STATISTICS APPLIED TO SOCIAL SCIENCES

Professor: Thiago SCARELLI
Academic Year 2020/2021: Spring Semester

COURSE DESCRIPTION

The course provides an introduction to descriptive statistics, probability distributions and inference, with emphasis on the interpretation of the statistical results and focus on empirical research.

Academic expectations
At the end of the semester, the students are expected (a) to be able to interpret the basic statistical concepts used in social sciences; and (b) to be prepared for more advanced quantitative methods.

Grading criteria + grading rubrics
1/3: **First group project**.
1/3: **Second group project**.
1/3: **Final group project**.
Extra points for participation: in class interactions and posts in the forum.

Late arrival policy
Students are advised to connect to the class on time.

Detailed outline

Topic 1: What is statistics and what do we need it for?
- Statistics as (a) study and practice of collection, analysis and presentation of data and (b) the results of the application of an statistical algorithm.
- Applied statistics as a tool to answer social science questions in a systematic way.
- Basic concepts: descriptive and inference statistics; population; sample; unit of observation; data set; parameters; variables; quantitative variables; and categorical variables.

Topic 2. Using statistics to describe a single variable
- Summaries of central tendency (mean, median, mode)
- Summaries of dispersion (range, IQR, variance, standard deviation)
- Summaries of position (quantiles, z-score)
- Graphical summaries: boxplots, histogram of frequencies, bar plot of categories.
- Extra: The log as an useful transformation

Topic 3. Using statistics to describe association between two variables
- The concept of independence and association
- The interpretation of contingency tables
- Covariance and correlation
- Simple linear regression as a descriptive model of association
- Interpretation of regression coefficients in simple models

Topic 4. Probability
- Probability of simple events and complementary events
- Probability of multiple events and joint events
- Probability of conditional events and total probability
- Conditional probability and independence
- Baye's rule

Topic 5. Random Variables and Probability Models
- Characterization of a random variable and the distribution function
- A. Discrete Uniform Distribution
- B. Bernoulli Distribution
- C. Binomial Distribution
- D. Continuous Uniform Distribution
- E. Exponential Distribution
- F. Normal Distribution
- Calculating probabilities of the form $P(a < X < b)$

Topic 6. Central Limit Theorem
- Central Theorem Limit and the empirical average
- Sampling, variation and error
- Confidence intervals
- Extra: Representative sample, random sampling, stratified sampling

Topic 7. Hypothesis testing
- Null and alternative hypotheses
- Type I and type II errors
- Critical region and significance level
- Decision: rejection or not of H0
- The Student's t-test
- The Chi-Square test of independence

Topic 8. Regression and inference
- Extending the regression model into the multivariate case
- The R^2 coefficient of determination
- Interpreting regression output (estimators, standard errors, different specification models)
- Extra: discussion on estimation and causality.

BIBLIOGRAPHY

Introductory level
Agresti et. al. 2016. *Statistics: The Art and Science of Learning From Data*.

Intermediary level
Agresti, Alan. 2018. *Statistical Methods for the Social Sciences.*
Imai, Kosuke. 2017. *Quantitative Social Science: An Introduction.*
Navarro, Danielle. 2018. *Learning Statistics with R: A Tutorial for Psychology Students and Other Beginners.*
[Available at https://learningstatisticswithr.com.]

Advanced level
Casella, George, and Roger L. Berger. 2002. Statistical Inference.