NCU Introduction to Data Science Fall 2022 – HW1

Colab link:

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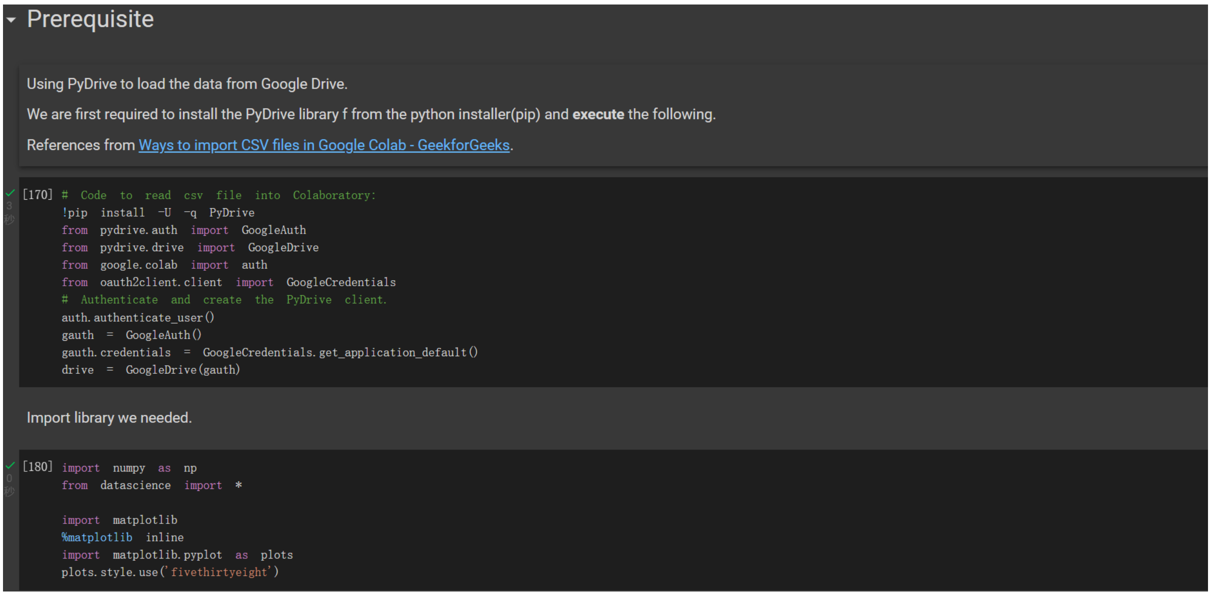
目錄

Prerequisite

I use *PyDrive* to load the data from Google Drive. To use tables, I also import all of the modules called *datascience.* And, we need to do visualization, so I import *matplotlib*.



Prerequisite

Using PyDrive to load the data from Google Drive.

We are first required to install the PyDrive library f from the python installer(pip) and **execute** the following.

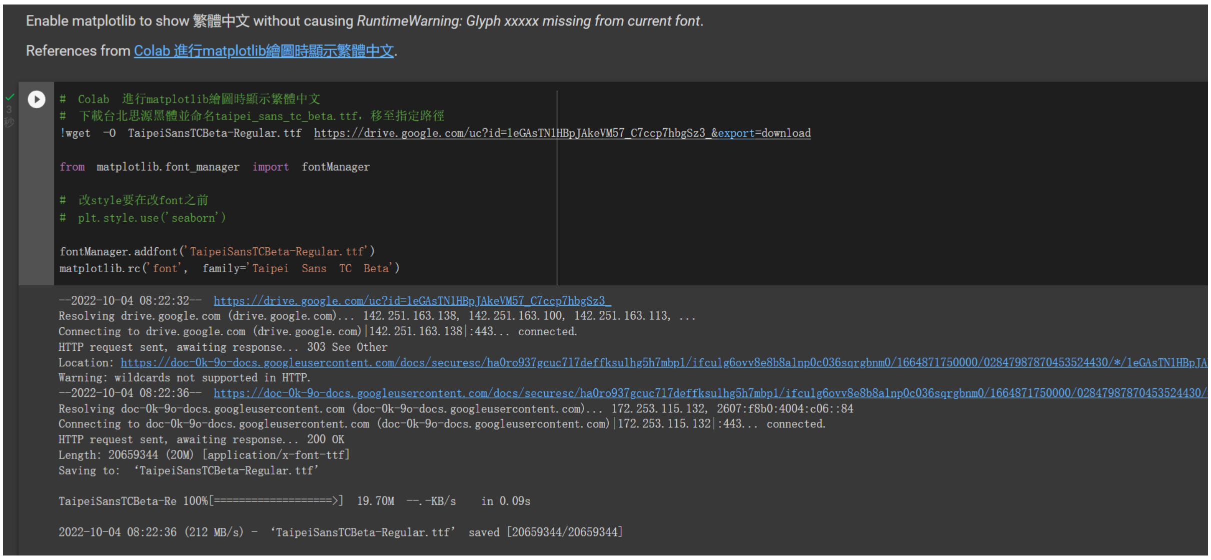
References from [Ways to import CSV files in Google Colab - GeekforGeeks](#).

```
[170] # Code to read csv file into Colaboratory:
      !pip install -U -q PyDrive
      from pydrive.auth import GoogleAuth
      from pydrive.drive import GoogleDrive
      from google.colab import auth
      from oauth2client.client import GoogleCredentials
      # Authenticate and create the PyDrive client.
      auth.authenticate_user()
      gauth = GoogleAuth()
      gauth.credentials = GoogleCredentials.get_application_default()
      drive = GoogleDrive(gauth)
```

Import library we needed.

```
[180] import numpy as np
      from datascience import *

      import matplotlib
      %matplotlib inline
      import matplotlib.pyplot as plots
      plots.style.use('fivethirtyeight')
```

In addition, we have to enable *matplotlib* to support 繁體中文 finely, otherwise we would get the *RuntimeWarning: Glyph xxxxx missing from current font*.



Enable matplotlib to show 繁體中文 without causing *RuntimeWarning: Glyph xxxxx missing from current font.*

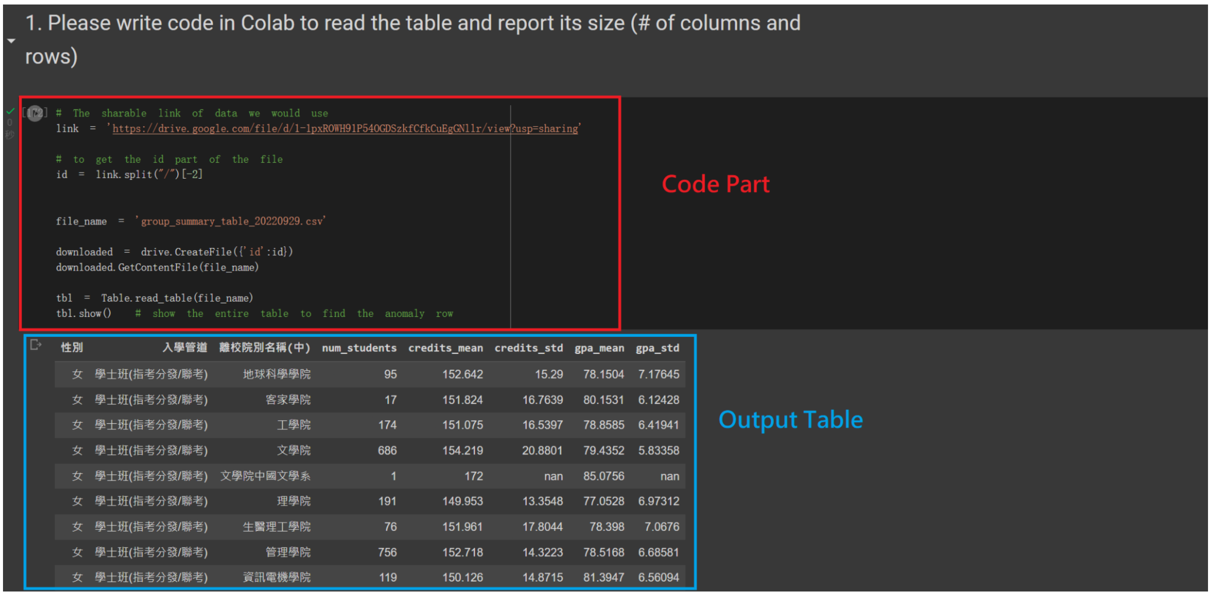
References from [Colab 進行matplotlib繪圖時顯示繁體中文](#).

```
# Colab 進行matplotlib繪圖時顯示繁體中文
# 下載台北思源黑體並命名taipei_sans_tc_beta.ttf，移至指定路徑
!wget -O TaipeiSansTCBeta-Regular.ttf https://drive.google.com/uc?id=1eGAsTN1HBpJAkeVM57_C7ccp7hbgSz3_&export=download

from matplotlib.font_manager import fontManager

# 改style要在改font之前
# plt.style.use('seaborn')

fontManager.addfont('TaipeiSansTCBeta-Regular.ttf')
matplotlib.rc('font', family='Taipei Sans TC Beta')
```

```
--2022-10-04 08:22:32--  https://drive.google.com/uc?id=1eGAsTN1HBpJAkeVM57_C7ccp7hbgSz3_
Resolving drive.google.com (drive.google.com)... 142.251.163.138, 142.251.163.100, 142.251.163.113, ...
Connecting to drive.google.com (drive.google.com)|142.251.163.138|:443... connected.
HTTP request sent, awaiting response... 303 See Other
Location: https://doc-0k-9o-docs.googleusercontent.com/docs/securesc/ha0ro937gcuc7l7deffksulhg5h7mbp1/ifculg6ovv8e8b8alnp0c036sqrgbnm0/1664871750000/02847987870453524430/*/1eGAsTN1HBpJA
Warning: wildcards not supported in HTTP.
--2022-10-04 08:22:36--  https://doc-0k-9o-docs.googleusercontent.com/docs/securesc/ha0ro937gcuc7l7deffksulhg5h7mbp1/ifculg6ovv8e8b8alnp0c036sqrgbnm0/1664871750000/02847987870453524430/
Resolving doc-0k-9o-docs.googleusercontent.com (doc-0k-9o-docs.googleusercontent.com)... 172.253.115.132, 2607:f8b0:4004:c06::84
Connecting to doc-0k-9o-docs.googleusercontent.com (doc-0k-9o-docs.googleusercontent.com)|172.253.115.132|:443... connected.
HTTP request sent, awaiting response... 200 OK
Length: 20659344 (20M) [application/x-font-ttf]
Saving to: ‘TaipeiSansTCBeta-Regular.ttf’

TaipeiSansTCBeta-Re 100%[===================>]  19.70M  --.-KB/s    in 0.09s

2022-10-04 08:22:36 (212 MB/s) - ‘TaipeiSansTCBeta-Regular.ttf’ saved [20659344/20659344]
```

1. Please write code in Colab to read the table and report its size (# of columns and rows)

I use the Table method *read_table* to read our imported CSV file and use the *show* method to print out the entire table to find the anomaly row.



1. Please write code in Colab to read the table and report its size (# of columns and rows)

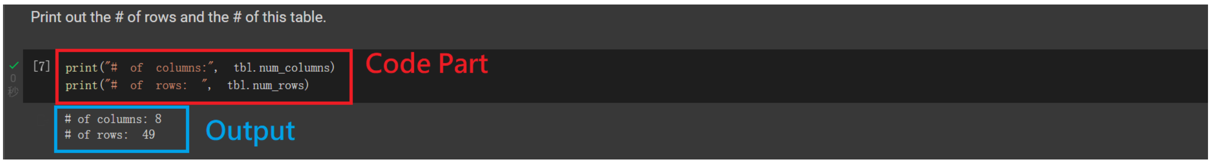
```
# The sharable link of data we would use
link = 'https://drive.google.com/file/d/1-1pxROWH91P540GDSzkfCfkCuEgGN1lr/view?usp=sharing'

# to get the id part of the file
id = link.split("/")[-2]


file_name = 'group_summary_table_20220929.csv'

downloaded = drive.CreateFile({'id':id})
downloaded.GetContentFile(file_name)

tbl = Table.read_table(file_name)
tbl.show()   # show the entire table to find the anomaly row
```

Code Part

性別	入學管道	離校院別名稱(中)	num_students	credits_mean	credits_std	gpa_mean	gpa_std
女	學士班(指考分發/聯考)	地球科學學院	95	152.642	15.29	78.1504	7.17645
女	學士班(指考分發/聯考)	客家學院	17	151.824	16.7639	80.1531	6.12428
女	學士班(指考分發/聯考)	工學院	174	151.075	16.5397	78.8585	6.41941
女	學士班(指考分發/聯考)	文學院	686	154.219	20.8801	79.4352	5.83358
女	學士班(指考分發/聯考)	文學院中國文學系	1	172	nan	85.0756	nan
女	學士班(指考分發/聯考)	理學院	191	149.953	13.3548	77.0528	6.97312
女	學士班(指考分發/聯考)	生醫理工學院	76	151.961	17.8044	78.398	7.0676
女	學士班(指考分發/聯考)	管理學院	756	152.718	14.3223	78.5168	6.68581
女	學士班(指考分發/聯考)	資訊電機學院	119	150.126	14.8715	81.3947	6.56094

Output Table

Then, I use the *num_rows* and *num_columns* methods in the Table object type to print out its size. We can see that the **# of columns is 8** and the **# of rows is 49**.



Print out the # of rows and the # of this table.

```
print("# of columns:", tbl.num_columns)
print("# of rows: ", tbl.num_rows)
```

Code Part

```
# of columns: 8
# of rows:  49
```

Output

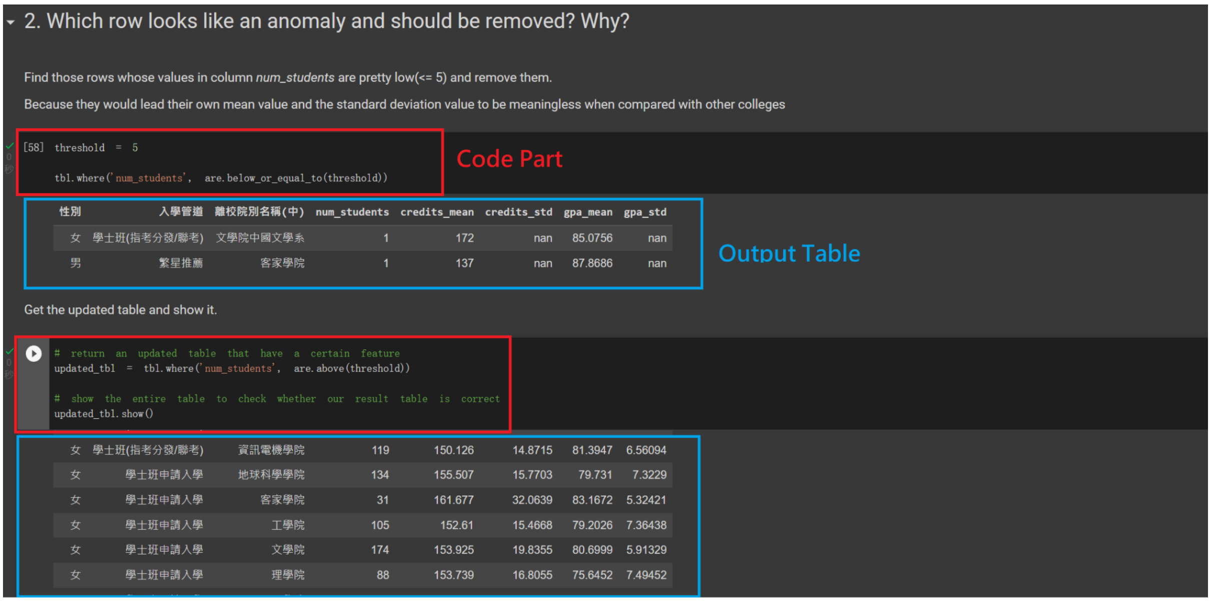
2. Which row looks like an anomaly and should be removed? Why?

2.1 Please explain.

I want to find those rows whose values in column ***num_students*** **are pretty low(<= 5)** because they would lead their mean value and the standard deviation value to be meaningless when compared with other colleges. Also, If the number of students is 1, which would cause the denominator to become 0 when we calculate the standard deviation.

Actually, I want to use IQR to find outliers and remove them, but I found the result is meaningless.

2.2 Please write code in Colab to remove it and return an updated table.



2. Which row looks like an anomaly and should be removed? Why?

Find those rows whose values in column *num_students* are pretty low(<= 5) and remove them.

Because they would lead their own mean value and the standard deviation value to be meaningless when compared with other colleges

```
[58] threshold = 5

     tbl.where('num_students', are.below_or_equal_to(threshold))
```

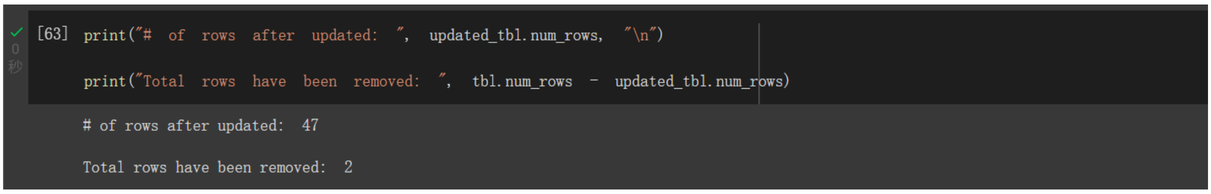
性別	入學管道	離校院別名稱(中)	num_students	credits_mean	credits_std	gpa_mean	gpa_std
女	學士班(指考分發/聯考)	文學院中國文學系	1	172	nan	85.0756	nan
男	繁星推薦	客家學院	1	137	nan	87.8686	nan

Get the updated table and show it.

```
# return an updated table that have a certain feature
updated_tbl = tbl.where('num_students', are.above(threshold))

# show the entire table to check whether our result table is correct
updated_tbl.show()
```

女	學士班(指考分發/聯考)	資訊電機學院	119	150.126	14.8715	81.3947	6.56094
女	學士班申請入學	地球科學學院	134	155.507	15.7703	79.731	7.3229
女	學士班申請入學	客家學院	31	161.677	32.0639	83.1672	5.32421
女	學士班申請入學	工學院	105	152.61	15.4668	79.2026	7.36438
女	學士班申請入學	文學院	174	153.925	19.8355	80.6999	5.91329
女	學士班申請入學	理學院	88	153.739	16.8055	75.6452	7.49452

Also, we can check the # of rows of the updated table and the total rows that have been removed to prove our operations are correct.



```
[63] print("# of rows after updated: ", updated_tbl.num_rows, "\n")

     print("Total rows have been removed: ", tbl.num_rows - updated_tbl.num_rows)

     # of rows after updated:  47

     Total rows have been removed:  2
```

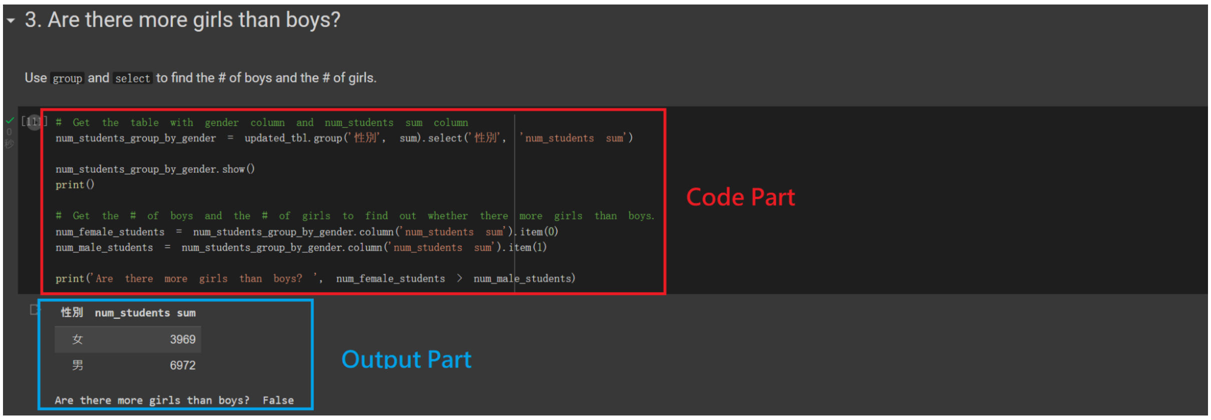
Note: I would use the updated table for the following question.

3. Are there more girls than boys?

No, there are boys more than girls. We can find out by the following table.

3.1 Please use `group` to do it.

The # of female students is **3969** while **the # of male students** is **6972**.



3. Are there more girls than boys?

Use `group` and `select` to find the # of boys and the # of girls.

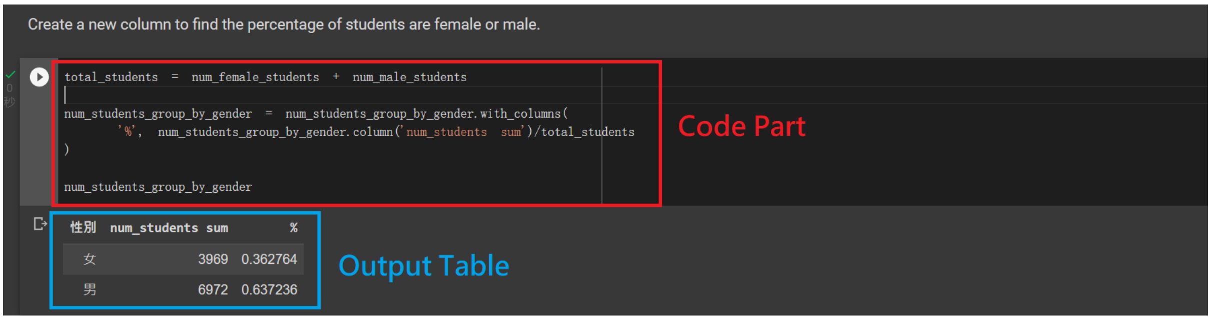
```
# Get the table with gender column and num_students sum column
num_students_group_by_gender = updated_tbl.group('性别', sum).select('性别', 'num_students sum')

num_students_group_by_gender.show()
print()

# Get the # of boys and the # of girls to find out whether there more girls than boys.
num_female_students = num_students_group_by_gender.column('num_students sum').item(0)
num_male_students = num_students_group_by_gender.column('num_students sum').item(1)

print('Are there more girls than boys? ', num_female_students > num_male_students)
```

性别	num_students sum
女	3969
男	6972

```
Are there more girls than boys?  False
```

3.2 What % of students are female?

36.28 % of the students are **female**, and **63.74%** of the students are **male**.



Create a new column to find the percentage of students are female or male.

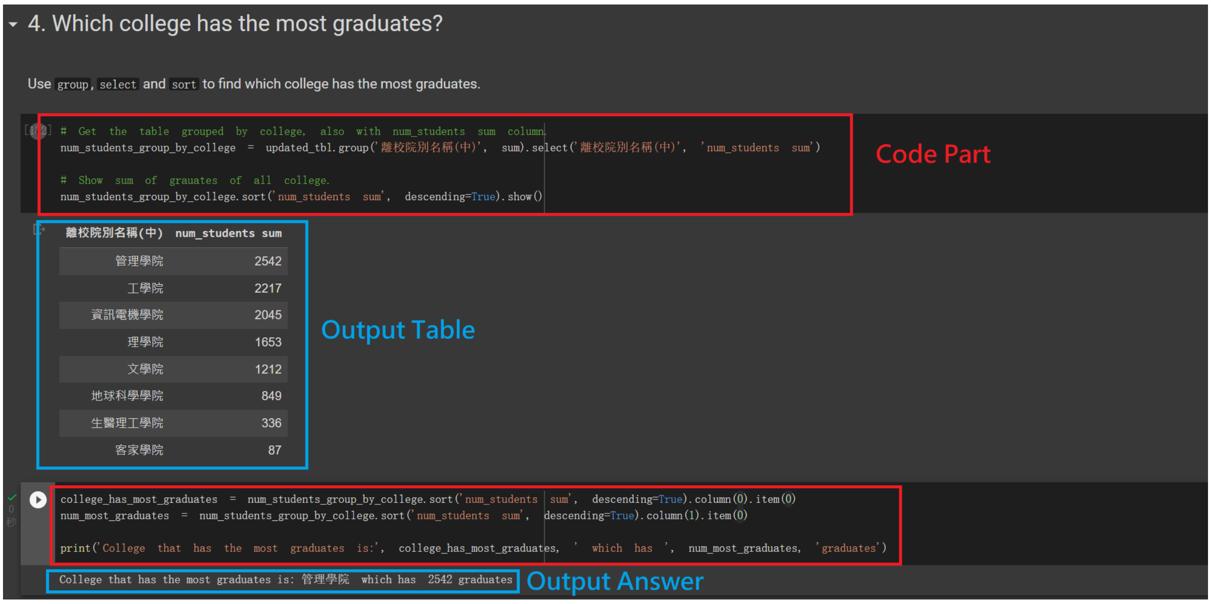
```
total_students = num_female_students + num_male_students

num_students_group_by_gender = num_students_group_by_gender.with_columns(
        '%', num_students_group_by_gender.column('num_students sum')/total_students
)

num_students_group_by_gender
```

性别	num_students sum	%
女	3969	0.362764
男	6972	0.637236

4. Which college has the most graduates?

The college that has the most graduates is 管理學院 which has 2542 graduates.

4.1 Please use `group` to do it.



4. Which college has the most graduates?

Use `group`, `select` and `sort` to find which college has the most graduates.

```
# Get the table grouped by college, also with num_students sum column
num_students_group_by_college = updated_tbl.group('離校院別名稱(中)', sum).select('離校院別名稱(中)', 'num_students sum')

# Show sum of grauates of all college.
num_students_group_by_college.sort('num_students sum', descending=True).show()
```

Code Part

離校院別名稱(中)	num_students sum
管理學院	2542
工學院	2217
資訊電機學院	2045
理學院	1653
文學院	1212
地球科學學院	849
生醫理工學院	336
客家學院	87

Output Table

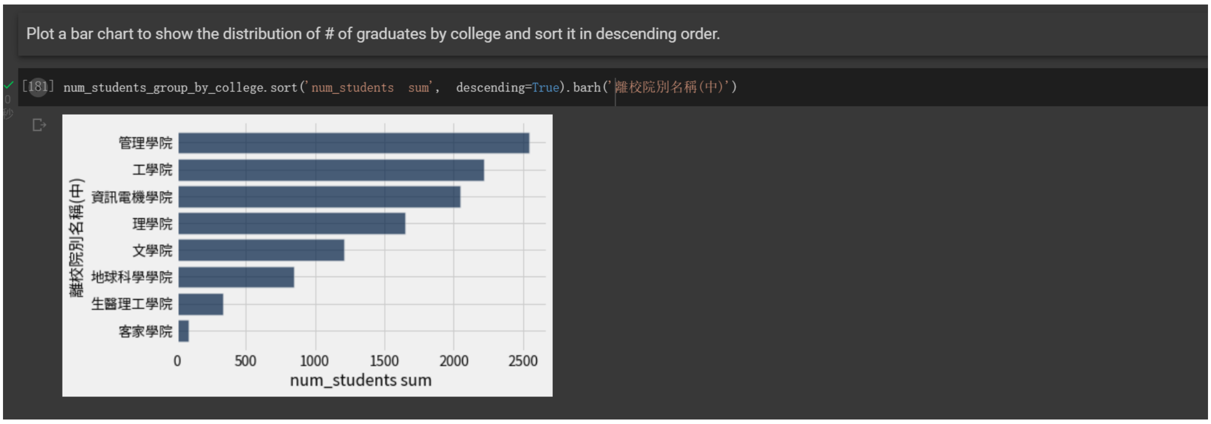
```
college_has_most_graduates = num_students_group_by_college.sort('num_students sum', descending=True).column(0).item(0)
num_most_graduates = num_students_group_by_college.sort('num_students sum', descending=True).column(1).item(0)

print('College that has the most graduates is:', college_has_most_graduates, ' which has ', num_most_graduates, 'graduates')
```

```
College that has the most graduates is: 管理學院  which has  2542 graduates
```

Output Answer

4.2 Please plot a bar chart to show the distribution of # of graduates by college and sort it in descending order.

I use the Table method *sort* and *barh* to plot a bar chart.



Plot a bar chart to show the distribution of # of graduates by college and sort it in descending order.

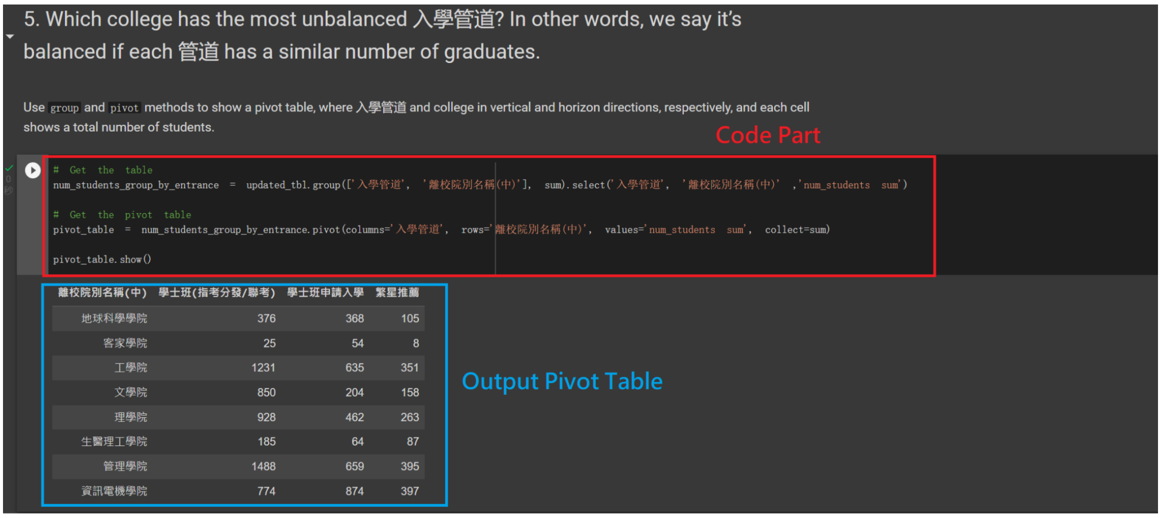
```
num_students_group_by_college.sort('num_students sum', descending=True).barh('離校院別名稱(中)')
```

5. Which college has the most unbalanced 入學管道? In other words, we say it’s balanced if each 管道 has a similar number of graduates.

管理學院 has the most unbalanced 入學管道.

5.1 Please use `group` to show a pivot table, where 入學管道 and college in vertical and horizon directions, respectively, and each cell shows a total number of students.

I use *group* and *pivot* methods to generate the pivot table and *show* it out.



5. Which college has the most unbalanced 入學管道? In other words, we say it’s balanced if each 管道 has a similar number of graduates.

Use `group` and `pivot` methods to show a pivot table, where 入學管道 and college in vertical and horizon directions, respectively, and each cell shows a total number of students.

Code Part

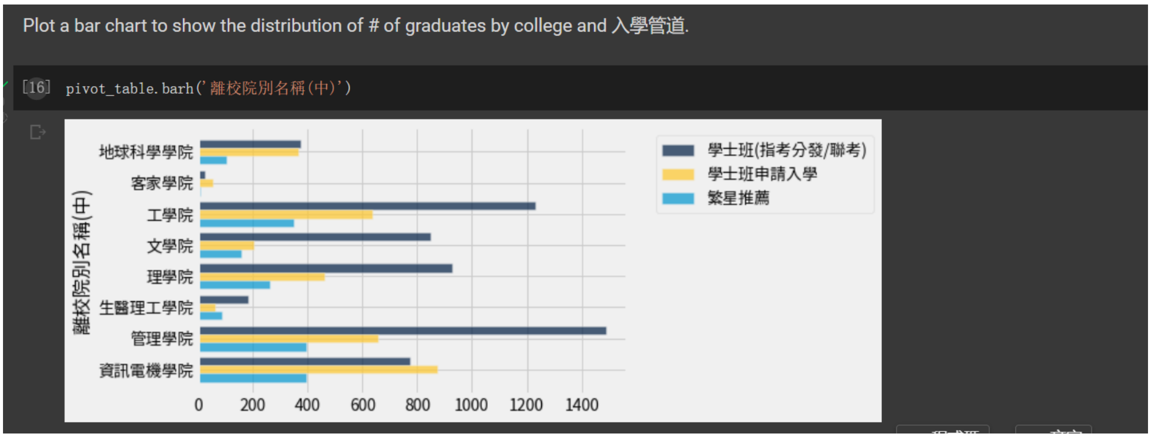
```
# Get the table
num_students_group_by_entrance = updated_tbl.group(['入學管道', '離校院別名稱(中)'], sum).select('入學管道', '離校院別名稱(中)' ,'num_students sum')

# Get the pivot table
pivot_table = num_students_group_by_entrance.pivot(columns='入學管道', rows='離校院別名稱(中)', values='num_students sum', collect=sum)

pivot_table.show()
```

離校院別名稱(中)	學士班(指考分發/聯考)	學士班申請入學	繁星推薦
地球科學學院	376	368	105
客家學院	25	54	8
工學院	1231	635	351
文學院	850	204	158
理學院	928	462	263
生醫理工學院	185	64	87
管理學院	1488	659	395
資訊電機學院	774	874	397

Output Pivot Table

5.2 Please plot a bar chart to show the distribution of # of graduates by college and 入學管道.

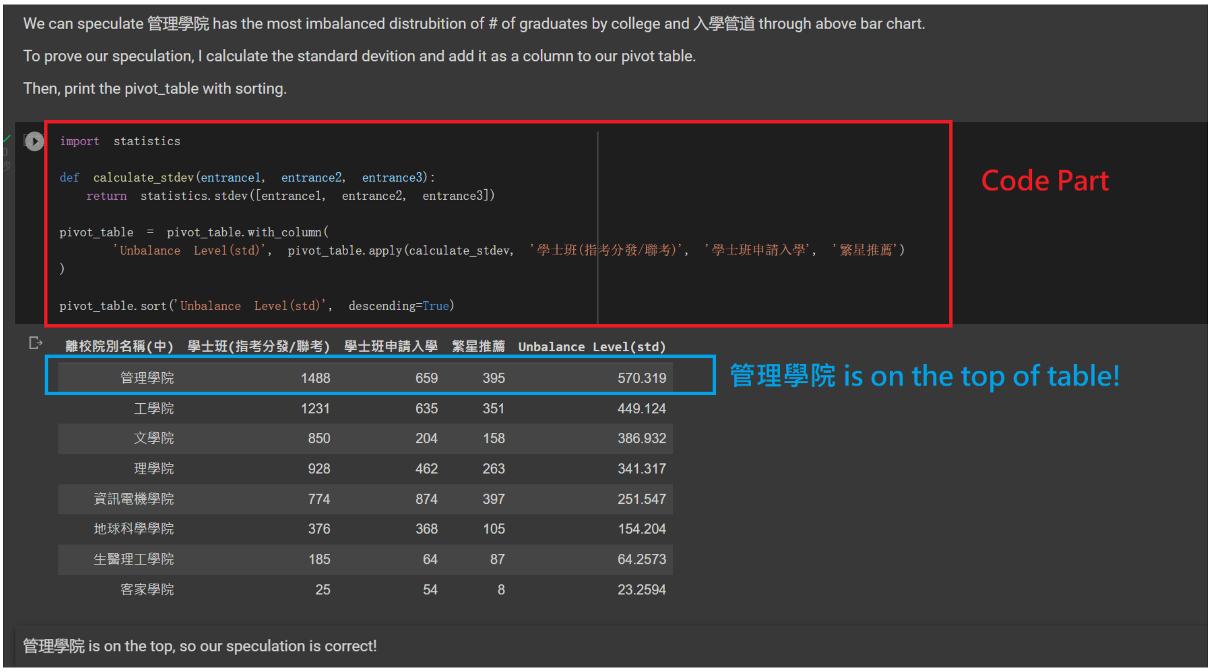
I use *barh* method to plot the bar chart to show the distribution of # of graduates by college and 入學管道。We can speculate 管理學院 has the most imbalanced distrubition of # of graduates by college and 入學管道 through above bar chart.



Plot a bar chart to show the distribution of # of graduates by college and 入學管道.

```
[16] pivot_table.barh('離校院別名稱(中)')
```

To prove our speculation, I calculate the **standard devition**(I think std could be seen as imblance level for distribution) and add it as a column to our pivot table. And then, print the *pivot_table* with sorting.



We can speculate 管理學院 has the most imbalanced distrubition of # of graduates by college and 入學管道 through above bar chart.

To prove our speculation, I calculate the standard devition and add it as a column to our pivot table.

Then, print the pivot_table with sorting.

```
import  statistics

def  calculate_stdev(entrance1,  entrance2,  entrance3):
    return  statistics.stdev([entrance1,  entrance2,  entrance3])

pivot_table  =  pivot_table.with_column(
        'Unbalance  Level(std)',  pivot_table.apply(calculate_stdev,  '學士班(指考分發/聯考)',  '學士班申請入學',  '繁星推薦')
)

pivot_table.sort('Unbalance  Level(std)',  descending=True)
```

Code Part

```
離校院別名稱(中)  學士班(指考分發/聯考)  學士班申請入學  繁星推薦  Unbalance Level(std)
     管理學院              1488           659       395             570.319
       工學院              1231           635       351             449.124
       文學院               850           204       158             386.932
       理學院               928           462       263             341.317
   資訊電機學院               774           874       397             251.547
   地球科學學院               376           368       105             154.204
   生醫理工學院               185            64        87             64.2573
     客家學院                25            54         8             23.2594
```

管理學院 is on the top of table!

管理學院 is on the top, so our speculation is correct!

Yes! 管理學院 is on the top of table, so we can say that 管理學院 has the most unbalanced 入學管道。

Reference

1. Data8 docs
2. Ways to import CSV files in Google Colab - GeekforGeeks
3. Colab 進行matplotlib繪圖時顯示繁體中文
4. Python statistics.stdev() Method - W3school