# Unit 3: Bivariate Data: Causality vs. Correlation

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| Content Area: | **Mathematics** |
| Course(s): | |
| Time Period: | **November** |
| Length: | **3.5 weeks** |
| Status: | **Published** |

## Unit Overview:

In unit 3, students will learn about bivariate data through discussions and data explorations around the theme of water usage. Students will explore scatter plots as a visual way to represent the relationship between two variables, within them they will create their own lines of best fit as well as learn about the ways in which these are usually determined and analyzed in data science work. Throughout the unit, they will use the analytic tools they are learning to make and refine claims about water usage based on both self-collected data and large, publicly available data sets. During the unit, students will work in Google Sheets, CODAP and Tableau.

## Essential Questions:

What is data and what is it good for? What can you do with data?

## Enduring Understandings:

- Represent two variable data on a scatter plot and describe how the variables are related. Fit a linear function on scatter plots where the data suggests a linear fit. Estimate a line of best fit for a single linear regression.

- Determine the fit of a function by plotting and analyzing residuals.

- Use technology to compute and interpret the correlation coefficient of a linear fit. Determine and interpret the strength of correlation to determine the best fit. Recognize possible associations and trends in the data.

## Standards/Indicators/Student Learning Objectives (SLOs):

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| MATH.9-12.F.BF.A.1 | Write a function that describes a relationship between two quantities. |
| MATH.9-12.F.BF.A.1.a | Determine an explicit expression, a recursive process, or steps for calculation from a context. |
| MATH.9-12.S.ID.B.6 | Represent data on two quantitative variables on a scatter plot and describe how the variables are related. |
| MATH.9-12.S.ID.B.6.a | Fit a function to the data (including with the use of technology); use functions fitted to data to solve problems in the context of the data. Use given functions or choose a function suggested by the context. Emphasize linear and exponential models. |
| MATH.9-12.S.ID.B.6.b | Informally assess the fit of a function by plotting and analyzing residuals, including with the use of technology. |

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| MATH.9-12.S.ID.C.7 | Interpret the slope (rate of change) and the intercept (constant term) of a linear model in the context of the data. |
| MATH.9-12.S.ID.C.8 | Compute (using technology) and interpret the correlation coefficient of a linear fit. |
| MATH.9-12.S.ID.C.9 | Distinguish between correlation and causation. |
| MATH.9-12.A.CED.A.1 | Create equations and inequalities in one variable and use them to solve problems. Include equations arising from linear and quadratic functions, and simple rational and exponential functions. |
| MATH.9-12.A.CED.A.2 | Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales. |
| MATH.9-12.A.REI.D.10 | Understand that the graph of an equation in two variables is the set of all its solutions plotted in the coordinate plane, often forming a curve (which could be a line). |
| MATH.9-12.S.MD.A.1 | Define a random variable for a quantity of interest by assigning a numerical value to each event in a sample space; graph the corresponding probability distribution using the same graphical displays as for data distributions. |
| MATH.9-12.F.LE.B.5 | Interpret the parameters in a linear or exponential function in terms of a context. |

## Lesson Titles:

- 3.1 Linear Regression and Bivariate Data
- 3.2 Using Probability to Analyze the fit of a Regression
- 3.3 Make Connections Between the Trend and the Context to Make Predictions
- 3.4 Spurious Correlations, Confounding and Mediating Variables and Data Ethics
- 3.5 Evaluating Claims: Spurious Correlation vs Causality

## Career Readiness, Life Literacies, & Key Skills:

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| WRK.K-12.P.4 | Demonstrate creativity and innovation. |
| WRK.K-12.P.5 | Utilize critical thinking to make sense of problems and persevere in solving them. |
| WRK.K-12.P.7 | Plan education and career paths aligned to personal goals. |
| WRK.K-12.P.8 | Use technology to enhance productivity increase collaboration and communicate effectively. |
| WRK.K-12.P.9 | Work productively in teams while using cultural/global competence. |

## Inter-Disciplinary Connections:

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| CS.9-12.8.1.12.DA.1 | Create interactive data visualizations using software tools to help others better understand real world phenomena, including climate change. |
| CS.9-12.8.1.12.DA.5 | Create data visualizations from large data sets to summarize, communicate, and support different interpretations of real-world phenomena. |
| TECH.8.1.12.A.1 | Create a personal digital portfolio which reflects personal and academic interests, achievements, and career aspirations by using a variety of digital tools and resources. |
| TECH.8.1.12.C.CS2 | Communicate information and ideas to multiple audiences using a variety of media and formats. |

| TECH.8.1.12.E.CS4 | Process data and report results. |
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| TECH.8.1.12.F.CS3 | Collect and analyze data to identify solutions and/or make informed decisions. |

## Equity Considerations

## Holocaust Mandate

Topic:

Materials Used:

Addresses the Following Component of the Mandate:

- Bias
- Bigotry
- Bullying
- Holocaust Studies
- Prejudice

## LGBTQ and Disabilities Mandate

Topic (Person and Contribution Addresses):

Materials Used:

Addresses the Following Component of the Mandate:

- Economic
- Political
- Social

## Climate Change

Topic (Person and Contribution Addresses): Water Usage in Cities

In this project students will individually create a write-up to make your case as to whether population and water usage in cities are causally related. They will be required to include evidence needed to support his/her claim. Visuals and color need to be included to highlight findings and make connections.

Remember that the data science process is iterative and everyone's process moving through will be different.

Materials Used:

[Population and Water Usage In Cities (Unit 3): Criteria and Feedback Rubric](#)

Link to Data .csv File:

https://drive.google.com/file/d/1hPrgM7T-AujvTwkMAJQ2uyEL9GDswgEv/view?usp=sharing

Link to Tableau Tutorial on Uploading .csv Files:

https://help.tableau.com/current/pro/desktop/en-us/examples_text.htm

Addresses the Following Component of the Mandate:

Climate change

## Asian American Pacific Islander Mandate

Topic (Person and Contribution Addresses):

Materials Used:

Addresses the Following Component of the Mandate:

- Economic
- Political
- Social

## Summative Assessment:

Students will collect and analyze data about water usage based on the number of people in their household. From this data they will estimate a line of best fit, describe where they place the line, why, and what it tells

them about the data. They will make connections to finding the line of best fit by using this line and their data to find the residuals and squares of residuals. They will compute r squared for their data and communicate what this tells them about their least squares line and their data. They will then make claims about their data based on their analysis and consider a model of the process to indicate how much of the story their data analysis tells. Students will then analyze a larger data set of water usage by city that includes additional variables. Students will explore and analyze this data set in Tableau, make statements based on their findings, and draw connections between different variables and water usage across cities.

- Build a Portfolio - Unit 3 Cities and Water Usage Project

## Benchmark Assessments

- Project-Based Assessment
- Skills Based Assessment

## Alternative Assessment

- Journal Reflections
- Performance tasks
- Portfolios
- Presentations
- Project-based assignments

## Formative Assessment:

- Data Talks/ Class Discussions
- Individual. Partner & Group Exploration Activities
- Jigsaw Assignments
- Math Journals

## Resources & Materials:

This curriculum will introduce students to the main ideas in data science through free tools such as Google Sheets, Python, Data Commons and Tableau. Students will learn to be data explorers in project-based units, through which they will develop their understanding of data analysis, sampling, correlation/causation, bias and uncertainty, probability, modeling with data, making and evaluating data-based arguments, the power of data in society, and more! At the end of the course students will have a portfolio of their data science work to showcase their newly developed abilities.

- Data Sets & Visuals

- YouCubed High School Data Science Curriculum

## Instructional Strategies, Learning Activities, and Levels of Blooms/DOK:

- Collect and organize data

- Evaluate claims considering spurious correlations, confounding and mediating variables

- Express trends within data using regression models as evidence to describe a narrative

- Understand that correlation does not necessarily imply causation

- Understand, utilize and interpret the meaning and fit of a linear regression within the context of the data set

## Modifications

## ELL Modifications:

- Choice of test format (multiple-choice, essay, true-false)

- Continue practicing vocabulary

- Provide study guides prior to tests

- Read directions to the student

- Read test passages aloud (for comprehension assessment)

- Vary test formats

## G&T  Modifications:

- Alternate assignments/enrichment assignments

- Enrichment projects

- Extension activities

- Higher-level cooperative learning activities

- Pairing direct instruction with coaching to promote self-directed learning

- Provide higher-order questioning and discussion opportunities

- Provide texts at a higher reading level

- Tiered assignments

- Tiered centers

## At Risk Modifications

The possible list of modifications/accommodations identified for Special Education students can be utilized for At-Risk students.  Teachers should utilize ongoing methods to provide instruction, assess student needs,

and utilize modifications specific to the needs of individual students.  In addition, the following may be considered:

- Additional time for assignments
- Adjusted assignment timelines
- Agenda book and checklists
- Answers to be dictated
- Assistance in maintaining uncluttered space
- Books on tape
- Concrete examples
- Extra visual and verbal cues and prompts
- Follow a routine/schedule
- Graphic organizers
- Have students restate information
- No penalty for spelling errors or sloppy handwriting
- Peer or scribe note-taking
- Personalized examples
- Preferential seating
- Provision of notes or outlines
- Reduction of distractions
- Review of directions
- Review sessions
- Space for movement or breaks
- Support auditory presentations with visuals
- Teach time management skills
- Use of a study carrel
- Use of mnemonics
- Varied reinforcement procedures
- Work in progress check

## IEP & 504  Modifications:

*All teachers of students with special needs must review each student's IEP.  Teachers must then select the appropriate modifications and/or accommodations necessary to enable the student to appropriately progress in the general curriculum.

Possible Modifications/Accommodations: (See listed items below):

- Allow for redos/retakes
- Assign fewer problems at one time (e.g., assign only odds or evens)
- Differentiated center-based small group instruction

- Extra time on assessments

- Highlight key directions

- If a manipulative is used during instruction, allow its use on a test

- Opportunities for cooperative partner work

- Provide reteach pages if necessary

- Provide several ways to solve a problem if possible

- Provide visual aids and anchor charts

- Test in alternative site

- Tiered lessons and assignments

- Use of a graphic organizer

- Use of concrete materials and objects (manipulatives)

- Use of word processor

## Technology Materials and Standards

- Chromebooks

- CODAP

- Edublocks

- Google Colab

- Google Jamboard

- Google Sheets

- Google Slides

- Promethean Board

- Tableau

## Computer Science and Design Thinking Standards

| CS.6-8.DA | Data & Analysis |