corr

April 4, 2023

[48]:
```
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

%matplotlib inline
```

[49]:
```
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 32 columns):
 #   Column                    Non-Null Count   Dtype
---  ------                    --------------   -----
 0   Animal ID                 149511 non-null  string
 1   Name                      106260 non-null  string
 2   DateTime                  149511 non-null  datetime64[ns]
 3   MonthYear                 149511 non-null  string
 4   Date of Birth             149511 non-null  datetime64[ns]
 5   Outcome Type              149485 non-null  string
 6   Outcome Subtype           68443 non-null   string
 7   Animal Type               149511 non-null  string
 8   Sex upon Outcome          149509 non-null  string
 9   Age upon Outcome          149465 non-null  string
 10  Breed                     149511 non-null  string
 11  Color                     149511 non-null  string
 12  Colors (count)            149511 non-null  Int64
 13  Color 0                   149511 non-null  string
 14  Color 1                   79869 non-null   string
 15  Color 0 R                 135638 non-null  Float64
```

```
 16  Color 0 G                 135638 non-null  Float64
 17  Color 0 B                 135638 non-null  Float64
 18  Color 0 H                 135638 non-null  Float64
 19  Color 0 S                 135638 non-null  Float64
 20  Color 0 V                 135638 non-null  Float64
 21  Color 1 R                 78596 non-null   Float64
 22  Color 1 G                 78596 non-null   Float64
 23  Color 1 B                 78596 non-null   Float64
 24  Color 1 H                 78596 non-null   Float64
 25  Color 1 S                 78596 non-null   Float64
 26  Color 1 V                 78596 non-null   Float64
 27  Age upon Outcome (years)  149465 non-null  Float64
 28  Male                      149509 non-null  boolean
 29  Female                    149509 non-null  boolean
 30  NeuteredOrSpayed          149509 non-null  boolean
 31  Adopted                   149485 non-null  boolean
dtypes: Float64(13), Int64(1), boolean(4), datetime64[ns](2), string(12)
memory usage: 35.1 MB
```

[49]:

	Animal ID	Name	DateTime	MonthYear	Date of Birth	Outcome Type	\
0	A794011	Chunk	2019-05-08 18:20:00	May 2019	2017-05-02	Rto-Adopt	
1	A776359	Gizmo	2018-07-18 16:02:00	Jul 2018	2017-07-12	Adoption	
2	A821648	<NA>	2020-08-16 11:38:00	Aug 2020	2019-08-16	Euthanasia	
3	A720371	Moose	2016-02-13 17:59:00	Feb 2016	2015-10-08	Adoption	
4	A674754	<NA>	2014-03-18 11:47:00	Mar 2014	2014-03-12	Transfer	

	Outcome Subtype	Animal Type	Sex upon Outcome	Age upon Outcome	…	\
0	<NA>	Cat	Neutered Male	2 years	…	
1	<NA>	Dog	Neutered Male	1 year	…	
2	<NA>	Other	Unknown	1 year	…	
3	<NA>	Dog	Neutered Male	4 months	…	
4	Partner	Cat	Intact Male	6 days	…	

	Color 1 G	Color 1 B	Color 1 H	Color 1 S	Color 1 V	\
0	1.0	1.0	0.0	0.0	1.0	
1	0.44	0.09	0.119444	0.85	0.59	
2	<NA>	<NA>	<NA>	<NA>	<NA>	
3	<NA>	<NA>	<NA>	<NA>	<NA>	
4	<NA>	<NA>	<NA>	<NA>	<NA>	

	Age upon Outcome (years)	Male	Female	NeuteredOrSpayed	Adopted
0	2.0	True	False	True	True
1	1.0	True	False	True	True
2	1.0	False	False	False	False
3	0.333333	True	False	True	True
4	0.016438	True	False	False	False

[5 rows x 32 columns]

[50]:
```
df_breeds_with_info.head()
```

[50]:

	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 43 columns]

1 Analysis by breed

There isn't much correlation appearing yet

[51]:
```
df_breeds_with_info_corr = df_breeds_with_info.corr()

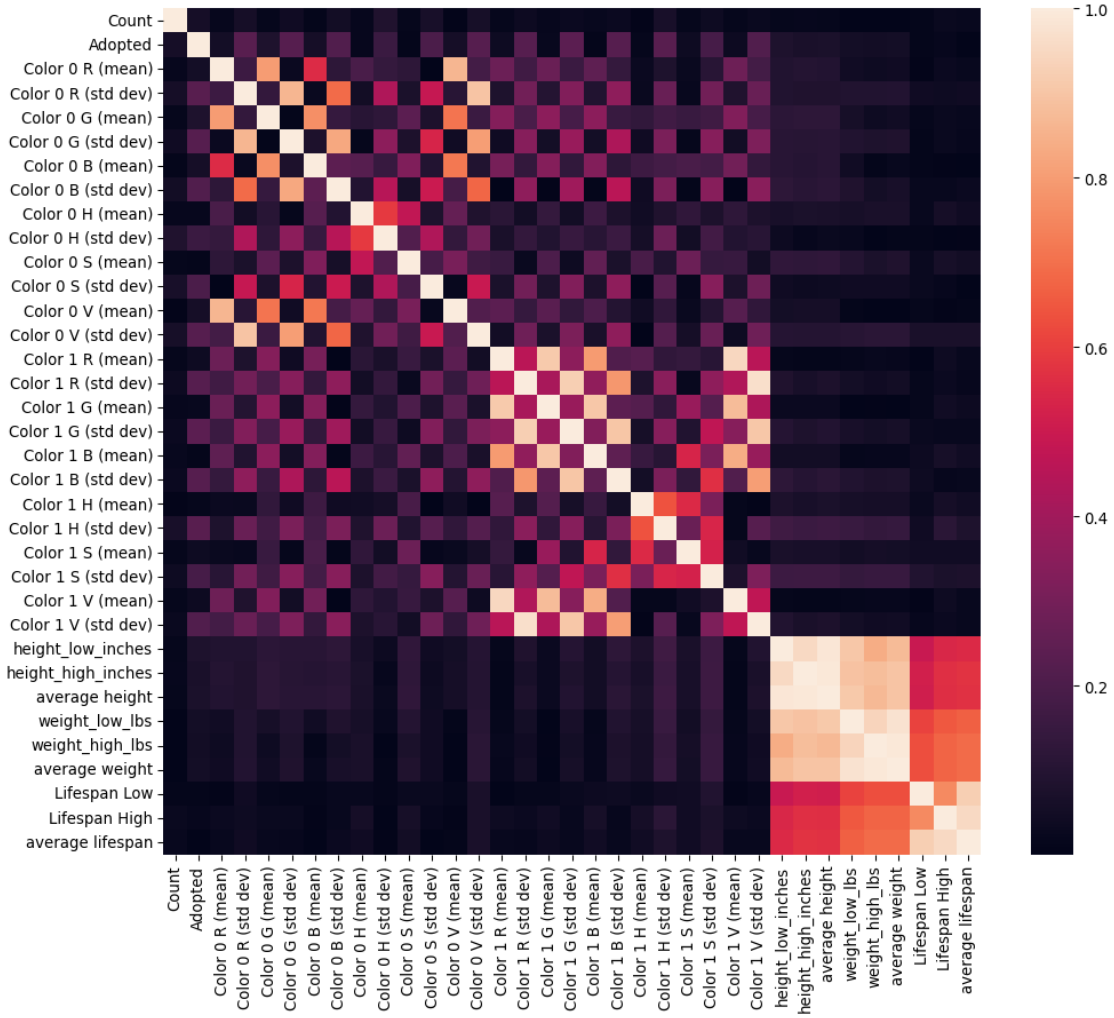
plt.figure(num=None, figsize=(12, 10), dpi=96, facecolor='w', edgecolor='k')
sns.heatmap(data=df_breeds_with_info_corr.abs())

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')
```

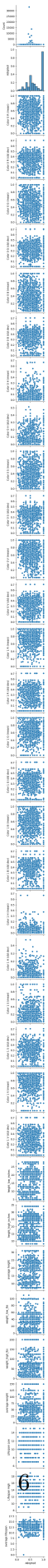
```
/tmp/ipykernel_105767/4118066584.py:1: FutureWarning: The default value of
numeric_only in DataFrame.corr is deprecated. In a future version, it will
default to False. Select only valid columns or specify the value of numeric_only
to silence this warning.
  df_breeds_with_info_corr = df_breeds_with_info.corr()
```

```
Corr(Adopted, Color 0 B (mean))   -0.057521961020765885
Corr(Adopted, Color 0 B (std dev))   -0.21220098425344674
Corr(Adopted, Color 0 V (mean))   -0.05892713325516749
Corr(Adopted, Color 0 V (std dev))   -0.22375794566214077
Corr(Adopted, average height)   0.07520172186737319
Corr(Adopted, height_low_inches)   0.08043859187253975
Corr(Adopted, height_high_inches)   0.06827302387620472
Corr(Adopted, Lifespan Low)   0.011194168083224364
```



[52]:
```
sns.pairplot(data=df_breeds_with_info, x_vars=['Adopted'])
```

[52]: <seaborn.axisgrid.PairGrid at 0x7fb719a13a90>

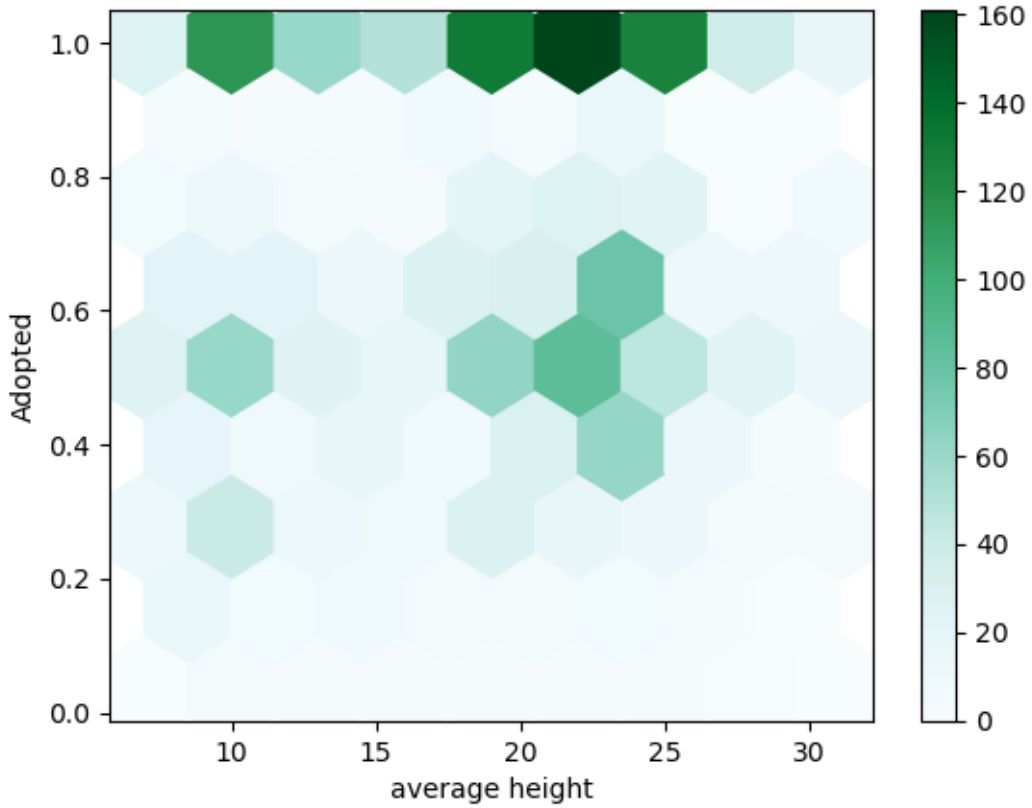

Count
Adopted
Child 1 Gender
Child 1 DOB Month
Child 2 Gender
Child 2 DOB Month
Child 3 Gender
Child 3 DOB Month
Child 4 Gender
Child 4 DOB Month
Child 5 Gender
Child 5 DOB Month
Child 6 Gender
Child 6 DOB Month
Child 7 Gender
Child 7 DOB Month
Child 8 Gender
Child 8 DOB Month
Child 9 Gender
Child 9 DOB Month
Child 10 Gender
Child 10 DOB Month
Child 11 Gender
Child 11 DOB Month
Child 12 Gender
Child 12 DOB Month
Child 13 Gender
Child 13 DOB Month
Child 14 Gender
Child 14 DOB Month
Child 15 Gender
Child 15 DOB Month
Mother_Has_Twins
Mother_Height_Inches
Pre-Pregn Weight
Weight_Gain_Pds
Weight_Gain_Pds
Pre-Pregn Weight
Obstetric Estim
Delivery Year
Live Birth Children

1.1 Height ~ adopted?

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

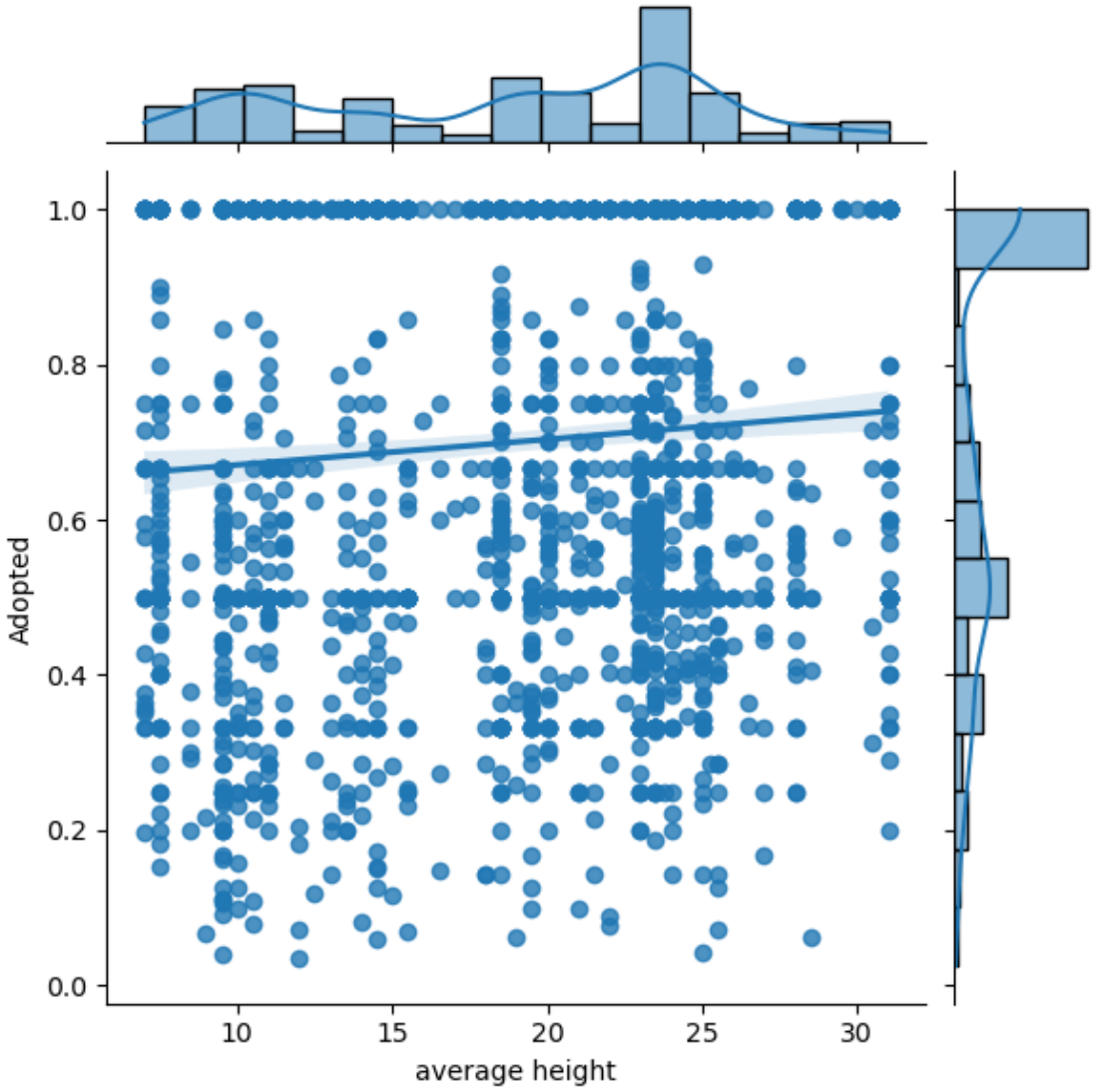
[53]:
```
df_breeds_with_info.plot.hexbin(x='average height', y='Adopted', gridsize=8)
```

[53]:
```
<AxesSubplot:xlabel='average height', ylabel='Adopted'>
```



[54]:
```
sns.jointplot(
    x=df_breeds_with_info['average height'].astype(dtype=float),
    y=df_breeds_with_info.Adopted.astype(dtype=float),
    kind='reg')
```

[54]:
```
<seaborn.axisgrid.JointGrid at 0x7fb718ed43d0>
```



2 Analysis by individuals

2.1 Color

(results)

[55]:
```
print('Colors')
print(df_out_with_breeds_info['Color 0'].unique())
print(df_out_with_breeds_info['Color 1'].unique())
```

```
Colors
<StringArray>
[      'Brown Tabby',              'White',               'Gray',
```

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

[56]:
```
df_out_colors_1 = df_out.loc[(df_out['Color 0'].notna() == True) &␣
 ↪(df_out['Color 1'].notna() == False)]
df_out_colors_2 = df_out.loc[(df_out['Color 0'].notna() == True) &␣
 ↪(df_out['Color 1'].notna() == True)]
```

[57]:
```
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]
```

[58]:
```
def bigCorr_bernoulli_custom_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_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]
```

[59]:
```
# 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)
```

[60]:
```
def chartColorAdoptionLikelihood(df_colors, color_relation):

    # 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 ({(1 - alpha):%} confidence)')
```

```
    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():
    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')

def colors_mixed():
    colors_adopted = bigCorr_bernoulli_custom_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')

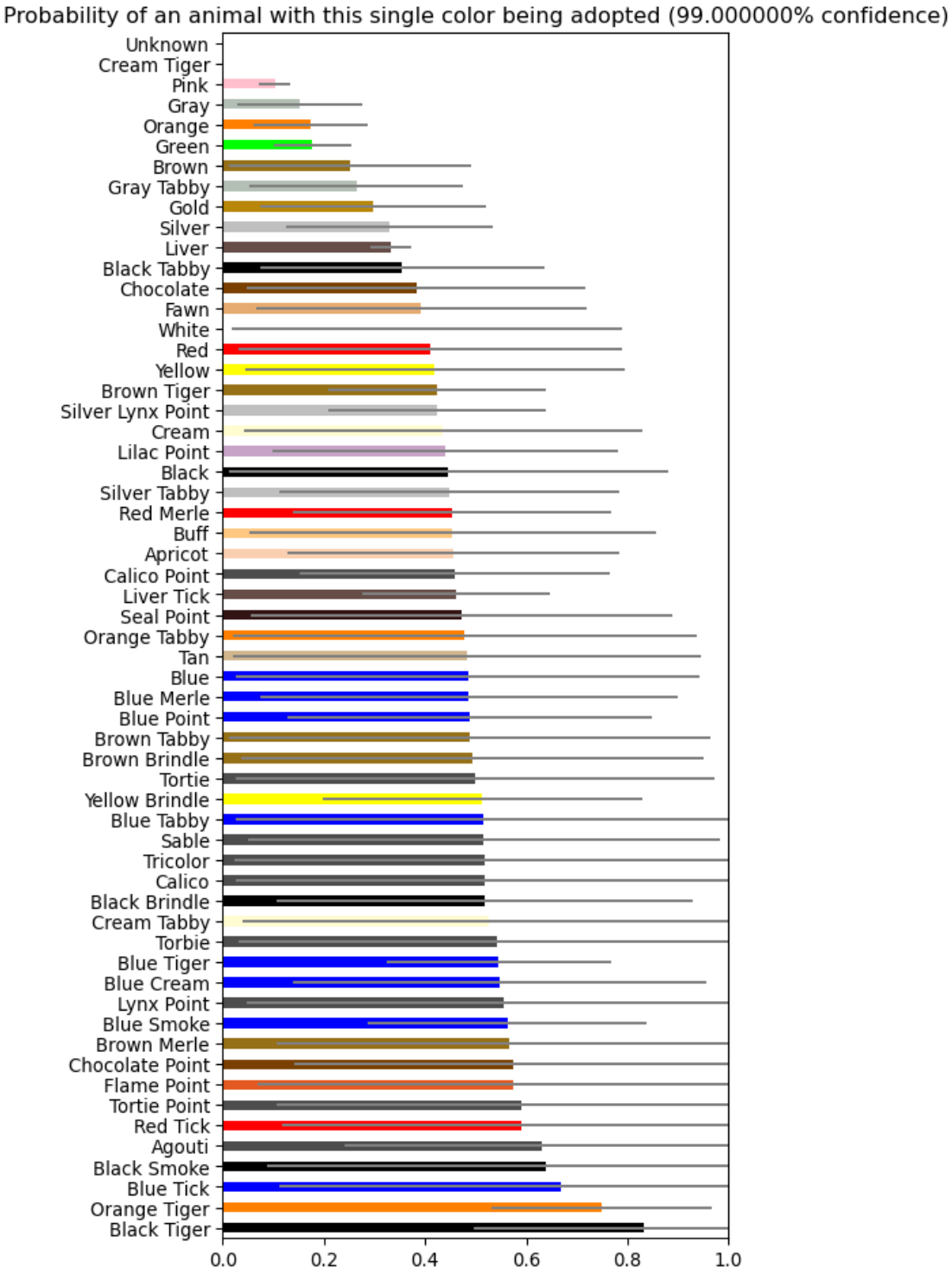
def colors_singleOrMixed():
    colors_adopted = bigCorr_bernoulli_custom_colors_1_or_2()
    colors_count = df_out_colors_1['Color 0'].value_counts().
↪add(df_out_colors_2['Color 0'].value_counts(), fill_value=0).
↪add(df_out_colors_2['Color 1'].value_counts(), fill_value=0)
    df_colors = pd.DataFrame(index=colors_count.index)
    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')

colors_single()
colors_mixed()
colors_singleOrMixed()

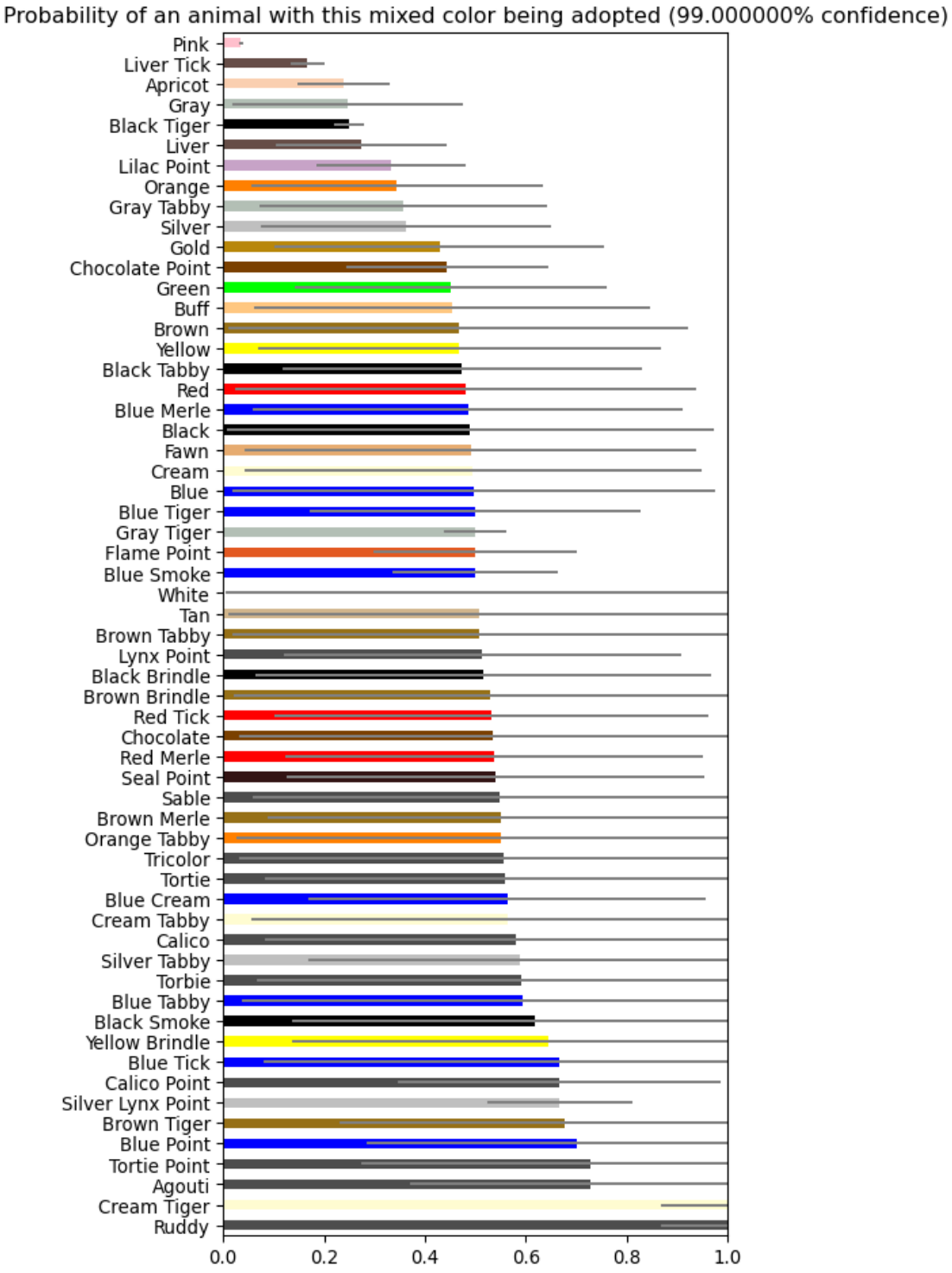
df_colors_outcomes = df_out_colors_1[['Outcome Type', 'Color 0']]
plt.figure(num=None, figsize=(5, 12), dpi=96, facecolor='w', edgecolor='k')
plt.title('Probability of an animal with this solid color having a certain␣
↪outcome')
sns.histplot(
```

```
    data=df_colors_outcomes,
    y='Color 0',
    hue='Outcome Type',
    multiple='fill',
)
```

```
/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 (99.000000% confidence)
Unknown
Cream Tiger
Pink
Gray
Orange
Green
Brown
Gray Tabby
Gold
Silver
Liver
Black Tabby
Chocolate
Fawn
White
Red
Yellow
Brown Tiger
Silver Lynx Point
Cream
Lilac Point
Black
Silver Tabby
Red Merle
Buff
Apricot
Calico Point
Liver Tick
Seal Point
Orange Tabby
Tan
Blue
Blue Merle
Blue Point
Brown Tabby
Brown Brindle
Tortie
Yellow Brindle
Blue Tabby
Sable
Tricolor
Calico
Black Brindle
Cream Tabby
Torbie
Blue Tiger
Blue Cream
Lynx Point
Blue Smoke
Brown Merle
Chocolate Point
Flame Point
Tortie Point
Red Tick
Agouti
Black Smoke
Blue Tick
Orange Tiger
Black Tiger
0.0
0.2
0.4
0.6
0.8
1.0

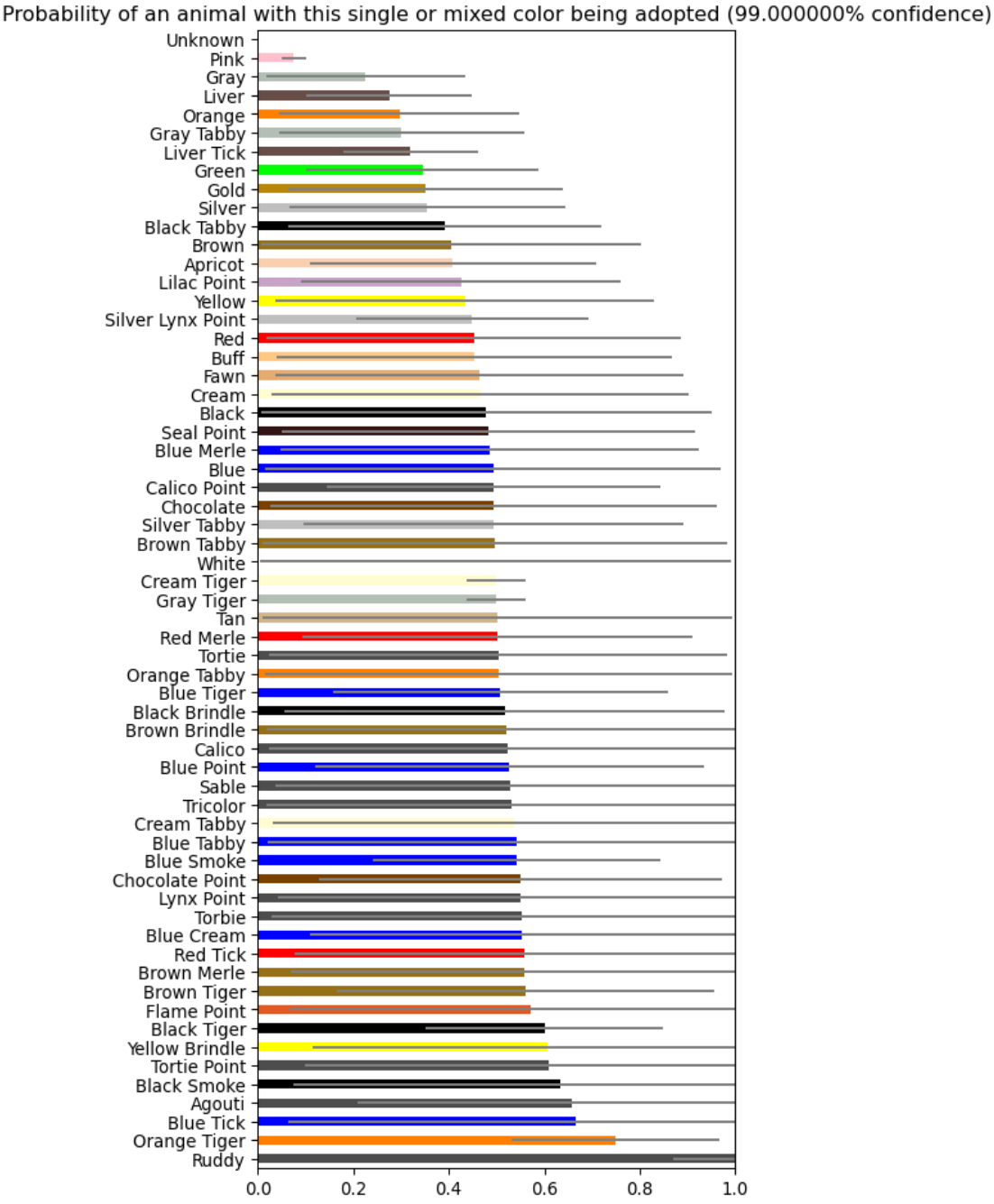
```
59 colors
```




```
59 colors

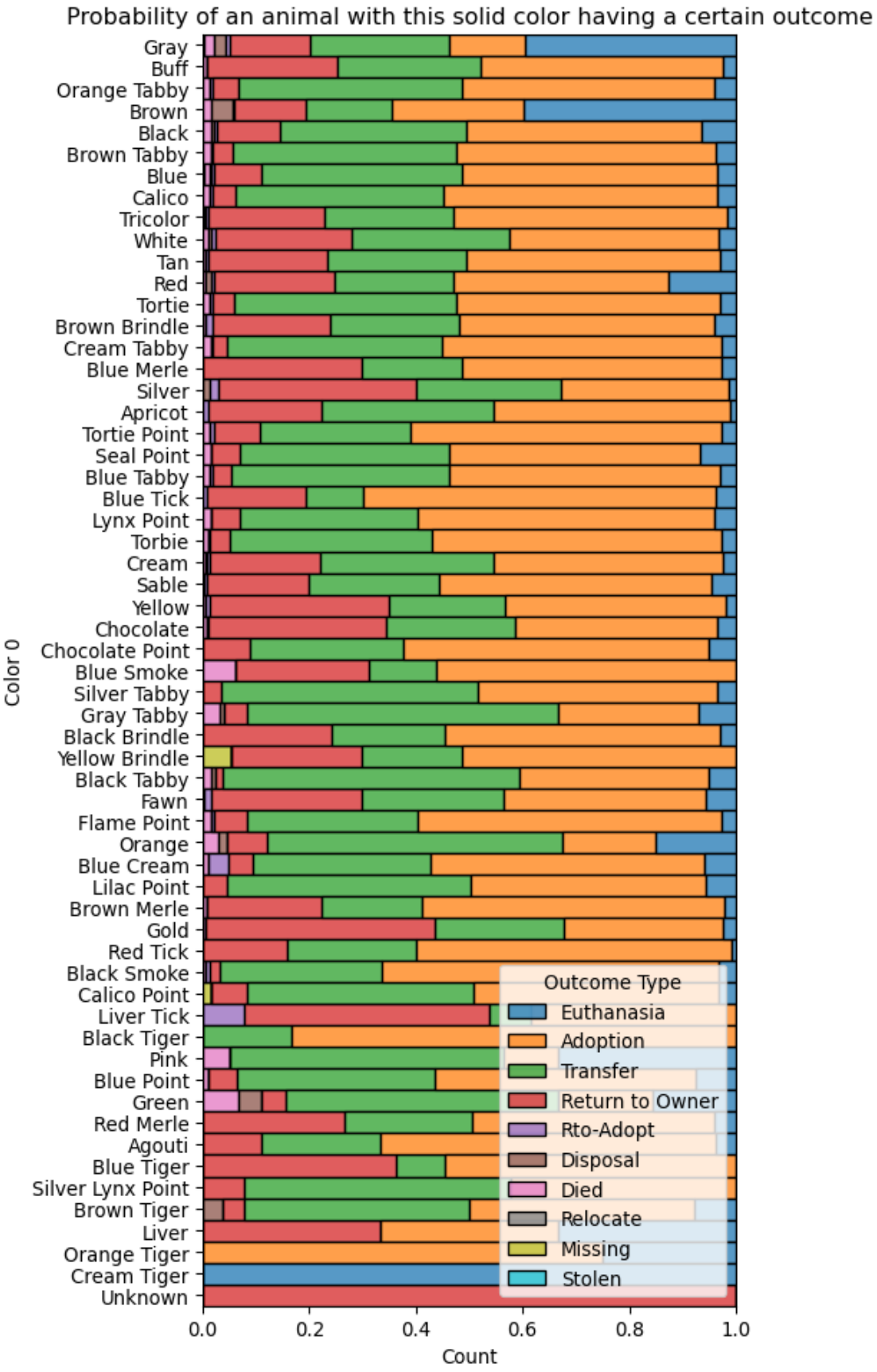
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
```

```
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)
```



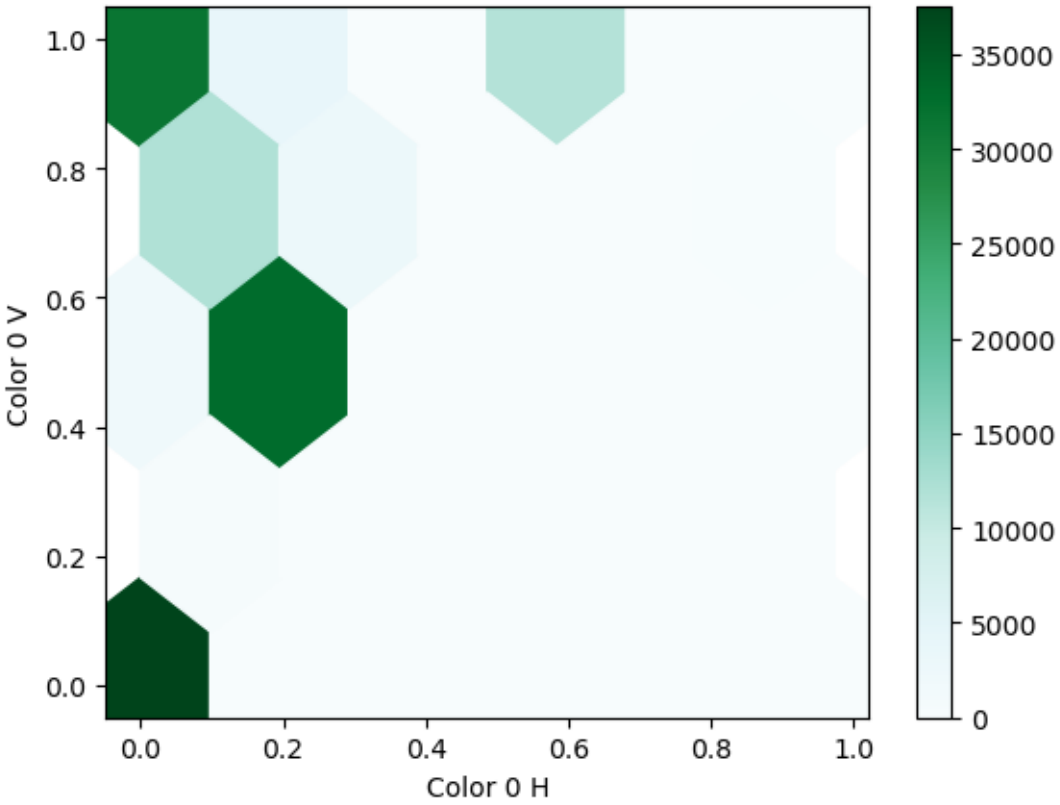
```
61 colors
```

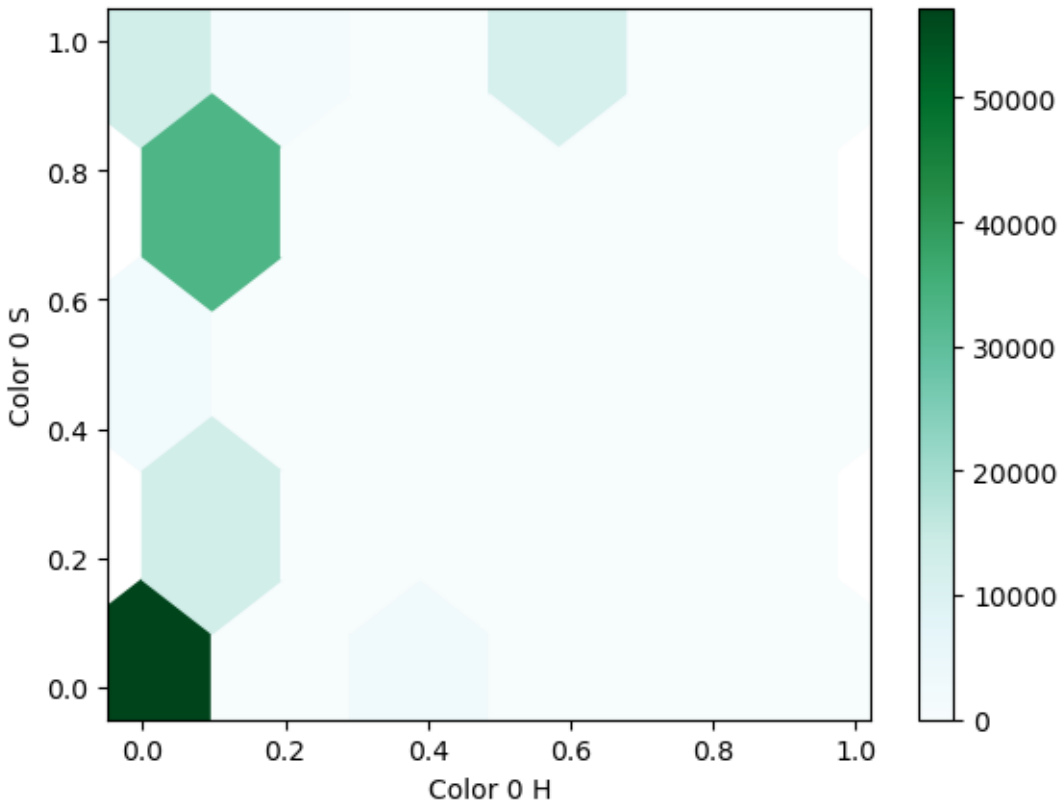
[60]:
```
<AxesSubplot:title={'center':'Probability of an animal with this solid color
having a certain outcome'}, xlabel='Count', ylabel='Color 0'>
```

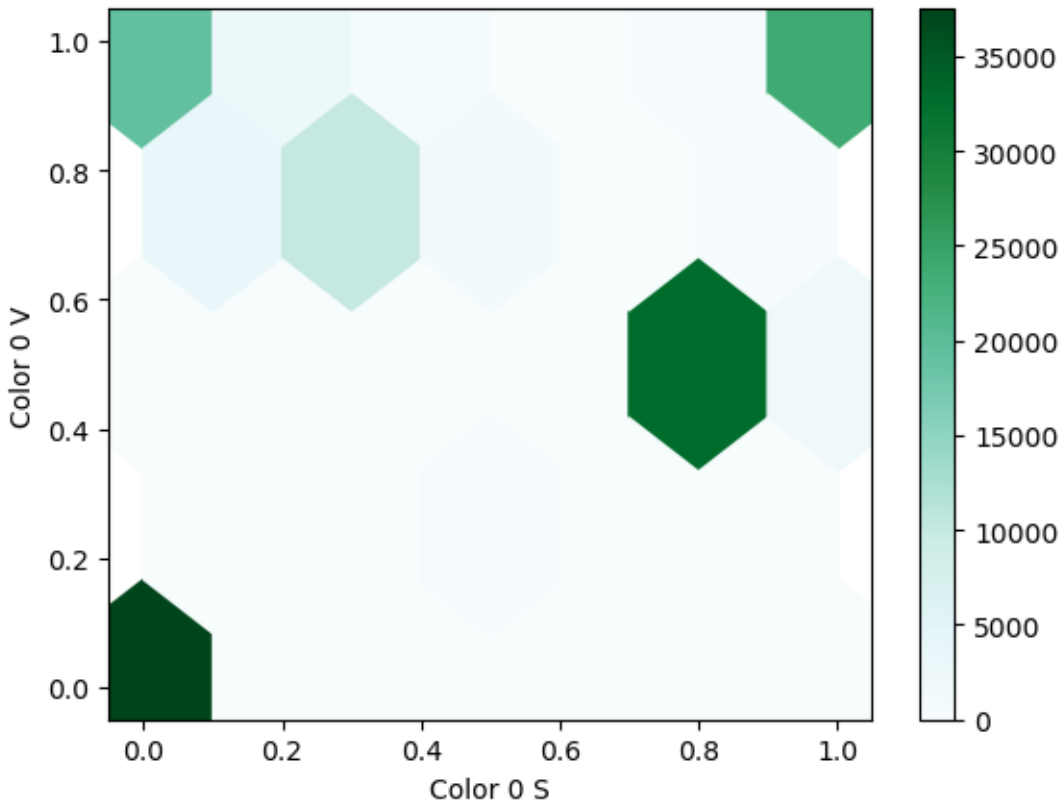

Probability of an animal with this solid color having a certain outcome
Color 0
Gray
Buff
Orange Tabby
Brown
Black
Brown Tabby
Blue
Calico
Tricolor
White
Tan
Red
Tortie
Brown Brindle
Cream Tabby
Blue Merle
Silver
Apricot
Tortie Point
Seal Point
Blue Tabby
Blue Tick
Lynx Point
Torbie
Cream
Sable
Yellow
Chocolate
Chocolate Point
Blue Smoke
Silver Tabby
Gray Tabby
Black Brindle
Yellow Brindle
Black Tabby
Fawn
Flame Point
Orange
Blue Cream
Lilac Point
Brown Merle
Gold
Red Tick
Black Smoke
Calico Point
Liver Tick
Black Tiger
Pink
Blue Point
Green
Red Merle
Agouti
Blue Tiger
Silver Lynx Point
Brown Tiger
Liver
Orange Tiger
Cream Tiger
Unknown
Outcome Type
Euthanasia
Adoption
Transfer
Return to Owner
Rto-Adopt
Disposal
Died
Relocate
Missing
Stolen
0.0
0.2
0.4
0.6
0.8
1.0
Count

[61]:
```
df_out.plot.hexbin(x='Color 0 H', y='Color 0 V', gridsize=5)
df_out.plot.hexbin(x='Color 0 H', y='Color 0 S', gridsize=5)
df_out.plot.hexbin(x='Color 0 S', y='Color 0 V', gridsize=5)
```

[61]: <AxesSubplot:xlabel='Color 0 S', ylabel='Color 0 V'>




1.0
0.8
0.6
0.4
0.2
0.0
Color 0 S
0.0
0.2
0.4
0.6
0.8
1.0
Color 0 H
50000
40000
30000
20000
10000
0



2.2 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: 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?

[62]:
```
df_out_1 = df_out.assign(Adopted=df_out.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}')
    sns.histplot(data=df,
                 x=independent,
                 hue=dependent,
                 multiple='fill',
```

```
            binwidth=binwidth)
    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],
    ['Color 0 H', 0.1],
    ['Color 0 S', 0.1],
    ['Color 0 V', 0.1]
]

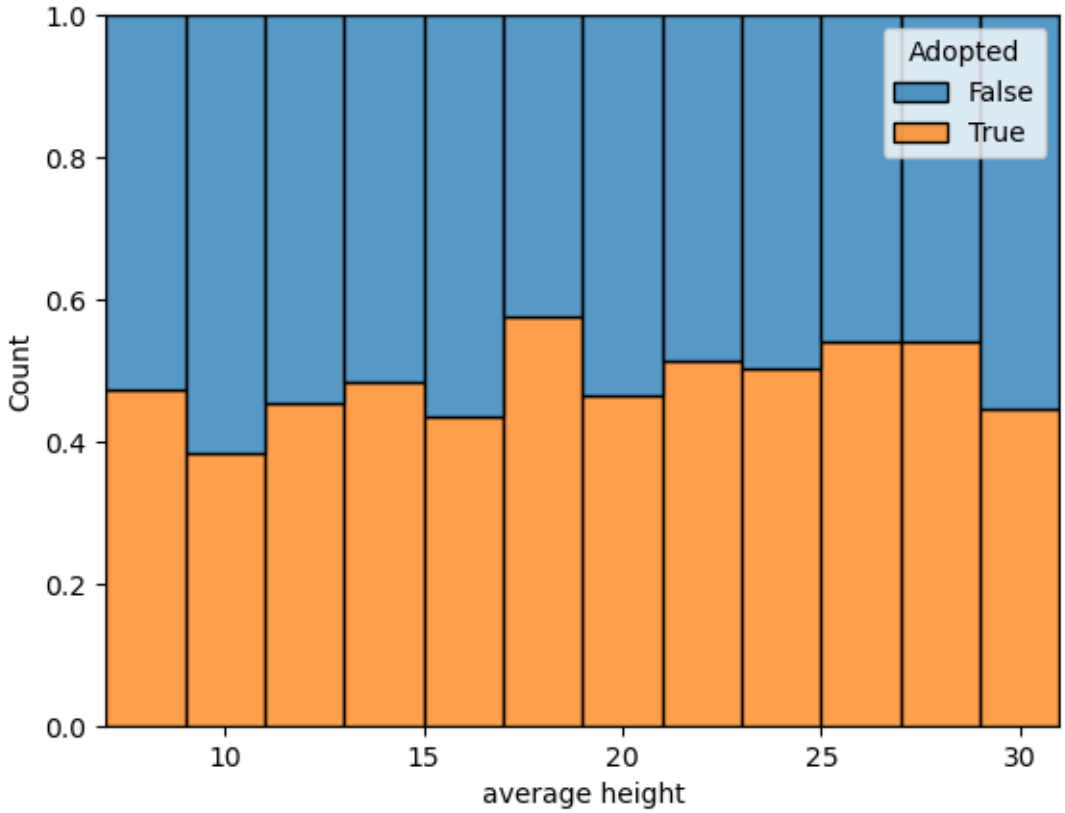
for [independent, binwidth] in independent_vars_breeds_info:
    for dependent in ['Adopted', 'Outcome Type']:
        correlo_histogram(df_out_with_breeds_info_1, independent, dependent,␣
 ↪binwidth)

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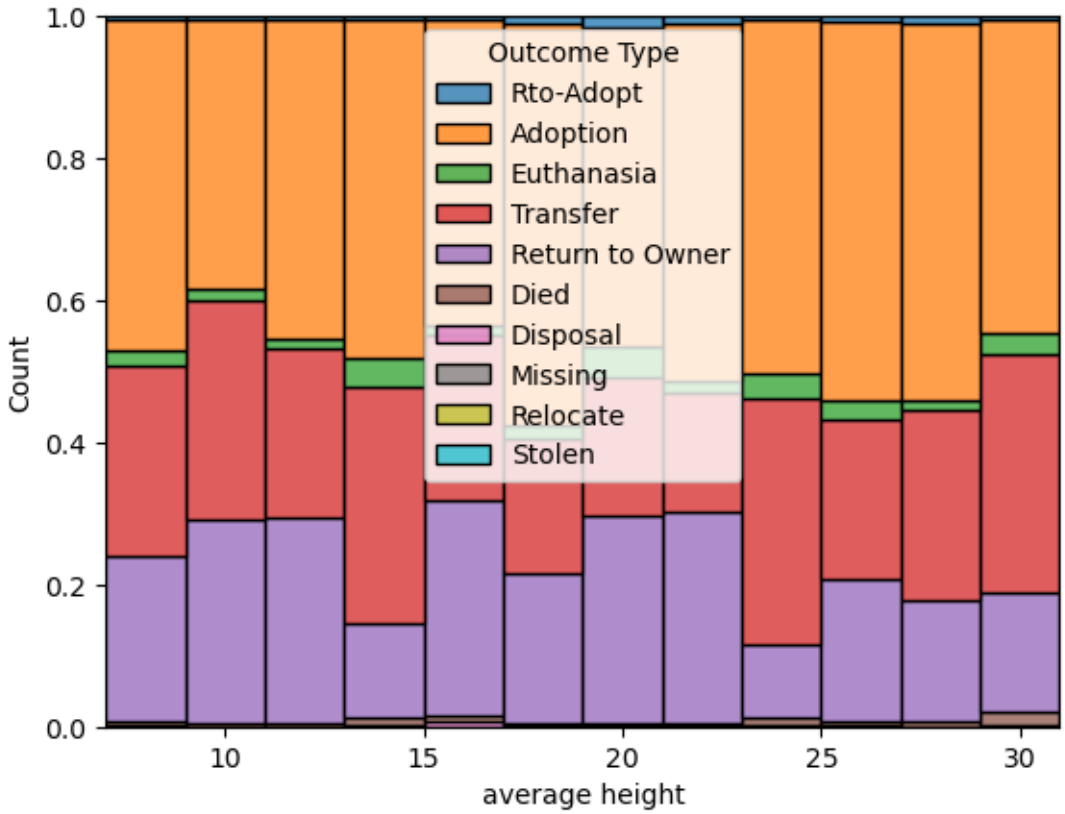
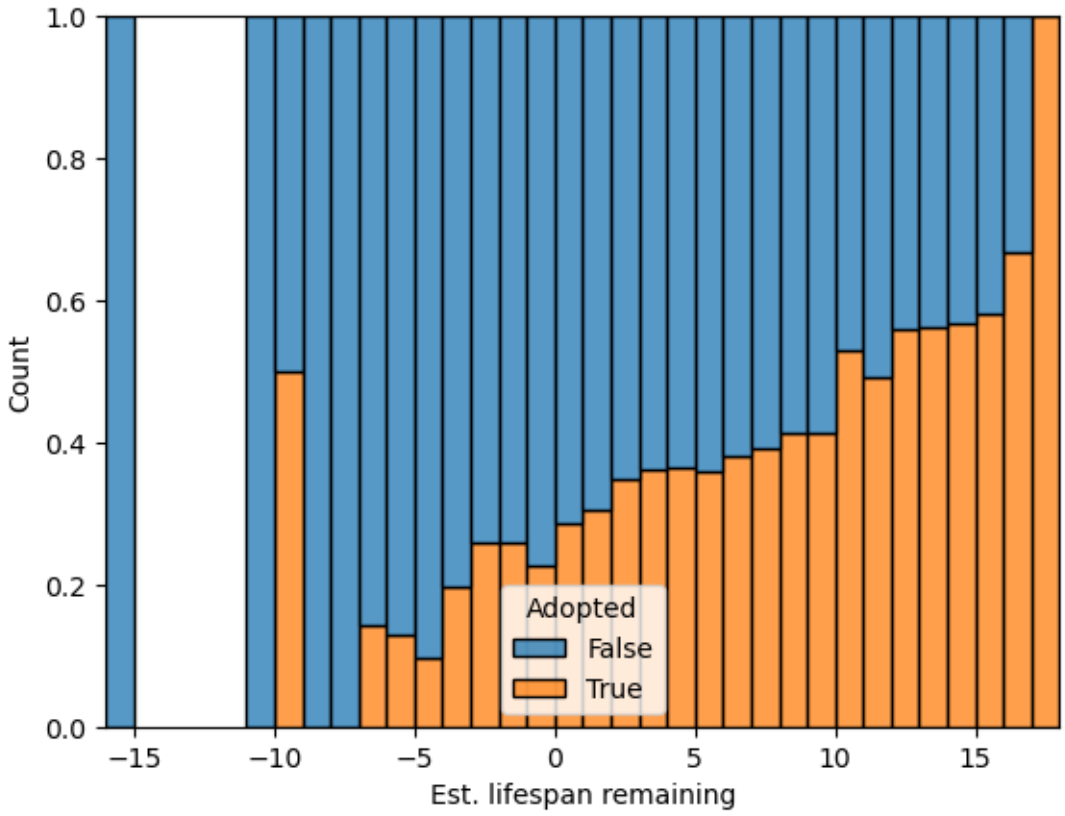
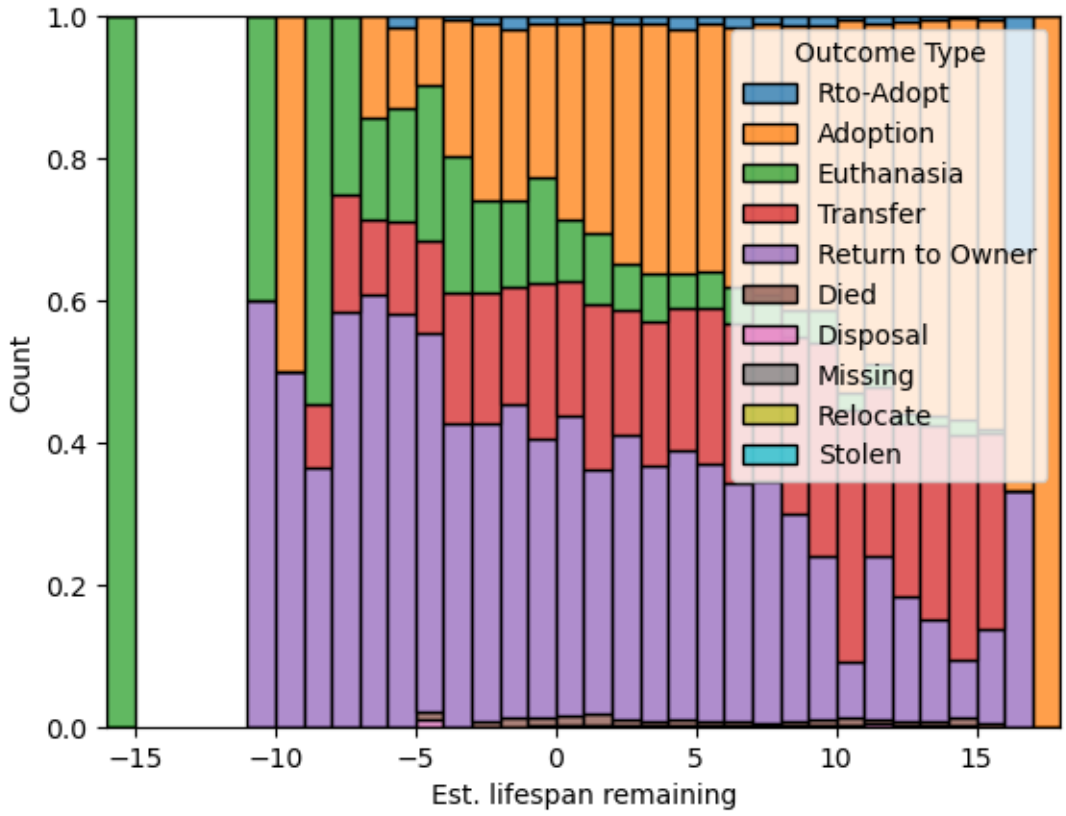
  pd.Index(widths, name="widths"),
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:499: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(edges, name="edges"),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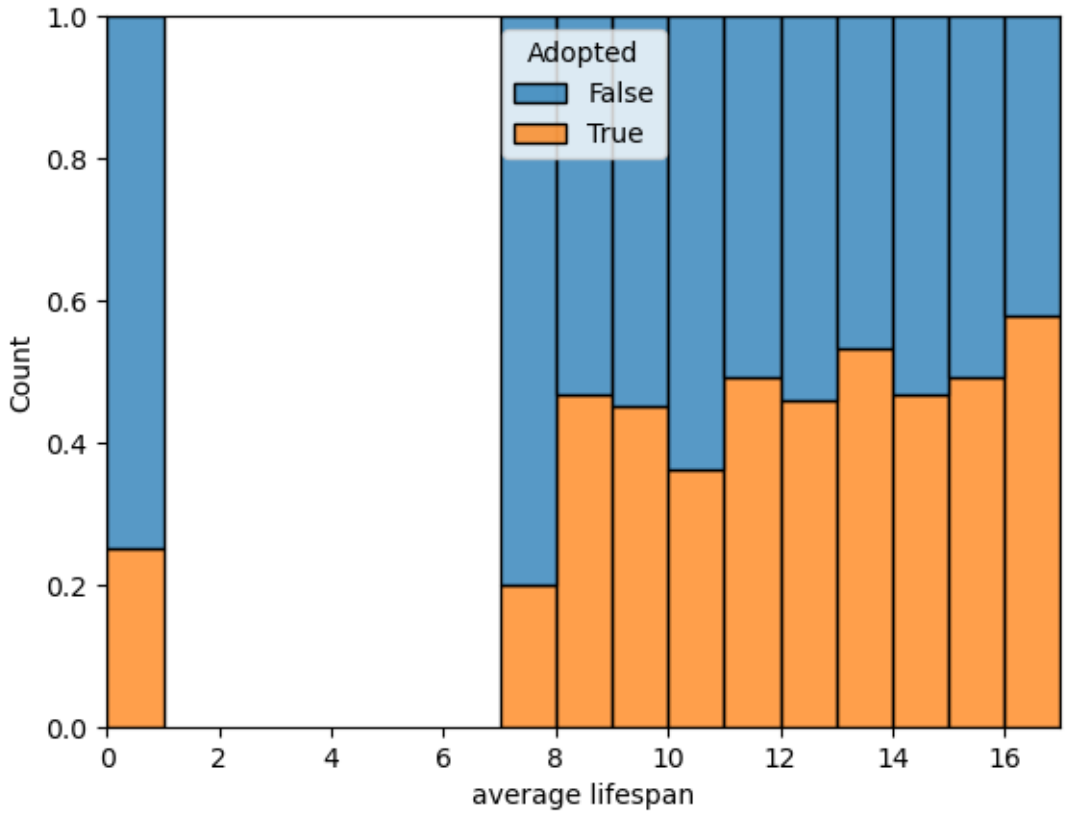
sequences (matching Series behavior)
  pd.Index(widths, name="widths"),
```




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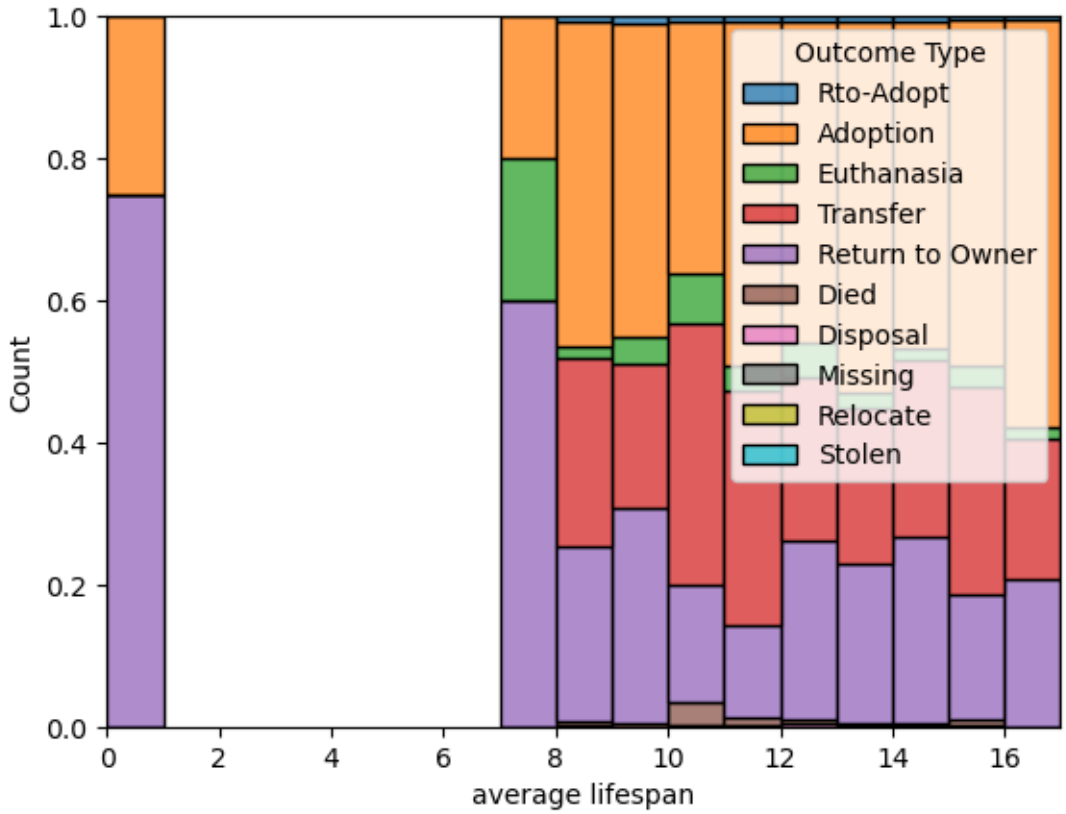
  pd.Index(edges, name="edges"),
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:500: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching Series behavior)
  pd.Index(widths, name="widths"),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



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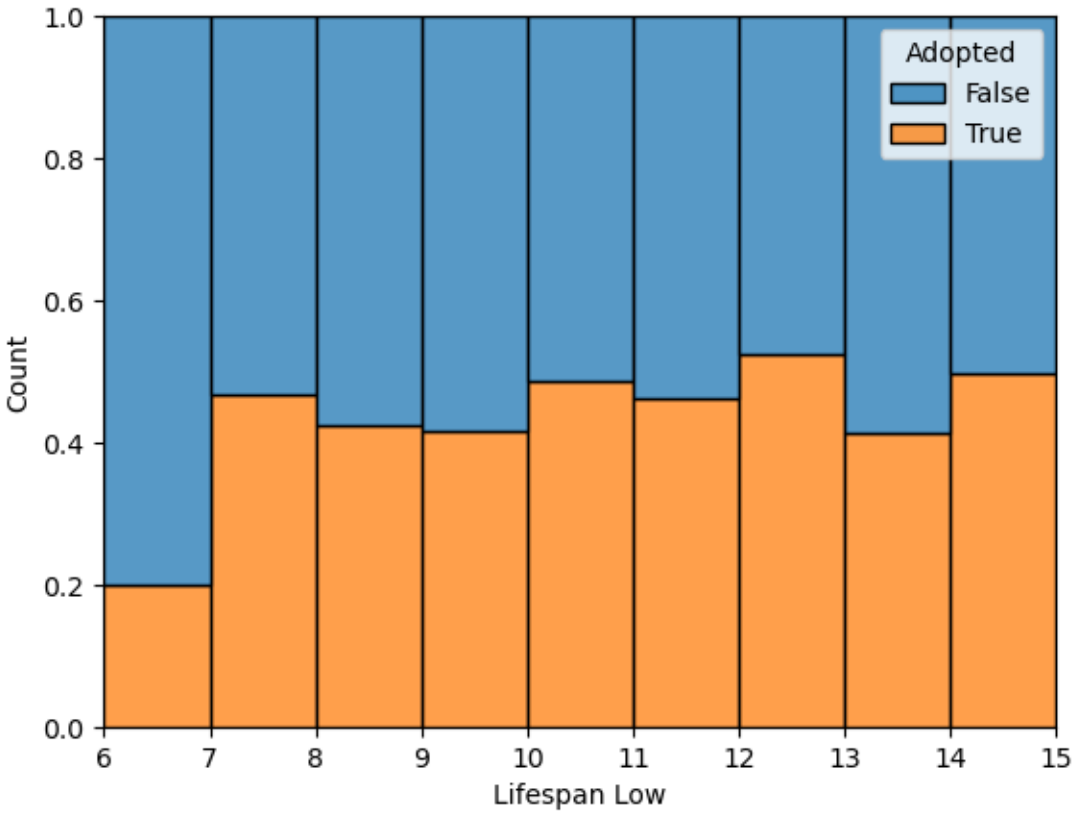
sequences (matching Series behavior)
  pd.Index(widths, name="widths"),
/home/isaac/miniconda3/envs/cse3380/lib/python3.10/site-
packages/seaborn/distributions.py:499: FutureWarning: In a future version, the
Index constructor will not infer numeric dtypes when passed object-dtype
sequences (matching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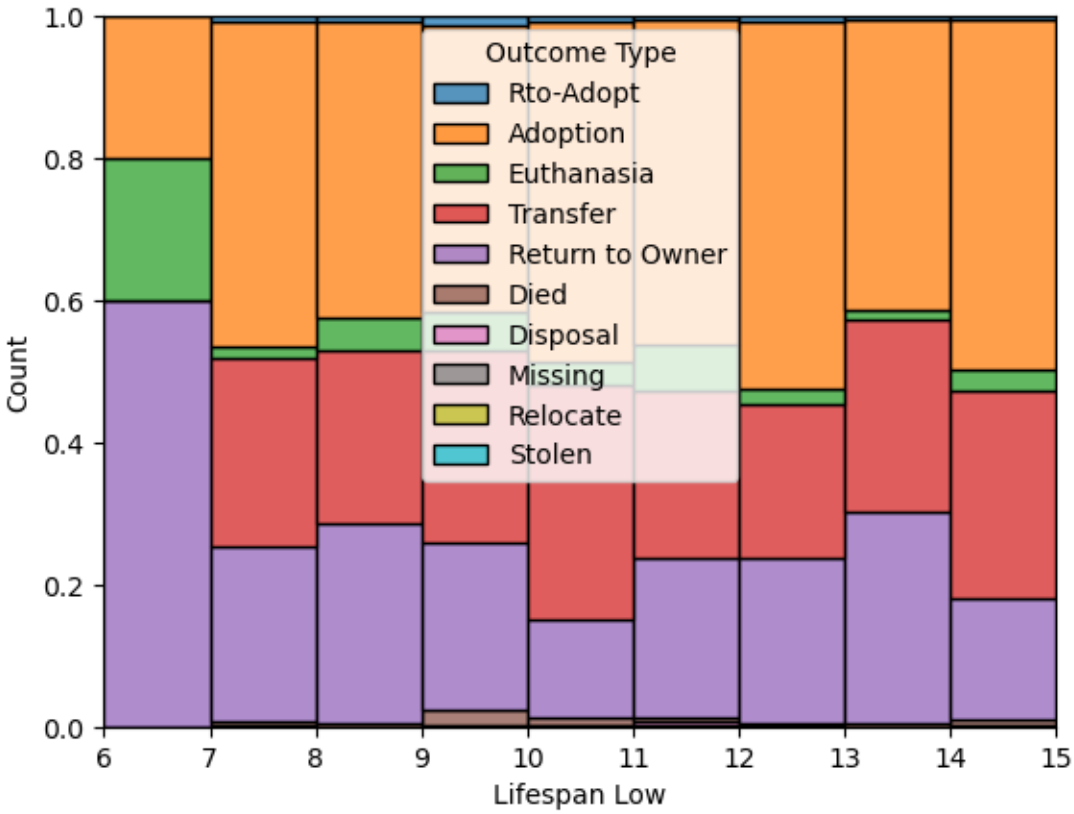

Lifespan High ~ Adopted

```
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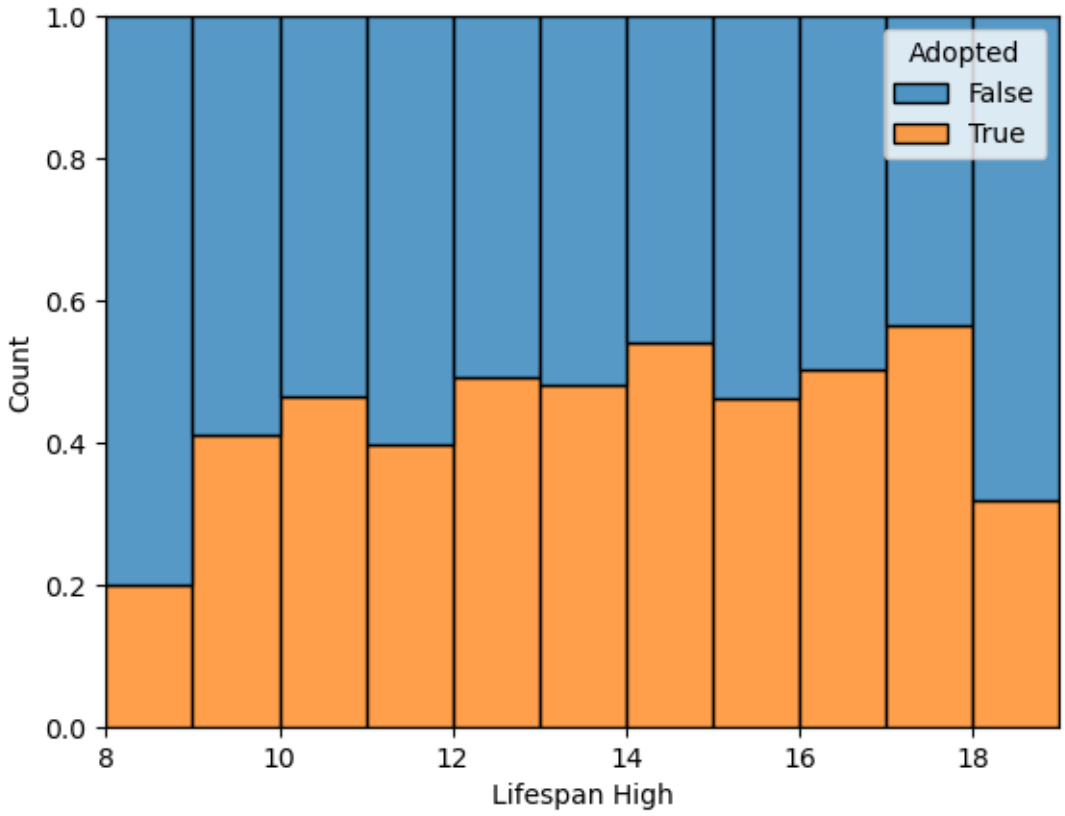

Lifespan High ~ Outcome Type

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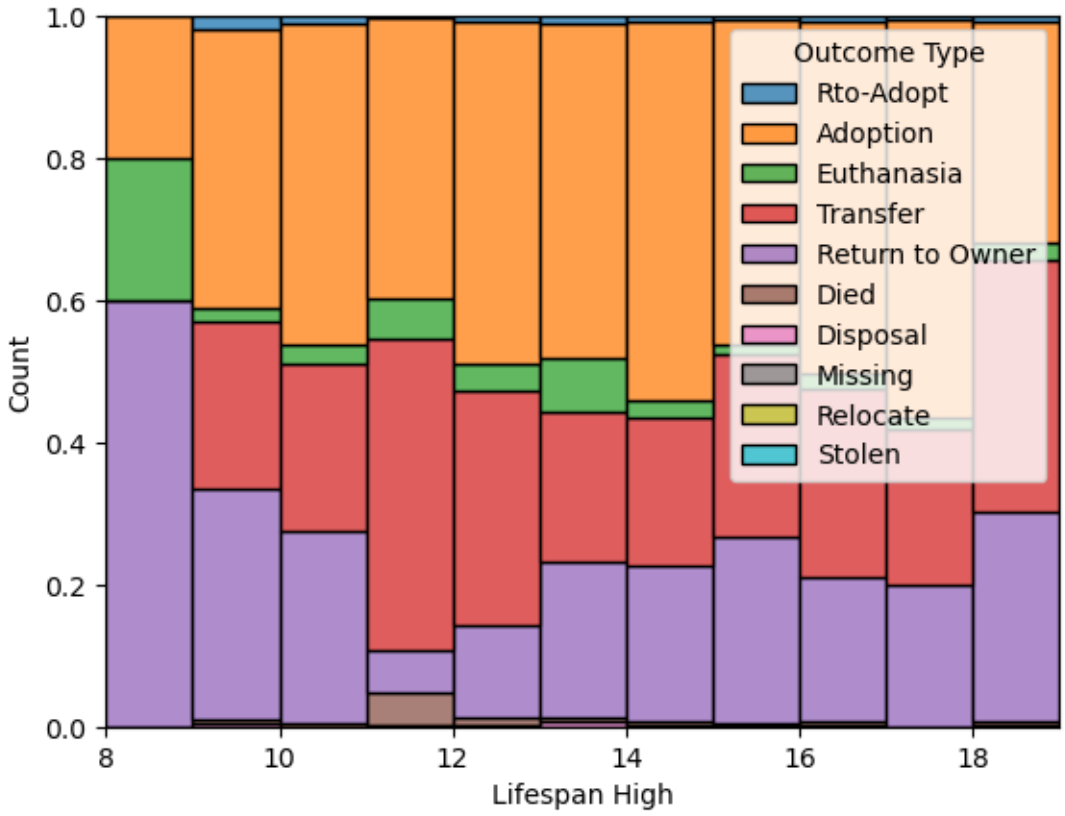

Age upon Outcome (years) ~ Adopted

```
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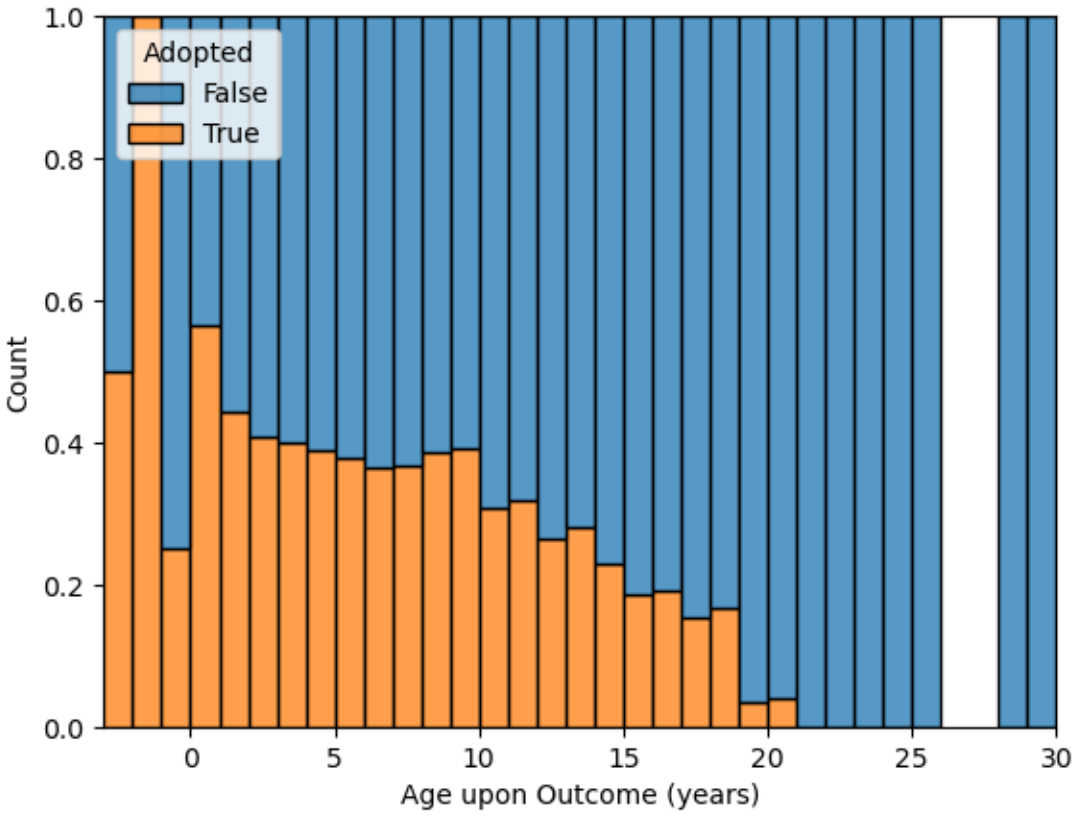

Age upon Outcome (years) ~ Outcome Type

```
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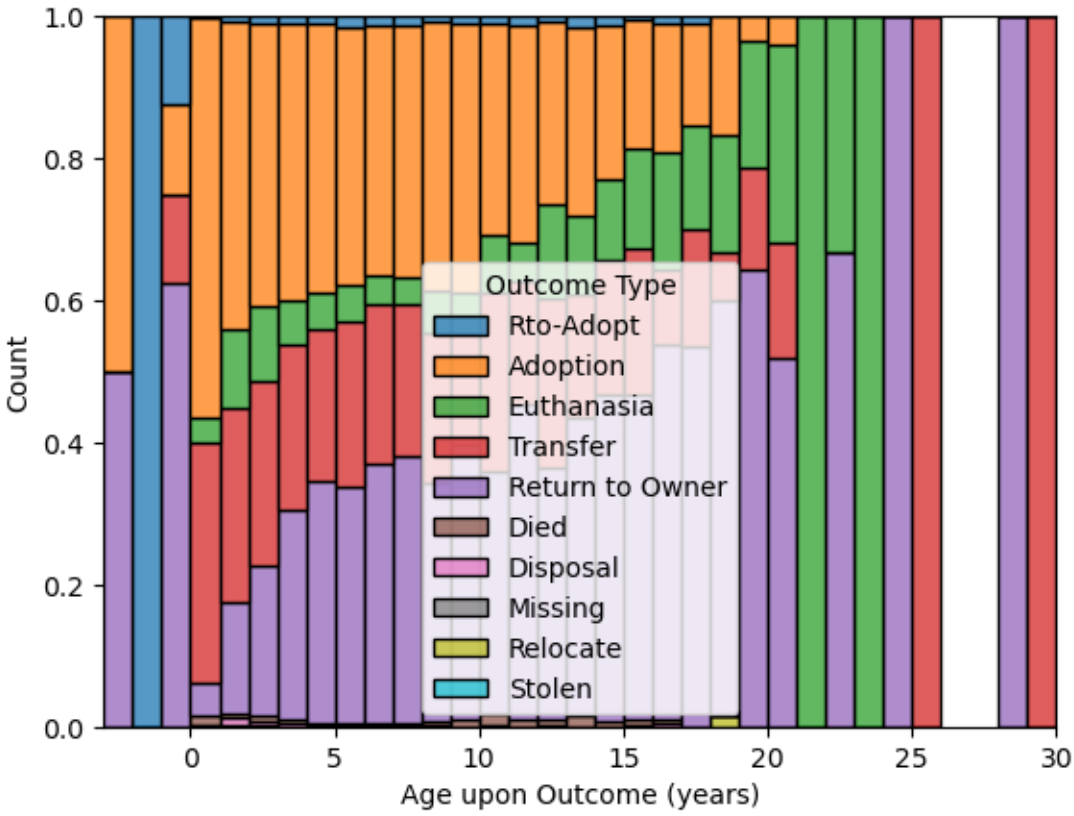


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Color 0 H ~ Adopted
```

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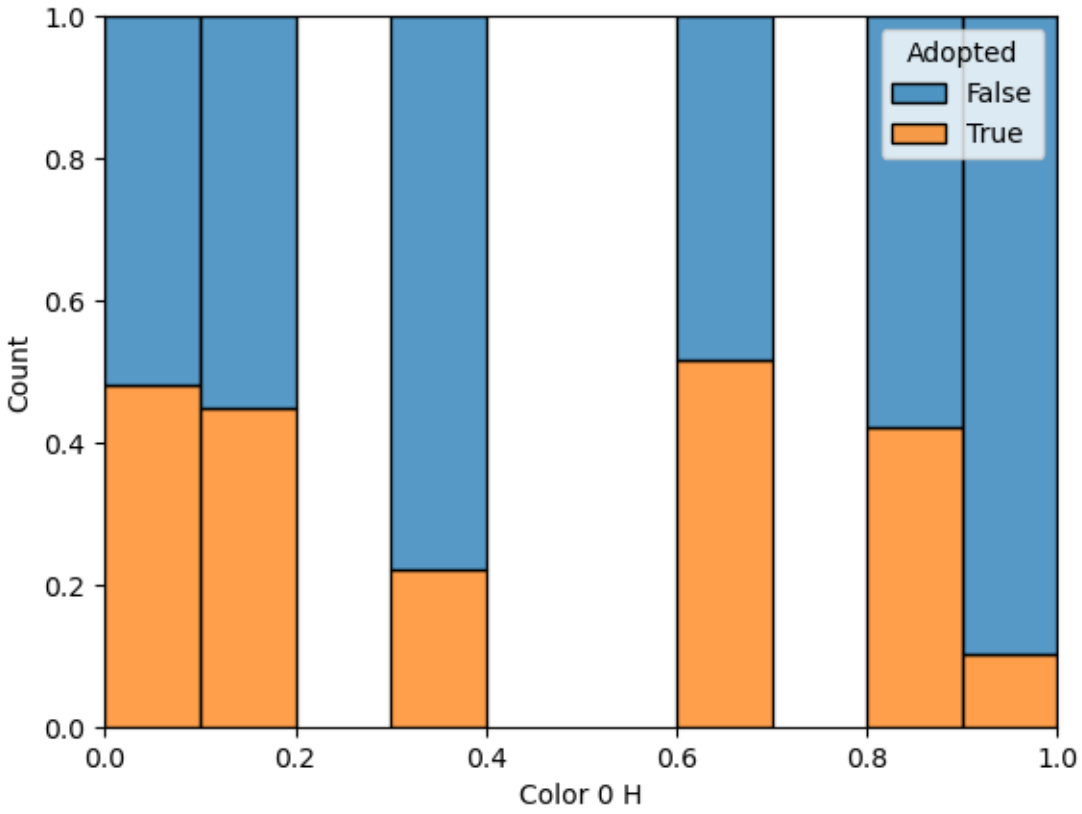

Color 0 H ~ Outcome Type

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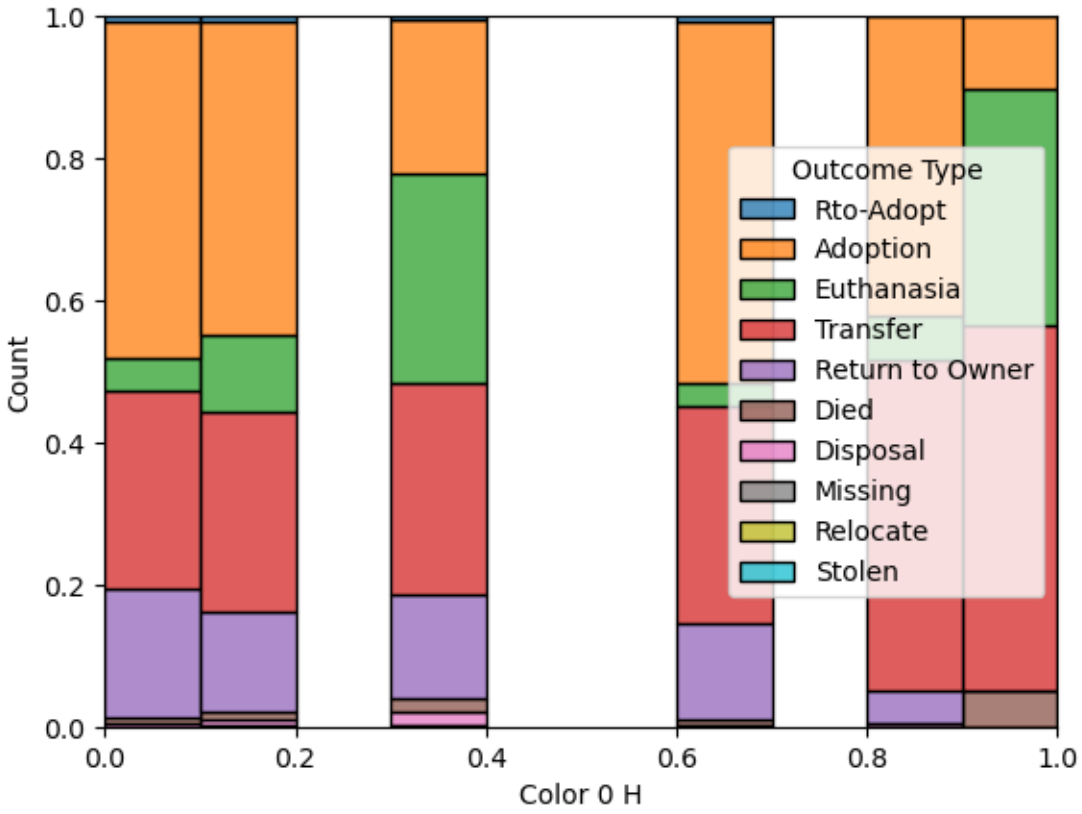

Color 0 S ~ Adopted

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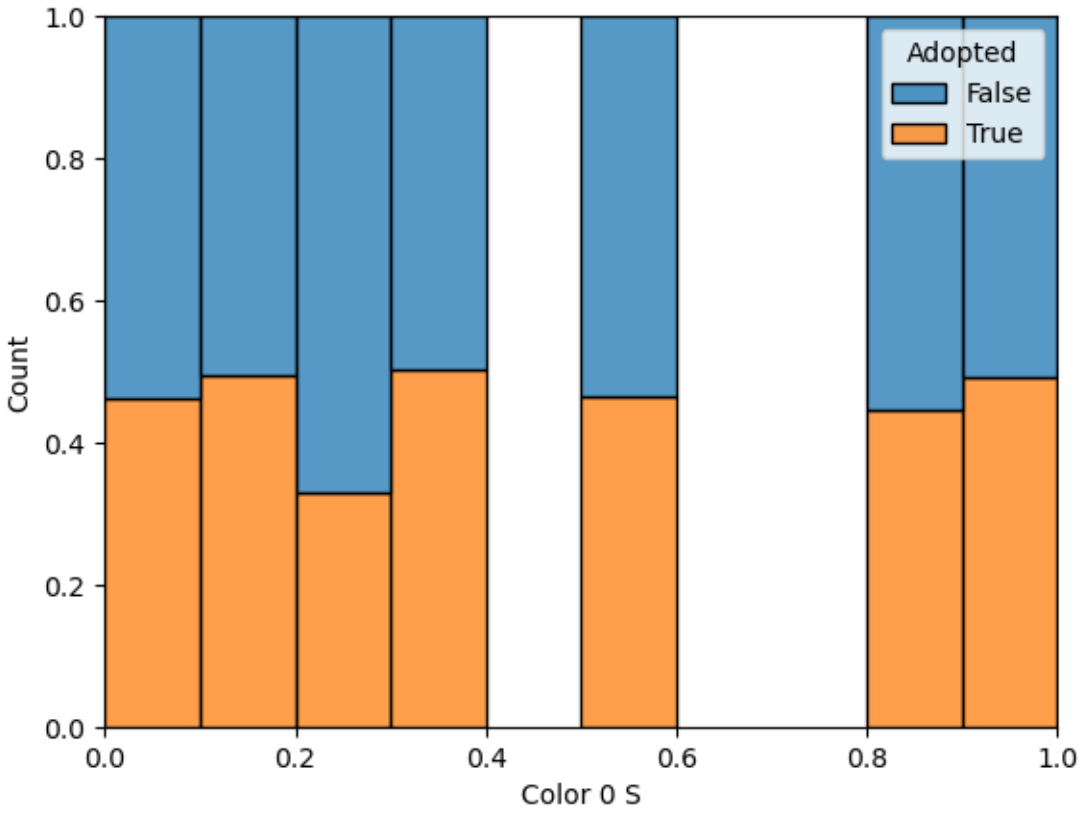

Color 0 S ~ Outcome Type

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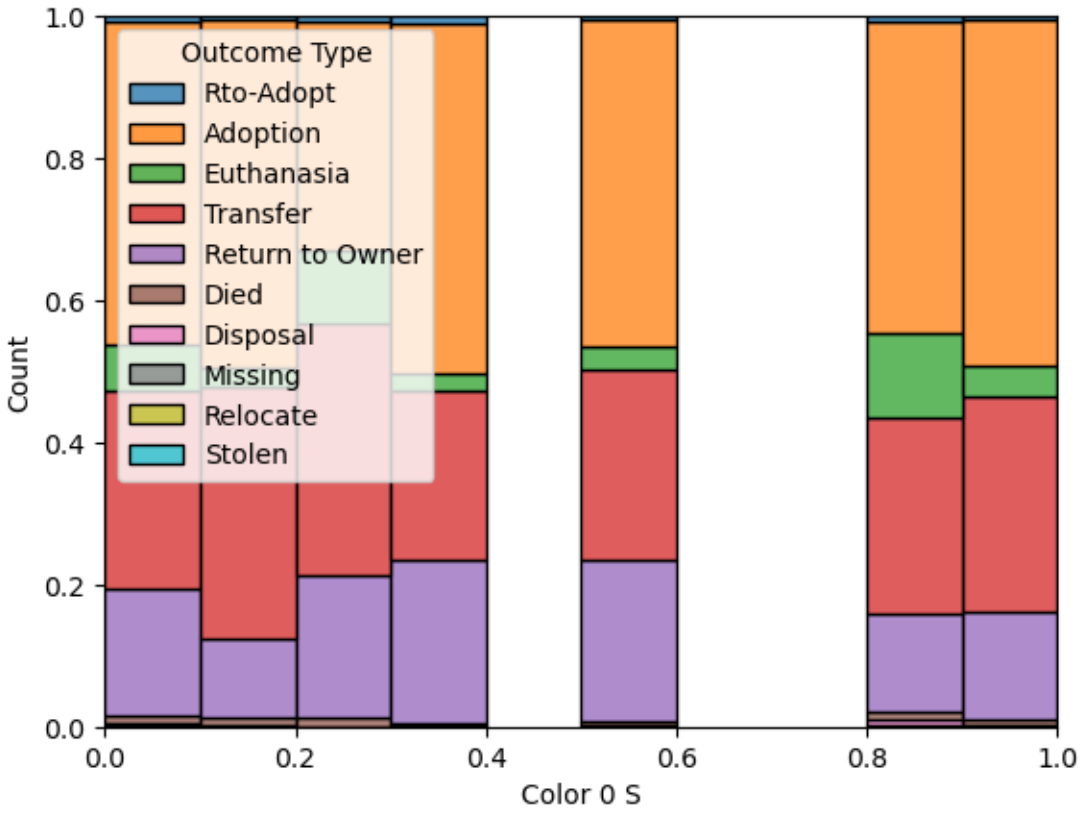


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Color 0 V ~ Adopted
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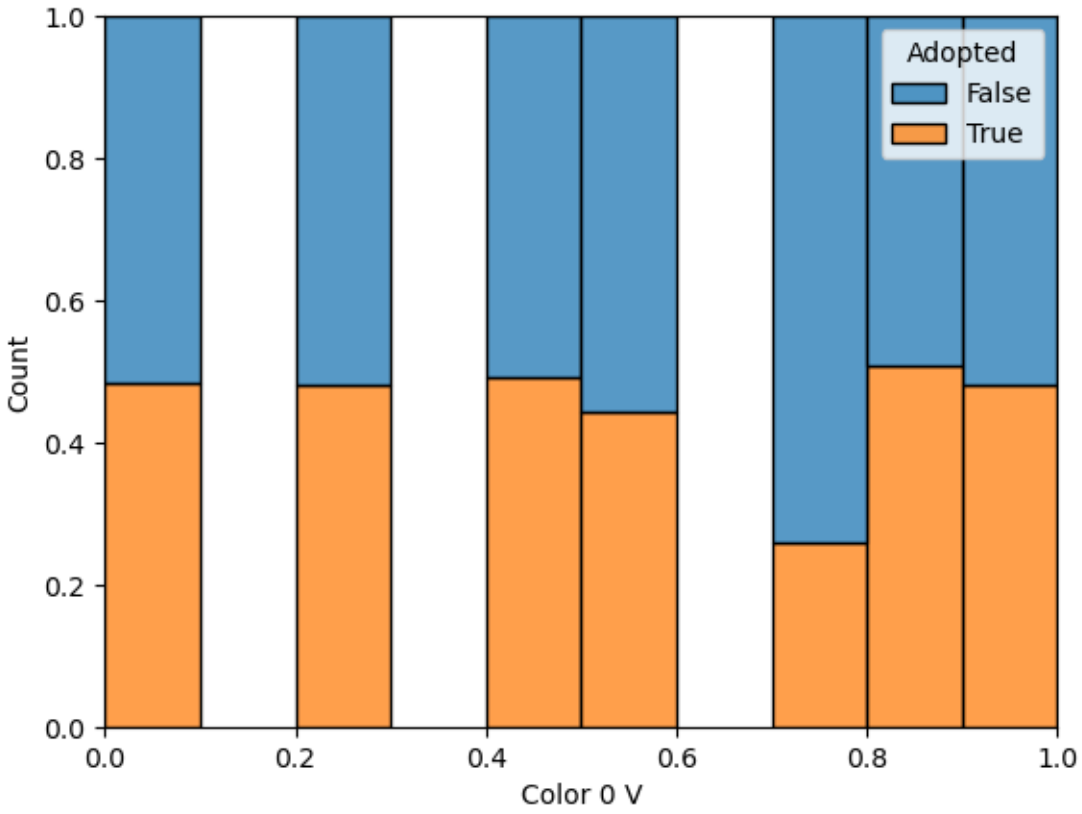

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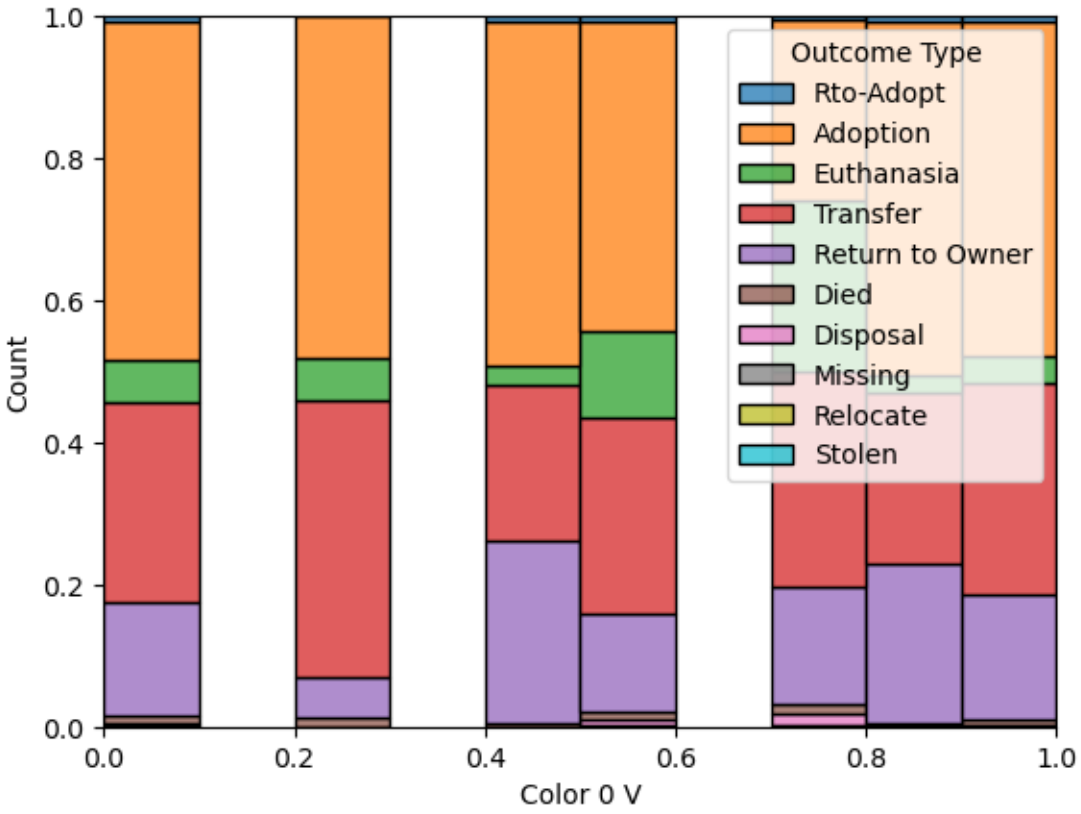
Outcome Type
Rto-Adopt
Adoption
Euthanasia
Transfer
Return to Owner
Died
Disposal
Missing
Relocate
Stolen
Count
Color 0 V
0.0
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1.0