California State University Chico

School of Education

SSP LESSON PLAN TEMPLATE

WHO	Who is Learning?

TEACHER: Kamille Delgardo (CT Emily Abshier) **DATE:** Friday 31 October 2025

INQUIRY-BASED LESSON TITLE:

How do I determine the Least Squares Regression Line?

CONTENT AREA: Integrated Math I

GRADE LEVEL(S): 9-11

NUMBER OF ELD STUDENTS AND LEVELS:

Numerous reclassified native Spanish speakers.
One English Learner in a Structured English Immersion Program
Levels (As of 2022):

- **Oral**: 3 out of 4
- **Written**: 2 out of 4
- **Listening**: somewhat/moderately
- **Speaking**: well developed

NUMBER OF IEP and/or 504 STUDENTS:

504 - 4
IEP - 4

STUDENTS' ASSETS:

STUDENTS' LEARNING NEEDS:

I anticipate students will need help with technology and generating residuals using Desmos.
Based on prior assessment results, every this unit we will be describing its domain and range.

LESSON LENGTH: 50 minutes (day 1 of 2)

WHAT	What are students learning?

CONTENT STANDARD(S) & MATHEMATICAL PRACTICE STANDARD(S):

Content Standards:

Number and Quantity: Quantities (N-Q):
Reason quantitatively and use units to solve problems.

1. Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.

Functions: Interpreting Functions (F-IF):
Interpret functions that arise in applications in terms of the context.

5. Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes.

Analyze functions using different representations.

7. Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases.

Statistics and Probability: Interpreting Categorical and Quantitative Data (S-ID):
Summarize, represent, and interpret data on two categorical and quantitative variables.

6. Represent data on two quantitative variables on a scatter plot, and describe how the variables are related.
    a. Fit a function to the data; use functions fitted to data to solve problems in the context of the data.
    c. Fit a linear function for a scatter plot that suggests a linear association.

Practice Standards:
Make sense of problems and persevere in solving them, reason abstractly and quantitatively, model with mathematics, use appropriate tools strategically, and attend to precision.

CONTENT-SPECIFIC LEARNING GOAL(S):

Goals:

- Students will be able to approximate a line of best fit.
- Students will be able to calculate the sum of the squares of residuals to determine which line approximates the best fit.

Success Criteria:

- Given a table of data:
    - Students will be able to write a slope-intercept line to approximate best fit on a scatterplot of the points.
    - Students will be able to calculate the sum of the squares of the residuals and describe its significance.

ENGLISH LANGUAGE DEVELOPMENT STANDARD(S):

Grades 9-10 Part I: Interacting in Meaningful Ways

A. Collaborative
    - 1. Exchanging information and ideas with others through oral collaborative discussions on a range of social and academic topics.

ENGLISH LANGUAGE DEVELOPMENT GOAL(S) FOR ELD STUDENTS:

Students will be able to describe what residuals are and how they relate to a line of best fit.

IEP GOAL(S) FOR IEP STUDENTS (if applicable):

Our ADHD student will self-regulate, stepping outside as needed (as indicated in his 504).

ACADEMIC/CONTENT LANGUAGE DEMANDS AND PLANNED SUPPORTS:

Language Demands
Function:
- Interpret sum of square of residuals.
- Compare varying lines of best fit and their sums of squares of residuals.

Vocabulary:
- Residual
- Sum of square of residuals

Discourse:
- Interpreting graphic representations as a group.
- Making and mathematically supporting a conjecture regarding which team has the line of best fit.

Syntax:
- ___ is the line of best fit because its sum of squares of residuals is ___

Supports
Input:
- Modeling residuals on Desmos

Output:
- Structured talk: our line of best fit was [equation]. The sum of residuals was []. The sum of squares of residuals was [].

Interaction Supports:
- Team-based collaborative problem solving

Evidence of Language Use:
- Written and oral reasoning or justification that their line is or isn't a good fit.

WHY — Why does this lesson matter? (Rationale)

RELEVANCE:

Students will move from approximating a line of best fit to finding a mathematical way to derive a line of best fit.

PRIOR KNOWLEDGE:

Students know how to plot data points on a Cartesian coordinate system. They know how to write a line in slope-intercept form. They can calculate differences, sums, and squares.
Residual = actual - predicted

HOW — How is Learning Being Facilitated?

CREATE HEALTHY CLASSROOM COMMUNITY:

Students are in new groups as of this week in a gender checkerboard pattern with the disruptive boys

separated. Ensure that groups are working respectively and collaboratively and that everyone is contributing to the group.
I will encourage participation from all students by drawing names from my playing card deck at random. I will try to select students to share their work as I circulate and see how they're doing.

ACADEMIC LITERACY (Listening, Reading, Writing, Speaking):

Students will listen to teachers as they present and to each other in groups. They will read the assignment steps from the textbook opened on the smartboard. They will write their findings as they discover them and speak their findings to the class using appropriate vocabulary and syntax..

ACCOMMODATIONS, MODIFICATIONS & UDL CONSIDERATIONS:

- A Spanish version of the textbook is available in print and on Chromebook.
- Mrs. Riley will be pushed in from the resource classroom to assist.
- Students are **not** required to memorize technology steps.

CO-TEACHING Strategy(s) AND/OR PARAPROFESSIONAL SUPPORT (If applicable)**:**

I will each take the lead on each question. CT Mrs. Abshier, Education Specialist Mrs. Riley, and I will circulate through groups individually after each main lesson.

INFORMAL ASSESSMENT(S):

As questions as we circulate among groups:

- What do we think about when deciding where to place a line of best fit?
- What makes one line a better model than another line?
- How can we find how *different* an actual value is to a predicted value?
- Is it important that we always have actual - predicted or could we do predicted - actual?
- What is the result when some residuals are positive and some are negative? (They cancel out.)
- How can we numerically describe how close the prediction made by the model is to a player's actual total points?
- Why is thinking about absolute value and total distance from the line of best fit important in this problem?

FORMAL ASSESSMENT(S):

By the end of day 1 (this lesson) students will have determined the sum of squares of residuals for their chosen line of best fit and be able to compare it to other teams' to decide which is the *best* best fit and why.

MATERIALS NEEDED:

Lesson 4.1.4 Resource Page (scatterplot)
Rulers
Student eTool (Desmos)

LEARNING ACTIVITY SEQUENCE: (Procedure)

0: We will start by checking the homework from lesson 4.1.3, then we will answer any questions

students bring up.

1. **Engaging Introduction**:

Draw a random scatterplot on the smartboard. Ask a few volunteers to come up and draw what they think is the line of best fit.
How can we determine which is best?

2. **Learning Activities**:

4-31. The following table shows data for one season of the El Toro professional basketball team. El Toro team member Antonio Kusoc was inadvertently left off of the list. Antonio Kusoc played for 2103 minutes. We would like to predict how many points he scored during the season.

[Table]

a. Obtain a Lesson 4.1.4 Resource Page or use the *4-31 Student eTool*. Draw a line of best fit for the data and then use it to write an equation that models the relationship between total points scored during the season and minutes played.

b. Which data point is an outlier for this data? Whose data does that point represent? What is his residual?

c. Would a player be more proud of a negative or positive residual?

d. Predict how many points Antonio Kusoc scored.

Introduce the problem as we hand out the scatter plot resource page.
Students are given a table of 14 basketball players, their total minutes played, and the total points they scored in a season. In groups they will draw a line of best fit for the scatterplot on their resource page, and find the equation of the line in slope-intercept form.
Students will find the outlier (Scottie Sordan) and his residual.

4-32. Different people will come up with different models for the relationship between total points scored and minutes played in the previous problem. They will also have different estimates for the number of points scored by Antonio Kusoc.

Your Task: Discuss with your team how you can decide which team's equation models the data the best. Compare your team's model to that of another team. Which of the two models is better?

I will have each team discuss with a nearby team how they can determine whose line was a better fit. Encourage them to think how they could mathematically prove that their line was better than another team's.
How did you decide where to put the line? What was your thinking? What would make one a better fit than another? Why is thinking about absolute value and total distance from the line of best fit important in this problem?
Select teams/individuals to share their thinking as we circulate, then bring everyone back together to discuss.
At this point, we will actually calculate residuals on Desmos. I will plot my (very bad) predicted line on Desmos as $P = \frac{1}{3}x_1$.
I will ask how we find individual residuals mathematically – confirm that they know it's the difference in y-values between actual and predicted.
I will show how we can get all residuals using Desmos: $D = y_1 - P$
When we see the points for D, ask students what they represent and why some are above the x-axis and some are below.

Ask if there's any way we could use these values to prove that one line is better than another. Demonstrate how to find total sum of residuals on Desmos: $total(D)$

4-33. Sometimes there are several different lines of best fit that can be drawn with the same sum of the absolute values of the residuals. To create a single *unique* line of best fit, statisticians use the sum of the squares of the residuals, instead of the absolute value, to make all the residuals positive.

a. What is the sum of the squares of the residuals for your line of best fit?

b. Compare your result to other teams in your class. Did any team have a better model than yours because they had a smaller sum of the squares of the residuals?

With the non-squared residual example on Desmos, let students find the sum of the squares of residuals. Circulate to help teams with technology.

3. **Learning Closure:**

Bring class back together and solicit answers for each team's sum of square residuals. Remind them of how we determined that the lowest number represents the best line of fit.

REFLECTION

ASSESSMENT RESULTS:

LESSON OBSERVATION FOCUS:

Demonstration of student thinking.