STAT 220 Learning Objectives

Every person in today’s society needs to have a basic understanding of data analysis and statistical concepts, in order to be able to think critically about the quantitative information we encounter every day, from opinion polls to headline news reports based on scientific studies. We need to be able to understand the information that is being presented and to ask the right questions about any conclusions that are drawn from it.

STAT 220 has no formal mathematics prerequisites, although high school algebra is assumed. Required numeracy skills include: fractions, percentages, square roots, exponents, and equation of a line. Any particular quarter there may be minor deviations from this list of objectives.

After completing this course, students should be able to:

- Explain and apply principles of study design and data collection.
  - Identify the relevant population, sample, study units (subjects), variables, and factors;
  - Distinguish between observational studies and controlled experiments;
  - Describe the impacts of study design on the resulting generality of conclusions that can be draw;
  - Recognize study designs that do/not permit conclusions about causation;
  - Describe how a study could be changed to allow conclusions about causation;
  - Describe basic sampling schemes (simple random sampling, stratified sampling, census versus sample), their strengths and weaknesses;
  - Identify sources of potential bias in study designs and strategies for reducing those biases. Issues include sampling and nonsampling bias, confounding, lurking variables, spuriousness, statistical control;
  - Identify issues of ethics in study designs;
  - Describe the impact of randomization in study design.
- Produce and interpret graphical summaries of data .
  - Histograms, stem-and-leaf diagrams, and scatterplots;
  - Recognize qualitative versus quantitative data and the relevant data displays for each;
  - Based on graphical displays, describe basic characteristics of the data distribution, including shape, center, spread, and outliers.
- Produce and interpret numerical summary statistics .
  - Mean, median, mode, range, standard deviation, variance, and percentiles;
  - Recognize which data summaries are suitable to which types of data;
  - Describe the impact of skewness and outliers on the various summary statistics;
  - Two-way tables of counts data.
- Understand properties of the normal curve .
  - Identify data that follow a normal curve;
  - Find chances and percentages using a normal curve.
- Graphically and numerically describe the relations between two quantitative variables.
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- Interpret and qualitatively describe the nature of the relationship between 2 variables, based on a scatterplot;
- Interpret a correlation coefficient, r, and a coefficient of determination, $R^2$ in terms of strength of association;
- Identify linearity, non-linearity, and outliers, and describe their impact on a simple linear regression model (ordinary least squares) and on the correlation coefficient;
- Fit simple linear regression models;
- Use a simple linear regression model to predict the value of one variable based on the value of an associated variable;
- Describe uncertainty in predictions;
- Describe the regression effect.

- Infer properties of a population from a sample.
  - Understand sampling distributions of sample means and sample proportions;
  - Estimate a population mean and a population proportion from a sample;
  - Evaluate the accuracy of sample estimates using standard errors
  - Explain and interpret margins of error for both qualitative and quantitative data;
  - Constructing confidence intervals and performing hypothesis tests for means and proportions within a group;
  - Recognize when it is appropriate to use confidence intervals and hypothesis tests;
  - Perform and interpret chi-squared test for independence (2 x 2);
  - Explain statistical significance;
  - Distinguish evidence from opinion.

- Compute simple probabilities of events.
  - Distinguish marginal, joint, and conditional probabilities;
  - Understand and apply the concept of independence of events.