STAT 216 Coursepack

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Montana State University

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This resource was developed by Melinda Yager, Jade Schmidt, and Stacey Hancock in 2021 to accompany the online textbook: Carnegie, N., Hancock, S., Meyer, E., Schmidt, J., and Yager, M. (2021). *Montana State Introductory Statistics with R.* Montana State University. https://mtstateintrostats.github.io/IntroStatTextbook/.

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Preface

This coursepack accompanies the textbook for STAT 216: Introduction to Statistics at Montana State University, which can be found at https://mtstateintrostats.github.io/IntroStatTextbook/. The syllabus for the course (including the course calendar), data sets, and links to D2L Brightspace, Gradescope, and the MSU RStudio server can be found on the course webpage: https://math.montana.edu/courses/s216/. Videos assigned in the course calendar and other notes and review materials are linked in D2L.

Each of the activities in this workbook is designed to target specific learning outcomes of the course, giving you practice with important statistical concepts in a group setting with instructor guidance. In addition to the in-class activities for the course, the coursepack includes reading guides to aid in taking notes while you complete the required readings and videos. Bring this workbook with you to class each class period, and take notes in the workbook as you would your own notes. A well-written completed workbook will provide an optimal study guide for exams!

The activities and labs in this coursepack will be completed during class time. Parts of each lab will be turned in on Gradescope. To aid in your understanding, read through the introduction for each activity before attending class each day.

STAT 216 is a 3-credit in-person course. In our experience, it takes six to nine hours per week outside of class to achieve a good grade in this class. By "good" we mean at least a C because a grade of D or below does not count toward fulfilling degree requirements. Many of you set your goals higher than just getting a C, and we fully support that. You need roughly nine hours per week to review past activities, read feedback on previous assignments, complete current assignments, and prepare for the next day's class. The following will give you an idea of what a typical week in the life of a STAT 216 student looks like.

- *Prior to class meeting*:
  - Read assigned sections of the textbook, using the provided reading guides to take notes on the material.
  - Watch assigned videos on that week's content, pausing to take notes and answer video quiz questions.
  - Read through the introduction to the day's in-class activity.
  - Read through the week's homework assignment and note any questions you may have on the content.
- *During class meeting*:
  - Work through the in-class activity or weekly lab with your classmates and instructor, taking detailed notes on your answers to each question in the activity.
- *After class meeting*:
  - Complete any parts of the activity you did not complete in class.
  - Review the activity solutions in the Math and Stat Center, and take notes on key points.
  - Finish watching any remaining assigned videos or readings for the week.
  - Complete the week's homework assignment.

0.1 Week 8 Lab: Poisonous Mushrooms

0.1.1 Learning outcomes

- Given a research question involving two categorical variables, construct the null and alternative hypotheses in words and using appropriate statistical symbols.
- Describe and perform a simulation-based hypothesis test for a difference in proportions.
- Interpret and evaluate a p-value for a simulation-based hypothesis test for a difference in proportions.

- Interpret and evaluate a confidence interval for a simulation-based confidence interval for a difference in proportions.

0.1.2 Poisonous Mushrooms

Wild mushrooms, such as chanterelles or morels, are delicious, but eating wild mushrooms carries the risk of accidental poisoning. Even a single bite of the wrong mushroom can be enough to cause fatal poisoning. An amateur mushroom hunter is interested in finding an easy rule to differentiate poisonous and edible mushrooms. They think that the mushroom's gills (the part which holds and releases spores) might be related to a mushroom's edibility. They used a data set of 8124 mushrooms and their descriptions. For each mushroom, the data set includes whether it is edible (e) or poisonous (p) and the spacing of the gills (Broad (b) or Narrow (n)). Is there evidence gill size is associated with whether a mushroom is poisonous? PLEASE NOTE: According to The Audubon Society Field Guide to North American Mushrooms, there is no simple rule for determining the edibility of a mushroom; no rule like "leaflets three, let it be'' for Poisonous Oak and Ivy.

Upload and open the R script file for Week 8 lab. Upload and import the csv file, `mushrooms`. Enter the name of the data set (see the environment tab) for datasetname in the R script file in line 6. Highlight and run lines 1–7 to get the counts for each combination of categories.

```
poisonous <- datasetname # Read data set in
poisonous %>% group_by(gill.size) %>% count(class) #finds the counts in each group
```

1. What is the explanatory variable? How are the two levels of the explanatory variable written in the data set?

2. What is the response variable? How are the two levels of the response variable written in the data set?

3. Fill in the following two-way table using the R output.

	Gill Size		
Edible	Broad	Narrow	Total
Poisonous			
Edible			
Total			

4. Write the parameter of interest for this study.

5. **Calculate the difference in proportion of mushrooms that are poisonous for broad gill mushrooms and narrow gill mushrooms. Use broad - narrow for the order of subtraction. Use appropriate notation.**

6. Write the null hypothesis for this study in notation.

7. **Using the research question, write the alternative hypothesis in words.**

Fill in the missing values/names in the R script file for the `two-proportion_test` function to create the null distribution and find the p-value for the test.

```
two_proportion_test(formula = response~explanatory, # response ~ explanatory
    data= poisonous, # Name of data set
    first_in_subtraction = "xx", # Order of subtraction: enter the name of Group 1
    number_repetitions = 1000, # Always use a minimum of 1000 repetitions
    response_value_numerator = "xx", # Define which outcome is a success
    as_extreme_as = xx, # Calculated observed statistic (difference in sample proportions)
    direction="xx") # Alternative hypothesis direction ("greater","less","two-sided")
```

8. Report the p-value for the study.

9. **Do you expect that a 90% confidence interval would contain the null value of zero? Explain your answer.**

Fill in the missing values/names in the R script file in the two_proportion_bootstrap_CI function to create a simulation 90% confidence interval. **Upload a copy of the bootstrap distribution to Gradescope.**

```
two_proportion_bootstrap_CI(formula = response~explanatory,
         data=poisonous, # Name of data set
         first_in_subtraction = "xx", # Order of subtraction: enter the name of Group 1
         response_value_numerator = "xx", # Define which outcome is a success
         number_repetitions = 1000, # Always use a minimum of 1000 repetitions
         confidence_level = xx) # Enter the level of confidence as a decimal
```

10. Report the 90% confidence interval.

11. Write a paragraph summarizing the results of the study as if writing a press release. Be sure to describe:

- Summary statistic and interpretation
- P-value and interpretation
  - Statement about probability or proportion of samples
  - Statistic (summary measure and value)
  - Direction of the alternative
  - Null hypothesis (in context)
- Confidence interval and interpretation
  - How confident you are (e.g., 90%, 95%, 98%, 99%)
  - Parameter of interest
  - Calculated interval
  - Order of subtraction when comparing two groups
- Conclusion (written to answer the research question)
  - Amount of evidence
  - Parameter of interest
  - Direction of the alternative hypothesis
- Scope of inference

Upload your group's confidence interval interpretation and conclusion to Gradescope.

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