Open in Colab

Assignment 8

Weeks 10 & 11 - matplotlib & seaborn

- In this homework assignment, you will explore and analyze a public dataset of your choosing. Since this assignment is "open-ended" in nature, you are free to expand upon the requirements below. However, you must meet the minimum requirments as indicated in each section.
- The preferred method for this analysis is in a .ipynb file. Feel free to use whichever platform of your choosing.

Some data examples:

• https://www.data.gov/

• https://opendata.cityofnewyork.us/

• https://datasetsearch.research.google.com/

• https://archive.ics.uci.edu/ml/index.php

Resources:

• https://pandas.pydata.org/pandas-docs/stable/getting_started/10min.html

• https://www.oreilly.com/library/view/python-data-science/9781491912126/ch04.html

• https://www.data-to-viz.com/

Headings or comments

You are required to make use of comments, or headings for each section. You must explain what your code is doing, and the results of running your code. Act as if you were giving this assignment to your manager - you must include clear and descriptive information for each section.

You may work as a group or indivdually on this assignment.

Introduction

This data was downloaded from 1994 Census bureau database by Ronny Kahovi and Barry Becker (Data Mining and Visualization, Silicon Graphics).

Listing of attributes:

- > 50K, <=50K.
- age: continuous.
- workclass: Private, Self-emp-not-inc, Self-emp-inc, Federal-gov, Local-gov, State-gov, Without-pay, Never-worked.
- fnlwgt: continuous.
- education: Bachelors, Some-college, 11th, HS-grad, Prof-school, Assoc-acdm, Assoc-voc, 9th, 7th-8th, 12th, Masters, 1st-4th, 10th, Doctorate, 5th-6th, Preschool.

- education-num: continuous.
- marital-status: Married-civ-spouse, Divorced, Never-married, Separated, Widowed, Married-spouse-absent, Married-AF-spouse.
- occupation: Tech-support, Craft-repair, Other-service, Sales, Exec-managerial, Prof-specialty, Handlers-cleaners, Machine-op-inspct, Adm-clerical, Farming-fishing, Transport-moving, Priv-house-serv, Protective-serv, Armed-Forces.
- relationship: Wife, Own-child, Husband, Not-in-family, Other-relative, Unmarried.
- race: White, Asian-Pac-Islander, Amer-Indian-Eskimo, Other, Black.
- sex: Female, Male.
- capital-gain: continuous.
- capital-loss: continuous.
- hours-per-week: continuous.
- native-country: United-States, Cambodia, England, Puerto-Rico, Canada, Germany, Outlying-US(Guam-USVI-etc), India, Japan, Greece, South, China, Cuba, Iran, Honduras, Philippines, Italy, Poland, Jamaica, Vietnam, Mexico, Portugal, Ireland, France, Dominican-Republic, Laos, Ecuador, Taiwan, Haiti, Columbia, Hungary, Guatemala, Nicaragua, Scotland, Thailand, Yugoslavia, El-Salvador, Trinadad&Tobago, Peru, Hong, Holand-Netherlands.

```
# install data repository from ucim
pip install ucimlrepo
```

```
Collecting ucimlrepo
  Downloading ucimlrepo-0.0.6-py3-none-any.whl (8.0 kB)
Installing collected packages: ucimlrepo
Successfully installed ucimlrepo-0.0.6
```

```
from ucimlrepo import fetch_ucirepo
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns
```

```
# fetch dataset
census_income = fetch_ucirepo(id=20)

# data (as pandas dataframes)
X = census_income.data.features
y = census_income.data.targets
```

```
# variable information
print(census_income.variables)
```

```
              name     role         type      demographic  \
0              age  Feature      Integer              Age
1        workclass  Feature  Categorical           Income
2           fnlwgt  Feature      Integer             None
3        education  Feature  Categorical  Education Level
4    education-num  Feature      Integer  Education Level
5   marital-status  Feature  Categorical            Other
6       occupation  Feature  Categorical            Other
7     relationship  Feature  Categorical            Other
8             race  Feature  Categorical             Race
9              sex  Feature       Binary              Sex
10    capital-gain  Feature      Integer             None
11    capital-loss  Feature      Integer             None
```

```
12  hours-per-week  Feature      Integer             None
13  native-country  Feature  Categorical            Other
14          income   Target       Binary           Income

                                        description units missing_values
0                                               N/A  None             no
1   Private, Self-emp-not-inc, Self-emp-inc, Feder...  None            yes
2                                              None  None             no
3    Bachelors, Some-college, 11th, HS-grad, Prof-...  None             no
4                                              None  None             no
5   Married-civ-spouse, Divorced, Never-married, S...  None             no
6   Tech-support, Craft-repair, Other-service, Sal...  None            yes
7   Wife, Own-child, Husband, Not-in-family, Other...  None             no
8   White, Asian-Pac-Islander, Amer-Indian-Eskimo,...  None             no
9                                      Female, Male.  None             no
10                                             None  None             no
11                                             None  None             no
12                                             None  None             no
13  United-States, Cambodia, England, Puerto-Rico,...  None            yes
14                                      >50K, <=50K.  None             no
```

Double-click (or enter) to edit

Data Exploration

Import your dataset into your .ipynb, create dataframes, and explore your data.

Include:

- Summary statistics means, medians, quartiles,
- Missing value information
- Any other relevant information about the dataset.

```
# combining Target and Feautures variables
concensus = pd.concat([X,y], axis = 1)
# look into the data
print(concensus.head())
# checking missing values
print(concensus.isna().sum())
```

```
   age         workclass  fnlwgt  education  education-num  \
0   39         State-gov   77516  Bachelors             13
1   50  Self-emp-not-inc   83311  Bachelors             13
2   38           Private  215646    HS-grad              9
3   53           Private  234721       11th              7
4   28           Private  338409  Bachelors             13

       marital-status         occupation   relationship   race     sex  \
0       Never-married       Adm-clerical  Not-in-family  White    Male
1  Married-civ-spouse    Exec-managerial        Husband  White    Male
2            Divorced  Handlers-cleaners  Not-in-family  White    Male
3  Married-civ-spouse  Handlers-cleaners        Husband  Black    Male
4  Married-civ-spouse     Prof-specialty           Wife  Black  Female

   capital-gain  capital-loss  hours-per-week native-country income
0          2174             0              40  United-States  <=50K
1             0             0              13  United-States  <=50K
2             0             0              40  United-States  <=50K
3             0             0              40  United-States  <=50K
4             0             0              40           Cuba  <=50K
```

```
age                 0
workclass         963
fnlwgt              0
education           0
education-num       0
marital-status      0
occupation        966
relationship        0
race                0
sex                 0
capital-gain        0
capital-loss        0
hours-per-week      0
native-country    274
income              0
dtype: int64
```

Data Wrangling

Perform data wrangling. You are free to use your best judgment here. If you are stuck, look at previous assignment.

```
# relevant desc
print(concensus.describe())
concensus.info()
```

```
                age        fnlwgt  education-num  capital-gain  capital-loss  \
count  47621.000000  4.762100e+04   47621.000000  47621.000000  47621.000000
mean      38.640684  1.897271e+05      10.090821   1091.137649     87.853489
std       13.558961  1.055695e+05       2.568320   7487.228336    404.010612
min       17.000000  1.228500e+04       1.000000      0.000000      0.000000
25%       28.000000  1.175840e+05       9.000000      0.000000      0.000000
50%       37.000000  1.782820e+05      10.000000      0.000000      0.000000
75%       48.000000  2.377200e+05      12.000000      0.000000      0.000000
max       90.000000  1.490400e+06      16.000000  99999.000000   4356.000000

       hours-per-week
count    47621.000000
mean        40.600050
std         12.260345
min          1.000000
25%         40.000000
50%         40.000000
75%         45.000000
max         99.000000
<class 'pandas.core.frame.DataFrame'>
Index: 47621 entries, 0 to 48841
Data columns (total 15 columns):
 #   Column          Non-Null Count  Dtype
---  ------          --------------  -----
 0   age             47621 non-null  int64
 1   workclass       47621 non-null  object
 2   fnlwgt          47621 non-null  int64
 3   education       47621 non-null  object
 4   education-num   47621 non-null  int64
 5   marital-status  47621 non-null  object
 6   occupation      47621 non-null  object
 7   relationship    47621 non-null  object
 8   race            47621 non-null  object
 9   sex             47621 non-null  object
 10  capital-gain    47621 non-null  int64
 11  capital-loss    47621 non-null  int64
 12  hours-per-week  47621 non-null  int64
 13  native-country  47621 non-null  object
 14  income          47621 non-null  object
dtypes: int64(6), object(9)
```

```
memory usage: 5.8+ MB
```

```
for each in concensus.columns:
    print('Percent of null values',each,':',concensus[each].isnull().mean()*100)

# remove  missing values
concensus = concensus.dropna()
print(f'the dimension of the dataset:{concensus.shape} and missing values : {concensus.isna().sum()}')
```

```
Percent of null values age : 0.0
Percent of null values workclass : 0.0
Percent of null values fnlwgt : 0.0
Percent of null values education : 0.0
Percent of null values education-num : 0.0
Percent of null values marital-status : 0.0
Percent of null values occupation : 0.0
Percent of null values relationship : 0.0
Percent of null values race : 0.0
Percent of null values sex : 0.0
Percent of null values capital-gain : 0.0
Percent of null values capital-loss : 0.0
Percent of null values hours-per-week : 0.0
Percent of null values native-country : 0.0
Percent of null values income : 0.0
the dimension of the dataset:(47621, 15) and missing values : age               0
workclass         0
fnlwgt            0
education         0
education-num     0
marital-status    0
occupation        0
relationship      0
race              0
sex               0
capital-gain      0
capital-loss      0
hours-per-week    0
native-country    0
income            0
dtype: int64
```

There is 9 categorical columns in the dataset. For each categorical variable, we are going to look into unique categorical values.

```
categorical_variables = [feature for feature in concensus.columns if concensus[feature].dtype in ['O','bool_']]
print('Number of categorical variables =>',len(categorical_variables),'\nCategorical Variables=>',categorical_variat

# Number of categories in categorical variables
total =0
for feature in categorical_variables:
    print(feature,'=>',concensus[feature].nunique())
    total += concensus[feature].nunique()
print('Total category:',total)
```

```
Number of categorical variables => 9
Categorical Variables=> ['workclass', 'education', 'marital-status', 'occupation', 'relationship', 'race', 'sex'
workclass => 9
education => 16
marital-status => 7
occupation => 15
relationship => 6
race => 5
sex => 2
native-country => 42
income => 4
```

```
Total category: 106
```

Visualizations

The main purpose of this assignment is to practice creating various visualizations using the matplotlib and seaborn library.

Part 1:

Using matplotlib, create ***two or more plots*** that incorporate at least **5** of the following properties:

Note: these properties vary based on your data. The goal is to practice creating visualizations and modifying its properties.

- Use and change a legend position
- Change a legend font size
- Place a legend outside of the plot
- Create a single legend for all subplots
- Change the title and x/y labels
- Change the marker, line colors, and line width
- Add annotations
- Modify Axis Text Ticks/Labels
- Change size of axis Labels
- Your own choice not included above

Plots that you can create **include**:

- Scatter Plot
- Bar plot
- Line Chart
- Multi Plots (e.g. using .subplot()
- Histogram

You can add another plot not listed here if it works better for your data. This is not a complete list of plots to create.

Part 2:

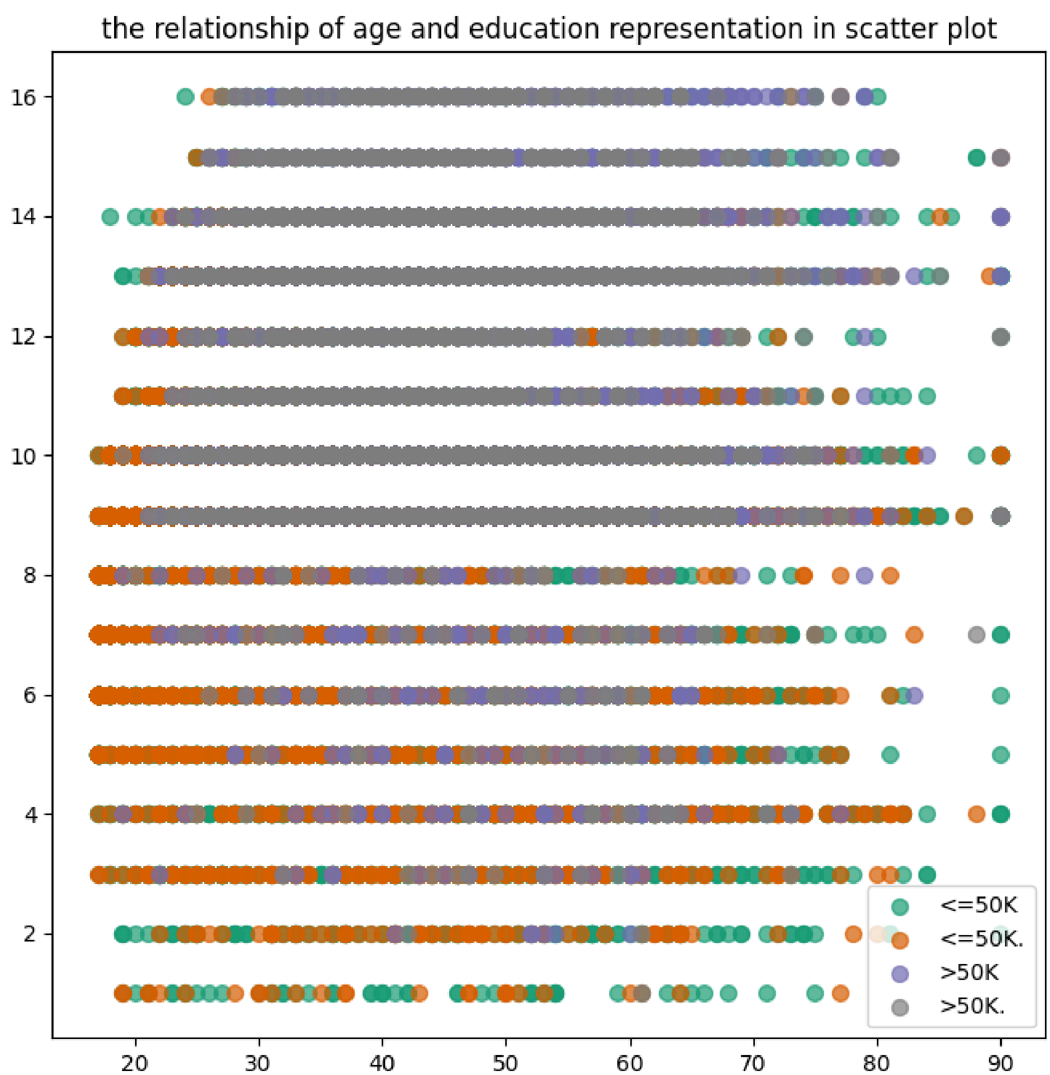
Recreate the visualizations above using the Seaborn library as best as possible.

You are required to explain what each of your plots is representing. Plots without comments will not be accepted. In addition, please explain the properties you are showcasing.

Part 3:

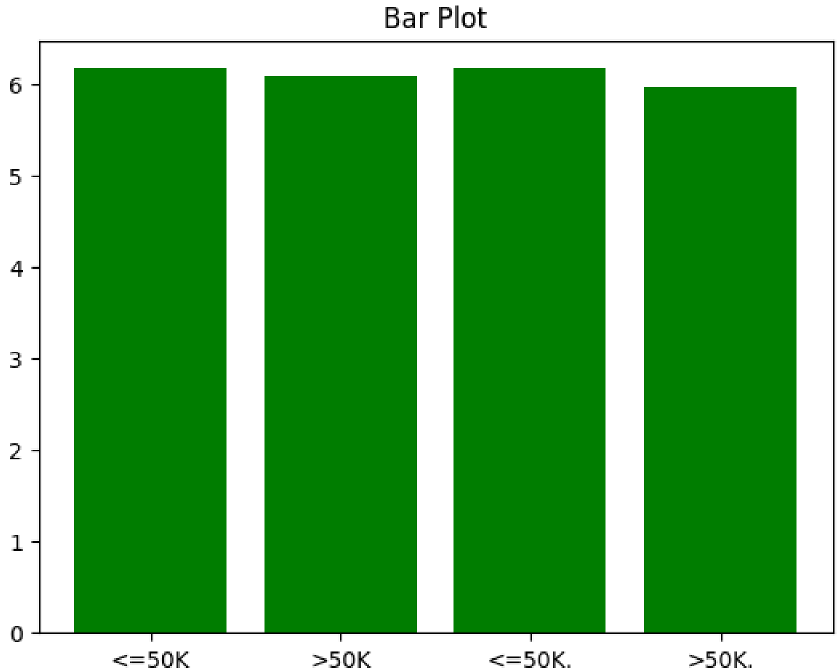
In a comment or text box, explain the differences between creating a plot in matplotlib and seaborn, based on your above plots.

```
# create a Scatter plot , BAR plot , Line Chart ,Historgram as multiplots
# scatter plot
concensus
AGE = concensus['age'].values
EDUCATION = concensus["education-num"].values

INCOME = concensus.income.values
INCOME_ = np.unique(INCOME)
COLORS = ["#1B9E77", "#D95F02","#7570B3",'grey']
fig, ax = plt.subplots(figsize=(8,8))
for income, color in zip(INCOME_, COLORS):
    idxs = np.where(INCOME == income)
    # No legend will be generated if we don't pass label=species
    ax.scatter(
        AGE[idxs], EDUCATION[idxs], label=income,
        s=50, color=color, alpha=0.7

    )
ax.legend()
plt.title('the relationship of age and education representation in scatter plot' )
plt.show()
```

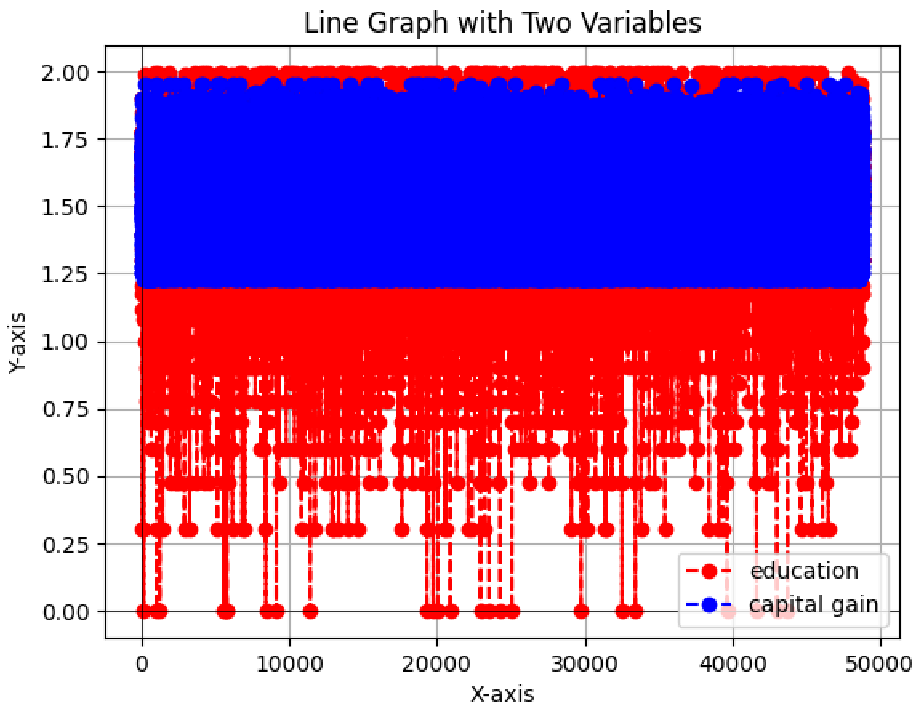



```
# barplot
plt.bar(x = concensus.income, height = np.log10(concensus.fnlwgt), color='green')
plt.title('Bar Plot')
```

```
Text(0.5, 1.0, 'Bar Plot')
```



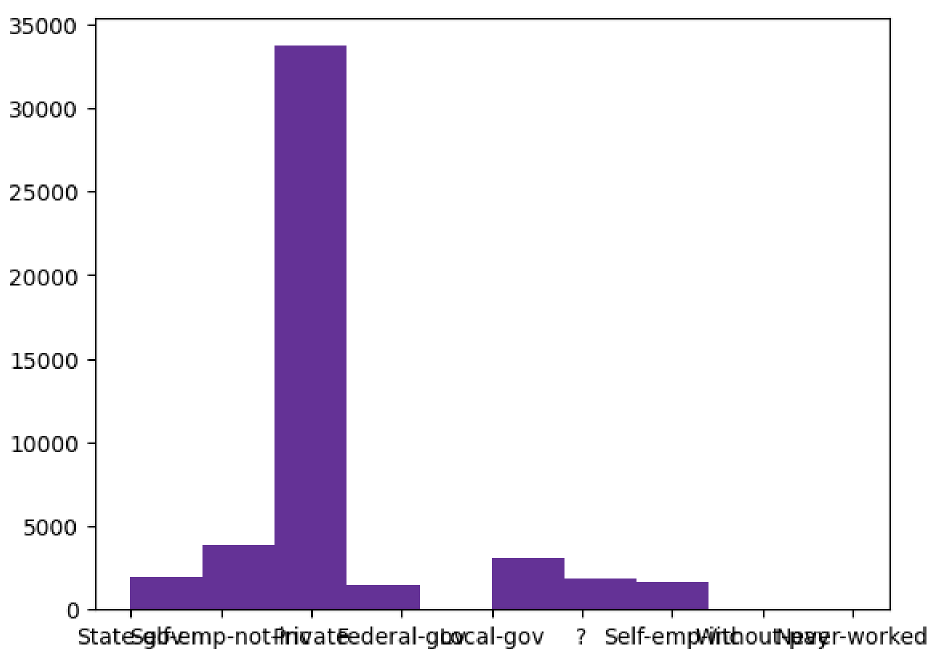

```
#plt.plot(np.cumsum(concensus['education-num']),np.cumsum(concensus['capital-gain']), alpha = 1.0)
plt.plot( np.log10(concensus['hours-per-week']), color='red', linestyle='dashed', marker='o', label='education')
plt.plot(np.log10(concensus['age']), color='blue', linestyle='dashed', marker='o', label='capital gain')


plt.xlabel('X-axis')
plt.ylabel('Y-axis')
plt.title('Line Graph with Two Variables')

# Add a grid
plt.grid(True)

# Change the background color
plt.axhline(0, color='black', linewidth=0.5)
plt.axvline(0, color='black', linewidth=0.5)

# Show the plot
plt.legend()
plt.show()
```



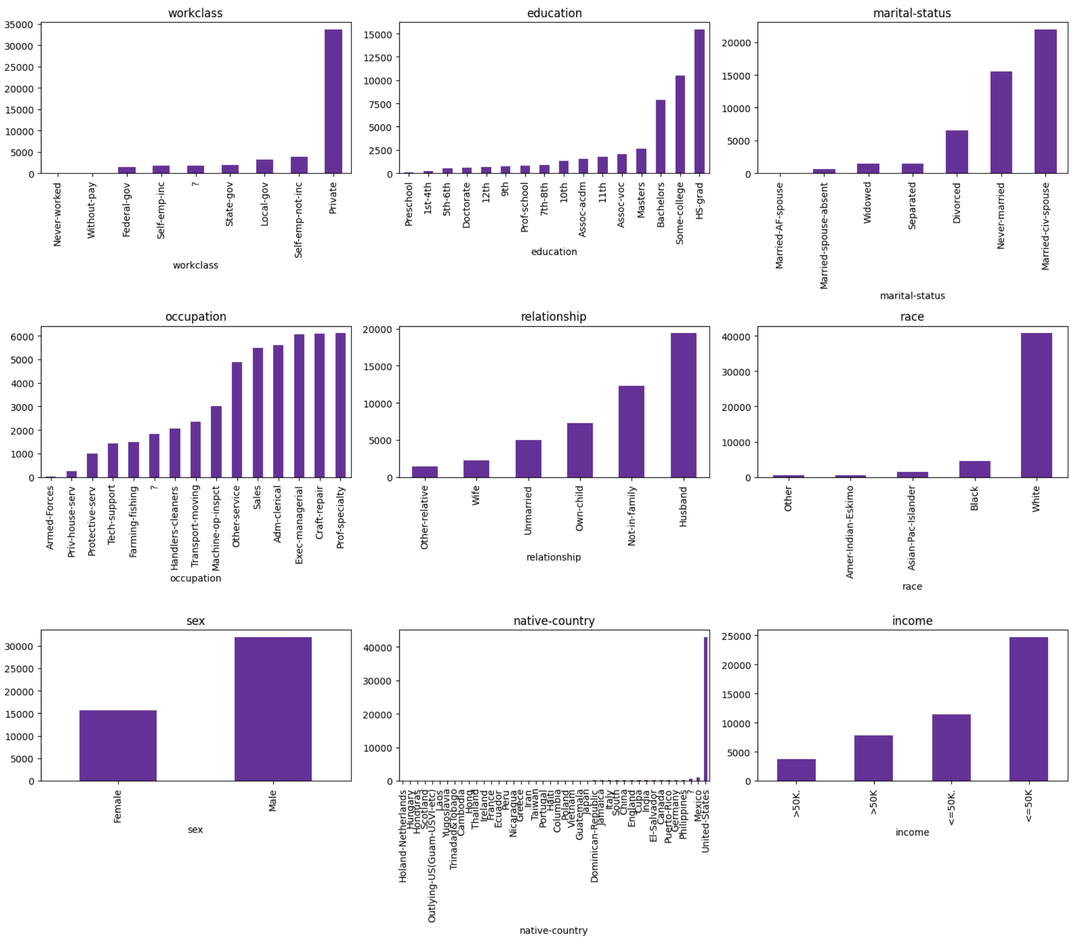
Start coding or generate with AI.

```
plt.hist( x='workclass',data = concensus,color='#663399')
plt.title('workclass')
```

```
(array([1.9650e+03, 3.8380e+03, 3.3717e+04, 1.4230e+03, 0.0000e+00,
        3.1260e+03, 1.8360e+03, 1.6880e+03, 2.1000e+01, 7.0000e+00]),
 array([0. , 0.8, 1.6, 2.4, 3.2, 4. , 4.8, 5.6, 6.4, 7.2, 8. ]),
 <BarContainer object of 10 artists>)
```



```
import math
or_palette = sns.cubehelix_palette(start=2.8, rot=0.1, dark=0.3, light=0.8, reverse=True)

fields=concensus.select_dtypes(exclude="number").columns

figuresize=(16,14)
cols=3
rows=math.ceil(len(fields)/cols)
#print()

plt.subplots(rows,cols,figsize=figuresize)
for i in range(1,len(fields)+1) :
    plt.subplot(rows,cols,i)
    concensus[fields[i-1]].value_counts().sort_values().plot.bar(color='#663399')
    plt.xticks(rotation=90)
    plt.title(fields[i-1])

plt.tight_layout()
plt.show()
```


workclass
Never-worked
Without-pay
Federal-gov
Self-emp-inc
?
State-gov
Local-gov
Self-emp-not-inc
Private
education
Preschool
1st-4th
5th-6th
Doctorate
12th
9th
Prof-school
7th-8th
10th
Assoc-acdm
11th
Assoc-voc
Masters
Bachelors
Some-college
HS-grad
marital-status
Married-AF-spouse
Married-spouse-absent
Widowed
Separated
Divorced
Never-married
Married-civ-spouse
occupation
Armed-Forces
Priv-house-serv
Protective-serv
Tech-support
Farming-fishing
?
Handlers-cleaners
Transport-moving
Machine-op-inspct
Other-service
Sales
Adm-clerical
Exec-managerial
Craft-repair
Prof-specialty
relationship
Other-relative
Wife
Unmarried
Own-child
Not-in-family
Husband
race
Other
Amer-Indian-Eskimo
Asian-Pac-Islander
Black
White
sex
Female
Male
native-country
Mexico
United-States
income
>50K.
>50K
<=50K.
<=50K

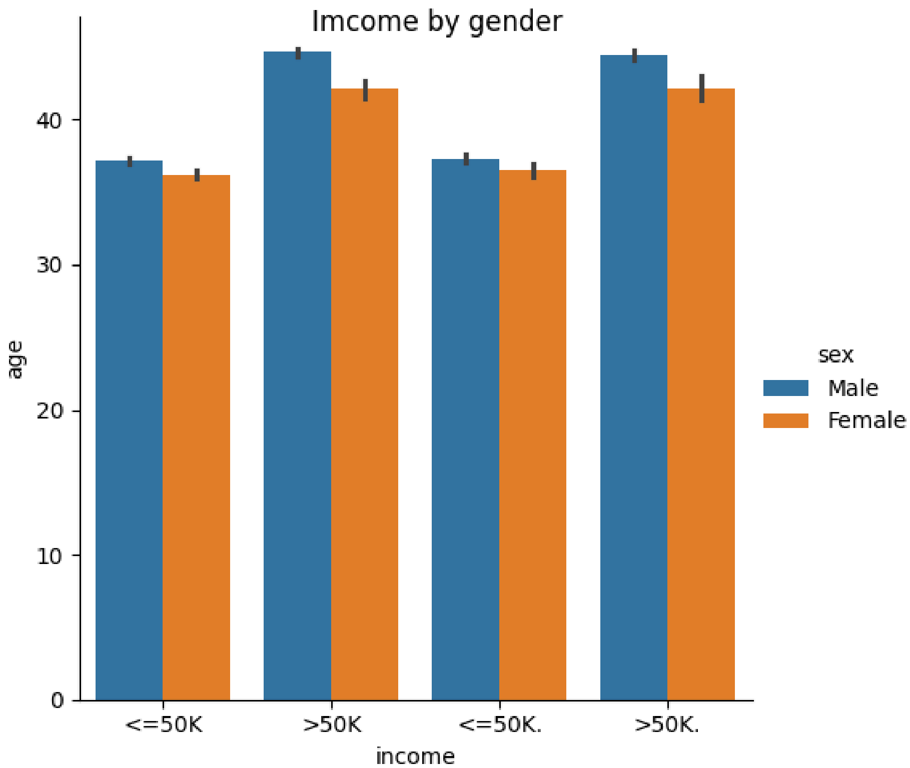
```
# Seaborm
we are going to create the same kind of plot using seaborn
often preferred over Matplotlib for its simplicity, built-
plotting capabilities, and aesthetically pleasing default
```

Seaborm

we are going to create the same kind of plot using seaborn library. Seaborn is often preferred over Matplotlib for its simplicity, built-in statistical plotting capabilities, and aesthetically pleasing default styles

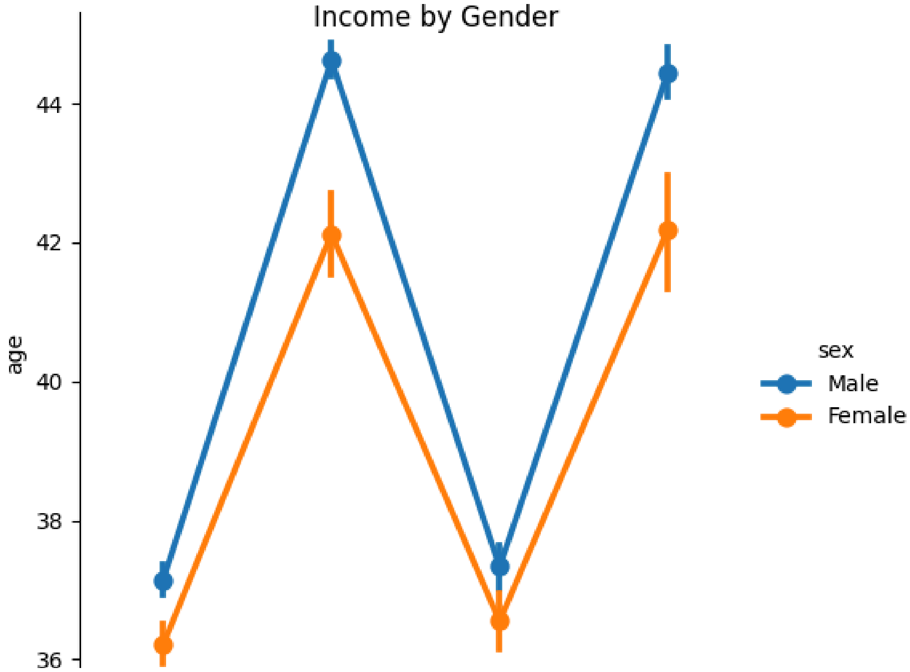
```
g = sns.catplot( x = 'income', y = 'age', data = concensus,
          kind = 'bar', hue = 'sex')
g.fig.suptitle('Income by Gender ')
```

```
Text(0.5, 0.98, 'Imcome by gender ')
```




```
g = sns.catplot( x = 'income', y = 'age', data = concensus,
          kind = 'point', hue = 'sex')
g.fig.suptitle('Income by Gender ')
```

```
Text(0.5, 0.98, 'Income by Gender ')
```




```
sns.scatterplot(x="capital-loss",
                y="age",
                data=concensus,
                hue="sex")
plt.title('Capital loss shown by women and men')
plt.show()
```