SAS Homework: Wildfire analysis in the state of North Carolina

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Introduction

Every single year human lives, ecosystems and properties are at risk due to wildfires in the state of North-Carolina (NC). Wildfires harm both air and water quality while efforts to fight wildfires are expensive and put emergency personel in harms way. A better understanding of the dynamics behind destructive wildfires can aid prevention efforts. This report analyses the causes, timings and sizes of wildfires accross different counties in NC. The data is obtained from the United States Forest Service (USFS) and spans accross 1992 to 2015.

The analyses in this report have been performed on a dataset containing the following categorical variables: the county the fire occured in, it's fips code, the year and month the fire was discovered in, the official cause with a matching cause code and the fire size binned into seven categories. The continuous variables studied are the discovery date of the fire, the fire size and the coordinates of the fire. The only missing values in the dataset are for the variables county and the fips code. The county variable also contained several erroneousness entrees, all of which were correctable. Below the first 5 rows of the dataset are depicted as an example.

Obs	Year	Discovery date	Cause code	Cause	Fire size	Fire size class	Latitude	Longitude	State	County	Fips code	Month
1	2005	11MAR05	2	Equipment Use	0.6	B	35.23	-82.88	NC	Buncombe	21	Mar
2	2005	27JAN05	7	Arson	50.3	C	35.00	-83.35	NC	Macon	113	Jan
3	2005	06FEB05	7	Arson	0.1	A	35.93	-81.72	NC	Caldwell	27	Feb
4	2005	12FEB05	5	Debris Burning	125	D	36.00	-81.59	NC	Caldwell	27	Feb
5	2005	16APR05	5	Debris Burning	25	C	35.99	-81.85	NC	Avery	11	Apr

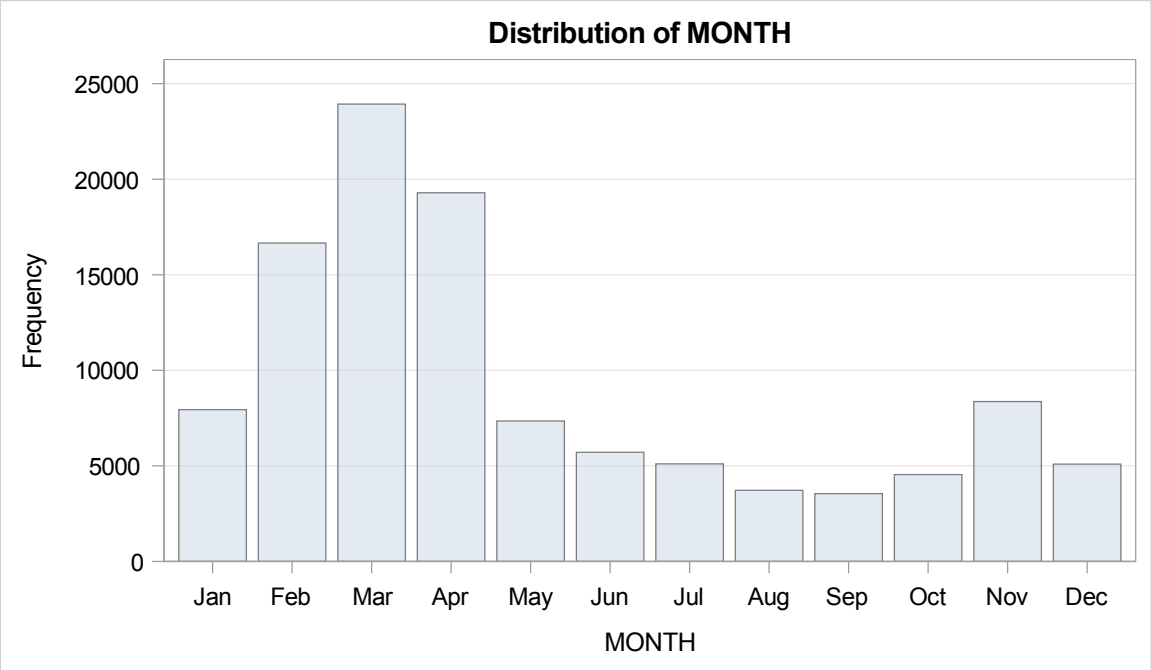
The FREQ Procedure

Number of Variable Levels				
Variable	Label	Levels	Missing Levels	Nonmissing Levels
STATE	Two-letter alphabetic code for the state in which the fire burned (or originated), based on the nominal designation in the fire report.	1	0	1
COUNTY	County, or equivalent, in which the fire burned (or originated), based on nominal designation in the fire report.	101	1	100
FIPS_CODE	Three-digit code from the Federal Information Process Standards (FIPS) publication 6-4 for representation of counties and equivalent entities.	101	1	100
FIRE_YEAR	Calendar year in which the fire was discovered or confirmed to exist.	24	0	24
STAT_CAUSE_CODE	Code for the (statistical) cause of the fire.	13	0	13
STAT_CAUSE_DESCR	Cause of the fire.	13	0	13

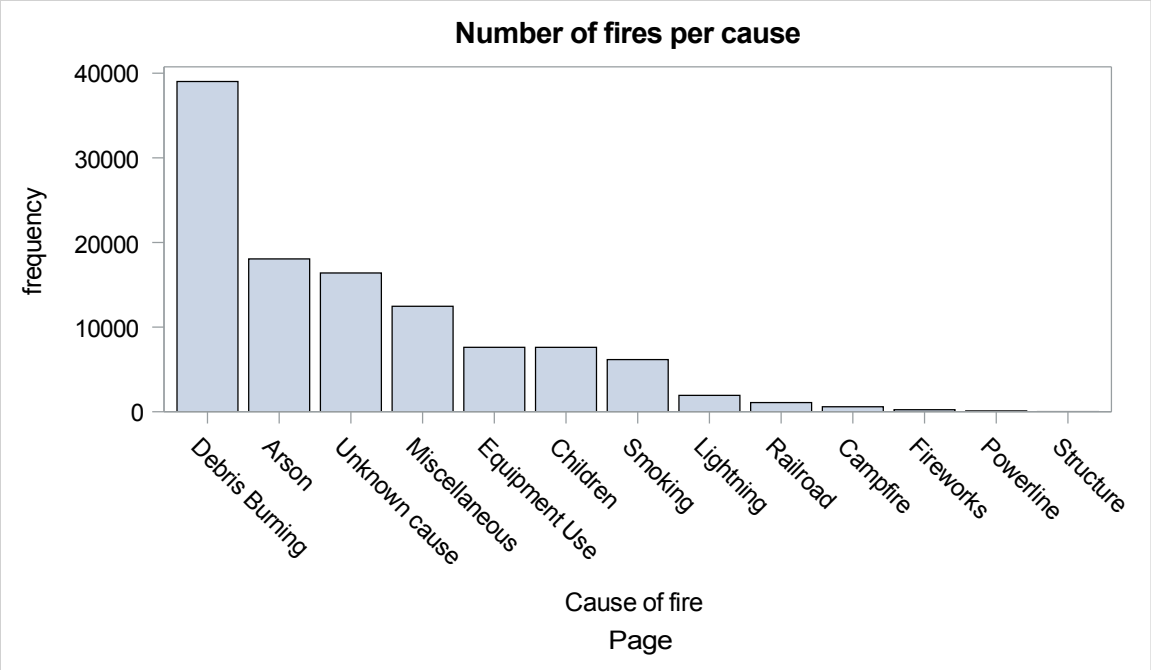
The table displays the number of levels for each categorical variable. The values for the state variable are all the same, namely 'NC' as a reference to the state of North-Carolina. Both the county and fips_code variables have 100 different levels and missing values. The data spans accross 24 years and contains thirteen different categories for causes.

There do not appear to be any inconsistencies in any continuous variables. However, the size of the wildfires is skewed to the right, with a few unusually large wildfires. The most extreme observation being a wildfire which, according to the data, burned 45294 acres of land. There's no reason to assume these extreme values are errors as they appear to be realistic.

The FREQ Procedure



During late winter and early spring wildfires occure more often while summer is the calmest period.

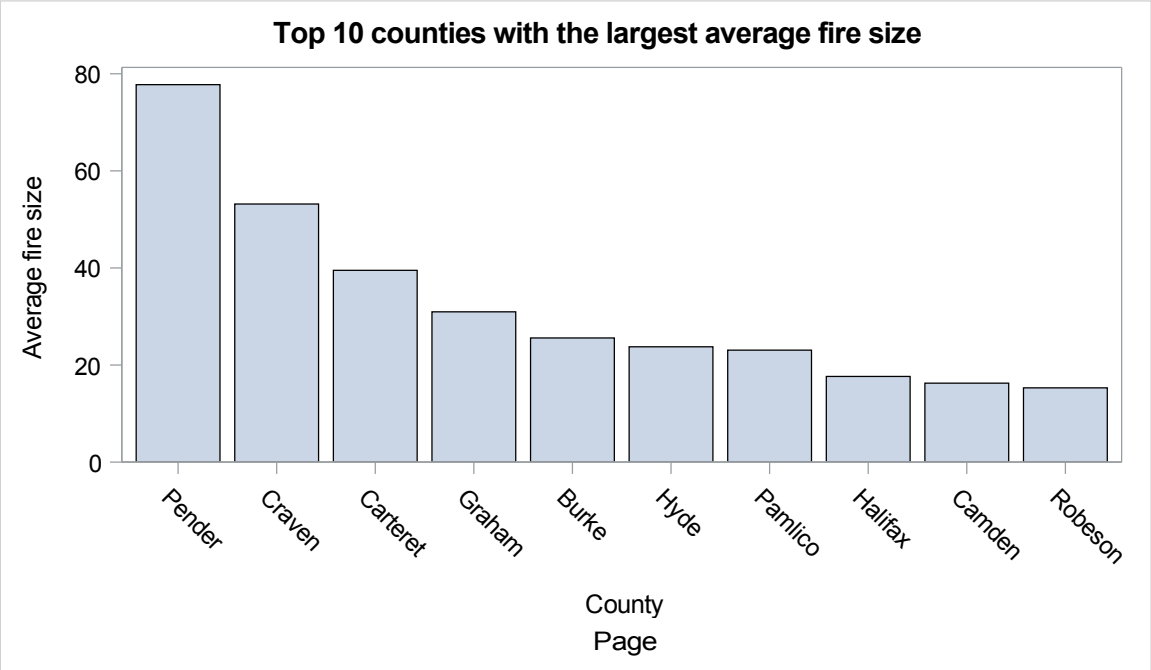


By far the most common cause of wildfires is debris burning, which accounts for more than one third of all wildfires. A distant second is Arson. The third most common official cause is equipment use, which has barely been documented more often compared to wildfires caused by children. However, the large amount of unknown causes leaves some room for ambiguity. The category of causes 'miscellaneous', by assumption, consists of a multitude of causes that cannot be assigned to any other category and thus to hold data for numerous less common causes. The category of wildfires with an unknown cause is not taken into account.

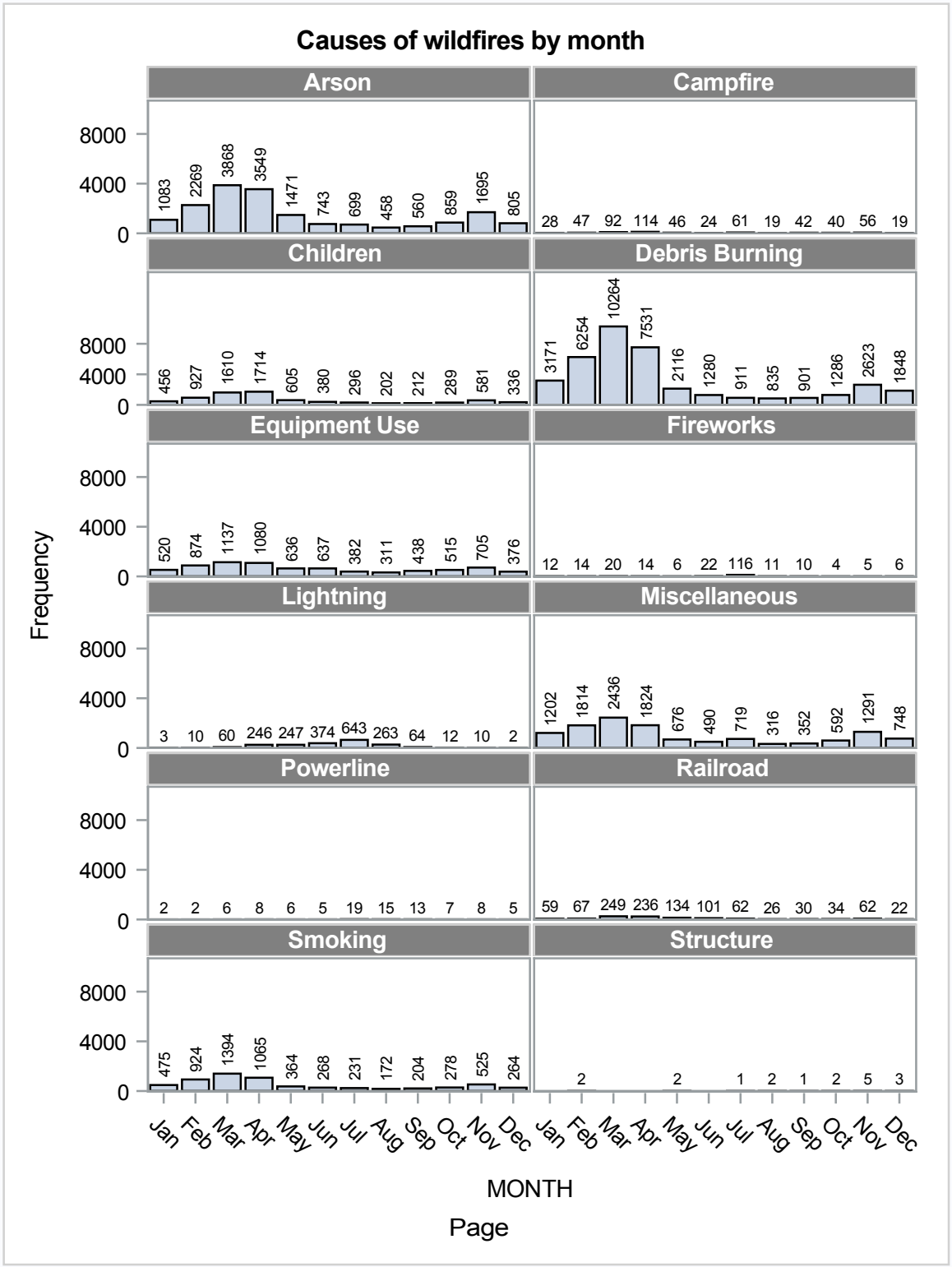
Observation with highest average fire size

Obs	COUNTY	_TYPE_	_FREQ_	n_obs	average	lower_CI	upper_CI
1	Pender	1	511	511	77.759041096	-42.45166728	197.96974947

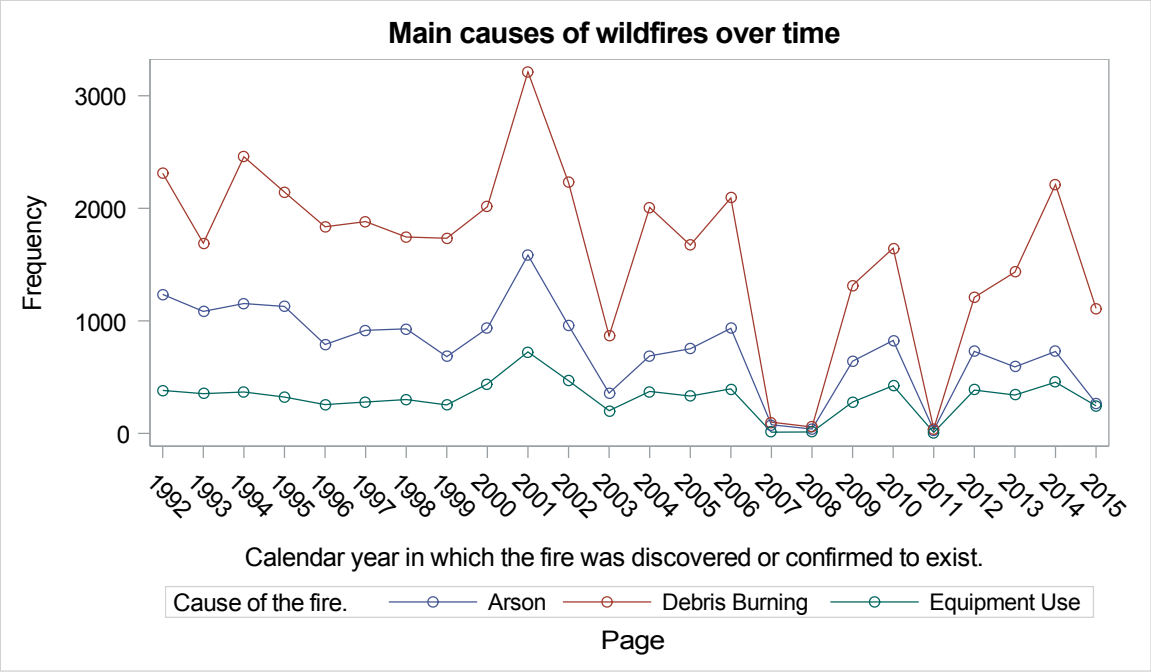
The county with historically the largest average fire size is Pender, where wildfires have on average burned 77.76 acres each.



The bar chart displays the 10 counties where historically the average fire size has been the largest. The county of Pender clearly towers above the others.



With the exception of lightning and fireworks, most causes follow the same trend. Namely a spike in late winter and early spring, while summer has the least occurences of wildfires. Fireworks and lightning go against the trend as they more often cause wildfires during summer.



The amount of wildfires due to debris burning and arson has been on the decline while the amount of wildfires caused by equipment use seem to be quite steady over time.

	Fire Size: Estimate of acres within the final perimeter of the fire			
	Number of fires	**Total size**	**Average size**	**Maximum size**
Top 3 causes of fire				
Debris Burning	39020	135370.5	3.469	2738.000
Arson	18059	175660.9	9.727	24600.00
Equipment Use	7611	39568.33	5.199	2300.000

Eventhough debris burning causes more wildfires, those wildfires are on average a lot more contained compared to those caused by arson and equipment use. Wildfires caused by arson have torched on average 30 % more acres of land while debris burning accounts for more than double the amount of wildfires.

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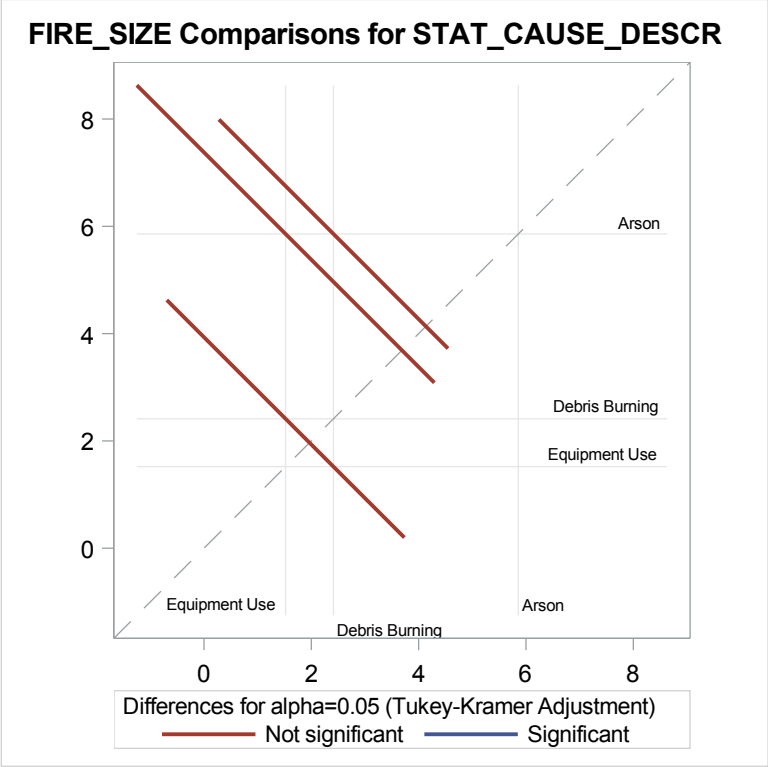
The GLM Procedure
Least Squares Means
Adjustment for Multiple Comparisons: Tukey-Kramer



The p-values are larger than 0.05 thus there's no significant difference between the fire sizes caused by any of the top three causes in 2015.

Conclusion.....