Introduction to Statistical Methods for Biosurveillance

Course Introduction

Professor Ron Fricker
University of California, Riverside
Spring Quarter, 2010
Contact Information

• Professor Ron Fricker
  – Office: Down the hall...
  – Phone
    • Cell: 831-869-8414
  – E-mail: rdfricker@nps.edu
  – Personal web site: http://faculty.nps.edu/rdfricke
  – Course web site: http://faculty.nps.edu/rdfricke/OA4910.htm
A Bit About Me

• Academic credentials
  – Ph.D. and M.A. in Statistics, Yale University
  – M.S. in Ops Research, The George Washington University
  – B.S. in Applied Mathematics, United States Naval Academy

• Teaching credentials
  – Started teaching post-graduate courses in mid-80s
  – Have taught at NPS, RAND Graduate School, and USC

• Research interests
  – Biosurveillance
  – Quality control and statistical process control
  – Survey design and analysis
  – Military manpower and personnel issues: recruiting, retention, effects of deployment
Course Syllabus

STAT 255R (Seminar): Statistics for Epidemiological Studies
Spring 2010. Four units, (3 units lecture, 1 unit discussion)
Tu-Th: 9-10:10 a.m. & Th 3:46-4:30 p.m.
Contact (email): rrfricker@ucr.edu

Course Description and Objectives:
In the post-9/11 world, biological terrorism is of increasing concern to government and public health officials. To address this threat adequately, systems have been put in place to monitor public health data with the intention of providing the earliest possible detection of an act of bioterrorism and real-time, ongoing information about its location and spread so the public health and medical communities can efficiently and effectively treat those affected. However, it is a difficult statistical problem to reliably extract a bioterrorism event “signal” from spatially and temporally varying natural disease incidence “noise” while simultaneously maintaining a tolerably low false positive signal rate.

The objective of the course is to introduce students to existing and proposed statistical methods for detecting and monitoring disease outbreaks. The focus will be both on the methods currently in use and the latest developments in the literature, including univariate and multivariate temporal methods as well as spatio-temporal methods.

The course will review: (1) existing and proposed new statistical methods for monitoring health data, (2) the connection of these methods to earlier work, particularly in the field of statistical process control, and (3) explore new advances and methodological possibilities for advancing the state of the art in this area. The format of the course will be lecture and group activity. Prof. Fricker will conduct regular lectures which will be supplemented by one or more group projects and presentations by course participants.

Course Materials:
- Textbook: The course text is Introduction to Statistical Methods for Biosurveillance by Ronald D. Fricker. Jr. This is a draft manuscript. Electronic copies will be provided to all students.
- Software: We will use R (www.r-project.org) for any data analysis done in class.
  - Both the text and software are free.

Grading:
Course grades will be based on a class presentation, homework, and my subjective assessment of your level of participation in the course. These will be weighted as follows:
- Presentation: 50%
- Homework: 30%
- Participation: 20%
About the Text

• An introductory text for public health practitioners
  – Focus is on the fundamentals, not advanced methods

• Current texts and papers are statisticians talking to statisticians
  – Sequential nature of problem often missed
“In other words, the fact that the criterion we happen to use has a fine ancestry of highbrow statistical theorems does not justify its use. Such justification must come from empirical evidence that it works.”

Walter A. Shewhart (1891-1967)
Sequence of Material

• Plan to cover a chapter a week
  – Will modify as needed
• Note that chapters 4 & 5 left until end of the quarter
  – I haven’t written them yet...
• Will be largely non-statistical for the first few weeks – need to cover important background material
On the Presentations

• Based on chapters from *Spatial & Syndromic Surveillance for Public Health* by Lawson and Kleinman (eds.)
  – More advanced methods
  – Some augmented with journal paper(s)

• To be given on Thursday afternoon sessions
Planned Presentations Topics

• Chapter 4: Spatial and Spatio-temporal Disease Analysis by Lawson
  – Augmented with A Review and Discussion of Prospective Statistical Surveillance in Public Health by Sonesson and Bach

• Chapter 5: Generalized Linear Models and Generalized Linear Mixed Models for Small-area Surveillance by Kleinman

• Chapter 6: Spatial Surveillance and Cumulative Sum Methods by Rogerson

• Chapter 7: Scan Statistics for Geographical Surveillance: An Overview by Kulldorff
  – Augmented with On the Use of Prospective Scan Methods for Health-related Surveillance by Woodall et al.

• Chapter 8: Distance-based Methods for Spatial and Spatio-temporal Surveillance by Forsberg et al.

• Chapter 9: Multivariate Surveillance by Sonesson and Frisen
  – Augmented with Comparing Directionally Sensitive MCUSUM and MEWMA Procedures with Application to Biosurveillance by Fricker et al. and A One-Sided MEWMA Chart for Health Surveillance et al.
On the Homework

• Weekly, based on chapter exercises
  – Also, each week must make up and answer one new question
    • I want to expand the chapter questions...

• Submit electronically
  – I would like to use your submissions as the basis for textbook’s solution manual

• Will grade based on accuracy and thoroughness

• On computer-based exercises:
  – Submit your code with your solution
  – Would like some done in R and some in SAS
On Class Participation

• This is a seminar-style class
  – Would like lots of interaction, discussion in class
  – Feel free to question, query everything

• The more feedback, the better
  – On the text
    • Clarity, exposition, typos, etc.
    • Topics that should be included/deleted
  – On the slides
  – On the material overall
Course Site
(http://faculty.nps.edu/rdfricke/OA4910.htm)

Administrative

- Syllabus
- Introductory Slides

Reading Assignments & Lecture Slides

- Part I: Introduction to Biosurveillance
  - Chapter 1: Overview (slides)
  - Chapter 2: Biosurveillance Data (slides)
  - Chapter 3: Simulating Biosurveillance Data (slides)
- Part II: Situational Awareness
  - Chapter 4: Descriptive Statistics for Displaying the Situation (slides)
  - Chapter 5: Statistical Models for Evaluating the Situation (slides)
- Part III: Early Event Detection
  - Chapter 6: Design & Performance Evaluation (slides)
  - Chapter 7: Univariate Temporal Methods (slides)
  - Chapter 8: Multivariate Temporal Methods (slides)
  - Chapter 9: Putting It All Together: Applying the Temporal Methods to Real Data (slides)
  - Chapter 10: Spatio-temporal Methods (slides)

Data Sets

- To be posted.

Supporting Material

- Methodological Issues in Biosurveillance, CDC Short Course, April 6, 2009.
- My papers on biosurveillance.
Miscellaneous

• Office hours by appointment
• Anything else???