Western Science

Department of Statistical and Actuarial Sciences

AS4823A/AS9004A

Survival Analysis
Course Outline

1. Course Information

Course Information

Name	Survival Analysis
Term	Fall 2022
Lecture Hours	Monday 2:30 – 4:20 PM Wednesday 3:30 – 4:20 PM
Location	NCB 293

List of Prerequisites
A minimum mark of 60% in SS3858.

Unless you have either the requisites for this course or written special permission from your Dean to enroll in it, you may be removed from this course and it will be deleted from your record. This decision may not be appealed. You will receive no adjustment to your fees in the event that you are dropped from a course for failing to have the necessary prerequisites.

2. Instructor Information

Instructors	Email	Office	Phone	Office Hours
Dr. Yang Miao (Instructor)	ymiao42@uwo.ca	WSC 190		TBA (via Zoom)*
Xingyi Zeng (TA)	xzeng85@uwo.ca	WSC 168		

Students must use their Western (@uwo.ca) email addresses when contacting their instructors.

*In-person office hours may be arranged upon the request of the students.

3. Course Syllabus, Schedule, Delivery Mode

Topics
Survival models, nonparametric estimation of the survival function, one and two or more sample hypothesis tests, inference for semiparametric regression models, inference for parametric regression models.

Learning Outcomes
This course is intended to provide students with an understanding of the theory and applications of survival analysis. By the end of the course, students are expected to be able to perform statistical inference for various types of survival data by using parametric,
semi-parametric or nonparametric survival models.

Table of Contents and Schedule
1. Introduction to survival analysis.
2. Essential preliminaries: survivor function, hazard function, cumulative hazard function, density function and their relationships for both continuous and discrete survival times. Censoring and truncation.
3. Basic properties of lifetime distributions: the common lifetime distributions, how the distributions are derived in survival analysis, and their properties that are essential in choosing distributions in practice.
4. Non-parametric estimation and graphical methods: Kaplan-Meier estimator, Nelson-Aalen estimator, and their variance estimators; Log-rank test for distribution difference; Graphical methods that combining nonparametric estimation and choices of parametric models in practice.
5. Parametric survival models: statistical inference for parametric model settings.
6. Regression analysis for parametric models: goodness of fit and model selection for regression models under parametric settings.
7. Regression analysis for semi-parametric models: goodness of fit and model selection for regression models under semi-parametric settings where part of the models is left unspecified.

A tentative schedule is attached at the end of this outline for your convenience. **Note that this schedule is subject to changes.**

Key Sessional Dates

Classes begin	September 8, 2022
Reading Week	October 31 – November 6, 2022
Classes end	December 8, 2022
Exam period	December 10 – 22, 2022

Mode of Delivery
Students are expected to attend in person lectures and evaluations. To accommodate students who will arrive late due to travel restrictions, live streaming of the lectures via Zoom will be provided before October 5 (included). The Zoom meeting link will be posted on OWL.

Contingency plan for an in-person class pivoting to 100% online learning
In the event of a COVID-19 resurgence during the course that necessitates the course delivery moving away from face-to-face interaction, affected course content will be delivered entirely online, either synchronously (i.e., at the times indicated in the timetable) or asynchronously (e.g., posted on OWL for students to view at their convenience). The grading scheme will **not** change. Any remaining assessments will also be conducted online as determined by the course instructor.

4. Course Materials

Primary materials
The course is based on the lecture slides which will be posted on OWL.

Optional materials
Statistical Models and Methods for Lifetime Data, 2nd Edition, by Jerald F. Lawless, John Wiley & Sons, 2003.

All course material will be posted to OWL: http://owl.uwo.ca. Students are responsible for checking the course OWL site on a regular basis for news and updates. This is the primary method by which information will be disseminated to all students in the class.

Calculator
A non-programmable calculator is needed for the course. Actuarial Science students are encouraged to use an SOA-approved model. For details, see https://www.soa.org.

If students need assistance with the course OWL site, they can seek support on the OWL Help page. Alternatively, they can contact the Western Technology Services Helpdesk. They can be contacted by phone at 519-661-3800 or ext. 83800.

5. Methods of Evaluation

The overall course grade will be calculated as listed below:

Midterm 1 (October 17)	15%
Midterm 2 (November 21)	15%
Project (up to 3 students/group)	20%
Final exam (date: TBA)	50%

The midterms will be in-class and will be 110 minutes in length. The final exam will be scheduled by the registrar's office and will take place in the winter exam period. Midterms and the final exam are closed-book. You may only use a non-programmable calculator during these tests.

The guideline for the project will be available on November 23. The project will be due on December 7 (the last class). Undergraduate students may form a group of less than 3 students. Graduate students need to finish the project individually.

6. Student Absences

If you are unable to meet a course requirement due to illness or other serious circumstances, please follow the procedures below.

Missed midterms(s):
If you miss a midterm with appropriate document, then the weight of the missed midterm will be reallocated to the other midterm and the final exam proportionally. Please note that approval of such accommodation can only be made by the student's Dean's Office/Academic Counselling unit.

For example, if you missed one midterm with appropriate approval, then the weight of the other midterm and the final exam would change to 18.46% and 61.54% respectively. If you missed two midterms with appropriate approval, then the weight of the final exam would change to 80%. If you missed any midterm without appropriate approval, then you would receive 0 for that midterm.

For work totalling 10% or more of the final course grade, you must provide valid medical or supporting documentation to the Academic Counselling Office of your Faculty of Registration as soon as possible. For further information, please consult the University's medical illness policy at

https://www.uwo.ca/univsec/pdf/academic_policies/appeals/accommodation_medical.pdf.

The Student Medical Certificate is available at

https://www.uwo.ca/univsec/pdf/academic_policies/appeals/medicalform.pdf.

Absences from Final Examinations
If you miss the Final Exam, please contact the Academic Counselling office of your Faculty of Registration as soon as you are able to do so. They will assess your eligibility to write the Special Examination (the name given by the University to a makeup Final Exam).

You may also be eligible to write the Special Exam if you are in a "Multiple Exam Situation" (e.g., more than 2 exams in 23-hour period, more than 3 exams in a 47-hour period).

If a student fails to write a scheduled Special Examination, the date of the next Special Examination (if granted) normally will be the scheduled date for the final exam the next time this course is offered. The maximum course load for that term will be reduced by the credit of the course(s) for which the final examination has been deferred. See the Academic Calendar for details (under Special Examinations).

6. Accommodation and Accessibility

Religious Accommodation
When a course requirement conflicts with a religious holiday that requires an absence from the University or prohibits certain activities, students should request accommodation for their absence in writing at least two weeks prior to the holiday to the course instructor and/or the Academic Counselling office of their Faculty of Registration. Please consult University's list of recognized religious holidays (updated annually) at

https://multiculturalcalendar.com/ecal/index.php?s=c-univwo.

Accommodation Policies
Students with disabilities are encouraged to contact Accessible Education, which provides recommendations for accommodation based on medical documentation or psychological and cognitive testing. The policy on Academic Accommodation for Students with Disabilities can be found at:

https://www.uwo.ca/univsec/pdf/academic_policies/appeals/Academic Accommodation_disabilities.pdf.

7. Academic Policies

The website for Registrarial Services is http://www.registrar.uwo.ca.

In accordance with policy,

https://www.uwo.ca/univsec/pdf/policies_procedures/section1/mapp113.pdf,

the centrally administered e-mail account provided to students will be considered the individual's official university e-mail address. It is the responsibility of the account holder to ensure that e-mail received from the University at their official university address is attended to in a timely manner.

Scholastic offences are taken seriously and students are directed to read the appropriate policy, specifically, the definition of what constitutes a Scholastic Offence, at the following Web site:

http://www.uwo.ca/univsec/pdf/academic_policies/appeals/scholastic_discipline_undergrad.pdf.

8. Support Services

Please visit the Science & Basic Medical Sciences Academic Counselling webpage for information on adding/dropping courses, academic considerations for absences, appeals, exam conflicts, and many other academic related matters: https://www.uwo.ca/sci/counselling/.

Students who are in emotional/mental distress should refer to Mental Health@Western (https://uwo.ca/health/) for a complete list of options about how to obtain help.

Western is committed to reducing incidents of gender-based and sexual violence and providing compassionate support to anyone who has gone through these traumatic events. If you have experienced sexual or gender-based violence (either recently or in the past), you will find information about support services for survivors, including emergency contacts at

https://www.uwo.ca/health/student_support/survivor_support/get-help.html.

To connect with a case manager or set up an appointment, please contact support@uwo.ca.

Please contact the course instructor if you require lecture or printed material in an alternate format or if any other arrangements can make this course more accessible to you. You may also wish to contact Accessible Education at

http://academicsupport.uwo.ca/accessible_education/index.html

if you have any questions regarding accommodations.

Learning-skills counsellors at the Student Development Centre (https://learning.uwo.ca) are ready to help you improve your learning skills. They offer presentations on strategies for improving time management, multiple-choice exam preparation/writing, textbook reading, and more. Individual support is offered throughout the Fall/Winter terms in the drop-in Learning Help Centre, and year-round through individual counselling.

Tentative Schedule

Monday	Wednesday
September 12 Introduction and review of course outline Lifetimes The trouble with lifetimes–censoring and truncation The survival package in R Some lifetimes data sets	**September 14** Review of lifetimes Functions that characterize lifetimes Examples of lifetime distributions
September 19 More common lifetime distributions Nonparametric models Discrete distributions The empirical distribution The Kaplan-Meier estimator Examples	**September 21** Greenwood's formula for the variance Examples survfit in R
September 26 Confidence intervals for survival function Parameter transformations and the delta method Confidence intervals using survfit Examples Greenwood's formula revisited	**September 28** The Nelson-Aalen estimator Examples Practice questions set 1
October 3 Estimating the hazard function Kernel function estimators Smoothing splines Estimating the hazard function using R Constructing a graduated life table	**October 5** Parametric models Log-location-scale models Examples
(THANKSGIVING)	**October 12** Statistical inference Solution 1

October 17 Midterm 1	**October 19** Fitting log-location-scale models using R Examples
October 24 Fitting parametric models using R More statistical inference Model selection and model checking	**October 26** Modelling the impact of explanatory variables Accelerated failure time models
November 7 Residuals of AFT models Influence analysis Proportional hazards models Partial likelihood function	**November 9** Fitting proportional hazards models using R Adjustment for tied failure times Practice questions set 2
November 14 Statistical inference for PH models Estimating the baseline distribution	**November 16** Stratified PH models Solution 2
November 21 Midterm 2	**November 23** Time-varying covariates
November 28 Model checking for PH models Examples Project guideline	**November 30** Tests for comparing lifetime distributions Log-rank and Wilcoxon tests Examples Practice questions set 3
December 5 Connection with the PH model Performing tests using R Stratified tests	**December 7** Review Solution 3 Project due