Experimental Design and Statistical Methods

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This is a course addressed to future researchers in the field of Animal and Food Sciences, but it is also applicable to other experimental sciences (mainly biological). In fact is an updating of a previous course launched in November 2014.

The objective is that the students be able to design properly experiments from a statistical point of view, and also to develop by themselves statistical analyses related to the most common statistical designs.

We have assumed the **CASE methodology**. For each topic a small dataset will be presented. This dataset will be analyzed and interpreted after explaining some essential statistical concepts.

The first lesson will allow the students to get in touch with the R software and become a little bit familiar with it, by detecting the most frequent errors that a beginner usually makes. The lessons are organized in a self contained way.

The material includes Powerpoint presentations, R programs (scripts), and small datasets needed to run them. It can be used in regular classes or for self learning.

Contents

0. A general view of the Experimental Design and the Statistical Analysis.
1. Data presentation and confidence intervals. Introduction to R.
2. Tests of hypothesis and contrast of normality.
3. Comparison of two means. Power and sample size.
4. Analysis of variance (ANOVA): Principles and Completely random design.
5. Factorial and nested designs.
6. Randomized block and Latin square designs.
7. Non parametric methods.
8. Simple linear regression.
9. Analysis of covariance.
10. Multiple linear regression.
11. Curvilinear regression.
12. Logistic regression.
13. Mixed models.

R Software

The R software is a free program that has capabilities to handle data (not covered in depth in this course), make statistical calculus and draw impressive graphics. It can be downloaded from http://cran.r-project.org/.

BIBLIOGRAPHY

- **Crawley M.J.** *The R book*, second edition. Wiley (2013).

- **Dalgaard P.** *Introductory Statistics with R*, second edition. Springer (2008). An electronic copy of the first edition can be downloaded from the Library of the UAB: http://download.springer.com/static/pdf/874/bfm%253A978-0-387-22632-3%252F1.pdf?auth66=1391024005_7c23ab7bd3c1d1fa3e9023cb93250ea4&ext=.pdf

- **Delgado R.** *Apuntes de Probabilidad y Estadística*. Servei Pub. UAB 2002, Materials 111 (2002).

- Kaps M., Lamberson W. *Biostatistics for Animal Science*. CABI, Wallingford (2004). http://www.cabi.org/cabebooks/FullTextPDF/2004/20043113065.pdf

- Montgomery D.C. *Design and analysis of experiments*, 5th ed. Wiley, New York (2001).

- **Petrie A., Watson P.** *Statistics for Veterinary and Animal Science*, third edition. Wiley-Blackwell (2013).

- Peña D. *Regresión y diseño de experimentos*. Alianza, Madrid (2002).

- Peña D. *Fundamentos de Estadística*. Alianza, Madrid (2008).

- Steel R.G.D., Torrie J.H. *Principles and procedures of Statistics*. McGraw Hill, Auckland (1981).

The student can find in Internet a great number of programs suitable for solving most of the common (and even complicated) statistical designs. In addition to the R website, it is possible to find many courses, lectures, … that have uploaded teachers and researchers of several universities and research centers across the world.

FILES R WORSHOP

Topic (pdf)	DATA (.csv)	SCRIPTS (.R)
General overview		
Presenting and summaryzing data. Confidence intervals		sdescriptive, spie_chart, sbar_chart
Hypothesis testing. Contrast of normality	adg6	sunivariate, sreadtable, stable-summary
Comparison of means of two samples. Parametric tests	lmareaAMBP, hamsters	st-test, st-test-power, st-test-paired
Comparison of means of several random samples. ANOVA	confbeef	scrd-oneway
Factorial designs and nested designs	solub, fatn	sfactorial, snested
Randomized complete block designs and Latin squares	penicillin, ls	srcbd, slatsq
Non-parametric tests	wrst, wsrt, kw,	swrst, swsrt, sk-w, scontingency
Simple linear regression and correlation	bloodpress	ssimplereg
Analysis of covariance	trigchange	sancova
Multiple linear regression	tendAM	smultreg
Curvilinear regression	fishgrowth	scurvreg
Logistic regression	arthrosis	slogreg
Mixed models	growth_mult	sgrowth