

THINGS TO KNOW FOR EXAM #1

Chapter 1: Looking at Data Distributions

- Know difference between categorical (nominal and ordinal) and quantitative (discrete and continuous) variables.
- Pie charts and bar graphs for categorical data.
- Stemplots and histograms for quantitative data.
- Pattern of Distributions: shape (skewness), center and spread.
- Difference between Descriptive and Inferential Statistics.
- Measuring the Center: Mean and Median.
- Measuring Spread: Quartiles, sample variance (s^2) and sample standard deviation (s).
- Five number summary and boxplots.
- Quartiles (Q1 and Q3) and the Interquartile Range (IQR).
- Density Curves for continuous random variables.
- Mode, mean and median of density curves.
- Normal and Standard Normal Distributions and the 68–95–99.7 Rule.
- Finding z-scores from normal probabilities.
- Transforming a Normal Distribution into a Standard Normal Distribution.
- Using tables to find area to the left for a normal distribution.
- Normal quantile plots.

Chapter 2: Looking at Data Relationships

- Response (dependent) variable and explanatory (independent) variable.

- Scatterplots (observe, form, direction and strength).
- Correlation (r): formula and properties.
- Interpretation of the Coefficient of Determination, r^2 .
- Lurking variables.
- Correlation does not imply Causation.
- Correlation between averages generally larger than correlation between individuals.
- Two Way Tables: row variable, column variable and cells.
- Joint and Marginal Distributions.
- Conditional Distributions.
- Simpson's Paradox.
- Determining Causation and confounding.

Chapter 3: Producing Data

- Surveys: sample, population, census, variable.
- Know difference between observational and experimental studies.
- Statistical Inference.
- Design of Experiments (DOE): experimental units (subjects) and treatments.
- Bias.
- Control, Randomize and Repetition for experimental design.
- Statistical Significance.
- Blind, Double Blind experiments and placebo effects.
- Matched Pair Design.

- Block Design.
- Sample Surveys: under-coverage, nonresponse and response bias.
- Sampling Variability and sampling distribution.
- Know difference between a statistic and a parameter.
- Reducing bias and variability of a statistic.
- Random samples, simple random samples and stratified random samples.
- Ethical Standards: review boards, informed consent and confidentiality.

Chapter 4: Probability: The Study of Randomness

- Definition of sample space, events, and probability function.
- Properties of Probability.
- Addition rule for disjoint events.
- Probability of the complement of an event.
- General addition rule for two events.
- Probabilities of equally likely outcomes.
- Meaning of independent events, A and B , and the multiplication rule for independent events, $P(A \text{ and } B) = P(A)P(B)$.
- Definition of Random Variables.
- Definition of a Discrete Random Variable, Discrete Probability Distribution and Probability Histograms.
- Definition of a Continuous Random Variable and Density Curves.
- Uniform Distribution, $X \sim \text{UNIF}(a, b)$.
- Means, μ , and Variances, σ^2 of Random Variables.
- Normal Distribution, $X \sim \text{N}(\mu, \sigma)$.

- Find $P(X \leq c)$ when X has a normal (not necessarily standard normal) distribution.
- Expectations of discrete random variables (and know how to calculate means).
- Law of Large Numbers.
- Properties of Means.
- Calculating variance, σ^2 and population standard deviation, σ for discrete random variables.
- Independent Random Variables \Rightarrow zero correlation.
- Rules for Variances and Standard Deviations including addition rule for variances.
- Definition of conditional probability, $P(B|A)$, and how to compute it.
- General Multiplication Rule for any two events, $P(A \text{ and } B) = P(A)P(B|A)$.

Chapter 5: Sampling Distributions

- Sampling distribution and population distribution.
- The mean and standard deviation of \bar{x} .
- The mean and standard deviation of \bar{x} of a normal population.
- Central Limit Theorem (CLT).
- Linear combinations of independent normal distributions are normal.
- Binomial distribution, $X \sim \text{BIN}(n, p)$.
- Density of binomial distribution, $P(X = j) = \binom{n}{j} p^j (1 - p)^{n-j}$.
- Mean and standard deviation of a binomial distribution.
- Sample proportion for a binomial sample.
- Normal approximation of binomial distribution and of the sample distribution.

- Continuity Correction when using normal approximation for binomial distribution.

Chapter 6: Introduction to Inference

- Estimators and unbiased estimators
- Confidence Intervals at $100(1 - \alpha)\%$ Confidence Level
- Definition of margin of error.
- Confidence intervals for mean when population variance known.
- Choosing sample size to obtain a desired margin of error for mean when population variance known.
- Hypothesis Testing with H_0 , H_1 and test values.
- Type I and Type II errors, significance levels and the power of a test.
- p -values.
- Rejection and Acceptance Regions and critical values.
- One Sample z -test.
- Hypothesis Testing and two sided confidence intervals.

ADVICE

Review homework problems and feel free to visit me during office hours.