

Name _____

Investigation 13: What Is the Expected Cost to Raise a Child?

Worksheet 13.2 Applying Expected Value

The following table shows the distribution of the number of motor vehicles per U.S. household. A “household” is defined by the U.S. Census Bureau as all persons occupying a housing unit such as a house, an apartment or other group of rooms, or a single room.

<http://www.census.gov/cps/about/cpsdef.html>

Number of Motor Vehicles	Relative Frequency (rounded to 2 decimal places)
0	0.09
1	0.34
2	0.37
3	0.14
4	0.06

1. The sum of the relative frequencies is 1.00. Does that mean that no U.S. household has more than four cars?

Suppose that the Department of Energy is planning to select a random sample of households in the U.S to conduct a survey about reformulated gasoline.

Define a random variable M to be the number of motor vehicles in a randomly selected U.S. household.

2. Find and interpret $E(M)$, the expected value of M .
3. If the Department of Energy randomly selected 1000 households, how many motor vehicles would we expect these households to have?

Scenario

Have you and your family ever taken part in a TV or radio rating survey? Maybe you were asked what TV shows you watched or what radio station you listened to on a regular basis. Have you heard of the Nielsen rating?

The Nielsen Corporation is a global marketing research firm. This company was founded in 1923 in Chicago by Arthur C. Nielsen Sr. in order to give marketers reliable and objective information on the impact of marketing and sales programs. One of Nielsen's best known creations is the Nielsen ratings, an audience measurement system that measures how many people are watching different TV shows or listening to different radio stations. Nielsen uses statistical sampling to randomly select a representative sample of about 5,000 households who agree to be part of the rating estimates. To find out what shows people are watching, meters are installed on all of the TV sets in the household. These meters keep track of what TVs are on at any given time and what show is the TV set is tuned to.

Source: https://en.wikipedia.org/wiki/Nielsen_Corporation

4. Why might Nielsen ratings be important information for a TV or radio station?

Imagine that the television network Nick Jr. is interested in what TV shows children under the age of 18 watch. Network executives could ask the Nielsen Corporation for help to determine the most watched children's TV shows.

The Nielsen Corporation plans on selecting a random sample of families across the U.S and is particularly interested in families with children under the age of 18. Prior to conducting the survey researchers at Nielsen find data on the number of children in U.S. families on the U.S. Census Bureau website. According to the U.S. Census Bureau in 2010 the number of children under 18 years of age per family has a distribution shown in the table below. A "family" is defined as a group of two or more persons related by birth, marriage, or adoption, residing together in a household.

Number of children under 18 in a family	Percent (rounded to 1 decimal place)
0	55.3
1	19.2
2	16.4
3	8.1
4	1.0

Refer to the distribution of number of children under 18 and answer the following questions.

5. Why do you think the percentage of families with 0 children is so high?
6. The sum of the percentages equals 100%. Does that mean no U.S. families have more than four children?

7. Construct a histogram of the number of children under 18 in U.S. families.

8. Find the mean and interpret the mean. Locate the mean on the horizontal scale of the histogram. Is the mean in the center of the graph? Why or why not?

The A.C. Nielsen Company randomly selects families for use in estimating the ratings of TV shows. Let the variable N represent the number of children under 18 in a randomly selected U.S. family.

9. If A.C. Nielsen randomly selected a family, what is the expected value of N , the number of children under 18 in a randomly selected family?

10. How many children in all would we expect to see in a random sample of 2500 families?

11. If Nielsen wants the opinion from at least 1000 children, how many families should be in their random sample?

Formulate a Statistical Question

Suppose families can expect to spend around \$13,000 a year to raise a child. Housing, food, child care, clothing, health care, and transportation are some of the expenses.

We want to study a probability distribution for a new random variable C , the cost to raise a child for one year.

Statistical Question: _____

Collect Appropriate Data

12. Using the data from Nielson pertaining to the number of children per family and the cost of raising a child per year, complete the probability distribution below. The first column should contain all the possibilities for C – the cost to raise children in a family for one year.

C	$P(C)$
0	
13000	

13. If a U.S. family is randomly selected, how much would you expect the cost for raising all the children in the family to cost?

Interpret the Results in the Context of the Original Question

14. What was the expected value of N , number of children under 18 in a randomly selected U.S. family?
15. How is the expected value of C , related to the expected value of N ?
16. Could you have found the expected value of C without building the probability distribution?