Assignment_1

August 23, 2024

ID:32508956 Task to explain:4 Task A1: Data Exploration and Visualisation

import pandas as pd students=pd.read_csv('Student_List.csv') students.count()

[8]:
```
students.head()
```

[8]:

	StudentID	Age	ParentalEducation	StudyTimeWeekly	Absences	Tutoring	ParentalSupport	Extracurricular	Sports	Music	Volunteering	GPA	GradeClass
0	1640	18	Some College	10.318918	5	No	2	No	Yes	No	No	2.655994	C
1	2939	16	Bachelor's	6.517803	2	Yes	2	No	Yes	No	No	3.474562	B
2	2877	15	Some College	0.815700	1	No	1	No	No	Yes	Yes	2.806878	C
3	1628	16	High School	6.304335	8	No	3	No	No	No	No	2.150546	D
4	2052	15	Some College	2.516047	14	Yes	3	Yes	No	No	No	2.253871	D

1. There are 1500 students. To determine how many students there is, I used the in built count method from Pandas. So far, this assumes that all the rows within the csv file are valid and represent a unique student.

[10]:
```
age=students['Age']
range=age.max()-age.min() ##largest - smallest age = age range
range
```

[10]: 3

2. The age range of this dataset is 3 years. More specifically the oldest age is 18 and the youngest is 15. (we can check this by looking at output of age.max() and age.min()

[12]:
```
students.dtypes ##provides details about the data type of each column of the␣
↪student dataframe.
```

[12]:
```
StudentID              int64
Age                    int64
ParentalEducation     object
StudyTimeWeekly      float64
Absences               int64
Tutoring              object
ParentalSupport        int64
Extracurricular       object
Sports                object
Music                 object
Volunteering          object
GPA                  float64
GradeClass            object
dtype: object
```

3. Columns StudentID, Age, Absences, Parental Support are all of type int64. This indicates that values in these columns are all integers. Data of this type can only be counted/shown discretely. eg StudentID is an integer, Age and absences are recorded as a whole number. (Note: this is a design choice of the creator, Age and absences could have been recorded as a float) Columns StudyTimeWeekly, GPA are of type float64. This means all values in this column are of the form ##.####etc. This is for data that is numerical but NOT discrete/integers. For example it is possible to study 4.234 hours a week or have a 4.5 GPA. Columns ParentalEducation, Tutoring, Extracurricular, Sports, Music, Volunteering, and GradeClass are all objects. Note that all values in these columns are strings (eg: "Yes", "No") which are regarded as objects in python.

[14]:
```
students=pd.read_csv('Student_List.csv')
students.groupby('GradeClass').count() #this counts how many rows/students␣
↪exist for each group (GradeClass)
```

[14]:

GradeClass	StudentID	Age	ParentalEducation	StudyTimeWeekly	Absences	Tutoring	ParentalSupport	Extracurricular	Sports	Music	Volunteering	GPA
A	60	60	60	60	60	60	60	60	60	60	60	60
B	183	183	183	183	183	183	183	183	183	183	183	183
C	244	244	244	244	244	244	244	244	244	244	244	244
D	248	248	248	248	248	248	248	248	248	248	248	248
F	765	765	765	765	765	765	765	765	765	765	765	765

```
             Volunteering  GPA
GradeClass
A                      60   60
B                     183  183
C                     244  244
D                     248  248
F                     765  765
```

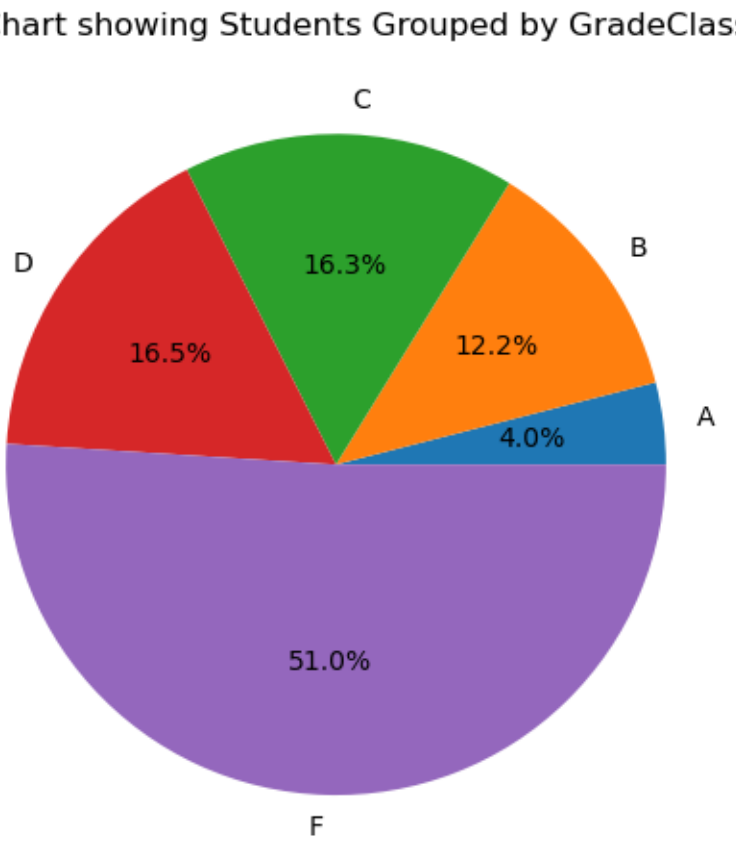
[16]:
```
for row in students.groupby('GradeClass').count()['StudentID']:
    print(100*row/1500) #converting the number of students in each GradeClass␣
 ↪group into a percentage
```

```
4.0
12.2
16.266666666666666
16.533333333333335
51.0
```

4. Grade A = 4% Grade B = 12.2% Grade C = 16.27% Grade D = 16.53% Grade F = 51%

[18]:
```
import matplotlib.pyplot as plt
%matplotlib inline
```

[26]:
```
x=[]
for row in students.groupby('GradeClass').count()['StudentID']:
    x.append(row)
x
labels = ['A','B','C','D','F']
fig, ax = plt.subplots()
ax.pie(x, labels=labels,autopct='%.1f%%')
ax.set_title('Pie Chart showing Students Grouped by GradeClass')
plt.tight_layout()
```



5. Looking at the above pie chart, it is clear that as the grades increase (from F to A), the number of students decrease. This trend makes sense, as it is expected for less students to achieve a higher grade of A or B because it is objectively harder to do so. However an important observation is that the proportion of students in GradeClass C and D are almost identical, and there are more than half of the students with an F grade. One may think that this is a huge proportion (51% for an F grade) but at a closer look this is not particularly surprising when you consider that an F grade here implies a GPA of 2.0> when an F grade is more commonly appointed to students with a 0.0 GPA.

Task A2: Exploring Parental Education

[28]:
```
students
```

[28]:

	StudentID	Age	ParentalEducation	StudyTimeWeekly	Absences	Tutoring	\
0	1640	18	Some College	10.318918	5	No	
1	2939	16	Bachelor's	6.517803	2	Yes	
2	2877	15	Some College	0.815700	1	No	
3	1628	16	High School	6.304335	8	No	
4	2052	15	Some College	2.516047	14	Yes	
…	…	…	…	…	…	…	

```
1495       1944   15      No Education        10.596678        12       No
1496       1566   16      Some College         3.278634         4      Yes
1497       3268   18      Some College         7.598010         0      Yes
1498       3237   17      Some College        15.078754        24       No
1499       1149   15            Higher         1.360205        22       No

      ParentalSupport Extracurricular Sports Music Volunteering       GPA  \
0                   2              No    Yes    No           No  2.655994
1                   2              No    Yes    No           No  3.474562
2                   1              No     No   Yes          Yes  2.806878
3                   3              No     No    No           No  2.150546
4                   3             Yes     No    No           No  2.253871
…                 …             …    …   …          …        …
1495                1              No     No    No          Yes  1.621012
1496                4             Yes     No    No           No  3.244882
1497                3              No     No    No           No  3.040730
1498                4              No     No   Yes           No  1.245091
1499                1             Yes    Yes    No          Yes  1.007226

     GradeClass
0             C
1             B
2             C
3             D
4             D
…         …
1495          F
1496          B
1497          F
1498          F
1499          F

[1500 rows x 13 columns]
```

[30]:
```
students.groupby('ParentalEducation').count()
```

[30]:
```
                   StudentID  Age  StudyTimeWeekly  Absences  Tutoring  \
ParentalEducation
Bachelor's               234  234              234       234       234
High School              458  458              458       458       458
Higher                    77   77               77        77        77
No Education             154  154              154       154       154
Some College             577  577              577       577       577

                   ParentalSupport  Extracurricular  Sports  Music  \
ParentalEducation
Bachelor's                     234              234     234    234
```

```
High School                    458             458     458     458
Higher                          77              77      77      77
No Education                   154             154     154     154
Some College                   577             577     577     577

                   Volunteering  GPA  GradeClass
ParentalEducation
Bachelor's                  234  234         234
High School                 458  458         458
Higher                       77   77          77
No Education                154  154         154
Some College                577  577         577
```

1. 77 parents have Higher Education 154 parents have no education The most common level of parental education is 'Some College', with 577 parents that have attended a college before.

[228]:
```
students.replace({'ParentalEducation':{'No Education':0, 'High School':1,'Some␣
↪College':2,'Bachelor\'s':3,'Higher':4}})
```

[228]:
```
      StudentID  Age ParentalEducation  StudyTimeWeekly  Absences Tutoring  \
0          1640   18                 2        10.318918         5       No
1          2939   16                 3         6.517803         2      Yes
2          2877   15                 2         0.815700         1       No
3          1628   16                 1         6.304335         8       No
4          2052   15                 2         2.516047        14      Yes
…           …   …                  …                …         …       …
1495       1944   15                 0        10.596678        12       No
1496       1566   16                 2         3.278634         4      Yes
1497       3268   18                 2         7.598010         0      Yes
1498       3237   17                 2        15.078754        24       No
1499       1149   15                 4         1.360205        22       No

      ParentalSupport Extracurricular Sports Music Volunteering       GPA  \
0                   2              No    Yes    No           No  2.655994
1                   2              No    Yes    No           No  3.474562
2                   1              No     No   Yes          Yes  2.806878
3                   3              No     No    No           No  2.150546
4                   3             Yes     No    No           No  2.253871
…                 …              …    …   …          …       …
1495                1              No     No    No          Yes  1.621012
1496                4             Yes     No    No           No  3.244882
1497                3              No     No    No           No  3.040730
1498                4              No     No   Yes           No  1.245091
1499                1             Yes    Yes    No          Yes  1.007226

     GradeClass
0             C
1             B
```

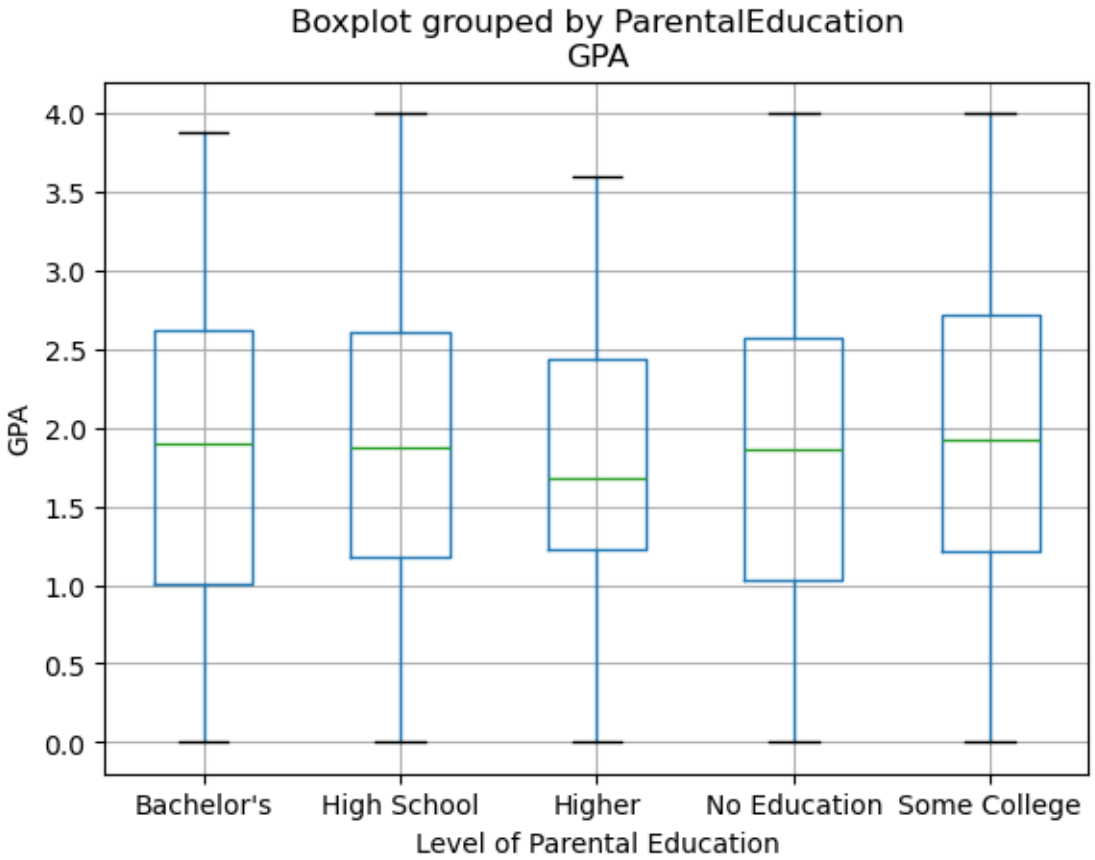
```
2              C
3              D
4              D
…          …
1495           F
1496           B
1497           F
1498           F
1499           F

[1500 rows x 13 columns]
```

2. shown above.. (Would like to note that at the time of coding and submission, this code still works, but there is a warning that using the 'replace' method will be removing in a future version)

[171]:
```
students.boxplot(column = 'GPA',by='ParentalEducation')
plt.ylabel('GPA')
plt.xlabel('Level of Parental Education')
```

[171]:
```
Text(0.5, 0, 'Level of Parental Education')
```

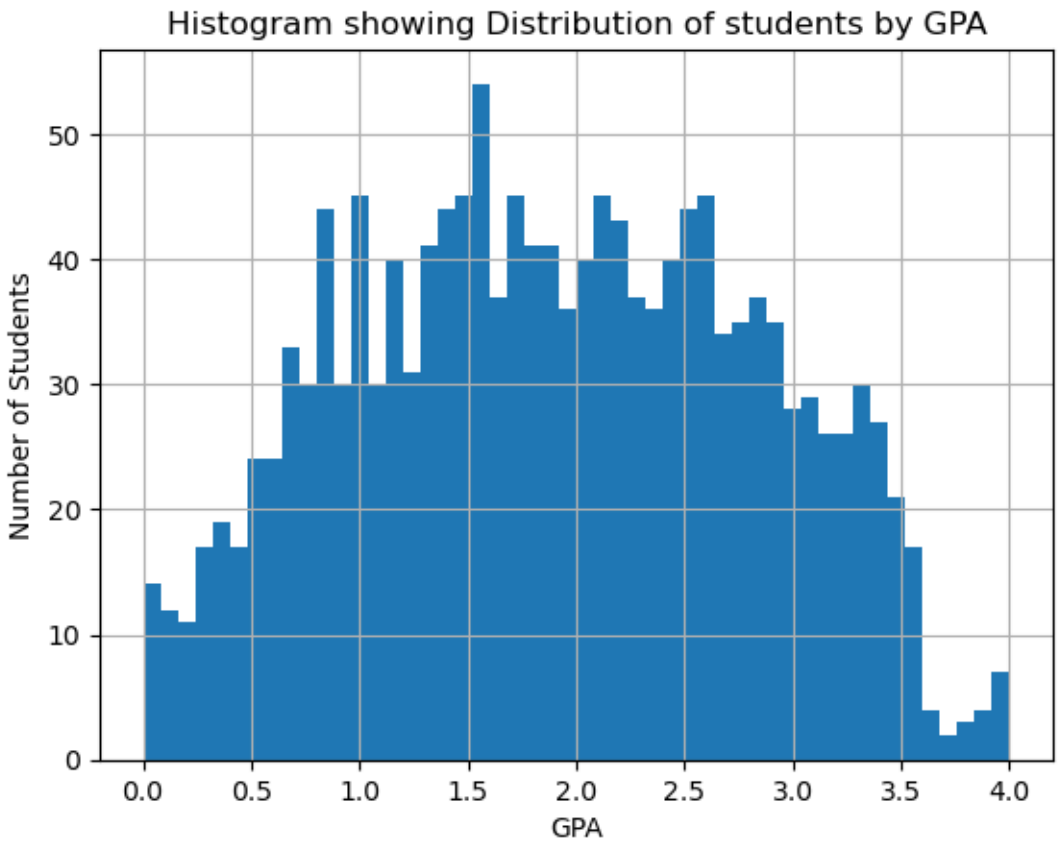


3. There is not a strong relationship between parental education and GPA. One would expect the GPA to increase, as the Parental Education increases, but contrarily, the highest parental education level have a noticeably lower range and median of GPA compared to all the other levels. Otherwise, the spread of GPA appears similar across all levels of parental education.

A3. GPA distribution and Correlation Analysis

[198]:
```
students.GPA.hist(bins=50)
plt.xlabel('GPA')
plt.ylabel('Number of Students')
plt.title('Histogram showing Distribution of students by GPA')
```

[198]:
```
Text(0.5, 1.0, 'Histogram showing Distribution of students by GPA')
```

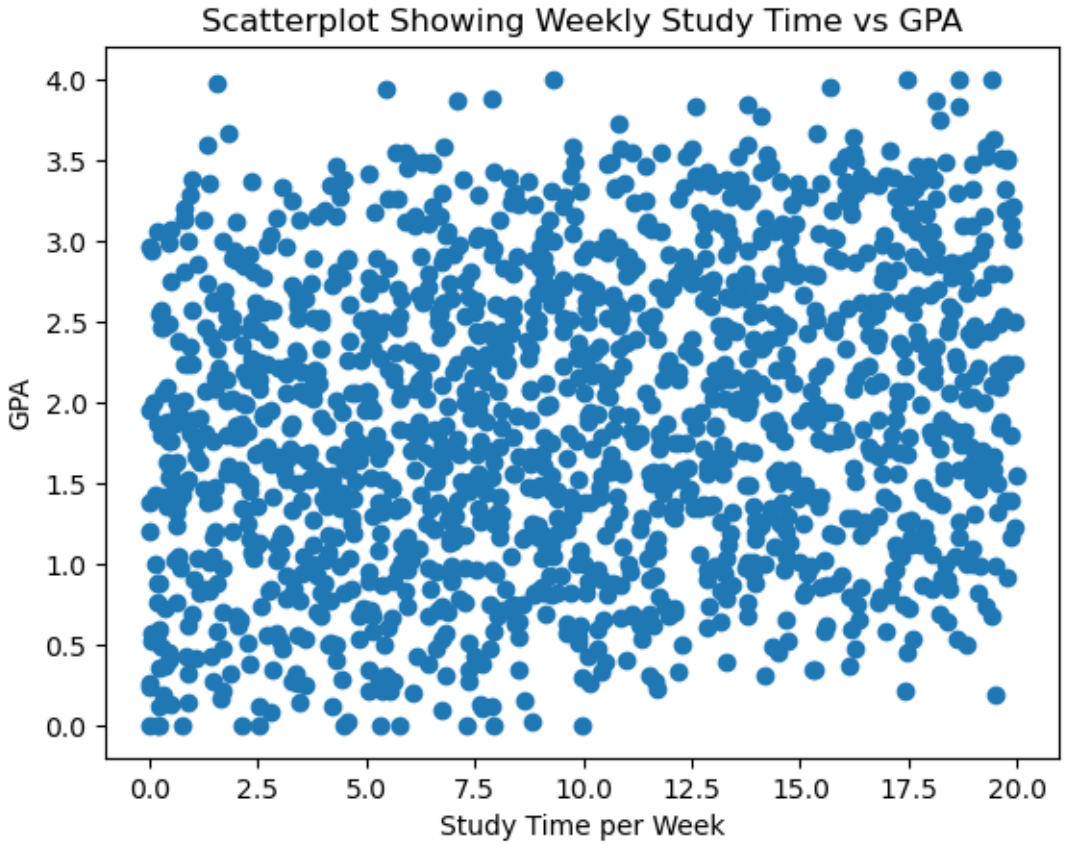


1. Histogram shown above. The distribution looks for the most part like a normal distribution, where more students populate the middle range of GPA (1.5-2.5) and there are less students as the GPA increases, and less students as the GPA decreases. Something noticeable is that there are a lot more students with around a 1.5 which does not follow the underlying normal distribution trend. The same can be said for students with a 0.8 and 1.0 GPA.

Also, taking a closer look at the 3.5 - 4.0 GPA range, an unexpected trend can be seen, where there are more students achieving a 3.8-4.0 GPA compared to the 3.6-3.8 range when the opposite should be expected.

[211]:
```
plt.scatter(students['StudyTimeWeekly'],students['GPA'])
plt.ylabel('GPA')
plt.xlabel('Study Time per Week')
plt.title('Scatterplot Showing Weekly Study Time vs GPA')
```

[211]:
```
Text(0.5, 1.0, 'Scatterplot Showing Weekly Study Time vs GPA')
```



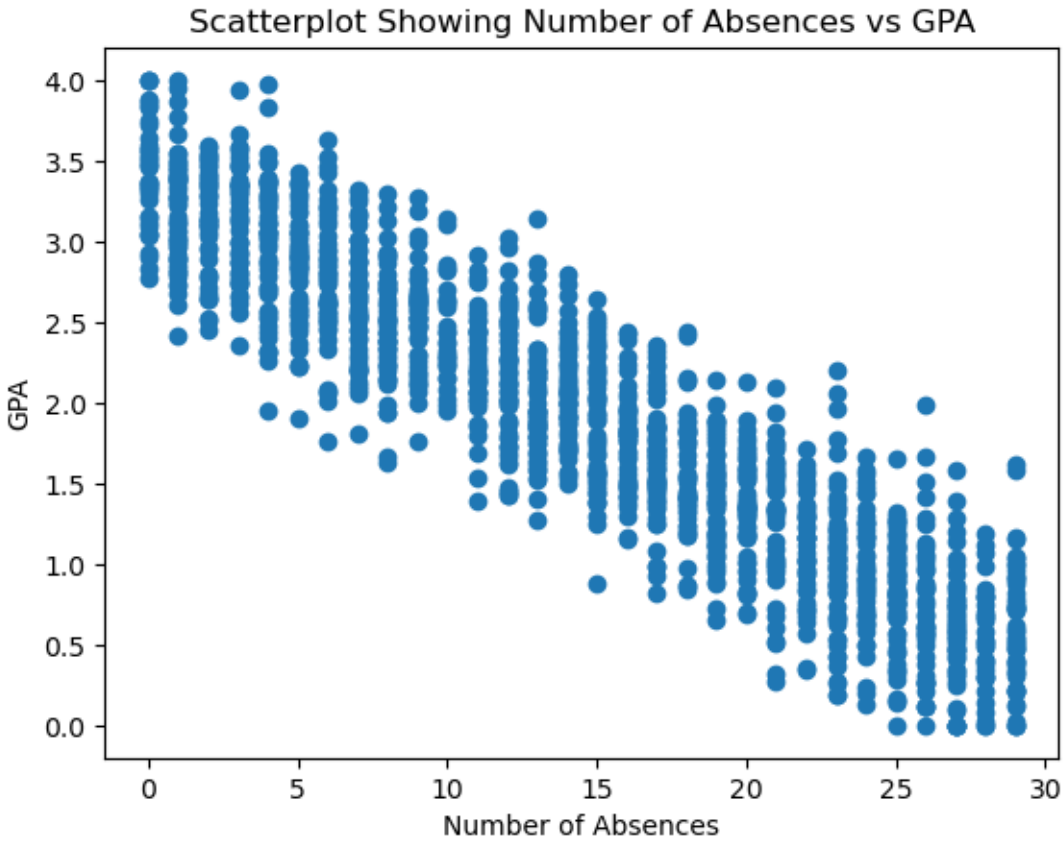
[191]:
```
correlation1 = students['GPA'].corr(students['StudyTimeWeekly'])
print(correlation1)
```

```
0.19049313037112514
```

2. The scatterplot looks like there is an extremely weak yet positive correlation between GPA and Study Time Weekly. This is further supported by the low correlation coefficient between these two (0.19). This indicates that a higher or lower weekly study time does not make a considerable difference to one's GPA. (Contrary to what is expected)

[213]:
```
plt.scatter(students['Absences'],students['GPA'])
plt.ylabel('GPA')
plt.xlabel('Number of Absences')
plt.title('Scatterplot Showing Number of Absences vs GPA')
```

[213]:
```
Text(0.5, 1.0, 'Scatterplot Showing Number of Absences vs GPA')
```



[217]:
```
correlation2 = students['GPA'].corr(students['Absences'])
print(correlation2)
```

```
-0.9194876943290947
```

3. The scatterplot shows a strong negative linear correlation, further supported by the correlation coefficient between GPA and Absences being -0.919. This indicates that an increase in the number of absences will negatively impact GPA.

A4. Extracurricular Activities

[88]:
```
students=pd.read_csv('Student_List.csv')
students
```

```
groupA=students.loc[(students['Sports'] == 'Yes')|(students['Music'] == 'Yes')␣
 ↪|(students['Volunteering'] == 'Yes')|(students['Extracurricular'] == 'Yes') ␣
 ↪]
#this selects rows that satisfy the following condition: at least one value of␣
 ↪Sports, Music, Volunteering and Extracurricular in the row are 'Yes'
groupA
```

[88]:

```
      StudentID  Age ParentalEducation  StudyTimeWeekly  Absences Tutoring  \
0          1640   18      Some College        10.318918         5       No
1          2939   16        Bachelor's         6.517803         2      Yes
2          2877   15      Some College         0.815700         1       No
4          2052   15      Some College         2.516047        14      Yes
5          2368   16      Some College        13.183111        21       No
…           …   …               …                …       …      …
1494       1965   17            Higher         2.405419         6      Yes
1495       1944   15      No Education        10.596678        12       No
1496       1566   16      Some College         3.278634         4      Yes
1498       3237   17      Some College        15.078754        24       No
1499       1149   15            Higher         1.360205        22       No

      ParentalSupport Extracurricular Sports Music Volunteering       GPA  \
0                   2              No    Yes    No           No  2.655994
1                   2              No    Yes    No           No  3.474562
2                   1              No     No   Yes          Yes  2.806878
4                   3             Yes     No    No           No  2.253871
5                   3              No    Yes    No           No  1.625552
…                 …              …     …   …          …       …
1494                1              No     No   Yes           No  2.806698
1495                1              No     No    No          Yes  1.621012
1496                4             Yes     No    No           No  3.244882
1498                4              No     No   Yes           No  1.245091
1499                1             Yes    Yes    No          Yes  1.007226

     GradeClass
0             C
1             B
2             C
4             D
5             F
…           …
1494          C
1495          F
1496          B
1498          F
1499          F

[1068 rows x 13 columns]
```

1. There are 1068 Students that are involved in Sports, Music, Volunteering and Extracurricular activities.

[92]:
```
groupB=students.loc[(students['Sports'] == 'No')&(students['Music'] ==␣
↪'No')&(students['Volunteering'] == 'No')&(students['Extracurricular'] ==␣
↪'No')  ]
groupB
```

[92]:

	StudentID	Age	ParentalEducation	StudyTimeWeekly	Absences	Tutoring	\
3	1628	16	High School	6.304335	8	No	
6	2555	18	Some College	3.521786	22	No	
7	2513	15	High School	4.459000	27	No	
8	2811	16	Some College	7.520836	5	No	
11	1220	17	High School	1.232160	17	No	
…	…	…	…	…	…	…	…
1479	2978	17	High School	9.921510	4	No	
1483	2773	15	High School	4.915006	21	No	
1487	1585	16	Some College	12.276919	22	No	
1489	2049	15	Bachelor's	6.997909	21	No	
1497	3268	18	Some College	7.598010	0	Yes	

	ParentalSupport	Extracurricular	Sports	Music	Volunteering	GPA	\
3	3	No	No	No	No	2.150546	
6	4	No	No	No	No	0.935779	
7	1	No	No	No	No	0.000000	
8	0	No	No	No	No	2.631368	
11	3	No	No	No	No	1.465549	
…	…	…	…	…	…	…	…
1479	1	No	No	No	No	2.307597	
1483	2	No	No	No	No	0.728795	
1487	4	No	No	No	No	1.583084	
1489	3	No	No	No	No	1.137900	
1497	3	No	No	No	No	3.040730	

	GradeClass
3	D
6	F
7	F
8	C
11	F
…	…
1479	D
1483	F
1487	F
1489	F
1497	F

```
[432 rows x 13 columns]
```

2. There are 432 students that are not involved in Sports, Music, Volunteering and Extracurricular activities.

[98]:
```
groupA['GPA'].mean() #average GPA of group A
```

[98]:
```
1.9697375186329584
```

[100]:
```
groupB['GPA'].mean()  #average GPA of group B
```

[100]:
```
1.7312226005532407
```

[102]:
```
groupA['GPA'].mean()-groupB['GPA'].mean()
```

[102]:
```
0.2385149180797177
```

[106]:
```
students['GPA'].mean() ##average GPA of all students
```

[106]:
```
1.9010452222260001
```

3. The students in group A have a higher GPA on average compared to group B by ~0.24. This MAY suggest that Sports, Music, Volunteering and Extracurricular activities may have a positive impact on GPA. However, it is important to consider that the number of students in group A is more than 2 times bigger than the number of students in group B (1068 vs 432 out of 1500 students), in fact the number of students in groupA is more than 2/3 of the number of total studnets. Taking a bigger sample size of the population would in general bring the average GPA closer to the GPA average of the entire population (1500 students) as the sample size approaches the size of the entire population. This means that the fact that average GPA of groupA>groupB does not necessarily mean that doing activies will increase a students GPA on average, however there may still be a slight effect. More analysis needs to be done to conclude this hypothesis. (suggestions: doing correlation of sports/music/volunteering/extracurricular with GPA)

A5. Exploring Parental Support and Tutoring

[110]:
```
students
```

[110]:

	StudentID	Age	ParentalEducation	StudyTimeWeekly	Absences	Tutoring	\
0	1640	18	Some College	10.318918	5	No	
1	2939	16	Bachelor's	6.517803	2	Yes	
2	2877	15	Some College	0.815700	1	No	
3	1628	16	High School	6.304335	8	No	
4	2052	15	Some College	2.516047	14	Yes	
…	…	…	…	…	…	…	
1495	1944	15	No Education	10.596678	12	No	
1496	1566	16	Some College	3.278634	4	Yes	
1497	3268	18	Some College	7.598010	0	Yes	
1498	3237	17	Some College	15.078754	24	No	

```
1499       1149   15            Higher         1.360205        22       No

      ParentalSupport Extracurricular Sports Music Volunteering       GPA  \
0                   2              No    Yes    No           No  2.655994
1                   2              No    Yes    No           No  3.474562
2                   1              No     No   Yes          Yes  2.806878
3                   3              No     No    No           No  2.150546
4                   3             Yes     No    No           No  2.253871
…                 …               …     …    …          …       …
1495                1              No     No    No          Yes  1.621012
1496                4             Yes     No    No           No  3.244882
1497                3              No     No    No           No  3.040730
1498                4              No     No   Yes           No  1.245091
1499                1             Yes    Yes    No          Yes  1.007226

     GradeClass
0             C
1             B
2             C
3             D
4             D
…         …
1495          F
1496          B
1497          F
1498          F
1499          F

[1500 rows x 13 columns]
```

[194]:
```
a5median=students.groupby('ParentalSupport').agg(medianGPA = ('GPA','median'))␣
↪## median GPA of students grouped by parental support
a5median=a5median.reset_index() #turning parental support group into column␣
↪values
a5median
```

[194]:
```
   ParentalSupport  medianGPA
0                0   1.471672
1                1   1.740455
2                2   1.817007
3                3   2.070669
4                4   2.215516
```

[196]:
```
a5mean=students.groupby('ParentalSupport').agg(meanGPA = ('GPA','mean'))## mean␣
↪GPA of students grouped by parental support
a5mean=a5mean.reset_index() #turning parental support group into column values
a5mean
```

[196]:

	ParentalSupport	meanGPA
0	0	1.521602
1	1	1.735855
2	2	1.845914
3	3	2.068174
4	4	2.227639

Q 1 part 1. mean and median GPA group by parental support are shown above in the tables.

[164]:
```
students.groupby('ParentalSupport')['GPA']
for i in [0,1,2,3,4]: #for each number in parental support 0,1,2,3,4
    z=students.loc[(students['ParentalSupport'] == i)] #select the rows
    print(z.loc[(z['Age'] == 18)].count()) # count how many of these rows are␣
 ↪have age = 18
```

```
StudentID            33
Age                  33
ParentalEducation    33
StudyTimeWeekly      33
Absences             33
Tutoring             33
ParentalSupport      33
Extracurricular      33
Sports               33
Music                33
Volunteering         33
GPA                  33
GradeClass           33
dtype: int64
StudentID            80
Age                  80
ParentalEducation    80
StudyTimeWeekly      80
Absences             80
Tutoring             80
ParentalSupport      80
Extracurricular      80
Sports               80
Music                80
Volunteering         80
GPA                  80
GradeClass           80
dtype: int64
StudentID            98
Age                  98
ParentalEducation    98
StudyTimeWeekly      98
Absences             98
```

```
Tutoring              98
ParentalSupport       98
Extracurricular       98
Sports                98
Music                 98
Volunteering          98
GPA                   98
GradeClass            98
dtype: int64
StudentID             116
Age                   116
ParentalEducation     116
StudyTimeWeekly       116
Absences              116
Tutoring              116
ParentalSupport       116
Extracurricular       116
Sports                116
Music                 116
Volunteering          116
GPA                   116
GradeClass            116
dtype: int64
StudentID             35
Age                   35
ParentalEducation     35
StudyTimeWeekly       35
Absences              35
Tutoring              35
ParentalSupport       35
Extracurricular       35
Sports                35
Music                 35
Volunteering          35
GPA                   35
GradeClass            35
dtype: int64
```

Q 1 part 2 The above loop shows that there are 33 students that are 18 and have no parental support (0). There are 80 students that are 18 and have low parental support (1). There are 98 students that are 18 and have moderate parental support (2). There are 116 students that are 18 and have high parental support (3). There are 35 students that are 18 and have very high parental support (4).

[254]:
```
a5median['ParentalSupport']=a5median['ParentalSupport'].replace(0,'None')
a5median['ParentalSupport']=a5median['ParentalSupport'].replace(1,'Low')
a5median['ParentalSupport']=a5median['ParentalSupport'].replace(2,'Moderate')
a5median['ParentalSupport']=a5median['ParentalSupport'].replace(3,'High')
```

```
a5median['ParentalSupport']=a5median['ParentalSupport'].replace(4,'Very High')
a5median
a5median['medianGPA']
x1 = []
for row in a5median['medianGPA']:
    x1.append(row)
x1 #putting the median GPAs of each parental support group into a list x1
```

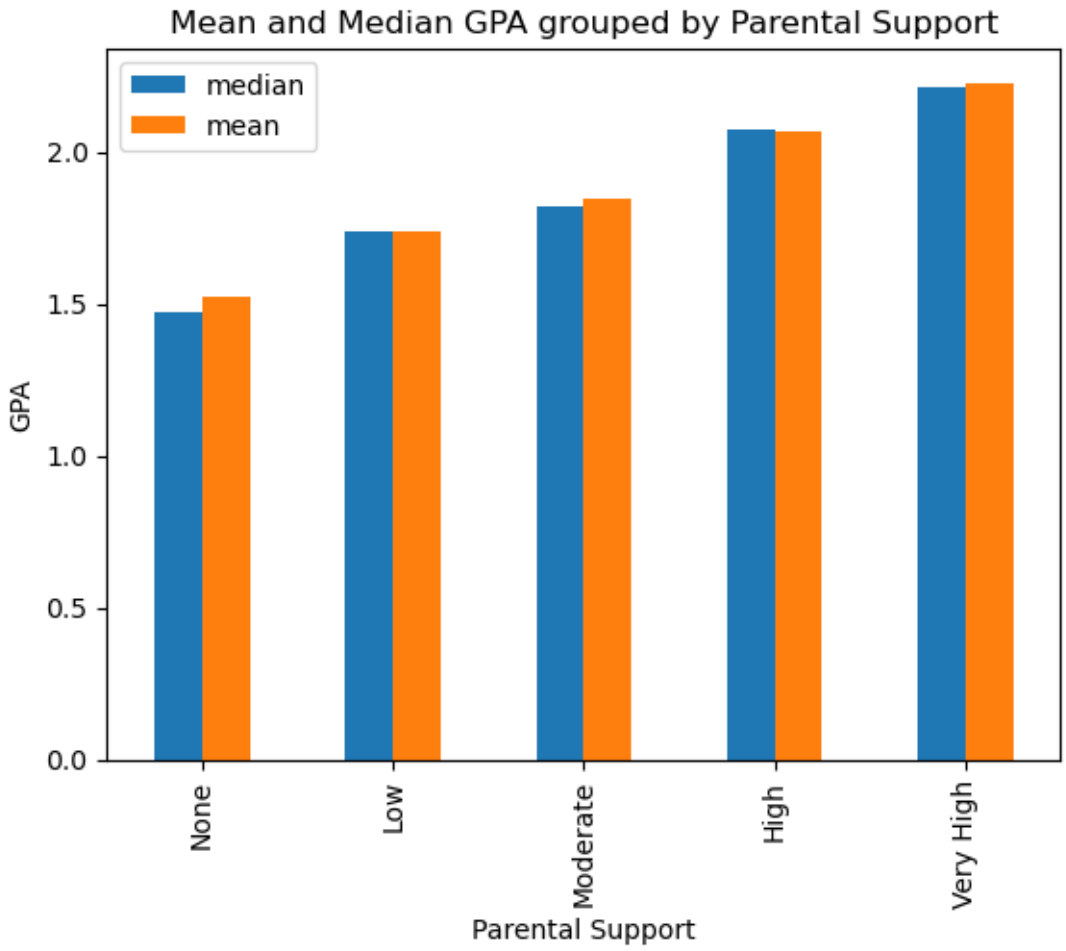
[254]:
```
[1.471672029, 1.7404551504999999, 1.817007139, 2.070669312, 2.215515609]
```

[256]:
```
a5mean['ParentalSupport']=a5median['ParentalSupport'].replace(0,'None')
a5mean['ParentalSupport']=a5median['ParentalSupport'].replace(1,'Low')
a5mean['ParentalSupport']=a5median['ParentalSupport'].replace(2,'Moderate')
a5mean['ParentalSupport']=a5median['ParentalSupport'].replace(3,'High')
a5mean['ParentalSupport']=a5median['ParentalSupport'].replace(4,'Very High')
a5mean
x2 = []
for row in a5mean['meanGPA']:
    x2.append(row)
x2 #putting the mean GPAs of each parental support group into a list x2
```

[256]:
```
[1.5216016961908398,
 1.7358547537601352,
 1.8459140227050208,
 2.0681743177448277,
 2.22763920595625]
```

[282]:
```
index = ['None','Low','Moderate','High','Very High']
df5=pd.DataFrame({'median' : x1,'mean':x2},index=index)
ax = df5.plot.bar()
plt.xlabel('Parental Support')
plt.ylabel('GPA')
plt.title('Mean and Median GPA grouped by Parental Support')
```

[282]:
```
Text(0.5, 1.0, 'Mean and Median GPA grouped by Parental Support')
```



2.Shown above

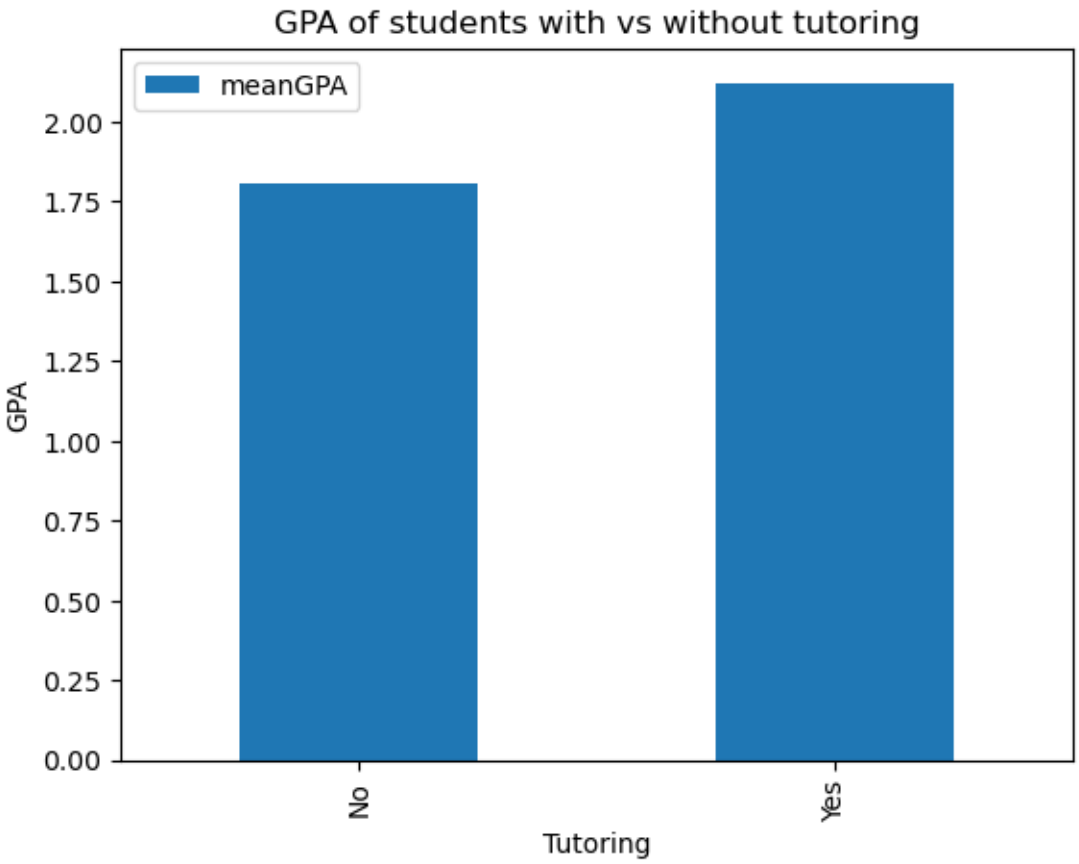
[301]:
```
a5q3=students.groupby('Tutoring').agg(meanGPA = ('GPA','mean'))
a5q3.reset_index()
```

[301]:

	Tutoring	meanGPA
0	No	1.804967
1	Yes	2.123106

[307]:
```
a5q3.plot.bar()
plt.xlabel('Tutoring')
plt.ylabel('GPA')
plt.title('GPA of students with vs without tutoring')
```

[307]:
```
Text(0.5, 1.0, 'GPA of students with vs without tutoring')
```



3. The bar shart displays that on average, students who receive tutoring on average have a higher GPA than those who do not (~0.32 more). On a logical basis, this result is not surprising, those who receive more assistance with their school work should understand their content better and therefore achieve a higher GPA on average than those who do not.

[ ]: