

What Affects Auto Insurance Costs?

Understanding the Data

SUBMITTED BY: Nina Hoe, University of Pennsylvania

SUBJECT(S): Computation

GRADE LEVEL(S): 9, 10, 11, 12

≡ OVERVIEW:

In this lesson, students read the Wharton Global Youth Program article, “Driver Alert: Car Insurance Will Cost You,” and look at data that compares average annual insurance expenditures, number of traffic fatalities, deaths per 100 million vehicle miles traveled, percentages of population living in urban areas, per capita incomes by state and state population. Students will use Microsoft Excel to examine statistics by state and produce scatter plots to investigate the relationship between several factors and the average annual auto insurance expenditure per state. Additionally, students sort these data to better understand statistical factors that affect auto insurance expenditures. *Note: This activity requires students to use computers with Microsoft Excel. If computers are not available for individual students, the teacher can project this on the overhead.

≡ NBEA STANDARD(S):

- Computation, II. Number Relationships and Operations
- Computation, V. Statistics and Probability

≡ RELATED ARTICLES:

- [“Driver Alert: Car Insurance Will Cost You”](#)
- [“Discovering the Power of Data to Predict Forest Fires”](#)

Purpose: The purpose of this lesson is for students to 1) gain experience using Microsoft Excel; 2) produce scatter plots in Excel; 3) investigate correlations; 4) discuss correlation and causation; 5) use Excel to calculate means, medians and modes through sorting data.

Common Core Standards:

- S-ID.2. Use statistics appropriate to the shape of the data distribution to compare center (median, mean) and spread (interquartile range, standard deviation) of two or more different data sets.
- S-ID.6. Represent data on two quantitative variables on a scatter plot, and describe how the variables are related.
- S-ID.9. Distinguish between correlation and causation.
- N-Q.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.

Resources/Materials: [Worksheet](#)

Activity:

Have students read the WGYM Article: "[Driver Alert: Car Insurance Will Cost You](#)"

1. Class Discussion (10 mins)

1. What are the things that affect auto insurance prices? Brainstorm as a class.

Note that, according to [III](#): Expenditures are affected by the coverages purchased as well as other factors. In **states where the economy is healthy, people are more likely to purchase new cars. Since new car owners are more likely to purchase physical damage coverages, these states will have a higher average expenditure.** The NAIC notes that **urban population, traffic density and per capita income have a significant impact on premiums.** The latest report shows that high premium states tend also to be highly urban, with higher wage and price levels and greater traffic density. **Tort liability and other auto laws, labor costs, liability coverage requirements, theft rates and other factors can also affect auto insurance prices.** Per capita income or income per person is the numerical quotient of income divided by population, in monetary terms. It is a measure of all sources of income in an economic aggregate, such as a country or city.

Note that an insurance company is a business, and insurance packages – specifically the premiums, are the products. Auto insurance, for example, is priced differently in different markets (i.e. states, cities, etc.). This lesson is about how insurance companies decide how to price their products.

2. What is **correlation**?

(a mutual relationship or connection between two or more things)

3. What is the difference between **correlation** and **causation**

(causation means that one thing causes the other, correlation means that the two exist at the same time)

4. How is **correlation** shown or proven?

(You can run tests in a statistical program, or you can graph and see if there is a trend. Draw some examples of positively and negatively correlated variables, and variables that have no correlation. For example, +: high school GPA and SAT scores – people with higher high school GPAs tend to have higher SAT scores. -: high school GPA and unexcused absences – students with higher GPAs are likely to have fewer unexcused absences. No correlation: high school GPA and day of the month born – a person’s high school GPA is not related to whether he/she was born on the 1st of last day of the month. Show these relationships graphically.)

5. If we wanted to investigate factors that are correlated with car insurance premiums, for what are we looking? Do these factors **cause** high insurance premiums?

6. Open the file: **“Computation4 – Excel.”** In this file, you will find data that compares average annual insurance expenditures, number of traffic fatalities, deaths per 100 million vehicle miles travel, percentages of population living in urban areas, per capita incomes by state, and state populations. Have students discuss these different categories.

- Why might the number of traffic fatalities, deaths per 100 million vehicle miles travel, percentages of population living in urban areas, per capita incomes, or state populations have any affect on average annual auto insurance expenditures? Why not?
- Have students make predictions about which of these factors might be the most related. ***(Make a list of these factors on the board and ask students to vote on which ones will be the most highly correlated.)***
- How can we tell if they are related? ***(Discuss scatter plots and trends within there – is there a pattern in the data?)***
- What is the difference between number of traffic fatalities and deaths per 100 million vehicle miles travel? Is one a more representative measure of the activity within a given

state? Which is best to make comparisons?

(number of traffic fatalities is raw. Thus, states with larger populations most likely have higher numbers. Deaths per 100 million vehicle miles traveled is standardized for varying population sizes.)

***NOTE: This activity requires students to use computers with Microsoft Excel. If computers are not available for individual students, the teacher can project this on the overhead.**

2. Student Activity. (20 mins)

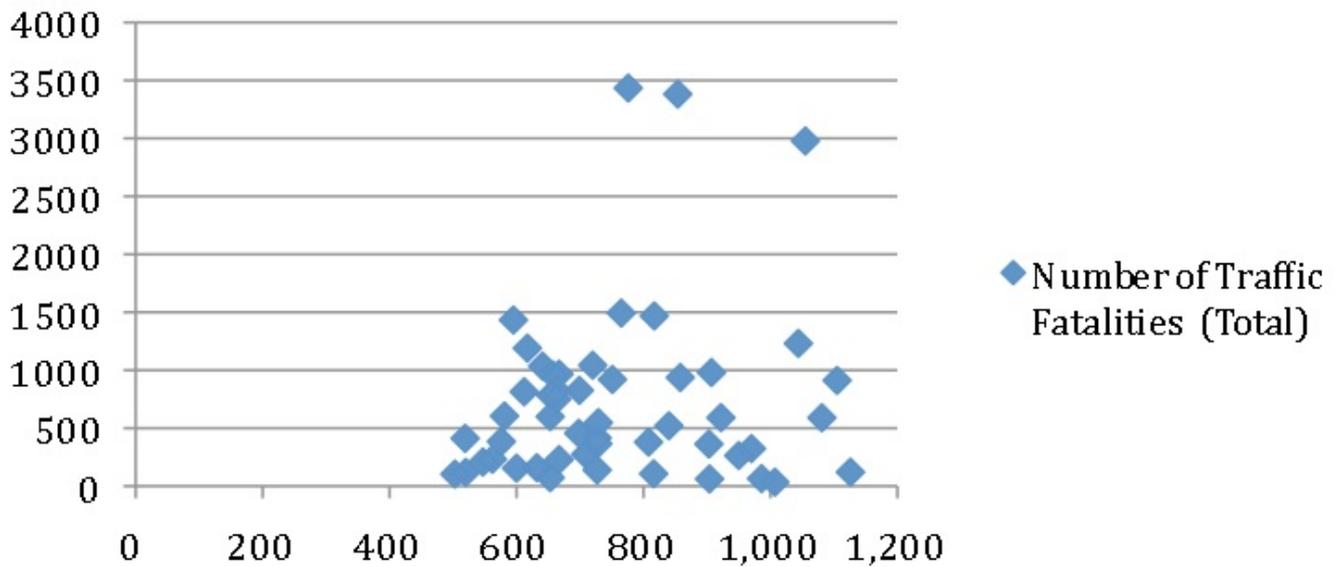
Have students open the Excel file. Students will make 5 scatter plots using these data.

- (1) Average annual expenditure vs. number of traffic fatalities
- (2) Average annual expenditure vs. deaths per 100 million vehicle miles traveled
- (3) Average annual expenditure vs. urban population (%)
- (4) Average annual expenditure vs. per capita income (\$)
- (5) Average annual expenditure vs. state population

To do this: 1) highlight column B (Average annual expenditure) and then alt/option+command/ctrl and click on the other column that you would like to compare, 2) select Chart à Graphs à Scatter Plot. 3) cut and paste the graph in a word document.

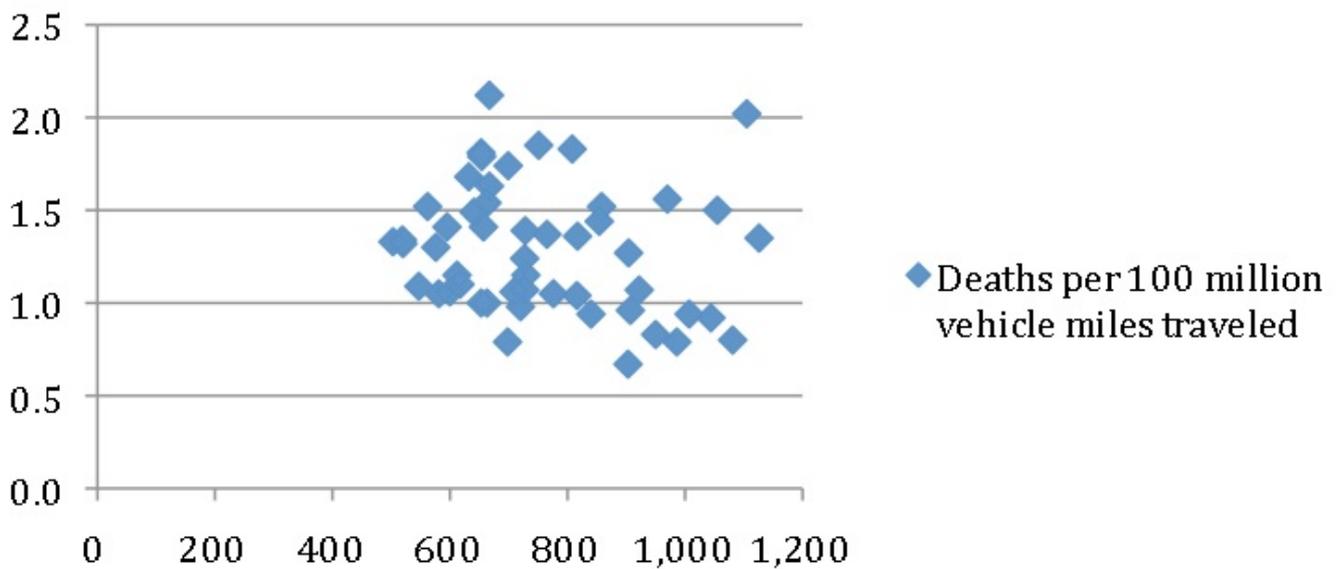
(1) Average annual expenditure vs. number of traffic fatalities

Number of Traffic Fatalities (Total)



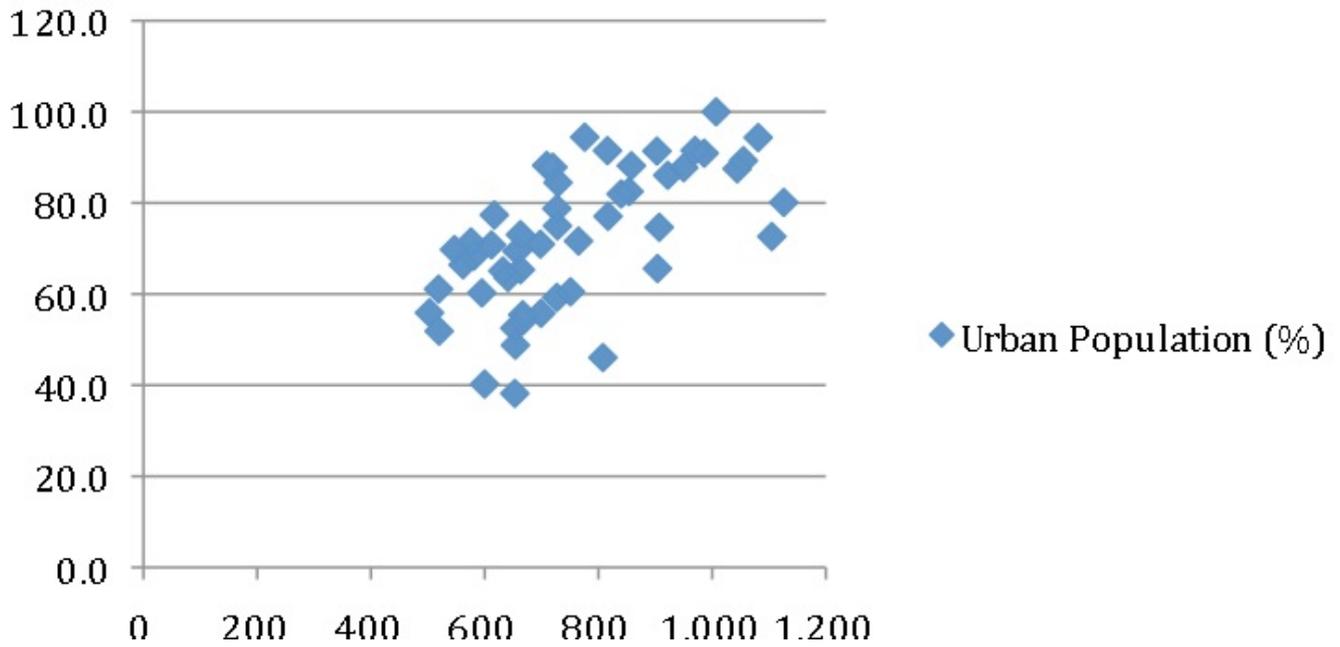
(2) Average annual expenditure vs. deaths per 100 million vehicle miles traveled

Deaths per 100 million vehicle miles traveled



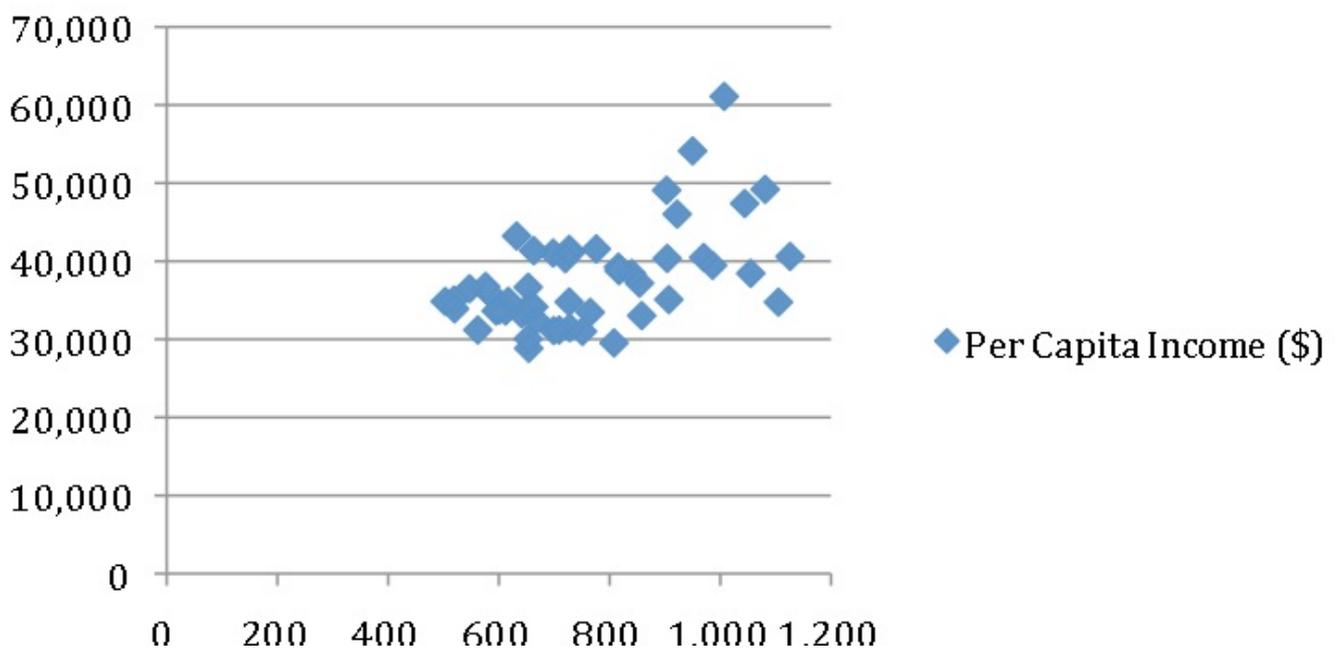
(3) Average annual expenditure vs. urban population (%)

Urban Population (%)

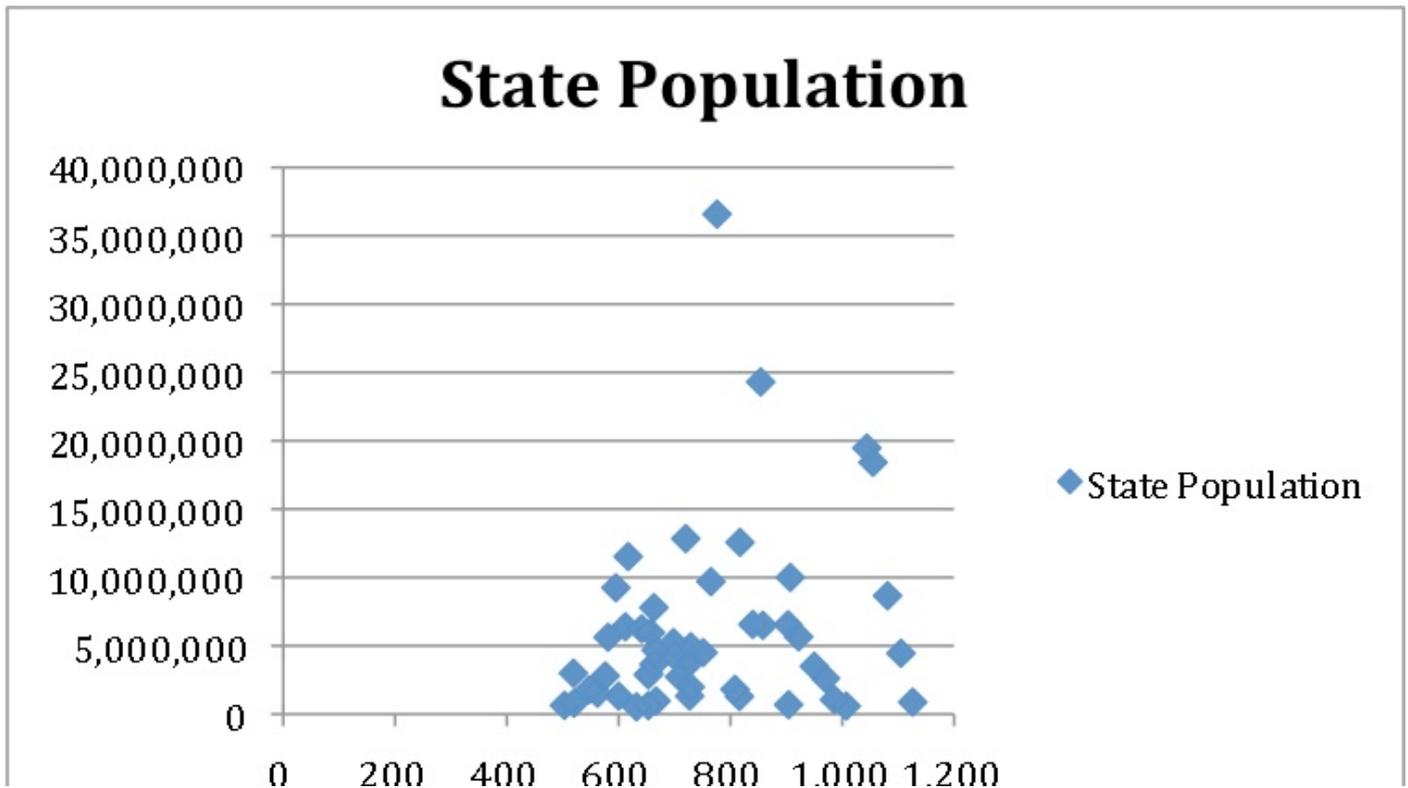


(4) Average annual expenditure vs. per capita income (\$)

Per Capita Income (\$)



(5) Average annual expenditure vs. state population



Questions:

1. Which factors are related or correlated?
(Urban population and per capita income)
2. How do you know? What patterns did you observe in the data?
(The higher urban population percentage and per capita income are associated with higher annual auto insurance expenditures.)
3. How did these correspond with what you thought previously?
(Answers will vary. But these correspond with III paragraph.)

Finding the means/averages or totals: (10 mins)

To make comparisons between individual states and the nation as a whole, it might be helpful to compute averages or totals for the different categories (or both!).

4. For which categories does it make sense to compute the mean/average?
5. For which categories does it make sense to compute the total?
6. Why is the overall average found from the "Average Annual Expenditure" by state different from the Average Annual Expenditure of the US?

(The US average appears to be weighted – i.e. takes into account different populations of each state.)

Using Excel, calculate the averages and totals (sums) for each category. To do this: 1) select the cell where you would like to record this information, 2) Highlight all of the numerical data in the column, 3) select “Auto Sum” from the tool bar and click either average or sum, 4) record the data below.

	Average	Number of	Deaths per			
United States	Annual Expenditure (\$)	Traffic Fatalities (Total)	100 million vehicle miles traveled	Urban Population (%)	Per Capita Income (\$)	State Population
Average	760	731	1	72	37,602	5,968,134
Total	38,764	37,261	66	3,685	1,917,720	304,374,846

(italicized is not useful/appropriate)

Optional Extension:

As a class, brainstorm other factors that might be associated with average annual auto insurance expenditure and find the data online. Cut and paste into excel document and produce a scatter plot.

Tying it all Together:

Class Discussion: (5 mins)

1. What information did we glean from doing the scatter plots?
2. What information did we glean from calculating the national averages and totals?
3. What are the implications of understanding the relationships between auto insurance and other statistics?

If you are a business owner trying to decide how to price your products in different markets, what factors might you consider? What factors might cause you to increase or decrease your prices?

