STATISTICAL ANALYSIS OF FINANCIAL DATA IN R (ISOM4530)

Instructor: Prof. Xinghua Zheng
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Lectures: Mon 15:00-17:50, LSK1034
Office hours: by appointment

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Tutorial sessions: Tue 11:00 - 12:00, LSK G012

Reference Books:

- *Statistical analysis of financial data in R* by René A. Carmona (Springer-Verlag); accessible at https://lbdiscover.ust.hk/bib/991012694823303412
- *Analysis of Financial Time Series* by Ruey S. Tsay (Wiley); accessible at https://lbdiscover.ust.hk/bib/991012622507603412

Course Website: http://canvas.ust.hk/

Course Objective: This course intends to introduce the students to modern data analysis using statistical software R, with an emphasis on financial applications. In this course, students will

(1) study the data exploration methods, regression and time series through applications to real financial data;
(2) gain experience in analyzing financial data; and
(3) become proficient in using R to do estimation, modeling, and forecasting.

On completion of the course, students will

(1) have in-depth grasp of the knowledge and tools in modern statistics;
(2) be able to think critically and make effective decisions based on appropriate statistical data analysis; and
(3) be effective users of statistical software R in financial applications.

Course Outline (all topics include financial applications using R):

- Univariate Exploratory Data Analysis
  - First examples of financial data
  - Parametric estimation for the standard distribution families
  - Nonparametric density estimation
  - Q-Q plots, VaR, extreme events and heavy tail distributions
  - First Monte Carlo simulations
- Multivariate Exploratory Data Analysis
  - Joint density and its estimation
  - Multivariate distributions; multivariate Gaussian (normal) distribution
  - Dependence; correlation coefficient
  - More dependence measures: Spearman's ρ and Kendall's τ
- Parametric Regression
  - Simple linear regression
  - Diagnostics, measures of influence and robust alternatives
  - Linear statistical models
  - ANOVA
  - Polynomial regression
  - Regression as a smoothing technique
  - Nonlinear regression techniques
  - Natural splines
- Time Series Models
  - Stochastic processes: seasonal effects, stationarity, mean, autocovariance and autocorrelation functions
  - Linear time series: White Noise (WN), AutoRegressive (AR) processes, Moving Average (MA) processes, ARMA
  - Forecasting procedures for time series
  - Nonlinear time series: ARCH, GARCH

Approximate schedule:

Week 1 $\sim$ 3	Unitary Data Analysis
Week 3 $\sim$ 4	Multivariate Data Analysis
Week 5$\sim$ 7	Parametric Regression
Week 8 $\sim$ 11	Time Series Models

Evaluation:

- 10% Attendance (up to 3 absences with legitimate reasons permitted)
- 20% Assignments
- 25% Midterm Examination (**Mon, Oct. 14, 15:00 - 17:00**)
- 45% Final Examination (date TBA)

About assignments: You can discuss with others about assignment, but you MUST turn in your own solutions: plagiarism is not allowed!

Warnings:

- No late homework will be accepted.
- No make-up midterm exams will be given. If you have to miss the midterm exam due to medical reasons, supported by medical certificate on the midterm exam day submitted no later than 24 hours after the midterm exam, the weight of the midterm exam will be counted into the final.
- No make-up final exam will be given except for cases approved by ARRO.

Attendance: Attendance of the class is required and essential. Many conceptual issues and statistical thinking are only taught in the class. They will appear in the midterm and final exams.

Academic Integrity: Academic dishonesty includes, but is not limited to, cheating, plagiarizing, fabricating of information, facilitating acts of academic dishonesty by others, having unauthorized possession of examinations, submitting work of other students, or tempering with the academic work of other students. All exam answers must be your own, and you must not provide any assistance to other students during exams.

Current university policy on academic dishonesty is:
(excerpted from `http://www.ust.hk/vpaao/integrity/student-5.html`)
" If you are discovered cheating, however minor the offence, your academic record will carry a notation of academic dishonesty. This notation stays with your record until graduation. If you cheat again, you will be dismissed from the University and the notation of academic dishonesty in your official transcript will not be removed."

Absence from Final Exam: (Excerpted from
`https://www.ab.ust.hk/arr/reg/em/em_std_reg/reg_makeup.html`) "Students who fail to attend a final examination as scheduled will be given zero mark for that examination. If the absence is due to extenuating circumstances beyond the student's control, such as medical emergencies, he/she may apply to the Admissions, Registration and Records Office (ARRO) within one week from the missed examination for a make-up examination to be held. For absence due to medical reasons, the student is required to submit certification issued by a registered medical practitioner. Appropriate documentation will be required for absences due to other reasons.

The ARRO will decide, in consultation with the Office of the Provost and the Department/Course Instructor concerned, whether the student's application should be approved. The student will be notified of the result of the application within one week from the date

the application is lodged with ARRO. The make-up examination will be held within five weeks after the regular examination period. The format of the make-up examination will be decided by the course instructor concerned."