Lecture 0

Introduction

Course Information

- Your instructor:
  - Hyunseung (pronounced Hun-Sung)
  - Or HK (not Hong Kong ☺)
  - E-mail: khyuns@wharton.upenn.edu
- Lecture:
  - Time: Mon/Tues/Wed/Thur at 10:45AM-12:15PM
  - Location: F45 JMHH
- Office Hours:
  - 434 JMHH
  - Mon/Tues/Wed/Thur: 12:15PM-1:30PM (after lec.)
- Course website: stat.wharton.upenn.edu/~khyuns/stat431/

- Textbook:
  - None required
  - Recommended textbooks are on reserve at Van Pelt (2nd floor)
- R
  - Free and widely used software (in academia) for data analysis
  - Download it from www.r-project.org
- Grading:
  - 25% assignments, 35% weekly quizzes, and 40% final project
  - Assignments handed out every Monday. Due following Monday BEFORE CLASS!!! Collaboration highly encouraged, but final write-up must be prepared individually
  - Weekly quizzes given every Monday at the beginning of class. Quizzes based on the assignment and the prior week's lectures

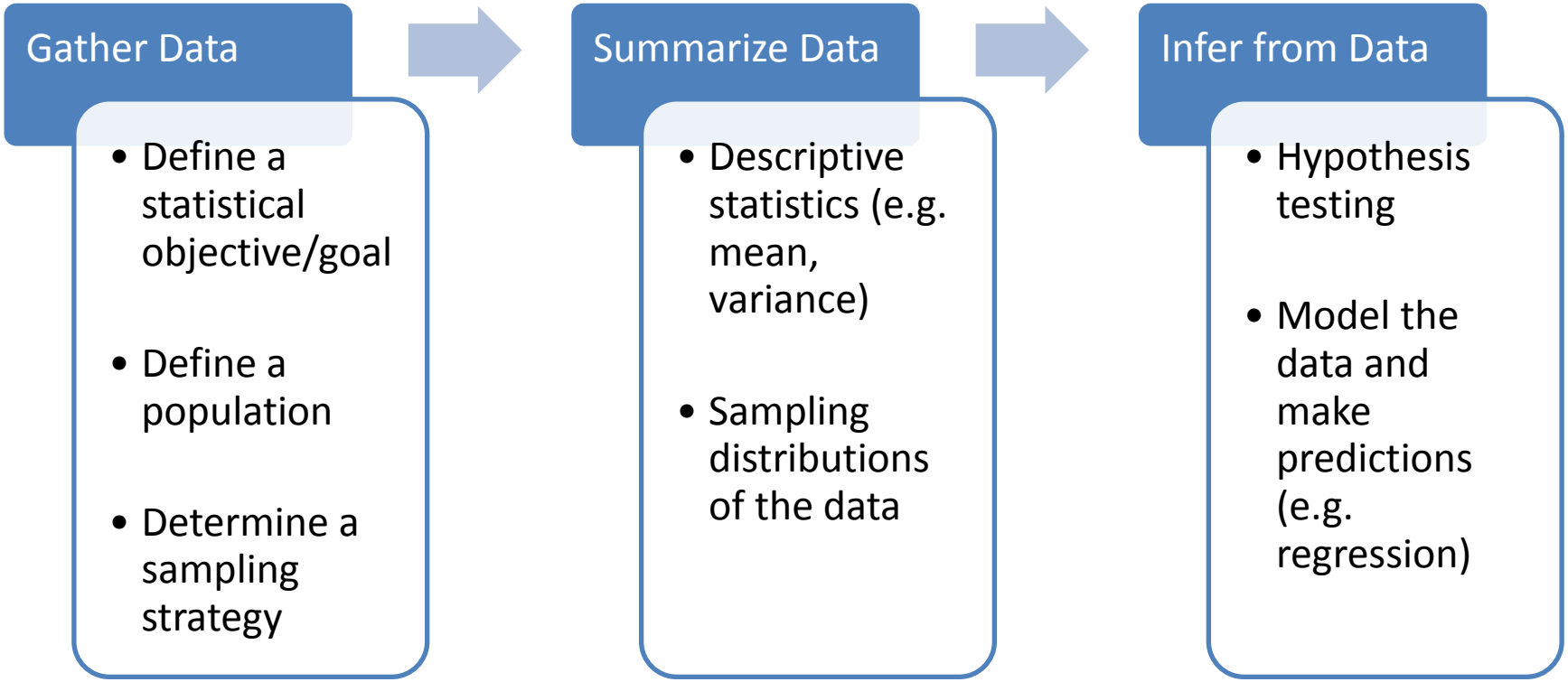
Final Project

- Goal
  - Analyze a real-world data set of your choosing
  - Provide numerical and theoretical justification of your analysis
- Details
  - May work in groups up to three people
  - Turn in (1) a one-page executive summary of your analysis and (2) a technical report containing all your analysis

Prerequisite

- "Fluency" with basic probability and analysis
  - Random variables
  - Probability distributions, Joint distributions, conditional probability
  - Independence/Correlation/Covariance
  - Law of Large Numbers
  - Central Limit Theorem
  - Moment generating functions
- Multivariable calculus is required.
- Linear algebra and R are not required, but useful

Statistical Inference in a Nutshell



Topics Covered

- Gather Data: Population/Sample, Sampling Procedures
- Summarize Data:
  - Mean, variance, risk, bias-variance trade-off
  - Histograms, Quantile-Quantile Plots, Scatterplots
- Inference: Sampling distributions (e.g Chi-square, t, and F distributions)
- Inference: One-Sample and Two-Sample Hypothesis Testing
  - Derivation of confidence intervals
  - Type I and II Error, Statistical power
  - Factorial Design (Chi-square Test for Independence)
- Inference: Regression
  - Simple linear regression
  - Multiple linear regression: ANOVA, MANOVA, ANCOVA, polynomial regression, weighted least squares regression
  - Generalized linear models (GLMs): Logistic regression, logit regression, Poisson regression, probit regression
  - Time Series Models: AR and ARMA models
  - Model Diagnostics: Stepwise, Lasso, Ridge, AIC/BIC/Mallow's Cp

Additional Topics (if we have time)

- Nonparametric Regression:
  - Moving average estimators
  - Kernel methods
  - B-splines
- Nonparametric Inference
  - Permutation Test
  - Welch's Test, Signed-Rank Test, Kolmogorov-Smirnov Test
- Bootstrap, Bayesian Inference, and Computation-based Inference
- Multivariate Methods:
  - PCA and CCA
  - SVD
- Likelihood-based Inference
  - Maximum Likelihood Estimators (MLE), Inference on MLEs

Questions?