Data Basics

Colby Community College

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	loan_amount	interest_rate	term	grade	state	total_income	homeownership
1	7500	7.34	36	A	MD	70000	rent
2	25000	9.43	60	B	OH	254000	mortgage
3	14500	6.08	36	A	MO	80000	mortgage
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Each column is called a **variable**.

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variable	description
loan_amount	Amount of the load received, in US dollars.
interest_rate	Interest rate on the loan, in an annual percentage.
term	The length of the loan, which is always a whole number of months.
grade	Loan grade, which takes values A through G and represents the quality of the loan and its likelihood of being repaid.
state	US state where the borrower resides.
total_income	Borrower's total income, including any second income, in US dollars.
homeownership	Indicates whether the person owns, owns but has a mortgage, or rents.

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The names and labels in categorical data are sometimes coded with numbers. When a number is used as a name it is **not** numerical data.

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Identification numbers $1, 2, 3, \ldots, 25$ *are assigned randomly to 25 subjects in a clinical trail. The identification numbers are?*

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The numbers in Example 4 don't actually measure or count anything.

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Example 6

Casino employees plan to roll a fair die until the number 5 is rolled, and they count the number of rolls required to get a 5. (It is possible, but unlikely, that a 5 could never be rolled.)

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A grade school teacher measures the heights of his students.

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Example 11

For an item on a survey, respondents are given a choice of possible answers, and they are coded as follows:

1 is coded as “I agree”

2 is coded as “I disagree”

3 is coded as “I don’t care”

4 is coded as “I refuse to answer”

The numbers 1,2,3, and 4 don’t count or measure anything.

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A college professor assigns grades of A, B, C, D, or F. These grades can be arranged in a meaningful order, but grades are very individualized so the difference between two students grades cannot be calculated.

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Example 13

A survey asks people what they felt their blood pressure was. The possible answers are “Low”, “Normal”, “High.” These responses can be arranged in a meaningful order, but the differences between “Low” and “High” doesn’t make sense.

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Body temperatures of 98.2°F and 98.9°F are examples of data at this interval level of measurement. The values are ordered, and we can calculate their difference. There is no natural starting point. (The value 0°F is an arbitrary choice and doesn't represent the complete absence of heat.)

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Example 15

The years 1492 and 1776 can be arranged in order, and the difference of 284 years is meaningful. But, time doesn't not have a natural starting point that represents "no time."

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Data are at the **ratio level of measurement** if they can be arranged in order, differences can be found and are meaningful, and there is a natural starting point which indicates that none of the quantity is present.

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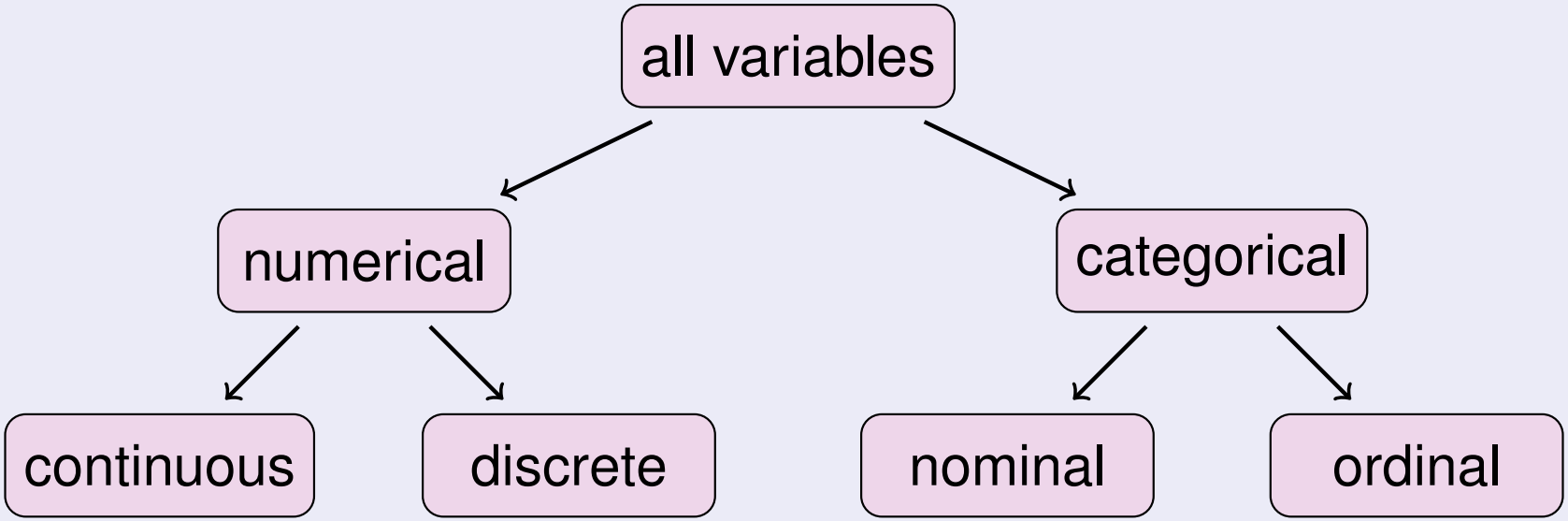
Example 17

The times of 50 minutes and 100 minutes for a math class are at the ratio level of measurement. (The starting point is 0 minutes and 100 minutes is twice as long as 50 minutes.)

Classification of Variables



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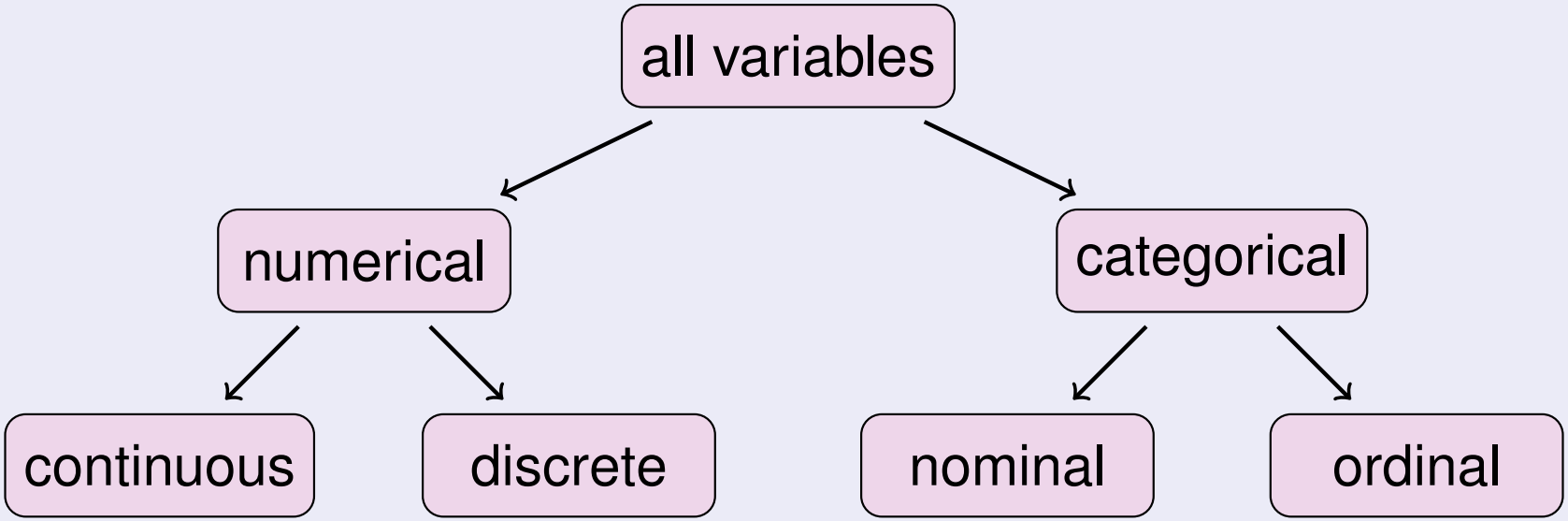

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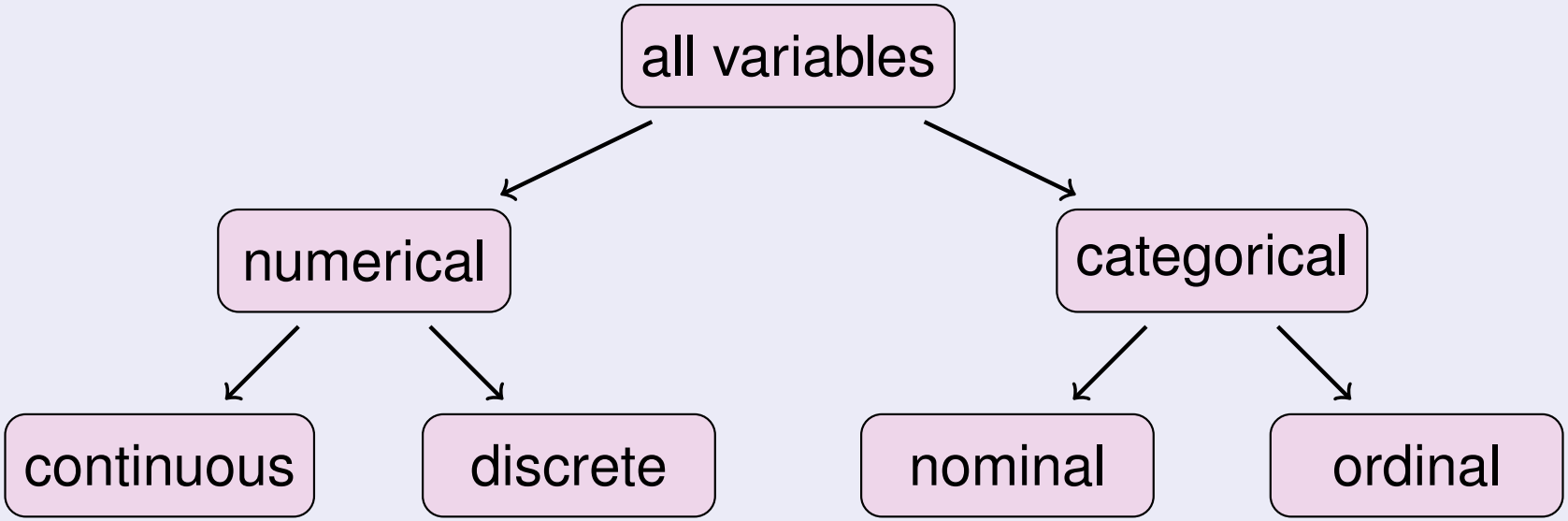

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If your data consists of real numbers, then it is usually continuous.

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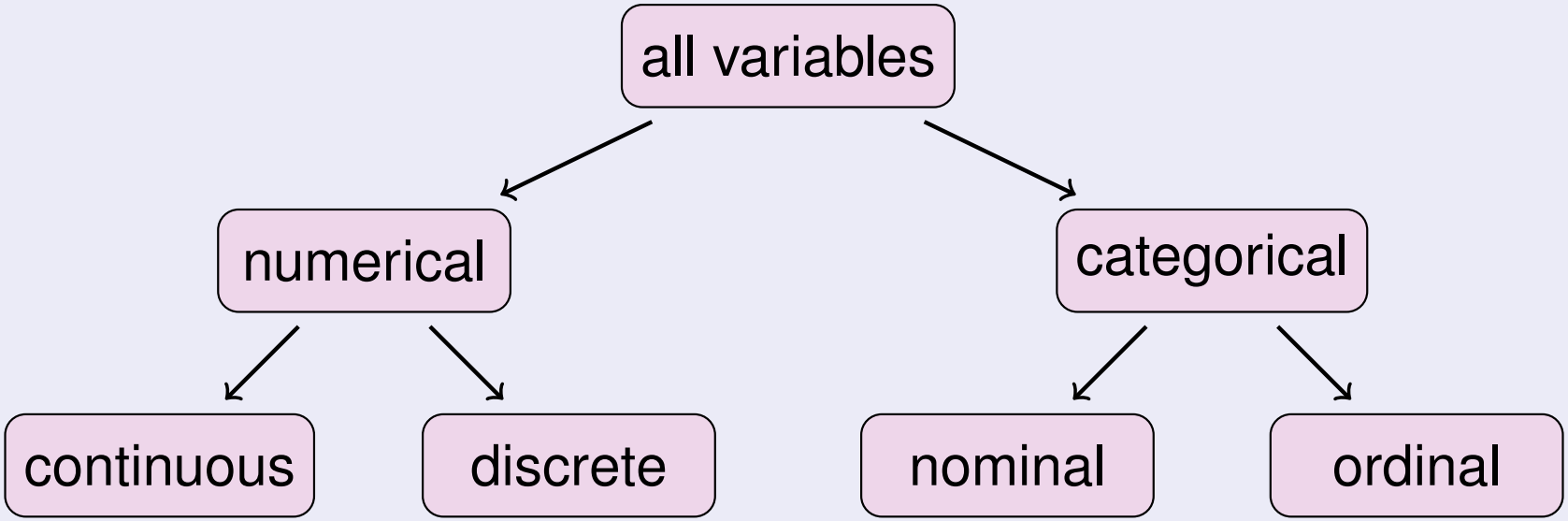

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If your data consists of only integers, then it is usually discrete.

Data Set

The following slides will use the `county` data set, which contains data on all 3142 counties in the United States.

variable	description
name	County names.
state	State names.
pop2000	Population in 2000.
pop2010	Population in 2010.
pop2017	Population in 2017.
pop_change	Population change from 2010 to 2017.
poverty	Percent of population in poverty in 2017.
homeownership	Home ownership rate, 2006-2010.
multi_unit	Percent of housing units in multi-unit structures, 2006-2010.
unemployment_rate	Unemployment rate in 2017.
metro	Whether the county contains a metropolitan area.
median_edu	Median education level (2013-2017).
per_capita_income	Per capita (per person) income (2013-2017).
median_hh_income	Median household income.
smoking_ban	Describes whether the type of county-level smoking ban in place in 2010, taking one of the values ‘‘none’’, ‘‘partial’’, or ‘‘comprehensive’’.

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- If homeownership is lower than the national average in one county, will the percent of multi-unit structures in that county tend to be above or below the national average?
- Does a higher than average increase in county population tend to correspond to counties with higher or lower median household incomes?
- How useful a predictor is median education level for the median household income for US counties?

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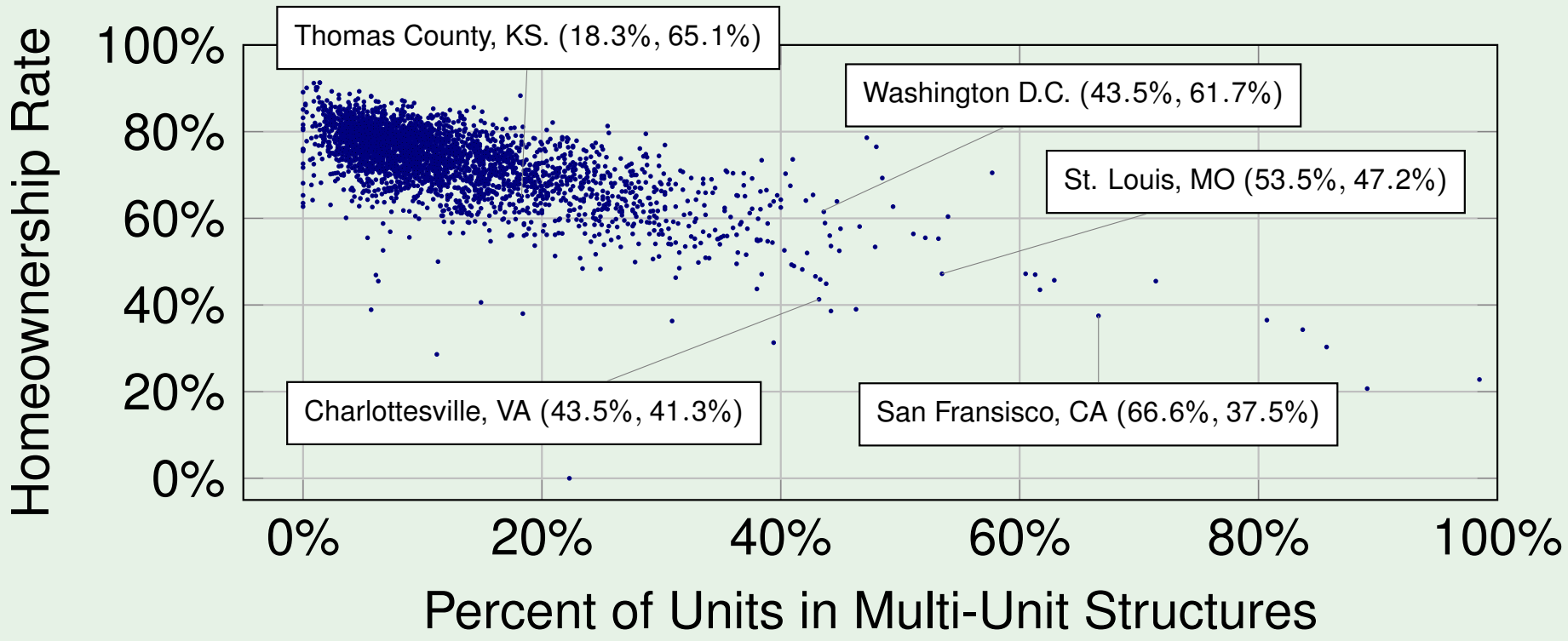

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It is impossible to be both associated and independent.

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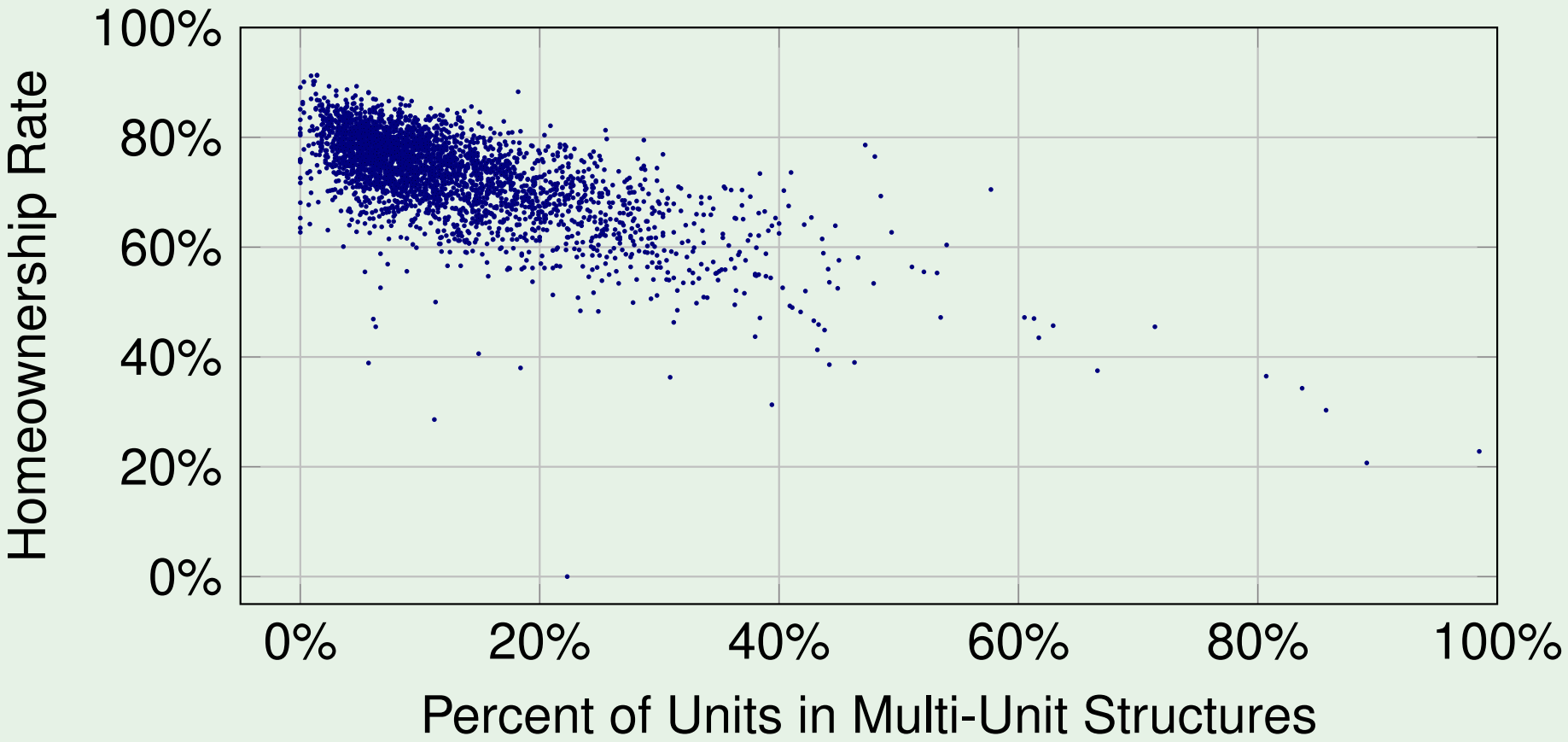

Are the Multi-Unit Structure Rate and the Homeownership Rate associated?

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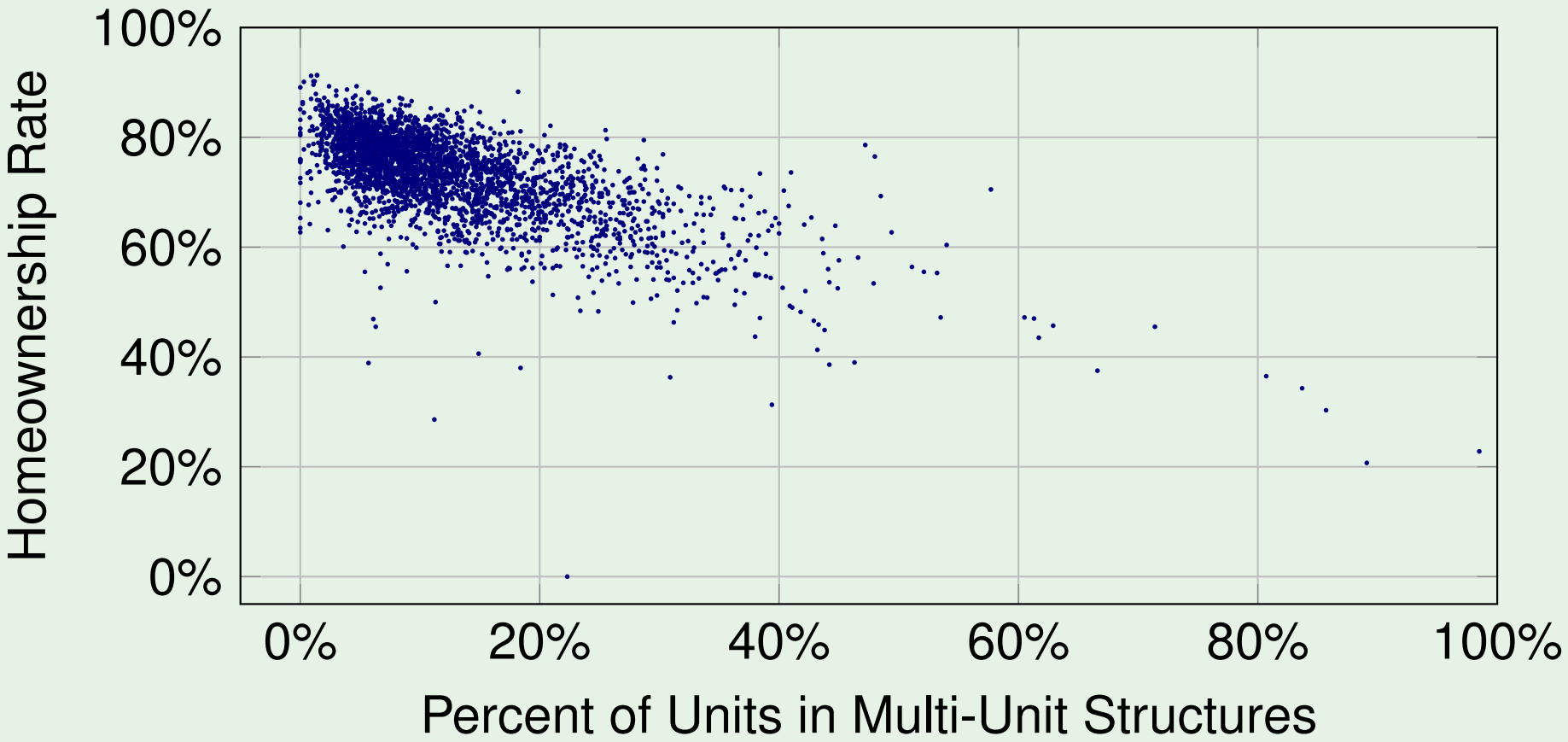

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Yes, they are negatively associated.

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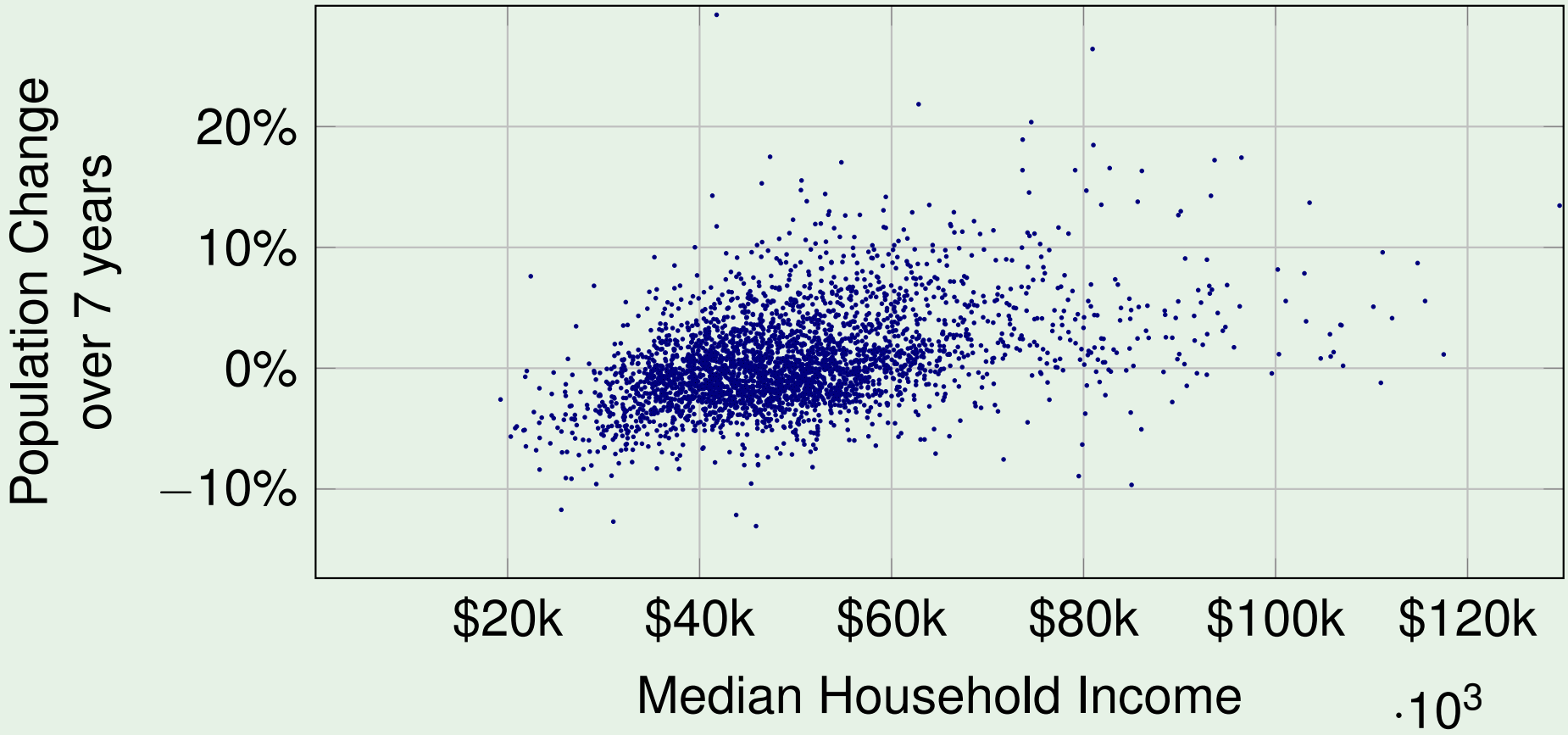

Are the Median Household Income and the Population Change associated?

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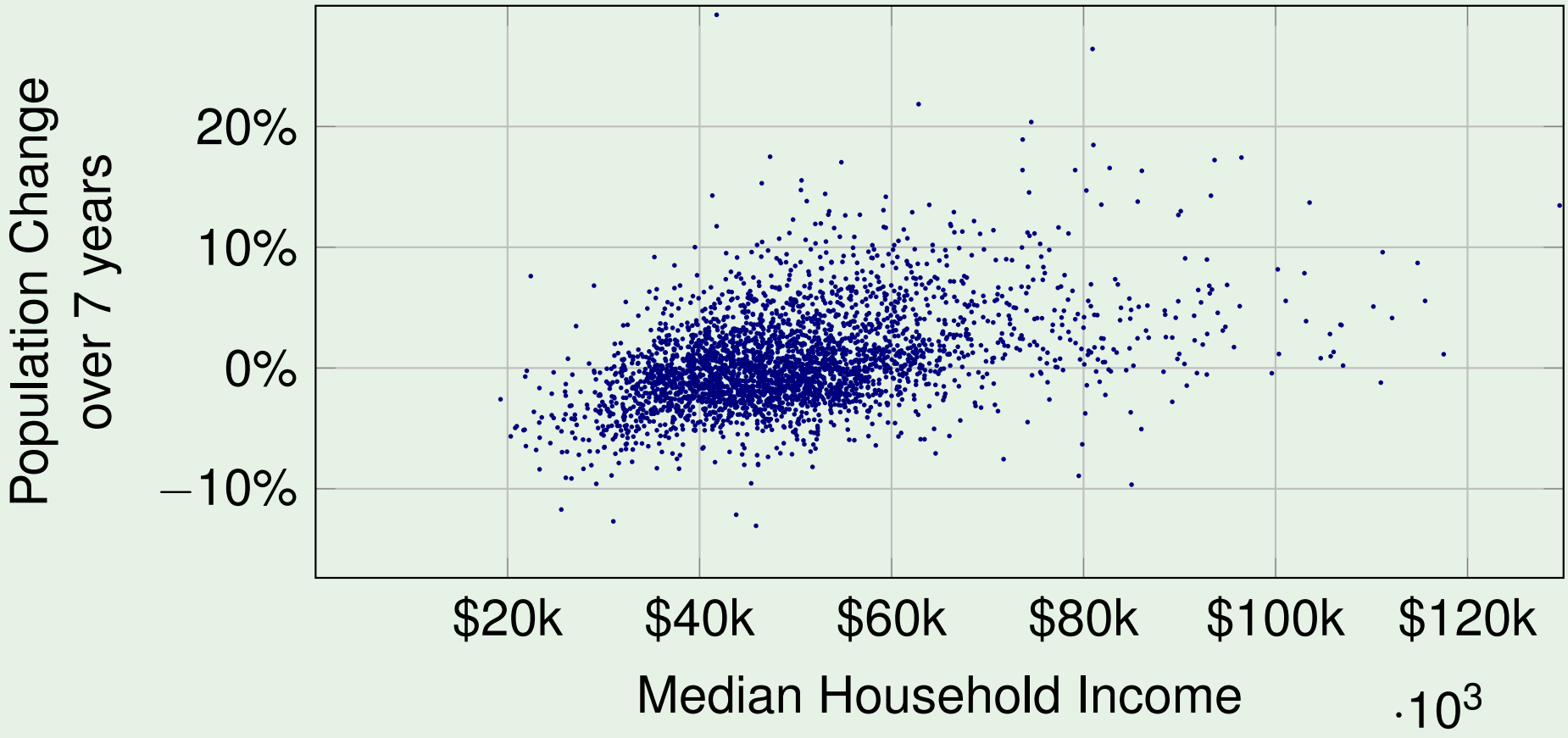

Are the Median Household Income and the Population Change associated?

Yes, they are positively associated.

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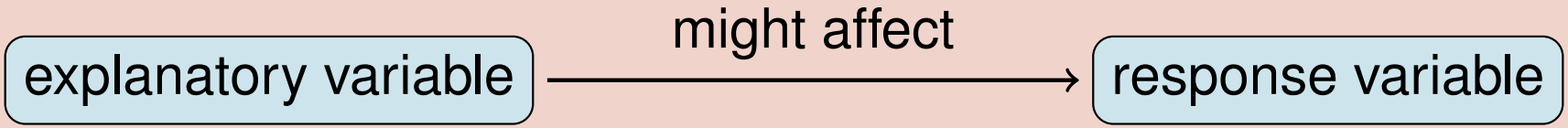

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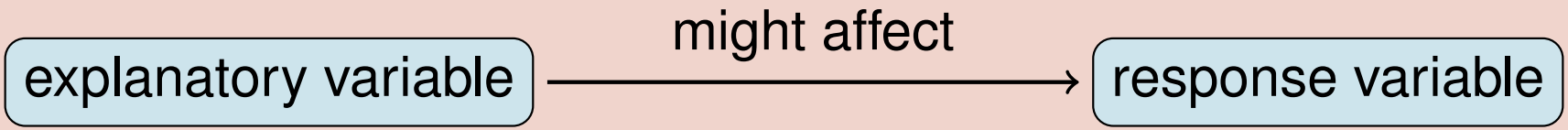

Note

Labeling a variable like this does **nothing** to guarantee that a causal relationship exists!

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In general, causation can only be inferred from a randomized experiment.

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- **Observational study:** We gather police reports about collisions and use them to determine if the person was listening to music or not.
- **Experiment:** We randomly assign subjects to either listen to music while driving or listen to nothing. We then count how many collisions each subject is involved in.