task-2

May 19, 2024

#Task-2 '''Load a CSV file into a Pandas DataFrame. Perform operations like filtering data based on conditions, handling missing values, and calculating summary statistics."'

```
[3]:
    import pandas as pd
     data = pd.read_csv("01.Data Cleaning and Preprocessing.csv")
[4]:
     type(data)
[4]: pandas.core.frame.DataFrame
[5]:
     data.info
[5]: <bound method DataFrame.info of
                                            Observation
                                                          Y-Kappa
                                                                    ChipRate
                                                                               BF-CMratio
     BlowFlow ChipLevel4
     0
             31-00:00
                          23.10
                                    16.520
                                                          1177.607
                                                121.717
                                                                         169.805
     1
             31-01:00
                          27.60
                                    16.810
                                                 79.022
                                                          1328.360
                                                                         341.327
     2
                                                                         239.161
             31-02:00
                          23.19
                                    16.709
                                                 79.562
                                                          1329.407
     3
                          23.60
             31-03:00
                                    16.478
                                                 81.011
                                                          1334.877
                                                                         213.527
     4
             31-04:00
                          22.90
                                    15.618
                                                 93.244
                                                          1334.168
                                                                         243.131
     319
             10-16:00
                          23.75
                                    12.667
                                                 93.450
                                                         1178.252
                                                                         276.955
     320
                          19.80
              9-19:00
                                    12.558
                                                 94.352
                                                          1184.119
                                                                         297.071
     321
                          23.01
              9-20:00
                                    12.550
                                                 90.842
                                                          1188.517
                                                                         289.826
     322
                          24.32
              9-21:00
                                    13.083
                                                 88.910
                                                          1192.879
                                                                         318.006
     323
              9-22:00
                          25.75
                                    13.417
                                                 85.451
                                                          1186.342
                                                                         248.312
                           T-lowerExt-2
           T-upperExt-2
                                            UCZAA
                                                    WhiteFlow-4
                                                                       SteamFlow-4
     0
                 358.282
                                   329.545
                                            1.443
                                                          599.253
                                                                             67.122
                 351.050
     1
                                   329.067
                                            1.549
                                                          537.201
                                                                             60.012
     2
                 350.022
                                   329.260
                                            1.600
                                                          549.611
                                                                             61.304
     3
                                                          623.362
                                                                             68.496
                 350.938
                                   331.142
                                            1.604
     4
                 351.640
                                   332.709
                                              NaN
                                                          638.672
                                                                             70.022
     . .
     319
                 347.286
                                   310.970
                                            1.523
                                                         513.956
                                                                             61.141
     320
                                            1.451
                                                                             67.667
                 399.135
                                   319.576
                                                          570.058
     321
                 373.633
                                   314.591
                                            1.457
                                                          549.306
                                                                             66.446
     322
                 364.081
                                   308.559
                                            1.523
                                                          504.852
                                                                             61.054
```

| 323 | 356.289 | 310.482 | 1.474 | 497.375 | 58.247 | |
|-----|---------------|----------------|------------|---------------------|-------------|---|
| | Lower-HeatT-3 | Upper-HeatT-3 | ChipMass-4 | WeakLiguorF | BlackFlow-2 | \ |
| 0 | 329.432 | 303.099 | _ | _ | 1319.039 | · |
| 1 | 330.823 | 304.879 | 163.202 | 665.975 | 1297.317 | |
| 2 | 329.140 | 303.383 | | | | |
| 3 | 328.875 | 302.254 | | | 1324.461 | |
| 4 | 328.352 | 300.954 | 183.929 | 888.448 | 1343.424 | |
| | ••• | ••• | ••• | ••• | ••• | |
| 319 | 330.117 | 304.006 | 148.174 | 1027.201 | 1357.271 | |
| 320 | 330.848 | 304.616 | 165.178 | 906.962 | 1311.177 | |
| 321 | 330.226 | 304.686 | 160.841 | 887.125 | 1319.226 | |
| 322 | 327.346 | 304.363 | 147.589 | 804.423 | 1320.225 | |
| 323 | 328.092 | 304.093 | 144.218 | 828.328 | 1320.848 | |
| | | | | G 7 1 1 1 1 1 1 1 1 | | |
| _ | | eamHeatF-3 T-T | | | | |
| 0 | 257.325 | 54.612 | 252.077 | NaN | | |
| 1 | 241.182 | 46.603 | 251.406 | 29.11 | | |
| 2 | 237.272 | 51.795 | 251.335 | NaN | | |
| 3 | 239.478 | 54.846 | 250.312 | 29.02 | | |
| 4 | 215.372 | 54.186 | 249.916 | 29.01 | | |
| | ••• | ••• | ••• | ••• | | |
| 319 | 381.643 | 45.264 | 252.947 | 30.86 | | |
| 320 | 25.494 | 50.528 | 252.092 | 30.70 | | |
| 321 | 0.638 | 45.549 | 252.438 | NaN | | |
| 322 | 0.000 | 43.725 | 253.176 | 31.13 | | |
| 323 | 1.276 | 43.840 | 253.216 | NaN | | |
| | | | | | | |

[324 rows x 23 columns]>

[6]: data.describe()

| 5 6 7 | | | | | | | | \ | |
|--------------|-------|-------------|------------------|-----------|----------|--------|---------|-------------|---|
| [6]: | | Y-Kappa | ${\tt ChipRate}$ | BF-CMrati | o Blo | owFlow | ChipLev | el4 \ | |
| | count | 324.000000 | 319.000000 | 307.00000 | 0 308. | 000000 | 323.00 | 0000 | |
| | mean | 20.635370 | 14.347937 | 87.46445 | 6 1237. | 837614 | 258.16 | 4483 | |
| | std | 3.070036 | 1.499095 | 7.99501 | 2 100. | 593735 | 87.98 | 7452 | |
| | min | 12.170000 | 9.983000 | 68.64500 | 0.0 | 000000 | 0.00 | 0000 | |
| | 25% | 18.382500 | 13.358000 | 81.82300 | 0 1193. | 215250 | 213.52 | 7000 | |
| | 50% | 20.845000 | 14.308000 | 86.73900 | 0 1273. | 138500 | 271.79 | 2000 | |
| | 75% | 23.032500 | 15.517000 | 92.37200 | 0 1289. | 196000 | 321.68 | 0000 | |
| | max | 27.600000 | 16.958000 | 121.71700 | 0 1351. | 240000 | 419.01 | 4000 | |
| | | | | | | | | | |
| | | T-upperExt- | 2 T-lowerE | xt-2 | UCZAA | White | Flow-4 | AAWhiteSt-4 | \ |
| | count | 322.0000 | 00 322. | 000000 29 | 9.000000 | 323 | .000000 | 173.000000 | |
| | mean | 356.9042 | 95 324. | 020180 | 1.492010 | 591 | .732260 | 6.140410 | |
| | std | 9.2092 | 90 7. | 621402 | 0.105923 | 67 | .016351 | 0.081609 | |
| | min | 339.1680 | 00 284. | 633000 | 1.182000 | 405 | .111000 | 5.890000 | |
| | | | | | | | | | |

```
25%
                350.241250
                                 321.420000
                                                1.431500
                                                             540.989500
                                                                              6.089000
     50%
                356.843000
                                 325.669000
                                                1.498000
                                                             592.895000
                                                                              6.135000
     75%
                362.242250
                                 329.175000
                                                1.560500
                                                             639.480500
                                                                              6.199000
                399.135000
                                 337.012000
                                                1.747000
                                                             731.394000
                                                                              6.340000
     max
                SteamFlow-4
                               Lower-HeatT-3
                                                                ChipMass-4
                                               Upper-HeatT-3
                  323.000000
                                  322.000000
                                                   322.000000
                                                                  323.000000
     count
                   66.668285
                                  325.567820
                                                   300.525699
                                                                  162.222322
     mean
                    5.708587
                                    4.609862
                                                      4.568484
                                                                   14.160688
     std
     min
                   48.568000
                                  318.051000
                                                    293.312000
                                                                  113.922000
     25%
                   62.518000
                                  321.385500
                                                    296.513250
                                                                  153.032500
     50%
                   67.429000
                                  324.741000
                                                   299.126000
                                                                  163.690000
     75%
                   71.522000
                                  329.845250
                                                    304.244750
                                                                  172.555000
            •••
                   76.147000
                                  333.854000
                                                   311.146000
                                                                  189.268000
     max
            WeakLiquorF
                            BlackFlow-2
                                           WeakWashF
                                                        SteamHeatF-3
                                                                        T-Top-Chips-4
               323.000000
                              322.000000
                                           323.000000
                                                           322.000000
                                                                            323.000000
     count
     mean
               873.828941
                             1175.917016
                                           263.543068
                                                            49.696907
                                                                            251.240087
     std
               122.073521
                              149.334010
                                           163.666942
                                                             4.551909
                                                                              1.283432
                              838.948000
     min
               486.938000
                                             0.000000
                                                            35.510000
                                                                            248.359000
     25%
               792.019500
                             1044.817500
                                           134.649000
                                                            46.389750
                                                                            250.312000
     50%
               865.254000
                             1150.221500
                                           269.193000
                                                            50.277000
                                                                            251.380000
     75%
                             1319.021250
                                                                            252.323500
               965.286500
                                           405.563000
                                                            53.294250
     max
              1226.277000
                             1395.767000
                                           715.715000
                                                            63.332000
                                                                            254.122000
            SulphidityL-4
                 173.000000
     count
                  30.411671
     mean
     std
                   0.701317
     min
                  29.010000
     25%
                  29.970000
     50%
                  30.370000
     75%
                  30.820000
     max
                  32.840000
     [8 rows x 22 columns]
[7]: data = data.drop_duplicates()
     data
                       Y-Kappa
                                 ChipRate
                                            BF-CMratio
                                                         BlowFlow
                                                                    ChipLevel4
         Observation
                         23.10
     0
             31-00:00
                                   16.520
                                               121.717
                                                         1177.607
                                                                        169.805
                         27.60
     1
             31-01:00
                                   16.810
                                                79.022
                                                         1328.360
                                                                        341.327
     2
             31-02:00
                         23.19
                                   16.709
                                                79.562
                                                         1329.407
                                                                        239.161
     3
            31-03:00
                         23.60
                                   16.478
                                                81.011
                                                         1334.877
                                                                        213.527
     4
                         22.90
                                                93.244
            31-04:00
                                   15.618
                                                         1334.168
                                                                        243.131
```

[7]:

| 298 | 12-09:00 | 20.90 15. | 167 | 84 | .640 | 1283.706 | | 339.440 | |
|---------|---------------|-------------|-----|---------|-------|----------|-------|-------------|----|
| 299 | 12-10:00 | | NaN | | .034 | 1278.345 | | 368.564 | |
| 300 | 12-11:00 | | NaN | | .013 | 1307.722 | | 278.842 | |
| 301 | 12-12:00 | | NaN | | .490 | 1255.986 | | 273.484 | |
| 307 | 31-05:00 | | 308 | | .172 | 1327.832 | | 251.120 | |
| 501 | 51 05.00 | 20.03 | 500 | 34 | .112 | 1027.002 | | 201.120 | |
| | T-upperExt-2 | T-lowerExt- | 2 | UCZAA | White | eFlow-4 | St | teamFlow-4 | \ |
| 0 | 358.282 | 329. | 545 | 1.443 | | 599.253 | | 67.122 | |
| 1 | 351.050 | 329. | 067 | 1.549 | | 537.201 | ••• | 60.012 | |
| 2 | 350.022 | 329. | 260 | 1.600 | | 549.611 | | 61.304 | |
| 3 | 350.938 | 331. | 142 | 1.604 | | 623.362 | | 68.496 | |
| 4 | 351.640 | 332. | 709 | NaN | | 638.672 | ••• | 70.022 | |
| | | | ••• | | ••• | ••• | • | . | |
| 298 | 354.803 | 311. | 041 | 1.635 | | 532.419 | ••• | 65.561 | |
| 299 | 357.723 | 321. | 387 | NaN | | 520.365 | ••• | 65.729 | |
| 300 | 357.438 | 323. | 757 | NaN | | 553.070 | ••• | 65.795 | |
| 301 | 361.365 | 322. | 689 | NaN | | 590.199 | ••• | 71.456 | |
| 307 | 351.263 | 332. | 485 | 1.522 | | 631.514 | ••• | 71.286 | |
| | | | _ | | | | _ | | |
| _ | Lower-HeatT-3 | | | ChipMa | | WeakLiq | | BlackFlow-2 | |
| 0 | 329.432 | | | | 5.964 | | 7.197 | 1319.03 | |
| 1 | 330.823 | | | | 3.202 | | 5.975 | 1297.31 | |
| 2 | 329.140 | | | | 4.013 | | 7.534 | 1327.07 | |
| 3 | 328.875 | | | | 1.487 | | 7.853 | 1324.46 | |
| 4 | 328.352 | | 954 | 18 | 3.929 | 88 | 8.448 | 1343.42 | 24 |
| 298 | 332.924 | 307. | 626 | 14 | 5.299 | 83 | 2.906 | 1344.70 | 18 |
| 299 | 332.523 | | | | 1.544 | | 5.639 | 1344.46 | |
| 300 | 331.263 | | | | 7.954 | | 8.691 | 1344.58 | |
| 301 | 333.032 | | | | 4.069 | | 6.206 | 1348.74 | |
| 307 | 328.699 | | | | 0.229 | | 3.605 | 1323.08 | |
| | | | | | | | | | |
| | WeakWashF S | teamHeatF-3 | T-T | op-Chip | s-4 | Sulphidi | tyL-4 | | |
| 0 | 257.325 | 54.612 | | | .077 | | Nal | | |
| 1 | 241.182 | 46.603 | | 251 | .406 | | 29.13 | 1 | |
| 2 | 237.272 | 51.795 | | 251 | .335 | | Nal | Ī. | |
| 3 | 239.478 | 54.846 | | 250 | .312 | | 29.02 | 2 | |
| 4 | 215.372 | 54.186 | | 249 | .916 | | 29.03 | 1 | |
| 208 | 399 011 | 49.524 | | 251 | .833 | ••• | 30 00 | 2 | |
| 298 | 388.911 | | | | | | 30.29 | | |
| 299 | 418.979 | 48.135 | | | .614 | | 30.47 | | |
| 300 | 462.712 | 54.373 | | | .197 | | Nal | | |
| 301 | 457.313 | 53.194 | | | .324 | | 30.46 | | |
| 307 | 232.729 | 54.503 | | 250 | .084 | | Nal | V | |

[8]: data.isnull()

| [8]: | | Observation | Y-Kappa | ChipRate | BF-CMr | atio | BlowFlow | w Chi | pLevel4 | \ | |
|------|---------|---------------|-----------|------------|----------|--------------|-----------|--------------|--|--------------|---|
| | 0 | False | False | False | F | alse | False | Э | False | | |
| | 1 | False | False | False | F | alse | False | Э | False | | |
| | 2 | False | False | False | F | alse | False | Э | False | | |
| | 3 | False | False | False | F | alse | False | Э | False | | |
| | 4 | False | False | False | F | alse | False | Э | False | | |
| | | ••• | ••• | ••• | ••• | ••• | | ••• | | | |
| | 298 | False | False | False | F | alse | False | Э | False | | |
| | 299 | False | False | True | F | alse | False | Э | False | | |
| | 300 | False | False | True | F | alse | False | Э | False | | |
| | 301 | False | False | True | F | alse | False | Э | False | | |
| | 307 | False | False | False | F | alse | False | Э | False | | |
| | | | | | | | | | | | |
| | | T-upperExt-2 | | rExt-2 | | White | Flow-4 | | eamFlow-4 | | |
| | 0 | False | | | False | | False | | False | | |
| | 1 | False | | | False | | False | | False | 9 | |
| | 2 | False | | | False | | False | | False | | |
| | 3 | False | | False | | | False | | False | | |
| | 4 | False | Э | False | True | | False | ••• | False | 9 | |
| | • • | ••• | | | | ••• | ••• | | | | |
| | 298 | False | | False | | | False | | False | | |
| | 299 | False | | False | True | | False | | False | | |
| | 300 | False | | False | True | | False | ••• | False | | |
| | 301 | False | | False | True | | False | ••• | False | | |
| | 307 | False | Э | False | False | | False | ••• | False | 9 | |
| | | | | | 01 · M | 4 | | | D1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 | 0 | , |
| | ^ | Lower-HeatT-3 | | False | - | s-4 alse | _ | orr False | BlackFlow | | \ |
| | 0 | False | | False | | | | False | | alse alse | |
| | 1 2 | False | | False | | alse alse | | False | | alse | |
| | 3 | False | | False | | alse | | False | | alse | |
| | 4 | False | | False | | alse | | False | | alse | |
| | | | 3 | | | aise | | raise | | irse | |
| | 298 | False | 3 | … False | E | alse | ••• | False | Fe | alse | |
| | 299 | False | | False | | alse | | False | | alse | |
| | 300 | False | | False | | alse | | False | | alse | |
| | 301 | False | | False | | alse | | False | | alse | |
| | 307 | False | | False | | alse | | False | | alse | |
| | 001 | I dib | 5 | 1 4100 | • | albo | • | albo | 10 | 1100 | |
| | | WeakWashF S | SteamHeat | F-3 T-T | op-Chips | -4 | Sulphidit | tyL-4 | | | |
| | 0 | False | | alse | | lse | - | True | | | |
| | 1 | False | F | alse | Fa | lse | | False | | | |
| | 2 | False | F | alse | Fa | lse | | True | | | |
| | 3 | False | F | alse | Fa | lse | | False | | | |
| | 4 | False | F | alse | Fa | lse | | False | | | |

```
298
          False
                          False
                                            False
                                                             False
299
          False
                          False
                                            False
                                                             False
                          False
                                                              True
300
          False
                                            False
301
          False
                          False
                                            False
                                                             False
307
          False
                          False
                                            False
                                                              True
```

[9]: data.isnull().sum()

```
[9]: Observation
                           0
     Y-Kappa
                           0
                           4
     ChipRate
     BF-CMratio
                          14
     BlowFlow
                          13
     ChipLevel4
                           1
     T-upperExt-2
                           1
     T-lowerExt-2
                           1
     UCZAA
                          24
     WhiteFlow-4
                           1
     AAWhiteSt-4
                         141
     AA-Wood-4
                           1
     ChipMoisture-4
                           1
     SteamFlow-4
                           1
     Lower-HeatT-3
                           1
     Upper-HeatT-3
                           1
     ChipMass-4
                           1
     WeakLiquorF
                           1
     BlackFlow-2
                           1
     WeakWashF
                           1
     SteamHeatF-3
                           1
     T-Top-Chips-4
                           1
     SulphidityL-4
                         141
     dtype: int64
```

[10]: data.isnull().sum()

[10]: Observation 0 0 Y-Kappa ChipRate 4 BF-CMratio 14 BlowFlow 13 ChipLevel4 1 T-upperExt-2 1 T-lowerExt-2 1 UCZAA 24

```
AAWhiteSt-4
                          141
      AA-Wood-4
                            1
      ChipMoisture-4
                            1
      SteamFlow-4
                            1
      Lower-HeatT-3
                            1
      Upper-HeatT-3
                            1
                            1
      ChipMass-4
      WeakLiquorF
                            1
      BlackFlow-2
                            1
      WeakWashF
                            1
      SteamHeatF-3
                            1
      T-Top-Chips-4
                            1
      SulphidityL-4
                          141
      dtype: int64
[11]: data.isnull().sum().sum()
[11]: 352
[12]: data2 = data.fillna(value=0)
      data2
[12]:
          Observation Y-Kappa ChipRate BF-CMratio
                                                        BlowFlow
                                                                   ChipLevel4
      0
             31-00:00
                          23.10
                                    16.520
                                               121.717
                                                        1177.607
                                                                       169.805
                          27.60
      1
             31-01:00
                                    16.810
                                                79.022
                                                        1328.360
                                                                       341.327
      2
                          23.19
                                    16.709
             31-02:00
                                                79.562
                                                        1329.407
                                                                       239.161
      3
             31-03:00
                          23.60
                                   16.478
                                                81.011
                                                        1334.877
                                                                       213.527
      4
                          22.90
             31-04:00
                                   15.618
                                                93.244
                                                        1334.168
                                                                       243.131
      298
             12-09:00
                          20.90
                                   15.167
                                                84.640
                                                        1283.706
                                                                       339.440
      299
             12-10:00
                          24.98
                                    0.000
                                                85.034
                                                        1278.345
                                                                       368.564
      300
                          21.00
                                    0.000
                                                88.013
                                                                       278.842
             12-11:00
                                                        1307.722
      301
                          21.40
                                    0.000
             12-12:00
                                                85.490
                                                        1255.986
                                                                       273.484
      307
             31-05:00
                          20.89
                                    14.308
                                                94.172
                                                        1327.832
                                                                       251.120
           T-upperExt-2
                           T-lowerExt-2
                                            UCZAA
                                                   WhiteFlow-4
                                                                     SteamFlow-4
      0
                 358.282
                                  329.545
                                            1.443
                                                         599.253
                                                                            67.122
      1
                 351.050
                                  329.067
                                            1.549
                                                         537.201 ...
                                                                            60.012
      2
                                                         549.611
                 350.022
                                  329.260
                                            1.600
                                                                            61.304
      3
                 350.938
                                  331.142
                                            1.604
                                                         623.362
                                                                            68.496
      4
                 351.640
                                  332.709
                                            0.000
                                                         638.672
                                                                            70.022
      . .
      298
                 354.803
                                  311.041 1.635
                                                         532.419
                                                                            65.561
      299
                 357.723
                                  321.387
                                           0.000
                                                         520.365
                                                                            65.729
      300
                 357.438
                                  323.757
                                            0.000
                                                        553.070
                                                                            65.795
      301
                 361.365
                                  322.689
                                           0.000
                                                         590.199
                                                                            71.456
```

WhiteFlow-4

1

| 307 | 351.2 | 63 332.4 | 185 1.522 | 631.514 | 71.286 | |
|-----|-------------|-----------------|---------------|---------------|-------------|---|
| | Lower-HeatT | -3 Upper-HeatT- | -3 ChipMass-4 | WeakLiquorF | BlackFlow-2 | \ |
| 0 | 329.4 | 32 303.0 | 175.964 | 1127.197 | 1319.039 | |
| 1 | 330.8 | 23 304.8 | 163.202 | 665.975 | 1297.317 | |
| 2 | 329.1 | 40 303.3 | 383 164.013 | 677.534 | 1327.072 | |
| 3 | 328.8 | 75 302.2 | 254 181.487 | 767.853 | 1324.461 | |
| 4 | 328.3 | 52 300.9 | 954 183.929 | 888.448 | 1343.424 | |
| | ••• | ••• | ••• | ••• | ••• | |
| 298 | 332.9 | 24 307.6 | 326 145.299 | 832.906 | 1344.708 | |
| 299 | 332.5 | 23 307.1 | 169 151.544 | 905.639 | 1344.469 | |
| 300 | 331.2 | 63 306.4 | 157.954 | 908.691 | 1344.588 | |
| 301 | 333.0 | 32 308.7 | 732 174.069 | 986.206 | 1348.747 | |
| 307 | 328.6 | 99 300.7 | 706 180.229 | 903.605 | 1323.082 | |
| | | | | | | |
| | WeakWashF | SteamHeatF-3 | T-Top-Chips-4 | SulphidityL-4 | | |
| 0 | 257.325 | 54.612 | 252.077 | 0.00 | | |
| 1 | 241.182 | 46.603 | 251.406 | 29.11 | | |
| 2 | 237.272 | 51.795 | 251.335 | 0.00 | | |
| 3 | 239.478 | 54.846 | 250.312 | 29.02 | | |
| 4 | 215.372 | 54.186 | 249.916 | 29.01 | | |
| • • | ••• | ••• | ••• | ••• | | |
| 298 | 388.911 | 49.524 | 251.833 | 30.29 | | |
| 299 | 418.979 | 48.135 | 251.614 | 30.47 | | |
| 300 | 462.712 | 54.373 | 251.197 | 0.00 | | |
| 301 | 457.313 | 53.194 | 251.324 | 30.46 | | |
| 307 | 232.729 | 54.503 | 250.084 | 0.00 | | |
| | | | | | | |

[13]: data2.isnull().sum().sum()

[13]: 0

[14]: data

| [14]: | Observation | Y-Kappa | ChipRate | BF-CMratio | BlowFlow | ChipLevel4 | \ |
|-------|-------------|---------|----------|------------|----------|------------|---|
| 0 | 31-00:00 | 23.10 | 16.520 | 121.717 | 1177.607 | 169.805 | |
| 1 | 31-01:00 | 27.60 | 16.810 | 79.022 | 1328.360 | 341.327 | |
| 2 | 31-02:00 | 23.19 | 16.709 | 79.562 | 1329.407 | 239.161 | |
| 3 | 31-03:00 | 23.60 | 16.478 | 81.011 | 1334.877 | 213.527 | |
| 4 | 31-04:00 | 22.90 | 15.618 | 93.244 | 1334.168 | 243.131 | |
| | ••• | ••• | ••• | | ••• | | |
| 298 | 3 12-09:00 | 20.90 | 15.167 | 84.640 | 1283.706 | 339.440 | |
| 299 | 9 12-10:00 | 24.98 | NaN | 85.034 | 1278.345 | 368.564 | |
| 300 | 12-11:00 | 21.00 | NaN | 88.013 | 1307.722 | 278.842 | |
| 301 | 12-12:00 | 21.40 | NaN | 85.490 | 1255.986 | 273.484 | |

| 307 | 31-05:00 | 20.89 14.308 | 94.172 | 1327.832 | 251.120 | |
|-----|---------------|---------------|-------------|-------------------|-------------|---|
| | T-upperExt-2 | T-lowerExt-2 | UCZAA White | eFlow-4 St | eamFlow-4 \ | |
| 0 | 358.282 | 329.545 | 1.443 | 599.253 | 67.122 | |
| 1 | 351.050 | 329.067 | 1.549 | 537.201 | 60.012 | |
| 2 | 350.022 | 329.260 | 1.600 | 549.611 | 61.304 | |
| 3 | 350.938 | 331.142 | 1.604 | 623.362 | 68.496 | |
| 4 | 351.640 | 332.709 | NaN | 638.672 | 70.022 | |
| | | | | | | |
| 298 | 354.803 | 311.041 | 1.635 | 532.419 | 65.561 | |
| 299 | 357.723 | 321.387 | NaN | 520.365 | 65.729 | |
| 300 | 357.438 | 323.757 | NaN | 553.070 | 65.795 | |
| 301 | 361.365 | 322.689 | NaN | 590.199 | 71.456 | |
| 307 | 351.263 | 332.485 | 1.522 | 631.514 | 71.286 | |
| 301 | 301.203 | 332.403 | 1.022 | 001.014 | 71.200 | |
| | Lower-HeatT-3 | Upper-HeatT-3 | ChipMass-4 | WeakLiquorF | BlackFlow-2 | \ |
| 0 | 329.432 | 303.099 | 175.964 | 1127.197 | 1319.039 | |
| 1 | 330.823 | 304.879 | 163.202 | 665.975 | 1297.317 | |
| 2 | 329.140 | 303.383 | 164.013 | 677.534 | 1327.072 | |
| 3 | 328.875 | 302.254 | 181.487 | 767.853 | 1324.461 | |
| 4 | 328.352 | 300.954 | 183.929 | 888.448 | 1343.424 | |
| | ••• | ••• | ••• | ••• | ••• | |
| 298 | 332.924 | 307.626 | 145.299 | 832.906 | 1344.708 | |
| 299 | 332.523 | 307.169 | 151.544 | 905.639 | 1344.469 | |
| 300 | 331.263 | 306.400 | 157.954 | 908.691 | 1344.588 | |
| 301 | 333.032 | 308.732 | 174.069 | 986.206 | 1348.747 | |
| 307 | 328.699 | 300.706 | 180.229 | 903.605 | 1323.082 | |
| | | | | G 7 1 1 1 1 1 7 4 | | |
| 0 | | | Cop-Chips-4 | SulphidityL-4 | | |
| 0 | 257.325 | 54.612 | 252.077 | NaN | | |
| 1 | 241.182 | 46.603 | 251.406 | 29.11 | | |
| 2 | 237.272 | 51.795 | 251.335 | NaN | | |
| 3 | 239.478 | 54.846 | 250.312 | 29.02 | | |
| 4 | 215.372 | 54.186 | 249.916 | 29.01 | | |
| | ••• | | | | | |
| 298 | 388.911 | 49.524 | 251.833 | 30.29 | | |
| 299 | 418.979 | 48.135 | 251.614 | 30.47 | | |
| 300 | 462.712 | 54.373 | 251.197 | NaN | | |
| 301 | 457.313 | 53.194 | 251.324 | 30.46 | | |
| 307 | 232.729 | 54.503 | 250.084 | NaN | | |
| | | | | | | |

[15]: data3 = data.fillna(method='pad')
data3

| [15]: | | Observation | Y-Kappa | ChipRate | BF-CMratio | BlowFlow Chi | pLevel4 \ | |
|-------|--|--|---|---|--|--|--|---|
| [10]. | 0 | 31-00:00 | 23.10 | 16.520 | 121.717 | 1177.607 | 169.805 | |
| | 1 | 31-01:00 | 27.60 | 16.810 | 79.022 | 1328.360 | 341.327 | |
| | 2 | 31-02:00 | 23.19 | 16.709 | 79.562 | 1329.407 | 239.161 | |
| | 3 | 31-03:00 | 23.60 | 16.478 | 81.011 | | 213.527 | |
| | 4 | 31-04:00 | 22.90 | 15.618 | 93.244 | | 243.131 | |
| | | | | 10.010 | | | 240.101 | |
| | 298 | 12-09:00 | 20.90 | 15.167 | 84.640 | 1283.706 | 339.440 | |
| | 299 | 12-10:00 | 24.98 | 15.167 | 85.034 | 1278.345 | 368.564 | |
| | 300 | 12-11:00 | 24.90 | 15.167 | 88.013 | 1307.722 | 278.842 | |
| | 301 | 12-11:00 | 21.40 | 15.167 | 85.490 | 1255.986 | 273.484 | |
| | | 31-05:00 | 20.89 | 14.308 | | | | |
| | 307 | 31-05:00 | 20.09 | 14.300 | 94.172 | 1321.032 | 251.120 | |
| | | T-upperExt-2 | T-low | erExt-2 | UCZAA Whit | eFlow-4 S | teamFlow-4 \ | |
| | 0 | 358.28 | 2 | 329.545 | 1.443 | 599.253 | 67.122 | |
| | 1 | 351.05 | 0 | 329.067 | 1.549 | 537.201 | 60.012 | |
| | 2 | 350.02 | 2 | 329.260 | 1.600 | 549.611 | 61.304 | |
| | 3 | 350.93 | 8 | 331.142 | 1.604 | 623.362 | 68.496 | |
| | 4 | 351.64 | 0 | 332.709 | 1.604 | 638.672 | 70.022 | |
| | | ••• | | | | | ••• | |
| | 298 | 354.80 | 3 | 311.041 | 1.635 | 532.419 | 65.561 | |
| | 299 | 357.72 | 3 | 321.387 | 1.635 | 520.365 | 65.729 | |
| | 300 | 357.43 | 8 | 323.757 | 1.635 | 553.070 | 65.795 | |
| | 301 | 361.36 | 5 | 322.689 | 1.635 | 590.199 | 71.456 | |
| | 307 | 351.26 | 3 | 332.485 | 1.522 | 631.514 | 71.286 | |
| | | | | | | | | |
| | | Lower-HeatT- | | | ChipMass-4 | _ | | \ |
| | 0 | 329.43 | | 303.099 | 175.964 | | | |
| | 1 | 330.82 | | 304.879 | 163.202 | | | |
| | 2 | 329.14 | | 303.383 | 164.013 | | | |
| | 3 | 328.87 | | 302.254 | 181.487 | | | |
| | 4 | 328.35 | 2 | 300.954 | 183.929 | 888.448 | 1343.424 | |
| | | *** | | ••• | ••• | ••• | ••• | |
| | 298 | 332.92 | 4 | 307.626 | 1/5 000 | 832.906 | 1344.708 | |
| | | | | 301.020 | 145.299 | 032.900 | | |
| | 299 | 332.52 | 3 | 307.169 | 151.544 | | | |
| | 299 300 | 332.52 331.26 | | | | 905.639 | 1344.469 | |
| | | | 3 | 307.169 | 151.544 | 905.639 908.691 | 1344.469 1344.588 | |
| | 300 | 331.26 | 3 2 | 307.169 306.400 | 151.544 157.954 | 905.639 908.691 986.206 | 1344.469 1344.588 1348.747 | |
| | 300 301 | 331.26 333.03 328.69 | 3 2 9 | 307.169 306.400 308.732 300.706 | 151.544 157.954 174.069 180.229 | 905.639 908.691 986.206 903.605 | 1344.469 1344.588 1348.747 1323.082 | |
| | 300 301 307 | 331.26 333.03 328.69 WeakWashF | 3 2 9 SteamHea | 307.169 306.400 308.732 300.706 tF-3 T-T | 151.544 157.954 174.069 180.229 Op-Chips-4 | 905.639 908.691 986.206 903.605 SulphidityL-4 | 1344.469 1344.588 1348.747 1323.082 | |
| | 300 301 307 | 331.26 333.03 328.69 WeakWashF 257.325 | 3 2 9 SteamHea 5 | 307.169 306.400 308.732 300.706 tF-3 T-1 4.612 | 151.544 157.954 174.069 180.229 'op-Chips-4 252.077 | 905.639 908.691 986.206 903.605 SulphidityL-4 Na | 1344.469 1344.588 1348.747 1323.082 | |
| | 300 301 307 0 1 | 331.26 333.03 328.69 WeakWashF 257.325 241.182 | 3 2 9 SteamHea 5 4 | 307.169 306.400 308.732 300.706 tF-3 T-1 4.612 6.603 | 151.544 157.954 174.069 180.229 Top-Chips-4 252.077 251.406 | 905.639 908.691 986.206 903.605 SulphidityL-4 Na 29.1 | 1344.469 1344.588 1348.747 1323.082 | |
| | 300 301 307 0 1 2 | 331.26 333.03 328.69 WeakWashF 257.325 241.182 237.272 | 3 2 9 SteamHea 5 4 5 | 307.169 306.400 308.732 300.706 tF-3 T-1 4.612 6.603 1.795 | 151.544 157.954 174.069 180.229 Cop-Chips-4 252.077 251.406 251.335 | 905.639 908.691 986.206 903.605 SulphidityL-4 Na 29.1 | 1344.469 1344.588 1348.747 1323.082 N 1 | |
| | 300 301 307 0 1 2 3 | 331.26 333.03 328.69 WeakWashF 257.325 241.182 237.272 239.478 | 3 2 9 SteamHea 5 4 5 | 307.169 306.400 308.732 300.706 tF-3 T-T 4.612 6.603 1.795 4.846 | 151.544 157.954 174.069 180.229 Cop-Chips-4 252.077 251.406 251.335 250.312 | 905.639 908.691 986.206 903.605 SulphidityL-4 Na: 29.1 29.1 | 1344.469 1344.588 1348.747 1323.082 N 1 | |
| | 300 301 307 0 1 2 3 4 | 331.26 333.03 328.69 WeakWashF 257.325 241.182 237.272 239.478 215.372 | 3 2 9 SteamHea 5 4 5 5 | 307.169 306.400 308.732 300.706 tF-3 T-1 4.612 6.603 1.795 4.846 4.186 | 151.544 157.954 174.069 180.229 Cop-Chips-4 252.077 251.406 251.335 250.312 249.916 | 905.639 908.691 986.206 903.605 SulphidityL-4 Na 29.1 | 1344.469 1344.588 1348.747 1323.082 N 1 | |
| | 300 301 307 0 1 2 3 | 331.26 333.03 328.69 WeakWashF 257.325 241.182 237.272 239.478 | 3 2 9 SteamHea 5 4 5 5 | 307.169 306.400 308.732 300.706 tF-3 T-T 4.612 6.603 1.795 4.846 | 151.544 157.954 174.069 180.229 Cop-Chips-4 252.077 251.406 251.335 250.312 | 905.639 908.691 986.206 903.605 SulphidityL-4 Na: 29.1 29.1 | 1344.469 1344.588 1348.747 1323.082 N 1 | |

| 299 | 418.979 | 48.135 | 251.614 | 30.47 |
|-----|---------|--------|---------|-------|
| 300 | 462.712 | 54.373 | 251.197 | 30.47 |
| 301 | 457.313 | 53.194 | 251.324 | 30.46 |
| 307 | 232.729 | 54.503 | 250.084 | 30.46 |

```
[16]: data4 = data.fillna(method='bfill')
data4
```

| [16]: | | Observation | V-Kanna | ChinRate | RF-CMratio | BlowFlow | Chin | Γρυρ] Δ | \ | |
|-------|-----|--------------|---------|------------|------------|----------|-------|-----------|-------|---|
| [10]. | 0 | 31-00:00 | 23.10 | 16.520 | 121.717 | | _ | 169.805 | ` | |
| | 1 | 31-01:00 | 27.60 | 16.810 | 79.022 | 1328.360 | | 341.327 | | |
| | 2 | 31-02:00 | 23.19 | 16.709 | 79.562 | 1329.407 | | 239.161 | | |
| | 3 | 31-03:00 | 23.60 | 16.478 | 81.011 | 1334.877 | | 213.527 | | |
| | 4 | 31-04:00 | 22.90 | 15.618 | 93.244 | 1334.168 | | 243.131 | | |
| | | | | | | | | 210.101 | | |
| | 298 | 12-09:00 | 20.90 | 15.167 | 84.640 | 1283.706 | | 339.440 | | |
| | 299 | 12-10:00 | 24.98 | 14.308 | 85.034 | 1278.345 | | 368.564 | | |
| | 300 | 12-11:00 | 21.00 | 14.308 | 88.013 | 1307.722 | | 278.842 | | |
| | 301 | 12-12:00 | 21.40 | 14.308 | 85.490 | | | 273.484 | | |
| | 307 | 31-05:00 | 20.89 | 14.308 | 94.172 | | | 251.120 | | |
| | | | | | | | | | | |
| | | T-upperExt-2 | T-low | erExt-2 | UCZAA Whit | eFlow-4 | St | eamFlow-4 | 1 \ | |
| | 0 | 358.28 | | 329.545 | 1.443 | 599.253 | ••• | 67.12 | 22 | |
| | 1 | 351.05 | 50 | 329.067 | 1.549 | 537.201 | ••• | 60.03 | 12 | |
| | 2 | 350.02 | 22 | 329.260 | 1.600 | 549.611 | ••• | 61.30 |)4 | |
| | 3 | 350.93 | 8 | 331.142 | 1.604 | 623.362 | ••• | 68.49 | 96 | |
| | 4 | 351.64 | :0 | 332.709 | 1.436 | 638.672 | ••• | 70.02 | 22 | |
| | | ••• | | | ••• | ••• | ••• | | | |
| | 298 | 354.80 | 3 | 311.041 | 1.635 | 532.419 | ••• | 65.56 | 31 | |
| | 299 | 357.72 | .3 | 321.387 | 1.522 | 520.365 | ••• | 65.72 | 29 | |
| | 300 | 357.43 | 88 | 323.757 | 1.522 | 553.070 | ••• | 65.79 | 95 | |
| | 301 | 361.36 | 55 | 322.689 | 1.522 | 590.199 | ••• | 71.45 | 56 | |
| | 307 | 351.26 | 3 | 332.485 | 1.522 | 631.514 | ••• | 71.28 | 36 | |
| | | | | | | | | | | |
| | | Lower-HeatT- | | | _ | _ | | BlackFlo | | \ |
| | 0 | 329.43 | | 303.099 | 175.964 | | 1.197 | | 9.039 | |
| | 1 | 330.82 | | 304.879 | 163.202 | | .975 | | 7.317 | |
| | 2 | 329.14 | | 303.383 | 164.013 | | 7.534 | | 7.072 | |
| | 3 | 328.87 | | 302.254 | 181.487 | | 7.853 | | 1.461 | |
| | 4 | 328.35 | 52 | 300.954 | 183.929 | 888 | 3.448 | 1343 | 3.424 | |
| | | ••• | | ••• | ••• | ••• | | ••• | | |
| | 298 | 332.92 | | 307.626 | 145.299 | | 2.906 | | 1.708 | |
| | 299 | 332.52 | | 307.169 | 151.544 | | .639 | | 1.469 | |
| | 300 | 331.26 | | 306.400 | 157.954 | | 3.691 | | 1.588 | |
| | 301 | 333.03 | 32 | 308.732 | 174.069 | 986 | 3.206 | 1348 | 3.747 | |

```
WeakWashF
                       SteamHeatF-3
                                      T-Top-Chips-4
                                                      SulphidityL-4
              257.325
      0
                              54.612
                                             252.077
                                                               29.11
      1
              241.182
                              46.603
                                             251,406
                                                               29.11
      2
              237.272
                              51.795
                                             251.335
                                                               29.02
      3
              239.478
                              54.846
                                             250.312
                                                               29.02
      4
              215.372
                              54.186
                                             249.916
                                                               29.01
      298
              388.911
                              49.524
                                             251.833
                                                               30.29
              418.979
                              48.135
                                             251.614
                                                               30.47
      299
      300
              462.712
                              54.373
                                             251.197
                                                               30.46
      301
              457.313
                              53.194
                                             251.324
                                                               30.46
      307
              232.729
                              54.503
                                             250.084
                                                                 NaN
      [301 rows x 23 columns]
[17]: import numpy as np
      import matplotlib.pyplot as plt
      import scipy as stats
[18]: #detecting the outliers using IQR
      data2.columns
[18]: Index(['Observation', 'Y-Kappa', 'ChipRate', 'BF-CMratio', 'BlowFlow',
             'ChipLevel4 ', 'T-upperExt-2 ', 'T-lowerExt-2 ', 'UCZAA',
             'WhiteFlow-4 ', 'AAWhiteSt-4 ', 'AA-Wood-4 ', 'ChipMoisture-4 ',
             'SteamFlow-4', 'Lower-HeatT-3', 'Upper-HeatT-3', 'ChipMass-4',
             'WeakLiquorF', 'BlackFlow-2', 'WeakWashF', 'SteamHeatF-3',
             'T-Top-Chips-4', 'SulphidityL-4'],
            dtype='object')
[19]: data2.drop(['Observation'], axis=1, inplace=True)
      data2.columns
[19]: Index(['Y-Kappa', 'ChipRate', 'BF-CMratio', 'BlowFlow', 'ChipLevel4',
             'T-upperExt-2 ', 'T-lowerExt-2 ', 'UCZAA', 'WhiteFlow-4 ',
             'AAWhiteSt-4', 'AA-Wood-4', 'ChipMoisture-4', 'SteamFlow-4',
             'Lower-HeatT-3', 'Upper-HeatT-3', 'ChipMass-4', 'WeakLiquorF',
             'BlackFlow-2', 'WeakWashF', 'SteamHeatF-3', 'T-Top-Chips-4',
             'SulphidityL-4 '],
            dtype='object')
[20]: Q1= data2.quantile(0.25)
      Q3= data2.quantile(0.75)
      IQR=Q3-Q1
      print(IQR)
```

307

328.699

300.706

180.229

903.605

1323.082

| Y-Kappa | 4.550 |
|----------------|---------|
| ChipRate | 2.233 |
| BF-CMratio | 10.912 |
| BlowFlow | 96.766 |
| ChipLevel4 | 105.868 |
| T-upperExt-2 | 11.994 |
| T-lowerExt-2 | 7.609 |
| UCZAA | 0.152 |
| WhiteFlow-4 | 100.098 |
| AAWhiteSt-4 | 6.143 |
| AA-Wood-4 | 1.486 |
| ChipMoisture-4 | 2.186 |
| SteamFlow-4 | 8.840 |
| Lower-HeatT-3 | 8.585 |
| Upper-HeatT-3 | 7.852 |
| ChipMass-4 | 19.347 |
| WeakLiquorF | 180.613 |
| BlackFlow-2 | 280.829 |
| WeakWashF | 267.219 |
| SteamHeatF-3 | 6.903 |
| T-Top-Chips-4 | 2.044 |
| SulphidityL-4 | 30.420 |
| dtype: float64 | |

[21]: data2=data2[~((data2<(Q1-1.5*IQR))|(data2>(Q3+1.5*IQR))).any(axis=1)] data2

| [2 | 1]: | Y-Kappa | ChipRat | e BF- | -CMratio | BlowF | low | ChipLevel | 4 | T-upperExt-2 | 2 ' |
|----|-----|----------|---------|-------|----------|-------|------|-----------|----|--------------|-----|
| | 1 | 27.60 | 16.81 | 0 | 79.022 | 1328. | 360 | 341.3 | 27 | 351.05 | 50 |
| | 2 | 23.19 | 16.70 | 9 | 79.562 | 1329. | 407 | 239.1 | 61 | 350.02 | 22 |
| | 3 | 23.60 | 16.47 | 8 | 81.011 | 1334. | 877 | 213.5 | 27 | 350.93 | 38 |
| | 5 | 14.23 | 15.35 | 0 | 85.518 | 1171. | 604 | 198.5 | 38 | 344.01 | 14 |
| | 6 | 13.49 | 13.70 | 0 | 98.186 | 1243. | 688 | 116.2 | 75 | 346.20 | 80 |
| | | ••• | ••• | | | ••• | | ••• | | ••• | |
| | 276 | 22.70 | 15.51 | 7 | 83.008 | 1288. | 010 | 306.8 | 86 | 350.15 | 55 |
| | 296 | 20.50 | 13.35 | 8 | 97.662 | 1304. | 597 | 377.6 | 78 | 347.67 | 72 |
| | 297 | 20.40 | 14.23 | 3 | 89.790 | 1278. | 006 | 379.4 | 58 | 354.29 | 90 |
| | 298 | 20.90 | 15.16 | 7 | 84.640 | 1283. | 706 | 339.4 | 40 | 354.80 | 03 |
| | 307 | 20.89 | 14.30 | 8 | 94.172 | 1327. | 832 | 251.1 | 20 | 351.26 | 33 |
| | | | | | | | | | | | |
| | | T-lowerE | Cxt-2 | UCZAA | WhiteFl | .ow-4 | AAWł | niteSt-4 | | SteamFlow-4 | \ |
| | 1 | 3 | 29.067 | 1.549 | 53 | 7.201 | | 6.076 | | 60.012 | 2 |
| | 2 | 3 | 29.260 | 1.600 | 54 | 9.611 | | 0.000 | | 61.304 | 1 |
| | 3 | 3 | 31.142 | 1.604 | 62 | 3.362 | | 6.054 | | 68.496 | 3 |
| | 5 | 3 | 25.195 | 1.436 | 62 | 8.245 | | 6.020 | | 65.225 | 5 |
| | 6 | 3 | 26.982 | 1.434 | 69 | 6.766 | | 0.000 | | 72.989 | 9 |
| | | | ••• | ••• | ••• | | • | | | ••• | |
| | | | | | | | | | | | |

| 276 296 297 298 307 | 322.485 313.147 315.558 311.041 332.485 | 1.546 4 1.515 4 1.635 5 | 68.752 96.460 91.374 32.419 31.514 | 6.170 6.340 0.000 6.340 0.000 | 67.678 60.119 60.424 65.561 71.286 | |
|---------------------------------|---|-------------------------------|--|---|--|---|
| | Lower-HeatT-3 | Upper-HeatT-3 | ChipMass-4 | WeakLiquorF | BlackFlow-2 | \ |
| 1 | 330.823 | 304.879 | 163.202 | 665.975 | 1297.317 | |
| 2 | 329.140 | 303.383 | 164.013 | 677.534 | 1327.072 | |
| 3 | 328.875 | 302.254 | 181.487 | 767.853 | 1324.461 | |
| 5 | 322.103 | 298.517 | 165.814 | 826.243 | 907.641 | |
| 6 | 322.982 | 296.080 | 182.018 | 784.281 | 929.527 | |
| | ••• | ••• | ••• | ••• | ••• | |
| 276 | 331.854 | 309.346 | 160.061 | 910.013 | 1381.389 | |
| 296 | 332.615 | 308.575 | 141.076 | 997.904 | 1334.703 | |
| 297 | 331.980 | 308.078 | 140.301 | 975.016 | 1344.835 | |
| 298 | 332.924 | 307.626 | 145.299 | 832.906 | 1344.708 | |
| 307 | 328.699 | 300.706 | 180.229 | 903.605 | 1323.082 | |
| | WeakWashF St | eamHeatF-3 T- | Top-Chips-4 | SulphidityL-4 | | |
| 1 | 241.182 | 46.603 | 251.406 | 29.11 | | |
| 2 | 237.272 | 51.795 | 251.335 | 0.00 | | |
| 3 | 239.478 | 54.846 | 250.312 | 29.02 | | |
| 5 | 595.875 | 52.807 | 249.580 | 30.34 | | |
| 6 | 201.272 | 58.118 | 248.741 | 0.00 | | |
| | ••• | ••• | ••• | ••• | | |
| 276 | 441.934 | 51.466 | 252.216 | 29.59 | | |
| 296 | 389.497 | 46.206 | 252.423 | 30.43 | | |
| 297 | 388.676 | 47.803 | 252.311 | 0.00 | | |
| 298 | 388.911 | 49.524 | 251.833 | 30.29 | | |
| 307 | 232.729 | 54.503 | 250.084 | 0.00 | | |

[226 rows x 22 columns]

[]: data2.describe()