

Hurricanes are inevitable. Thankfully, they come with a warning. While growing up in south Louisiana, I noticed a trend that Atlantic hurricane activity picks up during Presidential election years. I wanted to explore the data around hurricane activity for the Atlantic hurricanes to see what could be learned from the data. Below you will find the data set that I will use for the graphs and charts in this paper.

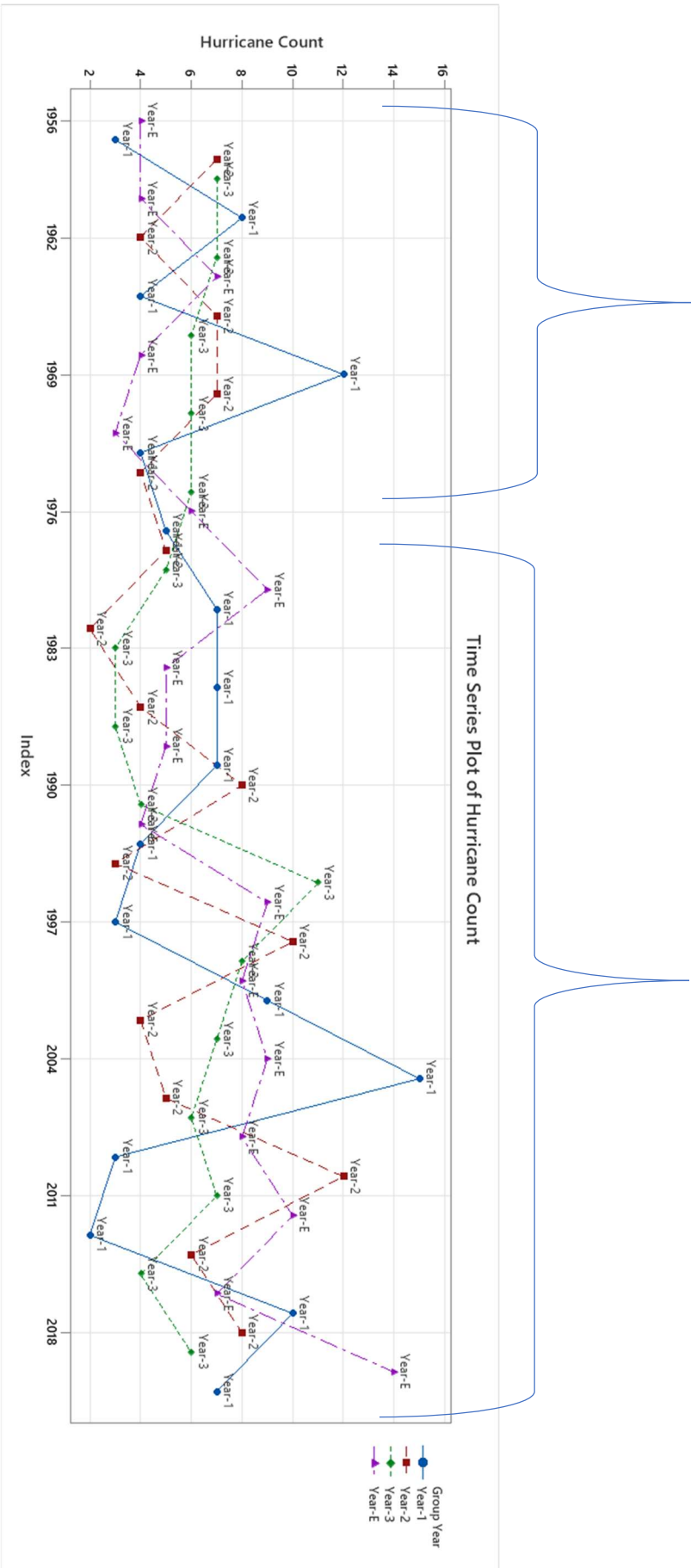
Year	Election Year?	Group Year	Hurricane Count	HURRICANE STRENGTH (1 to 5)					Total	W/O Cat 1 & 2
				1	2	3	4	5		
1956	Yes	Year-E	4	2	1	1	0	0	4	1
1957	No	Year-1	3	1	0	1	1	0	3	2
1958	No	Year-2	7	1	3	0	3	0	7	3
1959	No	Year-3	7	5	0	1	1	0	7	2
1960	Yes	Year-E	4	2	0	1	1	0	4	2
1961	No	Year-1	8	2	1	0	3	2	8	5
1962	No	Year-2	4	2	2	0	0	0	4	0
1963	No	Year-3	7	2	2	2	1	0	7	3
1964	Yes	Year-E	7	1	1	1	4	0	7	5
1965	No	Year-1	4	1	2	0	1	0	4	1
1966	No	Year-2	7	4	0	2	0	1	7	3
1967	No	Year-3	6	3	2	0	0	1	6	1
1968	Yes	Year-E	4	3	1	0	0	0	4	0
1969	No	Year-1	12	7	2	2	0	1	12	3
1970	No	Year-2	7	3	2	1	1	0	7	2
1971	No	Year-3	6	4	1	0	0	1	6	1
1972	Yes	Year-E	3	2	1	0	0	0	3	0
1973	No	Year-1	4	3	0	1	0	0	4	1
1974	No	Year-2	4	1	1	1	1	0	4	2
1975	No	Year-3	6	1	2	2	1	0	6	3
1976	Yes	Year-E	6	2	2	2	0	0	6	2
1977	No	Year-1	5	4	0	0	0	1	5	1
1978	No	Year-2	5	2	1	0	2	0	5	2
1979	No	Year-3	5	2	1	0	1	1	5	2
1980	Yes	Year-E	9	4	3	1	0	1	9	2
1981	No	Year-1	7	3	1	2	1	0	7	3
1982	No	Year-2	2	1	0	0	1	0	2	1
1983	No	Year-3	3	2	0	1	0	0	3	1
1984	Yes	Year-E	5	3	1	0	1	0	5	1

1985	No	Year-1	7	4	0	2	1	0	7	3
1986	No	Year-2	4	3	1	0	0	0	4	0
1987	No	Year-3	3	2	0	1	0	0	3	1
1988	Yes	Year-E	5	2	0	0	2	1	5	3
1989	No	Year-1	7	3	2	0	1	1	7	2
1990	No	Year-2	8	5	2	1	0	0	8	1
1991	No	Year-3	4	1	1	1	1	0	4	2
1992	Yes	Year-E	4	1	2	0	0	1	4	1
1993	No	Year-1	4	2	1	1	0	0	4	1
1994	No	Year-2	3	2	1	0	0	0	3	0
1995	No	Year-3	11	3	3	2	3	0	11	5
1996	Yes	Year-E	9	3	0	4	2	0	9	6
1997	No	Year-1	3	2	0	1	0	0	3	1
1998	No	Year-2	10	3	4	1	1	1	10	3
1999	No	Year-3	8	0	3	0	5	0	8	5
2000	Yes	Year-E	8	4	1	1	2	0	8	3
2001	No	Year-1	9	4	1	2	2	0	9	4
2002	No	Year-2	4	1	1	1	1	0	4	2
2003	No	Year-3	7	3	1	1	1	1	7	3
2004	Yes	Year-E	9	2	1	2	3	1	9	6
2005	No	Year-1	15	7	1	2	1	4	15	7
2006	No	Year-2	5	3	0	2	0	0	5	2
2007	No	Year-3	6	4	0	0	0	2	6	2
2008	Yes	Year-E	8	2	1	1	4	0	8	5
2009	No	Year-1	3	0	1	1	1	0	3	2
2010	No	Year-2	12	3	4	1	4	0	12	5
2011	No	Year-3	7	3	0	2	2	0	7	4
2012	Yes	Year-E	10	5	3	2	0	0	10	2
2013	No	Year-1	2	2	0	0	0	0	2	0
2014	No	Year-2	6	3	1	1	1	0	6	2
2015	No	Year-3	4	2	0	1	1	0	4	2
2016	Yes	Year-E	7	3	0	2	1	1	7	4
2017	No	Year-1	10	2	2	2	2	2	10	6
2018	No	Year-2	8	3	3	0	1	1	8	2
2019	No	Year-3	6	2	1	1	0	2	6	3
2020	Yes	Year-E	14	5	2	2	5	0	14	7
2021	No	Year-1	7	3	0	2	2	0	7	4

The first question I wanted to answer is whether this trend of increased hurricane activity is a new event or if historical data would show that the increase was current in years prior. The chart on the next page shows how the prior to 1980 hurricane activity had less dispersion than after 1980. My paper will focus on hurricane activity after 1980.

Pre-1980 shows far less dispersion for hurricane counts prior to 1980.

Hurricane activity after 1980 shows far more variability.



The hurricane data is grouped into 4-year intervals. With an elections year denoted as year-E, the first year after an election year is denoted as Year-1, the second year after an election year is denoted as Year-2, and the third year after an election year is denoted as Year-3. Of course, this sequence repeats every four years.

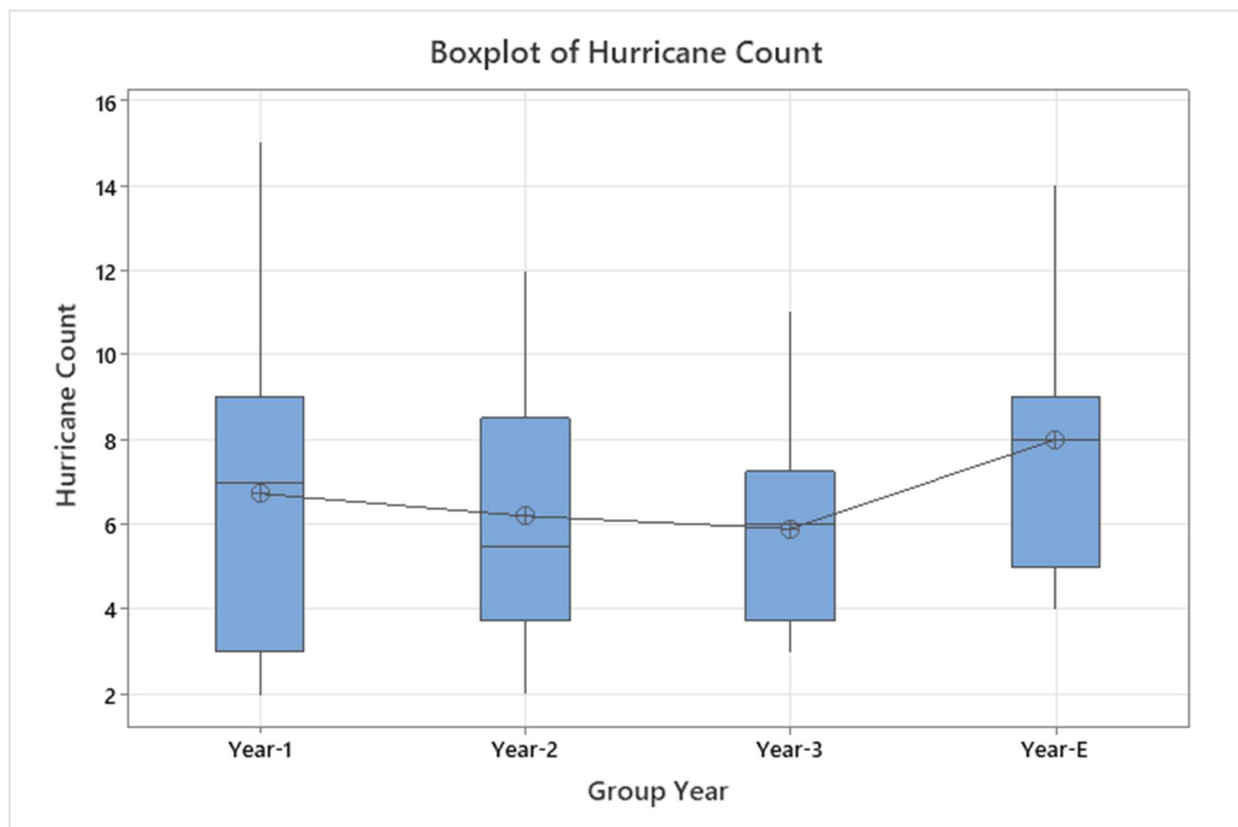
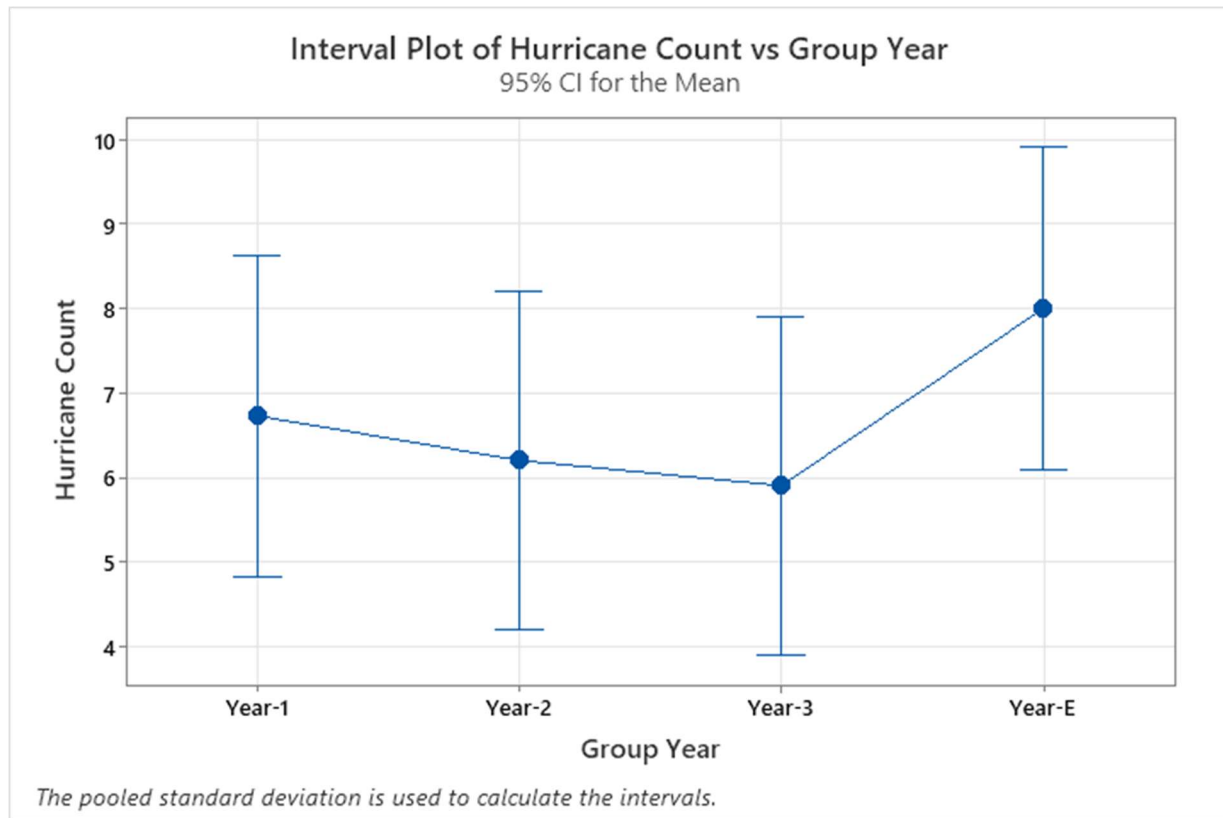
The next question I wanted to answer using this data is whether there truly is a difference between election years and non-election years for the Atlantic hurricane seasons between 1980 and 2021. I will explore two types of counts for hurricanes. The first is the total hurricane count for the year and the second is major hurricane counts for the year or hurricane counts with a category of 3 or greater. It should be noted that a known factor that increases hurricane strength is warmer gulf or ocean waters. When hurricane Katrina passed over the Gulf of Mexico it was 3 degrees warmer than normal.

From the summary statistics below, you will find between the years 1980 and 2021 there are, on average, more hurricanes than in other years. On election year the average hurricane count is 8 and on non-election years the hurricane count is closer to 6 total hurricanes per year.

#### Statistics

Variable	Group		N	N*	Mean	SE Mean	StDev	Minimum	Q1	Median	Q3
	Year										
Hurricane Count	Year-1		11	0	6.73	1.14	3.77	2.00	3.00	7.00	9.00
	Year-2		10	0	6.20	1.02	3.22	2.00	3.75	5.50	8.50
	Year-3		10	0	5.900	0.795	2.514	3.000	3.750	6.000	7.250
	Year-E		11	0	8.000	0.842	2.793	4.000	5.000	8.000	9.000
Variable	Group		N	N*	Mean	SE Mean	StDev	Minimum	Q1	Median	Q3
	Year	Maximum									
Hurricane Count	Year-1	15.00									
	Year-2	12.00									
	Year-3	11.000									
	Year-E	14.000									

The interval plot and the box plot both show an up-tick in overall hurricane activity during election years. The next question I would like to answer is whether this difference is significant.



The one-way ANOVA was used to determine if this difference in hurricane counts is significant.

#### Method

Null hypothesis	All means are equal
Alternative hypothesis	Not all means are equal
Significance level	$\alpha = 0.05$

*Equal variances were assumed for the analysis.*

#### Factor Information

Factor	Levels	Values
Group	4	Year-1, Year-2, Year-3, Year-E
Year		

#### Analysis of Variance

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Group Year	3	27.44	9.146	0.94	0.432
Error	38	370.68	9.755		
Total	41	398.12			

With a p-value of 0.432 I would fail to reject the null and conclude that there is no difference between hurricane activity when comparing election years to non-election years.

Next, I wanted to see if there is a difference in “major” hurricane counts between election years and non-election years. The data in the chart below shows an increase of 1 major hurricane per year when comparing election years to non-election years.

Variable	Election Year?	N	N*	Mean	SE Mean	StDev	Minimum	Q1	Median	Q3
W/O Cat 1 & 2	No	31	0	2.548	0.317	1.767	0.000	1.000	2.000	4.000
	Yes	11	0	3.636	0.636	2.111	1.000	2.000	3.000	6.000

Variable	Election Year?	Maximum
W/O Cat 1 & 2	No	7.000
	Yes	7.000

#### Method

Null hypothesis	All means are equal
Alternative hypothesis	Not all means are equal
Significance level	$\alpha = 0.05$

*Equal variances were assumed for the analysis.*

Hurricane data is count data, so when looking at discrete data the best to determine statistical significance is to use the Poisson method. When we look at all hurricanes ranging from a category 1 to category 5 we do not see statistical significance between election years and non-election years.

### Method

$\lambda_1$ : Poisson rate of Hurricane Count when Election Year? = Yes

$\lambda_2$ : Poisson rate of Hurricane Count when Election Year? = No

Difference:  $\lambda_1 - \lambda_2$

### Descriptive Statistics: Hurricane Count

Election Year?	N	Total Occurrences	Sample Rate
Yes	27	195	7.22222
No	80	497	6.21250

### Test

Null hypothesis  $H_0: \lambda_1 - \lambda_2 = 0$

Alternative hypothesis  $H_1: \lambda_1 - \lambda_2 \neq 0$

Method	Z-Value	P-Value
Exact		0.084
Normal approximation	1.72	0.086

With a p-value of 0.086 we can see the test is not significant. However, if remove the category 1 & 2 and rerun the test which only looks for major hurricane activity, we see the following.

### Method

$\lambda_1$ : Poisson rate of W/O Cat 1 & 2 when Election Year? = Yes

$\lambda_2$ : Poisson rate of W/O Cat 1 & 2 when Election Year? = No

Difference:  $\lambda_1 - \lambda_2$

## Descriptive Statistics: W/O Cat 1 & 2

Election Year?	N	Occurrences	Total	Sample Rate
Yes	27		88	3.25926
No	80		195	2.43750

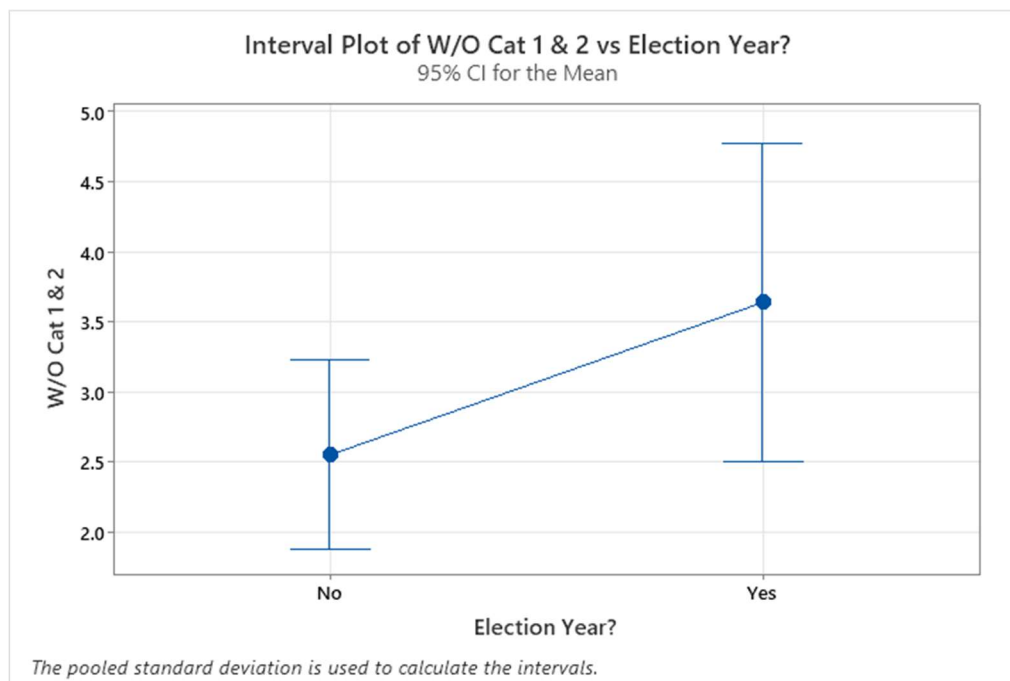
### Test

Null hypothesis  $H_0: \lambda_1 - \lambda_2 = 0$

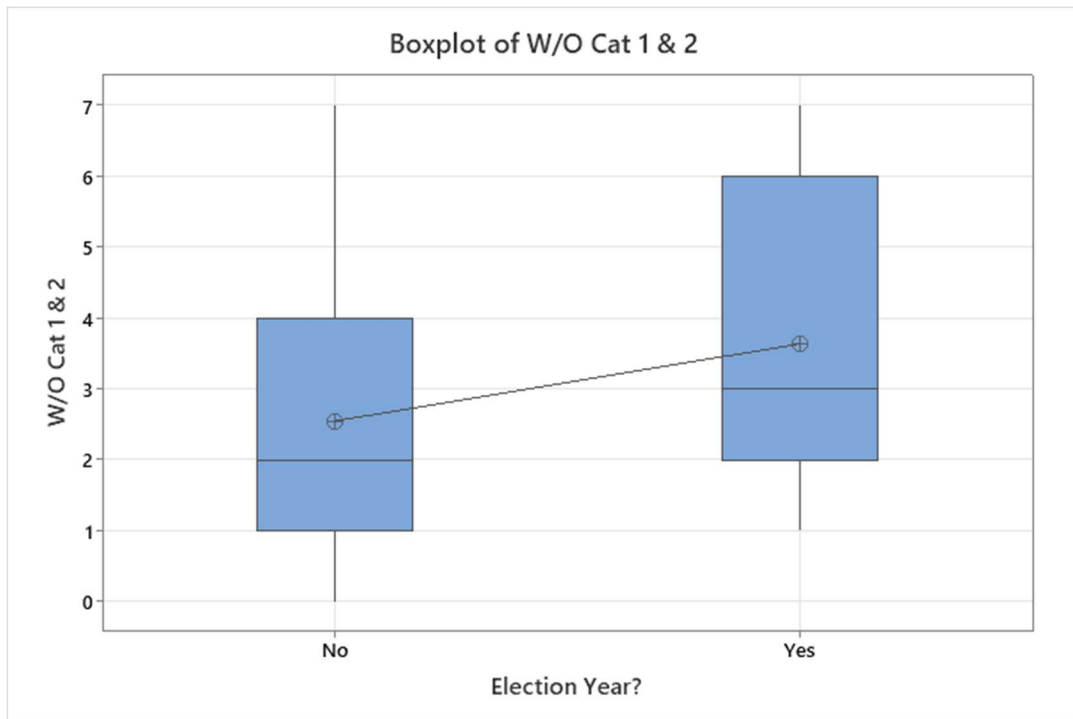
Alternative hypothesis  $H_1: \lambda_1 - \lambda_2 \neq 0$

Method	Z-Value	P-Value
Exact		0.031
Normal approximation	2.11	0.035

With a p-value of 0.031 I would reject the null and conclude there is a statistical difference in major hurricane activity when comparing election years to non-election years.







After studying the data, I would conclude that there is a real up-tick in hurricane activity during election years when compared to non-election years. The data is statistically significant when we look at only major hurricane activity and remove the lower-level hurricanes. I cannot explain why this trend exists. Is it that hurricanes are cyclical in nature and pick up every 4 years? This cyclical trend in the historical data is not present prior to 1956. It would be interesting to follow up this study with a study analyzing the Pacific hurricane seasons during the same period to see if the same trends are present in different oceans.

"Anger swirled in him, a tempest readying her strike." William Shakespeare, *The Tempest*