HANDS ON DAY 8 AND DAY 7: CLUSTERING AND SPLINE REGRESSION

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In this exercise, we integrate what we – Thinking Critically in the Age of Data, 2 Sitting for GD Group 4, Setting the bar(-ometer) diagnosis for a CHBG using spline regression – did on day three of these datasets provided: NGC 752, NGC 7789, NGC 7790

```
In [1]: %matplotlib inline
        %load_ext autoreload
        %autoreload 2

        import math
        import numpy as np, pandas as pd, pt

        import sklearn as sk
        import sklearn.cluster as cluster

        import matplotlib
        from matplotlib.pyplot import *

        from astropy.coordinates import Distance
        from astropy.table import Table

        from astroquery.vizier import Vizier
        from astroquery.gaia import Gaia
        import astroquery.gaia as gq
        from astroquery.simbad import Simbad, sim_kwlt

        import pickle as pk

        from pylab import *
        from matplotlib.mlab import mean, sqrt, nan, nanf
        from astroquery.vizier import *, *

        [INFO] time = 0
        [INFO] ipy = True
        [INFO] ipnb = True

        pd.set_option('display.max_columns', 50)
        pd.set_option('display.max_rows', 10)
        pd.set_option('display.precision', 3)
        pd.set_option('display.width', 1000)
        pd.set_option('display.colheader_justify', 'left')
        pd.set_option('display.notebook_repr_html', True)
        pd.set_option('display.expand_frame_repr', False)
        pd.set_option('display.chop_threshold', 0.0)
        %matplotlib inline
```

FIRST DATASET : NGC 752

1. Finding the rotation of the cluster

```
In [2]: dataf2ngc752 = pd.read_csv("gaiaedr3_ngc752.csv", delimiter=",")
```

```
In [3]: dataf2ngc752.shape
```

```
Out[3]: (2000, 19)
```

```
In [4]: dataf2ngc752.head()
```

	source_id	ra	e_ra	dec	e_dec	parallax	parallax_error	pm	pm_error	phot_g_mean_mag	phot_g
0	2387017863421330304	29.184	0.049	37.232	0.046	2.184	0.071	-11.000	0.064	12.000	0.003
1	2387017767941313664	29.401	0.049	37.073	0.046	2.221	0.071	-11.000	0.064	12.000	0.003
2	2387017664862098816	29.346	0.049	37.000	0.046	2.208	0.071	-11.000	0.064	12.000	0.003
3	2387017561782884224	29.287	0.049	36.928	0.046	2.208	0.071	-11.000	0.064	12.000	0.003
4	2387016943308190720	29.067	0.049	36.603	0.046	2.198	0.071	-11.000	0.064	12.000	0.003

5 rows x 19 columns

```
In [5]: dataf2ngc752.info()
```

```
Out[5]: <class'pd.core.frame.DataFrame'>
        RangeIndex: 2000 entries, 0 to 1999
        Data columns (total 19 columns):
        #   Column          Non-Null Count  Dtype
        ---  ------          --------------  -----
        0   source_id       2000 non-null   int64
        1   ra              2000 non-null   float64
        2   e_ra            2000 non-null   float64
        3   dec             2000 non-null   float64
        4   e_dec           2000 non-null   float64
        5   parallax        2000 non-null   float64
        6   parallax_error  2000 non-null   float64
        7   pm              2000 non-null   float64
        8   pm_error        2000 non-null   float64
        9   phot_g_mean_mag 2000 non-null   float64
        10  phot_g_mean_flux_error 2000 non-null   float64
        11  phot_g_mean_flux_over_error 2000 non-null   float64
        12  phot_bp_mean_mag 2000 non-null   float64
        13  phot_bp_mean_flux_error 2000 non-null   float64
        14  phot_bp_mean_flux_over_error 2000 non-null   float64
        15  phot_rp_mean_mag 2000 non-null   float64
        16  phot_rp_mean_flux_error 2000 non-null   float64
        17  phot_rp_mean_flux_over_error 2000 non-null   float64
        18  phot_bp_rp_excess_factor 2000 non-null   float64
        dtypes: int64: 1, float64: 18
        memory usage: 297.0 KB
```

```
In [6]: dataf2ngc752.describe(include=['float64', 'int64'], "percentile", [.5, .95], [.2, .3])
```

```
Out[6]:
```

	source_id	ra	e_ra	dec	e_dec	parallax	parallax_error	pm	pm_error	phot_g_mean_mag	phot_g
count	2.000e+03	2000.000	2000.000	2000.000	2000.000	2000.000	2000.000	2000.000	2000.000	2000.000	2000.000
mean	2.387e+18	29.500	0.049	37.000	0.046	2.208	0.071	-11.000	0.064	12.000	0.003
std	3.000e+03	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
min	2.387e+18	29.184	0.049	36.928	0.046	2.184	0.071	-11.000	0.064	12.000	0.003
50%	2.387e+18	29.500	0.049	37.000	0.046	2.208	0.071	-11.000	0.064	12.000	0.003
95%	2.387e+18	29.816	0.049	37.067	0.046	2.221	0.071	-11.000	0.064	12.000	0.003
max	2.387e+18	29.816	0.049	37.232	0.046	2.221	0.071	-11.000	0.064	12.000	0.003

2000 rows × 15 columns

```
In [7]: dataf2ngc752.describe(include=['object', 'bool'], "percentile", [.5, .95])
```

```
Out[7]:
```

	name	ra_hms	dec_dms	parallax_mas	pm_ra_cos_mas_yr	pm_dec_mas_yr	phot_g_mag	phot_bp_mag	phot_rp_mag	phot_bp_rp_mag	phot_g_mag_error	phot_bp_mag_error	phot_rp_mag_error	phot_bp_rp_mag_error
count	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
unique	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
top	2387017863421330304	01:57:44.7000	+37:13:55.2000	2.184	-11.000	-11.000	12.000	12.000	12.000	0.000	0.003	0.064	0.064	0.064
freq	1	1	1	1	1	1	1	1	1	1	1	1	1	1

```
In [8]: dataf2ngc752.dtypes
```

```
Out[8]: source_id                    int64
        ra                           float64
        e_ra                         float64
        dec                          float64
        e_dec                        float64
        parallax                     float64
        parallax_error               float64
        pm                           float64
        pm_error                     float64
        phot_g_mean_mag              float64
        phot_g_mean_flux_error       float64
        phot_g_mean_flux_over_error  float64
        phot_bp_mean_mag             float64
        phot_bp_mean_flux_error      float64
        phot_bp_mean_flux_over_error float64
        phot_rp_mean_mag             float64
        phot_rp_mean_flux_error      float64
        phot_rp_mean_flux_over_error float64
        phot_bp_rp_excess_factor     float64
        dtype: object
```

```
In [9]: dataf2ngc752 = dataf2ngc752[dataf2ngc752.parallax > 0]
        dataf2ngc752 = dataf2ngc752[dataf2ngc752.phot_g_mean_flux_over_error > 50]
        dataf2ngc752 = dataf2ngc752[dataf2ngc752.phot_rp_mean_flux_over_error > 50]
        dataf2ngc752 = dataf2ngc752[dataf2ngc752.phot_bp_mean_flux_over_error > 50]
        dataf2ngc752 = dataf2ngc752[dataf2ngc752.phot_bp_rp_excess_factor > 1.0 + 0.015*(dataf2ngc752.phot_bp_mag - dataf2ngc752.phot_rp_mag)**2]
        dataf2ngc752 = dataf2ngc752[dataf2ngc752.phot_bp_rp_excess_factor < 1.3 + 0.06*(dataf2ngc752.phot_bp_mag - dataf2ngc752.phot_rp_mag)**2]
        dataf2ngc752.shape
```

```
Out[9]: (1972, 19)
```

```
In [10]: dataf2ngc752.describe(include=['float64', 'int64'], "percentile", [.5, .95])
```

```
Out[10]:
```

	source_id	ra	e_ra	dec	e_dec	parallax	parallax_error	pm	pm_error	phot_g_mean_mag	phot_g
count	1.972e+03	1972.000	1972.000	1972.000	1972.000	1972.000	1972.000	1972.000	1972.000	1972.000	1972.000
mean	2.387e+18	29.500	0.049	37.000	0.046	2.208	0.071	-11.000	0.064	12.000	0.003
std	3.000e+03	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
min	2.387e+18	29.184	0.049	36.928	0.046	2.184	0.071	-11.000	0.064	12.000	0.003
50%	2.387e+18	29.500	0.049	37.000	0.046	2.208	0.071	-11.000	0.064	12.000	0.003
95%	2.387e+18	29.816	0.049	37.067	0.046	2.221	0.071	-11.000	0.064	12.000	0.003
max	2.387e+18	29.816	0.049	37.232	0.046	2.221	0.071	-11.000	0.064	12.000	0.003

2000 rows × 15 columns

```
In [11]: dataf2ngc752.describe(include=['object', 'bool'], "percentile", [.5, .95])
```

```
Out[11]:
```

	name	ra_hms	dec_dms	parallax_mas	pm_ra_cos_mas_yr	pm_dec_mas_yr	phot_g_mag	phot_bp_mag	phot_rp_mag	phot_bp_rp_mag	phot_g_mag_error	phot_bp_mag_error	phot_rp_mag_error	phot_bp_rp_mag_error
count	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
unique	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
top	2387017863421330304	01:57:44.7000	+37:13:55.2000	2.184	-11.000	-11.000	12.000	12.000	12.000	0.000	0.003	0.064	0.064	0.064
freq	1	1	1	1	1	1	1	1	1	1	1	1	1	1

```
In [12]: dataf2ngc752.dtypes
```

```
Out[12]: source_id                    int64
         ra                           float64
         e_ra                         float64
         dec                          float64
         e_dec                        float64
         parallax                     float64
         parallax_error               float64
         pm                           float64
         pm_error                     float64
         phot_g_mean_mag              float64
         phot_g_mean_flux_error       float64
         phot_g_mean_flux_over_error  float64
         phot_bp_mean_mag             float64
         phot_bp_mean_flux_error      float64
         phot_bp_mean_flux_over_error float64
         phot_rp_mean_mag             float64
         phot_rp_mean_flux_error      float64
         phot_rp_mean_flux_over_error float64
         phot_bp_rp_excess_factor     float64
         dtype: object
```

```
In [13]: dataf2ngc752.shape
```

```
Out[13]: (1972, 19)
```

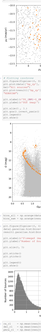
```
In [14]: dataf2ngc752.to_csv("dataf2ngc752.csv", sep=",")
```

```
In [15]: %matplotlib inline
         ra = dataf2ngc752['ra']
         dec = dataf2ngc752['dec']
         plot(ra, dec, '.')
         xlabel('ra')
         ylabel('dec')
         show()
```

```
Out[15]: [<matplotlib.lines.Line2D at 0x7f1d1d7f7f10>]
```

```
In [16]: %matplotlib inline
         ra = dataf2ngc752['ra']
         dec = dataf2ngc752['dec']
         plot(ra, dec, '.')
         xlabel('ra')
         ylabel('dec')
         show()
```

```
Out[16]: [<matplotlib.lines.Line2D at 0x7f1d1d7f7f10>]
```

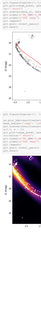



```
In [17]: %matplotlib inline
         ra = dataf2ngc752['ra']
         dec = dataf2ngc752['dec']
         plot(ra, dec, '.')
         xlabel('ra')
         ylabel('dec')
         show()
```

```
Out[17]: [<matplotlib.lines.Line2D at 0x7f1d1d7f7f10>]
```

```
In [18]: %matplotlib inline
         ra = dataf2ngc752['ra']
         dec = dataf2ngc752['dec']
         plot(ra, dec, '.')
         xlabel('ra')
         ylabel('dec')
         show()
```

```
Out[18]: [<matplotlib.lines.Line2D at 0x7f1d1d7f7f10>]
```




```
In [19]: %matplotlib inline
         ra = dataf2ngc752['ra']
         dec = dataf2ngc752['dec']
         plot(ra, dec, '.')
         xlabel('ra')
         ylabel('dec')
         show()
```

```
Out[19]: [<matplotlib.lines.Line2D at 0x7f1d1d7f7f10>]
```

```
In [20]: %matplotlib inline
         ra = dataf2ngc752['ra']
         dec = dataf2ngc752['dec']
         plot(ra, dec, '.')
         xlabel('ra')
         ylabel('dec')
         show()
```

```
Out[20]: [<matplotlib.lines.Line2D at 0x7f1d1d7f7f10>]
```

```
In [21]: %matplotlib inline
         ra = dataf2ngc752['ra']
         dec = dataf2ngc752['dec']
         plot(ra, dec, '.')
         xlabel('ra')
         ylabel('dec')
         show()
```

```
Out[21]: [<matplotlib.lines.Line2D at 0x7f1d1d7f7f10>]
```



```
In [22]: %matplotlib inline
         ra = dataf2ngc752['ra']
         dec = dataf2ngc752['dec']
         plot(ra, dec, '.')
         xlabel('ra')
         ylabel('dec')
         show()
```

```
Out[22]: [<matplotlib.lines.Line2D at 0x7f1d1d7f7f10>]
```



```
In [23]: %matplotlib inline
         ra = dataf2ngc752['ra']
         dec = dataf2ngc752['dec']
         plot(ra, dec, '.')
         xlabel('ra')
         ylabel('dec')
         show()
```

```
Out[23]: [<matplotlib.lines.Line2D at 0x7f1d1d7f7f10>]
```



```
In [24]: %matplotlib inline
         ra = dataf2ngc752['ra']
         dec = dataf2ngc752['dec']
         plot(ra, dec, '.')
         xlabel('ra')
         ylabel('dec')
         show()
```

```
Out[24]: [<matplotlib.lines.Line2D at 0x7f1d1d7f7f10>]
```



```
In [25]: %matplotlib inline
         ra = dataf2ngc752['ra']
         dec = dataf2ngc752['dec']
         plot(ra, dec, '.')
         xlabel('ra')
         ylabel('dec')
         show()
```

```
Out[25]: [<matplotlib.lines.Line2D at 0x7f1d1d7f7f10>]
```



```
In [26]: %matplotlib inline
         ra = dataf2ngc752['ra']
         dec = dataf2ngc752['dec']
         plot(ra, dec, '.')
         xlabel('ra')
         ylabel('dec')
         show()
```

```
Out[26]: [<matplotlib.lines.Line2D at 0x7f1d1d7f7f10>]
```



```
In [27]: %matplotlib inline
         ra = dataf2ngc752['ra']
         dec = dataf2ngc752['dec']
         plot(ra, dec, '.')
         xlabel('ra')
         ylabel('dec')
         show()
```

```
Out[27]: [<matplotlib.lines.Line2D at 0x7f1d1d7f7f10>]
```

```
In [28]: %matplotlib inline
         ra = dataf2ngc752['ra']
         dec = dataf2ngc752['dec']
         plot(ra, dec, '.')
         xlabel('ra')
         ylabel('dec')
         show()
```

```
Out[28]: [<matplotlib.lines.Line2D at 0x7f1d1d7f7f10>]
```

```
In [29]: %matplotlib inline
         ra = dataf2ngc752['ra']
         dec = dataf2ngc752['dec']
         plot(ra, dec, '.')
         xlabel('ra')
         ylabel('dec')
         show()
```

```
Out[29]: [<matplotlib.lines.Line2D at 0x7f1d1d7f7f10>]
```

```
In [30]: %matplotlib inline
         ra = dataf2ngc752['ra']
         dec = dataf2ngc752['dec']
         plot(ra, dec, '.')
         xlabel('ra')
         ylabel('dec')
         show()
```

```
Out[30]: [<matplotlib.lines.Line2D at 0x7f1d1d7f7f10>]
```

```
In [31]: %matplotlib inline
         ra = dataf2ngc752['ra']
         dec = dataf2ngc752['dec']
         plot(ra, dec, '.')
         xlabel('ra')
         ylabel('dec')
         show()
```

```
Out[31]: [<matplotlib.lines.Line2D at 0x7f1d1d7f7f10>]
```



```
In [32]: %matplotlib inline
         ra = dataf2ngc752['ra']
         dec = dataf2ngc752['dec']
         plot(ra, dec, '.')
         xlabel('ra')
         ylabel('dec')
         show()
```

```
Out[32]: [<matplotlib.lines.Line2D at 0x7f1d1d7f7f10>]
```

```
In [33]: %matplotlib inline
         ra = dataf2ngc752['ra']
         dec = dataf2ngc752['dec']
         plot(ra, dec, '.')
         xlabel('ra')
         ylabel('dec')
         show()
```

```
Out[33]: [<matplotlib.lines.Line2D at 0x7f1d1d7f7f10>]
```



```
In [34]: %matplotlib inline
         ra = dataf2ngc752['ra']
         dec = dataf2ngc752['dec']
         plot(ra, dec, '.')
         xlabel('ra')
         ylabel('dec')
         show()
```

```
Out[34]: [<matplotlib.lines.Line2D at 0x7f1d1d7f7f10>]
```



```
In [35]: %matplotlib inline
         ra = dataf2ngc752['ra']
         dec = dataf2ngc752['dec']
         plot(ra, dec, '.')
         xlabel('ra')
         ylabel('dec')
         show()
```

```
Out[35]: [<matplotlib.lines.Line2D at 0x7f1d1d7f7f10>]
```



```
In [36]: %matplotlib inline
         ra = dataf2ngc752['ra']
         dec = dataf2ngc752['dec']
         plot(ra, dec, '.')
         xlabel('ra')
         ylabel('dec')
         show()
```

```
Out[36]: [<matplotlib.lines.Line2D at 0x7f1d1d7f7f10>]
```



```
In [37]: %matplotlib inline
         ra = dataf2ngc752['ra']
         dec = dataf2ngc752['dec']
         plot(ra, dec, '.')
         xlabel('ra')
         ylabel('dec')
         show()
```

```
Out[37]: [<matplotlib.lines.Line2D at 0x7f1d1d7f7f10>]
```



```
In [38]: %matplotlib inline
         ra = dataf2ngc752['ra']
         dec = dataf2ngc752['dec']
         plot(ra, dec, '.')
         xlabel('ra')
         ylabel('dec')
         show()
```

```
Out[38]: [<matplotlib.lines.Line2D at 0x7f1d1d7f7f10>]
```



```
In [39]: %matplotlib inline
         ra = dataf2ngc752['ra']
         dec = dataf2ngc752['dec']
         plot(ra, dec, '.')
         xlabel('ra')
         ylabel('dec')
         show()
```

```
Out[39]: [<matplotlib.lines.Line2D at 0x7f1d1d7f7f10>]
```



```
In [40]: %matplotlib inline
         ra = dataf2ngc752['ra']
         dec = dataf2ngc752['dec']
         plot(ra, dec, '.')
         xlabel('ra')
         ylabel('dec')
         show()
```

```
Out[40]: [<matplotlib.lines.Line2D at 0x7f1d1d7f7f10>]
```



```
In [41]: %matplotlib inline
         ra = dataf2ngc752['ra']
         dec = dataf2ngc752['dec']
         plot(ra, dec, '.')
         xlabel('ra')
         ylabel('dec')
         show()
```

```
Out[41]: [<matplotlib.lines.Line2D at 0x7f1d1d7f7f10>]
```



```
In [42]: %matplotlib inline
         ra = dataf2ngc752['ra']
         dec = dataf2ngc752['dec']
         plot(ra, dec, '.')
         xlabel('ra')
         ylabel('dec')
         show()
```

```
Out[42]: [<matplotlib.lines.Line2D at 0x7f1d1d7f7f10>]
```



```
In [43]: %matplotlib inline
         ra = dataf2ngc752['ra']
         dec = dataf2ngc752['dec']
         plot(ra, dec, '.')
         xlabel('ra')
         ylabel('dec')
         show()
```

```
Out[43]: [<matplotlib.lines.Line2D at 0x7f1d1d7f7f10>]
```



```
In [44]: %matplotlib inline
         ra = dataf2ngc752['ra']
         dec = dataf2ngc752['dec']
         plot(ra, dec, '.')
         xlabel('ra')
         ylabel('dec')
         show()
```

```
Out[44]: [<matplotlib.lines.Line2D at 0x7f1d1d7f7f10>]
```



```
In [45]: %matplotlib inline
         ra = dataf2ngc752['ra']
         dec = dataf2ngc752['dec']
         plot(ra, dec, '.')
         xlabel('ra')
         ylabel('dec')
         show()
```

```
Out[45]: [<matplotlib.lines.Line2D at 0x7f1d1d7f7f10>]
```



```
In [46]: %matplotlib inline
         ra = dataf2ngc752['ra']
         dec = dataf2ngc752['dec']
         plot(ra, dec, '.')
         xlabel('ra')
         ylabel('dec')
         show()
```

```
Out[46]: [<matplotlib.lines.Line2D at 0x7f1d1d7f7f10>]
```



```
In [47]: %matplotlib inline
         ra = dataf2ngc752['ra']
         dec = dataf2ngc752['dec']
         plot(ra, dec, '.')
         xlabel('ra')
         ylabel('dec')
         show()
```

```
Out[47]: [<matplotlib.lines.Line2D at 0x7f1d1d7f7f10>]
```



```
In [48]: %matplotlib inline
         ra = dataf2ngc752['ra']
         dec = dataf2ngc752['dec']
         plot(ra, dec, '.')
         xlabel('ra')
         ylabel('dec')
         show()
```

```
Out[48]: [<matplotlib.lines.Line2D at 0x7f1d1d7f7f10>]
```



```
In [49]: %matplotlib inline
         ra = dataf2ngc752['ra']
         dec = dataf2ngc752['dec']
         plot(ra, dec, '.')
         xlabel('ra')
         ylabel('dec')
         show()
```

```
Out[49]: [<matplotlib.lines.Line2D at 0x7f1d1d7f7f10>]
```



```
In [50]: %matplotlib inline
         ra = dataf2ngc752['ra']
         dec = dataf2ngc752['dec']
         plot(ra, dec, '.')
         xlabel('ra')
         ylabel('dec')
         show()
```

```
Out[50]: [<matplotlib.lines.Line2D at 0x7f1d1d7f7f10>]
```



```
In [51]: %matplotlib inline
         ra = dataf2ngc752['ra']
         dec = dataf2ngc752['dec']
         plot(ra, dec, '.')
         xlabel('ra')
         ylabel('dec')
         show()
```

```
Out[51]: [<matplotlib.lines.Line2D at 0x7f1d1d7f7f10>]
```



```
In [52]: %matplotlib inline
         ra = dataf2ngc752['ra']
         dec = dataf2ngc752['dec']
         plot(ra, dec, '.')
         xlabel('ra')
         ylabel('dec')
         show()
```

```
Out[52]: [<matplotlib.lines.Line2D at 0x7f1d1d7f7f10>]
```



```
In [53]: %matplotlib inline
         ra = dataf2ngc752['ra']
         dec = dataf2ngc752['dec']
         plot(ra, dec, '.')
         xlabel('ra')
         ylabel('dec')
         show()
```

```
Out[53]: [<matplotlib.lines.Line2D at 0x7f1d1d7f7f10>]
```



```
In [54]: %matplotlib inline
         ra = dataf2ngc752['ra']
         dec = dataf2ngc752['dec']
         plot(ra, dec, '.')
         xlabel('ra')
         ylabel('dec')
         show()
```

```
Out[54]: [<matplotlib.lines.Line2D at 0x7f1d1d7f7f10>]
```



```
In [55]: %matplotlib inline
         ra = dataf2ngc752['ra']
         dec = dataf2ngc752['dec']
         plot(ra, dec, '.')
         xlabel('ra')
         ylabel('dec')
         show()
```

```
Out[55]: [<matplotlib.lines.Line2D at 0x7f1d1d7f7f10>]
```



```
In [56]: %matplotlib inline
         ra = dataf2ngc752['ra']
         dec = dataf2ngc752['dec']
         plot(ra, dec, '.')
         xlabel('ra')
         ylabel('dec')
         show()
```

```
Out[56]: [<matplotlib.lines.Line2D at 0x7f1d1d7f7f10>]
```



```
In [57]: %matplotlib inline
         ra = dataf2ngc752['ra']
         dec = dataf2ngc752['dec']
         plot(ra, dec, '.')
         xlabel('ra')
         ylabel('dec')
         show()
```

```
Out[57]: [<matplotlib.lines.Line2D at 0x7f1d1d7f7f10>]
```



```
In [58]: %matplotlib inline
         ra = dataf2ngc752['ra']
         dec = dataf2ngc752['dec']
         plot(ra, dec, '.')
         xlabel('ra')
         ylabel('dec')
         show()
```

```
Out[58]: [<matplotlib.lines.Line2D at 0x7f1d1d7f7f10>]
```



```
In [59]: %matplotlib inline
         ra = dataf2ngc752['ra']
         dec = dataf2ngc752['dec']
         plot(ra, dec, '.')
         xlabel('ra')
         ylabel('dec')
         show()
```

```
Out[59]: [<matplotlib.lines.Line2D at 0x7f1d1d7f7f10>]
```



```
In [60]: %matplotlib inline
         ra = dataf2ngc752['ra']
         dec = dataf2ngc752['dec']
         plot(ra, dec, '.')
         xlabel('ra')
         ylabel('dec')
         show()
```

```
Out[60]: [<matplotlib.lines.Line2D at 0x7f1d1d7f7f10>]
```



```
In [61]: %matplotlib inline
         ra = dataf2ngc752['ra']
         dec = dataf2ngc752['dec']
         plot(ra, dec, '.')
         xlabel('ra')
         ylabel('dec')
         show()
```

```
Out[61]: [<matplotlib.lines.Line2D at 0x7f1d1d7f7f10>]
```



```
In [62]: %matplotlib inline
         ra = dataf2ngc752['ra']
         dec = dataf2ngc752['dec']
         plot(ra, dec, '.')
         xlabel('ra')
         ylabel('dec')
         show()
```

```
Out[62]: [<matplotlib.lines.Line2D at 0x7f1d1d7f7f10>]
```



```
In [63]: %matplotlib inline
         ra = dataf2ngc752['ra']
         dec = dataf2ngc752['dec']
         plot(ra, dec, '.')
         xlabel('ra')
         ylabel('dec')
         show()
```

```
Out[63]: [<matplotlib.lines.Line2D at 0x7f1d1d7f7f10>]
```



```
In [64]: %matplotlib inline
         ra = dataf2ngc752['ra']
         dec = dataf2ngc752['dec']
         plot(ra, dec, '.')
         xlabel('ra')
         ylabel('dec')
         show()
```

```
Out[64]: [<matplotlib.lines.Line2D at 0x7f1d1d7f7f10>]
```



```
In [65]: %matplotlib inline
         ra = dataf2ngc752['ra']
         dec = dataf2ngc752['dec']
         plot(ra, dec, '.')
         xlabel('ra')
         ylabel('dec')
         show()
```

```
Out[65]: [<matplotlib.lines.Line2D at 0x7f1d1d7f7f10>]
```



```
In [66]: %matplotlib inline
         ra = dataf2ngc752['ra']
         dec = dataf2ngc752['dec']
         plot(ra, dec, '.')
         xlabel('ra')
         ylabel('dec')
         show()
```

```
Out[66]: [<matplotlib.lines.Line2D at 0x7f1d1d7f7f10>]
```



```
In [67]: %matplotlib inline
         ra = dataf2ngc752['ra']
         dec = dataf2ngc752['dec']
         plot(ra, dec, '.')
         xlabel('ra
```

```
In [24]: # The size of data analysis
         print("Shape of data: ",data.shape)
```

```
Shape of data:  (1000000, 40)
```

```
In [25]: data.sample(10,random_state=1)
```

	target_0	v_0	v_1	v_2	v_3	v_4	v_5	v_6	v_7	v_8	v_9
0	0.0371237774026	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1	0.0371237774026	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	0.0371237774026	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	0.0371237774026	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	0.0371237774026	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
999995	0.0371237774026	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
999996	0.0371237774026	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
999997	0.0371237774026	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
999998	0.0371237774026	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
999999	0.0371237774026	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

10 rows × 40 columns

```
In [26]: data.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 1000000 entries, 0 to 999999
Data columns (total 40 columns):
target_0    1000000 non-null float64
v_0         1000000 non-null float64
v_1         1000000 non-null float64
v_2         1000000 non-null float64
v_3         1000000 non-null float64
v_4         1000000 non-null float64
v_5         1000000 non-null float64
v_6         1000000 non-null float64
v_7         1000000 non-null float64
v_8         1000000 non-null float64
v_9         1000000 non-null float64
v_10        1000000 non-null float64
v_11        1000000 non-null float64
v_12        1000000 non-null float64
v_13        1000000 non-null float64
v_14        1000000 non-null float64
v_15        1000000 non-null float64
v_16        1000000 non-null float64
v_17        1000000 non-null float64
v_18        1000000 non-null float64
v_19        1000000 non-null float64
v_20        1000000 non-null float64
v_21        1000000 non-null float64
v_22        1000000 non-null float64
v_23        1000000 non-null float64
v_24        1000000 non-null float64
v_25        1000000 non-null float64
v_26        1000000 non-null float64
v_27        1000000 non-null float64
v_28        1000000 non-null float64
v_29        1000000 non-null float64
v_30        1000000 non-null float64
v_31        1000000 non-null float64
v_32        1000000 non-null float64
v_33        1000000 non-null float64
v_34        1000000 non-null float64
v_35        1000000 non-null float64
v_36        1000000 non-null float64
v_37        1000000 non-null float64
v_38        1000000 non-null float64
v_39        1000000 non-null float64
dtypes: float64(40)
memory usage: 305.2 MB
```

```
In [27]: data[target].value_counts()
```

```
0.0371237774026    963000
0.0                 37000
Name: target_0, dtype: int64
```

```
In [28]: data[target].value_counts/(data.shape[0])
```

```
0.0371237774026    0.963
0.0                0.037
Name: target_0, dtype: int64
```

```
In [29]: data[v_0].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_0, dtype: int64
```

```
In [30]: data[v_1].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_1, dtype: int64
```

```
In [31]: data[v_2].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_2, dtype: int64
```

```
In [32]: data[v_3].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_3, dtype: int64
```

```
In [33]: data[v_4].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_4, dtype: int64
```

```
In [34]: data[v_5].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_5, dtype: int64
```

```
In [35]: data[v_6].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_6, dtype: int64
```

```
In [36]: data[v_7].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_7, dtype: int64
```

```
In [37]: data[v_8].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_8, dtype: int64
```

```
In [38]: data[v_9].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_9, dtype: int64
```

```
In [39]: data[v_10].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_10, dtype: int64
```

```
In [40]: data[v_11].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_11, dtype: int64
```

```
In [41]: data[v_12].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_12, dtype: int64
```

```
In [42]: data[v_13].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_13, dtype: int64
```

```
In [43]: data[v_14].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_14, dtype: int64
```

```
In [44]: data[v_15].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_15, dtype: int64
```

```
In [45]: data[v_16].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_16, dtype: int64
```

```
In [46]: data[v_17].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_17, dtype: int64
```

```
In [47]: data[v_18].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_18, dtype: int64
```

```
In [48]: data[v_19].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_19, dtype: int64
```

```
In [49]: data[v_20].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_20, dtype: int64
```

```
In [50]: data[v_21].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_21, dtype: int64
```

```
In [51]: data[v_22].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_22, dtype: int64
```

```
In [52]: data[v_23].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_23, dtype: int64
```

```
In [53]: data[v_24].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_24, dtype: int64
```

```
In [54]: data[v_25].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_25, dtype: int64
```

```
In [55]: data[v_26].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_26, dtype: int64
```

```
In [56]: data[v_27].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_27, dtype: int64
```

```
In [57]: data[v_28].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_28, dtype: int64
```

```
In [58]: data[v_29].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_29, dtype: int64
```

```
In [59]: data[v_30].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_30, dtype: int64
```

```
In [60]: data[v_31].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_31, dtype: int64
```

```
In [61]: data[v_32].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_32, dtype: int64
```

```
In [62]: data[v_33].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_33, dtype: int64
```

```
In [63]: data[v_34].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_34, dtype: int64
```

```
In [64]: data[v_35].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_35, dtype: int64
```

```
In [65]: data[v_36].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_36, dtype: int64
```

```
In [66]: data[v_37].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_37, dtype: int64
```

```
In [67]: data[v_38].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_38, dtype: int64
```

```
In [68]: data[v_39].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_39, dtype: int64
```

```
In [69]: # The size of data analysis
         print("Shape of data: ",data.shape)
```

```
Shape of data:  (1000000, 40)
```

```
In [70]: data[v_0].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_0, dtype: int64
```

```
In [71]: data[v_1].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_1, dtype: int64
```

```
In [72]: data[v_2].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_2, dtype: int64
```

```
In [73]: data[v_3].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_3, dtype: int64
```

```
In [74]: data[v_4].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_4, dtype: int64
```

```
In [75]: data[v_5].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_5, dtype: int64
```

```
In [76]: data[v_6].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_6, dtype: int64
```

```
In [77]: data[v_7].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_7, dtype: int64
```

```
In [78]: data[v_8].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_8, dtype: int64
```

```
In [79]: data[v_9].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_9, dtype: int64
```

```
In [80]: data[v_10].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_10, dtype: int64
```

```
In [81]: data[v_11].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_11, dtype: int64
```

```
In [82]: data[v_12].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_12, dtype: int64
```

```
In [83]: data[v_13].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_13, dtype: int64
```

```
In [84]: data[v_14].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_14, dtype: int64
```

```
In [85]: data[v_15].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_15, dtype: int64
```

```
In [86]: data[v_16].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_16, dtype: int64
```

```
In [87]: data[v_17].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_17, dtype: int64
```

```
In [88]: data[v_18].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_18, dtype: int64
```

```
In [89]: data[v_19].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_19, dtype: int64
```

```
In [90]: data[v_20].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_20, dtype: int64
```

```
In [91]: data[v_21].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_21, dtype: int64
```

```
In [92]: data[v_22].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_22, dtype: int64
```

```
In [93]: data[v_23].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_23, dtype: int64
```

```
In [94]: data[v_24].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_24, dtype: int64
```

```
In [95]: data[v_25].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_25, dtype: int64
```

```
In [96]: data[v_26].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_26, dtype: int64
```

```
In [97]: data[v_27].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_27, dtype: int64
```

```
In [98]: data[v_28].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_28, dtype: int64
```

```
In [99]: data[v_29].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_29, dtype: int64
```

```
In [100]: data[v_30].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_30, dtype: int64
```

```
In [101]: data[v_31].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_31, dtype: int64
```

```
In [102]: data[v_32].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_32, dtype: int64
```

```
In [103]: data[v_33].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_33, dtype: int64
```

```
In [104]: data[v_34].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_34, dtype: int64
```

```
In [105]: data[v_35].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_35, dtype: int64
```

```
In [106]: data[v_36].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_36, dtype: int64
```

```
In [107]: data[v_37].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_37, dtype: int64
```

```
In [108]: data[v_38].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_38, dtype: int64
```

```
In [109]: data[v_39].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_39, dtype: int64
```

```
In [110]: # The size of data analysis
          print("Shape of data: ",data.shape)
```

```
Shape of data:  (1000000, 40)
```

```
In [111]: data[v_0].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_0, dtype: int64
```

```
In [112]: data[v_1].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_1, dtype: int64
```

```
In [113]: data[v_2].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_2, dtype: int64
```

```
In [114]: data[v_3].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_3, dtype: int64
```

```
In [115]: data[v_4].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_4, dtype: int64
```

```
In [116]: data[v_5].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_5, dtype: int64
```

```
In [117]: data[v_6].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_6, dtype: int64
```

```
In [118]: data[v_7].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_7, dtype: int64
```

```
In [119]: data[v_8].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_8, dtype: int64
```

```
In [120]: data[v_9].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_9, dtype: int64
```

```
In [121]: data[v_10].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_10, dtype: int64
```

```
In [122]: data[v_11].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_11, dtype: int64
```

```
In [123]: data[v_12].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_12, dtype: int64
```

```
In [124]: data[v_13].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_13, dtype: int64
```

```
In [125]: data[v_14].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_14, dtype: int64
```

```
In [126]: data[v_15].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_15, dtype: int64
```

```
In [127]: data[v_16].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_16, dtype: int64
```

```
In [128]: data[v_17].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_17, dtype: int64
```

```
In [129]: data[v_18].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_18, dtype: int64
```

```
In [130]: data[v_19].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_19, dtype: int64
```

```
In [131]: data[v_20].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_20, dtype: int64
```

```
In [132]: data[v_21].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_21, dtype: int64
```

```
In [133]: data[v_22].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_22, dtype: int64
```

```
In [134]: data[v_23].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_23, dtype: int64
```

```
In [135]: data[v_24].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_24, dtype: int64
```

```
In [136]: data[v_25].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_25, dtype: int64
```

```
In [137]: data[v_26].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_26, dtype: int64
```

```
In [138]: data[v_27].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_27, dtype: int64
```

```
In [139]: data[v_28].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_28, dtype: int64
```

```
In [140]: data[v_29].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_29, dtype: int64
```

```
In [141]: data[v_30].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_30, dtype: int64
```

```
In [142]: data[v_31].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_31, dtype: int64
```

```
In [143]: data[v_32].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_32, dtype: int64
```

```
In [144]: data[v_33].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_33, dtype: int64
```

```
In [145]: data[v_34].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_34, dtype: int64
```

```
In [146]: data[v_35].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_35, dtype: int64
```

```
In [147]: data[v_36].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_36, dtype: int64
```

```
In [148]: data[v_37].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_37, dtype: int64
```

```
In [149]: data[v_38].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_38, dtype: int64
```

```
In [150]: data[v_39].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_39, dtype: int64
```

```
In [151]: # The size of data analysis
          print("Shape of data: ",data.shape)
```

```
Shape of data:  (1000000, 40)
```

```
In [152]: data[v_0].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_0, dtype: int64
```

```
In [153]: data[v_1].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_1, dtype: int64
```

```
In [154]: data[v_2].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_2, dtype: int64
```

```
In [155]: data[v_3].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_3, dtype: int64
```

```
In [156]: data[v_4].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_4, dtype: int64
```

```
In [157]: data[v_5].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_5, dtype: int64
```

```
In [158]: data[v_6].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_6, dtype: int64
```

```
In [159]: data[v_7].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_7, dtype: int64
```

```
In [160]: data[v_8].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_8, dtype: int64
```

```
In [161]: data[v_9].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_9, dtype: int64
```

```
In [162]: data[v_10].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_10, dtype: int64
```

```
In [163]: data[v_11].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_11, dtype: int64
```

```
In [164]: data[v_12].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_12, dtype: int64
```

```
In [165]: data[v_13].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_13, dtype: int64
```

```
In [166]: data[v_14].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_14, dtype: int64
```

```
In [167]: data[v_15].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_15, dtype: int64
```

```
In [168]: data[v_16].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_16, dtype: int64
```

```
In [169]: data[v_17].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_17, dtype: int64
```

```
In [170]: data[v_18].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_18, dtype: int64
```

```
In [171]: data[v_19].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_19, dtype: int64
```

```
In [172]: data[v_20].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_20, dtype: int64
```

```
In [173]: data[v_21].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_21, dtype: int64
```

```
In [174]: data[v_22].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_22, dtype: int64
```

```
In [175]: data[v_23].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_23, dtype: int64
```

```
In [176]: data[v_24].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_24, dtype: int64
```

```
In [177]: data[v_25].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_25, dtype: int64
```

```
In [178]: data[v_26].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_26, dtype: int64
```

```
In [179]: data[v_27].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_27, dtype: int64
```

```
In [180]: data[v_28].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_28, dtype: int64
```

```
In [181]: data[v_29].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_29, dtype: int64
```

```
In [182]: data[v_30].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_30, dtype: int64
```

```
In [183]: data[v_31].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_31, dtype: int64
```

```
In [184]: data[v_32].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_32, dtype: int64
```

```
In [185]: data[v_33].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_33, dtype: int64
```

```
In [186]: data[v_34].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_34, dtype: int64
```

```
In [187]: data[v_35].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_35, dtype: int64
```

```
In [188]: data[v_36].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_36, dtype: int64
```

```
In [189]: data[v_37].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_37, dtype: int64
```

```
In [190]: data[v_38].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_38, dtype: int64
```

```
In [191]: data[v_39].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_39, dtype: int64
```

```
In [192]: # The size of data analysis
          print("Shape of data: ",data.shape)
```

```
Shape of data:  (1000000, 40)
```

```
In [193]: data[v_0].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_0, dtype: int64
```

```
In [194]: data[v_1].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_1, dtype: int64
```

```
In [195]: data[v_2].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_2, dtype: int64
```

```
In [196]: data[v_3].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_3, dtype: int64
```

```
In [197]: data[v_4].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_4, dtype: int64
```

```
In [198]: data[v_5].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_5, dtype: int64
```

```
In [199]: data[v_6].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_6, dtype: int64
```

```
In [200]: data[v_7].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_7, dtype: int64
```

```
In [201]: data[v_8].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_8, dtype: int64
```

```
In [202]: data[v_9].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_9, dtype: int64
```

```
In [203]: data[v_10].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_10, dtype: int64
```

```
In [204]: data[v_11].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_11, dtype: int64
```

```
In [205]: data[v_12].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_12, dtype: int64
```

```
In [206]: data[v_13].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_13, dtype: int64
```

```
In [207]: data[v_14].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_14, dtype: int64
```

```
In [208]: data[v_15].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_15, dtype: int64
```

```
In [209]: data[v_16].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_16, dtype: int64
```

```
In [210]: data[v_17].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_17, dtype: int64
```

```
In [211]: data[v_18].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_18, dtype: int64
```

```
In [212]: data[v_19].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_19, dtype: int64
```

```
In [213]: data[v_20].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_20, dtype: int64
```

```
In [214]: data[v_21].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_21, dtype: int64
```

```
In [215]: data[v_22].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_22, dtype: int64
```

```
In [216]: data[v_23].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_23, dtype: int64
```

```
In [217]: data[v_24].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_24, dtype: int64
```

```
In [218]: data[v_25].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_25, dtype: int64
```

```
In [219]: data[v_26].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_26, dtype: int64
```

```
In [220]: data[v_27].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_27, dtype: int64
```

```
In [221]: data[v_28].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_28, dtype: int64
```

```
In [222]: data[v_29].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_29, dtype: int64
```

```
In [223]: data[v_30].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_30, dtype: int64
```

```
In [224]: data[v_31].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_31, dtype: int64
```

```
In [225]: data[v_32].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_32, dtype: int64
```

```
In [226]: data[v_33].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_33, dtype: int64
```

```
In [227]: data[v_34].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_34, dtype: int64
```

```
In [228]: data[v_35].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_35, dtype: int64
```

```
In [229]: data[v_36].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_36, dtype: int64
```

```
In [230]: data[v_37].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_37, dtype: int64
```

```
In [231]: data[v_38].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_38, dtype: int64
```

```
In [232]: data[v_39].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_39, dtype: int64
```

```
In [233]: # The size of data analysis
          print("Shape of data: ",data.shape)
```

```
Shape of data:  (1000000, 40)
```

```
In [234]: data[v_0].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_0, dtype: int64
```

```
In [235]: data[v_1].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_1, dtype: int64
```

```
In [236]: data[v_2].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_2, dtype: int64
```

```
In [237]: data[v_3].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_3, dtype: int64
```

```
In [238]: data[v_4].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_4, dtype: int64
```

```
In [239]: data[v_5].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_5, dtype: int64
```

```
In [240]: data[v_6].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_6, dtype: int64
```

```
In [241]: data[v_7].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_7, dtype: int64
```

```
In [242]: data[v_8].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_8, dtype: int64
```

```
In [243]: data[v_9].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_9, dtype: int64
```

```
In [244]: data[v_10].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_10, dtype: int64
```

```
In [245]: data[v_11].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_11, dtype: int64
```

```
In [246]: data[v_12].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_12, dtype: int64
```

```
In [247]: data[v_13].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_13, dtype: int64
```

```
In [248]: data[v_14].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_14, dtype: int64
```

```
In [249]: data[v_15].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_15, dtype: int64
```

```
In [250]: data[v_16].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_16, dtype: int64
```

```
In [251]: data[v_17].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_17, dtype: int64
```

```
In [252]: data[v_18].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_18, dtype: int64
```

```
In [253]: data[v_19].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_19, dtype: int64
```

```
In [254]: data[v_20].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_20, dtype: int64
```

```
In [255]: data[v_21].value_counts/(data.shape[0])
```

```
0.0    0.963
0.0    0.037
Name: v_21, dtype:
```

THIRD DATASET : NGC 7789

Photometric data of NGC 7789

```
!wget -q -O ngc7789.zip "https://data.mendeley.com/datasets/jrc4ttrzxb/1"
!unzip -q -o ngc7789.zip
```

```
!ls -lh ngc7789.*
```

```
-rw-r--r-- 1 root root 1.1M Oct 13 2020 ngc7789.dat
-rw-r--r-- 1 root root 1.1M Oct 13 2020 ngc7789.txt
-rw-r--r-- 1 root root 1.1M Oct 13 2020 ngc7789.xls
```

```
!head -n 20 ngc7789.dat
```

```
Column Name Column Type Formatted
-------------------- ------------ ---------
ra double double
dec double double
g_mag double double
g_mag_err double double
r_mag double double
r_mag_err double double
i_mag double double
i_mag_err double double
u_mag double double
u_mag_err double double
z_mag double double
z_mag_err double double
g_mag_dereddened_flux double double
g_mag_dereddened_flux_err double double
g_mag_dereddened_mag double double
g_mag_dereddened_mag_err double double
r_mag_dereddened_flux double double
r_mag_dereddened_flux_err double double
r_mag_dereddened_mag double double
r_mag_dereddened_mag_err double double
i_mag_dereddened_flux double double
i_mag_dereddened_flux_err double double
i_mag_dereddened_mag double double
i_mag_dereddened_mag_err double double
```

```
!awk -F'|' '{print $1,$2,$3,$4,$5,$6,$7,$8,$9,$10,$11,$12,$13,$14,$15,$16,$17,$18,$19,$20,$21,$22,$23,$24,$25,$26,$27,$28,$29,$30,$31,$32,$33,$34,$35,$36,$37,$38,$39,$40,$41,$42,$43,$44,$45,$46,$47,$48,$49,$50,$51,$52,$53,$54,$55,$56,$57,$58,$59,$60,$61,$62,$63,$64,$65,$66,$67,$68,$69,$70,$71,$72,$73,$74,$75,$76,$77,$78,$79,$80,$81,$82,$83,$84,$85,$86,$87,$88,$89,$90,$91,$92,$93,$94,$95,$96,$97,$98,$99,$100,$101,$102,$103,$104,$105,$106,$107,$108,$109,$110,$111,$112,$113,$114,$115,$116,$117,$118,$119,$120,$121,$122,$123,$124,$125,$126,$127,$128,$129,$130,$131,$132,$133,$134,$135,$136,$137,$138,$139,$140,$141,$142,$143,$144,$145,$146,$147,$148,$149,$150,$151,$152,$153,$154,$155,$156,$157,$158,$159,$160,$161,$162,$163,$164,$165,$166,$167,$168,$169,$170,$171,$172,$173,$174,$175,$176,$177,$178,$179,$180,$181,$182,$183,$184,$185,$186,$187,$188,$189,$190,$191,$192,$193,$194,$195,$196,$197,$198,$199,$200,$201,$202,$203,$204,$205,$206,$207,$208,$209,$210,$211,$212,$213,$214,$215,$216,$217,$218,$219,$220,$221,$222,$223,$224,$225,$226,$227,$228,$229,$230,$231,$232,$233,$234,$235,$236,$237,$238,$239,$240,$241,$242,$243,$244,$245,$246,$247,$248,$249,$250,$251,$252,$253,$254,$255,$256,$257,$258,$259,$260,$261,$262,$263,$264,$265,$266,$267,$268,$269,$270,$271,$272,$273,$274,$275,$276,$277,$278,$279,$280,$281,$282,$283,$284,$285,$286,$287,$288,$289,$290,$291,$292,$293,$294,$295,$296,$297,$298,$299,$300,$301,$302,$303,$304,$305,$306,$307,$308,$309,$310,$311,$312,$313,$314,$315,$316,$317,$318,$319,$320,$321,$322,$323,$324,$325,$326,$327,$328,$329,$330,$331,$332,$333,$334,$335,$336,$337,$338,$339,$340,$341,$342,$343,$344,$345,$346,$347,$348,$349,$350,$351,$352,$353,$354,$355,$356,$357,$358,$359,$360,$361,$362,$363,$364,$365,$366,$367,$368,$369,$370,$371,$372,$373,$374,$375,$376,$377,$378,$379,$380,$381,$382,$383,$384,$385,$386,$387,$388,$389,$390,$391,$392,$393,$394,$395,$396,$397,$398,$399,$400,$401,$402,$403,$404,$405,$406,$407,$408,$409,$410,$411,$412,$413,$414,$415,$416,$417,$418,$419,$420,$421,$422,$423,$424,$425,$426,$427,$428,$429,$430,$431,$432,$433,$434,$435,$436,$437,$438,$439,$440,$441,$442,$443,$444,$445,$446,$447,$448,$449,$450,$451,$452,$453,$454,$455,$456,$457,$458,$459,$460,$461,$462,$463,$464,$465,$466,$467,$468,$469,$470,$471,$472,$473,$474,$475,$476,$477,$478,$479,$480,$481,$482,$483,$484,$485,$486,$487,$488,$489,$490,$491,$492,$493,$494,$495,$496,$497,$498,$499,$500,$501,$502,$503,$504,$505,$506,$507,$508,$509,$510,$511,$512,$513,$514,$515,$516,$517,$518,$519,$520,$521,$522,$523,$524,$525,$526,$527,$528,$529,$530,$531,$532,$533,$534,$535,$536,$537,$538,$539,$540,$541,$542,$543,$544,$545,$546,$547,$548,$549,$550,$551,$552,$553,$554,$555,$556,$557,$558,$559,$560,$561,$562,$563,$564,$565,$566,$567,$568,$569,$570,$571,$572,$573,$574,$575,$576,$577,$578,$579,$580,$581,$582,$583,$584,$585,$586,$587,$588,$589,$590,$591,$592,$593,$594,$595,$596,$597,$598,$599,$600,$601,$602,$603,$604,$605,$606,$607,$608,$609,$610,$611,$612,$613,$614,$615,$616,$617,$618,$619,$620,$621,$622,$623,$624,$625,$626,$627,$628,$629,$630,$631,$632,$633,$634,$635,$636,$637,$638,$639,$640,$641,$642,$643,$644,$645,$646,$647,$648,$649,$650,$651,$652,$653,$654,$655,$656,$657,$658,$659,$660,$661,$662,$663,$664,$665,$666,$667,$668,$669,$670,$671,$672,$673,$674,$675,$676,$677,$678,$679,$680,$681,$682,$683,$684,$685,$686,$687,$688,$689,$690,$691,$692,$693,$694,$695,$696,$697,$698,$699,$700,$701,$702,$703,$704,$705,$706,$707,$708,$709,$710,$711,$712,$713,$714,$715,$716,$717,$718,$719,$720,$721,$722,$723,$724,$725,$726,$727,$728,$729,$730,$731,$732,$733,$734,$735,$736,$737,$738,$739,$740,$741,$742,$743,$744,$745,$746,$747,$748,$749,$750,$751,$752,$753,$754,$755,$756,$757,$758,$759,$760,$761,$762,$763,$764,$765,$766,$767,$768,$769,$770,$771,$772,$773,$774,$775,$776,$777,$778,$779,$780,$781,$782,$783,$784,$785,$786,$787,$788,$789,$790,$791,$792,$793,$794,$795,$796,$797,$798,$799,$800,$801,$802,$803,$804,$805,$806,$807,$808,$809,$810,$811,$812,$813,$814,$815,$816,$817,$818,$819,$820,$821,$822,$823,$824,$825,$826,$827,$828,$829,$830,$831,$832,$833,$834,$835,$836,$837,$838,$839,$840,$841,$842,$843,$844,$845,$846,$847,$848,$849,$850,$851,$852,$853,$854,$855,$856,$857,$858,$859,$860,$861,$862,$863,$864,$865,$866,$867,$868,$869,$870,$871,$872,$873,$874,$875,$876,$877,$878,$879,$880,$881,$882,$883,$884,$885,$886,$887,$888,$889,$890,$891,$892,$893,$894,$895,$896,$897,$898,$899,$900,$901,$902,$903,$904,$905,$906,$907,$908,$909,$910,$911,$912,$913,$914,$915,$916,$917,$918,$919,$920,$921,$922,$923,$924,$925,$926,$927,$928,$929,$930,$931,$932,$933,$934,$935,$936,$937,$938,$939,$940,$941,$942,$943,$944,$945,$946,$947,$948,$949,$950,$951,$952,$953,$954,$955,$956,$957,$958,$959,$960,$961,$962,$963,$964,$965,$966,$967,$968,$969,$970,$971,$972,$973,$974,$975,$976,$977,$978,$979,$980,$981,$982,$983,$984,$985,$986,$987,$988,$989,$990,$991,$992,$993,$994,$995,$996,$997,$998,$999,$1000,$1001,$1002,$1003,$1004,$1005,$1006,$1007,$1008,$1009,$1010,$1011,$1012,$1013,$1014,$1015,$1016,$1017,$1018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