Analysis of European Alp Snow Depths

Team Members

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Questions Sought to Answer

- The questions sought to answer include:
  - How has average snow depths varied over the last 50 years?
  - Is there a significant difference in average snow depths at different elevations within a localized region?
  - How intensely are ski towns going to be affected by rising temperatures?

Data Preparation Work

- Data preparation worked was primarily reading in csv files as dataframes, merging dataframes together, and filtering based on certain requirements (elevation, region, etc.)

```
# read in Germany MONTHLY data
de = pd.read_csv('data/csv_data/data_monthly_DE_DWD.csv')

# Goes back to the 60's, cut out anything before 1970
de = de[de['year'] >= 1970]

# merge with meta to get elevation data
merged_de = de.merge(meta[['Name', 'Elevation']], on='Name', how='left')

# the goal is to focus on areas with high elevation, as they have the
# most interesting snow fall patterns. Cut out areas below 1000
# meters / ~3000 feet.
merged_de = merged_de[merged_de['Elevation'] >= 1000]

# lots of NaN values, cut them out for HNsum
merged_de.dropna(subset=['HNsum'], inplace=True)

# found the months with the most snowfall by far
valid_months = [11, 12, 1, 2]

# only include months with real snowfall, allows for more
# interesting pattern detection.
merged_de = merged_de[merged_de['month'].isin(valid_months)]
```

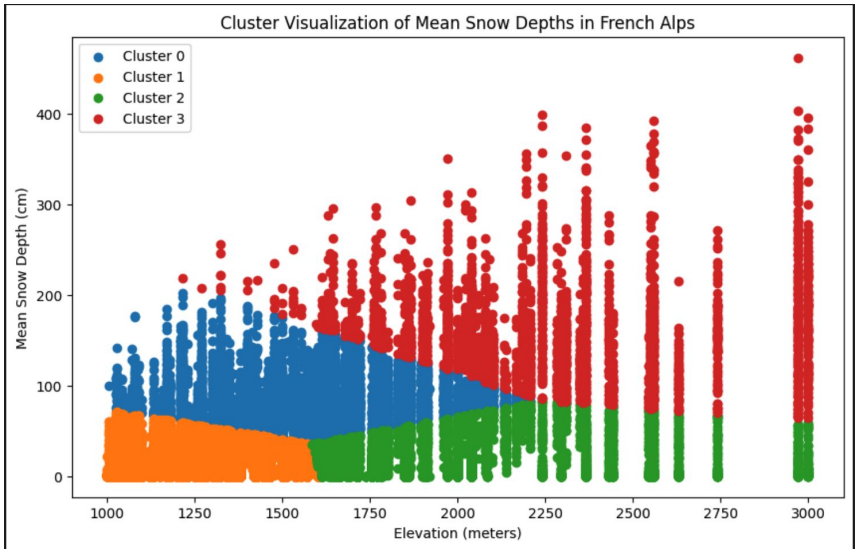
Tools Used

```
import pandas as pd
import plotly.express as px
from sklearn.preprocessing import StandardScaler
from sklearn.cluster import KMeans
import matplotlib.pyplot as plt
import statsmodels.api as sm
```

- Pandas was used for reading in data, data preparation, and merging of csv files.
- Plyplot and plotly express were used for data visualization.
- Sklearn was used to incorporate the elbow method, which helps determine the proper number of clusters to use as well as apply Kmeans clustering.
- Statsmodels.api was used to generate a large number of statistical results based on the relationship of elevation and average snow depth.

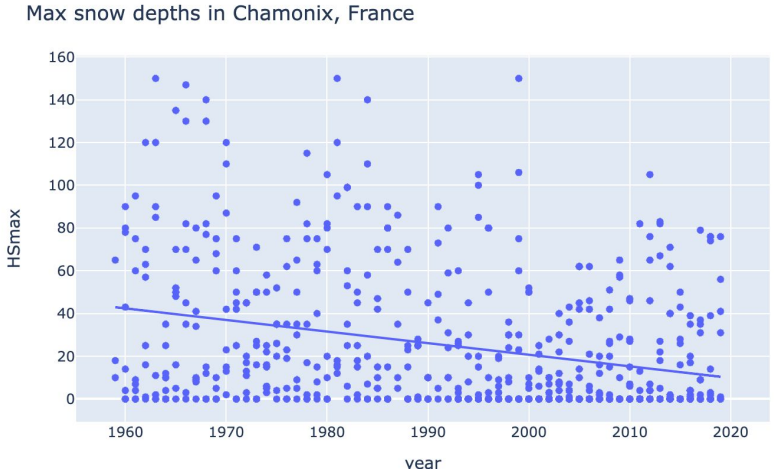
Classification/Clustering/etc. Applied

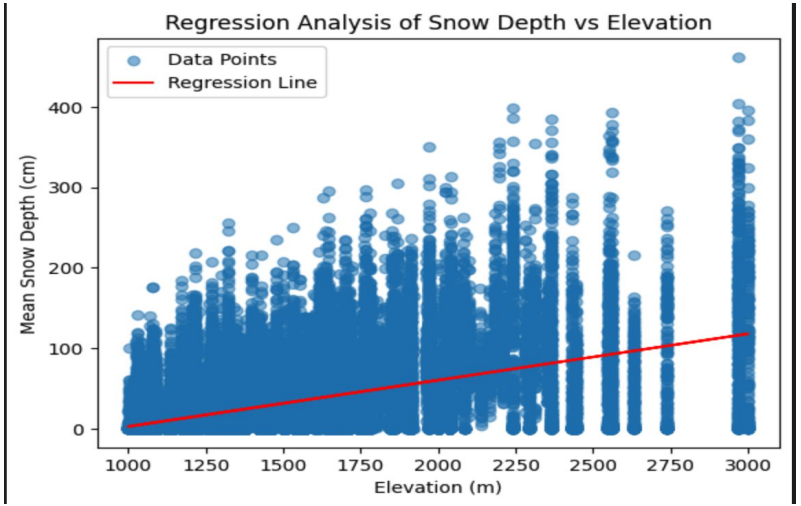
- Clustering was used on both normalized as well as raw data.
- First, elevation was normalized which was difficult to draw conclusions from.
- Secondly, the real elevation was used with 4 clusters.



Knowledge Gained

- Two main ideas were gained:
  - Not interesting: an increase in elevation is correlated with an increase in mean snow depth.
  - Average snow depths are decreasing, regardless of elevation.





How that Knowledge Can Be Applied

- This knowledge can be used in two ways:
  - Ideally, this knowledge can be used to show that despite how snowy and wintery the alps may appear, we must try to stop rising temperatures because the snowfall amounts are falling at alarming rates.
  - This will likely be used by ski resort giants such as Vail Resorts and Aspen to help them decide on future ski resorts to purchase.
    - A future project could be to look through all ski resort towns individually to determine which ones are decreasing at the slowest rate/ have the best chance of decent snow falls for decades to come.