Final exam review notes

(These notes cover the material since the midterm exam—you should also refer back to the notes I prepared for the midterm review.)

Research design

What do the concepts of internal validity and external validity mean in research design? What are some ways to evaluate both types of validity if you are presented with a summary of someone else’s research? In designing a piece of research, what can you do to heighten each type of validity?

Understand the notation used to summarize different experimental designs. Be able to create a diagram using these symbols that accurately summarizes the type of design used in a particular study.

Know the major types of study designs and what distinguishes them from one another. If you are provided with a description of a particular research study, be able to identify the type of research design used. (Remember that studies often don’t fall neatly into one category—it’s possible to have features associated with different designs.)

Know the strengths and weaknesses of different design features. For example, what purpose does a control group serve? Why might a before-and-after design be preferred to a “one time” design?

What are some ethical issues that arise in conducting social science research? Understand the tensions and debates here.

Hypothesis testing

What’s a hypothesis? Be able to recognize a hypothesis (and something that is not a hypothesis).

Understand what role hypothesis testing plays in inferential statistics. What are we trying to accomplish with tests of hypotheses?
What is a null hypothesis? An alternative hypothesis? How are they used? Know how to construct these in words and with formulas given a description of a particular research effort.

Know the general steps in hypothesis testing. What is a one-tailed and a two-tailed test and when would you apply each?

What does it mean, in plain English, to reject your null hypothesis? What about failing to reject your null hypothesis?

Know how to set up and compute a test statistic associated with a hypothesis test of a mean value (one- or two-tailed). (Know when you should employ a z or a t table—and note that these rules are the same as for confidence intervals.) Know how to find the p-value associated with that test statistic and interpret it in plain English. (Remember, don’t get so focused on the formulas that you forget what the ideas behind the tools mean.)

Understand the relationship between sample size and margin of error in a confidence interval. Given a particular set of information (mean, standard deviation, current sample size) know how to find the required sample size to obtain a particular margin of error value.

Know what Type I and Type II errors are in hypothesis testing. How do you reduce the risk of making each type of error? Understand why reducing the risk of a Type I error increases the risk of a Type II error, and think about situations in which one type of error would be easier to “tolerate” than the other.

Know how to set up and compute a test statistic associated with a hypothesis test of a proportion (one- or two-tailed). Know how to find the p-value associated with that test statistic and interpret it in plain English.

Know how to set up and compute a test statistic associated with a hypothesis test of two means (one- or two-tailed). Remember that there are 3 possibilities you need to be able to recognize and work with:
(1) Two independent samples with unequal population variance;
(2) Two independent samples with equal population variance; and
(3) Two paired (dependent) samples.

In each case, you should be able to set up the problem correctly, find the test statistic and associated p-value, and interpret your findings in plain English.

Know how to set up and compute a test statistic associated with a hypothesis test of two proportions (one- or two-tailed).

**Analyzing categorical data**

Know what types of data are appropriate for what types of analysis generally.

Know what the $X^2$ test is used for and how to implement it. What is the null hypothesis in a $X^2$ test? Given a set of information, know how to set up a contingency table of observed values, compute expected values, set up and compute a $X^2$ statistic, find the associated p-value (how do you find the appropriate degrees of freedom value for this?) and interpret your results.

In words, explain the reasoning behind the computation of the expected values for the $X^2$ test.

What are the criteria that must be satisfied in order to apply the $X^2$ test?

**Regression analysis**

Understand how regression analysis can be used in inferential statistics. How is hypothesis testing used in regression models? What is being tested? You should also know how to set up and compute a test statistic for a hypothesis about $\beta$, and to find and interpret the p-value associated with your test statistic value. You should also be able to construct a confidence interval for $\beta$. (Note that the techniques for hypothesis testing/confidence intervals with
\( \beta \) are analogous to those used for population means—just understand how the concepts transfer to regression coefficients and how the formulas change.)

Know how to interpret results from a simple or multiple linear regression model. How are the intercept value \((a)\) and the coefficients (the \(b_s\)) explained in simple language? How does the interpretation of the coefficients and of the \(r^2\) value change when more than one explanatory (independent) variable is in the model?

Know how to calculate predicted values for regression models and to explain what they mean.