

ISYE 4031 REGRESSION AND FORECASTING

Required for BSIE

Credit: 3-0-3

Coordinators: Profs. Ethan Lee and Jing Li Fall 2025

Prerequisite(s): ISYE 3030

Text:

- *Forecasting, Time Series, and Regression (FTR)* by Bowerman, O'Connel, and Koehler, Duxbury Applied Series, 4th Edition, Duxbury Applied Series.
- *Linear Models with R (LMR)* by Julian J. J. Faraway, 2nd/3rd edition, Chapman & Hall/CRC
- *An Introduction to Statistical Learning with Application in R (ISL)* by Gareth James, Daniela Witten, Trevor Hastie, Robert Tibshirani, 2nd edition, Springer
 - Online Resource:
<https://www.statlearning.com/>
 - ISL also has a version in Python
- *Forecasting: Principles and Practice (FPP)* by Rob Hyndman and George Athanasopoulos, 2nd/3rd edition, OTexts: Melbourne, Australia.
 - Online Resources:
<https://otexts.com/fpp2/>
<https://otexts.com/fpp3/>

Catalog Description:

Regression analysis: multiple linear regression, diagnostics, and variable selection.
Basic statistical learning methods: Logistic Regression, Ridge Regression & LASSO (Shrinkage methods), PCA. Optional: KNN, K-Means.
Forecasting: exponential smoothing techniques and autoregressive moving average models.

Course Description

The objective of this course is to learn about regression, basic statistical learning methods related to regression, time series, and other forecasting models and their applications in various fields of data science, machine learning and engineering.

Software

A software package will be used in this class for assignments and projects. *R* and *Python* are the preferred programming languages.

Topical Outline

The topical outline is shown in the table below. The table has 2 columns. The first column lists the topics to be covered. The second column lists the number of weeks these topics will be covered.

Topics	Weeks
Review of statistics, t-test, f-test, and the use of p -Value: FTR Ch2	1
Review of linear regression: FTR Ch3-4, LMR Ch2-4, ISL Ch3	2
Model diagnostics and residual analysis: FTR Ch5, LMR Ch5-7	2
Variable selection: FTRCh5, LMR Ch10, ISL Ch6	2
Statistical Learning methods: ISL Ch4, 6, 10, LMR Ch11	3-4
Forecasting: Time series regression: FTR Ch6, FPP Ch7	1
Exponential smoothing: FTR Ch8, FPP Ch8	1
ARIMA models: FTR Ch9, FPP Ch9	2
Optional: Seasonal ARIMA modeling: FTR Ch11	[1]
Total	14-15

Course Learning Outcomes

At the end of this course, students will be able to:

1. Formulate real life problems using regression, statistical learning and forecasting models.
2. Collect appropriate data to estimate the models and understand which data are useful in solving the problem.
3. Use statistical software to estimate the models from real data.
4. Draw conclusions from the estimated models to solve the real life problems.

The Mapping from the Course Outcomes to ABET Student Learning Outcomes

The table below shows the relationship between course outcomes and ABET student learning outcomes. The table has 8 columns. The first column lists the course learning outcomes listed above. The next 7 columns list the abbreviated ABET Student Learning Outcomes. The entry of H in a row with specific course learning outcome and column with specific ABET Student Learning Outcomes indicate the importance of attain this outcome is high and will be assessed.

Course outcome \ Program Outcomes	1. identify, formulate solve engg prob by engg, sci & Math	2. produce solutions consider public health, safety, welfare, global, cultural, social, environ & economic	3 communicate with a range of audience	4 recognize ethical & professional responsibilities, make informed judgement consider resolutions in global, economic, environ and societal context.	5. effective on a team provide leadership, collaborative and inclusive envirm, plan tasks & meet objectives	6. develop and conduct experiment, analyze and interpret data & use engineering judgement to draw conclusions.	7. acquire and apply new knowledge using appropriate learning strategies
1. Formulate real life problems using regression, statistical learning and forecasting models.	H						
2. Collect appropriate data to estimate the models and understand which data are useful in solving the problem						H	
3. Use statistical software to estimate the models from real data							
4. Draw conclusions from estimated models to solve real life problems						H	

Evaluation of the important outcomes

The outcome 1, 2 and 4 will be assessed by the project or assignment