students actively solving exercises together with the local coaches. These exercises are meant to deepen the understanding of the material, give an opportunity to practice, provide extensions etc. The main type of task will be case studies, which illustrate and exemplify the application of the material from central teaching to real data sets and real problems (where possible, data sets/examples specific to the subject matter of the respective schools will be used). Local coaching can be timed flexibly, subject to taking place between the central teaching slots.
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<tr><td>Assessment of learning outcome</td><td>

1. Final written individual exam (open book, using individual laptop computers to run statistical analyses using the course software) (80%)
2. Individual exercises spread over the entire module (20%)

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<tr><td>Format</td><td>7-weeks</td></tr>
<tr><td>Timing of the module</td><td>For ZHAW and FHNW: Autumn semester, CW 45-51
For BFH and HES-SO: Spring semester, CW 15-21</td></tr>
<tr><td>Venue</td><td>For ZHAW and FHNW: Olten
For BFH and HES-SO: Fribourg</td></tr>
<tr><td>Bibliography</td><td><u>Course material</u>
Box GEP, Hunter JS, Hunter WG, 2005. Statistics for Experimenters. 2nd ed. Wiley.</td></tr>
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	Casella G, 2008. Statistical Design. Springer. Dean A, Voss D, 1999. Design and Analysis of Experiments. Springer.
Language	English
Links to other modules	This module builds on D1 and complements D3.
Comments	Material treated during local teaching is relevant for the exam. Students have to make sure that an updated version of R is installed. Details will be communicated in advance.
Last Update	23.02.2018