

## **Survival Analysis with Correlated or Repeated Endpoints**

**Presented by: Terry M Therneau, Department of Health Science Research, Mayo Clinic**

**Sponsored by:** The Philadelphia, Delaware, and Northern New Jersey Chapters of the American Statistical Association and an award from the American Statistical Association.

**Date:** March 31, 2009

**Time:** 8:30 AM to 5:00 PM

**Location:** The University of Pennsylvania, Houston Hall, 2nd Floor, in the Golkin Room.

**Fee:** \$60.00. Full-time student with ID\*: \$30.00.

**Register at:** <http://asap2009springshortcourse.eventbrite.com/>

\* Those taking classes on a part-time basis are not included. All students must show a valid ID when picking up their registration materials at the meeting. Those who preregistered as students, but who cannot show a valid ID will lose their seat at the meeting and forfeit their enrollment fee.

### Schedule

8:30AM to 9:00AM	Registration : Coffee/muffins available
9:00AM to 12:00PM	Morning Session (tea/coffee available at 10:30AM)
12:00PM to 1:30PM	Lunch**
1:30PM to 5:00PM	Afternoon Session (snacks available at 3PM)

\*\*Lunch on your own. Follow this link for information on local restaurants:  
<http://www.ucityphila.org/cityguide/restaurants>

### Directions

Follow this link for information on transportation to University City. See detail map on page 4 for location of parking and meeting room.

[http://www.ucityphila.org/getting\\_around](http://www.ucityphila.org/getting_around)

## Presenter

Dr. Terry Therneau has worked as a programmer or statistician in the medical research field since 1976. Over the last years, he has had particular involvement in studies of liver disease, hematologic malignancies, and disease biomarkers. He has a long term interest in the Cox model, and is the author of the survival analysis suites found in Splus and R; all of the routines therein have arisen out of the analysis needs of particular studies. He is the coauthor, with Patricia Grambsch, of the book "Modeling Survival Data: Extending the Cox Model", which has found wide use among those who analyze medical studies for their daily bread.

## Program

### **Abstract**

The Cox model has become the standard for analysis of time-to-event data in the medical sciences. In this lecture we will look at the extension of the model to cases where the endpoints are correlated, either due to multiple endpoints per subject (such as repeated disease episodes) or interrelated subjects such as family studies. The two primary tools are the use of GEE like models and random effects models.

The material for the first of these overlaps substantially with that in the book by Therneau and Grambsch, that for random effects overlaps somewhat but is largely new. In particular the software has made great strides in the last several years, allowing for a much wider range of models. The primary focus of the course will be a set of examples, many from the presenter's ongoing consulting experience, which highlight some of the potential as well as the challenges of such data. More time will be spent on the random effects models, since the standard multiple events approach is now fairly well understood.

### **Learning Outcomes**

The target audience for the course would be the practicing biostatistician who is contemplating the addition of these methods to their working tool set. The medical examples would also be very informative for students. A working knowledge of survival analysis will be useful but not essential.

The intended outcome of the course is practical knowledge about how the methods presented may be applied to the attendees own data and problems. The course is centered on actual data sets and analyses done by the presenter. Course notes contain explicit SAS and/or Splus/R code necessary to carry out the analysis (often both are shown, SAS does not yet support random effects Cox models, however). Methodology information fleshes out the examples, but is subordinate to them. The techniques that are presented have all been found to be useful.

## Outline

### Introduction

- Cox model
- Notation and conventions
- Software used for examples
- Goals

### Cox models

- Use of (start, stop) notation for multiple intervals
- Simple examples
- When a simple model is sufficient, and when we need more

### Multi-event models

- Anderson-Gill, WLW, conditional
- Assumptions, strengths, weaknesses
- Comparison to other GEE models

### Random Effect models

- Introduction
- Attractive features of the model
- Historical rationale
- Available software

### Choice of model

- Distribution of the random effects
- Method of fitting: EM/ML/REML/...
- Time-dependent effects

### Simple random effects

- Random intercept (e.g. center effects)
- Relationship to marginal models
- Random treatment effects

### Correlated random effects

- Genetic models
- Cox model based LOD scores for linkage/association
- Latent family traits
- Familial interactions

### Data examples

- Repeated infections
- Response/relapse through multiple treatment cycles in multiple myeloma
- Repeated glycemc events

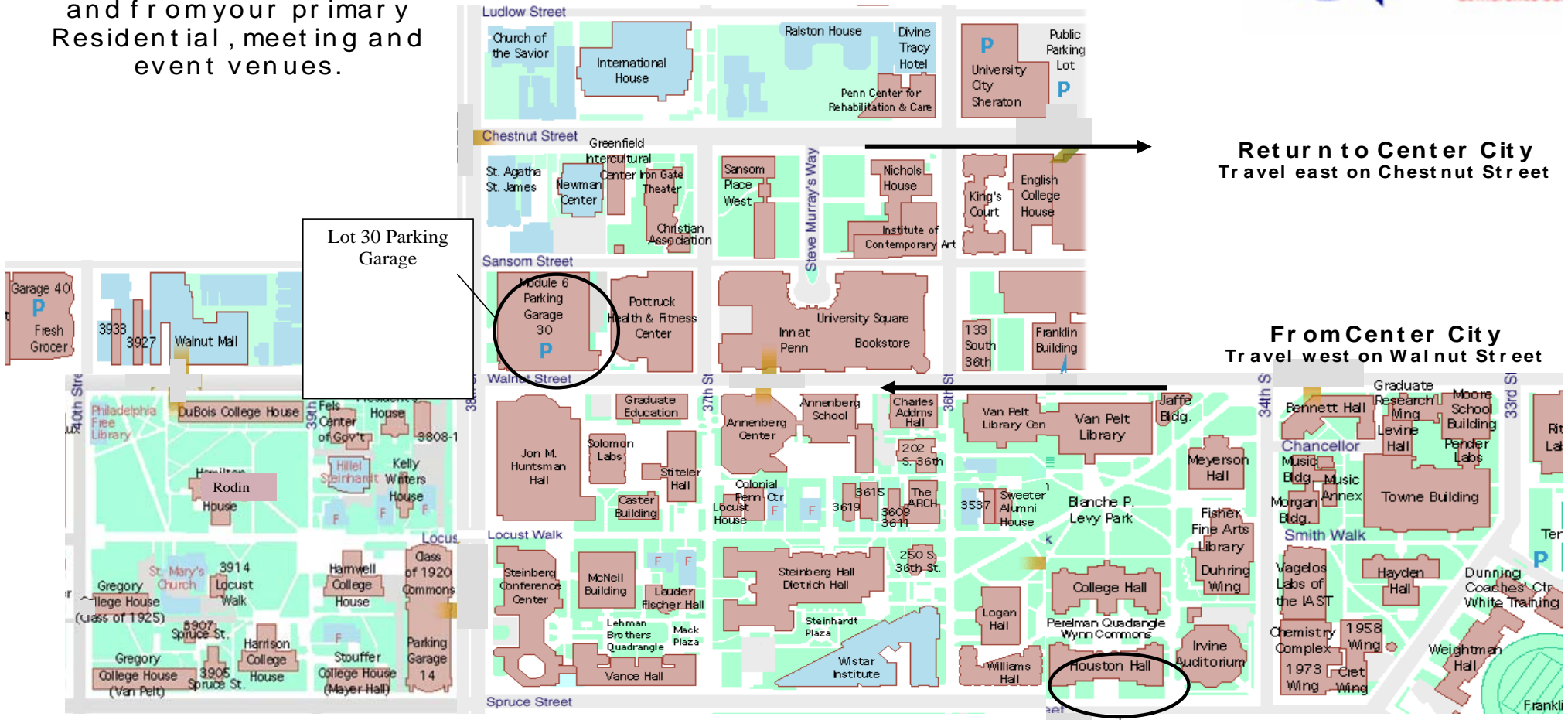
### Cox model based LOD scores for linkage/association

- Prostate and breast cancer in extended families
- Social interaction networks



# University of Pennsylvania

This map has been prepared to guide you to and from your primary Residential, meeting and event venues.



Return to Center City  
Travel east on Chestnut Street

From Center City  
Travel west on Walnut Street

Lot 30 Parking Garage

The Golkin room is located on the 2<sup>nd</sup> floor of Houston Hall (3417 Spruce St)