Task 2

March 27, 2024

```
import pandas as pd
[2]: data = pd.read_csv('C:\\Users\\hp\\Downloads\\01.Data Cleaning and_
      →Preprocessing.csv')
    type(data)
[3]:
[3]: pandas.core.frame.DataFrame
[4]:
     data.info
[4]: <bound method DataFrame.info of
                                            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
            31-04:00
     4
                         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
             9-20:00
                         23.01
                                   12.550
                                                90.842
                                                         1188.517
                                                                        289.826
     322
             9-21:00
                         24.32
                                   13.083
                                                88.910
                                                         1192.879
                                                                        318.006
                                                         1186.342
     323
             9-22:00
                         25.75
                                   13.417
                                                85.451
                                                                        248.312
          T-upperExt-2
                                            UCZAA
                                                                     SteamFlow-4
                          T-lowerExt-2
                                                   WhiteFlow-4
                                            1.443
     0
                 358.282
                                  329.545
                                                         599.253
                                                                            67.122
     1
                 351.050
                                  329.067
                                            1.549
                                                         537.201
                                                                            60.012
     2
                                            1.600
                                                         549.611
                 350.022
                                  329.260
                                                                            61.304
     3
                 350.938
                                  331.142
                                            1.604
                                                         623.362
                                                                            68.496
     4
                 351.640
                                  332.709
                                              NaN
                                                         638.672
                                                                            70.022
     . .
     319
                 347.286
                                  310.970
                                            1.523
                                                         513.956
                                                                            61.141
     320
                 399.135
                                  319.576
                                            1.451
                                                         570.058
                                                                            67.667
     321
                 373.633
                                  314.591
                                            1.457
                                                         549.306
                                                                            66.446
     322
                 364.081
                                  308.559
                                            1.523
                                                         504.852
                                                                            61.054
```

1.474

497.375

58.247

310.482

323

| | Lower-HeatT- | -3 Upper-HeatT | -3 ChipMass-4 | WeakLiquorF | BlackFlow-2 | \ |
|--------------|---------------|----------------|---------------|---------------|-------------|---|
| 0 | 329.43 | 303.0 | 099 175.964 | 1127.197 | 1319.039 | |
| 1 | 330.82 | 23 304.8 | 879 163.202 | 665.975 | 1297.317 | |
| 2 | 329.14 | 10 303.3 | 383 164.013 | 677.534 | 1327.072 | |
| 3 | 328.87 | 75 302.5 | 254 181.487 | 767.853 | 1324.461 | |
| 4 | 328.3 | 52 300.9 | 954 183.929 | 888.448 | 1343.424 | |
| | ••• | ••• | ••• | *** | *** | |
| 319 | 330.1 | 17 304.0 | 006 148.174 | 1027.201 | 1357.271 | |
| 320 | 330.84 | 18 304.6 | 616 165.178 | 906.962 | 1311.177 | |
| 321 | 330.22 | 26 304.6 | 686 160.841 | 887.125 | 1319.226 | |
| 322 | 327.3 | 16 304.3 | 363 147.589 | 804.423 | 1320.225 | |
| 323 | 328.09 | 92 304.0 | 093 144.218 | 828.328 | 1320.848 | |
| | | | | | | |
| | WeakWashF | SteamHeatF-3 | T-Top-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 | | |
| | ••• | ••• | ••• | ••• | | |
| 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 | | |
| [20 <i>1</i> | morra w 02 co | olumnal> | | | | |

[324 rows x 23 columns]>

[5]: data.shape

[5]: (324, 23)

[6]: data.describe()

| [6]: | | V-Kanna | ChinPata | BF-CMratio | BlowFlow | ChinI ovol4 | \ | |
|------|-------|--------------|------------------|-------------|-------------|-------------|------------|---|
| [0]. | | Y-Kappa | ${\tt ChipRate}$ | Dr-CMIatio | DIOMLIOM | ChipLevel4 | \ | |
| | count | 324.000000 | 319.000000 | 307.000000 | 308.000000 | 323.000000 |) | |
| | mean | 20.635370 | 14.347937 | 87.464456 | 1237.837614 | 258.164483 | 3 | |
| | std | 3.070036 | 1.499095 | 7.995012 | 100.593735 | 87.987452 | 2 | |
| | min | 12.170000 | 9.983000 | 68.645000 | 0.000000 | 0.00000 |) | |
| | 25% | 18.382500 | 13.358000 | 81.823000 | 1193.215250 | 213.527000 |) | |
| | 50% | 20.845000 | 14.308000 | 86.739000 | 1273.138500 | 271.792000 |) | |
| | 75% | 23.032500 | 15.517000 | 92.372000 | 1289.196000 | 321.680000 |) | |
| | max | 27.600000 | 16.958000 | 121.717000 | 1351.240000 | 419.014000 |) | |
| | | | | | | | | |
| | | T-upperExt-2 | T-lowerE | xt-2 | UCZAA White | Flow-4 AAV | √hiteSt-4 | \ |
| | count | 322.00000 | 0 322. | 000000 299. | 000000 323 | 3.000000 | 173.000000 | |
| | mean | 356.90429 | 5 324. | 020180 1. | 492010 591 | .732260 | 6.140410 | |

```
9.209290
                              7.621402
                                           0.105923
                                                         67.016351
                                                                          0.081609
std
           339.168000
                            284.633000
                                                        405.111000
min
                                           1.182000
                                                                          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
                                          Upper-HeatT-3
                                                           ChipMass-4
                                                                          \
                                               322.000000
                                                             323.000000
             323.000000
                             322.000000
count
                             325.567820
mean
              66.668285
                                              300.525699
                                                             162.222322
std
               5.708587
                               4.609862
                                                 4.568484
                                                              14.160688
       •••
              48.568000
                             318.051000
                                               293.312000
                                                             113.922000
min
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
max
              76.147000
                             333.854000
                                               311.146000
                                                             189.268000
       WeakLiquorF
                       BlackFlow-2
                                      WeakWashF
                                                   SteamHeatF-3
                                                                   T-Top-Chips-4
         323.000000
                         322.000000
                                      323.000000
                                                      322.000000
                                                                       323.000000
count
         873.828941
                                                                       251.240087
mean
                        1175.917016
                                      263.543068
                                                       49.696907
std
         122.073521
                         149.334010
                                      163.666942
                                                        4.551909
                                                                          1.283432
         486.938000
                         838.948000
                                        0.000000
                                                       35.510000
                                                                       248.359000
min
25%
         792.019500
                        1044.817500
                                      134.649000
                                                       46.389750
                                                                       250.312000
50%
         865.254000
                        1150.221500
                                      269.193000
                                                       50.277000
                                                                       251.380000
75%
         965.286500
                        1319.021250
                                      405.563000
                                                       53.294250
                                                                       252.323500
        1226.277000
                        1395.767000
                                      715.715000
                                                       63.332000
                                                                       254.122000
max
       SulphidityL-4
count
            173.000000
             30.411671
mean
std
              0.701317
             29.010000
min
25%
             29.970000
50%
             30.370000
75%
             30.820000
             32.840000
max
[8 rows x 22 columns]
```

[8]: data = data.drop_duplicates()

[9]: data

[9]: Observation Y-Kappa ChipRate BlowFlow ChipLevel4 \ BF-CMratio 23.10 16.520 0 31-00:00 121.717 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 16.4 | 178 8 | 31.011 13 | 34.877 | 213.527 | |
|---|--|--|----------------------------------|---|---|---|--|
| 4 | 31-04:00 | 22.90 15.6 | | | 334.168 | 243.131 | |
| 4 | 31-04.00 | 22.90 15.0 | 010 8 | 33.244 13 | 034.100 | 243.131 | |
| • • | ••• | | ••• | ••• | ••• | | |
| 298 | 12-09:00 | 20.90 15.1 | L67 8 | 34.640 12 | 283.706 | 339.440 | |
| 299 | 12-10:00 | 24.98 N | VaN 8 | 35.034 12 | 278.345 | 368.564 | |
| 300 | 12-11:00 | 21.00 M | VaN 8 | 38.013 13 | 307.722 | 278.842 | |
| 301 | 12-12:00 | | | | 255.986 | 273.484 | |
| | | | | | 327.832 | | |
| 307 | 31-05:00 | 20.89 14.3 | 500 | 94.172 13 | 021.032 | 251.120 | |
| | | | | | | | |
| | T-upperExt-2 | T-lowerExt-2 | 2 UCZA | ${\tt A}$ WhiteFl | low-4 | . SteamFlow-4 | \ |
| 0 | 358.282 | 329.5 | 545 1.443 | 3 59 | 99.253 | . 67.122 | |
| 1 | 351.050 | 329.0 | 067 1.549 | 53 | 37.201 | . 60.012 | |
| 2 | 350.022 | 329.2 | 260 1.600 | 54 | l9.611 | . 61.304 | |
| 3 | 350.938 | | | | 23.362 | | |
| 4 | | | | | | | |
| 4 | 351.640 | 332.7 | 709 NaN | v 63 | 38.672 | . 70.022 | |
| • • | *** | ••• | ••• | | | ••• | |
| 298 | 354.803 | 311.0 | 041 1.635 | 5 53 | 32.419 | . 65.561 | |
| 299 | 357.723 | 321.3 | 387 Na1 | V 52 | 20.365 | . 65.729 | |
| 300 | 357.438 | 323.7 | 757 Nal | V 55 | 3.070 | . 65.795 | |
| 301 | 361.365 | 322.6 | | | 0.199 | 5 4 450 | |
| 307 | 351.263 | 332.4 | | | 31.514 | | |
| 301 | 331.203 | 332.5 | 1.022 | 2 00 | | . 71.200 | |
| | | | 0 01 1 | | , ,,, | . D. 181 (| |
| | Lower-HeatT-3 | | -3 Chip | Mass-4 W | reakLiquo | rF BlackFlow-2 | 2 \ |
| | | | | | | | |
| 0 | 329.432 | | | 175.964 | 1127. | | |
| 0 1 | 329.432 330.823 | | | 175.964 163.202 | 1127. 665. | | |
| | | | 379 1 | | | 975 1297.31 | L7 |
| 1 | 330.823 | 304.8 | 379 1 383 1 | 163.202 | 665. | 975 1297.33 534 1327.07 | 17 72 |
| 1 2 3 | 330.823 329.140 328.875 | 304.8 303.3 302.2 | 379 1 383 1 254 1 | 163.202 164.013 181.487 | 665. 677. 767. | 975 1297.33 534 1327.07 853 1324.46 | 17 72 31 |
| 1 2 3 4 | 330.823 329.140 328.875 328.352 | 304.8 303.3 302.2 300.9 | 379 1 383 1 254 1 | 163.202 164.013 | 665. 677. | 975 1297.33 534 1327.07 853 1324.46 | 17 72 31 |
| 1 2 3 4 | 330.823 329.140 328.875 328.352 | 304.8 303.3 302.2 300.9 | 379 1 383 1 254 1 | 163.202 164.013 181.487 183.929 | 665. 677. 767. 888. | 975 1297.33 534 1327.07 853 1324.46 448 1343.42 | 17 72 31 24 |
| 1 2 3 4 298 | 330.823 329.140 328.875 328.352 332.924 | 304.8 303.3 302.2 300.9 | 379 1 383 1 254 1 954 1 | 163.202 164.013 181.487 183.929 | 665. 677. 767. 888. | 975 1297.33 534 1327.07 853 1324.46 448 1343.42 906 1344.70 | 17 72 31 24 |
| 1 2 3 4 298 299 | 330.823 329.140 328.875 328.352 332.924 332.523 | 304.8 303.3 302.2 300.9 307.6 | 379 | 163.202 164.013 181.487 183.929 145.299 | 665. 677. 767. 888. 832. 905. | 975 1297.33 534 1327.07 853 1324.46 448 1343.42 906 1344.70 639 1344.46 | 17 72 31 24 08 |
| 1 2 3 4 298 | 330.823 329.140 328.875 328.352 332.924 332.523 331.263 | 304.8 303.3 302.2 300.9 307.6 306.4 | 379 | 163.202 164.013 181.487 183.929 | 665. 677. 767. 888. 832. 905. | 975 1297.33 534 1327.07 853 1324.46 448 1343.42 906 1344.70 639 1344.46 691 1344.58 | 17 72 31 24 08 |
| 1 2 3 4 298 299 | 330.823 329.140 328.875 328.352 332.924 332.523 | 304.8 303.3 302.2 300.9 307.6 | 379 | 163.202 164.013 181.487 183.929 145.299 | 665. 677. 767. 888. 832. 905. | 975 1297.33 534 1327.07 853 1324.46 448 1343.42 906 1344.70 639 1344.46 691 1344.58 | 17 72 31 24 08 39 |
| 1 2 3 4 298 299 300 | 330.823 329.140 328.875 328.352 332.924 332.523 331.263 | 304.8 303.3 302.2 300.9 307.6 306.4 | 379 | 163.202 164.013 181.487 183.929 145.299 151.544 | 665. 677. 767. 888. 832. 905. | 975 1297.33 534 1327.07 853 1324.46 448 1343.42 906 1344.70 639 1344.58 691 1344.58 206 1348.74 | 17 72 51 24 08 69 38 |
| 1 2 3 4 298 299 300 301 | 330.823 329.140 328.875 328.352 332.924 332.523 331.263 333.032 | 304.8 303.3 302.2 300.9 307.6 307.1 306.4 | 379 | 163.202 164.013 181.487 183.929 145.299 151.544 157.954 174.069 | 665. 677. 767. 888. 832. 905. 908. | 975 1297.33 534 1327.07 853 1324.46 448 1343.42 906 1344.70 639 1344.58 691 1344.58 206 1348.74 | 17 72 51 24 08 69 38 |
| 1 2 3 4 298 299 300 301 | 330.823 329.140 328.875 328.352 332.924 332.523 331.263 333.032 328.699 | 304.8 303.3 302.2 300.8 307.6 306.4 308.7 | 379 | 163.202 164.013 181.487 183.929 145.299 151.544 157.954 174.069 180.229 | 665. 677. 767. 888. 905. 908. 986. 903. | 975 1297.33 534 1327.07 853 1324.46 448 1343.42 906 1344.70 639 1344.46 691 1344.58 206 1348.74 605 1323.08 | 17 72 51 24 08 69 38 |
| 1 2 3 4 298 299 300 301 307 | 330.823 329.140 328.875 328.352 332.924 332.523 331.263 333.032 328.699 | 304.8 303.3 302.2 300.9 307.6 306.4 308.7 300.7 | 379 | 163.202 164.013 181.487 183.929 145.299 151.544 157.954 174.069 180.229 | 665. 677. 767. 888. 832. 905. 908. | 975 1297.33 534 1327.07 853 1324.46 448 1343.42 906 1344.70 639 1344.58 206 1348.74 605 1323.08 | 17 72 51 24 08 69 38 |
| 1 2 3 4 298 299 300 301 307 | 330.823 329.140 328.875 328.352 332.924 332.523 331.263 333.032 328.699 WeakWashF S-257.325 | 304.8 303.3 302.2 300.9 307.1 306.4 308.7 300.7 | 379 | 163.202 164.013 181.487 183.929 145.299 151.544 157.954 174.069 180.229 ips-4 Su | 665. 677. 767. 888. 905. 908. 986. 903. | 975 1297.33 534 1327.07 853 1324.46 448 1343.42 906 1344.70 639 1344.46 691 1344.58 206 1348.74 605 1323.08 | 17 72 51 24 08 69 38 |
| 1 2 3 4 298 299 300 301 307 | 330.823 329.140 328.875 328.352 332.924 332.523 331.263 333.032 328.699 WeakWashF S- 257.325 241.182 | 304.8 303.3 302.2 300.9 307.6 306.4 308.7 300.7 teamHeatF-3 54.612 46.603 | 379 | 163.202 164.013 181.487 183.929 145.299 151.544 157.954 174.069 180.229 ips-4 Su 52.077 | 665. 677. 767. 888. 905. 908. 986. 903. | 975 1297.33 534 1327.07 853 1324.46 448 1343.42 906 1344.70 639 1344.46 691 1344.58 206 1348.74 605 1323.08 | 17 72 51 24 08 69 38 |
| 1 2 3 4 298 299 300 301 307 | 330.823 329.140 328.875 328.352 332.924 332.523 331.263 333.032 328.699 WeakWashF S- 257.325 241.182 237.272 | 304.8 303.3 302.2 300.9 307.6 307.1 306.4 308.7 300.7 teamHeatF-3 54.612 46.603 51.795 | 379 | 163.202 164.013 181.487 183.929 145.299 151.544 157.954 174.069 180.229 ips-4 Su 52.077 51.406 51.335 | 665. 677. 767. 888. 905. 908. 986. 903. | 975 1297.33 534 1327.07 853 1324.46 448 1343.42 906 1344.70 639 1344.46 691 1344.58 206 1348.74 605 1323.08 -L-4 NaN | 17 72 51 24 08 69 38 |
| 1 2 3 4 298 299 300 301 307 | 330.823 329.140 328.875 328.352 332.924 332.523 331.263 333.032 328.699 WeakWashF S- 257.325 241.182 237.272 239.478 | 304.8 303.3 302.2 300.9 307.1 306.4 308.7 300.7 teamHeatF-3 54.612 46.603 51.795 54.846 | 379 | 163.202 164.013 181.487 183.929 145.299 151.544 157.954 174.069 180.229 ips-4 Su 52.077 51.406 51.335 50.312 | 665. 677. 767. 888. 905. 908. 986. 903. | 975 1297.33 534 1327.07 853 1324.46 448 1343.42 906 1344.70 639 1344.46 691 1344.58 206 1348.74 605 1323.08 -L-4 NaN 29.11 NaN 29.02 | 17 72 51 24 08 69 38 |
| 1 2 3 4 298 299 300 301 307 | 330.823 329.140 328.875 328.352 332.924 332.523 331.263 333.032 328.699 WeakWashF S- 257.325 241.182 237.272 | 304.8 303.3 302.2 300.9 307.6 307.1 306.4 308.7 300.7 teamHeatF-3 54.612 46.603 51.795 | 379 | 163.202 164.013 181.487 183.929 145.299 151.544 157.954 174.069 180.229 ips-4 Su 52.077 51.406 51.335 | 665. 677. 767. 888. 905. 908. 986. 903. | 975 1297.33 534 1327.07 853 1324.46 448 1343.42 906 1344.70 639 1344.46 691 1344.58 206 1348.74 605 1323.08 -L-4 NaN | 17 72 51 24 08 69 38 |
| 1 2 3 4 298 299 300 301 307 | 330.823 329.140 328.875 328.352 332.924 332.523 331.263 333.032 328.699 WeakWashF S- 257.325 241.182 237.272 239.478 | 304.8 303.3 302.2 300.9 307.1 306.4 308.7 300.7 teamHeatF-3 54.612 46.603 51.795 54.846 | 379 | 163.202 164.013 181.487 183.929 145.299 151.544 157.954 174.069 180.229 ips-4 Su 52.077 51.406 51.335 50.312 | 665. 677. 767. 888. 905. 908. 986. 903. | 975 1297.33 534 1327.07 853 1324.46 448 1343.42 906 1344.70 639 1344.46 691 1344.58 206 1348.74 605 1323.08 -L-4 NaN 29.11 NaN 29.02 | 17 72 51 24 08 69 38 |
| 1 2 3 4 298 299 300 301 307 | 330.823 329.140 328.875 328.352 332.924 332.523 331.263 333.032 328.699 WeakWashF S- 257.325 241.182 237.272 239.478 215.372 | 304.8 303.3 302.2 300.9 307.6 307.1 306.4 308.7 300.7 teamHeatF-3 54.612 46.603 51.795 54.846 54.186 | 379 | 163.202 164.013 181.487 183.929 145.299 151.544 157.954 174.069 180.229 ips-4 Su 52.077 51.406 51.335 50.312 | 665. 677. 767. 888. 905. 908. 986. 903. nlphidity | 975 1297.33 534 1327.07 853 1324.46 448 1343.42 906 1344.70 639 1344.46 691 1344.58 206 1348.74 605 1323.08 -L-4 NaN 29.11 NaN 29.02 | 17 72 51 24 08 69 38 |
| 1 2 3 4 298 299 300 301 307 0 1 2 3 4 | 330.823 329.140 328.875 328.352 332.924 332.523 331.263 333.032 328.699 WeakWashF S- 257.325 241.182 237.272 239.478 215.372 388.911 | 304.8 303.3 302.2 300.9 307.6 307.1 306.4 308.7 300.7 teamHeatF-3 54.612 46.603 51.795 54.846 54.186 49.524 | 379 | 163.202 164.013 181.487 183.929 145.299 151.544 157.954 174.069 180.229 ips-4 Su 52.077 51.406 51.335 50.312 49.916 | 665. 677. 767. 888. 905. 908. 986. 903. nlphidity | 975 1297.33 534 1327.07 853 1324.46 448 1343.42 906 1344.70 639 1344.46 691 1344.58 206 1348.74 605 1323.08 -L-4 NaN 99.11 NaN 99.02 99.01 | 17 72 51 24 08 69 38 |
| 1 2 3 4 298 299 300 301 307 0 1 2 3 4 298 299 | 330.823 329.140 328.875 328.352 332.924 332.523 331.263 333.032 328.699 WeakWashF S- 257.325 241.182 237.272 239.478 215.372 388.911 418.979 | 304.8 303.3 302.2 300.8 307.6 307.1 306.4 308.7 300.7 teamHeatF-3 54.612 46.603 51.795 54.846 54.186 49.524 48.135 | 379 | 163.202 164.013 181.487 183.929 145.299 151.544 157.954 174.069 180.229 ips-4 Su 52.077 51.406 51.335 50.312 49.916 | 665. 677. 767. 888. 905. 908. 986. 903. nlphidity | 975 1297.33 534 1327.07 853 1324.46 448 1343.42 906 1344.76 639 1344.46 691 1344.58 206 1348.74 605 1323.08 **L-4 NaN 99.11 NaN 99.02 99.01 60.29 60.47 | 17 72 51 24 08 69 38 |
| 1 2 3 4 298 299 300 301 307 0 1 2 3 4 298 299 300 | 330.823 329.140 328.875 328.352 332.924 332.523 331.263 333.032 328.699 WeakWashF 257.325 241.182 237.272 239.478 215.372 388.911 418.979 462.712 | 304.8 303.3 302.2 300.8 307.6 307.6 306.4 308.7 300.7 teamHeatF-3 54.612 46.603 51.795 54.846 54.186 49.524 48.135 54.373 | 379 | 163.202 164.013 181.487 183.929 145.299 151.544 157.954 174.069 180.229 ips-4 Su 52.077 51.406 51.335 50.312 49.916 51.833 51.614 51.197 | 665. 677. 767. 888. 905. 908. 986. 903. alphidity | 975 1297.33 534 1327.07 853 1324.46 448 1343.42 906 1344.70 639 1344.46 691 1344.58 206 1348.74 605 1323.08 FL-4 NaN 19.11 NaN 19.02 19.01 10.29 10.47 NaN | 17 72 51 24 08 69 38 |
| 1 2 3 4 298 299 300 301 307 0 1 2 3 4 298 299 | 330.823 329.140 328.875 328.352 332.924 332.523 331.263 333.032 328.699 WeakWashF S- 257.325 241.182 237.272 239.478 215.372 388.911 418.979 | 304.8 303.3 302.2 300.8 307.6 307.1 306.4 308.7 300.7 teamHeatF-3 54.612 46.603 51.795 54.846 54.186 49.524 48.135 | 379 | 163.202 164.013 181.487 183.929 145.299 151.544 157.954 174.069 180.229 ips-4 Su 52.077 51.406 51.335 50.312 49.916 | 665. 677. 767. 888. 905. 908. 986. 903. alphidity | 975 1297.33 534 1327.07 853 1324.46 448 1343.42 906 1344.76 639 1344.46 691 1344.58 206 1348.74 605 1323.08 **L-4 NaN 99.11 NaN 99.02 99.01 60.29 60.47 | 17 72 51 24 08 69 38 |

| | Observation | | - | | | ${\tt ChipLevel4} \setminus $ |
|---------|--------------|-----------|-----------|------------|--------------|--------------------------------|
| 0 | False | False | False | Fals | se False | False |
| 1 | False | False | False | Fals | se False | False |
| 2 | False | False | False | Fals | se False | False |
| 3 | False | False | False | Fals | se False | False |
| 4 | False | False | False | Fals | se False | False |
| 298 | False | False | False | ₩ Fals | se False | False |
| 299 | False | False | True | Fals | se False | False |
| 300 | False | False | True | Fals | | False |
| 301 | False | False | True | Fals | | False |
| 307 | False | False | False | Fals | | False |
| | T-upperExt-2 | T-lowe | erExt-2 | UCZAA Whi | teFlow-4 | SteamFlow-4 |
| 0 | Fals | | False | False | False | False |
| 1 | Fals | е | False | False | False | False |
| 2 | Fals | | False | False | False | False |
| 3 | Fals | | False | | False | False |
| 4 | Fals | е | False | True | False | False |
| 298 | Fals | • | False | Falso | False | False |
| 299 | Fals | | False | True | | False |
| 300 | Fals | | False | True | False | False |
| 301 | Fals | | False | True | False | False |
| 307 | Fals | | False | False | False | False |
| | Lower-HeatT- | 3 Unner- | ·HeatT-3 | ChipMass-4 | ł WeakLiquon | rF BlackFlow-1 |
| 0 | Fals | | False | Fals | _ | |
| 1 | Fals | | False | Fals | | |
| 2 | Fals | | False | Fals | | |
| 3 | Fals | | False | Fals | | lse Fals |
| 4 | Fals | | False | Fals | | |
| | *** | | | ••• | ••• | ••• |
| 298 | Fals | е | False | Fals | se Fal | lse Fals |
| 299 | Fals | е | False | Fals | se Fal | lse Fals |
| 300 | Fals | е | False | Fals | se Fal | lse Fals |
| 301 | Fals | е | False | Fals | se Fal | lse Fals |
| 307 | Fals | е | False | Fals | se Fal | lse Fals |
| | WeakWashF | SteamHeat | F-3 T-T | op-Chips-4 | SulphidityI | 4 |
| 0 | False | | `alse | False | | True |
| | False | | alse | False | | |

| 2 | False | False | False | | True |
|-----|-------|-------|-------|-----|-------|
| 3 | False | False | False | | False |
| 4 | False | False | False | | False |
| | ••• | | | ••• | |
| 298 | False | False | False | | False |
| 299 | False | False | False | | False |
| 300 | False | False | False | | True |
| 301 | False | False | False | | False |
| 307 | False | False | False | | True |

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

[11]: Observation 0 Y-Kappa 0 ChipRate 4 BF-CMratio 14 BlowFlow 13 ChipLevel4 1 T-upperExt-2 1 T-lowerExt-2 1 24 UCZAA 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 1 WeakLiquorF BlackFlow-2 1 WeakWashF 1 SteamHeatF-3 1 T-Top-Chips-4 1 SulphidityL-4 141 dtype: int64

[12]: data.notnull()

[12]: BF-CMratio BlowFlow ChipLevel4 Observation Y-Kappa ChipRate True True True True True True 1 True True True True True True 2 True True True True True True 3 True True True True True True 4 True True True True True True

| • • | ••• | | | ••• | ••• | | ••• | | |
|-----|---------------|-------------|-------|---------|-------|----------|-------|-------------|----|
| 298 | True | True | True | | True | Tru | .e | True | |
| 299 | True | True | False | | True | Tru | .e | True | |
| 300 | True | True | False | | True | Tru | .e | True | |
| 301 | True | True | False | | True | Tru | .e | True | |
| 307 | True | True | True | | True | Tru | .e | True | |
| | | | | | | | | | |
| | T-upperExt-2 | T-lowerEx | t-2 | UCZAA | White | eFlow-4 | St | eamFlow-4 | \ |
| 0 | True | | True | True | | True | ••• | True | |
| 1 | True | | True | True | | True | ••• | True | |
| 2 | True | | True | True | | True | ••• | True | |
| 3 | True | | True | True | | True | | True | |
| 4 | True | | True | False | | True | ••• | True | |
| | ••• | | | , | ••• | ••• | ••• | | |
| 298 | True | | True | True | | True | ••• | True | |
| 299 | True | | True | False | | True | ••• | True | |
| 300 | True | | True | False | | True | ••• | True | |
| 301 | True | | True | False | | True | ••• | True | |
| 307 | True | | True | True | | True | | True | |
| 001 | 1140 | | 1140 | 1140 | | 11 40 | ••• | 1140 | |
| | Lower-HeatT-3 | Upper-Hea | tT-3 | ChipMa | ass-4 | WeakLig | uorF | BlackFlow-2 | \ |
| 0 | True | | True | | True | | True | Tru | .e |
| 1 | True | | True | | True | | True | Tru | e |
| 2 | True | | True | | True | | True | Tru | e |
| 3 | True | | True | | True | | True | Tru | e |
| 4 | True | | True | | True | | True | Tru | .e |
| | ••• | | ••• | ••• | | ••• | | ••• | |
| 298 | True | | True | | True | | True | Tru | .e |
| 299 | True | | True | | True | | True | Tru | e |
| 300 | True | | True | | True | | True | Tru | e |
| 301 | True | | True | | True | | True | Tru | |
| 307 | True | | True | | True | | True | Tru | e |
| | | | | | | | | | |
| ^ | | teamHeatF-3 | | op-Chip | | Sulphidi | • | | |
| 0 | True | Tru - | | | True | | False | | |
| 1 | True | Tru | | | True | | True | | |
| 2 | True | Tru | | | True | | False | | |
| 3 | True | Tru | e | | True | | True | | |
| 4 | True | Tru | e | | True | | True | | |
| | *** | ••• | | ••• | | ••• | | | |
| 298 | True | Tru | | | True | | True | | |
| 299 | True | Tru | e | | True | | True | | |
| 300 | True | Tru | e | | True | | False | | |
| 301 | True | Tru | e | | True | | True | | |
| 307 | True | Tru | e | | True | | False | | |
| | | | | | | | | | |

[13]: 352 [14]: data2 = data.fillna(value=0) data2 [14]: Observation Y-Kappa ChipRate BF-CMratio BlowFlow ChipLevel4 23.10 0 31-00:00 16.520 121.717 1177.607 169.805 1 31-01:00 27.60 16.810 79.022 1328.360 341.327 2 23.19 31-02:00 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 . . 20.90 298 12-09:00 15.167 84.640 1283.706 339.440 24.98 85.034 299 12-10:00 0.000 1278.345 368.564 300 12-11:00 21.00 0.000 88.013 1307.722 278.842 301 12-12:00 21.40 0.000 85.490 1255.986 273.484 307 31-05:00 20.89 14.308 94.172 1327.832 251.120 UCZAA SteamFlow-4 T-upperExt-2 T-lowerExt-2 WhiteFlow-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 0.000 638.672 70.022 . . ••• 298 311.041 354.803 1.635 532.419 65.561 299 357.723 321.387 0.000 520.365 65.729 300 65.795 357.438 323.757 0.000 553.070 301 361.365 322.689 0.000 590.199 71.456 307 351.263 332.485 631.514 71.286 1.522 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 2 677.534 329.140 303.383 164.013 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 1344.708 299 332.523 905.639 1344.469 307.169 151.544 300 331.263 306.400 157.954 908.691 1344.588 301 333.032 308.732 174.069 986.206 1348.747 307 328.699 300.706 180.229 903.605 1323.082

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

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 |
| 298 299 | 388.911 418.979 | 49.524 48.135 | 251.833 251.614 | 30.29 30.47 |
| | | | | |
| 299 | 418.979 | 48.135 | 251.614 | 30.47 |

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

[15]: 0

[16]: data

| [16]: | | 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 | 12-09:00 | 20.90 | 15.167 | 84.640 | 1283.706 | 339.440 | |
| | 299 | 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-low | erExt-2 | UCZAA Whi | teFlow-4 | SteamFlow- | 4 \ |
| | 0 | 358.28 | | 329.545 | 1.443 | 599.253 | 67.1 | 22 |
| | 1 | 351.05 | 50 | 329.067 | 1.549 | 537.201 | 60.0 | 12 |
| | 2 | 350.02 | 22 | 329.260 | 1.600 | 549.611 | 61.3 | 04 |
| | 3 | 350.93 | 88 | 331.142 | 1.604 | 623.362 | 68.4 | 96 |
| | 4 | 351.64 | -0 | 332.709 | NaN | 638.672 | 70.0 | 22 |
| | | ••• | | | | | ••• | |
| | 298 | 354.80 | 3 | 311.041 | 1.635 | 532.419 | 65.5 | 61 |
| | 299 | 357.72 | 23 | 321.387 | NaN | 520.365 | 65.7 | 29 |
| | 300 | 357.43 | 88 | 323.757 | NaN | 553.070 | 65.7 | 95 |
| | 301 | 361.36 | 55 | 322.689 | NaN | 590.199 | 71.4 | 56 |
| | 307 | 351.26 | 3 | 332.485 | 1.522 | 631.514 | 71.2 | 86 |
| | | Lower-HeatT- | -3 Unner | -Hea+T-3 | ChinMagg-4 | Weaklian | orF BlackFl | ow-2 \ |

| 2 | | | | | | | |
|--|--|---|---|---|--|---|---|
| | 329.1 | 40 | 303.383 | 164.013 | 677 | 534 13 | 327.072 |
| 3 | 328.8 | 75 | 302.254 | 181.487 | 767 | .853 13 | 324.461 |
| 4 | 328.3 | | 300.954 | 183.929 | 888 | | 343.424 |
| | ••• | | ••• | *** | | | |
| 298 | 332.9 | | 307.626 | 145.299 | 832 | .906 13 | 344.708 |
| 299 | 332.5 | | 307.169 | 151.544 | | | 344.469 |
| 300 | 331.2 | | 306.400 | 157.954 | | | 344.588 |
| 301 | 333.0 | | 308.732 | 174.069 | | | 348.747 |
| 307 | 328.6 | | 300.706 | 180.229 | | | 323.082 |
| 301 | 320.0 | 99 | 300.700 | 100.229 | 903 | .005 | 323.002 |
| | WeakWashF | SteamHea | tF-3 T-1 | Top-Chips-4 | Sulphidity | 7L-4 | |
| 0 | 257.325 | | 4.612 | 252.077 | | NaN | |
| 1 | 241.182 | 4 | 6.603 | 251.406 | 2 | 29.11 | |
| 2 | 237.272 | | 1.795 | 251.335 | | NaN | |
| 3 | 239.478 | | 4.846 | 250.312 | | 29.02 | |
| 4 | 215.372 | | 4.186 | 249.916 | | 29.01 | |
| | ••• | | | ••• | ••• | | |
| 298 | 388.911 | | 9.524 | 251.833 | 3 | 30.29 | |
| 299 | 418.979 | | 8.135 | 251.614 | | 30.47 | |
| 300 | 462.712 | | 4.373 | 251.197 | | NaN | |
| 301 | 457.313 | | 3.194 | 251.324 | 3 | 30.46 | |
| 307 | 232.729 | | 4.503 | 250.084 | | NaN | |
| [201 | rows x 23 c | olumns | | | | | |
| | rows x 23 c 2 = data.fil | | =0) | | | | |
| data2 | 2 = data.fil | | =0) | | | | |
| data2 | 2 = data.fil | lna(value | | BF-CMratio | BlowFlow | ChipLevel4 | \ |
| data2 | 2 = data.fil | lna(value | | | BlowFlow 1177.607 | ChipLevel4 | |
| data2 | 2 = data.fil 2 Observation | lna(value Y-Kappa | ChipRate | 121.717 | | - | 5 |
| data2 | 2 = data.fil 2 Observation 31-00:00 | lna(value Y-Kappa 23.10 | ChipRate 16.520 | 121.717 | 1177.607 | 169.80 | 5 7 |
| data2 data2 | 2 = data.fil 2 Observation 31-00:00 31-01:00 | Y-Kappa 23.10 27.60 | ChipRate 16.520 16.810 | 121.717 79.022 79.562 | 1177.607 1328.360 | 169.805 341.327 239.163 | 5 7 1 |
| data2 | 2 = data.fil 2 Observation 31-00:00 31-01:00 31-02:00 | Y-Kappa 23.10 27.60 23.19 | ChipRate 16.520 16.810 16.709 | 121.717 79.022 79.562 81.011 | 1177.607 1328.360 1329.407 | 169.809 341.327 239.163 213.527 | 5 7 1 7 |
| data2 | 2 = data.fil 2 Observation 31-00:00 31-01:00 31-02:00 31-03:00 | Y-Kappa 23.10 27.60 23.19 23.60 | ChipRate 16.520 16.810 16.709 16.478 | 121.717 79.022 79.562 81.011 93.244 | 1177.607 1328.360 1329.407 1334.877 | 169.809 341.327 239.163 213.527 | 5 7 1 7 |
| data2 data2 | 2 = data.fil 2 Observation 31-00:00 31-01:00 31-02:00 31-03:00 31-04:00 | Y-Kappa 23.10 27.60 23.19 23.60 22.90 | ChipRate 16.520 16.810 16.709 16.478 15.618 | 121.717 79.022 79.562 81.011 93.244 | 1177.607 1328.360 1329.407 1334.877 1334.168 | 169.808 341.327 239.163 213.527 243.133 | 5 7 1 7 1 |
| data2 data2 0 1 2 3 4 | 2 = data.fil 2 Observation | Y-Kappa 23.10 27.60 23.19 23.60 22.90 | ChipRate 16.520 16.810 16.709 16.478 15.618 | 121.717 79.022 79.562 81.011 93.244 84.640 | 1177.607 1328.360 1329.407 1334.877 1334.168 | 169.808 341.327 239.16: 213.527 243.13: | 5 7 1 7 1 |
| data2 data2 0 1 2 3 4 298 | 2 = data.fil 2 Observation 31-00:00 31-01:00 31-02:00 31-03:00 31-04:00 12-09:00 | Y-Kappa 23.10 27.60 23.19 23.60 22.90 20.90 | ChipRate 16.520 16.810 16.709 16.478 15.618 | 121.717 79.022 79.562 81.011 93.244 84.640 85.034 | 1177.607 1328.360 1329.407 1334.877 1334.168 1283.706 | 169.808 341.327 239.163 213.527 243.133 339.440 368.564 | 5 7 1 7 1 1 |
| data2 data2 0 1 2 3 4 298 299 | 2 = data.fil 2 Observation 31-00:00 31-01:00 31-02:00 31-03:00 31-04:00 12-09:00 12-10:00 | Y-Kappa 23.10 27.60 23.19 23.60 22.90 20.90 24.98 | ChipRate 16.520 16.810 16.709 16.478 15.618 15.167 0.000 | 121.717 79.022 79.562 81.011 93.244 84.640 85.034 88.013 | 1177.607 1328.360 1329.407 1334.877 1334.168 1283.706 1278.345 | 169.808 341.327 239.163 213.527 243.133 339.440 368.564 | 5 7 1 7 1 1 0 4 |
| data2 data2 0 1 2 3 4 298 299 300 | 2 = data.fil 2 Observation 31-00:00 31-01:00 31-02:00 31-03:00 31-04:00 12-09:00 12-10:00 12-11:00 | Y-Kappa 23.10 27.60 23.19 23.60 22.90 20.90 24.98 21.00 | ChipRate 16.520 16.810 16.709 16.478 15.618 15.167 0.000 0.000 0.000 | 121.717 79.022 79.562 81.011 93.244 84.640 85.034 88.013 85.490 | 1177.607 1328.360 1329.407 1334.877 1334.168 1283.706 1278.345 1307.722 | 169.808 341.327 239.163 213.527 243.133 339.440 368.564 278.842 | 5 7 1 7 1 1 0 4 2 4 |
| data2 data2 0 1 2 3 4 298 299 300 301 | 2 = data.fil 2 Observation | Y-Kappa 23.10 27.60 23.19 23.60 22.90 20.90 24.98 21.00 21.40 20.89 | ChipRate 16.520 16.810 16.709 16.478 15.618 15.167 0.000 0.000 0.000 14.308 | 121.717 79.022 79.562 81.011 93.244 84.640 85.034 88.013 85.490 | 1177.607 1328.360 1329.407 1334.877 1334.168 1283.706 1278.345 1307.722 1255.986 1327.832 | 169.808 341.327 239.163 213.527 243.133 339.440 368.564 278.842 273.484 | 5 7 1 7 1 1 0 4 2 4 0 |
| data2 data2 0 1 2 3 4 298 299 300 301 | 2 = data.fil 2 Observation | Y-Kappa 23.10 27.60 23.19 23.60 22.90 20.90 24.98 21.00 21.40 20.89 | ChipRate 16.520 16.810 16.709 16.478 15.618 15.167 0.000 0.000 0.000 14.308 | 121.717 79.022 79.562 81.011 93.244 84.640 85.034 88.013 85.490 94.172 | 1177.607 1328.360 1329.407 1334.877 1334.168 1283.706 1278.345 1307.722 1255.986 1327.832 | 169.808 341.327 239.16: 213.527 243.13: 339.44(368.564 278.842 273.484 251.120 | 5 7 1 7 1 1 0 4 2 4 0 |

175.964

163.202

303.099

304.879

1127.197

665.975

1319.039

1297.317

0

1

329.432

| 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 | 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 | |
| 307 | 351.263 | 332.485 | 1.522 | 631.514 | 71.286 | |
| | | | | | | |
| | 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 | |
| | | | | | | |
| | WeakWashF St | eamHeatF-3 T-T | op-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 | | |
| | | | | | | |

```
[20]: data4 = data.fillna(method='ffill')
   data4
```

C:\Users\hp\AppData\Local\Temp\ipykernel_10640\2159090985.py:1: FutureWarning: DataFrame.fillna with 'method' is deprecated and will raise in a future version. Use obj.ffill() or obj.bfill() instead.

data4 = data.fillna(method='ffill')

| [20]: | | Observation | Y-Kappa | ChipRate | BF-CMratio | BlowFlow | ChipLevel4 | 1 \ | |
|-------|-----|--------------|----------|-----------|-------------|-----------|------------|----------|---|
| | 0 | 31-00:00 | 23.10 | 16.520 | | 1177.607 | 169.80 | | |
| | 1 | 31-01:00 | 27.60 | 16.810 | | 1328.360 | 341.32 | | |
| | 2 | 31-02:00 | 23.19 | 16.709 | | 1329.407 | 239.16 | | |
| | 3 | 31-03:00 | 23.60 | 16.478 | | 1334.877 | 213.52 | | |
| | 4 | 31-04:00 | 22.90 | 15.618 | | | 243.13 | | |
| | | *** | | | | | | | |
| | 298 | 12-09:00 | 20.90 | 15.167 | | 1283.706 | 339.44 | 10 | |
| | 299 | 12-10:00 | 24.98 | 15.167 | | | 368.56 | | |
| | 300 | 12-11:00 | 21.00 | 15.167 | | 1307.722 | 278.84 | | |
| | 301 | 12-12:00 | 21.40 | 15.167 | | | 273.48 | | |
| | 307 | 31-05:00 | 20.89 | 14.308 | | | 251.12 | | |
| | 00. | 01 00.00 | | | 0 2 1 2 1 2 | 101, 1001 | | | |
| | | T-upperExt-2 | T-low | erExt-2 | UCZAA Whit | eFlow-4 | SteamFlo | ow-4 \ | |
| | 0 | 358.28 | 2 | 329.545 | 1.443 | 599.253 | 67 | 7.122 | |
| | 1 | 351.05 | 0 | 329.067 | 1.549 | 537.201 | 60 | 0.012 | |
| | 2 | 350.02 | 2 | 329.260 | 1.600 | 549.611 | 61 | 1.304 | |
| | 3 | 350.93 | 8 | 331.142 | 1.604 | 623.362 | 68 | 3.496 | |
| | 4 | 351.64 | 0 | 332.709 | 1.604 | 638.672 | 70 | 0.022 | |
| | | ••• | | ••• | | • ••• | ••• | | |
| | 298 | 354.80 | 3 | 311.041 | 1.635 | 532.419 | 65 | 5.561 | |
| | 299 | 357.72 | 3 | 321.387 | 1.635 | 520.365 | 65 | 5.729 | |
| | 300 | 357.43 | 8 | 323.757 | 1.635 | 553.070 | 65 | 5.795 | |
| | 301 | 361.36 | 5 | 322.689 | 1.635 | 590.199 | 71 | 1.456 | |
| | 307 | 351.26 | 3 | 332.485 | 1.522 | 631.514 | 71 | 1.286 | |
| | | | | | | | | | |
| | _ | Lower-HeatT- | | | ChipMass-4 | _ | | kFlow-2 | \ |
| | 0 | 329.43 | | 303.099 | | | | 1319.039 | |
| | 1 | 330.82 | | 304.879 | | | | 1297.317 | |
| | 2 | 329.14 | | 303.383 | | | | 1327.072 | |
| | 3 | 328.87 | | 302.254 | | | | 1324.461 | |
| | 4 | 328.35 | 2 | 300.954 | 183.929 | 888 | .448 | 1343.424 | |
| | • • | ••• | _ | ••• | ••• | | ••• | | |
| | 298 | 332.92 | | 307.626 | | | | 1344.708 | |
| | 299 | | | 307.169 | | | | 1344.469 | |
| | 300 | 331.26 | | 306.400 | | | | 1344.588 | |
| | 301 | 333.03 | | 308.732 | | | | 1348.747 | |
| | 307 | 328.69 | 9 | 300.706 | 180.229 | 903 | .605 | 1323.082 | |
| | | WeakWashF | StoamHoa | +F-3 T- | Top-Chips-4 | Sulphidit | 1π –Δ | | |
| | 0 | 257.325 | | 4.612 | 252.077 | Jarphraro | NaN | | |
| | 1 | 241.182 | | 6.603 | 251.406 | | 29.11 | | |
| | 2 | 237.272 | | 1.795 | 251.400 | | 29.11 | | |
| | 3 | 239.478 | | 4.846 | 250.312 | | 29.11 | | |
| | 4 | 215.372 | | 4.186 | 249.916 | | 29.02 | | |
| | | | | | | | 20.01 | | |
| | 298 | 388.911 | | 9.524 | 251.833 | ••• | 30.29 | | |
| | 298 | 300.911 | 4 | 3.024 | ∠01.033 | | JU. 29 | | |

```
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
      [301 rows x 23 columns]
[22]: import numpy as np
      import matplotlib.pyplot as plt
      from scipy import stats
     Matplotlib is building the font cache; this may take a moment.
[23]: data2.columns
[23]: 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')
[25]: data2.drop(['Observation'], axis=1,inplace=True)
      data2.columns
[25]: 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')
[27]: Q1=data2.quantile(0.25)
      Q3=data2.quantile(0.75)
      IQR=Q3-Q1
      print(IQR)
     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

```
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
[28]: data2=data2[\sim((data2<(Q1-1.5*IQR)))|(data2>(Q3+1.5*IQR))).any(axis=1)]
      data2
[28]:
           Y-Kappa ChipRate BF-CMratio
                                            BlowFlow
                                                      ChipLevel4
                                                                     T-upperExt-2
                                                                                    \
             27.60
                       16.810
                                    79.022
                                            1328.360
                                                           341.327
                                                                           351.050
      1
      2
             23.19
                       16.709
                                    79.562 1329.407
                                                           239.161
                                                                           350.022
                                    81.011 1334.877
      3
             23.60
                       16.478
                                                           213.527
                                                                           350.938
      5
             14.23
                                    85.518
                                            1171.604
                                                                           344.014
                       15.350
                                                           198.538
      6
             13.49
                       13.700
                                    98.186 1243.688
                                                           116.275
                                                                           346.208
      . .
               •••
                        •••
      276
             22.70
                       15.517
                                    83.008
                                           1288.010
                                                           306.886
                                                                           350.155
      296
             20.50
                       13.358
                                    97.662
                                           1304.597
                                                           377.678
                                                                           347.672
      297
             20.40
                       14.233
                                    89.790
                                            1278.006
                                                           379.458
                                                                           354.290
      298
             20.90
                                    84.640
                                            1283.706
                                                           339.440
                                                                           354.803
                       15.167
      307
             20.89
                       14.308
                                    94.172
                                            1327.832
                                                           251.120
                                                                           351.263
           T-lowerExt-2
                            UCZAA
                                    WhiteFlow-4
                                                   AAWhiteSt-4
                                                                    SteamFlow-4
      1
                   329.067
                            1.549
                                         537.201
                                                          6.076
                                                                           60.012
      2
                   329.260
                            1.600
                                         549.611
                                                          0.000
                                                                           61.304
      3
                   331.142
                            1.604
                                         623.362
                                                          6.054
                                                                           68.496
      5
                   325.195
                            1.436
                                         628.245
                                                          6.020
                                                                           65.225
      6
                   326.982
                            1.434
                                                          0.000
                                                                           72.989
                                         696.766
      . .
                       •••
      276
                   322.485
                            1.590
                                         568.752
                                                          6.170
                                                                           67.678
      296
                   313.147
                            1.546
                                         496.460
                                                          6.340
                                                                           60.119
      297
                   315.558
                            1.515
                                         491.374
                                                          0.000
                                                                           60.424
      298
                                                          6.340
                   311.041
                            1.635
                                         532.419
                                                                           65.561
                                                          0.000
      307
                   332.485
                            1.522
                                         631.514
                                                                           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
```

AA-Wood-4

| | 6 | 322.98 | 2 29 | 6.080 | 182.0 | 18 7 | 84.281 | 929.527 | |
|-------|--------|---------------|--------------|---------|----------|-----------|---------|-------------|---|
| | | ••• | | •• | ••• | ••• | | ••• | |
| | 276 | 331.85 | | 9.346 | 160.06 | | 10.013 | 1381.389 | |
| | 296 | 332.61 | | 3.575 | 141.0 | | 97.904 | 1334.703 | |
| | 297 | 331.980 | | 3.078 | 140.30 | | 75.016 | 1344.835 | |
| | 298 | 332.92 | | 7.626 | 145.29 | | 32.906 | 1344.708 | |
| | 307 | 328.699 | 9 300 | 0.706 | 180.22 | 29 9 | 03.605 | 1323.082 | |
| | W | leakWashF | SteamHeatF-3 | T-Top | -Chips-4 | Sulphid | ityL-4 | | |
| | 1 | 241.182 | 46.60 | _ | 251.406 | - | 29.11 | | |
| | 2 | 237.272 | 51.79 | 5 | 251.33 | 5 | 0.00 | | |
| | 3 | 239.478 | 54.84 | 3 | 250.312 | 2 | 29.02 | | |
| | 5 | 595.875 | 52.80 | 7 | 249.580 |) | 30.34 | | |
| | 6 | 201.272 | 58.118 | 3 | 248.743 | L | 0.00 | | |
| | | ••• | ••• | | ••• | ••• | | | |
| | 276 | 441.934 | 51.46 | 3 | 252.216 | 3 | 29.59 | | |
| | 296 | 389.497 | 46.20 | 3 | 252.423 | 3 | 30.43 | | |
| | 297 | 388.676 | 47.80 | 3 | 252.31 | 1 | 0.00 | | |
| | 298 | 388.911 | 49.52 | 1 | 251.833 | 3 | 30.29 | | |
| | 307 | 232.729 | 54.50 | 3 | 250.084 | 1 | 0.00 | | |
| [29]: | _ | cows x 22 co. | lumns] | | | | | | |
| | from s | | rt preproces | _ | le | | | | |
| 50.07 | | | | | | | | | |
| [30]: | data2. | describe() | | | | | | | |
| [30]: | | Y-Kappa | ChipRate | BF-CMr | atio | BlowFlow | ChipLev | el4 \ | |
| | count | 226.000000 | 226.000000 | 226.00 | 0000 22 | 26.000000 | 226.00 | 0000 | |
| | mean | 20.690487 | 14.673491 | 85.88 | 2181 129 | 55.288916 | 264.66 | 4912 | |
| | std | 2.982916 | 1.297369 | 7.03 | 3155 | 17.896055 | 74.34 | 5135 | |
| | min | 12.480000 | 10.833000 | 68.64 | 5000 108 | 34.083000 | 61.78 | 3000 | |
| | 25% | 18.457500 | 13.850000 | 80.98 | 4000 122 | 21.926000 | 220.35 | 6000 | |
| | 50% | 20.775000 | 14.729000 | 84.96 | 7000 128 | 30.291500 | 270.96 | 5000 | |
| | 75% | 23.010000 | 15.708000 | 91.17 | 8750 128 | 39.254000 | 322.49 | 2000 | |
| | max | 27.600000 | 16.958000 | 108.10 | 4000 13 | 51.240000 | 419.01 | 4000 | |
| | | T-upperExt | -2 T-lower | Ext-2 | UC | ZAA White | Flow-4 | AAWhiteSt-4 | \ |
| | count | 226.000 | | .000000 | 226.0000 | | .000000 | 226.000000 | • |
| | mean | 356.861 | | .341124 | 1.487 | | .242482 | 3.098164 | |
| | std | 7.4668 | | .557537 | 0.1080 | | .052197 | 3.078138 | |
| | min | 340.2220 | | .421000 | 1.1820 | | .841000 | 0.000000 | |
| | 25% | 350.704 | | .355500 | 1.4290 | | .611000 | 0.000000 | |
| | ,0 | 23001 | | | 120 | | | 2.00000 | |

5

322.103

298.517

165.814

826.243

```
50%
                 357.560500
                                  326.508500
                                                 1.492000
                                                              602.508000
                                                                               5.904500
      75%
                 361.555000
                                  329.264500
                                                              653.358500
                                                                               6.140000
                                                 1.556000
      max
                 375.047000
                                  337.012000
                                                 1.712000
                                                              731.394000
                                                                               6.340000
                 SteamFlow-4
                                Lower-HeatT-3
                                                Upper-HeatT-3
                                                                 ChipMass-4
                                                                               \
                   226.000000
                                   226.000000
                                                    226.000000
                                                                  226.000000
      count
                    67.545478
                                   324.752212
                                                    299.655420
                                                                  164.220102
      mean
      std
                     4.914301
                                     4.526481
                                                      4.383788
                                                                   11.423269
      min
                    52.962000
                                   318.051000
                                                    293.312000
                                                                  133.878000
      25%
                    63.954000
                                   321.179500
                                                    296.338500
                                                                  156.091000
      50%
                    68.147000
                                   322.380000
                                                    297.636500
                                                                  164.333000
      75%
                    71.760750
                                   329.575000
                                                    303.777000
                                                                  172.555000
                                   333.223000
      max
                    75.974000
                                                    309.854000
                                                                  189.268000
             •••
             WeakLiquorF
                             BlackFlow-2
                                                                         T-Top-Chips-4
                                            WeakWashF
                                                        SteamHeatF-3
      count
                226.000000
                               226.000000
                                            226.000000
                                                            226.000000
                                                                             226.000000
                874.123035
                                                                             251.177779
      mean
                              1149.895257
                                            273.739403
                                                             49.810239
      std
                120.259977
                               150.321416
                                            163.452307
                                                              4.143153
                                                                               1.221296
      min
                596.446000
                               838.948000
                                              0.00000
                                                             38.283000
                                                                             248.359000
      25%
                784.366750
                              1014.977000
                                            149.331750
                                                             46.639750
                                                                             250.290750
      50%
                866.170000
                              1126.513500
                                            283.079500
                                                             50.128500
                                                                             251.233000
      75%
                968.683250
                              1302.847000
                                            414.599750
                                                             52.889250
                                                                             252.240000
               1132.181000
                              1392.868000
                                                             59.564000
                                                                             254.122000
      max
                                           715.715000
              SulphidityL-4
      count
                  226.000000
      mean
                   15.391987
      std
                   15.297984
      min
                    0.00000
      25%
                    0.00000
      50%
                   29.065000
      75%
                   30.437500
      max
                   32.840000
      [8 rows x 22 columns]
[33]: data2.matrix=data2.values.reshape(-1,1)
      scaled=preprocessing.MinMaxScaler(feature_range=(0,10))
      scaled_data=scaled.fit_transform(data2)
      data2
[33]:
           Y-Kappa
                     ChipRate
                               BF-CMratio
                                            BlowFlow
                                                       ChipLevel4
                                                                     T-upperExt-2
                                                                                     \
      1
              27.60
                       16.810
                                    79.022
                                             1328.360
                                                            341.327
                                                                            351.050
      2
             23.19
                       16.709
                                    79.562
                                             1329.407
                                                            239.161
                                                                            350.022
      3
             23.60
                       16.478
                                    81.011
                                             1334.877
                                                            213.527
                                                                            350.938
```

1171.604

198.538

344.014

85.518

14.23

15.350

5

| _ | | | | | | |
|--------|--------------------|-------------|---------|-------------------------|---------------|------------|
| 6 | 13.49 | 13.700 | 98.186 | 1243.688 | 116.275 | 346.208 |
| | ••• | ••• | ••• | | ••• | |
| 276 | 22.70 | 15.517 | 83.008 | 1288.010 | 306.886 | 350.155 |
| 296 | 20.50 | 13.358 | 97.662 | 1304.597 | 377.678 | 347.672 |
| 297 | 20.40 | 14.233 | 89.790 | 1278.006 | 379.458 | 354.290 |
| | | | | | | |
| 298 | | 15.167 | 84.640 | 1283.706 | 339.440 | 354.803 |
| 307 | 20.89 14.308 | | 94.172 | 1327.832 | 251.120 | 351.263 |
| | | | | | | |
| | T-lowerExt | -2 UCZAA | WhiteFl | .ow-4 AAWhit | teSt-4 Ste | amFlow-4 \ |
| 1 | 329 | .067 1.549 | 53 | 37.201 | 6.076 | 60.012 |
| 2 | 329 | .260 1.600 | 54 | 9.611 | 0.000 | 61.304 |
| 3 | 331.142 1.604 | | 623.362 | | 6.054 | 68.496 |
| 5 | 325.195 1.436 | | 628.245 | | 6.020 | 65.225 |
| | | | 696.766 | | | |
| 6 | 326 | .982 1.434 | 69 | 0.766 | 0.000 | 72.989 |
| • • | | | ••• | ••• | | |
| 276 | 322 | .485 1.590 | 56 | 8.752 | 6.170 | 67.678 |
| 296 | 313 | .147 1.546 | 49 | 6.460 | 6.340 | 60.119 |
| 297 | 315 | .558 1.515 | 49 | 1.374 | 0.000 | 60.424 |
| 298 | 311.041 1.635 | | 532.419 | | 6.340 | 65.561 |
| 307 | | .485 1.522 | | 31.514 | 0.000 | 71.286 |
| 001 | 002 | . 100 1.022 | | .1.011 | 0.000 | 11.200 |
| | T 17 | | | C1 : M 4 | | ר בו בו |
| | Lower-Heat | | | - | WeakLiquorF | |
| 1 | 330. | | 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 | | | 309.346 | 160.061 | 910.013 | 1381.389 |
| | 331.854 332.615 | | | | | |
| 296 | | | 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 | SteamHeat | F-3 T-T | op-Chips-4 | SulphidityL-4 | |
| 1 | 241.182 | 46 | .603 | 251.406 | 29.11 | |
| 2 | 237.272 | | .795 | 251.335 | 0.00 |) |
| 3 | 239.478 | | .846 | 250.312 | 29.02 | |
| | | | | | | |
| 5 | 595.875 | | .807 | 249.580 | 30.34 | |
| 6 | 201.272 | 58 | .118 | 248.741 | 0.00 | |
| | ••• | ••• | | ••• | ••• | |
| 276 | 441.934 | 51 | .466 | 252.216 | 29.59 | 1 |
| 296 | 389.497 | 46 | .206 | 252.423 | 30.43 | ; |
| 297 | 388.676 | 47 | .803 | 252.311 | 0.00 | |
| 298 | 388.911 | | .524 | 251.833 | 30.29 | |
| 307 | 232.729 | | .503 | 250.084 | 0.00 | |
| .3(1)/ | | | | /// . \/\) | V. UU | |

[226 rows x 22 columns]

[]: