DSC550_Paulovici_Exercise_8_3

May 2, 2020

Week 8: File: DSC550_Paulovici_Exercise_8_3.py (.ipynb) Name: Kevin Paulovici Date: 5/2/2020 Course: DSC 550 Data Mining (2205-1) Assignment: 8.3 Exercise: Original Analysis Case Study Part 1, 2, 3

Part 1

Assignment Tasks Provide a short narrative describing an original idea for an analysis problem. Find or create appropriate data that can be analyzed. Write the step-by-step instructions for completing the Graph Analysis part of your case study.

In [1]:
```
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns
import yellowbrick
```

In [2]:
```
# Step 1: load the data into a dataframe
df = pd.read_csv("survey_results_public.csv")
headers = pd.read_csv("survey_results_schema.csv", index_col="Column")
```

In [3]:
```
# Step 2: check the dimension of the table
print("The dimension of the data is: {}".format(df.shape))
```

```
The dimension of the data is: (88883, 85)
```

In [4]:
```
# Step 3 - filter the data
# include only united states respondants
filt = (df["Country"] == "United States")

df = df.loc[filt]
```

In [5]:
```
# Step 4: check the dimension of the table
print("The dimension of the data is: {}".format(df.shape))
```

```
The dimension of the data is: (20949, 85)
```

In [6]:
```
# Step 5: display the first few rows of the dataset and header file
df.head()
```

Out[6]:

	Respondent	MainBranch	Hobbyist	OpenSourcer
3	4	I am a developer by profession	No	Never
12	13	I am a developer by profession	Yes	Less than once a month but more than once per ...
21	22	I am a developer by profession	Yes	Less than once per year
22	23	I am a developer by profession	Yes	Less than once per year
25	26	I am a developer by profession	Yes	Less than once per year

	OpenSource	Employment
3	The quality of OSS and closed source software ...	Employed full-time
12	OSS is, on average, of HIGHER quality than pro...	Employed full-time
21	OSS is, on average, of HIGHER quality than pro...	Employed full-time
22	The quality of OSS and closed source software ...	Employed full-time
25	The quality of OSS and closed source software ...	Employed full-time

	Country	Student	EdLevel
3	United States	No	Bachelors degree (BA, BS, B.Eng., etc.)
12	United States	No	Masters degree (MA, MS, M.Eng., MBA, etc.)
21	United States	No	Some college/university study without earning ...
22	United States	No	Bachelors degree (BA, BS, B.Eng., etc.)
25	United States	No	Some college/university study without earning ...

	UndergradMajor	...
3	Computer science, computer engineering, or sof...	...
12	Computer science, computer engineering, or sof...	...
21	NaN	...
22	Information systems, information technology, o...	...
25	Computer science, computer engineering, or sof...	...

	WelcomeChange
3	Just as welcome now as I felt last year
12	Somewhat more welcome now than last year
21	Just as welcome now as I felt last year
22	Just as welcome now as I felt last year
25	Just as welcome now as I felt last year

	SONewContent	Age	Gender	Trans
3	Tech articles written by other developers;Indu...	22.0	Man	No
12	Tech articles written by other developers;Cour...	28.0	Man	No
21	Tech articles written by other developers;Indu...	47.0	Man	No
22	Tech articles written by other developers;Tech...	22.0	Man	No
25	NaN	34.0	Man	No

```
                    Sexuality                      Ethnicity Dependents  \
3   Straight / Heterosexual  White or of European descent         No
12  Straight / Heterosexual  White or of European descent        Yes
21  Straight / Heterosexual  White or of European descent        Yes
22  Straight / Heterosexual   Black or of African descent         No
25            Gay or Lesbian                            NaN         No

              SurveyLength SurveyEase
3   Appropriate in length       Easy
12  Appropriate in length       Easy
21  Appropriate in length       Easy
22  Appropriate in length       Easy
25  Appropriate in length       Easy

[5 rows x 85 columns]
```

In [7]:
```
headers.sort_index(inplace=True)
headers
```

Out[7]:
```
                                                  QuestionText
Column
Age             What is your age (in years)? If you prefer not...
Age1stCode      At what age did you write your first line of c...
BetterLife      Do you think people born today will have a bet...
BlockchainIs    Blockchain / cryptocurrency technology is prim...
BlockchainOrg   How is your organization thinking about or imp...
...                                                           ...
WorkPlan                  How structured or planned is your work?
WorkRemote                        How often do you work remotely?
WorkWeekHrs      On average, how many hours per week do you work?
YearsCode       Including any education, how many years have y...
YearsCodePro    How many years have you coded professionally (...

[85 rows x 1 columns]
```

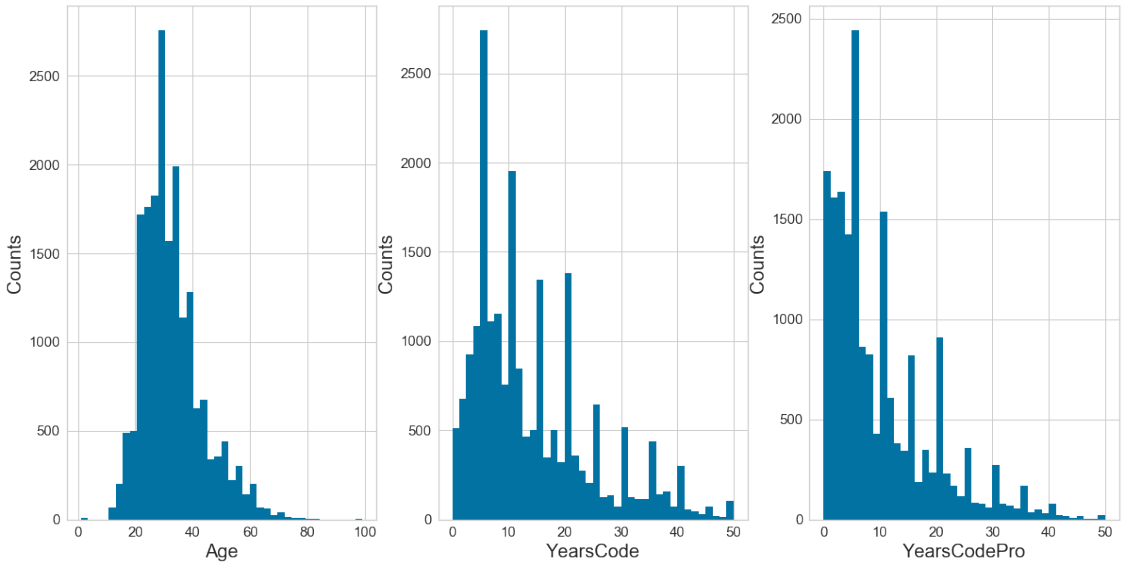
In [8]:
```
# step 6: Update values for YearsCode and YearsCodePro
df["YearsCode"] = df["YearsCode"].replace({"Less than 1 year": 0, "More than 50 years"
df["YearsCodePro"] = df["YearsCodePro"].replace({"Less than 1 year": 0, "More than 50 y
```

In [9]:
```
# Step 7: Convert YearsCode and YearsCodePro to numerics
df['Age'] = pd.to_numeric(df['Age'],errors='coerce')
df['YearsCode'] = pd.to_numeric(df['YearsCode'],errors='coerce')
df['YearsCodePro'] = pd.to_numeric(df['YearsCodePro'],errors='coerce')
```

In [10]:
```
# step 8: summary data for select features
 # age
 df["Age"].describe()
```

```
Out[10]: count    18864.000000
         mean        32.753281
         std         10.495166
         min          1.000000
         25%         25.000000
         50%         31.000000
         75%         38.000000
         max         99.000000
         Name: Age, dtype: float64

In [11]: # YearsCode
         df["YearsCode"].describe()

Out[11]: count    20790.000000
         mean        13.970996
         std         10.481683
         min          0.000000
         25%          6.000000
         50%         10.000000
         75%         20.000000
         max         50.000000
         Name: YearsCode, dtype: float64

In [12]: # YearsCode
         df["YearsCodePro"].describe()

Out[12]: count    18359.000000
         mean         9.915845
         std          9.002617
         min          0.000000
         25%          3.000000
         50%          7.000000
         75%         14.000000
         max         50.000000
         Name: YearsCodePro, dtype: float64

In [13]: # Step 9: Create histograms of Age, YearsCode, and YearsCodePro
         # set up the figure size
         plt.rcParams['figure.figsize'] = (20, 10)

         # make subplots
         fig, axes = plt.subplots(nrows = 1, ncols = 3)

         # Specify the features of interest
         num_features = ['Age', 'YearsCode', 'YearsCodePro']
         xaxes = num_features
         yaxes = ['Counts', 'Counts', 'Counts']

         # draw histograms
```

```
axes = axes.ravel()
for idx, ax in enumerate(axes):
    ax.hist(df[num_features[idx]].dropna(), bins=40)
    ax.set_xlabel(xaxes[idx], fontsize=20)
    ax.set_ylabel(yaxes[idx], fontsize=20)
    ax.tick_params(axis='both', labelsize=15)
plt.show()
```



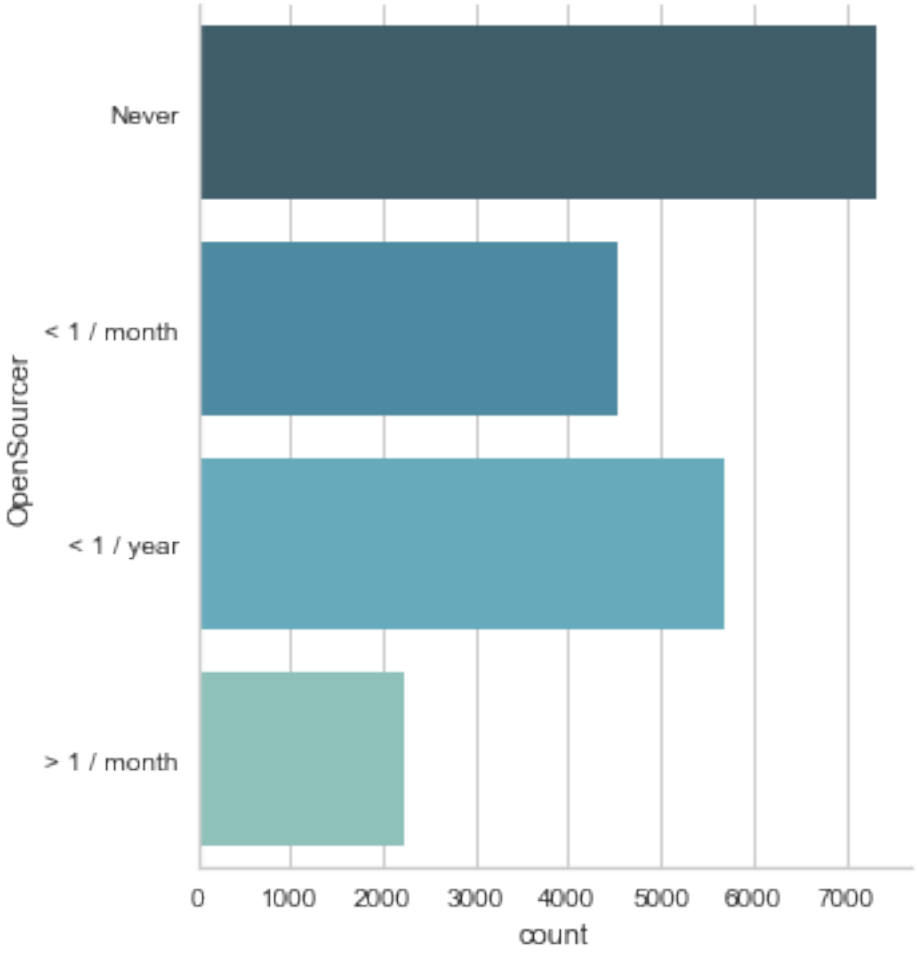
In [14]:
```
# Step 10: Replace Values for Opensourcer & Employment
# df.rename(columns={"OpenSourcer":"OpenSourcer/year"})
df["OpenSourcer"] = df["OpenSourcer"].replace({"Less than once per year": "< 1 / year"

df["Employment"] = df["Employment"].replace(
    {"Employed full-time":"Full-Time",
    "Employed part-time": "Part-Time",
    "Independent contractor, freelancer, or self-employed": "Independent",
    "Not employed, and not looking for work":"Not & ot looking",
    "Not employed, but looking for work":"Not & looking"})
```

In [15]:
```
# Step 11: Filter Gender to man and woman only
filt = (df["Gender"] == "Man") | (df["Gender"] == "Woman")
df = df.loc[filt]
df.shape
```

Out[15]:
```
(19792, 85)
```

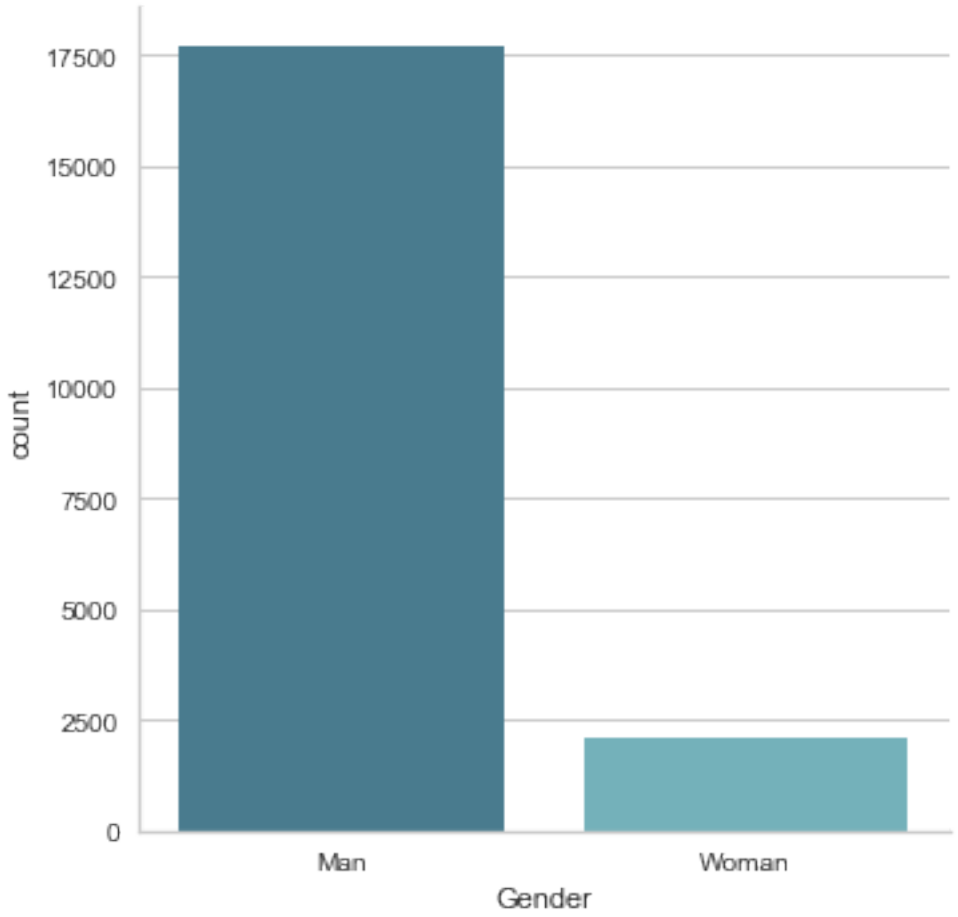
In [16]:
```
# Step 12: Create histograms of OpenSourcer, Gender, Hobbyist, Student, JobSat, MgrId
sns.catplot(y="OpenSourcer", palette="GnBu_d", kind="count", data=df)
```

Out[16]:
```
<seaborn.axisgrid.FacetGrid at 0x2b9822d0358>
```



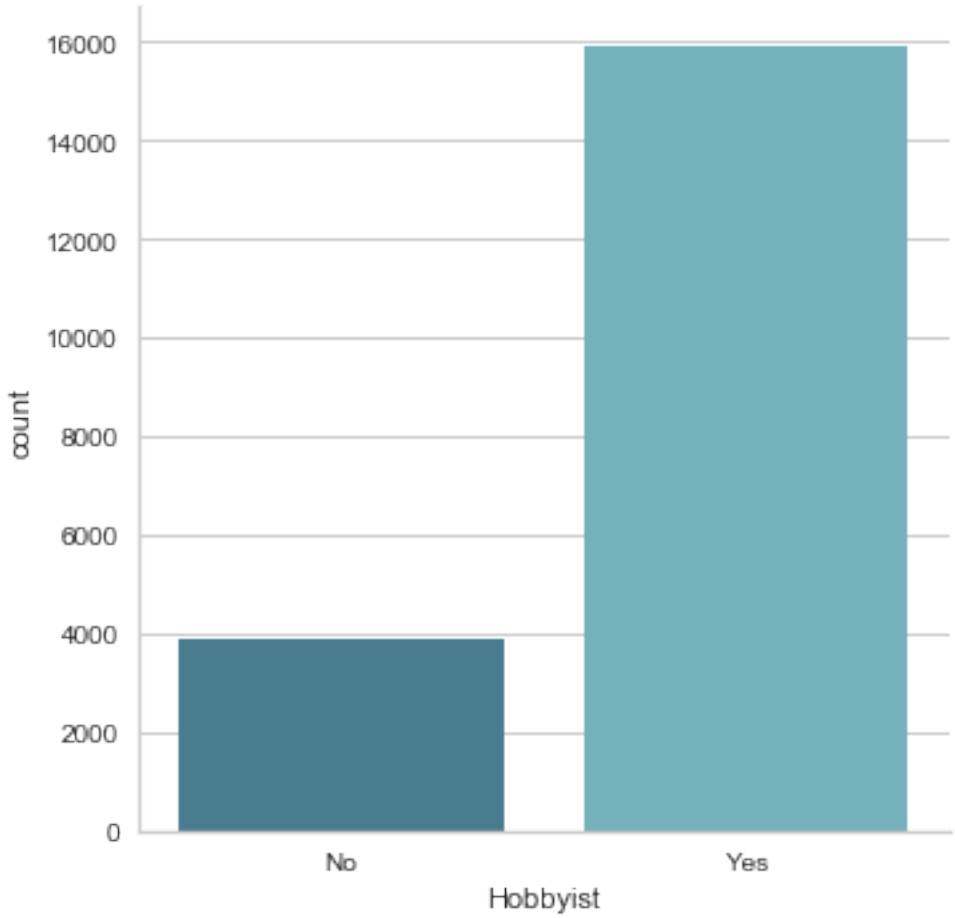

```
In [17]: sns.catplot(x="Gender", palette="GnBu_d", kind="count", data=df)
```

```
Out[17]: <seaborn.axisgrid.FacetGrid at 0x2b9822d0748>
```



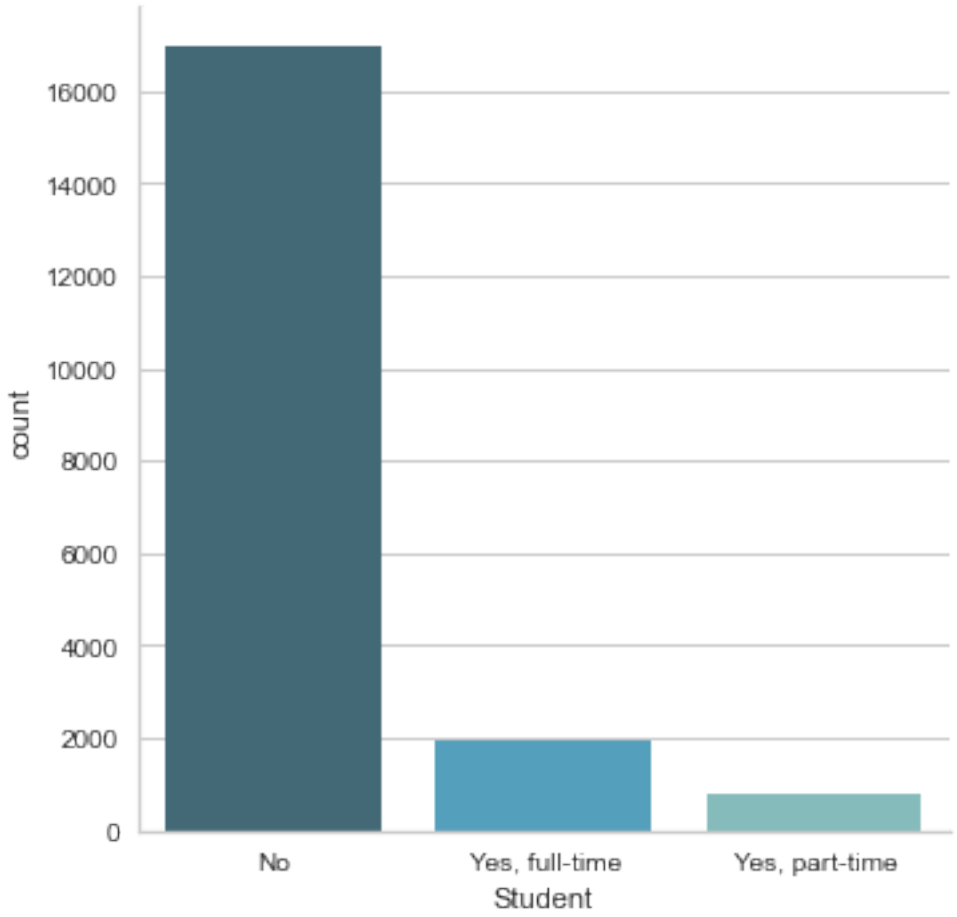

```
In [18]: sns.catplot(x="Hobbyist", palette="GnBu_d", kind="count", data=df)
```

```
Out[18]: <seaborn.axisgrid.FacetGrid at 0x2b982841e10>
```



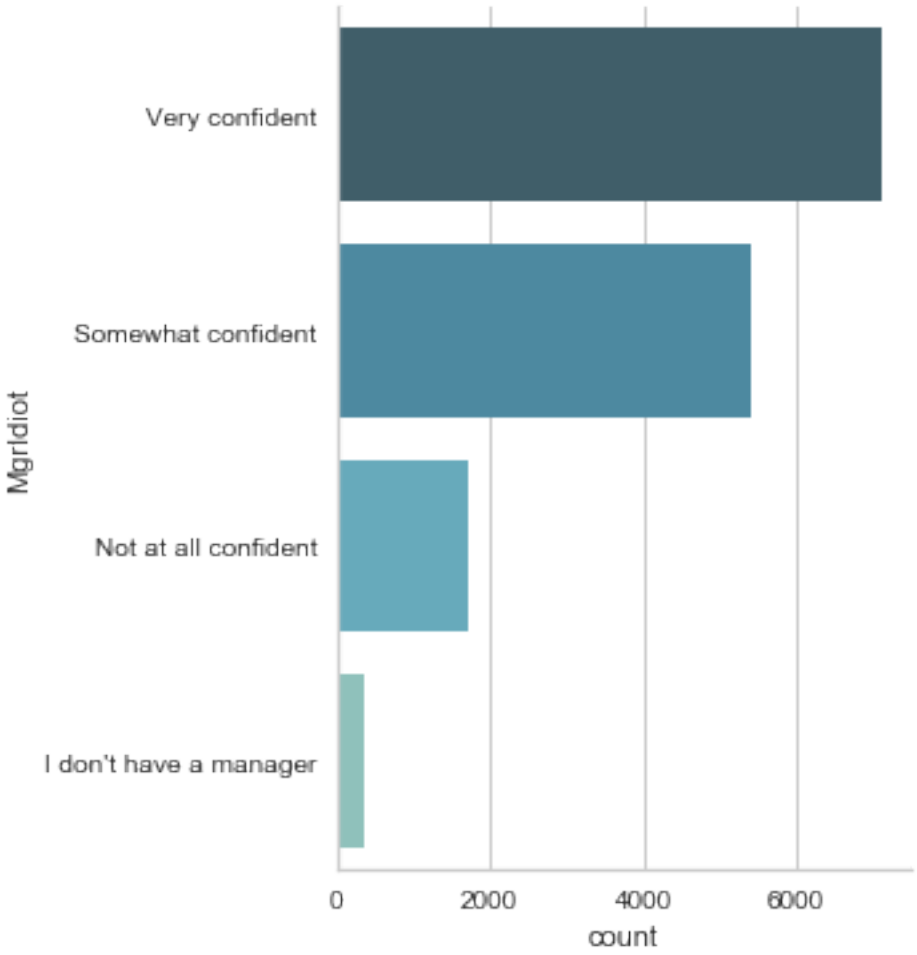

```
In [19]: sns.catplot(x="Student", palette="GnBu_d", kind="count", data=df)
```

```
Out[19]: <seaborn.axisgrid.FacetGrid at 0x2b98539c240>
```



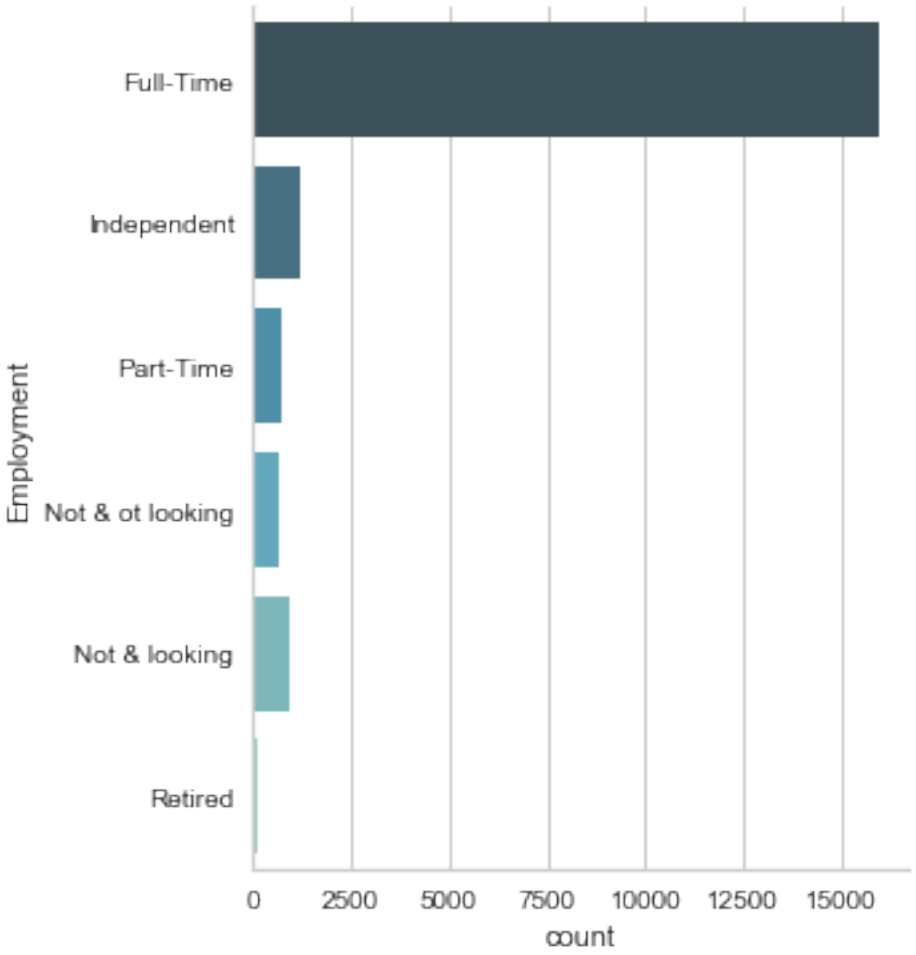

```
In [20]: sns.catplot(y="MgrIdiot", palette="GnBu_d", kind="count", data=df)
```

```
Out[20]: <seaborn.axisgrid.FacetGrid at 0x2b98536bdd8>
```



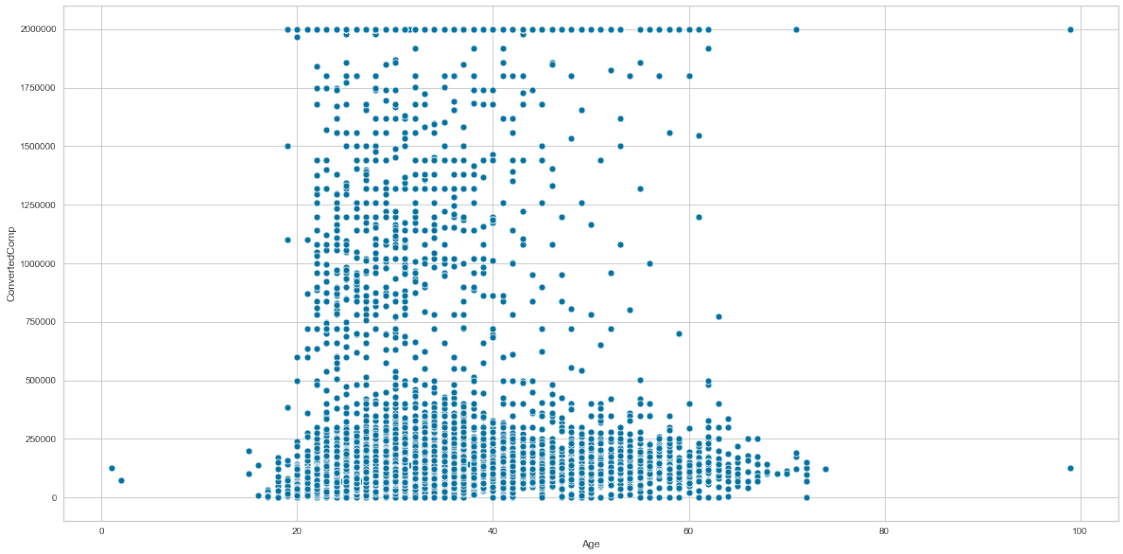

```
In [21]: sns.catplot(y="Employment", palette="GnBu_d", kind="count", data=df)
```

```
Out[21]: <seaborn.axisgrid.FacetGrid at 0x2b98541f128>
```




```
In [22]: # step 13: Scatter/Histogram plots of Salary Vs. Age
         sns.scatterplot(y="ConvertedComp", x="Age", palette="GnBu_d", data=df)
```

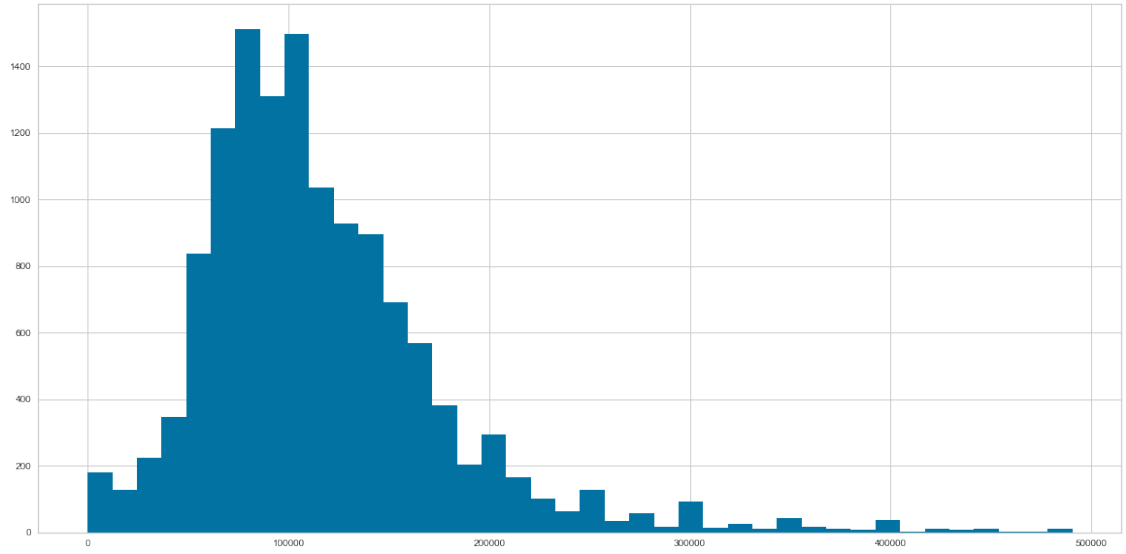
```
Out[22]: <matplotlib.axes._subplots.AxesSubplot at 0x2b985470128>
```




```
In [23]: # histogram of Salary
         # how many values are below 500K
         filt = df["ConvertedComp"] < 500000
         df_500 = df.loc[filt]
         df_500.ConvertedComp.describe()
```

```
Out[23]: count     13127.000000
         mean     116373.503466
         std       62200.536300
         min           0.000000
         25%       76000.000000
         50%      105000.000000
         75%      140000.000000
         max      490600.000000
         Name: ConvertedComp, dtype: float64
```

```
In [24]: temp = df_500["ConvertedComp"]
         plt.hist(temp, bins=40)
         plt.show()
```



Part 2

Assignment Tasks Create Part 2 of your Analysis Case Study project. Part 2 should consist of Dimensionality and Feature Reduction. You can use any methods/tools you think are most appropriate. Write the step-by-step instructions for completing the Dimensionality and Feature Reduction part of your case study.

```
In [25]: # Recap of filter done so far (dimensionality reduction)
         # Step 3 included only for United States and Python users
         # step 11 included only man and woman as genders

In [26]: # Step 14: Additional filter


         # employement, remove anyone not currently employeed
         filt = (df["Employment"] == "Full-Time") | (df["Employment"] == "Part-Time") | (df["Em
         df = df.loc[filt]

In [27]: print("The dimension of the data is: {}".format(df.shape))

The dimension of the data is: (17899, 85)


In [28]: # age, only include age range 18 - 65
         filt = (df["Age"] > 17) & (df["Age"] < 66)
         df = df.loc[filt]

In [29]: # ConvertedComp (Salary)
         filt = (df["ConvertedComp"] < 500000)
         df = df.loc[filt]
         print("The dimension of the data is: {}".format(df.shape))

The dimension of the data is: (12579, 85)
```

In [30]:
```
# Step 15: Remove features not of interest
# features = ["MainBranch", "Hobbyist", "OpenSourcer", "Employment", "Student",
# "OrgSize","YearsCode","YearsCodePro","CareerSat","JobSat","MgrIdiot",
# "ConvertedComp","WorkWeekHrs","WorkLoc","LanguageWorkedWith","OpSys","BetterLife",
# "Age","Gender","Dependents"]

features = ["MainBranch", "Hobbyist", "Employment", "OpenSourcer", "YearsCode","YearsC
"ConvertedComp","WorkWeekHrs", "Age","Gender"]

df = df[features]

df.shape
```

Out[30]: (12579, 11)

In [31]:
```
headers = pd.read_csv("survey_results_schema.csv")
```

In [32]:
```
# filt = (headers["Column"] == "MainBranch") | (headers["Column"] == "Hobbyist") | (h

filt = (headers["Column"] == "MainBranch") | (headers["Column"] == "Hobbyist") | (hea

headers = headers.loc[filt]
headers.set_index("Column")
headers.sort_index(inplace=True)
headers
```

Out[32]:

	Column	QuestionText
1	MainBranch	Which of the following options best describes ...
2	Hobbyist	Do you code as a hobby?
3	OpenSourcer	How often do you contribute to open source?
5	Employment	Which of the following best describes your cur...
13	YearsCode	Including any education, how many years have y...
15	YearsCodePro	How many years have you coded professionally (...
31	ConvertedComp	Salary converted to annual USD salaries using ...
32	WorkWeekHrs	On average, how many hours per week do you work?
77	Age	What is your age (in years)? If you prefer not...
78	Gender	Which of the following do you currently identi...

In [33]:
```
# step 16: na values
df = df.dropna()
df.shape
```

Out[33]: (12486, 11)

Part 3

In [34]:
```
# step 17: create target column
# print(df.ConvertedComp)
```

```
        # avg = 246592.5
        avg = df.ConvertedComp.mean()

        df["Above_Below_Avg_Sal"] = ""

        for index, row in df.iterrows():
            if row.ConvertedComp < avg:
                df.at[index, 'Above_Below_Avg_Sal'] = "Below Avg"
            else:
                df.at[index, 'Above_Below_Avg_Sal'] = "Above Avg"

        df.Above_Below_Avg_Sal.describe()
```

Out[34]:
```
count         12486
unique            2
top       Below Avg
freq           7307
Name: Above_Below_Avg_Sal, dtype: object
```

In [35]:
```
        # step 18: convert categorical data to numbers

        # categorical features
        cat_features = ['MainBranch','Hobbyist','OpenSourcer','Employment', 'Gender']
        df_cat = df[cat_features]

        #one hot encoding
        df_cat_dummies = pd.get_dummies(df_cat)

        print(df_cat_dummies.head())
```

```
    MainBranch_I am a developer by profession  \
3                                           1
12                                          1
21                                          1
22                                          1
25                                          1

    MainBranch_I am not primarily a developer, but I write code sometimes as part of my work  \
3                                                   0
12                                                  0
21                                                  0
22                                                  0
25                                                  0

    Hobbyist_No  Hobbyist_Yes  OpenSourcer_< 1 / month  \
3             1             0                        0
12            0             1                        1
21            0             1                        0
```

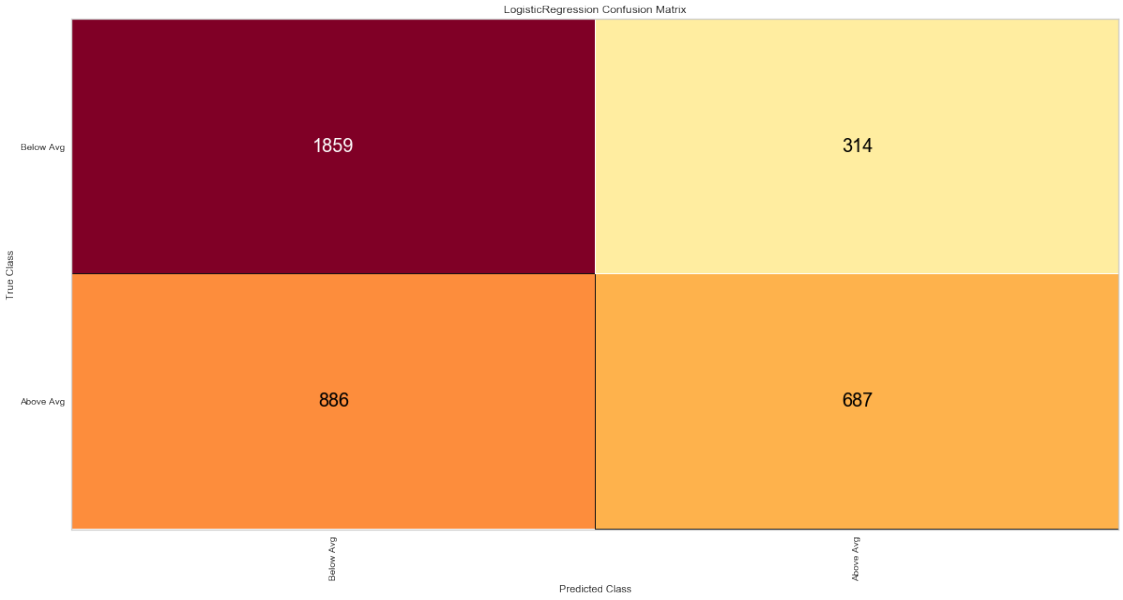
```
22            0             1                        0
25            0             1                        0

    OpenSourcer_< 1 / year  OpenSourcer_> 1 / month  OpenSourcer_Never  \
3                        0                        0                  1
12                       0                        0                  0
21                       1                        0                  0
22                       1                        0                  0
25                       1                        0                  0

    Employment_Full-Time  Employment_Independent  Employment_Part-Time  \
3                      1                       0                     0
12                     1                       0                     0
21                     1                       0                     0
22                     1                       0                     0
25                     1                       0                     0

    Gender_Man  Gender_Woman
3            1             0
12           1             0
21           1             0
22           1             0
25           1             0
```

In [36]:
```
# step 19: create whole features dataset for train/validation data splitting

# combine numerical data & dummie features together
features_model = ['YearsCodePro','WorkWeekHrs','Age']
df_model_x = df[features_model]
# df_model_x = pd.concat([df[features_model], df_cat_dummies], axis=1)
# set the target dataset
df_model_y = df['Above_Below_Avg_Sal']

# separate data into training and validation and check the details of the datasets
# import packages
from sklearn.model_selection import train_test_split

# split the data
x_train, x_val, y_train, y_val = train_test_split(df_model_x, df_model_y, test_size =0

# number of samples in each set
print("No. of samples in training set: ", x_train.shape[0])
print("No. of samples in validation set:", x_val.shape[0])

# Above / Below Avg
print('\n')
print('No. of Above / Below Avg in the training set:')
```

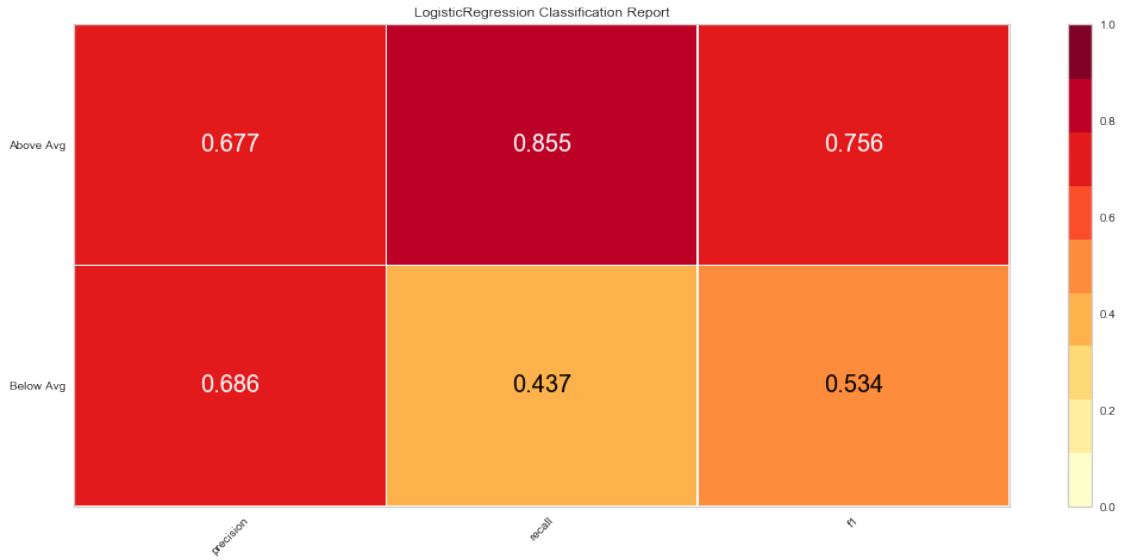
```
print(y_train.value_counts())

print('\n')
print('No. of Above / Below Avg in the validation set:')
print(y_val.value_counts())
```

```
No. of samples in training set:  8740
No. of samples in validation set: 3746


No. of Above / Below Avg in the training set:
Below Avg    5134
Above Avg    3606
Name: Above_Below_Avg_Sal, dtype: int64


No. of Above / Below Avg in the validation set:
Below Avg    2173
Above Avg    1573
Name: Above_Below_Avg_Sal, dtype: int64
```

```
In [37]: # step 20: Eval Metrics
from sklearn.linear_model import LogisticRegression

from yellowbrick.classifier import ConfusionMatrix
from yellowbrick.classifier import ClassificationReport
from yellowbrick.classifier import ROCAUC

# Instantiate the classification model
model = LogisticRegression()

#The ConfusionMatrix visualizer taxes a model
classes = ['Below Avg','Above Avg']
cm = ConfusionMatrix(model, classes=classes, percent=False)

# fit the model
cm.fit(x_train, y_train)

#To create the ConfusionMatrix, we need some test data. Score runs predict() on the d
#and then creates the confusion_matrix from scikit learn.
cm.score(x_val, y_val)

# change fontsize of the labels in the figure
for label in cm.ax.texts:
    label.set_size(20)

#How did we do?
cm.poof()
```



In [38]:
```
# Precision, Recall, and F1 Score
# set the size of the figure and the font size
#%matplotlib inline
plt.rcParams['figure.figsize'] = (15, 7)
plt.rcParams['font.size'] = 20

# Instantiate the visualizer
visualizer = ClassificationReport(model, classes=classes)

visualizer.fit(x_train, y_train)  # Fit the training data to the visualizer
visualizer.score(x_val, y_val)  # Evaluate the model on the test data
g = visualizer.poof()
```



In [39]:
```
# ROC and AUC
#Instantiate the visualizer
visualizer = ROCAUC(model)

visualizer.fit(x_train, y_train)  # Fit the training data to the visualizer
visualizer.score(x_val, y_val)  # Evaluate the model on the test data
g = visualizer.poof()
```