corr

April 19, 2023

[1]:
```
import matplotlib
import matplotlib.pyplot as plt
import numpy as np
import pandas as pd
import seaborn as sns
import statsmodels.api as sm
import scipy.stats as st
from sklearn.linear_model import LogisticRegression
from sklearn.metrics import classification_report, confusion_matrix
from sklearn.model_selection import train_test_split

%matplotlib inline
```

[2]:
```
df_out = pd.read_pickle('df_out.pkl')
df_breeds = pd.read_pickle('df_breeds.pkl')
df_out_with_breeds_info = pd.read_pickle('df_out_with_breeks_info.pkl')
df_breeds_with_info = pd.read_pickle('df_breeds_with_info.pkl')
df_out.info()
df_out.head()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 149511 entries, 0 to 149510
Data columns (total 41 columns):
 #   Column                   Non-Null Count   Dtype
---  ------                   --------------   -----
 0   index                    149511 non-null  Int64
 1   Animal ID                149511 non-null  string
 2   Name                     106260 non-null  string
 3   Outcome DateTime         149511 non-null  datetime64[ns]
 4   Outcome MonthYear        149511 non-null  string
 5   Date of Birth            149511 non-null  datetime64[ns]
 6   Outcome Type             149485 non-null  string
 7   Outcome Subtype          68443 non-null   string
 8   Animal Type              149511 non-null  string
 9   Sex upon Outcome         149509 non-null  string
 10  Age upon Outcome         149465 non-null  string
 11  Breed                    149511 non-null  string
 12  Color                    149511 non-null  string
```

```
 13  Intake MonthYear          147980 non-null  string
 14  Intake DateTime           147980 non-null  datetime64[ns]
 15  Found Location            147980 non-null  string
 16  Intake Type               147980 non-null  string
 17  Intake Condition          147980 non-null  string
 18  Sex upon Intake           147978 non-null  string
 19  Age upon Intake           147979 non-null  string
 20  Years in animal center    147980 non-null  Float64
 21  Colors (count)            149511 non-null  Int64
 22  Color 0                   149511 non-null  string
 23  Color 1                   79869 non-null   string
 24  Color 0 R                 135638 non-null  Float64
 25  Color 0 G                 135638 non-null  Float64
 26  Color 0 B                 135638 non-null  Float64
 27  Color 0 H                 135638 non-null  Float64
 28  Color 0 S                 135638 non-null  Float64
 29  Color 0 V                 135638 non-null  Float64
 30  Color 1 R                 78596 non-null   Float64
 31  Color 1 G                 78596 non-null   Float64
 32  Color 1 B                 78596 non-null   Float64
 33  Color 1 H                 78596 non-null   Float64
 34  Color 1 S                 78596 non-null   Float64
 35  Color 1 V                 78596 non-null   Float64
 36  Age upon Outcome (years)  149465 non-null  Float64
 37  Male                      149509 non-null  boolean
 38  Female                    149509 non-null  boolean
 39  NeuteredOrSpayed          149509 non-null  boolean
 40  Adopted                   149485 non-null  boolean
dtypes: Float64(14), Int64(2), boolean(4), datetime64[ns](3), string(18)
memory usage: 45.6 MB
```

[2]:

	index	Animal ID	Name	Outcome DateTime	Outcome MonthYear	Date of Birth	Outcome Type	Outcome Subtype	Animal Type	Sex upon Outcome	…	Color 1 G	Color 1 B	Color 1 H	Color 1 S	Color 1 V
0	61546	A659834	Dudley	2013-10-01 09:31:00	Oct 2013	2013-07-23	Adoption	Foster	Dog	Neutered Male	…	<NA>	<NA>	<NA>	<NA>	<NA>
1	50833	A664235	<NA>	2013-10-01 10:39:00	Oct 2013	2013-09-24	Transfer	Partner	Cat	Unknown						
2	93227	A664236	<NA>	2013-10-01 10:44:00	Oct 2013	2013-09-24	Transfer	Partner	Cat	Unknown						
3	109856	A664237	<NA>	2013-10-01 10:44:00	Oct 2013	2013-09-24	Transfer	Partner	Cat	Unknown						
4	12697	A664223	Moby	2013-10-01 11:03:00	Oct 2013	2009-09-30	Return to Owner	<NA>	Dog	Neutered Male						

```
1  …       1.0       1.0       0.0       0.0       1.0
2  …       1.0       1.0       0.0       0.0       1.0
3  …       1.0       1.0       0.0       0.0       1.0
4  …      <NA>      <NA>      <NA>      <NA>      <NA>

  Age upon Outcome (years)   Male Female NeuteredOrSpayed Adopted
0                 0.166667   True  False             True    True
1                 0.019231  False  False            False   False
2                 0.019231  False  False            False   False
3                 0.019231  False  False            False   False
4                      4.0   True  False             True   False

[5 rows x 41 columns]
```

[3]:
```
df_breeds_with_info.head()
```

[3]:
```
                    Breed  Count Animal Type   Adopted  Color 0 R (mean)  \
0   Domestic Shorthair Mix  33260         Cat  0.461425          0.439476
1       Domestic Shorthair  13808         Cat  0.553158          0.451115
2            Pit Bull Mix   9406         Dog  0.431427          0.513666
3   Labrador Retriever Mix   7913         Dog  0.546063          0.409771
4  Chihuahua Shorthair Mix   6689         Dog  0.483181          0.609789

   Color 0 R (std dev)  Color 0 G (mean)  Color 0 G (std dev)  \
0             0.412274          0.322711             0.323957
1             0.412934          0.331264             0.324532
2             0.403283          0.418784             0.381554
3             0.421755          0.329495             0.388036
4             0.370759          0.493648             0.361854

   Color 0 B (mean)  Color 0 B (std dev)  …  \
0          0.286948             0.413041  …
1          0.293482             0.413847  …
2          0.476534             0.439715  …
3          0.181561             0.323025  …
4          0.356013             0.369441  …

                         CKC Subgroup  height_low_inches  \
0                 11-A: Pointing Dogs               21.0
1                 11-A: Pointing Dogs               21.0
2         4-B: Bull-and-Terrier Breeds               17.0
3       11-C: Retrievers and Waterdogs               21.0
4  12-A: Americas and Caribbean Breeds                5.0

   height_high_inches  average height  weight_low_lbs  weight_high_lbs  \
0                26.0            23.5            45.0               70
1                26.0            23.5            45.0               70
```

```
2                22.0            19.5            30.0                75
3                25.0            23.0            55.0                80
4                10.0             7.5             1.0                 7

   average weight  Lifespan Low  Lifespan High  average lifespan
0            57.5            10             12              11.0
1            57.5            10             12              11.0
2            52.5            10             12              11.0
3            67.5            10             12              11.0
4             4.0            14             16              15.0

[5 rows x 45 columns]
```

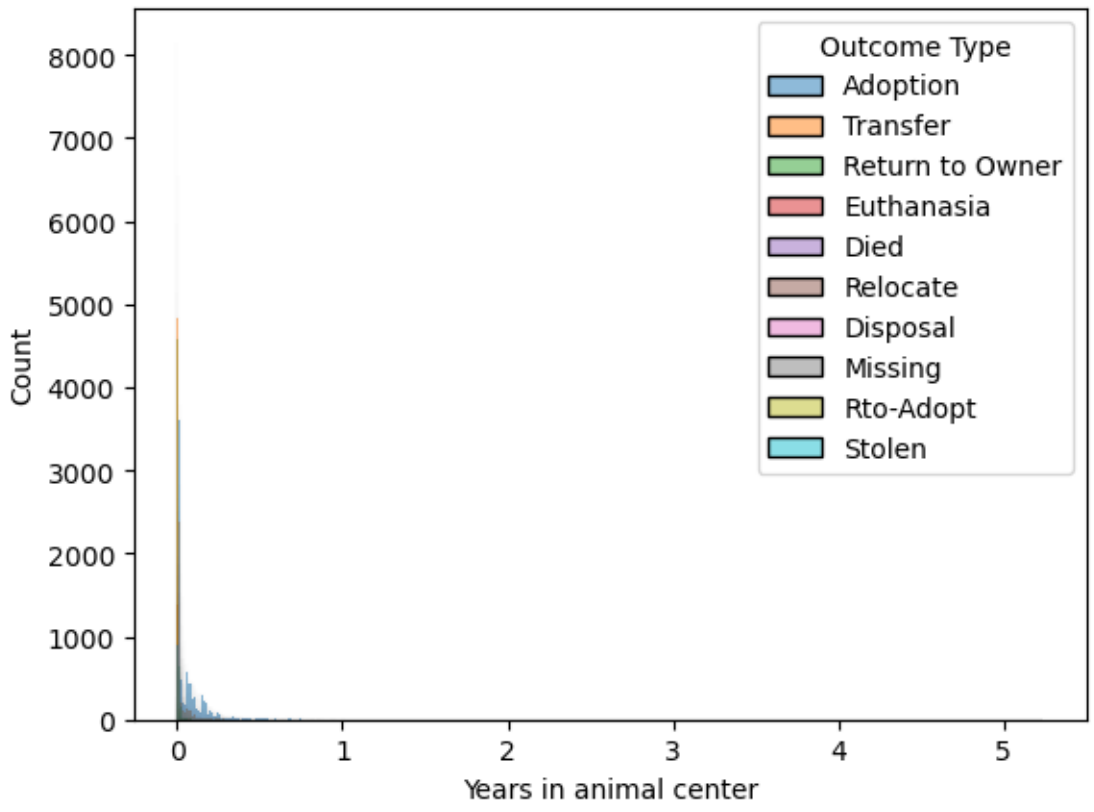
[4]:
```
def animalsLongerThan(days_limit):
    years_limit = days_limit / 365.25
    return df_out_with_breeds_info.loc[df_out_with_breeds_info["Years in animal␣
 ↪center"] > years_limit]
```

[5]:
```
sns.histplot(
    data=df_out,
    x='Years in animal center',
    hue='Outcome Type'
)
plt.show()
```

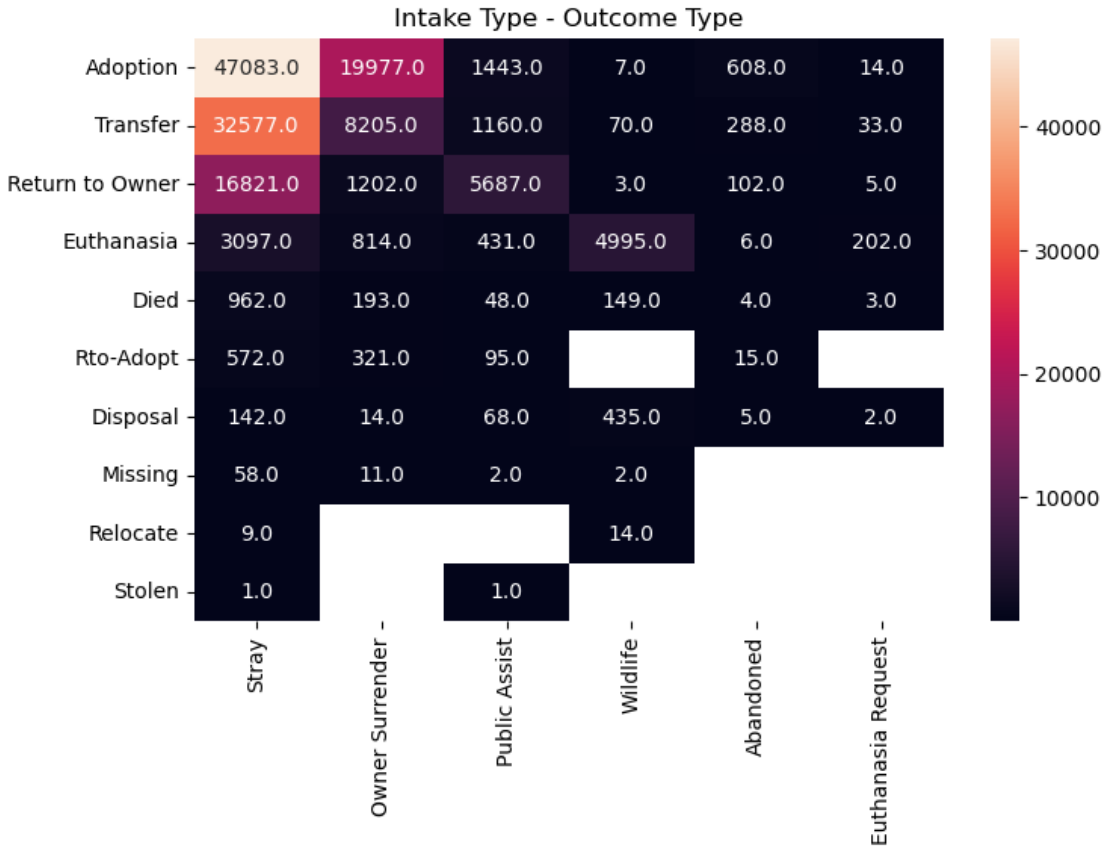
```
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:499: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(edges, name="edges"),
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:500: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(widths, name="widths"),
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:499: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(edges, name="edges"),
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:500: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(widths, name="widths"),
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:499: FutureWarning: In a future version, the
```

```
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(edges, name="edges"),
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:500: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(widths, name="widths"),
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:499: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(edges, name="edges"),
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:500: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(widths, name="widths"),
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:499: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(edges, name="edges"),
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:500: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(widths, name="widths"),
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:499: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(edges, name="edges"),
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:500: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(widths, name="widths"),
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:499: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(edges, name="edges"),
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:500: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(widths, name="widths"),
```

```
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:499: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(edges, name="edges"),
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:500: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(widths, name="widths"),
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:499: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(edges, name="edges"),
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:500: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(widths, name="widths"),
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:499: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(edges, name="edges"),
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:500: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(widths, name="widths"),
```



[6]:
```
df_intake_outcome_type = pd.DataFrame()
df_intake_outcome_type_grouped = df_out[["Intake Type", "Outcome Type"]].
 ↪value_counts()
for (intake_type, outcome_type), count in df_intake_outcome_type_grouped.
 ↪items():
    df_intake_outcome_type.at[outcome_type, intake_type] = int(count)

plt.figure(figsize=(8,5))
sns.heatmap(data=df_intake_outcome_type, annot=True, fmt="0")
plt.title("Intake Type - Outcome Type")
plt.show()
```



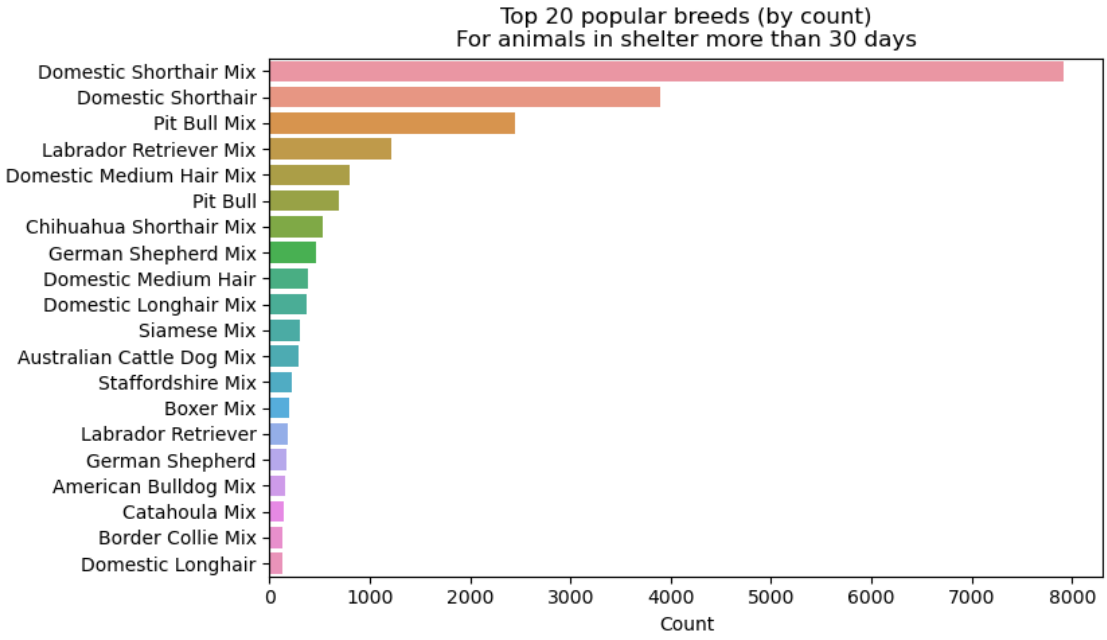
1 Analysis by breed

[7]:
```
def breeds(df_animals):
    df_breeds_filtered = pd.DataFrame(columns=['Breed', 'Count'])

    copy_columns = [column for column in df_breeds_with_info.columns if column␣
↪not in df_breeds.columns]

    for breed, loc in df_animals.groupby("Breed").groups.items():
        df_out_filtered_breed = df_animals.loc[loc]
        df_breeds_filtered.at[breed, 'Breed'] = breed
        df_breeds_filtered.at[breed, 'Count'] = df_out_filtered_breed.shape[0]
        df_breeds_filtered.at[breed, 'Adopted'] = df_out_filtered_breed.Adopted.
↪mean()

        df_breeds_with_info_row = df_breeds_with_info.loc[df_breeds_with_info.
↪Breed == breed]
        for column in copy_columns:
```

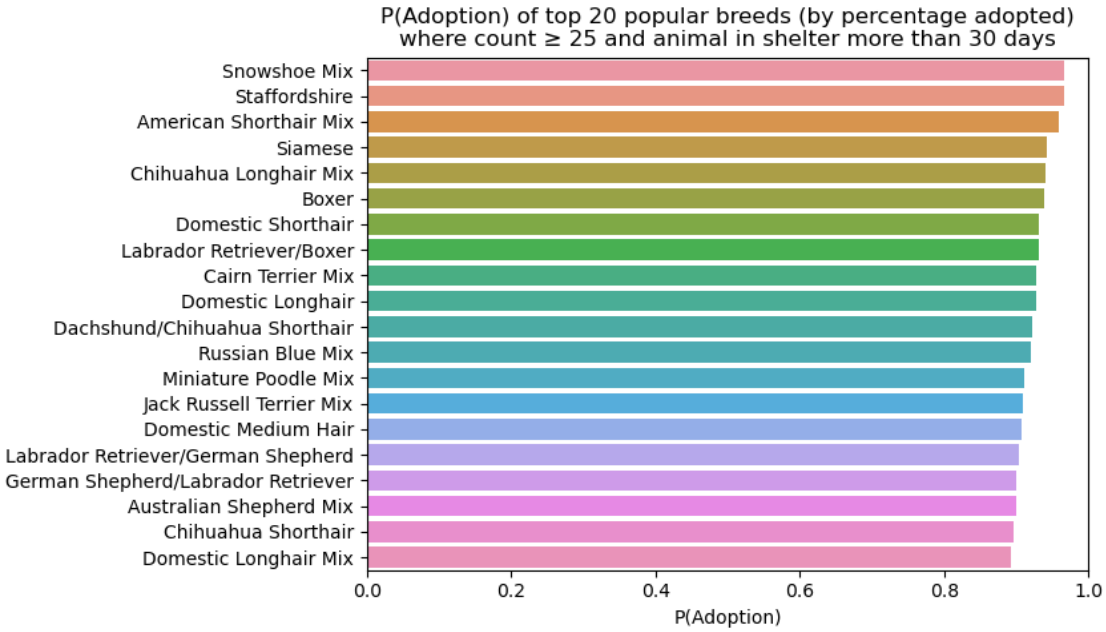
```
            df_breeds_filtered.at[breed, column] =␣
 ↪df_breeds_with_info_row[column].values[0]

    return df_breeds_filtered
```

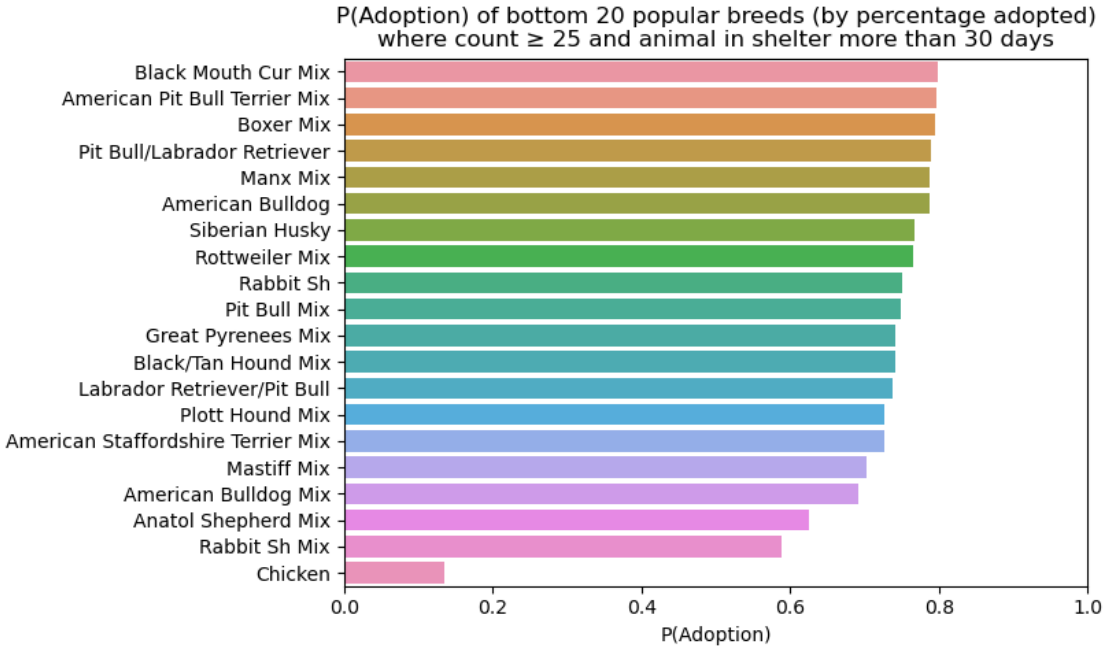
1.0.1 Popular breeds

[8]:
```
days_limit = 30

df_breeds_filtered = breeds(animalsLongerThan(days_limit))
df_breeds_filtered.sort_values('Count', ascending=False, inplace=True)

k = 20
plt.figure(figsize=(8,5))
sns.barplot(
    data=df_breeds_filtered.head(k),
    x='Count',
    y='Breed',
    errorbar=None,
)
plt.xlabel('Count')
plt.ylabel(None)
plt.title(f'Top {k} popular breeds (by count)\nFor animals in shelter more than␣
 ↪{days_limit} days')
plt.show()
```



[9]:
```
days_limit = 30
df_breeds_filtered = breeds(animalsLongerThan(days_limit))

n = 25
df_breeds_filtered = df_breeds_filtered.loc[df_breeds_filtered.Count >= n]

k = 20

plt.figure(figsize=(7,5))
ax = sns.barplot(
    data=df_breeds_filtered.sort_values('Adopted', ascending=False).head(k),
    x='Adopted',
    y='Breed',
    errorbar=None,
)
ax.set_xlim(0, 1)
plt.xlabel('P(Adoption)')
plt.ylabel(None)
plt.title(f'P(Adoption) of top {k} popular breeds (by percentage␣
 ↪adopted)\nwhere count  {n} and animal in shelter more than {days_limit}␣
 ↪days')
plt.show()

plt.figure(figsize=(7,5))
ax = sns.barplot(
    data=df_breeds_filtered.sort_values('Adopted', ascending=True).head(k).
 ↪sort_values('Adopted', ascending=False),
    x='Adopted',
    y='Breed',
    errorbar=None,
)
ax.set_xlim(0, 1)
plt.xlabel('P(Adoption)')
plt.ylabel(None)
plt.title(f'P(Adoption) of bottom {k} popular breeds (by percentage␣
 ↪adopted)\nwhere count  {n} and animal in shelter more than {days_limit}␣
 ↪days')
plt.show()
```





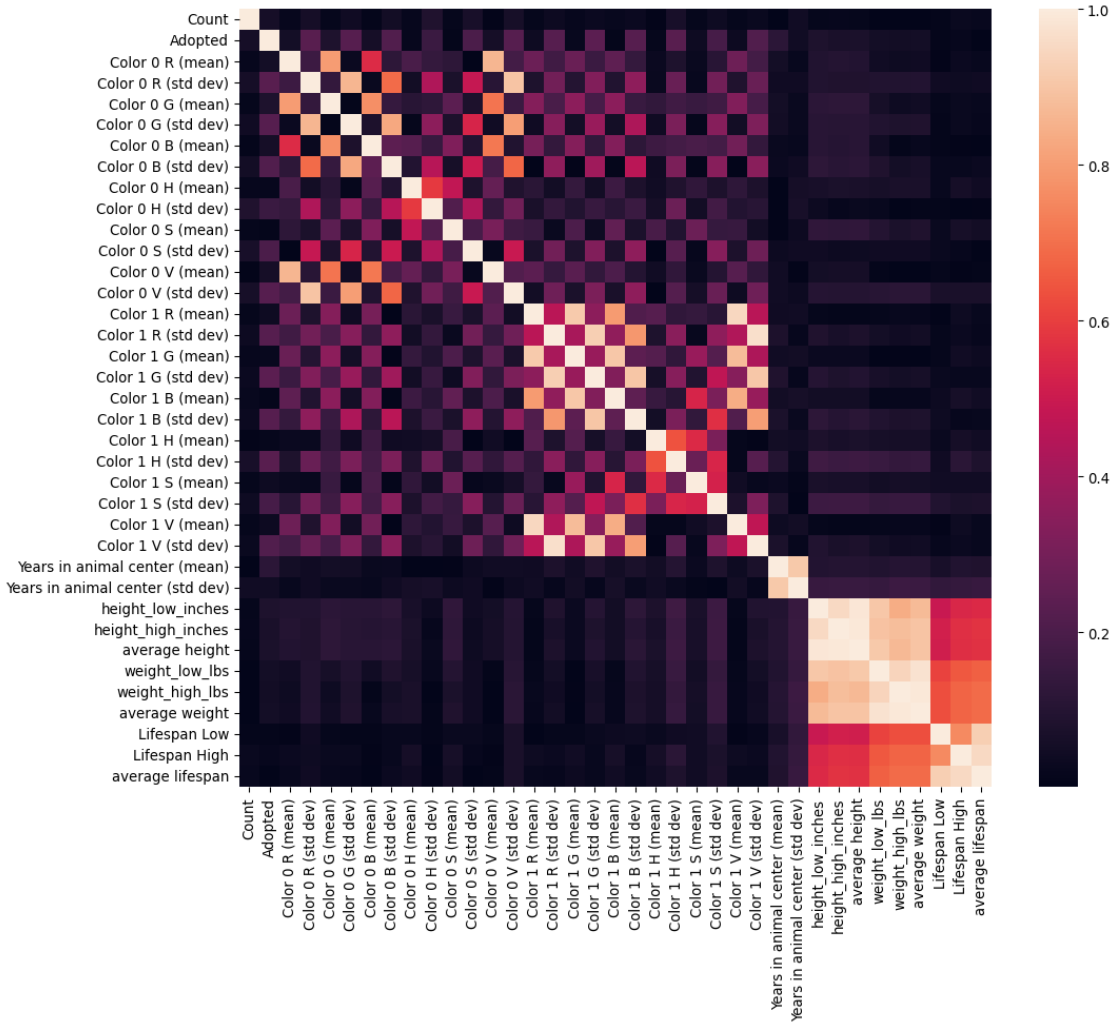
1.0.2 Correlating with every variable

There isn't much correlation appearing yet

[10]:
```
df_breeds_with_info_corr = df_breeds_with_info.corr()

plt.figure(num=None, figsize=(12, 10), dpi=96, facecolor='w', edgecolor='k')
sns.heatmap(data=df_breeds_with_info_corr.abs())

def score(df, var1, var2):
    print(f'Corr({var1}, {var2})  {df[var1][var2]}')

score(df_breeds_with_info_corr, 'Adopted', 'Color 0 B (mean)')
score(df_breeds_with_info_corr, 'Adopted', 'Color 0 B (std dev)')
score(df_breeds_with_info_corr, 'Adopted', 'Color 0 V (mean)')
score(df_breeds_with_info_corr, 'Adopted', 'Color 0 V (std dev)')
score(df_breeds_with_info_corr, 'Adopted', 'average height')
score(df_breeds_with_info_corr, 'Adopted', 'height_low_inches')
score(df_breeds_with_info_corr, 'Adopted', 'height_high_inches')
score(df_breeds_with_info_corr, 'Adopted', 'Lifespan Low')
```

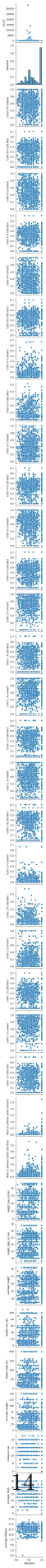
```
/tmp/ipykernel_83309/4118066584.py:1: FutureWarning: The default value of
numeric_only in DataFrame.corr is deprecated. In a future version, it will
default to False. Select only valid columns or specify the value of numeric_only
to silence this warning.
  df_breeds_with_info_corr = df_breeds_with_info.corr()
```

```
Corr(Adopted, Color 0 B (mean))  -0.05752196102076516
Corr(Adopted, Color 0 B (std dev))  -0.21220098425344627
Corr(Adopted, Color 0 V (mean))  -0.05892713325516757
Corr(Adopted, Color 0 V (std dev))  -0.2237579456621404
Corr(Adopted, average height)  0.07520172186737102
Corr(Adopted, height_low_inches)  0.08043859187254204
Corr(Adopted, height_high_inches)  0.06827302387620375
Corr(Adopted, Lifespan Low)  0.011194168083226583
```



[11]:
```
sns.pairplot(data=df_breeds_with_info, x_vars=['Adopted'])
```

[11]: <seaborn.axisgrid.PairGrid at 0x7f2fc8f65180>


Count
Attrition
Attrition
Age
BusinessTravel
DailyRate
Department
DistanceFromHome
Education
EducationField
EmployeeCount
EmployeeNumber
EnvironmentSatisfaction
Gender
HourlyRate
JobInvolvement
JobLevel
JobRole
JobSatisfaction
MaritalStatus
MonthlyIncome
MonthlyRate
NumCompaniesWorked
Over18
OverTime
PercentSalaryHike
PerformanceRating
RelationshipSatisfaction
StandardHours
StockOptionLevel
TotalWorkingYears
TrainingTimesLastYear
WorkLifeBalance
YearsAtCompany
YearsInCurrentRole
YearsSinceLastPromotion
YearsWithCurrManager
Attrition

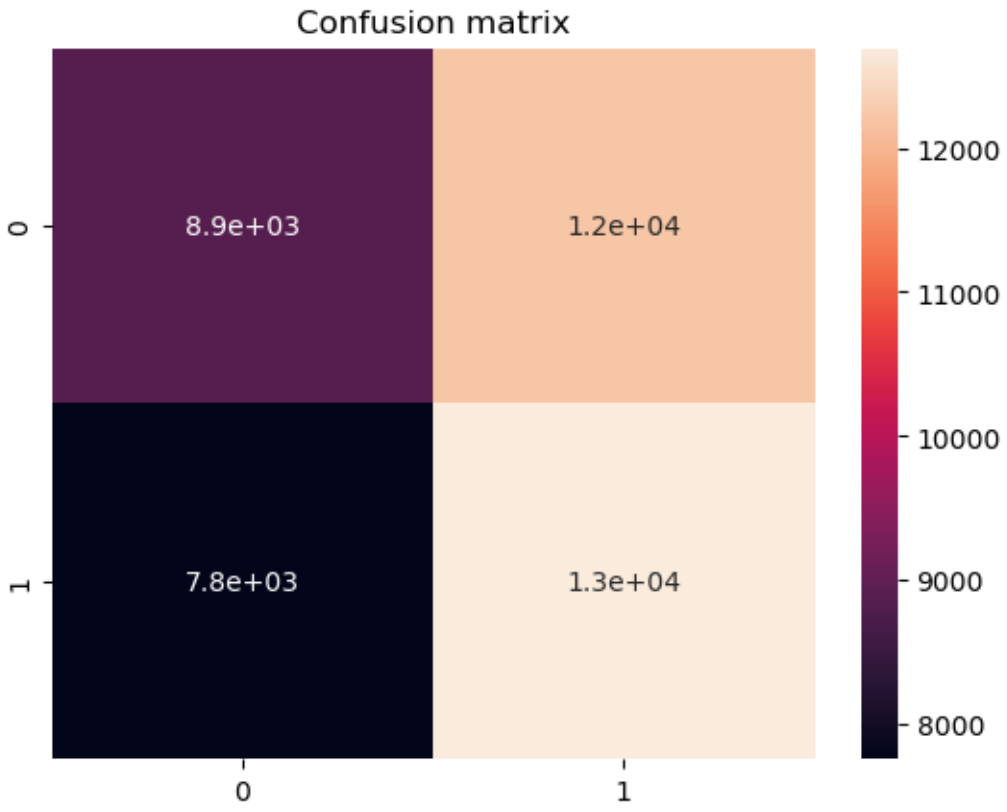
1.1 Height ~ adopted?

Is the average height of a breed correlated with likelihood of an animal from that breed being adopted? The Pearson correlation coefficient was Corr(Adopted, average height) 0.2286839421877296.

This section analyzes this by breed and also by individual animal.

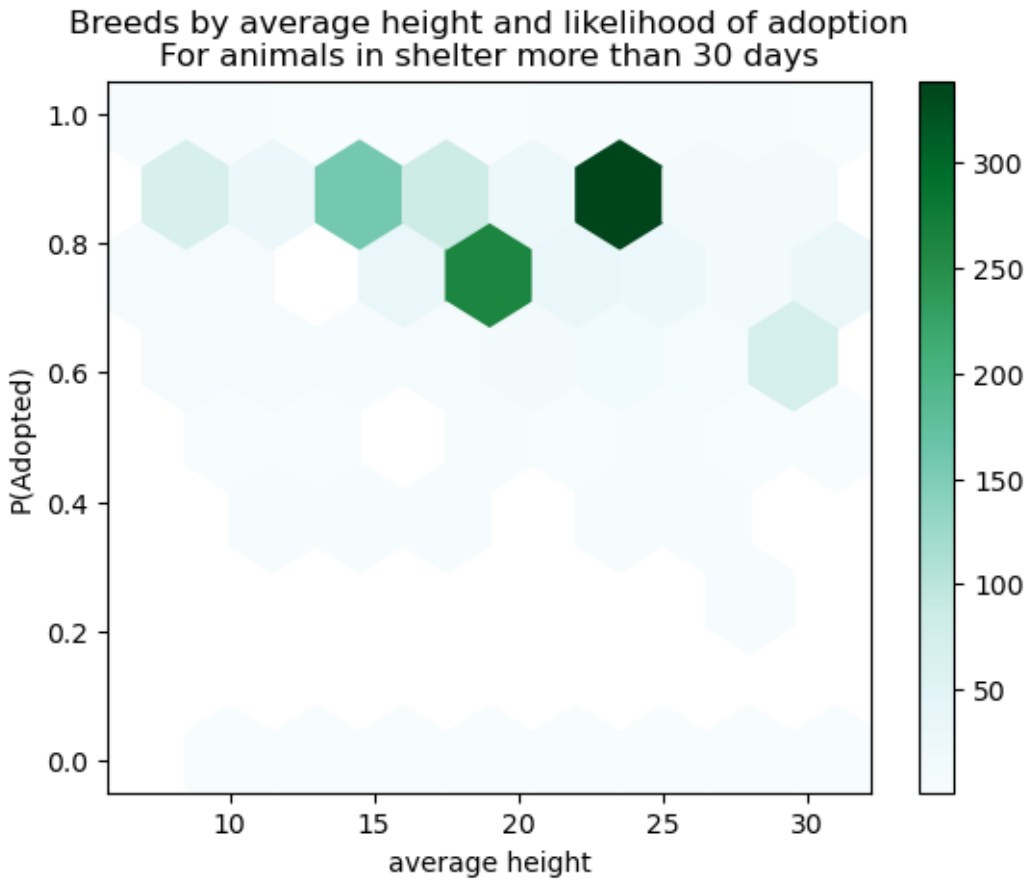
See also: toward the end of this notebook, there are histograms that compare many variables with adoption likelihood.

[12]:
```
days_limit = 30

df_out_with_breeds_info_filtered = animalsLongerThan(days_limit)

df_hl = df_out_with_breeds_info[['average height', 'Adopted']].dropna()

y_data = df_hl['Adopted'].astype(dtype=int)
x_data = df_hl['average height'].astype(dtype=float)

x_data = x_data.values.reshape(-1,1)

x_training_data, x_test_data, y_training_data, y_test_data =␣
 ↪train_test_split(x_data, y_data, test_size = 0.3)
model = LogisticRegression()
model.fit(x_training_data, y_training_data)
y_test_pred = model.predict(x_test_data)

sns.heatmap(data=confusion_matrix(y_test_data, y_test_pred), annot=True)
plt.title("Confusion matrix")
plt.show()

print("Classification report")
print(classification_report(y_test_data, y_test_pred))
```




```
Classification report
              precision    recall  f1-score   support

           0       0.53      0.42      0.47     21069
           1       0.51      0.62      0.56     20451

    accuracy                           0.52     41520
   macro avg       0.52      0.52      0.52     41520
weighted avg       0.52      0.52      0.51     41520
```

[13]:
```
days_limit = 30
df_breeds_filtered = breeds(animalsLongerThan(days_limit))
df_breeds_filtered.plot.hexbin(x='average height', y='Adopted', gridsize=8,␣
↪C='Count')
plt.ylabel("P(Adopted)")
plt.title(f"Breeds by average height and likelihood of adoption\nFor animals in␣
↪shelter more than {days_limit} days")
plt.show()
```



I think with all this analaysis on height ~ adoption, I dont find a strong correlation between the two.

2 Analysis by individuals

2.1 Color

(results)

[14]:
```
print('Colors')
print(df_out_with_breeds_info['Color 0'].unique())
print(df_out_with_breeds_info['Color 1'].unique())
```

```
Colors
<StringArray>
[            'Black',           'Orange',            'White',
              'Red',           'Tortie',             'Gray',
           'Silver',             'Blue',           'Torbie',
     'Orange Tabby',            'Brown',          'Apricot',
      'Brown Tabby',       'Blue Tabby',       'Blue Point',
```

```
            'Calico',     'Brown Brindle',               'Tan',
          'Chocolate',           'Yellow',       'Black Tabby',
        'Lilac Point',      'Cream Tabby',             'Buff',
           'Tricolor',            'Liver',            'Cream',
               'Fawn',       'Blue Merle',         'Red Merle',
       'Tortie Point',     'Calico Point',       'Brown Merle',
       'Silver Tabby',      'Black Smoke',        'Lynx Point',
              'Sable',            'Gold',        'Seal Point',
     'Black Brindle',       'Blue Cream',       'Brown Tiger',
          'Red Tick',      'Flame Point',         'Blue Tick',
        'Gray Tabby',            'Green',        'Blue Tiger',
    'Yellow Brindle',  'Chocolate Point',        'Blue Smoke',
             'Ruddy',      'Black Tiger',              'Pink',
        'Liver Tick',          'Agouti', 'Silver Lynx Point',
      'Orange Tiger',      'Cream Tiger',           'Unknown']
Length: 60, dtype: string
<StringArray>
[            <NA>,           'White',           'Brown',   'Brown Brindle',
       'Tricolor',             'Tan',           'Black',            'Blue',
          'Cream',            'Buff',      'Blue Merle',      'Blue Tabby',
           'Gray',    'Orange Tabby',     'Black Smoke',     'Brown Merle',
       'Red Tick',          'Orange',       'Red Merle',          'Silver',
            'Red',       'Chocolate',          'Yellow',      'Seal Point',
   'Black Brindle',     'Brown Tabby',      'Blue Cream',           'Liver',
           'Gold',          'Tortie',       'Blue Tick',      'Gray Tabby',
  'Yellow Brindle',         'Apricot',     'Brown Tiger',            'Pink',
      'Lynx Point',     'Black Tabby',     'Cream Tabby',     'Flame Point',
      'Gray Tiger',          'Calico',      'Blue Tiger',           'Green',
 'Chocolate Point',    'Tortie Point',    'Silver Tabby',      'Liver Tick',
    'Calico Point',           'Fawn',     'Lilac Point',      'Blue Point',
         'Agouti',     'Black Tiger']
Length: 54, dtype: string
```

[15]:
```python
def bigCorr_bernoulli(df, independent, dependent):
    numerator = (
        df[[independent, dependent]].groupby(independent).value_counts()
    )

    denominator = (
        df[[independent]].groupby(independent).value_counts()
    )

    return (numerator.div(denominator))[:,True]
```

[16]:
```python
def bigCorr_bernoulli_custom_colors_2(df_out_colors_1, df_out_colors_2):
    df_out_colors_2_color_0 = df_out_colors_2[['Color 0', 'Adopted']].
 ↪rename(columns={'Color 0': 'Color'})
```

```
    df_out_colors_2_color_1 = df_out_colors_2[['Color 1', 'Adopted']].
 ↪rename(columns={'Color 1': 'Color'})

    numerator = (
        df_out_colors_2_color_0.groupby('Color').value_counts().add(
            df_out_colors_2_color_1.groupby('Color').value_counts(),
            fill_value=0
        )
    )

    denominator = (
        df_out_colors_2_color_0[['Color']].groupby('Color').value_counts().add(
            df_out_colors_2_color_1[['Color']].groupby('Color').value_counts(),
            fill_value=0
        )
    )

    return (numerator.div(denominator))[:,True]

def bigCorr_bernoulli_custom_colors_1_or_2(df_out_colors_1, df_out_colors_2):
    df_out_colors_1_color_0 = df_out_colors_1[['Color 0', 'Adopted']].
 ↪rename(columns={'Color 0': 'Color'})
    df_out_colors_2_color_0 = df_out_colors_2[['Color 0', 'Adopted']].
 ↪rename(columns={'Color 0': 'Color'})
    df_out_colors_2_color_1 = df_out_colors_2[['Color 1', 'Adopted']].
 ↪rename(columns={'Color 1': 'Color'})

    numerator = (
        df_out_colors_1_color_0.groupby('Color').value_counts().add(
            df_out_colors_2_color_0.groupby('Color').value_counts().add(
                df_out_colors_2_color_1.groupby('Color').value_counts(),
                fill_value=0
            ),
            fill_value=0
        )
    )

    denominator = (
        df_out_colors_1_color_0[['Color']].groupby('Color').value_counts().add(
            df_out_colors_2_color_0[['Color']].groupby('Color').value_counts().
 ↪add(
                df_out_colors_2_color_1[['Color']].groupby('Color').
 ↪value_counts(),
                fill_value=0
            ),
            fill_value=0
```

```
        )
    )

    return (numerator.div(denominator))[:,True]
```

[17]:
```
# This is copied from prep.ipynb

from math import pi

# colors.csv was compiled from these wikipedia articles
# https://en.wikipedia.org/wiki/List_of_colors:_A-F
# https://en.wikipedia.org/wiki/List_of_colors:_G%E2%80%93M
# https://en.wikipedia.org/wiki/List_of_colors:_N%E2%80%93Z
# Then the "-" character was replaced with "0"
df_colors = pd.read_csv('colors.csv')
df_colors = df_colors.convert_dtypes(infer_objects=True)
df_colors['Name'] = df_colors['Name'].str.lower()
df_colors['Red (RGB)'] = pd.to_numeric(df_colors['Red (RGB)'].str.replace('%',␣
 ↪'')).div(100)
df_colors['Green (RGB)'] = pd.to_numeric(df_colors['Green (RGB)'].str.
 ↪replace('%', '')).div(100)
df_colors['Blue (RGB)'] = pd.to_numeric(df_colors['Blue (RGB)'].str.
 ↪replace('%', '')).div(100)
df_colors['Hue (HSL/HSV)'] = pd.to_numeric(df_colors['Hue (HSL/HSV)'].str.
 ↪replace('°', '')).div(360)
df_colors['Satur. (HSL)'] = pd.to_numeric(df_colors['Satur. (HSL)'].str.
 ↪replace('%', '')).div(100)
df_colors['Light (HSL)'] = pd.to_numeric(df_colors['Light (HSL)'].str.
 ↪replace('%', '')).div(100)
df_colors['Satur. (HSV)'] = pd.to_numeric(df_colors['Satur. (HSV)'].str.
 ↪replace('%', '')).div(100)
df_colors['Value (HSV)'] = pd.to_numeric(df_colors['Value (HSV)'].str.
 ↪replace('%', '')).div(100)
df_colors.head()

def colorInfo(color):
    color = color.lower()
    words = [color] if color.count(' ') == 0 else [color] + color.split(' ')
    for word in words:
        try:
            items = df_colors.loc[df_colors.Name == word]
            if len(items) > 0:
                return items
        except:
            continue
```

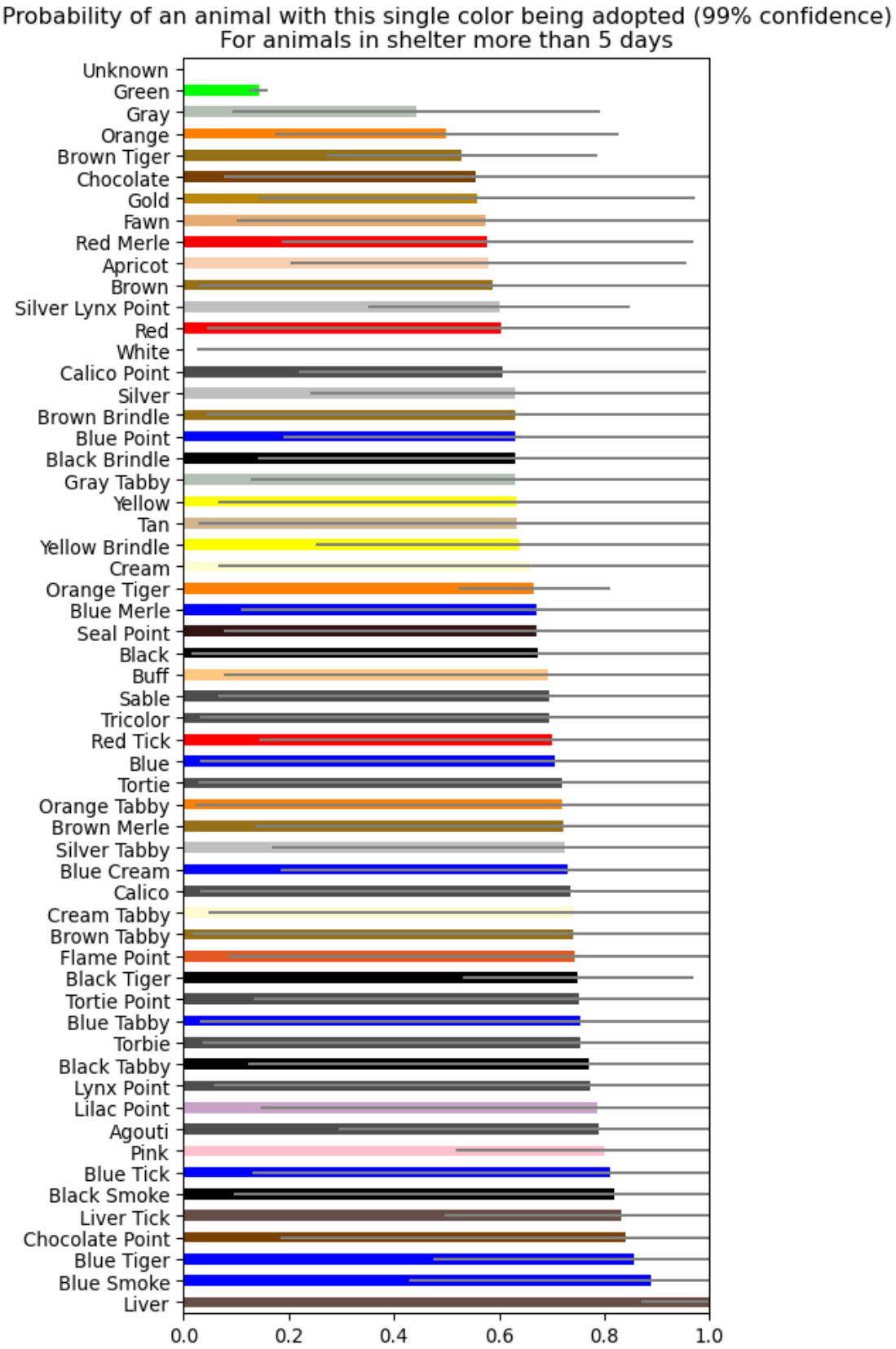
```
    for word in words:
        try:
            items = df_colors.loc[df_colors.Name.str.contains(word)]
            if len(items) > 0:
                return items
        except:
            continue

    return None

def rgb(color):
    info = colorInfo(color)
    if info is None: return (None, None, None)
    r = info['Red (RGB)'].values[0]
    g = info['Green (RGB)'].values[0]
    b = info['Blue (RGB)'].values[0]
    return (r, g, b)
```

[18]:
```
from math import floor


def color_dataframes(days_limit):
    df_out_filtered = animalsLongerThan(days_limit)
    df_out_colors_1 = df_out_filtered.loc[(df_out_filtered['Color 0'].notna()␣
 ↪== True) & (df_out_filtered['Color 1'].notna() == False)]
    df_out_colors_2 = df_out_filtered.loc[(df_out_filtered['Color 0'].notna()␣
 ↪== True) & (df_out_filtered['Color 1'].notna() == True)]
    return df_out_colors_1, df_out_colors_2

def chartColorAdoptionLikelihood(df_colors, color_relation, days_limit):
    disclaimer = f"For animals in shelter more than {days_limit} days"

    # Wilson confidence interval
    # https://en.wikipedia.org/wiki/Binomial_proportion_confidence_interval

    alpha = 0.01
    z = st.norm.ppf(1 - (alpha / 2))
    n = df_colors.Count
    p = df_colors.Adopted
    p_center = (1 / (1 + ((z ** 2) / n))) * (p + ((z ** 2) / (2 * n)))
    p_halfextent = (z / (1 + ((z ** 2) / n))) * ((( (p * (1 - p)) / (n) ) + ((z␣
 ↪** 2) / (4 * (n ** 2)))) ** (1/2))
    p_low = p_center - p_halfextent
    p_high = p_center - p_halfextent

    colors = [rgb(color) for color in df_colors.index]
    colors = [color if color[0] != None else '0.3' for color in colors]
```

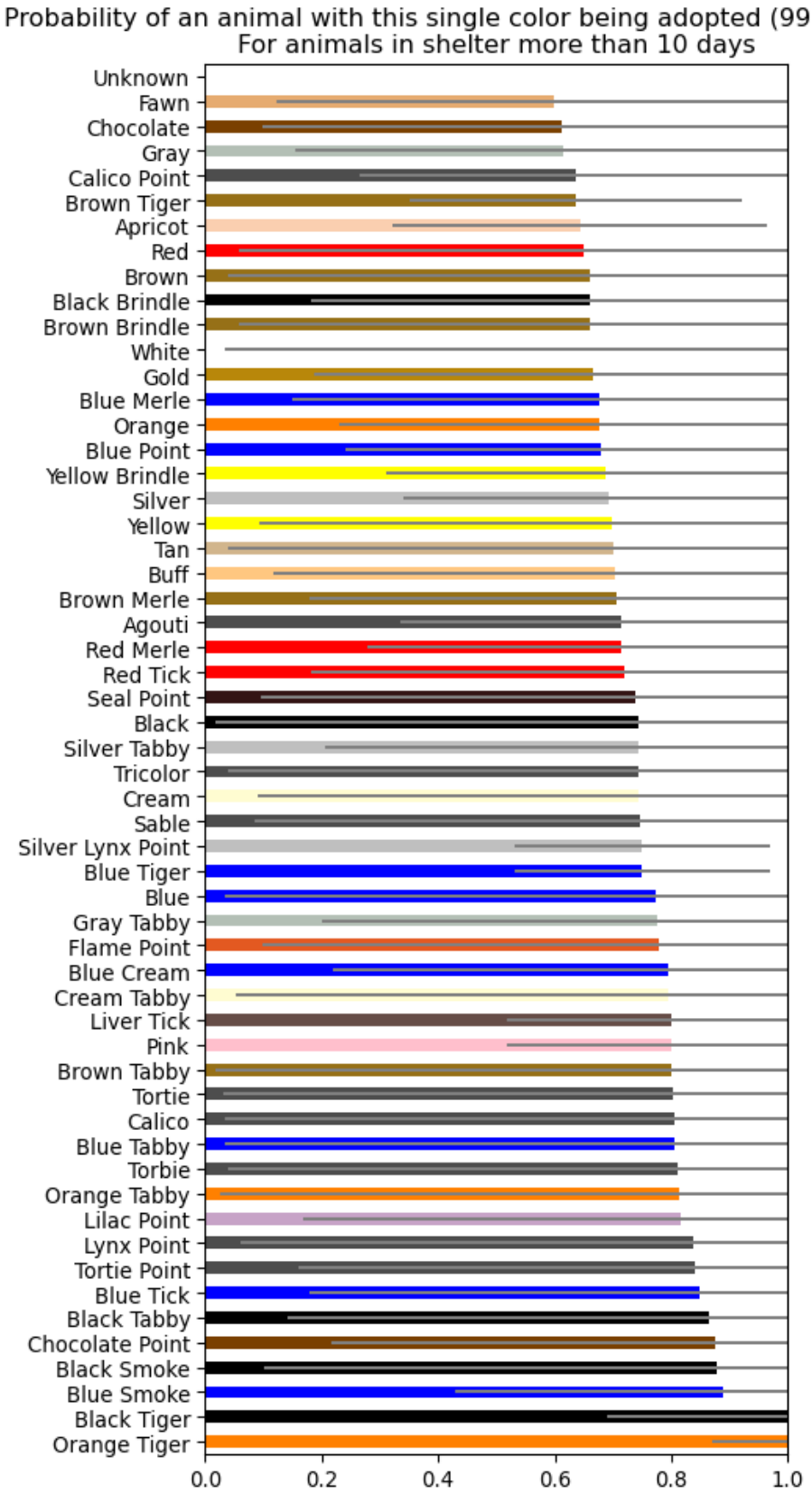
```
    plt.figure(num=None, figsize=(5, 12), dpi=96, facecolor='w', edgecolor='k')
    plt.title(f'Probability of an animal with this {color_relation} color being␣
 ↪adopted ({floor(100 * (1 - alpha))}% confidence)\n{disclaimer}')
    ax = df_colors.Adopted.plot.barh(x='Color', xerr=[p_low, p_high], ecolor='0.
 ↪5', color=colors)
    ax.set_xlim(0, 1)
    plt.show()
    print(f'{len(df_colors)} colors')
    print()

def colors_single(days_limit):
    df_out_colors_1, df_out_colors_2 = color_dataframes(days_limit)
    colors_adopted = bigCorr_bernoulli(df_out_colors_1, 'Color 0', 'Adopted')
    colors_count = df_out_colors_1['Color 0'].value_counts()
    df_colors = pd.DataFrame(index=colors_count.index)
    df_colors = df_colors.assign(Color=colors_count.index, Count=colors_count,␣
 ↪Adopted=colors_adopted)
    df_colors.sort_values(by='Adopted', ascending=False, inplace=True)
    chartColorAdoptionLikelihood(df_colors, 'single', days_limit)

def colors_mixed(days_limit):
    df_out_colors_1, df_out_colors_2 = color_dataframes(days_limit)
    colors_adopted = bigCorr_bernoulli_custom_colors_2(df_out_colors_1,␣
 ↪df_out_colors_2)
    colors_count = df_out_colors_2['Color 0'].value_counts().
 ↪add(df_out_colors_2['Color 1'].value_counts(), fill_value=0)
    df_colors = pd.DataFrame(index=colors_count.index)
    df_colors = df_colors.assign(Color=colors_count.index, Count=colors_count,␣
 ↪Adopted=colors_adopted)
    df_colors.sort_values(by='Adopted', ascending=False, inplace=True)
    chartColorAdoptionLikelihood(df_colors, 'mixed', days_limit)

def colors_singleOrMixed(days_limit):
    df_out_colors_1, df_out_colors_2 = color_dataframes(days_limit)
    colors_adopted = bigCorr_bernoulli_custom_colors_1_or_2(df_out_colors_1,␣
 ↪df_out_colors_2)
    colors_count = df_out_colors_1['Color 0'].value_counts().
 ↪add(df_out_colors_2['Color 0'].value_counts(), fill_value=0).
 ↪add(df_out_colors_2['Color 1'].value_counts(), fill_value=0)
    df_colors = pd.DataFrame(index=colors_count.index)
    df_colors = df_colors.assign(Color=colors_count.index, Count=colors_count,␣
 ↪Adopted=colors_adopted)
    df_colors.sort_values(by='Adopted', ascending=False, inplace=True)
    chartColorAdoptionLikelihood(df_colors, 'single or mixed', days_limit)
```

```
colors_single(5)
colors_single(10)
colors_single(30)
colors_mixed(5)
colors_mixed(10)
colors_mixed(30)
colors_singleOrMixed(5)
colors_singleOrMixed(10)
colors_singleOrMixed(30)
```

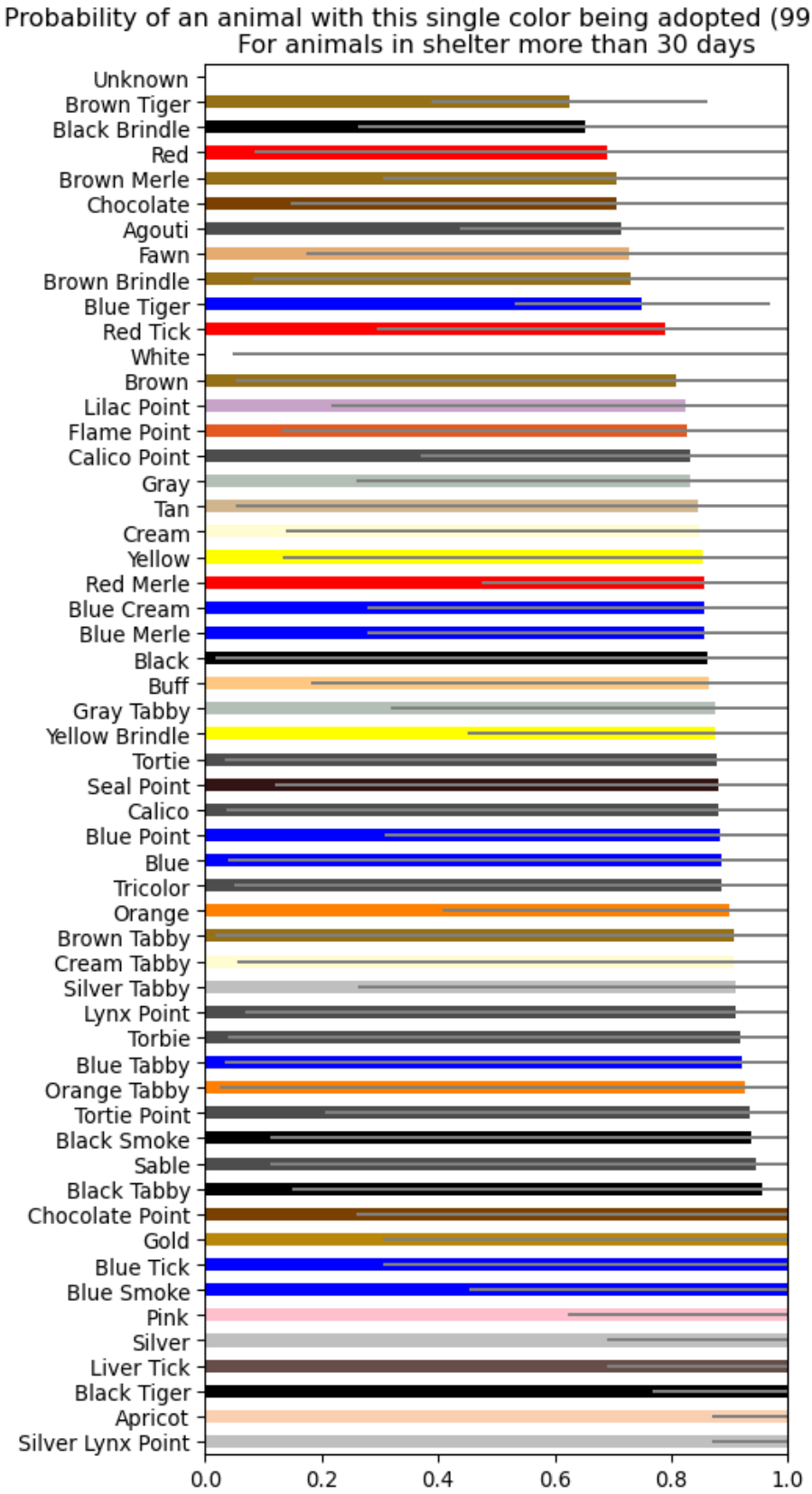
```
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/numpy/core/_methods.py:44: RuntimeWarning: invalid value encountered in
reduce
  return umr_minimum(a, axis, None, out, keepdims, initial, where)
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/numpy/core/_methods.py:40: RuntimeWarning: invalid value encountered in
reduce
  return umr_maximum(a, axis, None, out, keepdims, initial, where)
```


Probability of an animal with this single color being adopted (99% confidence)
For animals in shelter more than 5 days
Unknown
Green
Gray
Orange
Brown Tiger
Chocolate
Gold
Fawn
Red Merle
Apricot
Brown
Silver Lynx Point
Red
White
Calico Point
Silver
Brown Brindle
Blue Point
Black Brindle
Gray Tabby
Yellow
Tan
Yellow Brindle
Cream
Orange Tiger
Blue Merle
Seal Point
Black
Buff
Sable
Tricolor
Red Tick
Blue
Tortie
Orange Tabby
Brown Merle
Silver Tabby
Blue Cream
Calico
Cream Tabby
Brown Tabby
Flame Point
Black Tiger
Tortie Point
Blue Tabby
Torbie
Black Tabby
Lynx Point
Lilac Point
Agouti
Pink
Blue Tick
Black Smoke
Liver Tick
Chocolate Point
Blue Tiger
Blue Smoke
Liver
0.0
0.2
0.4
0.6
0.8
1.0

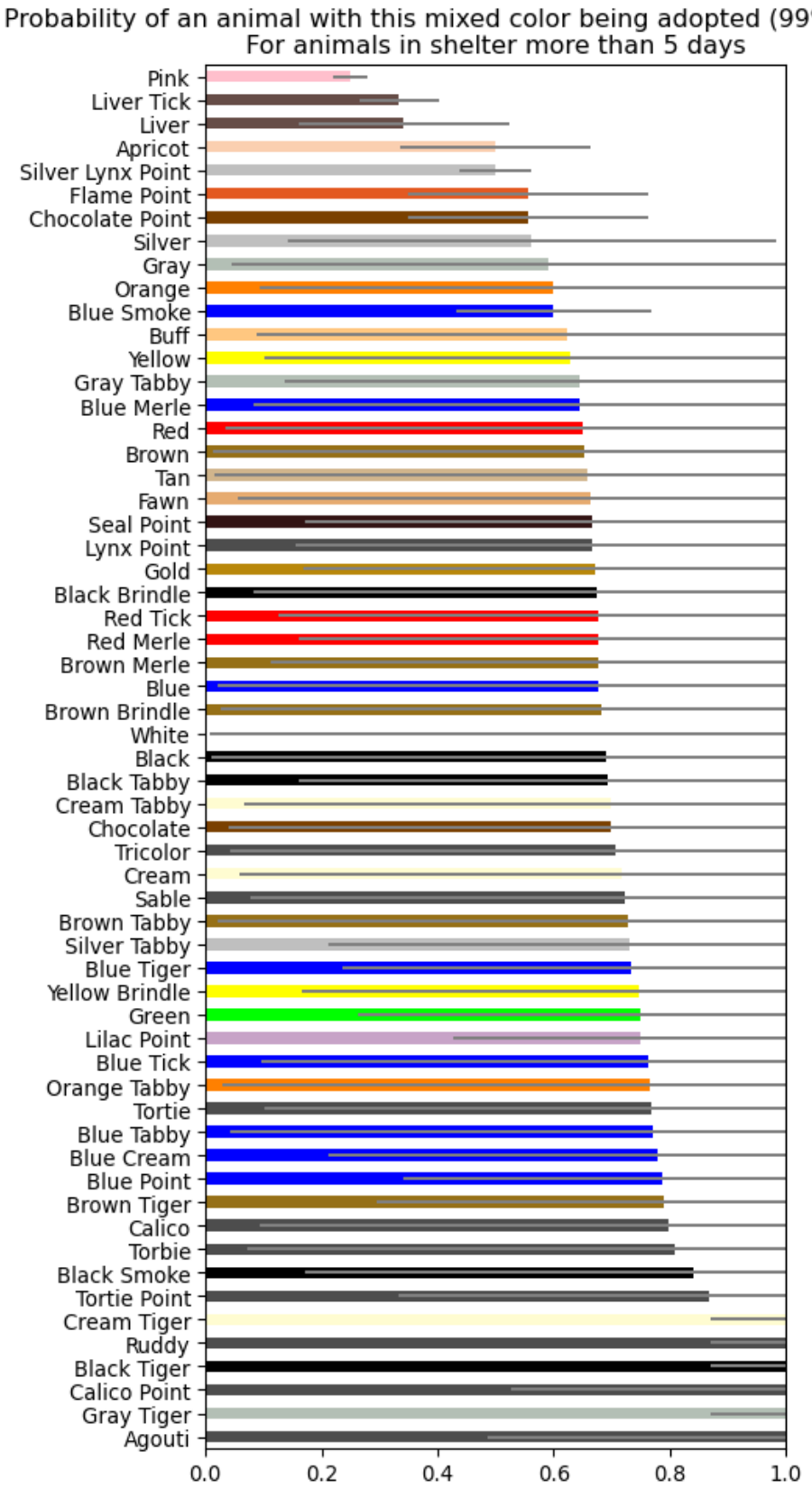
```
58 colors


/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/numpy/core/_methods.py:44: RuntimeWarning: invalid value encountered in
reduce
  return umr_minimum(a, axis, None, out, keepdims, initial, where)
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/numpy/core/_methods.py:40: RuntimeWarning: invalid value encountered in
reduce
  return umr_maximum(a, axis, None, out, keepdims, initial, where)
```


Probability of an animal with this single color being adopted (99% confidence)
For animals in shelter more than 10 days
Unknown
Fawn
Chocolate
Gray
Calico Point
Brown Tiger
Apricot
Red
Brown
Black Brindle
Brown Brindle
White
Gold
Blue Merle
Orange
Blue Point
Yellow Brindle
Silver
Yellow
Tan
Buff
Brown Merle
Agouti
Red Merle
Red Tick
Seal Point
Black
Silver Tabby
Tricolor
Cream
Sable
Silver Lynx Point
Blue Tiger
Blue
Gray Tabby
Flame Point
Blue Cream
Cream Tabby
Liver Tick
Pink
Brown Tabby
Tortie
Calico
Blue Tabby
Torbie
Orange Tabby
Lilac Point
Lynx Point
Tortie Point
Blue Tick
Black Tabby
Chocolate Point
Black Smoke
Blue Smoke
Black Tiger
Orange Tiger
0.0
0.2
0.4
0.6
0.8
1.0

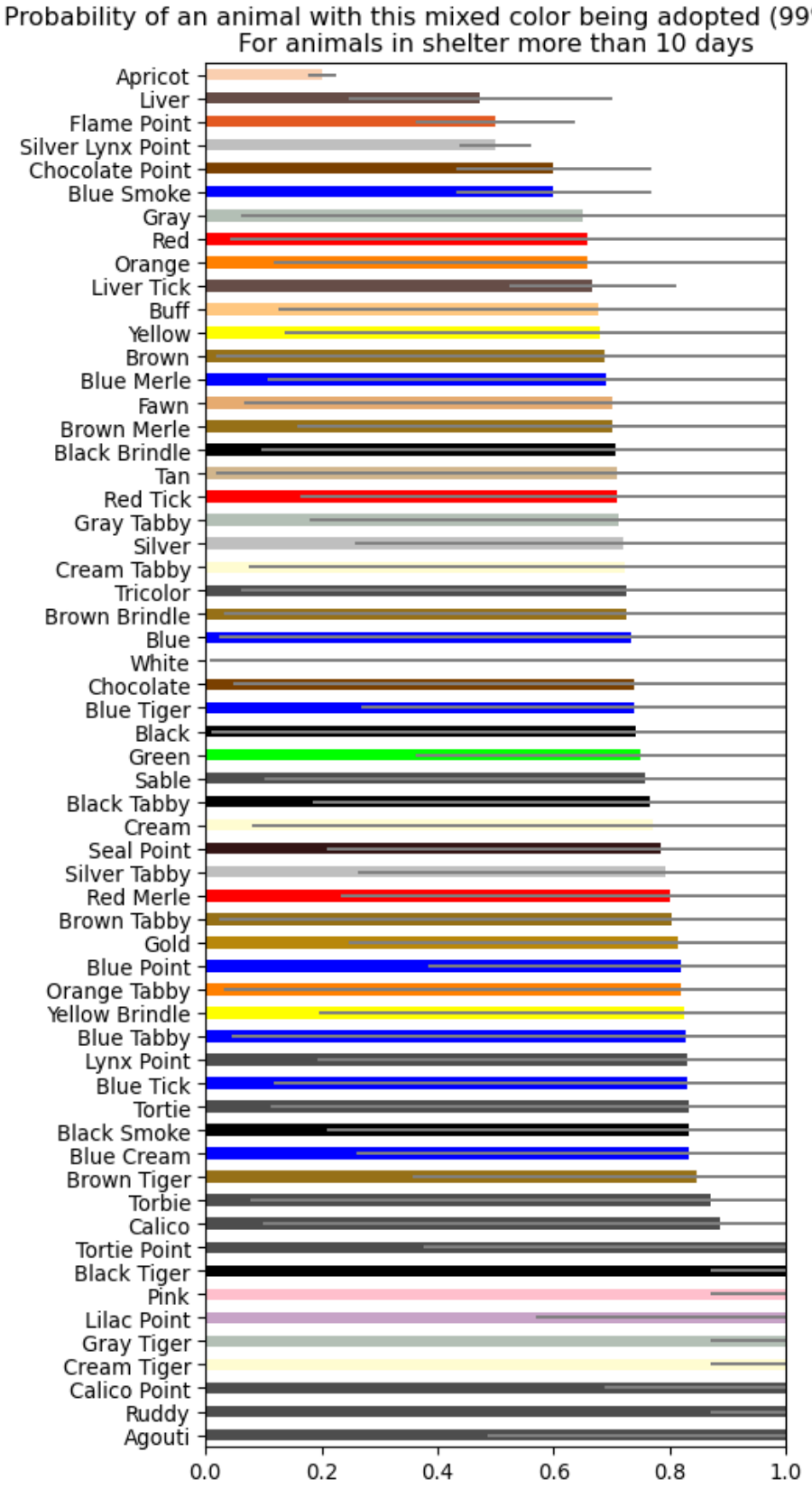
```
56 colors


/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/numpy/core/_methods.py:44: RuntimeWarning: invalid value encountered in
reduce
  return umr_minimum(a, axis, None, out, keepdims, initial, where)
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/numpy/core/_methods.py:40: RuntimeWarning: invalid value encountered in
reduce
  return umr_maximum(a, axis, None, out, keepdims, initial, where)
```


Probability of an animal with this single color being adopted (99% confidence)
For animals in shelter more than 30 days
Unknown
Brown Tiger
Black Brindle
Red
Brown Merle
Chocolate
Agouti
Fawn
Brown Brindle
Blue Tiger
Red Tick
White
Brown
Lilac Point
Flame Point
Calico Point
Gray
Tan
Cream
Yellow
Red Merle
Blue Cream
Blue Merle
Black
Buff
Gray Tabby
Yellow Brindle
Tortie
Seal Point
Calico
Blue Point
Blue
Tricolor
Orange
Brown Tabby
Cream Tabby
Silver Tabby
Lynx Point
Torbie
Blue Tabby
Orange Tabby
Tortie Point
Black Smoke
Sable
Black Tabby
Chocolate Point
Gold
Blue Tick
Blue Smoke
Pink
Silver
Liver Tick
Black Tiger
Apricot
Silver Lynx Point
0.0
0.2
0.4
0.6
0.8
1.0

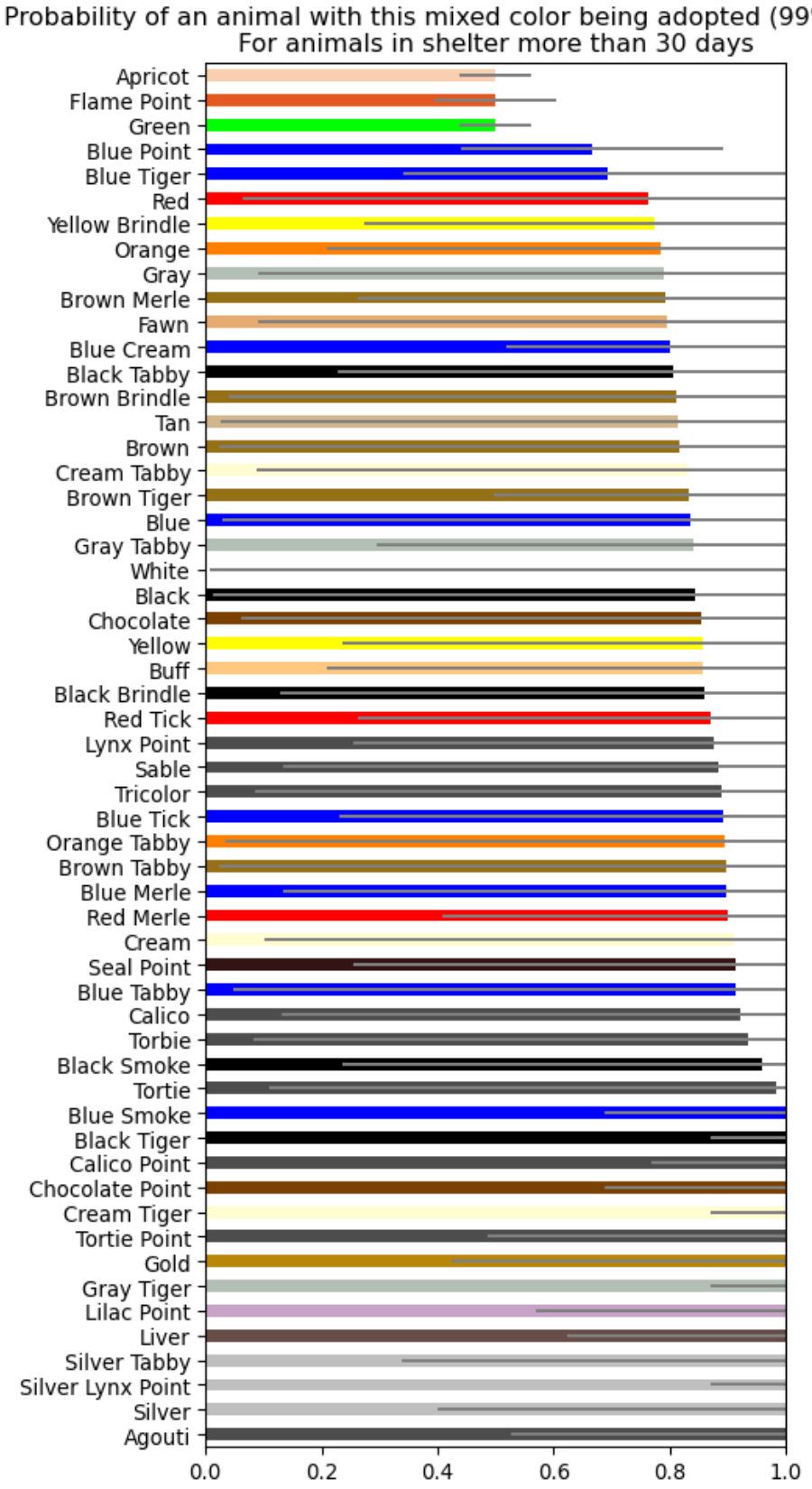
```
55 colors
```


Probability of an animal with this mixed color being adopted (99% confidence)
For animals in shelter more than 5 days
Pink
Liver Tick
Liver
Apricot
Silver Lynx Point
Flame Point
Chocolate Point
Silver
Gray
Orange
Blue Smoke
Buff
Yellow
Gray Tabby
Blue Merle
Red
Brown
Tan
Fawn
Seal Point
Lynx Point
Gold
Black Brindle
Red Tick
Red Merle
Brown Merle
Blue
Brown Brindle
White
Black
Black Tabby
Cream Tabby
Chocolate
Tricolor
Cream
Sable
Brown Tabby
Silver Tabby
Blue Tiger
Yellow Brindle
Green
Lilac Point
Blue Tick
Orange Tabby
Tortie
Blue Tabby
Blue Cream
Blue Point
Brown Tiger
Calico
Torbie
Black Smoke
Tortie Point
Cream Tiger
Ruddy
Black Tiger
Calico Point
Gray Tiger
Agouti
0.0
0.2
0.4
0.6
0.8
1.0

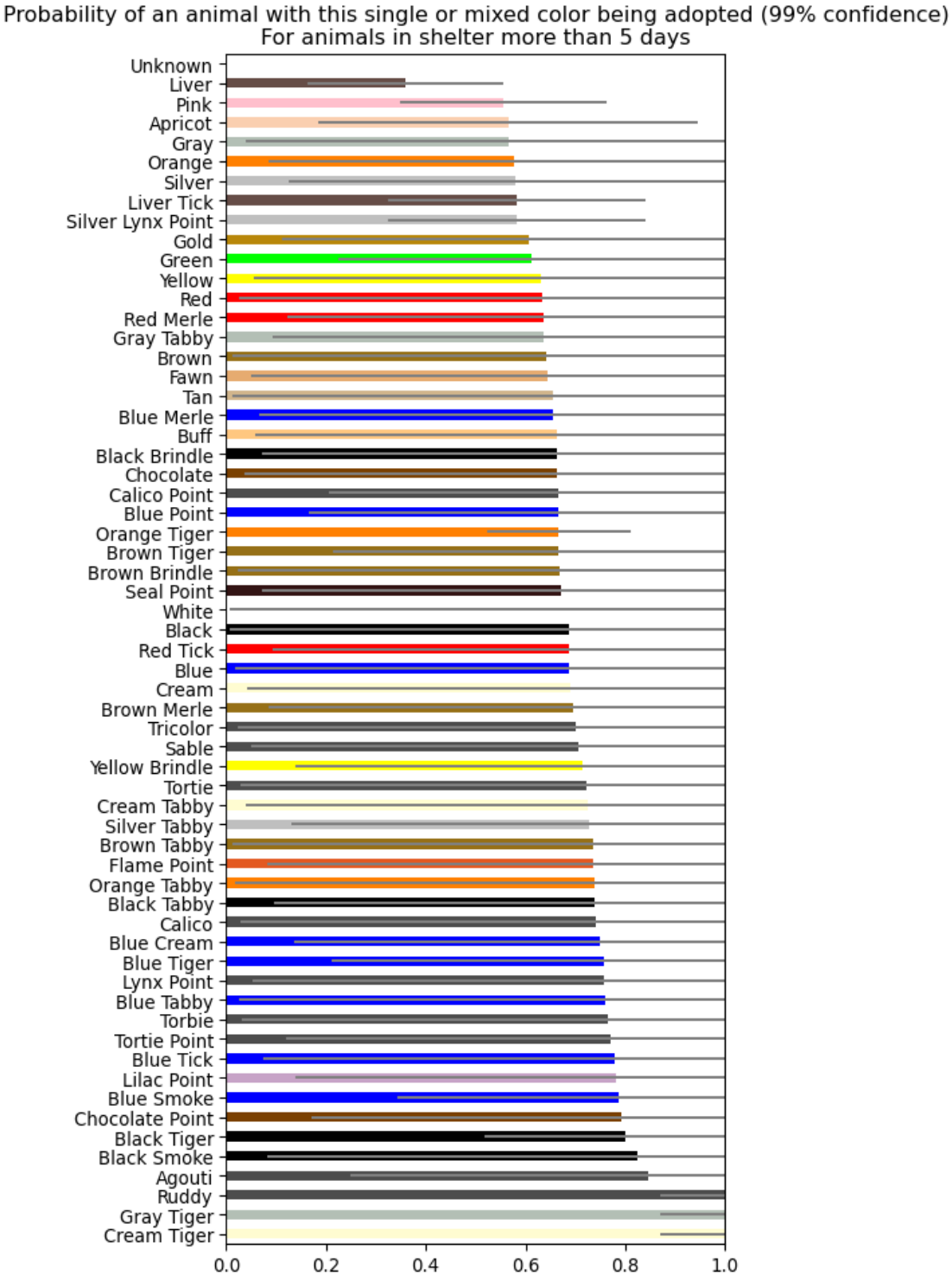
```
59 colors
```


Probability of an animal with this mixed color being adopted (99% confidence)
For animals in shelter more than 10 days
Apricot
Liver
Flame Point
Silver Lynx Point
Chocolate Point
Blue Smoke
Gray
Red
Orange
Liver Tick
Buff
Yellow
Brown
Blue Merle
Fawn
Brown Merle
Black Brindle
Tan
Red Tick
Gray Tabby
Silver
Cream Tabby
Tricolor
Brown Brindle
Blue
White
Chocolate
Blue Tiger
Black
Green
Sable
Black Tabby
Cream
Seal Point
Silver Tabby
Red Merle
Brown Tabby
Gold
Blue Point
Orange Tabby
Yellow Brindle
Blue Tabby
Lynx Point
Blue Tick
Tortie
Black Smoke
Blue Cream
Brown Tiger
Torbie
Calico
Tortie Point
Black Tiger
Pink
Lilac Point
Gray Tiger
Cream Tiger
Calico Point
Ruddy
Agouti
0.0
0.2
0.4
0.6
0.8
1.0

```
59 colors
```

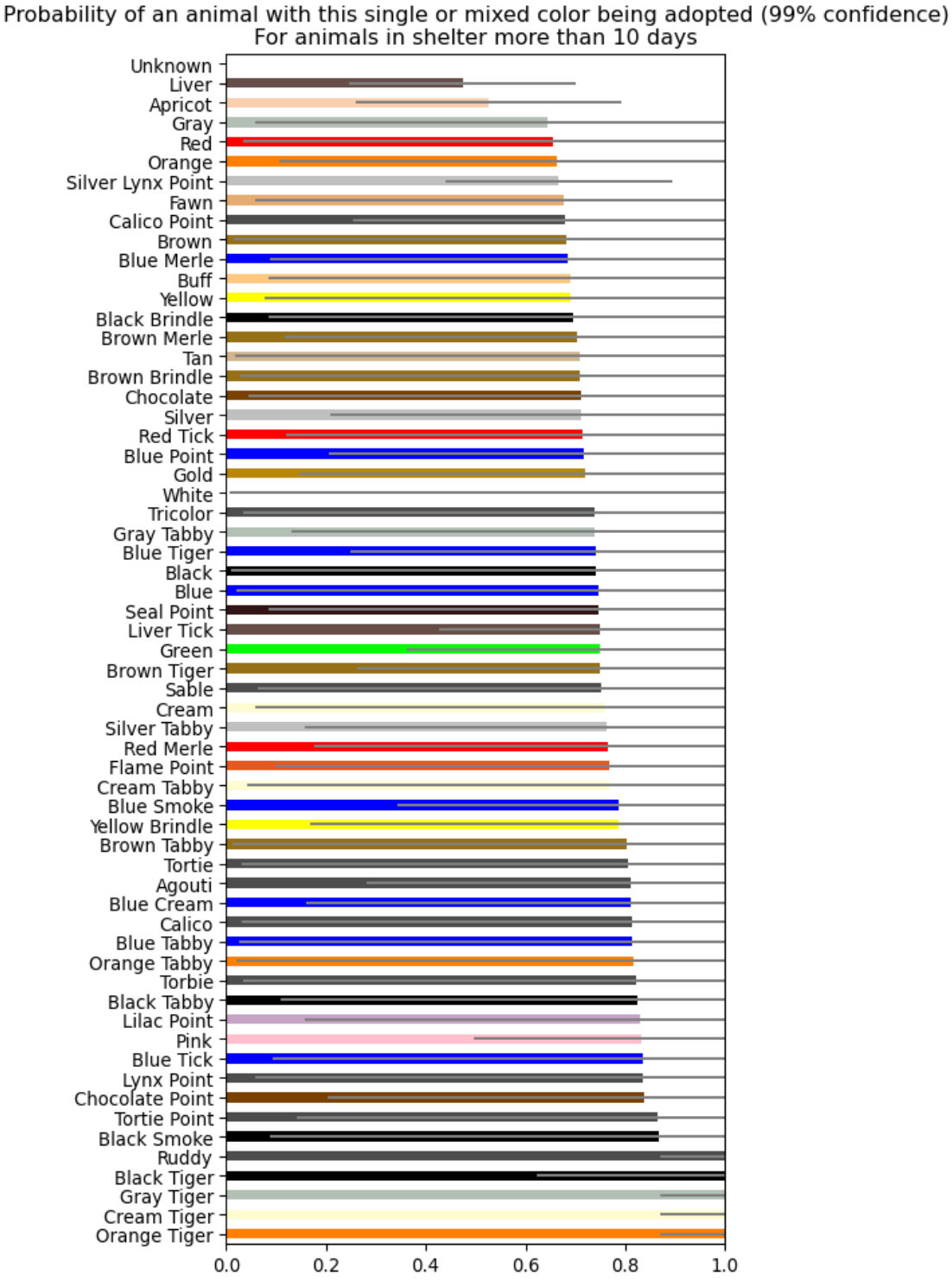

Probability of an animal with this mixed color being adopted (99% confidence)
For animals in shelter more than 30 days
Apricot
Flame Point
Green
Blue Point
Blue Tiger
Red
Yellow Brindle
Orange
Gray
Brown Merle
Fawn
Blue Cream
Black Tabby
Brown Brindle
Tan
Brown
Cream Tabby
Brown Tiger
Blue
Gray Tabby
White
Black
Chocolate
Yellow
Buff
Black Brindle
Red Tick
Lynx Point
Sable
Tricolor
Blue Tick
Orange Tabby
Brown Tabby
Blue Merle
Red Merle
Cream
Seal Point
Blue Tabby
Calico
Torbie
Black Smoke
Tortie
Blue Smoke
Black Tiger
Calico Point
Chocolate Point
Cream Tiger
Tortie Point
Gold
Gray Tiger
Lilac Point
Liver
Silver Tabby
Silver Lynx Point
Silver
Agouti
0.0
0.2
0.4
0.6
0.8
1.0

```
56 colors


/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/numpy/core/_methods.py:44: RuntimeWarning: invalid value encountered in
reduce
  return umr_minimum(a, axis, None, out, keepdims, initial, where)
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/numpy/core/_methods.py:40: RuntimeWarning: invalid value encountered in
reduce
  return umr_maximum(a, axis, None, out, keepdims, initial, where)
```


Probability of an animal with this single or mixed color being adopted (99% confidence)
For animals in shelter more than 5 days
Unknown
Liver
Pink
Apricot
Gray
Orange
Silver
Liver Tick
Silver Lynx Point
Gold
Green
Yellow
Red
Red Merle
Gray Tabby
Brown
Fawn
Tan
Blue Merle
Buff
Black Brindle
Chocolate
Calico Point
Blue Point
Orange Tiger
Brown Tiger
Brown Brindle
Seal Point
White
Black
Red Tick
Blue
Cream
Brown Merle
Tricolor
Sable
Yellow Brindle
Tortie
Cream Tabby
Silver Tabby
Brown Tabby
Flame Point
Orange Tabby
Black Tabby
Calico
Blue Cream
Blue Tiger
Lynx Point
Blue Tabby
Torbie
Tortie Point
Blue Tick
Lilac Point
Blue Smoke
Chocolate Point
Black Tiger
Black Smoke
Agouti
Ruddy
Gray Tiger
Cream Tiger
0.0
0.2
0.4
0.6
0.8
1.0

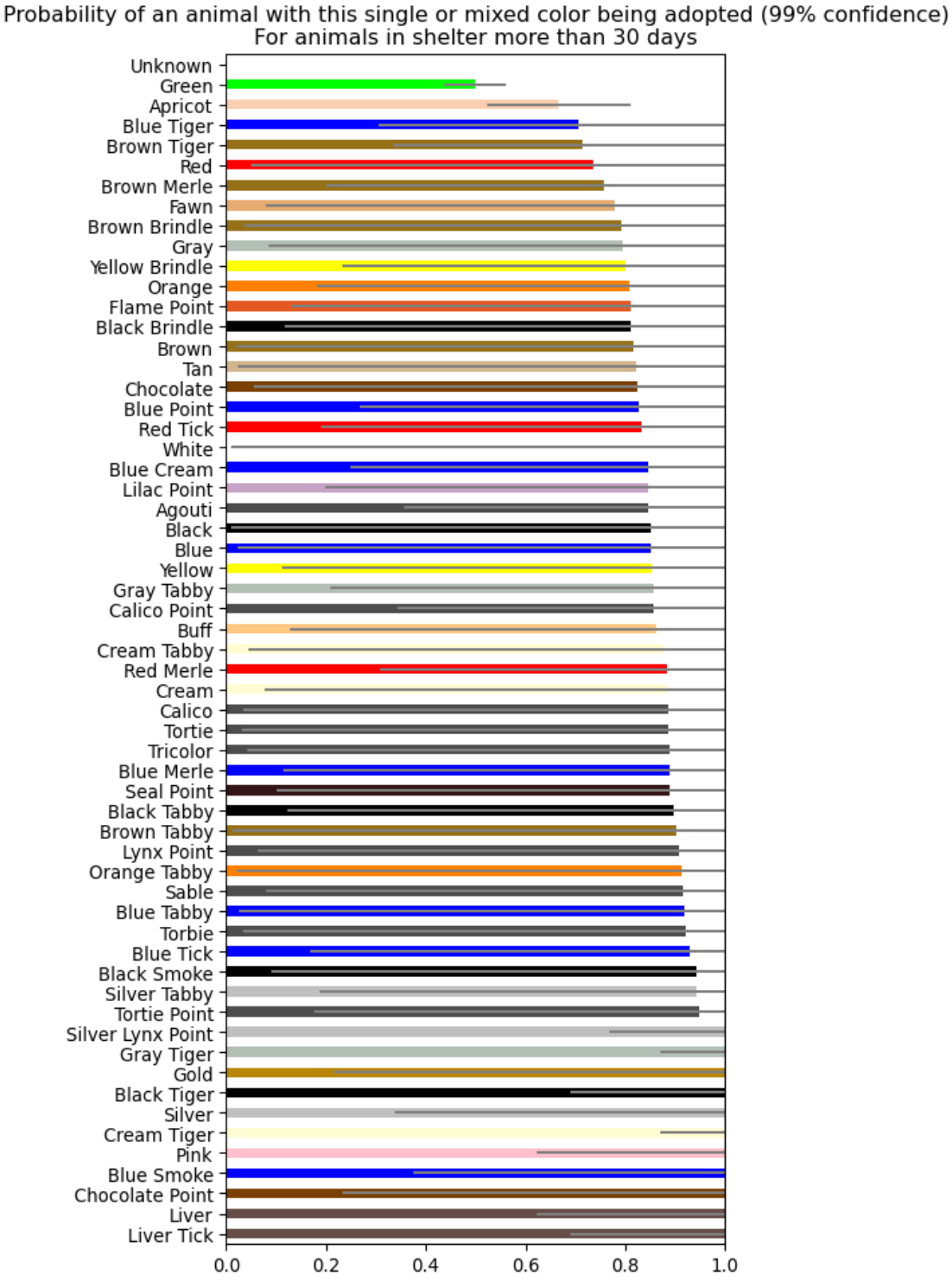
```
61 colors
```

```
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/numpy/core/_methods.py:44: RuntimeWarning: invalid value encountered in
reduce
  return umr_minimum(a, axis, None, out, keepdims, initial, where)
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/numpy/core/_methods.py:40: RuntimeWarning: invalid value encountered in
reduce
  return umr_maximum(a, axis, None, out, keepdims, initial, where)
```


Probability of an animal with this single or mixed color being adopted (99% confidence)
For animals in shelter more than 10 days
Unknown
Liver
Apricot
Gray
Red
Orange
Silver Lynx Point
Fawn
Calico Point
Brown
Blue Merle
Buff
Yellow
Black Brindle
Brown Merle
Tan
Brown Brindle
Chocolate
Silver
Red Tick
Blue Point
Gold
White
Tricolor
Gray Tabby
Blue Tiger
Black
Blue
Seal Point
Liver Tick
Green
Brown Tiger
Sable
Cream
Silver Tabby
Red Merle
Flame Point
Cream Tabby
Blue Smoke
Yellow Brindle
Brown Tabby
Tortie
Agouti
Blue Cream
Calico
Blue Tabby
Orange Tabby
Torbie
Black Tabby
Lilac Point
Pink
Blue Tick
Lynx Point
Chocolate Point
Tortie Point
Black Smoke
Ruddy
Black Tiger
Gray Tiger
Cream Tiger
Orange Tiger
0.0
0.2
0.4
0.6
0.8
1.0

```
61 colors
```

```
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/numpy/core/_methods.py:44: RuntimeWarning: invalid value encountered in
reduce
  return umr_minimum(a, axis, None, out, keepdims, initial, where)
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/numpy/core/_methods.py:40: RuntimeWarning: invalid value encountered in
reduce
  return umr_maximum(a, axis, None, out, keepdims, initial, where)
```

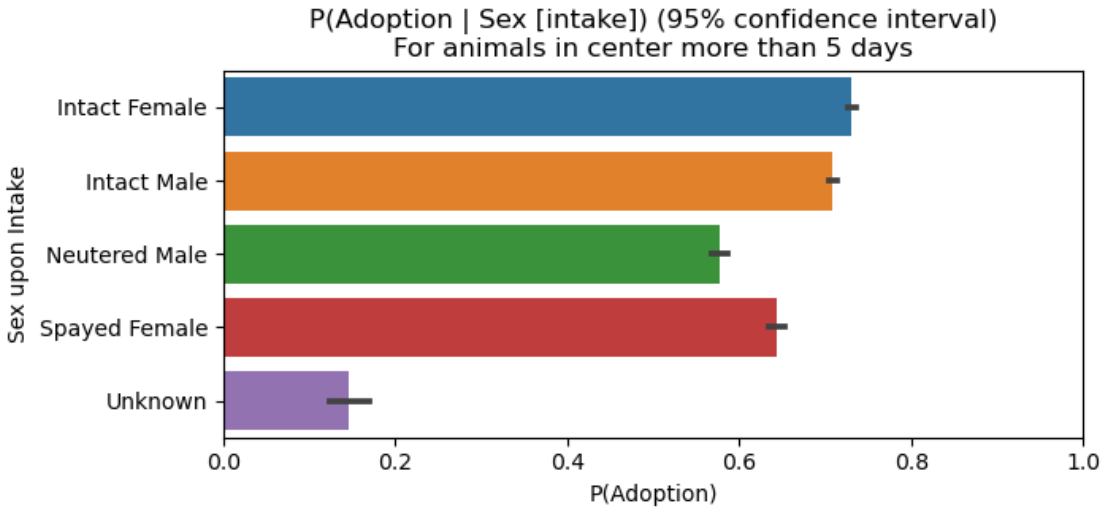

Probability of an animal with this single or mixed color being adopted (99% confidence)
For animals in shelter more than 30 days
Unknown
Green
Apricot
Blue Tiger
Brown Tiger
Red
Brown Merle
Fawn
Brown Brindle
Gray
Yellow Brindle
Orange
Flame Point
Black Brindle
Brown
Tan
Chocolate
Blue Point
Red Tick
White
Blue Cream
Lilac Point
Agouti
Black
Blue
Yellow
Gray Tabby
Calico Point
Buff
Cream Tabby
Red Merle
Cream
Calico
Tortie
Tricolor
Blue Merle
Seal Point
Black Tabby
Brown Tabby
Lynx Point
Orange Tabby
Sable
Blue Tabby
Torbie
Blue Tick
Black Smoke
Silver Tabby
Tortie Point
Silver Lynx Point
Gray Tiger
Gold
Black Tiger
Silver
Cream Tiger
Pink
Blue Smoke
Chocolate Point
Liver
Liver Tick
0.0
0.2
0.4
0.6
0.8
1.0

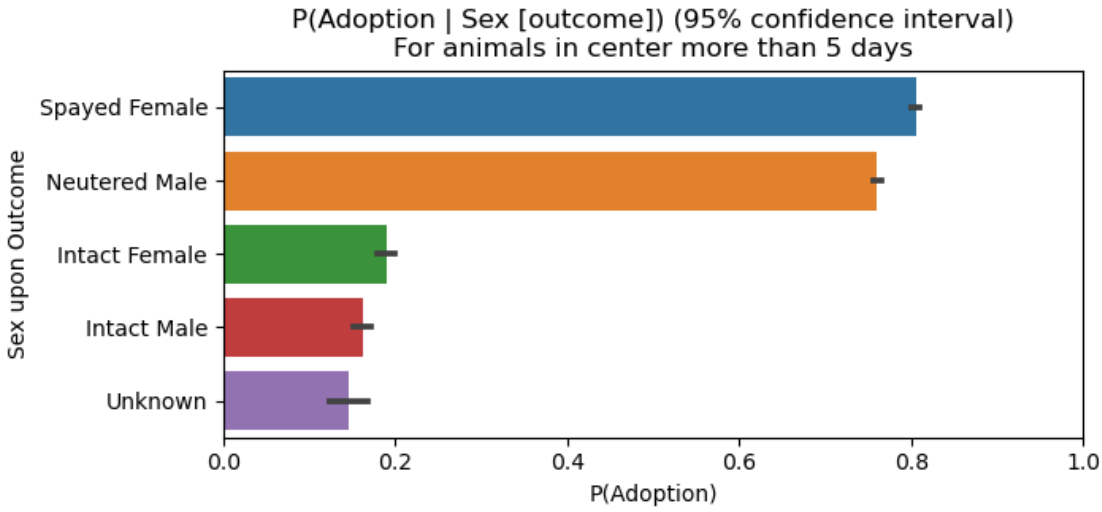
```
59 colors
```

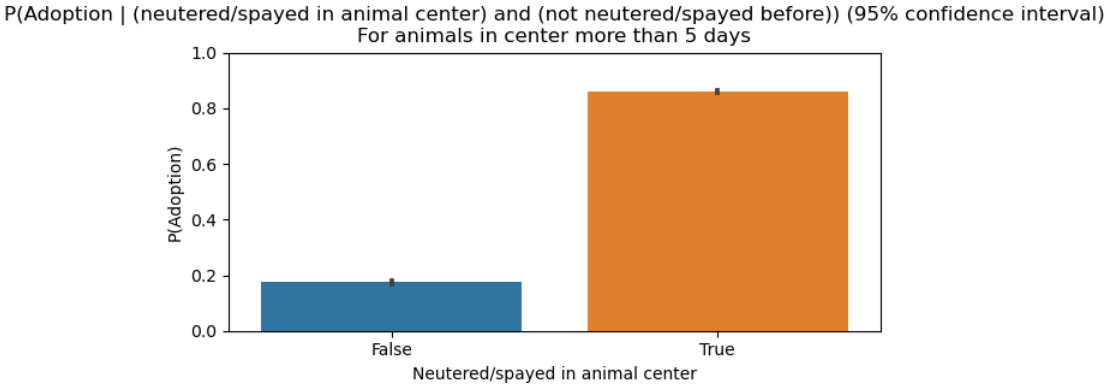
2.2 Sex

[19]:
```
# TODO 6: regress sex against adoption likelihood
# Please make 3 bar charts:
#  - "Sex upon Outcome" (neutered male, spayed female, intact male, intact␣
 ↪female)
#  - male or female
#  - neutered/spayed or intact
# Also please construct the 95% confidence interval and make it the error bars
# see the earlier cell in the section on color for an example of how to do this
days_limit = 5
confidence = 95
df = animalsLongerThan(days_limit)
df = df[['Sex upon Outcome', 'Sex upon Intake', 'Adopted']]
df = df.dropna()
df['NeuteredOrSpayed_Intake'] = (df['Sex upon Intake'].str.contains("Neuter"))␣
 ↪| (df['Sex upon Intake'].str.contains("Spay"))
df['NeuteredOrSpayed_Outcome'] = (df['Sex upon Outcome'].str.
 ↪contains("Neuter")) | (df['Sex upon Outcome'].str.contains("Spay"))
df['NeuteredOrSpayed_InCenter'] = df['NeuteredOrSpayed_Outcome'] &␣
 ↪~df['NeuteredOrSpayed_Intake']

plt.figure(figsize=(7,3))
ax=sns.barplot(
    data=df,
    y='Sex upon Intake',
    x='Adopted',
    estimator='mean',
    errorbar=('ci', confidence)
)
ax.set_xlim(0,1)
plt.title(f'P(Adoption | Sex [intake]) ({confidence}% confidence interval)\nFor␣
 ↪animals in center more than {days_limit} days')
plt.xlabel("P(Adoption)")
plt.show()

plt.figure(figsize=(7,3))
ax=sns.barplot(
    data=df,
    y='Sex upon Outcome',
    x='Adopted',
    estimator='mean',
    errorbar=('ci', confidence)
)
ax.set_xlim(0,1)
plt.title(f'P(Adoption | Sex [outcome]) ({confidence}% confidence␣
 ↪interval)\nFor animals in center more than {days_limit} days')
```

```
plt.xlabel("P(Adoption)")
plt.show()

plt.figure(figsize=(7,3))
ax=sns.barplot(
    data=df.loc[(df['NeuteredOrSpayed_Intake'] == False) & (df['Sex upon␣
 ↪Outcome'] != 'Unknown')],
    x='NeuteredOrSpayed_InCenter',
    y='Adopted',
    estimator='mean',
    errorbar=('ci', confidence)
)
ax.set_ylim(0,1)
plt.title(f'P(Adoption | (neutered/spayed in animal center) and (not neutered/
 ↪spayed before)) ({confidence}% confidence interval)\nFor animals in center␣
 ↪more than {days_limit} days')
plt.xlabel("Neutered/spayed in animal center")
plt.ylabel("P(Adoption)")
plt.show()
```







2.3 Breed characteristics

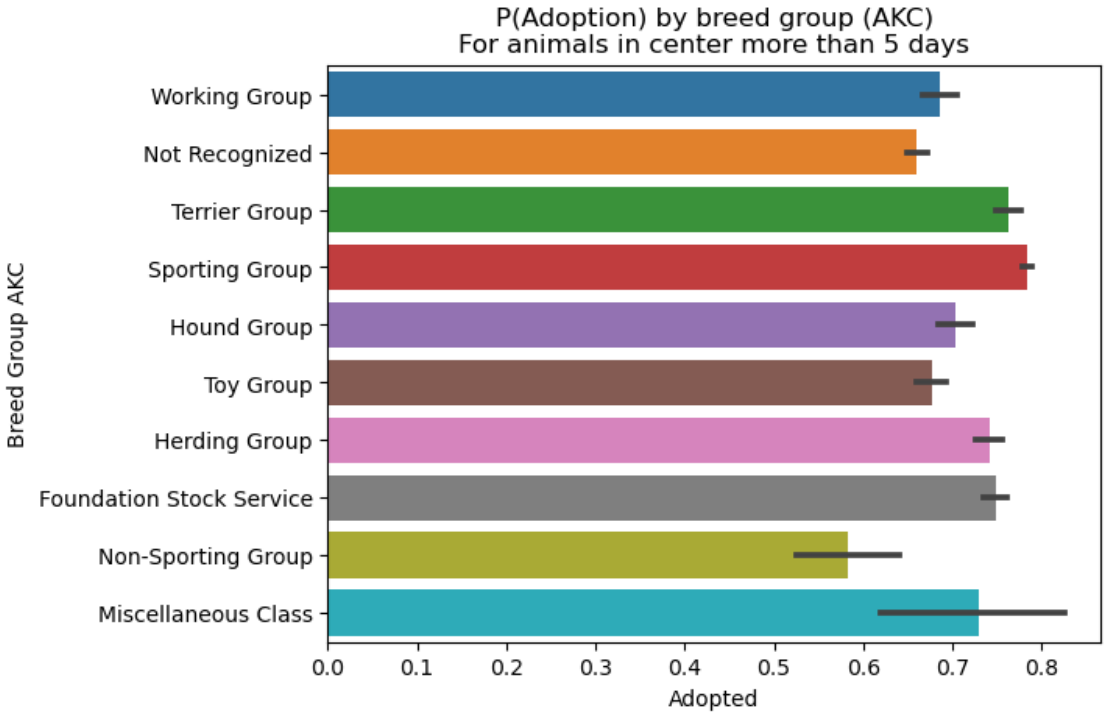
This analysis considers individual animals and looks for correlations between characteristics of their breed and their outcome.

It looks like the animals belonging to a breed with an average height around 20-25 (inches?) are more likely to be adopted than others, and animals between 5-12 inches are less likely than others to be adopted.

TODO 7: interpret the other graphs. Why are the different lifespan variables distributed the way they are, and why are they distributed differently compared to each other?

[20]:
```
day_limit = 10
df_out_1 = animalsLongerThan(day_limit)
df_out_1 = df_out_1.assign(Adopted=df_out_1.Adopted.fillna(False))
```

```
ax=sns.barplot(data=df_out_1,
               y='Breed Group AKC',
               x='Adopted',
               estimator="mean")
plt.title(f"P(Adoption) by breed group (AKC)\nFor animals in center more than␣
 ↪{days_limit} days")
plt.show()
```



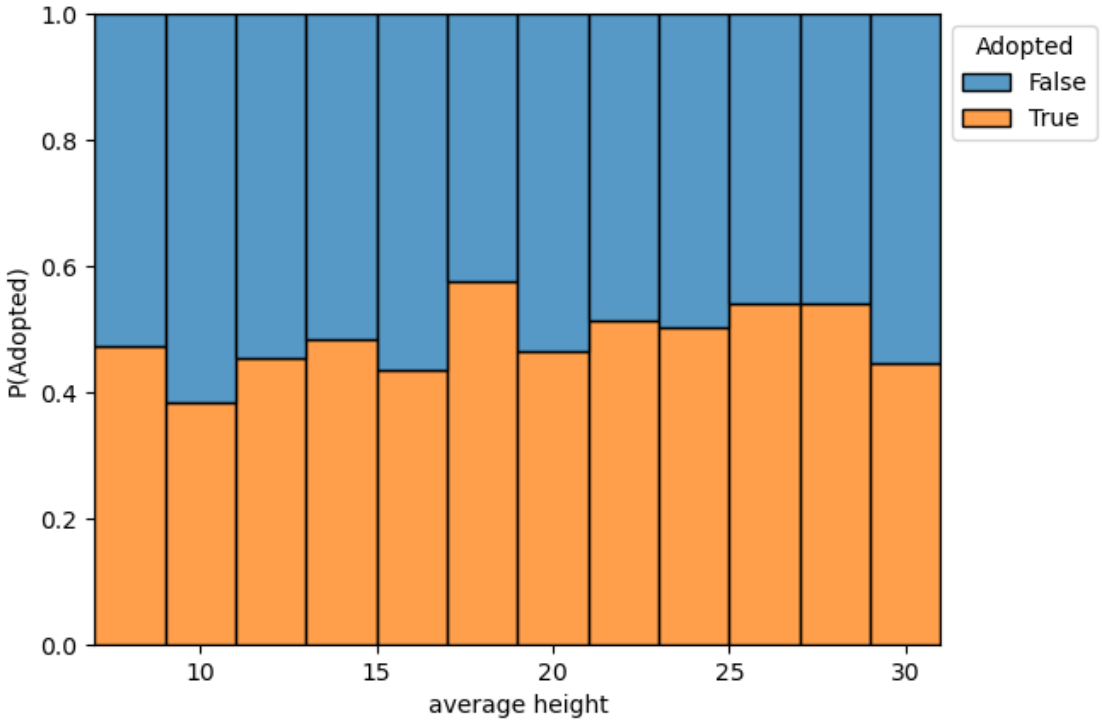
[21]:
```
day_limit = 10
df_out_1 = animalsLongerThan(day_limit)
df_out_1 = df_out_1.assign(Adopted=df_out_1.Adopted.fillna(False))
df_out_with_breeds_info_1 = df_out_with_breeds_info.assign(Adopted=df_out.
 ↪Adopted.fillna(False))

def correlo_histogram(df, independent, dependent, binwidth):
    print(f'{independent} ~ {dependent}')
    # TODO 8: add error bars when the dependent variable is "Adopted"
    # (see how the confidence interval was constructed in the previous cell
    # for regression by color)

    ax=sns.histplot(data=df,
             x=independent,
             hue=dependent,
```

```
            multiple='fill',
            binwidth=binwidth)
    sns.move_legend(ax, 'upper left', bbox_to_anchor=(1,1))
    plt.ylabel(f"P({dependent})")
    plt.show()

independent_vars_breeds_info = [
    ['average height', 2],
    ['Est. lifespan remaining', 1],
    ['average lifespan', 1],
    ['Lifespan Low', 1],
    ['Lifespan High', 1],
]

independent_vars_individuals = [
    ['Age upon Outcome (years)', 1],
    ['Years in animal center', 0.25],
    ['Color 0 H', 0.1],
    ['Color 0 S', 0.1],
    ['Color 0 V', 0.1],
]

for [independent, binwidth] in independent_vars_breeds_info:
    for dependent in ['Adopted', 'Outcome Type']:
        correlo_histogram(df_out_with_breeds_info_1, independent, dependent,␣
 ↪binwidth)

for [independent, binwidth] in independent_vars_individuals:
    for dependent in ['Adopted', 'Outcome Type']:
        correlo_histogram(df_out_1, independent, dependent, binwidth)
```

```
average height ~ Adopted
```

```
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:499: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(edges, name="edges"),
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:500: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(widths, name="widths"),
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:499: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(edges, name="edges"),
```

```
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:500: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(widths, name="widths"),
```

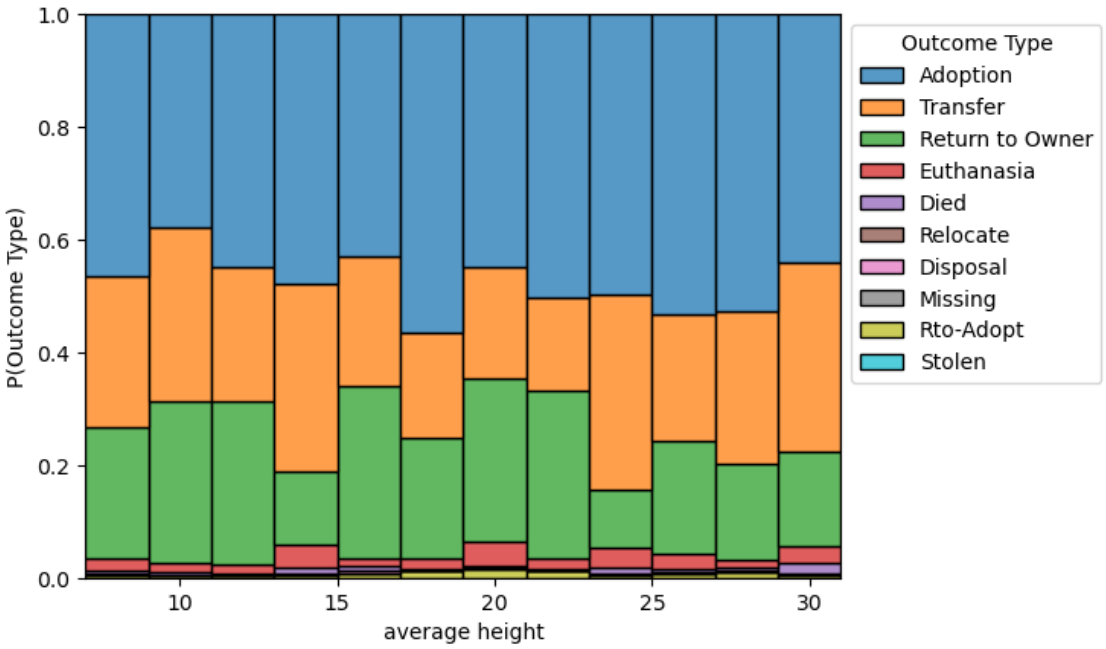



```
average height ~ Outcome Type
```

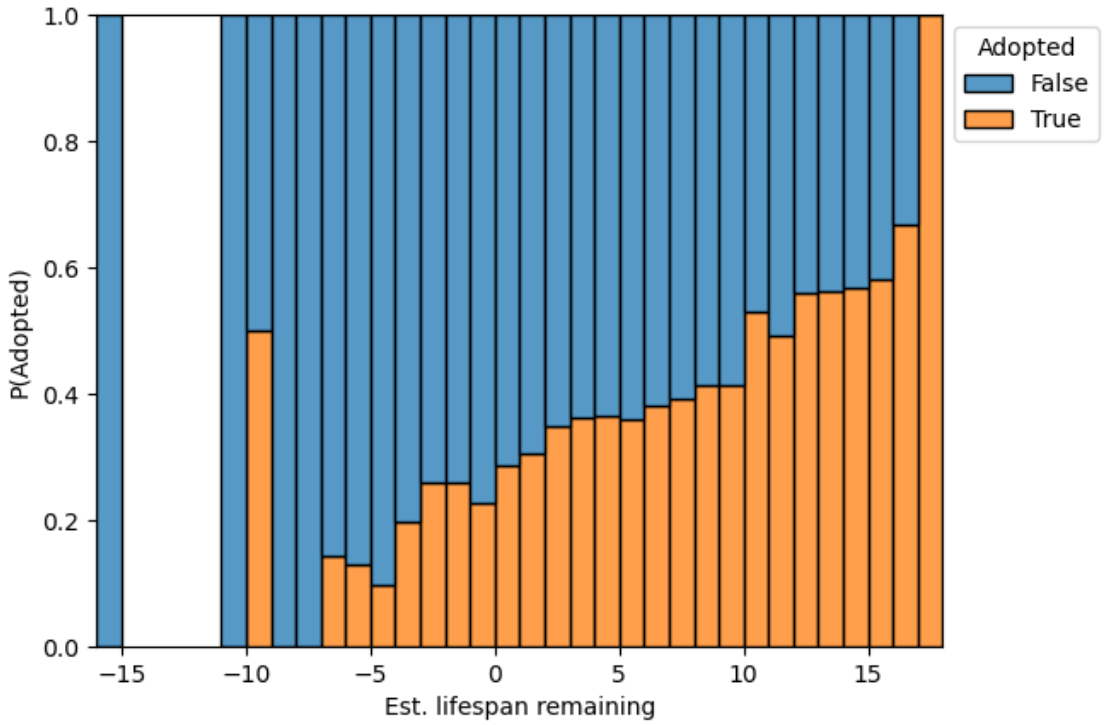
```
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:499: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(edges, name="edges"),
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:500: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(widths, name="widths"),
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:499: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(edges, name="edges"),
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
```

```
packages/seaborn/distributions.py:500: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(widths, name="widths"),
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:499: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(edges, name="edges"),
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:500: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(widths, name="widths"),
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:499: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(edges, name="edges"),
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:500: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(widths, name="widths"),
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:499: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(edges, name="edges"),
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:500: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(widths, name="widths"),
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:499: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(edges, name="edges"),
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:500: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(widths, name="widths"),
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:499: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
```

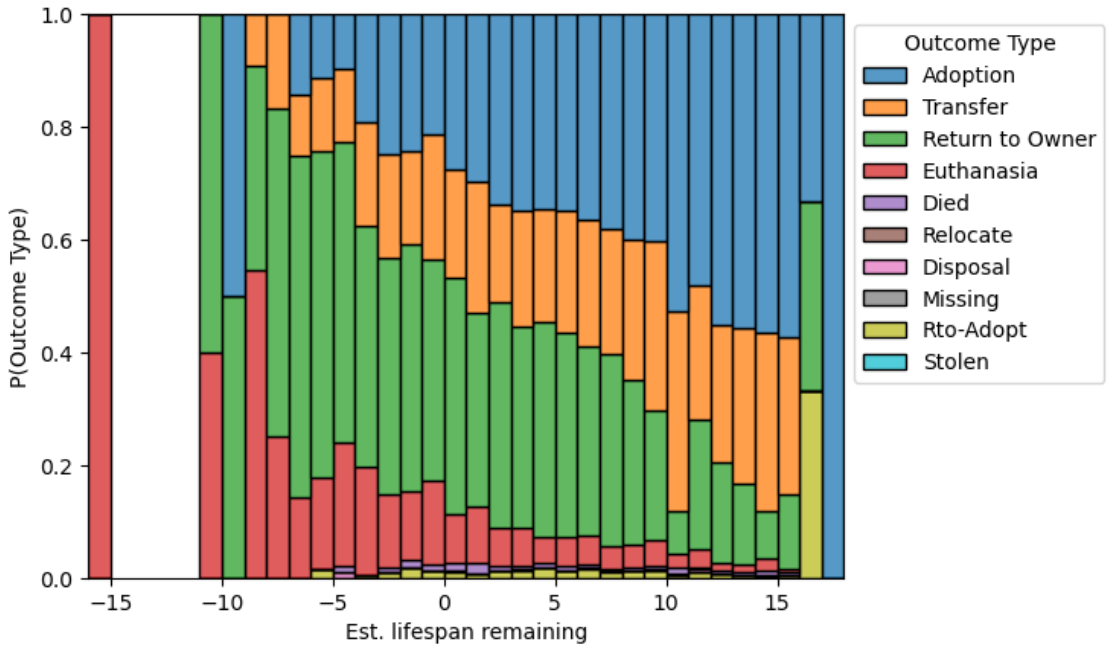
```
  pd.Index(edges, name="edges"),
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:500: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(widths, name="widths"),
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:499: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(edges, name="edges"),
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:500: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(widths, name="widths"),
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:499: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(edges, name="edges"),
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:500: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(widths, name="widths"),
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:499: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(edges, name="edges"),
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:500: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(widths, name="widths"),
```



`Est. lifespan remaining ~ Adopted`

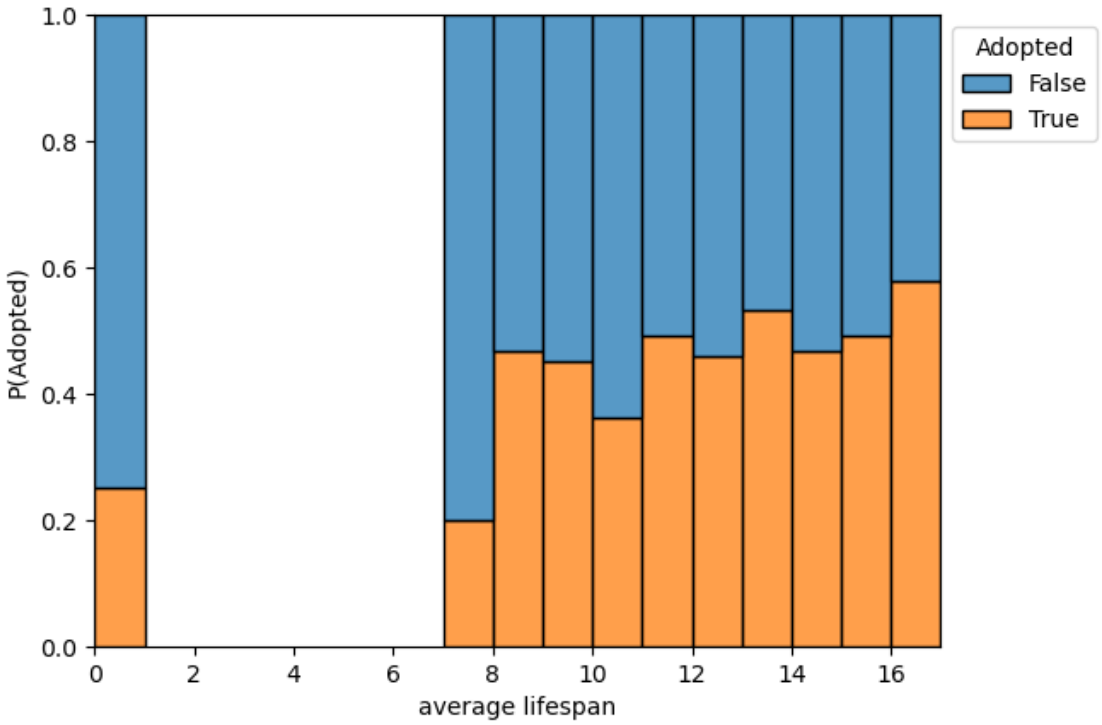


Est. lifespan remaining ~ Outcome Type



average lifespan ~ Adopted

```
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:499: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(edges, name="edges"),
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:500: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(widths, name="widths"),
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:499: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(edges, name="edges"),
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:500: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(widths, name="widths"),
```

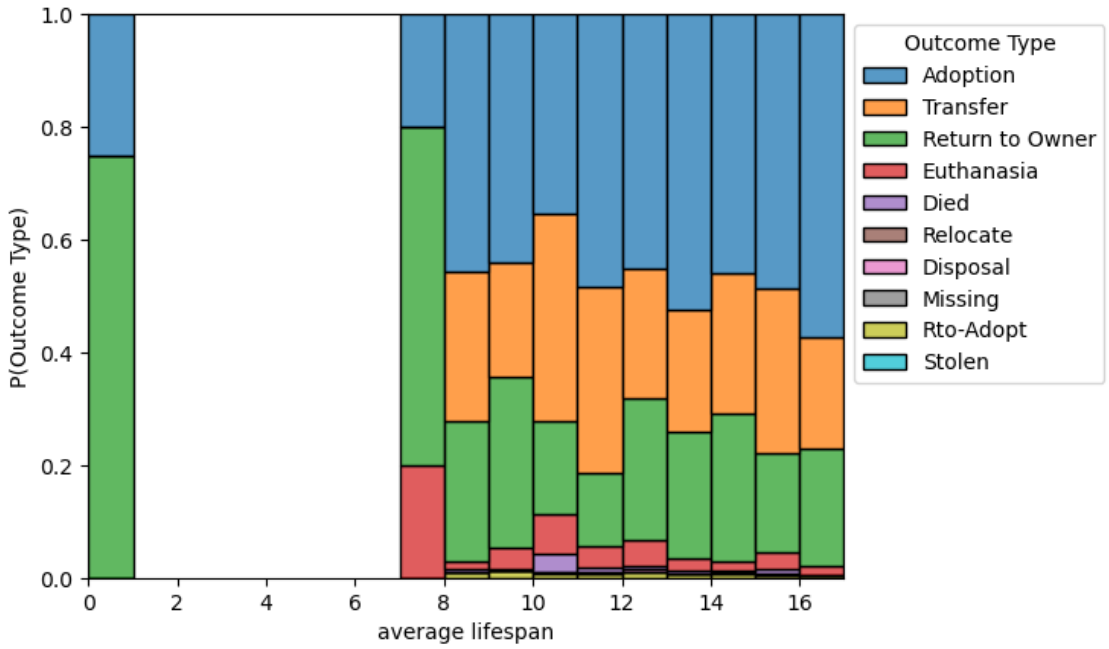



```
average lifespan ~ Outcome Type
```

```
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:499: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(edges, name="edges"),
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:500: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(widths, name="widths"),
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:499: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(edges, name="edges"),
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:500: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(widths, name="widths"),
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:499: FutureWarning: In a future version, the
```

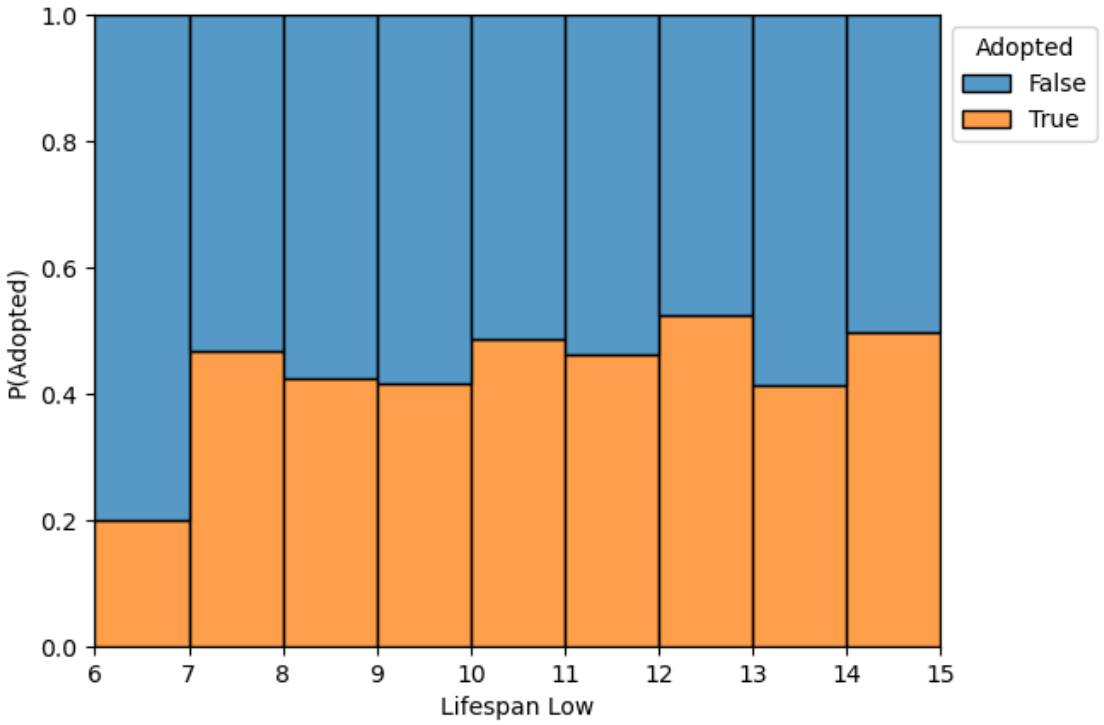
```
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(edges, name="edges"),
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:500: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(widths, name="widths"),
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:499: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(edges, name="edges"),
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:500: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(widths, name="widths"),
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:499: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(edges, name="edges"),
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:500: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(widths, name="widths"),
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:499: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(edges, name="edges"),
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:500: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(widths, name="widths"),
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:499: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(edges, name="edges"),
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:500: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(widths, name="widths"),
```

```
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:499: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(edges, name="edges"),
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:500: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(widths, name="widths"),
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:499: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(edges, name="edges"),
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:500: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(widths, name="widths"),
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:499: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(edges, name="edges"),
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:500: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(widths, name="widths"),
```



Lifespan Low ~ Adopted

```
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:499: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(edges, name="edges"),
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:500: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(widths, name="widths"),
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:499: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(edges, name="edges"),
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:500: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(widths, name="widths"),
```

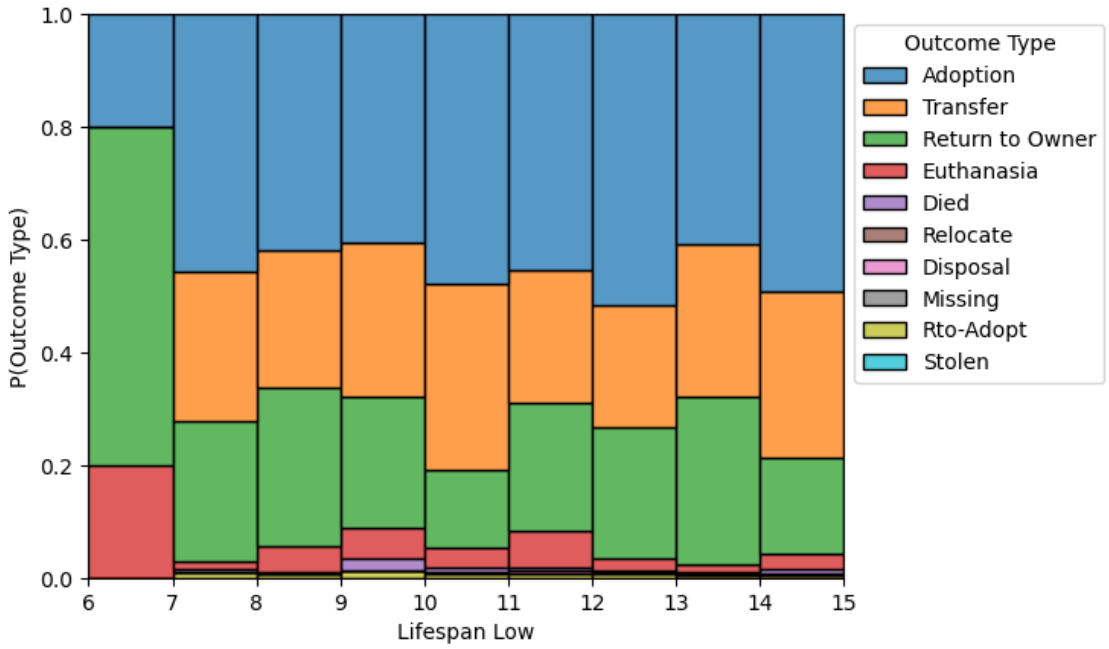


Lifespan Low ~ Outcome Type

```
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:499: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(edges, name="edges"),
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:500: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(widths, name="widths"),
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:499: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(edges, name="edges"),
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:500: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(widths, name="widths"),
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:499: FutureWarning: In a future version, the
```

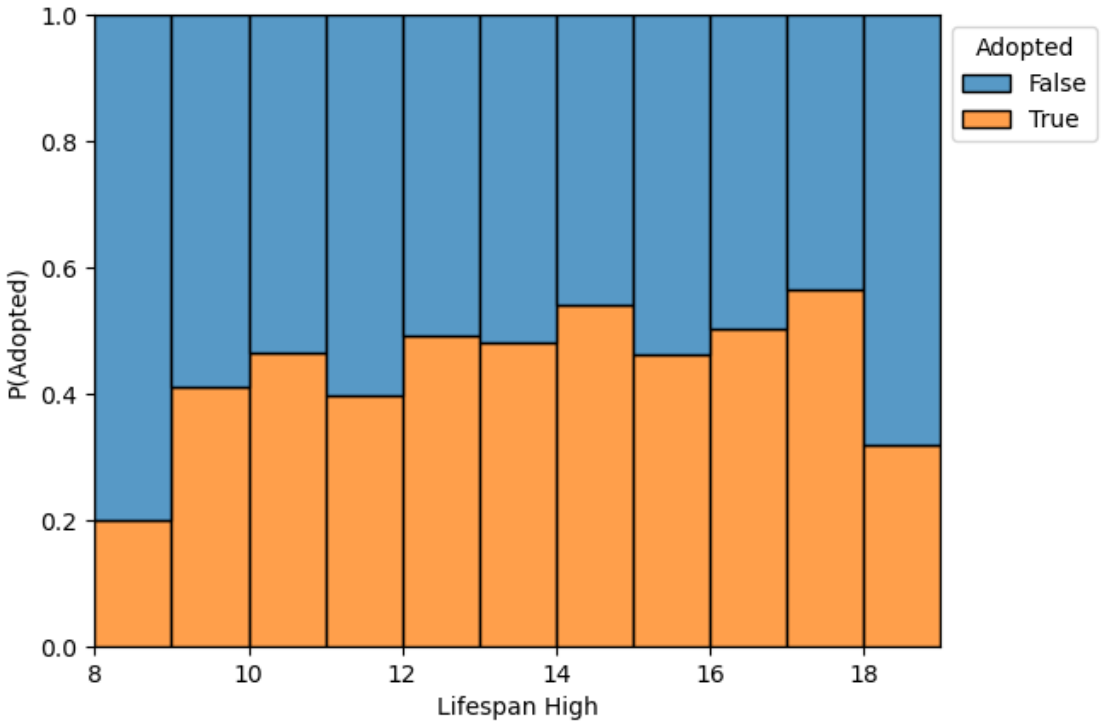
```
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(edges, name="edges"),
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:500: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(widths, name="widths"),
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:499: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(edges, name="edges"),
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:500: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(widths, name="widths"),
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:499: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(edges, name="edges"),
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:500: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(widths, name="widths"),
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:499: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(edges, name="edges"),
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:500: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(widths, name="widths"),
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:499: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(edges, name="edges"),
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:500: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(widths, name="widths"),
```

```
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:499: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(edges, name="edges"),
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:500: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(widths, name="widths"),
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:499: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(edges, name="edges"),
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:500: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(widths, name="widths"),
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:499: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(edges, name="edges"),
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:500: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(widths, name="widths"),
```



Lifespan High ~ Adopted

```
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:499: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(edges, name="edges"),
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:500: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(widths, name="widths"),
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:499: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(edges, name="edges"),
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:500: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(widths, name="widths"),
```

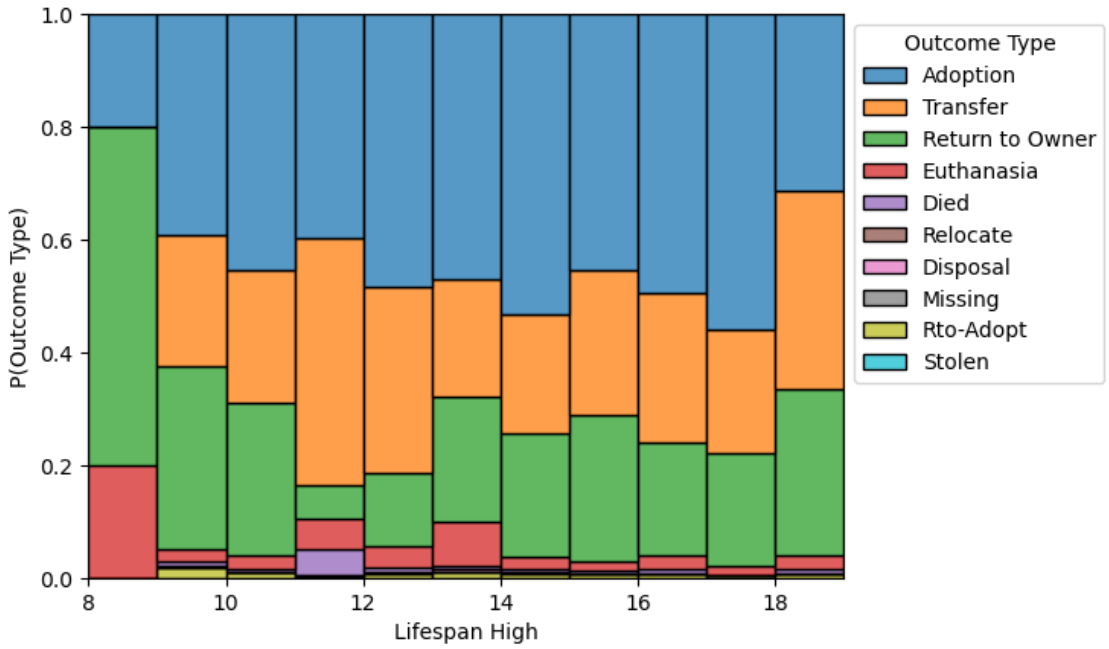


Lifespan High ~ Outcome Type

```
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:499: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(edges, name="edges"),
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:500: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(widths, name="widths"),
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:499: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(edges, name="edges"),
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:500: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(widths, name="widths"),
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:499: FutureWarning: In a future version, the
```

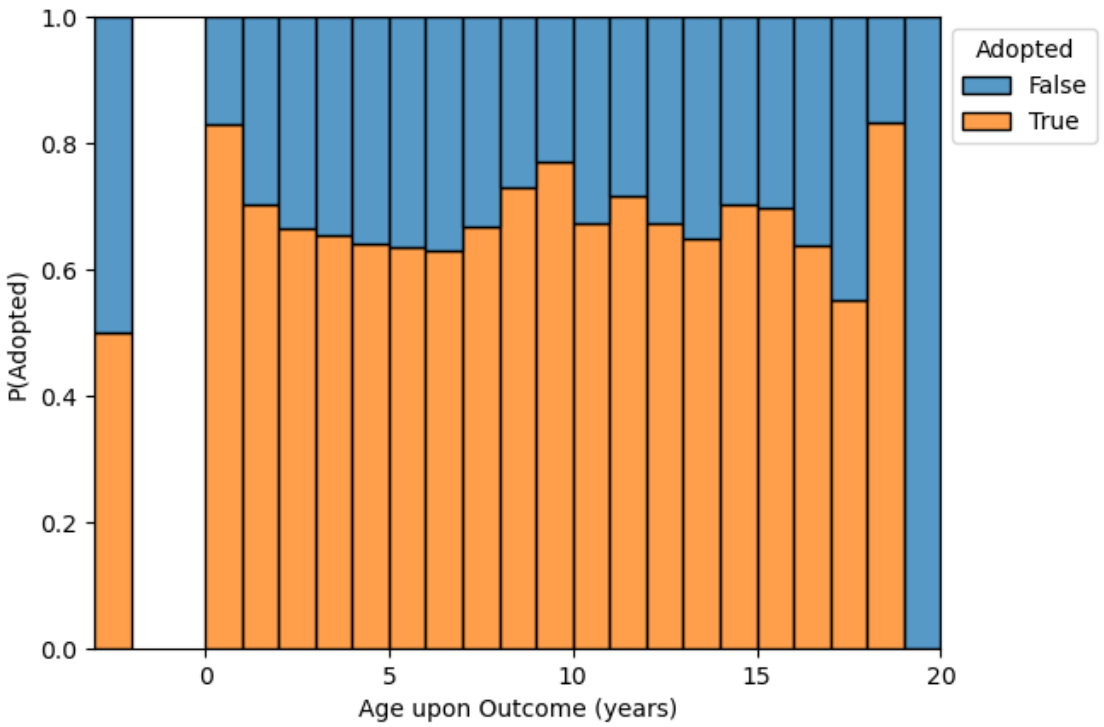
```
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(edges, name="edges"),
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:500: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(widths, name="widths"),
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:499: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(edges, name="edges"),
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:500: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(widths, name="widths"),
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:499: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(edges, name="edges"),
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:500: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(widths, name="widths"),
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:499: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(edges, name="edges"),
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:500: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(widths, name="widths"),
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:499: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(edges, name="edges"),
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:500: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(widths, name="widths"),
```

```
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:499: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(edges, name="edges"),
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:500: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(widths, name="widths"),
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:499: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(edges, name="edges"),
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:500: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(widths, name="widths"),
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:499: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(edges, name="edges"),
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:500: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(widths, name="widths"),
```



Age upon Outcome (years) ~ Adopted

```
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:499: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(edges, name="edges"),
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:500: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(widths, name="widths"),
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:499: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(edges, name="edges"),
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:500: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(widths, name="widths"),
```

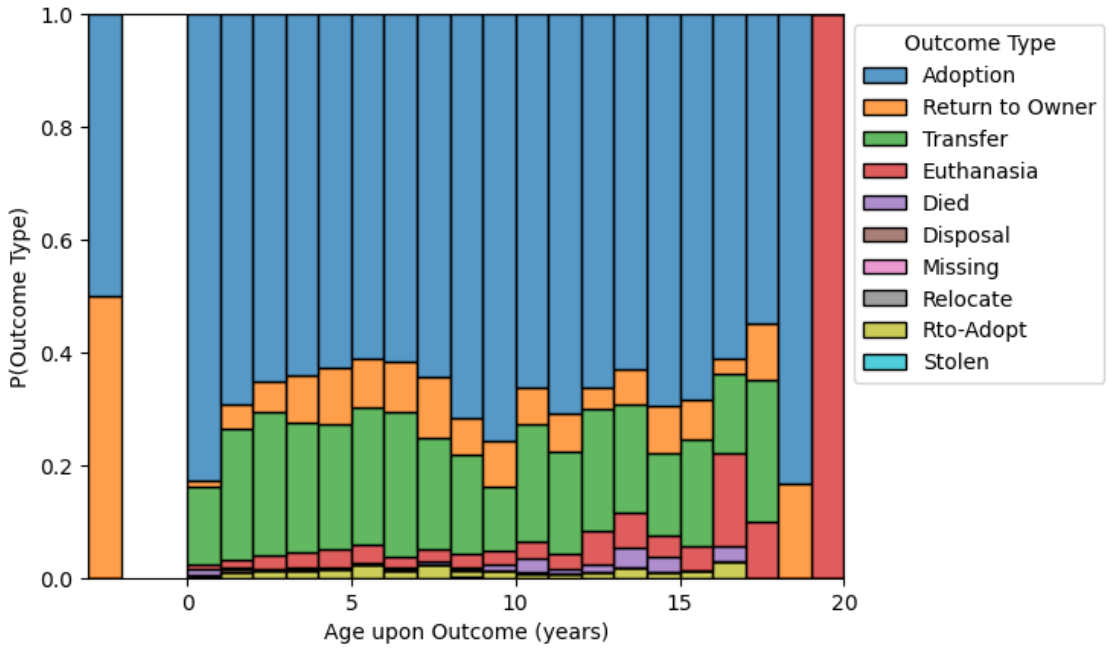


Age upon Outcome (years) ~ Outcome Type

```
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:499: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(edges, name="edges"),
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:500: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(widths, name="widths"),
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:499: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(edges, name="edges"),
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:500: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(widths, name="widths"),
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:499: FutureWarning: In a future version, the
```

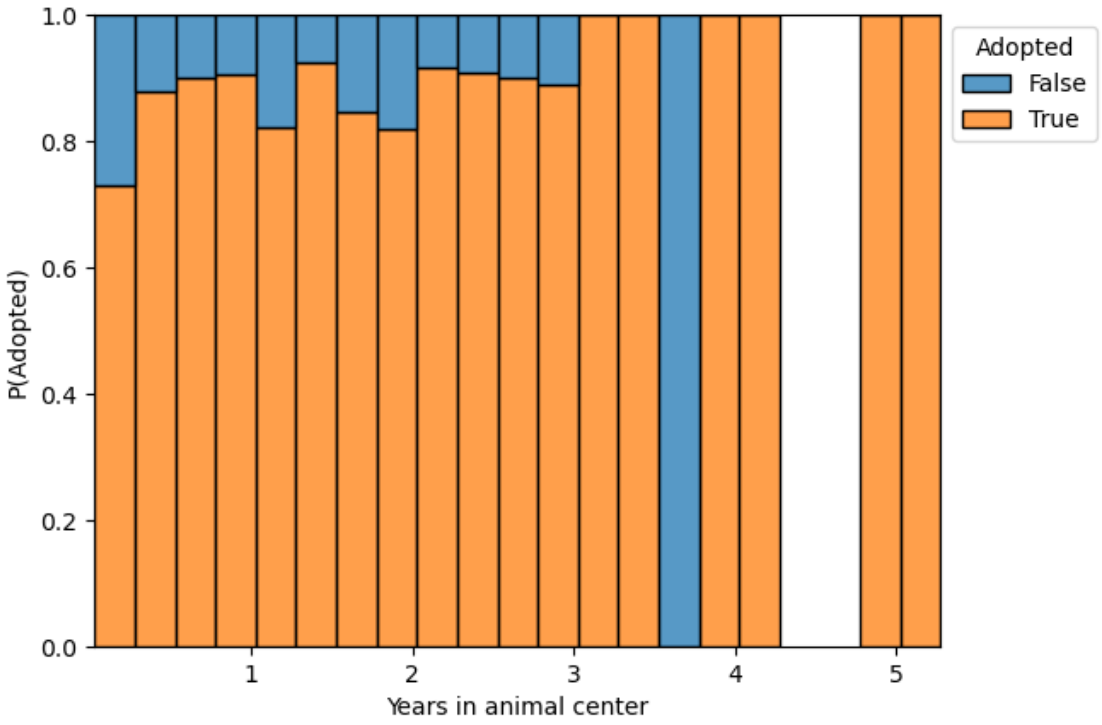
```
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(edges, name="edges"),
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:500: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(widths, name="widths"),
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:499: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(edges, name="edges"),
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:500: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(widths, name="widths"),
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:499: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(edges, name="edges"),
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:500: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(widths, name="widths"),
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:499: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(edges, name="edges"),
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:500: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(widths, name="widths"),
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:499: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(edges, name="edges"),
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:500: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(widths, name="widths"),
```

```
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:499: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(edges, name="edges"),
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:500: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(widths, name="widths"),
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:499: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(edges, name="edges"),
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:500: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(widths, name="widths"),
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:499: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(edges, name="edges"),
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:500: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(widths, name="widths"),
```



Years in animal center ~ Adopted

```
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:499: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(edges, name="edges"),
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:500: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(widths, name="widths"),
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:499: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(edges, name="edges"),
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:500: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(widths, name="widths"),
```

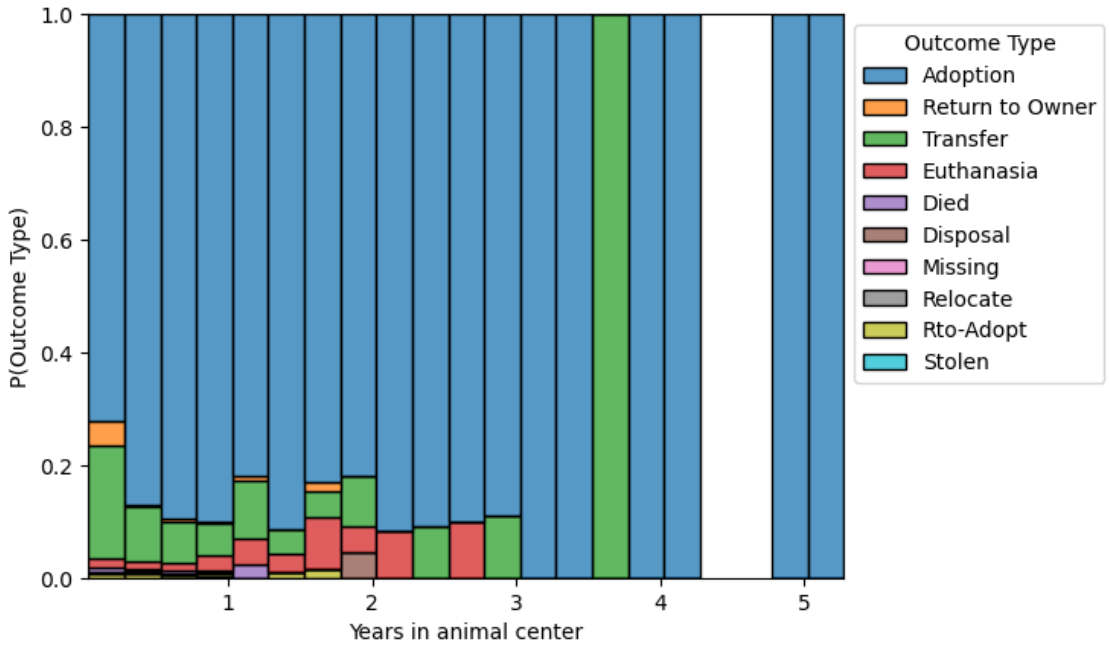



```
Years in animal center ~ Outcome Type
```

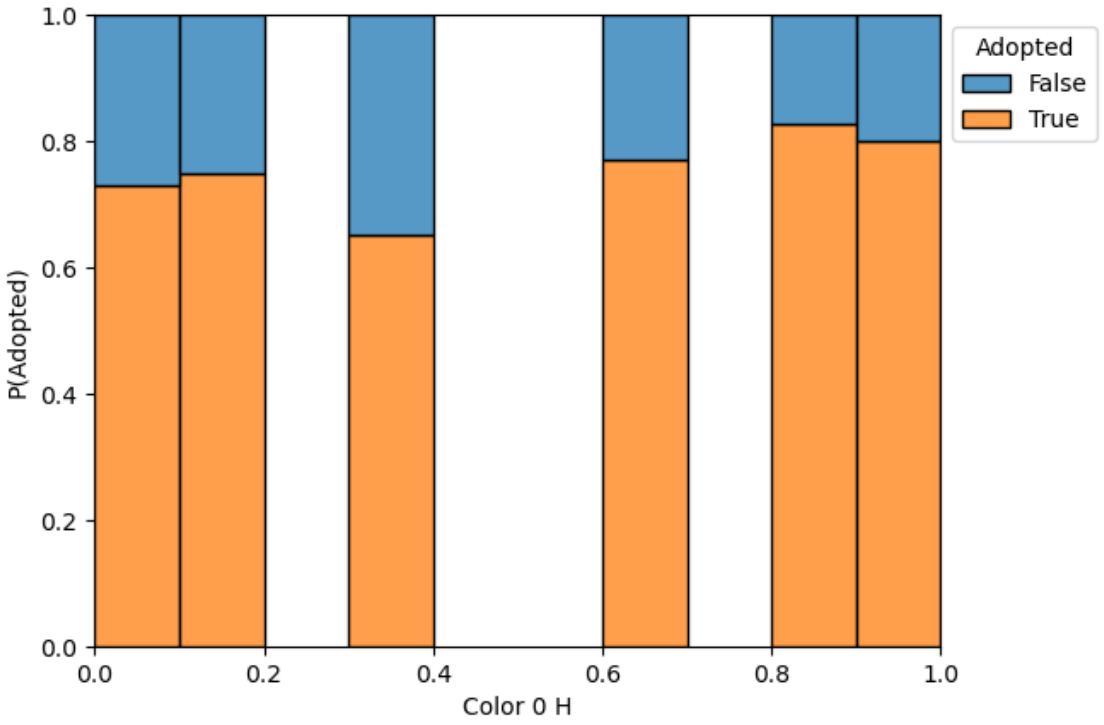
```
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:499: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(edges, name="edges"),
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:500: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(widths, name="widths"),
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:499: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(edges, name="edges"),
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:500: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(widths, name="widths"),
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:499: FutureWarning: In a future version, the
```

```
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(edges, name="edges"),
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:500: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(widths, name="widths"),
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:499: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(edges, name="edges"),
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:500: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(widths, name="widths"),
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:499: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(edges, name="edges"),
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:500: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(widths, name="widths"),
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:499: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(edges, name="edges"),
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:500: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(widths, name="widths"),
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:499: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(edges, name="edges"),
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:500: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(widths, name="widths"),
```

```
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:499: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(edges, name="edges"),
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:500: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(widths, name="widths"),
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:499: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(edges, name="edges"),
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:500: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(widths, name="widths"),
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:499: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(edges, name="edges"),
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:500: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(widths, name="widths"),
```




```
Color 0 H ~ Adopted

/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:499: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(edges, name="edges"),
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:500: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(widths, name="widths"),
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:499: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(edges, name="edges"),
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:500: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(widths, name="widths"),
```

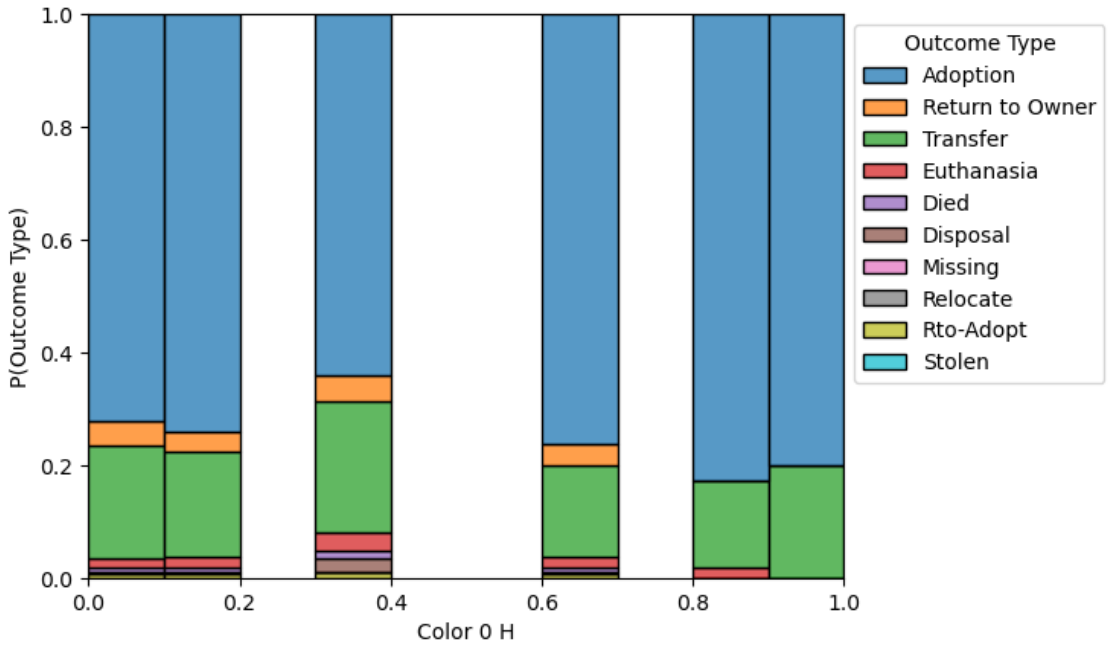


Color 0 H ~ Outcome Type

```
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:499: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(edges, name="edges"),
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:500: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(widths, name="widths"),
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:499: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(edges, name="edges"),
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:500: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(widths, name="widths"),
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:499: FutureWarning: In a future version, the
```

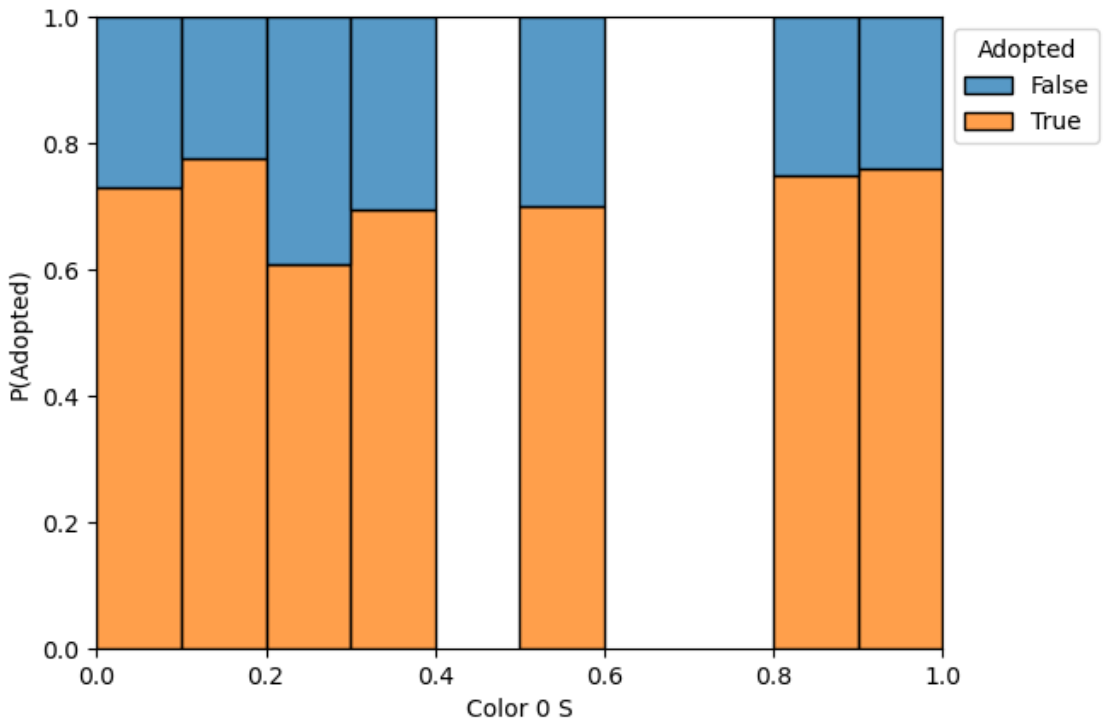
```
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(edges, name="edges"),
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:500: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(widths, name="widths"),
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:499: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(edges, name="edges"),
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:500: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(widths, name="widths"),
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:499: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(edges, name="edges"),
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:500: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(widths, name="widths"),
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:499: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(edges, name="edges"),
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:500: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(widths, name="widths"),
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:499: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(edges, name="edges"),
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:500: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(widths, name="widths"),
```

```
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:499: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(edges, name="edges"),
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:500: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(widths, name="widths"),
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:499: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(edges, name="edges"),
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:500: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(widths, name="widths"),
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:499: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(edges, name="edges"),
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:500: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(widths, name="widths"),
```



Color 0 S ~ Adopted

```
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:499: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(edges, name="edges"),
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:500: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(widths, name="widths"),
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:499: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(edges, name="edges"),
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:500: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(widths, name="widths"),
```

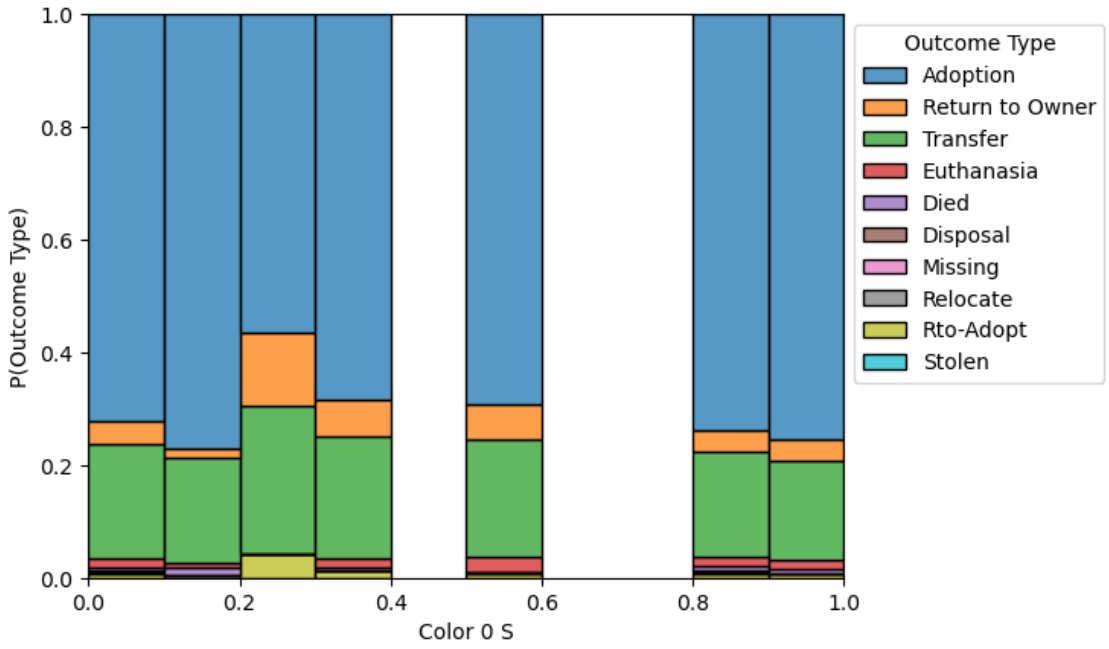


Color 0 S ~ Outcome Type

```
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:499: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(edges, name="edges"),
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:500: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(widths, name="widths"),
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:499: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(edges, name="edges"),
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:500: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(widths, name="widths"),
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:499: FutureWarning: In a future version, the
```

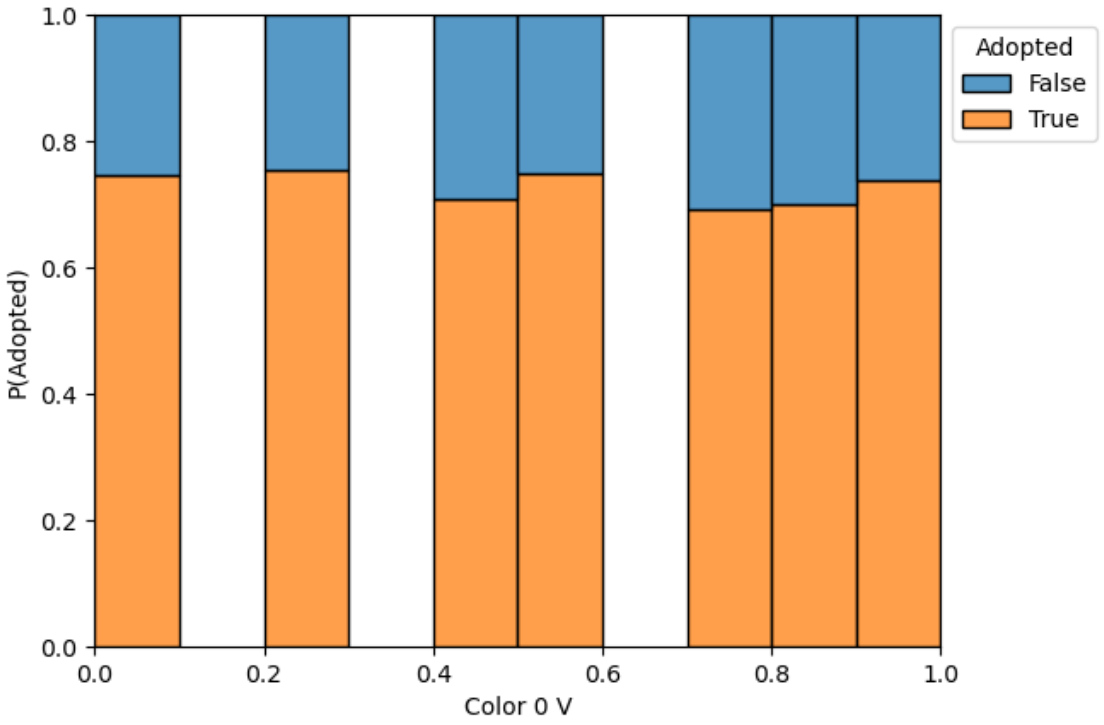
```
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(edges, name="edges"),
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:500: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(widths, name="widths"),
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:499: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(edges, name="edges"),
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:500: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(widths, name="widths"),
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:499: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(edges, name="edges"),
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:500: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(widths, name="widths"),
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:499: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(edges, name="edges"),
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:500: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(widths, name="widths"),
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:499: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(edges, name="edges"),
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:500: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(widths, name="widths"),
```

```
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:499: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(edges, name="edges"),
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:500: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(widths, name="widths"),
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:499: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(edges, name="edges"),
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:500: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(widths, name="widths"),
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:499: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(edges, name="edges"),
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:500: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(widths, name="widths"),
```



Color 0 V ~ Adopted

```
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:499: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(edges, name="edges"),
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:500: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(widths, name="widths"),
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:499: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(edges, name="edges"),
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:500: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(widths, name="widths"),
```

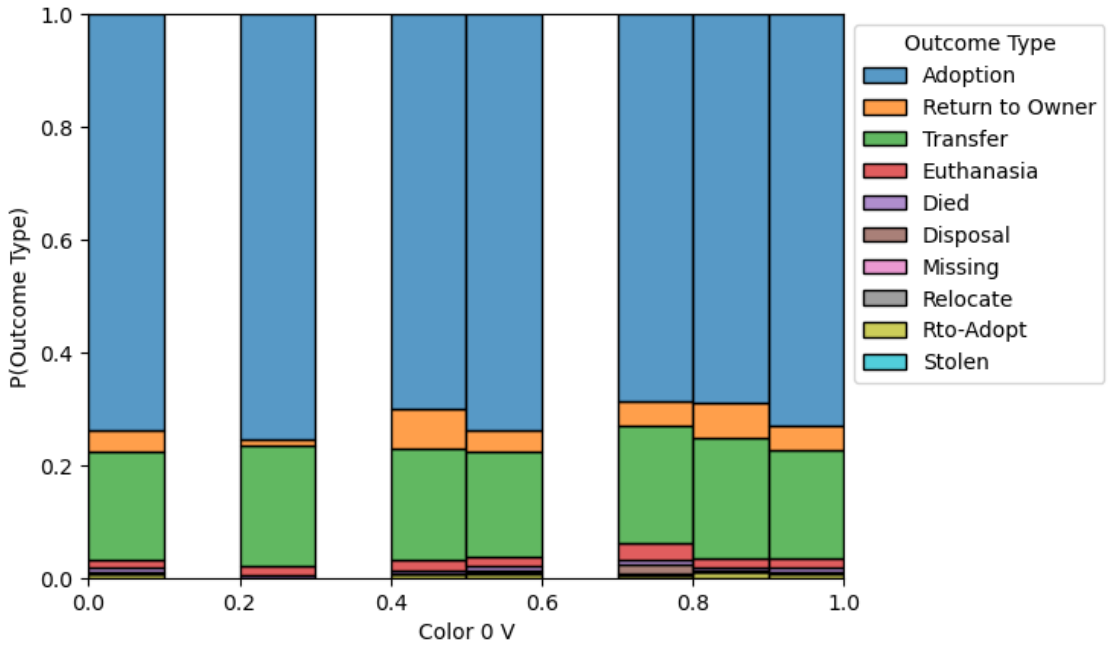


Color 0 V ~ Outcome Type

```
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:499: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(edges, name="edges"),
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:500: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(widths, name="widths"),
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:499: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(edges, name="edges"),
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:500: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(widths, name="widths"),
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:499: FutureWarning: In a future version, the
```

```
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(edges, name="edges"),
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:500: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(widths, name="widths"),
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:499: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(edges, name="edges"),
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:500: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(widths, name="widths"),
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:499: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(edges, name="edges"),
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:500: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(widths, name="widths"),
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:499: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(edges, name="edges"),
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:500: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(widths, name="widths"),
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:499: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(edges, name="edges"),
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:500: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(widths, name="widths"),
```

```
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:499: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(edges, name="edges"),
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:500: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(widths, name="widths"),
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:499: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(edges, name="edges"),
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:500: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(widths, name="widths"),
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:499: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(edges, name="edges"),
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:500: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(widths, name="widths"),
```



Based on these charts it seems the strongest indicator of adoption in a pet is its age. The graph 'est lifespan remaining ~ adopted' shows this very strongly as does the graph 'age upon outcome ~ adopted'.

Another correlation in these graphs is in 'average lifespan ~adoption'. This once again shows that potential adopters favor pets with a lot of years ahead of them.

This seems to imply that the biggest indicator of whether or not an animal will be adopted is its age. Younger pets are more likely to be adopted by a rather strong degree.

2.4 Age

Lets see if we can pull of some logistic regression of age ~ adoption

[22]:
```
bins = [0, 1/365.25, 7/365.25, 1/12, 1/2, 1, 2, 5, 10]
labels = ['0-1 days', '1 day - 1 week', '1 week - 1 month', '1-6 months', '0.
 ↪5-1 years', '1-2 years', '2-5 years', '5-10 years']
df_out_1 = df_out.assign(**{'Time in animal center': pd.cut(df_out['Years in␣
 ↪animal center'], bins, labels=labels, include_lowest=True, right=False)})
df_out_1 = df_out_1[['Adopted', 'Time in animal center', 'Age upon Outcome␣
 ↪(years)']]
df_out_1.dropna(inplace=True)

# sns.histplot(data=df_out_1, x='Age upon Outcome (years)', hue='Years in␣
 ↪animal center', binwidth=1, element='poly', fill=None)

# the histogram is manually made to add more features
```

```
df_out_1 = df_out_1.assign(**{'Age upon Outcome (years)': pd.cut(df_out_1['Age␣
 ↪upon Outcome (years)'], 10)})
```

[23]:
```
df_out_2 = df_out_1.groupby(['Time in animal center', 'Age upon Outcome␣
 ↪(years)']).Adopted.mean()
df_out_2 = df_out_2.reset_index()
df_out_2.dropna(inplace=True)
df_out_2_ageUponOutcome = df_out_2['Age upon Outcome (years)']
df_out_2 = df_out_2.assign(**{'Age upon Outcome (years)': df_out_2['Age upon␣
 ↪Outcome (years)'].apply(lambda x: x.left).astype(float) })
df_out_2.info()
df_out_2.describe()
```

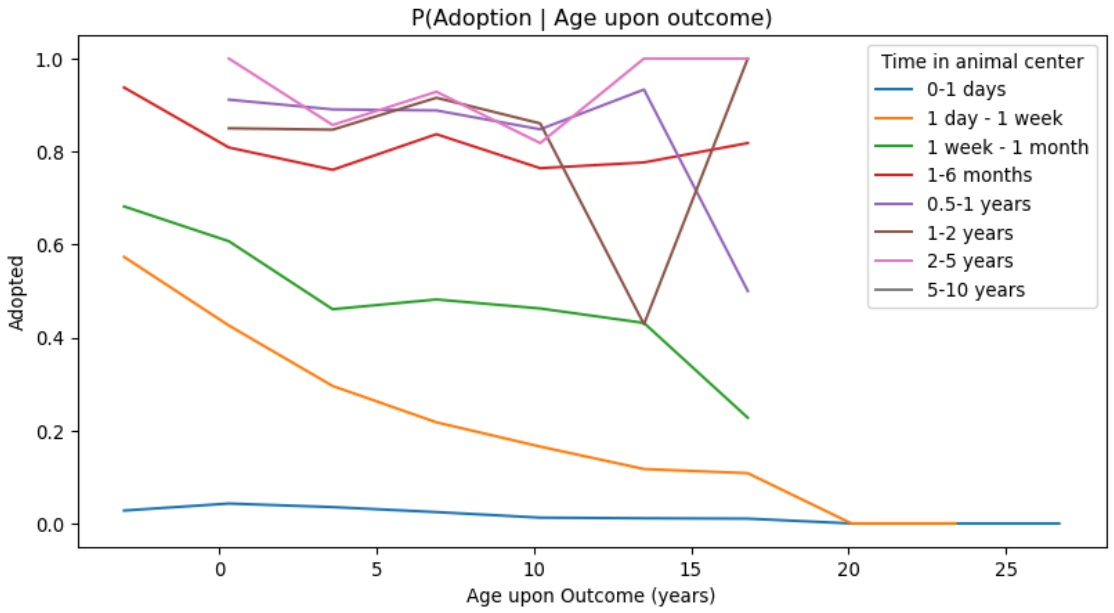
```
<class 'pandas.core.frame.DataFrame'>
Int64Index: 52 entries, 0 to 74
Data columns (total 3 columns):
 #   Column                     Non-Null Count  Dtype
---  ------                     --------------  -----
 0   Time in animal center      52 non-null     category
 1   Age upon Outcome (years)   52 non-null     float64
 2   Adopted                    52 non-null     Float64
dtypes: Float64(1), category(1), float64(1)
memory usage: 1.7 KB
```

[23]:

	Age upon Outcome (years)	Adopted
count	52.000000	52.0
mean	9.055154	0.530769
std	7.537376	0.375057
min	-3.033000	0.0
25%	3.600000	0.114832
50%	10.200000	0.590232
75%	13.500000	0.857973
max	26.700000	1.0

[24]:
```
# for time, time_loc in df_out_1.groupby('Time in animal center').groups.
 ↪items():
#     df_out_1_loc = df_out_1.loc[time_loc]
#     i = df_out_2.shape
#     df_out_2.at[]

plt.figure(figsize=(10, 5),dpi=96)
ax=sns.lineplot(data=df_out_2, x='Age upon Outcome (years)', y='Adopted',␣
 ↪hue='Time in animal center', errorbar=None)
plt.title('P(Adoption | Age upon outcome)')
# sns.move_legend(ax, 'upper left', bbox_to_anchor=(1,1))
# plt.xticks(ticks=df_out_2['Age upon Outcome (years)'],␣
 ↪labels=df_out_2_ageUponOutcome, rotation='vertical')
```

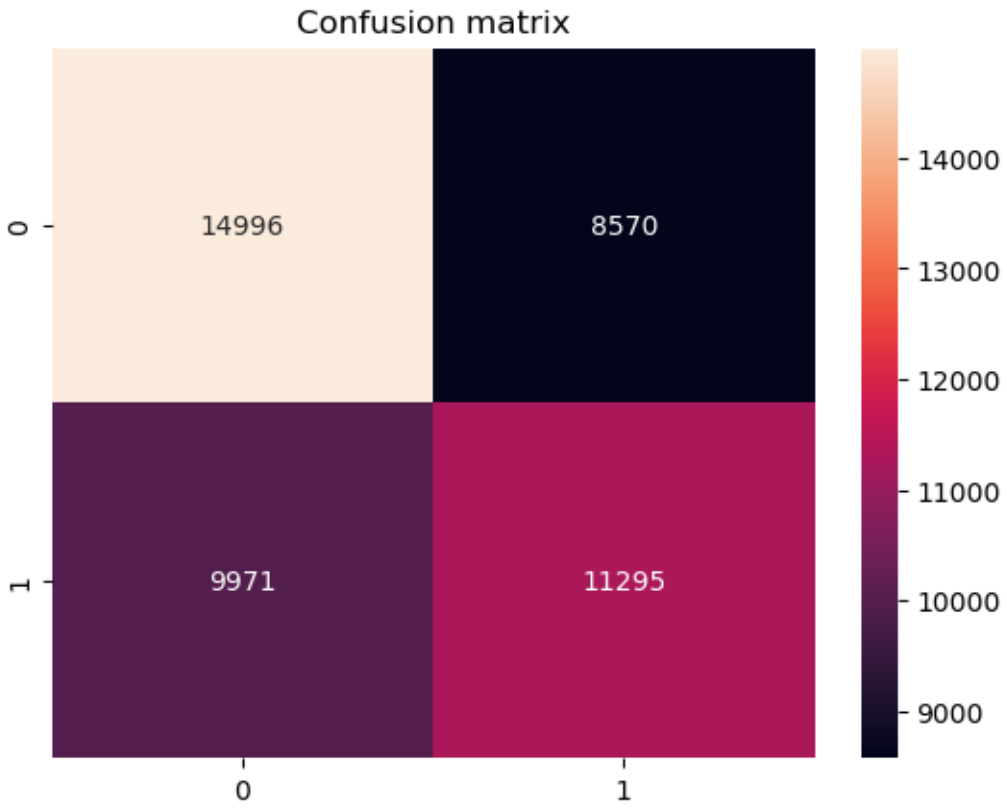
```
plt.show()
```



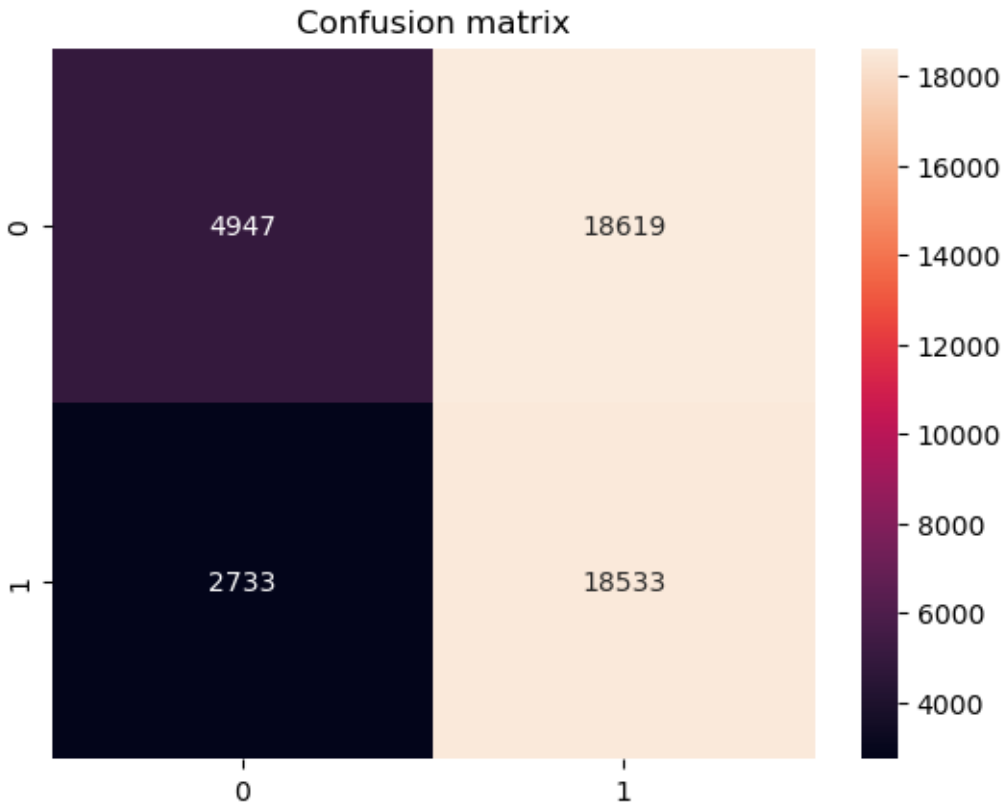
[25]:
```
from sklearn.ensemble import RandomForestClassifier
from sklearn.naive_bayes import GaussianNB

df_al = df_out[['Adopted', 'Age upon Outcome (years)']].dropna()
y_data = df_al['Adopted'].astype(dtype=int)
x_data = df_al['Age upon Outcome (years)'].astype(dtype=float)


x_data = x_data.values.reshape(-1,1)

x_training_data, x_test_data, y_training_data, y_test_data =␣
 ↪train_test_split(x_data, y_data, test_size = 0.3)
models = [LogisticRegression, GaussianNB, RandomForestClassifier]
for modelType in models:
    print("Adopted ~ Age upon outcome (years)")
    print(modelType.__name__)
    model = modelType()
    model.fit(x_training_data, y_training_data)
    # predictions = model.predict(x_test_data)
    sns.heatmap(confusion_matrix(y_test_data, model.predict(x_test_data)),␣
 ↪annot=True, fmt="0")
    plt.title("Confusion matrix")
    plt.show()
    print("Classification report")
```

```
    print(classification_report(y_test_data, model.predict(x_test_data)))
    print()
```

```
Adopted ~ Age upon outcome (years)
LogisticRegression
```



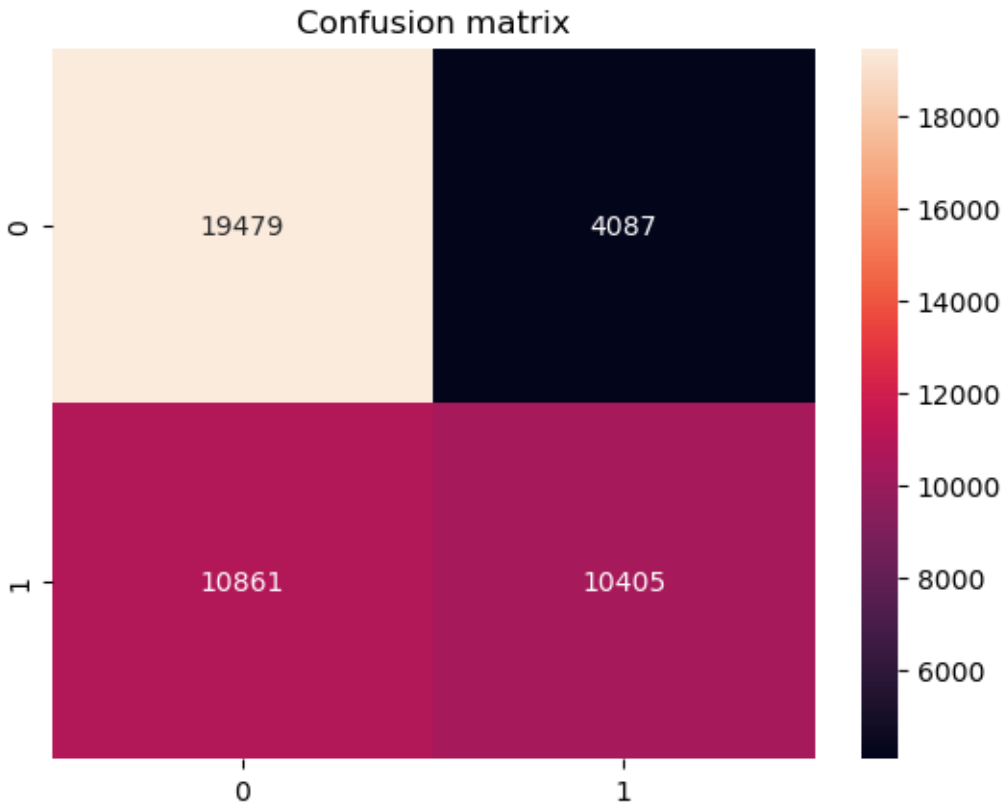

```
Classification report
              precision    recall  f1-score   support

           0       0.60      0.64      0.62     23566
           1       0.57      0.53      0.55     21266

    accuracy                           0.59     44832
   macro avg       0.58      0.58      0.58     44832
weighted avg       0.59      0.59      0.59     44832


Adopted ~ Age upon outcome (years)
GaussianNB
```



Classification report

	precision	recall	f1-score	support
0	0.64	0.21	0.32	23566
1	0.50	0.87	0.63	21266
accuracy			0.52	44832
macro avg	0.57	0.54	0.48	44832
weighted avg	0.58	0.52	0.47	44832

Adopted ~ Age upon outcome (years)
RandomForestClassifier




```
Classification report
              precision    recall  f1-score   support

           0       0.64      0.83      0.72     23566
           1       0.72      0.49      0.58     21266

    accuracy                           0.67     44832
   macro avg       0.68      0.66      0.65     44832
weighted avg       0.68      0.67      0.66     44832
```

They have around 50-70% accuracy.