03- Collecting Data

Content Area: **Mathematics**
Course(s): **AP Statistics**
Time Period: **December**
Length: **7-8 blocks**
Status: **Published**

Transfer

Exam Weighting: 12-15%

Previous Coursework: This is probably a completely new topic for students. There is a lot of writing and calls for specificity in language.

Developing Understanding: Depending on how data are collected, we may or may not be able to generalize findings or establish evidence of causal relationships. For example, if random selection is not used to obtain a sample from a population, bias may result and statistics from the sample cannot be assumed to generalize to the population. For data collected using well-designed experiments, statistically significant differences between or among experimental treatment groups are evidence that the treatments caused the effect. Students learn important principles of sampling and experimental design in this unit; they will learn about statistical inference in Units 6-9.

Building Course Skills: Statisticians must be adept at determining "What is this question asking?" Students should get into the habit of identifying the task in the given prompt before they begin, then checking that their response addresses that task. For example, when asked if it would be appropriate to generalize the results of a given experiment, students need to provide a clear "yes" or "no" decision in their response, along with an explanation that supports their decision. Although students may recognize that they need to justify their reasoning, they often struggle to include explicit evidence supporting their claims. For instance, claims about non-response bias should be supported with evidence indicating whether the sample result is likely to be too high or too low compared to the population value that is being estimated. As another example, students need to clearly explain why a particular variable might lead to confounding in a given setting.

Enduring Understandings

Methods for data collection that do not rely on chance result in untrustworthy conclusions.

The way we collect data influences what we can and cannot say about a population.

Well-designed experiments can establish evidence of causal relationships.

Essential Questions

Why is randomization in data collection important?

How do data collection methods influence possible inferential conclusions?

Why are the prinicples of experimental design necessary when planning an experiement?

Student Learning Objectives

TEXT Section 4.1: Sampling and Surveys

- Identify the population and sample in a statistical study.
- Identify voluntary response sampling and convenience sampling and EXPLAIN how these sampling methods can lead to bias.
- Describe how to select a simple random sample with technology or a table of random digits.
- Describe how to select a sample using stratified random sampling and cluster sampling,
- Distiguish stratified random sampling from cluster sampling, and GIVE an advantage of each method.
- Explain how undercoverage, nonresponse, question wording, and other aspects of a sample survey can lead to bias.

TEXT Section 4.2: Experiments

- Explain the concept of confounding and how it limits the ability to make cause-and-effect conclusions.
- Distinguish between an observational study and an experiment
- Idenitfy the explanatory and response variables in each type of study.
- Identify the experimental units and treatments in an experiment.
- Describe the placebo effect and the purpose of blinding in an experiment.

TEXT Section 4.3: Using Studies Wisely

- Explain the concept of sampling variability when making an inference about a population and how sample size affects sampling variability.
- Explain the meaning of statistically significant in the context of an experiment
- Use simulation to determine if the results of an experiment are statistically significant.
- Identify when it is appropriate to make an inference about a population and when it is appropriate to make an inference about cause and effect.
- Evaluate if a statistical study has been carried out in an ethical manner.(*not on AP Exam)

Vocabulary and Planned Learning Experiences

Vocabulary: census, population, sample survey, sample, convenience sample, voluntary response sampling,

bias, simple random sample (SRS), sampling without replacement, stratified random sampling, strata, cluster sampling, systematic random sampling, undercoverage, nonresponse, response bias, explanatory variable, response variable, confounded, observational studies, experiments, treatments, experimental units, subjects, levels (factors), placebo, control group, placebo effect, double-blind, single-blind, comparison, random assignment, control, replication, completely randomized design, randomized block design, blocks, matched pairs design, sampling variability, statistically significant, Inference about a population, inference about cause and effect, institutional review board, informed consent, confidential

Planned Learning Experiences:

Graphic Organizer: Provide students with a table listing all possible combinations of whether a study involves random sampling (yes or no) and random assignment (yes or no). Ask them to fill in each cell with both the type of conclusion that is appropriate (association or causation) and the generalizability of the results (to the population or to only those similar to the study participants).

Odd One Out: After modeling an odd one out example, have students form groups of four and give each of them a description of a statistical study. Explain that three of the studies are of the same type (observational or experimental) and one is different. Have students work together in their groups to determine which study is the odd one out and explain why.

Password-Style Games: After completing the lessons on sampling and surveying, use the following 10 terms in a password-style game: census, simple random sample, stratified random sample, cluster sample, systematic random sample, bias, voluntary response bias, undercoverage,nonresponse bias, and response bias. The winner is the pair whose partner guesses the most terms correctly from the descriptions given.

Sentence Starters: Provide students with the scenario from 2006 Form B FRQ 5. Have them complete the following sentence starter to explain confounding: " _____ are confounded with _____ because each was used in only one _____. If a difference in the draft is observed, we will not know whether the difference is due _____ to the or the _____ .

Think-Pair-Share: Provide students with a description of a well-designed experiment (e.g., 2010 FRQ I) and ask them to individually identify the type of design, the experimental units, the treatments, and how the study addresses the principles of a well-designed experiment (including random assignment, control, blinding, and replication). Then have students share their thoughts with their neighbor.

Resources

TEXT: The Practice of Statistics, 6th Edition

AP Classroom and the APCD 2019 Course Description

Rossman-Chance Applets

Stats Medic

Assessments

Reading Quiz: Sampling and Surveys (Introductory Level)

Reading Quiz: Experiments (Introductory Level)

Reading Quiz: Using Studies Wisely (Introductory Level)

Test: Collecting Data (AP Level)

Standards

NJSLS Standards in Mathematics Copied and Pasted as well as linked.

NJSLS Standards - Mathematics

MA.S-IC.A.1 Understand statistics as a process for making inferences about population parameters based on a random sample from that population.
MA.S-IC.A.2 Decide if a specified model is consistent with results from a given data-generating process, e.g., using simulation.
MA.S-IC.B.3 Recognize the purposes of and differences among sample surveys, experiments, and observational studies; explain how randomization relates to each.
MA.S-IC.B.4 Use data from a sample survey to estimate a population mean or proportion; develop a margin of error through the use of simulation models for random sampling.
MA.S-IC.B.6 Evaluate reports based on data.

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Modifications (ELL, Special Education, At-Risk Students, Gifted & Talented, & 504 Plans)

ELL:

- Use visuals
- Introduce key vocabulary before lesson
- Provide peer tutoring

- Guided notes and/or scaffold outline for written assignments

Supports for Students With IEPs:

- Allow extra time to complete assignments or tests
- Guided notes and/or scaffold outline for written assignments
- Work in a small group
- Follow all IEP modifications

At-Risk Students:

- Guided notes and/or scaffold outline for written assignments
- Introduce key vocabulary before lesson
- Work in a small group
- Lesson taught again using a differentiated approach
- Use visuals / Anchor Charts

Gifted and Talented:

- Create an enhanced set of introductory activities (e.g. advance organizers, concept maps, concept puzzles)
- Organize and offer flexible small group learning activities
- Teach cognitive and methodological skills
- Organize integrated problem-solving simulations
- Propose interest-based extension activities

Supports for Students With 504 Plans:

- Follow all the 504 plan modifications
- Text to speech/audio recorded selections