

NUMB3RS Activity: Social Security Numbers Episode: "Spree, Part II – Two Daughters"

Topic: Combinatorics

Grade Level: 9 - 12

Objective: Count the number of possible Social Security numbers

Time: 15 minutes

Introduction

Charlie and Amita are trying to track down someone based on a Social Security number. Charlie explains that numbers are assigned according to a system. "The first three digits of a social are assigned by the zip code of the applicant. And the next two break down numbers from the same area into smaller, easier-to-manage blocks." Amita says, "Even if we focus on the numbers generated in southern California, that still leaves us with a lot of data." Charlie adds, "Each hospital is assigned a batch of Social Security numbers based on birth rate projections." Using the limited number of possibilities allows for a more efficient search.

This activity presents combinatorics questions based on Social Security numbers and a few interesting historical facts about Social Security numbers.

Discuss with Students

Most of the questions in this activity involve permutations. A few warm-up questions are given below.

1. If your wardrobe of clean clothes consists of three pairs of pants and two shirts, how many different outfits can you make?
2. A combination lock has a code that consists of three digits. Each digit can be any number from 0 to 9, but the combination cannot be 000. How many combinations are possible?
3. If you are asked to select an integer from 134 to 356, including those two values, how many choices do you have?

Discuss with Students Answers:

1. $(3)(2) = 6$ 2. $(10)(10)(10) - 1 = 999$ 3. $356 - 133 = 223$

Student Page Answers:

1. $10^9 = 1$ billion 2a. 001-01-0001; Grace D. Owen of Concord, New Hampshire

2b. $(10^3 - 1)(10^2 - 1)(10^4 - 1) = 988,911,099$ 3. $(585 - 0) + (729 - 699) = 615$; $615(10^2 - 1)(10^4 - 1) = 608,789,115$ 4. $54(99)(9,999) = 53,454,654$ 5. In area 862, the even group numbers less than 10 have not yet been assigned.

Name _____ Date _____

NUMB3RS Activity: Social Security Numbers

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A Social Security number has the form XXX-XX-XXXX. The first three digits of the number are called the "area number." As Charlie mentions, these are assigned by zip code, with lesser numbers for the East Coast and greater numbers for the West Coast. As the population has grown, some exceptions have arisen, but a given "area number" will refer to a certain area of the country.

1. If each of the nine numbers can be any digit from 0 to 9, how many different Social Security numbers are possible?

Not all possible Social Security numbers are valid. One restriction is that no block of numbers can be all zeros (the area number can never be 000, the next two cannot be 00, and the last set of four cannot be 0000, but zero can be used otherwise).

2.
 - a. What is the lowest possible Social Security number? (Bonus: To whom was it assigned?)
 - b. With the "no block of zeros" restriction, how many different Social Security numbers are possible?

In 1936, when numbers were first assigned, the area numbers were either from 001 to 585 or from 700 to 729 (the first set were assigned by area of the country and the second set were assigned to railroad workers). The "no block of zeros" rule from question 2 still applies.

3. In 1936, how many Social Security numbers were available?

During the episode, Amita and Charlie are searching a database for a social security number from California. They know the possible area numbers, but, as Amita comments "that still leaves us with a lot of data." The area numbers for California range from 545 to 573 and from 602 to 626.

4. How many possible Social Security numbers are there for people applying from California?

The two digits after the area number are called the group number. They are assigned in the following order:

- a.) odd numbers from 01 to 09
 - b.) even numbers from 10 to 98
 - c.) even numbers from 02 to 08
 - d.) odd numbers from 11 to 99
5. The highest group number assigned for each Social Security number area is published monthly. If 26 is the highest group number assigned to area 862, explain why the Social Security number 862-06-2775 is not yet a valid number.

The goal of this activity is to give your students a short and simple snapshot into a very extensive math topic. TI and NCTM encourage you and your students to learn more about this topic using the extensions provided below and through your own independent research.

Extensions

For the Student

- In question 2, you calculated that there are 988,911,099 possible Social Security numbers if the "no block of zeros" rule is in effect. One way to develop this number is to perform the calculation $(10^3 - 1)(10^2 - 1)(10^4 - 1)$, excluding one combination from each group. Suppose you do not know the number of possible Social Security numbers. Can you determine a way to count the 11,088,901 invalid numbers?
- What is the probability of having a Social Security number comprising of only two different digits (for example, 939-93-3339)? More detail on the question and the answer can be found at <http://mathforum.org/library/drmath/view/65414.html>.

Additional Resources

- Much of the data for this activity was gathered from the Social Security Web site. More information is available at <http://www.socialsecurity.gov>.
- To learn about the history of Social Security numbers go to the Web site: <http://people.howstuffworks.com/social-security-number.htm>