```
import pandas as pd
import numpy as np
import seaborn as sns
import matplotlib.pyplot as plt
import sklearn
%matplotlib inline
```

```
income_df = pd.read_csv('adult.csv')
income_df.head()
```

	age	workclass	fnlwgt	education	educational-num	marital-status	occupation	relationship	race	gender	c
0	25	Private	226802	11th	7	Never-married	Machine-op-inspct	Own-child	Black	Male	
1	38	Private	89814	HS-grad	9	Married-civ-spouse	Farming-fishing	Husband	White	Male	
2	28	Local-gov	336951	Assoc-acdm	12	Married-civ-spouse	Protective-serv	Husband	White	Male	
3	44	Private	160323	Some-college	10	Married-civ-spouse	Machine-op-inspct	Husband	Black	Male	

```
income_df.describe()
```

	age	fnlwgt	educational-num	capital-gain	capital-loss	hours-per-week
count	48842.000000	4.884200e+04	48842.000000	48842.000000	48842.000000	48842.000000
mean	38.643585	1.896641e+05	10.078089	1079.067626	87.502314	40.422382
std	13.710510	1.056040e+05	2.570973	7452.019058	403.004552	12.391444
min	17.000000	1.228500e+04	1.000000	0.000000	0.000000	1.000000
25%	28.000000	1.175505e+05	9.000000	0.000000	0.000000	40.000000
50%	37.000000	1.781445e+05	10.000000	0.000000	0.000000	40.000000
75%	48.000000	2.376420e+05	12.000000	0.000000	0.000000	45.000000
max	90.000000	1.490400e+06	16.000000	99999.000000	4356.000000	99.000000

```
income_df.isnull().sum()
```

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

```
income_df.age = income_df.age.astype(float)
income_df['hours-per-week'] = income_df['hours-per-week'].astype(float)
```

```
my_df = income_df.dropna()
```

```
my_df['predclass'] = my_df['income']
del my_df['income']
my_df['education-num'] = my_df['educational-num']
del my_df['educational-num']
```

```
my_df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 48842 entries, 0 to 48841
Data columns (total 15 columns):
 #   Column          Non-Null Count  Dtype  
---  ------          --------------  -----  
 0   age             48842 non-null  float64
 1   workclass       48842 non-null  object 
 2   fnlwgt          48842 non-null  int64  
 3   education       48842 non-null  object 
 4   marital-status  48842 non-null  object 
 5   occupation      48842 non-null  object 
 6   relationship    48842 non-null  object 
 7   race            48842 non-null  object 
 8   gender          48842 non-null  object 
 9   capital-gain    48842 non-null  int64  
 10  capital-loss    48842 non-null  int64  
 11  hours-per-week  48842 non-null  float64
 12  native-country  48842 non-null  object 
 13  predclass       48842 non-null  object 
 14  education-num   48842 non-null  int64  
dtypes: float64(2), int64(4), object(9)
memory usage: 5.6+ MB
```

```
my_df.isnull().sum()
```

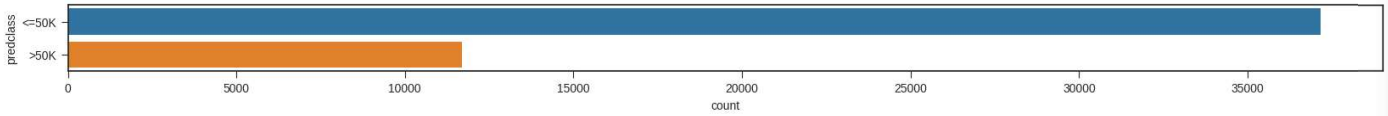
```
age               0
workclass         0
fnlwgt            0
education         0
marital-status    0
occupation        0
relationship      0
race              0
gender            0
capital-gain      0
capital-loss      0
hours-per-week    0
native-country    0
predclass         0
education-num     0
dtype: int64
```

```
print('workclass',my_df.workclass.unique())
print('education',my_df.education.unique())
print('marital-status',my_df['marital-status'].unique())
print('occupation',my_df.occupation.unique())
print('relationship',my_df.relationship.unique())
print('race',my_df.race.unique())
print('gender',my_df.gender.unique())
print('native-country',my_df['native-country'].unique())
print('predclass',my_df.predclass.unique())
```

```
workclass ['Private' 'Local-gov' '?' 'Self-emp-not-inc' 'Federal-gov' 'State-gov'
 'Self-emp-inc' 'Without-pay' 'Never-worked']
education ['11th' 'HS-grad' 'Assoc-acdm' 'Some-college' '10th' 'Prof-school'
 '7th-8th' 'Bachelors' 'Masters' 'Doctorate' '5th-6th' 'Assoc-voc' '9th'
 '12th' '1st-4th' 'Preschool']
marital-status ['Never-married' 'Married-civ-spouse' 'Widowed' 'Divorced' 'Separated'
 'Married-spouse-absent' 'Married-AF-spouse']
occupation ['Machine-op-inspct' 'Farming-fishing' 'Protective-serv' '?'
 'Other-service' 'Prof-specialty' 'Craft-repair' 'Adm-clerical'
 'Exec-managerial' 'Tech-support' 'Sales' 'Priv-house-serv'
 'Transport-moving' 'Handlers-cleaners' 'Armed-Forces']
relationship ['Own-child' 'Husband' 'Not-in-family' 'Unmarried' 'Wife' 'Other-relative']
race ['Black' 'White' 'Asian-Pac-Islander' 'Other' 'Amer-Indian-Eskimo']
gender ['Male' 'Female']
native-country ['United-States' '?' 'Peru' 'Guatemala' 'Mexico' 'Dominican-Republic'
 'Ireland' 'Germany' 'Philippines' 'Thailand' 'Haiti' 'El-Salvador'
 'Puerto-Rico' 'Vietnam' 'South' 'Columbia' 'Japan' 'India' 'Cambodia'
 'Poland' 'Laos' 'England' 'Cuba' 'Taiwan' 'Italy' 'Canada' 'Portugal'
 'China' 'Nicaragua' 'Honduras' 'Iran' 'Scotland' 'Jamaica' 'Ecuador'
 'Yugoslavia' 'Hungary' 'Hong' 'Greece' 'Trinadad&Tobago'
 'Outlying-US(Guam-USVI-etc)' 'France' 'Holand-Netherlands']
predclass ['<=50K' '>50K']
```

```
fig = plt.figure(figsize=(20,1))
plt.style.use('seaborn-ticks')
sns.countplot(y="predclass", data=my_df)
```

```
<ipython-input-35-c6f8321f2681>:2: MatplotlibDeprecationWarning: The seaborn styles shipped by Matplotlib are deprecated since 3.6, as t
  plt.style.use('seaborn-ticks')
<Axes: xlabel='count', ylabel='predclass'>
```



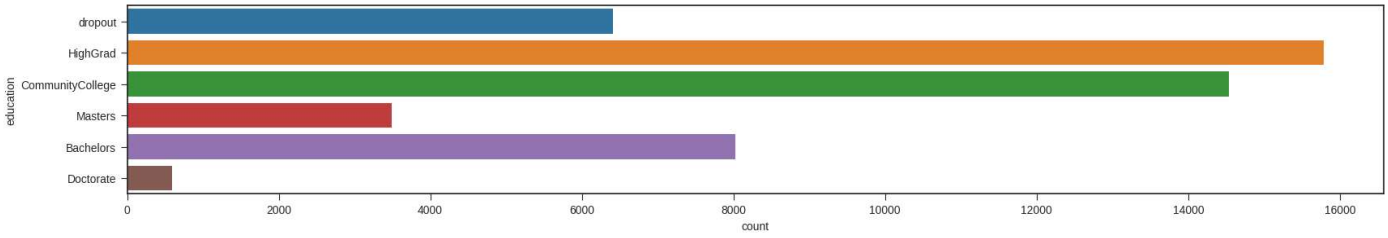

```
my_df['education'].replace('Preschool', 'dropout',inplace=True)
my_df['education'].replace('10th', 'dropout',inplace=True)
my_df['education'].replace('11th', 'dropout',inplace=True)
my_df['education'].replace('12th', 'dropout',inplace=True)
my_df['education'].replace('1st-4th', 'dropout',inplace=True)
my_df['education'].replace('5th-6th', 'dropout',inplace=True)
my_df['education'].replace('7th-8th', 'dropout',inplace=True)
my_df['education'].replace('9th', 'dropout',inplace=True)
my_df['education'].replace('HS-Grad', 'HighGrad',inplace=True)
my_df['education'].replace('HS-grad', 'HighGrad',inplace=True)
my_df['education'].replace('Some-college', 'CommunityCollege',inplace=True)
my_df['education'].replace('Assoc-acdm', 'CommunityCollege',inplace=True)
my_df['education'].replace('Assoc-voc', 'CommunityCollege',inplace=True)
my_df['education'].replace('Bachelors', 'Bachelors',inplace=True)
my_df['education'].replace('Masters', 'Masters',inplace=True)
my_df['education'].replace('Prof-school', 'Masters',inplace=True)
my_df['education'].replace('Doctorate', 'Doctorate',inplace=True)
```

```
my_df[['education', 'education-num']].groupby(['education'], as_index=False).mean().sort_values(by='education-num', ascending=False)
```

	education	education-num
2	Doctorate	16.000000
4	Masters	14.238900
0	Bachelors	13.000000
1	CommunityCollege	10.361967
3	HighGrad	9.000000
5	dropout	5.614544

```
fig = plt.figure(figsize=(20,3))
plt.style.use('seaborn-ticks')
sns.countplot(y="education", data=my_df)
```

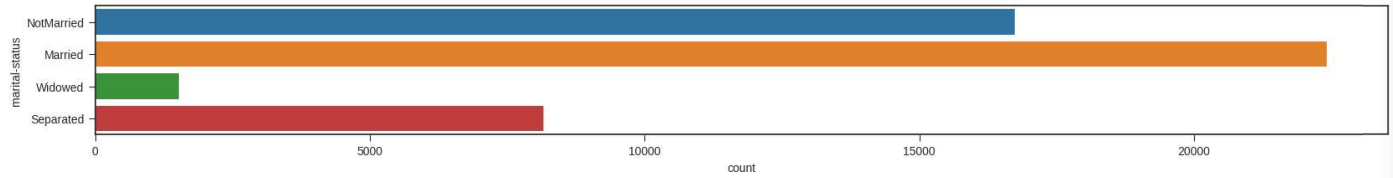
```
<ipython-input-38-72c53feb210f>:2: MatplotlibDeprecationWarning: The seaborn styles shipped by Matplotlib are deprecated since 3.6, as t
  plt.style.use('seaborn-ticks')
<Axes: xlabel='count', ylabel='education'>
```




```
my_df['marital-status'].replace('Never-married', 'NotMarried',inplace=True)
my_df['marital-status'].replace(['Married-AF-spouse'], 'Married',inplace=True)
my_df['marital-status'].replace(['Married-civ-spouse'], 'Married',inplace=True)
my_df['marital-status'].replace(['Married-spouse-absent'], 'NotMarried',inplace=True)
my_df['marital-status'].replace(['Separated'], 'Separated',inplace=True)
```

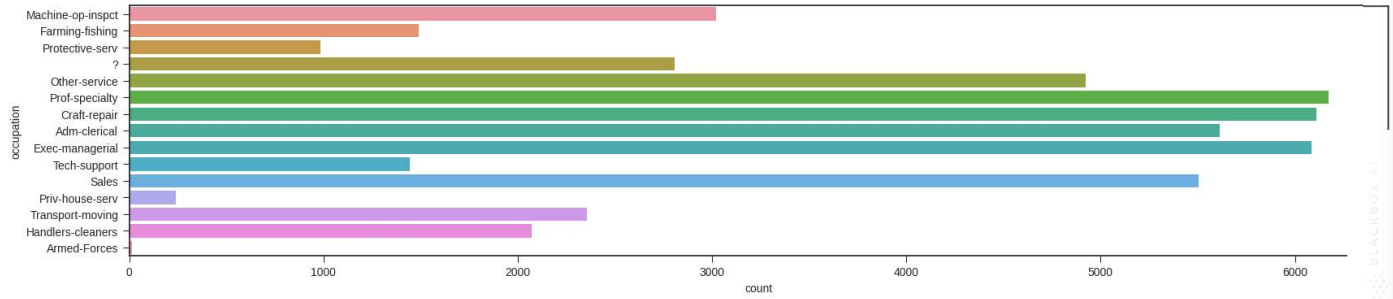
```
my_df['marital-status'].replace(['Divorced'], 'Separated',inplace=True)
my_df['marital-status'].replace(['Widowed'], 'Widowed',inplace=True)


fig = plt.figure(figsize=(20,2))
plt.style.use('seaborn-ticks')
sns.countplot(y="marital-status", data=my_df)
```

```
<ipython-input-40-268f72a2957a>:2: MatplotlibDeprecationWarning: The seaborn styles shipped by Matplotlib are deprecated since 3.6, as t
  plt.style.use('seaborn-ticks')
<Axes: xlabel='count', ylabel='marital-status'>
```



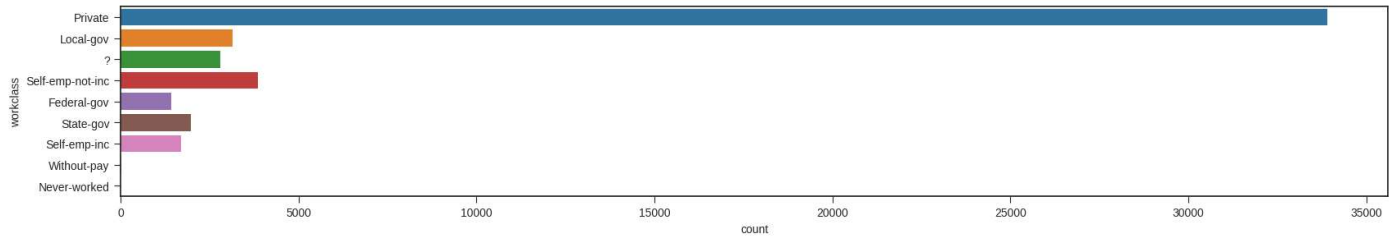

```
plt.style.use('seaborn-ticks')
plt.figure(figsize=(20,4))
sns.countplot(y="occupation", data=my_df)
```

```
<ipython-input-41-d9412fb057f5>:1: MatplotlibDeprecationWarning: The seaborn styles shipped by Matplotlib are deprecated since 3.6, as t
  plt.style.use('seaborn-ticks')
<Axes: xlabel='count', ylabel='occupation'>
```




```
plt.style.use('seaborn-ticks')
plt.figure(figsize=(20,3))
sns.countplot(y="workclass", data=my_df)
```

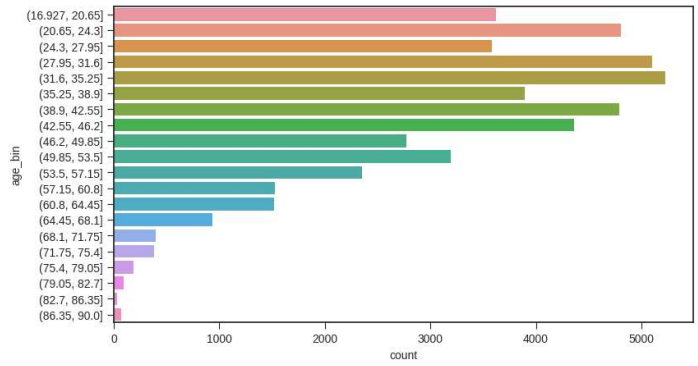
```
<ipython-input-42-9ba067be87be>:1: MatplotlibDeprecationWarning: The seaborn styles shipped by Matplotlib are deprecated since 3.6, as t
  plt.style.use('seaborn-ticks')
<Axes: xlabel='count', ylabel='workclass'>
```

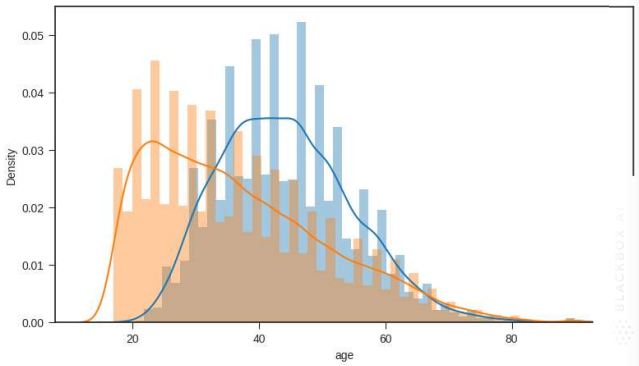



```
my_df['age_bin'] = pd.cut(my_df['age'], 20)


plt.style.use('seaborn-ticks')
fig = plt.figure(figsize=(20,5))
plt.subplot(1, 2, 1)
```

```
sns.countplot(y="age_bin", data=my_df)
plt.subplot(1, 2, 2)
sns.distplot(my_df[my_df['predclass'] == '>50K']['age'], kde_kws={"label": ">$50K"})
sns.distplot(my_df[my_df['predclass'] == '<=50K']['age'], kde_kws={"label": "<=$50K"})
```

```
<ipython-input-44-89f9fb6bb86e>:1: MatplotlibDeprecationWarning: The seaborn styles shipped by Matplotlib are deprecated since 3.6, as t
  plt.style.use('seaborn-ticks')
<ipython-input-44-89f9fb6bb86e>:6: UserWarning:

`distplot` is a deprecated function and will be removed in seaborn v0.14.0.

Please adapt your code to use either `displot` (a figure-level function with
similar flexibility) or `histplot` (an axes-level function for histograms).

For a guide to updating your code to use the new functions, please see
https://gist.github.com/mwaskom/de44147ed2974457ad6372750bbe5751

  sns.distplot(my_df[my_df['predclass'] == '>50K']['age'], kde_kws={"label": ">$50K"})
<ipython-input-44-89f9fb6bb86e>:7: UserWarning:

`distplot` is a deprecated function and will be removed in seaborn v0.14.0.

Please adapt your code to use either `displot` (a figure-level function with
similar flexibility) or `histplot` (an axes-level function for histograms).

For a guide to updating your code to use the new functions, please see
https://gist.github.com/mwaskom/de44147ed2974457ad6372750bbe5751

  sns.distplot(my_df[my_df['predclass'] == '<=50K']['age'], kde_kws={"label": "<=$50K"})
<Axes: xlabel='age', ylabel='Density'>
```





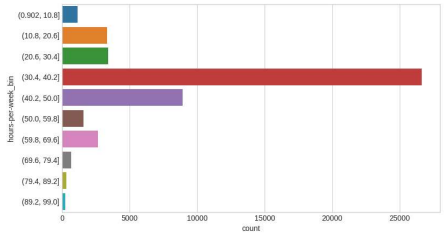

```
my_df[['predclass', 'age']].groupby(['predclass'], as_index=False).mean().sort_values(by='age', ascending=False)
```

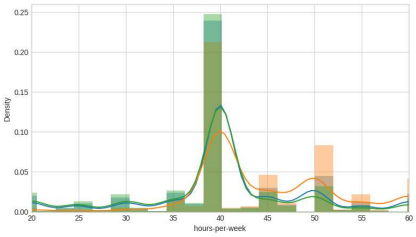
	predclass	age
1	>50K	44.275178
0	<=50K	36.872184

```
plt.style.use('seaborn-whitegrid')
x, y, hue = "race", "prop", "gender"
#hue_order = ["Male", "Female"]
plt.figure(figsize=(20,5))
f, axes = plt.subplots(1, 2)
sns.countplot(x=x, hue=hue, data=my_df, ax=axes[0])

prop_df = (my_df[x]
           .groupby(my_df[hue])
           .value_counts(normalize=True)
           .rename(y)
           .reset_index())

sns.barplot(x=x, y=y, hue=hue, data=prop_df, ax=axes[1])


my_df['hours-per-week_bin'] = pd.cut(my_df['hours-per-week'], 10)
my_df['hours-per-week'] = my_df['hours-per-week']
```

```
plt.style.use('seaborn-whitegrid')
fig = plt.figure(figsize=(20,5))
plt.subplot(1, 2, 1)
sns.countplot(y="hours-per-week_bin", data=my_df);
plt.subplot(1, 2, 2)
sns.distplot(my_df['hours-per-week']);
sns.distplot(my_df[my_df['predclass'] == '>50K']['hours-per-week'], kde_kws={"label": ">$50K"})
sns.distplot(my_df[my_df['predclass'] == '<=50K']['hours-per-week'], kde_kws={"label": "<$50K"})
plt.ylim(0, None)
plt.xlim(20, 60)
```

```
<ipython-input-47-06f68c8fef22>:1: MatplotlibDeprecationWarning: The seaborn styles shi
  plt.style.use('seaborn-whitegrid')
<ipython-input-47-06f68c8fef22>:6: UserWarning:

`distplot` is a deprecated function and will be removed in seaborn v0.14.0.

Please adapt your code to use either `displot` (a figure-level function with
similar flexibility) or `histplot` (an axes-level function for histograms).

For a guide to updating your code to use the new functions, please see
https://gist.github.com/mwaskom/de44147ed2974457ad6372750bbe5751

  sns.distplot(my_df['hours-per-week']);
<ipython-input-47-06f68c8fef22>:7: UserWarning:

`distplot` is a deprecated function and will be removed in seaborn v0.14.0.

Please adapt your code to use either `displot` (a figure-level function with
similar flexibility) or `histplot` (an axes-level function for histograms).

For a guide to updating your code to use the new functions, please see
https://gist.github.com/mwaskom/de44147ed2974457ad6372750bbe5751

  sns.distplot(my_df[my_df['predclass'] == '>50K']['hours-per-week'], kde_kws={"label":
<ipython-input-47-06f68c8fef22>:8: UserWarning:

`distplot` is a deprecated function and will be removed in seaborn v0.14.0.

Please adapt your code to use either `displot` (a figure-level function with
similar flexibility) or `histplot` (an axes-level function for histograms).

For a guide to updating your code to use the new functions, please see
https://gist.github.com/mwaskom/de44147ed2974457ad6372750bbe5751

  sns.distplot(my_df[my_df['predclass'] == '<=50K']['hours-per-week'], kde_kws={"label":
(20.0, 60.0)
```

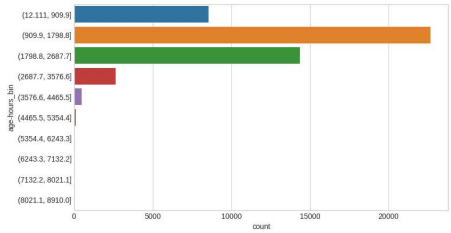


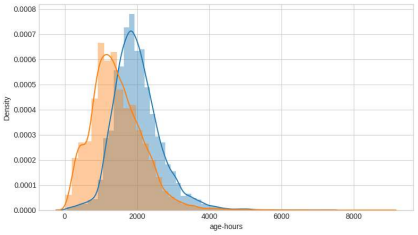



```
my_df['age-hours'] = my_df['age']*my_df['hours-per-week']
my_df['age-hours_bin'] = pd.cut(my_df['age-hours'], 10)
```

```
plt.style.use('seaborn-whitegrid')
fig = plt.figure(figsize=(20,5))
plt.subplot(1, 2, 1)
sns.countplot(y="age-hours_bin", data=my_df);
plt.subplot(1, 2, 2)
sns.distplot(my_df[my_df['predclass'] == '>50K']['age-hours'], kde_kws={"label": ">$50K"})
sns.distplot(my_df[my_df['predclass'] == '<=50K']['age-hours'], kde_kws={"label": "<$50K"})
```

```
<ipython-input-51-0a87169248b1>:1: MatplotlibDeprecationWarning: The seaborn styles shi
  plt.style.use('seaborn-whitegrid')
<ipython-input-51-0a87169248b1>:6: UserWarning:

`distplot` is a deprecated function and will be removed in seaborn v0.14.0.

Please adapt your code to use either `displot` (a figure-level function with
similar flexibility) or `histplot` (an axes-level function for histograms).

For a guide to updating your code to use the new functions, please see
https://gist.github.com/mwaskom/de44147ed2974457ad6372750bbe5751

  sns.distplot(my_df[my_df['predclass'] == '>50K']['age-hours'], kde_kws={"label": ">$5
<ipython-input-51-0a87169248b1>:7: UserWarning:

`distplot` is a deprecated function and will be removed in seaborn v0.14.0.

Please adapt your code to use either `displot` (a figure-level function with
similar flexibility) or `histplot` (an axes-level function for histograms).

For a guide to updating your code to use the new functions, please see
https://gist.github.com/mwaskom/de44147ed2974457ad6372750bbe5751

  sns.distplot(my_df[my_df['predclass'] == '<=50K']['age-hours'], kde_kws={"label": "<$5
<Axes: xlabel='age-hours', ylabel='Density'>
```






```
#EDA
#pair plots of entire dataset
pp = sns.pairplot(my_df, hue = 'predclass', palette = 'deep',
                  size=3, diag_kind = 'kde', diag_kws=dict(shade=True), plot_kws=dict(s=20) )
pp.set(xticklabels=[])
```

```
/usr/local/lib/python3.10/dist-packages/seaborn/axisgrid.py:2095: UserWarning: The `size` parameter has been renamed to `height`; please
  warnings.warn(msg, UserWarning)
/usr/local/lib/python3.10/dist-packages/seaborn/axisgrid.py:1507: FutureWarning:

`shade` is now deprecated in favor of `fill`; setting `fill=True`.
This will become an error in seaborn v0.14.0; please update your code.

  func(x=vector, **plot_kwargs)
/usr/local/lib/python3.10/dist-packages/seaborn/axisgrid.py:1507: FutureWarning:

`shade` is now deprecated in favor of `fill`; setting `fill=True`.
This will become an error in seaborn v0.14.0; please update your code.

  func(x=vector, **plot_kwargs)
/usr/local/lib/python3.10/dist-packages/seaborn/axisgrid.py:1507: FutureWarning:

`shade` is now deprecated in favor of `fill`; setting `fill=True`.
This will become an error in seaborn v0.14.0; please update your code.

  func(x=vector, **plot_kwargs)
/usr/local/lib/python3.10/dist-packages/seaborn/axisgrid.py:1507: FutureWarning:

`shade` is now deprecated in favor of `fill`; setting `fill=True`.
This will become an error in seaborn v0.14.0; please update your code.

  func(x=vector, **plot_kwargs)
/usr/local/lib/python3.10/dist-packages/seaborn/axisgrid.py:1507: FutureWarning:

`shade` is now deprecated in favor of `fill`; setting `fill=True`.
This will become an error in seaborn v0.14.0; please update your code.

  func(x=vector, **plot_kwargs)
/usr/local/lib/python3.10/dist-packages/seaborn/axisgrid.py:1507: FutureWarning:

`shade` is now deprecated in favor of `fill`; setting `fill=True`.
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  func(x=vector, **plot_kwargs)
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  func(x=vector, **plot_kwargs)
<seaborn.axisgrid.PairGrid at 0x7a7feace7e50>
```
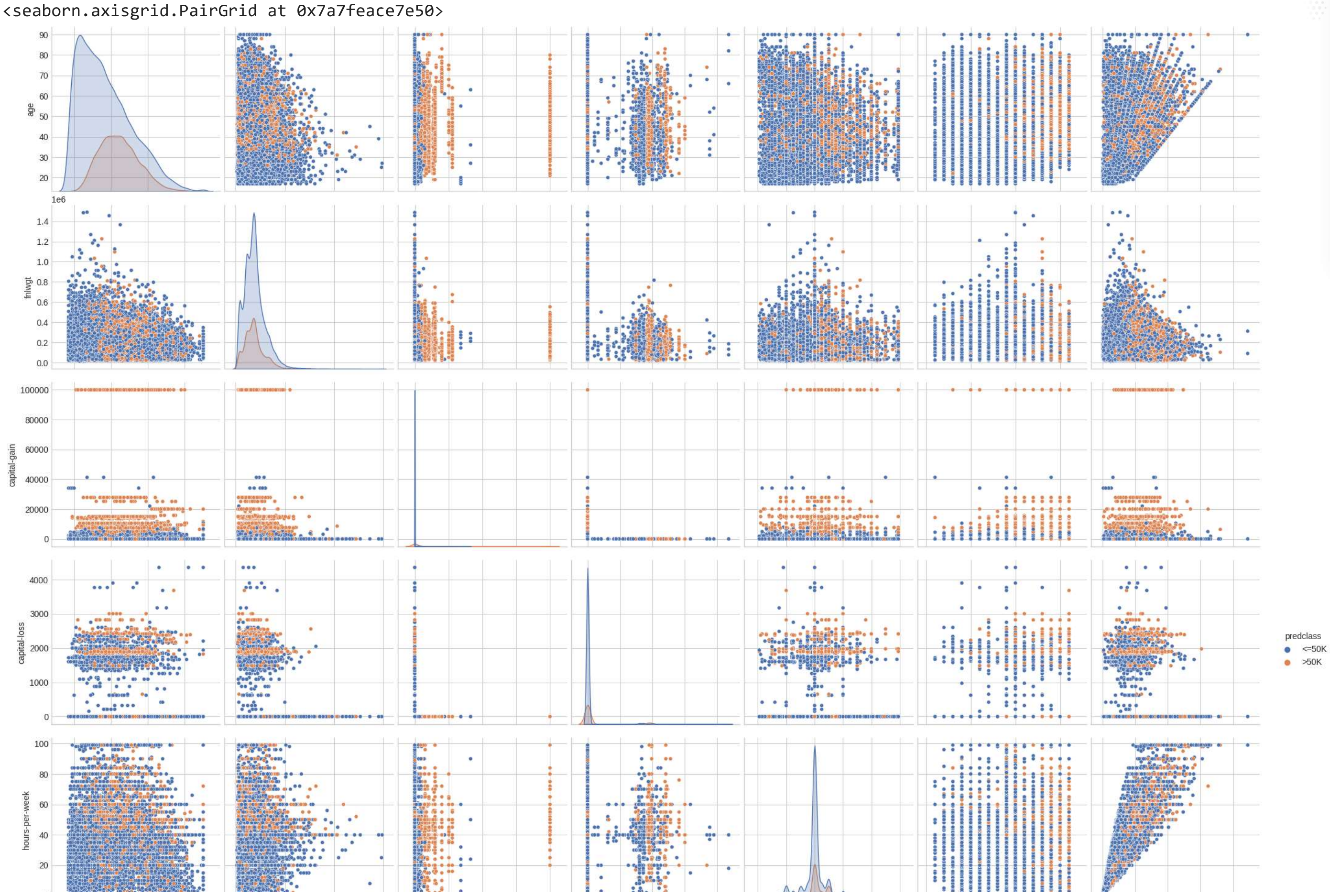
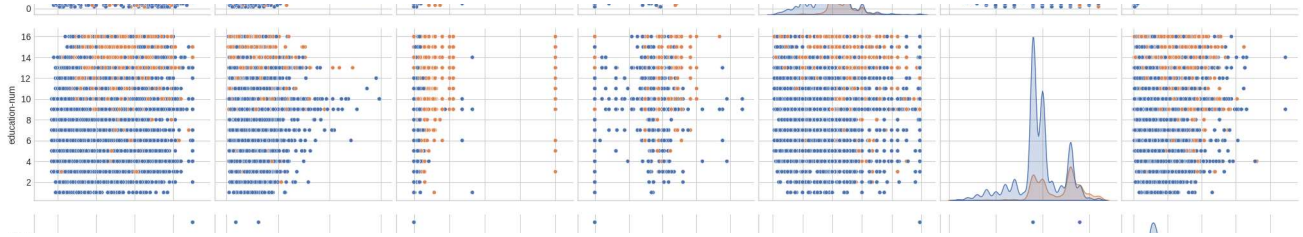
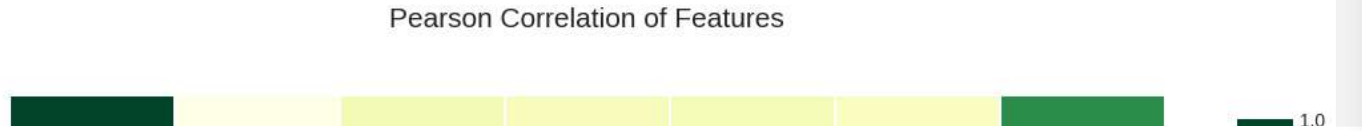






```
#correlation heatmap of dataset
def correlation_heatmap(df):
    _ , ax = plt.subplots(figsize =(14, 12))
    colormap = sns.diverging_palette(220, 10, as_cmap = True)

    _ = sns.heatmap(
        df.corr(),
        cmap = "YlGn",
        square=True,
        cbar_kws={'shrink':.9 },
        ax=ax,
        annot=True,
        linewidths=0.1,vmax=1.0, linecolor='white',
        annot_kws={'fontsize':12 }
           )

    plt.title('Pearson Correlation of Features', y=1.05, size=15)

correlation_heatmap(my_df)
```

```
<ipython-input-53-b393201a783c>:7: FutureWarning: The default value of numeric_only in DataFrame.corr is deprecated. In a future vers
  df.corr(),
```




```
from sklearn.cluster import KMeans
from matplotlib import cm
from sklearn.metrics import silhouette_samples
from sklearn.metrics import silhouette_score
from sklearn.metrics import accuracy_score

from sklearn.decomposition import PCA
from pandas.plotting import scatter_matrix

from mpl_toolkits.mplot3d import Axes3D

from sklearn.model_selection import GridSearchCV


#importing all the required ML packages
from sklearn.linear_model import LogisticRegression #logistic regression
from sklearn import svm #support vector Machine
from sklearn.ensemble import RandomForestClassifier #Random Forest
from sklearn.neighbors import KNeighborsClassifier #KNN
from sklearn.naive_bayes import GaussianNB #Naive bayes
from sklearn.tree import DecisionTreeClassifier #Decision Tree
from sklearn import metrics #accuracy measure
from sklearn.metrics import confusion_matrix #for confusion matrix
```


```
from sklearn.svm import SVR
from sklearn.preprocessing import LabelEncoder
from sklearn.model_selection import train_test_split #training and testing data split
```

```
my_df = my_df.apply(LabelEncoder().fit_transform)
my_df.head()
```

	age	workclass	fnlwgt	education	marital-status	occupation	relationship	race	gender	capital-gain	capital-loss	hours-per-week	native-country	predclas
0	8	4	19329	5	1	7	3	2	1	0	0	39	39	0
1	21	4	4212	3	0	5	0	4	1	0	0	49	39	0
2	11	2	25340	1	0	11	0	4	1	0	0	39	39	1
3	27	4	11201	1	0	7	0	2	1	98	0	39	39	1
4	1	0	5411	1	1	0	3	4	0	0	0	29	39	0

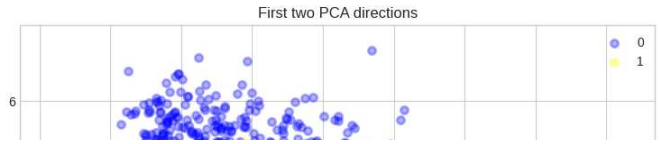
```
drop_elements = ['education', 'native-country', 'predclass', 'age_bin', 'age-hours_bin','hours-per-week_bin']
y = my_df["predclass"]
X = my_df.drop(drop_elements, axis=1)
X.head()
```

	age	workclass	fnlwgt	marital-status	occupation	relationship	race	gender	capital-gain	capital-loss	hours-per-week	education-num	age-hours
0	8	4	19329	1	7	3	2	1	0	0	39	6	478
1	21	4	4212	0	5	0	4	1	0	0	49	8	818
2	11	2	25340	0	11	0	4	1	0	0	39	11	530
3	27	4	11201	0	7	0	2	1	98	0	39	9	766
4	1	0	5411	1	0	3	4	0	0	0	29	9	285

```
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2, random_state=2)
```

```
#PCA
from sklearn import preprocessing
from sklearn.preprocessing import StandardScaler


std_scale = preprocessing.StandardScaler().fit(my_df.drop('predclass', axis=1))
X = std_scale.transform(my_df.drop('predclass', axis=1))
y = my_df['predclass']

# Formatting
target_names = [0,1]
colors = ['blue','yellow','pink']
lw = 2
alpha = 0.3
# 2 Components PCA
plt.style.use('seaborn-whitegrid')
plt.figure(2, figsize=(20, 8))

plt.subplot(1, 2, 1)
pca = PCA(n_components=2)
X_r = pca.fit(X).transform(X)
for color, i, target_name in zip(colors, [0, 1], target_names):
    plt.scatter(X_r[y == i, 0], X_r[y == i, 1],
                color=color,
                alpha=alpha,
                lw=lw,
                label=target_name)
plt.legend(loc='best', shadow=False, scatterpoints=1)
plt.title('First two PCA directions');
# 3 Components PCA
ax = plt.subplot(1, 2, 2, projection='3d')

pca = PCA(n_components=3)
X_reduced = pca.fit(X).transform(X)
for color, i, target_name in zip(colors, [0, 1], target_names):
    ax.scatter(X_reduced[y == i, 0], X_reduced[y == i, 1], X_reduced[y == i, 2],
               color=color,
               alpha=alpha,
               lw=lw,
               label=target_name)
plt.legend(loc='best', shadow=False, scatterpoints=1)
ax.set_title("First three PCA directions")
ax.set_xlabel("1st eigenvector")
ax.set_ylabel("2nd eigenvector")
ax.set_zlabel("3rd eigenvector")

# rotate the axes
ax.view_init(30, 10)
```

```
<ipython-input-62-565455103c07>:11: MatplotlibDeprecationWarning: The seaborn styles shipped by Matplotlib are deprecated since 3.6, as
  plt.style.use('seaborn-whitegrid')
```




```
sc = StandardScaler()
X_train_std = sc.fit_transform(X_train)
pca = PCA(n_components=None)
x_train_pca = pca.fit_transform(X_train_std)
a = pca.explained_variance_ratio_
a_running = a.cumsum()
a_running
```

```
array([0.21396606, 0.32900641, 0.42619426, 0.5087123 , 0.5886566 ,
       0.66655697, 0.74117332, 0.81015145, 0.87025797, 0.92510506,
       0.96812167, 0.99800627, 1.        ])
```

```
from sklearn.linear_model import Perceptron
ppn = Perceptron(eta0=1, random_state=1)
ppn.fit(X_train, y_train)
```

```
Perceptron(eta0=1, random_state=1)
```

```
y_pred = ppn.predict(X_test)
accuracy_score(y_pred,y_test)
```

```
0.7731599959054151
```

```
from sklearn.model_selection import cross_val_score
score_ppn=cross_val_score(ppn, X,y, cv=5)
score_ppn.mean()
```

```
0.7758887424820478
```

```
gaussian = GaussianNB()
gaussian.fit(X_train, y_train)
# y_pred = gaussian.predict(X_test)
score_gaussian = gaussian.score(X_test,y_test)
print('The accuracy of Gaussian Naive Bayes is', score_gaussian)
```

```
The accuracy of Gaussian Naive Bayes is 0.8213737332377931
```

```
# K-Nearest Neighbors
knn = KNeighborsClassifier()
knn.fit(X_train, y_train)
#y_pred = knn.predict(X_test)
score_knn = knn.score(X_test,y_test)
print('The accuracy of the KNN Model is',score_knn)
```

```
The accuracy of the KNN Model is 0.7581123963558194
```

```
# Random Forest Classifier
randomforest = RandomForestClassifier()
randomforest.fit(X_train, y_train)
#y_pred = randomforest.predict(X_test)
score_randomforest = randomforest.score(X_test,y_test)
print('The accuracy of the Random Forest Model is', score_randomforest)
```

```
The accuracy of the Random Forest Model is 0.8555635172484389
```