

List of Topics

Components of an Experiment

| Topic | Concepts | Skills (examples) |
|-----------------------------|--|--|
| Components of an experiment | Treatment and conditions Response Experimental unit Measurement unit Validity Potential outcomes Potential outcomes schedule Average treatment effect | Identify an experiment's units, conditions, and response. Evaluate the reliability and validity of a response, or explain what information would be needed to do so. Describe the potential outcomes schedule for an experiment and understand which of the potential outcomes are observed. Define and calculate an estimate of the Average Treatment Effect from a study table. |

Inference and Testing

| Topic | Concepts | Skills (examples) |
|-----------------------|--|---|
| Inference and Testing | Null and alternative hypotheses Test statistic Model-based inference Randomization inference Null distribution Sampling distribution and Permutation Tests Assumptions Normal and F distributions | Give the assumptions needed for randomization inference. For a randomization test, describe Fisher's sharp null hypothesis and impute values in the potential outcomes schedule. Give the assumptions needed for model-based inference, especially for 2 sample t-tests, F-tests etc. Write a formula for a t/F-statistic in terms of estimated model parameters. Calculate and interpret p-values for both modes of inference. |

Power

| Topic | Concepts | Skills (examples) |
|--------------|--|--|
| Power | <p>Statistical Power and relation to p-values and significance</p> <p>Factors of an experiment that drive power</p> <p>Power Curves and Alternate Hypothesis</p> <p>Calculating Power in Randomization Inference</p> <p>Calculating Power in Model-Based Inference</p> | <p>Define statistical power of an experiment.</p> <p>Compare two experiments and decide which would have more power based on designs.</p> <p>Conduct power calculations and understand the relation between sample size, effect size, variance etc.</p> <p>Impute a potential outcomes schedule under the alternate and calculate power.</p> <p>Have a brief idea of non-central distributions and how to calculate power from them.</p> |

Factorial Design

| Topic | Concepts | Skills (examples) |
|------------------|--|---|
| Factorial Design | Advantages of Factorial Design Factors and Levels F-tests for significance Interpreting Beehive Plots Linear Model and Estimates of Effects Interaction Effects Interpretation and Interaction Plots | Identify the factors and levels within a described design, identify CR designs etc. State the assumptions behind the F-test and the Linear Model used in upto 3-way ANOVA. Calculate the degrees of freedom for a factor, write the F-statistics for main and interaction effects. Basic properties of the estimators for effects such as unbiasedness. Interpret the effects either from group-wise averages or effects plots. |

Multiple Testing and Blocking

| Topic | Concepts | Skills (examples) |
|-------------------------------|---|--|
| Multiple Testing and Blocking | Confidence Intervals / Simultaneous CIs Strong Familywise Error Rate Bonferroni Corrections Blocking CBD designs Blocking and Variance | Define a Confidence Interval, a Simultaneous CI, and the Strong Familywise Error Rate. Apply the Bonferroni Correction to a set of p-values, from an ANOVA table. Identifying Blocking Factors from a described study design and its advantages. Explain in detail how to randomize units to treatment in a CBD[k] design. Explain the effect of blocking on the variance of the ATE estimate. |

Best of Luck! :)