

Analyzing Numerical Data: Estimating Large Numbers

I.A Student Activity Sheet 3: Not Enough Numbers

Telephone Numbers

During the past few years, there have been several statements of the form: “It is conceivable that we may run out of area codes and telephone numbers within the next 10 years.” The shortage of phone numbers is due to the proliferating use of cell phones, pagers, and fax machines. In the next few problems, you will estimate the number of possible telephone numbers in North America. The assignment of telephone numbers is coordinated by the North American Numbering Plan Administration (www.nanpa.com). (NANPA actually covers only the United States and its territories, Canada, and the Caribbean. Mexico is not included.)

A telephone number in the form $NYZ\text{-}ABC\text{-}XXXX$ has three sections:

NYZ	ABC	XXXX
area code	exchange code	station code

Before 1995, all area codes had the form NYZ , where N was any digit from 2 to 9 (2-9), Y was 0 or 1, and Z was 1-9 if Y was 0 or Z was 2-9 if Y was 1. The restrictions on N saved 0 for *call operator* and 1 for long-distance calls. In addition, codes such as 800 and 911 were (and still are) used for special purposes.

The restriction that $Y = 0$ or 1 was removed in 1995 because all possible area codes had been assigned. Today N is 2-9, Y is 0-8, and Z is 0-9; the exception to these rules are codes of the form $37Z$ and $96Z$, which are being reserved for future use. Area codes where $Y = Z$ are called *easily recognizable codes* and are often assigned to special services such as 800 and 877.

1. How many area codes were possible before 1995?
2. According to the post-1995 rules, how many area codes are possible today?
3. The 7-digit numbers in a given area code have the form $ABC\text{-}XXXX$, where X , B , and C can be any digit 0-9 and A is restricted to 2-9. There are two other restrictions:
 - B and C cannot both equal 1 since these values are designated for other purposes such as 911 (emergency) and 411 (information), and
 - 555-0100 through 555-0199 are reserved for fictional uses such as in television shows or movies.

According to these conditions, how many 7-digit numbers are possible in a single area code?

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4. Using your answers to the previous questions, determine how many 10-digit numbers are possible in North America.
5. **EXTENSION:** Some states are running out of license plate numbers. Delaware currently uses six-digit numbers in its license plate numbering system, although recent reports show that its numbers are approaching 1 million (Delaware uses retired numbers for new cars in many cases). The state of Washington recently stated that it needs to explore options to its system of three numerical digits followed by three letters because it is running out of numbers. New Jersey changed its system of three letters followed by two numerical digits and one letter to a new system of one letter, two numerical digits, and three letters. (The last number under the old system was ZZZ 99Z, followed by A10 AAA in the new system.)
 - a. How could you determine how many plate numbers New Jersey was able to assign under the previous system? What assumptions did you make in your calculation?
 - b. How many additional license plate numbers can New Jersey assign under the new numbering system?
 - c. Why do you think the first license plate under the new system was not A00 AAA?
 - d. How do New Jersey's previous and new systems relate to the license plate numbering systems used in Delaware and Washington?
 - e. What do license plate numbers tell you about the population in the state?
6. **REFLECTION:** In solving real-world problems such as estimating a crowd size, the number of possible telephone numbers, or the answer to a Fermi question, why is it necessary to first make some reasonable assumptions about the situation?