Explanatory & Response Variables · Scatter Plots

Statistics Worksheet · Grade 9–12

Name: _____ Date: _____

Learning Objectives

- Identify the explanatory (independent) and response (dependent) variables in a given experiment
- Determine when a clear explanatory or response variable exists in a study
- Understand scatter plots as graphical displays of the relationship between two quantitative variables

Problems

1. A researcher studies how the number of hours a student studies affects their test score. Identify the explanatory variable and the response variable.

2. A scientist measures the amount of fertilizer given to plants and then records the height of each plant after 30 days. Identify the explanatory variable and the response variable.

3. In algebra, we call the two variables in a relationship the independent and dependent variables, represented by x and y. Match these to their statistical counterparts used when analyzing two quantitative data sets.

4. A study records both the shoe size and the reading level of children. Is there a clear explanatory variable and response variable? Explain.

5. On a scatter plot, which axis represents the explanatory variable and which axis represents the response variable? Describe how a scatter plot is set up.

6. The table below shows data from an experiment measuring the amount of alcohol (in grams) given to mice and the change in their body temperature (in degrees Celsius). Identify the explanatory and response variables, then describe what the scatter plot axes would be labeled.

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Mouse	Alcohol (g)	Temp Change (°C)

7. A coach wants to know if the number of practice sessions per week is related to the number of goals scored in a season by soccer players. Identify the explanatory and response variables and write the ordered pair format that would be plotted on a scatter plot.

(practice sessions per week, goals scored)

8. A researcher collects the following data on daily temperature (in degrees Fahrenheit) and ice cream sales (in dollars). Plot the five ordered pairs on a scatter plot and identify any apparent relationship. Also state the explanatory and response variables.

Day	Temperature (°F)	Ice Cream Sales ($)

9. For each scenario below, decide whether there is a clear explanatory variable and response variable (write EV and RV), or whether it is unclear (write 'No clear EV/RV'). Scenarios: A) Hours of sleep and reaction time in a driving test. B) Mean SAT Math scores and Mean SAT Critical Reading scores for the same group. C) Amount of rainfall and crop yield. D) Height and weight of adults.

10. A study collects data on the number of absences a student has and their final grade percentage. The data is shown in the table. Identify the EV and RV, write the ordered pairs, describe the type of relationship shown (positive, negative, or none), and explain what the scatter plot would look like.

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Student	Absences	Final Grade (%)

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Explanatory & Response Variables · Scatter Plots — Answer Key

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Answer Key

1. Answer: Explanatory variable: number of hours studied; Response variable: test score

- The explanatory variable is the one that explains or predicts change — it is the number of hours studied.
- The response variable measures the outcome — it is the test score.

2. Answer: Explanatory variable: amount of fertilizer; Response variable: plant height after 30 days

- The explanatory variable is the one manipulated in the experiment — the amount of fertilizer.
- The response variable is what is measured as an outcome — the height of the plant after 30 days.

3. Answer: Independent variable (x) = Explanatory variable; Dependent variable (y) = Response variable

- In statistics, we use 'explanatory variable' instead of independent variable (x).
- We use 'response variable' instead of dependent variable (y).
- Both pairs describe the same relationship but are named differently by context.

4. Answer: No clear explanatory or response variable; neither variable clearly causes or predicts the other.

- Shoe size does not cause or predict reading level, and reading level does not cause shoe size.
- Both variables may increase with age, but neither is clearly the explanatory or response variable.
- This is a case where the EV and RV are not clearly defined.

5. Answer: The explanatory variable is plotted on the horizontal (x) axis; the response variable is plotted on the vertical (y) axis.

- In a scatter plot, the horizontal axis (x-axis) represents the explanatory variable.
- The vertical axis (y-axis) represents the response variable.
- Each data point is plotted as an ordered pair (x, y) to show the relationship between the two variables.

6. Answer: Explanatory variable: Amount of alcohol (x-axis); Response variable: Change in body temperature (y-axis)

Mouse	Alcohol (g)	Temp Change (°C)
1	1.0	-0.5
2	1.5	-1.0
3	2.0	-1.8

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Mouse	Alcohol (g)	Temp Change (°C)
4	2.5	-2.3
5	3.0	-2.9

- The amount of alcohol is given to the mice — it is the explanatory variable (x-axis).
- The change in body temperature is measured as an outcome — it is the response variable (y-axis).
- Each mouse provides one ordered pair (alcohol amount, temp change) to be plotted.

7. Answer: Explanatory variable: practice sessions per week (x); Response variable: goals scored (y); Ordered pair: (practice sessions, goals scored)

- The number of practice sessions is the variable that explains or predicts — it is the explanatory variable.
- The number of goals scored is the measured outcome — it is the response variable.
- Each player's data is plotted as the ordered pair (practice sessions per week, goals scored in a season).

8. Answer: Explanatory variable: Temperature (x-axis); Response variable: Ice cream sales (y-axis); As temperature increases, sales increase — positive relationship.

Day	Temperature (°F)	Ice Cream Sales ($)
1	65	120
2	70	145
3	75	175
4	80	210
5	90	260

- The explanatory variable is temperature — it is on the x-axis.
- The response variable is ice cream sales — it is on the y-axis.
- Plot each ordered pair: (65,120), (70,145), (75,175), (80,210), (90,260).
- As temperature increases, ice cream sales also increase, showing a positive relationship.

9. Answer: A) EV: hours of sleep, RV: reaction time. B) No clear EV/RV. C) EV: amount of rainfall, RV: crop yield. D) No clear EV/RV (neither clearly causes the other).

- A) Hours of sleep can explain/predict reaction time, so sleep is EV and reaction time is RV.
- B) Neither SAT math nor reading score clearly causes the other — no clear EV or RV.
- C) Rainfall can predict crop yield, so rainfall is EV and crop yield is RV.
- D) Height and weight are related but neither clearly causes the other in general adult data — no clear EV or RV.

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10. Answer: EV: number of absences (x-axis); RV: final grade % (y-axis); Negative relationship — as absences increase, final grade decreases. Points trend downward from left to right.

Student	Absences	Final Grade (%)
A	0	95
B	2	88
C	5	76
D	8	65
E	10	58
F	14	45

- The explanatory variable is the number of absences — it is plotted on the x-axis.
- The response variable is the final grade percentage — it is plotted on the y-axis.
- Ordered pairs: (0,95), (2,88), (5,76), (8,65), (10,58), (14,45).
- As the number of absences increases, the final grade decreases — this is a negative relationship.
- On the scatter plot, the points would trend downward from the upper-left to the lower-right, indicating a negative association.

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