Consumer Chronicles

Correlation Coefficient

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Grade Level	11th – 12th Grade	**Time Frame**	100 Minutes
Subject	Mathematics	**Duration**	2-3 Class Periods
Course	AP Statistics, Statistics		

Essential Question

How can we analyze relationships in bivariate data?

Summary

In this lesson, students learn to analyze relationships in bivariate data by exploring scatter plots and calculating the correlation coefficient. Prerequisite knowledge for this lesson includes z-scores using summation notation (sigma), mean (x bar), and standard deviation. Students build their understanding of describing scatter plots and the correlation coefficient through engaging activities such as watching an interview with a Data Analyst, completing card sorts to understand essential vocabulary, and constructing and interpreting scatter plots.

Snapshot

Engage:

Students watch the first half of an ICAP interview, in which they learn about a Data Analyst's job, responsibilities, and educational background.

Explore 1:

Students work in pairs to complete a series of three card sorts to establish prior knowledge of essential vocabulary for describing scatter plots.

Explain 1:

Students formalize their knowledge of describing scatter plots and calculating correlation coefficient.

Explore 2:

Students work in pairs to construct knowledge on how a scatter plot's affects the *r*-value, strength of the correlation, and line of best fit.

Explain 2:

Students formalize their knowledge of correlation coefficient in order to describe the strength of the relationship described by the data and calculate the correlation coefficient of a given set of data.

Extend:

Students watch the second half of an ICAP interview, during which the Data Analyst describes the data

they work with, the characteristics they look for, and the ways they determine the reliability of data trends.

Evaluate:

Students will complete an exit ticket that summarizes their learning from the lesson.

Standards

AP Statistics Course and Exam Description (Course at a Glance)

2.4: Representing the Relationship Between Two Quantitative Variables
2.5: Correlation

Oklahoma Academic Standards Mathematics (Statistics and Probability)

S.DA.4.3: Analyze scatter plots for patterns, linearity, outliers, and influential points.
S.DA.4.4: Using technology, compute and interpret the correlation coefficient.

Attachments

- Beauty Trends (Sample Responses)—Consumer Chronicles.docx
- Beauty Trends (Sample Responses)—Consumer Chronicles.pdf
- Beauty Trends—Consumer Chronicles - Spanish.docx
- Beauty Trends—Consumer Chronicles - Spanish.pdf
- Beauty Trends—Consumer Chronicles.docx
- Beauty Trends—Consumer Chronicles.pdf

Materials

- Beauty Trends handout (attached; one per student; print front/back)
- Beauty Trends (Sample Responses) document (attached; for teacher use)
- Pencils
- Paper
- Graphing calculator technology
- Student devices with internet access

10 minutes

Engage

Teacher's Note: Desmos Classroom Activity Preparation

To use this Desmos Classroom activity, select the following link: "Consumer Chronicles, Part 1." Create an account or sign in under the "Activity Sessions" heading. After you log in, the "Assign" dropdown button will be active. Click the arrow next to the word "Assign," then select "Single Session Code." After making some setting selections, select "Create Invitation Code" and give the session code to students. For more information about previewing and assigning a Desmos Classroom activity, go to https://k20center.ou.edu/externalapps/using-activities/.

For more detailed information about Desmos features and how-to tips, go to https://k20center.ou.edu/externalapps/desmos-home-page/.

To set up the activity's pacing for students, select "View Dashboard" (next to the session code). In the upper-left corner of your screen, select the icon above the word "Pacing." Desmos Classroom should then prompt you to select the first and last screens that you want students to see. When prompted to set a range, select screens 1 and 4. Select "Restrict to Screens 1–4" to confirm your selection. This allows students to access only screens 1–4 at this time. For more information about teacher pacing, go to https://k20center.ou.edu/externalapps/pacing-activities/.

Provide students with your session code. Then, have students go to student.desmos.com and enter the session code.

Teacher's Note: Desmos sign-in Options

If students sign in with their Google or Desmos accounts, their progress is saved. They can resume the activity or view their work later. If students continue without signing in, they can complete the activity, but they must do so in one sitting. It is strongly recommended that students sign in; otherwise, they risk losing their work.

Introduce the lesson using **screens 1-2**, which display the lesson's essential question and learning objectives. Review each of these with your class to the extent you feel necessary.

Teacher's Note: ICAP Video

Decide whether you would like students to watch the ICAP video independently with headphones or play it on the main screen for the class to watch together. The ICAP video is split into two parts: the first half is played in Engage, and the second part is played in Extend.

Direct students to **screen 3**. Here, they watch the K20 ICAP - Consumer Chronicles video of a Product Manager introducing themselves and discussing their job, responsibilities, and educational background.

Have the student watch the ICAP video before progressing to **screen 4** to reflect on the video using the S-I-T strategy to answer the following questions:

- What did you find surprising?
- What did you find interesting?
- What is your biggest takeaway from the video?

After the students submit their responses to the prompts, they will see responses from other students on their screen. Ask students to read those responses then hold a whole-group discussion over the responses by asking the students to share a response other than their own that they agree with or one that interests them.

10 minutes

Explore 1

Instruct students to find a partner or assign students partners.

On the Dashboard, press the orange plus sign three times to allow students to progress to **screens 5-7** at their own pace. Introduce students to the Card Matching strategy and direct their attention to **screen 5**. Instruct them to match every vocabulary word (green card) with the correct definition and example cards by clicking and dragging the cards to lock together. At the top of the screen, students will see how many cards were matched correctly; however, they will be able to progress to the next screen without having all of the cards correctly matched. At this point in the lesson, the students do not need to have correct answers, they will learn the proper vocabulary and definitions in the Explain portion of the lesson.

On **screens 6-7**, students continue to match the green vocabulary cards to the correct definition and example cards using the same click-and-drag method from **screen 5**.

Teacher's Note: Pacing the Lesson

If some groups complete the three card sorts before other groups, encourage them to revisit the screens and continue working until they have sorted all cards correctly.

20 minutes

Explain 1

Keep students in their same pairs from the Explore to continue the lesson together. Each student should be progressing through the screens on their own device while communicating and clearing up misconceptions with their partner.

On the Dashboard, press the orange plus sign six times to allow students to progress to **screens 8-13**.

Direct students' attention to **screen 8**, where students are given a scenario and data set to analyze. On **screen 9**, students learn that the first step to analyzing data is to construct a scatter plot of the data.

As students move through **screens 10-13**, they engage with the new vocabulary associated with describing scatter plots: *direction*, *unusual features*, *form*, and *strength (DUFS)*. Using the DUFS acronym, students describe the initial given linear data set (from screen 8) that has been represented with a scatter plot.

Walk around the room as students read through the prompts on each screen to answer any questions. As students have chosen an answer on the screen a check mark or x will appear below the answer choice accompanied by an explanation on why the student's choice was correct or incorrect.

Once you have noticed that most students have completed **screen 13**, press the orange plus sign once to allow students to progress to **screen 14**. Use this time in the lesson to speak to the whole class to add any important information or clear up misconceptions you noticed while walking around the room. Here students learn about different types of unusual features: outliers in the *x*-direction, *y*-direction, *x*- and *y*-directions, and a cluster by clicking on the individual scatter plots on the screen.

Teacher's Note: Pacing the Lesson

During a traditional 45-minute class period, this lesson will naturally need to be paused and resumed the next day. A smooth transition could be to pause the lesson after completing **screen 14** and resume it on **screen 15** the next day.

If time allows, consider pressing the orange plus sign once, showing students **screen 15**, and sending them home thinking about the strength of scatter plots. The next class period can begin with students sharing their ideas and ordering the graphs from strongest to weakest correlation.

20 minutes

Explore 2

On the Dashboard, press the orange plus sign once to allow students to progress to **screen 15.** Introduce the Partner Speaks strategy and ask pairs to discuss what a strong or weak correlation would look like visually on a graph. Hold a whole class discussion by asking students to share what their partners said.

Allow time for pairs to order the graphs from strongest to weakest correlation. Pairs have unlimited attempts to get the correct sequence and will receive feedback on the screen when they click the "Check My Work" button. Encourage them to look back at **screen 12** if they do not order the graphs correctly. Once pairs begin to get the correct answer, encourage them to help other groups by sharing their thought process and considerations while ordering.

After all students have completed **screen 15**, press the orange plus on the Dashboard, sign four times to allow students to progress to **screens 16-19**.

While students work, walk around the room to answer questions and ensure that pairs are working together on the task.

On **screen 16**, students will click and drag the points around the coordinate plane and note how the location of points affects the *r*-value and strength of the correlation. Once students feel they understand how the mechanics of the screen function, ask them to progress to the next screen.

- On **screens 17-19**, students are asked to move the points to make *r* equal specific values.
- After students make $r = 1$ on **screen 17**, they are asked, "What made this task challenging?"
- Once students make $r = 0$ on **screen 18**, they are asked to describe what their data points look like.
- Then after making $r < 0$ on **screen 19**, students are asked to reflect on the activity and how *r* might be related to the slope, even though it is not the slope.
- Just like on **screen 16**, students are expected to click and drag the points on the coordinate plane to adjust the *r*-value on the screen.

Explain to students that they can progress to the next screen after they have completed and submitted their reflection. Just like before, encourage pairs to work on their own devices and support each other through the tasks.

20 minutes

Explain 2

Press the orange plus sign on the Dashboard two times to allow students to progress to **screens 20-21**.

On **screen 20**, have students read the definition of *correlation coefficient* and click on each of the three graphs to learn the definition of a perfect positive correlation, perfect negative correlation, and no linear correlation.

A common misconception is that the correlation coefficient is synonymous with the slope of the line, which is not correct. **Screen 21** clarifies this misconception by showing the students that the two terms are represented by different letters. To show they understand the difference, students identify the slope and correlation coefficient of the scatter plot on the screen.

Teacher's Note: Pacing the Lesson

Screen 21 would be a good place to pause the lesson and hold a whole class discussion about what they have learned so far in the lesson or clear up misconceptions you may have seen while walking around the classroom.

On the Dashboard, press the orange plus sign eight times to allow students to progress to **screens 22-29**. Just as you have done before, ask partners to work together to progress through these screens and walk around the room as students work to answer questions and keep students on track.

Teacher's Note: Prerequisite Knowledge

In this part of the lesson, if students do not recall *z*-scores, the means for *x* and *y* (*x* bar and *y* bar), sigma notation, etc., use this time to review as needed.

As students progress through these screens, ask them to answer questions about the same scenario as from the first Explain phase. They learn how the value of the correlation coefficient determines how to best describe the strength of a relationship. **Screens 24-29** walk students through the process of how to calculate the correlation coefficient of a given set of data by hand, receiving feedback as they progress. Each screen in this portion of the lesson builds upon the previous information so it is important that students understand and get the correct answer before moving on to the next screen. Remind students to use the given feedback to make corrections as needed. Encourage students to take their time and read all the information presented on each screen.

10 minutes

Extend

Teacher's Note: ICAP Video

Decide whether you would like students to watch the ICAP video independently with headphones or play it on the main screen for the class to watch together.

On the Dashboard, click the orange “Stop” button; now students can complete the Desmos activity at their own pace.

Direct students to **screen 30**. Introduce the I Used to Think... But Now I Know strategy and ask them to respond to the prompt, “What do you think statistics is used for?” Have students watch the K20 ICAP - Consumer Chronicles Part 2 video on **screen 31**, where the same Product Manager from the Engage phase describes the data that they work with, the characteristics they look for in data, and the ways that information is relayed to the client. After watching the video, have students move to **screen 32** and complete the strategy by responding to the prompt, “What do you now think statistics is used for?”

After the students have had an opportunity to respond to the prompt on **screen 32**, ask them to read other responses made by their classmates. Hold a whole-group discussion over the responses by asking the students to share a response other than their own that they agree with or one that interests them.

10 minutes

Evaluate

Pass out the attached **Beauty Trends** handout to each student and ask them to answer the questions they read on the screen on their handout.

Once students have completed their handout, consider using the attached **Beauty Trends (Sample Responses)** document to either grade students' submitted work or to display to the class for them to self-evaluate, like they would with AP-style free response questions.

Resources

- K20 Center. (n.d.). Card matching. Strategies. https://learn.k20center.ou.edu/strategy/1837
- K20 Center. (n.d.). Desmos classroom. Tech Tools. https://learn.k20center.ou.edu/tech-tool/1081
- K20 Center. (n.d.). I used to think... but now I know. Strategies. https://learn.k20center.ou.edu/strategy/137
- K20 Center. (n.d.). Partner speaks. Strategies. https://learn.k20center.ou.edu/strategy/62
- K20 Center. (n.d.). S-I-T (surprising, interesting, troubling). Strategies. https://learn.k20center.ou.edu/strategy/926