Categorical vs. Quantitative Variables

Statistics Worksheet · Grade 6–9

Name: _____ Date: _____

Learning Objectives

- Distinguish between categorical and quantitative variables
- Explain why arithmetic operations must make sense for a variable to be quantitative
- Classify variables in real-world data sets as categorical or quantitative

Problems

1. A categorical variable describes a characteristic or category of an individual. A quantitative variable takes numerical values on which arithmetic operations make sense. Classify each of the following as categorical (C) or quantitative (Q): favorite color, number of siblings, type of pet.

Variable	Categorical or Quantitative?
Favorite color	
Number of siblings	
Type of pet	

2. A student survey collected the following information: student ID number, height in centimeters, and grade level (Freshman, Sophomore, Junior, Senior). Classify each variable as categorical or quantitative.

Variable	Categorical or Quantitative?
Student ID number	
Height (cm)	
Grade level	

3. Explain in your own words why a zip code, even though it is made up of numbers, is considered a categorical variable rather than a quantitative variable.

4. The table below shows data collected on four athletes. Classify each variable (jersey number, weight in pounds, sport) as categorical or quantitative, and explain your reasoning for jersey number.

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Athlete	Jersey Number	Weight (lbs)	Sport
Athlete 1	7	185	Soccer
Athlete 2	23	210	Basketball
Athlete 3	99	265	Football
Athlete 4	12	175	Soccer

5. A data set contains the following variables: annual income in dollars, country of birth, number of hours worked per week, blood type, and age in years. Sort each variable into the correct column of the table below.

Variable	Type
Annual income (dollars)	
Country of birth	
Hours worked per week	
Blood type	
Age (years)	

6. Three students collected data for a science project. The variables recorded were: student name, test score out of 100, favorite subject, number of books read this month, and locker number. How many of the five variables are quantitative? List them.

7. A hospital records the following data for each patient: patient ID, temperature in degrees Fahrenheit, diagnosis (e.g., flu, cold), number of days hospitalized, and room number. A nurse claims that room number is quantitative because it is a number. Is the nurse correct? Classify all five variables and justify your answer for room number.

8. The dot plot below shows the ages of 9 participants in a study. Based on this chart, identify the variable being displayed, classify it as categorical or quantitative, and find the average age.

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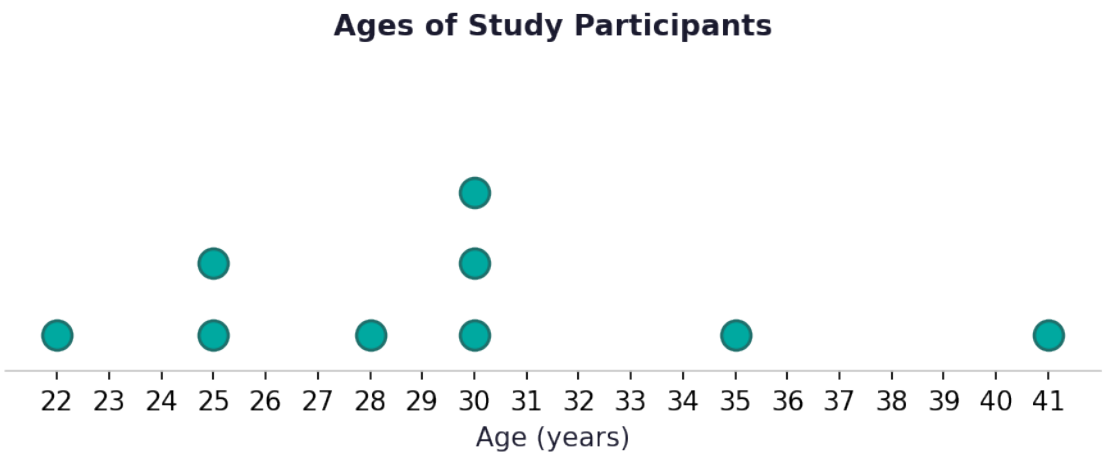

9. A researcher designs a survey and records six variables: respondent number, city of residence, monthly spending on groceries in dollars, number of people in household, political party affiliation, and satisfaction rating on a scale of 1 to 5. The researcher wants to compute averages for some variables. For which variables does computing an average make sense? For which does it not? Classify all six and justify your answer for satisfaction rating.

10. A teacher recorded the following data for 5 students. Complete the classification table, then answer: How many total categorical variables are there? How many quantitative? If you added a new column for 'phone number,' which type would it be and why?

Variable	Sample Values	Categorical or Quantitative?	Reason
Student ID	1001, 1002, 1003		
GPA	3.2, 2.8, 3.9		
Hometown	Austin, Denver, Miami		
Credits earned	45, 60, 30		
Major	Biology, Math, History		

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Categorical vs. Quantitative Variables — Answer Key

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Answer Key

1. Answer: See completed table

Variable	Categorical or Quantitative?
Favorite color	Categorical
Number of siblings	Quantitative
Type of pet	Categorical

- Favorite color describes a characteristic — it is Categorical.
- Number of siblings is a count on which arithmetic makes sense — it is Quantitative.
- Type of pet describes a category — it is Categorical.

2. Answer: See completed table

Variable	Categorical or Quantitative?
Student ID number	Categorical
Height (cm)	Quantitative
Grade level	Categorical

- Student ID numbers identify individuals — arithmetic on them is meaningless, so they are Categorical.
- Height in centimeters is a measurable value on which arithmetic makes sense — it is Quantitative.
- Grade level (Freshman, etc.) describes a category — it is Categorical.

3. Answer: Arithmetic operations on zip codes (like averaging them) do not produce meaningful results. Zip codes identify locations, not measurable amounts.

- A quantitative variable requires that arithmetic operations make sense.
- Adding or averaging zip codes gives a number that has no real meaning.
- Zip codes serve as labels or identifiers, which is the role of a categorical variable.

4. Answer: Jersey Number: Categorical; Weight (lbs): Quantitative; Sport: Categorical. Jersey numbers label players — averaging them is not meaningful.

- Jersey Number: These are labels for players. Finding the average jersey number has no real meaning, so this is Categorical.
- Weight (lbs): This is a measurable quantity — you can find the average weight, so this is Quantitative.
- Sport: This describes a category of activity — it is Categorical.

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5. Answer: See completed table

Variable	Type
Annual income (dollars)	Quantitative
Country of birth	Categorical
Hours worked per week	Quantitative
Blood type	Categorical
Age (years)	Quantitative

- Annual income in dollars — you can average incomes, so it is Quantitative.
- Country of birth — this is a label/category, so it is Categorical.
- Hours worked per week — a count on which arithmetic makes sense, so it is Quantitative.
- Blood type (A, B, AB, O) — this is a label, so it is Categorical.
- Age in years — a measurable value, so it is Quantitative.

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6. Answer: 2 quantitative variables: test score out of 100, and number of books read this month.

- Student name — identifies the individual, Categorical.
- Test score out of 100 — arithmetic makes sense (average score), Quantitative.
- Favorite subject — a category, Categorical.
- Number of books read — a count on which arithmetic makes sense, Quantitative.
- Locker number — a label identifying a locker, Categorical.
- There are 2 quantitative variables: test score and number of books read.

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7. Answer: The nurse is incorrect. Room number is Categorical. All five: Patient ID = Categorical, Temperature = Quantitative, Diagnosis = Categorical, Days hospitalized = Quantitative, Room number = Categorical.

- Patient ID: identifies a patient, not a measurable amount — Categorical.
- Temperature (°F): arithmetic makes sense (average temperature) — Quantitative.
- Diagnosis: describes a medical condition/category — Categorical.
- Days hospitalized: a count; averaging days is meaningful — Quantitative.
- Room number: labels a room; averaging room numbers is meaningless — Categorical.
- The nurse is incorrect because arithmetic operations on room numbers do not produce meaningful results.

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8. Answer: Variable: Age — Quantitative. Average age = (22+25+25+28+30+30+30+35+41) / 9 = 266 / 9 ≈ 29.6 years.

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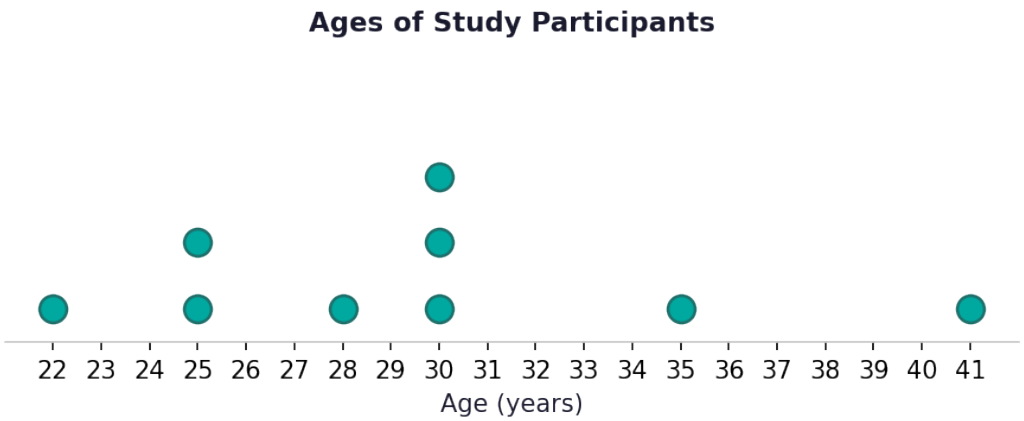

- The variable displayed is age in years.
- Age is a measurable quantity on which arithmetic operations (like averaging) make sense — it is Quantitative.
- Sum of ages: 22 + 25 + 25 + 28 + 30 + 30 + 30 + 35 + 41 = 266.
- Average = 266 ÷ 9 ≈ 29.6 years.

9. Answer: Averages make sense for: monthly spending, number of people in household, satisfaction rating (treated as quantitative). Averages do not make sense for: respondent number, city of residence, political party affiliation. Satisfaction rating is debatable but is generally treated as quantitative because arithmetic operations produce meaningful results.

- Respondent number: a label/ID — Categorical; averaging it is meaningless.
- City of residence: a location category — Categorical; averaging city names is impossible.
- Monthly spending (dollars): measurable amount — Quantitative; average spending is meaningful.
- Number of people in household: a count — Quantitative; average household size is meaningful.
- Political party affiliation: a category label — Categorical; averaging party names is meaningless.
- Satisfaction rating (1–5): numeric scale on which arithmetic operations produce meaningful results (e.g., average satisfaction score) — generally treated as Quantitative.
- Averages make sense for: monthly spending, number in household, and satisfaction rating.

10. Answer: 2 quantitative (GPA, Credits earned), 3 categorical (Student ID, Hometown, Major). Phone number would be Categorical — arithmetic on phone numbers is meaningless.

Variable	Sample Values	Categorical or Quantitative?	Reason
Student ID	1001, 1002, 1003	Categorical	Labels that identify students; averaging IDs is meaningless
GPA	3.2, 2.8, 3.9	Quantitative	Numeric measure; average GPA is meaningful
Hometown	Austin, Denver, Miami	Categorical	Describes a location category; not a measurable amount

Variable	Sample Values	Categorical or Quantitative?	Reason
Credits earned	45, 60, 30	Quantitative	A count; average credits earned is meaningful
Major	Biology, Math, History	Categorical	Describes a field of study; not a measurable amount

• Student ID: identifies students — Categorical.
• GPA: measurable value; you can find the average GPA — Quantitative.
• Hometown: describes a location — Categorical.
• Credits earned: a count; averaging credits is meaningful — Quantitative.
• Major: describes a field of study — Categorical.
• Total: 3 categorical variables, 2 quantitative variables.
• Phone number: even though it is numeric, arithmetic on phone numbers (adding or averaging them) is meaningless — it would be Categorical.

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