Exploratory analysis

March 18, 2021

```
[102]: %reload_ext autoreload
       %autoreload 2
       default_figsize=(14,12)
[103]: import datasets
       import numpy as np
       import pandas as pd
       import seaborn as sn
       import matplotlib.pyplot as plt
       import matplotlib
       matplotlib.rcParams['figure.figsize'] = (14, 12)
       dataset_name = "mohr_smith"
       dataset_module = datasets.datasets_by_name_all[dataset_name]
       x,y,metadata = dataset_module.load(dropna=True,verbose=True)
       y = datasets.map_y_em(y,dataset_name)
       \# generate dataframe with both x and y
       xy = pd.concat([x,y],axis=1)
       xy.describe()
      Warning loading data from Mohr-Smith_2017.csv:
      Dropped 38 rows with missing values.
      Rows (original):
                          5915
      Rows (after drop): 5877
[103]:
                                   gmag
                                                                          Hamag
                     umag
                                                rmag
                                                              imag
       count
              5877.000000
                           5877.000000
                                         5877.000000
                                                      5877.000000
                                                                    5877.000000
       mean
                17.216993
                             16.980114
                                           15.609820
                                                        14.803716
                                                                      15.268086
       std
                 2.328989
                              1.966562
                                            1.659154
                                                         1.527776
                                                                       1.620235
                             13.004000
                                           11.957000
                                                        11.081000
                                                                      11.620000
       min
                12.143000
       25%
                15.378000
                             15.410000
                                           14.243000
                                                        13.561000
                                                                      13.940000
       50%
                17.371000
                             17.121000
                                           15.716000
                                                        14.847000
                                                                      15.362000
       75%
                19.272000
                             18.684000
                                           16.989000
                                                        16.049000
                                                                      16.606000
                21.260000
       max
                             19.998000
                                           18.669000
                                                        17.864000
                                                                      18.737000
                                               Kmag
                    Jmag
                                  Hmag
       count 5877.00000 5877.000000 5877.000000 5877.000000
```

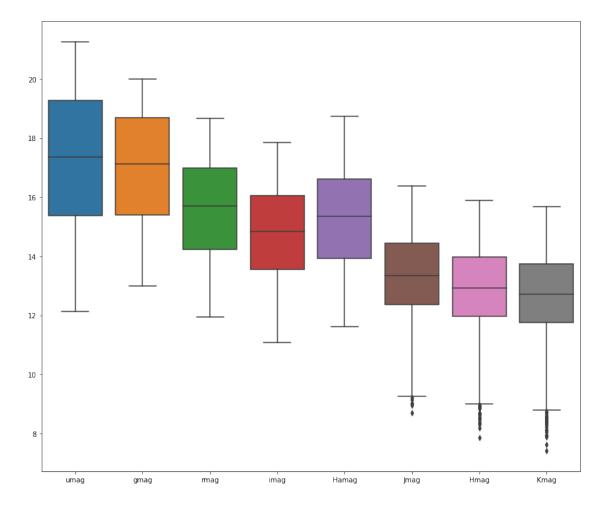
mean	13.37808	12.937877	12.713908	0.055470
std	1.39622	1.373603	1.387794	0.228916
min	8.69300	7.870000	7.414000	0.000000
25%	12.35800	11.977000	11.765000	0.000000
50%	13.34900	12.930000	12.710000	0.000000
75%	14.44600	13.976000	13.742000	0.000000
max	16.38600	15.896000	15.691000	1.000000

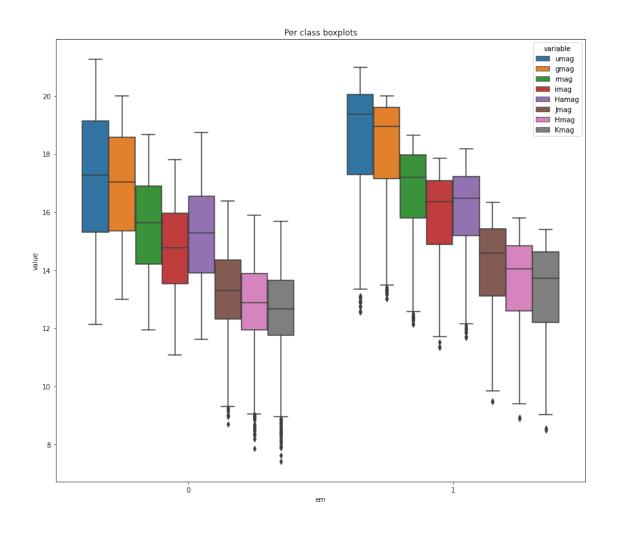
1 Variable visualization

```
[104]: sn.boxplot(data=x)

plt.figure()
xy_long = pd.melt(xy, id_vars='em')
sn.boxplot(x='em', y='value', hue='variable', data=xy_long)
plt.title("Per class boxplots")
```

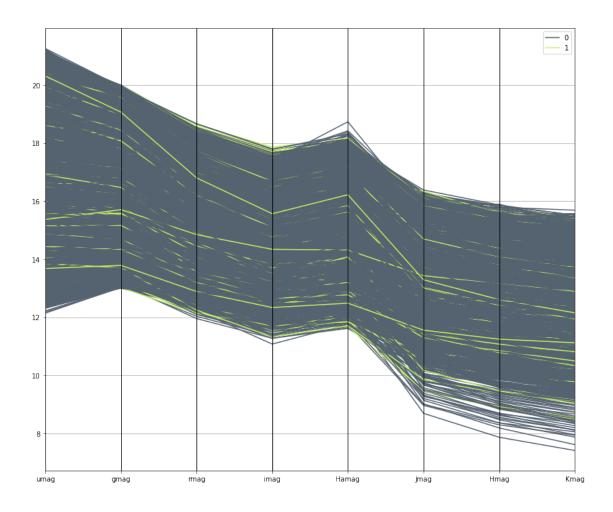
[104]: Text(0.5, 1.0, 'Per class boxplots')

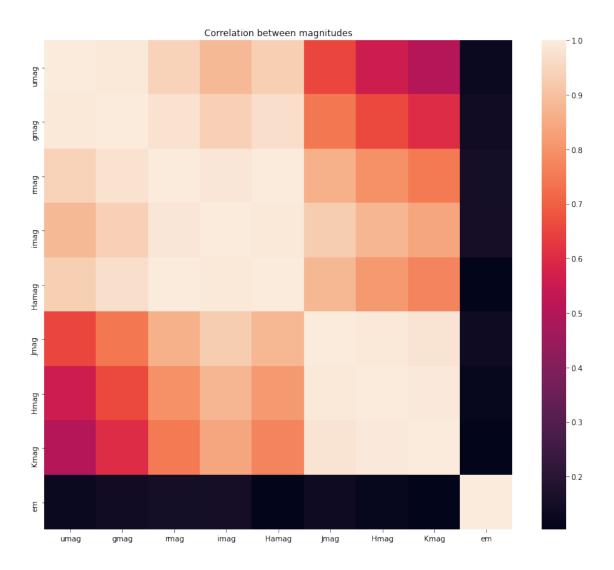




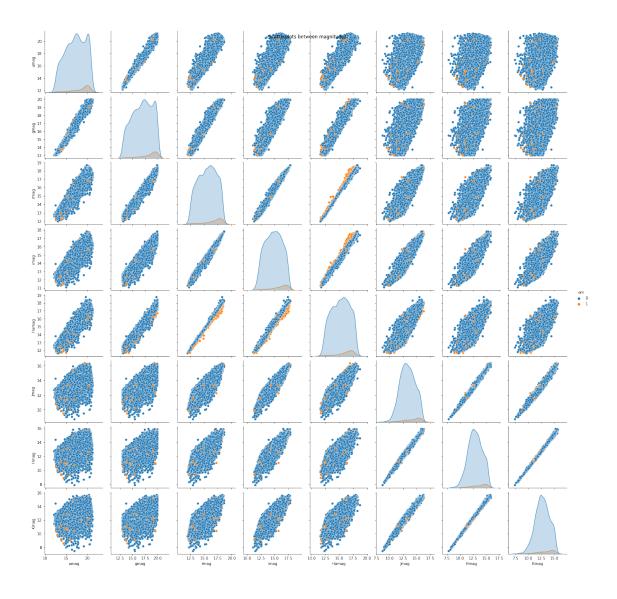
```
[105]: pd.plotting.parallel_coordinates(xy,"em",color=('#556270','#C7F464'))
```

[105]: <AxesSubplot:>





[106]: Text(0.5, 0.98, 'Scatterplots between magnitudes')



2 Outlier detection via confidence interval

```
[107]: from scipy import stats
    m = len(x.columns) # number of columns = number of hypothesis
    confidence= 0.98
    adjusted_confidence = 1- (1-confidence)/m # bonferroni-adjusted confidence
    max_zscore = stats.norm.ppf(adjusted_confidence)
    print(f"Confidence (desired): {confidence}")
    print(f"Confidence (adjusted): {adjusted_confidence}")
    print(f"Z-score (adjusted): {max_zscore}")

indices = (np.abs(stats.zscore(x-x.mean())) > max_zscore).any(axis=1)
    outliers_x = x[indices]
```

```
if dataset_name != "all_em":
     outliers_metadata = metadata[indices]
     outliers_x = outliers_x.
 →merge(outliers_metadata,left_index=True,right_index=True)
outliers x
Confidence (desired): 0.98
Confidence (adjusted): 0.9975
Z-score
           (adjusted): 2.807033768343811
                                                  Jmag
                                                         Hmag
                                                                 Kmag
                                                                           AO \
        umag
                         rmag
                                  imag
                                         Hamag
                 gmag
33
      17.230
               15.975
                       13.523
                               12.100
                                        13.031
                                                 9.670
                                                        8.930
                                                               8.536
                                                                        7.852
40
                       13.405
                               11.925
                                        12.928
                                                 9.317
                                                                        7.995
      17.566
              15.969
                                                        8.560
                                                                8.115
46
      17.929
                               11.917
                                        12.970
                                                 9.144
                                                        8.367
                                                                7.875
                                                                        8.524
               16.214
                       13.487
57
      17.728
               16.367
                       13.978
                               12.543
                                                10.023
                                                        9.224
                                                                8.802
                                        13.478
                                                                        7.826
                                                 9.383
                                                                8.270
98
      16.304
              15.184
                       12.878
                               11.698
                                        12.404
                                                        8.702
                                                                        7.143
131
      16.936
              15.480
                       12.953
                               11.486
                                        12.341
                                                 8.693
                                                        7.870
                                                               7.414
                                                                        8.350
152
                       15.374
                                        14.826
                                                10.056
                                                        9.057
                                                                8.424
      20.597
               18.508
                               13.514
                                                                       10.406
185
      16.588
              15.619
                       13.410
                               12.131
                                        12.934
                                                 9.722
                                                        9.025
                                                               8.567
                                                                        7.475
241
                       13.570
                               12.095
                                        13.049
                                                 9.327
                                                        8.474
                                                               7.953
                                                                        8.544
      17.558
              16.161
301
      14.975
              14.257
                       12.236
                               11.081
                                        11.762
                                                 8.968
                                                        8.297
                                                                7.940
                                                                        6.844
306
      14.794
               14.270
                      12.475
                               11.404
                                        12.034
                                                 9.516
                                                        8.969
                                                               8.667
                                                                        6.190
437
                       14.245
                                                 9.479
                                                        8.656
                                                                8.113
      19.141
               17.146
                               12.551
                                        13.746
                                                                        9.147
455
      15.700
               14.928
                       12.883
                               11.681
                                        12.432
                                                 9.315
                                                        8.620
                                                                8.200
                                                                        7.261
469
      17.844
               16.488
                       14.034
                               12.574
                                        13.513
                                                 9.870
                                                        9.100
                                                                8.600
                                                                        8.195
549
                      12.575
                                                 9.273
                                                               8.371
      14.600
               14.320
                               11.566
                                        12.225
                                                        8.673
                                                                        6.772
558
      14.593
              14.293
                       12.563
                               11.542
                                        12.169
                                                 9.450
                                                        8.950
                                                               8.520
                                                                        6.496
1120
                       12.437
                                                 9.488
                                                                8.498
      14.979
               14.243
                               11.366
                                        11.680
                                                        8.925
                                                                        6.007
                                                        8.365
1713
              14.395
                       12.444
                               11.318
                                        11.885
                                                 9.005
                                                                8.059
      15.168
                                                                        6.855
1783
      14.353
               13.961
                       12.394
                               11.538
                                        11.903
                                                 9.465
                                                        8.881
                                                                8.555
                                                                        5.901
```

[107]:

1937

2245

2361

5563

5605

5722

17.744

16.736

15.297

14.949

15.297

20.484

4753 16.710

5170 16.262

5359 16.351

16.371

16.161

14.605

15.442

15.748

15.423

14.260

14.487

18.317

13.813

13.962

12.680

13.140

13.700

13.115

12.473

12.594

15.149

12.309

12.592

11.556

11.778

12.411

11.700

11.405

11.352

13.372

13.302

13.489

12.232

12.642

13.154

12.603

12.035

12.067

14.604

9.674

9.756

9.689

9.577

9.975

9.018

9.485

9.205

9.970

8.837

8.880

9.120

8.856

9.167

8.190

8.892

8.511

9.007

8.406

8.334

8.725

8.469

8.738

7.617

8.531

8.126

8.402

8.375

8.616

6.294

7.189

7.747

8.415

6.086

6.790

10.121

	DEJ2000	Rv	r2mag	RAJ2000	VPHAS-OB1	mu	chi2	logTeff
33	-57.331160	3.525	13.512	152.448798	85	10.64	1.60	4.507
40	-57.545887	3.538	13.394	152.325021	109	8.41	1.57	4.324
46	-57.463467	3.528	13.506	152.598693	130	8.49	2.09	4.366
57	-56.957887	3.698	13.955	153.389629	157	9.24	3.14	4.343
98	-57.016295	3.638	12.880	153.926987	261	8.89	3.60	4.352
131	-57.407289	3.794	12.942	153.668178	331	7.76	1.83	4.341

```
152
    -57.090546 3.769
                        15.327
                                154.220685
                                                  376
                                                        9.29 4.29
                                                                      4.417
                                                                      4.423
185
    -57.348754
                3.836
                        13.438
                                154.072129
                                                  444
                                                        9.80
                                                             1.52
241
    -57.546570
                3.787
                        13.571
                                154.177204
                                                  559
                                                        8.89 0.54
                                                                      4.404
                        12.251
301
    -57.917252 3.769
                                154.224633
                                                  708
                                                        9.91 0.28
                                                                      4.488
306
   -58.156718 3.722
                        12.432
                                153.990057
                                                  724
                                                       10.92
                                                             1.75
                                                                      4.509
437
    -57.159384 3.589
                        14.247
                                156.036587
                                                 1006
                                                        8.19
                                                              4.96
                                                                      4.315
   -58.052421 4.026
                        12.882
                                                 1041
                                                        9.43 0.84
                                                                      4.424
455
                                155.131682
469
    -57.769781
                3.791
                        14.009
                                155.582926
                                                 1069
                                                        9.21
                                                             3.05
                                                                      4.366
                                                              4.69
549
    -57.758620 4.400
                        12.582
                                156.004990
                                                 1216
                                                       10.69
                                                                      4.530
558 -57.759795 4.159
                        12.569
                                156.009539
                                                       11.33 2.25
                                                                      4.562
                                                 1226
                        12.286
                                                        8.94 6.16
1120 -58.818031
                3.785
                                158.143987
                                                 2881
                                                                      4.316
1713 -59.199053 4.013
                        12.356
                                160.281809
                                                 4755
                                                        8.68 6.44
                                                                      4.363
1783 -59.454645
                4.484
                        12.401
                                160.248764
                                                 4980
                                                        8.76 6.84
                                                                      4.300
1937 -58.782316 3.647
                        13.814
                                161.481177
                                                 5468
                                                       10.03 2.12
                                                                      4.470
2245 -59.783881
                4.526
                        13.954
                                161.403107
                                                 6480
                                                       11.66 3.46
                                                                      4.624
2361 -59.220889
                3.607
                        12.676
                                162.343201
                                                 6880
                                                       10.38 5.33
                                                                      4.449
                                                12768
4753 -60.884853 3.479
                        13.127
                                167.855369
                                                        9.22 4.68
                                                                      4.365
5170 -61.242734 4.254
                        13.696
                                168.747828
                                                       12.28 3.22
                                                                      4.632
                                                13501
5359 -61.330502 4.098
                        13.109
                                168.918911
                                                13765
                                                       10.10 3.48
                                                                      4.548
5563 -61.559307
                3.835
                        12.517
                                169.582737
                                                14153
                                                        9.12 1.34
                                                                      4.338
                                                                      4.360
5605 -61.469052 3.954
                        12.545
                                169.767548
                                                14229
                                                        8.81 7.18
                        15.143
                                170.078909
5722 -61.949044
                3.680
                                                             1.96
                                                                      4.369
                                                14506
                                                        8.86
```

3 Outlier detection via IQR

```
[108]:
               umag
                       gmag
                               rmag
                                        imag
                                               Hamag
                                                         Jmag
                                                               Hmag
                                                                       Kmag
                                                                                 AO \
                             13.523
                                                       9.670 8.930
       33
             17.230
                     15.975
                                      12.100
                                              13.031
                                                                      8.536
                                                                              7.852
       40
             17.566
                     15.969
                             13.405
                                      11.925
                                              12.928
                                                       9.317
                                                              8.560
                                                                      8.115
                                                                              7.995
             17.929
                     16.214
                             13.487
                                      11.917
                                              12.970
                                                       9.144 8.367
                                                                      7.875
                                                                              8.524
       46
       98
             16.304
                     15.184
                             12.878
                                      11.698
                                              12.404
                                                       9.383
                                                              8.702
                                                                     8.270
                                                                              7.143
       131
             16.936
                     15.480
                             12.953
                                      11.486
                                              12.341
                                                       8.693
                                                              7.870
                                                                      7.414
                                                                              8.350
       152
                             15.374
                                              14.826
                                                      10.056 9.057
                                                                      8.424
             20.597
                     18.508
                                     13.514
                                                                             10.406
```

185	16.588 1	5.619	13.410	12.131 1	2.934 9.	722 9.025	8.567	7.475
241			13.570			327 8.474	7.953	8.544
301			12.236			968 8.297	7.940	6.844
306			12.475			516 8.969	8.667	
								6.190
437			14.245			479 8.656	8.113	9.147
455			12.883			315 8.620	8.200	7.261
469			14.034			870 9.100	8.600	8.195
549			12.575			273 8.673	8.371	6.772
558			12.563			450 8.950	8.520	6.496
1120			12.437			488 8.925	8.498	6.007
1713			12.444			005 8.365	8.059	6.855
1783			12.394			465 8.881	8.555	5.901
1937	17.744 1	6.371	13.813	12.309 1	3.302 9.	674 8.837	8.406	8.375
2245	16.736 1	6.161	13.962	12.592 1	3.489 9.	756 8.880	8.334	8.616
2361	15.297 1	4.605	12.680	11.556 1	2.232 9.	689 9.120	8.725	6.294
4753	16.710 1	5.442	13.140	11.778 1	2.642 9.	577 8.856	8.469	7.189
5170	16.262 1	5.748	13.700	12.411 1	3.154 9.	975 9.167	8.738	7.747
5359	16.351 1	5.423	13.115	11.700 1	2.603 9.	018 8.190	7.617	8.415
5563	14.949 1	4.260	12.473	11.405 1	2.035 9.	485 8.892	8.531	6.086
5605	15.297 1	4.487	12.594	11.352 1	2.067 9.	205 8.511	8.126	6.790
5722	20.484 1	8.317	15.149	13.372	4.604 9.	970 9.007	8.402	10.121
	DEJ2000	Rv	r2mag	RAJ2	000 VPHAS	-OB1 mu	chi2	logTeff
33	-57.331160	3.525	_		798	85 10.64		4.507
40	-57.545887					109 8.41		4.324
46	-57.463467	3.528				130 8.49	2.09	4.366
98	-57.016295	3.638				261 8.89	3.60	4.352
131	-57.407289	3.794				331 7.76	1.83	4.341
152	-57.090546	3.769				376 9.29	4.29	4.417
185	-57.348754					444 9.80	1.52	4.423
241	-57.546570					559 8.89	0.54	4.404
301	-57.917252					708 9.91	0.28	4.488
306	-58.156718	3.722				724 10.92	1.75	4.509
437	-57.159384					1006 8.19		4.315
455	-58.052421					1041 9.43		4.424
469	-57.769781					1041 9.43 1069 9.21		4.366
	-31.103101	3.131			320	1009 9.21	3.05	
549		4 400	10 500	156 004	000	1016 10 60	4 60	
EEO	-57.758620					1216 10.69		4.530
558	-57.758620 -57.759795	4.159	12.569	156.009	539	1226 11.33	2.25	4.562
1120	-57.758620 -57.759795 -58.818031	4.159 3.785	12.569 12.286	156.009 158.143	539 987	1226 11.33 2881 8.94	2.25 6.16	4.562 4.316
1120 1713	-57.758620 -57.759795 -58.818031 -59.199053	4.159 3.785 4.013	12.569 12.286 12.356	156.009 5 158.143 6 160.281	539 987 809	1226 11.33 2881 8.94 4755 8.68	2.25 6.16 6.44	4.562 4.316 4.363
1120 1713 1783	-57.758620 -57.759795 -58.818031 -59.199053 -59.454645	4.159 3.785 4.013 4.484	12.569 12.286 12.356 12.401	156.009 5 158.143 6 160.281 160.248	539 987 809 764	1226 11.33 2881 8.94 4755 8.68 4980 8.76	2.25 6.16 6.44 6.84	4.562 4.316 4.363 4.300
1120 1713 1783 1937	-57.758620 -57.759795 -58.818031 -59.199053 -59.454645 -58.782316	4.159 3.785 4.013 4.484 3.647	12.569 12.286 12.356 12.401 13.814	156.009 5 158.143 6 160.281 160.248 1 161.481	539 987 809 764 177	1226 11.33 2881 8.94 4755 8.68 4980 8.76 5468 10.03	2.25 6.16 6.44 6.84 2.12	4.562 4.316 4.363 4.300 4.470
1120 1713 1783 1937 2245	-57.758620 -57.759795 -58.818031 -59.199053 -59.454645 -58.782316 -59.783881	4.159 3.785 4.013 4.484 3.647 4.526	12.569 12.286 12.356 12.401 13.814 13.954	156.009 158.143 160.281 160.248 161.481 161.403	539 987 809 764 177	1226 11.33 2881 8.94 4755 8.68 4980 8.76 5468 10.03 6480 11.66	2.25 6.16 6.44 6.84 2.12 3.46	4.562 4.316 4.363 4.300 4.470 4.624
1120 1713 1783 1937 2245 2361	-57.758620 -57.759795 -58.818031 -59.199053 -59.454645 -58.782316 -59.783881 -59.220889	4.159 3.785 4.013 4.484 3.647 4.526 3.607	12.569 12.286 12.356 12.401 13.814 13.954	156.009 5 158.143 6 160.281 160.248 161.481 161.403 162.343	539 987 809 764 177 107 201	1226 11.33 2881 8.94 4755 8.68 4980 8.76 5468 10.03 6480 11.66 6880 10.38	2.25 6.16 6.44 6.84 2.12 3.46 5.33	4.562 4.316 4.363 4.300 4.470 4.624 4.449
1120 1713 1783 1937 2245 2361 4753	-57.758620 -57.759795 -58.818031 -59.199053 -59.454645 -58.782316 -59.783881 -59.220889 -60.884853	4.159 3.785 4.013 4.484 3.647 4.526 3.607 3.479	12.569 12.286 12.356 12.401 13.814 13.954 12.676	156.009 158.143 160.248 160.248 161.481 161.403 162.343 167.855	539 987 809 764 177 107 201 369	1226 11.33 2881 8.94 4755 8.68 4980 8.76 5468 10.03 6480 11.66 6880 10.38 2768 9.22	2.25 6.16 6.44 6.84 2.12 3.46 5.33 4.68	4.562 4.316 4.363 4.300 4.470 4.624 4.449 4.365
1120 1713 1783 1937 2245 2361 4753 5170	-57.758620 -57.759795 -58.818031 -59.199053 -59.454645 -58.782316 -59.783881 -59.220889 -60.884853 -61.242734	4.159 3.785 4.013 4.484 3.647 4.526 3.607 3.479 4.254	12.569 12.286 12.356 12.401 13.814 13.954 12.676 13.127	156.009 158.143 160.281 160.248 161.481 161.403 162.343 167.855 168.747	539 987 809 764 177 107 201 369 1 828	1226 11.33 2881 8.94 4755 8.68 4980 8.76 5468 10.03 6480 11.66 6880 10.38 2768 9.22 3501 12.28	2.25 6.16 6.44 6.84 2.12 3.46 5.33 4.68 3.22	4.562 4.316 4.363 4.300 4.470 4.624 4.449 4.365 4.632
1120 1713 1783 1937 2245 2361 4753 5170	-57.758620 -57.759795 -58.818031 -59.199053 -59.454645 -58.782316 -59.783881 -59.220889 -60.884853	4.159 3.785 4.013 4.484 3.647 4.526 3.607 3.479 4.254	12.569 12.286 12.356 12.401 13.814 13.954 12.676 13.127	156.009 158.143 160.281 160.248 161.481 161.403 162.343 167.855 168.747	539 987 809 764 177 107 201 369 1 828	1226 11.33 2881 8.94 4755 8.68 4980 8.76 5468 10.03 6480 11.66 6880 10.38 2768 9.22	2.25 6.16 6.44 6.84 2.12 3.46 5.33 4.68 3.22	4.562 4.316 4.363 4.300 4.470 4.624 4.449 4.365

```
5563 -61.559307
                 3.835
                         12.517
                                  169.582737
                                                   14153
                                                           9.12
                                                                1.34
                                                                          4.338
                                                                7.18
                                                                          4.360
5605 -61.469052
                 3.954
                         12.545
                                  169.767548
                                                   14229
                                                           8.81
5722 -61.949044
                 3.680
                         15.143
                                  170.078909
                                                   14506
                                                           8.86
                                                                1.96
                                                                          4.369
```

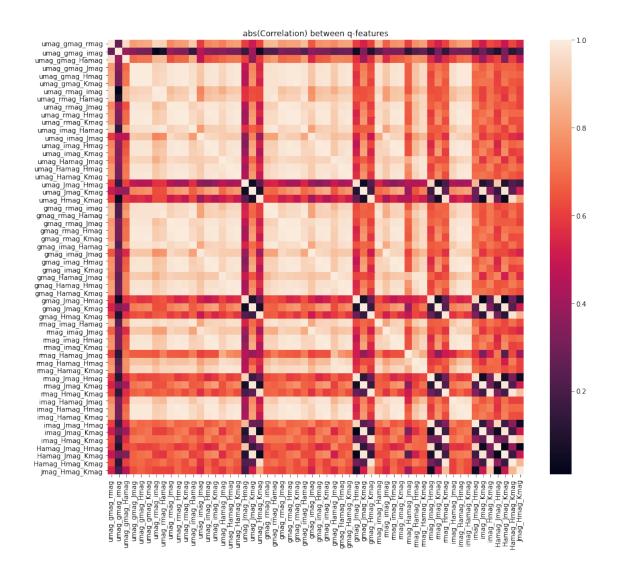
4 Analysis of q-features (q_3) (all magnitudes)

```
[109]: x_np=x.to_numpy()
       import qfeatures
       coefficients = dataset module.coefficients
       systems = dataset module.systems
       coefficients np = np.array([coefficients[k] for k in x.columns])
       systems = [systems[k] for k in x.columns]
       q=qfeatures.calculate(x_np,coefficients_np,x.columns,systems,combination_size=3)
       m = q.magnitudes
       q_df = pd.DataFrame(m, columns = q.column_names)
       q_df.describe()
[109]:
                                                                  umag_gmag_Jmag
              umag_gmag_rmag
                               umag_gmag_imag
                                                umag_gmag_Hamag
                                   5877.000000
                  5877,000000
                                                     5877,000000
                                                                     5877.000000
       count
                    -0.409710
                                     -1.150416
                                                       -0.635135
                                                                        -5.216200
       mean
       std
                     0.258130
                                      0.130671
                                                        0.224254
                                                                         1.549386
       min
                    -1.183961
                                     -2.091596
                                                       -1.406519
                                                                       -10.758042
                                     -1.227567
       25%
                    -0.599502
                                                       -0.791967
                                                                        -6.291792
       50%
                    -0.426035
                                     -1.124708
                                                       -0.651668
                                                                        -5.218694
       75%
                    -0.227082
                                     -1.053386
                                                                        -4.125556
                                                       -0.482411
       max
                     0.672143
                                     -0.832544
                                                        0.275799
                                                                        -0.477486
                                                                 umag_rmag_Hamag
              umag_gmag_Hmag
                               umag_gmag_Kmag
                                                umag_rmag_imag
                 5877.000000
                                  5877.000000
                                                   5877.000000
                                                                     5877.000000
       count
                                   -14.959737
                                                       0.626648
                    -9.341466
                                                                         1.275020
       mean
                     3.078338
                                                                         0.885778
       std
                                      5.187979
                                                       0.614700
       min
                   -20.305761
                                                                        -1.448589
                                    -33.831131
                                                      -1.319994
       25%
                   -11.489065
                                    -18.563993
                                                       0.177035
                                                                         0.620065
       50%
                    -9.338935
                                    -14.950752
                                                       0.605485
                                                                         1.244047
       75%
                    -7.134609
                                    -11.265647
                                                       1.063117
                                                                         1.900215
       max
                     0.201065
                                      1.158850
                                                       3.173503
                                                                         4.805280
                                                                      imag_Hamag_Hmag
              umag_rmag_Jmag
                               umag_rmag_Hmag
                                                    imag_Hamag_Jmag
                                                        5877.000000
                                                                          5877.000000
       count
                  5877.000000
                                  5877.000000
                    -4.840076
       mean
                                    -10.474658
                                                           0.664383
                                                                             1.713869
       std
                     1.527176
                                      3.667144
                                                           0.260581
                                                                             0.676747
                                    -25.465348
       min
                   -11.826778
                                                          -0.156500
                                                                            -0.411696
       25%
                    -5.907778
                                   -13.052304
                                                           0.482347
                                                                             1.232391
       50%
                    -4.782889
                                    -10.416435
                                                           0.657583
                                                                             1.705935
       75%
                    -3.768000
                                     -7.872522
                                                                             2.190152
                                                           0.844611
```

max	-0.261444	0.832565	. 1.75368	1 4.289304
count mean std min 25% 50% 75%	imag_Hamag_Kmag 5877.000000 3.124834 1.254977 -0.772131 2.239379 3.103575 4.002680	imag_Jmag_Hmag 5877.000000 0.478241 0.269327 -0.953239 0.305826 0.482783 0.661935	imag_Jmag_Kmag 5877.000000 -0.723156 0.442834 -2.635706 -0.988647 -0.677353 -0.413118	imag_Hmag_Kmag \ 5877.000000 0.950934 0.476000 -2.127608 0.630033 0.932301 1.275706
max	7.736477	1.935283	0.788412	2.847046
count mean std min 25% 50% 75% max	Hamag_Jmag_Hmag 5877.000000 0.531117 0.376616 -1.730391 0.302348 0.538217 0.786391 2.403304	Hamag_Jmag_Kmag 5877.000000 -1.192100 0.683245 -4.544699 -1.585222 -1.109229 -0.722118 0.906758	Hamag_Hmag_Kmag 5877.000000 1.100577 0.618342 -2.820353 0.691098 1.080824 1.519471 3.560882	Jmag_Hmag_Kmag 5877.000000 0.249903 0.141120 -0.617078 0.154026 0.240222 0.338431 1.061144

[8 rows x 56 columns]

```
[110]: sn.heatmap(q_df.corr().abs())
   plt.title("abs(Correlation) between q-features")
   plt.show()
```



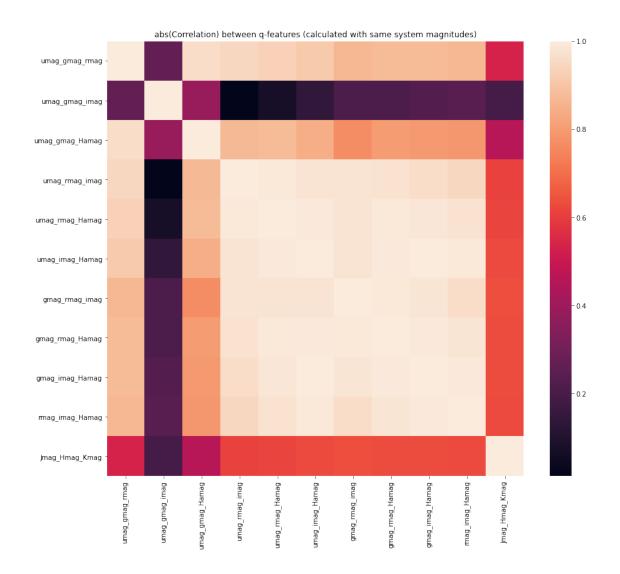
5 Analysis of q-features (q_3) (calculated by system)

q_df.describe() [111]: umag_gmag_rmag umag_gmag_imag umag_gmag_Hamag umag_rmag_imag 5877.000000 count 5877.000000 5877.000000 5877.000000 -0.409710 -1.150416 -0.635135 0.626648 mean std 0.258130 0.130671 0.224254 0.614700 min -1.183961 -2.091596 -1.406519 -1.31999425% -0.599502 -1.227567 -0.791967 0.177035 50% -0.426035 -1.124708 -0.651668 0.605485 75% -0.227082 -1.053386 -0.482411 1.063117 0.672143 -0.832544 0.275799 max3.173503 umag_rmag_Hamag umag_imag_Hamag gmag_rmag_imag gmag_rmag_Hamag 5877.000000 5877.000000 5877.000000 5877.000000 count 1.275020 2.994825 0.903602 1.212202 mean 0.323645 0.453192 std 0.885778 1.486126 min -1.448589-1.556037-0.101579-0.16278525% 0.620065 1.906206 0.676158 0.892037 50% 1.244047 2.951140 0.904684 1.206126 75% 1.900215 4.049458 1.132737 1.533299 4.805280 8.726065 2.139211 2.915874 max gmag_imag_Hamag rmag_imag_Hamag Jmag_Hmag_Kmag 5877.000000 5877.000000 5877.000000 count 2.521421 0.936302 0.249903 mean std 0.917666 0.339618 0.141120 min -0.251388 -0.071486 -0.61707825% 1.853561 0.689159 0.154026 50% 2.506949 0.927701 0.240222 75% 3.170589 1.175449 0.338431 max5.968804 2.227850 1.061144 [115]: sn.heatmap(q_df.corr().abs())

[115]: Text(0.5, 1.0, 'abs(Correlation) between q-features (calculated with same system magnitudes)')

→magnitudes)")

plt.title("abs(Correlation) between q-features (calculated with same system_



```
[114]: q_dfy=pd.concat([q_df,y],axis=1)
sn.pairplot(q_dfy,hue="em")
_=plt.suptitle("Scatter plots between q-features (calculated with same system
→magnitudes)")
```

[114]: Text(0.5, 0.98, 'Scatter plots between q-features (calculated with same system magnitudes)')

