hw4-1

February 13, 2024

HW4

[8]:
```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
```

[9]:
```
data_path = "/covertype.csv"
df = pd.read_csv('/covertype.csv')
```

[ ]:
```
df
```

[ ]:
```
          index  elevation  aspect  slope  horizontal_distance_to_hydrology  \
0             0       2596      51      3                               258
1             1       2590      56      2                               212
2             2       2804     139      9                               268
3             3       2785     155     18                               242
4             4       2595      45      2                               153
…           …         …       …     …                                 …
581007   581007       2396     153     20                                85
581008   581008       2391     152     19                                67
581009   581009       2386     159     17                                60
581010   581010       2384     170     15                                60
581011   581011       2383     165     13                                60

         vertical_distance_to_hydrology  horizontal_distance_to_roadways  \
0                                     0                              510
1                                    -6                              390
2                                    65                             3180
3                                   118                             3090
4                                    -1                              391
…                                   …                               …
581007                               17                              108
581008                               12                               95
581009                                7                               90
581010                                5                               90
581011                                4                               67

         hillshade_9am  hillshade_noon  hillshade_3pm  \
```

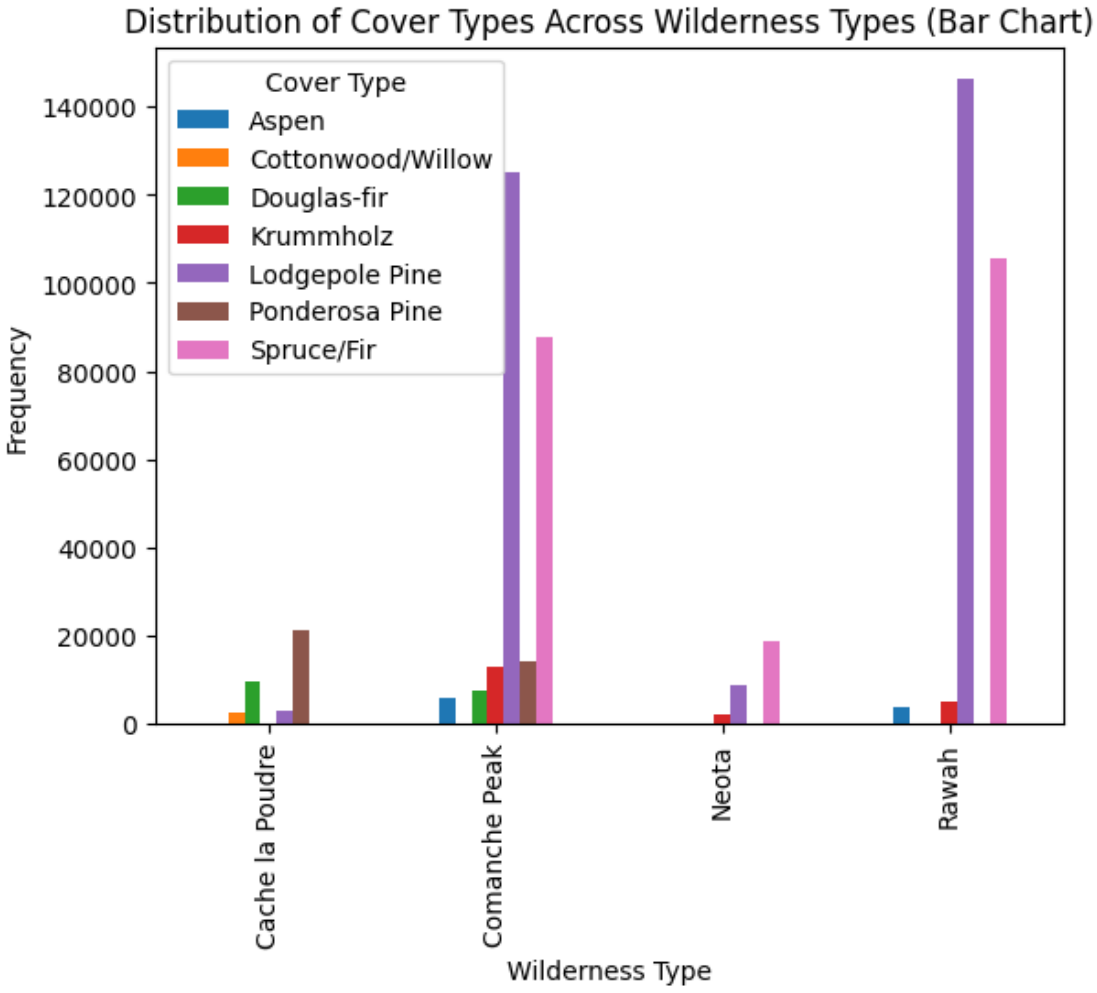
```
0                221             232             148
1                220             235             151
2                234             238             135
3                238             238             122
4                220             234             150
…                …               …               …
581007           240             237             118
581008           240             237             119
581009           236             241             130
581010           230             245             143
581011           231             244             141

        horizontal_distance_to_fire_points wilderness_type  usfs_code  \
0                                     6279           Rawah       7745
1                                     6225           Rawah       7745
2                                     6121           Rawah       4744
3                                     6211           Rawah       7746
4                                     6172           Rawah       7745
…                                        …               …          …
581007                                 837   Comanche Peak       2703
581008                                 845   Comanche Peak       2703
581009                                 854   Comanche Peak       2703
581010                                 864   Comanche Peak       2703
581011                                 875   Comanche Peak       2703

                                          usfs_code_desc  climatic_zone  \
0        Como - Legault families complex, extremely stony      subalpine
1        Como - Legault families complex, extremely stony      subalpine
2               Legault family - Rock land complex, stony        montane
3       Como family - Rock land - Legault family compl…      subalpine
4        Como - Legault families complex, extremely stony      subalpine
…                                                    …            …
581007        Vanet - Ratake families complex, very stony  lower montane
581008        Vanet - Ratake families complex, very stony  lower montane
581009        Vanet - Ratake families complex, very stony  lower montane
581010        Vanet - Ratake families complex, very stony  lower montane
581011        Vanet - Ratake families complex, very stony  lower montane

                 geologic_zone      cover_type
0       igneous and metamorphic           Aspen
1       igneous and metamorphic           Aspen
2       igneous and metamorphic  Lodgepole Pine
3       igneous and metamorphic  Lodgepole Pine
4       igneous and metamorphic           Aspen
…                           …               …
581007  igneous and metamorphic  Ponderosa Pine
581008  igneous and metamorphic  Ponderosa Pine
```

```
581009  igneous and metamorphic  Ponderosa Pine
581010  igneous and metamorphic  Ponderosa Pine
581011  igneous and metamorphic  Ponderosa Pine

[581012 rows x 17 columns]
```

1. Distribution of cover_type across different wilderness_type

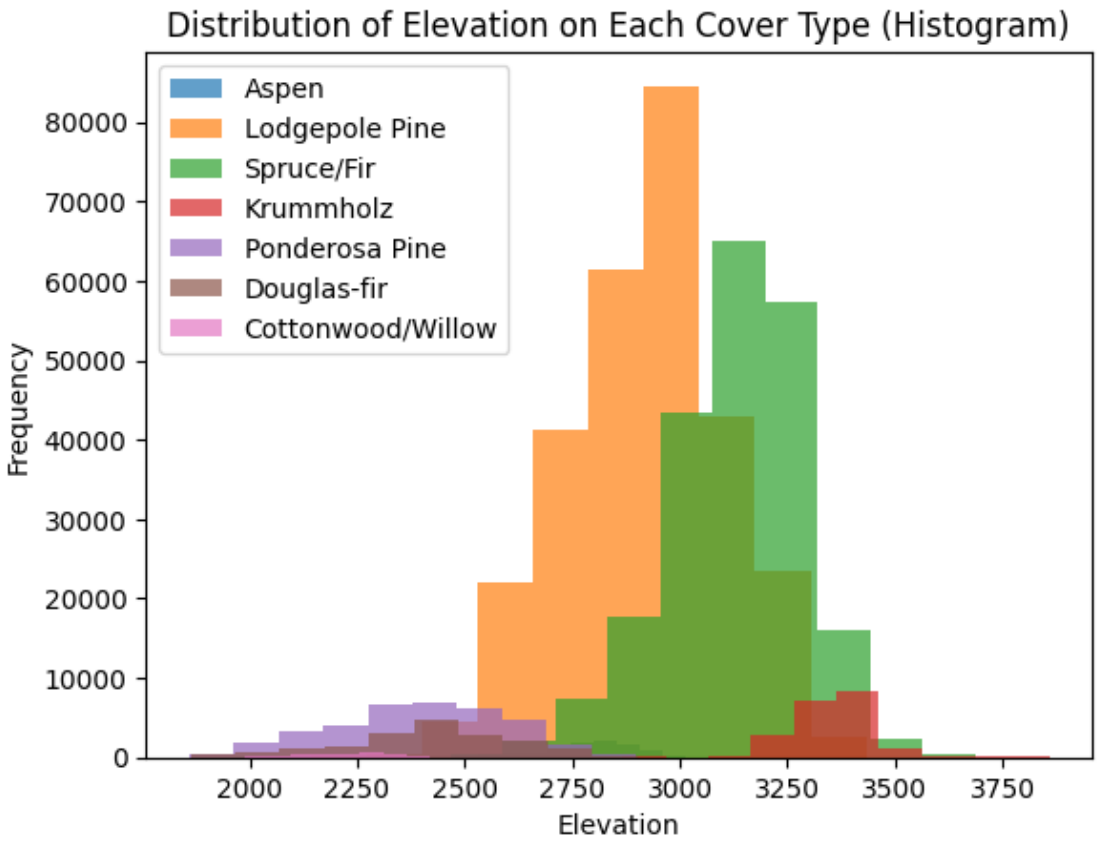
[ ]:
```
plt.figure(figsize=(10, 6))
df.groupby(["wilderness_type", "cover_type"]).size().unstack().plot(kind="bar",␣
 ↪stacked=False)
plt.xlabel("Wilderness Type")
plt.ylabel("Frequency")
plt.title("Distribution of Cover Types Across Wilderness Types (Bar Chart)")
plt.legend(title="Cover Type")
plt.show()
```

```
<Figure size 1000x600 with 0 Axes>
```



2. Distribution of elevation on each cover type

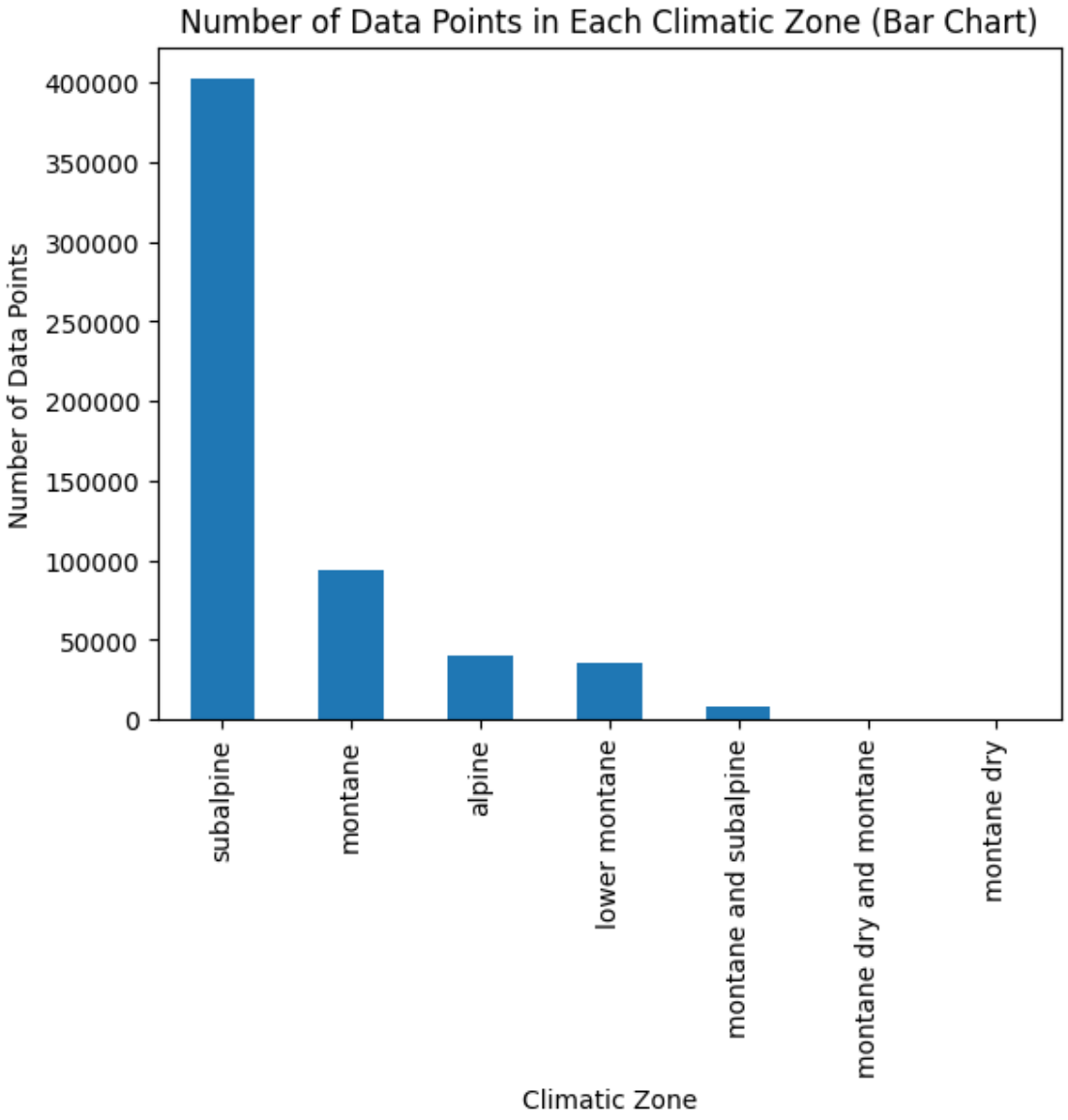
```
[ ]: for cover_type in df["cover_type"].unique():
         df_current = df[df["cover_type"] == cover_type]
         plt.hist(df_current["elevation"], label=cover_type, alpha=0.7)

     plt.xlabel("Elevation")
     plt.ylabel("Frequency")
     plt.title("Distribution of Elevation on Each Cover Type (Histogram)")
     plt.legend()
     plt.show()
```



3. Number of data points on each climatic zone

```
[ ]: zone_counts = df["climatic_zone"].value_counts()
     zone_counts.plot(kind="bar", colormap="tab20")
     plt.xlabel("Climatic Zone")
     plt.ylabel("Number of Data Points")
```

```
plt.title("Number of Data Points in Each Climatic Zone (Bar Chart)")
plt.show()
```



4. Which cover type dominates subalpine climate?

[ ]:
```
df_subalpine = df[df["climatic_zone"] == "subalpine"]

dominant_cover_type = df_subalpine["cover_type"].mode()[0]

print("The dominant cover type in the 'subalpine' climatic zone is:",␣
↪dominant_cover_type)
```

```
# print(dominant2_cover_type)
```

```
The dominant cover type in the 'subalpine' climatic zone is: Lodgepole Pine
```

5. Which cover type is likely to be found near a body of water?

[ ]:
```
df["combined_distance"] = np.abs(df["horizontal_distance_to_hydrology"]) + np.
 ↪abs(df["vertical_distance_to_hydrology"])
grouped_data = df.groupby("cover_type")["combined_distance"].mean()  # Or␣
 ↪"min", "median", etc.

lowest_distance_cover_type = grouped_data.idxmin()
print(lowest_distance_cover_type)
```

```
Cottonwood/Willow
```

6. Which cover type is likely to be found in a shady area from 9 am to noon?

[ ]:
```
df["average_shading"] = (df["hillshade_9am"] + df["hillshade_noon"]) / 2
df["max_shading"] = df[["hillshade_9am", "hillshade_noon"]].max(axis=1)
grouped_data2 = df.groupby("cover_type")["average_shading"].mean()

highest_shading_cover_type = grouped_data2.idxmax()
print(highest_shading_cover_type)
```

```
Cottonwood/Willow
```

7. Which cover type is likely to be found away from hazardous points (roadways/firepoints)?

[ ]:
```
df["combined_distance_roadway"] = np.abs(df["horizontal_distance_to_roadways"])␣
 ↪+ np.abs(df["horizontal_distance_to_fire_points"])

grouped_data = df.groupby("cover_type")["combined_distance_roadway"].mean()  #␣
 ↪Or "min", "median", "max" for different criteria

lowest_distance_cover_type2 = grouped_data.idxmax()
print(lowest_distance_cover_type2)
```

```
Krummholz
```

8. Determine whether elevation provides more information to distinguish Krummholz from Cottonwood/Willow than horizontal_distance_to_hydrology ? Ans. No horizontal_distance_to_hydrology can confirm that is cotton wood/ willow more than elevation

[ ]:
```
df[['climatic_zone','horizontal_distance_to_hydrology','vertical_distance_to_hydrology','hills
 ↪"average_shading", "max_shading"]].sort_values(by='max_shading',␣
 ↪ascending=False).head(20)
# df[(df['cover_type'] == 'Cottonwood/Willow')]
```

[ ]:

	climatic_zone	horizontal_distance_to_hydrology	\
557065	subalpine	228	
479999	subalpine	95	
361564	lower montane	180	
480001	subalpine	127	
361563	lower montane	180	
480002	subalpine	150	
480003	subalpine	175	
480004	subalpine	180	
556239	lower montane	270	
480005	subalpine	180	
257428	alpine	624	
480006	subalpine	180	
480007	subalpine	175	
560320	lower montane	85	
475335	subalpine	30	
415186	montane	150	
574022	lower montane	30	
236123	subalpine	300	
463941	subalpine	95	
301418	subalpine	170	

	vertical_distance_to_hydrology	hillshade_9am	hillshade_noon	\
557065	51	200	254	
479999	41	192	254	
361564	43	186	254	
480001	42	190	254	
361563	37	184	254	
480002	50	191	254	
480003	55	193	254	
480004	72	196	254	
556239	-18	188	254	
480005	69	199	254	
257428	240	179	254	
480006	76	202	254	
480007	50	202	254	
560320	16	201	254	
475335	4	199	254	
415186	33	184	254	
574022	10	178	254	
236123	133	199	254	
463941	9	186	254	
301418	46	254	188	

	cover_type	combined_distance	average_shading	max_shading
557065	Lodgepole Pine	279	227.0	254
479999	Lodgepole Pine	136	223.0	254

```
361564  Ponderosa Pine              223          220.0          254
480001  Lodgepole Pine              169          222.0          254
361563  Ponderosa Pine              217          219.0          254
480002  Lodgepole Pine              200          222.5          254
480003  Lodgepole Pine              230          223.5          254
480004  Lodgepole Pine              252          225.0          254
556239  Lodgepole Pine              288          221.0          254
480005  Lodgepole Pine              249          226.5          254
257428      Spruce/Fir              864          216.5          254
480006  Lodgepole Pine              256          228.0          254
480007  Lodgepole Pine              225          228.0          254
560320  Lodgepole Pine              101          227.5          254
475335      Spruce/Fir               34          226.5          254
415186  Lodgepole Pine              183          219.0          254
574022  Ponderosa Pine               40          216.0          254
236123  Lodgepole Pine              433          226.5          254
463941  Lodgepole Pine              104          220.0          254
301418      Spruce/Fir              216          221.0          254
```

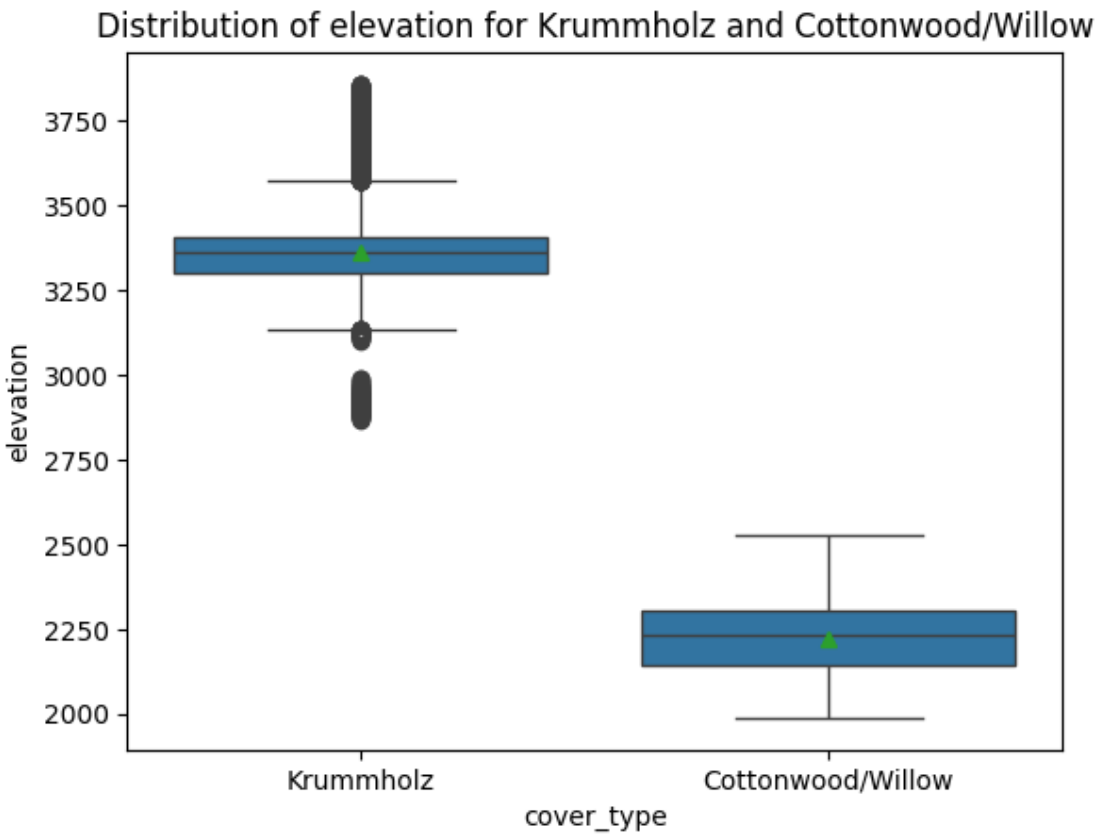
[ ]:
```
print(df.cover_type.unique())
print(df.climatic_zone.unique())
print(df.usfs_code_desc.unique())
```

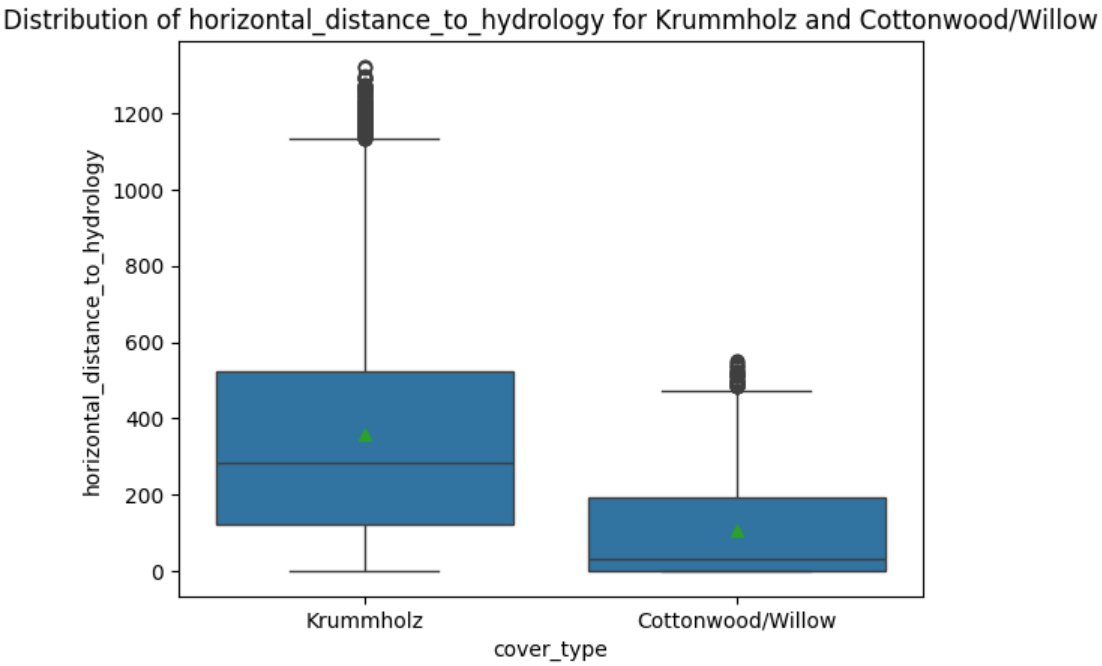
```
['Aspen' 'Lodgepole Pine' 'Spruce/Fir' 'Krummholz' 'Ponderosa Pine'
 'Douglas-fir' 'Cottonwood/Willow']
['subalpine' 'montane' 'montane and subalpine' 'alpine' 'montane dry'
 'lower montane' 'montane dry and montane']
['Como - Legault families complex, extremely stony'
 'Legault family - Rock land complex, stony'
 'Como family - Rock land - Legault family complex, extremely stony'
 'Rogert family, very stony' 'Cryaquolis - Cryoborolis complex'
 'Typic Cryaquepts - Typic Cryaquolls complex'
 'Leighcan family, extremely stony'
 'Leighcan family, till substratum - Typic Cryaquolls complex'
 'Moran family - Cryorthents - Rock land complex, extremely stony'
 'Typic Cryaquolis - Borohemists complex'
 'Supervisor - Limber families complex'
 'Leighcan family, till substratum, extremely bouldery'
 'Moran family - Cryorthents - Leighcan family complex, extremely stony'
 'Troutville family, very stony'
 'Leighcan - Moran families - Cryaquolls complex, extremely stony'
 'Leighcan - Catamount families - Rock outcrop complex, extremely stony'
 'Leighcan - Catamount families complex, extremely stony'
 'Catamount family - Rock outcrop - Leighcan family complex, extremely stony'
 'Bullwark - Catamount families - Rock land complex, rubbly'
 'Bullwark - Catamount families - Rock outcrop complex, rubbly'
 'Vanet family - Rock outcrop complex complex, rubbly'
```

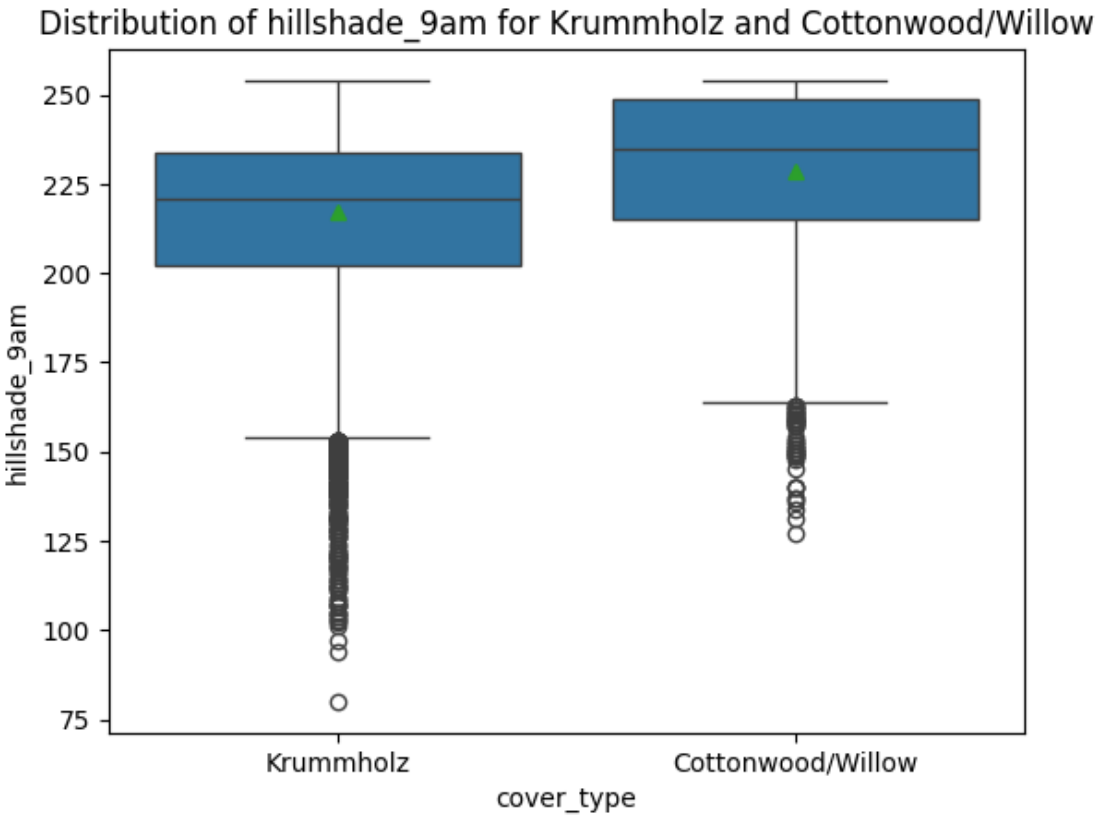
```
'Leighcan family - Rock outcrop complex, extremely stony'
'Ratake family - Rock outcrop complex, rubbly'
'Cathedral family - Rock outcrop complex, extremely stony'
'Catamount family - Rock land - Bullwark family complex, rubbly'
'Vanet - Ratake families complex, very stony'
'Gateview family - Cryaquolis complex'
'Haploborolis - Rock outcrop complex, rubbly'
'Cryorthents - Rock land complex, extremely stony'
'Vanet - Wetmore families - Rock outcrop complex, stony'
'Pachic Argiborolis - Aquolis complex'
'Rock outcrop - Cryumbrepts - Cryorthents complex, extremely stony'
'Cryumbrepts - Rock outcrop - Cryaquepts complex'
'Bross family - Rock land - Cryumbrepts complex, extremely stony'
'Typic Cryaquolls - Leighcan family, till substratum complex'
'Granile - Catamount families complex, very stony'
'Leighcan family, warm - Rock outcrop complex, extremely stony'
'Leighcan family, warm, extremely stony' 'Gothic family'
'unspecified in the USFS Soil and ELU Survey']
```

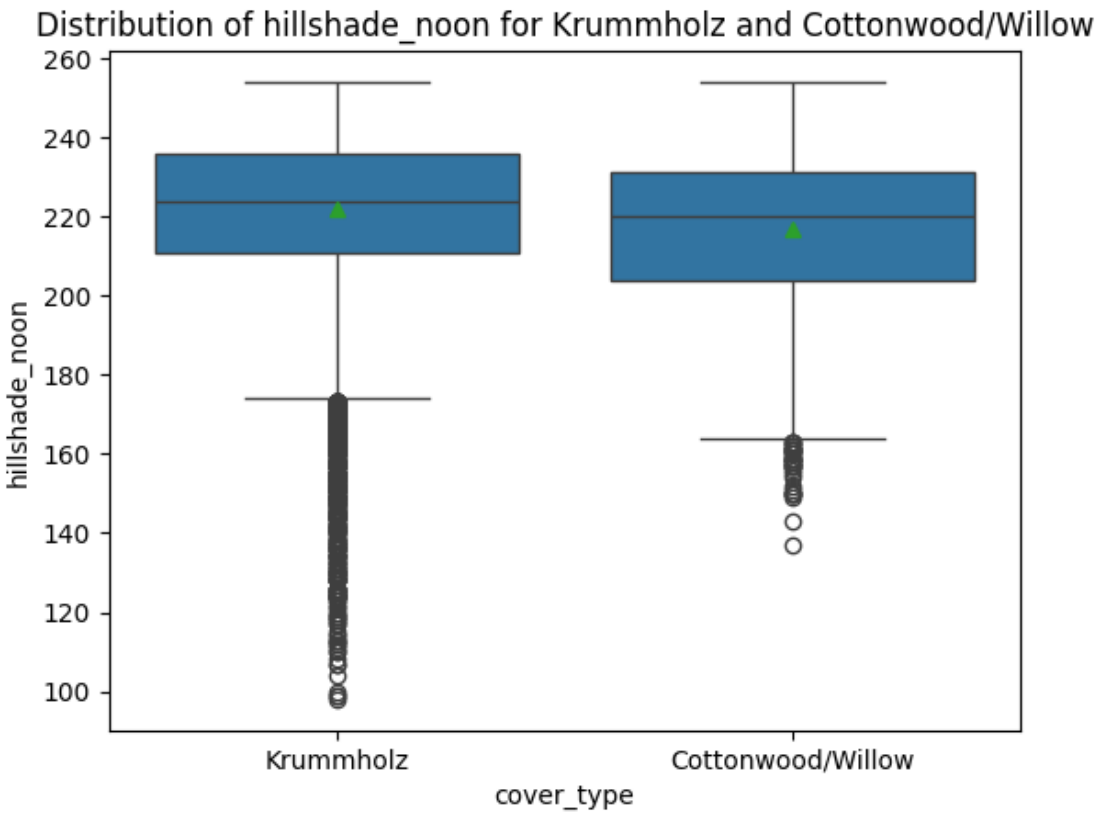
9. Plot histogram of elevation, aspect, and slope. Discuss the shape of the distribution.

[ ]:
```
import seaborn as sns
import matplotlib.pyplot as plt

df_filtered = df[df["cover_type"].isin(["Krummholz", "Cottonwood/Willow"])]

features = ["elevation", "horizontal_distance_to_hydrology", "hillshade_9am",␣
 ↪"hillshade_noon"]
for feature in features:
    sns.boxplot(
        x = "cover_type",
        y = feature,
        showmeans=True,
        data=df_filtered
    )
    plt.title(f"Distribution of {feature} for Krummholz and Cottonwood/Willow")
    plt.show()
```

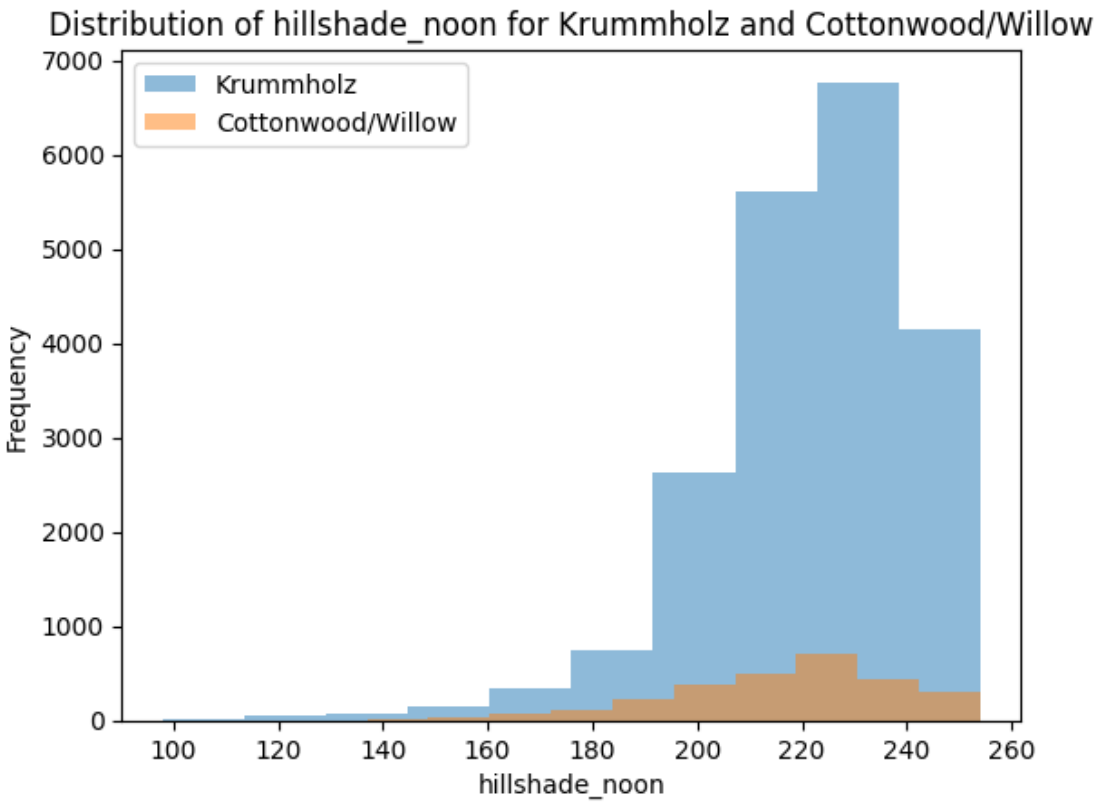

Distribution of elevation for Krummholz and Cottonwood/Willow
elevation
3750
3500
3250
3000
2750
2500
2250
2000
Krummholz
Cottonwood/Willow
cover_type


Distribution of horizontal_distance_to_hydrology for Krummholz and Cottonwood/Willow
horizontal_distance_to_hydrology
1200
1000
800
600
400
200
0
Krummholz
Cottonwood/Willow
cover_type

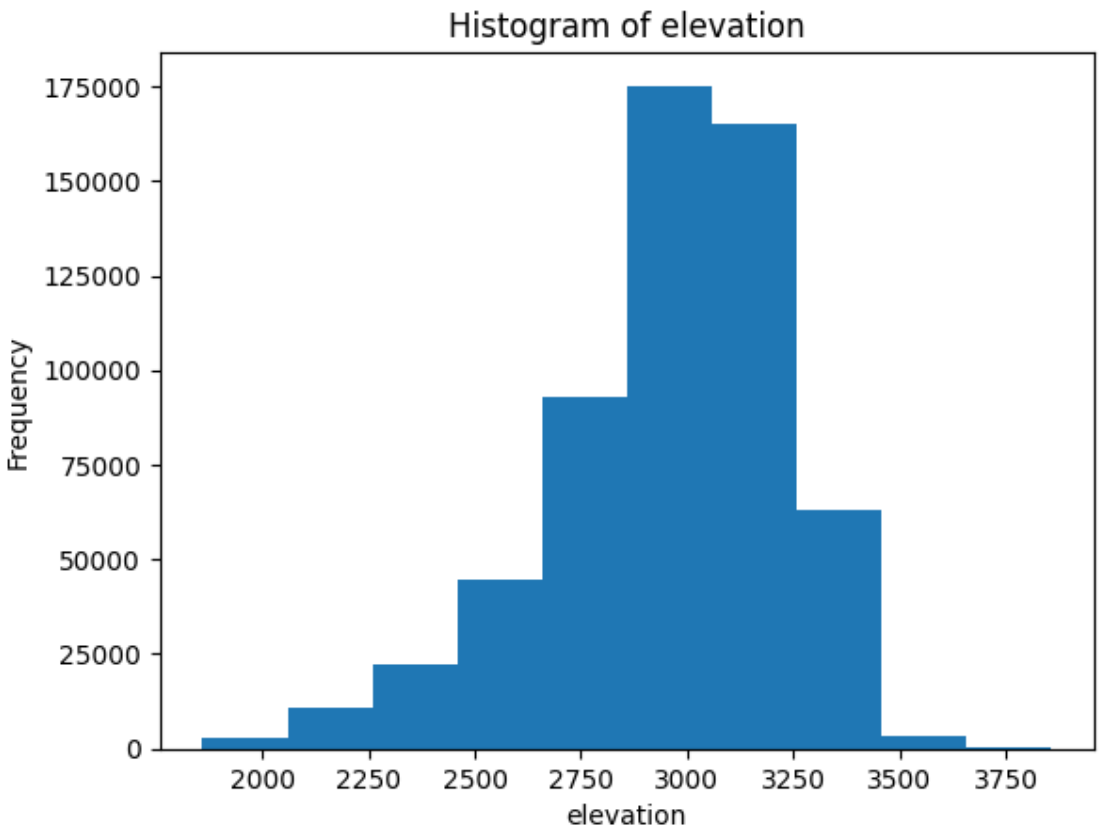

Distribution of hillshade_9am for Krummholz and Cottonwood/Willow
hillshade_9am
250
225
200
175
150
125
100
75
Krummholz
Cottonwood/Willow
cover_type

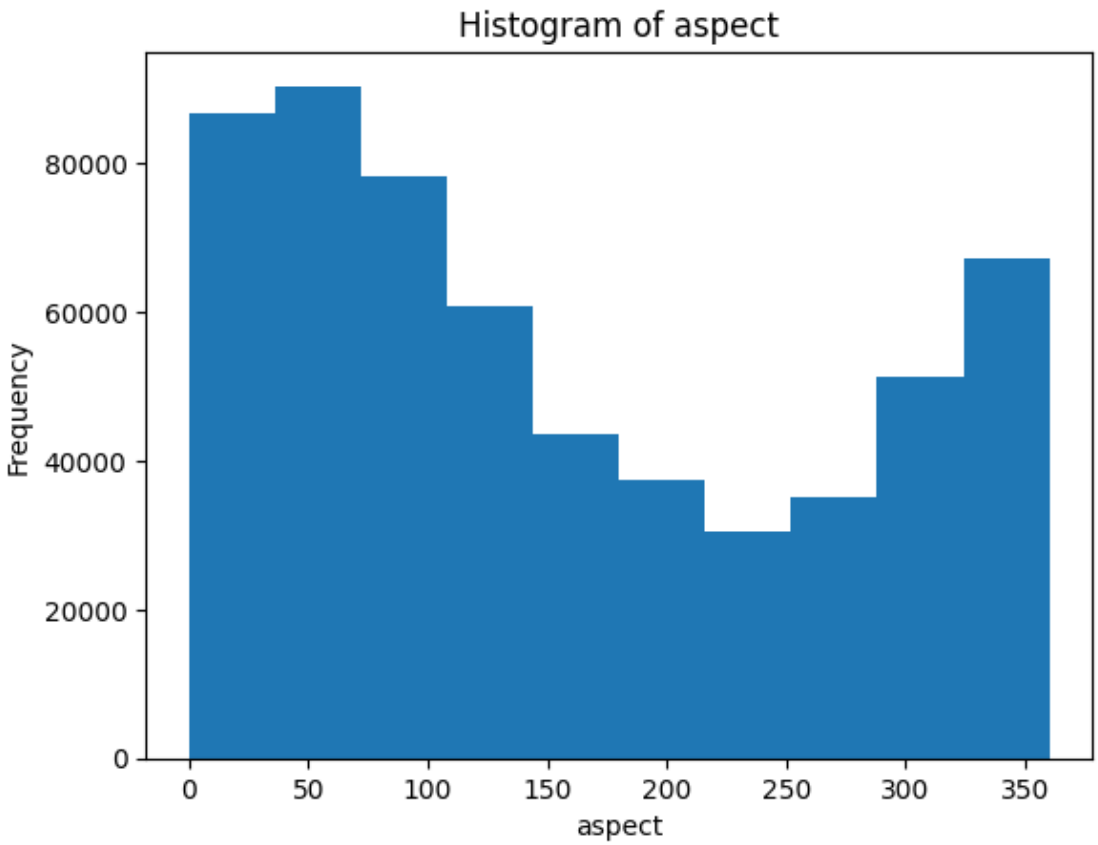


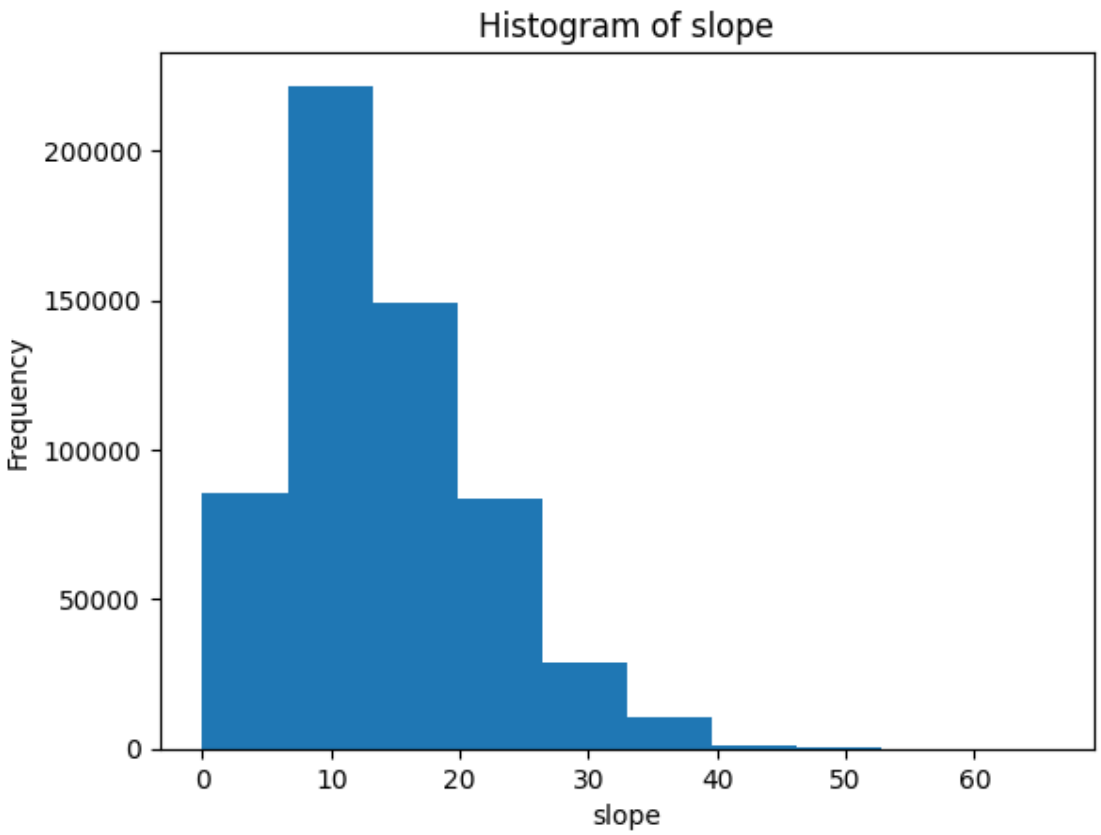
[ ]:
```
plt.hist(df_filtered[feature][df_filtered["cover_type"] == "Krummholz"],␣
  ↪alpha=0.5, label="Krummholz")
plt.hist(df_filtered[feature][df_filtered["cover_type"] == "Cottonwood/
  ↪Willow"], alpha=0.5, label="Cottonwood/Willow")
plt.xlabel(feature)
plt.ylabel("Frequency")
plt.title(f"Distribution of {feature} for Krummholz and Cottonwood/Willow")
plt.legend()
plt.show()
```



[ ]:
```
features = ["elevation", "aspect", "slope"]
df_features = df[features]
for feature in features:
    plt.hist(df_features[feature])
    plt.xlabel(feature)
    plt.ylabel("Frequency")
    plt.title(f"Histogram of {feature}")
    plt.show()
```


Histogram of elevation
Frequency
175000
150000
125000
100000
75000
50000
25000
0
2000
2250
2500
2750
3000
3250
3500
3750
elevation

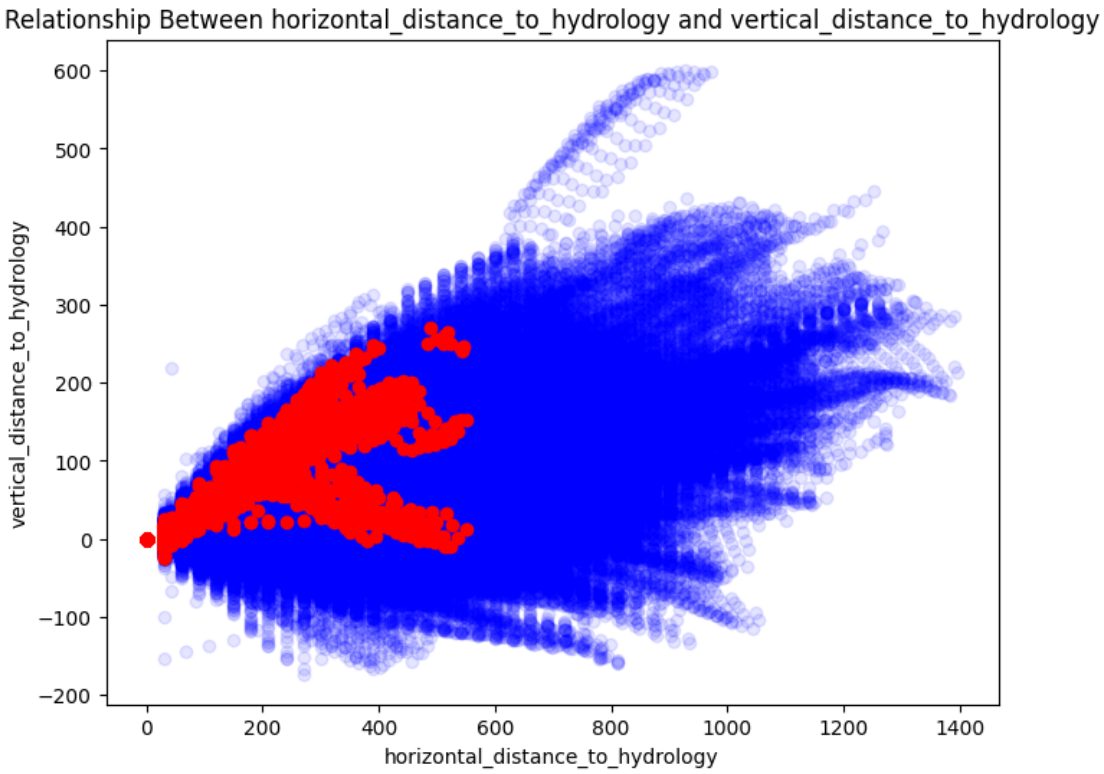

Histogram of aspect
Frequency
80000
60000
40000
20000
0
0
50
100
150
200
250
300
350
aspect



10. For each member in your group, plot another useful visualization from this dataset.

Member1

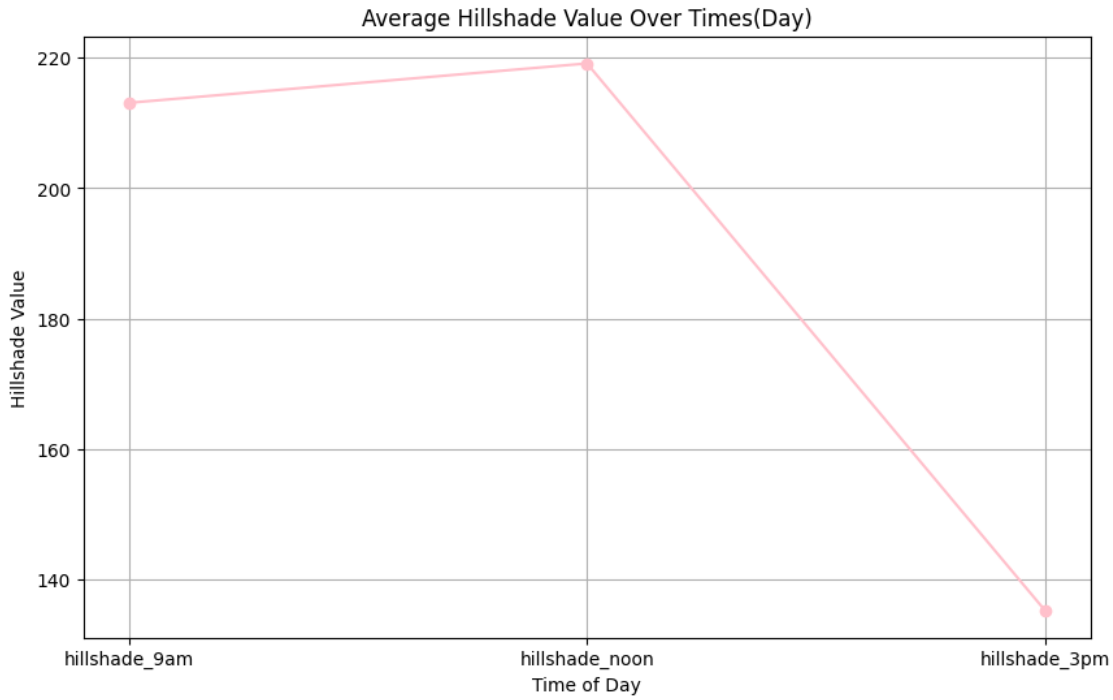
[ ]:
```
plt.figure(figsize=(8, 6))
plt.scatter(df.horizontal_distance_to_hydrology, df.
  ↪vertical_distance_to_hydrology, alpha=0.1, c="blue")
plt.scatter(df[(df['cover_type'] == 'Cottonwood/Willow')].
  ↪horizontal_distance_to_hydrology, df[(df['cover_type'] == 'Cottonwood/
  ↪Willow')].vertical_distance_to_hydrology, c="red")

plt.xlabel("horizontal_distance_to_hydrology")
plt.ylabel("vertical_distance_to_hydrology")
plt.title("Relationship Between horizontal_distance_to_hydrology and␣
  ↪vertical_distance_to_hydrology")
plt.show()
```



This scatter show that the cover type that nearly hydrology is Cottonwood/Willow show in red dot grouping nearly zero values

Member2

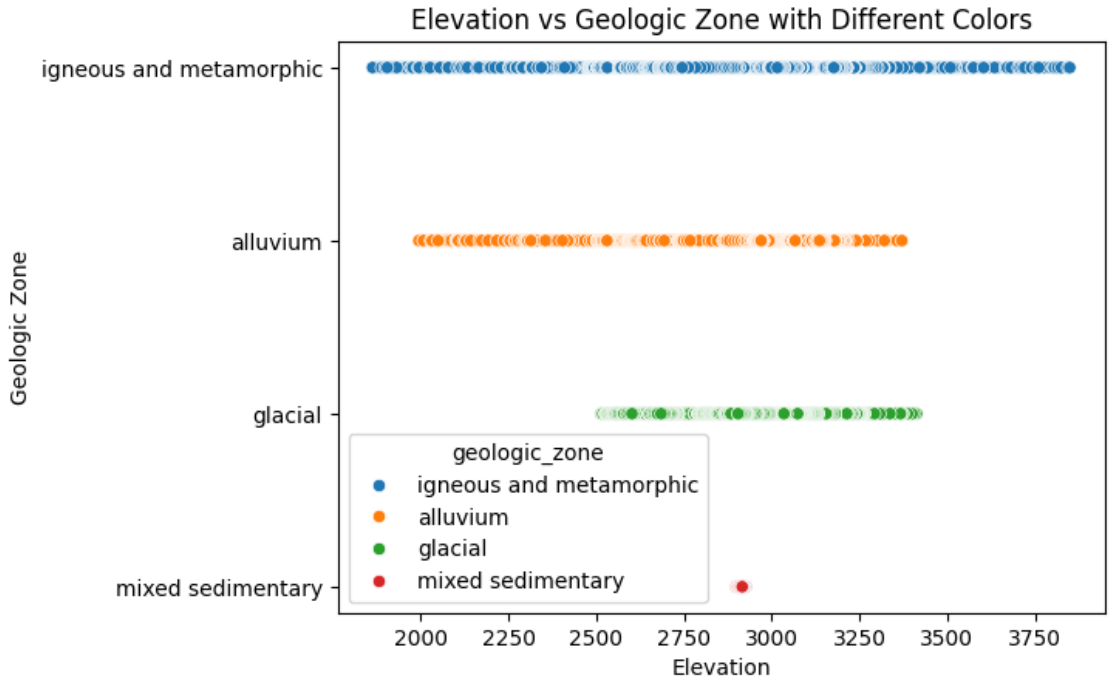
[12]:
```
import matplotlib.pyplot as plt

hillshade_9am = df['hillshade_9am']
hillshade_noon = df['hillshade_noon']
hillshade_3pm = df['hillshade_3pm']

times = ['hillshade_9am', 'hillshade_noon', 'hillshade_3pm']

plt.figure(figsize=(10, 6))
plt.plot(times, [hillshade_9am.mean(), hillshade_noon.mean(), hillshade_3pm.
 ↪mean()], marker='o', color='pink')

plt.xlabel('Time of Day')
plt.ylabel('Hillshade Value')
plt.title('Average Hillshade Value Over Times(Day)')

plt.grid(True)
plt.show()
```



This graph visualizes the average hillshade value over different times of day, as seen at 9 a.m., noon, and 3 p.m. From 9 a.m. to before noon, its value tends to gradually increase until it reaches a peak at noon, then decreases till 3 p.m.

Member3

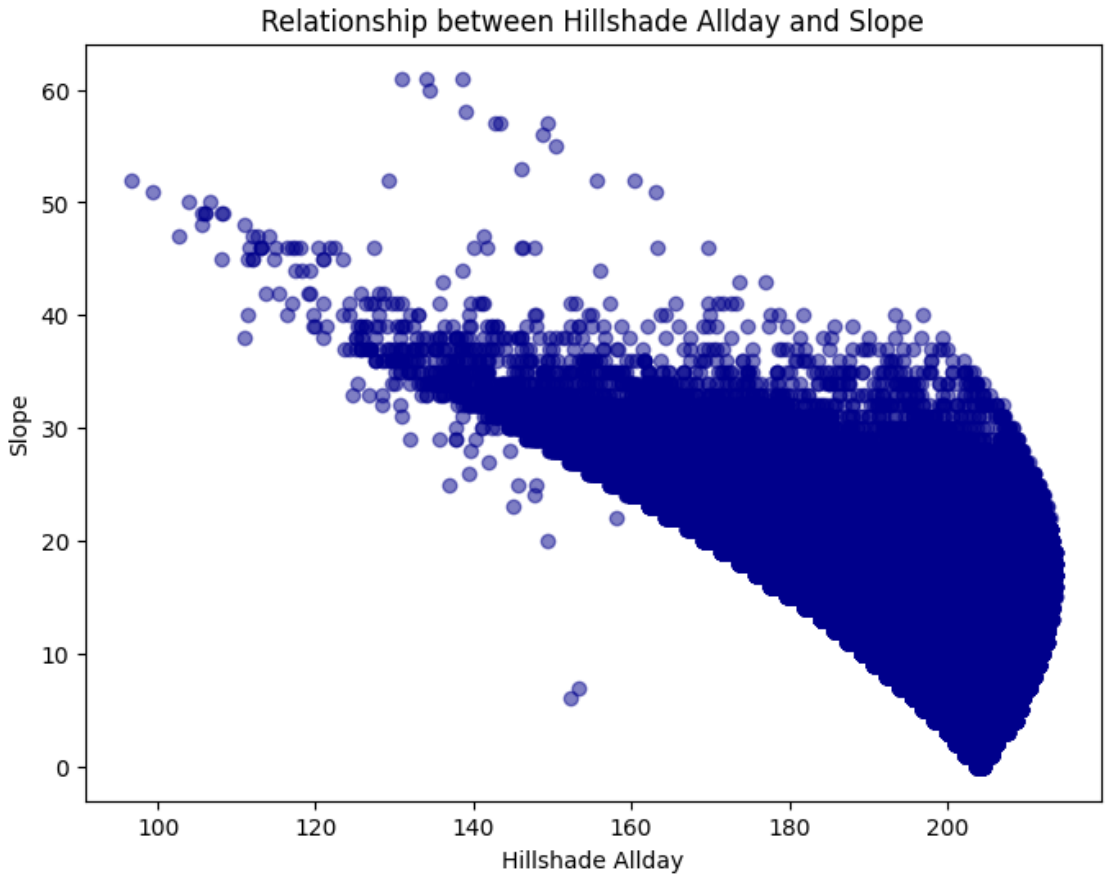
[12]:
```
sns.scatterplot(x='elevation', y='geologic_zone', hue='geologic_zone', data=df)

plt.xlabel('Elevation')
plt.ylabel('Geologic Zone')
plt.title('Elevation vs Geologic Zone with Different Colors')

plt.show()
```



The graph shows that the elevation of the geological zones increases from left to right. The igneous and metamorphic zone is stand for all elevation zone, followed by the alluvium zone is the elevation stared below 2000 to around 3400, the glacial zone the range is between 2500 to 3450, and the mixed sedimentary zone is strongly stand on 2900.

Member4

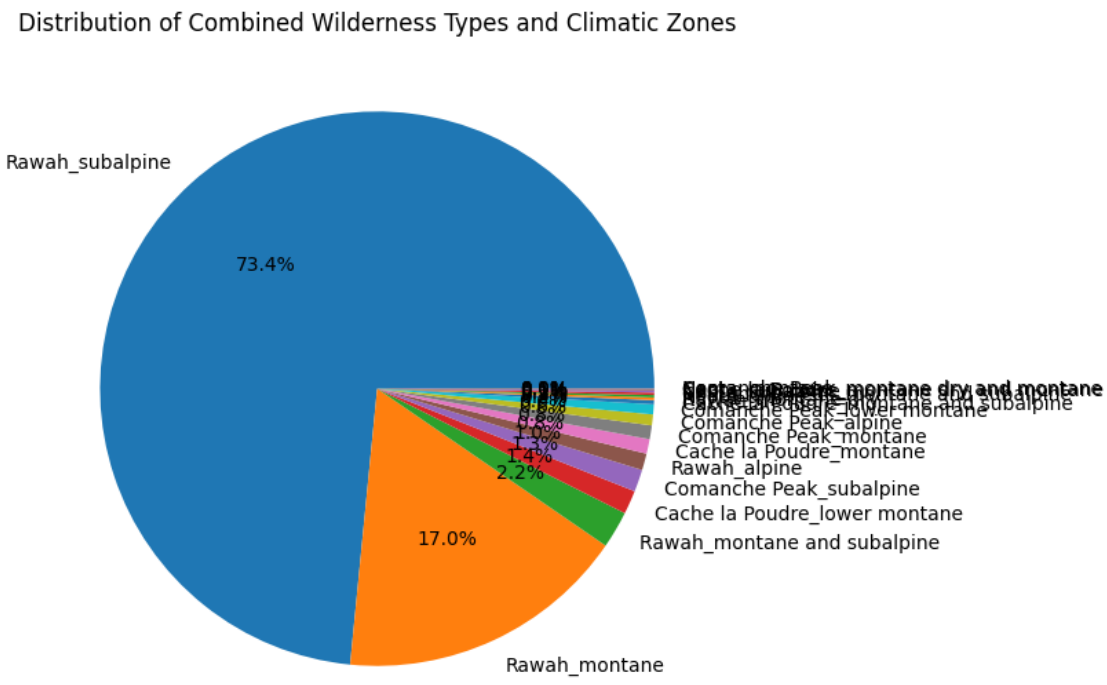
[15]:
```
covertype = df
covertype['Hillshade Allday'] = covertype[['hillshade_9am', 'hillshade_noon',␣
 ↪'hillshade_3pm']].mean(axis=1)

plt.figure(figsize=(8, 6))
plt.scatter(covertype['Hillshade Allday'], covertype['slope'],␣
 ↪color='darkblue', alpha=0.5)

plt.title('Relationship between Hillshade Allday and Slope')
plt.xlabel('Hillshade Allday')
plt.ylabel('Slope')

plt.show()
```



The Hillshade represent the amount of illumination a terrain receives, simulating the effects of sunlight on the landscape. The chart indicates that places with gentle slopes generally receive more shade throughout the day, resulting in higher average hillshade values. On the other hand, areas with steeper slopes tend to receive less shade, leading to lower hillshade values.

Member5

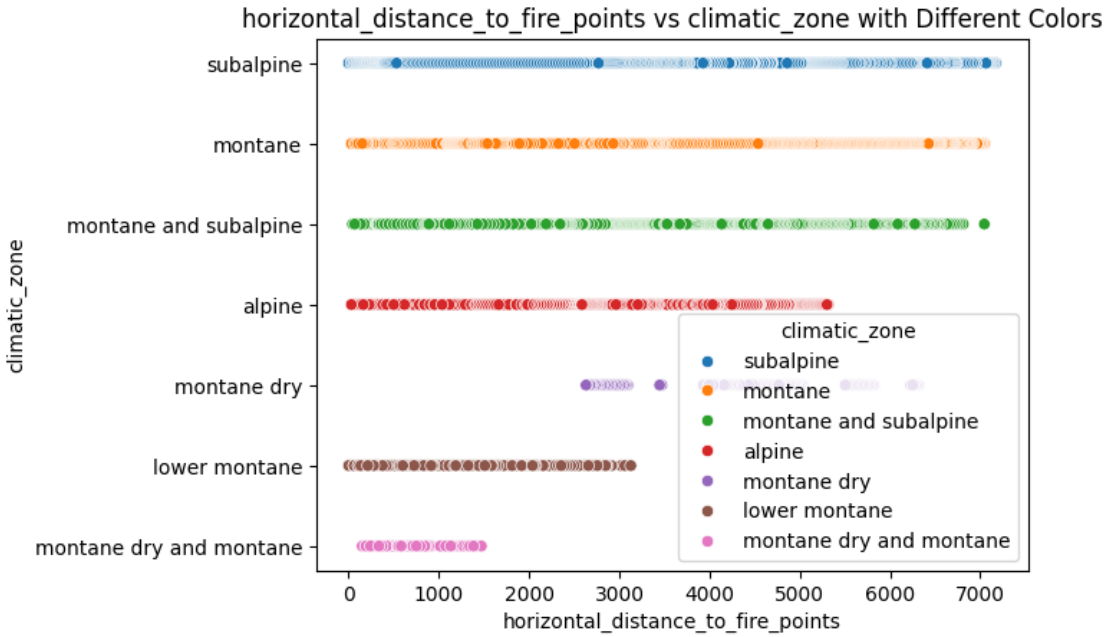
[16]:
```
data = df

data['combined'] = data['wilderness_type'] + '_' + data['climatic_zone']

plt.figure(figsize=(8, 8))
data['combined'].value_counts().plot(kind='pie', autopct='%1.1f%%')
plt.title('Distribution of Combined Wilderness Types and Climatic Zones')
plt.ylabel('')
plt.tight_layout()
plt.show()
```



A pie chart combining wilderness types and climatic zones, displaying probability percentages.

Member6

[19]:
```
sns.scatterplot(x='horizontal_distance_to_fire_points', y='climatic_zone',␣
↪hue='climatic_zone', data=df)

plt.xlabel('horizontal_distance_to_fire_points')
plt.ylabel('climatic_zone')
plt.title('horizontal_distance_to_fire_points vs climatic_zone with Different␣
↪Colors')

plt.show()
```



This graft show label of fire distance and climatic zone to combine the fire distance with climatic zone