assignment3

October 20, 2023

1 Assignment 3 - Building a Custom Visualization

In this assignment you must choose **one** of the options presented below and submit a visual as well as your source code for peer grading. The details of how you solve the assignment are up to you, although your assignment must use matplotlib so that your peers can evaluate your work. The options differ in challenge level, but there are no grades associated with the challenge level you chose. However, your peers will be asked to ensure you at least met a minimum quality for a given technique in order to pass. Implement the technique fully (or exceed it!) and you should be able to earn full grades for the assignment.

Ferreira, N., Fisher, D., & Konig, A. C. (2014, April). Sample-oriented task-driven visualizations: allowing users to make better, more confident decisions. In Proceedings of the SIGCHI Conference on Human Factors in Computing Systems (pp. 571-580). ACM. (video)

In this paper the authors describe the challenges users face when trying to make judgements about probabilistic data generated through samples. As an example, they look at a bar chart of four years of data (replicated below in Figure 1). Each year has a y-axis value, which is derived from a sample of a larger dataset. For instance, the first value might be the number votes in a given district or riding for 1992, with the average being around 33,000. On top of this is plotted the 95% confidence interval for the mean (see the boxplot lectures for more information, and the yerr parameter of barcharts).

Figure 2c from (Ferreira et al. 2014). Note that the colorbar legend at the bottom as well as the arrows are not required in the assignment descriptions below.

A challenge that users face is that, for a given y-axis value (e.g. 42,000), it is difficult to know which x-axis values are most likely to be representative, because the confidence levels overlap and their distributions are different (the lengths of the confidence interval bars are unequal). One of the solutions the authors propose for this problem (Figure 2c) is to allow users to indicate the y-axis value of interest (e.g. 42,000) and then draw a horizontal line and color bars based on this value. So bars might be colored red if they are definitely above this value (given the confidence interval), blue if they are definitely below this value, or white if they contain this value.

Figure 2c from (Ferreira et al. 2014). Note that the colorbar legend at the bottom as well as the arrows are not required in the assignment descriptions below.

Easiest option: Implement the bar coloring as described above - a color scale with at least three colors, (e.g. blue, white, and red). Assume the user provides the y axis value of interest as a parameter or variable.

Harder option: Implement the bar coloring as described in the paper, where the color of the bar is actually based on the amount of data covered (e.g. a gradient ranging from dark blue for the distribution being certainly below this y-axis, to white if the value is certainly contained, to dark red if the value is certainly not contained as the distribution is above the axis).

Even Harder option: Add interactivity to the above, which allows the user to click on the y axis to set the value of interest. The bar colors should change with respect to what value the user has selected.

Hardest option: Allow the user to interactively set a range of y values they are interested in, and recolor based on this (e.g. a y-axis band, see the paper for more details).

Note: The data given for this assignment is not the same as the data used in the article and as a result the visualizations may look a little different.

[1]:

```python
# Use the following data for this assignment:

import pandas as pd
import numpy as np

np.random.seed(12345)

df = pd.DataFrame([np.random.normal(32000,200000,3650),
                   np.random.normal(43000,100000,3650),
                   np.random.normal(43500,140000,3650),
                   np.random.normal(48000,70000,3650)],
                  index=[1992,1993,1994,1995])
df
```

[1]:

```
                0              1              2              3     \
1992   -8941.531897  127788.667612  -71887.743011  -79146.060869
1993  -51896.094813  198350.518755 -123518.252821 -129916.759685
1994  152336.932066  192947.128056  389950.263156  -93006.152024
1995  -69708.439062  -13289.977022  -30178.390991   55052.181256

                4              5              6              7     \
1992  425156.114501  310681.166595   50581.575349   88349.230566
1993  216119.147314   49845.883728  149135.648505   62807.672113
1994  100818.575896    5529.230706  -32989.370488  223942.967178
1995  152883.621657   12930.835194   63700.461932   64148.489835

                8              9     …           3640           3641  \
1992  185804.513522  281286.947277  …  171938.760289  150650.759924
1993   23365.577348 -109686.264981  …  -44566.520071  101032.122475
1994  -66721.580898   47826.269111  …  165085.806360   74735.174090
1995  -29316.268556   59645.677367  …  -13901.388118   50173.686673

                3642           3643           3644           3645  \
1992  203663.976475 -377877.158072 -197214.093861  24185.008589
1993  117648.199945  160475.622607  -13759.888342 -37333.493572
1994  107329.726875  199250.734156  -36792.202754 -71861.846997
1995   53965.990717    4128.990173   72202.595138  39937.199964

               3646           3647           3648          3649
1992  -56826.729535  -67319.766489  113377.299342  -4494.878538
1993  103019.841174  179746.127403   13455.493990  34442.898855
1994   26375.113219  -29328.078384   65858.761714 -91542.001049
1995  139472.114293   59386.186379   73362.229590  28705.082908

[4 rows x 3650 columns]
```

[2]:
```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
Index: 4 entries, 1992 to 1995
Columns: 3650 entries, 0 to 3649
dtypes: float64(3650)
memory usage: 114.1 KB
```

[3]:
```
df[df.index == 1992]
```

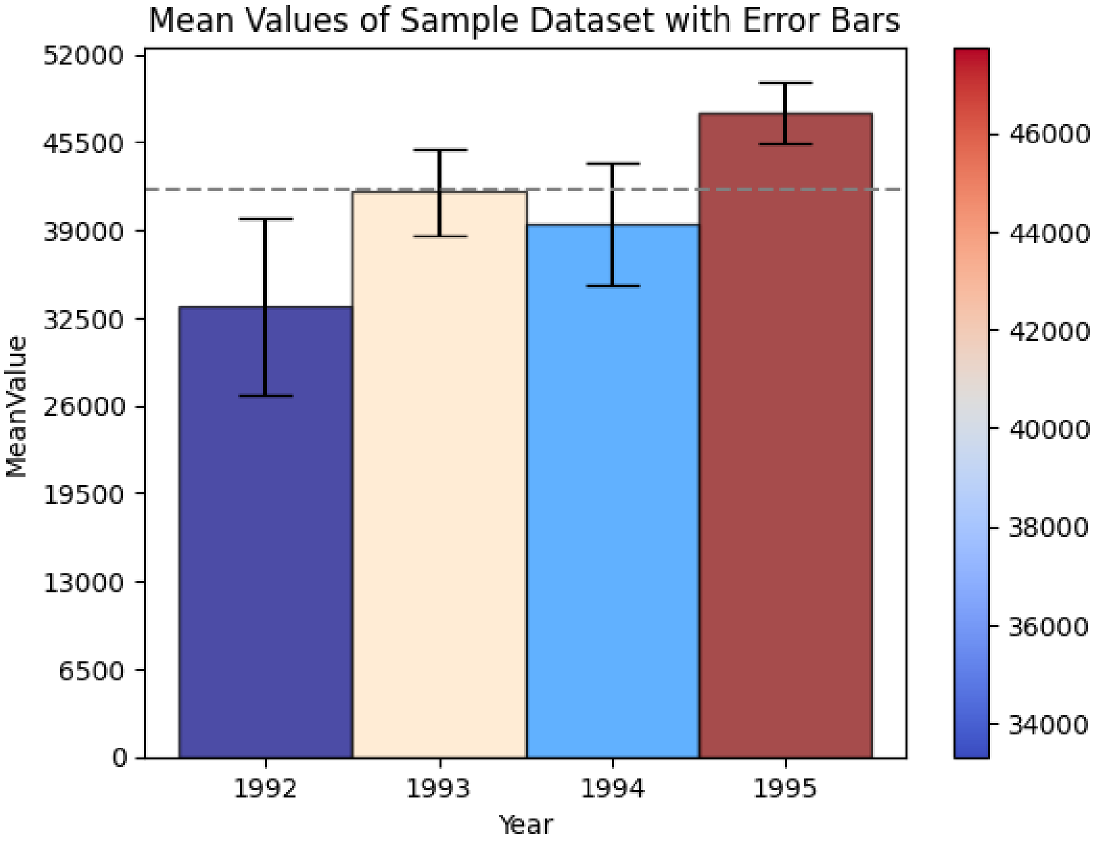
[3]:
```
             0              1             2             3              4     \
1992 -8941.531897  127788.667612 -71887.743011 -79146.060869  425156.114501

               5             6             7              8              9     \
1992  310681.166595  50581.575349  88349.230566  185804.513522  281286.947277

      …           3640           3641           3642           3643  \
1992  …  171938.760289  150650.759924  203663.976475 -377877.158072

               3644          3645          3646          3647           3648  \
1992 -197214.093861  24185.008589 -56826.729535 -67319.766489  113377.299342

             3649
1992 -4494.878538

[1 rows x 3650 columns]
```

[4]:
```
%matplotlib inline
import matplotlib.pyplot as plt
```

[5]:
```
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
```

```
np.random.seed(12345)


data = [
    np.random.normal(32000, 200000, 3650),
    np.random.normal(43000, 100000, 3650),
    np.random.normal(43500, 140000, 3650),
    np.random.normal(48000, 70000, 3650)
]

years = [1992, 1993, 1994, 1995]

df = pd.DataFrame(data, index=years)


means = df.mean(axis=1)
std_errors = df.sem(axis=1) * 1.96


fig, ax = plt.subplots()


bars = ax.bar(years, height = means,yerr=std_errors,  align='center', alpha=0.
 ↪7, capsize=10,color = ['navy','bisque','dodgerblue','maroon'],edgecolor =␣
 ↪'black',
             width =1)


ax.set_xlabel('Year')
ax.set_ylabel('MeanValue')
ax.set_title('Mean Values of Sample Dataset with Error Bars')
ax.set_yticks(range(0,55000,6500))


reference_y = 42000
ax.axhline(reference_y, color='gray', linestyle='--')


norm = plt.Normalize(means.min(), means.max())
sm = plt.cm.ScalarMappable(cmap="coolwarm", norm=norm)
sm.set_array([])
cbar = plt.colorbar(sm, ax=ax)



ax.set_xticks(years)
```

```
plt.show()
```



Mean Values of Sample Dataset with Error Bars
52000
45500
39000
32500
26000
19500
13000
6500
0
MeanValue
1992
1993
1994
1995
Year
46000
44000
42000
40000
38000
36000
34000

[ ]:

```

```