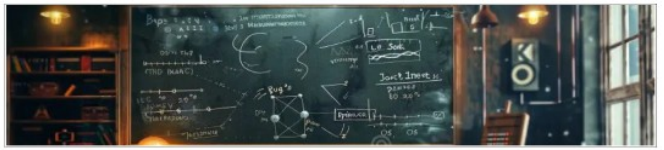
Politics : From Propaganda to Democracy

First Murder Mystery: A Warm-Up

Mrs Campbell was found dead in her physics classroom; a bullet to the brain seemed to be the cause of her death. It was not suicide for the bullet wound was on the left side and Mrs Campbell was right handed. Also, Mrs Campbell was too arrogant to end her own life.
After much asking around, Sherlock was able to gather that Mrs Campbell was the most hated teacher at St. Duke's school of scientific arts. Which made it a bit hard to narrow down the suspects. The only clue Sherlock found on the blackboard, in the room where she was murdered, was:

E=MC2



The suspects are:
Simeon Thompson: The student body president, who Mrs Campbell had been blackmailing.
Mary Campbell: Mrs. Campbell's twin, who had always been jealous of her twin sister.
Ruby Griffith: The principal, who had been looking for an excuse to fire her since day one.
Megan Fishwooten: The left-handed best friend, who had always been stuck in the shadow of Mrs Campbell.

Who was the culprit?

Second Murder Mystery

You and your class have rented out a mansion for an end of year celebration. Everyone is having a lot of fun hanging out, playing games, and eating food. Suddenly you all hear a loud scream coming from the upstairs of the mansion. Everyone rushes upstairs and you all see that on their way to the bathroom one of your classmates had discovered a dead body in the hallway outside of the library. The man who has died is the owner of the mansion and no one seems to know who did it. The only thing everyone agrees on is that it must be someone in the class because there was no one else in the mansion. At the time the body was found the entire class is present.

One of your friends comes up with the suggestion that maybe if they knew the time of death you can determine who must be the murderer based on who was most likely to be with the mansion owner at that time.

How would you proceed ?

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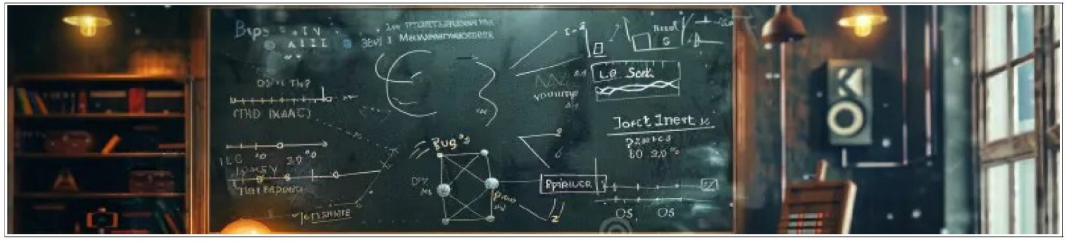

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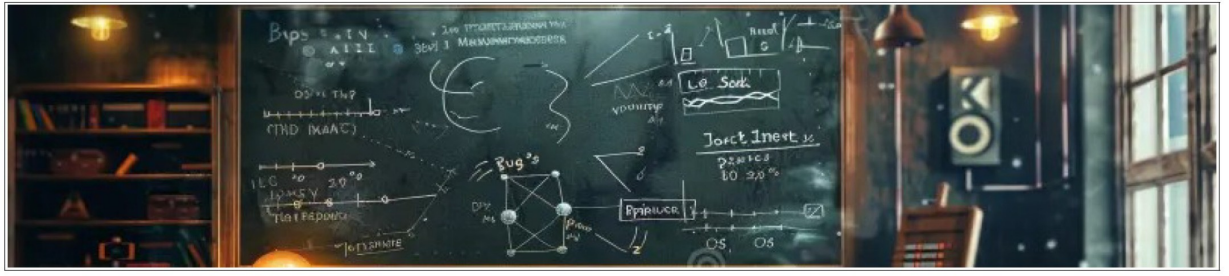

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Who was the culprit?

Answer:
MC=Mary Campbell
2=Twin
Mary Campbell is the culprit.

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Second Murder Mystery

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Another one of your friends has the idea that knowing the temperature of the body would help to figure out the time of his death, so immediately a thermometer is found and the corpse's body temperature is taken. According to these measurements the body was 33.89 degrees Celsius at 6 pm when the body was found. Two hours later the body's temperature is taken again but it is now found to be 30.33 degrees Celsius.

The facts:

- The mansion owner was found in the hallway near the library.
- There is only one pathway in front of the library and it leads to the bathroom.
- The temperature of the body was 33.89 degrees Celsius at 6 pm.
- The temperature of the body was 30.33 degrees Celsius at 8 pm.
- The thermostat was found to be set at 21.11 degrees Celsius.

After much discussion everyone was able to remember the times that they were up in the hall passing by the library to walk to the bathroom.

Make sure you can explain and describe your calculations in English.

Did you know?

An exponential equation such as $e^x = 3$ can be rewritten as the equivalent logarithmic equation $x = \log_e 3$. We often use the special notation ln for the natural logarithm, instead of log_e.

Newton's formula for cooling: $T(t) = T_{env} + (T_0 - T_{env})\, e^{-kt}$

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Newton's formula for cooling: $T(t) = T_{env} + (T_0 - T_{env})\, e^{-kt}$

Where:

- $T(t)$ is the temperature of the body at time t,
- T_{env} is the temperature of the surrounding environment,
- T_0 is the initial temperature of the body (look up average body temperature for this),
- t is the time after death in hours, and
- k is a constant that can be calculated using the formula $e^{-2k} = \dfrac{T(t+2) - T_{env}}{T(t) - T_{env}}$.

Answer:

According to the wording of the problem treated, after substituting the values and processing the date, it can be said k approximately equals 0.07.
So the time t elapsed before the body was found at 6pm is about 1.38 hours: the owner was killed around 4.62 pm or 4:37pm (4:40pm).

Example of description: To find exponential minus 2k, we subtract the temperature of the surrounding environment from the temperature of the body at time t plus 2, and we divide the result by the temperature of the body at time t minus the temperature of the surrounding environment.

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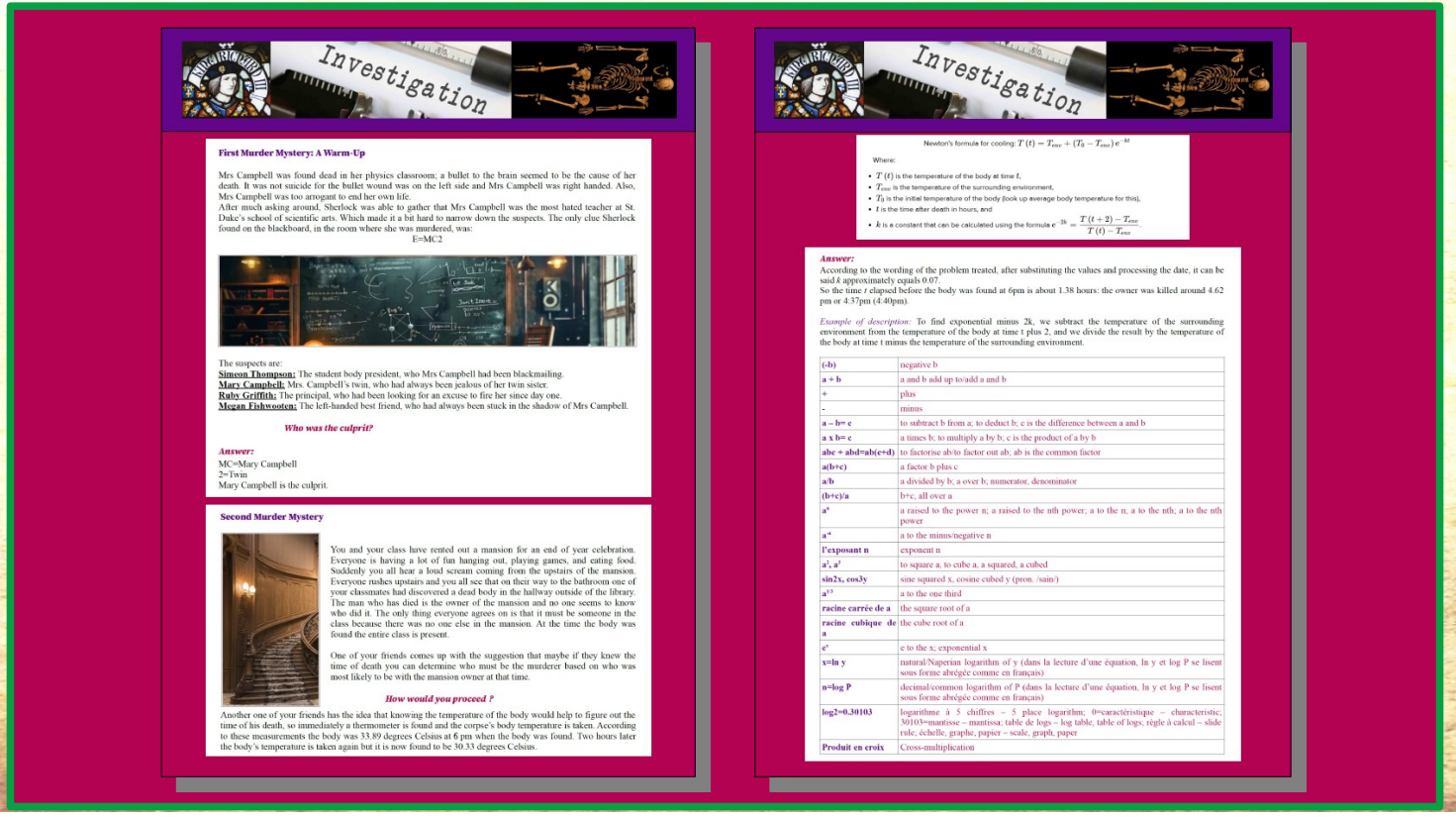

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La phrase complexe en anglais : propositions subordonnées et circonstancielles, pronoms et détermination

1. Dans chaque cas, fusionnez les phrases en les reliant par un pronom relatif, voire une conjonction de subordination. Certaines modifications peuvent être nécessaires.

1. Richard III betrayed his brother Clarence.
   He was sent to prison.

2. Richard III sent Elizabeth Woodville's sons to the Tower of London.
   They may have died in this place.

3. William Shakespeare lived under the reign of Henry Tudor's granddaughter.
   The play was written in 1593.

4. The body of Richard III was discovered under a parking lot in 2012.
   Tudor propaganda against Richard III was partly undone by historians and scientists.
   The hate campaign lasted for over four centuries.

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1. Richard III betrayed his brother Clarence, **who** was sent to prison.

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4. Tudor propaganda against Richard III, **which** lasted for over four centuries, was partly undone by historians and scientists **when** the body of Richard III was discovered under a parking lot in 2012.

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2. Dans les mêmes phrases, faites disparaître les expressions soulignées en les remplaçant par un pronom, un adverbe ou un déterminant équivalent. Aucune autre modification ne doit être apportée.

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Les verbes à préposition

3. Les traductions du verbe "accuser" en anglais ont toutes recours à des prépositions. Complétez les phrases suivantes avec le verbe et la préposition qui conviennent.

Les voleurs ont été accusés d'avoir volé des bijoux d'une valeur de 6000 euros.	The thieves …….. stealing 6,000 euros worth of jewellery.
On a accusé la nounou d'arriver en retard au travail.	The nanny …… arriving late at work.
Vous pourriez être accusé d'avoir induit la cour en erreur.	You could …….. misleading the court.
Le comptable a été inculpé pour blanchiment d'argent.	The accountant …….. money laundering.

Attention:

Beaucoup de verbes en anglais se construisent avec une préposition ou une particule spécifique, mais certains n'en ont pas besoin, contrairement à leur équivalent français. Par exemple:

__Answer__ the question.
__Discuss__ the situation.
__Enter__ the supermarket.
The candidate __lacks__ experience.
She __married__ an accountant.
You have to __obey__ the rules.
Left-wing parties __oppose__ the plan.
You must __resist__ the temptation.

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On a accusé la nounou d'arriver en retard au travail.	The nanny **was blamed/criticized for** arriving late at work.
Vous pourriez être accusé d'avoir induit la cour en erreur.	You could **be charged with** misleading the court.
Le comptable a été inculpé pour blanchiment d'argent.	The accountant **was indicted for** money laundering. /ai/

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Adapté depuis *Word Perfect* par Jean Max Thomson et Mary Chalot

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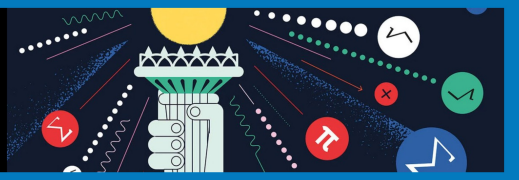
How Math Can Save Democracy



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Right or Wrong?

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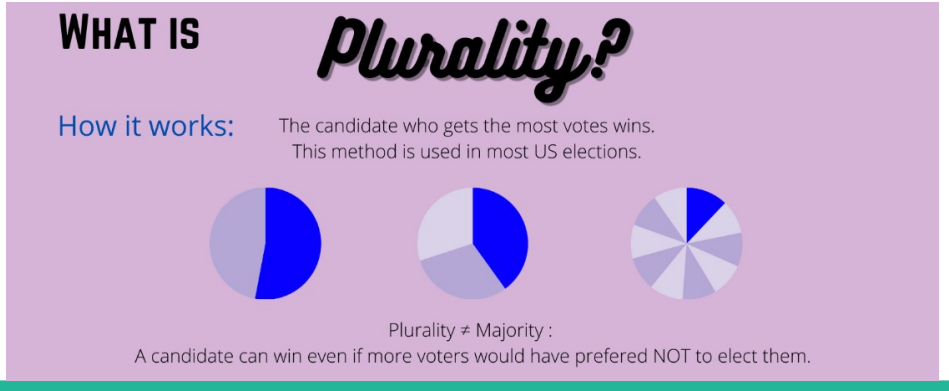

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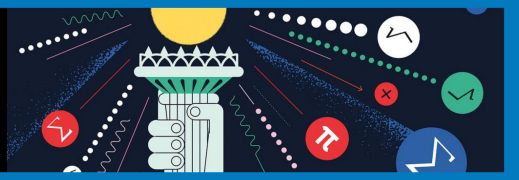

2. Approval voting is used by a lot of mathematicians because it has no drawbacks.

Right or Wrong?

WHAT IS *Approval Voting?*

How it works: Voters check any number of candidates they would be okay with being elected. The candidate with the most cumulative votes wins.

For example: A family is voting on what to have for dinner:

- ☑ Pizza
- Burgers
- ☑ Soup

This voter is okay with either pizza or soup for dinner.

Candidates - Votes

- **Pizza - 4**
- Burgers - 1
- Soup - 2

The family will have pizza for dinner!

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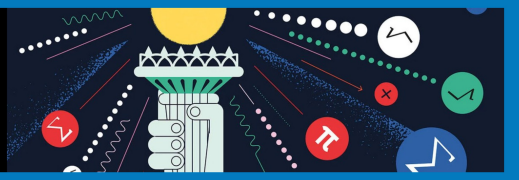

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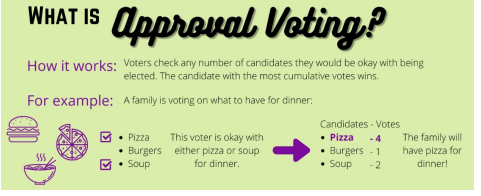

Approval voting is not susceptible to strategic voting. It eliminates the spoiler effect and reduces the possibility of vote splitting, thus encouraging participation by smaller parties. It does not fall under the Arrow Impossibility Theorem since it is not a ranked choice method.

BUT it may not be expressive enough as it is impossible to communicate which candidate you prefer the most.

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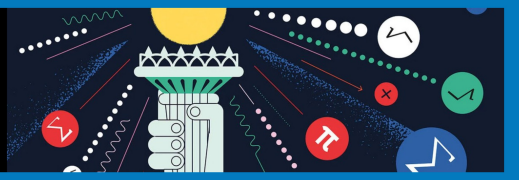

3. Ranked-Choice procedures are ideal methods of voting.

Right or Wrong?

the Condorcet Method?

Ranked Choice Voting?

Borda Count?

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Wrong

THEOREM

Arrow's Impossibility Theorem

It is impossible to fulfill all of the three above features (Unanimity, No Dictators, IIA) at the same time in any ranked voting system.

Our intuitive concept of fairness contains a number of assumptions that may contradict each other. Arrow's Impossibility Theorem says that no ranked choice voting is perfect. It's impossible to fulfill the three desirable features for a voting system (unanimity, no dictators, independence of irrelevant alternatives) at the same time in any ranked voting system.

For example, in Instant Runoff, the winner may never have been in a first position and may be part of the majority's least preferred options.

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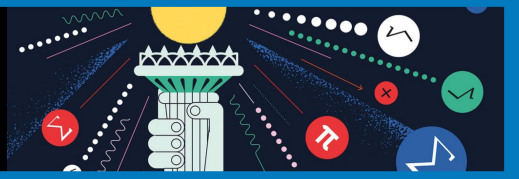


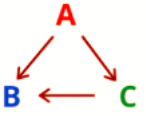
4. The method presented here is not called Borda Count.

Right or Wrong?

Ballot:	1	2	3
	C	B	A
	A	A	C
	B	C	B

A vs B: A B vs C: B A vs C: A

A is the winner!



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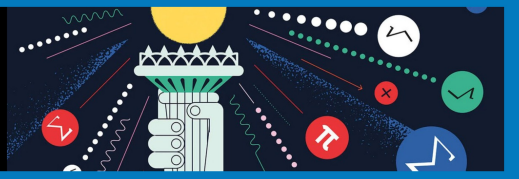

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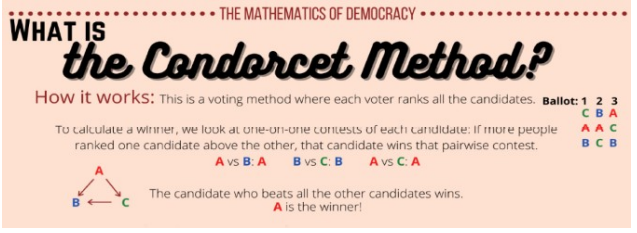

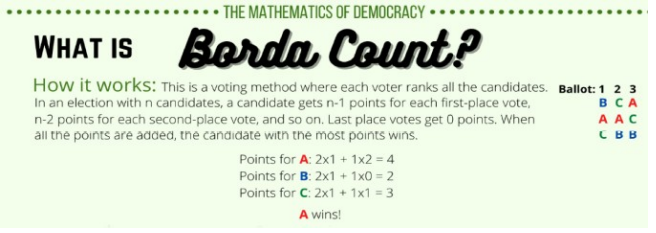

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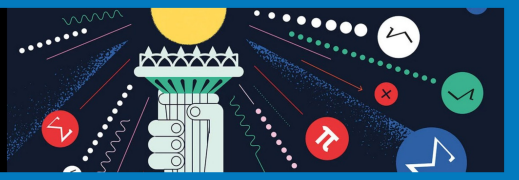

5. Condorcet would not be the greatest method to elect a president.

Right or Wrong?

THE MATHEMATICS OF DEMOCRACY

WHAT IS *the Condorcet Method?*

How it works: This is a voting method where each voter ranks all the candidates.

Ballot:	1	2	3
	C	B	A
	A	A	C
	B	C	B

To calculate a winner, we look at one-on-one contests of each candidate: If more people ranked one candidate above the other, that candidate wins that pairwise contest.

A vs B: A B vs C: B A vs C: A

The candidate who beats all the other candidates wins.
A is the winner!

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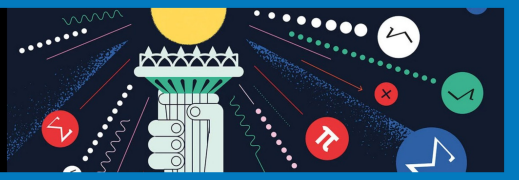

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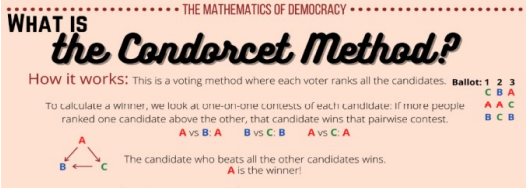

You need ONE president, but if a Condorcet circle occurs, the method may fail to produce a winner. Additionally, a candidate does not have to be ranked first to win, they just have to be ranked higher. It produces a good compromise candidate, but fails to provide an incentive for candidates to be innovative or take a stand on controversial issues (the winner may simply be the least offensive)

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The United States is the world's oldest democracy.

But oldest doesn't always mean *best*.

The New York Times

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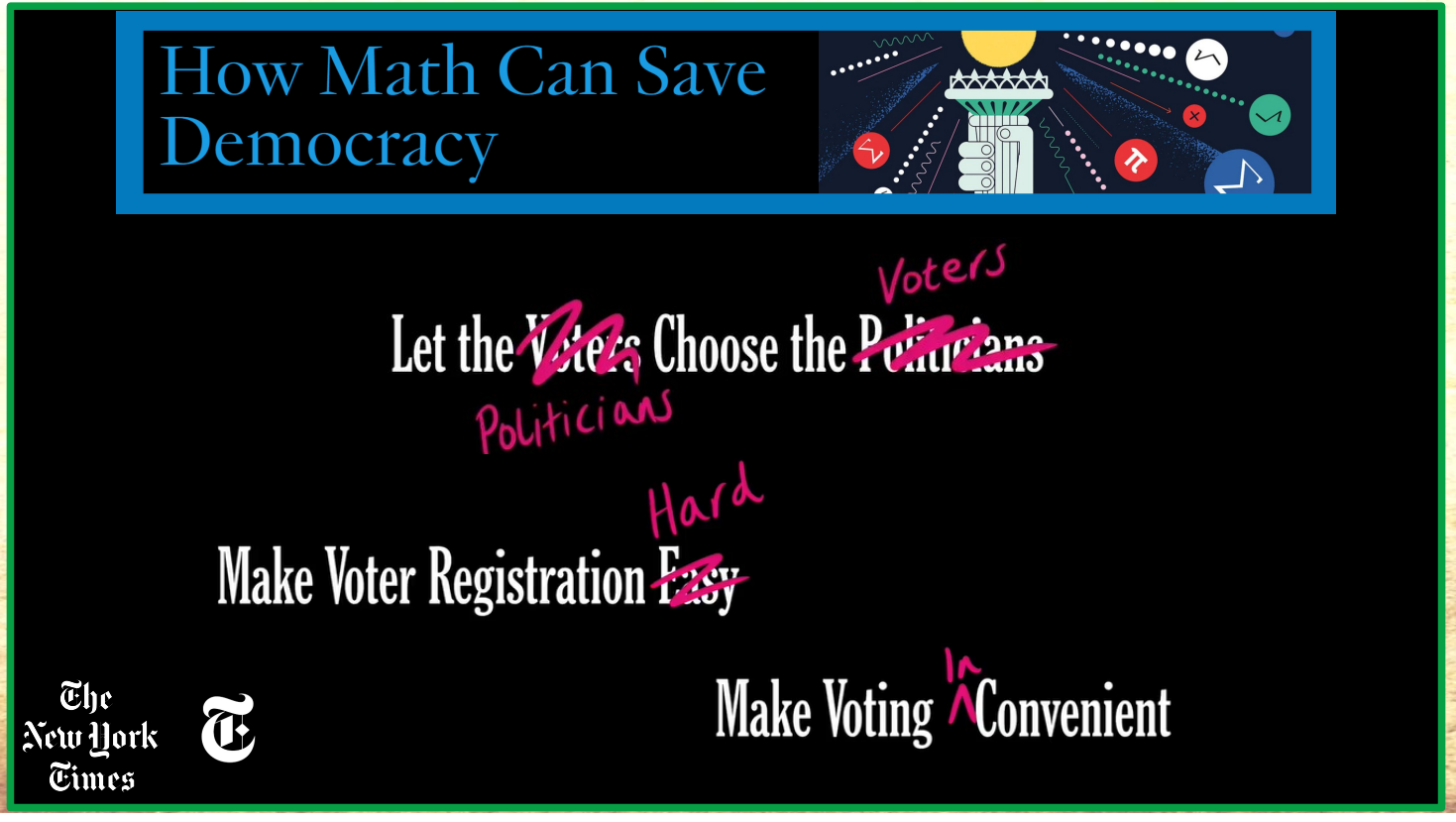

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How Math Can Save Democracy

Every four years, Americans participate in a presidential election. However, they do not vote for president. Rather, they vote for electors who represent their state in a second round of voting. The candidate who wins a state wins all its electors, and those people, called the Electoral College, actually vote for the president.

The Winner-take-all principle explains why the result of the presidential election does not always reflect popular votes.

Some argue that if your candidate loses in your state, then your vote "doesn't count" in the Electoral College. They feel they should have a direct election for president, every citizen gets one vote, and whoever gets the most votes should win. Although some people think this system is unfair, it keeps small states from being overwhelmed by big states, and rural areas from being overshadowed by cities. Historically, the Electoral College was created as a compromise that allowed the 13 original states, which viewed themselves as separate independent nations, to cooperate and choose a central government.

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Let the ~~Voters~~ Choose the ~~Politicians~~

Voters

Politicians

The New York Times

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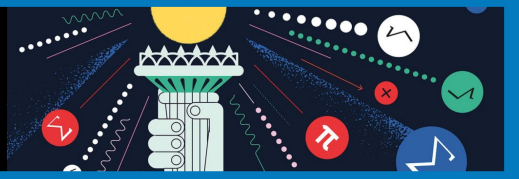

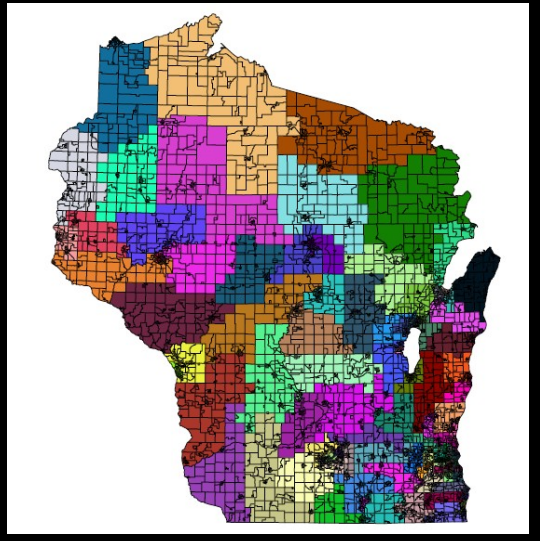

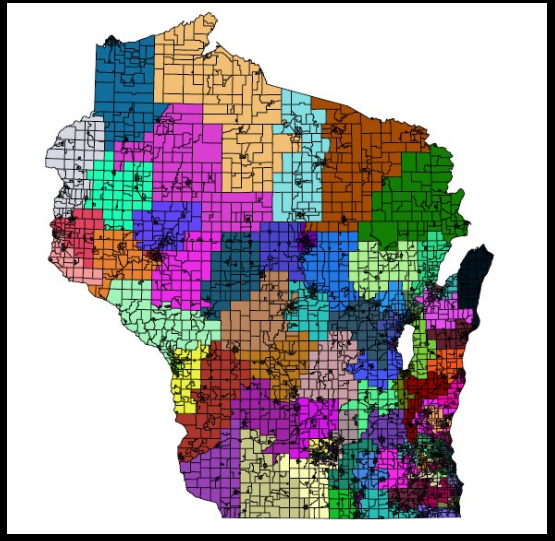

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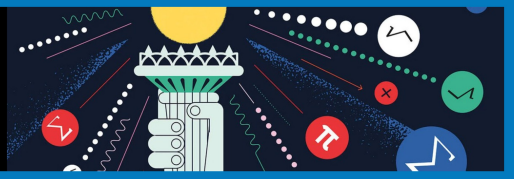
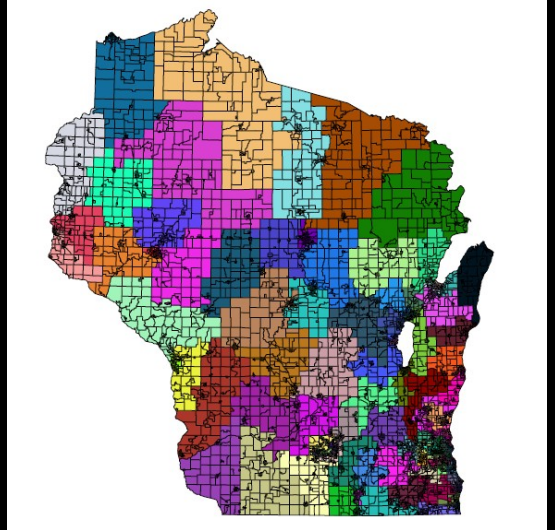


Can Math Solve the Gerrymandering Problem?

CMU mathematicians' work on detecting bias in congressional district maps makes its debut before the U.S. Supreme Court



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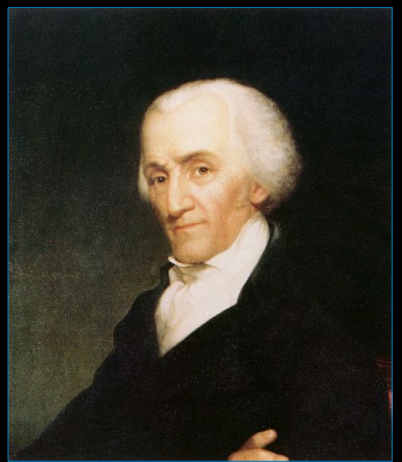


Gerrymandering

Data Manipulation

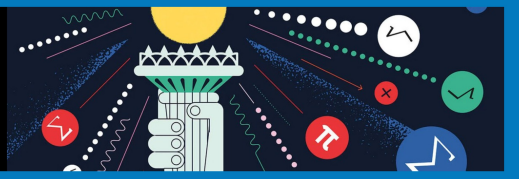
How Math Can Save Democracy

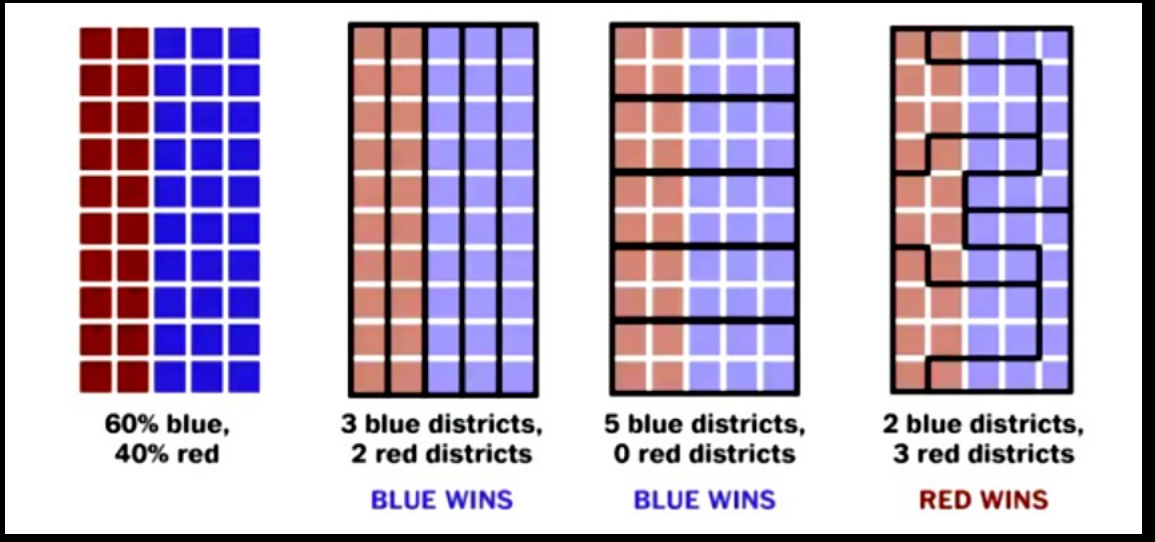
The term gerrymandering is a portmanteau of a salamander and Elbridge Gerry, Vice President of the United States until his death, who, as governor of Massachusetts in 1812, signed a bill that created a partisan district in the Boston area that was compared to the shape of a mythological salamander. The term has negative connotations, and gerrymandering is almost always considered a corruption of the democratic process.

Gerrymandering is the political manipulation of electoral district boundaries to advantage a party, group, or socioeconomic class within the constituency. Wayne Dawkins describes it as politicians picking their voters instead of voters picking their politicians.

Data Manipulation

How Math Can Save Democracy





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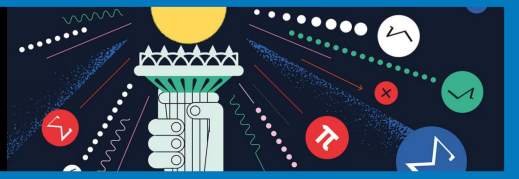
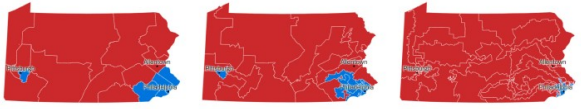


Can Math Solve the Gerrymandering Problem?

1. What kind of 2018 maps are you looking at?

a. Which state do they represent?

b. What is each map's relation to the gerrymandering problem? Justify.



2. As a mathematician, what could you do to prove a case of partisan gerrymandering?

a. Which data, criteria or parameters would you study to evaluate the degree of partisan gerrymandering of a particular map and its impact on elections?

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3. Watch *Vox*'s video about "The algorithm that could help end partisan gerrymandering" (00:00-02:10) and answer the following questions.

a. Why is it so difficult for the Supreme Court to rule against gerrymandering? In other words, why do they need mathematicians?

b. What is the mathematicians' strategy to prove a partisan gerrymandering?

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4. Now that you gathered more information, consider question 2 again.

a. What specific data and figures would you analyze to account for the various criteria? What relations would you pay attention to through equations?

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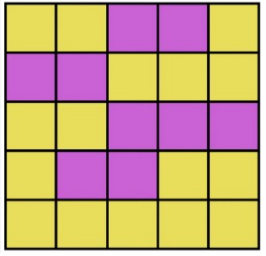
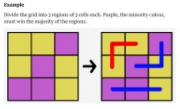
Puzzle 1: Easy

Divide the grid into 5 regions of 5 cells each. Purple, the minority colour, must win the majority of regions.



Try and solve Alex Bellos's gerrymandering puzzles. If you are lost, your partner may look at the solution for the second puzzle on Célène and give you directions.



Puzzle 2: Medium

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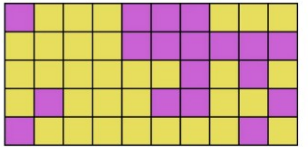

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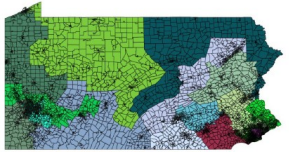
Can Math Solve the Gerrymandering Problem?



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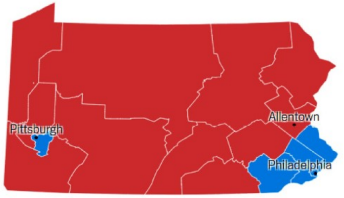

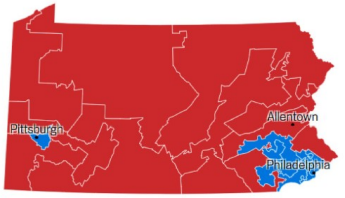

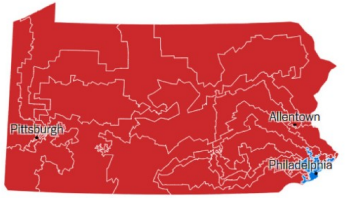

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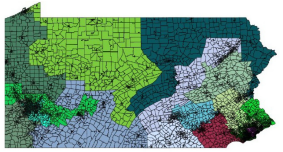
Can Math Solve the  Gerrymandering Problem?

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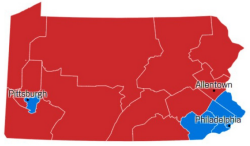
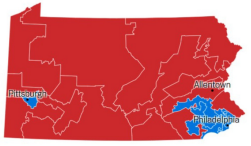
Possible nonpartisan map



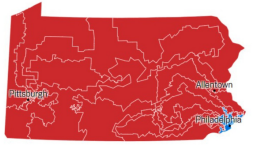
7 Clinton Districts 11 Trump Districts

Current map



6 Clinton Districts 12 Trump Districts

Possible extreme gerrymander



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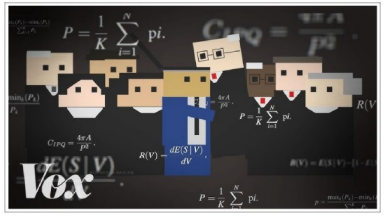

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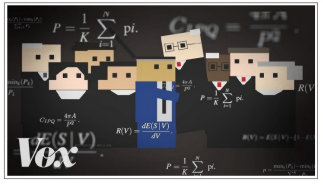

a. Why is it so difficult for the Supreme Court to rule against gerrymandering? In other words, why do they need mathematicians? The Supreme Court has yet to settle on a standard or definition of political fairness. They just simply don't want to declare a partisan gerrymandering without some way to measure them. They need mathematicians to build a measurement tool to help the Court measure whether political parties have manipulated a map to gain an unfair advantage – a gerrymandering ruler. The court wants to be able to determine the intent behind the district maps that were drawn – they want to read the minds of the map drawers.

b. What is the mathematicians' strategy to prove a partisan gerrymandering? First mathematicians identified what criteria are important to the Court. Then they use a supercomputer to generate district maps based on those criteria. They create a billion maps using only the criteria required by law and the traditional districting principles – no political information (nonpartisan). If the current map doesn't look like any of the possibilities generated by the algorithm, that's a good indication a partisan gerrymander has occurred.

c. What criteria are they taking into account? The criteria are : population equity (about the same number of people in every district) ; contiguity and compactness (they can't be broken up into a bunch of pieces) ; traditional districting principles (political subdivisions, such as cities, counties, municipal boundaries or identifiable communities of like-minded individuals, should be preserved).

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THE MATHEMATICS OF DEMOCRACY

WHAT IS *Packing and Cracking?*

Definitions: When district lines are drawn, various tactics can be used to maintain political power. For example:

Putting opposition voters into a small number of conceded districts is called **packing**.

Spreading opposition voters thinly over the rest of the districts to minimize their impact is called **cracking**.

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THE MATHEMATICS OF DEMOCRACY

WHAT IS *the Efficiency Gap?*

Wasted votes are those that do not affect an election: either votes above the 50% majority threshold for a winning candidate or any for a losing candidate. The **efficiency gap (EG)** is one method for measuring gerrymandering

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Wasted votes are those that do not affect an election: either votes above the 50% majority threshold for a winning candidate or any for a losing candidate. The **efficiency gap (EG)** is one method for measuring gerrymandering by adding up the wasted votes of each party's candidates over all electoral districts.

$$EG = \frac{|(\text{one party's wasted votes}) - (\text{other party's wasted votes})|}{\text{total number of votes}}$$

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THE MATHEMATICS OF DEMOCRACY

WHAT IS Polsby-Popper Compactness Score?

We can try to quantify gerrymandering by measuring how "reasonably shaped" a voting district is. The **Polsby-Popper Compactness Score** of district S, PP(S), measures how much "unnecessary" perimeter S has.

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$$PP(S) = 4\pi \frac{\text{area enclosed by the district}}{(\text{perimeter of the district})^2}$$

If there is too much perimeter for the area, PP(S) is closer to

If there is a small amount of perimeter for the area, PP(S) is closer to

If PP(s) is close to , this indicates that the district might have been gerrymandered.

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If there is too much perimeter for the area, PP(S) is closer to 0.

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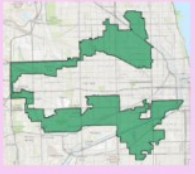

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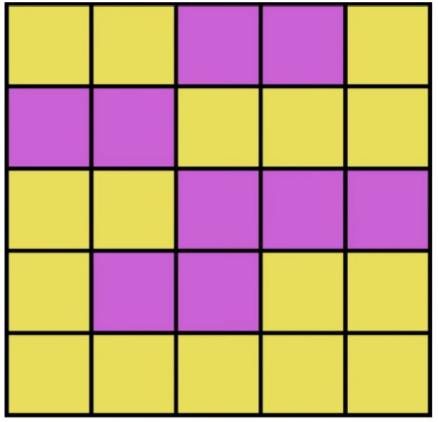

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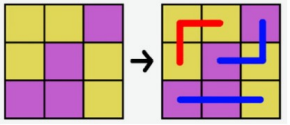
Example

Divide the grid into 3 regions of 3 cells each. Purple, the minority colour, must win the majority of the regions.



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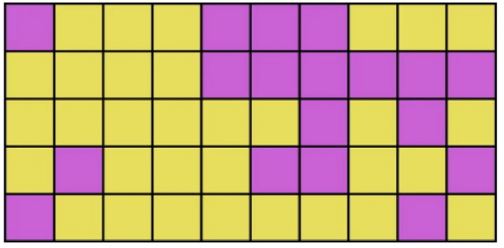

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