BiodiversityProject

July 23, 2025

[4]:
```
from matplotlib import pyplot as plt
import pandas as pd
species = pd.read_csv('species_info.csv')
```

[5]:
```
species = pd.read_csv('species_info.csv')
```

[6]:
```
species.head()
```

[6]:

	category	scientific_name	common_names	conservation_status
0	Mammal	Clethrionomys gapperi gapperi	Gapper's Red-Backed Vole	NaN
1	Mammal	Bos bison	American Bison, Bison	NaN
2	Mammal	Bos taurus	Aurochs, Aurochs, Domestic Cattle (Feral), Dom…	NaN
3	Mammal	Ovis aries	Domestic Sheep, Mouflon, Red Sheep, Sheep (Feral)	NaN
4	Mammal	Cervus elaphus	Wapiti Or Elk	NaN

[7]:
```
species.scientific_name.nunique()
```

[7]:
```
5541
```

[8]:
```
species.category.unique()
```

[8]:
```
array(['Mammal', 'Bird', 'Reptile', 'Amphibian', 'Fish', 'Vascular Plant',
       'Nonvascular Plant'], dtype=object)
```

[9]:
```
species.conservation_status.unique()
```

[9]:
```
array([nan, 'Species of Concern', 'Endangered', 'Threatened',
       'In Recovery'], dtype=object)
```

[10]:
```
species.groupby('conservation_status').scientific_name.nunique().reset_index()
```

[10]:

	conservation_status	scientific_name
0	Endangered	15
1	In Recovery	4
2	Species of Concern	151
3	Threatened	10

[11]:
```
species.fillna('No Intervention', inplace=True)
```

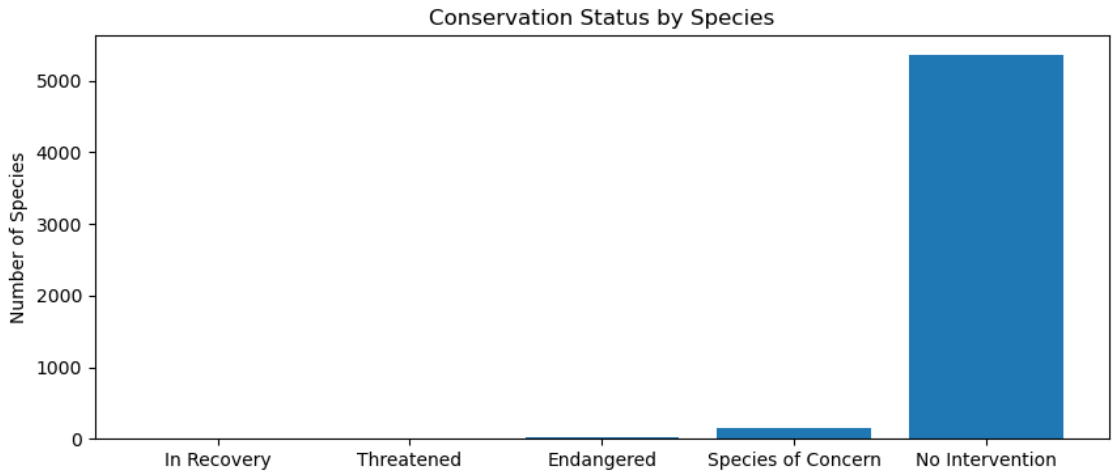
[12]:
```
species.groupby('conservation_status').scientific_name.nunique().reset_index()
```

[12]:

	conservation_status	scientific_name
0	Endangered	15
1	In Recovery	4
2	No Intervention	5363
3	Species of Concern	151
4	Threatened	10

[14]:
```
protection_counts = species.groupby('conservation_status')\
    .scientific_name.nunique().reset_index()\
    .sort_values(by='scientific_name')
```

[15]:
```
plt.figure(figsize=(10, 4))
ax = plt.subplot()
plt.bar(range(len(protection_counts)),
        protection_counts.scientific_name.values)
ax.set_xticks(range(len(protection_counts)))
ax.set_xticklabels(protection_counts.conservation_status.values)
plt.ylabel('Number of Species')
plt.title('Conservation Status by Species')
plt.show()
```



[16]:
```
species['is_protected'] = species.conservation_status != 'No Intervention'
```

[18]:
```
category_counts = species.groupby(['category', 'is_protected'])\
                         .scientific_name.nunique().reset_index()
```

[19]:
```
category_counts.head()
```

[19]:

	category	is_protected	scientific_name
0	Amphibian	False	72
1	Amphibian	True	7
2	Bird	False	413
3	Bird	True	75
4	Fish	False	115

[20]:
```
category_pivot = category_counts.pivot(columns='is_protected',
                                       index='category',
                                       values='scientific_name')\
                                .reset_index()
```

[21]:
```
category_pivot
```

[21]:

is_protected	category	False	True
0	Amphibian	72	7
1	Bird	413	75
2	Fish	115	11
3	Mammal	146	30
4	Nonvascular Plant	328	5
5	Reptile	73	5
6	Vascular Plant	4216	46

[22]:
```
category_pivot.columns = ['category', 'not_protected', 'protected']
```

[23]:
```
category_pivot['percent_protected'] = category_pivot.protected / \
                                      (category_pivot.protected +␣
 ↪category_pivot.not_protected)
```

[24]:
```
category_pivot
```

[24]:

	category	not_protected	protected	percent_protected
0	Amphibian	72	7	0.088608
1	Bird	413	75	0.153689
2	Fish	115	11	0.087302
3	Mammal	146	30	0.170455
4	Nonvascular Plant	328	5	0.015015
5	Reptile	73	5	0.064103
6	Vascular Plant	4216	46	0.010793

[25]:
```
contingency = [[30, 146],
               [75, 413]]
```

[26]:
```
from scipy.stats import chi2_contingency
```

[27]:
```
chi2_contingency(contingency)
```

[27]:
```
Chi2ContingencyResult(statistic=0.1617014831654557, pvalue=0.6875948096661336,
dof=1, expected_freq=array([[ 27.8313253, 148.1686747],
       [ 77.1686747, 410.8313253]]))
```

[28]:
```
contingency = [[30, 146],

               [5, 73]]

chi2_contingency(contingency)
```

[28]:
```
Chi2ContingencyResult(statistic=4.289183096203645, pvalue=0.03835559022969898,
dof=1, expected_freq=array([[ 24.2519685, 151.7480315],
       [ 10.7480315,  67.2519685]]))
```

[29]:
```
observations = pd.read_csv('observations.csv')

observations.head()
```

[29]:
```
            scientific_name                            park_name  observations
0        Vicia benghalensis  Great Smoky Mountains National Park            68
1            Neovison vison  Great Smoky Mountains National Park            77
2         Prunus subcordata               Yosemite National Park           138
3      Abutilon theophrasti                  Bryce National Park            84
4  Githopsis specularioides  Great Smoky Mountains National Park            85
```

[30]:
```
# Does "Sheep" occur in this string?
str1 = 'This string contains Sheep'
'Sheep' in str1
```

[30]:
```
True
```

[31]:
```
# Does "Sheep" occur in this string?

str2 = 'This string contains Cows'

'Sheep' in str2
```

[31]:
```
False
```

[32]:
```
species['is_sheep'] = species.common_names.apply(lambda x: 'Sheep' in x)

species.head()
```

[32]:
```
  category                scientific_name  \
0   Mammal  Clethrionomys gapperi gapperi
1   Mammal                      Bos bison
2   Mammal                     Bos taurus
3   Mammal                     Ovis aries
4   Mammal                 Cervus elaphus

                                      common_names conservation_status  \
0                          Gapper's Red-Backed Vole     No Intervention
1                             American Bison, Bison     No Intervention
2  Aurochs, Aurochs, Domestic Cattle (Feral), Dom…     No Intervention
3  Domestic Sheep, Mouflon, Red Sheep, Sheep (Feral)     No Intervention
4                                   Wapiti Or Elk     No Intervention

  is_protected  is_sheep
0        False     False
1        False     False
2        False     False
3        False      True
4        False     False
```

[33]:
```
species[species.is_sheep]
```

[33]:
```
            category              scientific_name  \
3             Mammal                   Ovis aries
1139  Vascular Plant             Rumex acetosella
2233  Vascular Plant           Festuca filiformis
3014          Mammal              Ovis canadensis
3758  Vascular Plant             Rumex acetosella
3761  Vascular Plant            Rumex paucifolius
4091  Vascular Plant                 Carex illota
4383  Vascular Plant  Potentilla ovina var. ovina
4446          Mammal      Ovis canadensis sierrae

                                          common_names conservation_status  \
3     Domestic Sheep, Mouflon, Red Sheep, Sheep (Feral)     No Intervention
1139                      Sheep Sorrel, Sheep Sorrell     No Intervention
2233                            Fineleaf Sheep Fescue     No Intervention
3014                     Bighorn Sheep, Bighorn Sheep  Species of Concern
3758  Common Sheep Sorrel, Field Sorrel, Red Sorrel,…     No Intervention
3761   Alpine Sheep Sorrel, Fewleaved Dock, Meadow Dock     No Intervention
4091                     Sheep Sedge, Smallhead Sedge     No Intervention
4383                                Sheep Cinquefoil     No Intervention
4446                      Sierra Nevada Bighorn Sheep          Endangered

      is_protected  is_sheep
3            False      True
1139         False      True
2233         False      True
3014          True      True
3758         False      True
3761         False      True
4091         False      True
4383         False      True
4446          True      True
```

[34]:
```
sheep_species = species[(species.is_sheep) & (species.category == 'Mammal')]

sheep_species
```

[34]:
```
     category          scientific_name  \
3      Mammal               Ovis aries
3014   Mammal           Ovis canadensis
4446   Mammal  Ovis canadensis sierrae

                                         common_names conservation_status  \
```

```
3     Domestic Sheep, Mouflon, Red Sheep, Sheep (Feral)     No Intervention
3014                      Bighorn Sheep, Bighorn Sheep  Species of Concern
4446                       Sierra Nevada Bighorn Sheep          Endangered

      is_protected  is_sheep
3            False      True
3014          True      True
4446          True      True
```

[35]:
```
sheep_observations = observations.merge(sheep_species)

sheep_observations
```

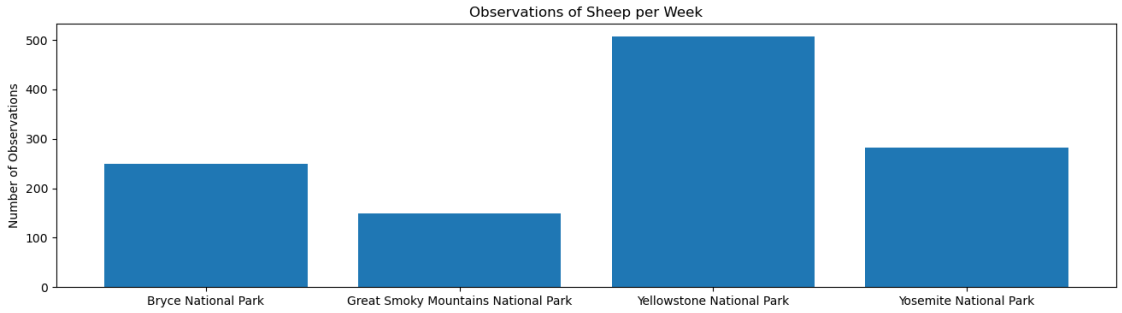
[35]:
```
            scientific_name                          park_name  \
0           Ovis canadensis            Yellowstone National Park
1           Ovis canadensis                 Bryce National Park
2           Ovis canadensis               Yosemite National Park
3           Ovis canadensis  Great Smoky Mountains National Park
4   Ovis canadensis sierrae            Yellowstone National Park
5   Ovis canadensis sierrae               Yosemite National Park
6   Ovis canadensis sierrae                  Bryce National Park
7   Ovis canadensis sierrae  Great Smoky Mountains National Park
8                Ovis aries               Yosemite National Park
9                Ovis aries  Great Smoky Mountains National Park
10               Ovis aries                  Bryce National Park
11               Ovis aries            Yellowstone National Park

    observations category                                        common_names  \
0            219   Mammal                          Bighorn Sheep, Bighorn Sheep
1            109   Mammal                          Bighorn Sheep, Bighorn Sheep
2            117   Mammal                          Bighorn Sheep, Bighorn Sheep
3             48   Mammal                          Bighorn Sheep, Bighorn Sheep
4             67   Mammal                           Sierra Nevada Bighorn Sheep
5             39   Mammal                           Sierra Nevada Bighorn Sheep
6             22   Mammal                           Sierra Nevada Bighorn Sheep
7             25   Mammal                           Sierra Nevada Bighorn Sheep
8            126   Mammal  Domestic Sheep, Mouflon, Red Sheep, Sheep (Feral)
9             76   Mammal  Domestic Sheep, Mouflon, Red Sheep, Sheep (Feral)
10           119   Mammal  Domestic Sheep, Mouflon, Red Sheep, Sheep (Feral)
11           221   Mammal  Domestic Sheep, Mouflon, Red Sheep, Sheep (Feral)

   conservation_status  is_protected  is_sheep
0   Species of Concern          True      True
1   Species of Concern          True      True
2   Species of Concern          True      True
3   Species of Concern          True      True
```

```
4           Endangered          True      True
5           Endangered          True      True
6           Endangered          True      True
7           Endangered          True      True
8      No Intervention         False      True
9      No Intervention         False      True
10     No Intervention         False      True
11     No Intervention         False      True
```

[36]:
```
obs_by_park = sheep_observations.groupby('park_name').observations.sum().
 ↪reset_index()

obs_by_park
```

[36]:
```
                            park_name  observations
0                  Bryce National Park           250
1  Great Smoky Mountains National Park           149
2            Yellowstone National Park           507
3               Yosemite National Park           282
```

[37]:
```
plt.figure(figsize=(16, 4))

ax = plt.subplot()

plt.bar(range(len(obs_by_park)),

        obs_by_park.observations.values)

ax.set_xticks(range(len(obs_by_park)))

ax.set_xticklabels(obs_by_park.park_name.values)

plt.ylabel('Number of Observations')

plt.title('Observations of Sheep per Week')

plt.show()
```



[38]:
```
minimum_detectable_effect = 100 * 0.05 / 0.15

minimum_detectable_effect
```

[38]:
```
33.333333333333336
```

[39]:
```
baseline = 15
```

[40]:
```
sample_size_per_variant = 870

# Note: This could be 890 if you used 33% for the "Minimum Detectable Effect"␣
 ↪instead of 33.33%.  That's fine.
```

[41]:
```
sample_size_per_variant = 870

# Note: This could be 890 if you used 33% for the "Minimum Detectable Effect"␣
 ↪instead of 33.33%.  That's fine.
```

[42]:
```
bryce = 870 / 250.

yellowstone = 810 / 507.

# Approximately 3.5 weeks at Bryce and 1.5 weeks at Yellowstone.
```

[ ]:
```

```