

**Prefix, Number and Name of Course:** ACM 661 Survival Analysis

**Credit Hours:** 1

**In Class Instructional Hours:** 1

**Labs:** 0

**Field Work:** 0

**Catalogue Description:**

*Prerequisite: MAT 202 or equivalent*

Survival and Hazard functions, life tables, Kaplan-Meier survival analysis, Cox regression proportional hazards model and Cox regression with time-dependent variables, comparison with logistic regression approaches.

**Reasons for addition:**

To create a one-semester-hour module for the graduate Professional Applied and Computational Mathematics program where students will formulate and solve real life problems in various settings using an analytic approach called survival analysis which is a collection of statistical procedures for data analysis in which the outcome variable of interest is *time until an event occurs*.

| <b>Student Learning Outcomes:</b><br>Students will:   | <b>Content Reference</b> | <b>Assessment</b>  |
|---|--------------------------|--|
| 1. discriminate the type of analytic problems addressed by survival analysis.                     | I - VI                   | Individual homework assignments, group work, examinations and computer projects. |
| 2. use the Life Table Method of analysis.   | II, VI                   | Individual homework assignments, group work, examinations and computer projects. |
| 3. use Kaplan-Meier survival analysis.  | III, VI                  | Individual homework assignments, group work, examinations and computer projects. |
| 4. use the Cox Regression Proportional Hazards Model and the model with time-dependent variables. | IV - VI                  | Individual homework assignments, group work, examinations and computer projects. |
| 5. examine and experiment on how statistical software can be used in the field.                   | III.                     | Individual homework assignments, group work, examinations and computer projects. |

**Course Content:**

I. Introduction to survival analysis

- A. Censored data
  - B. Survival and hazard functions
  - C. Goals of survival analysis
- II. Life tables
- A. Assumptions needed to use the life table
  - B. Lost to follow-up
  - C. Plotting and comparing survival functions
- III. Kaplan-Meier survival analysis
- A. Kaplan-Meier estimators
  - B. Comparing survival distributions - log-rank test
- IV. Cox regression - proportional hazards (PH) model
- A. Maximum likelihood estimation of the Cox PH model
  - B. Evaluating the PH assumption
  - C. Graphical displays - examination of residuals
  - D. The stratified Cox procedure
  - E. The no-interaction assumption and how to test it
- V. Cox regression - Time-Dependent variables
- VI. Use of statistical software

**Resources:**

Scholarships in the Field:

Balakrishnan, N. and Rao, C. R., *Advances in Survival Analysis*, Elsevier North-Holland, 2004.

Cox, D. R. and Oakes, D., *Analysis of Survival Data*, New York: Chapman and Hall, 1984.

Elandt-Johnson, R. C. and Johnson, N. L., *Survival Models and Data Analysis*, New York: Wiley, 1980.

Hosmer, D. W., Lemeshow, S. and May, S., *Applied Survival Analysis: regression modelling of time-to-event data*, 2<sup>nd</sup> ed. Wiley Interscience, 2008.

Kalbfleisch, J. D. and Prentice, R. L., *The Statistical Analysis of Failure-Time Data*, New York: Wiley, 1980.

Kleinbaum, D. G., *Survival Analysis: a self-learning text*, 2<sup>nd</sup> ed. Springer Science, 2005.

Le, C. T., *Applied Survival Analysis*, New York: Wiley, 1997.

Lee, E. T. and Wang, J. W., *Statistical Methods for Survival Data Analysis*, 3<sup>rd</sup> ed. New York: Wiley, 2003.

Machin, D., Cheung, Y. B. and Parmar, M. K. B., *Survival Analysis: a practical approach*, 2<sup>nd</sup> ed. NJ: Wiley, 2006.

Parmar, M. K. B. and Machin, D., *Survival Analysis: A Practical Approach*, New York: Wiley, 1995.

Ruppert, G., *Survival Analysis*, New York: Wiley, 1981.

Periodicals:

*Annals of Applied Statistics*

*Annals of Mathematical Statistics*

*Annals of Statistics*

*Biometrics*

*Biometrika*

*Communications in Statistics*

*Demography*

*International Statistical Review*

*Journal of the American Statistical Association*

*Journal of Applied Statistics*

*Journal of Applied Statistical Science*

*Journal of Statistical Computation and Simulation*

*Journal of the Royal Statistical Society*

*Life-time Data Analysis*

*Scandinavian Journal of Statistics*

*Statistics in Medicine*

*Statistical Methods in Medical Research*

*Technometrics*

*The American Statistician*

Electronic and/or Audiovisual Resources:

Electronic Journal of Statistics

Link to electronic journals web site (<http://www.e-journals.org/>)