Disguised structure found within voter ID numbers in New York and New Jersey

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Abstract

In New York and New Jersey, voter identification numbers are designed to simultaneously create a highly organized structure and conceal that it was done. The net effect is that there is a public-facing voter identification numbering system and a second, hidden numbering system. The key to this is an algorithmic key that sorts the numbers differently than the face value of each number. The public-facing numbers are sorted in sequential order. They appear normal. The hidden systems used in New York and New Jersey sort in a manner that is impossible to replicate using normal database management tools.

The hidden structures found in New York and New Jersey's voter ID numbers are stable, predictable, and clearly intentional. They appear to have been designed with considerable ingenuity for no immediately obvious purpose. For instance, voter personal information is not protected because none of that data is concealed or masked by the numbering system, nor could it be without violating public access laws. The numbering systems do not enhance database efficiency or improve accuracy. If anything, these renumbering systems could retard efficiency and reduce the the utility of individual record numbers by divorcing them from natural and utilitarian affinities, such as with registration dates, registration method or voting districts.

Rather than resembling any normal serial number assignment pattern, the patterns found in New York and New Jersey's voter rolls are reminiscent of the WWII-era cryptographic device known as the "Enigma Machine". To decode an encrypted message, one needed the coded message, rotor calibration settings, and the machine itself. In New York and New Jersey, the voter roll ID numbers are the coded message, the algorithm used to restructure those numbers is the calibration setting, and the software needed to extract meaning from the message is the Enigma machine.

Introduction

A study of New York's voter rolls conducted by this author with the cooperation of New York Citizen's Audit (NYCA) has discovered strong evidence of concealed information in voter rolls maintained by the states of New York and New Jersey. In both cases, complex algorithms were used to assign voter ID numbers that can be sorted in two ways. First, by serial order (normal sort), and second, based on a complex algorithmic pattern that transforms the numbers (algorithm sort). The normal sort can be accomplished with any tool available within a database or spreadsheet application. For instance, sort by name, date of birth, registration date, or ID number. None of those tools are capable of directly revealing the existence of the algorithm-based sort order. The algorithm sort order is only visible to someone with knowledge of the algorithm. To make effiicient use of the algorithm sort, software designed for that purpose is required.

The effect of the algorithmic sort order is the appearance of full public disclosure while concealing records of interest. The method used to conceal the information resembles steganography.

Steganography

Steganography is a form of cryptography, designed to conceal information in plain sight. In cryptography, a message is written in code to prevent disclosure to unauthorized recipients. Cryptographic messages do not conceal that they are ciphers, though the message itself is concealed by the encoding process. Steganography conceals both message and the fact that there is a message. For instance, publishers of music and filmed entertainment use steganography to conceal copyright information and serial numbers in music CDs and film DVDs [1, 2]. One can listen to a music CD or watch a DVD movie without detecting hidden information within them.

To be effective, any steganographic method must be:

- embedded within the host media so that it may not be removed
- cannot create perceptible artifacts that would compromise the integrity of the public-facing data
- cannot be perceived without knowledge of the hidden data and the key needed to extract it
- computational cost must be low enough to prevent detectible performance impact
- the data must be recoverable without access to the original data source
- the media must be public so that security depends on access to the key, not the media it resides on [3].

An early example of steganography illustrates its utility in a military context. In it, Demaratus, a king of Sparta, warned his countrymen of a Greek invasion by concealing a message under a layer of wax. The wax tablets were apparently blank and attracted no notice from Greek troops posted to city entry points.

Voter rolls are an atypical place to find steganography. Unlike other examples, no obvious commercial or military purpose is at stake in a state's voter rolls. They are, however, essential to any scheme to commit election fraud. This is because fraudulently cast ballots are more easily discovered if they cannot be reconciled with the number of voters recorded as having voted. To reconcile fraudulently cast ballots with the voter rolls, fraudulent registrations are required. Fraudulent registrations must be hidden among legitimate registrations so that they can be used when needed without revealing their presence. To complicate matters, voter rolls are public. Therefore, steganography is an obvious solution to the problem. It can conceal phantom registrations within public data.

In addition to steganography, patterns found in New York and Nersey's voter rolls resemble a "linear cipher". A linear cipher transforms each character of plaintext to create the encoded ciphertext [4]. For instance, the "Caeser Cipher" transforms each letter of the alphabet 3 positions to the left (Table 1). The transformations found in the voter rolls are more complex than this but use a similar principle.

Table 1 the first 10 characters of the Caesar Cipher

A	B	C	D	E	F	G	H	I	J
D	E	F	G	H	I	J	K	L	M

2020 Election

Context on the potential utility of steganography in New York and New Jersey's voter rolls is provided by events surrounding the 2020 General Election.

On November 3, 2020, a General Election was held in the United States for the offices of president, vice-president, and many other positions in federal, state, and local government. The contest between incumbent President Donald Trump and challenger Joseph Biden was particularly vitriolic for an American election. There were dozens of riots, protests, lawsuits, and other forms of unrest throughout the country. Then-President Trump warned voters that "There is NO WAY (ZERO!) that Mail-in Ballots will be anything less than substantially fraudulent"[5]. Many politicians and media personalities objected to Trump's warnings as baseless. For instance, in an April 10, 2020 article, Jane C. Timm of NBC News raised the following points to rebut Trump's claim:

> *"Richard Hasen, an election law expert…found just 491 incidents of alleged absentee voter fraud [over] more than a decade of elections"*
>
> *"Election officials in mail voting states say they don't have problems with fraud."*
>
> *Republican Secretary of State (WA) Kim Wyman stated that "We're not seeing the rampant fraud that the president talked about"[6].*

On election day, and the months following, many thousands of voter and election fraud accusations were made by prominent attorneys Sidney Powell, Lin Wood, and Rudy Giuliani, researchers Bobby Piton, Dr. Douglas Frank, and Captain Seth Keshel, as well as hundreds of individual witnesses [7]. Each of these parties and many others claimed to have evidence of fraud at either the voter level or among those responsible for conducting the election [8]. The claims were brought to several state legislatures in public hearings and to various courts of law in lawsuits. Many of the cases were dismissed on procedural grounds without hearing evidence. Not all of the cases were dismissed [9], as has been reported, nor did all of the remaining cases lose [10], as has also been reported.

It is in the context of these competing claims of fraud vs. a fraud-free election that New York's voter rolls were examined. The goal was to determine the truth of some of the claims regarding the 2020 election. New Jersey was examined later, to determine if the steganography discovered in New York was limited to the one state or if other states also had steganographically-concealed information in their rolls.

Election Law

In cooperation with the citizen group New York Citizens Audit (NYCA), I obtained access to the New York state voter rolls. The rolls are publicly accessible under the Voter registration Act of 1993. The law states that, "Each state shall maintain for at least 2 years and shall make available for public inspection…all records concerning the implementation of programs and activities conducted for ensuring the accuracy and currency of official lists of eligible voters" [11]. This sentence describes the scope and purpose of NYCA's investigation.

Among other anomalies found in the rolls, one stood out as particularly striking. A single individual with an address in Brooklyn was assigned a total of 11 unique State Board of Elections Identification (SBOEID) numbers on 2 consecutive days, February 19 and 20, 2020. According to the 2020 New York state election law, at least 10 of those registrations are illegal [12]. Regulation § 6217.2 of the 2020 election law rules and regulations states that a "unique identifier" (SBOEID number) is assigned to a voter only after "all duplicate registration issues have been resolved". County clerks are required by law to check their database for existing registrations before processing a pending application to register. This is to "ensure that the application is not a new registration and is an update or change to an existing record within the county" [13, §6217.10]. If an existing registration is found, the application must be rejected. If an application is approved, it is processed and sent to the New York State Board of Elections (NYBOE). Those registrations must be checked again for duplicate registrations "within the integrated statewide voter registration list". The reason duplicates must be resolved is that in New York state, each voter is allowed only one SBOEID number for their "voting life" [§ 6217.612].

NYCA has discovered no less than 308,837 apparently fraudulent registrations [14]. All are of the "multiple registration" or "clone" type, where a single voter's record is duplicated, including signature, and then assigned a new (illegal) SBOEID number. Tens of thousands of these records have votes attached to them in the voter history. Votes attached to ineligible voter registrations are defective and must not be counted.

NYCA has discovered tens of thousands of other types of fraudulent registrations but this is sufficient to establish that significant numbers of such records were present on the voter rolls examined for this article. The presence of illegally cloned records with votes attached to them establishes a motive to clandestinely track those records.

Chaim's eleven

For privacy reasons, the voter with 11 SBOEID numbers is anonymized in this article by changing his name to "Chaim Metzner". Metzner's SBOEID numbers followed an unusual pattern. The numbers used in Table 1 are masked but they accurately represent the pattern observed. Metzner's 11 records led to the discovery that a steganographic process was utilized to assign SBOEID numbers in New York State.

Table 1 shows Chaim's SBOEID numbers sorted from smallest to largest. In New York, voters are given County Identification (CID) numbers in addition to their unique New York State (NYS) SBOEID number. Metzner's CID numbers are in the same order as his SBOEID numbers when sorted by SBOEID. Unlike SBOEID numbers, voters are allowed to have multiple CID numbers. This provision accommodates moves to different counties within the state.

Table 2 Chaim Metzner's (Masked) SBOEID and County ID (CID) numbers

Registration Date	CID (Masked)	CID gap to previous	SBOEID (Masked)	SBOEID gap to previous	Status	Registration Source
2/20/2020	6593		45171		ACTIVE	MAIL
2/20/2020	6594	1	45172	1	ACTIVE	MAIL
2/20/2020	6595	1	45173	1	ACTIVE	MAIL
2/20/2020	6596	1	45174	1	ACTIVE	MAIL
2/20/2020	6597	1	45175	1	ACTIVE	MAIL
2/20/2020	6598	1	45176	1	ACTIVE	MAIL
2/20/2020	6599	1	45177	1	ACTIVE	MAIL

2/20/2020	6600	1	45178	1	ACTIVE	MAIL
2/19/2020	7375	775	53691	8513	ACTIVE	MAIL
2/19/2020	7376	1	53695	4	ACTIVE	MAIL
2/20/2020	7497	121	53783	88	ACTIVE	MAIL

Serial numbers normally ascend as they are assigned. In Metzner's case, they do this for the first 8 numbers but then they skip 8,513 numbers, then 4, then 88. This might be explained by the fact that the numbers weren't assigned on the same day but 2 numbers with high values were assigned the day before 8 numbers with lower values. The numbers were not assigned in serial order.

The questions raised by Metzner's 11 SBOEID numbers are: "How were 11 numbers assigned to the same person?" And, "why are the numbers out of sequence?"

To answer these questions, I started by analyzing the rolls for Allegany County, a small county that promised to be more manageable than Metzner's (Kings County), which is the most populous in NY state.

Analysis of Allegany County's SBOEID and CID numbers revealed a strong but hidden pattern within the data. The same pattern was found in 50 other NY counties, for a total of 51. I have named this pattern the "Spiral" pattern. The 5 counties that comprise New York City and Livingston used a different but related pattern ("Reverse Spiral"), as did 1 other, Schoharie County ("Blur"). An unrelated pattern was found in Nassau, Erie, Westchester, and Wyoming counties ("Metronome"). All 62 New York counties had an algorithmically-produced pattern in their voter rolls. A total of 4 patterns were found in one portion of the voter rolls, and another in the remainder ("Tartan").

The Patterns

Spiral

The Spiral is visible provided the following are done:

1) Records are filtered by the SBOEID range of interest (see section New York State/Out of Range)
2) A second filter is applied based on the county of interest
3) The records are sorted by CID number
4) A calculation field is added to calculate the gap between consecutive SBOEID numbers ("Gap Value")

The Spiral is typified by the following (Figure 1):

- The first SBOEID number is the minimum value SBOEID number for the county (Min)
- Gap values of 111,111, 11,111, 1,111, 111, 11, and 1
- Every 10th, 100th, 1,000th , 10,000th, and 100,000th gap value is 12, 112, 1,112, 11,112, and 111,112, respectively
- The highest gap values appear at the beginning of the pattern and then "step down" periodically throughout the range until the smallest gap values are reached
- SBOEID numbers ascend until they reach an artificial ceiling for the range (Max). When they are too close to the Max to add another number with a gap value equal to the previous one without

exceeding the Max, the next gap value is a negative number to reset the count near the minimum value for the range. This is a “Drop Value”.

- The first Drop Value reduces the current SBOEID number to a value equal to the minimum value for the range (MIN) plus the highest ¾ RepUnit (see Pattern Characteristics/Repunits). Each subsequent Drop Value is a power of 10 less than the previous one.
- The first Drop Value appears in Row 11, then 86, followed by 836, and then 8,336 and (in larger counties) 83,336. The gaps between these rows are: 75, 750, 7,500, and 75,000.
- The Max value appears adjacent to the Min +1 and the last Drop Value (not to be confused with the last value, which can be 10,000 or more rows beyond the MAX value).

SBOEID	Short ID	SBOEID Gaps
000000000009091767	9,091,767	-230,434
000000000009119545	9,119,545	27,778
000000000009230656	9,230,656	111,111
000000000009324159	9,324,159	93,503
000000000009335270	9,335,270	11,111
000000000009357492	9,357,492	22,222
000000000009368603	9,368,603	11,111
000000000009379714	9,379,714	11,111
000000000009100100	9,100,100	-279,614
000000000009111211	9,111,211	11,111
000000000009122323	9,122,323	11,112
000000000009133434	9,133,434	11,111
000000000009144545	9,144,545	11,111
000000000009155656	9,155,656	11,111
000000000009166767	9,166,767	11,111
000000000009177878	9,177,878	11,111
000000000009188989	9,188,989	11,111
000000000009200100	9,200,100	11,111
000000000009211211	9,211,211	11,111
000000000009222322	9,222,322	11,111
000000000009233434	9,233,434	11,112
000000000009244545	9,244,545	11,111
000000000009255656	9,255,656	11,111
000000000009266767	9,266,767	11,111
000000000009277878	9,277,878	11,111
000000000009288989	9,288,989	11,111
000000000009300100	9,300,100	11,111
000000000009311211	9,311,211	11,111
000000000009322214	9,322,214	11,003
000000000009323325	9,323,325	1,111
000000000009324437	9,324,437	1,112
000000000009325548	9,325,548	1,111
000000000009326659	9,326,659	1,111
000000000009327770	9,327,770	1,111
000000000009328881	9,328,881	1,111
000000000009329992	9,329,992	1,111
000000000009331103	9,331,103	1,111

1	SBOEID	Short ID	SBOEID Gap	SBOEID Sum
2	NY000000000009557733	9,557,733	16,127	
3	NY000000000009585511	9,585,511	27,778	
4	NY000000000009625408	9,625,408	39,897	67,675
5	NY000000000009636519	9,636,519	11,111	
6	NY000000000009647630	9,647,630	11,111	
7	NY000000000009658741	9,658,741	11,111	
8	NY000000000009669852	9,669,852	11,111	
9	NY000000000009680963	9,680,963	11,111	
10	NY000000000009692074	9,692,074	11,111	
11	NY000000000009566066	9,566,066	-126,008	
12	NY000000000009577177	9,577,177	11,111	
13	NY000000000009588289	9,588,289	11,112	2,778
14	NY000000000009599400	9,599,400	11,111	
15	NY000000000009610511	9,610,511	11,111	
16	NY000000000009617908	9,617,908	7,397	
17	NY000000000009619019	9,619,019	1,111	
18	NY000000000009620130	9,620,130	1,111	
19	NY000000000009621241	9,621,241	1,111	
20	NY000000000009622352	9,622,352	1,111	
21	NY000000000009623463	9,623,463	1,111	
22	NY000000000009624574	9,624,574	1,111	
23	NY000000000009625686	9,625,686	1,112	37,397
24	NY000000000009626797	9,626,797	1,111	
25	NY000000000009627908	9,627,908	1,111	
26	NY000000000009629019	9,629,019	1,111	
27	NY000000000009630130	9,630,130	1,111	
28	NY000000000009631241	9,631,241	1,111	
29	NY000000000009632352	9,632,352	1,111	
30	NY000000000009633463	9,633,463	1,111	
31	NY000000000009634574	9,634,574	1,111	
32	NY000000000009635685	9,635,685	1,111	
33	NY000000000009636797	9,636,797	1,112	11,111
34	NY000000000009637908	9,637,908	1,111	
35	NY000000000009639019	9,639,019	1,111	
36	NY000000000009640130	9,640,130	1,111	
37	NY000000000009641241	9,641,241	1,111	
38	NY000000000009642352	9,642,352	1,111	
39	NY000000000009643463	9,643,463	1,111	
40	NY000000000009644574	9,644,574	1,111	

1	SBOEID	Short ID	SBOEID Gap	SBOEID Sum
2	NY000000000009382494	9,382,494	-68,107	
3	NY000000000009397107	9,397,107	14,613	
4	NY000000000009408218	9,408,218	11,111	-3,502
5	NY000000000009419329	9,419,329	11,111	
6	NY000000000009430440	9,430,440	11,111	
7	NY000000000009441551	9,441,551	11,111	
8	NY000000000009452662	9,452,662	11,111	
9	NY000000000009463773	9,463,773	11,111	
10	NY000000000009474884	9,474,884	11,111	
11	NY000000000009390827	9,390,827	-84,057	
12	NY000000000009396273	9,396,273	5,446	
13	NY000000000009397385	9,397,385	1,112	278
14	NY000000000009398496	9,398,496	1,111	
15	NY000000000009399607	9,399,607	1,111	
16	NY000000000009400718	9,400,718	1,111	
17	NY000000000009401829	9,401,829	1,111	
18	NY000000000009402940	9,402,940	1,111	
19	NY000000000009404051	9,404,051	1,111	
20	NY000000000009405162	9,405,162	1,111	
21	NY000000000009406273	9,406,273	1,111	
22	NY000000000009407384	9,407,384	1,111	
23	NY000000000009408496	9,408,496	1,112	11,111
24	NY000000000009409607	9,409,607	1,111	
25	NY000000000009410718	9,410,718	1,111	
26	NY000000000009411829	9,411,829	1,111	
27	NY000000000009412940	9,412,940	1,111	
28	NY000000000009414051	9,414,051	1,111	
29	NY000000000009415162	9,415,162	1,111	
30	NY000000000009416273	9,416,273	1,111	
31	NY000000000009417384	9,417,384	1,111	
32	NY000000000009418495	9,418,495	1,111	
33	NY000000000009419607	9,419,607	1,112	11,111
34	NY000000000009420718	9,420,718	1,111	
35	NY000000000009421829	9,421,829	1,111	
36	NY000000000009422940	9,422,940	1,111	
37	NY000000000009424051	9,424,051	1,111	
38	NY000000000009425162	9,425,162	1,111	
39	NY000000000009426273	9,426,273	1,111	
40	NY000000000009427384	9,427,384	1,111	
41	NY000000000009428495	9,428,495	1,111	
42	NY000000000009429606	9,429,606	1,111	
43	NY000000000009430718	9,430,718	1,112	11,111

1	SBOEID	Short ID	SBOEID Gap	SBOEID Sum
2	NY000000000020284051	20,284,051	-21,925	
3	NY000000000020286829	20,286,829	2,778	
4	NY000000000020297940	20,297,940	11,111	8,333
5	NY000000000020306285	20,306,285	8,345	
6	NY000000000020307396	20,307,396	1,111	
7	NY000000000020308507	20,308,507	1,111	
8	NY000000000020309618	20,309,618	1,111	
9	NY000000000020310729	20,310,729	1,111	
10	NY000000000020311840	20,311,840	1,111	
11	NY000000000020284884	20,284,884	-26,956	
12	NY000000000020285995	20,285,995	1,111	
13	NY000000000020287107	20,287,107	1,112	278
14	NY000000000020288218	20,288,218	1,111	
15	NY000000000020289329	20,289,329	1,111	
16	NY000000000020290440	20,290,440	1,111	
17	NY000000000020291551	20,291,551	1,111	
18	NY000000000020292662	20,292,662	1,111	
19	NY000000000020293773	20,293,773	1,111	
20	NY000000000020294884	20,294,884	1,111	
21	NY000000000020295995	20,295,995	1,111	
22	NY000000000020297106	20,297,106	1,111	
23	NY000000000020298218	20,298,218	1,112	11,111
24	NY000000000020299329	20,299,329	1,111	
25	NY000000000020300440	20,300,440	1,111	
26	NY000000000020301551	20,301,551	1,111	
27	NY000000000020302662	20,302,662	1,111	
28	NY000000000020303773	20,303,773	1,111	
29	NY000000000020304884	20,304,884	1,111	
30	NY000000000020305979	20,305,979	1,095	
31	NY000000000020306090	20,306,090	111	
32	NY000000000020306201	20,306,201	111	
33	NY000000000020306313	20,306,313	112	8,095
34	NY000000000020306424	20,306,424	111	
35	NY000000000020306535	20,306,535	111	
36	NY000000000020306646	20,306,646	111	
37	NY000000000020306757	20,306,757	111	
38	NY000000000020306868	20,306,868	111	
39	NY000000000020306979	20,306,979	111	
40	NY000000000020307090	20,307,090	111	
41	NY000000000020307201	20,307,201	111	
42	NY000000000020307312	20,307,312	111	
43	NY000000000020307424	20,307,424	112	1,111

Figure 1 sample of Spiral pattern from 4 different counties: Onondaga, Niagara, Schenectady, and Allegany

In Figure 1, the first 43 rows of SBOEID numbers from each of 4 counties are shown in algorithm sort order. Each group of numbers is created using the same algorithm. Any apparent disagreement is due to differences in county size. Once the pattern is established in the first 11 rows, it becomes stable after that.

A member of the NYCA team wrote a program that exactly replicates the SBOEID and CID number sort order found in all 51 counties that use the Spiral (Figure 2). On that basis, the Spiral algorithm is considered “solved”. The program uses 2 inputs and 200 lines of code to calculate the result. The 2 inputs are: 1) MIN SBOEID and 2) Total range. No other algorithms have been solved but the Reverse Spiral and a pattern found in the state of New Jersey are close.

```java
public IDArray(int StartID, int NumberOfIDs, int IDoffset) {
    // Constructor
    int [] repunits = {11111111,1111111,111111,11111,1111,111,11,1};
    int [] repquarter = {2777778, 277778, 27778, 2778, 278, 28, 3, 1};
    int tencount = 10;
    int row = 0;
    int i=0;
    int id=0;     // index into the ids array
    int repu=0;   // index into the repunit array
    int startRepU = 0;
    int repuiterations = 0;
    int repuplusiterations = 0;
    int distanceToAnchor = 0;
    int repuplusdistance = 0;
    int anchor = 0;    // Anchor ID for quarter repunit down
    // Initialize the IDArray class data
    this.StartID = StartID;
    this.IDoffset = IDoffset;
    this.ids = new int[NumberOfIDs];
```

Figure 2 Code section from Spiral algorithm re-creation

Reverse Spiral

The Reverse Spiral is visible provided the following are done:

1) Records are filtered by the SBOEID range of interest
2) A second filter is applied based on the county of interest
3) The records are left in the order found on the DVD provided by the New York State Board of Elections. The order used for the same counties, as provided directly by those counties is different (precinct, then party, then first name sort) and will not reveal the Reverse Spiral. Any attempt to sort these records will irreversibly destroy the Reverse Spiral pattern.

The Reverse Spiral is typified by the following:

- A mixture of numeric and alphanumeric CID numbers
- Alphanumeric CID numbers are interlaced between numeric CID numbers at regular intervals. This pattern cannot be reproduced and is easily destroyed. Any normal use of the database irretrievably destroys this sort order.
- Each alpha character has a corresponding numeric value. For instance, the letter “M” = 11, “C” = 111 if it appears in the 9th row after another letter, 1,111 if it appears in the 4th row. “B”=11,111 if it appears in the 9th row, 111,111 if it appears in the 4th row.
- Every 10th occurrence of the same value will result in the final number being split into 2 rows and +1 added to the final value. For instance, after 10 groups of 11, instead of 11 rows, there are 12. Instead of ending with 112 (111+1), row 9 = 84 and row 12 =28 (84+28=112). The sum for the group is 224, or 112*2. (Figure 3).
- Alpha characters count the distance in rows between each iteration of the same character
- Most (84.38%) of all alphanumeric CID numbers (*n*=121,395 in New York County) have a New Year’s Day registration date. Exceptions to this are sections where one alphanumeric CID counts every 10th row of 9 other but different alphanumeric CID numbers. The 10th value is always a January 1 Registration Date.
- Gap values of 111,111, 11,111, 1,111, 111, 11, and 1
- Each gap value is counted in groups of 10 with certain alpha values assigned for that purpose
- The highest and all other gap values are interlaced according to a pattern defined by placement of alphanumeric CID numbers
- SBOEID numbers are in sequential order from Minimum to Maximum, with few gaps

The 5 counties of New York City (Kings, Queens, New York, Bronx, and Richmond) and Livingston County use the Reverse Spiral algorithm (Figure 4).

Record ID	RID Gap	RID Gap Sum	RID Gap Count	Alpha Key	CID	Short ID
8,612,292	111		11	C	C0514053	37,301,274
8,612,295	12		1	N	N1321571	37,301,277
8,612,306	11		2	N	N1321582	37,301,288
8,612,317	11		3	N	N1321587	37,301,299
8,612,328	11		4	N	N1321591	37,301,310
8,612,339	11		5	N	N1321597	37,301,321
8,612,350	11		6	N	N1321606	37,301,332
8,612,361	11		7	N	N1321609	37,301,343
8,612,372	11		8	N	N1321613	37,301,354
8,612,376	84		8	C	C0006904	37,301,358
8,612,384	12		9	N	N1321617	37,301,366
8,612,395	11		10	N	N1321621	37,301,377
8,612,404	28		12	C	C0514180	37,301,386
8,612,407	12		1	N	N1321628	37,301,389
8,612,418	11		2	N	N1321658	37,301,400

Figure 3 111 10 count punctuated by split repunits and repunit +1 (numeric CID numbers filtered out)

AI	AJ	AM	AN	AO	AP	AQ	AR	AT	AW	AX	AY
CountyCode	CountyVRNumber	Counter - 11	Counter - 111	Counter - 1,111	Counter - 11,111	Counter -111,111	RegDate	Last 4 digits RD	ShortID NUM	ShortID Gap	VRSource
31	301522070	1	76	993	7,936	77,383	19920831	831	37689119		MAIL
31	301522073	2	77	994	7,937	77,384	19920902	902	37689120	1	MAIL
31	301522104	3	78	995	7,938	77,385	19920831	831	37689121	1	MAIL
31	301522105	4	79	996	7,939	77,386	19920902	902	37689122	1	MAIL
31	M0176702	5	80	997	7,940	77,387	19780101	101	37689123	1	LOCALREG
31	301522109	1	81	998	7,941	77,388	19920903	903	37689124	1	MAIL
31	301522131	2	82	999	7,942	77,389	19920831	831	37689125	1	MAIL
31	301522154	3	83	1,000	7,943	77,390	19920831	831	37689126	1	MAIL
31	301522158	4	84	1,001	7,944	77,391	19920902	902	37689127	1	MAIL
31	301522167	5	85	1,002	7,945	77,392	19920903	903	37689128	1	MAIL
31	301522181	6	86	1,003	7,946	77,393	19920831	831	37689129	1	MAIL
31	301522188	7	87	1,004	7,947	77,394	19920903	903	37689130	1	MAIL
31	301522194	8	88	1,005	7,948	77,395	19920831	831	37689131	1	MAIL
31	301522195	9	89	1,006	7,949	77,396	19920903	903	37689132	1	MAIL
31	301522196	10	90	1,007	7,950	77,397	19920827	827	37689133	1	MAIL
31	M0176709	11	91	1,008	7,951	77,398	19780101	101	37689134	1	LOCALREG
31	301522210	1	92	1,009	7,952	77,399	19920903	903	37689135	1	MAIL
31	301522225	2	93	1,010	7,953	77,400	19920903	903	37689136	1	MAIL
31	301522237	3	94	1,011	7,954	77,401	19920821	821	37689137	1	MAIL
31	301522254	4	95	1,012	7,955	77,402	19920903	903	37689138	1	MAIL
31	301522283	5	96	1,013	7,956	77,403	19920827	827	37689139	1	MAIL
31	301522290	6	97	1,014	7,957	77,404	19920903	903	37689140	1	MAIL
31	301522305	7	98	1,015	7,958	77,405	19920903	903	37689141	1	MAIL
31	301522310	8	99	1,016	7,959	77,406	19920827	827	37689142	1	MAIL
31	301522324	9	100	1,017	7,960	77,407	19920831	831	37689143	1	MAIL
31	301522327	10	101	1,018	7,961	77,408	19920131	131	37689144	1	MAIL
31	M0176711	11	102	1,019	7,962	77,409	19770101	101	37689145	1	MAIL
24	301522333	1	103	1,020	7,963	77,410	19920831	831	37689146	1	MAIL
31	301522335	2	104	1,021	7,964	77,411	19920831	831	37689147	1	MAIL
31	301522336	3	105	1,022	7,965	77,412	19920831	831	37689148	1	MAIL
31	301522339	4	106	1,023	7,966	77,413	19920903	903	37689149	1	MAIL
31	301522345	5	107	1,024	7,967	77,414	19920831	831	37689150	1	MAIL
31	301522347	6	108	1,025	7,968	77,415	19920831	831	37689151	1	MAIL
31	301522351	7	109	1,026	7,969	77,416	19920831	831	37689152	1	MAIL
31	301522357	8	110	1,027	7,970	77,417	19920903	903	37689153	1	MAIL
31	C0132303	9	111	1,028	7,971	77,418	19640101	101	37689154	1	LOCALREG
31	301522360	10	1	1,029	7,972	77,419	19920903	903	37689155	1	MAIL
31	301522362	11	2	1,030	7,973	77,420	19920903	903	37689156	1	MAIL
31	M0176740	12	3	1,031	7,974	77,421	19780101	101	37689157	1	LOCALREG
31	301522376	1	4	1,032	7,975	77,422	19920903	903	37689158	1	MAIL

Figure 4 Reverse Spiral pattern uses alphanumeric CID numbers to punctuate groups of numeric CID numbers

The Reverse Spiral sort order is impossible to reproduce using any normal sort tools available in a database or spreadsheet program. Alphanumeric CID numbers will always sort together, not interlaced between numbers. The only way to interlace alphanumeric numbers with numeric CID numbers like this is to position them using custom software designed to do it. This sort was discovered when I had to restore my copy of the database from the original file provided by the NYBOE on a DVD disk. The disk provided by the NYBOE had the interlaced sort order embedded in the files.

County-provided DVDs for all Reverse Spiral counties were sorted first by precinct, then party, then first name. That sort order disguises the presence of the algorithm sort. Although the algorithm sort was provided on the NYBOE DVD, it was unlikely to be discovered because it had to be imported into a database program to be viewed. Once imported, almost any use of the file would have irretrievably destroyed the sort order. Unless one knew to look for it, there would be no reason to go back to the original disk to restore it. In my case, I had to due to an electrical storm that caused my computer to lose power and the loss of my database file. It is unlikely that any person without prior knowledge of the algorithms used in the voter rolls would have spotted it.

New Year's Day registration dates in New York County (Figure 5) represent 7.00% of all records (*n*=1,735,294). The linkage between alphanumeric CID numbers in the Reverse Spiral and a New Year's Day registration date implies that the date is a subordinate priority to the position of the CID number in the pattern.

Record ID	RID Gap	RID Gap Sum	RID Gap Count	Alpha Key	CID	Short ID		Reg Date	Reg Date
8,608,606	11		9	N	N1318171	37,297,588	1984	19840101	0101
8,608,617	11		10	N	N1318174	37,297,599	1984	19840101	0101
8,608,626	111	222	11	C	C0510790	37,297,608	1972	19720101	0101
8,608,629	12		1	N	N1318177	37,297,611	1984	19840101	0101
8,608,640	11		2	N	N1318180	37,297,622	1984	19840101	0101
8,608,651	11		3	N	N1318191	37,297,633	1984	19840101	0101
8,608,662	11		4	N	N1318203	37,297,644	1984	19840101	0101
8,608,673	11		5	N	N1318214	37,297,655	1984	19840101	0101
8,608,684	11		6	N	N1318224	37,297,666	1984	19840101	0101
8,608,695	11		7	N	N1318272	37,297,677	1984	19840101	0101
8,608,706	11		8	N	N1318273	37,297,688	1984	19840101	0101
8,608,717	11		9	N	N1318276	37,297,699	1984	19840101	0101
8,608,728	11		10	N	N1318277	37,297,710	1984	19840101	0101
8,608,737	111	222	11	C	C0510876	37,297,719	1972	19720101	0101
8,608,740	12		1	N	N1318279	37,297,722	1984	19840101	0101
8,608,751	11		2	N	N1318291	37,297,733	1984	19840101	0101
8,608,762	11		3	N	N1318292	37,297,744	1984	19840101	0101
8,608,773	11		4	N	N1318295	37,297,755	1984	19840101	0101
8,608,784	11		5	N	N1318314	37,297,766	1984	19840101	0101
8,608,795	11		6	N	N1318315	37,297,777	1984	19840101	0101
8,608,806	11		7	N	N1318351	37,297,788	1984	19840101	0101
8,608,817	11		8	N	N1318374	37,297,799	1984	19840101	0101
8,608,828	11		9	N	N1318381	37,297,810	1984	19840101	0101
8,608,839	11		10	N	N1318383	37,297,821	1984	19840101	0101

Figure 5 Reverse Spiral, with numeric CID numbers filtered out

Metronome

The Metronome is visible provided the following are done:

1) Records are sorted by SBOEID
2) A scatterplot is made of CID numbers

The Metronome is typified by the following:

- A scatterplot that resembles a solid block of values encompassing the full range of CID numbers assigned to the county
- A scatterplot of a small number of values (between 100 to 10,000) resembles the path of a metronome swinging from right to left and back again if each value is connected by a line to show the order of each number
- A scatterplot that does not connect values resembles a dense concentration of 90° arcs with offset center points and rectangles aligned along a 45° slope

The Metronome pattern starts in the center of a county's range. It then assigns numbers to the extreme high end of the range followed by the extreme low end, and then swings back and forth between either extreme, assigning numbers on either side and near the center as it traverses the range. The final effect is of a solid brick of blue dots in a scatterplot. The construction method is visible in a detail plot of any small section of the range (Figures 6-8). The Metronome algorithm is unsolved. It appears in Nassau, Westchester, Erie, and Wyoming counties.

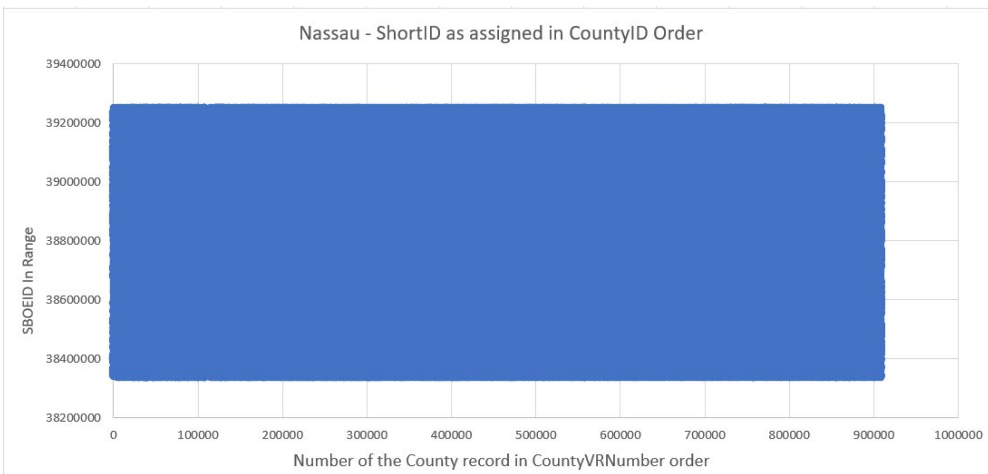

Figure 6 Nassau County scatterplot of SBOEID numbers sorted by CID numbers; "Metronome" pattern

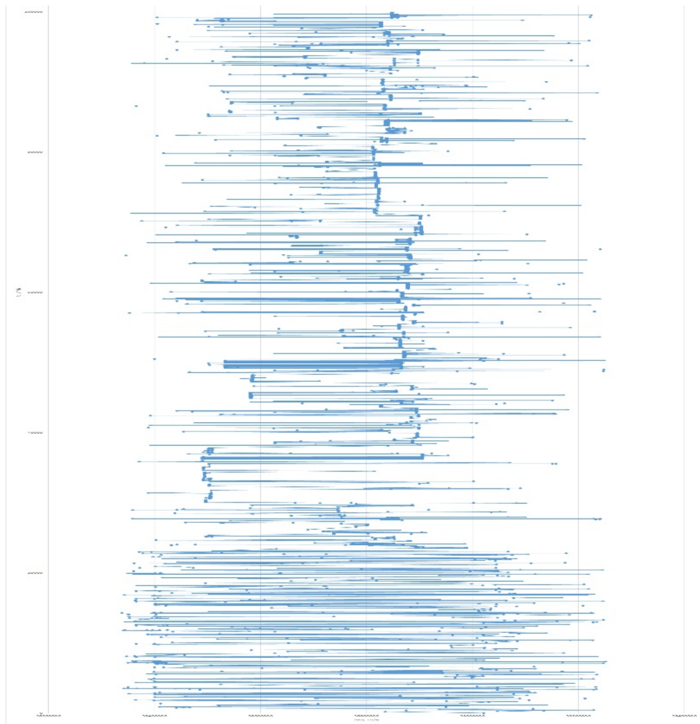

Figure 7 Detail, Nassau County Metronome scatterplot

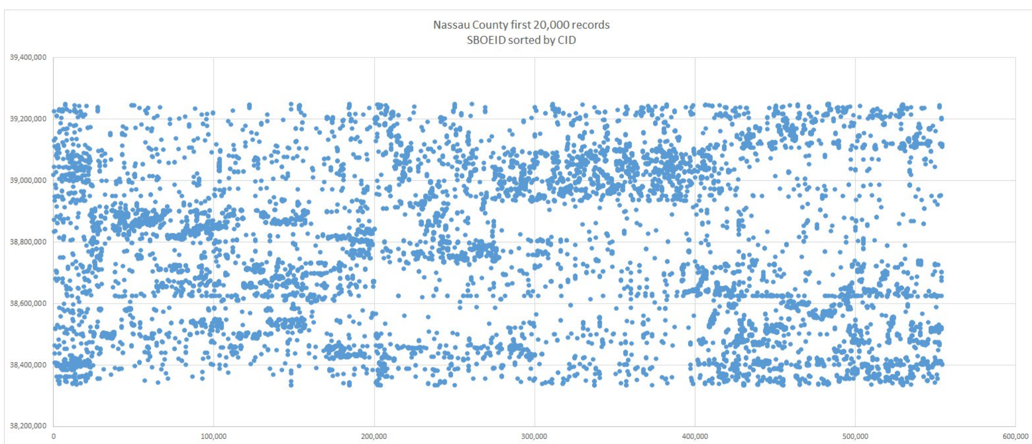

Figure 8 first 20,000 SBOEID numbers, Nassau County, sorted by CID

Blur

The Blur algorithm only appears in Schoharie County (Figure 9). It resembles the Reverse Spiral for long series of numbers but significant periodic offsets disrupt the pattern (Figure 10). Like the Reverse Spiral, the Blur counts records in groups of 11, 111, 1,111 and so on. Instead of interlacing alphanumeric and numeric CID numbers (Schorarie doesn't use alphanumeric numbers), it interlaces different number sequences. For instance, at row 5,668, it counts single rows with the sequence 1038356, 1038357, 1038358… At the 11th row, it interrupts the sequence with 1027947. It then continues the original series until it again reaches the 11th row, then inserts the next value in the second sequence, 1027948, and so on.

1	Record ID	RegDate Ref	CountyVR	CID	Counter	CID Gap		Short ID	SBOEID Gap
35	77	7/23/1992	1031101	1031101	5	1		8502593	1
36	78	10/13/1973	1031102	1031102	6	1		8502594	1
37	79	10/5/1976	1031103	1031103	7	1		8502595	1
38	80	7/23/1992	1031104	1031104	8	1		8502596	1
39	81	10/10/1987	1031105	1031105	9	1		8502597	1
40	82	10/13/1973	1031106	1031106	10	1		8502598	1
41	83	10/16/1982	1031107	1031107	11	1		8502599	1
42	84	9/30/1998	1028483	1028483	1	-2624		8502600	1
43	85	10/5/1976	1031108	1031108	2	2625	11	8502601	1
44	86	2/19/2004	1031109	1031109	3	1		8502602	1
45	87	10/13/1973	1031110	1031110	4	1		8502603	1
46	88	10/13/1973	1031111	1031111	5	1		8502604	1
47	89	1/29/2004	1031112	1031112	6	1		8502605	1
48	90	9/30/2002	1031113	1031113	7	1		8502606	1
49	91	10/11/1986	1031114	1031114	8	1		8502607	1
50	92	9/17/1982	1031115	1031115	9	1		8502608	1
51	93	4/1/1971	1031116	1031116	10	1		8502609	1
52	94	10/13/1990	1031117	1031117	11	1		8502610	1
53	95	12/2/2005	1028484	1028484	1	-2633		8502611	1
54	96	10/10/1992	1031118	1031118	2	2634	11	8502612	1
55	97	1/1/1995	1031119	1031119	3	1		8502613	1
56	98	10/12/1989	1031120	1031120	4	1		8502614	1
57	99	10/13/1990	1031121	1031121	5	1		8502615	1
58	100	7/16/2002	1031122	1031122	6	1		8502616	1
59	101	10/12/1989	1031123	1031123	7	1		8502617	1
60	102	3/24/1971	1031124	1031124	8	1		8502618	1
61	103	1/21/1989	1031125	1031125	9	1		8502619	1
62	104	4/30/1984	1031126	1031126	10	1		8502620	1
63	105	1/30/1992	1031127	1031127	11	1		8502621	1
64	106	9/30/1998	1028485	1028485	1	-2642		8502622	1
65	107	12/4/1987	1031128	1031128	2	2643	11	8502623	1
66	108	10/7/1967	1031129	1031129	3	1		8502624	1
67	109	5/18/1990	1031130	1031130	4	1		8502625	1

Figure 10 Schoharie "Blur" pattern resembles Reverse Spiral

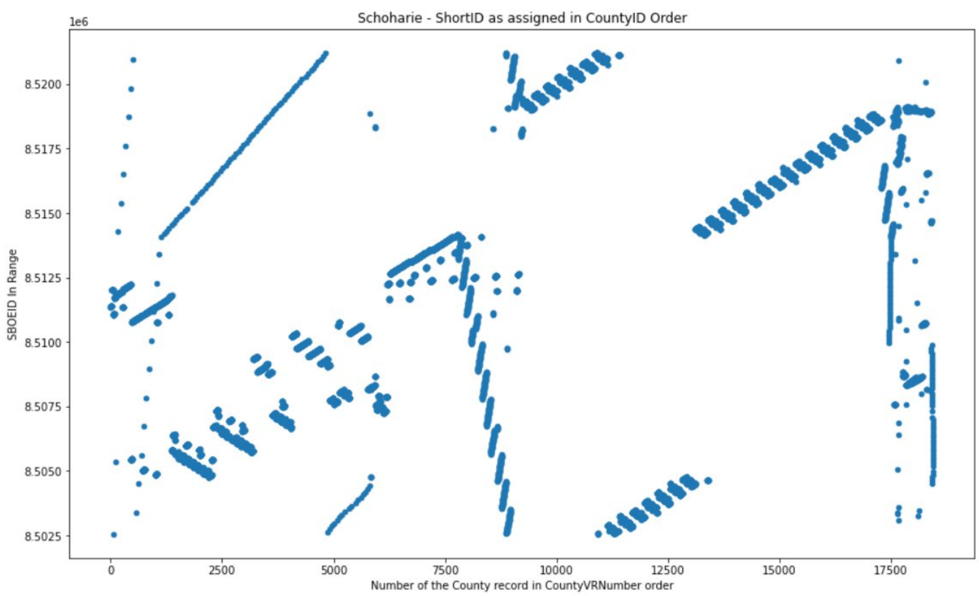

Figure 11 Schoharie scatter plot of SBOEID numbers (Y axis) and CID numbers (X axis)

Algorithm distribution

The following county voter roll records contained patterns produced by these 4 algorithms:

Spiral (51 counties): Albany, Allegany, Broome, Cattaraugus, Cayuga, Chautauqua, Chemung, Chenango, Clinton, Columbia, Cortland, Delaware, Dutchess, Essex, Franklin, Fulton, Genesee, Greene, Hamilton, Herkimer, Jefferson, Lewis, Madison, Monroe, Montgomery, Niagara, Oneida, Onondaga, Ontario, Orange, Orleans, Oswego, Otsego, Putnam, Rensselaer, Rockland, Saratoga, Schenectady, Schuyler, Seneca, St. Lawrence, Steuben, Suffolk, Sullivan, Tioga, Tompkins, Ulster, Warren, Washington, Wayne, and Yates.

Reverse spiral (5 counties): Bronx, Kings, New York, Queens, and Richmond (collectively, “New York City”) and Livingston

Metronome (4 counties): Erie, Nassau, Westchester, Wyoming

Blur (1 county): Schoharie

Two groups of 4 and 5 counties each were identified as groups before the algorithm patterns were discovered.

The five counties of New York City have more discrepancies between vote counts provided by Secretary of State and the state board of elections than any other counties. Those discrepancies are significantly out of proportion to their population and the populations of other counties. For instance, there are 345,990 registered voters in Richmond County, one of the 5 New York City counties. Onondaga County has 329,306 registered voters but the number of vote count discrepancies in their county barely registers in a graph comparing all 62 counties (Figure 11). All 5 of these counties use the Reverse Spiral algorithm.

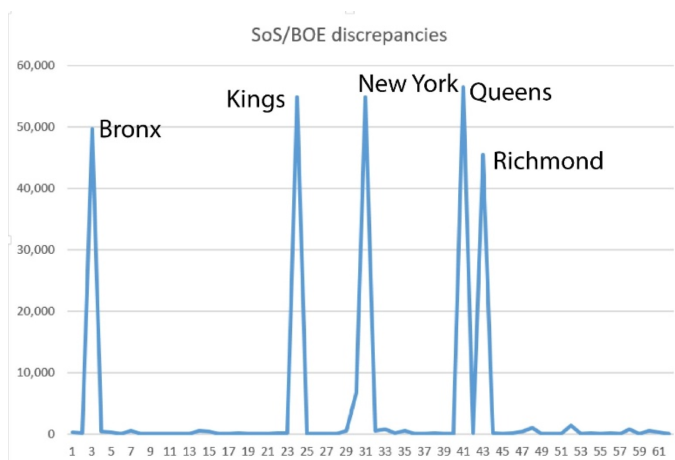

Figure 12 NYC vote count discrepancies match counties using the Reverse Spiral algorithm

Another grouping characteristic, this time found in “Metronome” counties, are extraordinarily high registration rates relative to other counties (Figure 12).

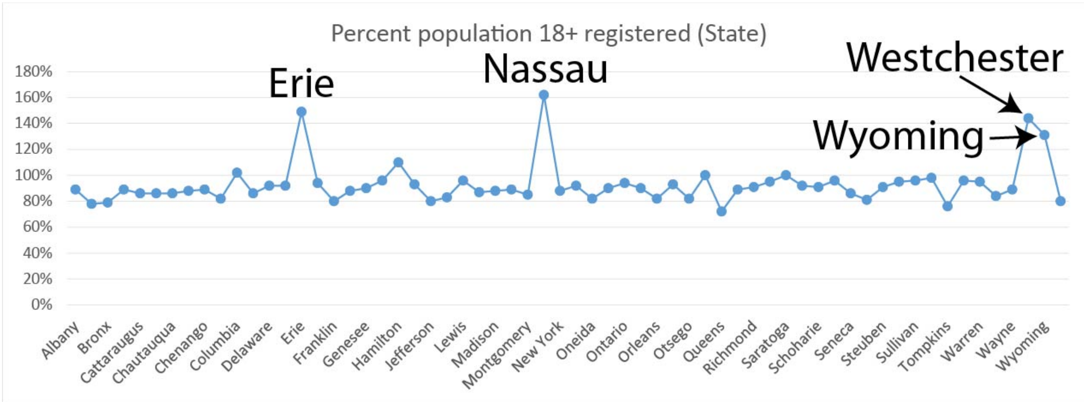

Figure 13 Registered population in Metronome counties exceeds all other counties

Pattern obfuscation

The NYBOE voter rolls obtained by NYCA in Octoberber of 2021 contain 20,765,242 records. Excel can load only 1,048,576 records (1 megabyte). For this reason, I created a Filemaker Pro database to examine the records. However, the version I used could only load 8,480,000 records[1]. To access the remainder, I obtained assistance from members of the NYCA research team, who used SQL queries to search the full database without opening it.

Below are the obfuscation methods used to conceal the presence of steganographically-introduced data within the NYBOE voter rolls.

Obfuscation method 1: State partitions

SBOEID numbers are 20 digits long. They start with the characters "NY" for "New York", continue with 10 leading zeroes, and end with 8 digits used to produce unique numbers (Figure 14). This means that the total numbers available within current constraints is 99,999,999. That is 4.81 times the number of records contained in the rolls obtained by NYCA. The 99,999,999 available numbers are the "number space" used by the NYBOE to assign SBOEID numbers.

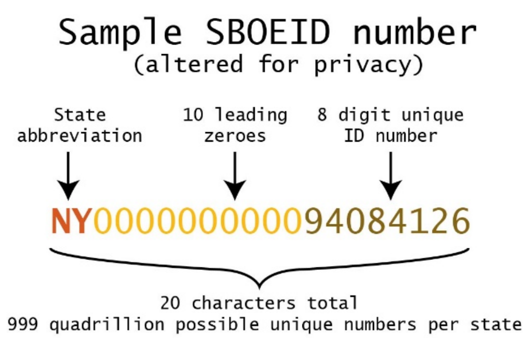

Figure 14 structure of SBOEID number

The number space is divided into 3 primary partitions: 1 "in-range" and 2 "out of range" partitions on either side of the in-range partition. In-range numbers are consecutive SBOEID numbers assigned to the

[1] Later, I obtained a recent version of Filemaker capable of loading the full database.

same county. Out of range numbers are non-consecutive numbers either below the lowest in-range number or above the highest in-range number (Figure 15).

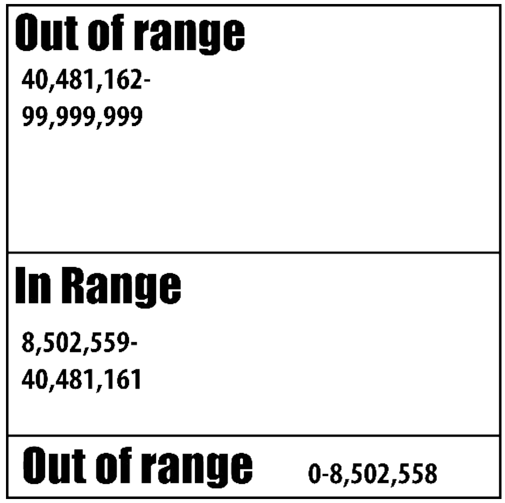

Figure 15 In and out of range SBOEID numbers

The in-range partition assigns SBOEID numbers to counties in 62 sub-partitions, 1 for each county. The out of range partitions blend SBOEID numbers from all counties together. The in-range partition contains an average of about 60.0% of all county registrations. The out of range partition contains all remaining registrations. The existence of these partitions is invisible to any normal user of the NYBOE voter roll database. There are no fields to allow its discovery.

Obfuscation method 2: County ranges

In New York, all counties are assigned a "county code". The county code is a 2 digit number, from 01-62, that represents each of New York's 62 counties in alphabetical order, from Albany (county 01) to Yates (county 62). Chaim Metzner's registrations are all in Kings County, county 24. Because the voter roll database is large, it makes sense to filter the results by county code. To do that, one simply types "24" into the 'countyCode" field to see all the registrations for Kings County. That simple and logical step obfuscates the county range partitions. The reason is that almost half of the SBOEID numbers assigned to New York's 5 counties, including Kings, are in the out of range partition. A sort by county without knowledge of the partitions yields numbers that span the entire number space instead of the numbers assigned to each of the patterns found in the in-range partition.

In-range numbers account for 8,763,593 of New York's 14,880,938 registered voters (58.89%) [12] and 42.20% of the 20,765,242 records found in New York's voter rolls. In-range SBOEID numbers had 4,732,165 votes attached to them, or 56.2% of the total votes cast. The out of range partition is divided into 2 sections, one above and one below the in-range partition. The in-range partition is divided into 67 sections. These are broken down into 2 types: "Buffers" and "Counties". There are 62 county sections and 5 buffer sections (Figure 16). None of the numbers contained within the buffers have been assigned. Almost all of the SBOEID numbers available in the county sections have been assigned to voter records (average over 62 counties = 97.80%). In 34 counties, more than 99.00% percent of available numbers are assigned.

It is essential to be aware of the in-range, out of range, and county partitions to discover the algorithm patterns.

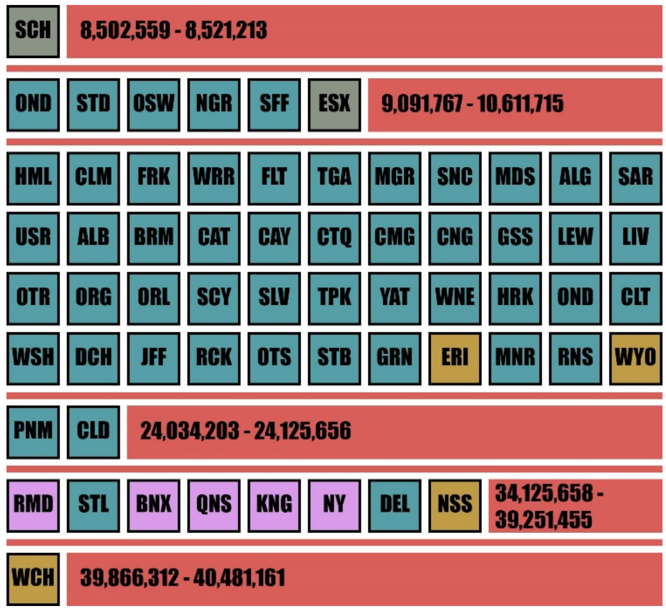

Figure 16 the in-range partition, broken down by county and buffer sections. Buffers displayed in red

Obfuscation method 3: 2 number margin

A defining characteristic of the in-range county sections is that all but 3 counties have 1 unassigned value at the start and end of each county range. This creates a 2 number boundary between each pair of adjacent counties[i]. The effect of the 2 number margin is that new registrations are limited to the few unassigned numbers within each county range or the out of range partitions. Otherwise, the margin between counties is eroded and numbers must be confiscated from adjacent counties. Records can be "deleted" by removing voter information from any given number but if this is done, the pattern is altered.

A secondary effect of the margin is that it links counties in a non-alphabetical sequence. By scrambling the order of county ranges, more manual labor is required to define the ranges and identify where each county belongs relative to other counties (Appendix 1).

Obfuscation method 4: SBOEID/CID incongruence

If a voter moves from one county to another and registers to vote in the new county, he is assigned a new CID number. The voter then has 2 records or more in the NYS voter rolls. All will have the same SBOEID number, name, DOB, and other personal information. The CID numbers will be different, as is the address. Votes can be attached to any CID but can only be counted once per unique SBOEID. Therefore, the two CID numbers in the hypothetical example above cannot be used to vote twice. Chaim Metzner's 11 SBOEID numbers, on the other hand, can be used to account for 11 votes.

In-range SBOEID numbers identify the county of origin based on which county is assigned those numbers (Figure 17). This means that if a person first registers to vote in Yates County, his SBOEID number (if it is in-range) will be between the values 21,704,366 – 21,718,821 inclusive. If the same person moves to Albany, his SBOEID remains the same but he is given a new CID for Albany.

	A	B	C	D	E	F	G	H
1	County	County ID	Votes cast (SoS)	DIFF in range records to SoS votes	MIN SBOEID	MAX SBOEID	Gap to previous	MIN to MAX size
40	Yates	62	10,788	-1,301	21,704,366	21,718,821	2	14456
41	Wayne	59	45,031	-2,911	21,718,823	21,775,896	2	57074
42	Herkimer	22	29,565	259	21,775,898	21,816,803	2	40906
43	Oneida	33	102,587	5,448	21,816,805	21,942,752	2	125948
44	Clinton	10	35,637	7,994	21,942,754	21,993,496	2	50743
45	Washington	58	28,256	-1,033	21,993,498	22,030,574	2	37077
46	Dutchess	14	151,889	-19,027	22,030,576	22,201,830	2	171255
47	Jefferson	23	44,129	7,719	22,201,832	22,261,962	2	60131
48	Rockland	44	151,381	-8,627	22,261,964	22,437,102	2	175139
49	Otsego	39	28,223	-2,414	22,437,104	22,472,255	2	35152
50	Steuben	51	46,516	1,909	22,472,257	22,530,584	2	58328
51	Greene	20	25,320	-3,616	22,530,586	22,561,813	2	31228
52	Erie	15	476,913	123,825	22,561,815	23,362,226	2	800412
53	Monroe	28	383,499	19,554	23,362,228	23,808,701	2	446474
54	Rensselaer	42	79,962	-8,085	23,808,704	23,914,045	3	105342
55	Wyoming	61	19,483	2,627	23,914,047	23,952,246	2	38200
56	Buffer 3			0	23,952,247	24,034,202	1	81,956
57	Putnam	40	55,320	-18,069	24,034,203	24,096,076	1	61874
58	Cortland	12	21,893	-1,604	24,096,078	24,125,656	2	29579
59	Buffer 4			0	24,125,657	34,125,657	1	10,000,001
60	Richmond	43	217,899	5,289	34,125,658	34,377,091	1	251434
61	St.Lawrence	50	45,267	8,303	34,377,093	34,439,638	2	62546

Figure 17 County section SBOEID number ranges

The effect of keeping an SBOEID number "for life" but changing CID numbers depending on moves to different counties, is that some voters have mismatched SBOEID and CID numbers. They also have multiple records in the NYS voter roll database. These records are distinct from the 11 records in Chaim Metzner's name because those records have the same address and county code but different SBOEID numbers. From the perspective of the NYBOE, Chaim's 11 SBOEID numbers represent 11 distinct individuals. Multiple CID numbers attached to the same SBOEID number are counted as one individual.

In combination with the out of range partitions, which do not respect county boundaries, mismatched SBOEID and CID numbers are sufficient to mask the existence of partitions within the state and county sections. The ranges assigned to individual counties also become difficult to find (Figures 18 and 19).

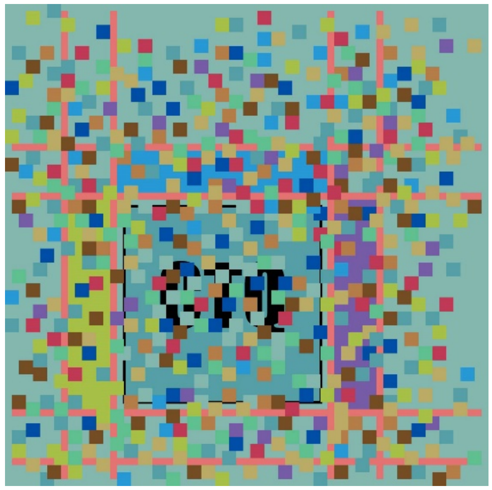

Figure 18 Chautauqua County partition, masked by out of range and mismatched SBOEID numbers

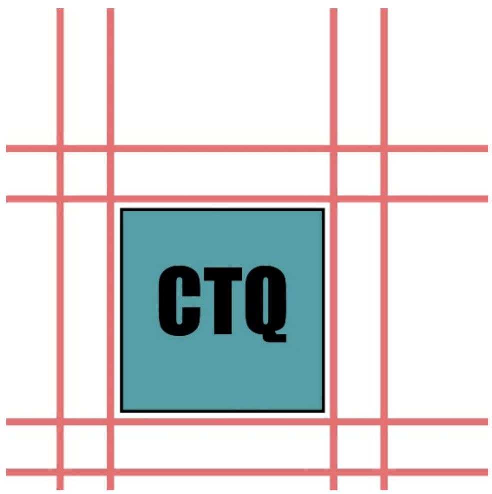

Figure 19 Chautauqua County partition, filtered by county range with mismatched SBOEID/CID numbers removed

Obfuscation method 5: Sort order

The algorithm-generated pattern in the NY voter rolls is dependent on correct filtering and sort order. The first step toward making the Spiral pattern visible is to filter SBOEID numbers by county range. This is impossible unless the county range is known, which in turn is impossible if the existence of in range and county range partitions are unknown. Second, SBOEID numbers must be filtered by county code. This step removes SBOEID/CID incongruences. Third, the found set must be sorted by CID numbers (Table 3).

Table 3 SBOEID numbers sorted alphabetically by last name (left) and by CID (right)

Alpha sort		CID sort	
SBOEID	CID	SBOEID	CID
20298357	380	20298357	380
20299357	400	20298468	386
20299134	397	20298579	387
20298801	390	20298690	388

20298912	391	20298801	390
20298579	387	20298912	391
20299245	399	20299023	395
20299023	395	20299134	397
20298468	386	20299245	399
20298690	388	20299357	400

Obfuscation method 6: Calculation

The last step required to make the pattern visible is to add a column to the database and perform a simple calculation. Each SBOEID number must be subtracted from the next. This reveals the pattern (Figure 20). The gap between each pair of SBOEID numbers is a "Gap Unit".

SBOEID	CID	SBOEID Gap	SUM
20288218	23	1111	
20289329	25	1111	
20290440	26	1111	
20291551	27	1111	
20292662	31	1111	
20293773	33	1111	
20294884	36	1111	
20295995	37	1111	
20297106	38	1111	
20298218	39	1112	11111

Figure 20 ten rows demonstrating the SBOEID pattern found within the Allegany County voter rolls

Pattern characteristics

The algorithms assign SBOEID numbers to specific CID numbers to produce the desired pattern without ever overlapping previously assigned numbers. For the Spiral pattern, the CID numbers establish the sort order of SBOEID numbers. The algorithm then calculates the necessary values to use as much of the total in-range number space as possible while positioning numbers as dictated by the pattern. The Reverse Spiral injects alphanumeric CID numbers between numeric CID numbers to establish the desired pattern. The Blur pattern likely utilizes a similar method. The mechanism behind the Metronome is currently unknown.

To utilize almost every number while skipping large groups of consecutive numbers, the Spiral literally spirals in on itself. For instance, in Suffolk County, the algorithm sort causes the number 9,837,503 to appear before the number 9,848,614 in rows 18 and 19, respectively. These 2 numbers are 11,111 units apart. The 11,111 numbers between them are found elsewhere in the pattern.They start appearing in row 160,048, with gaps of 111, 112, 11, 12, and 2 that offset some of the numbers even more. A sort by SBOEID will not reveal the algorithmically-introduced gaps because almost all of the SBOEID numbers are used, leaving only a few small gaps, usually of only 1 or 2 units. In Suffolk, only 7,432 numbers out of 889,872 numbers (0.84%), or 1 in every 120, are unassigned.

Repunits

A “repunit” is a number that is composed of nothing but the same number. For instance, the numbers “11”, “111”, “1,111”, “11,111”, and “111,111” are all repunits [15]. The first group of 10 packets in Allegany County uses the repunit “1,111” punctuated by “1,112” to define the first and last packets in its range. However, the constants of the pattern are not the numbers “1,111” and “1,112”, but repunits based on the number “1” or the same repunit +1, which creates a product ending with the number “2”. In this way, each group of 10 SBOEID numbers is bounded by a repunit that ends in 2. Another quality of this grouping is that 10 repunits comprised of 1’s will not equal the next higher order of repunit. However, 10 of these repunits plus 1 does equal the next order of repunit. For instance, 10 times 111 equals 1,110. Add 1 and the sum is 1,111. This is why the tenth number in each of these sequences is counted as a repunit +1 instead of 1,112.

Gap units in the Allegany voter rolls contain the 5 repunits “11,111”, “1,111”, “111”, “11” and “1”. It also contains the 4 modified repunits “1,112”, “112”, 12”, and “2”. These 9 numbers are referred to as “special numbers”. The 9 special numbers collectively appear 27,633 times out of 27,847 total gap units. The remaining 214 numbers generally do not repeat unless they are a multiple of 11, such as “22” and “33” (Table 3). Another type of number that appears is any one of the repunits added to the number “12”, such as “23” (11+12) and “123” (111+12). These numbers are referred to as “compound units”.

Table 4 Allegany repunit count and characteristics

value	count	multiplied	start row	end row	gap	range
11111	1	11111	4	4		
1111	21	23331	6	29	2	24
111	223	24753	31	284	2	254
11	2228	24508	286	2824	2	2539
1	21919	21919	2826	27847	2	25022
Totals	24392	105622				
value	count	multiplied	start row	end row	gap	range
11112	0	0				
1112	2	2224	13	23		11
112	27	3024	33	275	10	243
12	278	3336	295	2819	20	2525
2	2934	5868	2827	27843	8	25017
	3241	14452				

Quarter Repunits

If any repunit is divided by 4, it yields a “quarter repunit” (Table 4). Quarter repunits and multiples of quarter repunits, are found throughout SBOEID gap values when sorted by CID numbers. The first, a full quarter repunit, always appears in row 3. The second appears in row 5 as 3 quarter repunits. Between them is a full repunit that is the sum of the 2 quarter repunits it is bracketed by. The most common quarter repunits in the county patterns is a single quarter repunit (2,777.75) and a triple quarter repunit (8,333.25). Together, they equal a full repunit (11,111).

Table 5 Repunits and quarter repunits

CONSTANTS	1	2	3	4	5	6
RepUnit	1	11	111	1,111	11,111	111,111
RepUnit +1	2	12	112	1,112	11,112	111,112
RepUnit /4	0	3	28	278	2,778	27,778
Diff to prev	0	3	25	250	2,500	25,000
RepUnit /4 *3	1	8	83	833	8,333	83,333
Diff to prev	0	8	75	750	7,500	75,000
RepUnit /4 *5	1	14	139	1,389	13,889	138,889
Diff to prev	0	13	125	1,250	12,500	125,000

Repetition

Each of the special numbers repeats as many times as it can within the county range of numbers without intruding on numbers needed to assign all remaining SBOEID numbers. In Allegany, the total range of numbers allows for 28,068 unique SBOEID numbers. Of that range, 488 numbers (1.74%) are unassigned.

The number 11,111 appears only once in the Allegany rolls. It can appear twice within the Allegany county range but not if it is to allow room for other numbers. Because 11,111 only appears once, it is not bounded by “11,112” at the end of each sequence. In contrast, Kings County has more than 1,000,000 in-range records. The highest repunit value found there is 111,111 and it appears 5 times. The 5 Kings county 111,111’s are separated by one 111,112 (Table 6).

Each group of 10 SBOEID numbers is punctuated at the end of the sequence. The 10th number is separated from the previous SBOEID by the current RepUnit +1. For instance, if the current RepUnit is 1,111, then the 10th SBOEID will be 1,112 units distant from the previous SBOEID. In this way, each group of 10 is punctuated by a number ending in “2”.

The Spiral pattern keeps track of groups of 100 SBOEID numbers. To do it, a number equal to the current RepUnit +1 appears in row 8 of a group of 10, then again 100 rows later in row 8 of the 10th group of 10.

Table 6 Kings County special number count (Note that the Kings County pattern is related to but different from the Allegany pattern)

Number	Count	Value
1,111,111	0	0
111,111	5	555,555
11,111	92	1,022,212
1,111	936	1,039,896
111	9,219	1,023,309
11	40,660	447,260
1	804,046	804,046
Subtotal	854,958	
111,112	1	111,112
11,112	11	122,232

1,112	116	128,992
112	1,149	128,688
12	5,061	60,732
2	159,413	318,826
Subtotal	165,751	
Total	1,020,709	97.34%

Position

The Allegany algorithm begins each sequence with the highest number first. Once it has used as many numbers as will fit within the range without obstructing other gap units, it removes the first digit from the special numbers. For instance, “11,111” becomes “1,111”. It then continues until it has used up its allotment of the current number and then drops another leading digit, and so on (Figure 21). The angles generated by these values in a scatterplot become progressively shallower as the numbers decrease.

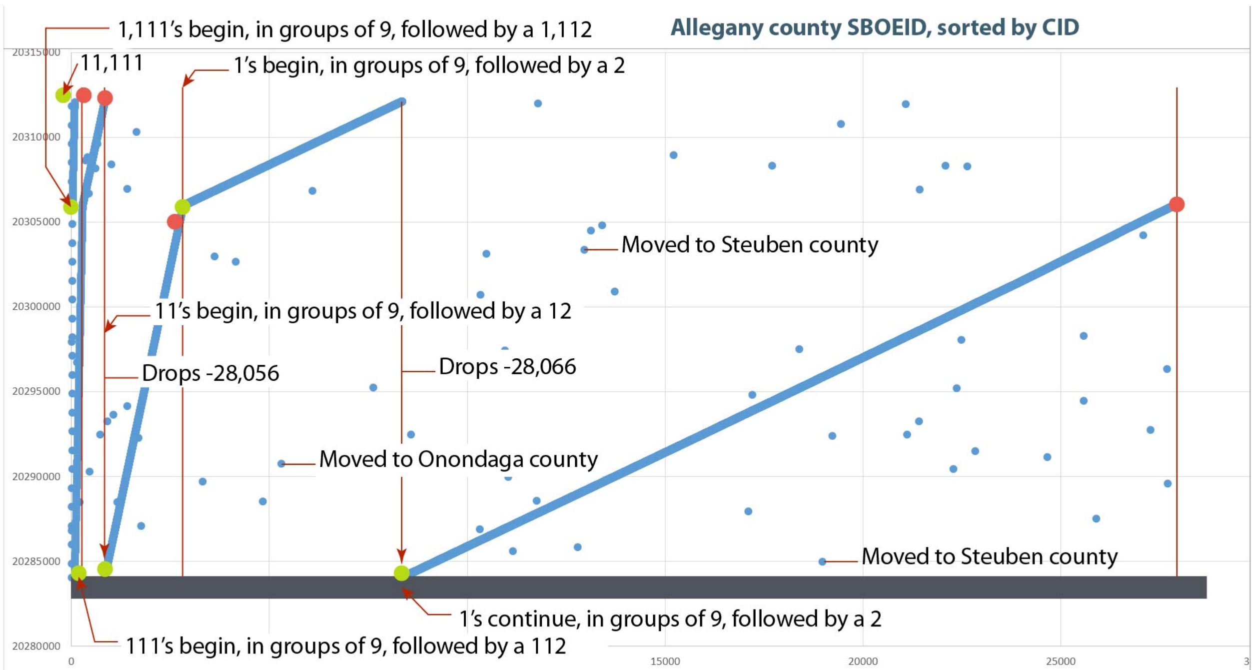

Figure 21 Allegany SBOEID numbers (Y axis) sorted by CID number (X axis) with unfiltered strays

Drop values

The first repunit, 11,111, appears near the maximum limit of the county range. As each repunit approaches the ceiling allowed by the county range, it drops near to the bottom of the range. These drops create regular interference in the pattern. It is not the only form of interference but one of many. Each interference type offsets the numbers in the series unless handled appropriately, and disrupts the pattern. In these cases, the interference does not camouflage the presence of the pattern but does change the values so that any data encoded by the algorithm is affected (Table 7). Note the symmetry of the value changes from one drop value to the next and the row spacing between each occurrence of a number in the series. There is a symmetrical relationship where one value is increased by a factor of 10 as the other number also increases by a factor of 10.

Table 7 Allegany County drop value series

Row	Spacing	Value	Diff	Distance to Max
10	0	1,111	0	-3
11	0	-26956	0	7
85	75	111	-1000	-25
86	75	-27956	-1000	75
835	750	11	-100	-250
836	750	-28056	-100	750
8,329	7,500	1	-10	-2,500
8,330	7,500	-28066	-10	7,500

The way to deal with intrusive values that are not special or compound special numbers is to count them as a normal row (figure 22).

1	SBOEID	Flagged	SBOEID Gap	Gap transform	ACTION	Count 1112 groups	Count 1111 groups	Gap	Frame	Count by 100	Count 75, 750, 7500	CID Number	CID gap
2	20284051				End UNK		1		1	91		1	
3	20286829		2778		GAP		2		2	92		2	1
4	20297940		11111		Start/End 11,111		3		3	93		4	2
5	20306285		8345		GAP			1	4	94		7	3
6	20307396		1111		Start 1,111		1	2	5	95		8	1
7	20308507		1111				2	3	6	96		9	1
8	20309618		1111				3	4	7	97		10	1
9	20310729		1111				4	5	8	98		15	5
10	20311840		1111				5	6	9	99		16	1
11	20284884		-26956				6	7	10	100		17	1
12	20285995		1111				1	8	11	1	1	19	2
13	20287107		1112		Start 1,112	1	2	9	12	2	2	20	1
14	20288218		1111			2	3	10	13	3	3	23	3
15	20289329		1111			3	4	11	14	4	4	25	2
16	20290440		1111			4	5	12	15	5	5	26	1
17	20291551		1111			5	6	13	16	6	6	27	1
18	20292662		1111			6	1	14	17	7	7	31	4
19	20293773		1111			7	2	15	18	8	8	33	2
20	20294884		1111			8	3	16	19	9	9	36	3
21	20295995		1111			9	4	17	20	10	10	37	1
22	20297106		1111			10	5	18	21	11	11	38	1
23	20298218		1112		End 1,112	11	6	19	22	12	12	39	1
24	20299329		1111				1	20	23	13	13	42	3
25	20300440		1111				2	21	24	14	14	44	2
26	20301551		1111				3	22	25	15	15	46	2
27	20302662		1111				4	23	26	16	16	47	1
28	20303773		1111				5	24	27	17	17	48	1
29	20304884		1111		End 1,111		6	25	28	18	18	50	2
30	20305979		1095		GAP			26	29	19	19	51	1
31	20306090		111		Start 111		1		30	20	20	52	1
32	20306201		111		GAP		2		31	21	21	53	1
33	20306313		112		Start 112		3		32	22	22	55	2

Figure 22 the first 33 rows of the Allegany County pattern

Another form of interference are numbers divisible by repunits. When these numbers appear as gap values, they must be counted as a number of rows equal to the product of the calculation *n*/current repunit. Therefore, the number 22 in a row signifies that the row must be counted as 2 rows to complete the 9x1, 1x1+1 10 row packet structure. In the same way, the numbers “33” and “3” are used numerous times toward the end of the series to count as 3 rows each. Repunit multiples like these may be the product of deleted records or obfuscation.

Structure

The algorithm is based on 2 values: the minimum SBOEID number in a county range and the total number of values between and including the minimum and maximum value for each county’s range (Table 8). From these 2 numbers, the algorithm calculates how to fill the range with numbers separated by repunits and quarter repunits interlaced with drop values and a remainder value to account for population size that cannot be divided evenly into the algorithm. Once that is done, it records the sort order in the CID numbers.

Table 8 MAX SBOEID value and MIN +1, Schenectady County

Row	CID	Short ID	SBOEID Gap	Dist to MIN	Dist to MAX
82885	382786	9477662	1	95168	0
82886	382787	9382495	95167	1	95167

Drop values are spaced at regular but uneven intervals of 75, 750, 7,500, and (in large counties) 75,000 rows, each increasing by a power of 10. Drop values are used to reduce a number from 1 quarter repunit below the maximum in-range number to 3 quarter repunits above the minimum in-range value. The quarter repunits are reduced by successive powers of 10 to avoid overlap. These are used as often as needed to keep SBOEID numbers within the county range.

The Matrix

Each pattern found in New York accomplishes the same thing: the creation of a "Matrix" for voter identification numbers. The algorithms assign Voter ID numbers based on carefully designed offsets and link them to CID numbers that have been assigned values consistent with the algorithm's sort order.

Instead of each successive number being 1 unit larger, an intricate lattice of related but non-consecutive values are used. The effect is similar to transform matrices found in 3D computer graphics (CGI). In CGI, one use of matrices is to determine position, orientation, and size of a 3D entity over time based on X, Y, and Z coordinate values (table 9).

Table 9 CGI Transform Matrix

	X	Y	Z
XFORM	0	0	0
ROT	0	45	0
SCALE	1	1	1

Table 9 represents the transform matrix of a 3D object. What it tells us is that the object is rotated 45 degrees in the Y-axis. This simple matrix allows animation of the object because every value in the matrix refers to a constant "origin", represented by "0" values in each of the 6 cells for transformation and rotation, and "1" (100%) in the three cells reserved for scale. The values in the cells can change on a frame by frame basis without losing the original shape, position, or orientation of the animated object. If, for instance, the 45 Y rotation value is changed to 0, the object returns to its original rotation.

The algorithms used in voter rolls accomplish the same thing. They assign voter ID numbers (SBOEID and CID) to shift their position away from any sort order likely to be encountered in the normal course of business. Keyholders with knowledge of the matrix created by this process can recover the hidden sort order with software designed to interact with the matrices found in the voter rolls. Normal users are unlikely to discover it because they lack the tools, knowledge, and motive to sort records by the matrix transformations. This is similar to the problem faced by codebreakers confronted with the WWII era

"Enigma code"[16]. To break it, they had to get a copy of the device used to encode the messages. It offset the 26 characters of the alphabet by using a rotor mechanism that was changed daily. The effect was of apparently nonsense text.

A "normal sort" by SBOEID number yields the values found in Table 10. The numbers aren't "nonsense" but they also lack any special meaning. A "matrix sort" yields the values found in Table 11. All of the numbers used for this example come from the same county.

Table 10 normal sort ID numbers are in consecutive order

Record ID	CID	SBOEID
XXX5156	XXX223	XXX84055
XXX5157	XXX224	XXX84056
XXX5158	XXX225	XXX84057
XXX5159	XXX226	XXX84058

Table 11 Transformed ID numbers are no longer consecutive

Record ID	CID	SBOEID	XFORM
XXX8497	XXXX8	XXX07396	1,111
XXX9608	XXXX9	XXX08507	1,111
XXX0718	XXX10	XXX09618	1,111
XXX1829	XXX15	XXX10729	1,111

New York State

Algorithms in every county

After the Allegany work was complete, the task of checking other NY counties was handed off to NYCA. They found the presence of algorithm-produced patterns in all 62 counties. They produced scatterplots of SBOEID numbers sorted by CID numbers to visualize the patterns. A few are presented below to provide an idea how consistent they are (Figures 23-25).

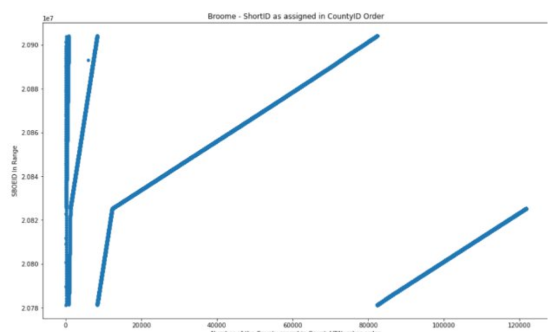

Figure 23 Broome County SBOEID numbers, sorted by CID numbers

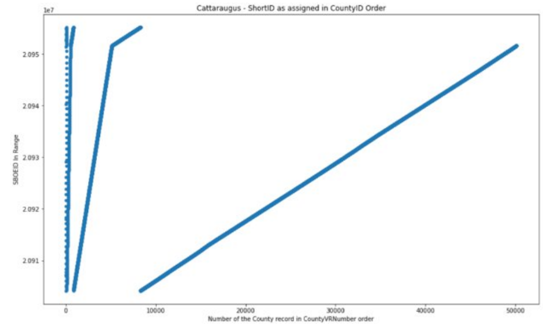

Figure 24 Cattaraugus County SBOEID numbers, sorted by CID numbers

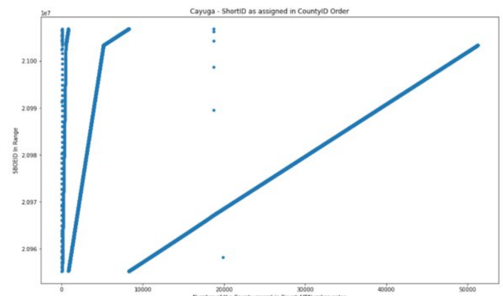

Figure 25 Cayuga County SBOEID numbers, sorted by CID numbers

Out of Range

Preliminary work on the high out of range partition reveals a complex algorithm that links SBOEID numbers from different counties in a carefully interlaced pattern. This pattern resembles a tartan, or Scottish plaid. One quality of the Tartan region is that most of the known phantom SBOEID numbers are found here. Phantom SBOEID numbers appear in segregated sections of the tartan region. For instance, a scatterplot of Erie voters shows a “staircase” pattern of shingle-like shapes (Figure 26). The yellow values in the plot have been flagged for various reasons, and the black values are high confidence phantom SBOEID numbers. The density of phantom SBOEID numbers in the upper right portion of the staircase is striking, as is the fact that the entire staircase is made of flagged SBOEID numbers. Non-flagged numbers appear elsewhere in the grid portion of the pattern.

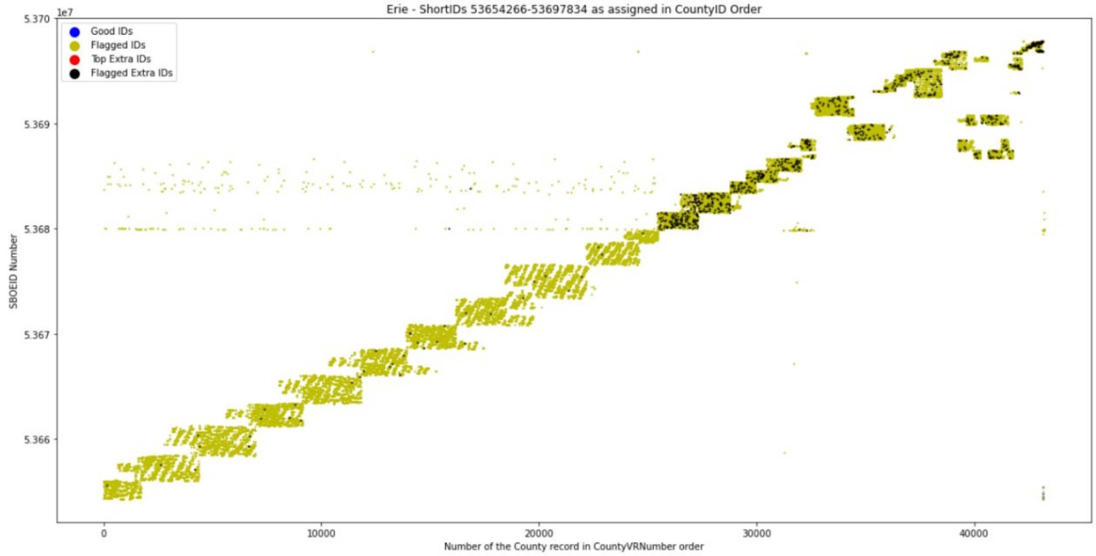

Figure 26 Erie County "shingle" pattern in Out of Range section, phantom SBOEIDs in black.

Another example comes from the low Out of Range region. In this chart, most high confidence phantom SBOEID numbers appear close together and apart from other values (Figure 27).

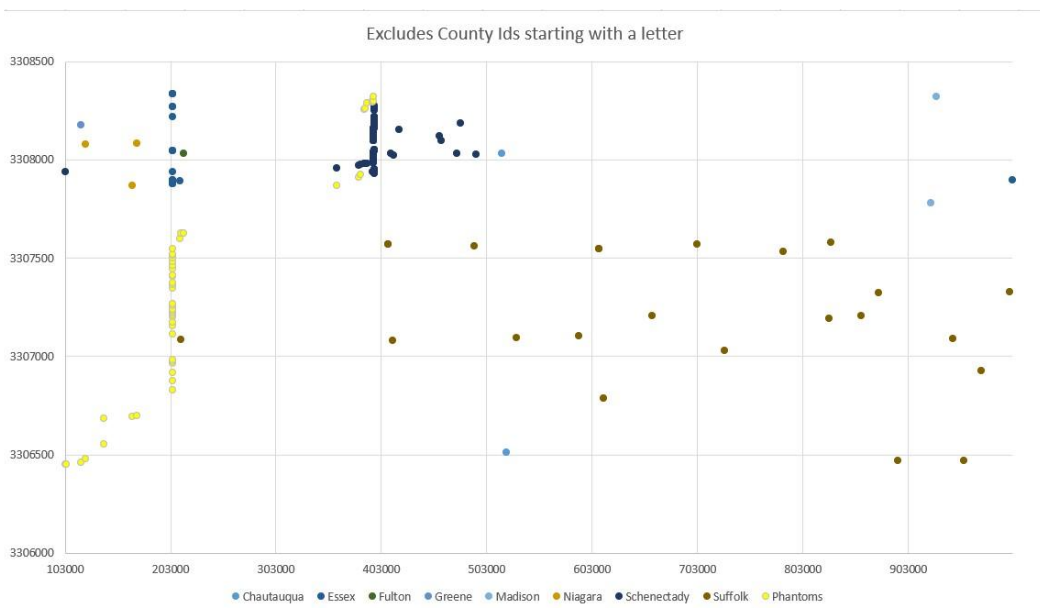

Figure 27 Low Out of range SBOEID numbers, with phantom cluster on lower left

The implication of these findings is that high confidence phantom SBOEID numbers are segregated from other numbers within the voter rolls.

Tartan

The fifth pattern identified in New York to date is the “Tartan” pattern. The Tartan appears in the out of range partition for all counties (see next section for description of partitions). The two most distinctive characteristics of the Tartan pattern are: 1) squares divided by lines and 2) gradients between and within lines. The gradients are formed by a concentration of one county's SBOEID numbers on one side of a square or line, blended with a concentration of another county's numbers from the other side (Figure 28).

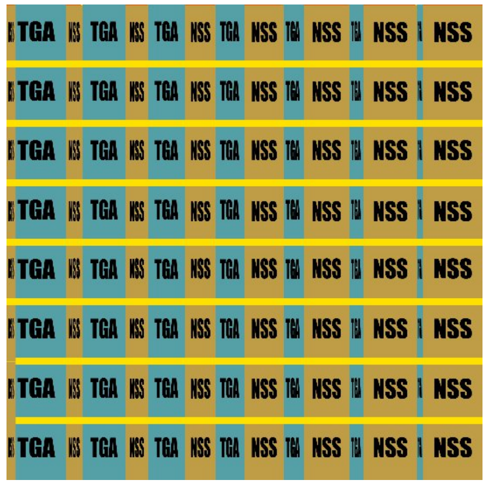

Figure 28 Out of Range gradient

Numbers assigned to out of range regions adhere to a county-specific structure. Ranges for counties in this area are defined as shapes rather than a range defined by minimum and maximum values. For instance, In the Kings County chart, vertical and horizontal white lines are visible. These areas have no numbers assigned to them from Kings. However, other counties are assigned numbers within those ranges, thus allowing them to fill in the lines. Another characteristic of the Tartan pattern is that it makes "gradients" out of the numbers. It first creates vertical and horizontal "walls" and then assigns numbers near the walls first, then farther away, then farther than that. The result looks akin to dripping water or paint (Figure 29).

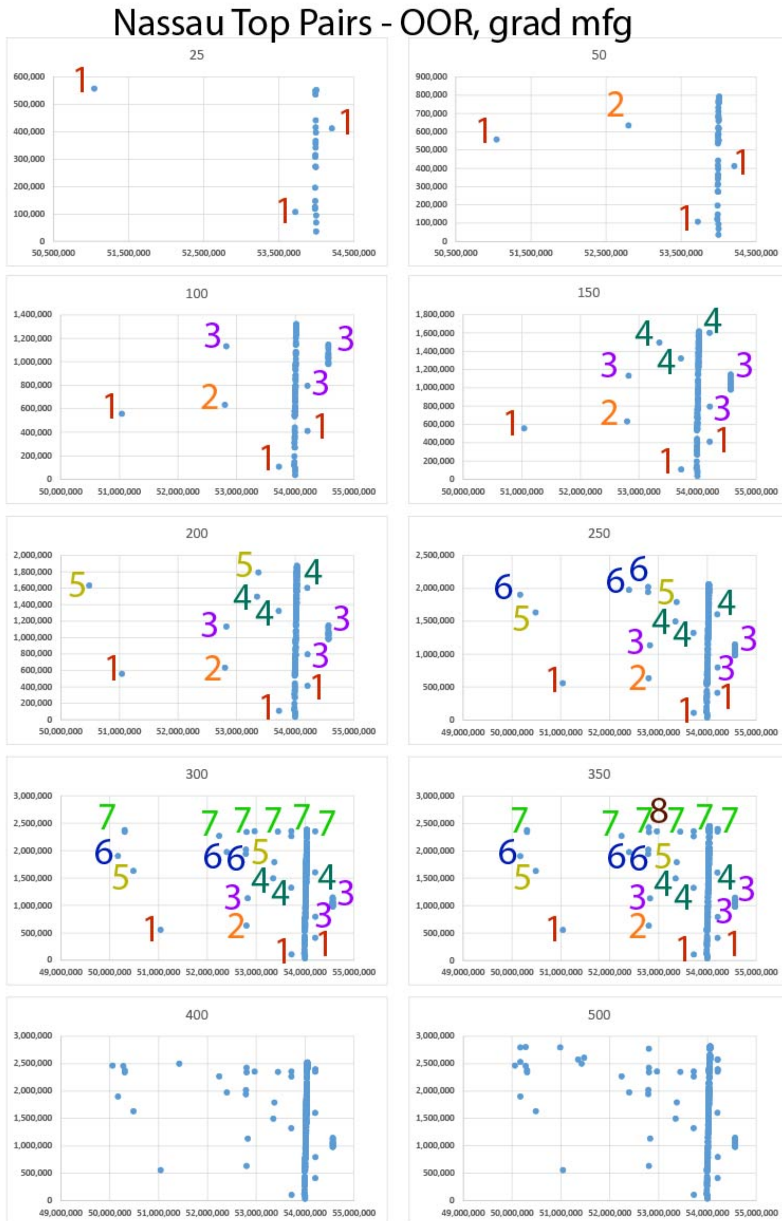

Figure 29 Nassau County; SBOEID distribution over time

Algorithms in other states

I looked for signs of algorithm use in voter roll and election-related data from Pennsylvania, Ohio, Idaho, Oklahoma, Texas, and New Jersey. In Pennsylvania, an independent researcher found examples of the Metronome pattern in mail-in voting cast vote ID numbers and voter rolls. A chart of walk-in vs. mail-in ballot identification numbers arranged by precinct has distinct patterns for each category. Walk in voters appear in an ascending line, mail-in ballots appear as a solid blue brick, easily recognizable as an example of the Metronome pattern (Figure 30). The same phenomenon is visible in charts for Colorado and Florida.

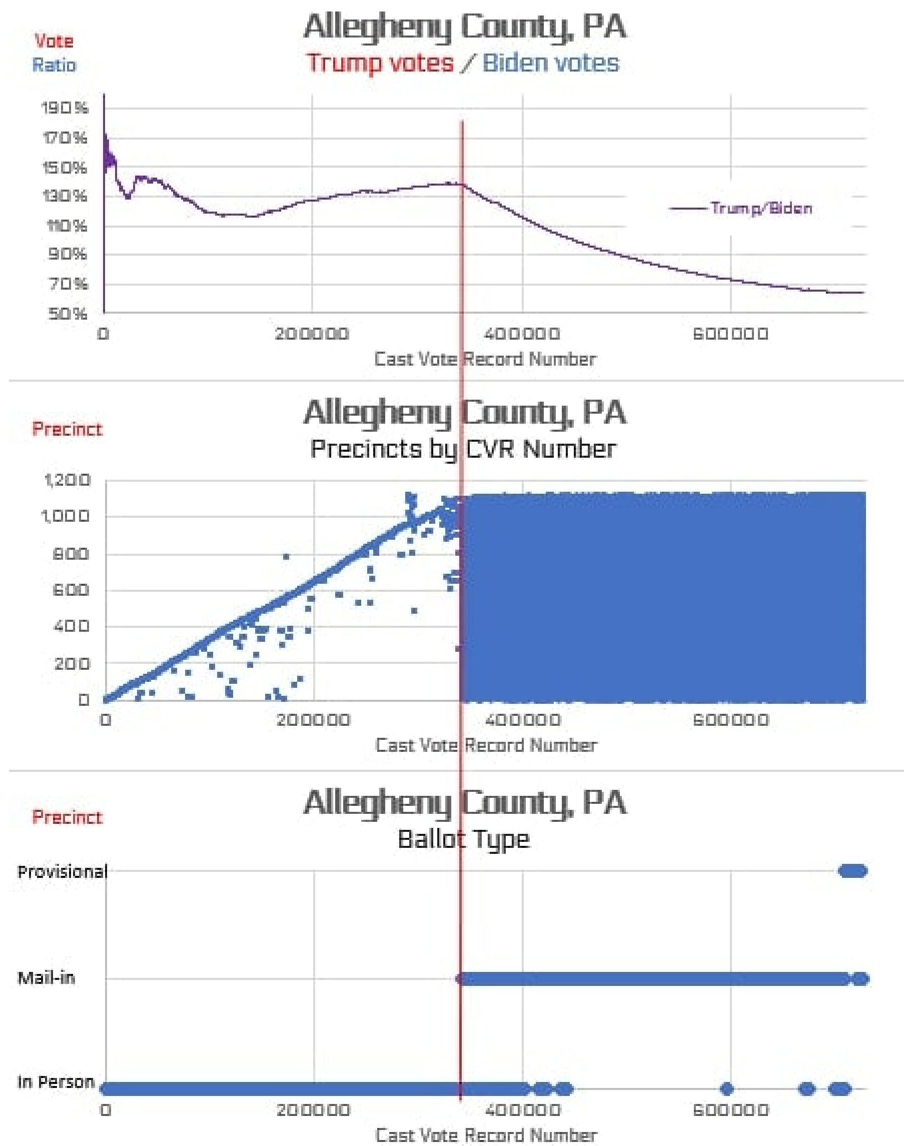

Figure 30 The Metronome pattern in Allegheny County Pennsylvania mail-in votes

Ohio's voter rolls were the most similar to New York's, because they used both CID and SBOEID numbers, unlike some states. All but one of the Ohio counties reviewed by NYCA appeared to have the Tartan algorithm hidden in their voter rolls (Figure 31).

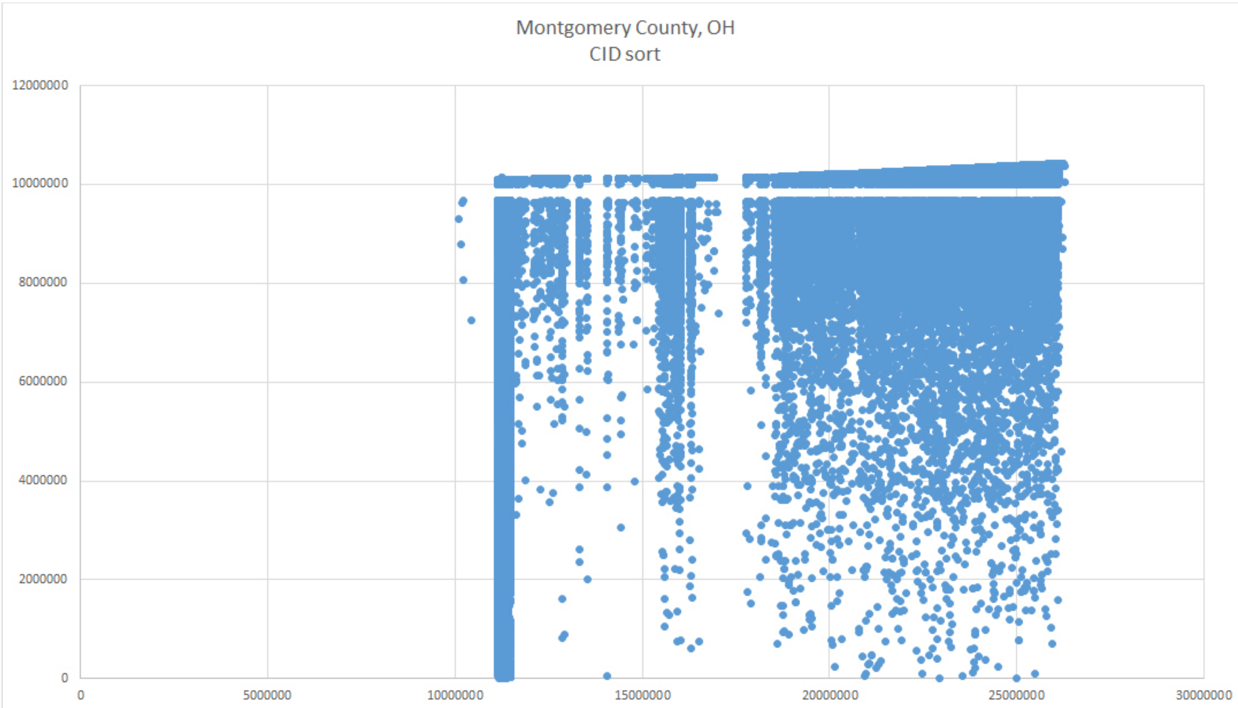

Figure 31 Montgomery County, Ohio, example of Tartan pattern.

On closer examination, a secondary pattern is visible in the Ohio and out of range New York scatterplots: a series of quarter arcs (Figure 32). These arcs are rotated at different angles and appear to be part of the method used to create the appearance of evenly-distributed SBOEID numbers. When a cryptography expert was shown this chart, he described it as an example of a “Pachinko Algorithm”. The Pachinko Algorithm is based on a gambling machine popular in Japan, known as Pachinko. Pachinko resembles a vertical pinball board wherein ball bearings are dropped from the top of the table and then bounce in random fashion off of brass pins embedded in the play surface. The pins are often arranged in quarter arcs designed to protect portions of the play field.

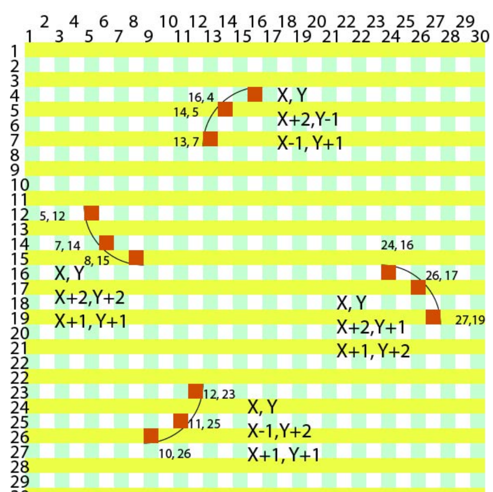

Figure 32 "Pachinko" arcs found in Ohio and out of range New York

New Jersey

New Jersey uses the same 3 algorithms in all 21 counties. The first 2 patterns are called "Arcade 1" and "Arcade 2" for their resemblance to 8-bit video game graphics. The 3rd is called "Icicle". The icicle is a blend of Arcade 1 and a more prominent pattern that resembles dripping icicles.

To view the Arcade and Icicle patterns, one must first dissect New Jersey's voter ID numbers. The numbers are 11 digits long. The first is a letter between A through P. The 2nd through 11th digits are all numbers. The 10 numbers must be divided into the left 5 digits (Left ID) and the right 5 digits (Right ID)(Table 12).

Table 12 New Jersey Voter ID number breakdown

Full ID	Alpha Tag	Number Only	Left ID	Right ID
A0003752068	A	0003752068	00037	52068
A0003900677	A	0003900677	00039	00677

After dividing the number, its three elements must be sorted in the following order: Right ID, Alpha, Left ID (Table 13). This sort order is not obvious, natural, or possible using any normal sort tools available in the database, making it impossible to reproduce within any normal database operations.

Table 13 New Jersey ID numbers reconfigured as Right ID, Alpha, Left ID

Converted Full ID	Right ID	Alpha Tag	Left ID
52068A00037	52068	A	00037
			00039
00677A00039	00677	A	

New Jersey segregates Right ID numbers into 4 partitions: low out of range, in-range, high out of range 1 and high out of range 2 (Table 14). Also like New York, the two out of range partitions use the same algorithm (Arcade), distinct from the algorithm used in range (Icicle). The effect of New Jersey's algorithms are the same as algorithms found in New York: they restructure voter ID numbers and conceal the fact they have done so.

Table 14 start and end values Partitions 1-4

	Partition 1	Partition 2	Partition 3	Partition 4
Start Right ID	0	51,174	54,074	65,536
End Right ID	51,173	54,073	65,535	96,584

Arcade 1 and 2

Unlike the Spiral, New Jersey's algorithms are not easily viewed as raw numbers (Table 15). This is because the RightID value is associated with specific counties. That must be taken into account first.

Table 15 the first 12 rows of Camden County, NJ, after ID conversion and sort

FullID	Right ID	Alpha ID	Left ID	Count Right ID	full gap
00000M30425	00000	M	30425	1	
00003B27891	00003	B	27891	1	-253399997
00006I17926	00006	I	17926	1	-996499997
00009C51756	00009	C	51756	1	3383000003
00017I41105	00017	I	41105	1	-1065099992
00020E70168	00020	E	70168	1	2906300003
00023F59262	00023	F	59262	1	-1090599997
00024B18289	00024	B	18289	1	-4097299999
00026F50288	00026	F	50288	2	3199900002
00026J44727	00026	J	44727	2	-556100000
00028G30852	00028	G	30852	1	-1387499998

There are legitimate reasons to add a geographical tag to a serial number. If used, the geo tag works only if it is consistently assigned to the same region. The zip code “10005” is one of 106 zip codes assigned to New York County in New York. If that code were assigned to addresses in multiple New York counties, it would be useless as a geo tag.

New Jersey assigned Right ID numbers to multiple counties in all 4 partitions. Table 15 shows how the 68,392 Right ID numbers used in New Jersey are distributed among the 21 available counties. For each partition and the total of all partitions, the number of Right IDs assigned increases and decreases at a constant rate. The result is a normal distribution curve (Table 16). The smallest number of Right ID numbers (n=2,900, 4.24%) is found in the in-range partition.

Table 16 Number of Right ID numbers assigned to number of counties grouped by range

Num Counties	Low OOR	IR	High OOR 1	High OOR 2	Total per county
1	17	0	1	2,336	2,354
2	113	0	29	460	602
3	528	2	123	61	714
4	1,732	2	398	6	2,138
5	3,964	9	917	1	4,891
6	6,815	16	1,546	0	8,377
7	9,171	23	2,044	0	11,238
8	9,734	23	2,218	0	11,975
9	8,347	18	1,826	0	10,191
10	5,593	6	1,245	0	6,844
11	3,153	9	684	0	3,846
12	1,343	6	286	0	1,635
13	489	12	97	0	598
14	138	14	34	0	186
15	32	19	6	0	57
16	4	54	1	0	59
17	0	109	0	0	109
18	0	283	0	0	283

19	0	516	0	0	516
20	0	495	0	0	495
21	0	1,284	0	0	1,284
Total Right ID	51,173	2,900	11,455	2,864	68,392
Percent Right ID	74.82%	4.24%	16.75%	4.19%	100%

In total, only 3.44% (*n*=2,354) of all Right ID numbers (*n*=68,392) are assigned to a single county. The remaining 96.55% (n=66,038) are assigned to 2 or more counties. In-Range Right ID numbers are a minority of all Right ID numbers (4.24%) and all possible numbers (2.9%) but account for 89.42% of all records (*n*=5,776,317) (Table 17). Within this group, 2,786 Right ID numbers (96.06%) are shared among 13 to 24 counties.

Table 17 Number of voter records in each partition

	Low OOR	IR	High OOR 1	High OOR 2	Total
Total records	555,537	5,776,317	124,063	3,516	6,459,433
Percent Records	8.60%	89.42%	1.92%	0.05%	100.00%

Numbers should be unique to any given county if the goal is to append a valid location reference to the ID number. New Jersey shares Right ID numbers across as many as all 21 counties. Normally, this would indicate that the right ID numbers are not linked to location. The Arcade patterns conceal the connection between county and Right ID (Figure 33).

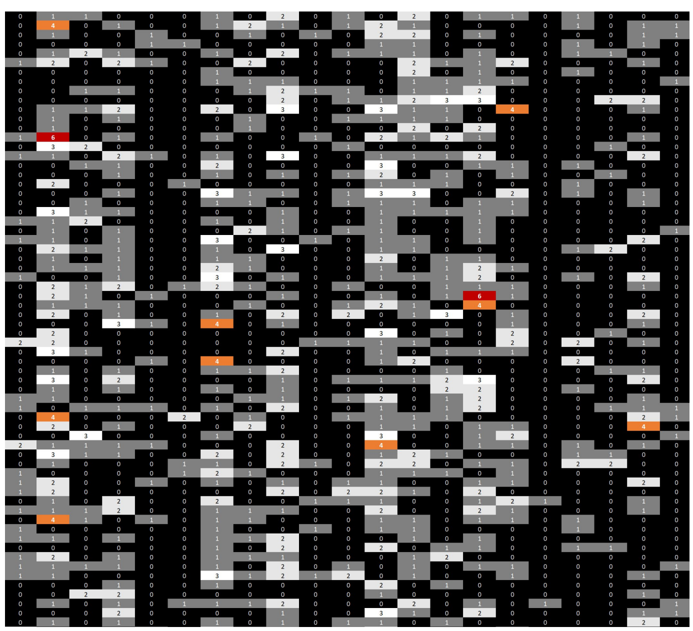

Figure 34 section, Arcade 1 pattern; X-Axis = County, Y-axis = Right ID

Both Arcade patterns are typified by simulated randomness. It is accomplished by assigning Right ID values to multiple counties so that the number of records with a given Right ID value line up in parallel diagonal rows that intersect columns of similar numbers. This repeats for as long as the pattern is active. The number of records assigned to the same Right ID number in the 1st and 3rd partitions (Arcade 1) is between 0-27. The full range in the 4th partition (Arcade 2) is 1-4. The highest number of records in any one county within the Arcade 1 pattern is 7. Within Arcade 2, the maximum is 3 (Figure 35).

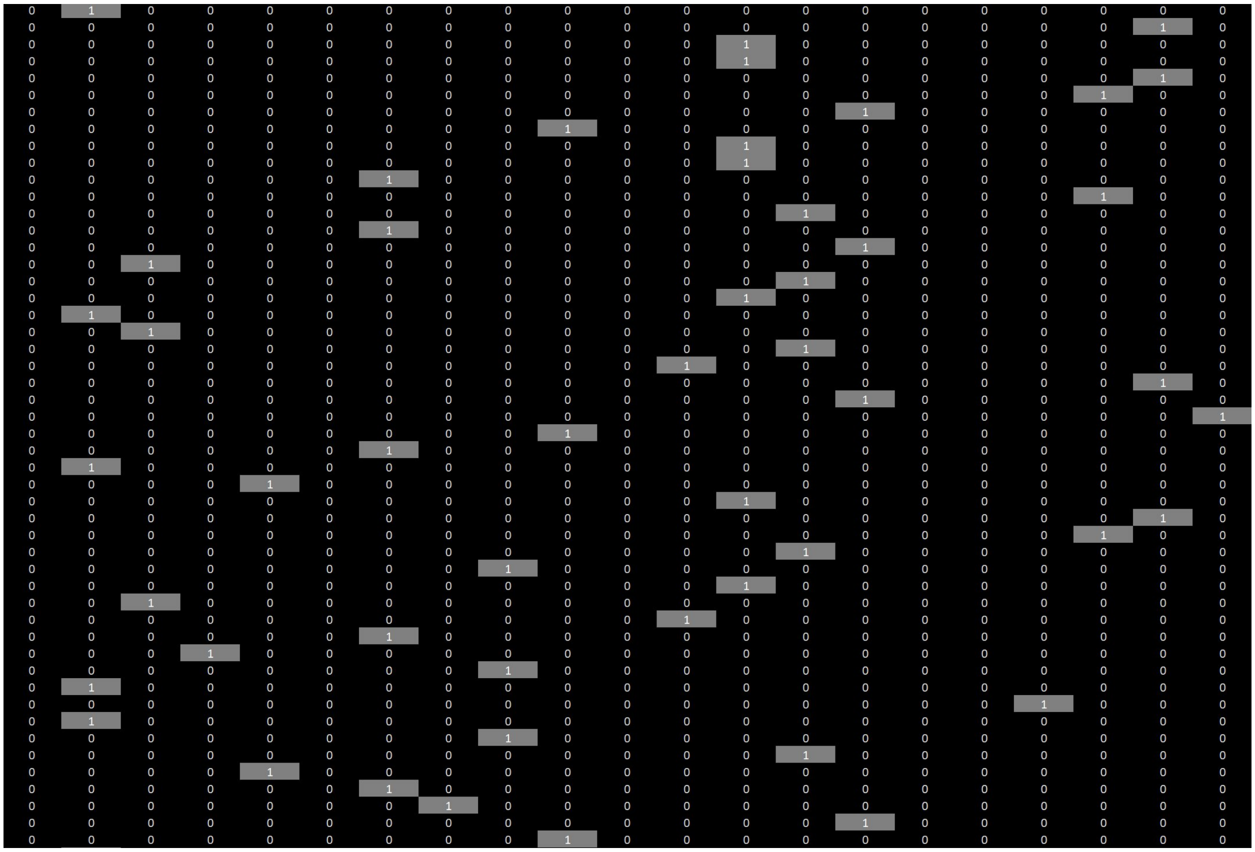

Figure 35 section, Arcade 2; X-axis = County, Y-axis = Right ID

Icicle

The Icicle is located between Partitions 1 and 2. It contains 89.42% of all records for the state of New Jersey but they are squeezed into only 2.9% of the available Right ID numbers and 4.24% of the used Right ID numbers. All Right ID numbers found in the Icicle pattern share a minimum of 3 Counties up to the maximum of 21 counties. Of the total 2,900 Right ID numbers in the Icicle, 93 (3.2%) share between 3-9 counties. The remaining 96.8% of Short ID numbers share between 10-21 counties. On this basis, it would be fair to conclude that Right ID numbers are unrelated to counties. This conclusion, however, is wrong.

In what appears to be an effort to obfuscate or conceal information, Right ID numbers are assigned to specific counties in certain percentages. When sorted by Right ID, Alpha, Left ID, counties assigned to consecutive Short ID numbers present a distinctive concentration of records that sharply contrasts with all surrounding counties. This is very difficult to detect in isolation. For instance, if a single Right ID is extracted, and the number of records assigned per county are examined, one will find seemingly random numbers assigned to most or all counties (Table 18). This can easily be attributed to population variation between counties. However, that conclusion is also wrong.

Table 18 Records per county within the same Right ID (Icicle pattern)

IDright	Atlantic	Bergen	Burlington	Camden	Cape May	Cumberland	Essex	
51211	1	15	10	1	1	3	1797	
	Gloucester	Hudson	Hunterdon	Mercer	Middlesex	Monmouth	Morris	
	1	10	7	9	23	22	49	
	Ocean	Passaic	Salem	Somerset	Sussex	Union	Warren	All
	41	16	1	17	12	79	12	2127

Right ID numbers are distributed across counties based on percentages of the total. The highest concentration of records in one county is either the highest concentration in the following RightID, or it switches to another county. This creates strands, or “icicles” where between 50-150 consecutive rows have the highest concentration of records in the same county. This is also true of the 2nd highest concentration of records, 3rd highest, and so on (Figure 36). The icicles cycle through the entire list of counties, then the cycle repeats. The relationship is unmistakable but it is not a genuine location ID. If it was, it would not be apportioned to other counties at all, nor in descending percentages as is found in New Jersey’s voter rolls.

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W
IDright	Atlantic	Bergen	Burlington	Camden	Cape May	Cumberla	Essex	Glouceste	Hudson	Hunterdo	Mercer	Middlesex	Monmout	Morris	Ocean	Passaic	Salem	Somerset	Sussex	Union	Warren	All
51302	2	38	20	11	1	1	1428	1	47	10	10	45	27	67	10	21	1	28	11	117	15	1911
51303	5	50	13	8	1	1	1545	4	37	5	10	65	14	89	19	26	0	35	9	117	15	2068
51304	4	46	22	6	1	0	1572	2	41	6	8	44	25	90	12	31	0	25	16	96	10	2057
51305	1	62	10	8	2	1	1438	2	42	12	11	51	22	95	17	54	0	38	8	96	9	1979
51306	7	49	23	5	1	1	1566	3	36	8	14	65	32	81	22	37	1	29	20	119	9	2128
51307	9	52	14	7	2	3	1548	4	55	1	6	52	22	85	24	38	1	26	18	119	12	2098
51308	2	39	19	10	0	2	1470	5	45	5	12	56	27	93	23	30	1	24	9	102	14	1988
51309	4	53	11	11	1	1	1603	2	47	6	11	46	22	91	25	37	1	28	11	108	8	2127
51310	7	80	19	11	0	2	1408	6	51	8	16	59	24	92	23	43	0	30	20	94	6	1999
51311	1	49	17	8	0	3	1619	3	38	8	15	47	23	68	13	32	2	24	8	120	6	2104
51312	1	37	7	3	2	1	1058	2	27	7	8	40	8	35	9	31	1	18	6	104	4	1409
51313	0	9	8	6	0	4	517	1	12	0	7	13	6	7	6	8	1	6	2	59	2	674
51314	3	5	13	6	2	1	689	1	20	2	8	19	8	13	4	8	1	8	4	74	8	897
51315	3	6	8	9	0	1	454	2	14	1	5	19	5	5	12	5	1	8	1	43	4	606
51316	2	6	7	8	0	2	315	0	17	1	6	2	1	8	7	5	1	1	2	27	4	422
51317	1	5	4	0	1	1	273	2	10	2	5	2	1	6	2	2	0	2	1	38	3	361
51318	6	2	8	9	10	8	41	1122	3	0	3	9	1	2	3	2	2	2	0	5	0	1238
51319	4	1	2	23	14	4	3	1448	3	1	2	3	0	3	2	2	8	3	1	1	2	1530
51320	16	4	14	30	30	5	1	1778	2	0	2	5	0	0	2	1	12	0	0	2	0	1904
51321	20	1	13	26	23	16	2	1778	0	0	1	0	6	2	7	1	13	2	1	1	0	1913
51322	21	0	5	26	53	13	0	1882	0	1	1	0	3	1	4	0	15	1	0	0	0	2026
51323	34	1	13	51	30	10	0	1972	0	0	4	5	2	3	5	0	13	0	0	0	0	2143
51324	19	3	10	46	50	9	0	2004	1	0	0	1	2	0	4	0	20	0	0	1	0	2170
51325	20	1	9	50	34	6	1	1942	2	0	1	2	1	0	5	2	21	1	2	0	0	2100
51326	19	2	16	75	41	12	2	2007	0	0	4	3	2	2	4	1	19	0	0	1	0	2210
51327	32	2	18	53	30	16	1	2071	3	0	1	0	1	2	9	0	33	1	0	0	0	2273
51328	16	1	11	24	23	3	0	835	0	0	5	0	1	0	3	0	13	1	1	0	1	938
51329	14	1	7	27	24	7	0	789	0	0	0	1	1	0	3	0	7	1	0	2	0	884
51330	28	2	28	66	38	11	1	1776	0	0	4	1	4	1	6	1	21	0	0	1	0	1989
51331	25	1	17	61	30	12	2	1539	0	0	2	0	1	1	1	1	26	1	1	0	0	1721
51332	22	4	23	68	44	11	3	1786	1	0	2	2	2	1	8	1	13	1	0	1	0	1993
51333	30	0	21	56	43	17	5	1718	1	0	1	2	0	1	10	1	27	0	1	1	0	1935
51334	30	0	20	78	22	20	4	1607	1	2	5	2	1	2	6	0	33	3	0	0	2	1838
51335	34	4	18	76	23	21	2	1405	1	0	0	4	2	0	10	0	20	1	1	0	1	1623

Figure 36 Section, "Icicle" pattern at change row from Essex to Gloucester County

To see this more clearly, Figure 37 compares the number of records per county relative to the total as percentages.

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W
IDright	Atlantic	Bergen	Burlington	Camden	Cape May	Cumberla	Essex	Glouceste	Hudson	Hunterdo	Mercer	Middlesex	Monmout	Morris	Ocean	Passaic	Salem	Somerset	Sussex	Union	Warren	All
51300	0.2022%	2.3761%	0.9606%	0.7078%	0.0000%	0.1517%	72.6491%	0.2022%	2.0728%	0.4044%	0.7078%	2.1739%	1.8200%	4.6512%	1.3145%	2.1739%	0.0506%	1.6178%	0.6572%	4.4995%	0.6067%	1978
51301	0.1835%	2.8440%	0.5505%	0.4587%	0.0917%	0.0459%	73.5321%	0.1835%	1.6514%	0.4587%	0.6881%	2.5229%	1.1927%	4.3578%	1.3303%	2.2018%	0.0000%	1.6972%	0.8716%	4.7706%	0.3670%	2180
51302	0.1047%	1.9885%	1.0466%	0.5756%	0.0523%	0.0523%	74.7253%	0.0523%	2.4594%	0.5233%	0.5233%	2.3548%	1.4129%	3.5060%	0.5233%	1.0989%	0.0523%	1.4652%	0.5756%	6.1224%	0.7849%	1911
51303	0.2418%	2.4178%	0.6286%	0.3868%	0.0484%	0.0484%	74.7099%	0.1934%	1.7892%	0.2418%	0.4836%	3.1431%	0.6770%	4.3037%	0.9188%	1.2573%	0.0000%	1.6925%	0.4352%	5.6576%	0.7253%	2068
51304	0.1945%	2.2363%	1.0695%	0.2917%	0.0486%	0.0000%	76.4220%	0.0972%	1.9932%	0.2917%	0.3889%	2.1390%	1.2154%	4.3753%	0.5834%	1.5070%	0.0000%	1.2154%	0.7778%	4.6670%	0.4861%	2057
51305	0.0505%	3.1329%	0.5053%	0.4042%	0.1011%	0.0505%	72.6630%	0.1011%	2.1223%	0.6064%	0.5558%	2.5771%	1.1117%	4.8004%	0.8590%	2.7287%	0.0000%	1.9202%	0.4042%	4.8509%	0.4548%	1979
51306	0.3289%	2.3026%	1.0808%	0.2350%	0.0470%	0.0470%	73.5902%	0.1410%	1.6917%	0.3759%	0.6579%	3.0545%	1.5038%	3.8064%	1.0338%	1.7387%	0.0470%	1.3628%	0.9398%	5.5921%	0.4229%	2128
51307	0.4290%	2.4786%	0.6673%	0.3337%	0.0953%	0.1430%	73.7846%	0.1907%	2.6215%	0.0477%	0.2860%	2.4786%	1.0486%	4.0515%	1.1439%	1.8112%	0.0477%	1.2393%	0.8580%	5.6721%	0.5720%	2098
51308	0.1006%	1.9618%	0.9557%	0.5030%	0.0000%	0.1006%	73.9437%	0.2515%	2.2636%	0.2515%	0.6036%	2.8169%	1.3581%	4.6781%	1.1569%	1.5091%	0.0503%	1.2072%	0.4527%	5.1308%	0.7042%	1988
51309	0.1881%	2.4918%	0.5172%	0.5172%	0.0470%	0.0470%	75.3644%	0.0940%	2.2097%	0.2821%	0.5172%	2.1627%	1.0343%	4.2783%	1.1754%	1.7395%	0.0470%	1.3164%	0.5172%	5.0776%	0.3761%	2127
51310	0.3502%	4.0020%	0.9505%	0.5503%	0.0000%	0.1001%	70.4352%	0.3002%	2.5513%	0.4002%	0.8004%	2.9515%	1.2006%	4.6023%	1.1506%	2.1511%	0.0000%	1.5008%	1.0005%	4.7024%	0.3002%	1999
51311	0.0475%	2.3289%	0.8080%	0.3802%	0.0000%	0.1426%	76.9487%	0.1426%	1.8061%	0.3802%	0.7129%	2.2338%	1.0932%	3.2319%	0.6179%	1.5209%	0.0951%	1.1407%	0.3802%	5.7034%	0.2852%	2104
51312	0.0710%	2.6260%	0.4968%	0.2129%	0.1419%	0.0710%	75.0887%	0.1419%	1.9163%	0.4968%	0.5678%	2.8389%	0.5678%	2.4840%	0.6388%	2.2001%	0.0710%	1.2775%	0.4258%	7.3811%	0.2839%	1409
51313	0.0000%	1.3353%	1.1869%	0.8902%	0.0000%	0.5935%	76.7062%	0.1484%	1.7804%	0.0000%	1.0386%	1.9288%	0.8902%	1.0386%	0.8902%	1.1869%	0.1484%	0.8902%	0.2967%	8.7537%	0.2967%	674
51314	0.3344%	0.5574%	1.4493%	0.6689%	0.2230%	0.1115%	76.8116%	0.1115%	2.2297%	0.2230%	0.8919%	2.1182%	0.8919%	1.4493%	0.4459%	0.8919%	0.1115%	0.8919%	0.4459%	8.2497%	0.8919%	897
51315	0.4950%	0.9901%	1.3201%	1.4851%	0.0000%	0.1650%	74.9175%	0.3300%	2.3102%	0.1650%	0.8251%	3.1353%	0.8251%	0.8251%	1.9802%	0.8251%	0.1650%	1.3201%	0.1650%	7.0957%	0.6601%	606
51316	0.4739%	1.4218%	1.6588%	1.8957%	0.0000%	0.4739%	74.6445%	0.0000%	4.0284%	0.2370%	1.4218%	0.4739%	0.2370%	1.8957%	1.6588%	1.1848%	0.2370%	0.2370%	0.4739%	6.3981%	0.9479%	422
51317	0.2770%	1.3850%	1.1080%	0.0000%	0.2770%	0.2770%	75.6233%	0.5540%	2.7701%	0.5540%	1.3850%	0.5540%	0.2770%	1.6620%	0.5540%	0.5540%	0.0000%	0.5540%	0.2770%	10.5263%	0.8310%	361
51318	0.4847%	0.1616%	0.6462%	0.7270%	0.8078%	0.6462%	3.3118%	90.6300%	0.2423%	0.0000%	0.2423%	0.7270%	0.0808%	0.1616%	0.2423%	0.1616%	0.1616%	0.1616%	0.0000%	0.4039%	0.0000%	1238
51319	0.2614%	0.0654%	0.1307%	1.5033%	0.9150%	0.2614%	0.1961%	94.6405%	0.1961%	0.0654%	0.1307%	0.1961%	0.0000%	0.1961%	0.1307%	0.1307%	0.5229%	0.1961%	0.0654%	0.0654%	0.1307%	1530
51320	0.8403%	0.2101%	0.7353%	1.5756%	1.5756%	0.2626%	0.0525%	93.3824%	0.1050%	0.0000%	0.1050%	0.2626%	0.0000%	0.0000%	0.1050%	0.0525%	0.6303%	0.0000%	0.0000%	0.1050%	0.0000%	1904
51321	1.0455%	0.0523%	0.6796%	1.3591%	1.2023%	0.8364%	0.1045%	92.9430%	0.0000%	0.0000%	0.0523%	0.0000%	0.3136%	0.1045%	0.3659%	0.0523%	0.6796%	0.1045%	0.0523%	0.0523%	0.0000%	1913
51322	1.0365%	0.0000%	0.2468%	1.2833%	2.6160%	0.6417%	0.0000%	92.8924%	0.0000%	0.0494%	0.0494%	0.0000%	0.1481%	0.0494%	0.1974%	0.0000%	0.7404%	0.0494%	0.0000%	0.0000%	0.0000%	2026
51323	1.5866%	0.0467%	0.6066%	2.3798%	1.3999%	0.4666%	0.0000%	92.0205%	0.0000%	0.0000%	0.1867%	0.2333%	0.0933%	0.1400%	0.2333%	0.0000%	0.6066%	0.0000%	0.0000%	0.0000%	0.0000%	2143
51324	0.8756%	0.1382%	0.4608%	2.1198%	2.3041%	0.4147%	0.0000%	92.3502%	0.0461%	0.0000%	0.0000%	0.0461%	0.0922%	0.0000%	0.1843%	0.0000%	0.9217%	0.0000%	0.0000%	0.0461%	0.0000%	2170
51325	0.9524%	0.0476%	0.4286%	2.3810%	1.6190%	0.2857%	0.0476%	92.4762%	0.0952%	0.0000%	0.0476%	0.0952%	0.0476%	0.0000%	0.2381%	0.0952%	1.0000%	0.0476%	0.0952%	0.0000%	0.0000%	2100
51326	0.8597%	0.0905%	0.7240%	3.3937%	1.8552%	0.5430%	0.0905%	90.8145%	0.0000%	0.0000%	0.1810%	0.1357%	0.0905%	0.0905%	0.1810%	0.0452%	0.8597%	0.0000%	0.0000%	0.0452%	0.0000%	2210
51327	1.4078%	0.0880%	0.7919%	2.3317%	1.3198%	0.7039%	0.0440%	91.1131%	0.1320%	0.0000%	0.0440%	0.0000%	0.0440%	0.0880%	0.3960%	0.0000%	1.4518%	0.0440%	0.0000%	0.0000%	0.0000%	2273
51328	1.7058%	0.1066%	1.1727%	2.5586%	2.4520%	0.3198%	0.0000%	89.0192%	0.0000%	0.0000%	0.5330%	0.0000%	0.1066%	0.0000%	0.3198%	0.0000%	1.3859%	0.1066%	0.1066%	0.0000%	0.1066%	938
51329	1.5837%	0.1131%	0.7919%	3.0543%	2.7149%	0.7919%	0.0000%	89.2534%	0.0000%	0.0000%	0.0000%	0.1131%	0.1131%	0.0000%	0.3394%	0.0000%	0.7919%	0.1131%	0.0000%	0.2262%	0.0000%	884
51330	1.4077%	0.1006%	1.4077%	3.3183%	1.9105%	0.5530%	0.0503%	89.2911%	0.0000%	0.0000%	0.2011%	0.0503%	0.2011%	0.0503%	0.3017%	0.0503%	1.0558%	0.0000%	0.0000%	0.0503%	0.0000%	1989
51331	1.4526%	0.0581%	0.9878%	3.5445%	1.7432%	0.6973%	0.1162%	89.4248%	0.0000%	0.0000%	0.1162%	0.0000%	0.0581%	0.0581%	0.0581%	0.0581%	1.5107%	0.0581%	0.0581%	0.0000%	0.0000%	1721
51332	1.1039%	0.2007%	1.1540%	3.4119%	2.2077%	0.5519%	0.1505%	89.6136%	0.0502%	0.0000%	0.1004%	0.1004%	0.1004%	0.0502%	0.4014%	0.0502%	0.6523%	0.0502%	0.0000%	0.0502%	0.0000%	1993
51333	1.5504%	0.0000%	1.0853%	2.8941%	2.2222%	0.8786%	0.2584%	88.7855%	0.0517%	0.0000%	0.0517%	0.1034%	0.0000%	0.0517%	0.5168%	0.0517%	1.3953%	0.0000%	0.0517%	0.0517%	0.0000%	1935

Figure 37 Icicle pattern, percentage comparison of records assigned to counties within each Right ID

Phantom registrations

A preliminary search for phantom registrations in New Jersey yielded 114, 548 records. Sorted by Right ID, the first record is assigned to Right ID 51,174 and the last record is assigned to Right ID 54,073. These are the first and last values, respectively for the Icicle pattern. There are no outliers in either of the Arcade partitions. The search for phantoms was conducted before the discovery of the Arcade or Icicle patterns.

Phantoms were determined based on the following criteria:

- Matching first name, last name, and date of birth with 2 or more voter ID numbers ("clone")
- Registration date before voter is 12 years old
- Age on election day 2020 is less than 15
- Registration date is federal holiday
- Voter date of birth is too young to vote (many have birth dates that are in the future)
- Voter date of birth is earlier than that of the oldest known living American at the time of the 2020 GE

Discussion

New York State's voter rolls contain SBOEID numbers assigned by 4 or more algorithms. The algorithm links CID numbers to SBOEID numbers in a manner designed to produce a sort order that cannot be reproduced using any normal sort methods. The dependency between CID and SBOEID numbers requires that county ranges are fixed, or the sort order would be disrupted. The sort order creates a unique grouping structure, or "matrix". The groups thus produced are hidden from any user who is unaware of the algorithm and the several steps needed to reveal it.

The obfuscation techniques utilized to hide the SBOEID matrices is a combination of 2 techniques known as "data masking" and "data shuffling" in the Information Security (IS) industry. Data masking is used to disguise the existence of county ranges and the need to perform a calculation to reveal the pattern. Data shuffling is used to provide access to specific SBOEID numbers via a hidden calculation.

Another way to look at the grouping structure is as identity units. The algorithm sorts SBOEID numbers into packets that resemble File Transfer Protocol (FTP) packets. Each of these is segregated from the others by their packet number. These packet numbers, or the SBOEID number's position within each matrix, can be used to identify records of interest. The purpose of using an algorithm to accomplish this task appears to be clandestine. Otherwise, it would be simpler and more efficient to add a field to the record and use it to flag the same files.

The reason why algorithms were used to do this is unknown. However, it is peculiar that they appear to have been designed to accomplish a task of great importance to anyone involved in election fraud. That task is to identify phantom voters.

"Phantom voters" are false registrations placed in the voter rolls to accommodate false votes, such as those distributed via ballot harvesting operations. If a ballot harvester deposits 10 illegitimate votes in a ballot box, they will be counted. However, if the number of voters counted by the board of elections is significantly different from the number of ballots counted, there is a serious risk of discovery. To reduce the risk, phantom registrations may be inserted into the voter rolls. Then, provided the number of illegitimate votes is known, a corresponding number of phantom registrations are marked to indicate that a vote was cast in the name appearing on those records.

The problem with phantom voters is that they are useless if their presence is known and they can be differentiated from legitimate registrations. Thus, the phantom voters must be hidden. That presents another problem. If the phantom voters are hidden in a sizable database, such as the NYS voter rolls, it would be impossible for any person connected to the fraud to utilize those records unless they had a way to easily identify them.

Therefore, a tool that can clandestinely mark voter roll records as phantom voters would have great value to any person with intent to commit election fraud. The patterns seen in the voter rolls examined to date are clandestine and they reorganize the data in such a way that any number of software solutions could be used to directly extract or interact with records of interest. The algorithms used in New York are examples of "in-band steganography", the practice of hiding information in plain sight, in this case by utilizing an existing structure.

It remains to be seen whether the algorithms have been used to flag phantom voters. To discover whether this is true, more research is needed. However, it is known that the NYS voter rolls contain at least 320,000 records that can be described as "phantom voters", including at least 10 of the 11 records assigned to Chaim Metzner. The state of New Jersey, like New York, has used complex hidden algorithms to generate a matrix of transformed voter ID numbers. Other states show signs of the same sort of matrices in their rolls as well.

The presence of known fraudulent registration records, and an unknown number yet to be discovered, is enough to reasonably expect that whatever person or persons placed them there would have a compelling reason to access those records clandestinely. The possibility this has happened is suggested by the finding that all of the New Jersey records found in a search for phantom voters occupied the same partition, without outliers. It is unlikely that 114,548 randomly selected records would land in the same partition by chance.

It is peculiar that data obfuscation techniques would be utilized to disguise legitimate group membership found in publicly available data. Data obfuscation is normally used to conceal sensitive information. Credit card numbers, Social Security numbers, and Driver's license numbers, are sensitive. Laws exist to prevent their public disclosure. On the other end of the spectrum of "sensitive information", laws exist to designate voter roll records, including SBOEID numbers, as public. Any citizen who requests a county's voter rolls, given certain easily satisfied conditions, is allowed to have them. By law, the SSN and Driver's license numbers contained in those records must be redacted or deleted. The rolls received by NYCA are an example of this. Every county and the state deleted SSN and Driver's license numbers from the voter rolls they provided but all of them included SBOEID and CID numbers.

This study has more ground to cover but it has already revealed the clandestine presence of steganography at work in the New York and New Jersey voter rolls. This is a concern for the following reasons:

- The algorithms are complex, demonstrating sophisticated knowledge of steganographic techniques
- The records are public, and thus should not be encrypted in any way. Doing so potentially violates public access laws
- Voter ID numbers are an essential key to the electoral process. If they have been illegitimately manipulated, so has any election that depends on them
- The algorithms appear in a minimum of 2 states, with indications of more to be discovered
- The effort to create the matrices found in this study exceeds any likely legitimate purpose
- The effort required to find the matrices indicate a serious effort to conceal them. This is indicative of an illegitimate purpose.

Appendix

County codes

Table 19 County code sort order and county range sort order compared

	County Code	County range order	County Code	County Range ID
Albany	1	Out of range 0		1
Allegany	2	Schoharie	47	1.01
Bronx	3	Buffer 1		2
Broome	4	Onondaga	34	2.01
Cattaraugus	5	Schenectady	46	2.02
Cayuga	6	Oswego	38	2.03
Chautauqua	7	Niagara	32	2.04
Chemung	8	Suffolk	52	2.05
Chenango	9	Essex	16	2.06
Clinton	10	Buffer 2		3
Columbia	11	Hamilton	21	3.01
Cortland	12	Columbia	11	3.02
Delaware	13	Franklin	17	3.03
Dutchess	14	Warren	57	3.04
Erie	15	Fulton	18	3.05
Essex	16	Tioga	54	3.06
Franklin	17	Montgomery	29	3.07
Fulton	18	Seneca	49	3.08
Genesee	19	Madison	27	3.09
Greene	20	Allegany	2	3.1
Hamilton	21	Saratoga	45	3.11
Herkimer	22	Ulster	56	3.12
Jefferson	23	Albany	1	3.13
Kings	24	Broome	4	3.14
Lewis	25	Cattaraugus	5	3.15
Livingston	26	Cayuga	6	3.16
Madison	27	Chautauqua	7	3.17
Monroe	28	Chemung	8	3.18
Montgomery	29	Chenango	9	3.19
Nassau	30	Genesee	19	3.2
New York	31	Lewis	25	3.21
Niagara	32	Livingston	26	3.22
Oneida	33	Ontario	35	3.23
Onondaga	34	Orange	36	3.24
Ontario	35	Orleans	37	3.25
Orange	36	Schuyler	48	3.26
Orleans	37	Sullivan	53	3.27

Oswego	38	Tompkins	55	3.28
Otsego	39	Yates	62	3.29
Putnam	40	Wayne	59	3.3
Queens	41	Herkimer	22	3.31
Rensselaer	42	Oneida	33	3.32
Richmond	43	Clinton	10	3.33
Rockland	44	Washington	58	3.34
Saratoga	45	Dutchess	14	3.35
Schenectady	46	Jefferson	23	3.36
Schoharie	47	Rockland	44	3.37
Schuyler	48	Otsego	39	3.38
Seneca	49	Steuben	51	3.39
St. Lawrence	50	Greene	20	3.4
Steuben	51	Erie	15	3.41
Suffolk	52	Monroe	28	3.42
Sullivan	53	Rensselaer	42	3.43
Tioga	54	Wyoming	61	3.44
Tompkins	55	Buffer 3		4
Ulster	56	Putnam	40	4.01
Warren	57	Cortland	12	4.02
Washington	58	Buffer 4		5
Wayne	59	Richmond	43	5.01
Westchester	60	St.Lawrence	50	5.02
Wyoming	61	Bronx	3	5.03
Yates	62	Queens	41	5.04
		Kings	24	5.05
		New York	31	5.06
		Delaware	13	5.07
		Nassau	30	5.08
		Buffer 5		6
		Westchester	60	6.01
		Out of Range 1		7
		Out of Range 2		8
		Out of Range 3		9
		Out of Range 4		10
		Out of Range 5		11
		Out of Range 6		12

Table 20 Schenectady SBOEID analysis, first 33 rows and rows 82,885 and 82,866

Row	CID	Short ID	SBOEID Gap	SBOEID Sum	Dist to MIN	Dist to MAX
2	3	9,382,494			0	95,168
3	4	9,397,107	14,613		14,613	80,555
4	10	9,408,218	11,111		25,724	69,444
5	11	9,419,329	11,111		36,835	58,333
6	13	9,430,440	11,111		47,946	47,222
7	28	9,441,551	11,111		59,057	36,111
8	29	9,452,662	11,111		70,168	25,000
9	39	9,463,773	11,111		81,279	13,889
10	40	9,474,884	11,111		92,390	2,778
11	55	9,390,827	-84,057		8,333	86,835
12	56	9,396,273	5,446		13,779	81,389
13	57	9,397,385	1,112	278	14,891	80,277
14	79	9,398,496	1,111		16,002	79,166
15	80	9,399,607	1,111		17,113	78,055
16	82	9,400,718	1,111		18,224	76,944
17	92	9,401,829	1,111		19,335	75,833
18	105	9,402,940	1,111		20,446	74,722
19	133	9,404,051	1,111		21,557	73,611
20	136	9,405,162	1,111		22,668	72,500
21	165	9,406,273	1,111		23,779	71,389
22	190	9,407,384	1,111		24,890	70,278
23	191	9,408,496	1,112	11,111	26,002	69,166
24	215	9,409,607	1,111		27,113	68,055
25	216	9,410,718	1,111		28,224	66,944
26	247	9,411,829	1,111		29,335	65,833
27	260	9,412,940	1,111		30,446	64,722
28	261	9,414,051	1,111		31,557	63,611
29	308	9,415,162	1,111		32,668	62,500
30	309	9,416,273	1,111		33,779	61,389
31	313	9,417,384	1,111		34,890	60,278
32	339	9,418,495	1,111		36,001	59,167
33	352	9,419,607	1,112	11,111	37,113	58,055
82,885	382,786	9,477,662	1		95,168	0
82,886	382,787	9,382,495	-95,167		1	95,167

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[i] There is a 3 number gap between Livingston and Ontario counties, Monroe and Rensellaer counties, and New York and Delaware counties.