

STA 371G Outline

Spring 2014

Professor: Mingyuan Zhou

Office: CBA 6.462

Phone: 512-232-6763

Email: mingyuan.zhou@mcombs.utexas.edu

Office Hours: Tuesday Thursday 3:30-4:30 PM. You are welcome to come by my office at other times, but to make sure that I will be there then, you may first call my office, send me an email, or talk to me before or after class to make an appointment.

Tuesday, January 14

Topics:

- Introduction
- Probability
- Random variables
- Probability distributions
- Mean, variance and standard deviation of a random variable

Thursday, January 16

Topics:

- Add a constant to a random variable
- Multiply a random variable by a constant
- Conditional, joint and marginal probabilities
- Independent random variables, sum of independent random variables
- Continuous random variables
- Probability density function: area under the curve represents probability
- Standard normal distribution $Z \sim \mathcal{N}(0, 1)$
- Standard normal calculations in Excel: NORMSDIST, or in R: pnorm (type “?pnorm” in R for help).

Reading Assignments:

If you are not familiar with the topics discussed in class, you are recommended to read:

pp. 156-168, 189-195, of Data analysis and decision making, 4th edition

or

pp. 196-206, 225-231 of Data analysis and decision making, 3rd edition

To learn more about these topics, you may further read:

Chapters 2.1, 2.2, 2.4, and 2.5 of OpenIntro Statistics, 2nd edition

Tuesday, January 21

- Normal distribution $X \sim \mathcal{N}(\mu, \sigma^2)$
- Understand the meaning of the standard deviation σ in a normal distribution: $P(\mu - \sigma < X < \mu + \sigma) = ?$ and $P(\mu - 2\sigma < X < \mu + 2\sigma) = ?$
- Normal calculations in Excel:
NORMSDIST, NORMDIST
NORMSINV, NORMINV
or in R:
pnorm, qnorm (type “?pnorm” and “?qnorm” in R for help).
- Plot a normal distribution in Excel and R
- Example: Testing at ZTel, we will make an Excel spreadsheet for calculations

Reading Assignments:

To get familiar with the normal distribution, you are recommended to read:

pp. 211-215, 217-225 of Data analysis and decision making, 4th edition

or

pp. 247-250, 253-260 of Data analysis and decision making, 3rd edition

You may further read:

Chapters 3.1.1, 3.1.2, 3.1.4 and 3.1.5 of OpenIntro Statistics, 2nd edition

Thursday, January 23

- Case study, Texas BBA Salary Statistics
- Conditional, joint and marginal probabilities
- Expectation of a random variable
- If $X \sim \mathcal{N}(\mu, \sigma^2)$, then $P(X < x) = P\left(\frac{X-\mu}{\sigma} < \frac{x-\mu}{\sigma}\right) = P(Z < \frac{x-\mu}{\sigma})$.
- Standardizing a normal random variable $Z = \frac{X-\mu}{\sigma} \sim \mathcal{N}(0, 1)$
Interpretation: the value of Z is the number of standard deviations that X deviates towards the left (if $Z < 0$) or the right (if $Z > 0$) of the mean.

Tuesday, January 28

Class cancelled due to adverse weather conditions.

Thursday, January 30

- Common problems in Homework 1
- Case study: Texas BBA Statistics
- Binomial distribution $X \sim \text{Binomial}(n, p)$. Examples: the number of “Heads” in 100 coin flips, the number of votes for Republican in 1000 voters
- The normal approximation to the binomial $X \sim \mathcal{N}(np, np(1 - p))$
- Important concepts: Population and Sample
- Sampling distribution of a sample proportion
- Case study: A national poll of 803 adults by Anzalone Liszt Grove Research

Reading Assignments:

Lecture notes 3 and 4 posted in Canvas/files

To learn more about the binomial distribution, its normal approximation, and the sampling distribution of a sample proportion, please read:

pp. 233-239, 403-404 of Data analysis and decision making, 4th edition

or

pp. 268-273, 438-439 of Data analysis and decision making, 3rd edition

For this topic, you may further read:

Chapters 3.4.1, 3.4.2 and 6.1 of OpenIntro Statistics, 2nd edition

Tuesday, February 4

- Population mean, variance, standard deviation
- Sample mean, sample variance, standard error of the sample mean
- Sampling distribution of the sample mean
- Central limit theorem
- t distribution (optional)
- Confidence interval
- Case study, Texas BBA Salary Statistics

Reading Assignments:

To learn more about estimation and sampling distribution, please read:

pp. 352-353, 366-371, 374, 388-395 of Data analysis and decision making, 4th edition
or

pp. 378-379, 393-398, 400-401, 422-430 of Data analysis and decision making, 3rd edition

For this topic, you may further read:

Chapters 4.1, 4.2, 4.4 and 5.3 of OpenIntro Statistics, 2nd edition

Thursday, February 6

- Simple linear regression
- Linear prediction: $Y = b_0 + b_1X$
- Least squares estimation of b_0 and b_1
- Examples: predict house price, baseball runs per game
- Using Excel and R to do the calculation
- Excel add-in: if you are using Mac, please install StatPlus:mac LE (available at <http://www.analystsoft.com/en/products/statplustmacle/>); if you are using windows, please install Analysis ToolPak or Decision Tools Standard 6.1
(available at <http://www.mcombs.utexas.edu/tech/computer-services/coe#DecisionTools>).

Tuesday, February 11

- Sample mean, variance, and standard deviation
- Sample covariance, sample correlation
- Linear relationship between X and Y
- $b_0 = \bar{y} - b_1\bar{x}$, $b_1 = r_{xy} \times \frac{s_y}{s_x}$
- $\text{mean}(e)=0$, $\text{Corr}(e, X)=0$, $\text{Corr}(e, \hat{Y})=0$, $\text{Corr}(\hat{Y}, X)=1$
- SST, SSR, SSE
- Coefficient of determination: $R^2 = \frac{SSR}{SST} = 1 - \frac{SSE}{SST}$
- $R^2 = r_{xy}^2$ measures the proportion of variation in Y explained by X .
- Statistical model for simple linear regression

Reading Assignments:

Chapters 7.1 and 7.2 of OpenIntro Statistics, 2nd edition
pp. 531-551 of Data analysis and decision making, 4th edition
or
pp. 562-584 of Data analysis and decision making, 3rd edition

Thursday, February 13

- Statistical model for simple linear regression:
 $Y = \beta_0 + \beta_1 X + \epsilon$, $\epsilon \sim \mathcal{N}(0, \sigma^2)$
 $Y \sim \mathcal{N}(\beta_0 + \beta_1 X, \sigma^2)$
- Conditional distribution of Y given X
- 95% prediction interval of Y given X : $\beta_0 + \beta_1 X \pm 2\sigma$
- Conditional and marginal distributions of Y
- Interpretation of ϵ and σ
- The error terms ϵ_i are independently and identically distributed
- Least squares estimation and Gaussian maximum likelihood (optional)
- True line $\beta_0 + \beta_1 X$ and least squares line $b_0 + b_1 X$
- Degrees of freedom
- In SLR, σ^2 is estimated with $s^2 = \frac{\sum_{i=1}^n e_i^2}{n-2} = \frac{SSE}{n-2}$.
- SLR regression standard error: $s = \sqrt{SSE/(n-2)}$

Reading Assignments:

PDF “Simple Linear Regression” posted in Canvas/files

Tuesday, February 18

- Sampling distributions of regression parameters
- Confidence intervals of regression parameters
- Case study: Waite First Securities, Milk and Money

Thursday, February 20

- Topic summary for Midterm #1

- Discuss Practice Exam #1
- Common problems in homework assignments
- Hypothesis testing in SLR: t -statistic and p -value

Tuesday, February 25

- Midterm Exam #1

Thursday, February 27

- Forecasting with linear regression models
- Multiple regression
- Example: Auto MPG data

Tuesday, March 4

- Multiple regression
- T-test and F-test
- Example: Supervisor performance data
- Understanding multiple regression
- Correlation and causation
- Example: Number of beer and weight & height
- Examples: Auto MPG, Baseball

Thursday, March 6

- Multicollinearity
- Dummy variables and interactions
- Example: Gender Discrimination in Salary at Fifth National Bank
- Example: MidCity House Price
- Case study: Orion Bus Industries—Contract Bidding Strategy

Tuesday, March 18

- Diagnostics
- Polynomial regression
- Variable interaction
- Log transformation
- Outliers

Thursday, March 20

- Discuss Homework Assignment 6 (due next Thursday)
- Case Study, Oakland A's (A)
- Case Study, Oakland A's (B)
- Time series: fitting a trend

Reading Assignments:

Chapters 10, 11.1-11.5, and 11.8-11.11 of Data analysis and decision making, 4th edition
or

Chapters 11, 12.1-12.5, and 12.8-12.11 of Data analysis and decision making, 3rd edition

Tuesday, March 25

- Autocorrelation
- Time series regression, Hotel Occupancy Case
- Random walk models
- Autoregressive models
- Example: Monthly stock closing prices
- Example: Daily/Monthly temperature
- Example: Monthly Boston Armed Robberies Jan.1966-Oct.1975

Thursday, March 27

- Seasonal models
- Example: Fisher river daily temperatures
- Example: Monthly airline passengers
- Example: Monthly liquor sales
- Case study: Northern Napa Valley Winery, Inc.

Reading Assignments:

Chapter 12 of Data analysis and decision making, 4th edition
or
Chapter 13 of Data analysis and decision making, 3rd edition

Tuesday, April 1

- Moving averages, exponential smoothing and ARMA
- Hypothesis testing: Type I Error, Type II Error, significant level, and power
- Understanding prediction errors in linear regression
- Model selection

Thursday, April 3

- Review for Midterm Exam #2
- Model selection

Tuesday, April 8

- Midterm Exam #2

Thursday, April 10

- Model selection
- Measure uncertainty with probability
- Frequency probability and subjective probability
- Probability, lotteries and betting odds
- Payoff tables
- Conditional probability and conditional bets or conditional reference contracts
- Bayes' theorem
- Simpson's paradox