HoneywellPreliminaryModelling

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Sprint:PO_SPRINT_04_JAN_2019 Objective:Assemble Dataset for Regression Modelling

Introduction:Honeywell Chemical Manufacuturing data contains more than 1000 PI tags divided into 10 phases across 3 years along with 15 test parameters.

Scope:The sample contains 26 Process Variable PI tags from phase 2 from October to December which has 25 batches (2 offspec) modelled against ABD parameter. Below is a glimpse of the assembeled data. In order to assemble this dataset some assumptions were made:

1.There is no Threshhold value for PI tag recording 2.There is no recording inbetween minutes 3.There is a linear relationshipbetween PItags and ABD

Below is a glimpse of the assembled sample which contains raw values with dimensions 50,000 rows and 26 coloumns

```
##     ProcessOrderNumber BatchNumber Totalminutes ABDvalue
##  1:              71646        2429        12405    0.556
##  2:              71646        2429        12405    0.556
##  3:              71646        2429        12405    0.556
##  4:              71646        2429        12405    0.556
##  5:              71646        2429        12405    0.556
##  6:              71646        2429        12405    0.556
##  7:              71646        2429        12405    0.556
##  8:              71646        2429        12405    0.556
##  9:              71646        2429        12405    0.556
## 10:              71646        2429        12405    0.556
## 11:              71646        2429        12405    0.556
##                      t1 SC2_AI20461.pv_Ph_2
##  1: 2017-10-13 01:26:00         0.873102248
##  2: 2017-10-13 01:27:00         0.873102248
##  3: 2017-10-13 01:28:00         0.873102248
##  4: 2017-10-13 01:30:00         0.873102248
##  5: 2017-10-13 01:31:00         0.873102248
##  6: 2017-10-13 01:32:00         0.873102248
##  7: 2017-10-13 01:33:00         0.873102248
##  8: 2017-10-13 01:34:00         0.873102248
##  9: 2017-10-13 01:35:00         0.873102248
## 10: 2017-10-13 01:36:00         0.873102248
## 11: 2017-10-13 01:37:00         0.873102248
```

Aggregated Dataset

To begin analysis the PI tags have been aggregated by mean for each batch. From the snapshotbelow we can see that offspec Batch 2430 has the lowest value among all means of SC2_AI20461.pv. This similar phenonmenon has been observed for several other tags as well.

From the snapshot we can formulate a hypothesis:

Ho: Offspec batch Mean AI_20461.pv = Onspec batch Mean
H1: Offspec batch Mean AI_20461.pv < Onspec batch Mean

```
##     BatchNumber ABDvalue SC2_AI20461.pv_Ph_2 SC2_AI20462.pv_Ph_2
##  1:        2430    0.566           39.368500            1.396258
##  2:        2431    0.600           42.594194            1.391664
##  3:        2432    0.617           42.649895            1.403265
##  4:        2433    0.605           42.653104            1.408822
##  5:        2434    0.631           42.589493            1.404799
##  6:        2435    0.640           42.161390            1.408783
##  7:        2436    0.623           42.549377            1.412337
##  8:        2437    0.585           42.700269            1.413621
##  9:        2438    0.602           42.818366            1.413997
## 10:        2439    0.604           42.842110            1.412944
## 11:        2440    0.596           42.870462            1.409627
## 12:        2441    0.590           43.189251            1.410417
## 13:        2442    0.603           42.713147            1.411802
## 14:        2443    0.600           42.491696            1.410636
## 15:        2444    0.612           42.819586            1.409472
## 16:        2445    0.611           42.702345            1.409589
## 17:        2446    0.622           42.684539            1.409356
## 18:        2447    0.623           42.782644            1.410671
## 19:        2448    0.620           42.563939            1.410945
## 20:        2449    0.622           42.683105            1.410956
## 21:        2450    0.630           42.670590            1.411047
## 22:        2451    0.635            6.108809            1.394147
## 23:        2452    0.634           40.992476            1.410018
## 24:        2453    0.634           20.122706            1.390782
## 25:        2454    0.634           37.231057            1.399343
## 26:        2455    0.634           42.435805            1.415191
## 27:        2456    0.634           42.602582            1.414749
## 28:        2457    0.634           42.630735            1.414369
## 29:        2458    0.634           42.251995            1.413979
## 30:        2459    0.634           42.414787            1.415251
## 31:        2460    0.634           42.084023            1.415082
## 32:        2461    0.634           42.061863            1.414375
## 33:        2462    0.634           42.087445            1.411959
## 34:        2463    0.634           42.431820            1.410280
## 35:        2464    0.634           42.552073            1.410008
## 36:        2465    0.634           42.621297            1.409802
## 37:        2466    0.634           42.702987            1.410263
## 38:        2467    0.634           42.715495            1.410957
## 39:        2468    0.634           42.590783            1.413251
## 40:        2469    0.634           42.667175            1.412498
## 41:        2470    0.634           42.704041            1.413455
## 42:        2471    0.634           42.715999            1.414308
## 43:        2472    0.634           42.852517            1.414255
##     BatchNumber ABDvalue SC2_AI20461.pv_Ph_2 SC2_AI20462.pv_Ph_2
##     SC2_AI20464.pv_Ph_2 SC2_AI20757.pv_Ph_2 SC2_AI20759.pv_Ph_2
##  1:            1.009121           0.9953143            1.411375
##  2:            1.009850           0.9941802            1.391290
##  3:            1.009259           0.9940469            1.403505
##  4:            1.008822           0.9930902            1.408857
##  5:            1.010421           0.9970227            1.405950
##  6:            1.009850           0.9982790            1.409351
##  7:            1.010499           0.9969566            1.408938
##  8:            1.010712           0.9991041            1.413375
```

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##  9:            1.010712          0.9996008           1.414292
## 10:            1.010585          0.9983492           1.413651
## 11:            1.010415          0.9960261           1.410462
## 12:            1.010414          0.9961830           1.409832
## 13:            1.010698          0.9983468           1.411721
## 14:            1.010336          0.9947553           1.410805
## 15:            1.009613          0.9933445           1.409581
## 16:            1.009613          0.9931749           1.409458
## 17:            1.009429          0.9934262           1.410168
## 18:            1.009479          0.9931797           1.411165
## 19:            1.009552          0.9929456           1.411418
## 20:            1.009491          0.9937339           1.411770
## 21:            1.008887          0.9937288           1.411728
## 22:            1.010183          0.9979967           1.411375
## 23:            1.010137          0.9974308           1.411375
## 24:            1.010617          0.9988739           1.411375
## 25:            1.010712          1.0000864           1.411375
## 26:            1.010712          0.9983416           1.414884
## 27:            1.010712          0.9987967           1.414741
## 28:            1.010712          0.9981443           1.414452
## 29:            1.010712          0.9985229           1.414733
## 30:            1.010712          0.9985862           1.415407
## 31:            1.010712          0.9982299           1.415135
## 32:            1.010712          0.9981661           1.414907
## 33:            1.010712          0.9973154           1.412911
## 34:            1.010555          0.9960676           1.411078
## 35:            1.010312          0.9959748           1.410732
## 36:            1.010258          0.9962841           1.411363
## 37:            1.009154          0.9954866           1.411411
## 38:            1.009308          0.9947109           1.411728
## 39:            1.010485          0.9996769           1.414008
## 40:            1.010712          0.9986284           1.413160
## 41:            1.010712          0.9998444           1.414179
## 42:            1.010712          0.9985752           1.414943
## 43:            1.010712          0.9995943           1.415173
##     SC2_AI20464.pv_Ph_2 SC2_AI20757.pv_Ph_2 SC2_AI20759.pv_Ph_2
##     SC2_FIC20461.pv_Ph_2 SC2_FIC20462.pv_Ph_2 SC2_FIC20463.pv_Ph_2
##  1:             55.92646             26.63250             17.983888
##  2:             56.56925             21.73457              9.806779
##  3:             68.32130             20.77475             13.684864
##  4:             69.69248             22.92029             13.407348
##  5:             47.03100             10.44629             26.613586
##  6:             65.15665             19.45924             50.528361
##  7:             70.15016             22.31488             49.889383
##  8:             67.79588             22.23884             47.697729
##  9:             63.51368             21.19581             44.002113
## 10:             67.75988             21.78397             42.477453
## 11:             62.79883             21.99617             44.097484
## 12:             62.16672             21.81639             41.310540
## 13:             67.77485             22.37974             33.362847
## 14:             63.04623             23.18894             38.313411
## 15:             60.44070             22.88247             39.507895
## 16:             62.14612             23.00485             40.028234
## 17:             63.27970             22.42233             44.555962
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## 18:             61.33973             23.22240            39.312331
## 19:             62.33850             23.49547            44.732605
## 20:             61.25455             22.28055            45.413183
## 21:             62.33886             22.87874            35.888986
## 22:             62.48923             26.63250            20.420876
## 23:             62.48923             26.63250            27.564544
## 24:             62.48923             26.63250            38.313411
## 25:             62.48923             23.30392            16.471388
## 26:             67.60988             26.63250            17.184200
## 27:             67.79529             26.63250            19.126323
## 28:             66.54400             25.77102            16.897956
## 29:             66.69280             26.63250            39.203939
## 30:             58.17716             42.48756            52.840801
## 31:             50.78585             46.80318            50.993378
## 32:             63.30846             26.63250            47.649283
## 33:             57.66630             26.63250            53.095934
## 34:             56.55021             26.63250            53.081938
## 35:             57.53421             26.63250            42.437489
## 36:             57.85826             39.99114            49.878032
## 37:             60.00640             40.74891            50.860191
## 38:             62.57140             38.99495            52.203863
## 39:             64.93213             37.92619            48.758597
## 40:             63.37869             37.90489            48.557462
## 41:             63.00817             25.46356            52.344297
## 42:             65.86250             30.31180            44.981140
## 43:             65.95690             30.09620            41.996633
##     SC2_FIC20461.pv_Ph_2 SC2_FIC20462.pv_Ph_2 SC2_FIC20463.pv_Ph_2
##     SC2_FIC20464.pv_Ph_2 SC2_FIC20759.pv_Ph_2 SC2_FIC23500.pv_Ph_2
##  1:             39.19845             22.45285             72.84584
##  2:             31.82082             22.23084             68.20277
##  3:             44.21690             24.00611             69.81465
##  4:             45.36703             21.70887             73.80051
##  5:             45.92947             13.25669             64.54193
##  6:             55.79304             17.61175             70.66040
##  7:             55.57940             18.13231             74.01857
##  8:             54.75063             18.15211             74.32838
##  9:             52.78287             17.90750             72.68821
## 10:             50.52951             18.72695             73.27677
## 11:             49.46933             18.54940             72.40903
## 12:             49.69552             18.78171             72.26019
## 13:             44.88083             18.73988             74.50045
## 14:             45.60264             19.24219             74.63427
## 15:             47.98450             18.57912             72.85912
## 16:             48.63920             18.81153             70.70223
## 17:             49.19247             18.95234             70.70223
## 18:             45.81457             18.59915             71.27025
## 19:             47.38305             19.00797             72.44484
## 20:             49.66100             19.01265             72.44484
## 21:             48.13639             19.49725             72.43872
## 22:             43.57420             19.46470             72.84584
## 23:             46.15570             20.35464             72.84584
## 24:             36.11656             19.06950             72.84584
## 25:             24.83436             20.05559             72.84584
## 26:             27.72829             21.16626             85.71072
```

```
## 27:             28.13670             19.56310             72.84584
## 28:             29.64085             19.38125             72.84584
## 29:             30.00474             19.22099             72.84584
## 30:             31.89672             17.03190             74.93608
## 31:             33.24686             15.75976             67.38182
## 32:             31.94956             22.06805             73.41159
## 33:             30.88770             21.82401             75.25254
## 34:             30.85408             16.71926             72.51458
## 35:             30.73417             17.10304             72.15900
## 36:             29.75757             17.43839             72.44815
## 37:             26.36243             17.64509             71.91480
## 38:             28.88873             17.17157             72.52204
## 39:             29.05444             18.68823             74.76530
## 40:             29.38917             17.65888             74.11395
## 41:             33.45457             18.43587             74.62499
## 42:             34.19850             18.35926             74.51594
## 43:             30.40906             18.21683             75.33469
##     SC2_FIC20464.pv_Ph_2 SC2_FIC20759.pv_Ph_2 SC2_FIC23500.pv_Ph_2
##     SC2_IT20903.pv_Ph_2 SC2_IT21850.pv_Ph_2 SC2_IT21853.pv_Ph_2
##  1:           40.850898           42.206128           0.0000000
##  2:           40.831364           42.349343           0.0000000
##  3:           41.262172           42.391719           1.3820106
##  4:           40.995109           42.662281           1.6603339
##  5:           13.966780           29.162087           1.7083654
##  6:           41.016547           41.756178           1.7289843
##  7:           40.863833           42.569586           1.6857118
##  8:           41.215962           41.849521           1.6504411
##  9:           41.795514           41.997942           1.6504411
## 10:           41.336176           42.079179           1.6504411
## 11:           42.041208           41.963060           1.6504411
## 12:           42.002812           42.040737           1.6504411
## 13:           41.935298           42.201036           1.4066218
## 14:           41.763770           42.743777           2.1802423
## 15:           40.886476           41.684484           2.1802423
## 16:           41.007839           42.568639           2.1802423
## 17:           41.240638           42.745542           2.1802423
## 18:           41.957894           42.532566           2.1802423
## 19:           41.804836           42.887163           2.1802423
## 20:           41.955749           43.245277           2.1802423
## 21:           41.840565           43.187674           2.1802423
## 22:            8.728368           24.840760           1.6783191
## 23:           42.128922           42.595426           0.3968542
## 24:            1.564849            3.015655           0.2990245
## 25:           39.796956           42.599494           4.9048965
## 26:           41.650635           42.967208           5.4451122
## 27:           41.687387           42.999820           5.4626659
## 28:           41.608033           42.966088           5.4718887
## 29:           41.393312           43.217827           5.5083944
## 30:           34.087273           41.447267           5.7059924
## 31:           41.744743           42.997528           6.0628071
## 32:           41.378166           42.378920           6.0445994
## 33:           41.175800           42.221107           5.7942443
## 34:           41.129282           42.072268           5.7942443
## 35:           41.131484           42.056717           5.7942443
```

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## 36:           40.996334           42.224072           5.6270731
## 37:           41.379076           42.252396           5.0618000
## 38:           41.586949           42.341770           5.0874227
## 39:           41.803931           42.761929           5.6883072
## 40:           41.880713           42.716084           5.3042863
## 41:           41.606929           42.389607           5.2784189
## 42:           41.395667           42.631213           5.7396265
## 43:           41.329452           42.638055           5.8107243
##     SC2_IT20903.pv_Ph_2 SC2_IT21850.pv_Ph_2 SC2_IT21853.pv_Ph_2
##     SC2_JI20902.pv_Ph_2 SC2_JI20903.pv_Ph_2 SC2_LIC20003.pv_Ph_2
##  1:           0.4480117            717.2105            80.484607
##  2:           0.4480117          19608.2637            80.484607
##  3:           1.0639163          19608.2637            80.484607
##  4:           1.1000864          19749.9902            80.484607
##  5:           1.2098342           1597.1881            84.168968
##  6:           1.0819510              0.0000            83.953369
##  7:           1.0256593          13997.2852            83.953369
##  8:           0.9826960          19874.1426            83.953369
##  9:           0.9167760          19874.1426            83.953369
## 10:           0.9167760           7190.5142            84.291121
## 11:           0.9167760           5602.4658            83.672600
## 12:           0.9433967          19893.2598            83.730154
## 13:           1.0193688          20175.1758            83.836874
## 14:           0.9695919          20175.1758            84.423466
## 15:           0.9753715          20175.1758            84.231087
## 16:           0.9753715          20175.1758            84.231087
## 17:           0.9753715          19814.2405            84.231087
## 18:           1.0353517          10482.7422            84.226544
## 19:           0.9702129          17508.8639            83.269752
## 20:           0.9424116          20162.7246            83.269752
## 21:           0.9424116          20162.7246            85.841048
## 22:           0.4546018           4064.6768             7.037228
## 23:           0.8365324              0.0000            45.264379
## 24:           0.2418177            239.1054            80.607149
## 25:           1.1717249              0.0000            34.995649
## 26:           1.2588495              0.0000            86.147652
## 27:           1.2555314          14344.9066            86.147652
## 28:           1.2555314          19990.7876            86.147652
## 29:           1.1797848          19502.5422            85.372974
## 30:           1.2649673          13052.2160            83.786227
## 31:           1.5448469              0.0000            84.612564
## 32:           1.5448469              0.0000            84.612564
## 33:           1.5090536              0.0000            84.464977
## 34:           1.4502395              0.0000            84.126877
## 35:           1.3809265              0.0000            83.935059
## 36:           1.3524695              0.0000            84.738635
## 37:           1.4508665          12472.2695            87.215869
## 38:           1.4297139          19906.3691            88.470108
## 39:           1.2656532          19906.3691            87.158240
## 40:           1.2339538          19906.3691            86.416214
## 41:           1.2895681          19906.3691            85.467695
## 42:           1.3201106          19942.5652            86.185365
## 43:           1.2311167          19883.7959            86.751915
##     SC2_JI20902.pv_Ph_2 SC2_JI20903.pv_Ph_2 SC2_LIC20003.pv_Ph_2
```

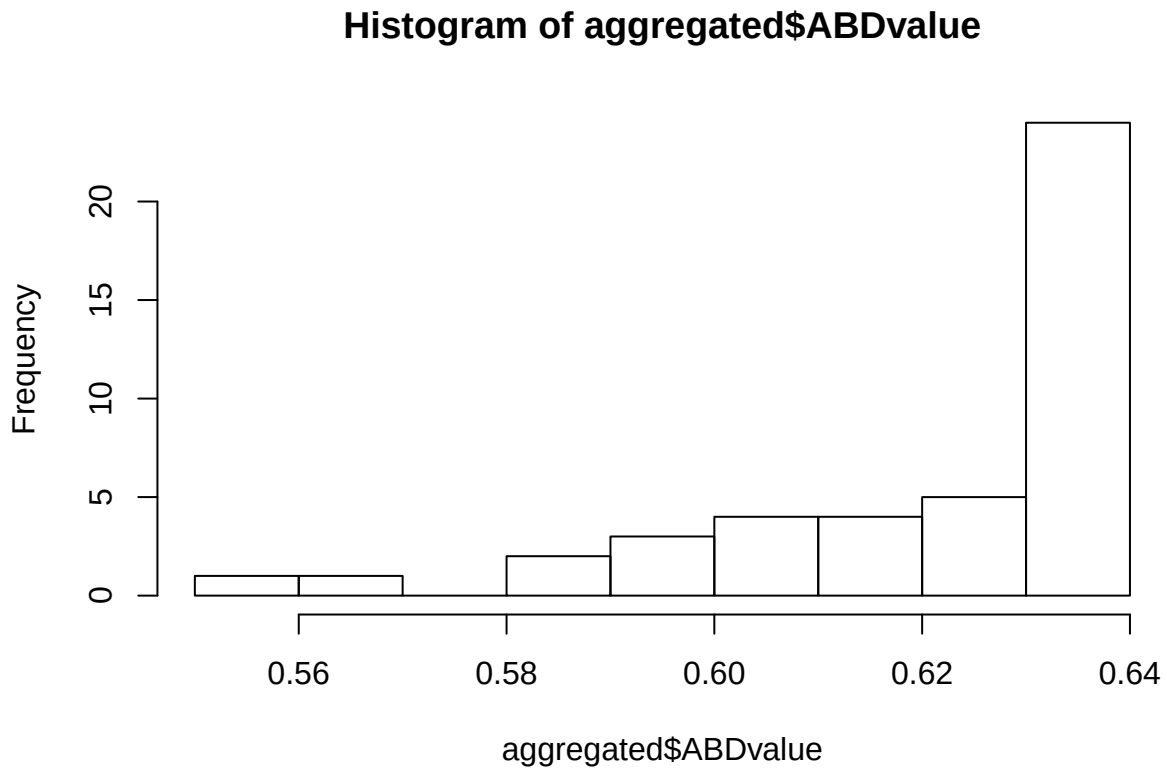
```
##     SC2_LIC20064.pv_Ph_2 SC2_PIC20002.pv_Ph_2 SC2_PIC20065.pv_Ph_2
##  1:             62.03506            100.00000             61.98457
##  2:             59.03395            100.00000             45.81439
##  3:             64.26167            100.00000             48.03117
##  4:             65.34029             69.70431             55.02578
##  5:             73.12724             56.53377             48.53404
##  6:             76.34978             61.17130             49.01110
##  7:             76.13102             61.17130             43.39413
##  8:             67.51476             61.17130             43.41602
##  9:             74.68536             61.17130             44.03109
## 10:             68.28508             61.17130             48.17450
## 11:             72.52933             60.16159             62.88949
## 12:             67.05108             57.23941             45.77620
## 13:             69.20430             59.06832             43.88654
## 14:             69.82707             55.50950             44.95768
## 15:             66.22463             51.53540             53.22691
## 16:             60.84170             47.57773             57.59085
## 17:             63.81206             49.34111             49.80858
## 18:             67.14103             48.73577             47.25542
## 19:             78.68629             53.60536             53.86866
## 20:             65.84866             48.14608             59.44270
## 21:             76.94669             48.40397             55.67169
## 22:             23.79264             85.47732             71.36173
## 23:             68.89231             51.45261             54.96511
## 24:             33.45641             79.28915             32.49862
## 25:             67.27851             71.09803             26.44560
## 26:             73.95875             61.06485             25.91989
## 27:             73.09288             61.11026             20.78948
## 28:             78.32186             60.25517             22.35138
## 29:             75.49153             59.45427             19.78402
## 30:             78.26236             59.91924             23.56883
## 31:             85.13139             60.60671             24.35987
## 32:             82.34537             60.60671             23.18442
## 33:             74.83243             60.60671             22.83700
## 34:             75.17869             60.60671             20.81600
## 35:             67.38525             60.60671             19.40367
## 36:             68.33501             59.31278             23.00106
## 37:             83.11471             59.14182             24.22266
## 38:             93.52446             59.14182             21.25725
## 39:             91.88473             59.14182             20.76560
## 40:             79.76979             59.14182             20.85322
## 41:             78.74616             60.91572             23.93621
## 42:             85.03319             59.41247             24.61288
## 43:             81.23047             59.35240             23.34367
##     SC2_LIC20064.pv_Ph_2 SC2_PIC20002.pv_Ph_2 SC2_PIC20065.pv_Ph_2
##     SC2_TI20585.pv_Ph_2 SC2_TI20586.pv_Ph_2 SC2_TI20587.pv_Ph_2
##  1:            78.80184            42.19118            65.67278
##  2:            78.80184            40.51332            65.67278
##  3:            66.51832            40.51332            65.67278
##  4:            37.01143            39.93311            65.67278
##  5:            63.50540            55.30069            66.86149
##  6:            42.42683            38.51741            59.59349
##  7:            42.42683            39.38775            59.59349
##  8:            42.42683            42.36274            59.59349
```

```
##  9:           42.42683           42.36274           59.59349
## 10:           42.42683           39.33439           59.59349
## 11:           38.24144           38.34346           59.59349
## 12:           44.94045           38.34346           59.59349
## 13:           42.57290           38.34346           60.10458
## 14:           41.13953           41.98137           61.20798
## 15:           41.82257           43.30839           61.32389
## 16:           41.82257           43.47972           61.32389
## 17:           41.82257           43.23349           61.32389
## 18:           41.82257           44.02056           61.32389
## 19:           41.82257           44.11145           61.32389
## 20:           43.45245           44.11145           61.32389
## 21:           46.30878           45.35901           61.20082
## 22:           49.28144           49.23747           59.12302
## 23:           49.69451           55.79431           58.03034
## 24:           61.18098           59.48622           60.39577
## 25:           47.10532           38.72799           41.01688
## 26:           46.01332           38.72799           41.01688
## 27:           43.06772           38.72799           54.57665
## 28:           43.06772           38.72799           60.50905
## 29:           43.06772           38.72799           61.24145
## 30:           40.73360           39.82063           60.10690
## 31:           38.77377           39.99146           59.08994
## 32:           38.77377           40.02253           65.31737
## 33:           38.77377           39.98986           68.33704
## 34:           38.77377           38.82870           68.33704
## 35:           38.83605           38.82870           68.33704
## 36:           42.72897           38.82870           68.19219
## 37:           42.72897           41.40334           65.95062
## 38:           42.72897           43.38816           65.55376
## 39:           41.98180           43.38816           65.55376
## 40:           40.15625           43.38816           66.32900
## 41:           40.69751           43.38816           67.11935
## 42:           41.34648           43.05594           65.89767
## 43:           41.34648           38.17865           65.77349
##     SC2_TI20585.pv_Ph_2 SC2_TI20586.pv_Ph_2 SC2_TI20587.pv_Ph_2
##     SC2_TI20588.pv_Ph_2 SC2_TI20589.pv_Ph_2 SC2_TIC20627.pv_Ph_2
##  1:           80.05615           73.84869            80.82522
##  2:           80.05615           32.20751            80.82522
##  3:           80.05615           20.48097            80.82522
##  4:           80.05615           20.48097            80.82522
##  5:           72.87946           32.70513            67.77599
##  6:           51.44505           27.97021            68.28211
##  7:           51.44505           27.97021            68.28211
##  8:           51.44505           28.10879            68.28211
##  9:           51.44505           28.66324            68.28211
## 10:           54.71559           26.12021            68.28211
## 11:           58.54957           22.87057            68.28211
## 12:           59.28792           30.59570            68.28211
## 13:           58.76034           30.51800            68.28211
## 14:           58.76034           26.25909            68.28211
## 15:           58.76034           25.71795            68.28211
## 16:           58.76034           25.71795            68.28211
## 17:           58.76034           28.97619            68.28211
```

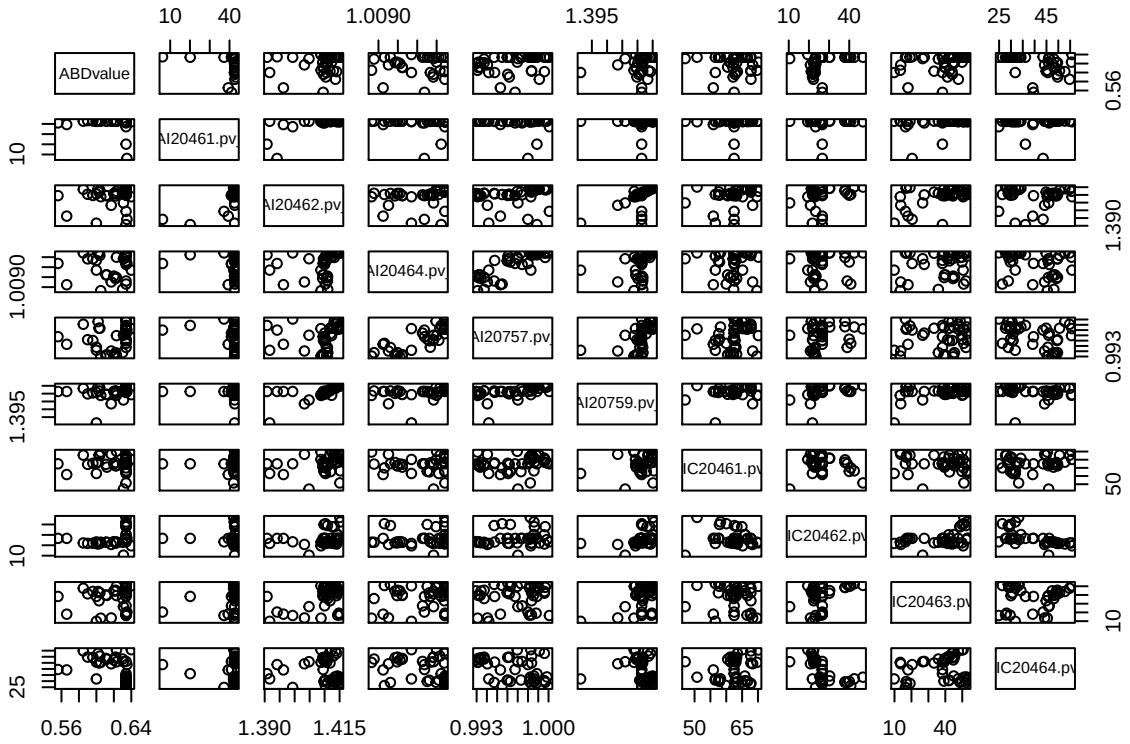
```
## 18:            58.76034            30.73519            68.28211
## 19:            61.43834            30.73519            68.28211
## 20:            64.12550            30.73519            68.28211
## 21:            64.12550            34.41910            54.51255
## 22:            61.25094            27.78862            51.44337
## 23:            55.79394            28.54701            53.89874
## 24:            60.29860            34.69346            59.59203
## 25:            51.71069            53.49590            43.30576
## 26:            59.08099            50.11428            43.30576
## 27:            58.87584            27.58707            43.30576
## 28:            56.92923            27.51059            43.30576
## 29:            56.92923            26.52364            45.62615
## 30:            54.86419            26.23968            45.55560
## 31:            51.41758            24.76577            46.22639
## 32:            57.06406            24.76577            45.99325
## 33:            58.84274            24.79712            45.89679
## 34:            58.84274            27.15537            45.89679
## 35:            58.84274            27.15537            45.89679
## 36:            60.48717            27.76649            45.89679
## 37:            71.64352            29.40764            45.89679
## 38:            71.84362            29.40764            45.89679
## 39:            71.84362            29.40764            45.89679
## 40:            71.84362            29.40035            46.89036
## 41:            71.84362            27.87866            46.34368
## 42:            71.84362            27.87866            45.72283
## 43:            71.84362            27.87866            45.54428
##     SC2_TI20588.pv_Ph_2 SC2_TI20589.pv_Ph_2 SC2_TIC20627.pv_Ph_2
##     SC2_TIC20629.pv_Ph_2 SC2_TIC20756.pv_Ph_2
##  1:             58.00043             22.18696
##  2:             58.00043             22.18696
##  3:             58.00043             22.18696
##  4:             58.00043             19.99742
##  5:             58.00043             19.68146
##  6:             58.00043             19.94079
##  7:             58.00043             19.94079
##  8:             58.00043             19.94079
##  9:             58.00043             19.94079
## 10:             58.00043             19.90767
## 11:             58.00043             19.69054
## 12:             58.00043             19.69054
## 13:             58.00043             19.69054
## 14:             58.00043             19.93409
## 15:             58.00043             20.09090
## 16:             58.00043             20.09949
## 17:             58.00043             20.09949
## 18:             58.00043             20.07758
## 19:             58.00043             20.04456
## 20:             58.00043             20.04456
## 21:             58.00043             20.04456
## 22:             58.00043             20.04456
## 23:             58.00043             20.04456
## 24:             58.00043             20.04456
## 25:             58.00043             20.04456
## 26:             58.00043             20.04456
```

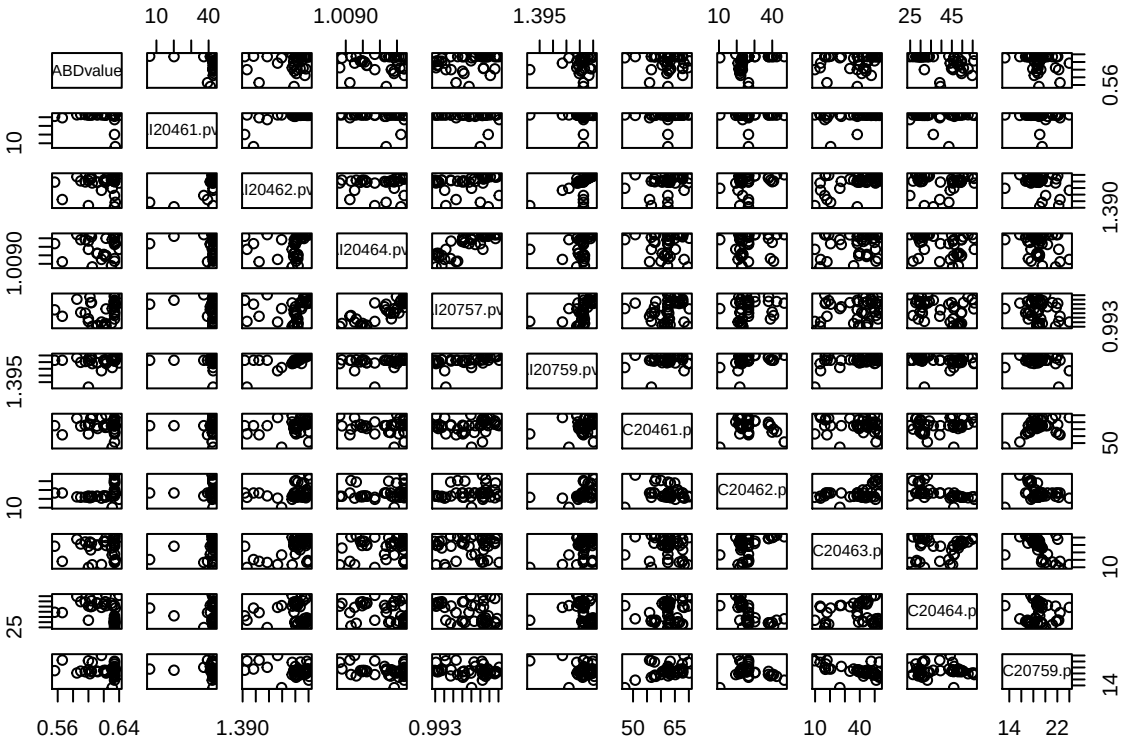
```
## 27:             58.00043             20.04456
## 28:             58.00043             20.04456
## 29:             58.00043             20.04456
## 30:             61.55557             20.04456
## 31:             65.00137             20.04456
## 32:             65.00137             20.04456
## 33:             65.00137             20.04456
## 34:             65.00137             20.04456
## 35:             65.00137             20.04456
## 36:             65.00137             20.04456
## 37:             65.00137             20.04456
## 38:             65.00137             20.04456
## 39:             65.00137             20.04456
## 40:             65.00137             20.04456
## 41:             65.00137             20.04456
## 42:             65.00137             20.04456
## 43:             65.00137             20.04456
##     SC2_TIC20629.pv_Ph_2 SC2_TIC20756.pv_Ph_2
```

```
hist(aggregated$ABDvalue)
```

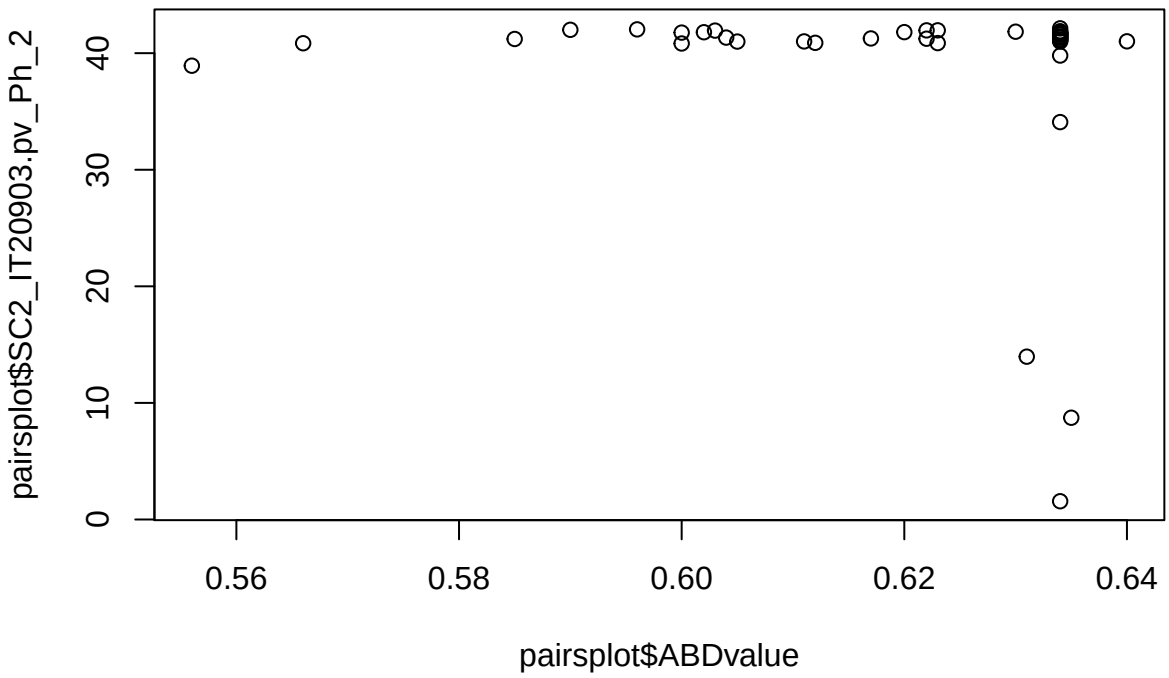


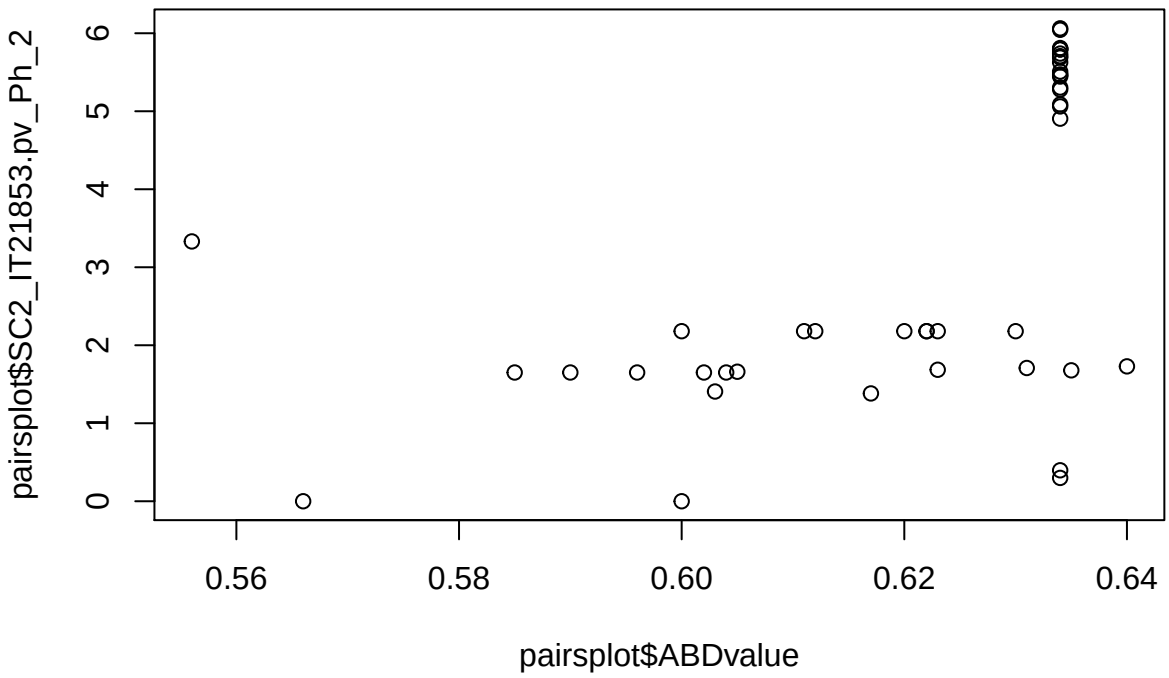
From the table of aggregated values of PI for each batch, pairplots have been prepared between ABD and the first 10 variables. The first variables on the top left corner "ABD" are plotted against the available "AI.pv" tags which had high regression coefficients.

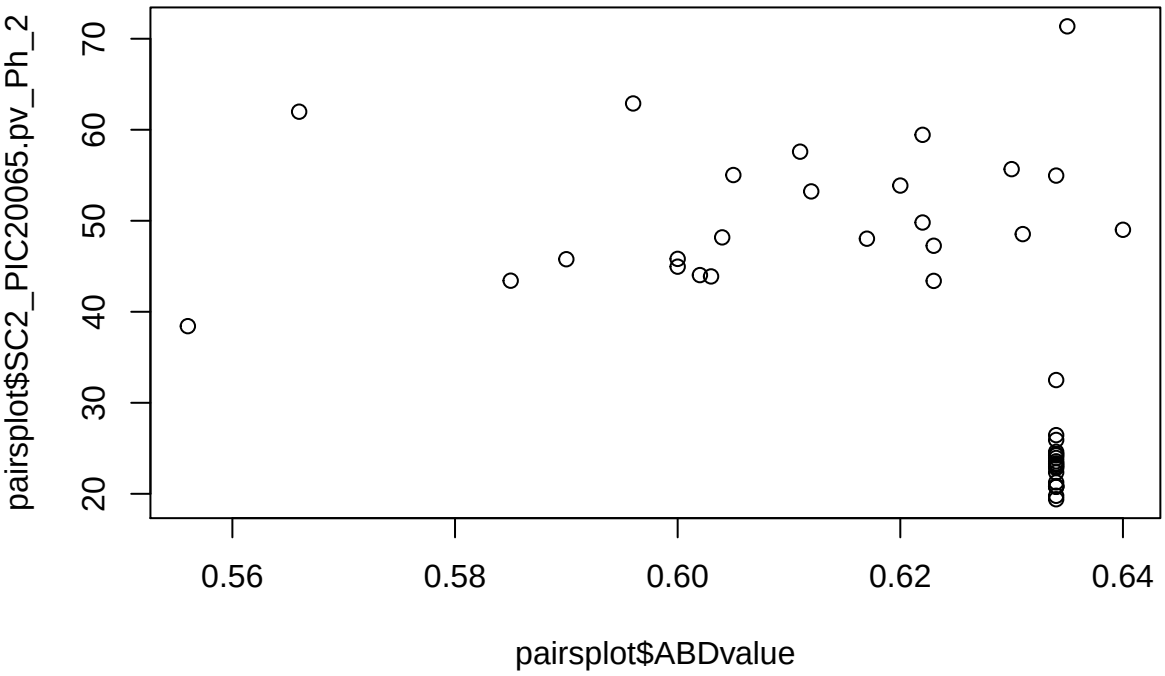

ABDvalue
AI20461.pv
AI20462.pv
AI20464.pv
AI20757.pv
AI20759.pv
IC20461.pv
IC20462.pv
IC20463.pv
IC20464.pv
10 40
1.0090
1.395
10 40
25 45
0.56
1.390
0.993
50
10
0.56 0.64
1.390 1.415
0.993 1.000
50 65
10 40

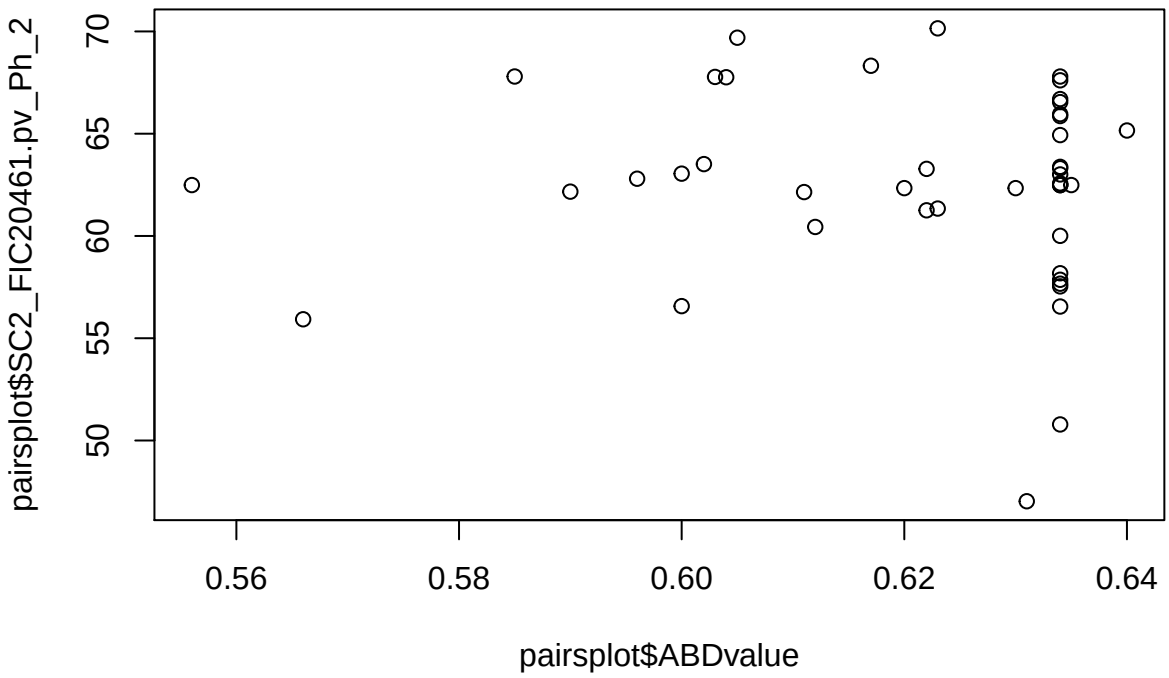


The above visualisation bieng large and unreadable at glance has been broken into 3 scatter plots which show a slightly inverse relationship between the AI tag and ABD value.


pairsplot$SC2_IT20903.pv_Ph_2
0
10
20
30
40
0.56
0.58
0.60
0.62
0.64
pairsplot$ABDvalue


pairsplot$SC2_IT21853.pv_Ph_2
0
1
2
3
4
5
6
0.56
0.58
0.60
0.62
0.64
pairsplot$ABDvalue


pairsplot$SC2_PIC20065.pv_Ph_2
20
30
40
50
60
70
0.56
0.58
0.60
0.62
0.64
pairsplot$ABDvalue




```
##                     PItag Beta
##  1:  SC2_IT21850.pv_Ph_2   -2
##  2: SC2_PIC20002.pv_Ph_2   -2
##  3:  SC2_AI20759.pv_Ph_2   -1
##  4: SC2_LIC20003.pv_Ph_2   -1
##  5: SC2_PIC20065.pv_Ph_2   -1
##  6:  SC2_TI20585.pv_Ph_2   -1
##  7:  SC2_TI20586.pv_Ph_2   -1
##  8: SC2_TIC20627.pv_Ph_2   -1
##  9: SC2_TIC20629.pv_Ph_2   -1
## 10:          (Intercept)    0
## 11:  SC2_AI20461.pv_Ph_2    0
## 12:  SC2_AI20464.pv_Ph_2    0
## 13:  SC2_AI20757.pv_Ph_2    0
## 14: SC2_FIC20461.pv_Ph_2    0
## 15: SC2_FIC20462.pv_Ph_2    0
## 16: SC2_FIC20463.pv_Ph_2    0
## 17: SC2_FIC20464.pv_Ph_2    0
## 18: SC2_FIC20759.pv_Ph_2    0
## 19: SC2_FIC23500.pv_Ph_2    0
## 20:  SC2_IT20903.pv_Ph_2    0
## 21:  SC2_IT21853.pv_Ph_2    0
## 22:  SC2_JI20902.pv_Ph_2    0
## 23:  SC2_JI20903.pv_Ph_2    0
## 24: SC2_LIC20064.pv_Ph_2    0
## 25:  SC2_TI20587.pv_Ph_2    0
```

```
## 26:  SC2_TI20589.pv_Ph_2    0
## 27:  SC2_AI20462.pv_Ph_2    1
## 28:  SC2_TI20588.pv_Ph_2    1
## 29: SC2_TIC20756.pv_Ph_2    2
##                    PItag Beta
```

Y=a+b1*X1+e

ABDvalue=Intercept+coefficients*Sensorvalue

ABDvalue=0.8167078673-0.2066246939(SC2__AI20757.pv__Ph__2)+e