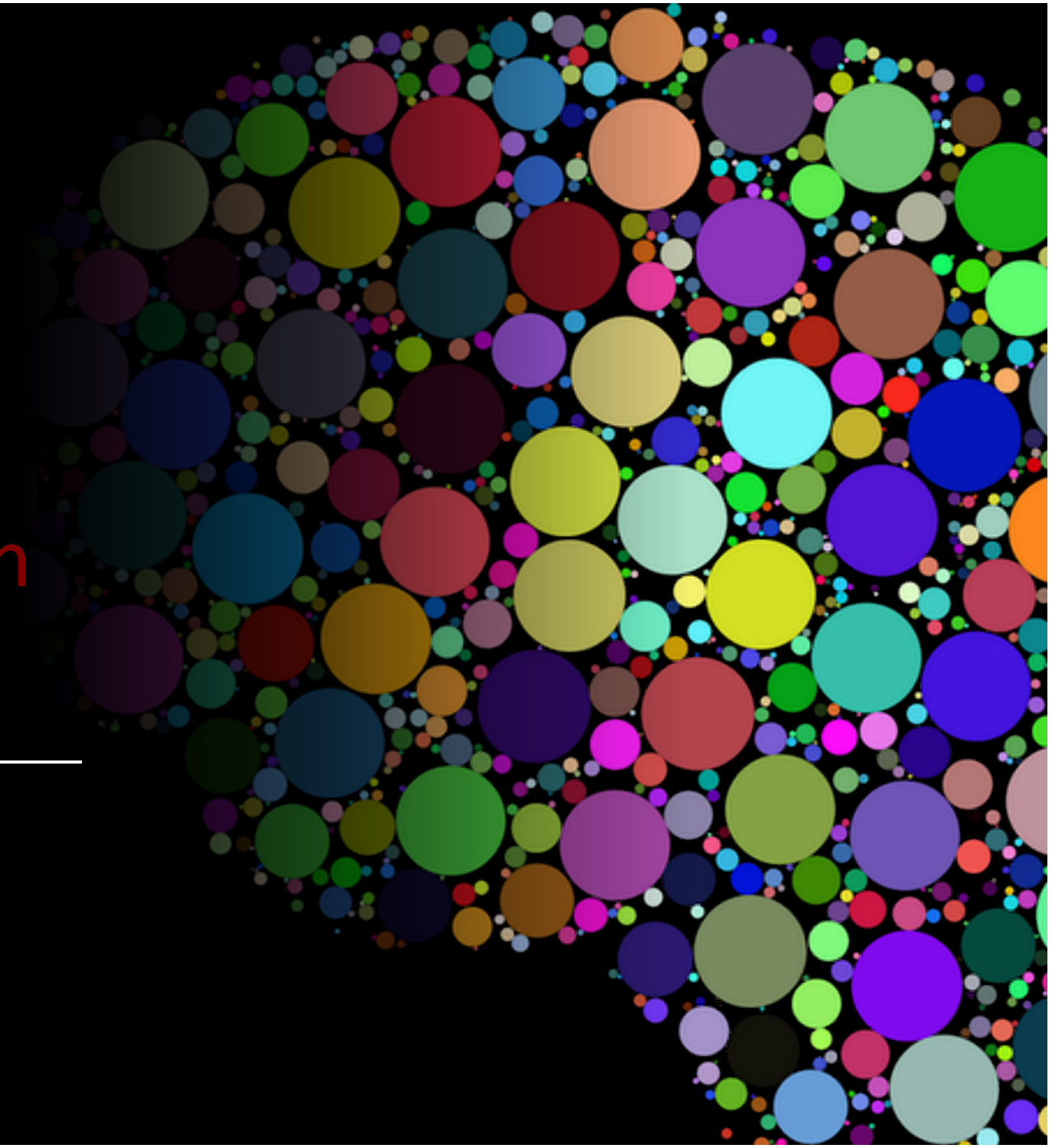
Hypothesis Testing with z Tests

Chapter 7



A quick review

- This section should be a review because we did a lot of these examples in class for chapter 6.
- Go back here if you want to view more examples of problems.

Check Your Learning

- If the population mean is 10 and the standard deviation is 2:
  - What is the percentile rank of a sample mean of 6? of 11?
  - What percentage of the samples would score higher than a score of 6? of 11?

Working with Samples

- Generally, researchers work with samples, rather than just determining how one person's score differed from the mean.
- Remember the formula for sample tests requires you to use standard error

$$\sigma_M = \frac{\sigma}{\sqrt{N}}$$

An Example

- The average quiz test taking time for a 10 item test is 22.5 minutes with a standard deviation of 10 minutes. My class of 25 students took 19 minutes on the test.

An Example

- Label:
  - Population mean uM
  - Population standard deviation: σ
  - Sample mean: M
  - Standard error: σM

An Example

- What is the percentage of scores:
  - Above my class' average score?
  - Below my class' average score?

Second Example

- Every year, the Educational Testing Service (ETS) administers the Major Field Test in Psychology (MFTP) to graduating psychology majors. In 2003, Baylor University wondered how its students compared to the national average. On its Web site, Baylor reported that the mean and the standard deviation of the 18,073 U.S. students who took this exam were 156.8 and 14.6, respectively. Thirty-six students in the Psychology and Neuroscience Department at Baylor took the exam; these students had a mean score of 164.6.

Second Example

- Label:
  - Population mean uM
  - Population standard deviation: σ
  - Sample mean: M
  - Standard error: σM

Second Example

- What is the percentage of scores:
  - Above Baylor's average score?
  - Below Baylor's average score?

So now what?

- Now we have all the background ideas for hypothesis testing:
  - Hypotheses (null versus research, levels, groups, variables, etc.)
  - Distributions (how to compare scores, z distribution)
  - P-values (percentages)
  - Decisions (reject, fail to reject null)
- How do we bring all that together?

The Assumptions and the Steps of Hypothesis Testing

- Requirements to conduct analyses
  - Assumption: characteristic about a population that we are sampling necessary for accurate inferences
  - In English: the things that have to be in place for your results to mean what you think they mean

Parametric v. Nonparametric Tests

- Parametric tests: inferential statistical test based on assumptions about a population

- Nonparametric tests: inferential statistical test not based on assumptions about the population

Assumptions

- Most statisticians use parametric tests (that's z, t, ANOVA, regression, basically this whole class).
- Three assumptions (for now!)

Assumptions

- Dependent variable is at least a scale variable
  - Can you break it?
  - …interval options are tricky, but definitely not nominal or ordinal

Assumptions

- Random selection of participants
  - Eek!
  - Can you break it?
  - Yes, using random assignment and careful generalization.

Assumptions

- Population or sampling distribution are normal (Normality assumption).
  - Can you break it?
  - Yes with the magic number N = 30.

Assumptions

- So we can break all the rules?
- Robust tests = hypothesis testing that gives you fairly accurate results even though the assumptions may not be quite met.

Hypothesis Testing Steps

- Step 1. Identify:
  - Population(s)
  - Comparison distribution
  - Assumptions

Hypothesis Testing Steps

- Step 2. State the null and research hypotheses.
  - Sentences are great, but using the following format will help you:
    - Null: sample = population
    - Res: sample /= population
    - (two other options coming up!)

Hypothesis Testing Steps

- Step 3. Determine the characteristics of the comparison distribution.
  - What? Write down the numbers/symbols that describe step 1 and 2.
  - See layout thing Dr. B suggests.

Hypothesis Testing Steps

- Step 4. Determine critical values, cut off scores.
  - Cut off scores (aka critical values) – scores beyond which we would reject the null hypothesis.
  - Critical region – area of the distribution (tails) where we would reject the null hypothesis.

Hypothesis Testing Steps

- Step 4 – continued.
  - Usually we use 5% or 1% (so you might see $p < .05$ in journals).
  - Call the p – level (or p-critical)…I find this confusing with the actual p value (what we did in chapter 6).
  - Better to call it ALPHA (remember type 1 error).

Hypothesis Testing Steps

- Step 4 – continued.
  - So can we figure out what the critical scores would be?
  - pnorm!

Hypothesis Testing Steps

- Step 5. Calculate the test statistic.
  - Step 4 is where you figure out the critical score (what do you got to get to … ?).
  - Step 5 you calculate your sample value (what did you actually get …?)
  - (so we are going to compare z scores in this section, but later we will switch to other types of statistical distributions).

Hypothesis Testing Steps

- Step 6. Make a decision.
  - Reject the null hypothesis
    - Your step 5 found score is in the critical region, farther out than the step 4 cut off score
  - Fail to reject the null hypothesis
    - Your step 5 score is NOT in the critical region, less extreme than the step 4 cut off score

A quick note

- Statistical significance only means that your p values are small (or your found scores in step 5 are in the critical region).
- Does not mean that it is practically useful
  - We will cover how to figure this part out later.

An Example of the z Test

- The z test
  - When we know the population mean and the standard deviation
- The z test
  - The six steps of hypothesis testing
    - H0, H1
    - One-tailed vs. two-tailed tests

Back to Hypothesis Testing Steps

- Directional or one-tailed test
  - You predict a change in scores, either up or down.
  - So you are only using one of the tails of the distribution
- Null?
  - Remember the technical definition of the null (it's the OPPOSITE).

Back to Hypothesis Testing Steps

- Directional or one-tailed test
  - Scores going up:
    - Null: sample = < population
    - Res: sample > population
  - Scores going down:
    - Null: sample = > population
    - Res: sample < population
  - See how opposites?

Back to Hypothesis Testing Steps

- Nondirectional or two tailed test
  - You predict a change in scores but not a direction
    - Null: sample = population
    - Res: sample /= population

Check Your Learning

- Food labeling has become a targeted campaign to help with the obesity problem found in many states. 25 participants were asked to estimate how many calories meals labeled “organic” had and guessed an average of 525. The real meals had an average 650 calories with a standard deviation of 250 calories.
- Would this be a significant difference using $p < .05$?
- Label the hypothesis testing steps.