Analysis of Florida constitutional amendments

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STA4211 Design of Experiments

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Background

The ballot for the 2018 midterm elections in Florida included 12 amendments (13, one of which was rectroactively disqualified) to the Florida constitution. These amendments were initiated by a petition process in which proposed amendments are submitted along with a certain qualifying number of signatures.[1] Out of those 12 amendments, 11 passed with a vote of YES, despite requiring a 60% majority to succeed.

If we assume that a given amendment passes with probability 0.5 (an assumption we examine later on), then we may look at this result as the outcome of a binomial random variable. Given 12 amendments, there would be a mere 0.317% chance of 11 or more amendments passing. This extremely low probability prompted me to wonder whether other factors are at play with respect to voting on amendments. Namely, I am curious as to whether there is a tendency to simply vote YES on these amendments, which would increase the probability that they pass.

The system of amending the Florida constitution was introduced in 1968, but was used for the first time in 1978. An important change to the system was introduced in 2006, when the percentage of votes required to pass an amendment was increased from 50% (which it had been since 1968 until and including 2006) to 60% for the years after 2006.[2] For clarity, we call the years requiring a 50% vote to pass the 'pre-2007' years, and the years requiring a 60% vote to pass the 'post-2007' years. Note that there is no election in 2007, this serves only to disambiguate the group that the year 2006 belongs to. This change of required percentage of the vote will necessitate separate treatment of the data between the years on either side of this divide.

Aims

1. Examine the proportion of Flordia constitutional amendments that have passed since the beginning of their regular use in 1978; while requiring a majority before

[1] Florida Division of Elections, "Consitutional Amendments", https://dos.myflorida.com/elections/laws-rules/constitutional-amendments/

[2] Ballotpedia, "History of Initiative & Referendum in Florida", https://ballotpedia.org/History_of_Initiative_%26_Referendum_in_Florida

2007 and a super-majority after 2007, how likely are amendments to pass once on the ballot?

2. Compare the proportion of amendments passed in 2018 to the proportion of amendments passed in all other years; was 2018 an anomalous election, or with expectations relative to other years?

Data

The Florida Division of Elections website contains a database of all proposed contitutional amendments, which may be queried on their website and copied/pasted into a spreadsheet program.[3] Included in the data is the title, year, sponsor, and status (pass/fail) of each initiative. Data ranges between the years of 1978 and 2020 (the 2020 data are amendments currently collecting signatures). Further data such as financial info and number of signatures can be found by following links on individual initiatives. The columns of importance for our goals are 'Year' and 'Status'. The total number of amendments for each year are added up and so are the total number pass for that year, so that a proportion of those passed can be calculated.

A sample of the data once the useful information is extracted follows:

	Year	Group	Total	Passed	Proportion
1	1978	0	9	0	0.0000000
2	1980	0	12	11	0.9166667
3	1982	0	2	2	1.0000000
4	1984	0	8	7	0.8750000
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18	2012	1	11	3	0.2727273
19	2014	1	3	1	0.3333333
20	2016	1	5	4	0.8000000
21	2018	1	12	11	0.9166667

Analysis plan

This data is observational – no experimental treatment was applied, therefore this data cannot prove a cause-and-effect relationship but only provide evidence for a correlation.

To proceed, we consider the hypothesis that each amendment passes with probability P, assuming $P = 0.5$. This is an unrealistically simple model, but a reasonable place to start; one might argue that under an idealized election system laws would be implemented

[3] Florida Division of Elections, "Initiatives / Amendments / Revisions Database", https://dos.elections.myflorida.com/initiatives/

as soon as a majority of the population supported it. Further research into this topic would involve a more nuanced analysis of this assumption.

For the first aim, we estimate p, the observed probability of an amendment passing. In each group, we compare the number of amendments passed between all years considered to the total number of amendments proposed; the quotient of the numbers is p for the group. We consider the hypotheses $H_0 : p = P$ vs. $H_a : p > P$. Under the null hypothesis, we would observe 50% of the amendments passing. There are enough proposed amendments in each group to warrant a normal approximation to the binomial distribution. This allows us to test the hypotheses using the standard z-test.

With respect to the second aim, we may test whether 2018 is an anomalous year by determining the distribution of the post-2007 years excluding the data for 2018. We may then compare the observed proportion of amendments passed in 2018 to the new distribution. We exclude the 2018 data because otherwise our approximations will be biased. We may again use the normal approximation to the binomial distribution. If we write the observed proportion in 2018 as p_{2018} and the experimental distribution as $N(p_1, \sigma_1^2)$, then the hypothesis test for our second aim will be $H_0 : p_{2018} = p_1$ vs. $H_a : p_{2018} > p_1$.

Results

Figure 1 is a graph of the proportion of amendments passed in each given year, along with a line at 0.5. Pre- and post-2007 data is divided by the vertical line. Upon visual inspection, there appears to be a tendency for more amendments to pass than would be expected under the null hypothesis.

1. Below, we estimate p for the pre-2007 and post-2007 data.

```
> total <- with(fl, tapply(Total, Group, sum))
> passed <- with(fl, tapply(Passed, Group, sum))
> proportion <- passed / total

            pre-2007 post-2007
total            109        44
passed            89        27
proportion 0.8165138 0.6136364
```

   These proportions are plotted along with the data in Figure 2. We next calculate the p-value for the hypothesis tests.

```
> P <- 0.5
> pval <- 1 - pnorm(proportion, mean=P, sd=sqrt(P*(1-P)/total))

         pre-2007    post-2007
pval 1.934608e-11 6.583401e-02
```

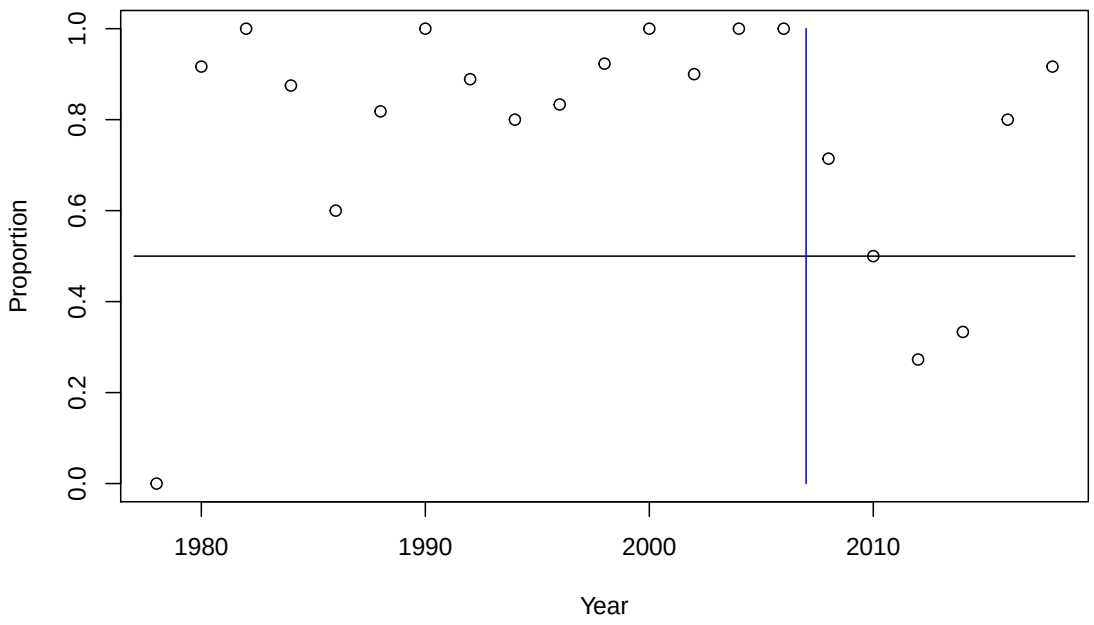

Figure 1: Proportion of amendments passed by year, including expected proportion under the null hypothesis.

The results of the tests indicate that pre-2007, we should conclude at level $\alpha = 0.05$ that the observed proportion is not equal to 0.5, and our best estimate for the true proportion is .8165. However, for the post-2007 data, we fail the reject the null hypothesis and conclude that the observed proportion does not differ significantly from 0.5.

2. We fit a normal distribution to the post-2007 data similarly to above, but excluding the year 2018.

```
> flpart <- with(fl, fl[Year > 2006 & Year < 2018,])
> p.1 <- with(flpart, sum(Passed) / sum(Total))
> s <- with(fl, p.1 * (1 - p.1) / sum(Total))

p.1   0.500000000
s     0.001633987
```

Thus, we approximate the post-2007 data excluding 2018 using a normal distribution with $p_1 = 0.5$ and $\sigma = 0.0016$. Under this distribution, we calculate the probability of observing the 2018 result.

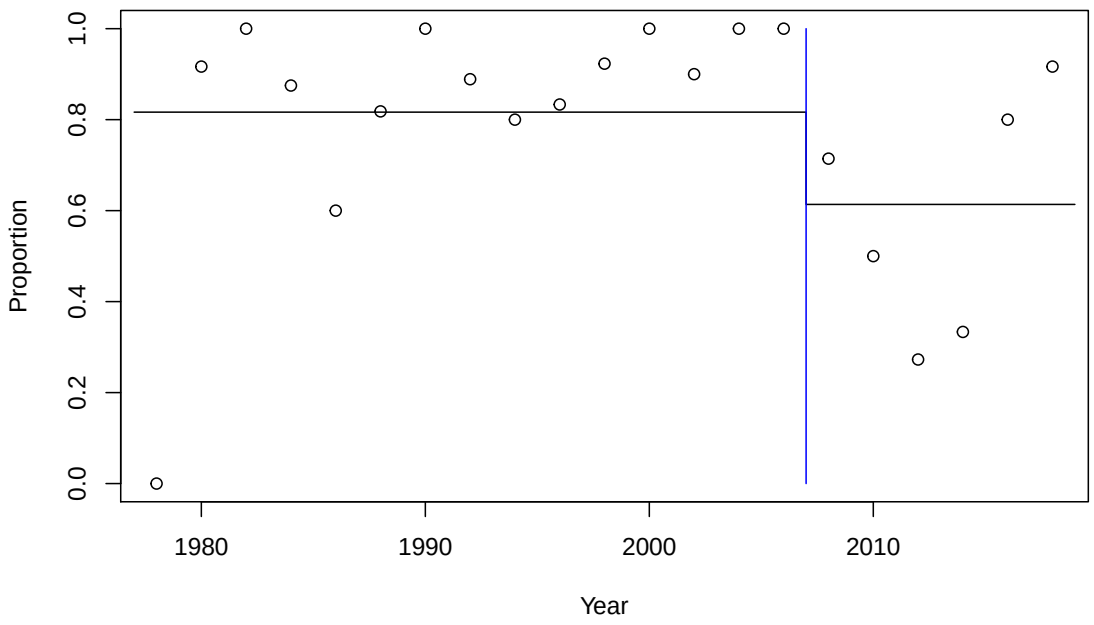

Figure 2: Proportion of amendments passed by year, including estimated groupwise proportion.

```
> p.2018 <- 11/12
> pval <- 1 - pnorm(p.2018, p.1, s)

p.2018 0.9166667
pval   0.0000000
```

Therefore, we reject the null hypothesis at level $\alpha = 0.5$ and conclude that the 2018 result is significantly higher that the results of comparable years.

Conclusion

For our first aim, since we rejected the null hypothesis for the pre-2007 years, we find that amendments pass with probability greater than 0.5. This means that an amendment, once on the ballot, has a relatively good chance of passing. One explanation for this may be that only amendments that already have sufficient public support make it to the ballot to begin with. This would raise the question: why is it that amendments only make it to the ballot once they have an estimated 80% support? Further research using this data could attempt to answer that question by analyzing the conditions under which an amendment gets on the ballot.

As for the post-2007 years, we fail the reject the null hypothesis and conclude that the probability that an amendemnt passes does not differ significantly from 0.5 for these years. It makes sense that given an increase in the percentage of votes required to pass an amendment, we would expect the proportion of amendments passing to decrease. However, we are left wondering why legislators implemented this change in the first place; was it to artifically force a 0.5 proportion? Further research into the history behind this change is necessary to answer this sort of question.

In investigating the second aim, we find that the proportion of amendments that passed in 2018 is significantly higher than what we would have expected based on previous years. One reason for this may be unaccounted-for variance; although we have enough amendment data points to assume a normal distribution, the data does not span a great number of years, so if there were a large year-dependent effect it may go unnoticed. For instance, there may be a general trend towards an increasing proportion of amendments being accepted, or there may be an effect of a changing political landscape. As before, further, more controlled experimentation is required to prove any cause-and-effect relationship, as this analysis is purely observational.