

Expect the Unexpected With
Math

SHAKE, RATTLE, & ROLL

Inside You'll Find:

3 Ready-to-Use Classroom Activities

31 Family Activities (One for Each Student)

Photo: © Photodisc/age fotostock, inc.

Answer Key for Activities Inside

Activity 1, A Roof Over Our Heads: 1. House A has a more valuable roof because it is 8 years younger. 2. Students should calculate the value of the roof based on the years remaining in the life of the roof. The age of House A's roof is 15 years. So, House A's roof is worth approximately \$2,500. Subtract the \$1,000 deductible, and the owners of House A receive approximately \$1,500 to replace their roof. House B has a much less valuable roof (worth approx. \$1,167) but has a replacement policy. So the owners of House B receive \$4,000 (\$5,000 replacement cost - \$1,000 deductible) to replace their roof. 3. The owners of House B paid \$250 more for their premium. 4. The owners of House A paid a \$500 premium, a \$1,000 deductible, and an additional \$2,500 to fix their roof. (\$5,000 for the cost of a roof minus \$1,500 from the insurance agency leaves \$3,500 total to be paid. The insurance company pays \$1,500, because the actual value of the roof is \$2,500 and Family A paid the \$1,000 deductible. This \$3,500 is paid for with the \$1,000 deductible and an extra \$2,500 out-of-pocket.) Out-of-pocket total costs for House A in this year: \$4,000. The owners of House B paid a \$750 premium and a \$1,000 deductible. Total replacement costs for House B: \$1,750. House A paid \$2,250 more. 5. In this case, the higher premium of the Replacement Cost Policy is worth it. This will not always be true. It depends on how long you have paid a higher premium before needing to file a claim. Think About It: The following factors might affect insurance costs for roof replacement: Age of the roof, what the roof is made of, the number of layers of insulation beneath the roof, whether any demolition is needed to remove the old roof, the pay rates for the laborers, etc.

Activity 2, A Map of Claims: 1. Section 2 had the highest amount in claims: more than \$50,000,000. 2. Sections 1, 5, and 8 had the lowest amounts in claims: between 1,000,000 and \$10,000,000 each. 3. As you move from south to north along the coast, the amount of claims increases steadily and then decreases sharply. 4. There are generally lower claim amounts in the western area of the county than there are on the coast. 5. Answers may vary slightly. Insurance companies might collect more premiums in Region 2, larger areas with greater populations, or regions near the coast because they tend to have higher claim amounts. 6. A histogram, because histograms are good for examining a range of data. Think About It: Coastal areas are often appealing to homebuyers because of the access to, and views of the ocean. It would likely be more expensive to insure because property is worth more and there is a higher rate of insurance claims.

Activity 3, A Bridge to the Future: 1. \$8 million. 2. \$8 million/5 = \$1,600,000 per year. \$1,600,000/365 days = approx. \$4,384 per day. \$4,384/10,000 crossings = 44 cents or 50 cents per crossing. 3. \$1 million/365 days = approx. \$2,740 per day. \$2,740/10,000 crossings = 27 cents or 30 cents per crossing. 4. Answers will vary. Extra toll money could be invested to offset inflation, set aside for technological improvements, used for beautification or landscaping, etc. 5. Maintenance and salaries will go up. Extra toll money can be invested to offset this, or the possibility of periodic toll increases can be considered. Think About It: Answers will vary. This is a complex question. In addition to the costs of salary and building materials, encourage students to think about "unseen" costs: permits, demolition, landfill and hauling costs, redirection of traffic patterns and signage, etc. Invite a representative from your local office of public works to speak to your class.

DEVELOPED WITH



THE ACTUARIAL
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A Roof Over Our Heads

NAME: _____

DATE: _____

If you lost your entire roof in a tornado, how much would you need to pay for a new one? That depends on the kind of insurance policy you have, where you live, the cost of building materials and construction of your roof, and other factors. Understanding factors such as these helps actuaries set premiums for insurance companies.

There are two general types of policies: *replacement cost* (payment based on what it would cost to replace something) and *actual cash value* (payment based on what something is currently worth).

In the examples below, House A and House B have identical roofs and are next door to each other. House A had its roof replaced more recently than House B. Look at the information below and answer the questions.

	House A	House B
<u>Type of Policy</u>	Actual Cash Value	Replacement Cost
<u>Age of Roof</u>	15 years	23 years
<u>Life of Roof</u>	30 years	30 years
<u>Deductible</u>	\$1,000	\$1,000
<u>Yearly Premium</u>	\$500	\$750

Cost of replacing roof with new 30-year shingles is \$5,000 (each).

Work the Math:

- Which roof is worth more? _____
- How much would you estimate House A's owners received from their insurance company to fix their roof? _____
House B's owners? _____
- Who paid more for their premium? _____ How much more? _____
- Now consider the premium, deductible, and costs to replace the roof.
Who paid more to fix their roof? _____ How much more? _____
- In this case, is the higher premium of the Replacement Cost Policy worth it? _____
Why or why not? _____
Will this always be true? _____

Think About It

What factors might affect insurance costs for roof replacement following damage from a tornado?



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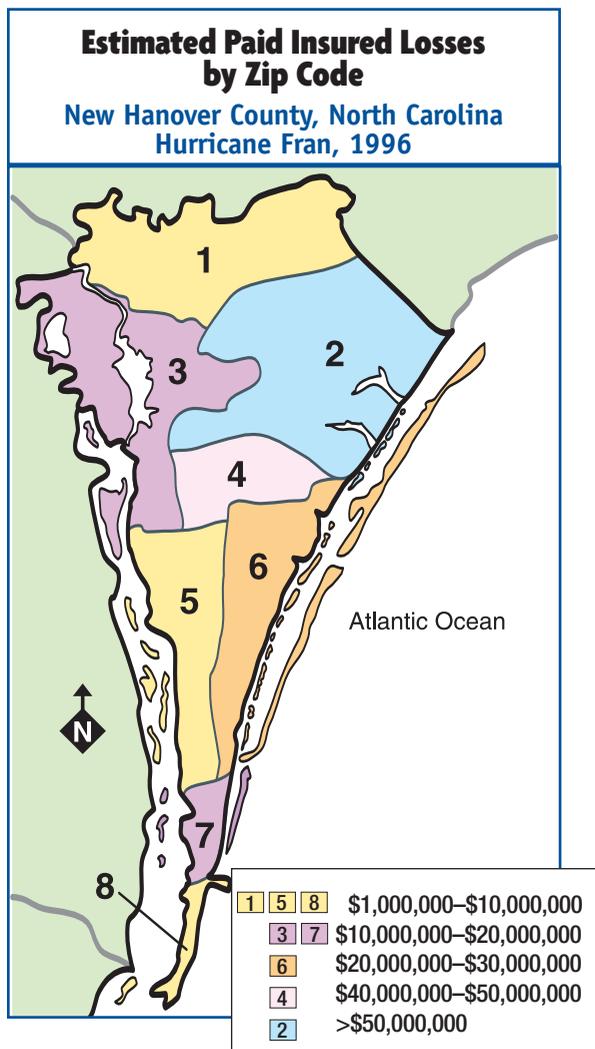
A Map of Claims



NAME: _____

DATE: _____

The amount of insurance claims paid by insurance companies as a result of hurricanes has increased over the last 10 years. New technologies such as GPS (Global Positioning System) and GIS (Geographic Information Systems) allow actuaries and insurance companies to estimate the amounts to be paid for claims in the future based on the natural events that have occurred and the related number of submitted claims in a particular area. These tools help actuaries plan for covering their customers fairly. Study the map below and then answer the questions.



Work the Math:

- Which section had the highest amount paid in claims?
 _____ What was the amount? _____
- Which sections had the lowest amount paid in claims?
 _____ What was the amount? _____
- As you move from south to north along the coast, what do you notice about the level of claims?

- As you move inland from east to west, what do you notice about the level of claims?

- From which areas should more total premiums be collected?

 Why? _____

- If you were to represent this data on a chart, would you choose a histogram or a scatterplot?

 Why? _____

Map Source: Adapted from the National Oceanic and Atmospheric Administration, www.csc.noaa.gov/products/nchaz/html/fran_6.htm#two. Photos, clockwise from top left: © Photostock/age fotostock, inc.; © Emma Lee/Life File/Getty Images; © Javier Pieini/Photodisc/Getty Images.

Think About It

Which area might be the most appealing to a home buyer? Would that area be more or less affordable to insure?



ACTIVITY 3:

Reproducible

A Bridge to the Future



NAME: _____

DATE: _____

Priate residences aren't the only things damaged in times of a natural disaster. Public infrastructure can also be wrecked. When a bridge is destroyed, it can be difficult for a community to get back on its feet. Actuaries need to understand costs of repairs and building materials, and the timeline of rebuilding projects, so they can make pricing estimates for repair jobs.

Go figure!

Examine the costs below for repairing a bridge destroyed in an earthquake. Based on the information given, answer the questions below.

Cost to Rebuild Bridge	\$3 million
Cost of Bridge Maintenance and Salaries (per year)	\$1 million
Number of Crossings (per day)	10,000



Work the Math:

1. What are the total costs (rebuilding, maintenance, and salaries) after 5 years? _____
2. If the costs you found in question 1 are to be paid off during those five years, what toll should you charge per crossing? (Round your answer up to the nearest 5s or 10s place.) _____
3. After the bridge construction is paid off, how much do you need to charge per toll crossing to cover maintenance and salaries each year? _____
4. If you kept the toll the same as the amount you found in question 2, what could you do with the extra toll money? _____
5. How do you think the cost of maintenance and salaries would be affected by inflation? _____

Think About It

What kinds of costs must be considered when building any public structure? Research online or through your town's public works department and see what you can find.

