

Instructor.

Name: Dr. Honglang Wang

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Course.

Prerequisite: STAT I511 or equivalent (basic probability and statistics, as well as linear algebra)

Textbook: Kutner, Nachtsheim, and Neter (McGrawHill, 2004, ISBN 0072386916) *Applied Linear Regression Models*, 4th edition.

Lectures: MW 4:30 – 5:45 PM in IP 208

TA: Xuchen Fang (xf8@iu.edu)

Office hours. MW 03:30–04:30 PM, LD 270B. You may also make appointment with me via email.

Course summary. The aim of this course is to provide training in both the theoretical foundations and the practical use of linear regression models. Students who successfully complete this course will not only be able to achieve a sound understanding of the theory of linear models, but also be able to apply a wide variety of regression techniques in real data analysis projects. Students are also trained to use diagnostic tools to assess the validity of regression models, and apply variable selection and model building strategies in linear regression models. Extensive use of the computer is needed to conduct data analyses and programming in R.

Grades.

| | |
|----------------|-------------------------------|
| Homework | (20 pts \times 7 = 140 pts) |
| Attendance | (100 pts) |
| In-class Exam | (100 pts) |
| Take-home Exam | (100 pts) |
| Final Project | (100 pts) |

- **Attendance.** Attendance is very important to learn from this course. In terms of grades, it counts for around 20%. There will be one attendance sheet to sign for every lecture. Students can miss at most two lectures without any loss of credits in case of illness, family emergencies, etc.. Otherwise, students need to get the instructor's permission beforehand for absence without loss of credits.
- **Homework.** There will be 7 homework assignments throughout the semester. These may include analyses of real data sets, writing R scripts and conducting simulations, or derivations of theoretical properties. Collaboration on homework assignments is acceptable, but all write-ups must be done independently and clearly indicate the submitter's understanding of the material. Unclear or disorganized homework may have points removed, even if the content is correct. **No hardcopy of the report will be turned in, but the**

pdf file of your report should be submitted electronically on canvas. And late homework will not be accepted without instructor's permission beforehand.

Communicating your results to others is as important as getting good results in the first place. A portion of the points available for every homework will be set aside to reflect the clarity of your writing, figures, data presentation, and other marks of communication. (Rubrics will be provided for each assignment.)

- Exams. The **closed-book in-class exam** will focus on theoretical and conceptual facts in simple linear regression model. The **take-home exam** will focus on practical as well as theoretical aspects of multiple linear regression model.
- Final project. There will be a **final group (2-3 people) project**. You have 2 weeks to complete the project. The project has two components, written and oral with the following breakdown: **final written report** (60 pts), **oral presentation** including answering questions from the instructor and the peers (40 pts). The written report will be due at the last class and the oral presentation will take place during the exam week.
- Overall course grades will be assigned according to the following rule:

$$A \geq 90\% > B \geq 80\% > C \geq 70\% > D \geq 60\% > F,$$

with “+” and “-” attached for scores falling in the upper and lower third of the range, respectively. I reserve the right to make adjustments to the overall grading policy, but the letter grade cutoffs will be no stricter than those advertised above.

- **No make up** is allowed for take-home exam or final project. Makeup of the in-class exam may be given in only a very special (and documented) circumstance, such as: the death of a family member, religious observances, sickness, hospitalization, military duty or the likes.
- Incompletes. Grades of Incomplete will only be given in accordance with university policy¹. Specifically, students must be passing at the 3/4 mark of the semester to qualify for assigning an incomplete. The instructor must agree that an incomplete is appropriate and it must be approved by the Associate Chair of the Department of Mathematical Sciences.

Software. This course uses the R statistical software. This software is available on all university PCs, but you can download it for your own computer since it is open source and free. Many of you will have some prior exposure to the language; for the rest, now is a great time to start learning. Almost every assignment will require you to use it. No other form of computational work will be accepted. Here is the link for R: <https://www.r-project.org/>, where you can find R availability, online help, and other info. No previous R experience is assumed—online tutorials are available by searching in Google or Youtube. R **Markdown** is an extension to R which lets you embed your code, and the calculations it produces, in ordinary text, which can also be formatted, contain figures and equations, etc. Using R Markdown is required for the homework. RStudio (<https://www.rstudio.com/>) is the powerful and productive user interface for R as well for R **Markdown**, which is also free and open source.

Accommodations². Students needing accommodations because of a disability will need to register with Adaptive Educational Services (AES) and complete the appropriate forms issued by AES before accommodations will be given.

¹See <https://indianapolis.iu.edu/academics/records-grades/grades/incomplete.html>

²See <https://diversity.indianapolis.iu.edu/offices/aes/index.html> for more information

Dishonesty and Student Misconduct. Cheating will result in a minimum penalty of receiving a grade of F in the course. The IUI Department of Mathematical Sciences expects all students to adhere to the regulations put forth in the “IU Code of Student Rights, Responsibilities, and Conduct” concerning academic misconduct or personal misconduct. Procedures for imposing academic and disciplinary sanctions are outlined in the Code³.

Campus Wide Policies Governing the Conduct of Courses at IUI⁴. There are links to specific policies in the general areas of attendance, academic policy, conduct and related policies.

Administrative Withdrawal. A basic requirement of this course is that you will participate in all class meetings and conscientiously complete all required course activities and/or assignments. Keep in touch with me if you are unable to attend, participate, or complete an assignment on time. If you miss more than half of the required activities within the first 25% of the course without contacting me, you may be administratively withdrawn from this course. Administrative withdrawal may have academic, financial, and financial aid implications. Administrative withdrawal will take place after the full refund period, and if you are administratively withdrawn from the course you will not be eligible for a tuition refund.

Withdrawals. If you decide to withdraw from the course, be sure to process all paperwork by the appropriate deadlines outlined in the following table⁵: After the 3/4 mark of the semester,

| Times | Signatures Required |
|----------------------|-------------------------|
| First Week | None |
| After First Week | Advisor |
| 1/2 mark of Semester | Advisor and Instructor |
| 3/4 mark of Semester | Associate Chair, LD 270 |

course instructors cannot sign a drop slip. The student must see the Associate Chair of the Department of Mathematical Sciences. The School of Science Dean’s Office will not endorse a withdrawal after the 3/4 mark of the semester for students unless an extremely serious and documentable excuse is established.

³See <https://studentcode.iu.edu/>

⁴See <https://indianapolis.iu.edu/academics/policies/>

⁵Official details can be found at <https://indianapolis.iu.edu/academics/classes-registration/register/withdrawal/>

Table 1: **Tentative Schedule**

| Week | Topic | HW/Exams/Project |
|-----------------|--|--|
| 01(08/26-08/30) | Chapter 1: Simple Linear Regression (SLR) | |
| 02(09/02-09/02) | Labor Day Holiday | |
| 02(09/03-09/06) | Chapter 1: Simple Linear Regression | |
| 03(09/09-09/13) | Chapter 2: Inferences in SLR | HW1 (W) |
| 04(09/16-09/20) | Chapter 2: Inferences in SLR; Chapter 5: Matrix Approach to SLR | |
| 05(09/23-09/27) | Chapter 3: Diagnostics and Remedial Measures | |
| 06(09/30-10/04) | Chapter 3: Diagnostics and Remedial Measures | |
| 07(10/07-10/11) | Chapter 6/7: Multiple Linear Regression (MLR) | HW2(M) |
| 08(10/14-10/18) | Chapter 6/7: Inference and Diagnostics for MLR | HW3(M) |
| 09(10/21-10/25) | Review and Exam 1 Exam on Wednesday, Oct. 23 | |
| 10(10/28-11/01) | Chapter 8: Interaction, Polynomials and Categorical Predictors | |
| 11(11/04-11/08) | Chapter 9: Model Selection and Validation | HW4(M) |
| 12(11/11-11/15) | Chapter 9: Model Selection and Validation | |
| 13(11/18-11/22) | Chapter 10: Outliers and Influential Observations | HW5(M) |
| 14(11/25-11/26) | Chapter 10: Outliers and Influential Observations | |
| 14(11/27-11/29) | Thanksgiving Holiday | |
| 15(12/02-12/06) | Chapter 11: Multicollinearity, Weighted Least Squares Regression, Piecewise and Ridge Regression | HW6(M) |
| 16(12/09-12/13) | Chapter 11: Multicollinearity, Weighted Least Squares Regression, Piecewise and Ridge Regression | Exam 2 Fri-Sun, Dec. 13-15 HW7(W) |
| 17(12/16-12/16) | Lasso and Bootstrapping | |
| 17(12/18-12/18) | Presentations (Oral Assessment) (3:30 – 5:30 PM) in lecture room | Final Report |