

Nuclear Explosion Tests

Soyugur, Cankat*

Abstract

This research is about the nuclear explosion testings that happened between 1945 and 1998. The norm of nuclear warfare and nuclear testing is important in politics as these tests were used as a show of power. In this research the tests of the USA and France will be discussed with regards to the question “Were the USA’s nuclear tests more effective than the French nuclear tests on average?”. The main method used in this research is a Two-Sided T-Test, the reason why I used this method is in order to conclude an understandable comparison for the 2 countries, the T-Test was the most efficient way of doing so. I found that the USA’s nuclear tests were more effective even by looking at the graphs. The T-Test also gave a hint at this conclusion as the difference was somewhat significant in a statistical way.

1 Introduction

The purpose of my work is to investigate the dataset about nuclear explosions. By editing the given dataset, I removed the rows that included “NA” values and also deleted the columns that were no use to me such as “magnitude_body” and “magnitude_surface”. The other variables are: date_long(Shows the complete date of the testing), year, country(Which country conducted the test), region(Where the test was conducted at), latitude, longitude, depth, yield_lower, yield_higher, purpose(Why the test was conducted for), name(Name of the detonated warhead) and type(How the nuclear test was conducted).

The question I decided on is “Were the USA’s nuclear tests more effective than the French nuclear tests on average?”. The question is related with the 4 articles I have found and they provided me with extra information I stated in the literature review section. Also from the dataset, I can gather the needed data by using some functional codes.

For the analysis, I will compare the occurrences of US nuclear tests and the French nuclear tests with regards to the upper and lower yield to understand the effectiveness of the tests. I will be using a T-Test for this research in order to do a better comparison.

The test is two-sided. The null hypothesis is “USA’s nuclear tests were more efficient than the French ones. The alternative hypothesis is “USA’s nuclear tests weren’t more efficient than the French ones.”

*20080501

1.1 Literature Review

Even though the literature I found is mostly made of data from the tests of nuclear weapons, the 4 articles and reports I found also include and give valuable information about the question.

The US is shown to have conducted almost all of its nuclear tests in Nevada Test Site or NTS as an abbreviation. Before the tests at NTS, USA conducted its tests at various places around the Pacific as given in quote: (Nils-Olov Bergkvist, 2000) “Nuclear weapon development continued in the USA and tests were conducted in 1946-62 at various atolls and islands in the Pacific Ocean. The first hydrogen bomb was tested in 1951, at Enewetak Atoll, then part of a UN Trust territory administered by the USA, now part of the Marshall Islands.” In the introduction section of the article from (Seantel Anaïs, 2016) it is stated how many tests were conducted and how big of a yield the tests had at the NTS is stated, which is also relevant to my first question with quote: “At the Nevada Test Site (NTS) northwest of Las Vegas, Nevada, 928 above- and below-ground nuclear tests occurred between 1951 and 1992. There were nearly 90 tests at the NTS in 1962 alone (NTS interviewee). Bombs of 61 and 74 kilotonnes were detonated at the NTS during the 1950s – by contrast, the bomb dropped on Hiroshima had a nuclear yield of approximately 15 kilotonnes.”

Information about the French nuclear tests are less shared to the public than the USA’s nuclear tests because of various reasons. These reasons include the failures of the tests, the health problems created by the test as stated in (Danielsson, 1984) with quote: “Most political, church and civic leaders in French Polynesia immediately voiced strong fears that any nuclear tests made in the Tuamotus might, as the American tests did in Micronesia, adversely affect the health of the 7 000 people living there.” and “By the beginning of July 1966, after three years of intense preparations, the Moruroa testing base was operational. The first bomb was placed on a barge anchored in the lagoon and detonated. The result was a catastrophe-all the water contained in the shallow reef basin was sucked up into the air and then rained down, covering all islets with heaps of irradiated fish and clams, whose slowly rotting flesh continued to stink for weeks.” However, from (Willis, 2006) it can be said that the testing of the French warheads were mostly conducted in the French Polynesia, especially in Moruroa and Tuamotus islands, but these were also not that effective and therefore, were not reported as after the failure of the first few tests, the types of which were “SURFACE” and “TOWER”, the French converted to different types of testing types.

2 Data

I found this data from “<https://github.com/rfordatascience/tidytuesday>”. The dataset was hard to find as I wanted to do a research on something that I was interested in. The main source of the dataset is SIPRI, Stockholm International Peace Research Institute, that conducts researches about anything from wars to illegal weapons trade.

The main dataset is named “nuclear_explosions1”. With cropping the rows that had “NA” values, I had 1382 entries in total. This was the only edit I did on the main dataset. Other

than this, I had to create a subset named “comparison1” in order to conduct a test relevant to my question. This subset has 2 columns: “country” and “upper_yield”. Since my question is about the effectiveness of the tests between the US and France, I deleted the rows that had the names other than USA and France. By doing this, I had 1236 entries in total inside “comparison1”.

The summary statistics shows the upper yield of the 2 countries seperately. Table 1 shows the statistics of France and table 2 shows the statistics of the US. Each table shows the mean, standard deviation(Given as “Std.Dev”), minimum value of the tests(Given as “Min”), median value of the tests(Given as “Median”) and finally, the maximum value of the tests(Given as “Max”).

Table 1: France Nuclear Test Statistics

	Mean	Std.Dev	Min	Median	Max
yield_upper	103.89	213.23	0.00	20.00	1000.00

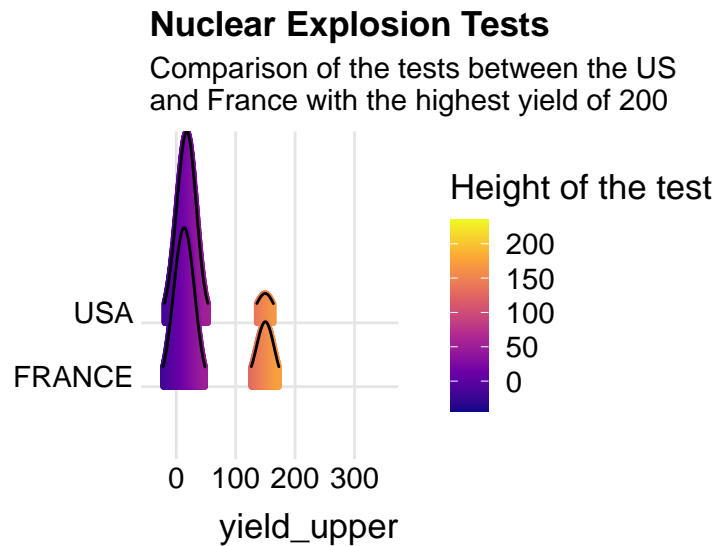
Table 2: USA Nuclear Test Statistics

	Mean	Std.Dev	Min	Median	Max
yield_upper	226.34	1094.94	0.00	20.00	15000.00

3 Methods and Data Analysis

I conducted a Two Sided T-Test to analyse the effectiveness of the nuclear tests of the US and France. It can be said that the populations are not normally distributed. From the T-Test, it can be seen that France has a mean of 103.8889 while the tests of the US has a mean of 226.3377.

The graph below shows the nuclear test ratios of the US and France that has a upper yield(Abbreviated for thousands.) lower than 200. It can be seen that the difference of these tests are not significant as they look close. With this, it can’t be said that the tests of these countries with the filtered yield is more significant than one another. However, conducting a Two-Sided T-Test gives the result needed.



Conducting the Ansari-Bradley Test gives me the result that the variances are equal therefore I can conduct a Two-Sided T-Test rather than a Welch T-Test.

```
##
##  Ansari-Bradley test
##
## data:  yield_upper by country
## AB = 62861, p-value = 0.7139
## alternative hypothesis: true ratio of scales is not equal to 1
```

Before conducting the test, my hypothesis is given as below:

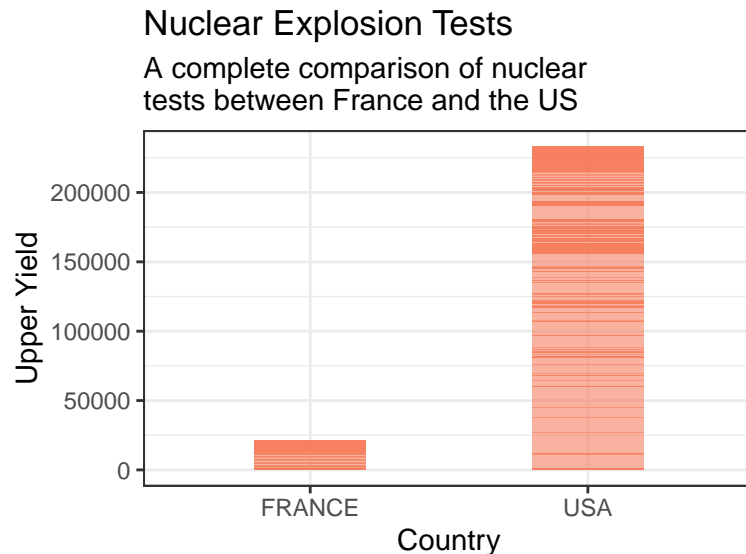
H1: The nuclear tests of the US were more effective than the nuclear tests of France.

H0: The nuclear tests of the US were not more effective than the nuclear tests of France.

```
##
##  Two Sample t-test
##
## data:  yield_upper by country
## t = -1.6024, df = 1234, p-value = 0.1093
## alternative hypothesis: true difference in means between group FRANCE and group USA is not equal to 0
## 95 percent confidence interval:
##  -272.37008  27.47237
## sample estimates:
## mean in group FRANCE      mean in group USA
##      103.8889              226.3377
```

The T-Test gives an outcome that the nuclear tests of the US were way more effective than the ones of France. From looking at the p value(Which is 0.1093), it is can be seen that with

a 95 percent confidence interval, the null hypothesis can be accepted, meaning that I failed to reject the hypothesis. Even though the difference between two countries in the T-Test can be significant and gives the conclusion that the tests of the US were more effective, looking at the graphs given under can strengthen this conclusion even more. Also, the mean of the US(226.3377) shows that there is a significant difference between the mean of France(103.8889) which supports my null hypothesis even more. Looking at the graph below gives a clearer sign that the US's tests were more effective.



This graph shows the barplotted tests of both countries. The x axis has the names of both countries and the y axis shows the upper yield of the nuclear tests of those countries. It can be clearly seen that the US's nuclear tests goes all the way up to the point above 200000. Meanwhile France's tests only reaches a point that is below 50000 and around 10000 upper yield. This is also a clear indication that the tests of the US were way more effective than the ones of France's.

4 Conclusion

Summarize the results of your analysis in this section. Discuss to what extent your results responded to the research question you identified at the beginning and how this work could be improved in the future.

5 References

- Danielsson, B. (1984). Under a cloud of secrecy: The french nuclear tests in the southeastern pacific. *Ambio*, 13. https://www.jstor.org/stable/4313070?saml_data=eyJzYW1sVG9rZW4iOiJjYTc2ZTcyYS1iZjM5LTQ3YmItOWUxZS1hZjhjMDFhODhiNzgiLCJpbnNO
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