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The Role-Type Classification

Learning Objective: Classify a data analysis situation (involving two variables) according to the "role-type classification," and state the appropriate display and/or numerical measures that should be used in order to summarize the data.

If we further classify each of the two relevant variables according to **type** (categorical or quantitative), we get the following 4 possibilities for "**role-type classification**"

1. Categorical explanatory and quantitative response
2. Categorical explanatory and categorical response
3. Quantitative explanatory and quantitative response
4. Quantitative explanatory and categorical response

This role-type classification can be summarized and easily visualized in the following table (note that the explanatory variable is always listed first):

		Response	
		Categorical	Quantitative
Explanatory	Categorical	$C \rightarrow C$	$C \rightarrow Q$
	Quantitative	$Q \rightarrow C$	$Q \rightarrow Q$

This role-type classification serves as the infrastructure for this entire section. In each of the 4 cases, different statistical tools (displays and numerical measures) should be used in order to explore the relationship between the two variables.

This suggests the following important principle:

Principle

When confronted with a research question that involves exploring the relationship between two variables, the first and most crucial step is to determine which of the 4 cases represents the data structure of the problem. In other words, the first step should be classifying the two relevant variables according to their role and type, and only then can we determine what statistical tools should be used to analyze them.

Now let's go back to our 8 examples and determine which of the 4 cases represents the data structure of each:

Example: 1

- **Gender** is the **explanatory** variable and it is **categorical**.
- **Test score** is the **response** variable and it is **quantitative**.
- Therefore this is an example of **case $C \rightarrow Q$** .

Example: 3

- **Light Type** is the **explanatory** variable and it is **categorical**.
- **Nearsightedness** is the **response** variable and it is **categorical**.
- Therefore this is an example of **case $C \rightarrow C$** .

Example: 5

- **SAT Score** is the **explanatory** variable and it is **quantitative**.
- **GPA of Freshman Year** is the **response** variable and it is **quantitative**.
- Therefore this is an example of **case $Q \rightarrow Q$** .

Example: 7

- **Time** is the **explanatory** variable and it is **quantitative**.
- **Driving Test Outcome** is the **response** variable and it is **categorical**.

- Therefore this is an example of **case Q→C**.

Scenario: Example Research Questions with Two Variables

Now you complete the rest... Refer to the eight examples listed below when answering the questions.

Examples

1. Is there a relationship between **gender** and **test scores** on a particular standardized test?

Other ways of phrasing the same research question:

- Is performance on the test related to gender?
 - Is there a gender effect on test scores?
 - Are there differences in test scores between males and females?
2. How is the **number of calories** in a hot dog related to (or affected by) the **type of hot dog** (beef, meat or poultry)? In other words, are there differences in the number of calories among the three types of hot dogs?
 3. Is there a relationship between the **type of light** a baby sleeps with (no light, night-light, lamp) and whether or not the child develops **nearsightedness**?
 4. Are the **smoking habits** of a person (yes, no) related to the person's **gender**?
 5. How well can we predict a student's freshman year **GPA** from his/her **SAT score**?
 6. What is the relationship between driver's **age** and sign legibility **distance** (the maximum distance at which the driver can read a sign)?
 7. Is there a relationship between the **time** a person has practiced driving while having a learner's permit, and **whether or not this person passed the driving test**?
 8. Can you predict a person's **favorite type of music** (classical, rock, jazz) based on his/her **IQ level**?

Learn By Doing

1/1 point (graded)

Example 2:

Number of calories is the response variable. Is it categorical or quantitative?

☐ categorical

☒ quantitative ✓

Answer

Correct: Number of calories is quantitative.

Submit

Learn By Doing

1/1 point (graded)

Example 2:

Type of hot dog is the explanatory variable. Is it categorical or quantitative?

☒ categorical ✓

☐ quantitative

Answer

Correct: Type of hot dog is categorical.

Submit

Learn By Doing

1/1 point (graded)

Example 2:

Therefore, which case is this an example of?

☒ Case $C \rightarrow Q$ ✓

☐ Case $C \rightarrow C$

☐ Case $Q \rightarrow Q$

☐ Case $Q \rightarrow C$

Answer

Correct: This is an example of Case $C \rightarrow Q$

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Learn By Doing

1/1 point (graded)

Example 4:

Gender is the explanatory variable. Is it categorical or quantitative?

☒ categorical ✓

☐ quantitative

Answer

Correct: Gender is categorical.

Submit

Learn By Doing

1/1 point (graded)

Example 4:

Smoking habits is the response variable. Is it categorical or quantitative?

☒ categorical ✓

☐ quantitative

Answer

Correct: Smoking habits is categorical.

Submit

Learn By Doing

1/1 point (graded)

Example 4:

Therefore, which case is this an example of?

☐ Case $C \rightarrow Q$

☒ Case $C \rightarrow C$ ✓

☐ Case $Q \rightarrow Q$

☐ Case $Q \rightarrow C$

Answer

Correct: This is an example of Case $C \rightarrow C$.

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Learn By Doing

1/1 point (graded)

Example 6:

Age is the explanatory variable. Is it categorical or quantitative?

☐ categorical

☒ quantitative ✓

Answer

Correct: Age is quantitative.

Submit

Learn By Doing

1/1 point (graded)

Example 6:

Legibility distance is the response variable. Is it categorical or quantitative?

☐ categorical

☒ quantitative ✓

Answer

Correct: Legibility distance is quantitative.

Submit

Learn By Doing

1/1 point (graded)

Example 6:

Therefore, which case is this an example of?

☐ Case $C \rightarrow Q$

☐ Case $C \rightarrow C$

☒ Case $Q \rightarrow Q$ ✓

☐ Case $Q \rightarrow C$

Answer

Correct: This is an example of Case $Q \rightarrow Q$.

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1/1 point (graded)

Example 8:

Favorite type of music is the response variable. Is it categorical or quantitative?

☒ categorical ✓

☐ quantitative

Answer

Correct: Favorite type of music is categorical.

Submit

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1/1 point (graded)

Example 8:

IQ level is the explanatory variable. Is it categorical or quantitative?

☐ categorical

☒ quantitative ✓

Answer

Correct: IQ level is quantitative.

Submit

Learn By Doing

1/1 point (graded)

Example 8:

Therefore, which case is this an example of?

☐ Case $C \rightarrow Q$

☐ Case $C \rightarrow C$

☐ Case $Q \rightarrow Q$

☒ Case $Q \rightarrow C$ ✓

Answer

Correct: This is an example of Case $Q \rightarrow C$.

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Did I Get This?

In each of the following three problems, you are presented with a brief description of a study involving two variables. Based on the role-type classification of the two variables, you'll be asked to determine which of the four cases represents the data structure of the problem.

For your convenience, here again is the role-type classification table:

		Response	
		Categorical	Quantitative
Explanatory	Categorical	$C \rightarrow C$	$C \rightarrow Q$
	Quantitative	$Q \rightarrow C$	$Q \rightarrow Q$

Did I Get This

1/1 point (graded)

A store asked 250 of its customers whether or not they were satisfied with the service. The purpose of this study was to examine the relationship between the customer's satisfaction and gender.

This study is an example of which role-type classification?

☐ Case $C \rightarrow Q$

☒ Case $C \rightarrow C$ ✓

☐ Case $Q \rightarrow Q$

☐ Case $Q \rightarrow C$

Answer

Correct:

Both the explanatory (gender) and response (satisfaction) variables are categorical in this case. Therefore, this is an example of case $C \rightarrow C$.

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Did I Get This

1/1 point (graded)

A study was conducted in order to explore the relationship between the number of beers a person drinks, and his/her Blood Alcohol Content (BAC, in %).

This study is an example of which role-type classification?

☐ case $C \rightarrow Q$

☐ case $C \rightarrow C$

☒ case $Q \rightarrow Q$ ✓

☐ case $Q \rightarrow C$

Answer

Correct:

Both the explanatory (number of beers) and response (BAC) variables are quantitative in this case, and therefore this is an example of case $Q \rightarrow Q$.

Submit

Did I Get This

1/1 point (graded)

A study was conducted in order to determine whether longevity (how long a person lives) is related to a person's handedness (right-handed/left-handed).

This study is an example of which role-type classification?

☒ Case $C \rightarrow Q$ ✓

☐ Case $C \rightarrow C$

☐ Case $Q \rightarrow Q$

☐ Case $Q \rightarrow C$ **Answer**

Correct:

In this case the explanatory variable (handedness) is categorical and the response variable (longevity) is quantitative. Therefore, this is an example of case $C \rightarrow Q$.

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The remainder of this section on exploring relationships will be guided by this role-type classification. In the next three parts we will elaborate on cases $C \rightarrow Q$, $C \rightarrow C$, and $Q \rightarrow Q$. More specifically, we will learn the appropriate statistical tools (visual display and numerical summaries) that will allow us to explore the relationship between the two variables in each of the cases. Case $Q \rightarrow C$ will *not* be discussed in this course, and is typically covered in more advanced courses. The section will conclude with a discussion on causal relationships.

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