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Santa Rosa Junior College Math 10: Nature of Math Fall 2018


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## Question

What is an election?

## Question

What is the difference between a war and an election?

## Question

A prime goal of democracy is to replace wars with elections by replacing bullets with ballots.

## An Election

The Electorate

Voters

Suffrage: Who can vote?

## An Election

## Ballots

One person - one vote?

## An Election

## Who wins?

Ballots

## The 2016

Presidential
Election

## The Electorate



## Two Models

$>$ States Model
> Electoral College Model

## The States Model

## The electorate consists of the 50 states plus the District of Columbia.

Each state's ballot is weighted as indicated by the numbers.

## Electoral College Model



## The Electoral College

The College consists of a slate of electors from each state. The number of electors equals the number of members of Congress-the number of representatives and senators.

Amendment XXIII (ratified 1961) gives the District of Columbia three electors.

## The Electoral System

The electoral system is a process.

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$\checkmark$ National Election Day 8 November 2016.
In a presidential election when you vote for candidate $X$ you are voting for the slate of electors pledged to candidate X .

## The Electoral System

The electoral system is a process.
$\checkmark$ National Election Day 8 November 2016
$\checkmark$ Electors Day 19 December 2016

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$\checkmark$ Submission Day 28 December 2016


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$\checkmark$ National Election Day 8 November 2016
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$\checkmark$ Submission Day 28 December 2016
$\checkmark$ Decision Day 6 January 2017
> Inauguration Day 20 January 2017

## CONGRESSIONAL SEATS


http://www.census.gov/2010census/data/apportionment-data.php

## CONGRESSIONAL SEATS



The Electoral College is heavily weighted to smaller states.

California has 66 times the population of Wyoming.

The electoral vote ratio is CA 55 and WY 3.

(US apportionment population $=309,183,463$ )/435 $\approx 710,767$

# Distributing 435 seats among 50 states according to their respective populations is a math problem. 

## A Math Skill

How do I average two nonnegative whole numbers?

What is the average of 8 and 12 ?

## The Average

Example: ave $(8,12)=$

$$
\begin{array}{ll}
\text { Maximum } & >\max (8,12)=12 \\
\text { Minimum } & >\min (8,12)=8 \\
\text { Arithmetic Mean } & >\operatorname{AM}(8,12)=10 \\
\text { Harmonic Mean } & >\operatorname{HaM}(8,12)=\frac{2}{\frac{1}{8}+\frac{1}{12}}=9.6
\end{array}
$$

Geometric Mean $>\operatorname{GeM}(8,12)=\sqrt{8 \times 12} \approx 9.8$

## Apportionment by Priority

Step 1. Give one seat to each state.
Step 2. Attach a priority number to each state.
Step 3. Award seats one at a time by priority until the desired House size is reached.

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Priority number<br>for a state with<br>$n$ seats

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$$
\begin{gathered}
\text { Priority number } \\
\text { for a state with } \\
n \text { seats }
\end{gathered}=\frac{\text { state population }}{\text { ave }(n, n+1)}
$$

## Apportionment by Priority

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$$
\begin{aligned}
& \text { Priority number } \\
& \text { for a state with } \\
& 1 \text { seat }
\end{aligned}=\frac{\text { state population }}{\text { ave }(1,2)}
$$

## Apportionment by Priority

Step 1. Give one seat to each state.
Step 2. Attach a priority number to each state.
Step 3. Award seats one at a time by priority until the desired House size is reached.

$$
\begin{gathered}
\text { Priority number } \\
\text { for a state with } \\
1 \text { seat }
\end{gathered}=\frac{\text { state population }}{\text { ave }(1,2)}
$$

$\begin{gathered}\text { Priority number } \\ \text { for a state with } \\ 2 \text { seats }\end{gathered}=\frac{\text { state population }}{\text { ave }(2,3)}$

## Five Averages

## ave

- Greatest Divisors max
- Harmonic Means HaM
- Equal Proportions GeM
- Major Fractions AM
- Smallest Divisors min

| U.S. Census Bureau |  |  |  |
| :---: | :---: | :---: | :---: |
| PRIORITY VALUES FOR 2010 CENSUS |  |  |  |
| HOUSE | PRIORITY | STATE | STATE |
| SEAT | VALUE | ABBREVIATION | SEAT |
| 51 | 26404774 | CA | 2 |
| 52 | 17867470 | TX | 2 |
| 53 | 15244803 | CA | 3 |
| 54 | 13732760 | NY | 2 |
| 55 | 13364865 | FL | 2 |
| 56 | 10779704 | CA | 4 |
| 57 | 10315788 | TX | 3 |
| 58 | 9096490 | IL | 2 |
| 59 | 9004938 | PA | 2 |

## The Last Seat

## Who got the $435^{\text {th }}$ seat?

ave 435

- Greatest Divisors max IL
- Harmonic Means HaM MN
- Equal Proportions GeM MN
- Major Fractions AM NC
- Smallest Divisors min WA


## The Last Seat

Who gets the $436^{\text {th }}$ seat?

$$
\text { ave } \quad 435 \quad 436
$$

- Greatest Divisors max IL WA
- . ic Means HaM MN CA
iportions GeM MN NC ,u. ractions AM NC MO
- smallest Divisors min WA PA

The distribution of seats in the House and thus the Electoral College depends on Congress's choice of averaging two numbers.

## The Last Seat

Who gets the $436^{\text {th }}$ seat?
ave $435 \quad 436$

- Greatest Divisors max IL WA
- Harmonic Means HaM MN CA
- Equal Proportions GeM MN NC
- Major Fractions AM NC MO
- Smallest Divisors min WA PA


## The 2016 Presidential Election

The popular vote:

| Hillary Clinton: | $65,853,516$ | $48.18 \%$ |
| :--- | ---: | ---: |
| Donald Trump: | $62,984,825$ | $46.09 \%$ |
| Others: | $7,850,896$ | $5.73 \%$ |



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The Electoral College vote:
Hillary Clinton: 227
Donald Trump: 304

Flips can happen because of the winner-take-all feature states have in selecting their electoral slates.

Others: 7

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The Electoral College vote:


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## The Popular Vote

Arguably, on 4 other occasions in U. S. history the electoral and popular systems produced different results.

1. John Quincy Adams vs. Andrew Jackson 1824
2. Rutherford B. Hayes vs. Samuel Tilden 1876
3. Benjamin Harrison vs. Grover Cleveland 1888
4. George Bush vs. Al Gore 2000

Source: http://www.factcheck.org/2008/03/presidents-winning-without-popular-vote/

## 1876

| Candidate | Party | Popular Vote | Electoral Vote |
| :---: | :---: | :---: | :---: |
| Rutb | Hayes (OH) | Republican | $4,034,142$ |
| en (NY) | Democratic | $4,286,808$ | 185 |
| Y$)$ | Greenback | 83,726 | --- |

## 2000

| Candidate | Party | Popular Vote | Electoral Vote |
| :--- | :---: | :---: | :---: |
| George W. Bush (TX) | Republican | $50,456,062$ | 271 |
| Albert Gore (TN) | Democratic | $50,996,582$ | 266 |
| Ralph Nader (DC) | Green | 250,017 | --- |
| Patrick Buchanan (VA) | Reform | 149,115 | --- |

Lesson: Bush's Electoral College win was an artifact of the size of the House.

## House Size Effects

## Consider the Electoral College vote based on House sizes 50-1000 using the current method of congressional apportionment:

smaller than 492 Bush wins, larger than 597 except 655 Gore wins.

Between 492-597 there are 24 ties, Bush wins 53 times, and Gore wins 29 times.
http://www.thirty-thousand.org/pages/Neubauer-Zeitlin.htm

## 2000

The 2000 election showed another potential problem. The number of electoral votes each state gets is tied to the decennial census. Although the election was in 2000, apportionment of the House was based on the 1990 census.

An election held in a census year is based on a population that is ten years old.

What would have been the result of Bush vs. Gore if the Electoral College were based on the 2000 census?

## 2000

In comparison with the 1990 census the 2000 census shifted 12 House seats affecting 18 states.

Accordingly, the electoral vote would have changed from
Bush 271 and Gore 266 to
Bush 278 and Gore 259.

## Reform

Over the past 200 years, over 700 proposals have been introduced in Congress to reform or eliminate the Electoral College. There have been more proposals for Constitutional amendments on changing the Electoral College than on any other subject.

## Today's Debate

Resolved: The electoral system should be replaced by a popular vote system.

What's a Popular Vote System?

## The 2016 Presidential Election

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## Fairness

Individual Sovereignty:
Each voter gets the same
ballot with the same
instructions and is free to
vote as they choose
within these constraints.
One Person - One Vote

## Question 1

## Should there be a uniform national presidential ballot?

Ballots differ among states. GA, IN, OK listed 3 candidates; CA 5; TN 7; UT 10; CO 22.

http://www.politico.com/2016-election/results/map/president

## Question 1

Should there be a write-in provision?

Today 9 states do not allow a write-in.

## Question 2

Should there be uniform suffrage for a national popular vote?

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Should there be uniform suffrage for a national popular vote?
$>$ Should all American citizens "in goodstanding" be allowed to vote in the national popular election for President?

http://felonvoting.procon.org/view.resource.p hp?resourceID=000286

## Question 2

Should there be uniform suffrage for a national popular vote?
$>$ Should all American citizens "in goodstanding" be allowed to vote in the national popular election for President?
> What about American citizens who live in a U.S. territory but are not citizens of a state or residents of D. C.?

## Question 3

What should be the structure of the ballot in a national presidential election?

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$>$ Vote for One.

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What should be the structure of the ballot in a national presidential election?
$>$ Vote for One.
$>$ Approval.
$>$ Ranked Choice.

## The Ballot

An election must feature a ballot. Assume the ballot is the same for each voter; further, one person/one ballot.

## The Ballot

## The structure of the ballot determines

 your voice in an election.
## The Ballot

## During the Stalin era of the Soviet Union, a ballot looked like this:

## The Ballot

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District Commisar Vote for One<br>$\square$ Alesander Kolnovic

## The Ballot

## A two-option ballot looks like this:

| Vote for One |
| :--- |
| $\square$ Option A |
| $\square$ Option B |

## The Single Vote Ballot

A multi-option ballot looks like this:

| Instruction |  |
| :--- | :--- |
| $\square$ | Option A |
| $\square$ | Option B |
| $\square$ | Option C |
| $\square$ | Option D |
| $\square$ | Option E |

## The Single Vote Ballot

A multi-option ballot looks like this:

| Vote for One |  |
| :--- | :--- |
| $\square$ | Option A |
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| $\square$ | Option C |
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A multi-option ballot looks like this:

| Vote for One |  |
| :--- | :--- |
| $\square$ | Option A |
| $\square$ | Option B |
| $\square$ | Option C |
| $\square$ | Option D |
| $\square$ | Option E |

Notice how restricted the voter's voice is.

## The Single Vote Ballot

A multi-option ballot looks like this:

| Vote for One |
| :--- |
| $\square$ |
| Option A |
| $\square$ |
| Option B |
| $\square$ Option C |
| $\square$ Option D |
| $\square$ Option E |

Notice how restricted the voter's voice is.

Many voters vote
strategically rather than honestly.

## Approval Voting

A multi-option ballot looks like this:

| Approval List |  |
| :--- | :--- |
| $\square$ Option A | Vote for all options |
| $\square$ Option B | that you approve. |
| $\square$ Option C |  |
| $\square$ Option D |  |
| $\square$ Option E |  |

## Which Ballot?



## Which Ballot?



Vote for all Approved
Hillary Clinton and Tim Kaine
Democratic
$\square$ Gloria Estela La Riva and Dennis J. Banks
Peace and Freedom
$\square$ Donald J. Trump
and Michael R. Pence
Republican, American Independent
$\square$ Gary Johnson
and Bill Weld
Libertarian
$\square$ Jill Stein
and Ajamu Baraka
Green

## Ranked Choice Voting

In a ranked choice ballot the voter ranks some or all of the candidates.

In a full ranked system, if the ballot displays five choices, then you rank those choices 1 though 5.

News Flash In the 2016 election Maine approved a full ranked system for statewide offices.<br>https://ballotpedia.org/Maine Ranked Choice Voting Initiative, Question 5 (2016)



## A National Popular Vote

- Abolishing the electoral system requires a constitutional amendment.
- A uniform national vote procedure requires federal legislation concerning ballot access, suffrage, ballot structure, and election mechanics.


# A <br> Moderate <br> Alternative 

## State Sovereignty

Keep voting as a state's rights matter.
Suffrage, ballot access, ballot structure, voting mechanics are left up to each state. Then count the certified popular vote in each state as is currently done.

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This is the approach of the National Popular Vote Bill.

## National Popular Vote Bill

> A State Act in which a state joins an interstate compact to elect the President and Vice-President of the United States by national popular vote.

$>$ A state's slate of electors will be awarded to the candidate with a plurality of the national (instead of statewide) popular vote.
$>$ The law takes effect in each state in the compact when the compact reaches 270 electoral votes.

Should the electoral system be replaced by a popular vote system?

Should the U. S. move to a national popular vote for President and Vice-President?

## Democracy

## What is an Election? <br> One Person - One Vote

We the People of the United States, . . .

http://www.theconstitutionproject.com/portfolio/one-person-one-vote/

$\leftarrow \rightarrow C$

## Charles M. Biles, Ph.D. Congressional Apportionment



Chapter 1. Congressional Apportionment Based on the Census: 1790.
Chapter 2. Congressional Apportionment Based on the Census: 1800-1840. Chapter 3. Congressional Apportionment Based on the Census: 1850-1890. Chapter 4. Congressional Apportionment Based on the Census: 1900-1930. Chapter 5. Congressional Apportionment Based on the Census: 1940-2010. Chapter 6. An Historical Overture.
How many seats in the U. S. House of Representatives does eca sta set?
How many seats in the U. S. House of Representatives does each stat set? applications a recent book, The History of Congressional Apportionm nt.

## Constitutional Congregressional Apportionme ti Pblem



## Thank You

http://www.nia977.wix.com/drbcap

## Gerrymandering



Illinois $4^{\text {th }}$ congressional district.

## Gerrymandering

| $\bullet$ | $\bullet$ | $\bullet$ | $\bullet$ | $\bullet$ | $\bullet$ | $\bullet$ |
| :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- |
| $\bullet$ | $\bullet$ | $\bullet$ | $\bullet$ | $\bullet$ | $\bullet$ | $\bullet$ |
| $\bullet$ | $\bullet$ | $\bullet$ | $\bullet$ | $\bullet$ | $\bullet$ |  |
| $\bullet$ | $\bullet$ | $\bullet$ | $\bullet$ | $\bullet$ |  |  |

Apportion into five districts.

## Gerrymandering

## $\bullet \bullet \bullet \bullet \bullet \bullet \bullet \bullet \bullet \quad 0$ $\bullet \bullet \bullet \bullet \bullet \bullet \bullet \bullet \bullet \bullet$ <br> $\bullet \bullet \bullet \bullet \bullet \bullet \bullet \bullet \bullet \quad 0$ <br> 

## Gerrymandering



## Gerrymandering

$$
\begin{array}{|llllllllll|}
\hline \bullet & \bullet & \bullet & \bullet & \bullet & \bullet & \bullet & \bullet & \bullet & \bullet \\
\hline \bullet & \bullet & \bullet & \bullet & \bullet & \bullet & \bullet & \bullet & \bullet & \bullet \\
\bullet & \bullet & \bullet & \bullet & \bullet & \bullet & \bullet & \bullet & \bullet & \bullet \\
\bullet & \ddots & \bullet & \bullet & \bullet & \bullet & \bullet & \bullet & \bullet & \bullet \\
\bullet & \bullet & \bullet & \bullet & \bullet & \bullet & \bullet & \bullet & \ddots & \bullet \\
\hline
\end{array}
$$

