Course Syllabus

Lectures: Sunday   June 12th 9:30 - 12:30 and 13:30-16:00
            Saturday June 18th 9:30 - 12:30 and 13:30-16:00

Location: Department of Statistics Seminar Room
Instructor: Dr. Ivor Cribben
Email: cribben@ualberta.ca
Office hours: Wednesday 3-5pm

Course Description: The course is based on methods for estimating high-dimensional regression models and sparse graphical models/undirected graphs. Initial topics to be covered include the least absolute shrinkage and selection operator (lasso), elastic net, adaptive lasso, graphical lasso and Smoothly Clipped Absolute Deviation (SCAD). After this we will consider time-varying graphical models and change point methods for graphs. The area of application will focus on neuroimaging data such as functional magnetic resonance imaging (fMRI) and Electroencephalography (EEG). The objective of the course is for students to have a thorough understanding of high-dimensional statistical methods and how they can be used to estimate brain networks and time-varying brain networks.

Prerequisites: It is expected that students have taken at least one semester of regression, one semester of maximum likelihood and a solid knowledge of R. A course in time series would also be beneficial.

The statistical software we will be using in this course, R, is free and can be downloaded from www.r-project.org. You will find more details in using R from:
W.N. Venables, D.M. Smith and the R Develop Core Team (2007), An Introduction to R. (www.r-project.org).
W.N. Venables and B.D. Ripley (2003), Modern Applied Statistics with S (4th Edition). Springer.

Organization: The majority of the classroom time will be used to outline the statistical methods. However, to assist students' understanding of the materials, some of the classroom time will also be conducted with the help of R exercises to help the students become familiar with the data and how the methods can be implemented in R/Matlab. **Please bring your laptop with you to class.**

Reading materials: I will take some of the class materials from the following articles:
[1] Allen, E. A., Damaraju, E., Plis, S. M., Erhardt, E. B., Eichele, T., & Calhoun, V. D. (2012). Tracking whole-brain connectivity dynamics in the resting state. *Cerebral cortex*.
[2] Cribben, I., & Yu, Y. (2015). Estimating whole brain dynamics using spectral clustering. *arXiv preprint arXiv:1509.03730*.
[3] Cribben, I., Haraldsdottir, R., Atlas, L. Y., Wager, T. D., & Lindquist, M. A. (2012). Dynamic connectivity   regression: determining   state-related   changes   in   brain

connectivity. *NeuroImage*, *61*(4), 907-920.

[4] Fan, J., Feng, Y., & Wu, Y. (2009). Network exploration via the adaptive LASSO and SCAD penalties. *The Annals of Applied Statistics*, *3*(2), 521.

[5] Friedman, J., Hastie, T., & Tibshirani, R. (2008). Sparse inverse covariance estimation with the graphical lasso. *Biostatistics*, *9*(3), 432-441.

[6] Zhou, S., Lafferty, J., & Wasserman, L. (2010). Time varying undirected graphs. *Machine Learning*, *80*(2-3), 295-319.

[7] Tibshirani, R. (1996). Regression shrinkage and selection via the lasso. *Journal of the Royal Statistical Society Series B* 58(1), 267 – 288.

Evaluation: Students' grades are calculated from the following components:

  Final paper 50%
  Individual Presentation 50%

Individual Presentation: For the presentation, each student will pick a journal article from the literature. Each student will present the method and main results of the paper (statement of the problem, data description, description of the statistical method, the main conclusion and most importantly the pitfalls of the paper or method) to the class. Students may also try to replicate the analysis if the data and code used is freely available. Students will have 30 minutes for the presentation.

Office Hours: It is important that you attend office hours if you have problems with the course material.

Classroom policy: Please do not use cell phones or laptops during the lectures. Please also refrain from talking or eating during the lectures.

Course Schedule
(This schedule may change as the course proceeds.)

Sunday   June 12th Introduction to high dimensional methods
                Introduction to graphical models
                Estimating brain networks in R

Saturday June 18th Introduction to time-varying network methods
                Introduction to network change points
                Estimating time-varying brain networks in R
                Student Presentations