CALIFORNIA POLYTECHNIC STATE UNIVERSITY
San Luis Obispo, California

STAT 417 – Introduction to Survival Analysis Methods **Winter 2016**

1. Catalog Description

STAT 417 Introduction to Survival Analysis Methods (4 units)

Parametric and nonparametric methods for analyzing survival data. Topics include Kaplan-Meier and Nelson-Aalen estimates, Cox regression models, accelerated failure time models. Use of statistical software to implement methods throughout course. Prerequisite: STAT 302 or consent of instructor

2. Required Background and/or Experience

STAT 302 or consent of instructor

3. Expected Outcomes

The student should:

a. Recognize characteristics of survival time random variables, and recognize types of data where survival analysis techniques are appropriate
b. Identify and distinguish between various censoring and truncation mechanisms
c. Know the definitions and mathematical expressions for different functions of the survival time random variable, including the survivorship function, hazard function, and cumulative hazard function, and be able to find these functions for a given distribution of the survival time random variable.
d. Be able to compute descriptive measures of the survival time random variable under parametric and non-parametric assumptions and know their interpretations
e. Be able to construct the Kaplan-Meier and Nelson-Aalen estimators for the survival function
f. Know various methods for comparing survival curves including log-rank and Wilcoxon tests
g. Know what the Cox regression model is, and be able to interpret and perform inference for model parameters
h. Be able to assess the Cox regression model assumptions using residual diagnostics and other procedures
i. Know what the accelerated failure time model is, and be able to apply it to survival data under different distributional assumptions
j. Be able to read and interpret results of survival analyses from real studies
k. Be able to implement all survival analysis methods using statistical software

4. Suggested Texts and References

Kleinbaum, D.G. & Klein, M. (2012). Survival Analysis: A Self-Learning Text, 3rd Ed. New York: Springer.

Hosmer D., Lemeshow S., May S. (2008). *Applied Survival Analysis: Regression Modeling of Time To Event Data*, 2nd Ed. New York: Wiley.

Klein, J.P., & Moeschberger, M.L. (2003). *Survival Analysis: Techniques for Censored and Truncated Data*, 2nd Ed. New York: Springer.

5. Minimum Student Materials

Access to computing facilities

6. Minimum University Facilities

Chalkboards for classroom use, overhead projectors, computer facilities for student use in preparing assignments.

7. Expanded Description of Content and Method

CONTENT	LECTURE HOURS
A. Introduction to survival data	**4**
1. Characteristics of survival data	
2. Censoring and truncation mechanisms	
3. Introduction to statistical software	
B. Parametric Models and Descriptive Measures for Survival Data	**4**
1. Survival function	
2. Hazard function	
3. Cumulative hazard function	
4. Mean survival time	
5. Percentiles of the survival time distribution.	
C. Nonparametric Estimators for Right-Censored Data	**6-7**
1. Kaplan-Meier and Nelson-Aalen estimators of the survival function	
2. Estimators of the hazard and cumulative hazard functions	
3. Estimators of mean and percentiles of survival time	
D. Inference for Survival Probabilities and Descriptive Measures	**4**
1. Pointwise confidence intervals for survival probabilities	
2. Confidence bands for the survival function	
3. Confidence intervals for the mean and median survival time	
4. Log-rank and Wilcoxon tests for comparing survival functions	
E. Semi-Parametric Regression Models for Right-Censored Survival Data	**7-8**
1. Cox proportional hazards model	
2. Interpretation and inference for model parameters	
3. Hazard ratios	
4. Stratified proportional hazards model.	
5. Inclusion of time-varying predictors	
F. Residual diagnostics for the Cox regression model	**3**
1. Cox-Snell residuals for assessing goodness-of-fit	
2. Martingale residuals for assessing functional form of predictors	
3. Schoenfeld residuals for assessing proportional hazards assumption	
4. Likelihood displacement statistics for identifying unusual observations	
G. Parametric Regression Models for Survival Data	**2**
1. Accelerated failure time (AFT) models for Weibull and log-logistic survival data	
H. Nonparametric Estimators for Non-Right-Censored Data	**3**
1. Estimator of Survival function for left, double, and interval censoring	
2. Estimator of Survival function for right truncated data	
3. Cox regression model for left-censored data	
I. Models for Discrete-Time Survival Data	**3**
1. Estimator of Hazard function	

2. Estimator of Survival function

TOTAL: 36-38

METHOD

Material will be presented in a lecture format. Students will be required to use available computer resources.

8. Method of Evaluating Outcome

Homework assignments, exams, and individual or team projects.