A Compendium of Statistical Fallacies in Claims about ‘Massive and Widespread Fraud’ in the 2020 Presidential Election[[1]](#footnote-1)

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## ABSTRACT

An immense amount has been written about alleged massive electoral fraud in the 2020 presidential election. Years after the election, tens of millions of voters, and many Republican officials, continue to insist that the 2020 election was stolen. Here, we examine claims of massive fraud in the presidential election of 2020 that are based on aggregate election data, and we further limit ourselves to claims in which the data itself is essentially undisputed. We show that the implications of that data for the presence of massive fraud have been largely or entirely misinterpreted through invalid statistical or logical reasoning. Our goal is not to provide new insights, since virtually all the points we make have been made by others, but rather to put together in one place a compendium of recent glaring misuses of statistical inference in a form that we believe will be useful as a teaching tool for the press, public, and students about the dangers of sloppy use of statistics. We discuss the fallacies in a non-technical way to make our critiques broadly accessible to non-specialist audiences.

# Introduction

After the 2020 presidential election, the losing candidate, Donald Trump, claimed that he had been the victim of massive voter fraud that denied him the election. At the time, many Republican members of Congress, state attorneys general, and other Republican office holders endorsed this claim — a claim which his supporters continue to reiterate. Tens of millions of voters, including a clear majority of Republicans and non-trivial numbers of independents and Democrats believed after the election that there was massive fraud in 2020 (Gardner, 2021; Solender, 2020; UMass Amherst, 2021). Others believe that most elections are rigged (Zorn, 2017). In the 2022 primaries, some Republican candidates made the assertion of massive election fraud in 2020 a fundamental part of their election platform. Many of those candidates won their primary, and several will be able to affect future election administration in their states after winning in November (Medina et al., 2022).[[4]](#footnote-4) Thus, not only have claims about 2020 election fraud remained politically salient, but the persistence of voter beliefs in these claims, and the deep partisan divide about them leading to affective polarization, have frightening implications for the prospects of democratic breakdown in the U.S. (Grofman, 2022; Homans & Peterson, 2022; Leonhardt, 2022).

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| Figure 1 – Truth Social post by former President Donald Trump re the lengths he would be prepared to go to overturn the 2020 election results |
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| Note: Post accessed June 16, 2023. https://truthsocial.com/@realDonaldTrump/posts/109449803240069864 |

The supposed evidence supporting massive election fraud comes in many forms, including personal affidavits alleging fraud in particular precincts (McClallen, 2021), to videos allegedly showing direct evidence of vote tampering by poll workers (Gray, 2020), to how-to-videos showing the supposed ease of manipulating the record of votes produced by voting machines or mail ballots, to claims about a conspiracy by a particular voting machine vendor (Sganga, 2022), to assertions that more voters voted than were on the jurisdiction’s electoral roll (Ayyadurai, 2020; Swenson, 2020), to statistical claims of the kind rebutted in the present essay.

In April of 2023, Dominion, a company who manufactures voting machines, reached a settlement of $787.5 million in a defamation lawsuit again Fox News for the propagation of claims that Dominion machines changed votes from Trump to Biden (Poniewozik, 2023). To prove defamation, one must show “’actual malice’ -- that the statement was made with knowledge of its falsity or with reckless disregard of whether it was true or false.” *New York Times v. Sullivan* 376 U.S. 254 (1964). In documents that were revealed during the discovery phase of the trial, Fox News host admitted that they did not believe the claims they were making on television but repeated them because “[o]ur viewers are good people and they believe it” (Poniewozik, 2023).

Despite the implausibility of a massive multi-state conspiracy, the volume and variety of claims make them it almost impossible to successfully rebut all of them to a given voter’s satisfaction. Moreover, the fact that many of these claims about massive fraud in 2020 (including most of those we discuss in this essay) are plausible on their face, even though fallacious, make them harder to refute. Also, there is the mesmerizing power of repetition; the claim of massive fraud in 2020 is stated ad nauseam in conservative media sources and by former President Trump and his allies.[[5]](#footnote-5) Factual claims are often repeated even after clear contrary evidence has been presented (Hsu & Thompson, 2022).

There are many reasons that can be offered about why beliefs about massive election fraud in 2020 persist (see e.g., Berlinski et al., 2021; Douglas et al., 2019; Edsall, 2022; Holman & Lay, 2018). One obvious key factor is the level of present-day polarization, in which partisan identities shape beliefs (Iyengar et. al., 2019; Abramowitz and Webster 2018). Strongly embedded partisan identities mean that the public polarizes on the fraud claim based on partisanship. Relatedly, we have a siloization of communication channels along partisan and ideological lines (Prior, 2013; Robertson et. al. 2023). The fraud claims are echoed as indisputable by a multiplicity of sources that some voters trust (see above about Dominion and Fox News). Relatedly, Lenz (2012), among others, has shown that the public changes its policy views to match the politicians they support (e.g., attitudes toward Russia among Republicans track Trump’s changing views about Putin). Also, sources supporting the claim of Trump’s having won the 2020 election denigrate the reliability of the mainstream media who refute the fraud claim and insist that the mainstream media are simply partisan mouthpieces for the Democrats.

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| Media choice is not the only factor. It was impossible not to be constantly reminded about the fraud claims regardless of which media sources one followed. Virtually every claim made in the conservative press alleging election fraud was given considerable space in the mainstream media, followed by a rebuttal that often went on longer than the statement of the claim. For example, claims that a particular election had more voters than were registered were subsequently rebutted by showing that the list of eligible voters used for the comparison was incomplete (Reality Check team, 2020). And there were follow-up pieces in the mainstream press repeating multiple claims of fraud and their rebuttals, sometimes drawing on social science analysis such as the discussion of fallacious assertions about voting machine vulnerability to fraud in Eggers et al. (2021). In the *Washington Post,* President Trump had previously been given tens of thousands of Pinocchio points based on other kinds of claims he made found by the *Post* to be untruthful, with points added every time the claim was repeated (Kessler, 2020). This constant drumbeat about Trump’s factual misstatements and deceitfulness by a source that conservative voters did not trust may simply have reinforced the view among these voters that Trump was telling truths that the mainstream press was determined to hide. Relevant in psychological terms is the aphorism that “the lady doth protest too much,” in which repeated assertions that a given allegation is untrue become taken as support for a belief that it probably is true. |

But exploring why voters believe what they do (Bump, 2022) is not the purpose of this essay. Moreover, in this essay we will not discuss the vast bulk of claims about fraud in 2020, namely those that rest on contested facts. Our concern here is a narrowly focused one.

We deal solely with claims about fraud that are grounded, at least in part, on indisputable facts about statistical features of the 2020 presidential election, and comparisons of its outcomes to those of previous presidential elections or other 2020 elections. Similarly, we do not wish to argue about what state or federal courts should or should not have decided about election law in the cases brought before them in 2020.

Our goal is not to provide new insights about these statistical fallacies. Rather, our goal is put together in one place a useful compendium of many of the most glaring recent misuses of statistical reasoning as applied to understanding elections, [[6]](#footnote-6) and to do so in a way that is readily accessible to non-technical readers.[[7]](#footnote-7) We believe strongly that a discussion of statistical fallacies based on real-world examples should be part of any statistics or public policy curriculum.

We begin our inventory of fallacies with (a) arithmetic fallacies of a simple sort, such as drawing conclusions from unweighted averages where use of weighted average was required, cherry-picking the data to emphasize only those facts that lead to the desired conclusion, and confusing percentages and percentage point changes. Then we discuss (b) improper use of statistical significance, and then turn to (c) inaccurate probabilistic reasoning, such as improperly using as an indicia of fraud having voters with the same name and date of birth. Then we discuss (d) syllogistic arguments based on cross-election statistical comparisons that are either fallacious in form, or that have at least one premise that is indubitably false, and thus which give rise either to invalid or unfounded conclusions. Finally, we briefly consider similar types of statistical errors in (e) syllogistic arguments based on within-election comparisons. Though we certainly do not claim that we have identified every fallacious claim about 2020 that fits within our classification scheme, we believe we have a typology that includes the most common errors involving analysis of aggregate election data.

# Fallacious Statistically Based Claims about Massive Fraud in the 2020 Presidential Election

## Arithmetic Fallacies

Cherry-picking the data. The most primitive form of failing to weigh the data properly is cherry-picking the data to emphasize only those facts that lead to the desired conclusion. In presenting only some facts, a claimant can appear to have been honest while suppressing pertinent information that otherwise would prove their claims either false or incomplete. Because the data being cited are accurate, cherry-picking can prove a persuasive tool.

A standard way to cherry pick 2020 election data to show the potential for fraud is to focus on racial or demographic groups and to highlight the situations where Biden did worse than Clinton. For example, Biden won fewer counties than Clinton. You can also get even more specific, e.g., Trump won a greater share of the vote in the city of Philadelphia in 2020 than he did in 2016; and you can find other big cities where Biden underperformed Clinton. In these cherry-picked examples, Biden did less well against Trump than did the previous Democratic candidate and, since Trump beat Clinton, absent fraud, the implicit (and often explicit) conclusion is Trump must also have beaten Biden in terms of overall total vote nationally. But, of course, while there were some urban areas where support for Biden was lower than for Hillary Clinton, there were also urban areas where support for Biden was higher than for Hillary Clinton. Similarly, as discussed below, it is true that in terms of percentage voting for the Democratic candidate, racial minority support for Biden was (marginally) lower than for Hillary Clinton, and Trump did better among rural voters in 2020 than he did in 2016. However, support among categories of white voters, namely the college-educated and those living in suburbs, was higher for Biden than for Hillary Clinton. And there are many more voters living in suburban residences than in rural areas.

It is, of course, the combination of all the subgroup patterns of voting and the (changes) in their sizes across elections that matters for the total popular vote. To reiterate the obvious, looking only at some subsets of voters, or only some geographic areas, e.g., only rural counties, is misleading and can lead to ridiculous claims that the candidate who received more votes did not actually receive more votes.[[8]](#footnote-8)

Failing to weight units. There were various instances of this type of error in discussions of the 2020 election. We first focus on the most common instance. Failing to recognize that large changes in one direction in small population subsets or small population demographic subgroups can be compensated for by small changes in the other direction in large population subsets or demographic units is a common mistake.

It was observed that Trump won more counties in 2020 than he did in 2016, with the implication being that he must have done better in 2020 than in 2016 (Swenson, 2021). But this ignores the number of people in each county. Counties Trump did worse in, though fewer in number, had more voters in them. In fact, in Los Angeles County, Biden netted an additional 609,000 more votes in 2020 than Clinton did in 2016. Out of the over 3,000 counties in the United States[[9]](#footnote-9), the largest 150 contained half of the total votes cast. Biden won 125 of those 150 (83.3%) (see **Figure 2)**. In the 19 most populous counties, Biden received 7,360,531 more votes than Trump (Biden also won a slight majority in the first 3,134 counties, but by only 52,640 votes).

| Figure 2 – Votes in each County |
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| Note: One bar per county. Most counties have very few voters (long tail on the left of the plot). Among small and modestly populated counties, Trump won a majority in most; among those with the largest populations, Biden won a majority. Even in the largest counties, there are plenty of Trump voters, and in the smallest counties, there are some Biden voters. |

Errors in using unweighted averages when it is appropriate to use a weighted average can be plotted in several ways. Consider a histogram that shows the 2020 presidential vote share for each county. When plotted without any reference to the number of voters in each county (**Figure 3**, top plot), it appears that Trump won an overwhelming landslide in the 2020 election. However, if you represent the number of voters by making the height of the bar reflect the number of votes in each county (**Figure 3** bottom plot), we can now see how Biden received a larger share of the total vote.

| Figure New 2 – Histogram of the 2020 Presidential Election Results, by county |
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| Note: Both histograms consist of one bin each representing the Democratic share of the vote, from 0% to 100%. The top histogram shows that the majority of counties preferred Trump of Biden. The bottom histogram corrects the bars so that they reflect both the number of counties in each bin, and the number of votes in each county. |

Next, consider a choropleth map of election results by county (**Figure 2**). As Chief Justice Earl Warren famously quipped in *Reynolds v. Sims* (1964), “legislators represent people, not trees or acres.” Trump certainly won more acres, but he did not win more voters. If you look at map of U.S. counties showing those won by President Trump in red and those by Hillary Clinton (or Joe Biden) in blue, you will see a sea of red and only a relative handful of pockets of blues. But those pockets (mostly big cities) have lots of voters in them. **Figure 2** depicts the 2020 election with an overwhelming number of counties colored red, indicating Trump won those counties. It does not indicate the number of votes each county was won by. Biden won 556 counties (59,019,426 votes in those counties), while Trump won 2,595 (33,564,182 votes in those counties).[[10]](#footnote-10) In counties won by Trump, he received 40,644,014 votes (Biden won 22,245,568). Thus, Biden had 25,455,244 more votes in counties he won, versus 18,398,446 vote advantage for Trump in counties he carried (see **Table 1**).

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| Table 1 – Popular Vote in Counties Carried by Each Candidate | | |
|  | Biden Counties | Trump Counties |
| Biden Votes | 59,019,426 | 22,245,568 |
| Trump Votes | 33,564,182 | 40,644,014 |
| Difference | -25,455,244 | +18,398,446 |
| Note: Each candidate received many votes in counties they did not carry. Still, in aggregate, Biden received far more votes overall. | | |

When counties are instead represented on a map in proportion to their votes, such as with a cartogram – a map that has been resized so the units’ area is weighted to its population or some other numeric quantity – it become clear that the 2020 election was close, and certainly not an overwhelmingly “red” county shown by a county-level election map.[[11]](#footnote-11) Similarly, in the context of unequally sized units, a “bubble map” can be especially useful (see **Figure 3**).

| Figure 2 - Choropleth Plot, 2020 Presidential Election by county |
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| Note: This choropleth map shows the 2020 Presidential election results by county. Each county is shown using the Albers projection. |

But it is still virtually impossible to visually sum-total results from a cartogram or bubble map to determine an election winner, especially when the number of units (say counties) is large, though the bubble size gradations on a bubble map make this task easier than the color variations on a cartogram that usually have a limited number of victory margin categories.[[12]](#footnote-12) Moreover, to further confound simple calculations, it is helpful to remember that the county with the most Republican votes anywhere in the United States was Los Angeles County, California. Trump received 1,145,530 votes there, although that number was dwarfed by Biden’s 3,028,885.[[13]](#footnote-13) In fact, Trump’s 10 largest county vote totals in 2020 come in counties won by Biden.

| Figure 2 –Bubble Plot, 2020 Presidential Election by county |
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| Note: This bubble map shows a vote-weighted representation of the 2020 election. It describes three simultaneous variables, the winner of the county, the number of votes cast, and the number of votes the county was won by. Counties colored in blue were won by Joe Biden, and those colored in red were won by Donald Trump. The size of the circle indicates the number of votes cast. The opacity indicates what the margin of victory was. Because the bubbles overlap, it can be hard to see the densest areas with many counties. |

Two-party vote share versus shares of total votes cast. Comparing the share of votes between the two major political parties and the distribution of votes among different demographic groups provides insights into President Trump's support. In 2020, his level of support increased among all racial subgroups, including Whites, Blacks, Hispanics, Asians, and Others, compared to 2016 (refer to **Table 2**). Notably, he gained an estimated 12% of the Black vote in 2020, up from 8% in 2016. Similarly, his estimated share of the Hispanic vote increased by four percentage points, reaching 32% in 2020. Additionally, he gained one percentage point more of the White vote in 2020 than in 2016.

However, despite these gains, President Trump lost the election in 2020 after winning in 2016. So, why didn't he perform better in 2020? The answer lies in key differences between the two election years.

One crucial factor that contributed to Biden's victory over Trump was the composition of the electorate. In 2020, both the raw number (+11.5 million) and proportion (+3 percentage points) of minority voters increased compared to 2016. Trump's support increased among all demographic subgroups in 2020, including Whites. At first glance, these facts might suggest that Biden performed worse than Clinton in terms of the popular vote share in 2016. However, to understand what happened, we need to examine changes in each group's share of the electorate, which depends on changes in the size of voting populations and changes in voting preferences within those populations.

In 2020, 67% of voters identified as White in the exit polls, which made any gains in this category overshadow decreases among other demographics. Consequently, the combination of losses among minority voters and gains among White voters resulted in Biden securing 81.2 million votes (51.3% of the popular vote) in 2020, compared to Clinton's 65.8 million votes (48.2%) in 2016.

Moreover, the overall increase in voter turnout further strengthened Biden's margin of victory over Trump. While Trump lost to Clinton by 2.9 million votes in 2016, he faced a larger defeat in 2020, losing to Biden by 7 million votes.

In 2016, Donald Trump won 54.3 million non-Hispanic White votes, accounting for 57% of the total votes and representing 70% of the electorate (see **Table 3**). In the 2020 election, Trump managed to increase his votes among White voters to 61.6 million, making up 58% of the total White votes. However, the proportion of White voters in the electorate decreased to 67%. On the other hand, Hillary Clinton received 35.2 million White votes in 2016, comprising 37% of the total White votes. In 2020, Joe Biden garnered 43.5 million White votes, constituting 41% of the total White votes.

This means that the Democratic candidate for 2020 witnessed an increase of 8.3 million White votes compared to Clinton's performance in 2016. Meanwhile, the Republican candidate, Trump, saw an increase of 7.3 million votes among White voters. In terms of percentage points, Trump gained one percentage point, while Biden gained four percentage points more than Clinton. In raw numbers, Biden's increase among White voters in 2020 surpassed Trump's growth relative to his performance among that group in 2016 (see Table 3 for reference).

While Trump made gains from minority voters in terms of the absolute number of votes received and the proportion of support, Biden's improved performance among the larger group of White voters offset those gains. Furthermore, despite Trump's percentage point gains among minority voters in 2020 compared to 2016, as well as gains in raw vote totals, Biden outperformed Clinton among minority voters since there were more minority voters in 2020 than in 2016.

Another distinction lies in the total number of votes cast in each election. Turnout increased in 2020 for both minority and non-Hispanic White voters (see **Table 3)**. In 2016, approximately 95 million voters were non-Hispanic White, whereas in 2020, that number rose to approximately 106 million (a difference of 9 million). Similarly, the number of minority voters grew from 40.8 million in 2016 to 52.2 million in 2020 (a difference of 11.5 million). As a result, the percentage of minority voters within the electorate increased from roughly 30% in 2016 to 33% in 2020. Although Trump performed one percentage point better than Clinton among White voters in 2016, Biden's performance improved by four percentage points within the same demographic.

**It's important to note that exit polls do not express data in terms of two-party vote share, so the sum of Democratic and Republican shares does not necessarily add up to 100%.** In 2016, third-party candidates received a significant number of popular votes, totaling nearly 8 million votes (almost 5% of the electorate). However, in 2020, no candidate besides Trump or Biden received more than 1.25% of the national vote, with minor party candidates collectively accounting for less than 2% of the electorate's raw vote totals (refer to **Table 4**).

Ultimately, what truly matters for Electoral College outcomes is where these changes occur. Since presidential elections consist of 51 separate statewide elections (except for two states awarding votes by congressional districts), winning a surplus of votes in states where the majority has already been secured results in "wasted" votes that do not contribute to winning additional electors. Furthermore, national aggregated data on demographic shifts may hide potential local or state-level dynamics that could significantly impact popular vote trends.

Considering all these factors makes clear how Biden benefited from changes that occurred between 2016 and 2020, which played a decisive role in propelling him to the presidency, including narrow victories in several states that Trump had won by slim margins in 2016.

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| Table 2 - 2016 and 2020 Exit Polls, by Race |
| |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | | 2016 | White | Black | Latino | Asian | Other racial/ethnic groups | |  | 70% | 12% | 11% | 4% | 3% | | Clinton | 37% | 89% | 66% | 65% | 56% | | Trump | 57% | 8% | 28% | 27% | 36% | | 24,537 total respondents | | | | | | |  |  |  |  |  |  | | 2020 | White | Black | Latino | Asian | Other racial/ethnic groups | |  | 67% | 13% | 13% | 4% | 4% | | Biden | 41% | 87% | 65% | 61% | 55% | | Trump | 58% | 12% | 32% | 34% | 41% | | 15,590 total respondents | | | | | | |
| Note: Exit Polls conducted by Edison Research for the National Election Pool. |

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| Table 3 – Change in Non-Hispanic White Votes between 2016 and 2020 |
| |  |  |  |  | | --- | --- | --- | --- | |  | 2016 | 2020 | Difference | | Trump | 54,531,026 (57%) | 61,565,755 (58%) | +7,034,729 | | Clinton/Biden | 35,397,332 (37%) | 43,520,620 (41%) | +8,123,288 | | Other | 5,740,108 (6%) | 1,061,479 (1%) | -4,678,629 | | Non-Hispanic White Votes | 95,668,466 (70%) | 106,147,853 (67%) | +10,479,387 | | All Votes | 136,669,237 | 158,429,631 | +21,760,394 | |
| Note: The White proportion of the total votes cast was 70%. In 2020, it was 67%. Data from CNN Exit Polls, 2016, 2020. Data are estimated. |

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| Table 4 – 2016 and 2020 Popular Vote Totals | | | |
|  | 2016 | 2020 | Difference |
| Trump | 62,984,825 (46.3%) | 74,223,975 (46.8%) | +11,239,150 |
| Clinton/Biden | 65,853,516 (48.4%) | 81,283,501 (51.3%) | +15,429,985 |
| Others | 7,160,821 (5.3%) | 2,922,155 (1.8%) | -4,238,666 |
| All Votes | 135,999,162 | 158,429,631 | +22,430,469 |

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| There are other types of statistical confusions related to the Electoral College that we simply mention in passing because they are not directly linked to issues of fraud. Many voters have trouble understanding how the Electoral College works. It can most simply be thought of an example of weighted voting, where the weights are the number of electors each state is allocated; namely the sum of the number of representatives the state has in the U.S. House plus two, the number of U.S. Senators from the state. A common fallacy is to believe that a reversal of the popular vote outcome in the Electoral College occurs simply because of the two-seat “federal bonus” favoring small states. But Donald Trump would have won the Electoral College in 2016 even without the two-seat bonus (Cervas & Grofman, 2019). The vote in an Electoral College with only 438 members (538 minus 100 for the senate bonus) in 2016 would have been 248/438 (56.6%) as compared to the actual EC, 306/538 (56.9%); while Biden’s percentage of the Electoral College of 438 members in 2020 would only have gone up from 256/438 (58.4%) from the actual result of 306/538 (56.9%). Because the Electoral College is a state-based weighted voting game (except for the two states where seats are allocated at the congressional district level as well), once a unit is won by a candidate, the margin of victory is irrelevant for Electoral College seat share but is relevant in terms of the popular vote share. Thus, we can have a candidate winning some states by very close margins in such a fashion that there is a discrepancy between the popular vote winner and Electoral College winner. Of the four instances post-Civil War examples of such a discrepancy, two of the four, 1888 and 2016, would still have happened without the bonus. But, in 2000, without the bonus, Al Gore would have been elected president, and in 1876 there also would have been no inversion had the two-seat bonus been eliminated. (Cervas & Grofman, 2019; Table 2, pp. 1328-29). Of course, we must be careful in asserting counterfactuals. For example, had there been no two-seat bonus in 2000, Gore and Bush might have deployed campaign resources differently. |

## Misinterpreting Statistical Significance

In statistics, warnings about misinterpreting statistical significance are legion. One point frequently made is that statistical significance can only be interpreted in the context of the specific null hypothesis being tested. Another is a reminder that p-values are very strongly linked to sample sizes. A third point is a warning not to confuse statistical significance with substantive importance.

Our first example of misuse of statistical significance falls into the second and third categories. Our second example involves the misinterpretation of causality. Both are found in the expert witness testimony of Dr. Charles Cicchetti in the lawsuit brought by Texas Attorney General Ken Paxton challenging election results in Georgia, Michigan, Pennsylvania, and Wisconsin (*Texas v. Pennsylvania*, 592 U.S. \_\_\_, 2020).[[14]](#footnote-14) Dr. Charles Cicchetti’s calculations were picked up and widely spread on the internet.

First, in comparisons between what was found in 2020 and what was found in 2016, Dr. Cicchetti noted that he could demonstrate beyond any possibility of error that the vote share distribution for Joe Biden in 2020 differed from that of Hillary Clinton to a statistically improbable degree. He is certainly right about that fact.

But what that shows about election fraud is — exactly nothing! The hypothesis Dr. Cicchetti proposes was “the performance of the two Democrat candidates were statistically similar by comparing Clinton to Biden.” (Cicchetti Declaration, page 3). He tests this by examining the county-level election results in 2016 and 2020. And indeed, Dr. Cicchetti does show that the vote share distribution for Donald Trump in 2016 was not the same as in 2020. But we could have picked ANY two adjacent presidential election years and showed that the vote shares of the Democratic candidates in those two elections at the level of states or counties or precincts differed from one another. With a large enough sample size, such comparisons are virtually certain to generate statistically significant differences.

Second, in a comparison of partisan voting patterns in ballots in 2020 among ballots that are tallied early in the counting process and those that are tallied later, Dr. Cicchetti pointed out that, in some states, President Trump’s share of the vote declined relative to those first reported as polls closed on election night as more ballots were tabulated, while in other states he found the reverse pattern. Here, the proposed hypothesis was “the votes tabulated in the two time periods [were from] random samples from the same population of all votes cast.” (Cicchetti Declaration, page 4). He found the difference between the early vote share for Trump and later vote share for Trump to be statistically significant beyond any reasonable doubt, though of course, the directionality of the difference was not uniform. Though technically correct, what that shows about election fraud is – once again, exactly nothing! Indeed, for those familiar with elections, it shows a pattern that was predicted in advance (Foley & Stewart III, 2020).[[15]](#footnote-15)

While once it was believed that mail-in (absentee) ballots were disproportionately Republican, for the last two decades or so the evidence has shifted, suggesting that mail-in ballots are more Democratic-leaning than is the case for ballots cast in person.[[16]](#footnote-16) In some states in 2020, mail-in ballots were tallied as they came in; thus, they were the first ballot results to be reported; in other states, the tallying of mail-in ballots did not begin until after the polls were closed; and in select states, they were the last to be tallied. Thus, we would expect that there would be differences across states that would be in part predictable by when mail-in ballots were tallied. This could account for why, in some states, the early vote was more Democratic than the later vote, while the reverse was true in other states. Thirty-seven states allow election officials to begin processing mail-in ballots as they arrive prior to election day. Another ten states allow processing to begin on election day, but prior to polls closing. Only Maryland does not permit counting mail-in ballots until after polls close.[[17]](#footnote-17) Battleground states Michigan, Wisconsin, and Pennsylvania are among the ten states that do not allow counting mail-in ballots until election day.

But there is also another reason why late ballot tallies and early ballot tallies might be expected to be different in their partisan outcomes. Ballots tallies come in from counties and then get tallied statewide. When ballots get reported depends upon the efficiency of the county officials doing the tallying. But it is often easier to complete in-person voting tallies in small rural counties where there are few polling stations than in counties with large cities. But rural counties differ from urban counties in their partisan propensities. So, it is essentially guaranteed that there will be differences in partisan vote share as county reports come in at different times on election night. In the end, only the final count of all ballots is valid.

In sum, when the null hypothesis is nonsensical (such as a hypothesis that there is no difference in the vote share distribution in 2016 and the 2020 distribution), there is nothing at all surprising about it being rejected at a high level of statistical significance, especially when the sample size is high.

## Meretricious Probabilistic Reasoning

Voters with the Same Name and Date and Year of Birth. It has been noted that Joe Frazier voted in Pittsburgh in 2020 even though he had died in 2011 (Sadeghi, 2020). This fact was taken as evidence of fraud. But of course, not all Joe Fraziers’ are the famous (and now dead) boxer. Similarly, instances, where individuals with the same name and same birthday, and/or same birth year were found on voter rolls, have been taken as evidence of fraud.

It should be noted that some states record a default birth date (or a code for missing data) if none is provided, particularly if no date was provided when this information was collected on paper. This will, of course, if not corrected for, increase the likelihood of the appearance of voters who appear on the voter rolls multiple times. But the likelihood of occurrence of voters appearing on voting lists who have identical names, or identical years of birth, and even identical birth dates, is dramatically underestimated by virtually everybody, except for those who have truly understood the famous “Birthday Paradox.” The Birthday Paradox in its basic form is about how the number of people in a group affects the probability that some pair of them have the same birthday.

When first confronted with the question of how the number of people in a group affects the probability that some pair of them have the same birthday, students in statistics classes (or at least those in the undergraduate statistics classes taught by one of the present authors) think that, since any given birthday has a probability of only 1/365, it would take around 183 people (half of 365) before you would get a probability of 50% that two people in the group had the same birthday. The Birthday Paradox is called a paradox because it only takes a group of size 23 for the probability of two people in the group to have the same birthday to exceed 50%.

The probability that two people in a group of size *n* do NOT share the same birthday can be written as . This product goes down much faster than one might think, and thus the probability that at least two people in the group share the same birthday, which is one minus this product, goes up much faster than one might think. Indeed, with only 75 people, the probability of a birthday match rises to 99.95%. In a similar way one can calculate the expected proportion of a group of size who share a birthday with at least one other person in the group. The difficulty in appreciating how the increasing number of possible pairs that could share a birthday (and other attributes) increases in a non-linear way with increasing is relevant to claims made in 2020 (and earlier) that find examples of people with the same name and same date of birth on the voting rolls was *evidence* of “double-voting” fraud (Hasen, 2020; Weiser et al., 2006).

For any given name, it is obviously harder to find someone with the same name, born on the same day, and in the same year as it is merely to find people with the same name and the same birthday (but not the same year of birth). The logic of figuring out the probability of such a match happening is the same as the simple product formula given above, but now the divisor is larger than 365 (and thus probability lower) since we need to consider the years in which a person might have been born (though we may reasonably assume that everyone who votes was born at least 18 years ago). Moreover, as a further complication, we must consider the degree of heterogeneity in the distribution of names.[[18]](#footnote-18) But if we take name, birthday, and birth year as mutually independent factors,[[19]](#footnote-19) then we can simply multiply probabilities.[[20]](#footnote-20) We can further simplify by assuming a uniform distribution across the first two factors and assess the likelihood of two randomly chosen individuals bearing the same name from the name distribution in empirical data.[[21]](#footnote-21)

Of course, multiplying probabilities for three different factors gives us low probability values, but not as low as one might think.[[22]](#footnote-22) For example, if a randomly chosen person has a 0.000074 percent chance of sharing both a first and a last name with the next randomly chosen person, which was the estimate from the McDonald & Levitt (2008; p. 119, fn. 26)study,[[23]](#footnote-23) a total electorate of only 21,071 is enough to bring the probability of finding two people with the same name and the same birthday and the same birth year above 50%. And an of 57,314 brings that probability to 99.5%. Moreover, as McDonald & Levitt (2008) demonstrate with their detailed analyses of New Jersey electoral rolls, there are other reasons why we see some identical data among individuals, including flaws in the data such as the same individual simply being entered twice or individuals with missing data birth data (assigned a particular missing data code) being treated as having identical records.

Benford’s Law. There have been many attempts to use statistical tools to detect election fraud. One of these involve looking at suspicious data, e.g., vote tallies that disproportionately end in 0’s or 5’s since, in “inventing” data, there can be a human tendency to call these numbers to mind more often than would be expected from a purely uniform distribution (“Russian Elections Once Again Had a Suspiciously Neat Result,” 2021). While it makes no sense to look at the first digits of election returns since these will be obviously contingent on the mean size of the units,[[24]](#footnote-24) in investigating fraud, the frequency of digits other than the last or first digit has also been investigated. Benford’s Law, which is a hypothesized frequency distribution of kth digits, is an example of one tool that has been used to assess prima facie evidence of voter fraud. The political scientist Walter Mebane applied this tool to elections in multiple countries (Mebane & Kalinin, 2009). In the 2020 presidential election, analyses based on Benford’s Law were provided in videos and tweets as evidence that, in various locales, elections had been rigged (Jenny, 2020)﻿. We will make no attempt to repeat the logic that leads to Benford’s Law (see the discussion of the supposed Law in Wikipedia and references therein);[[25]](#footnote-25) we simply note that almost all of those who have investigated it empirically is dubious about its application to elections.[[26]](#footnote-26)

According to (Mebane, 2011), *Benford’s Law* implies that the mean value of the second digit of a distribution of votes at the precinct or other unit-level should equal 4.187. But a little reflection will show that the frequency of even second digits will be linked both to the size of units and their variance.

Imagine, for example, that the mean Democratic votes cast in a set of precincts is 1,650 voters, with a variance of 200. The second digit will have disproportionately many more 4’s, 5’s, 6’s, 7’s and 8’s than it has other numbers. If we change either the mean or the standard deviation of that distribution, then the expected mean value of the second digit will also change. Thus, there cannot be some fixed value that is the expectation of the mean value of the 2nd digit in all distributions. And the same point applies to whichever digit we focus on, or whether we look at all of them since the scale of units will affect which digits are most likely to deviate from Benford’s Law expectation. But perhaps even more importantly, it is quite possible for Benford’s Law to work well for some candidates and badly for others since different candidates will have different means and variances in their vote distribution across units.

The next two examples of meretricious probabilistic reasoning are more about human psychology than they are about statistics, *per se*.

Tip of the iceberg fallacy. No one who studies elections thinks that the level of election fraud in 2020 was zero. In an election with over 150 million voters, there will be some irregularities such as voting when not entitled to do so, voting twice, ballots lost, some mail ballots that are stolen and cast by others, some who mis-interpreted the laws (like returning an absentee ballot for their spouse), and some who voted while dead (perhaps having died after casting a ballot). And there will be some election officials who (at least initially) reported inaccurate results. But while fraud in any given state may have cases in the tens, or perhaps even hundreds, this level is not enough to change presidential election outcomes (see below).

One fallacy of probabilistic inference is to infer from the indubitable fact of some electoral wrongdoing in most states that electoral fraud is massive in both magnitude and geographic spread. The careful studies of fraud, such as the one of the 2020 election undertaken by the Ohio Secretary of State, reveals fraud at a miniscule level of fraud: 27 cases out of nearly 6 million ballots cast in Ohio (McDade, 2022). However, findings such as those of the Ohio Secretary of State, rather than being taken as evidence that the fraud level was trivial, are sometimes interpreted for a high probability of massive fraud. There is also a belief in conservative internet circles that, if there is fraud, it will be fraud committed by Democrat officials and found among the kinds of voters (such as racial minorities) who are most likely to vote Democratic. But is it is amusing to note that one of the first documented examples of actual fraud in 2020, so-called “voting the graveyard,” was committed by a Republican “in an attempt to further President Trump’s campaign” (Vella, 2020). The implicit and quite wrong-headed probabilistic argument is that any examples of fraud that are found should be presumed to be “only the tip of the iceberg.” As Andrew Gelman (2021) points out, some people say things like “who’s to say” when they hear claims that are patently implausible but respond in a way suggesting that they believe that claim might be true. Here, possibility is confounded with probability. A common aphorism also relates to this confusion, e.g., “Where there is smoke there is fire.” Here, the size of the fire remains unspecified. In the context of election fraud, confusing possibility with probability is likely to be more prevalent among those who see the world in conspiratorial terms. Gelman quotes one person who accepts claims Barack Obama is a Muslim as saying: “We see what they want us to see, I mean anything could be anything.”

Straw man fallacy. On the other hand, the claim that there was no massive fraud can be rhetorically equated to the claim that there was no fraud, and the latter claim rebutted as a straw man, as if successfully rebutting the claim of no fraud demonstrated the truth of the claim of massive fraud. Straw man arguments can be used to perpetuate a big lie, as has been the case following the 2020 presidential election.

Now let us turn to a set of other claims that have as their general form: “The only way these election results could have happened is if there was massive fraud.”

## Logically Invalid Arguments with a True Premise involving Historical Election Results Comparisons

Spoiled ballots. There is an empirically accurate observation that the spoiled ballot rate of mail-in ballots in 2020 was much lower (in some states remarkably lower) than in 2016. This fact is taken to be evidence of mail-ballot fraud by Trump supporters. Presumably the theory is that the lowered spoilage rate came about either because more ballots were illegally cast in 2020 than in 2016 and that those stealing unfilled-in or incomplete mail ballots and submitting them knew how to properly fill out the forms, or that ballot workers in polling stations where the mail ballots were likely to be Democratic ones deliberately allowed improperly filled out mail ballots to pass muster in a way that they had not in 2016.

We can write the argument as

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| If there is ballot fraud involving mail-in ballots (A),  then the spoilage rate among mail-in ballots will be lower than in the past (B).  The spoilage rate among mail-in ballots was lower than in the past. (B)  Therefore, there was ballot fraud involving mail-in ballots (A). |

Here we have the fallacy of *affirming the consequent*.

There are good reasons why ballot spoilage was lower in 2020 than in 2016 that have nothing to do with fraud, namely much greater effort on the part of election administrators to inform voters of what they needed to do to cast a valid ballot. For instance, popular late night comedy Stephen Colbert created a rather sophisticated website aimed at informing those in all 50 states about the specifics for casting a ballot in each of those states (*Better Know a Ballot*, 2021). His “Better Know a Ballot” also aired many times in the months before the elections on his highly rated “The Late Show.” Ads developed by the states themselves aired on television channels and as ads on streaming services.[[27]](#footnote-27) The Democratic National Committee spent millions of dollars on television ads with information about returning mail-in ballots (*DNC Launches New Digital Ads in PA Reaching Vote-By-Mail Voters: “How to Return Your Ballot!"*, 2020). There was furthermore ample coverage in newspapers about properly filing out and mailing a ballot so that it would not be rejected (Lai, 2020).

#### Likewise, in some states, there were greater efforts to prevent mail-in ballots from being rejected. County election offices, which usually administer elections, ensured that those who submitted a mailed-in ballot in a secrecy envelope which had some correctable error that would prevent the ballot inside the still unopened envelope from being counted were informed of the error and given the opportunity to correct it. Eighteen states allowed voters to “cure” their ballots if there is a discrepancy (*States That Permit Voters to Correct Signature Discrepancies*, 2020). These states are disproportionately Democratic; Trump won just 5 of the 18. But in our federal system, absent genuine issues of potential voting rights violations, states can and do differ in the details of their election administration. Moreover, counties themselves sometimes have discretion about whether to allow individuals to correct deficiencies in their cast mail-in ballots (Farley, 2020).[[28]](#footnote-28)

## Logically Valid Arguments with a False Premise involving Historical Election Results Comparisons

Now we turn to claims about election fraud that fall into the category of valid arguments with one or more false premises.

Presidential coattails. One claim about election fraud was based on the observation that winning presidential candidates have coattails that aid members of their party in the House of Representatives to gain seats. The Democrats lost 13 seats in the House of Representatives in 2020, which violates this expectation, and so the claim goes that the implication is that there must have been massive multi-state fraud.

The structure of this argument is:

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| If a presidential candidate wins election (A),  then there will be a gain in the number of members of his party in the U.S. House of Representative (B).  There was no gain for the Democrats in the House in 2020 (not B)  Therefore, Biden must have lost the election (not A) |

This is a valid argument. It is an example of *denying the consequent*. However, the premise on which is built, that presidential coattails are inevitable, is false.

By *coattails,* we are referring to an increase in the number of members in the U.S. House of Representatives that share the incoming president’s party (Campbell, 1986). Negative coattails are not uncommon, and in contemporary politics, have become more likely.[[29]](#footnote-29) Since 1868, there have been thirteen elections where a president has had negative coattails (including 2016 and 2020). Negative coattails are more likely when (a) elections are close in popular vote (b) there is substantial partisan bias against the party of the presidential winner in the House, (c) a substantial portion of the votes for the winning presidential candidate are wasted in states that are won by large margins, and (d) the winning president’s party picked up a significant number of seats in the previous midterm election. All four of these features are found in 2020.

Biden’s share of the major party vote was only 52.27%; the estimated partisan bias in 2020 in the House of Representatives in 2020 was 2.7%. Congressional districts have become far less competitive in recent elections, leaving fewer chances for a president to provide coattails large enough to flip seats (Engstrom, 2020). If we were to eliminate the states that gave the widest raw margin to Biden (California and New York and Massachusetts) from the calculations, Trump won a majority of the total vote in the remaining states – hence, we would not expect to see Biden coattails in those remaining states.[[30]](#footnote-30) Democratic gains in the House in the 2018 midterm were significant, and turnout was a level not seen before universal adult franchise (Jacobson, 2019). Moreover, up through 2016 there is a time trend of decreasing presidential coattails which, when projected onto 2020, would create an expectation of a negative coattail in the 2020 election.[[31]](#footnote-31) But perhaps most importantly, there were 35 House constituencies carried by Trump in 2016 but with a Democratic House member elected in 2018,[[32]](#footnote-32) and only 5 House constituencies lost by Trump in 2016 but with a Republican House member elected in 2018.[[33]](#footnote-33) Thus, Democrats in 2020 had many more vulnerable House seats than did the Republicans.

Bellwether counties. An argument of a similar form is that Biden lost most of the counties that had been bellwether counties, and therefore since bellwether counties predict presidential elections, Biden must really have lost the election.

Again, we can write this argument as

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| If a presidential candidate wins the election (A)  then they can be expected to carry almost all the bellwether counties (B),  Biden lost almost all the bellwether counties (not B)  Therefore, Biden must have lost the election (not A) |

This, too, is a valid argument – another example of *denying the consequent*. However, even though “not B” is empirically accurate, the premise on which the argument is built, namely that bellwethers predict elections, is false.

Many decades ago, the political scientist Edward Tufte (1974; chapter 3) wrote a devastating rebuttal to work on the power of bellwethers. Tufte showed that, over the period 1916-1968, there were no real state-level bellwethers and, most importantly, the U.S. counties identified as presidential bellwethers at time had no better track record at the next presidential election than the non-bellwether counties. Hopkins (2017) showed the same result for much more recent data. Yet, belief in bellwether units of geography, more particularly in the existence of bellwether counties, refuses to die.

Grofman & Chen (2022) explain the predictive failures of bellwethers partly in terms of classic work of Deutsch & Madow (1961). A simple binomial model shows that by chance alone, in large groups, some individuals can appear to have repeated (predictive) success even though, for any given event, the probability of success of any actor is only 0.5. This is true when we are dealing with independent trials where past success tells us exactly nothing about future success. But Grofman and Chen also elaborate on the conditional probability model that generates the likelihood of bellwethers by showing that as partisan polarization increases, and presidential politics nationally is competitive, the Electoral College sometimes have Democrats winning and sometimes Republican winning (three each in the 21st century), the likelihood of bellwethers declines. The intuition here – which they examine at the level of counties – is a very simple one: in order to be a bellwether county, a county must vote for the winner both when the winner is a Democrat and when the winner is a Republican, but *ceteris paribus*, the increasingly polarized patterns of voting have by now put virtually all counties firmly into one partisan camp or the other. In the 21st century, Grofman and Chen show that more than 70%+ of all counties vote consistently Republican, and another portion are dependably Democrat (see also Bishop and Cushing 2008). These counties make great bellwethers only when their party is always winning, but awful bellwethers otherwise. Indeed, Eggers et al. (2021; Figure 2) show that only 2% of counties had a different party winner in 2020 than they did in 2016. Thus, bellwether performance has been falling. Moreover, if inter-election changes in vote propensities vary across types of voters (or geographic units) than bellwethers can perform particularly dismally in a subsequent election. As a graph from the website FiveThirtyEight shows, counties that previously served as bellwethers have been shifting rightward (Matsumoto, 2021). Thus, when the Republican candidate loses, they will not serve as bellwethers.

Other Cross-Election Comparisons. Other arguments with specious premises supposedly demonstrating that Biden could not have won in 2020 also make use of differences between the 2020 election and patterns found in previous elections. For example, Trump supporters such as Shurk (2020) noted that no incumbent who has won more than 75% of the primary vote has lost their election. Therefore, since Trump had won 94% of the primary vote, he must have won re-election.[[34]](#footnote-34) Shurk also observes that “no incumbent in over 100 years who has gained votes in his reelection bid has lost his quest for reelection.” This claim fails to account for well-known political science theory that suggests that competitive elections increase voter turnout (Downs, 1957), and the empirical fact that modern elections are increasingly competitive at the national level (Lee, 2016). On the other hand, we could just as easily claim that incumbents whose overall presidential approval rating among independents was as low as that of President Trump must lose re-election. Unfortunately for this type of argument, there is no guarantee that what was true in the past will be true in the future. And, of course, these historical comparisons are based on small *n*, especially when we limit our comparisons to those where there is an incumbent running for re-election. We might alternatively argue that neither Trump nor Hillary Clinton could possibly have been elected President in 2016 since both were so disliked. Of course, no matter how unpopular one candidate may be, the other person might be even more unpopular. But also, relative likeability, is only one of the factors affecting vote choice.

***Logically Valid Arguments with False Statistical Premises Using Comparisons Based on Features or Components of the Same Presidential Election***

*Matching design (within-election, split ticket voting versus straight ticket voting).* One matching comparison involves comparison of an election where ballots are cast either as straight ticket votes (where a single check casts a vote for all candidates of a given party for all offices) or when this box is not checked, and voters choose candidates for each contest separately. Ayyadurai (2020) claims that support levels in straight ticket votes and split ticket votes should be unrelated to Trump’s share in a precinct unless there is voter fraud. To examine his expectation at the precinct level, he produces a scatterplot with the y-axis the percentage of support in a precinct that Trump receives from those who do not choose a straight-ticket vote MINUS the share of Trump vote from voters who do choose straight party and the Trump percentage from straight-ticket vote on the x-axis. His claim is that he should get a flat line, i.e., no correlation. He uses data from four counties in Michigan where the straight ticket vote option was available. Ayyadurai asserts that a negative correlation (among precincts) between his y and x variables indicates that the split ticket votes have been manipulated to reduce the apparent Trump share of the vote, i.e., that a negative correlation is a sign of voter fraud.

We can write this argument as

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| If the difference between straight ticket vote share for the candidate of a given party and split ticket vote share for the candidate of that party is negatively correlated with total votes for that candidate (A),  then there is vote fraud in favor of the other party (B).  The difference between straight ticket vote Republican share and split ticket Republican vote share in four Michigan counties is negatively correlated with straight ticket Republican vote share (A).  Therefore, there must have been vote fraud favoring the Democrats in those counties (B). |

This is, in principle, a valid argument. But there are both statistical and rational problems with the argument.

The basic problem is that the premise makes no sense.

We show in **Figure 4** the same plot Ayyadurai (2020) creates for Kent County. It does indeed show a clear negative correlation. But what does this negative regression demonstrate about fraud? Ayyadurai’s hypothesis can be stated as ‘if there is not fraud, the slope of this relationship will be zero.’ What it says is that as a party vote share increases in the precinct, split ticket voters will increasingly choose a candidate from the opposing party. And, if the same pattern appears when the data is plotted for Biden, it cannot be simultaneously true that there is fraud against Biden AND against Trump. By making the same plot, using the same dataset, but instead focused on the Democratic share of the straight-party vote and Biden’s share of split-ticket votes, the same pattern emerges.[[35]](#footnote-35)

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| Figure 4 – Kent County, Michigan 2020 election data plotted as Ayyadurai shows |
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| Note: Plot A shows the same data and scatterplot showing Ayyadurai’s YouTube video. Plot B shows the pattern when using Biden’s share of the vote plotted in the same manner. Each point is a precinct in Kent County, Michigan, one of the four counties analyzed in Ayyadurai’s video. 252 total precincts. The slope of the regression line in plot A is -0.40 and plot B is -0.36.  Data: https://electionreporting.com/4539283c-3f09-4fdf-ad93-0bfd82d32be1/county/db3f9865-656b-4704-9429-bd38e726ab42 |

We show in **Figure 4B**, the same scatterplot shown by Ayyadurai (2020) but this time focused from the Democratic point of view. It shows a clear negative correlation. This negative correlation is guaranteed when the slope of a regression line between split-ticket voters share of the vote for a candidate is less than their party’s straight-ticket vote share is less than one (see **Figure 5**). So, the interesting statistical question is not about the negative correlation when the data is plotted this way, but instead “why does Trump (Biden) get a lower percentage of split-ticket voters conditioned on their straight-ticket voter share increasing?” It turns out there is an easy explanation for this, and it is not fraud, but instead *conditional probability*.

We know that there are two kinds of split ticket, voters those who vote for Trump and a Democrat for Congress (or other lower office) and those who vote for the Democratic presidential candidate and a Republican for other offices. Among both types of voters, we expect them to be highly positively correlated (see **Figure 5**). But, in a heavily Republican precinct, split-ticket voters are likely to be those voting against Trump (and since Trump ran well among Republicans in heavily Republican precincts, there won’t be many of them); this contrasts with heavily Democratic precincts where split-ticket voters are likely to be ones voting for Trump, so Trump will do better in Democratic districts among split-ticket voters. Thus, the more of a party’s supporters that are in a precinct, the more likely someone choosing to split their ballot goes against their own party’s candidate. Politics, NOT vote fraud, can generate a negative correlation when the data is plotted in the way Ayyadurai presents it. Hence, to understand these patterns in the data we must understand conditional probabilities.

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| Figure 5 – Kent County, Michigan Precinct comparison between Trump Straight-ticket and Trump Split-Ticket Support |
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| Note: Each point is a precinct in Kent County, Michigan, one of the four counties analyzed in Ayyadurai’s video. 252 total precincts. The slope of the regression line in plot A is 0.60 and plot B is 0.64.  Data: https://electionreporting.com/4539283c-3f09-4fdf-ad93-0bfd82d32be1/county/db3f9865-656b-4704-9429-bd38e726ab42 |

Ayyadurai highlights that Trump's share of the vote among split-ticket voters is higher when all straight-ticket ballots are cast for Democrats. Consider the conditional probability of a voter in a precinct that is 100% Republican. Because all the voters in the precinct prefer Republican candidates, *if* they were to split their vote, there is a greater possibility that the split would go against Trump. Likewise, in strongly Democratic precincts, a split vote has a higher prospect of going against Biden. Stated differently, when there are more regular Democratic voters, split-ticket voters will increase Trump’s vote, but when there are more regular Republican voters, splitting ballots will increase Biden’s vote.

Comparison of differences involving samples with different means. There’s a second type of fallacy involved with the examples shown in Ayyadurai. It is claimed that in Wayne County the pattern is different (no correlation), and therefore the algorithm that transferred votes to Biden was not used. However, one need only look at the x-axis to see that in Wayne County the most Republican precinct has only about 30% Trump support. In the other counties, some precincts have 80% Trump support. In the range of the Wayne County plot, the pattern is like the other counties. One must be careful when presenting or consuming information from graphs that may mislead, even if done in ways that are not intentional. In this case, the data simply does not exist such that there are heavily Republican precincts in Wayne County to compare to the other counties.

Matching design (within-election comparisons of areas with and without fraud claims). Lott (2020) uses an apparently sophisticated attempt to prove election fraud via statistical analysis, which is now forthcoming in a peer-reviewed journal (Lott, n.d.). While Lott offers various forms of analysis, the most intriguing one, which appears to be quite plausible,[[36]](#footnote-36) is a matched pairs analysis which compares the difference in support for Trump in adjacent precincts in counties in Georgia and counties in Pennsylvania, such that one of each pair is in a county which voted for Biden and one is in a county which voted for Trump.[[37]](#footnote-37) The counties are distinguished by their expected partisan outcome. Lott takes a major urban county (which voted heavily for Biden) and treats it as one in which fraud might be present; the adjacent counties (which are either suburban or rural) are usually Republican dominated (and voted for Trump) are treated as a baseline in which no fraud would be expected.[[38]](#footnote-38) Lott attempts to explain the difference in absentee votes for Trump between adjacent pairs of precincts in the two types of counties by comparing them to the difference in in-person votes for Trump in the same pairs of precincts. The regression model includes a dummy variable for precincts located in the county which voted for Biden. He claims that a positive sign on this dummy variable indicated the presence of fraud. He obtains positive but not statistically significant results for both Georgia precinct pairs and Pennsylvania precinct pairs. He speculates that “One reason [for combining the two states] for doing so is to ask whether the failure of some estimates to reach statistical significance arises from the very small numbers of observations for each state (Lott, 2020, page 12).”

Eggers et al. (2021) provide a variety of arguments, both theoretical and empirical, to show that the econometric designs in the (Lott, 2020) study are so flawed that its conclusions are completely vitiated. That study has the advantage of making use of the data provided by Lott for replication purposes.[[39]](#footnote-39) Here we simply make two points about conceptual flaws in the Lott analyses.

On the one hand, it is a huge leap to believe that a positive sign on the dummy variable for precincts in pro-Biden counties in his analyses can be taken as evidence of fraud. There can be many reasons that have nothing to do with fraud for why Trump vote shares among mail-in voters differ from in-person voters across precincts. For example, while we do expect the area on the border between the two paired counties are similar, in Pennsylvania where we are most familiar with the data, there are key differences, such as income levels, homeownership levels and tax rates between the two paired counties that can be expected to affect voting choices. These differences are unlikely to be captured by control variables such as age and gender and can lead to differences in mean levels of Trump voting that can have major consequences for how the expected shape of in-person versus mail-in ballots across the two counties. Such matching/experimental design assumes that the units (and the individuals who make up that unit) are identical on every meaningful characteristic. The premise is the same as a laboratory experiment when a scientist wants to determine if a treatment has an effect. If the control group varies from the treated group, we cannot know whether the treatment has caused the effect, or if some other difference has a causal impact. Counties, which are the administrators of elections, vary on many aspects of election administration that make comparisons across counties potential fraught. For instance, the location and number of polling places might differ. The availability and location (accessibility) of drop-boxes for mail-in ballots might have an impact on the propensity of voters to utilize those resources. County administers might also have different procedures for curing ballots.[[40]](#footnote-40) Most importantly, the likelihood that a person chooses to vote by mail is correlated highly with vote choice. Even in matched precincts in adjacent counties, there might be significant problems with an independence assumption.

More particularly, implicit in the Lott regression model is that in all precincts, both in counties where Trump wins and in counties where Trump loses, the share of the Trump vote that is cast in-person is independent of the level of Trump support in the precinct. That is, the share of the Trump vote that is cast in person (as opposed to mail) is uncorrelated with Trump’s share of the overall vote. Since the total vote in a precinct, , is the sum of the two types of ballots, or , and with . We can posit that, on average, one (say, in-person, ), is not correlated with (and therefore is not correlated with ).

We show in Figure 5 that the assumption of independence is meritless.

If this assumption, which is critical to Lott’s argument were to hold, then we can write the in-person vote share difference between the precincts (weighed by the population in the precincts) in a pro-Trump county and those in a pro-Biden county as , where is the Trump share of each county’s vote. We can likewise write the mail-in vote difference between the precincts in the pro-Trump county and those in the pro-Biden county as . Hence, we can form a regression with Trump mail-in vote share in County 1 minus Trump mail-in vote share in County 2 as the dependent and Trump in-person vote share in County 1 minus Trump in-person vote share in County 2 as the independent variable. But, in accord with the homogeneity assumption above, this leads us to the regression .

In this regression, because of the posited linearity, we should find an intercept of zero. Lott interprets a non-zero intercept as evidence of fraud. But any non-uniformity in the posited linkages can produce a non-zero intercept. Below we demonstrate this non-uniformity for precincts in Allegheny and Butler Counties in Pennsylvania, two of the counties analyzed by Lott. Indeed, what we find is that the higher the Republican vote share in the precinct, the higher the proportion of voters who cast in-person votes. Moreover, the two counties have similar levels of in-person voting at similar precinct Trump support. We interpret this as a result of the more highly Republican areas having been more effectively cautioned by party leaders against the use of mail-in ballots.

| Figure 5 – Trump mail-in vote by level of total support |
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| Chart, scatter chart Description automatically generated |
| Note: Each dot is one precinct. There are many more precincts in Allegheny County than Butler County. |

# Conclusions

To paraphrase Jeremy Bentham, claims of massive fraud based on aggregate level statistical features of the 2020 election are not just nonsense, but “nonsense on stilts” (Bentham, 2002). While it is impossible to address all the misleading claims and specious arguments made on the internet or even by President Trump himself, we believe the compendium of statistical fallacies given above can be useful to those interested in the misuse of statistics. And, as noted earlier, this essay is deliberately written in a non-technical way to be comprehensible to beginning students in statistics. We further note that although the rebuttal of claims in this essay are focused on those made by Republicans, misuses of statistics is not *per se* partisan, and one does not need to look hard to find statistical fallacies made by partisans of any stripe. But the scope of the claims made by former President Trump and his allies, and the repetition of those claims despite repeated compelling rebuttal imply a credulity and willingness to believe in lies and/or a deliberate intent to deceive.

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2. University of California, Irvine, [bgrofman@uci.edu](mailto:bgrofman@uci.edu), <https://orcid.org/0000-0002-2801-3351> [↑](#footnote-ref-2)
3. Carnegie Mellon University, [cervas@cmu.edu](mailto:cervas@cmu.edu), <https://orcid.org/0000-0001-9686-6308> [↑](#footnote-ref-3)
4. Over 170 federal or statewide candidates won their general election contests in November 2022. Thus, although many of the over 291 candidates for these offices that emerged from the primary lost in the general election, enough won their elections to exert influence on future election administration. See e.g., Blanco et al (2022). [↑](#footnote-ref-4)
5. We would also note that, in the four years before the election, the claim that the 2020 election would be stolen by the Democrats was also repeatedly asserted by President Trump and his supporters, thus preparing the way for the post-election claims of fraud. [↑](#footnote-ref-5)
6. We do, however, believe that the framework of classifying election-related statistical fallacies that we offer may prove useful to other scholars. [↑](#footnote-ref-6)
7. We would call particular attention to the excellent survey and analysis of 2020 presidential election fallacies by Eggers et al. (2021). We began writing our own essay before we were familiar with this article in its on-line form, but we have learned a lot from it and cite to it herein. Their detailed rebuttal of fallacies is more technical than ours, and we cover some fallacies that they do not. There are also various journalistic surveys of election fraud claims (Alba & Frenkel, 2021; Corasaniti et al., 2020; Feldman, 2020), but these primarily include claims that do not fall within the scope of this essay. [↑](#footnote-ref-7)
8. Moreover, in understanding Electoral College outcomes, we need also to look at the geographic location of each candidate’s support. [↑](#footnote-ref-8)
9. As of 2020, there were 3,143 total counties and county equivalents. In our data, we have 3,153 because Alaska reports election results from Electoral Districts, of which there were 10 more than their county equivalents. [↑](#footnote-ref-9)
10. Data is estimated, as no official national election results are compiled. Dave Leip’s Atlas of Presidential Elections, a widely reputed accumulator of election results, reports totals that do not match the certified, official federal elections results produced by the FEC. The Brookings Institute reports the differential to be 2,588 Trump counties to 551 Biden counties (Frey, 2021). [↑](#footnote-ref-10)
11. For a nice overview of political graphics of different kinds, including a cartogram of the 2020 presidential election at the county level, see Bliss & Patino (2020). See also Cartographic Views of the 2020 US Presidential Election - Worldmapper (2020). [↑](#footnote-ref-11)
12. Though, note that the circle size in our map is scaled using the square root of the vote total, so the circle size itself is not a linear scale. [↑](#footnote-ref-12)
13. The number of votes cast in Los Angeles County surpassed the total votes in 39 states! [↑](#footnote-ref-13)
14. As we noted earlier, we are providing a compendium; this and other claims of Dr. Cicchetti have already been rebutted elsewhere (see e.g., <http://web.archive.org/web/20220416221931/https://reason.com/volokh/2020/12/09/more-on-statistical-stupidity-at-scotus/> and <http://web.archive.org/web/20220416221815/https://statmodeling.stat.columbia.edu/2020/12/08/the-p-value-is-4-76x10%E2%88%92264-1-in-a-quadrillion/>. That report has been devastatingly critiqued in the expert witness report of Gary King in the same case. Claims about election fraud in Texas v. Pennsylvania, including Dr. Cicchetti’s report, can be found here: <https://www.supremecourt.gov/DocketPDF/22/22O155/163048/20201208132827887_TX-v-State-ExpedMot%202020-12-07%20FINAL.pdf> [↑](#footnote-ref-14)
15. In the hearings by the House Select Committee investigating January 6, this discrepancy between the patterns in early and late votes was referred to as a “red mirage.” [↑](#footnote-ref-15)
16. Perhaps because states with more Democrats allow for more wide-spread use of mail-in balloting, e.g., eight states conduct general elections entirely by mail. They include California, Colorado, Hawaii, Nevada, Oregon, Utah, Vermont, and Washington. See (*Voting Outside the Polling Place: Absentee, All-Mail and Other Voting at Home Options*, 2022). All of these, except Utah, voted their electors to both Democratic nominees Clinton (2016) and Biden (2020). [↑](#footnote-ref-16)
17. Two states, Connecticut (Conn. Gen. Stat. § 9-150a) and Ohio (Ohio Rev. Code § 3509.06), do not specify when counting may begin. For more information, see Voting Outside the Polling Place: Absentee, All-Mail and Other Voting at Home Options (2022; Table 16). [↑](#footnote-ref-17)
18. Calculating this probability from the name distribution in the population requires calculating an average based on name and surname. Names vary greatly in their frequency and vary geographically. The U.S. Bureau of the Census publishes a list of surname frequencies based on national values, but the distribution of names (and their degree of heterogeneity) will vary with the racial/ethnic composition of the political unit (Grofman & Garcia, 2014, 2015). [↑](#footnote-ref-18)
19. Birth year and name are not fully independent of one another. Changing patterns of immigration affect the relative surname shares in different generations, and some rather dramatic changes over time in the popularity of first names mean that first name probabilities are not independent of the year of birth. Also, first and last names are far from independent since both are linked to ethnicity. Indeed, we could, in principle, estimate birth decade probabilities just by looking at the prevalence of first and last names of those born during the decade (cf., Grofman & Garcia, 2014, 2015) [↑](#footnote-ref-19)
20. Note that the probability of finding such a match from among a set of *n* voters must not be confused with the probability of any specific name + birthday + birthyear combination being repeated. For obvious reasons the likelihood of a given combination being repeated will depend, *ceteris paribus*, on how common is the name. [↑](#footnote-ref-20)
21. The most sophisticated study of double voting of which we are aware (McDonald & Levitt, 2008) investigates complaints of election fraud in New Jersey in 2004 that were based on apparent observance of thousands of instances of double voting, includes a comparison of the assumption of uniform distribution of year of birth and name distribution to actual data and show that assuming a uniform distribution over a 64 year interval and over the names in the data set tends to underestimate the prevalence of birth year matching by about , see p. 119). The more there are birth bulges (as in the post-WWII baby boom), the more likely it is that two randomly chosen individuals will share the same year of birth, and some names are much more prevalent than others. [↑](#footnote-ref-21)
22. And, of course, this assumes that the probabilities are independent of each other. [↑](#footnote-ref-22)
23. For further compatibility with the McDonald & Levitt (2008) study, in the model, presented below, we also took our birth year time-period as a 64-year span. [↑](#footnote-ref-23)
24. Mebane (2020) notes that “It is widely understood that the first digits of precinct vote counts are not useful for trying to diagnose election frauds.” [↑](#footnote-ref-24)
25. Wikipedia entry on Benford’s Law: <https://en.wikipedia.org/wiki/Benford%27s_law#cite_note-37> [↑](#footnote-ref-25)
26. See e.g., Deckert et al. (2011). Even Mebane, who has been a repeated applicant of the Law as a fraud detector in elections in multiple countries, has reiterated that while its violation might be taken as suggesting an anomaly, a violation of the supposed Law does not prove fraud. Fraud would need to be directly investigated (Mebane, 2020). [↑](#footnote-ref-26)
27. In Pennsylvania, this included pointing viewers to a website developed by the Department of State. Ads featured prominent actors and athletes from the state. [↑](#footnote-ref-27)
28. Trump’s White House Press Secretary Kayleigh McEnany falsely claimed that “[a] mere survey of the facts shows that voters in blue counties like Philadelphia County were given certain privileges that voters in red counties were not afforded. The Constitution’s equal protection clause requires uniform standards, but Democrat election officials created disparities depending on where citizens lived and where they voted in the state.” However, the PA Department of State gave guidance to all counties that they could allow voters to make corrections to rejected mail-in ballots. Some counties, predominantly Trump-majority in their partisanship, choose not to. [↑](#footnote-ref-28)
29. See Morris Fiorina (2017) “Unstable Majorities”, and Frances Lee (2016) “Insecure Majorities”. Modern elections are very likely to result in divided government, and control of any branch of government is often won or lost in the margins. Partisan bias, such as that introduced by malapportionment or gerrymandering, can also affect the ability to carry marginal House or Senate seats. [↑](#footnote-ref-29)
30. House Democrats nationally underperformed their 2018 performance, which accounts for the fourteen net seats gained by the Republicans. Relative to the 115th Congress (2016-2018), the 177th Congress (2021-2023) has 28 more Democrats. [↑](#footnote-ref-30)
31. Figure omitted for space reasons. [↑](#footnote-ref-31)
32. An increase of 22 from 2016. [↑](#footnote-ref-32)
33. A decrease by 19 from 2016. [↑](#footnote-ref-33)
34. This “thread” is filled with statistics purportedly showing how Biden is the historic underdog going into the 2020 election (by this account, Trump should have been heavily favored), e.g., “Incumbents are 6/6 when facing re-election during civil unrest”. See more: <https://twitter.com/davidchapman141/status/1315440579485069314?s=20> Internal links to this claim on Twitter say that the first primary was in 1912 and that Trump had received a higher percentage of the primary vote than Eisenhower, Nixon, Clinton, and Obama. And it is noted that only five incumbents have received at least 90% of their primary vote. [↑](#footnote-ref-34)
35. This rebuttal to Ayyadurai (2020) is presented in Eggers et al. (2021), acknowledging its previous elucidation by Kabir (2020) and Parker (2020), each of whom show empirical evidence of the party-independence of results. However, the Eggers, Garro, and Grimmer main rebuttal to the Ayyadurai (2020) claim uses the logic of latent variable analysis by demonstrating how regression to the mean effects lead to negatively sloped regression lines in the situation posited by Ayyadurai. [↑](#footnote-ref-35)
36. Indeed, we regard Lott’s analysis as sufficiently plausible, on its face, to explain why, despite being either completely wrong or at best much overstated, it could nonetheless pass peer review. [↑](#footnote-ref-36)
37. Lott (2020) also offers a similar kind of argument about why turnout differences in adjacent pro-Biden versus pro-Trump counties could also be indicators of fraud. But that argument also is fundamentally flawed because it assigns to fraud differences across units that have other very plausible non-fraudulent explanations. See Eggers et al. (2021). [↑](#footnote-ref-37)
38. In Lott (2020, page 6), he says “In 2020, Fulton County contains 384 precincts and Cherokee County had 42 precincts. In one case, Fulton County precinct ML02A matches up with four different precincts in Cherokee County (Mountain Road 28, Avery 3, Union Hill 38, and a small portion of Freehome 18).” He further says “While each county (or, in the case of Pennsylvania, each township) had its own precinct maps, comparisons across the political boundaries had to be done by hand. The goal is to compare the precincts of Fulton County that are most similar to precincts in nearby counties with no fraud allegations. In that way, we can isolate the impact of Fulton county’s vote-counting process (including potential fraud).” However, these comparisons are fraught with potential error because even demographically similar precincts may have different voting patterns. Indeed, it was widely reported that suburban areas shifted towards Biden and the Democrats in 2020 (Skelley et. al., 2020) but rural areas remain Trump country (McGreal, 2020). [↑](#footnote-ref-38)
39. One point made by Eggers et al. (2021) is that the results for Democratic vs. Republican County comparisons depend upon the order in which we select the units; another point they make is that which precincts are paired can reverse the sign of the results and that Lott’s specification is one of those that results in a higher level of statistical significance for the dummy variable. [↑](#footnote-ref-39)
40. Counties following different procedures for allowing the correction of what would be invalid ballots in Pennsylvania was challenged and led to a lawsuit. White House Press Secretary Kayleigh McEnany said that the PA Secretary of State allowed ballot curing to “tip the scales of an election to functionally favor the Democrat Party.” But all counties were provided the opportunity to cure ballots, even if some refused to. For more information in the differential treatment of invalid ballots across PA counties, see (Farley, 2020). [↑](#footnote-ref-40)