Psychology 253, Spring 2015
Ewart Thomas

Psychology 253: Statistical Theory, Models and Methodology
Lectures: TTh 11-12:15; Building 420-050
Section: F 10:30-12:00; Building 420-417

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Overview
This course will review, as appropriate, the more familiar procedures covered in Psychology 252, namely, the general linear model (`lm {stats}` in R), the generalised linear model (`glm {stats}`), and linear mixed models (`lme {nlme}, lmer {lme4}`). Also, we will consider less familiar applications of these R functions, and more 'advanced' procedures, such as, reliability, factor analysis, penalized regression, and structural equation modeling.

Texts: (Each text is used for a small amount of time.)
Howell, Statistical Methods for Psychology, Duxbury.
Agresti and Finlay, Statistical Methods for the Social Sciences, Prentice Hall.
Venables & Smith, An Introduction to R, in the folder, "R", of our Coursework site.
Verzani, simpleR – Using R for Introductory Statistics, at
http://cran.r-project.org/doc/contrib/Verzani-SimpleR.pdf

Please download from the CRAN website the **latest** version (**R 3.1.3**) of the elegant, powerful and *free* package, R, for doing statistics (now containing 6450+ packages). (There is another user-friendly freeware package, **Mx (**http://views.vcu.edu/mx**)**, for doing structural equation modeling (SEM) that has an attractive GUI. For SEM we will use the R package, `lavaan`, which has a less attractive GUI.) Tables of Z, t and χ^2 can be found at http://stat.utilities.googlepages.com/tables.htm. Also, the 'whole' range of discrete and continuous distributions is tabulated at http://www.alewand.de/stattabneu/stattab.htm.

The web (e.g., http://en.wikipedia.org/wiki/Score_test) is a great source of digestible information about the topics in this course. Try 'googling', e.g., "logistic regression" or "odds ratio", for additional explanation.

Requirements

1. *Homework*. There will be about 7 homework sets. Students may work in small groups, but must **write up their own solutions**. Students may not consult material (e.g., Homework or Quiz answers) from previous versions of Psych 253. Consistently with the **Honor Code**, I presume that, if a student were asked to independently reproduce a solution handed in as homework, he or she would be able to do so. Homework solutions should be handed in on time. The total homework score will make up 30% of the final grade.

2. *Midterm exam*. There will be a take-home mid-term that will be handed out on 4/30 (end of Week 5) and due on 5/7. This will make up 35% of the final grade. Students may **not** give or receive help on the midterm.

3. *Final.* There will be a take-home final that will be handed out on 6/2 (the last class) and due on 6/9. This will make up 35% of the final grade. Students may **not** give or receive help on the final.

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Syllabus for Psychology 253
Statistical Theory, Models and Methodology
(`[*n*]' means that approximately *n* lectures will be devoted to the topic.)

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1. Reliability [4].
    a. Cohen's *kappa*, Cronbach's *α*, Intraclass Correlation (ICC)
    b. Cognitive models; maximum likelihood & Bayesian estimation
    c. Test Theory model; Spearman-Brown formula; construction of reliable tests
    d. Structural model for disattenuating observed correlations
    e. Applications to 'mediational role of thought', 'voxel-based measurement of brain adaptation.'

2. Analysis of Structure [4]
    a. Factor Analysis
    b. Cluster Analysis
    c. Comparison with Multidimensional Scaling
    d. Multinomial Logistic Regression (`mlogit()`)

3. Linear Mixed-Effects Models [3].
    a. `lme()`, `lmer()`
    b. Ordinal Regression with cumulative link models (`clm()`)
    c. Signal Detection Theory

4. Penalized (or Regularized) Regression [4]
    a. LASSO/LARS (using `glmpath()`)
    b. Comparison to Stepwise Regression
    c. Model fits, e.g., AIC, BIC, cross-validation (CV) accuracy

5. Structural Equation Modeling (SEM) (using the `lavaan` and `semPlot` packages) [4]
    a. Multi-group comparisons