National Parks Trail Capstone
Full report, draft 1
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This project is focused around understanding national park trail data (U.S.), specifically what trail statistics, features, and activities have the strongest and weakest effects on the trail's popularity, rating, and usage. The purpose is to help learn how and where future trails can best be designed to create the most interest. The process of trail-making is a long and difficult one so having a better idea of what the demand is like may help National Park Services improve overall trail systems.

All of the data was collected by AllTrails (online/phone app) that helps users find a fitting trail. The data was downloaded from Kaggle.com from user 'jane'[1]. The following paper will review how the data was cleaned, organized, explored, and analyzed.

The data was imported and converted into a pandas dataframe. Each of the activities (hiking, camping, biking, etc) and features (waterfalls, wildflowers, viewpoints, etc) were grouped under a single variable. Since we want to see the effects of each feature and activity implementing one hot-encoding to the dataframe will split each one up into fifteen and fourteen separate categorical (boolean) variables of features and activities respectively. Now between these two and the general trail statistics there are a total of thirty four independent variables not including location (area, city, and state).

The data was explored for any missing values using pandas info function; it was found that visitor usage was lacking 253 values. Out of 3313 this is not too significant and while it may change some specifics of how the trails are distributed through the states etc. there will still be plenty of data left to compare the three main dependent variables of interest.
Some data is mislabeled at well; Maui is listed as its own state (it's a county/island within Hawaii) so this has been fixed. The country name for both also needed to be changed from 'Hawaii' to 'United States'.

Digging a bit deeper into the data it was found that Georgia only had one trail listed and it was actually a local park/events space and not within a national park, so Georgia was removed entirely from the data.

The data appears to be clean and organized for the purposes of this project; moving on to exploratory data analysis and storytelling to get a better understanding of the data itself.

Only twenty-nine states contain any national park trails at all, with California having about 20% of them. Location and accessibility will be very important in trail popularity and how often they're used. This makes sense as a large portion of the state (which is quite large) is national park land. California has a great location which also gives it generally nice weather and

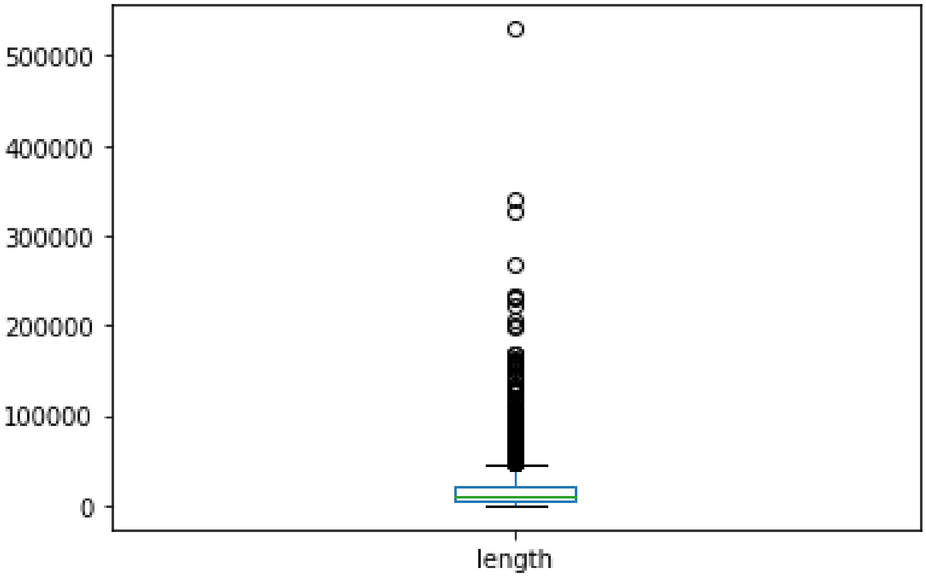
[1] https://www.kaggle.com/planejane/national-park-trails

is already a highly-populated area. Some guesses can be made about variables like elevation gain. For example Florida, North Dakota, and Minnesota are very flat states but summed they only have 55/3313 trails (3060 in the cleaned set). Meanwhile California contains huge areas of mountains and hills.

Another huge factor will be trail length, people have varying levels of skills and physical conditioning when it comes to hiking. Some people go out to push their limits for weeks on end, while others are simply out for a casual sight-seeing stroll. Below is a box plot of the trail lengths in approximate yards. The trails have quite a large range of length, from hundreds of miles to one that is so short it is listed at a length of 0. The biggest outlier is a 329 mile driving loop around the Olympic Peninsula. The second and third are ~200 mile backpacking trail through Yosemite Valley. The fourth is another driving trail (offroad) through Death Valley.

On the other end of the spectrum is the trail with 0 length mentioned earlier. This is the Newspaper Rock Trail in Utah. This ‘trail’ really is more like a large rock that doesn’t require any real hiking at all and is more of a drive-up viewpoint that is covered in Indian Petroglyphs which are a type of ancient carving. This is a fantastic trail option because it is accessible to almost everyone and has a unique feature that could attract people of all ages and interests in outdoor activities. Since having such a particular and uncommon feature, this also needs to be kept in mind when comparing trail popularity as it is not something that is included directly in the data set.

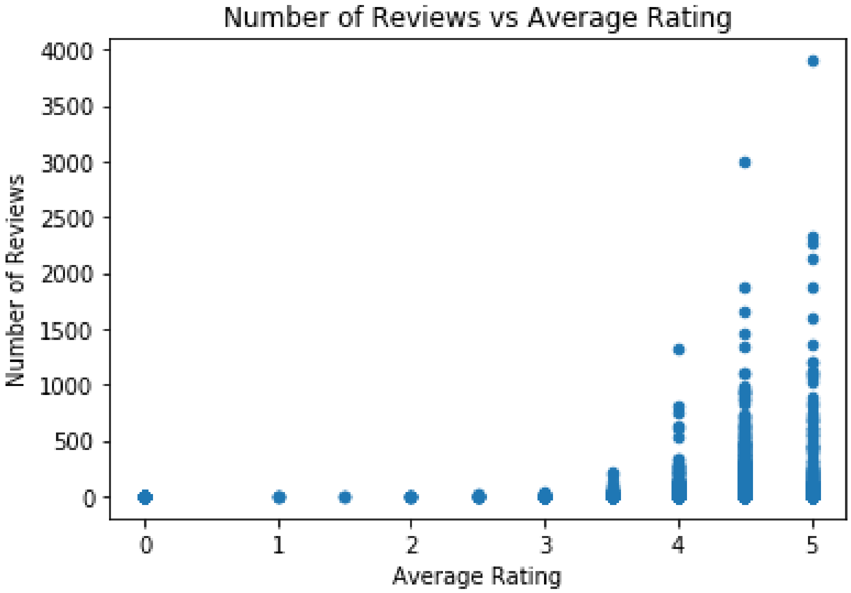
There are a few other trails as well with incredibly short lengths that are designed more as quick road-side stopping points for drivers, for example “Sunset View Trail” which is less than a tenth of a mile long.



While these are major outliers to the data they are still important points when we’re looking at national park trails. They help demonstrate the wide variety of not only the type of trails but also how they're used. These data points won't be taken out of the set but they will be accounted for and potentially excluded when looking at some statistics such as averages.

Note: While there are plenty of trails above the 50,000 and 100,000 mark, a large majority of the trails are found below 50,000 (~28miles). 3108 trails are 28 miles or shorter and 205 trails are longer.

A similar box plot can be seen for change in elevation with similar conclusions. It has a large factor in trail difficulty and in turn can affect consumer's trail choice. A few very very large outliers and a high density through the lower half of the range (2000 to 5000 ft). This could be interpreted as the demand of trail type; more people want a 'do-able' trail that doesn't require a lot of exertion but it is also restricted by the topography within the parks.

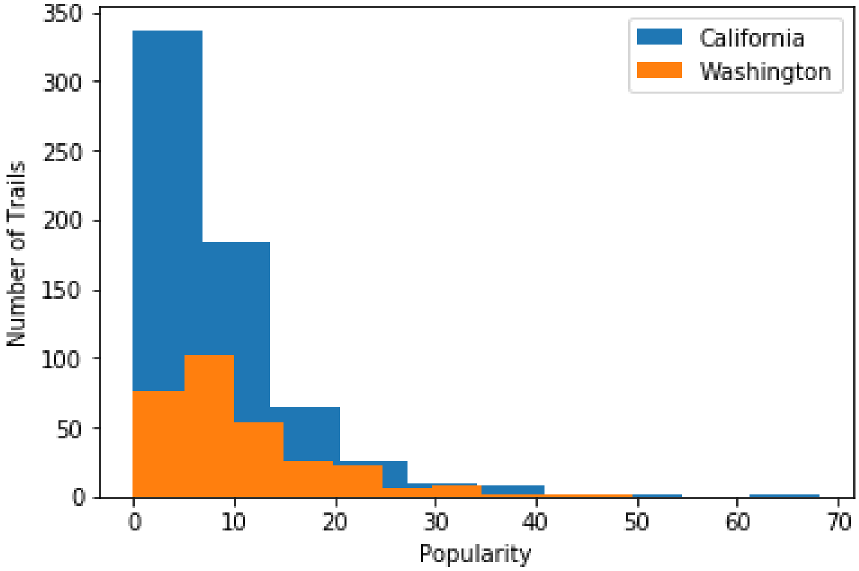


When comparing the number of reviews versus average rating, it's not entirely surprising that there is a positive relationship between the two. When a trail receives good ratings it increases the chances that more people are going to use that trail, increasing both the trail's overall rating as well as usage.

After getting a bit more acquainted with the data it's time to do some actual analysis. First using inferential statistics to look at some other relationships within the data.

Null hypothesis: The average rating for California's trails are equal to those of Washington's
Alternative hypothesis: The average ratings are not equal
Using an alpha of 5%, this two-tailed test will have a z-score of 1.96

After the necessary calculations the Z-test value was -11.29; which is far to the left of the distribution and strongly recommends the null hypothesis to be rejected. This concludes that the average rating for California's trails are not equal to those of Washington's. Similar results were found when comparing popularity and usage.



Above is a histogram of CA and WA's trail popularity. It is obvious here that CA has many more trails, however it's worth noting that both state's distribution of trail popularity are very similar. (Histograms of the other variables look very similar as well)

While CA has more than twice as many trails as WA it might be a good idea to run the same tests with Wyoming and Utah, states that only have a difference of 8 trails. CA also has a much higher population as well as tourist traffic than the other two states. After running through the hypothesis testing program with new inputs the end conclusion is similar (Z-test = -5.33), the rating along with the popularity of the two states' trails are not equal. Oddly enough, the visitor usage does fall within the 1.96 Z-score distribution at .098 for these two states, so we can state with significance that visitor usage between Wyoming and Utah are equal.

Looking at a few more variables, elevation gain, popularity, and the difficulty rating:

Null hypothesis: Elevation gain has no effect on trail popularity
Alternative hypothesis: Elevation gain has a positive or negative effect on popularity

A two tailed test yielded that the t stat is 39.68 indicating that elevation gain has a strong effect on trail popularity. The p-value is far below the alpha (1.36e-306) supporting a rejection of the null hypothesis. A similar test and results can be run with elevation gain and difficulty as well - as expected elevation gain has a significant effect on a trail's difficulty rating.

This dataset invites a multitude of different analyses all with many insights and possible interpretations. I would like to continue exploring these by looking at the effects of the variables on the number of reviews, trail rating, trail usage, and maybe most importantly the popularity. In the end I would like to have completed a regression analysis of the previously discussed variables (length, elevation gain) as well as all the features and activities included (these were not talked about at all here but include things like if the trail has waterfalls, wild-flowers or if biking, camping, etc are allowed) in order to understand how these change the trail rating, popularity, and usage.