A telephone number in the form NYZ-ABC-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?

|  |  |  |  |
| --- | --- | --- | --- |
| N [2-9] | Y (1 or 0) | Z [1-9] | Possible Area Codes |
| 8 | ● 1 ● | 9 | = 72 possible area codes for NYZ, when Y = 0 |
|  |  |  |  |
| 8 | ● 1 ● | 8 | = 64 possible area codes for N1Z, when Y = 1 |
|  |  |  |  |
|  |  |  | = 136 Possible Area Codes |

2. According to the post-1995 rules, how many area codes are possible today?

8 ● 9 ● 10 — 20 [37Z and 96Z] = 700

There are in fact a few other restrictions that reduce the number of available area codes to 681. As of September 2008, 277 area codes have been assigned.

3. The 7-digit numbers in a given area code have the form ABC-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?

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **A****[2-9]** | **B****[0-9]** | **C****[0-9]** | **—** | **X****[0-9]** | **X****[0-9]** | **X****[0-9]** | **X****[0-9]** |
| **8** | **9** | **9** |  | **10** | **10** | **10** | **10** |

8 $● 10^{6}-(8 ● 1 ● 1 ● 10^{4})-100 \left(fictional numbers\right)=7, 919,900 $

4. Using your answers to the previous questions, determine how many 10-digit numbers are possible in North America.

700 ● 7,919,900 = 5,543,930,000

This answer is an upper estimate because there are some other restrictions and reserved numbers.

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?

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Z** | **Z** | **Z** | **9** | **9** | **Z** |  |
| **26** ● | **26** ● | **26** ● | **10** ● | **10** ● | **26** ● | **= 45,697,600** |

b. How many additional license plate numbers can New Jersey assign under the new numbering system?

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **A** | **9** | **9** | **A** | **A** | **A** |  |
| **26** ● | **9** ● | **10** ● | **26** ● | **26** ● | **26** ● | **= 41,127,840** |

You get this value if you assume that the 1st numerical digit could be anything other than 0 and the 2nd digit is anything from 0 through 9; and if you assume that any letter value can be any letter from A to Z (26 options).

c. Why do you think the first license plate under the new system was not A00 AAA?

One possible explanation: The first numerical digit starts with 1 rather than 0, probably to reduce confusion that it might be thought of as the letter O.

d. How do New Jersey’s previous and new systems relate to the license plate numbering systems used in Delaware and Washington?

In Delaware, the number of possibilities is limited by the numerical format to 999,999 unless additional digits or letters are used.

In a system with three letters and three numerical digits, the number of possibilities for any designated sequence (three letters followed by three digits or vice versa or any combination of three letters and three digits in a particular sequence) can be found by calculating:

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Z** | **Z** | **Z** | **9** | **9** | **9** |  |
| **26** ● | **26** ● | **26** ● | **10** ● | **10** ● | **10** ● | **= 17,576,000** |

e. What do license plate numbers tell you about the population in the state?

Possible explanations:

So, while there might be some gross estimations of which states have greater populations based on the numbering system they use in license plates, there could be many factors involved in making generalizations.