Dear PhD Student,

Welcome to the joint PhD course “Design and Analysis of Experiments.” We hope you will enjoy and find it useful for your further studies.

Is this the right course for me?

It is important that the course meet your expectations. It must be emphasised that this is not a course on laboratory techniques and, due to the number of participants, there will not be time to work out detailed plans for the individual participant’s experiments. One the other hand, several participants from previous runs have contacted me after the conclusion of the course and we have had fruitful discussions about their experiments.

Although the mathematical level is moderate (calculus is rarely used), there will be a certain mathematical flavour. You should know that the title refers to a branch of statistics. Unfortunately, there won’t be time to cover subjects like time series, survival analysis and questionnaires. Some of these could no doubt be useful for some of you. However, mastering the general principles will certainly have a rub-off effect.

The course has been granted 4 ECTS, translated to 10 lectures.

Time and location

According to the schedule in

http://phdcourse.aau.dk/index.php?list=29574

the lectures will be held on the following Wednesday and Friday afternoons, at 12.30–16.00,

September 28, 30
October 5, 7, 12, 14, 19, 21, 26, 28

The lectures take place in

Fredrik Bajers Vej 7G, room G5-109.
Besides the textbook, you should bring a portable computer (see below). At some time in the afternoon, we shall have coffee/tea and cake.

**Textbook**

We shall use

Douglas C. Montgomery  
*Design and Analysis of Experiments, 7th ed.*  
Wiley, 2009

which seems to be a widely used text-book around the world. The mathematical level should be easy for an engineer. The book should be available at the University Bookshop (Centerboghandelen), FrB 7, B2-221. We shall cover as much as time permits.

**Computing**

Today it is unthinkable doing statistics without a computer. Portable computers are now so widespread that we can rely on that you all have one at your disposal during the course. In short,

*Please, come with a laptop (extension cords welcome).*

The statistics package we shall be using has the short name of *R*. It is free software and can be downloaded from CRAN at

http://cran.r-project.org/

The most recent release is R-2.13.1, and it works equally well on Linux/Unix, Windows and Macintosh. In our view it is state of the art in statistical computing. It has a professional standard, better than most—in our opinion all—proprietary statistics packages. The syntax is very close to the proprietary package S-Plus. We hope that you will find *R* useful in your later career, too.

It is easy to make small programmes in *R* and to modify existing routines. Unlike recent versions of S-Plus, *R* has few click buttons and pull-down menus which, in my opinion, is an advantage. To be prepared for learning about *R*, you should do the *Preliminary Exercise* below.
Must I learn a new language?

Maybe you are familiar with other computer packages, a spreadsheet like Microsoft Excel or perhaps Matlab. A spreadsheet is completely inadequate for serious statistics. Matlab, being excellent for other purposes, is not good enough here, although the Statistics Toolbox is becoming pretty good. Other statistics packages are of course adequate, but many of them give too much output which can be misinterpreted by the non-savvy. \( R \) is rather succinct and mostly only answers what you ask for. \( R \) (and S-Plus) is constructed in such a way that it can support your thinking about statistical problems instead of giving pre-concocted solutions.

Having said that we must emphasise that statistical computing is not the main topic in the course. Only a small subset of the many available commands in \( R \) is needed. The important matter is the statistical concepts. If you think you can do the exercises just as well with another package, good luck!

Supplementary reading

Some years, we used as textbook


The authors are/was first-class statisticians, but some participants found that the abstraction level was too low for an engineering PhD student and there was too much babbling. But we can recommend it as supplementary reading.

From the plethora of books on statistics can be mentioned


Recently, many books about \( R \) has appeared. A few of these are


Maria Rizzo. *Statistical Computing with \( R \)*. Chapmann & Hall/CRC,
2008.


Books from Springer’s *use-R* series.

**Preliminary Exercise**

Fetch *R* from CRAN and install it on your portable computer, and run *R* to check that it works. Included in the package are several manuals. It would be a good idea to find “*An Introduction to R*.”

**Communication**

You should regularly check the home page for the course,

http://www.math.aau.dk/~jgr/teaching/design11/

Jakob G. Rasmussen
Fredrik Bajers Vej 7G, G1-125
Phone: 9940 8878
e-mail: jgr@math.aau.dk