Code Breaking: What Your ID Numbers *Really* Mean

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Abstract

Investigating the types of information one can find about a person given just an ID number of theirs. Will look into the methods of which to come up with certain ID numbers given just the person's name and date of birth, for example. Will mainly deal with Minnesota's method for assigning driver's license but will compare with other states methods.

Introduction

While the most common methods for assigning driver's license numbers have little mathematical basis, many states do encode data regarding the license holder into the number being assigned. Name, date of birth, and sex being the most frequently encoded attributes. Some states go as far as to append check digits to license numbers to help protect against fraud. Check digits are extra digits added to the end of identification numbers that can be used to verify numbers and protect against both single-digit errors and transportation errors, where the positions of numbers are switched.

The "Soundex Coding System" (see Diagram 1) and variations there of are utilized in creating parts of the driver's license numbers in several states based on name.

Some states have a method for mapping names to certain numbers based on the first few letters. For example, in Minnesota, Michigan, and Maryland, names are mapped based on their first two letters- with a few exceptions. Extremely common two letter combinations rely on the third letter to provide a more unique number for these names. There are also eleven cases where specific names were deemed popular enough to have their own specific number mapped to them.

In these three states the days of each month are also mapped to identifying numbers. These numbers typically increment by twos and threes (with some exceptions), which allows potentially duplicate numbers to increment and utilize the numbers between adjacent dates thus avoiding duplicates in most cases.

Diagram 1: Soundex Coding System

```
              Start
                |
     Delete occurrences
         of h and w
                |
  Assign the remaining letter as follows:
  a, e, i, o, u, y → 0
  b, f, p, v → 1          l → 4
  c, g, j, k, q, s, x, z → 2   m, n → 5
  d, t → 3                r → 6
                |
  If two letters with the same
  numeric value are adjacent,
  omit the second letter
                |
  Delete the first character of the original name
         if still present
                |
       Delete all
  occurrences of a, e,
     i, o, u and y
                |
  Use the first three digits
  corresponding to the remaining
  letters; append trailing zeros if
  less than three letters remain
```

Examples

Joseph Allen Brown lives in Minnesota and is born on March 21. The first 4 digits of his license will be obtained using the Soundex Coding System for his last name. The first step is to delete the w in Brown to Bron. The letters of Bron get assigned the digits according to Diagram 1 in step 2. This leaves the digits 1605. These digits do not have the same numeric value adjacent therefore step 3 is skipped. The first character B which is assigned 1 is deleted based on step 4. The 0 is deleted in step 5 because it represents the letter o. This leaves 65 as the remaining digits. For the last step, a zero is appended on the end because 65 is less than 3 digits. The first four digits of the license is B650. The following 3 digits are obtained using the first name. Joseph is a popular name and has its own digits. As mentioned previously, these digits are 441. The next three digits are assigned using the middle name. Allen is a special case for A. Based on Table 2, Allen is assigned 051. The last three digits are obtained using the license owner's birth day and month. According to Table 3, March 21 is assigned 229. Together this gives Joseph Allen Brown's license number to be B650-441-051-229.

References

Gallian, J. A. (1991). Assigning Driver's License Numbers. *Mathematics Magazine, 64*(1), 13-22.

Gallian, J. A. (2004). Breaking Driver's License Codes. In D. Hayes & T. Shubin (Eds.), *Mathematical Adventures For Students and Amateurs* (pp. 27-39). Washington DC: Mathematical Association of America.

Methods

An example of a method of decoding/assigning driver's license numbers is the process that Minnesota uses. There are several different pieces of personal information (mostly involving the person's name) that Minnesota looks at to determine each individual's license number. Overall, the generic format that Minnesota uses is: *1st letter of last name, last name code, first name code, middle name code, day and month of birth code.*

Refer to the flowchart for how the last digit code. Below is a flowchart for Schworer, going through all six steps:

Schworer → Scorer (after step 1) → **Scorer** [220606] (after Step 2) → **Sorer** [20606] (after step 3) → **orer** [0606] (after step 4) → **rr** [66] (after step 5) → **S-660** (after step 6)

The next two steps to decoding Minnesota's license plate number is to crack the first name and middle name codes. Luckily for the decoder, both 3-digit numbers are found the exact same way. For almost every one of the 676 two-letter combinations in the alphabet (Aa, Ab, Ce, Di, Yz, etc.), there is a different three-digit code that goes along with it. The first two letter combination, Aa, has a code of 028, for example. Ab's code is 029. Ac's is 030. So on and so forth. However, there are a few three-letter combinations that are so popular, like Ali and Ala, that Al(*) goes through it's own cycle with the third digit being all 26 letters a-z. To illustrate:

Table 1: Minnesota Code for First and Middle Names Beginning with A

Aa	028	Ag	034	Al	-	Aq	070	Av	075
Ab	029	Ah	035	Am	066	Ar	071	Aw	076
Ac	030	Ai	036	An	067	As	072	Ax	077
Ad	031	Aj	037	Ao	068	At	073	Ay	078
Ae	032	Ak	038	Ap	069	Au	074	Az	079
Af	033								

Table 2 : Minnesota Code for First and Middle Names Beginning with Al

Ala	040	Alg	046	All	051	Alq	056	Alv	061
Alb	041	Alh	047	Alm	052	Alr	057	Alw	062
Alc	042	Ali	048	Aln	053	Als	058	Alx	063
Ald	043	Alj	049	Alo	054	Alt	059	Aly	064
Ale	044	Alk	050	Alp	055	Alu	060	Alz	065
Alf	045								

There are 11 super popular names, like John, Joseph, James, William, Mary, Robert, etc. that each have their very own specific 3-digit code amidst the first-three-letters rather than first-two-letters exceptions. To illustrate this:

Joh = 428**,** John = 429, Joi = 430,.. Jos = 440, Joseph = 441**,** Jot = 442

It's important to note that the vast majority of the scenarios for first and middle names will be taken from just the first two letters, rather than the exceptions noted above.

The final 3-digit number for Minnesota license numbers is based off the person's day and month of birth. The pattern is similar to that of the first and middle name numbers, but there is a slight twist. Instead of each 3-digit number going up by 001 every proceeding name, consecutive birth dates go up by increments of 002 and 003, which alternate. To illustrate:

January 2 = 007**,** January 3 = 010, January 4 = 012,... January 9 = 027, January 10 = 030**,** January 11 = 032

An exception to this rule can be found in the month of March, which has a random anomaly of March 19 = 207 and March 20 = 227. It is impossible to know when these random "jumps" will occur throughout all the months and days of the year. Below is the code for March:

Table 3: Minnesota Code Dates in March

1	159	7	174	13	192	19	207	25	239
2	162	8	177	14	194	20	227	26	242
3	164	9	179	15	197	21	229	27	244
4	167	10	182	16	199	22	232	28	247
5	169	11	184	17	202	23	234	29	249
6	172	12	187	18	204	24	237	30	252
								31	254

Notice that Minnesota did not take into consideration several factors that other states across America do. For example, New Jersey incorporates gender into their license numbers, Montana uses the social security number, South Dakota incorporates the year a person was born, and Utah uses a check digit for it's last digit. Many states, like Ohio, use computer randomized/sequential numbers to help come up with their license numbers. Rather monotonously, Ohio entirely uses computer sequential numbers. The chart of all states and all personal information they use to come up with their license numbers are below:

Table 4: Summary of States Schemes for Assigning Driver's License Numbers

State	Social Security Number	Computer or Sequential Number	Check Digit	Last Name Coded	First Name Coded	Middle Name Coded	Year of Birth Coded	Month of Birth Coded	Day of Birth Coded	Sex Coded	State	Social Security Number	Computer or Sequential Number	Check Digit	Last Name Coded	First Name Coded	Middle Name Coded	Year of Birth Coded	Month of Birth Coded	Day of Birth Coded	Sex Coded
Alabama		X									Montana	X					X(A)		X(A)	X(A)	X(A)	X(A)
Alaska		X									Nebraska		X								
Arizona	X										Nevada		X	X(A)							
Arkansas	X	X(A)									New Hampshire				X	X		X	X	X	
California		X									New Jersey				X	X	X				X
Colorado		X									New York		X	X mod 11							
Connecticut		X					X				New Mexico				X(?)	X(?)	X(?)	X	X(?)	X(?)	?
Delaware		X				X					North Carolina		X								
Florida				X	X	X	X	X	X	X	North Dakota	X	X(A)								
Georgia	X	X(A)									Ohio		X								
Hawaii	X										Oklahoma	X	X(A)								
Idaho	X	X(A)									Oregon		X								
Illinois		X		X	X	X	X	X	X		Pennsylvania		X								
Indiana	X	X(A)		X							Rhode Island		X								
Iowa	X										South Carolina		X								
Kansas		X									South Dakota	X	X(A)				X			X	X
Kentucky	X										Tennessee		X	X mod 11							
Louisiana	X										Texas		X								
Maine		X		X	X	X					Utah		X	X mod 10							
Maryland				X	X	X		X	X		Vermont	X	X	X mod 11							
Massachusetts	X										Virginia		X	X(A)							
Michigan		X	X	X		X	X				Washington				X mod 10	X	X	X	X	X	
Minnesota				X	X	X	X	X	X		West Virginia		X								
Mississippi	X										Wisconsin				X(?)			X	X	X	X
Missouri		X(?)	X(?)	X(?)	X	X	X				Wyoming		X(?)								

Discussions

Much was learned while researching an interesting topic such as this one. We learned that you can use mathematical coding methods to come up with a lot of information about a person just by looking at their driver's license number. Unfortunately for us, we couldn't apply what we found to the state we live in, but it is still intriguing to go through the entire process of code-breaking an ID number for a person living in some state. This is one of the countless examples in mathematics where the applications of the math used is very interesting. The methods are pretty straightforward, only having a handful of minor exceptions, and the mathematics involved is very simple.