

Title: Unveiling the Power of Data: Exploring the Statistical Investigative Process

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Overview

This lesson introduces high school students to the statistical investigative process, emphasizing how it aids in answering real-world questions using data. Students will learn the importance of formulating questions and understand the structured approach of statistical analysis.

Intended Audience:
Grades 8-12

Learning Standards

[The Statistical Investigative Process](#)

MA19.MM.1 Use the full Mathematical Modeling Cycle or Statistical Problem-Solving Cycle to answer a real-world problem of particular student interest, incorporating standards from across the course.

Objectives

- Students will comprehend the steps of the statistical investigative process.
- Students will understand how to formulate clear, specific, and answerable research questions.
- Students will apply these concepts to analyze real-world scenarios.

Duration

Approximately 90-135 minutes

Materials and Resources:

Lesson Rubric

Research Question Generation Template

Printed or projected handouts of the Scavenger Hunt articles (Located in QuantHub Upskill)

Scavenger Hunt: [The Power of the Statistical Investigative Process](#)

Scavenger Hunt: [The Power of Questions in the Statistical Investigative Process](#)

Background Knowledge

Students should have a basic knowledge of the following vocabulary and/or concepts:

- *Analysis*: The process of studying or examining data in detail to identify patterns, relationships, or trends.
- *Bias*: A tendency to lean in a certain direction, either in favor of or against a particular thing. In research, bias can affect the validity of results.
- *Causation*: When a change in one variable directly causes a change in another. This is different from correlation, where variables might change together but one does not directly cause the other to change.
- *Correlation*: A statistical measure that describes the extent to which two variables change together. However, correlation does not imply causation.
- *Data*: Information collected for analysis or reference. Data can be numbers, words, measurements, observations, or even just descriptions of things.
- *Evidence-Based*: Relying on data, facts, and solid evidence when making decisions or conclusions, rather than on assumptions or guesses.
- *Experiment*: A scientific procedure to make a discovery, test a hypothesis, or demonstrate a known fact. Experiments are a way to gather data under controlled conditions.
- *Hypothesis*: A proposed explanation made based on limited evidence as a starting point for further investigation.
- *Interpretation*: Explaining or finding the meaning of something. In data analysis, interpretation involves understanding what the data and the results of the analysis mean in relation to the research question.

- *Research Question*: A detailed question that guides a research project. It is a specific query that the research aims to answer using data.
- *Sample*: A part of a population used in research to represent the whole group. A sample should ideally be representative so that the conclusions drawn from it can be applied to the entire population.
- *Statistics*: A branch of mathematics dealing with the collection, analysis, interpretation, and presentation of masses of numerical data.
- *Survey*: A method of collecting data by asking people questions and recording their responses. Surveys can be done in person, on the phone, or online.
- *Variable*: Anything that can vary or change in a study. Variables are the elements that researchers measure, manipulate, or control in research.

Engage Activity (30 minutes)

Begin with a class discussion on how statistics influence our everyday decisions. Introduce the topic and present key questions that the lesson will address.

Introducing the Statistical Investigative Process:

Example Introduction:

“Today, we’re diving into the world of statistics, but not just the numbers and charts. We’re exploring how statistics help us make decisions and answer questions in everyday life. This is part of what we call the ‘Statistical Investigative Process.’ It’s a methodical approach used in various fields - from meteorology to marketing, from sports to social sciences. This process helps us collect, analyze, and interpret data to make informed decisions. Throughout this lesson, we’ll learn how to use this process to answer our own questions about the world.”

Discussion Questions:

1. “How do you think meteorologists predict the weather for the week? What kind of data might they use?”
 - Possible Answers: Meteorologists use data from satellites, radars, and weather stations. They analyze temperature, wind patterns, humidity, and historical weather data.
2. “Consider how businesses decide which products to stock. What statistical data might influence their decisions?”
 - Possible Answers: Businesses might look at sales data, customer surveys, and market trends to decide which products are popular or in demand.
3. “How do sports teams make decisions about which players to draft or trade? What role do statistics play?”
 - Possible Answers: Teams analyze player performance statistics, including past game performances, health records, and consistency in playing well.

Explain Activity (30 minutes)

Overview of the Statistical Investigative Process:

Example Overview:

“The Statistical Investigative Process involves several key steps: First, we ask a question. Then, we plan how to collect relevant data. After collecting the data, we analyze it to find patterns or insights. Finally, we interpret our findings and draw conclusions. This process is cyclical and iterative, meaning we often refine our questions or methods based on what we learn along the way.”

Case Study Discussion:

Sample Case Study:

“Imagine a local bookstore trying to decide which genres of books to stock more of. They start by asking, ‘Which book genres are most popular among our customers?’ They collect sales data over six months, categorizing books by genre. After analyzing the data, they find that mystery novels and cookbooks have the highest sales. So, they interpret these findings to mean they should stock more of these genres.”

Discussion Questions:

1. “What was the key question in this case study?”
 - Possible Answer: The key question was determining the most popular book genres among customers.
2. “How did the bookstore collect and analyze their data?”
 - Possible Answer: They collected sales data over a period and categorized books by genre to analyze trends.
3. “What decision did the bookstore make based on their analysis?”
 - Possible Answer: The bookstore decided to stock more mystery novels and cookbooks based on the sales data.

Elaborate Activity (30-45 minutes)

Divide students into groups and assign them to read [“The Power of the Statistical Investigative Process.”](#)

Each group will develop a research question based on a topic of their choice and outline how they would apply the statistical investigative process to answer it.

Introduction to the Activity

Guidance for Developing a Research Question:

Discuss the importance of specificity and clarity in a research question.

- Explain that a clear and specific question helps guide the research process by focusing on a particular aspect. This makes it easier to determine what data is needed and how to analyze it. *Example: Turn the broad question “Do people like sports?” into a specific one like “What is the percentage of high school students in our school who participate in organized sports?”*

Emphasize that the question should be answerable with data.

- Discuss how a good research question should be empirical, meaning it can be answered through data collection and analysis. *Example: “What factors influence students’ choices in after-school activities?” This question can be answered by collecting data through surveys or interviews.*

Provide examples of broad questions and narrowing them down.

- Show how broad questions often cover too much ground to be effectively answered in a single study. Narrowing down the scope makes them more manageable. Example: Broad question - “How do people use social media?” Narrowed down - “How much time do teenagers spend on social media on weekends?”

Encourage students to think about topics that interest them.

- Explain that choosing a topic of personal interest can make the research process more engaging and rewarding. Suggest that they consider current issues, hobbies, or areas they are curious about.

Guide students to consider what kind of data is needed.

- Teach students to think about the type of data that would provide answers to their questions. Is it quantitative (like numbers and statistics) or qualitative (like opinions and descriptions)? Discuss different data collection methods like surveys, experiments, interviews, or observation. *Example: For the question about screen time, data collection could involve a survey among peers about their screen time habits.*

Assessment

- Participation and contribution in class discussions.
- Group presentation of their formulated research question and proposed investigative process.
- Completion of QuantHub Study Activities associated with The Statistical Investigative Process skill.
- Formative Assessment: Scavenger Hunt, Study Items

Acceleration

For advanced students: Assign more complex research questions or have them critique and refine their peers’ questions. You can also assign them to read this supplemental resource: [The Power of Questions in the Statistical Investigative Process](#).

Intervention

For students needing additional support: Provide guided questions and more structured examples.

Guided Questions to Help Develop Research Questions:

- Provide templates for formulating questions (Template Attached).

Prompting Questions for Narrowing Down Topics:

- Offer a list of prompting questions to help students refine their research questions. For example:
 - “Who is the specific group you are interested in studying?”
 - “What specific aspect of the topic are you curious about?”
 - “When and where will your study take place?”
 - “Why is this question important or interesting to you?”

Checklist for a Good Research Question:

- Create a checklist that students can use to self-assess their questions. It might include points like:
 - Is the question clear and specific?
 - Can the question be answered with data?
 - Is the question focused on a single topic or issue?

Structured Example for Understanding the Statistical Investigative Process:

Simple Case Study:

A school is conducting a survey to determine the most popular cafeteria food.

Walk through each step of the statistical investigative process with this example:

- Question: What is the most popular cafeteria food among students?
- Plan: Decide to conduct a survey during lunch hours.
- Data Collection: Distribute surveys for a week and gather responses.
- Analysis: Count the number of votes for each food item.
- Interpretation: Conclude which food is most popular based on survey results.

Best Practices

- Use the Scavenger Hunts as bell ringer activities: [The Power of Questions in the Statistical Investigative Process](#)
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Research Question Generation Template

Step 1: Identify a Broad Topic

Example: Pop Culture Influence, Social Media Trends, etc.

Step 2: Narrow Down the Focus

What aspect of the topic interests you?

Example: Influence of pop culture on fashion trends, the impact of social media on music popularity, etc.

Step 3: Specify Your Interest

Who? (population of interest)

What? (specific aspect or variable)

Where? (location or setting)

When? (time frame)

Why? (importance of the question)

Step 4: Formulate the Question

Combine the answers from Step 3 to form a clear, focused research question.

Structure:

“How does [variable] affect [population] in [location] during [time frame]?”

“What is the relationship between [variable 1] and [variable 2] among [population] in [setting]?”

“Why does [phenomenon] occur in [population/setting] and what are its implications?”

Step 5: Review and Refine

Is the question clear and specific?

Can it be answered with data or research?

Is it relevant and interesting to you and potentially to others?

Examples of Refined Research Questions:

- Influence of Pop Culture on Fashion Trends
“How have specific pop culture events (like movie releases or celebrity appearances) in the past year influenced teenage fashion choices in urban high schools?”
- Impact of Social Media on Music Popularity
“What role does Instagram play in the popularity of new music genres among teenagers aged 13-17 in the United States?”