統一資訊股份有限公司
President Information CORP.

會員輪廓自動化分群
說明文件

數據中心 數據策略

20230810

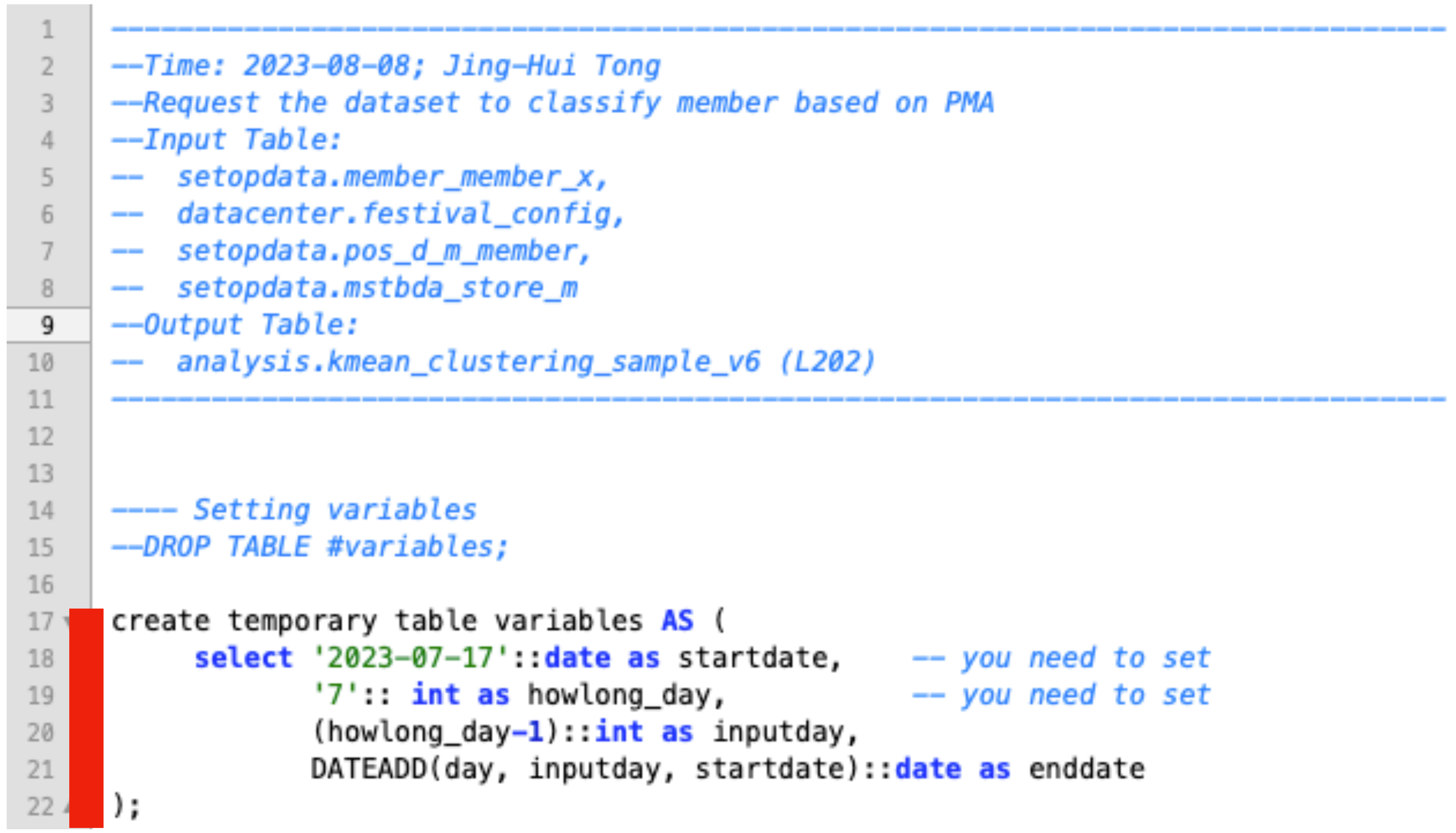
Outlines

Request Data in SQL environment

Take aws-redshift as example

- ***Program***
  - 00_MasterStore.sql
  - 00_Request.sql

  *Files in blue are manually set by users



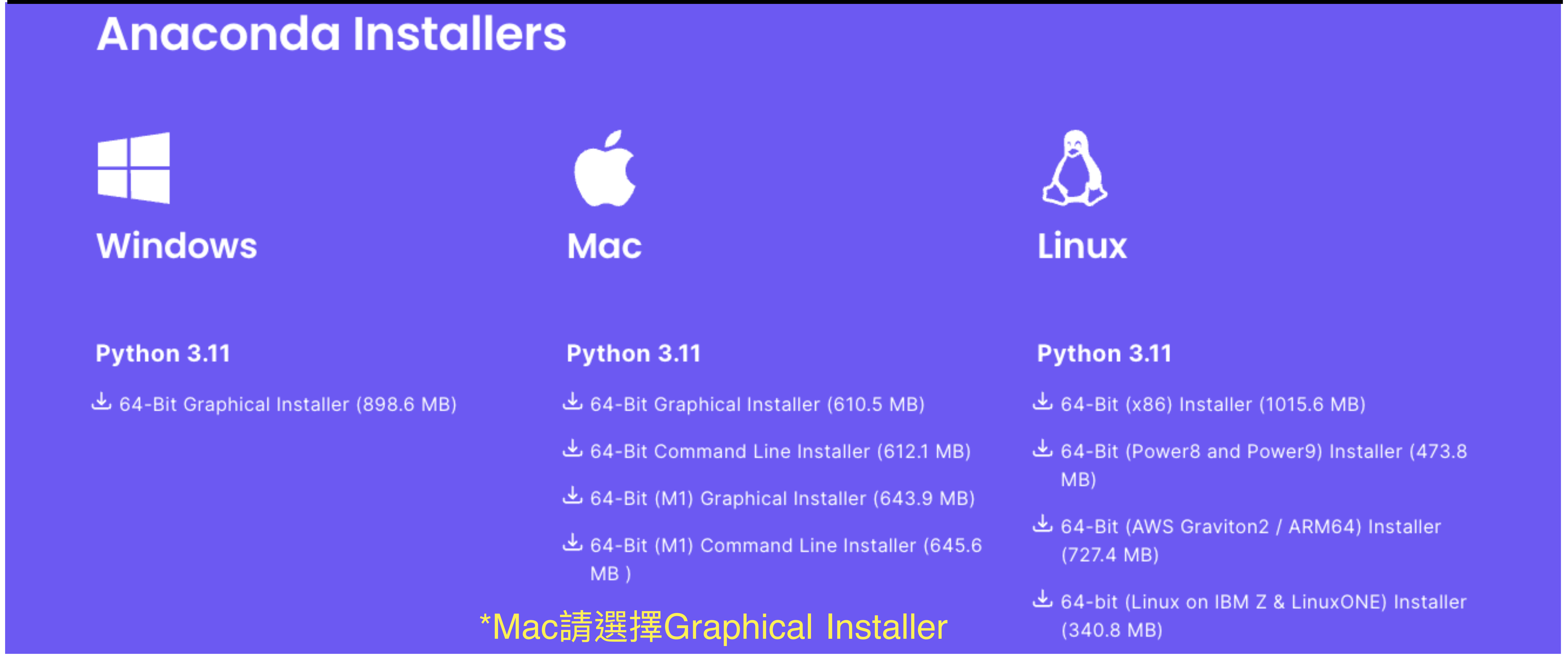
```
--------------------------------------------------------------------------------
--Time: 2023-08-08; Jing-Hui Tong
--Request the dataset to classify member based on PMA
--Input Table:
--   setopdata.member_member_x,
--   datacenter.festival_config,
--   setopdata.pos_d_m_member,
--   setopdata.mstbda_store_m
--Output Table:
--   analysis.kmean_clustering_sample_v6 (L202)
--------------------------------------------------------------------------------



---- Setting variables
--DROP TABLE #variables;

create temporary table variables AS (
     select '2023-07-17'::date as startdate,     -- you need to set
            '7':: int as howlong_day,            -- you need to set
            (howlong_day-1)::int as inputday,
            DATEADD(day, inputday, startdate)::date as enddate
);
```

Temporary Table for 時間區段
後續串接與此表有關

Basic Python Installation

Website to download Anaconda: https://www.anaconda.com/download/
(滑到最下面)

According to your system


Anaconda Installers

Windows	Mac	Linux
Python 3.11	Python 3.11	Python 3.11
64-Bit Graphical Installer (898.6 MB)	64-Bit Graphical Installer (610.5 MB)	64-Bit (x86) Installer (1015.6 MB)
	64-Bit Command Line Installer (612.1 MB)	64-Bit (Power8 and Power9) Installer (473.8 MB)
	64-Bit (M1) Graphical Installer (643.9 MB)	64-Bit (AWS Graviton2 / ARM64) Installer (727.4 MB)
	64-Bit (M1) Command Line Installer (645.6 MB)	64-bit (Linux on IBM Z & LinuxONE) Installer (340.8 MB)

*Mac請選擇Graphical Installer

websites to refer

https://walker-a.com/archives/6260

https://www.datacamp.com/tutorial/installing-anaconda-mac-os-x

https://ivonblog.com/posts/linux-anaconda/

Outlines

Step 0. Putting these files in the same folder

- ***Program***
  - 01_Clustering.py
  - arguments.py
  - autoclassify.py
  - output.py
  - preprocess.py
  - checkfonts.py
- ***Config***
  - category_config.json
  - pma_config.csv
  - store_area_config.csv
- ***Fonts***
  - fonts/TaipeiSansTCBeta-Bold.ttf
  - fonts/TaipeiSansTCBeta-Light.ttf
  - fonts/TaipeiSansTCBeta-Regular.ttf
- ***Data***
  - KmeanClustering_sampledata_v6.csv

*Files in blue are manually set by users

Step 1. The modules you need to install in Anaconda Prompt(for Windows)/Terminal (for MacOS/Linux)

kmodes	➡ pip install kmodes
kneed	➡ pip install kneed
matplotlib	➡ pip -m pip install -U matplotlib
sklearn	➡ pip install -U scikit-learn
sklearn_extra	➡ pip install scikit-learn-extra
pandas	➡ pip install pandas
中文字體	➡ *python checkfonts.py*

中文字體下載: https://pyecontech.com/2020/03/27/python_matplotlib_chinese/

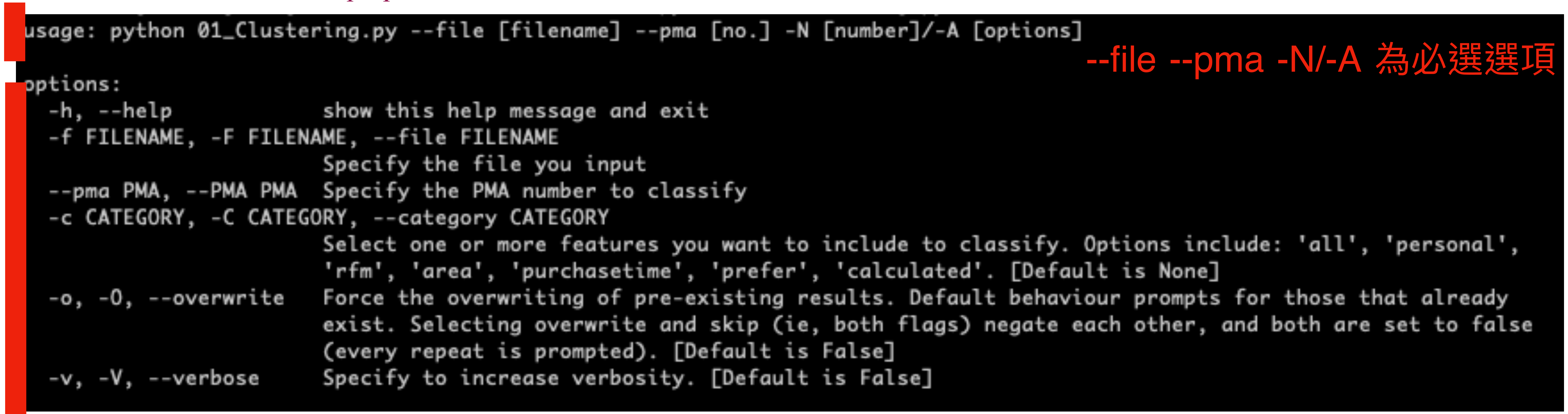
Step 3. Execute Program

1. Open Terminal/Anaconda Prompt
2. Enter the folder where you put the code
3. %*python 01_Clustering.py -h*

Tips for entering the folder:
Asking ChatGPT →
- Windows: 在cmd 底下，如何進入特定的資料夾
- MacOS/Linux: 在terminal 底下，如何進入特定的資料夾

*The purple fonts should enter in terminal

執行



```
usage: python 01_Clustering.py --file [filename] --pma [no.] -N [number]/-A [options]

options:
  -h, --help            show this help message and exit
  -f FILENAME, -F FILENAME, --file FILENAME
                        Specify the file you input
  --pma PMA, --PMA PMA  Specify the PMA number to classify
  -c CATEGORY, -C CATEGORY, --category CATEGORY
                        Select one or more features you want to include to classify. Options include: 'all', 'personal',
                        'rfm', 'area', 'purchasetime', 'prefer', 'calculated'. [Default is None]
  -o, -O, --overwrite   Force the overwriting of pre-existing results. Default behaviour prompts for those that already
                        exist. Selecting overwrite and skip (ie, both flags) negate each other, and both are set to false
                        (every repeat is prompted). [Default is False]
  -v, -V, --verbose     Specify to increase verbosity. [Default is False]
```

--file --pma -N/-A 為必選選項

選項說明與預設值

Cluster method:
分群方法選擇

Auto Classify Settings:
指定群數/自動分群選項

RFM level:
若分析特徵包含RFM，可選擇如何分等級方式、RFM是否只選兩個特徵(i.e. f & m)

Path:
檔案路徑設定

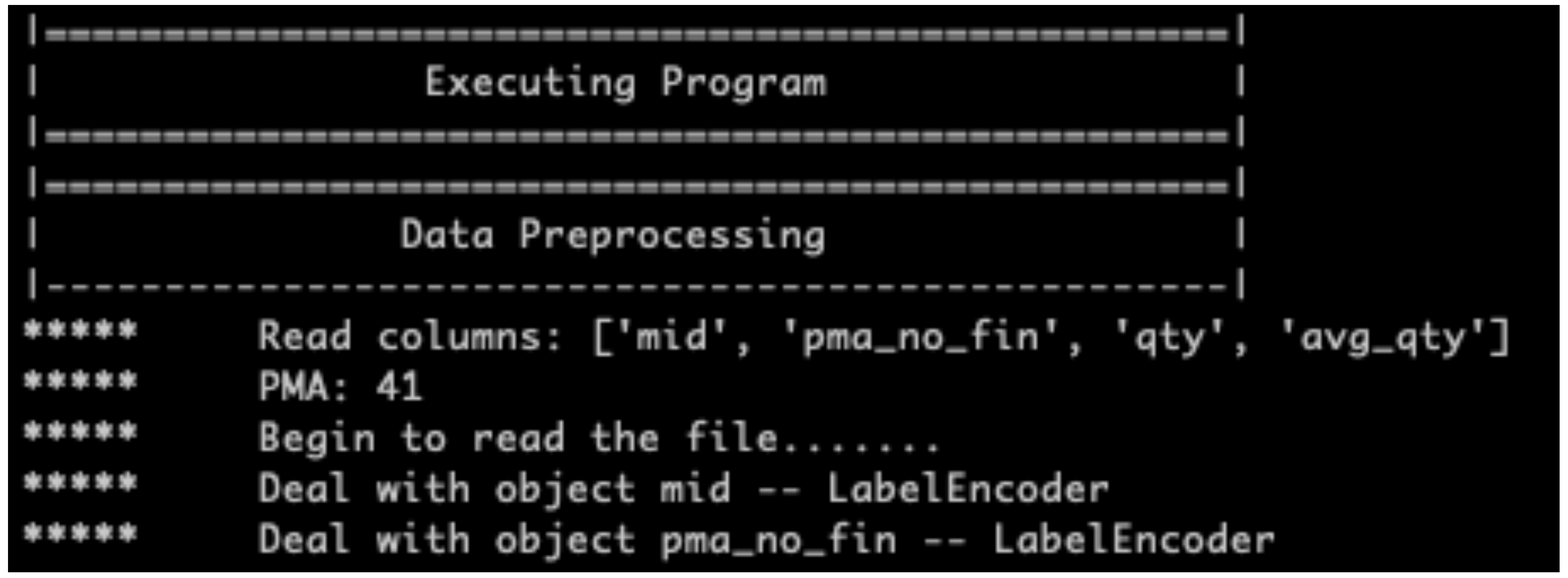
Step 3. Execute Program (Continued)

4. %*python 01_Clustering.py --file KmeanClustering_sampledata_v5.csv --pma 41 -A -V*

*The purple fonts should enter in terminal

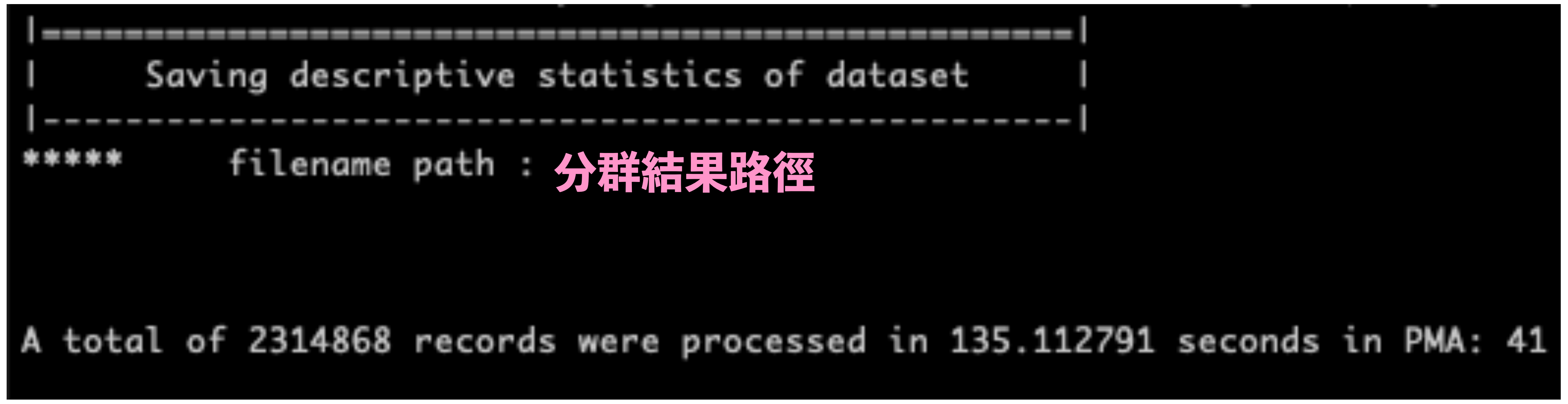
指令邏輯正確畫面

程式開始



```
|================================================|
|                Executing Program               |
|================================================|
|================================================|
|               Data Preprocessing               |
|------------------------------------------------|
*****      Read columns: ['mid', 'pma_no_fin', 'qty', 'avg_qty']
*****      PMA: 41
*****      Begin to read the file.......
*****      Deal with object mid -- LabelEncoder
*****      Deal with object pma_no_fin -- LabelEncoder
```

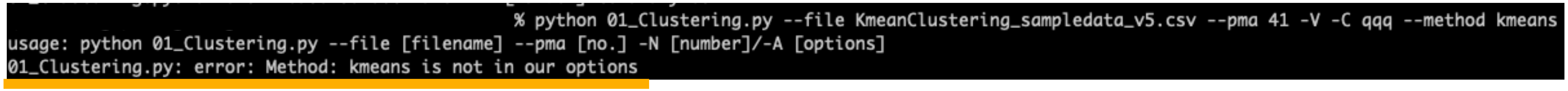
程式結束



```
|================================================|
|     Saving descriptive statistics of dataset   |
|------------------------------------------------|
*****       filename path : 分群結果路徑


A total of 2314868 records were processed in 135.112791 seconds in PMA: 41
```

指令邏輯錯誤畫面

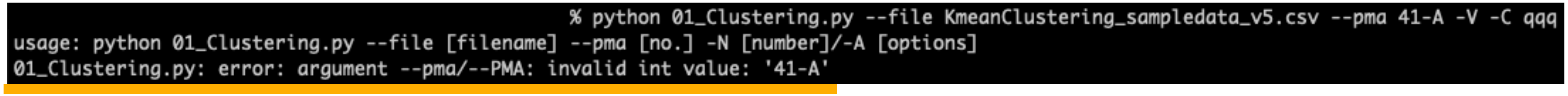
Example 1



```
% python 01_Clustering.py --file KmeanClustering_sampledata_v5.csv --pma 41 -V -C qqq --method kmeans
usage: python 01_Clustering.py --file [filename] --pma [no.] -N [number]/-A [options]
01_Clustering.py: error: Method: kmeans is not in our options
```

>> Method should follow the description (—method); 此例為大小寫錯誤

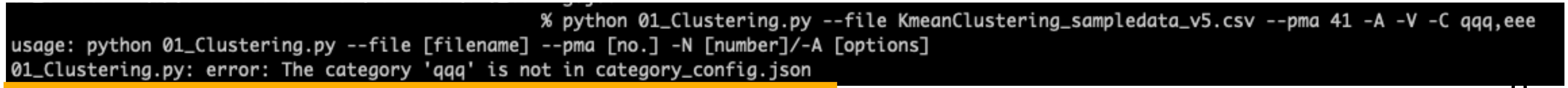
Example 2



```
% python 01_Clustering.py --file KmeanClustering_sampledata_v5.csv --pma 41-A -V -C qqq
usage: python 01_Clustering.py --file [filename] --pma [no.] -N [number]/-A [options]
01_Clustering.py: error: argument --pma/--PMA: invalid int value: '41-A'
```

>> 每個選項間應有空格; 正確: --pma[空格]41[空格]-A

Example 3



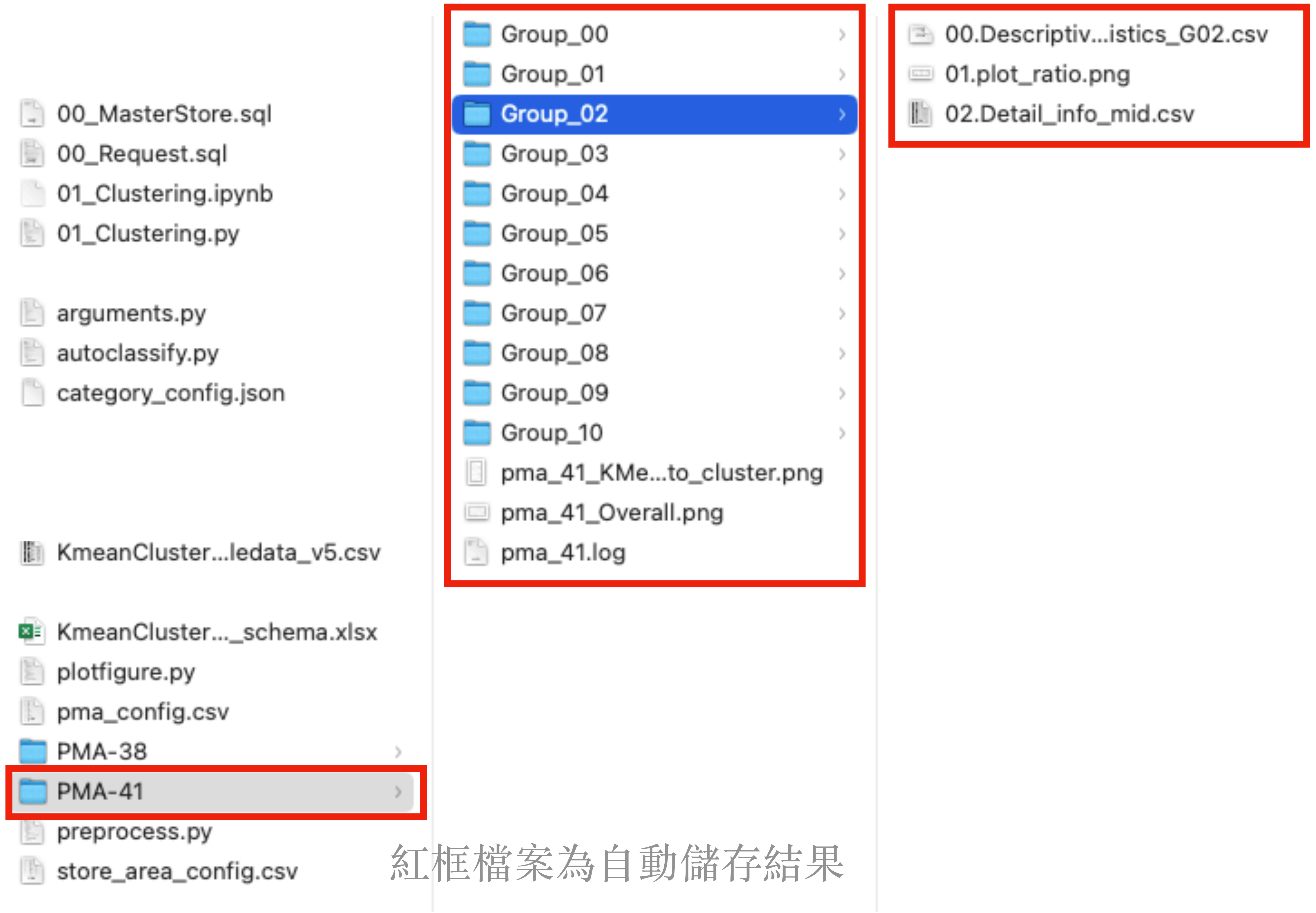
```
% python 01_Clustering.py --file KmeanClustering_sampledata_v5.csv --pma 41 -A -V -C qqq,eee
usage: python 01_Clustering.py --file [filename] --pma [no.] -N [number]/-A [options]
01_Clustering.py: error: The category 'qqq' is not in category_config.json
```

*orange line: error message

>> 欄位qqq 不在設定檔內

Step 4. Results

程式放置的資料夾 > PMA-41 > Group



- 00_MasterStore.sql
- 00_Request.sql
- 01_Clustering.ipynb
- 01_Clustering.py
- arguments.py
- autoclassify.py
- category_config.json
- KmeanCluster...ledata_v5.csv
- KmeanCluster..._schema.xlsx
- plotfigure.py
- pma_config.csv
- PMA-38
- PMA-41
- preprocess.py
- store_area_config.csv

- Group_00
- Group_01
- Group_02
- Group_03
- Group_04
- Group_05
- Group_06
- Group_07
- Group_08
- Group_09
- Group_10
- pma_41_KMe...to_cluster.png
- pma_41_Overall.png
- pma_41.log

- 00.Descriptiv...istics_G02.csv
- 01.plot_ratio.png
- 02.Detail_info_mid.csv

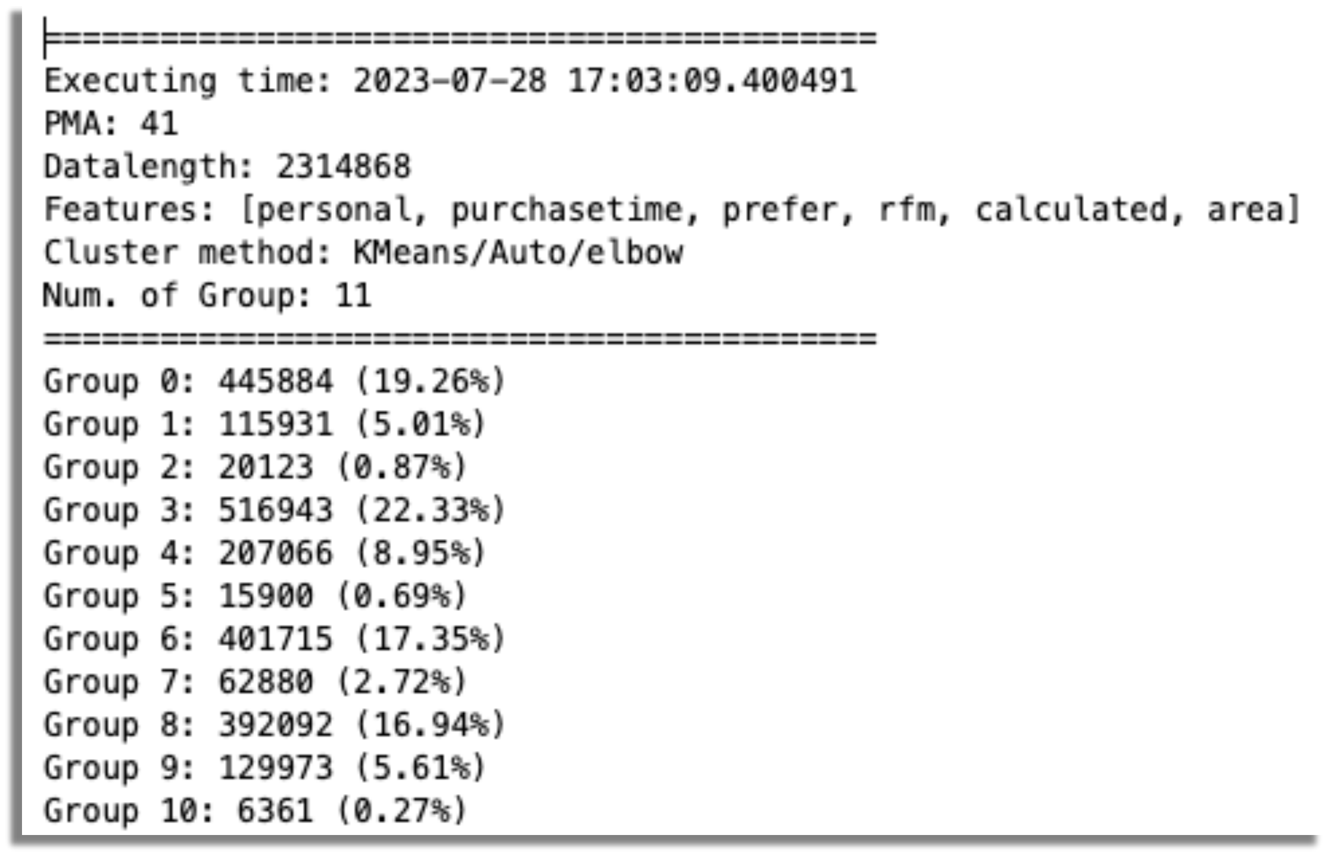
紅框檔案為自動儲存結果

Default path：程式存放位置。可藉由選項 --savepath [yourpath]更改

[PMA-41] 各分類結果

- pma_41.log

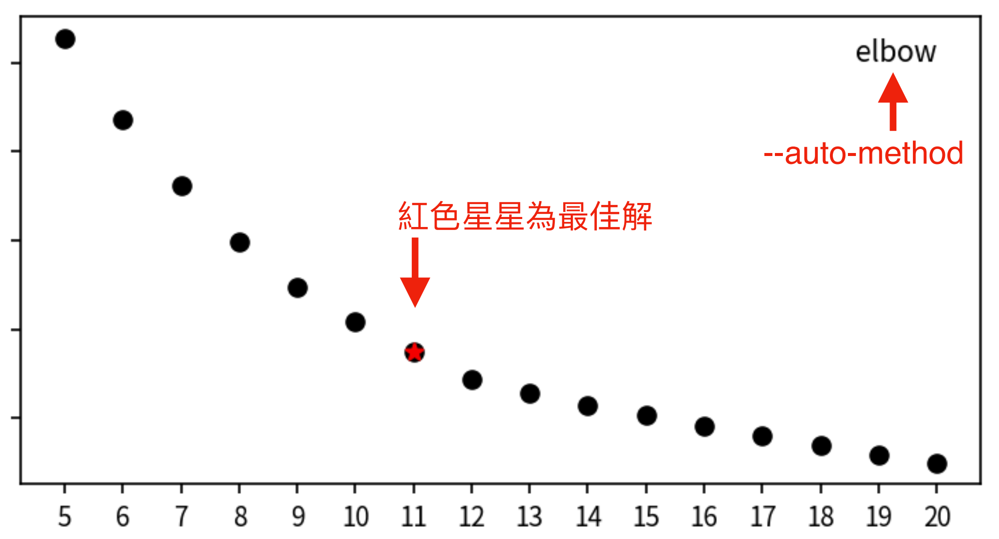
  > log檔，紀錄程式執行選項設定與各群數量與比例



```
==========================================
Executing time: 2023-07-28 17:03:09.400491
PMA: 41
Datalength: 2314868
Features: [personal, purchasetime, prefer, rfm, calculated, area]
Cluster method: KMeans/Auto/elbow
Num. of Group: 11
==========================================
Group 0: 445884 (19.26%)
Group 1: 115931 (5.01%)
Group 2: 20123 (0.87%)
Group 3: 516943 (22.33%)
Group 4: 207066 (8.95%)
Group 5: 15900 (0.69%)
Group 6: 401715 (17.35%)
Group 7: 62880 (2.72%)
Group 8: 392092 (16.94%)
Group 9: 129973 (5.61%)
Group 10: 6361 (0.27%)
```

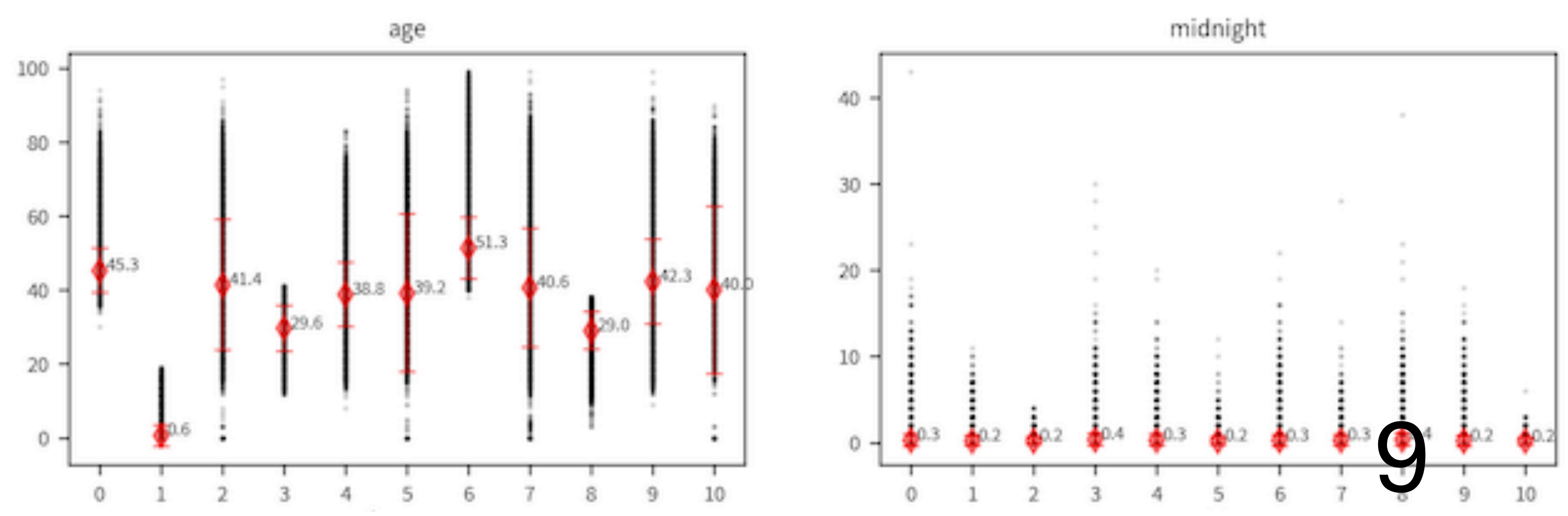
- pma_41_KMeans_auto_cluster.png

  > 自動決定分群分佈圖
  > 若為指定分群數目，則無此檔案



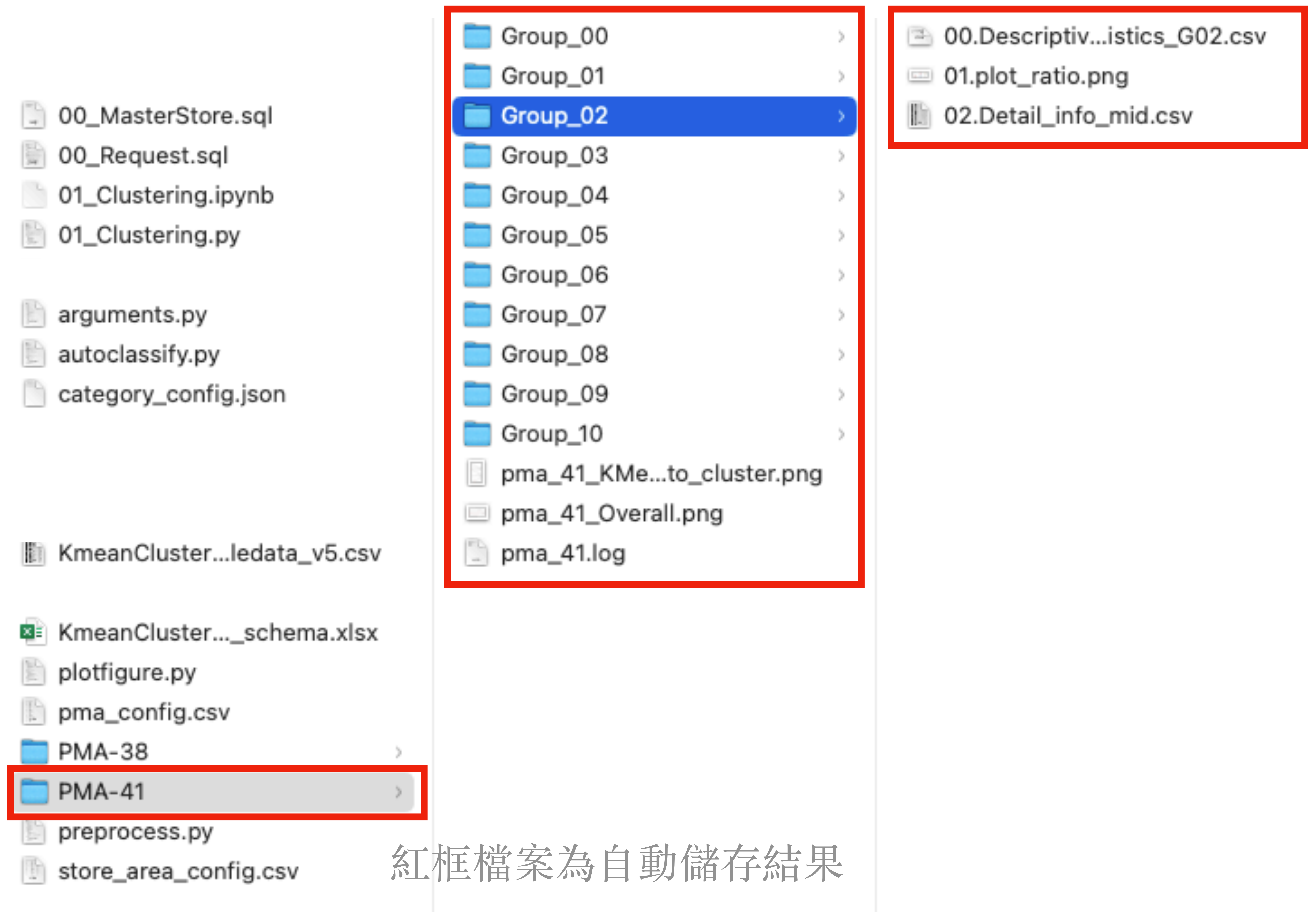
- pma_41_Overall.png

  > 各分析欄位分佈圖 (format: values)
  > 紅點為平均值



Step 4. Results (Continued)

程式放置的資料夾 > PMA-41 > Group



00_MasterStore.sql
00_Request.sql
01_Clustering.ipynb
01_Clustering.py
arguments.py
autoclassify.py
category_config.json
KmeanCluster...ledata_v5.csv
KmeanCluster..._schema.xlsx
plotfigure.py
pma_config.csv
PMA-38
PMA-41
preprocess.py
store_area_config.csv

Group_00
Group_01
Group_02
Group_03
Group_04
Group_05
Group_06
Group_07
Group_08
Group_09
Group_10
pma_41_KMe...to_cluster.png
pma_41_Overall.png
pma_41.log

00.Descriptiv...istics_G02.csv
01.plot_ratio.png
02.Detail_info_mid.csv

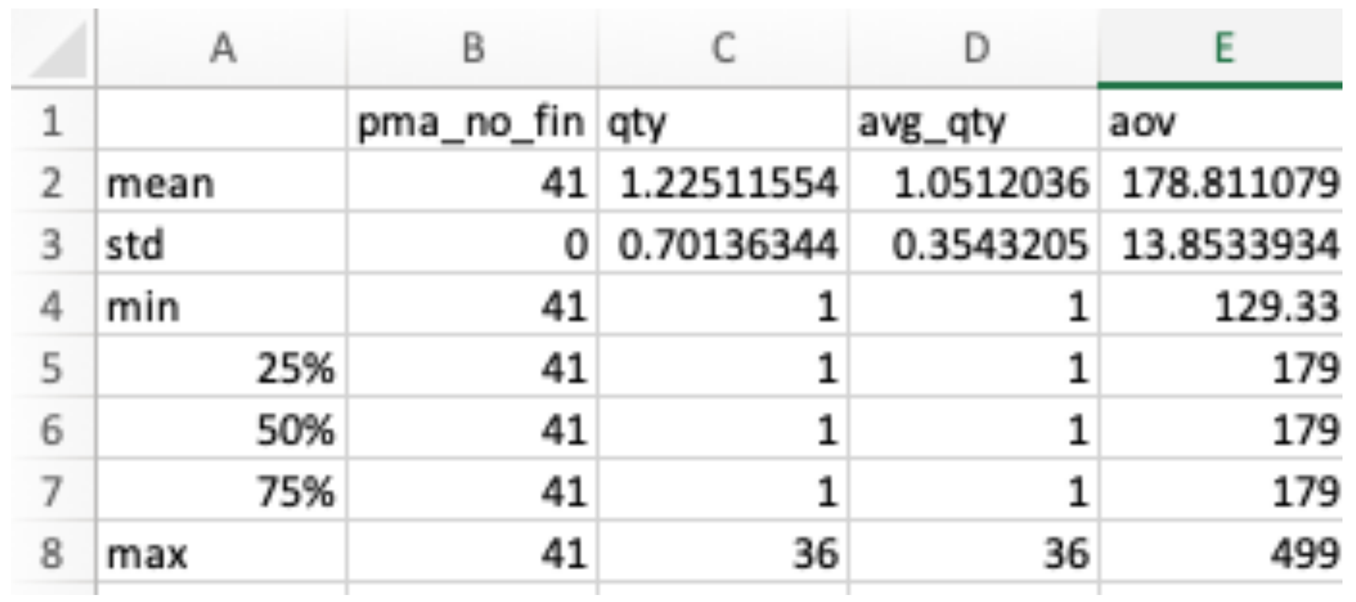
紅框檔案為自動儲存結果

Default path：程式存放位置。可藉由選項 --savepath [yourpath]更改

[Group_02] 各群結果

- 00.Descriptive_statistics_G02.csv

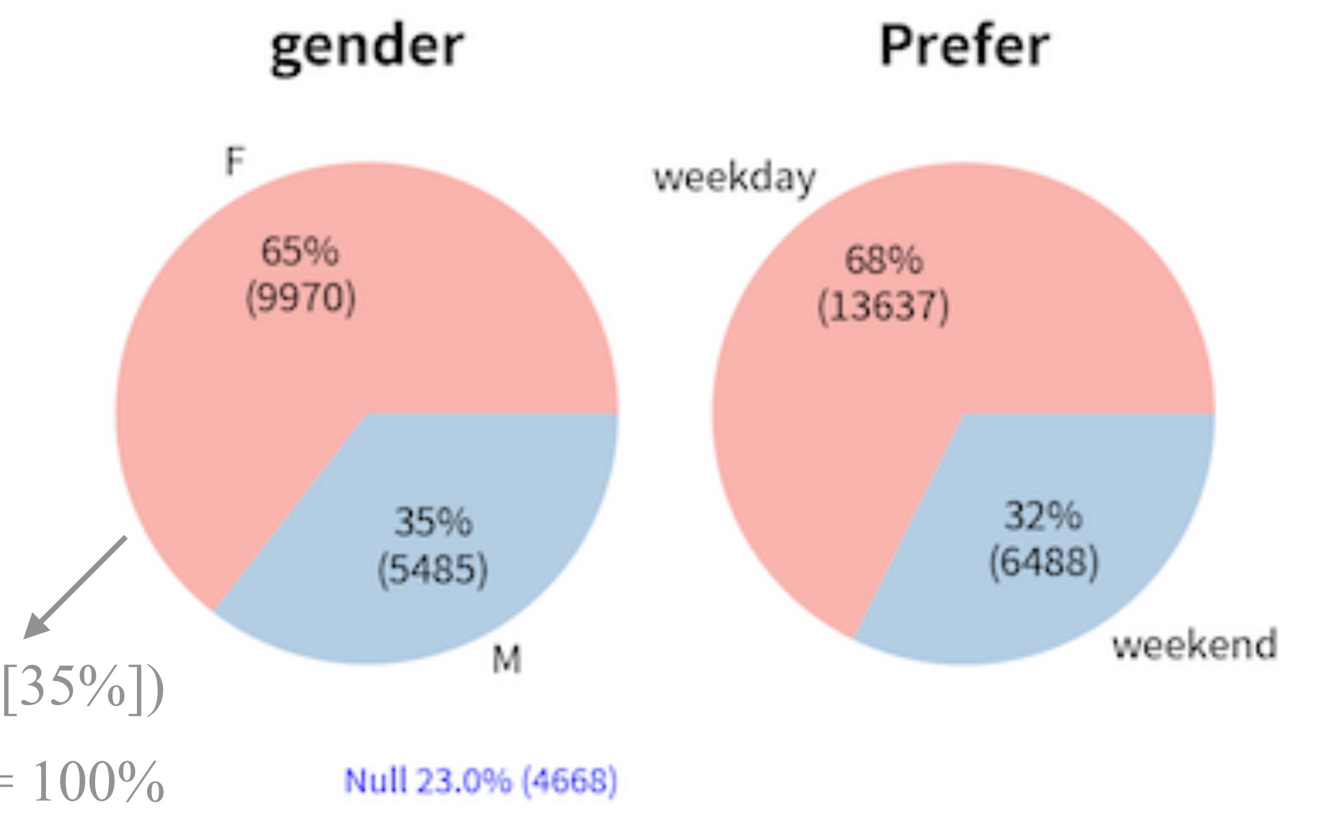
  > 各欄位敘述性統計值



	A	B	C	D	E
1		pma_no_fin	qty	avg_qty	aov
2	mean	41	1.22511554	1.0512036	178.811079
3	std	0	0.70136344	0.3543205	13.8533934
4	min	41	1	1	129.33
5	25%	41	1	1	179
6	50%	41	1	1	179
7	75%	41	1	1	179
8	max	41	36	36	499

- 01.plot_ratio.png

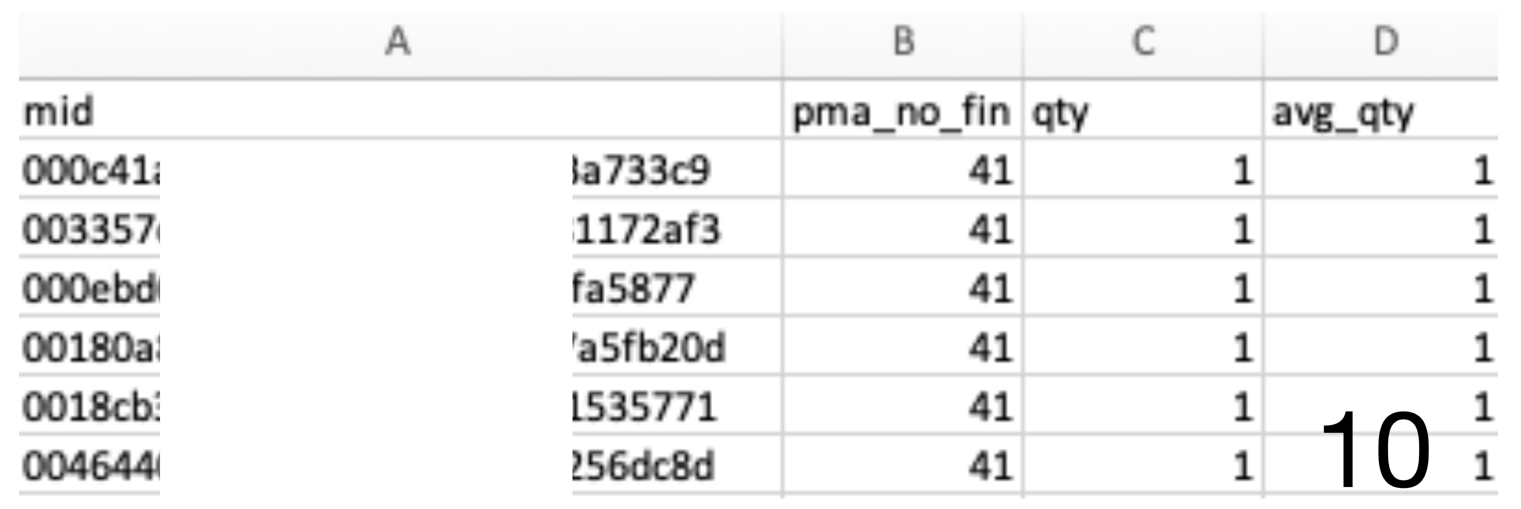
  > 各分析欄位圓餅圖
  (format: object)
  > Null數量以藍字標記



Null [23%]+gender [77%]*(F [65%]+M [35%])
= 100%

- 02.Detail_info_mid.csv

  > 完整欄位串mid

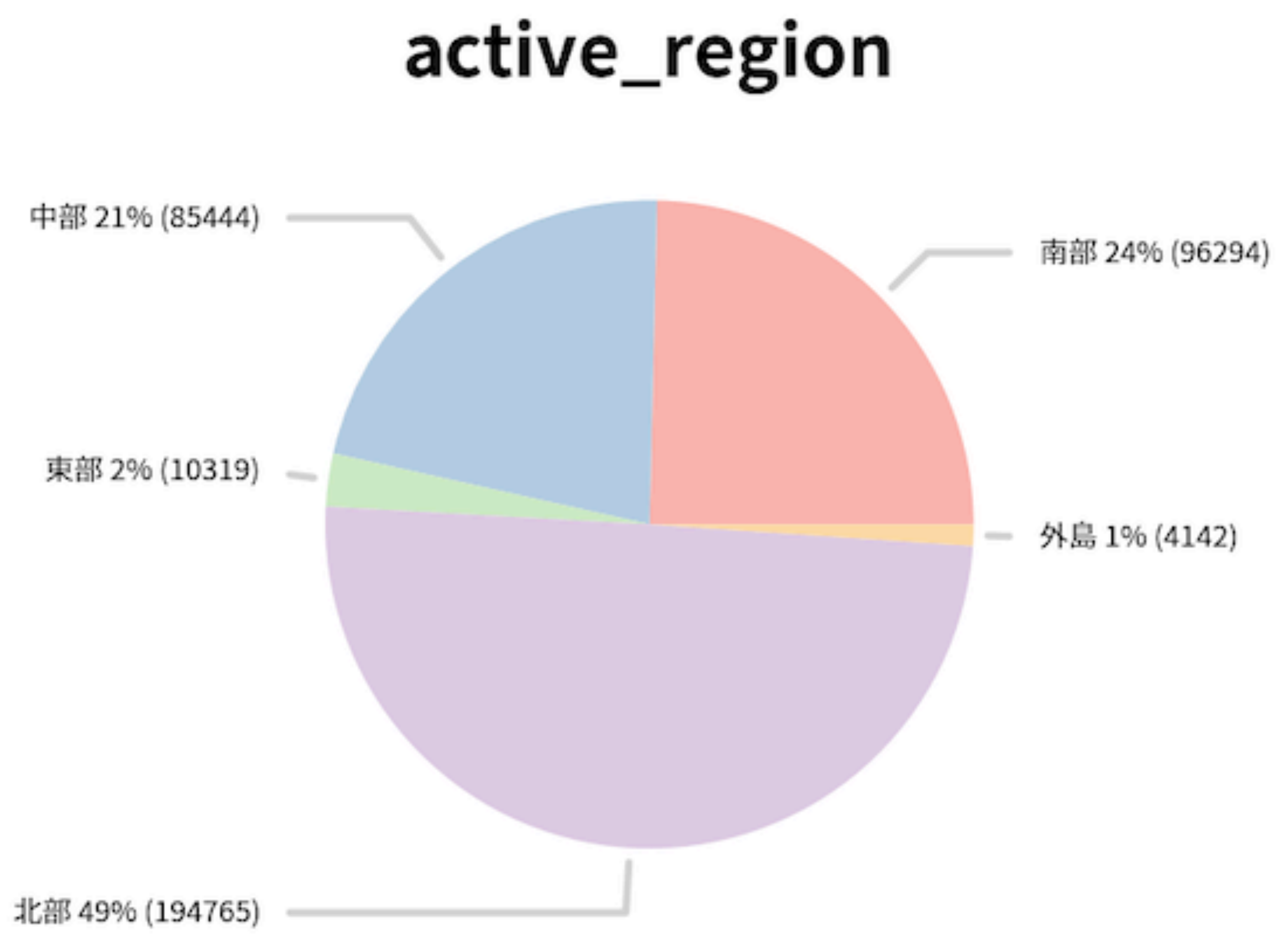


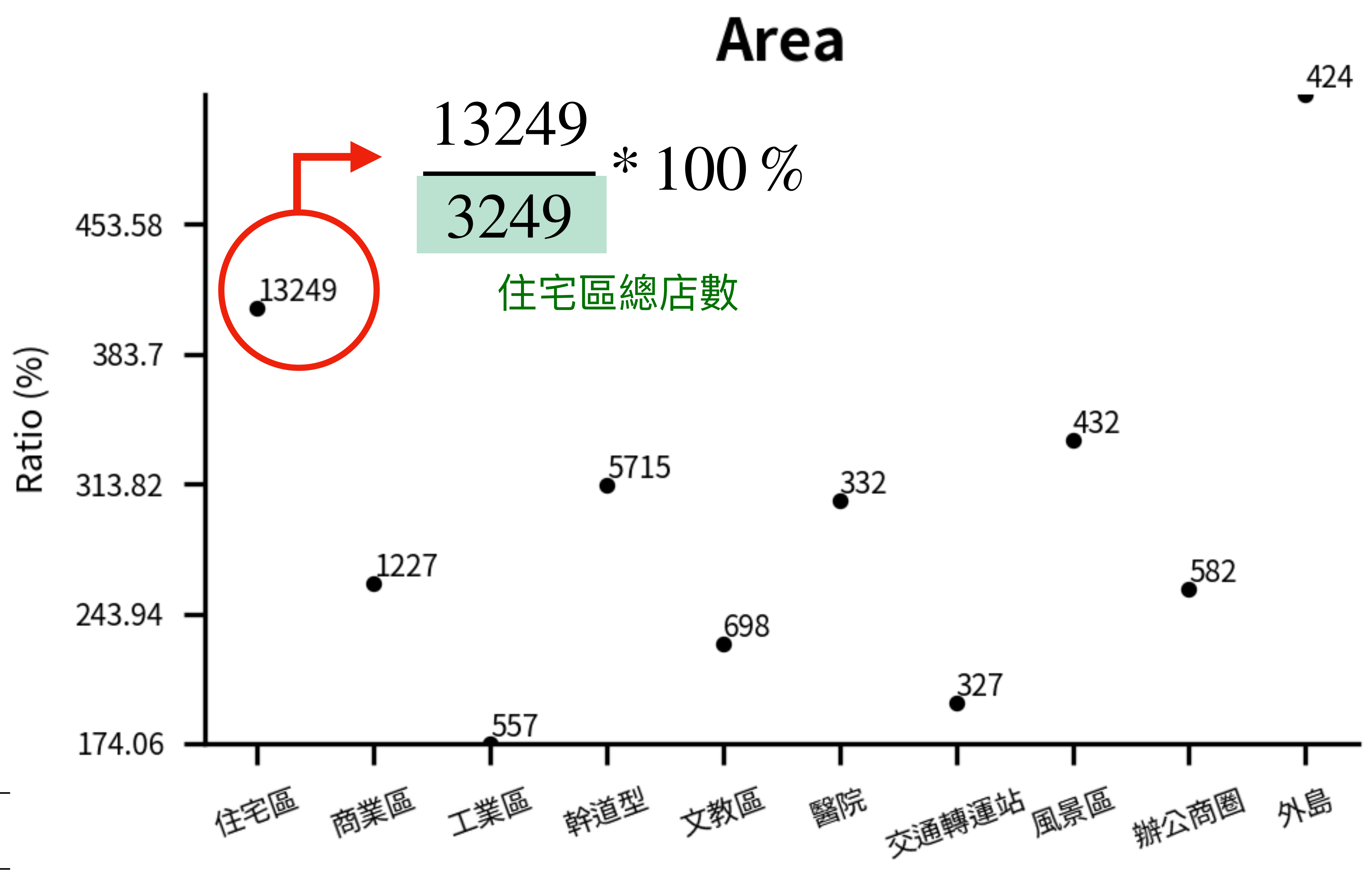
A		B	C	D
mid		pma_no_fin	qty	avg_qty
000c41ε	ła733c9	41	1	1
003357ι	1172af3	41	1	1
000ebdι	fa5877	41	1	1
00180aε	'a5fb20d	41	1	1
0018cb:	ı535771	41	1	1
004644ι	?56dc8d	41	1	1

Step 4. Results (Continued)

各群結果：[Group_02]

- 01.plot_ratio.png





$$\frac{13249}{3249} * 100\,\%$$

母商圈

北部	臺北市|新北市|基隆市|新竹市|桃園市|新竹縣|宜蘭縣
中部	臺中市|苗栗縣|彰化縣|南投縣|雲林縣
南部	高雄市|臺南市|嘉義市|嘉義縣|屏東縣
東部	花蓮縣|台東縣
離島	金門縣|連江縣|澎湖縣

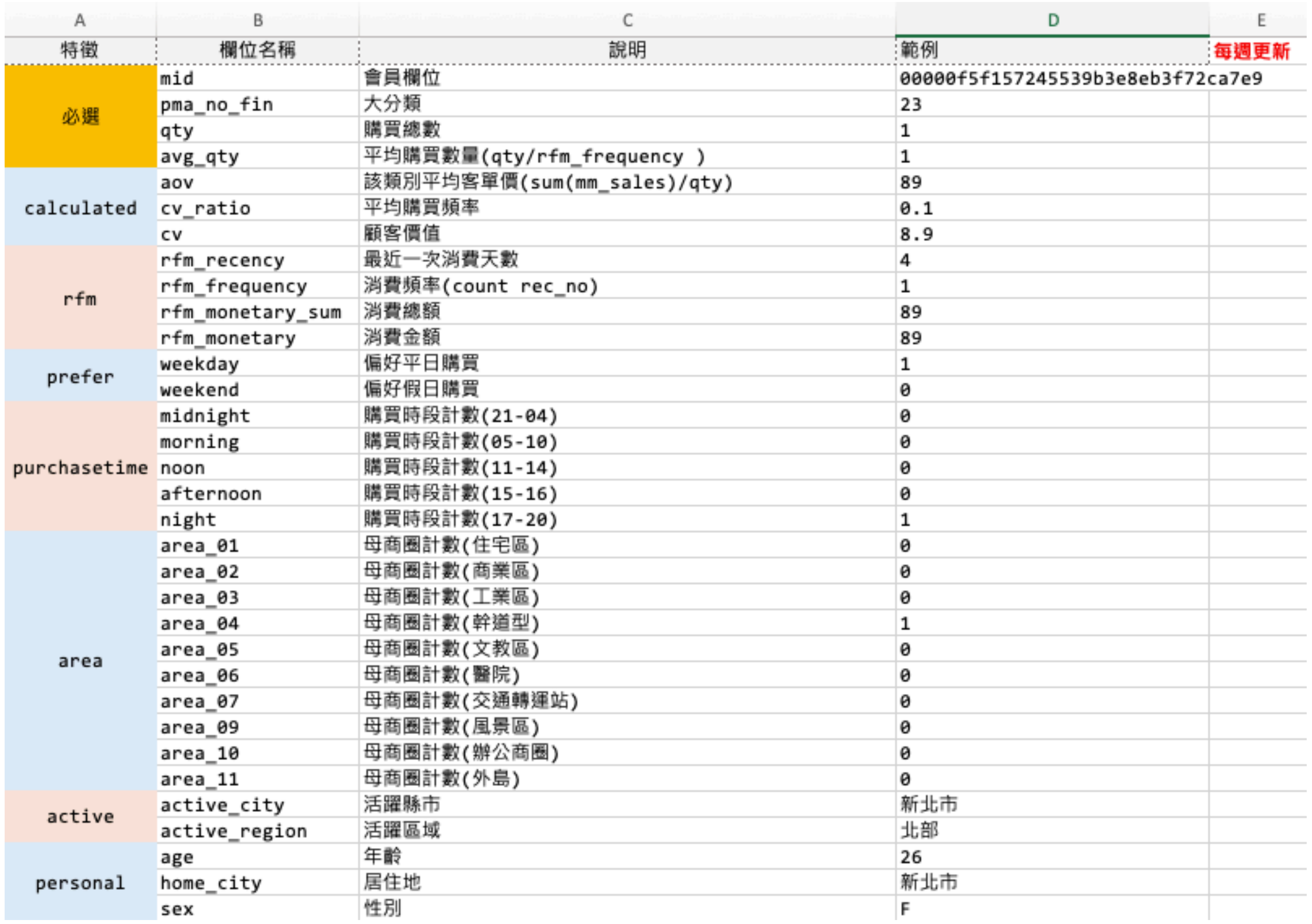
Outlines

Detail of Input File

Your analysis files need to be set up with the columns in category_config.json.

- KmeanClustering_schema.xlsx

必選欄位名稱
不可缺失與更改



A	B	C	D	E
特徵	欄位名稱	說明	範例	每週更新
必選	mid	會員欄位	00000f5f157245539b3e8eb3f72ca7e9	
	pma_no_fin	大分類	23	
	qty	購買總數	1	
	avg_qty	平均購買數量(qty/rfm_frequency)	1	
calculated	aov	該類別平均客單價(sum(mm_sales)/qty)	89	
	cv_ratio	平均購買頻率	0.1	
	cv	顧客價值	8.9	
rfm	rfm_recency	最近一次消費天數	4	
	rfm_frequency	消費頻率(count rec_no)	1	
	rfm_monetary_sum	消費總額	89	
	rfm_monetary	消費金額	89	
prefer	weekday	偏好平日購買	1	
	weekend	偏好假日購買	0	
purchasetime	midnight	購買時段計數(21-04)	0	
	morning	購買時段計數(05-10)	0	
	noon	購買時段計數(11-14)	0	
	afternoon	購買時段計數(15-16)	0	
	night	購買時段計數(17-20)	1	
area	area_01	母商圈計數(住宅區)	0	
	area_02	母商圈計數(商業區)	0	
	area_03	母商圈計數(工業區)	0	
	area_04	母商圈計數(幹道型)	1	
	area_05	母商圈計數(文教區)	0	
	area_06	母商圈計數(醫院)	0	
	area_07	母商圈計數(交通轉運站)	0	
	area_09	母商圈計數(風景區)	0	
	area_10	母商圈計數(辦公商圈)	0	
	area_11	母商圈計數(外島)	0	
active	active_city	活躍縣市	新北市	
	active_region	活躍區域	北部	
personal	age	年齡	26	
	home_city	居住地	新北市	
	sex	性別	F	

Detail of Config Setting

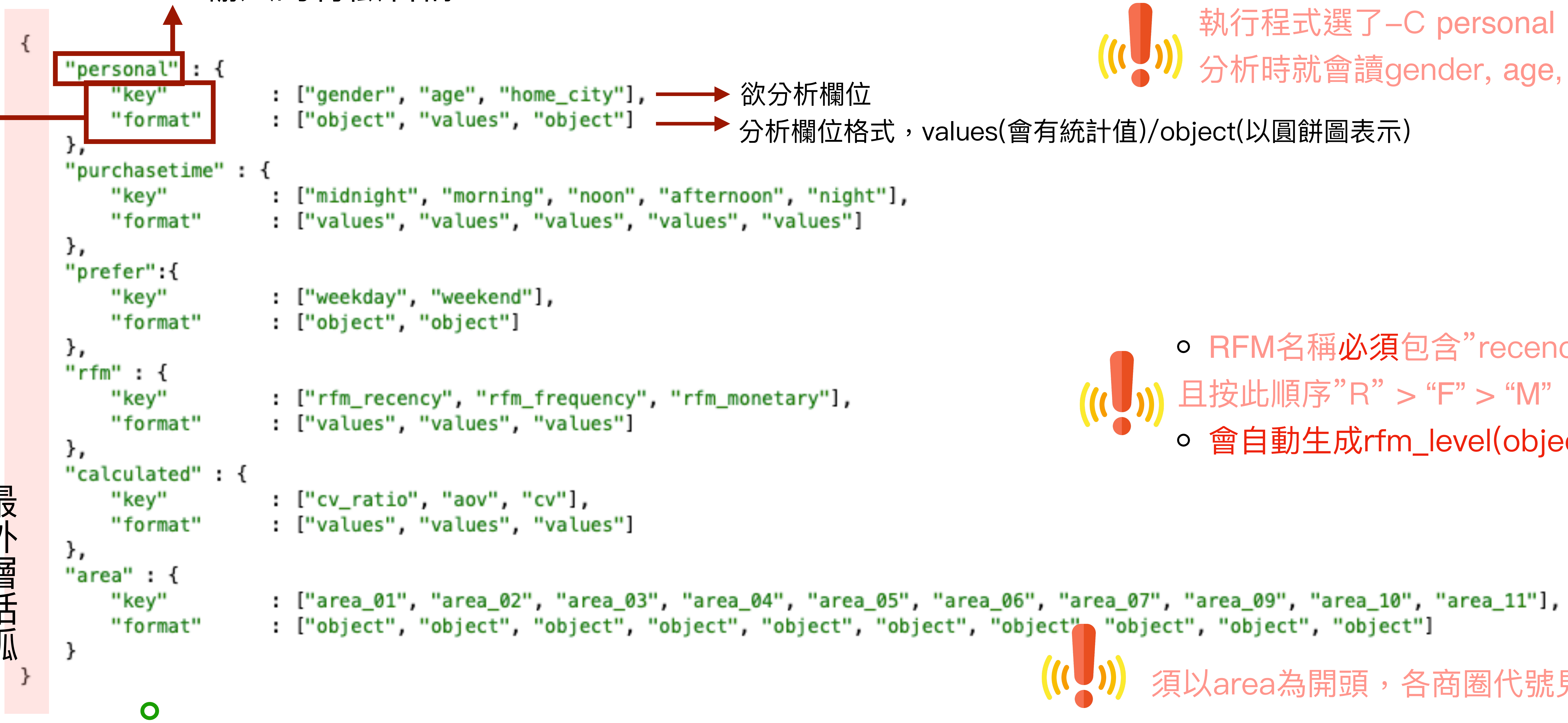
- category_config.json 只接受json 格式

[default]

-C 輸入的特徵名稱

不可更改

最外層括弧



```
{
"personal" : {
    "key"          : ["gender", "age", "home_city"],
    "format"       : ["object", "values", "object"]
},
"purchasetime" : {
    "key"          : ["midnight", "morning", "noon", "afternoon", "night"],
    "format"       : ["values", "values", "values", "values", "values"]
},
"prefer":{
    "key"          : ["weekday", "weekend"],
    "format"       : ["object", "object"]
},
"rfm" : {
    "key"          : ["rfm_recency", "rfm_frequency", "rfm_monetary"],
    "format"       : ["values", "values", "values"]
},
"calculated" : {
    "key"          : ["cv_ratio", "aov", "cv"],
    "format"       : ["values", "values", "values"]
},
"area" : {
    "key"          : ["area_01", "area_02", "area_03", "area_04", "area_05", "area_06", "area_07", "area_09", "area_10", "area_11"],
    "format"       : ["object", "object", "object", "object", "object", "object", "object", "object", "object", "object"]
}
}
```

→ 欲分析欄位

→ 分析欄位格式，values(會有統計值)/object(以圓餅圖表示)

執行程式選了–C personal
分析時就會讀gender, age, home_city這三個欄位

- RFM名稱必須包含”recency”, “frequency”,”monetary
  且按此順序”R” > “F” > “M”
- 會自動生成rfm_level(object)

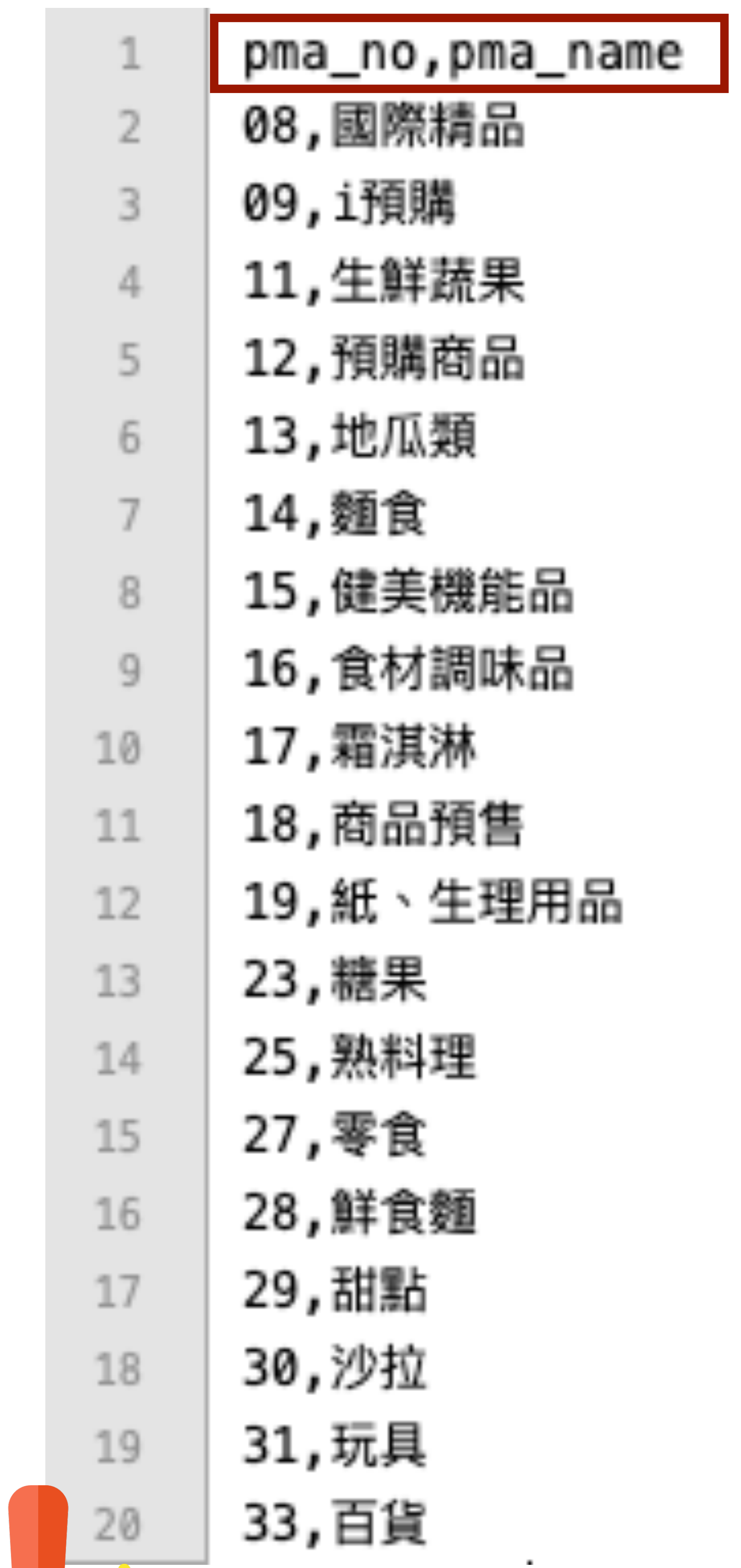
須以area為開頭，各商圈代號見store_area_config.csv

-
-
-

欲新增特徵，務必保持此資料格式(json)

Detail of Config Setting

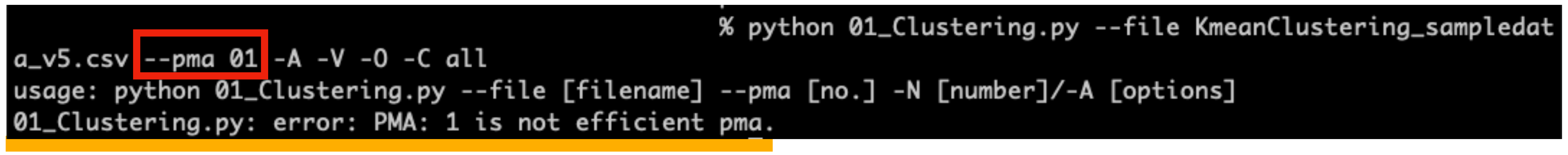
- pma_config.csv



```
pma_no,pma_name
08,國際精品
09,i預購
11,生鮮蔬果
12,預購商品
13,地瓜類
14,麵食
15,健美機能品
16,食材調味品
17,霜淇淋
18,商品預售
19,紙、生理用品
23,糖果
25,熟料理
27,零食
28,鮮食麵
29,甜點
30,沙拉
31,玩具
33,百貨
```

header不要更改

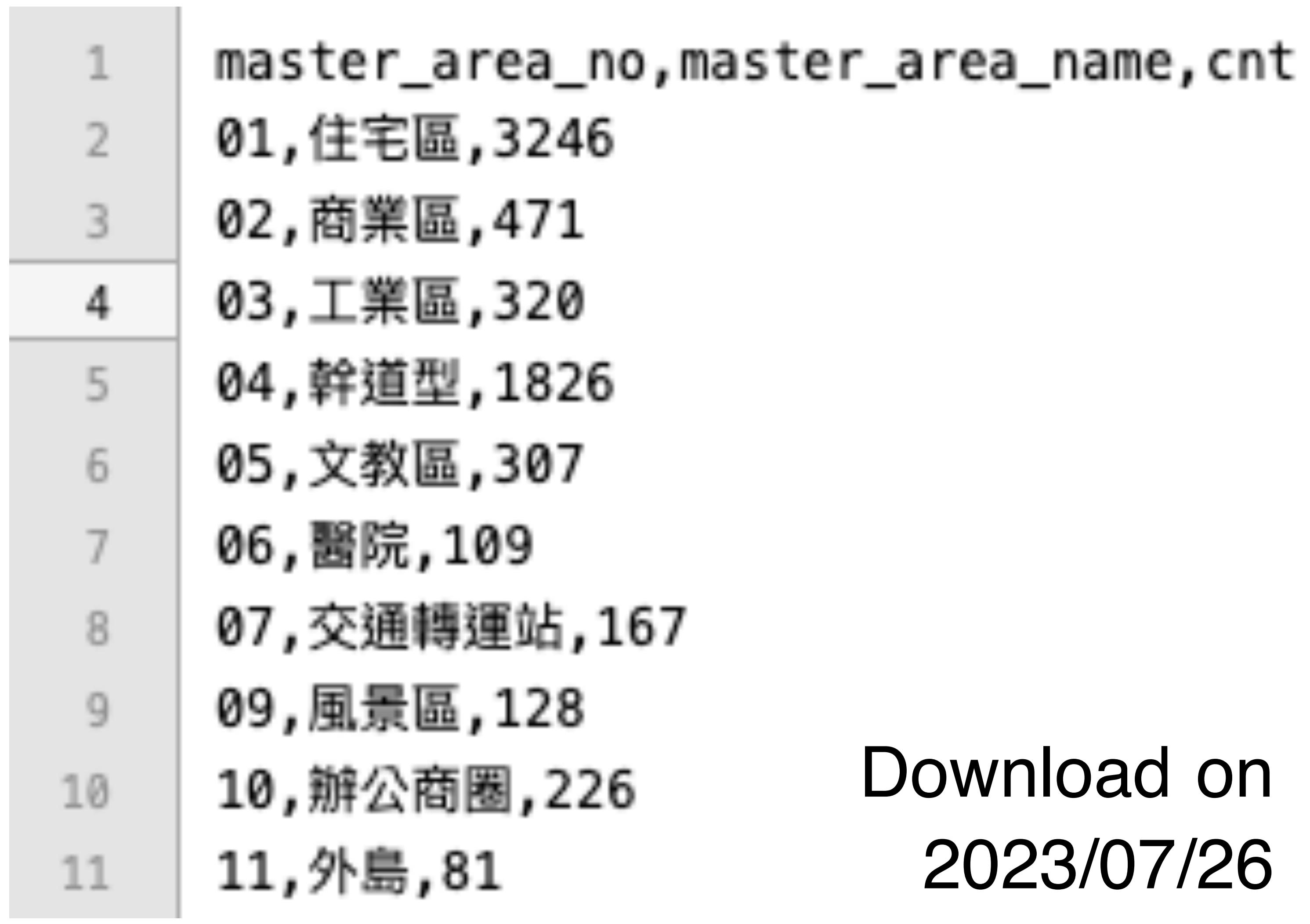
若分析的分類編號沒有在此檔案，會報錯！



```
                                                  % python 01_Clustering.py --file KmeanClustering_sampledat
a_v5.csv --pma 01 -A -V -O -C all
usage: python 01_Clustering.py --file [filename] --pma [no.] -N [number]/-A [options]
01_Clustering.py: error: PMA: 1 is not efficient pma.
```

- store_area_config.csv

檔名不要更改



```
master_area_no,master_area_name,cnt
01,住宅區,3246
02,商業區,471
03,工業區,320
04,幹道型,1826
05,文教區,307
06,醫院,109
07,交通轉運站,167
09,風景區,128
10,辦公商圈,226
11,外島,81
```

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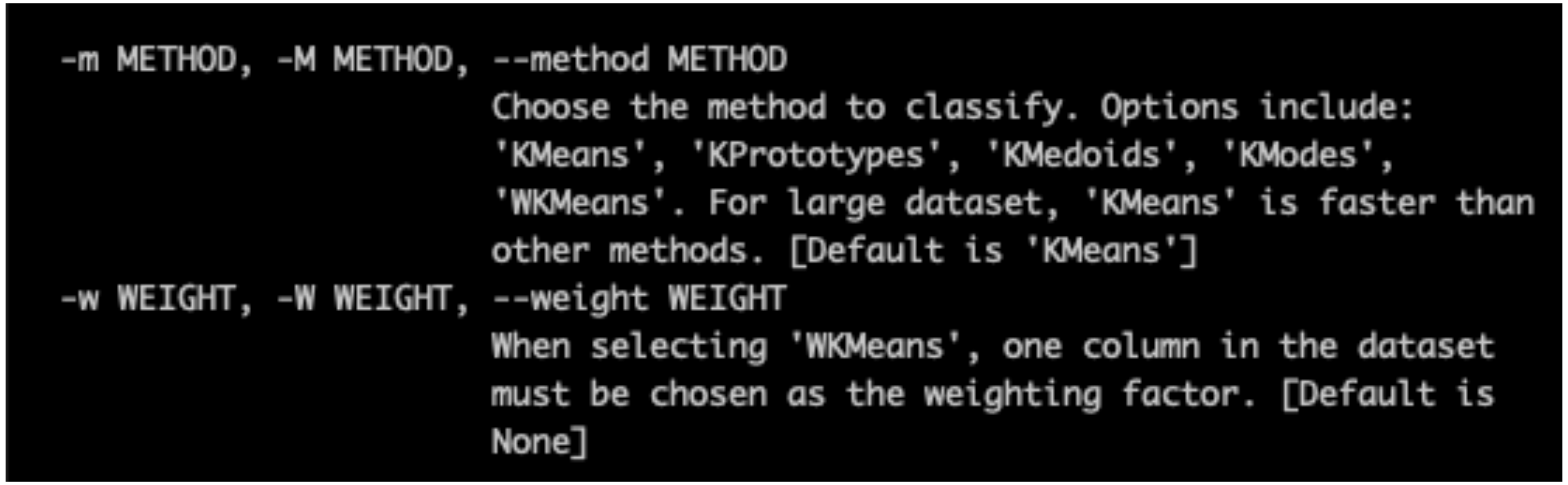
Detail of Parameters Setting: Method



```
  -m METHOD, -M METHOD, --method METHOD
                        Choose the method to classify. Options include:
                        'KMeans', 'KPrototypes', 'KMedoids', 'KModes',
                        'WKMeans'. For large dataset, 'KMeans' is faster than
                        other methods. [Default is 'KMeans']
  -w WEIGHT, -W WEIGHT, --weight WEIGHT
                        When selecting 'WKMeans', one column in the dataset
                        must be chosen as the weighting factor. [Default is
                        None]
```

執行時間測試

資料數量: 2,314,868
指定分群數量: 10

Method	Time
KMeans	2m06s
KModes	1h53m
KPrototypes	6h6m
KMedoids	Killed
Weight-KMeans	1m18s

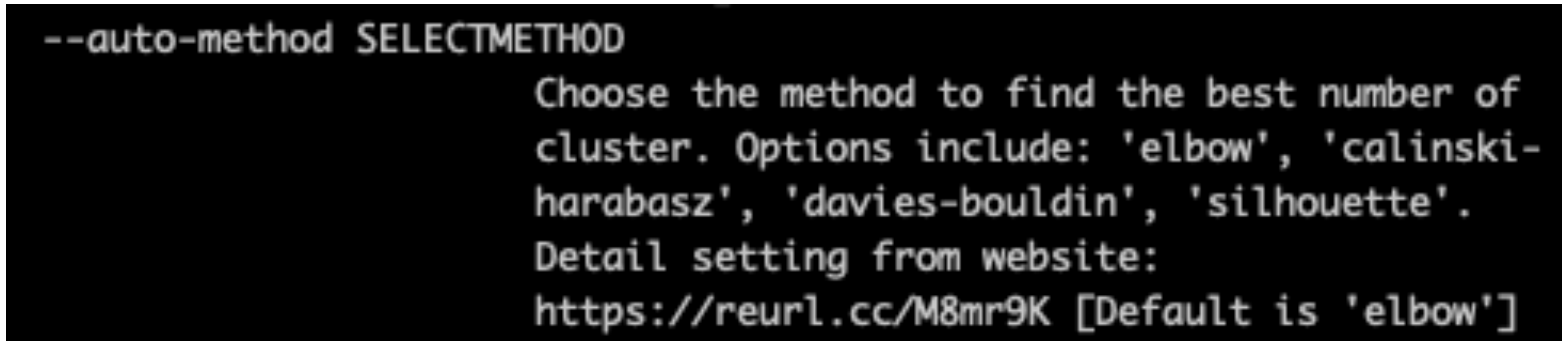
執行時間測試

分群方法: KMeans

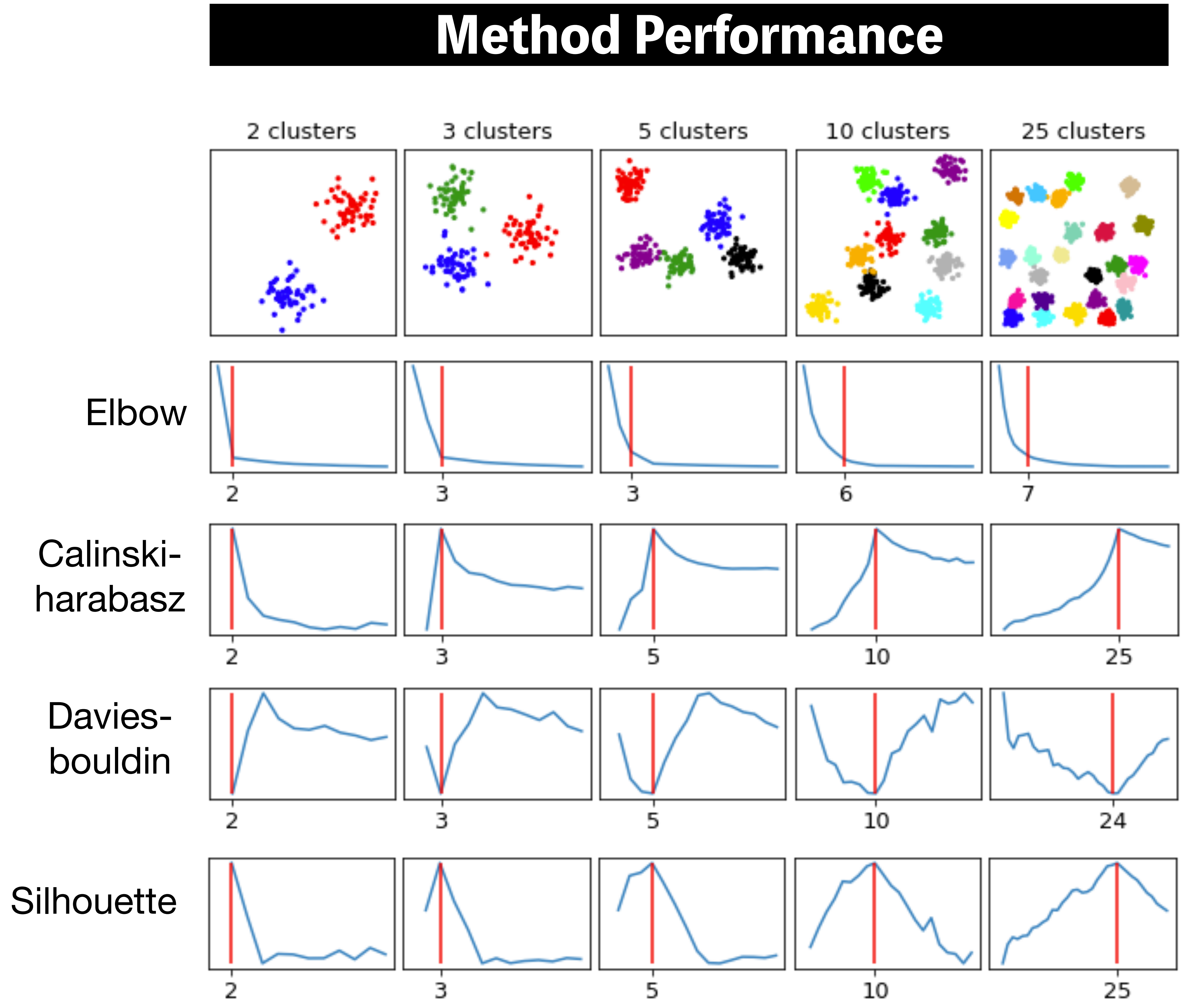
	PMA	Records	Auto/Manual	Time (s)
分群	38 (香菸)	774,397	Auto	217.428405
			Manual(10)	66.472927
	65 (米飯)	1,604,118	Auto	382.838203
			Manual(10)	113.588311
	41 (冷藏飲品)	2,314,868	Auto	395.461441
			Manual(10)	124.532646

- KMeans: 利用歐式距離計算算數平均值，資料形式只限Values，在此程式會把Object部分做LabelEncoder
- KModes: 只接受資料形式為Object
- KPrototypes: KMeans+KModes，可接受混合型數據(Values+Object)，執行時間久
- KMedoids: 利用歐式距離計算群內距離和最小的方式(i.e. 中位數)
- WKMeans: 對於每個欄位給予權重，權重須藉由–w 給予

Detail of Parameters Setting: Select-Method



```
--auto-method SELECTMETHOD
                        Choose the method to find the best number of
                        cluster. Options include: 'elbow', 'calinski-
                        harabasz', 'davies-bouldin', 'silhouette'.
                        Detail setting from website:
                        https://reurl.cc/M8mr9K [Default is 'elbow']
```



https://github.com/smazzanti/are_you_still_using_elbow_method/blob/main/are-you-still-using-elbow-method.ipynb

- Elbow: 尋找各群的距離平方和的轉折點
- Calinski-harabasz: 群與群間的離散度 / 群內點跟點的離散度，分數越高越好
- Davies-bouldin: 計算群與群之間的相似度，分數越低(相似度越低)越好
- Silhouette: 計算A點與同群樣本點的距離與其他群樣本點距離，分數越高越好，計算複雜度高(計算時間很久)

Reference:

https://towardsdatascience.com/are-you-still-using-the-elbow-method-5d271b3063bd
https://medium.com/@haataa/how-to-measure-clustering-performances-when-there-are-no-ground-truth-db027e9a871c

Detail of Parameters Setting: RFM level

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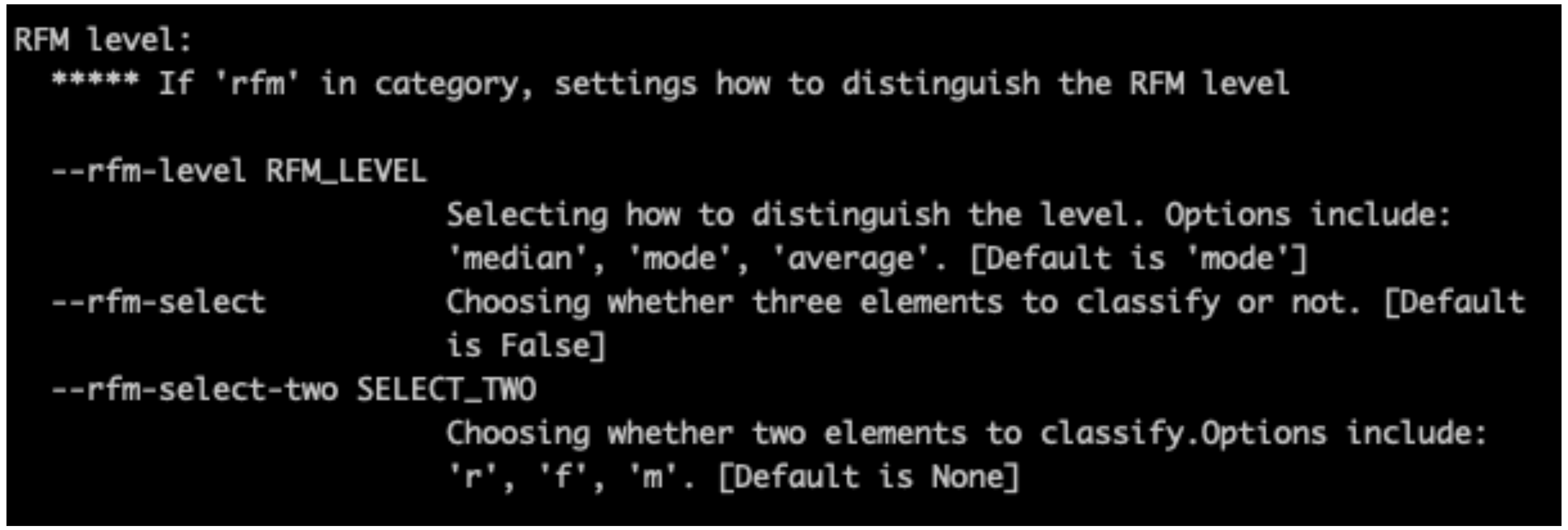
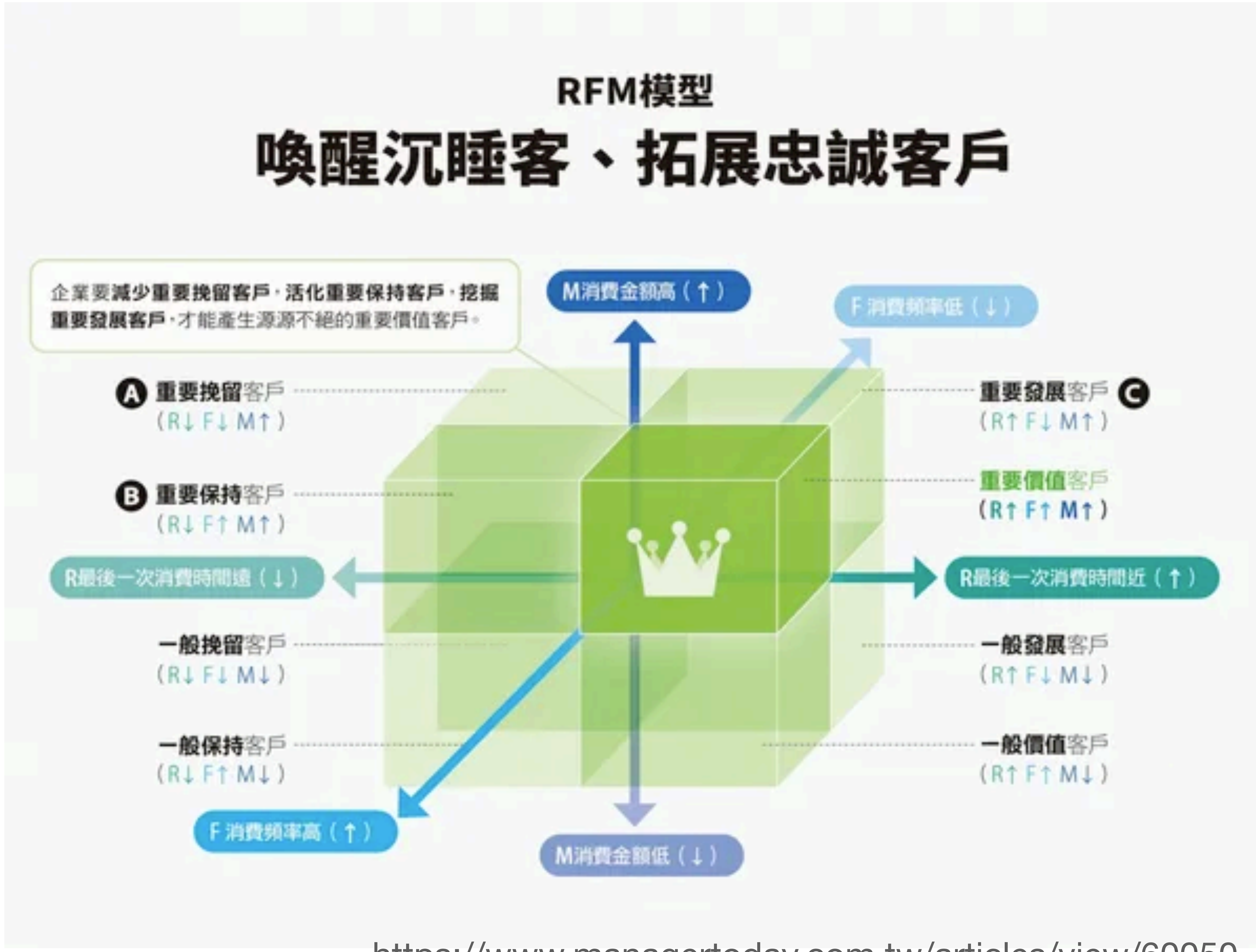


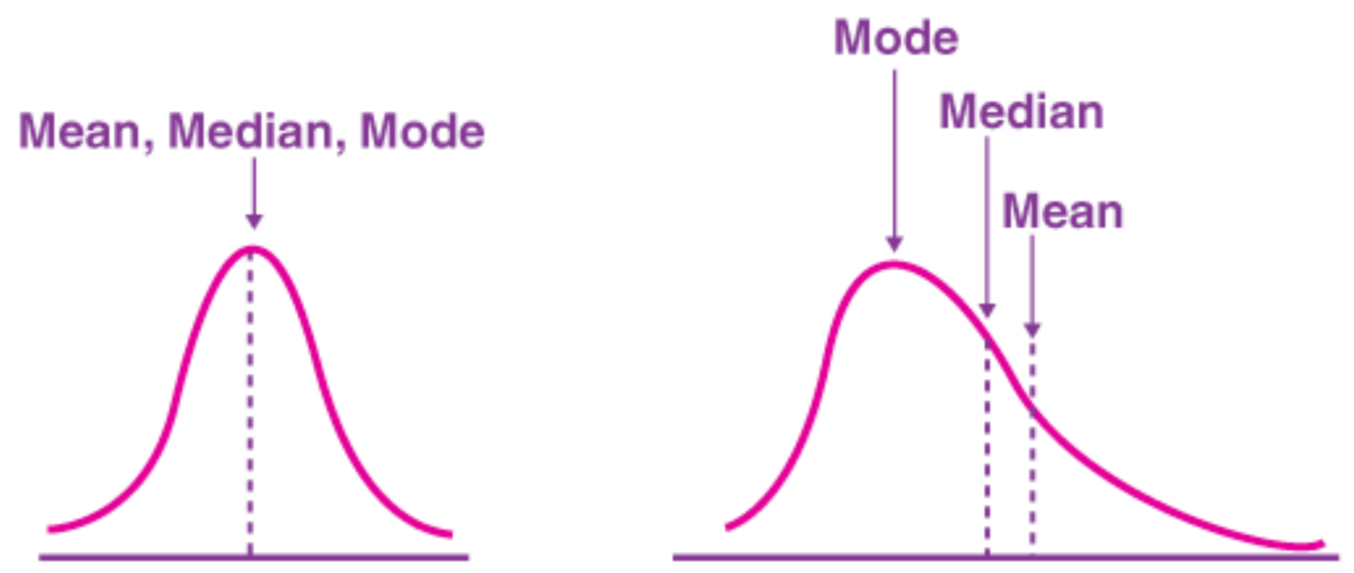
```
RFM level:
  ***** If 'rfm' in category, settings how to distinguish the RFM level

  --rfm-level RFM_LEVEL
                        Selecting how to distinguish the level. Options include:
                        'median', 'mode', 'average'. [Default is 'mode']
  --rfm-select          Choosing whether three elements to classify or not. [Default
                        is False]
  --rfm-select-two SELECT_TWO
                        Choosing whether two elements to classify.Options include:
                        'r', 'f', 'm'. [Default is None]
```



https://www.managertoday.com.tw/articles/view/60050

- rfm-level: 以平均(avgerage)、中位數(median)或眾數(mode)來區分RFM等級

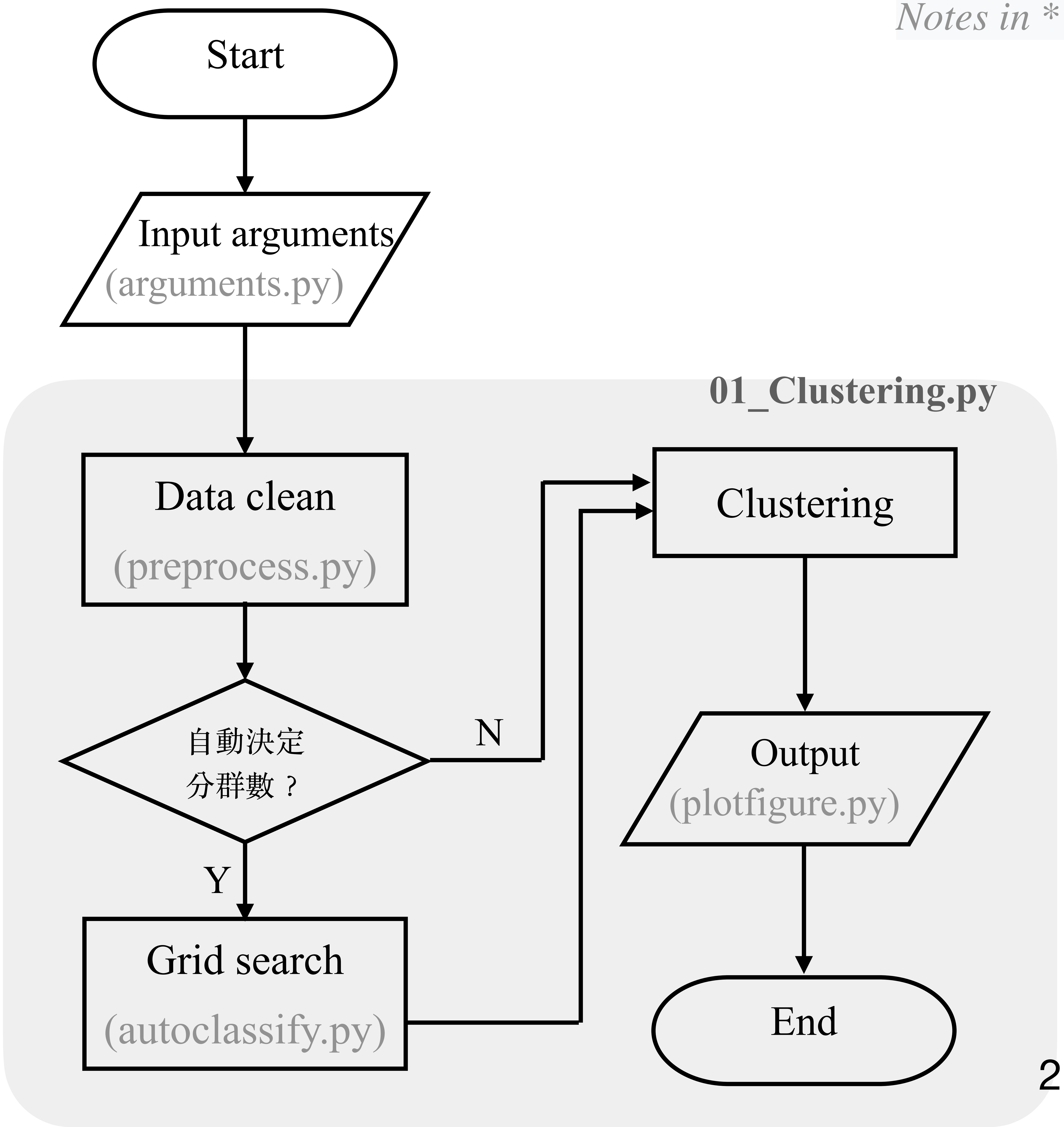


- rfm-select-two: 若僅分析兩項指標，必選 --rfm-select，以避免誤下指令。
  原先三個指標取其中兩個，使用方法為: --rfm-select-two f,m

Outlines

Detail of Program Setting

*Notes in *.py*



- 專案開發環境: MacOS v12.6.4, Python 3.11.3
- 使用套件版本: kmodes v0.12.2, kneed v0.8.5, matplotlib v3.7.1
  numpy v1.24.2, pandas v1.5.3, scikit-learn v1.2.2,
  scikit-learn-extra v0.3.0, pip v23.1.2