Uniform Audit Tally Sheets

Edited by Ray Lutz, Citizens' Oversight

Version history
V0.2 2019-06-15 COMMUNITY DRAFT Posted online to https://copswiki.org/Common/M1939
V0.2 2019-12-05 Ported to Google Docs to allow easier comment
V0.3 2019-12-10 Submitted to California Secretary of State re RLA Regulations
V0.4 2020-10-26 Enhanced descriptions to support polling place report projects
V0.5 2020-10-27 Simplified table structure in spreadsheet format

Objective

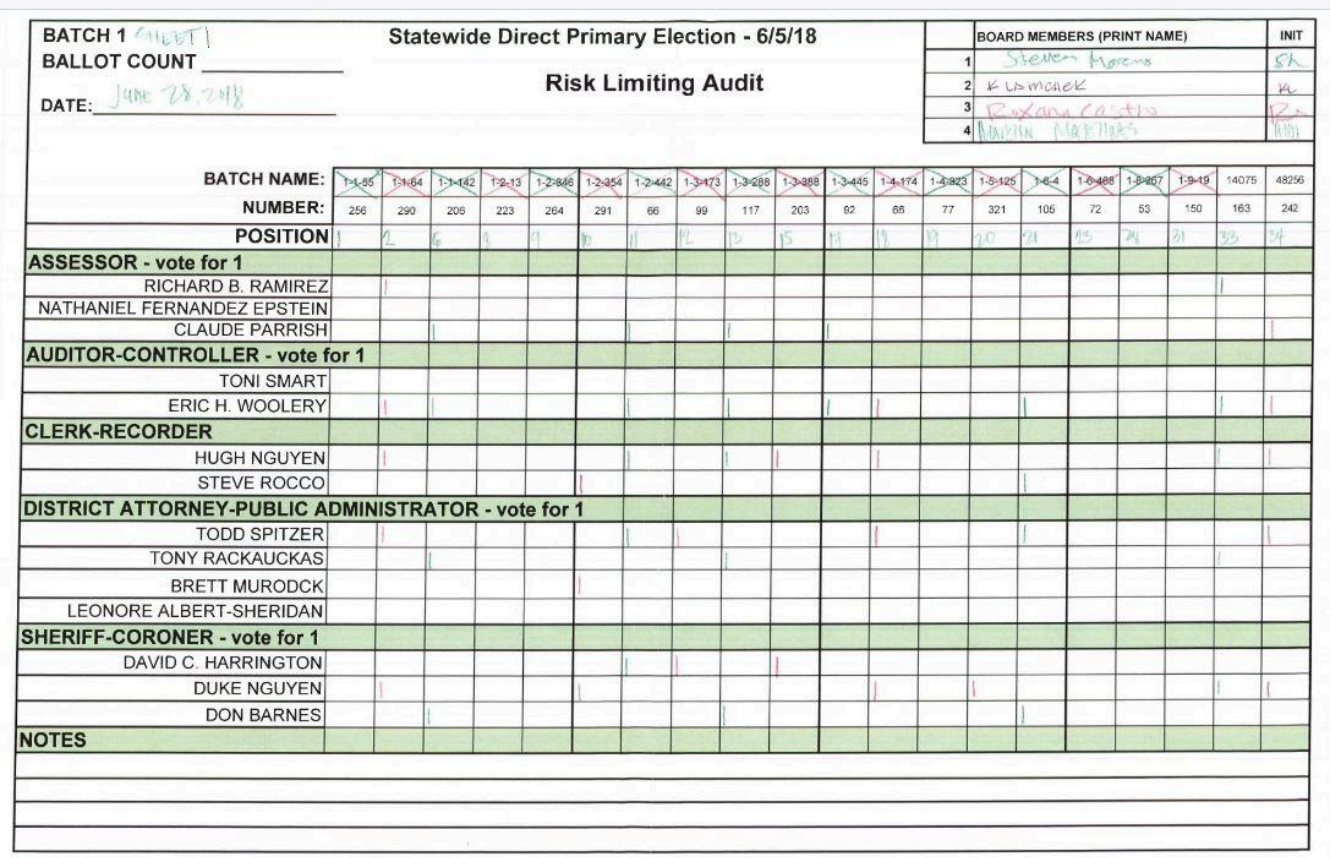
The objective of this document is to define a uniform tally sheet format, method and procedure that can be used with various audit protocols. Tally sheets are an integral part of any audit procedure because they:

1. provide a way to enter data without reliance on any software or system that might lose or alter the data being entered.
2. can reduce the amount of data entered into any software by 20 to 100 times, thereby reducing potential data entry error (in the case of ballot-polling and batch comparison audits).
3. can provide simple column and row checksums to reduce human errors when the tally sheets are completed and compared as well as when the data is entered in auditing software or a system from the tally sheets.
4. can be scanned to create high-resolution PDF images to be included as a public record and as solid source evidence for auditors in their review of paper ballots. Tally sheets should be a convenient size (either "letter" 8.5" x 11" or "legal" 8.5" x 14") to facilitate scanning.
5. should include the printed names and initials of each of the members of the tally team and the ballot access team who accessed the ballots and pulled them according to the picklist.
6. can be used by redundant teams to eliminate any risk of human error during the interpretation of voter intent and tallying process.
7. can be used for any voting method, such as, plurality, score then automatic runoff (STAR), rank-choice, etc.
8. can be used in approximately the same form for ballot-polling, ballot-comparison, and batch-comparison audits.

9. facilitate data gathering as an independent step while avoiding any risk of improperly comparing with the Cast-Vote-Record (CVR) for any ballot or tally batch, so as to avoid innocent "fix-up" errors.

Features

The tally sheets that were used in the Orange County, CA pilot ballot-polling audit will be used as a starting point for this recommendation. An illustration of one of these tally sheets is shown in Figure 1.



BATCH 1 SHEET 1
BALLOT COUNT _____
DATE: June 28, 2018

Statewide Direct Primary Election - 6/5/18

Risk Limiting Audit

	BOARD MEMBERS (PRINT NAME)	INIT
1	Steven Marcus	SK
2	K Lamarck	KL
3	Roxana Castro	RC
4	Marvin Martinez	MM

BATCH NAME:	1-1-85	1-1-64	1-1-142	1-2-13	1-2-846	1-2-354	1-2-442	1-3-173	1-3-288	1-3-388	1-3-445	1-4-174	1-4-823	1-5-125	1-6-4	1-6-488	1-8-257	1-9-19	14075	48256
NUMBER:	256	290	205	223	264	291	66	99	117	203	92	66	77	321	105	72	53	150	163	242
POSITION	1	2	6	9	11	10	11	12	13	15	14	18	19	20	21	23	24	31	33	34
ASSESSOR - vote for 1																				
RICHARD B. RAMIREZ		1																1		
NATHANIEL FERNANDEZ EPSTEIN																				
CLAUDE PARRISH			1				1		1		1									1
AUDITOR-CONTROLLER - vote for 1																				
TONI SMART																				
ERIC H. WOOLERY		1	1				1		1		1	1			1			1		1
CLERK-RECORDER																				
HUGH NGUYEN		1					1		1	1		1						1		1
STEVE ROCCO						1									1					
DISTRICT ATTORNEY-PUBLIC ADMINISTRATOR - vote for 1																				
TODD SPITZER		1					1	1				1			1					1
TONY RACKAUCKAS			1						1									1		
BRETT MURODCK						1														
LEONORE ALBERT-SHERIDAN																				
SHERIFF-CORONER - vote for 1																				
DAVID C. HARRINGTON						1	1		1											
DUKE NGUYEN		1				1						1		1				1		1
DON BARNES			1					1							1					
NOTES																				

Figure 1: Tally Sheets as used in Orange County, CA in 2018.

Ballot options in rows, ballots in columns. Each of the races and ballot options is listed as a separate row with the individual ballots reviewed in each column. This format is typically what is already used when tallying ballots. Ballot options should include only the official ballot options and any officially accepted write-in candidates.

For ballot-oriented audits, there is no need for "vote for 1" or similar notations; however, in batch-based audits, this information IS required to determine over-votes. It is necessary for the procedures recommended here that the contest name be confined to the first column and not

overflow into the subsequent columns, as those columns will be used for notations in the contest-name row.

Multiple sheets are used when there are more contests and contest options than will fit on one sheet so as to create more rows. Such a set of sheets that list all the options of all contests involved in the audit, and yet limited to the number of ballots across the sheet, is called a tally-group. Thus, multiple sheets can be added to a single tally-group to create more rows but not more columns. Additional ballots are supported by creating a new tally-group.

Convenient Number of Ballots. A tally-group is to be limited to a reasonable number of ballots i.e. columns, such that they can be identified across the top. The example used here limits the number of ballots to 20. When there is an option, it will be most convenient to round-up the total number of samples in each stage to that number, for example multiples of 20.

In the case of batch-comparison audits, the number of ballots can be expanded to a total of 100 per sheet using by tallying multiple ballots per column, typically using the "five bar gate" tally mark method[1]. Then the top row is not ballot identifiers, but groups of tallies, where each group contains 5 tally marks, and each sheet can hold 100 tallies for each ballot option, for example. Such batches should be split into at least two tally-groups so that any one tally team will not be able to "seek" the total they may already know from public information published about the totals in each batch.

Ballot Identifiers. For ballot-oriented audits, each column has information at the top that identifies the ballots to be included in the tally. This typically means a batch identifier (like precinct number or box number) and offset within that batch, and perhaps a distinct ballot ID number. This information can be pre-printed by the auditing software that generates the tally sheets.

Used as a pick-list. The tally sheet(s) can be used as a pick-list to access the ballots. As each ballot is accessed, it is added to the tally-group in the order shown along the top line, and processed as a group.

Checksum column and row. There should be a checksum column at the far right end and checksum row at the bottom. The checksums are specific to the votes on a single sheet and do not span other sheets in the same tally-group or other tally-groups. Each tally team should count the number of votes in each row and in each column and enter the numbers accordingly. The grand total of all the entries in the checksum row at the bottom should match the total of the entries in the checksum column. The checksums can help to locate simple human errors and facilitate tally-sheet comparisons, as well as facilitate checking during data entry.

Supports Redundant Teams. It is considered best-practice to use two teams to review the ballots and enter the result independently on their own tally-group sheets. The sheets can then be compared, including comparing the checksums to locate any errors in interpreting voter intent.

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[1] https://en.wikipedia.org/wiki/Tally_marks

(If a system such as STAR is used, it is necessary to enter two numbers, the total score and a count of the number of ballots with votes for that option.)

The checksum column will be used directly for data-entry for ballot-polling and batch-comparison audits and is an important feature to reduce data entry time and limit errors.

Indications for NA and No Marks. For ballot-oriented audits, there is a need for two other indications.

a) First, if the ballot does not have the contest at all, then that will be indicated with a vertical line through all the boxes of that race and NA written in the row of the contest name. Please note that this is not the same as having the race with no votes.

b) Second, if a ballot DOES include the race but there are no marks at all, then this will be indicated with no tally marks and by entering 0 in the checksum row for that ballot column.

When each column on the tally sheet represents a single ballot, it is not necessary to separately notate over or under votes, as those can be discerned by the marks that are provided.

If multiple ballots are included in each column, (batch-oriented audits) it is also necessary to separately capture the number of over-vote, under-votes, and NA ballots in the tally-group.

Procedure

1. **Printing Tally Sheets**

   The election audit software should generate the tally sheets based on the audit method being used. This software should print each of the contests and ballot options in the left-most column that are included in the audit. Multiple sheets will be necessary for a given tally-group if there are more contests and ballot options that are included in the audit than will fit on one sheet. This set of sheets is included in the same tally-group.

   For ballot-oriented audits, the election audit software should use the official Cast-Vote Record (CVR) file, random seed, and public random number generator (RNG) to select the ballots that will be included in the audit. These can be ordered and grouped together within each stage of the audit so the ballots can be conveniently accessed from storage. That is, even though the random ballots were chosen in a different order, it is allowed to keep ballots that are from the same source in the same tally-group as long as any risk assessment is performed only at the end.

2. **The column headers:**

For a ballot-polling audit, the Batch Name and Offset within the batch, and optionally, if there is a ballot ID number that exists in the CVR that can help to identify the ballot within the batch, should be shown along the top of the tally sheet.

For a ballot-comparison audit, it is necessary to have a one-to-one correspondence of ballot and the CVR record, so an exact ballot ID number that can uniquely identify the ballot is required, and should be fully specified along the top row.

For batch-comparison audits, at least two tally-groups are used for each batch included in the audit.

3. **Pulling the Sample**

   The tally sheets can be used also as a pick-list to access individual ballots (ballot-comparison or ballot-polling audit) or as a traveler to access a batch (batch-comparison audit).

   The members of the audit board that pull the sample should list their names and initial the tally sheet. (Note: If ballots are pulled using a batch and offset, "k-cut" or measurement technique, it is important to select the ballot using a knife blade as the last step without any opportunity to see the ballot being selected from a larger group. Once selected, the selected ballot must not be modified or corrected unless the procedure is restarted.)

   Tally-groups in ballot-based audits should have the tally sheet(s) on top, with the ballots in order behind it. Batch-oriented audits can deliver the batch, unopened to the tally center, with the set of tally-group sheets on top.

4. **Splitting Batches**

   For batch-comparison audits, the first step is to count and split the batch into at least two tally-groups, where each one has less than 100 ballots (for example). This will ensure that one set of tally sheets will be sufficient for each tally-group. It is essential that each batch is split into at least two tally-groups to avoid seeking the result of any published totals for the batches.

5. **Tallying**

   The fastest and most reliable method of tallying is the "read-and-tally" method. We recommend three-person tally teams composed of a reader, a tallier, and an observer who watches both the reading and tallying. The tally team should print their names on the tally sheet. There should be no access to any computer report or other information during the tallying process.

   a) The reader places the next ballot on the table so it can be seen by the observer, and the tallier places the tally sheet in the same fashion.

b) For ballot-comparison audits and ballot-polling audit, the reader identifies the ballot and confirms it matches the identification on the tally sheet.

c) The reader reads each race and the voter's selection, or "no selection." If there is any difficulty in interpreting the voter's intent, the tally team can request official adjudication. Any such adjudication should be mentioned in the notes section at the bottom of the tally sheet.

d) The tallier adds a single tally mark to the center of the tally box for ballot-based audits.For batch-comparison audits, add a tally mark to create a 5 tally in each box.

e) If the race does not exist on the ballot, the tallier will draw a vertical line through the boxes for the race (ballot-based audits) . [This raises an issue, how do we denote "contest not on ballot" for batch comparison audits?]

f) Continue from (b) for each ballot in the tally-group.

g) When all ballots are completed, the tallier will count all the votes in each row and column, and enter the sum in the checksum column and row. The sum of the entries in each row and column should sum to the same value. Calculators should be available to assist in generating the totals of the sums in each row and column.

h) The observer should check the work of the tallier and then when all members of the team believe they have accurately and correctly interpreted the marks on the ballots, they should then initial next to their printed names.

6. **Tally Team Comparison and Reconciliation**
   Two independent teams should tally each tally-group of ballots and generate a separate tally sheet. Once completed, the two teams will then compare their tally sheets with the other. If there is any discrepancy, they must work to resolve why and correct them accordingly. During this process, there should be no comparison with the official Cast-Vote Record report.

7. **Scanning tally sheets prior to data entry**
   Once each tally-group has been completed and the two teams have reconciled any differences, the tally sheet can then be approved for data-entry. Scanning the tally sheet can freeze the data and ensure that the tally results cannot be modified during the data-entry process so it will match the computer report. Scanned tally sheets should be published to the internet in a form that can be accessed and downloaded by members of the public.

8. **Data Entry**
   The tally sheets (or the images of the tally sheets) can then be moved to the data entry area where auditing team members can enter the data. The exact method of entering the data

from the tally sheet differs slightly in various auditing software platforms. The data from each sheet can be entered either in column or row order.

For ballot-polling and batch-comparison audits, the totals of each row are entered into the auditing software. This reduces data entry by 20 to 100 times compared with entering each ballot. For batch-oriented software analysis, the data can be entered into a spreadsheet format for analysis.

For ballot-comparison audits, it is necessary to enter every ballot separately.

9. **Risk Evaluation**
   Once all the tally-groups in the auditing stage are processed, a risk evaluation is feasible.
10. **Audit Escalation**
    If additional audit stages are called for, the entire procedure outlined here should be repeated identically for each stage.

Variations based on audit types

Ballot-comparison audits require that every single ballot is entered into the election software to enable direct ballot-to-ballot comparisons with the corresponding CVR. That means that the tally sheet must break out and identify every single ballot separately. Because each ballot is entered in a separate column, it is not necessary to enter over-votes or under-votes because those can be readily determined by inspecting the data for any single ballot, if all the marks are provided. The column and row checksums are not entered during the data-entry step, but are very useful to check that the data has been correctly entered, as the user interface can calculate the checksums and allow the data entry operator to check that they match those on the paper tally sheet.

Ballot-polling audits do not compare any ballot with the CVR, so it is not essential that each ballot is separately entered. However, each ballot must be separately identified so it can be accessed from the ballots in storage. It makes sense to still treat each ballot as a separate column.

Batch-oriented audits do not need to specify ballots separately. In the end, it is only the total number of votes for each of the ballot options being audited and the number of over-votes and under-votes that will be used by the auditing software to estimate the risk. In this case, the "five-bar gate" method can be used in each column rather than viewing each column as a single ballot. If this method is used, then each column can be labeled with the sum when that column is filled, such as 5, 10, 15, 20... There is no need for a checksum row at the bottom. The sum column on the total number of tallies in the tally-group for that ballot option. This can be easily determined by looking at the header row and noting if the five-bar-gate is completed, and then writing the number in the right column.

When the five-bar-gate method is used, it is then necessary to also separately tally the number of undervotes and overvotes. This means that the tally team must watch for over and under votes and

enter these counts properly as they are not actually shown on the ballot. Thus, there is more room for error when using this method although there is some time savings by using fewer tally groups. For districts that use party-line voting, it is also necessary to remember if the party line vote was made, and then even if the contest has no votes, that it is noted appropriately on the tally sheet. This is another aspect that can increase human error.

Machine Assistance

There are several opportunities for machine assistance in the process of capturing the voter intent from ballot evidence.

1. **Concurrent entry.**
   As each ballot is processed, data entry operators listen to the reader and enter into a software interface that mimics the tally sheet, as other board members enter into the tally sheets, and observers watch.

2. **One team enters into the physical tally sheet(s), the second team enters into software.**
   To realize the two-team approach, one team independently reviews the actual ballots and enters into hardcopy tally sheets then (either before or after) a second team also views the actual ballots and enters directly into the auditing software which mimics the tally sheet instead of entering into two tally sheets. Auditing board members compare the hard-copy tally sheets with the entered data and resolve any differences.

3. **Mark-Sense Scanning of Tally Sheets.**
   The tally sheets in each tally group are completed as described above and then scanned and marks detected. The tally sheets should be designed with an oval in each ballot and option location, and the user will darken-the-bubble on the sheet to match the vote on the ballot. This eliminates the data entry step, and anyone can check that the tally sheets match the data entered. (Anything other than simple voting methods may be difficult to express with mark-sense bubbles).

4. **Imaging the selected ballots during the audit and direct computer entry from the images.**
   Ballot images would be created by scanning the physical ballots pulled during the auditing process. Note that these images are not the ones that may already exist from the election system under audit. Auditors would view ballot images in each tally group, and enter the votes as interpreted concurrently into auditing software and/or into tally sheets. Since the imaged ballots can be published as part of the auditing data and viewed (and confirmed) by anyone later, the tally sheets are not as important as they are if no ballot images are available.

   Two teams could independently enter the data from the ballot images separately (but perhaps concurrently in time as the ballot images can be shared) and the data entered into

separate digital tally sheets, which can be digitally compared for any differences between the teams.

An amendment to this approach is to provide only the physical ballots to one team and the ballot images to the other team. Each directly enters the data into auditing software that mimics the tally sheets described here. In this way, the ballot images are also validated from paper to improve the validity of those ballot images.

5. **Direct computer entry from images created by the election system being audited.**
   Similar to (4) above but the images are not separately created from the ballots pulled in each audit group, but instead the data is directly entered from the images created during the original scanning process.

   Two teams are used, one that views the images and one that views paper ballots, each team enters directly into auditing software and these are compared digitally.

   This method can only work if it is feasible to access the ballot images exactly for the physical ballots that are accessed. This would be true for ballot-comparison audits or batch-comparison audits when the election district also uses software that images the ballots during normal processing. It is not feasible to use this method if no images are already created or if it is not possible to match the images with the physical ballots, such as in a ballot-polling audit.

   Note that this is the process that should be used whenever the images are used directly from the election system under audit in a ballot-image audit.

   An amendment to this method is to include a physical tally sheet. Since the images are from the system being audited, they are not as reliable as the physical ballots, and thus the physical tally sheets are again (perhaps) required. Entry into the physical tally sheets can be concurrent with the entry into the auditing system as described in option (1) while the physical ballots are reviewed.

6. **Entering data into a standard spreadsheet format.**
   A standard spreadsheet program can be used to enter the data from the tally sheets, or as a result of other data collection protocols. In the case of batch-comparison audits or polling place report review, the following format is recommended. The first three columns identify the location (state, county), and ballot group (ElectDay, Mail, etc). Columns four and five identify the contest and ballot option. Columns 6+ relates to a specific a) precinct, b) batch or c) tally sheet of a ballot polling audit. The first row contains the column names, subsequent rows contain the data for each ballot option.

   In practice, the first three columns can be hidden from the user entering data, and the next two columns frozen so that just the contest and option column are shown frozen on the left.

Then the current (precinct or batch) entry column can be moved over so it is the first column to the right of the option column.

If the value is 0, then it need not be entered. However, it is common that for many elections, a large number of contests are not included on the ballot at all. It can be helpful in those cases to enter 0 where the contest **does** appear but no votes were cast for that option. This is to distinguish contests that **did** appear on the ballot but received no votes, with those that **did not** appear at all.

Since this is a spreadsheet, the total number of votes can be summed in the lines entered and compared with the total rows at the top for error control. These calculation rows at the bottom are considered comments due to the '#' in the first character position so the whole thing can be exported and importing software can ignore those rows.

There is a single additional "header row" for each contest where the 'vote_for' value can be included as an aide in human data entry and review, and also a blank line between contests is recommended.

This format is also well suited for poll-tape collection projects, where the values from the poll tapes can be extracted using either automated means, or manually entered into the spreadsheet. These spreadsheets can then be easily processed for data analysis. They can be easily converted to a fully "tidy" format by unpivoting the batch columns to create a longer and narrower table. Then, they can be combined simply by concatenating (and removing redundant header lines).

In the sample below, we have entered actual data from poll tapes from Volusia County, FL in the presidential preference primary. Thus, the first three columns are the same for every row, but this allows it to be combined with other areas (once the precinct columns are unpivoted).

Although shown with only four columns here, the columns would continue to be added for each precinct or batch included.

This format is recommended because it is common for there to be many contests and options, and treating them as columns is difficult for data entry operations. Considering one column per batch allows the data to be aligned with polling place reports and to hand tally sheets.

state	county	group	contest	option	101	105	107	201	...
FL	Volusia County	ElectDay		ballots cast - total	85	82	130	293	
FL	Volusia County	ElectDay		ballots cast - DEM	40	37	50	152	
FL	Volusia County	ElectDay		ballots cast - REP	45	45	80	141	
FL	Volusia County	ElectDay		ballots cast - NP					
FL	Volusia County	ElectDay		ballots cast - blank		1		1	
FL	Volusia County	ElectDay	President (DEM)	#contest vote_for=1					
FL	Volusia County	ElectDay	President (DEM)	Michael Bennet					
FL	Volusia County	ElectDay	President (DEM)	Joe Biden	27	24	34	101	
FL	Volusia County	ElectDay	President (DEM)	Michael R. Bloomberg					
FL	Volusia County	ElectDay	President (DEM)	Cory Booker					
FL	Volusia County	ElectDay	President (DEM)	Pete Buttigieg					
FL	Volusia County	ElectDay	President (DEM)	Julian Castro					
FL	Volusia County	ElectDay	President (DEM)	John Delaney					
FL	Volusia County	ElectDay	President (DEM)	Tulsi Gabbard	1	1	1		
FL	Volusia County	ElectDay	President (DEM)	Amy Klobuchar				2	
FL	Volusia County	ElectDay	President (DEM)	Deval Patrick				1	
FL	Volusia County	ElectDay	President (DEM)	Bernie Sanders	12	11	15	46	
FL	Volusia County	ElectDay	President (DEM)	Joe Sestak					
FL	Volusia County	ElectDay	President (DEM)	Tom Steyer					
FL	Volusia County	ElectDay	President (DEM)	Elizabeth Warren				1	
FL	Volusia County	ElectDay	President (DEM)	Marianne Williamson					
FL	Volusia County	ElectDay	President (DEM)	Andrew Yang					
FL	Volusia County	ElectDay	President (DEM)	overvotes					
FL	Volusia County	ElectDay	President (DEM)	undervotes		1		1	
FL	Volusia County	ElectDay	President (REP)	#contest vote_for=1					
FL	Volusia County	ElectDay	President (REP)	Roque "Rocky" De La Fuente				1	
FL	Volusia County	ElectDay	President (REP)	Donald J. Trump	45	42	77	136	
FL	Volusia County	ElectDay	President (REP)	Joe Walsh		1		2	
FL	Volusia County	ElectDay	President (REP)	Bill Weld		2	2	2	
FL	Volusia County	ElectDay	President (REP)	overvotes					
FL	Volusia County	ElectDay	President (REP)	undervotes					
#				sum of all votes	85	82	130	293	
#				error check	0	0	0	0	