

5410 Final Write Up

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1 Introduction:

Is there an association between socioeconomic status and trail access?

Studies have suggested that hiking and trail access have a significant impact on the mental health, and by extension, the happiness of participants (Thomson 2018). Our goal with this research was to determine whether there is a significant relationship between economic status and the distance to nearby public trails. The state of Utah is a great place to conduct this analysis due to the high amount of trails and the density of the population, most of which is concentrated in the Wasatch Front.

For the purposes of this analysis we picked two counties, one in the Wasatch Front and one outside of it, Salt Lake County and Cache County. We chose Salt Lake because it houses the largest metro population in the state, and thus provided us with the most consistent data. It could also be representative of the Wasatch front on a whole. Cache county was chosen to connect with our audience mainly composed of people living in Cache county. It is also representative of people living outside of the Wasatch Front, but still near the mountains.

To compose this analysis we decided to pull the census tract data using the American Community Survey. This data included information on the population and mean income level of each state. We drilled down to the census tract level for our analysis.

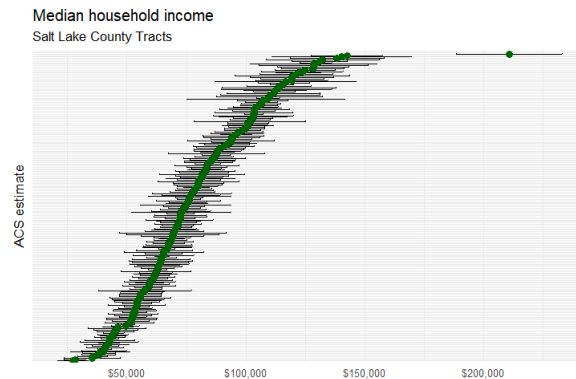


Figure 1: Median Household Income of Tracts in Salt Lake County

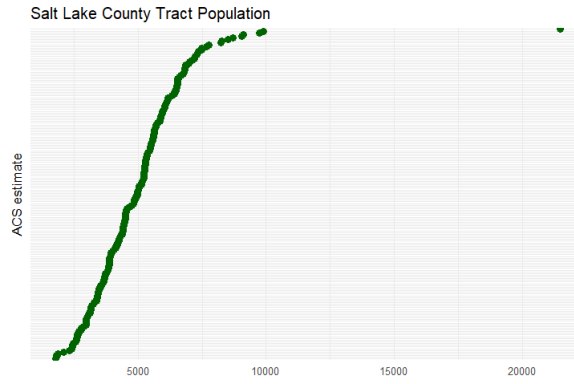


Figure 2: Population of tracts in Salt Lake Countny

Some of the tracts in our chosen counties had very low or zero population (see Figure 1) and we found that the tracts with the lowest populations also tended to be the largest in area. Thus, after consultation with Dr. Bean, we filtered the tracts down by area, and then chose to analyze Salt Lake and Cache county areas. We chose Salt Lake because it is the largest metro in the state, and thus provided us with the most consistent and diverse data. Cache county was chosen to connect with our audience which was mainly composed of people living in Cache county.

The next data source we utilized came from the Utah Geospatial Research Center. This data included the shape files for trails and pathways in Utah.

The following table provides a description for each of these types of trails.

Hiking Only	Hiking and walking are the only uses allowed on this facility
Hiking and Biking	Singletrack, natural surface facility. Hiking and biking are allowed
Paved Shared Use	Paved shared use path, recreational path, urban pathway
Road-concurrent	Facility is on or adjacent to a road, generally a natural surface double track, forest service road, canal road, etc.
Biking Only	Biking is the primary or only use on this facility. High speeds, blind corners and technical features are common. For safety reasons, hiking, if not expressly prohibited, is not recommended.
Equestrian Primary	Equestrian is the primary use on this facility
Steps	Steps, staircase, or other feature that is not accessible to wheeled or assistive devices on otherwise paved / accessible route
Bridge, Tunnel	Grade change above or below ground surface, generally a bridge or tunnel
Link	Network route connection, see Link on CVDomain_TrailClass tab

2 Methodology

First, trail data and Utah income data were mapped to visualize and further understand the data. These data were projected onto the WGS84 projection. Since the scale of this analysis is small, we don't expect there to be any skew caused by this projection.

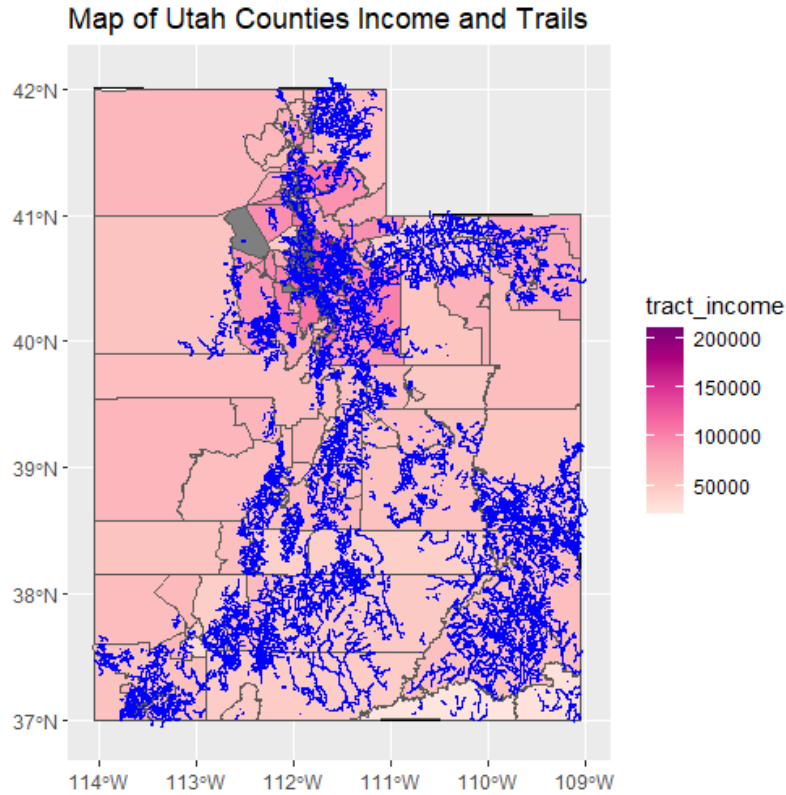


Figure 3: Salt Lake County Tract Incomes and Trails

Trails are represented in Figure 3 in blue and counties filled in pink and are scaled by income level. The first issue arose at this step: counties with low populations and high areas are skewing the plot. To resolve this, we removed the tracts in the first quartile of the area. The grey county in Figure 3 is a location in which there is not enough data present to include it in our analysis. This is where the Salt Lake City airport is located. Since the spread of this data is so broad we decided as a group to limit our analysis to Salt Lake County and Cache County.

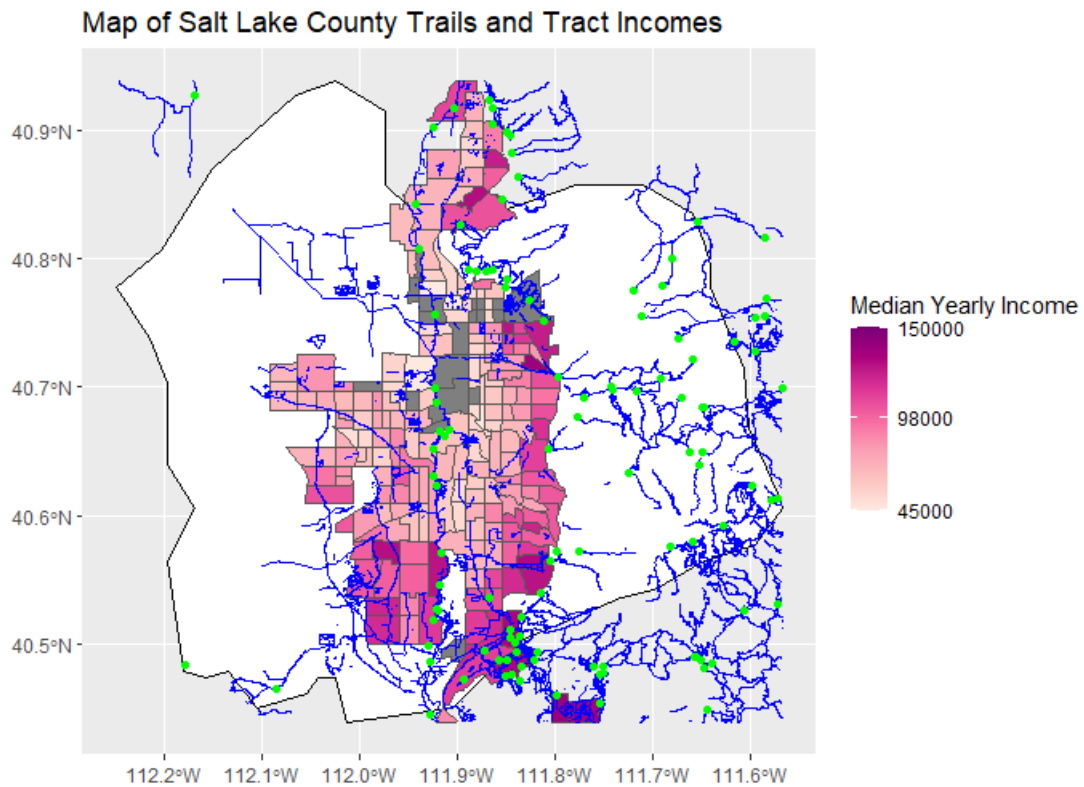


Figure 4: Salt Lake County Tract Income and Trails

Figure 4 is a choropleth of the Salt Lake County tracts, trails, and trail-heads. This is included as a way to visualize where high income households are relative to trails in the county. The deeper pink color corresponds with tracts that had higher median income, blue represents trails and green represents trail-heads. Again, grey areas are tracts in which there was not income data available for areas that didn't pass through the population filter. From initial visual inspection we can see that the lighter pink color clusters in the center of the map further away from the mountains, while the darker colors seem to cluster on the edges, near the mountains.

3 Average Distance

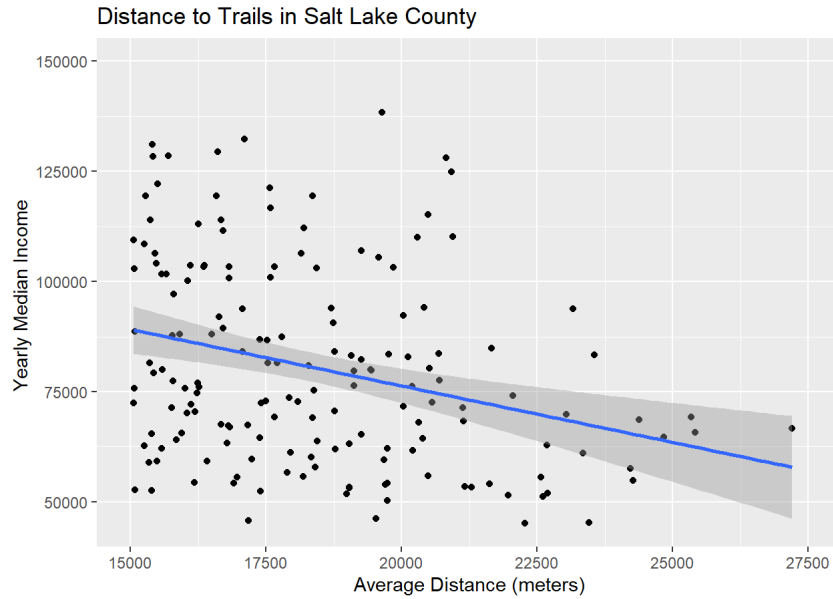


Figure 5: Average Distance to Trails in Salt Lake County

Figure 5 is a scatter plot of the average distance to trails from the center of tracts for different income levels in Salt Lake County. Included is a downward sloping trend line that indicates a relationship in which higher income is associated with better trail access and lower income is associated with worse trail access. A linear model was fit to this data and returned a significant p-value, therefore we have statistically significant evidence to conclude that there is a linear relationship between average distance to trails and income level in Salt Lake County. More specifically, for lower household incomes, the average distance to trails is higher.

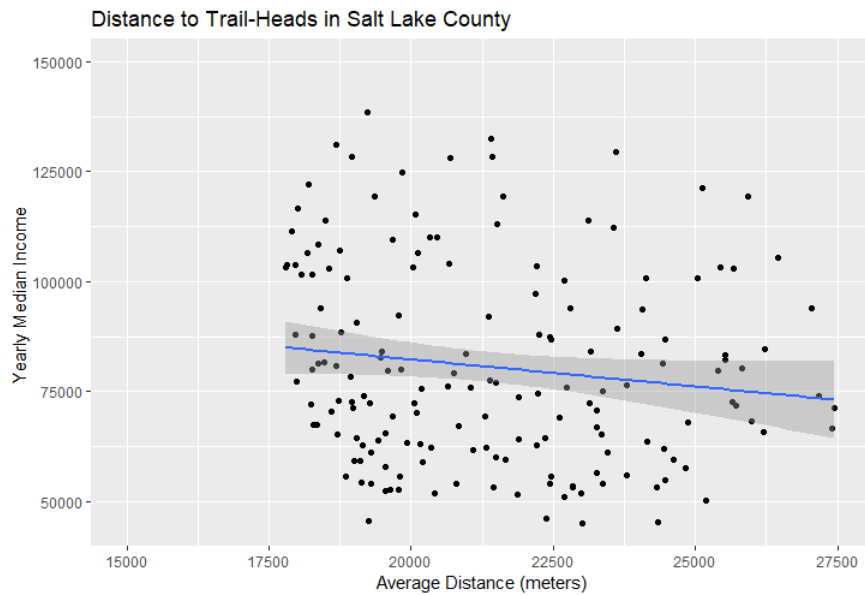


Figure 6: Distance to Trail-Heads in Salt Lake County

Shown in Figure 6 is a scatter plot of the distance to trail heads in Salt Lake county. Included is the trend line of the data to see if the model could predict distance to trails when given an income level. This returned a

p-value less than 0.05, therefore, we again have statistically significant evidence to conclude that there is a linear relationship between median income and average distance to trail-heads in Salt Lake County. The relationships of average distance to trails and average distance to trail heads against median household income are the same.

4 Minimum Distance

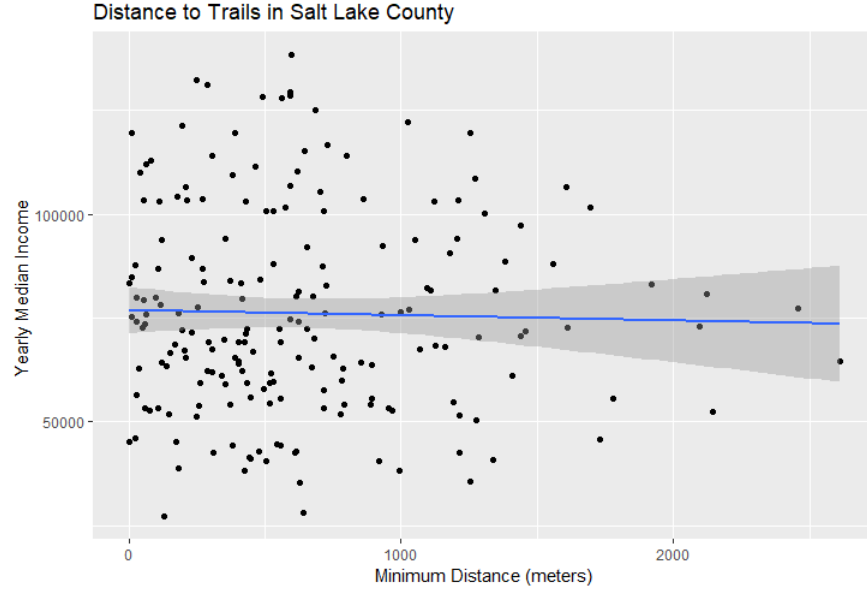


Figure 7: Minimum Distance to Trails in Salt Lake County

Figure 7 shows a different relationship than the previous figures. This is a plot of minimum distance from tract centers to trails against median household income of tracts in Salt Lake County. There doesn't appear to be a strong linear relationship present in this figure.

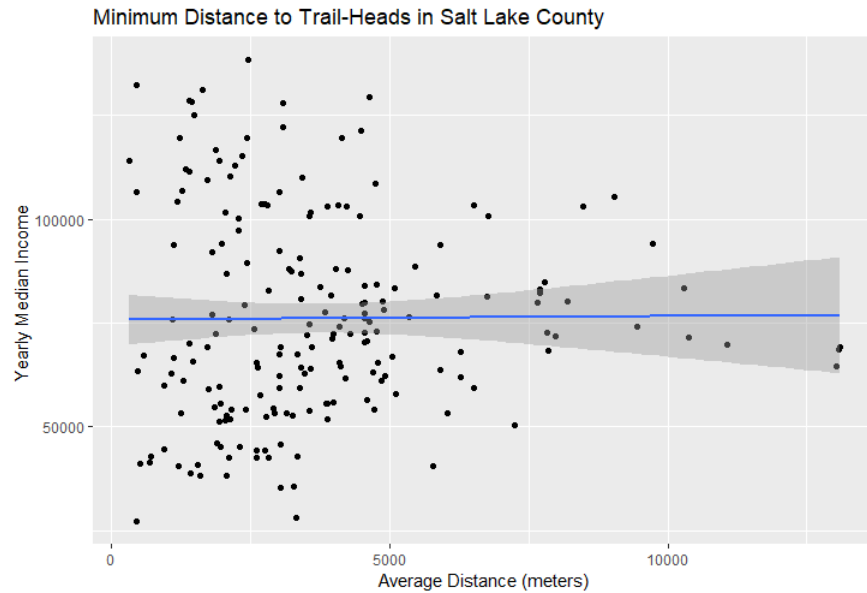


Figure 8: Minimum Distance to Trail-heads in Salt Lake County

Similar to the previous plot, Figure 8 differs in that it shows minimum distance from tract centers to trail heads. Again, there doesn't appear to be a linear relationship present between minimum distance and median household

income. To justify these findings, a linear model was fit to the data which returned an insignificant p-value for both minimum distance to trails and trail heads. This allows us to conclude that there is no evidence of a meaningful relationship between minimum distance to trail-head, trails and yearly household income in Salt Lake County.

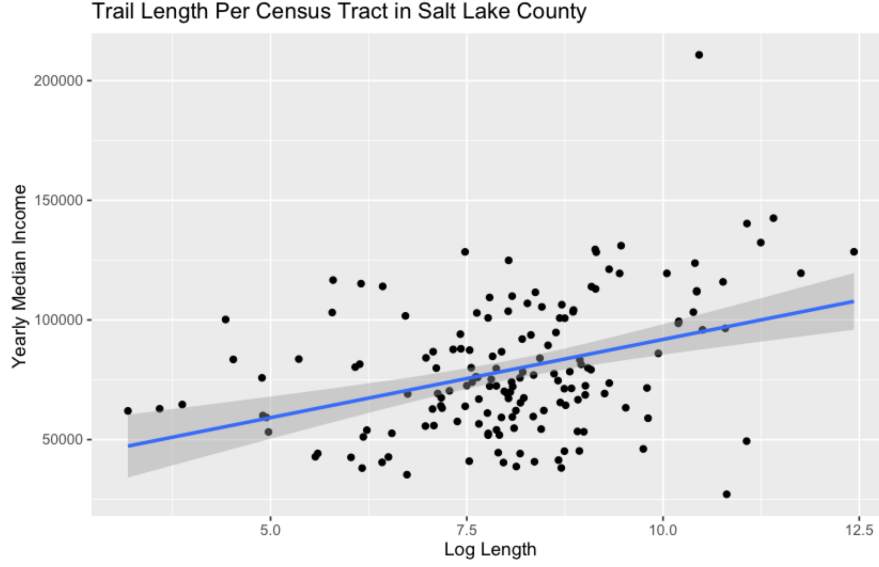


Figure 9: Log length of trails within SLC census tracts

Another metric we examined for our analysis was the total length of trails and pathways contained within each census tract in Salt Lake and Cache county. A log transformation was applied to this data due to skewing by the large amount of tracts where a trail may just skim a corner or edge, giving a trail length of just a few meters. Examining Figure 9 post log transformation does show a significant relationship between total trail length and mean income of a tract with a p-value that is $<$

5 Cache County

We understand that the experience that someone has in Salt Lake County cannot be extrapolated to be representative of the whole state. In order to understand how this relationship might differ in other counties, we also conducted this analysis on Cache county. This might not be an intuitive choice, the reasoning behind the choice is that it is the county in which the authors reside.

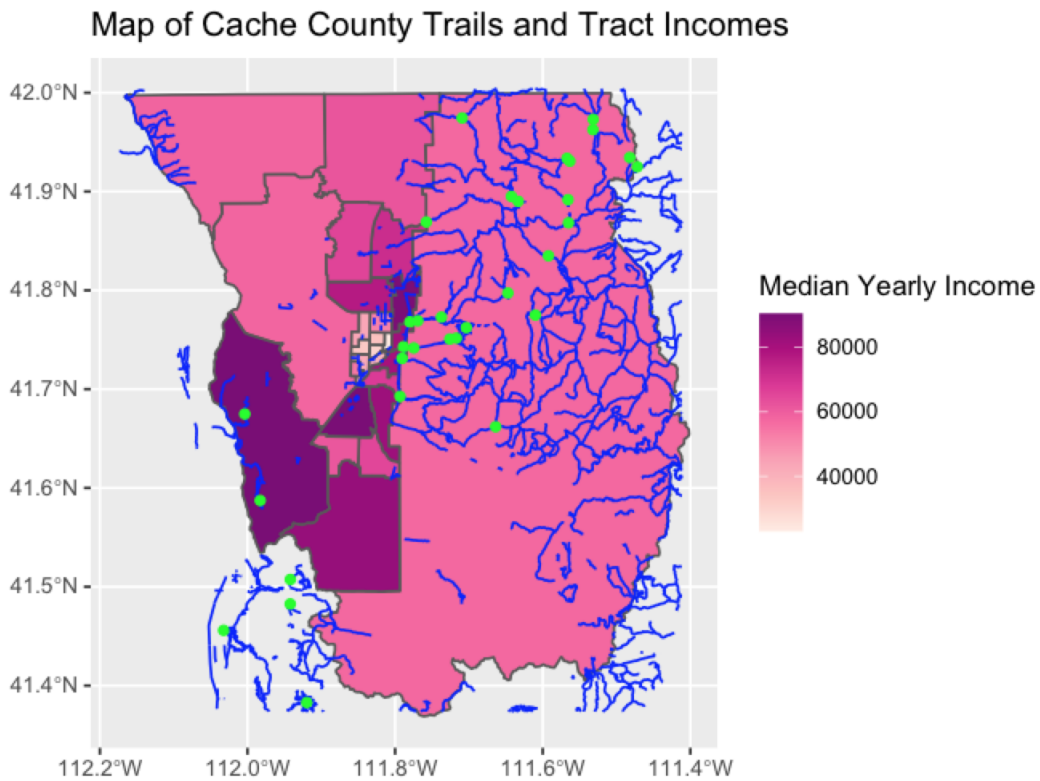


Figure 10: Cache County Tracts Income and Trails

Figure 10 is included as a way to visualize where high income households are relative to trails in Cache county. The deeper pink color corresponds with tracts that had higher median income, blue represents trails and green represents trail-heads. Again, grey areas are tracts in which there was not income data available that met the area to population filter.

As we can see in Figure 10 there are far fewer populous tracts than in Salt Lake County. This scarcity in the data presents some problems as we do this analysis. However, we still went forward with the analysis understanding that our results might not be accurate.

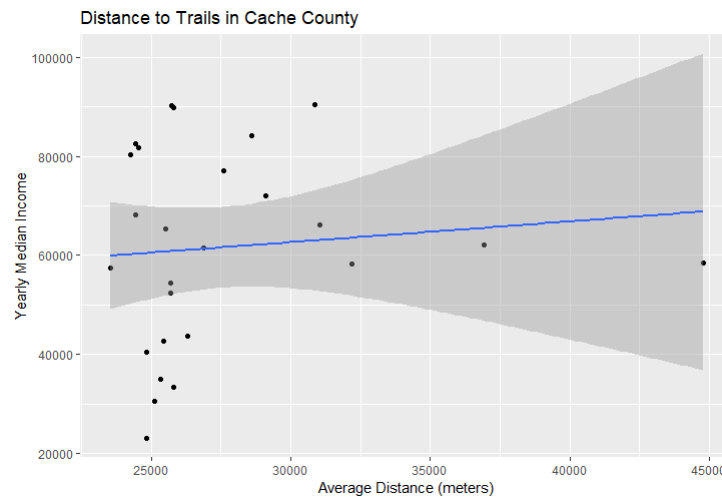


Figure 11: Average Distance to Trails in Cache County

Figure 11 shows a slight positive linear association between average distance from tract centers and trails.

We fit a linear model on the Cache County data and average distance to trails, which returned an insignificant p-value. This tells us that there is not a linear relationship between distance to trails from tract centers and median yearly income in Cache county.

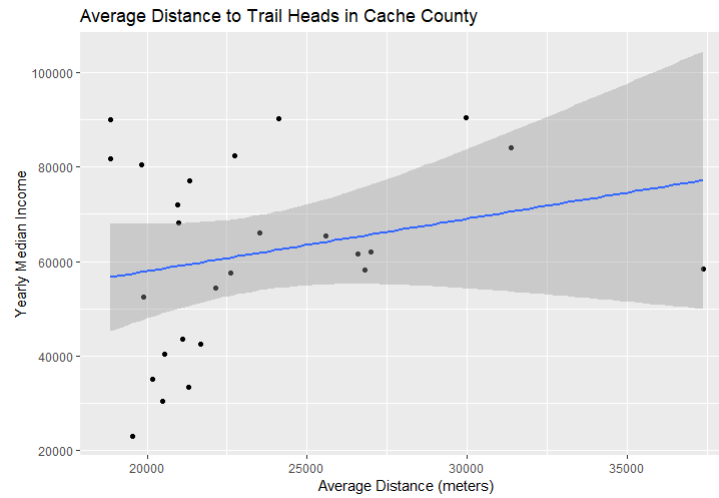


Figure 12: Average Distance to Trail Heads in Cache County

Figure 12 shows what appears to be a positive relationship between median household income and minimum distance to trail heads from tract centers in cache county. Again, a linear model was run on this data which returned an insignificant p-value. We cannot conclude that there is any linear relationship between minimum distance to trail-heads and median household income in Cache County.

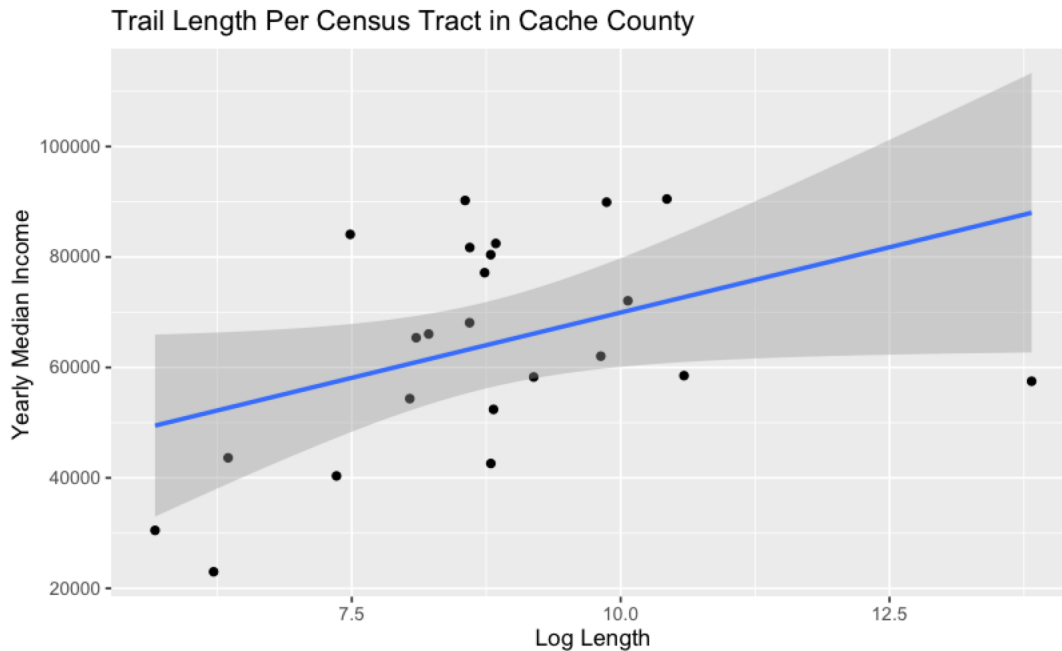


Figure 13: Log length of trails in Cache County

A linear model was fit to show the relationship between the log length of trails within tracts and the yearly median income in Cache County, the data in Figure 13 showcases this analysis. The plot appears to show a positive relationship between trail length and income, however the p-value for this was found to be insignificant. This suggests that there is no relationship between trail length and household income in Cache County. If we had more data

available in Cache County this result may change though.

Cache County Analysis Issues:

The issue with running our analysis on Cache county is the limited amount of data points. There are very few populous tracts in Cache County to run our analysis on. This means that our results are not justified.

6 Implications:

After doing this analysis we found some important things:

1. We did find a significant relationship between median household income and access to trails in Salt Lake county. Generally, the higher the household income, the more trails available.
2. We also learned that everyone, no matter what the household income is, has about the same distance the closest trail head. This means that everyone in Salt Lake County can equally access a trail, but higher income tracts have *more* trails nearby.
3. Census tracts with a higher income level also generally had a larger length of trails running through the tract.
4. Cache county is different from Salt Lake in that we did not see a significant overall relationship between income and trail access. This could be due to a number of confounding factors.

This analysis has implications for the legislature of Utah. A big draw of living in Utah is access to outdoor recreation. Having dispersed access to trails would raise property values and increase citizen well being. These analyses can be replicated in each county to find opportunities for trail creation.

Even a metropolitan center like Salt Lake City within Salt Lake county has opportunities to expand trail networks. Urban trails are a great way to increase access throughout the community, and connecting mountain trails with urban trail networks increases everyone's ability to experience nature. City planners in counties such as Cache that are planning on experiencing large growth can use this analysis to assist them in building out optimal urban and mountain trail networks of their own that will encourage the most people to get out and get hiking and biking.

For citizens, this analysis could be used for trying to pick property. To citizens specifically looking for outdoor recreation, this could be especially useful. Since there is a relationship between distance to trails and household income in highly populated counties (in Salt Lake County, not Cache County), citizens with higher income have greater access to trails and are likely going to experience a higher quality of life than those who live farther from trails.

A few hang ups that we had over the course of the analysis was the awkwardness of the trail data. What is designated as a trail was a little tricky. We experienced difficulties filtering the trail data to only include footpaths of biking paths, it appears that there may be overlap between the classifiers and shape files. The variation of the shapes and sized of the census tracts was another issue that made some visualizations difficult.

Opportunities for further research could include a richer data set. Data that might be included could be home prices, property tax information, and zoning information. This further data could be useful in order to dive deeper into understanding our chosen region and indicate a more granular area to look at income and wealth. Other avenues of research could also include replicating this analysis over all the counties in Utah.

7 References

- Walker K, Herman M (2022). tidycensus: Load US Census Boundary and Attribute Data as 'tidyverse' and 'sf'-Ready Data Frames. R package version 1.1.9.9000, <https://walker-data.com/tidycensus/>.
- Utah Mapping Portal. Utah GIS Portal. (n.d.). Retrieved March 15, 2022, from <https://gis.utah.gov/data/recreation/trails/>
- Thomsen, J. M., Powell, R. B., Monz, C. (2018). A systematic review of the physical and mental health benefits of wildland recreation. *Journal of Park and Recreation Administration*, 36(1).