metabolite data of lung cancer

2024-07-04

R Markdown

The metabolomics dataset were extracted from the Metabolomics Workbench (https://www.metabolomicsworkbench.org/) with study ID ST001231. The dataset consists of 31 plasma samples from individuals with lung cancer (experimental group) and 35 plasma samples from individuals without lung cancer (control group). The data were acquired using untargeted metabolomics via UPLC-QE-MS experiments, resulting in a metabolite intensity matrix for all samples, which was used for subsequent statistical analysis.

```
load("Rmarkdown_lung_cancer.RData")
head(data_LC,3)
```

```
##
     group 70.4385511982798_8.53392166666667 70.9459556875659_0.471844973333333
## X1 treat
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                                                                    260155.0339
## X2 treat
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                                                                    196287.2587
## X3 treat
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                                                                    303776.0334
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##
## X1
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## X2
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## X3
                     7203440.272
                                                426274.0454
##
     554222.5838
## X1
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## X2
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## X3
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## X1
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## X2
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##
## X1
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## X2
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                                                             215485.1963
## X3
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                                                             218814.0883
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##
## X1
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## X2
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                                                       1090021.621
## X3
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                                                       1352878.806
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## X1
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## X2
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                                                               1811855.061
## X3
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     77.0144286186203_10.784427 78.9187395494629_10.6943703333333
## X1
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## X2
                    139027.8547
                                                      320970.0265
## X3
                    163663.3202
                                                      705393.3511
```

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## X1
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                            74034.23129
## X2
                                                               464687.8124
## X3
                             181482.386
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## X1
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                                                         591376.9452
## X2
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## X3
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## X2
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## X3
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## X2
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                                                        42038.02202
## X3
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                          128033.6482
## X2
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## X3
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                                                        699706.9215
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## X2
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## X3
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                                                               678672.4956
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## X1
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## X2
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                     1064009.518
                                                         2032160.252
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## X2
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## X3
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## X1
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## X2
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## X3
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## X2
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## X2
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                     992818.6368
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## X2
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## X3
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## X2
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## X3
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## X3
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## X2
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## X3
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## X2
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## X3
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## X2
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## X2
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## X2
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## X3
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## X3
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## X3
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## X3
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## X3
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## X3
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## X2
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## X2
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## X3
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## X1
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## X2
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## X3
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                                                       5138369.468
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## X1
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## X2
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## X3
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                           2510663.961
## X2
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## X2
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## X3
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## X1
## X2
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## X3
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## X2
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## X3
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## X3
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## X2
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## X2
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## X1
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## X2
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## X3
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## X1
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## X2
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                                                       900584.2959
## X3
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## X1
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## X2
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## X2
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## X3
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## X2
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## X3
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```

```
93.0092623947407 9.07240716666667 93.0092579816054 7.54990888333333
## X1
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## X2
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## X2
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## X3
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## X2
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## X3
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## X2
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## X3
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## X2
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## X2
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## X3
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## X3
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## X3
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## X2
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## X2
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## X3
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## X2
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## X3
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```

```
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## X3
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## X2
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## X3
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## X3
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## X2
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## X3
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## X2
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## X3
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3506987.052
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## X3
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## X2
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## X3
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## X2
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## X2
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## X2
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## X3
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## X3
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## X3
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## X2
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## X3
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## X3
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## X2
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## X3
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## X3
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## X3
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## X2
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## X1
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## X2
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## X3
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## X3
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## X2
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## X2
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## X2
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## X3
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## X2
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## X2
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## X2
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## X3
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## X2
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## X1
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## X2
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## X3
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## X2
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## X3
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## X1
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## X2
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## X3
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## X1
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## X2
                                    Ω
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## X3
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## X2
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## X3
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## X2
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## X3
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## X2
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## X2
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## X2
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## X3
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## X1
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## X2
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## X2
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## X2
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## X2
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## X3
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## X2
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## X3
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## X2
## X3
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## X2
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## X3
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## X1
## X2
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## X3
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## X2
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## X2
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## X2
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## X2
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## X2
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## X2
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## X3
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## X2
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## X3
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## X2
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## X3
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## X2
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## X3
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## X2
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## X2
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## X2
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## X3
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## X3
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## X3
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## X2
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## X2
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## X2
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## X3
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## X1
## X2
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## X3
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## X2
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## X3
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## X1
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## X2
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## X2
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## X2
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## X2
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## X3
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## X1
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## X2
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## X2
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## X2
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## X3
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## X2
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## X3
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## X2
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## X2
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## X2
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## X3
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## X2
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## X2
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## X3
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## X2
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## X2
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## X3
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## X2
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## X2
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## X3
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## X2
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## X2
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## X3
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## X2
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                                                    4014382.778
     870.675504716003 8.1982104 871.532706169603 8.4169188
## X1
                   1492064.272
                                             3017225.357
## X2
                   1280202.753
                                              3926395.348
## X3
                    2211623.228
                                             2348169.245
     871.623833897545_8.22663075 871.688822315213_8.21398563333333
                    5472920.411
## X1
                                                     3932359.044
## X2
                    4873050.657
                                                     4826245.001
                    8254457.087
                                                     6364104.474
     872.535995324674_8.41925483333333 872.629215769781_8.20387193333333
## X1
                          1225270.573
                                                           1290345.807
## X2
                          1951841.189
                                                             1179756.4
## X3
                            1362959.5
                                                           2676890.224
     872.692463379251_8.19634803333333 873.428101774753_7.790298
                          1815968.299
## X2
                          779505.8073
                                                             0
## X3
                          3236622.008
                                                             0
     874.432335907506_7.78953273333333 874.487896663073_10.6366025
                                    0
## X1
                                                     907246.0966
## X2
                                    0
                                                     1220324.344
                                    0
                                                     4276925.634
     ## X1
                          936394.8584
                                                          45744.12784
## X2
                           750047.621
                                                           70231.1321
                          764974.8837
                                                          24521.35127
##
     875.419394565931_6.85800606666667 875.443845015387_5.99672575
## X1
                          214163.5604
## X2
                          116676.6405
## X3
                                                               0
                          539941.0821
     876.42175384965 6.85776688333333 876.447169675002 5.99712686666667
## X1
                         102053.4539
                                                          1833.763615
## X2
                         73312.13009
                                                                   0
## X3
                         319491.7002
                                                                    0
     877.420677495268 6.86210753333333 879.042900650076 0.516412976666667
## X1
                          22319.08182
                                                            1452295.015
## X2
                          11227.94315
                                                            1565716.069
                          138040.3802
                                                            1812758.853
     881.517442192887_8.2725963 882.520957586734_8.2733039
## X1
                   8602629.044
                                           4131938.815
                   14570513.09
                                             7695226.146
                   8708671.944
## X3
                                            4324267.007
     883.532758244163_8.3410101 884.536343984573_8.34170106666667
## X1
                   19499477.74
                                                    9313244.449
## X2
                    24018576.19
                                                    12333337.51
## X3
                   15303451.77
                                                    6835772.755
     885.544108850113_8.33719783333333 885.548763149576_10.7348706666667
## X1
                        8121068.381
                                                          1637799.521
## X2
                          9966998.216
                                                          1203417.063
## X3
                          8995331.725
                                                           1376548.721
```

```
885.548593721298 8.52929635 885.548728167308 8.164969
                                                10097698.87
## X1
                      173104194.4
## X2
                      113738562.9
                                                12087712.24
## X3
                      127348111.1
                                                14123191.52
      886.551903736169_10.7347306666667 886.55197954711_8.5292318
## X1
                           818311.7635
                                                    91739310.48
## X2
                            513147.2933
                                                      58333571.38
                                                      68476212.53
## X3
                            686468.4142
     886.552067372492_8.1667942 887.555057193051_8.52927535
                                                 27033265.59
## X1
                    6277870.302
## X2
                     8378649.822
                                                  19068676.8
## X3
                     8936221.923
                                                 21162331.75
     887.563125243154_8.2194574 887.55502792761_10.7345741666667
## X1
                                                      166172.9878
                  4858309.182
## X2
                    15224941.85
                                                      118693.4121
## X3
                     20687349.7
                                                      160610.5965
##
     888.557808528991_8.521246 888.567942580078_8.22264836666667
                  6360386.838
                                                      4211686.038
## X2
                    2904674.941
                                                      7205927.593
## X3
                    4760706.681
                                                      10240494.34
##
     889.570794514137_8.2257243 891.589307646775_8.26056326666667
## X1
                    2212278.771
## X2
                     3116179.658
                                                       609398.8281
                     3840088.661
## X3
                                                       264134.9023
     892.606558113276 8.20928748333333 892.606395201654 7.85756085
## X1
                            10786460.87
                                                        2234485.64
## X2
                            3530836.597
                                                        1334030.966
                            9844996.301
                                                        1898702.728
     893.608268612078_8.23878135 894.618900178455_8.23274935
## X1
                      6480365.386
                                                  1783100.458
## X2
                      2246801.986
                                                  947798.2532
## X3
                      6146865.979
                                                  3159244.524
     895.622265428411_8.22125046666667 901.542804305251_8.23278233333333
## X1
                             1709552.84
                                                              251908.9371
## X2
                            848566.2436
                                                               226830.5606
## X3
                            2448204.558
                                                              167709.3049
     903.0036079081 0.520911176666667 904.567320268961 6.97392886666667
## X1
                           767166.8651
                                                             257354.8183
## X2
                            901226.611
                                                             305066.9832
## X3
                           1226152.866
                                                             131069.9176
     907.532769664172 8.29582945 908.535894278839_8.29497876666667
## X1
                      559929.1783
                                                        327647.9265
## X2
                      1331212.227
                                                        645542.4072
                      393742.3801
                                                        202160.7969
     909.548672575181_8.46146298333333 910.552186728796_8.461470866666667
## X1
                            9149287.621
                                                              4856569.922
## X2
                            11569462.94
                                                              6292538.029
## X3
                            8292128.501
                                                              4459572.886
     911.555799291369_8.46628463333333 913.578704548917_8.30233925
## X1
                            1855980.303
                                                       114809.3561
## X2
                            2278984.949
                                                        350160.0268
## X3
                            1406537.88
                                                        907050.3323
     939.645938996734_6.86251161666667 947.570912573723_6.86321193333333
## X1
                             60585.2019
                                                              7270.799139
```

```
## X2
                             7786.345662
                                                                           0
## X3
                             16430.36163
                                                                558583.7372
##
      952.566461689504 6.72004565 953.562473533508 6.67534931666667
## X1
                      109240.0594
                                                          45717.78862
## X2
                        180584.306
                                                          39020.20797
## X3
                      72957.48165
                                                          15406.22145
##
      957.798756930756 8.37662256666667 958.801697436737 8.37652593333333
## X1
                             7211926.323
                                                                 4635411.189
## X2
                             8755698.813
                                                                 5534390.408
## X3
                             6809191.299
                                                                 4461099.263
      968.613587155947_6.85092746666667 968.693651869065_7.76195686666667
## X1
                             57111.96887
                                                                 392113.3758
## X2
                             42465.94415
                                                                 78488.54464
                                                                 9692.120274
## X3
                             119142.4966
##
      969.696865875013_7.76063576666667 978.59196861324_9.65190376666667
## X1
                             197063.9017
                                                                37666.28029
## X2
                             27886.87203
                                                               28388.12756
## X3
                                                               10840.77701
##
      979.594413162971_9.64992088333333 981.797701170069_7.9522751
## X1
                                       0
                                                         130817.0057
## X2
                             3515.689342
                                                         468687.7873
## X3
                                                         1326823.439
      983.813367096127_8.53799166666667 984.7615230973_7.36618456666667
##
## X1
                             1810387.156
                                                              174729.3528
## X2
                             1523607.676
                                                              214113.4414
## X3
                             1120981.641
                                                              307186.5647
##
      985.76474386917_7.36614323333333
## X1
                            59307.43907
## X2
                            103569.1116
## X3
                            153348.8713
```

differential genes expression analysis

Metabolites with P value less than 0.05 and $|\log FC|$ value greater than or equal to 1 were taken as differential expression metabolites

```
library(tidyr)
library(limma)

group_LC <- data_LC[,1]
new_LC <- t(data_LC[,-1])

new_LC <- new_LC %>% data.frame(stringsAsFactors = FALSE) %>%
    data.matrix()

design <- model.matrix(~0 + factor(group_LC))
    colnames(design) <- c("control", "treat")

rownames(design) <- colnames(new_LC)
    contrast.matrix <- makeContrasts(treat - control, levels = design)

fit <- lmFit(new_LC, design)
fit_2 <- eBayes(contrasts.fit(fit, contrast.matrix))</pre>
```

```
temoutput <- limma::topTable(fit_2, n = Inf, adjust = "fdr")
temoutput <- na.omit(temoutput)

temoutput <- dplyr::mutate(temoutput, g = ifelse(temoutput$adj.P.Val < 0.05 & abs(temoutput$logFC) >= 1
temoutput
```

```
logFC
##
                                                         AveExpr
## 535.057748778031_0.516444926666667
                                       -5.340094e+03 3555.54545 -1.661309e+01
## 319.059288454398_0.503172796666667
                                       -3.237126e+03 2011.30303 -1.552727e+01
## 536.060934451734 0.51198382
                                        -5.362665e+03 3176.77273 -1.514360e+01
## 452.05393045566 0.511999755
                                        -5.008143e+03 3140.83333 -1.425010e+01
## 401.062156875193_0.503139795
                                        -2.889405e+03 1902.96970 -1.322162e+01
## 557.135105183477_2.26974333333333
                                         4.698516e+03 2207.87879
                                                                  1.211395e+01
## 535.153316859592_2.26960363333333
                                         4.120194e+03 1936.24242
                                                                 1.121835e+01
## 617.060741213668 0.516419016666667
                                        -3.521524e+03 2644.89394 -1.073731e+01
## 633.121359540055_2.2698982
                                        3.538968e+03 1663.24242 1.022473e+01
## 436.913444123101_0.503115546666667
                                        -4.242477e+03 4435.12121 -9.549304e+00
## 114.941269442118_0.440606633333333
                                       -3.771688e+03 4465.36364 -9.272554e+00
## 208.049255862961_0.516499983333333
                                        -5.055706e+03 3395.37879 -9.248522e+00
## 624.963599847832_0.516384533333333
                                         1.629447e+03 2646.06061
                                                                  9.022871e+00
## 402.999365970348_0.520933191666667
                                         1.746786e+03 2195.80303
                                                                  8.886321e+00
## 320.996439093429_0.525293571666667
                                         1.826269e+03 3076.87879
                                                                  8.838676e+00
## 350.079457934943_2.26948646666667
                                         4.058602e+03 2342.22727
                                                                  8.809833e+00
## 536.156637245006_2.26969965
                                        3.617560e+03 1731.50000
                                                                  8.809075e+00
## 331.072319421068_2.26940625
                                         3.557140e+03 2244.86364
                                                                  8.758431e+00
## 649.007979600328 0.52084103
                                        1.571957e+03 5213.25758
                                                                  8.735263e+00
## 309.154964317632 2.72117703333333
                                        3.059400e+03 1477.59091
                                                                  8.606750e+00
## 544.958150900704_0.512039131666667
                                        -3.941289e+03 4422.04545 -8.575806e+00
## 460.957986031464_0.516458413333333
                                        1.552685e+03 5036.34848
                                                                  8.564924e+00
## 158.988625419471_0.53440056
                                        2.144758e+03 3919.75758
                                                                  8.552535e+00
## 340.933562882742_0.503131951666667
                                        4.713406e+03 2659.27273
                                                                  8.538255e+00
## 542.961011361576 0.516437988333333
                                         1.463335e+03 3914.92424
                                                                  8.223501e+00
## 366.108238160521_0.574231496666667
                                        -2.430327e+03 4886.19697 -8.068433e+00
## 132.946253124056_0.50758487
                                        2.235360e+03 3234.48485
                                                                  8.058878e+00
## 210.038007691908_0.54314355
                                        2.225230e+03 3370.46970
                                                                  7.950126e+00
## 89.0242967146565_0.51204397
                                         1.581563e+03 3147.96970
                                                                  7.940716e+00
## 336.036552493321_0.507567673333333
                                         1.744465e+03 4531.22727
                                                                  7.842813e+00
## 146.982769203412_0.503096021666667
                                         1.847807e+03 4891.16667
                                                                  7.805869e+00
## 409.084255950965_2.2698859
                                                                  7.680115e+00
                                         3.592849e+03 1908.37879
## 288.047988057831_0.516412976666667
                                        3.116625e+03 3151.21212
                                                                  7.657466e+00
## 427.017839882045_0.52980429
                                        -1.204820e+03 5152.24242 -7.601849e+00
## 253.030153484578_0.511987655
                                        1.675641e+03 5179.75758
                                                                  7.595242e+00
## 353.181020554741_2.85932433333333
                                        3.397685e+03 1665.93939
                                                                  7.571532e+00
## 335.03314861485 0.511941871666667
                                         1.584116e+03 4773.45455
                                                                  7.481377e+00
## 417.036058433393_0.511766318333333
                                         1.502998e+03 3532.43939
                                                                  7.465404e+00
## 131.016827280082_0.574686833333333
                                         3.165707e+03 2722.15152
                                                                  7.461038e+00
## 663.044843833303_0.508092806666667
                                         1.502002e+03 4342.00000
                                                                  7.421712e+00
## 539.335808109453_6.978329
                                         3.809018e+03 2708.96970
                                                                  7.409160e+00
## 290.196878030415 5.11415323333333
                                        -1.725479e+03 3722.83333 -7.354102e+00
## 271.069183670649_1.01121336666667
                                        3.226738e+03 2062.56061
                                                                  7.316362e+00
                                                                  7.227798e+00
## 261.072227184374_0.458920866666667
                                         1.923756e+03 2391.43939
## 474.994425728499_0.507473163333333
                                         1.744965e+03 4674.83333 7.154718e+00
```

```
## 418.039571774348 0.507557733333333
                                        1.582113e+03 3970.74242 7.113492e+00
## 299.036696042566_1.01998113333333
                                       -2.351497e+03 4063.90909 -7.088998e+00
## 354.910610691207 0.503070741666667
                                       -3.799377e+03 4415.27273 -7.058864e+00
## 254.033545283912_0.507583366666667
                                        1.739324e+03 4008.46970
                                                                 7.009558e+00
## 353.144736095909_2.2426602
                                        2.851887e+03 1642.89394
                                                                  6.905149e+00
## 350.150420062586 3.81887753333333
                                        3.092300e+03 2965.01515
                                                                 6.895066e+00
## 138.055860220427_2.09109626666667
                                        1.593698e+03 4537.21212
                                                                 6.893980e+00
## 368.279986266896_6.3189638333333
                                        1.513478e+03 3293.33333
                                                                  6.845450e+00
## 210.904216560153_0.436168466666667
                                        2.904811e+03 3185.66667
                                                                  6.667887e+00
## 554.345402714694_6.97019313333333
                                       -1.183279e+03 4840.30303 -6.663220e+00
## 133.01404860916_0.454098365
                                        1.518953e+03 4916.33333
                                                                  6.577967e+00
## 258.930693760227_0.49873178
                                        4.139961e+03 2533.72727
                                                                  6.556883e+00
## 348.996799949636_2.26977693333333
                                        3.015342e+03 1537.69697
                                                                  6.544354e+00
## 188.045662579776_1.03785626666667
                                       -1.951628e+03 3534.21212 -6.537765e+00
## 394.984923432345_2.27070703333333
                                        3.055891e+03 2562.00000
                                                                  6.511223e+00
## 171.833922325949_1.03789706666667
                                        2.797218e+03 2913.78788
                                                                  6.462802e+00
## 431.078746668599_2.26952316666667
                                        3.127624e+03 3062.12121
                                                                  6.456602e+00
## 263.945957992775 3.8153425
                                        1.810549e+03 913.66667
                                                                  6.452293e+00
## 380.952128792933_0.51643371
                                        1.863720e+03 2339.21212
                                                                 6.352758e+00
## 382.295522146656_7.71800705
                                        1.551648e+03 3547.57576
                                                                 6.334456e+00
## 158.118319733183_3.16548675
                                       -2.364217e+03 4009.10606 -6.323964e+00
## 593.016149244834_0.511752056666667
                                       -3.962288e+03 2967.43939 -6.256156e+00
## 278.98593869209_0.547708663333333
                                       -2.914835e+03 4950.93939 -6.254203e+00
## 277.180429259534 5.38458585
                                        1.100864e+03 4394.01515
                                                                  6.220431e+00
## 323.170525401051 2.90978
                                        2.370218e+03 1136.22727
                                                                 6.219712e+00
## 731.010049381763_0.51646473
                                        1.625513e+03 2839.72727
                                                                 6.197692e+00
## 346.999000268828_2.26953266666667
                                        3.109663e+03 1742.48485
                                                                 6.177656e+00
## 100.945918903381_0.57434732
                                        3.188028e+03 2594.12121
                                                                  6.030652e+00
## 395.315950336619_8.15751426666667
                                       -2.021545e+03 4600.51515 -6.007874e+00
## 357.060998335189_3.0030745
                                        2.563666e+03 4315.06061
                                                                  5.960975e+00
## 312.985746883113_0.50309732
                                        1.821295e+03 2771.74242
                                                                  5.953008e+00
## 181.009126867215_0.547671171666667
                                       -6.606249e+02 2609.36364 -5.932355e+00
## 214.021365548178_1.07435906666667
                                        2.442069e+03 3781.31818 5.860924e+00
## 398.892003878167_0.494178765
                                       -7.206092e+02 4247.56061 -5.831703e+00
## 574.992467326389_0.529790338333333
                                       -1.309966e+03 3408.22727 -5.819618e+00
## 147.986170207479_0.498636266666667
                                       -3.315139e+03 3715.06061 -5.807700e+00
## 136.032968287365 0.471705501666667
                                        1.684009e+03 3486.54545 5.800271e+00
## 396.894966731414_0.494179713333333
                                       -7.211502e+02 4441.36364 -5.781736e+00
## 594.481097739_8.53352223333333
                                       -2.105203e+03 4575.62121 -5.778484e+00
## 233.077341130831_0.463075411666667
                                       -2.822021e+03 4732.59091 -5.738933e+00
## 636.348905069396_6.97830331666667
                                       -1.262909e+03 3144.27273 -5.725968e+00
## 568.008484970225_0.516498283333333
                                       -3.145940e+03 4115.07576 -5.725361e+00
## 556.997441412877_0.507489066666667
                                        1.558118e+03 2933.75758 5.709706e+00
## 515.012737802413_0.511704691666667
                                       -2.557359e+03 4796.53030 -5.697731e+00
## 259.954409016008_3.81607853333333
                                       -2.496538e+03 5068.21212 -5.660746e+00
## 238.993485026727_0.52959145
                                       -3.467361e+03 4277.59091 -5.641484e+00
## 372.055122961213_0.516291003333333
                                       -1.537230e+03 1352.68182 -5.634004e+00
## 582.045359229543_0.507575996666667
                                       -3.190662e+03 3684.72727 -5.606456e+00
## 229.01142020976_0.463025056666667
                                        1.539174e+03 3443.54545 5.579960e+00
## 482.314716568124_6.97397986666667
                                       -1.130534e+03 3502.10606 -5.571067e+00
## 538.35072714226_7.19417111666667
                                       -1.206219e+03 5248.24242 -5.570975e+00
## 404.997346754374_0.520869313333333
                                       -2.773159e+03 4850.96970 -5.566854e+00
## 237.05630936532_0.503132033333333
                                       -1.932597e+03 1719.63636 -5.553669e+00
## 170.8329276204 0.46299265
                                       -1.959163e+03 4398.27273 -5.553236e+00
```

```
## 465.357868666681_7.05983
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                                       -1.207373e-01 4135.25758 -5.367308e-04
                                        2.064516e-01 2701.69697 5.072824e-04
## 488.358750323585 8.65862483333333
```

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## 505.311150649179 6.72355315
                                        -1.105991e-01 5563.09091 -2.289763e-04
## 365.031306232995_4.7091405
                                         9.861751e-02 5038.56061 1.855433e-04
## 677.413450363744 7.8754834
                                        -7.771561e-16
                                                         1.00000 -1.192200e-17
## 696.297654586899_6.78077953333333
                                        -7.771561e-16
                                                         1.00000 -1.192200e-17
## 724.296672525038_5.47637796666667
                                        -7.771561e-16
                                                         1.00000 -1.192200e-17
## 725.300037403398 5.47645233333333
                                        -7.771561e-16
                                                         1.00000 -1.192200e-17
## 726.303820575997_5.47806873333333
                                        -7.771561e-16
                                                         1.00000 -1.192200e-17
## 822.399089274727_6.58264146666667
                                        -7.771561e-16
                                                         1.00000 -1.192200e-17
## 831.417384026492_6.96955376666667
                                        -7.771561e-16
                                                         1.00000 -1.192200e-17
## 834.436622661497_5.28448363333333
                                        -7.771561e-16
                                                         1.00000 -1.192200e-17
## 873.428101774753_7.790298
                                        -7.771561e-16
                                                         1.00000 -1.192200e-17
  874.432335907506_7.78953273333333
                                        -7.771561e-16
                                                         1.00000 -1.192200e-17
                                                        adj.P.Val
##
                                                                          В
                                             P.Value
## 535.057748778031_0.516444926666667
                                        2.273372e-25 1.817561e-21 -4.591266
                                                                               Down
  319.059288454398_0.503172796666667
                                        8.227751e-24 3.289043e-20 -4.591374
                                                                               Down
## 536.060934451734_0.51198382
                                        3.028297e-23 8.070412e-20 -4.591416
                                                                               Down
## 452.05393045566_0.511999755
                                        6.768205e-22 1.352795e-18 -4.591522
                                                                               Down
## 401.062156875193 0.503139795
                                        2.744063e-20 4.387757e-17 -4.591663
                                                                               Down
## 557.135105183477_2.26974333333333
                                        1.719324e-18 2.291000e-15 -4.591840
                                                                                 Up
## 535.153316859592_2.26960363333333
                                        5.443043e-17 6.216732e-14 -4.592005
                                                                                 Up
## 617.060741213668_0.516419016666667
                                        3.615856e-16 3.613596e-13 -4.592103
                                                                               Down
## 633.121359540055_2.2698982
                                        2.792770e-15 2.480910e-12 -4.592215
                                                                                 Uр
## 436.913444123101_0.503115546666667
                                        4.285844e-14 3.426532e-11 -4.592375
                                                                               Down
## 114.941269442118 0.440606633333333
                                        1.325930e-13 9.637098e-11 -4.592445
                                                                               Down
## 208.049255862961 0.516499983333333
                                        1.462920e-13 9.746705e-11 -4.592452
                                                                               Down
## 624.963599847832_0.516384533333333
                                        3.689062e-13 2.268773e-10 -4.592511
                                                                                 Uр
## 402.999365970348_0.520933191666667
                                        6.465621e-13 3.692331e-10 -4.592548
                                                                                 Uр
## 320.996439093429_0.525293571666667
                                        7.865697e-13 4.178501e-10 -4.592561
                                                                                 Uр
## 350.079457934943_2.26948646666667
                                        8.857191e-13 4.178501e-10 -4.592569
## 536.156637245006_2.26969965
                                        8.884868e-13 4.178501e-10 -4.592569
                                                                                 Uр
## 331.072319421068_2.26940625
                                        1.094509e-12 4.861446e-10 -4.592583
## 649.007979600328_0.52084103
                                        1.204117e-12 5.066797e-10 -4.592589
                                                                                 Uр
## 309.154964317632_2.72117703333333
                                        2.045326e-12 8.176190e-10 -4.592625
                                                                                 Up
## 544.958150900704_0.512039131666667
                                        2.323850e-12 8.832945e-10 -4.592634
                                                                               Down
## 460.957986031464 0.516458413333333
                                        2.430579e-12 8.832945e-10 -4.592637
                                                                                 Up
## 158.988625419471_0.53440056
                                        2.558077e-12 8.892098e-10 -4.592641
                                                                                 Up
## 340.933562882742 0.503131951666667
                                        2.713384e-12 9.038960e-10 -4.592645
                                                                                 Uр
## 542.961011361576_0.516437988333333
                                        9.962311e-12 3.185947e-09 -4.592736
                                                                                 Uр
## 366.108238160521_0.574231496666667
                                        1.892190e-11 5.818484e-09 -4.592783
                                                                               Down
## 132.946253124056_0.50758487
                                        1.968500e-11 5.828947e-09 -4.592786
                                                                                 Up
                                                                                 Uр
## 210.038007691908 0.54314355
                                        3.087358e-11 8.815508e-09 -4.592819
## 89.0242967146565_0.51204397
                                        3.209956e-11 8.849517e-09 -4.592822
                                                                                 Up
## 336.036552493321_0.507567673333333
                                        4.813492e-11 1.282796e-08 -4.592852
                                                                                 Uр
## 146.982769203412_0.503096021666667
                                        5.608601e-11 1.446476e-08 -4.592863
## 409.084255950965_2.2698859
                                        9.436563e-11 2.357666e-08 -4.592903
                                                                                 Uр
## 288.047988057831_0.516412976666667
                                        1.036339e-10 2.510766e-08 -4.592910
                                                                                 Uр
## 427.017839882045_0.52980429
                                        1.304347e-10 3.062023e-08 -4.592928
                                                                               Down
## 253.030153484578_0.511987655
                                        1.340473e-10 3.062023e-08 -4.592930
                                                                                 Up
## 353.181020554741_2.85932433333333
                                        1.478541e-10 3.283592e-08 -4.592937
                                                                                 Uр
## 335.03314861485_0.511941871666667
                                        2.146181e-10 4.637490e-08 -4.592966
                                                                                 Uр
## 417.036058433393_0.511766318333333
                                        2.292594e-10 4.785378e-08 -4.592971
                                                                                 Up
## 131.016827280082_0.574686833333333
                                        2.334331e-10 4.785378e-08 -4.592973
                                                                                 Up
## 663.044843833303_0.508092806666667
                                        2.746061e-10 5.488689e-08 -4.592986
                                                                                 Uр
## 539.335808109453 6.978329
                                        2.892171e-10 5.639734e-08 -4.592990
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## 290.196878030415 5.11415323333333
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                                                                               Down
## 271.069183670649_1.01121336666667
                                        4.242134e-10 7.887410e-08 -4.593020
                                                                                 Up
## 261.072227184374_0.458920866666667
                                        6.112344e-10 1.110641e-07 -4.593049
                                                                                 Uр
## 474.994425728499_0.507473163333333
                                        8.259862e-10 1.467502e-07 -4.593074
                                                                                 Uр
## 418.039571774348_0.507557733333333
                                        9.787781e-10 1.701159e-07 -4.593087
                                                                                 Uр
## 299.036696042566 1.01998113333333
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                                                                               Down
## 354.910610691207_0.503070741666667
                                        1.225444e-09 2.041130e-07 -4.593106
                                                                               Down
## 254.033545283912_0.507583366666667
                                        1.500796e-09 2.448748e-07 -4.593123
                                                                                 Up
## 353.144736095909 2.2426602
                                        2.304042e-09 3.684163e-07 -4.593158
                                                                                 Up
## 350.150420062586_3.81887753333333
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                                                                                 Up
## 138.055860220427_2.09109626666667
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                                                                                 Uр
## 368.279986266896_6.31896383333333
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                                                                                 Up
## 210.904216560153_0.43616846666667
                                        6.083270e-09 9.006620e-07 -4.593241
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## 554.345402714694_6.97019313333333
                                        6.200241e-09 9.012896e-07 -4.593242
                                                                               Down
## 133.01404860916_0.454098365
                                        8.776945e-09 1.253066e-06 -4.593272
                                                                                 Uр
## 258.930693760227_0.49873178
                                        9.563569e-09 1.341416e-06 -4.593280
                                                                                 Uр
## 348.996799949636_2.26977693333333
                                        1.006380e-08 1.387243e-06 -4.593284
                                                                                 Up
## 188.045662579776 1.03785626666667
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                                                                               Down
## 394.984923432345_2.27070703333333
                                        1.151533e-08 1.534418e-06 -4.593296
                                                                                 Up
## 171.833922325949_1.03789706666667
                                        1.401835e-08 1.837323e-06 -4.593313
                                                                                 Up
## 431.078746668599_2.26952316666667
                                        1.437562e-08 1.853760e-06 -4.593315
                                                                                 Uр
## 263.945957992775_3.8153425
                                        1.462923e-08 1.856519e-06 -4.593317
                                                                                 Uр
## 380.952128792933 0.51643371
                                        2.189671e-08 2.735378e-06 -4.593353
                                                                                 Uр
## 382.295522146656 7.71800705
                                        2.357907e-08 2.900226e-06 -4.593359
                                                                                 ďυ
## 158.118319733183 3.16548675
                                        2.460074e-08 2.980044e-06 -4.593363
                                                                               Down
## 593.016149244834_0.511752056666667
                                        3.234794e-08 3.833338e-06 -4.593388
                                                                               Down
## 278.98593869209_0.547708663333333
                                        3.260375e-08 3.833338e-06 -4.593388
                                                                               Down
## 277.180429259534_5.38458585
                                        3.735752e-08 4.279146e-06 -4.593401
                                                                                 Up
## 323.170525401051_2.90978
                                        3.746595e-08 4.279146e-06 -4.593401
                                        4.093923e-08 4.609988e-06 -4.593409
## 731.010049381763_0.51646473
                                                                                 Uр
## 346.999000268828_2.26953266666667
                                        4.437595e-08 4.927580e-06 -4.593416
                                                                                 Uр
## 100.945918903381_0.57434732
                                        8.001829e-08 8.763647e-06 -4.593470
                                                                                 Uр
## 395.315950336619_8.15751426666667
                                        8.764549e-08 9.469267e-06 -4.593479
                                                                               Down
## 357.060998335189_3.0030745
                                        1.056874e-07 1.126628e-05 -4.593496
                                                                                 Uр
## 312.985746883113 0.50309732
                                        1.090980e-07 1.147682e-05 -4.593499
                                                                                 Up
## 181.009126867215_0.547671171666667
                                        1.184549e-07 1.229932e-05 -4.593507
                                                                               Down
## 214.021365548178 1.07435906666667
                                        1.573616e-07 1.612956e-05 -4.593533
                                                                                 Uр
## 398.892003878167_0.494178765
                                        1.767014e-07 1.788262e-05 -4.593544
                                                                               Down
## 574.992467326389_0.529790338333333
                                        1.853704e-07 1.852545e-05 -4.593549
                                                                               Down
## 147.986170207479_0.498636266666667
                                        1.943310e-07 1.918119e-05 -4.593553
                                                                               Down
## 136.032968287365_0.471705501666667
                                        2.001316e-07 1.951283e-05 -4.593556
                                                                                 Up
## 396.894966731414_0.494179713333333
                                        2.153600e-07 2.074461e-05 -4.593563
                                                                               Down
## 594.481097739 8.53352223333333
                                        2.181475e-07 2.076297e-05 -4.593564
                                                                               Down
## 233.077341130831_0.463075411666667
                                        2.550382e-07 2.398859e-05 -4.593579
                                                                               Down
## 636.348905069396_6.97830331666667
                                        2.684232e-07 2.472624e-05 -4.593584
                                                                               Down
                                        2.690660e-07 2.472624e-05 -4.593584
## 568.008484970225_0.516498283333333
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## 556.997441412877_0.507489066666667
                                        2.861952e-07 2.600149e-05 -4.593590
                                                                                 Up
## 515.012737802413_0.511704691666667
                                        3.000198e-07 2.695121e-05 -4.593595
                                                                               Down
## 259.954409016008_3.81607853333333
                                        3.470154e-07 3.082653e-05 -4.593608
                                                                               Down
## 238.993485026727_0.52959145
                                        3.742957e-07 3.288455e-05 -4.593616
                                                                               Down
## 372.055122961213_0.516291003333333
                                        3.854510e-07 3.349653e-05 -4.593619
                                                                               Down
## 582.045359229543_0.507575996666667
                                        4.294329e-07 3.691738e-05 -4.593629
                                                                               Down
## 229.01142020976_0.463025056666667
                                        4.763915e-07 4.051862e-05 -4.593639
                                                                                 Up
## 482.314716568124 6.97397986666667
                                        4.932591e-07 4.109399e-05 -4.593642
                                                                               Down
```

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## 538.35072714226 7.19417111666667
                                        4.934363e-07 4.109399e-05 -4.593642
                                                                               Down
## 404.997346754374_0.520869313333333
                                        5.014548e-07 4.133125e-05 -4.593644
                                                                               Down
## 237.05630936532 0.503132033333333
                                        5.279800e-07 4.271066e-05 -4.593649
                                                                               Down
## 170.8329276204_0.46299265
                                        5.288749e-07 4.271066e-05 -4.593649
                                                                               Down
## 465.357868666681_7.05983
                                        5.371016e-07 4.294127e-05 -4.593651
                                                                               Down
## 215.032494416389 0.547570756666667
                                        5.685458e-07 4.500518e-05 -4.593656
                                                                               Down
## 538.418649709681 7.54571551666667
                                        5.742036e-07 4.500743e-05 -4.593657
                                                                               Down
## 250.152585412631_4.99693186666667
                                        6.071635e-07 4.712886e-05 -4.593663
                                                                               Down
## 594.481340005105_8.20295023333333
                                        6.555856e-07 5.039814e-05 -4.593670
                                                                               Down
## 173.830930395119_1.03794936666667
                                        8.832278e-07 6.725149e-05 -4.593699
                                                                                 Up
## 273.933775462661_3.290272766666667
                                        9.480831e-07 7.150872e-05 -4.593706
                                                                                 Uр
## 99.006232287265_0.565375331666667
                                        1.039113e-06 7.740695e-05 -4.593715
                                                                               Down
## 165.978765620987_8.16260306666667
                                        1.045647e-06 7.740695e-05 -4.593716
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## 540.36663104219_7.19577315
                                        1.058121e-06 7.761171e-05 -4.593717
                                                                               Down
## 338.936520948841_0.503157826666667
                                        1.290757e-06 9.373427e-05 -4.593737
                                                                               Down
## 76.9541571332643_0.485180796666667
                                        1.301376e-06 9.373427e-05 -4.593738
                                                                               Down
## 403.019713678078_0.507590766666667
                                        1.401394e-06 1.000370e-04 -4.593745
                                                                                 Up
## 360.988980566008 0.538804946666667
                                        1.445686e-06 1.022855e-04 -4.593748
                                                                               Down
## 328.964126650608_0.583598886666667
                                        1.579608e-06 1.107804e-04 -4.593757
                                                                               Down
## 314.892318553716_0.494129443333333
                                        1.648253e-06 1.145894e-04 -4.593761
                                                                               Down
## 146.045674397822_0.467355076666667
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## 172.030578530107 0.51193418
                                        1.893998e-06 1.292135e-04 -4.593775
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## 656.995652562909_0.525417065
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                                                                               Down
## 509.020662938084 0.529749776666667
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                                                                               Down
## 584.945613373927 0.507517413333333
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                                                                               Down
## 303.22348942_7.32175318333333
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                                                                               Down
## 437.266558242528_7.76641536666667
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## 451.378953329309_10.7435408333333
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                                                                               Down
## 476.99118164379_0.503131133333333
                                        2.564540e-06 1.636189e-04 -4.593806
                                                                               Down
## 201.037714611869_0.503108283333333
                                        2.568361e-06 1.636189e-04 -4.593806
                                                                               Down
## 278.183783151671_5.38253991666667
                                        2.578609e-06 1.636189e-04 -4.593806
                                                                                 Up
## 171.027212187701_0.516371378333333
                                        2.937536e-06 1.849260e-04 -4.593820
                                                                                 Uр
## 263.043564349954_2.18295145
                                        3.055395e-06 1.901289e-04 -4.593824
                                                                                 Uр
## 218.032641858919_0.547582846666667
                                        3.067747e-06 1.901289e-04 -4.593824
                                                                               Down
## 537.415237053037_7.54481893333333
                                        3.407926e-06 2.095875e-04 -4.593835
                                                                                 Up
## 714.953618174396_0.525108341666667
                                        3.824844e-06 2.334323e-04 -4.593847
                                                                                 Up
## 500.04261449142 0.507557733333333
                                        3.977606e-06 2.409164e-04 -4.593851
                                                                                 Uр
## 302.220146054456_7.3218413
                                        4.256745e-06 2.558848e-04 -4.593857
                                                                               Down
## 156.964688942638_0.565097098333333
                                        4.376038e-06 2.610927e-04 -4.593860
                                                                                 Uр
## 370.156736961555_4.6108284
                                        4.409568e-06 2.611444e-04 -4.593861
                                                                               Down
## 401.087456940656_3.9549381
                                        5.054918e-06 2.971623e-04 -4.593875
                                                                               Down
## 298.113791537606_0.538663596666667
                                        5.320761e-06 3.105072e-04 -4.593880
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## 135.030726115997_2.26954636666667
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                                                                                 Up
## 125.042950751645_0.520933566666667
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                                                                               Down
## 585.385463371393_7.7665104
                                        6.064766e-06 3.463415e-04 -4.593894
                                                                               Down
## 502.397714266446_10.74371
                                        7.002763e-06 3.970715e-04 -4.593909
                                                                               Down
## 269.138824963646_4.1382092
                                        7.222016e-06 4.066198e-04 -4.593912
                                                                               Down
## 556.351298261426_6.9738578
                                        7.489643e-06 4.161714e-04 -4.593916
                                                                               Down
## 558.355060846266_6.97403556666667
                                        7.495770e-06 4.161714e-04 -4.593916
                                                                               Down
## 113.936452152832_0.440637235
                                        7.551186e-06 4.163568e-04 -4.593917
                                                                                 Uр
## 256.058944188336_0.578974703333333
                                       7.703109e-06 4.218244e-04 -4.593919
                                                                                 Uр
## 231.062557999639_0.56127706
                                        7.836334e-06 4.253416e-04 -4.593921
                                                                               Down
## 413.290208198733_8.1411114
                                        7.873741e-06 4.253416e-04 -4.593921
                                                                               Down
## 157.086678039344 3.6761788
                                        7.967720e-06 4.275297e-04 -4.593922
                                                                               Down
```

```
## 523.35106681916 7.19628296666667
                                        8.660287e-06 4.615933e-04 -4.593931
                                                                               Down
## 173.081536166708_0.624467976666667
                                        9.026448e-06 4.779235e-04 -4.593935
                                                                              Down
## 579.348876338249 6.71952666666667
                                        9.508496e-06 5.001344e-04 -4.593941
                                                                               Down
## 359.299181566155_8.01944895
                                        9.629346e-06 5.031805e-04 -4.593942
                                                                              Down
## 539.430898161926_8.0824117
                                        9.905712e-06 5.142608e-04 -4.593945
                                                                               Down
## 509.342259317148 7.76687138333333
                                        1.031902e-05 5.291052e-04 -4.593949
                                                                                 Up
## 179.997642058168_3.81598638333333
                                        1.032471e-05 5.291052e-04 -4.593949
                                                                                 Uр
## 238.967817077007_0.547528655
                                        1.039018e-05 5.291052e-04 -4.593950
                                                                                 Up
## 134.01742806926 0.454090516666667
                                        1.045976e-05 5.292773e-04 -4.593951
                                                                                 Uр
## 170.832945062383_1.03788626666667
                                        1.168242e-05 5.874273e-04 -4.593962
                                                                               Down
## 551.344739083159_7.34856551666667
                                        1.214548e-05 6.068947e-04 -4.593966
                                                                               Down
## 665.383841937602_7.7670533
                                        1.263438e-05 6.256382e-04 -4.593971
                                                                               Down
## 502.94267018909_0.507516063333333
                                        1.267710e-05 6.256382e-04 -4.593971
                                                                               Down
## 344.071956763295_0.984306496666667
                                        1.285753e-05 6.306499e-04 -4.593972
                                                                               Down
## 144.975133211878_0.62801578
                                        1.351468e-05 6.574214e-04 -4.593978
                                                                               Down
## 295.227327809921_6.09997066666667
                                        1.356780e-05 6.574214e-04 -4.593978
                                                                               Down
## 308.09816590638_0.54770258
                                        1.368184e-05 6.589538e-04 -4.593979
                                                                                 Up
## 192.893643141608 0.436184238333333
                                        1.432313e-05 6.832832e-04 -4.593984
                                                                               Down
## 193.994700921771_1.00210066666667
                                        1.435792e-05 6.832832e-04 -4.593984
                                                                                 Up
## 518.392218215059_8.39221291666667
                                        1.455800e-05 6.887054e-04 -4.593986
                                                                               Down
## 180.059154979449_0.534295981666667
                                        1.470600e-05 6.916147e-04 -4.593987
                                                                                 Up
## 132.030035198237_0.465036423333333
                                        1.512991e-05 7.073897e-04 -4.593990
                                                                               Down
## 220.17836031809_8.11506976666667
                                        1.569276e-05 7.294399e-04 -4.593994
                                                                              Down
## 329.18982531344 4.27776108333333
                                        1.591189e-05 7.353503e-04 -4.593995
                                                                               Down
                                        1.622389e-05 7.454598e-04 -4.593997
## 418.324864531539 9.01633603333333
                                                                               Down
## 582.376799089275_7.7579223
                                        1.707192e-05 7.799427e-04 -4.594002
                                                                               Down
## 242.175836632148_8.71347473333333
                                        1.731831e-05 7.867041e-04 -4.594004
                                                                                 Up
## 136.034309909673_1.01124706666667
                                        1.944161e-05 8.781678e-04 -4.594016
                                                                               Down
## 303.058957038554_1.06956111666667
                                        2.075462e-05 9.322088e-04 -4.594023
                                                                                 Up
## 562.416403390877_8.09821333333333
                                        2.102280e-05 9.389791e-04 -4.594025
                                                                               Down
## 526.986938747033_0.51208683
                                        2.161204e-05 9.599346e-04 -4.594028
                                                                               Down
## 110.898759394717_0.48530167
                                        2.232770e-05 9.862430e-04 -4.594031
                                                                               Down
## 444.984007380353_0.51205152
                                        2.352966e-05 1.033624e-03 -4.594037
                                                                               Down
## 268.126733687042_4.19828388333333
                                        2.388458e-05 1.037625e-03 -4.594038
                                                                               Down
## 557.35387844505 6.97834286666667
                                        2.399470e-05 1.037625e-03 -4.594039
                                                                               Down
## 494.392688424305_8.2492368
                                        2.404653e-05 1.037625e-03 -4.594039
                                                                               Down
## 239.128487130393 4.21592158333333
                                        2.418879e-05 1.037625e-03 -4.594040
                                                                               Down
## 504.939598018915_0.507441016666667
                                        2.426965e-05 1.037625e-03 -4.594040
                                                                              Down
## 322.077621776546_0.984478653333333
                                        2.470953e-05 1.050812e-03 -4.594042
                                                                              Down
## 292.127322794766_6.6688346666667
                                        2.508102e-05 1.060967e-03 -4.594044
                                                                              Down
## 237.062451152406 2.49275171666667
                                        2.562285e-05 1.078183e-03 -4.594046
                                                                               Down
## 489.35780421211 7.2824911
                                        2.626372e-05 1.099363e-03 -4.594048
                                                                              Down
## 338.08649229764_0.997671815
                                        2.658145e-05 1.106868e-03 -4.594050
                                                                               Down
## 508.339196297155_7.76627956666667
                                        2.881110e-05 1.193496e-03 -4.594058
                                                                               Down
## 146.027881147635_1.11825203333333
                                        2.984675e-05 1.230025e-03 -4.594062
                                                                                 Uр
## 527.990344209265_0.51199028
                                        3.004236e-05 1.231737e-03 -4.594063
                                                                               Down
## 325.124655207482_0.534248363333333
                                        3.203067e-05 1.306557e-03 -4.594070
                                                                               Down
## 672.969181398776_0.529839513333333
                                        3.282083e-05 1.331993e-03 -4.594072
                                                                               Down
## 196.010367922451_2.8624037
                                        3.406772e-05 1.375613e-03 -4.594077
                                                                               Down
## 251.059347005042_5.8482527
                                        3.653963e-05 1.468012e-03 -4.594084
                                                                               Down
## 149.045203135921_0.534410736666667
                                        3.715757e-05 1.485374e-03 -4.594086
                                                                               Down
## 422.936603791935_0.504118883333333
                                        3.908210e-05 1.554534e-03 -4.594091
                                                                               Down
## 277.907410449323_4.34875256666667
                                        3.981204e-05 1.575729e-03 -4.594093
                                                                               Down
## 275.021034371417 0.44063878
                                        4.390888e-05 1.729318e-03 -4.594104
```

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## 690.993070780453 0.512040915
                                        4.497124e-05 1.762476e-03 -4.594107
                                                                               Down
## 351.153953968664_3.81582713333333
                                        4.652672e-05 1.814542e-03 -4.594110
                                                                               Down
## 339.232244844327 8.3278316
                                        4.797622e-05 1.861990e-03 -4.594114
                                                                                 Up
## 482.347549260414_6.93889135
                                                                                 Uр
                                        4.951903e-05 1.903542e-03 -4.594117
## 304.227737296306_7.23946586666667
                                        4.952304e-05 1.903542e-03 -4.594117
                                                                              Down
## 364.977825419942 0.512049253333333
                                        5.344632e-05 2.044513e-03 -4.594125
                                                                               Down
## 204.004013607022 0.47628407
                                        5.406560e-05 2.045927e-03 -4.594127
                                                                               Down
## 610.987117409645_0.512016968333333
                                        5.422971e-05 2.045927e-03 -4.594127
                                                                               Down
## 219.174943377053_8.11564478333333
                                        5.425097e-05 2.045927e-03 -4.594127
                                                                               Down
## 634.037891680723_0.516445496666667
                                        5.516952e-05 2.070645e-03 -4.594129
                                                                               Down
## 240.131798850664_4.99639743333333
                                        5.542439e-05 2.070645e-03 -4.594129
                                                                                 Uр
## 567.005349619173_0.520870583333333
                                        5.598846e-05 2.081990e-03 -4.594130
                                                                               Down
## 158.126448987982_4.7645258
                                        5.652539e-05 2.092225e-03 -4.594132
                                                                                 Up
## 287.125763692291_2.73470556666667
                                        5.679751e-05 2.092609e-03 -4.594132
                                                                               Down
## 172.01100875375_1.00725383333333
                                        5.779689e-05 2.119661e-03 -4.594134
                                                                               Down
## 316.889177635939_0.494127396666667
                                        5.863696e-05 2.140651e-03 -4.594136
                                                                               Down
## 456.047710070595_6.04151688333333
                                        6.014440e-05 2.185702e-03 -4.594138
                                                                               Down
## 693.402891479419 10.7568495
                                        6.086634e-05 2.201929e-03 -4.594140
                                                                               Down
## 225.061452748359_4.06083646666667
                                        6.213574e-05 2.237726e-03 -4.594142
                                                                                 Up
## 78.9187560971201_0.480881148333333
                                        6.293335e-05 2.256288e-03 -4.594143
                                                                                 Up
## 484.976157606683_0.529868816666667
                                        6.549773e-05 2.337743e-03 -4.594148
                                                                              Down
## 593.478064567397_10.747616
                                        6.764388e-05 2.403613e-03 -4.594151
                                                                               Down
## 404.002716372203 0.520914786666667
                                        6.871670e-05 2.430929e-03 -4.594153
                                                                                 Up
## 175.933767036979 10.6091216666667
                                        6.951840e-05 2.448456e-03 -4.594154
                                                                                 Up
                                        7.158102e-05 2.504536e-03 -4.594157
## 509.384025635158 6.8493455
                                                                                 Up
## 144.045186513762_4.16625448333333
                                        7.174838e-05 2.504536e-03 -4.594158
                                                                                 Uр
## 410.238572604128_6.97397158333333
                                        7.205044e-05 2.504536e-03 -4.594158
                                                                               Down
## 280.235873885917_6.9336056
                                        7.253614e-05 2.510504e-03 -4.594159
                                                                               Down
## 152.029179587664_1.07335046666667
                                        7.332387e-05 2.526829e-03 -4.594160
                                                                               Down
## 597.015752053503_0.511915996666667
                                        7.502553e-05 2.574374e-03 -4.594163
                                                                               Down
## 159.06591948911_0.961937686666667
                                        7.966155e-05 2.714080e-03 -4.594169
                                                                               Down
## 369.109200217439_0.56541958
                                        7.990788e-05 2.714080e-03 -4.594170
                                                                               Down
## 541.36998761672_7.19573743333333
                                        8.011543e-05 2.714080e-03 -4.594170
                                                                                 Uр
## 150.001582722192_4.45351993333333
                                        8.155431e-05 2.751168e-03 -4.594172
                                                                                 Up
## 715.037570853308_0.51644586666667
                                        8.254104e-05 2.753812e-03 -4.594173
                                                                                 Up
## 310.988707708539_0.507474238333333
                                        8.260943e-05 2.753812e-03 -4.594173
                                                                               Down
## 465.248516847887 4.34590213333333
                                        8.266602e-05 2.753812e-03 -4.594173
                                                                               Down
## 210.931273396538_3.5265593
                                        8.599152e-05 2.852706e-03 -4.594178
                                                                               Down
## 423.238257480888_4.9926472
                                        9.028951e-05 2.982912e-03 -4.594183
                                                                                 Uр
## 584.258799255574_6.66663806666667
                                        9.383921e-05 3.087426e-03 -4.594187
                                                                              Down
## 240.080133632772_0.534303103333333
                                        9.657039e-05 3.160498e-03 -4.594190
                                                                               Down
## 722.251530412069 4.6065473
                                        9.685078e-05 3.160498e-03 -4.594191
                                                                                 Up
## 547.436120128857_10.7436896666667
                                        1.004958e-04 3.266113e-03 -4.594195
                                                                               Down
## 271.091673731163_0.542807236666667
                                        1.023321e-04 3.312329e-03 -4.594197
                                                                               Down
## 281.98146374431_0.511962065
                                        1.036822e-04 3.342497e-03 -4.594198
                                                                               Down
## 145.04837752907_4.16635296666667
                                        1.070648e-04 3.437685e-03 -4.594202
                                                                               Down
## 563.336847492777_6.72337853333333
                                        1.112948e-04 3.559209e-03 -4.594206
                                                                               Down
## 370.078596066525_1.02906616666667
                                        1.126057e-04 3.573175e-03 -4.594207
                                                                                 Up
                                                                                Uр
## 321.017106273729_0.507588106666667
                                        1.126254e-04 3.573175e-03 -4.594207
## 706.966226064568_0.512035195
                                        1.131295e-04 3.574982e-03 -4.594208
                                                                               Down
## 71.0137391163537_0.53434448
                                        1.149589e-04 3.618491e-03 -4.594210
                                                                               Down
## 279.144342290608_2.74809513333333
                                        1.166030e-04 3.655846e-03 -4.594211
                                                                                 Up
## 315.163222929977_4.54808208333333
                                        1.170644e-04 3.655977e-03 -4.594212
                                                                                 Uр
## 633.034520187311 0.51646761
                                        1.194908e-04 3.717234e-03 -4.594214
                                                                              Down
```

```
## 528.983807342766 0.512044943333333
                                       1.227364e-04 3.803400e-03 -4.594217
                                                                               Down
## 482.356145354954_5.69280276666667
                                        1.251938e-04 3.864573e-03 -4.594219
                                                                               Down
                                        1.316393e-04 4.047909e-03 -4.594225
## 552.034933231051 0.5164581
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## 239.128504808069_4.9965787
                                        1.333761e-04 4.085602e-03 -4.594226
                                                                                 Up
## 430.157085922612_2.7390478
                                        1.349744e-04 4.118779e-03 -4.594228
                                                                               Down
## 189.98929766251 1.02440668333333
                                        1.362982e-04 4.143361e-03 -4.594229
                                                                               Down
## 461.326624083142 7.59562378333333
                                        1.381638e-04 4.184166e-03 -4.594230
                                                                               Down
## 116.043245585947_1.03787566666667
                                        1.443344e-04 4.354542e-03 -4.594235
                                                                               Down
## 410.371364487215_9.28569473333333
                                        1.454862e-04 4.372791e-03 -4.594236
                                                                               Down
## 205.088852057089_2.73911998333333
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                                                                               Down
## 239.076820272027_0.534274716666667
                                        1.494195e-04 4.457495e-03 -4.594239
                                                                               Down
## 362.981171630935_0.512087743333333
                                        1.515817e-04 4.505190e-03 -4.594241
                                                                               Down
## 519.405016774546_7.92059506666667
                                        1.610740e-04 4.769582e-03 -4.594247
                                                                               Down
## 209.933757183997_0.993174163333333
                                        1.644284e-04 4.850940e-03 -4.594250
                                                                               Down
## 150.055735920261_3.17752361666667
                                        1.679259e-04 4.935909e-03 -4.594252
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## 224.027181112529_5.62293825
                                        1.718754e-04 5.029910e-03 -4.594255
                                                                                 Uр
## 473.073245745126_0.520883956666667
                                        1.723822e-04 5.029910e-03 -4.594255
                                                                               Down
## 315.929797642829 0.980170666666667
                                        1.742164e-04 5.064946e-03 -4.594256
                                                                               Down
## 363.984595061939_0.512012691666667
                                        1.769627e-04 5.126149e-03 -4.594258
                                                                               Down
## 271.005617625539 0.58798931
                                        1.831976e-04 5.256181e-03 -4.594262
                                                                               Down
## 435.347223268282_8.07187496666667
                                        1.835998e-04 5.256181e-03 -4.594262
                                                                               Down
## 202.071762488107_0.957675996666667
                                        1.838786e-04 5.256181e-03 -4.594262
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## 272.007727568427_0.440606633333333
                                        1.840814e-04 5.256181e-03 -4.594262
                                                                               Down
## 165.978770734578_4.66008261666667
                                        1.863881e-04 5.303108e-03 -4.594264
                                                                                 Up
                                        1.885082e-04 5.339553e-03 -4.594265
## 387.096547484076_7.87542703333333
                                                                               Down
## 321.242978916787_6.42960058333333
                                        1.890048e-04 5.339553e-03 -4.594265
                                                                               Down
## 407.352298977694_8.82220633333333
                                        1.932032e-04 5.438941e-03 -4.594268
                                                                                 Up
## 583.255406075797_4.3982046
                                        1.963686e-04 5.500850e-03 -4.594270
                                                                               Down
## 560.400548176705_7.5456356
                                        1.967784e-04 5.500850e-03 -4.594270
                                                                               Down
## 477.394443736839_10.7435721666667
                                        2.080868e-04 5.796705e-03 -4.594276
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## 264.890472770576_4.7007165
                                        2.123443e-04 5.894766e-03 -4.594278
                                                                               Down
## 427.17871635529_3.52351656666667
                                        2.137752e-04 5.913954e-03 -4.594279
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## 699.063396453473_0.5120551
                                        2.207596e-04 6.081150e-03 -4.594283
                                                                               Down
## 234.886272672887_0.489725393333333
                                        2.213402e-04 6.081150e-03 -4.594283
                                                                               Down
## 280.978100245302 0.511974141666667
                                        2.222800e-04 6.086057e-03 -4.594283
                                                                               Down
## 409.295355217495_5.69128218333333
                                        2.270341e-04 6.195009e-03 -4.594286
                                                                               Down
## 465.357841755537 6.86232426666667
                                        2.310185e-04 6.282289e-03 -4.594288
                                                                               Down
## 171.006112242482_0.463036963333333
                                        2.379283e-04 6.417042e-03 -4.594291
                                                                               Down
## 176.927766118249_0.489777501666667
                                        2.381759e-04 6.417042e-03 -4.594291
                                                                               Down
## 287.044406466979_2.44860915
                                        2.383817e-04 6.417042e-03 -4.594291
                                                                               Down
## 339.25354686108 5.77160906666667
                                        2.488096e-04 6.675277e-03 -4.594296
                                                                               Down
## 199.978577516479_0.503162066666667
                                        2.577594e-04 6.892262e-03 -4.594300
                                                                               Down
## 369.300405829977_7.11541013333333
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## 294.080141850783_4.00381216666667
                                        2.638342e-04 6.960084e-03 -4.594303
                                                                                 Up
## 133.013977377834_0.661903341666667
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                                                                               Down
## 446.980729365371_0.512045646666667
                                        2.643553e-04 6.960084e-03 -4.594303
                                                                                 Uр
## 162.039238871951_2.44008731666667
                                        2.653262e-04 6.960084e-03 -4.594303
                                                                                 Up
## 644.274220333404_4.60683248333333
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                                                                               Down
## 282.975190081623_0.511986163333333
                                        2.695675e-04 7.043110e-03 -4.594305
                                                                               Down
## 426.119609478192_4.61059036666667
                                        2.733358e-04 7.118304e-03 -4.594307
                                                                               Down
## 537.330295005305_6.97385828333333
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                                                                               Down
## 445.987432574387_0.511989126666667
                                        2.871046e-04 7.428483e-03 -4.594312
                                                                               Down
## 113.021888928065_0.623977071666667
                                        2.911437e-04 7.492105e-03 -4.594314
                                                                               Down
## 195.138694596195 5.07339
                                        2.914377e-04 7.492105e-03 -4.594314
```

```
## 142.995843368926 0.57544121
                                        3.051600e-04 7.810702e-03 -4.594319
                                                                               Down
## 594.376934160917_7.52297386666667
                                        3.057848e-04 7.810702e-03 -4.594320
                                                                              Down
## 551.03151453405 0.516472553333333
                                        3.087896e-04 7.862333e-03 -4.594321
                                                                               Down
## 173.104030721307_0.569824316666667
                                        3.112364e-04 7.899477e-03 -4.594322
                                                                                 Uр
## 333.279394993847_8.92963398333333
                                        3.173092e-04 8.012267e-03 -4.594324
                                                                                 Uр
## 321.07974019768 0.534193013333333
                                        3.176846e-04 8.012267e-03 -4.594324
                                                                               Down
## 555.348741565892 6.97089821666667
                                        3.260080e-04 8.196332e-03 -4.594327
                                                                                 Uр
## 213.149373817786_5.7271824
                                        3.290142e-04 8.245982e-03 -4.594328
                                                                                 Up
## 240.063713481507_5.62291836666667
                                        3.377973e-04 8.439653e-03 -4.594331
                                                                                 Uр
## 313.93301463503_0.98009566
                                        3.574502e-04 8.902849e-03 -4.594337
                                                                               Down
## 243.170833918563_3.0954461
                                        3.636787e-04 9.029849e-03 -4.594339
                                                                               Down
## 517.389053643291_8.38486558333333
                                        3.668725e-04 9.068097e-03 -4.594340
                                                                                 Up
## 203.066862333137_0.46744895
                                        3.674876e-04 9.068097e-03 -4.594340
                                                                               Down
## 505.352724772694_6.41932095
                                        3.727091e-04 9.140816e-03 -4.594342
                                                                               Down
## 540.329999156455_6.8334292
                                        3.741255e-04 9.140816e-03 -4.594342
                                                                               Down
## 420.939668982366_0.507454466666667
                                        3.743234e-04 9.140816e-03 -4.594343
                                                                                 Uр
## 521.3348489091_6.97394226666667
                                        3.758557e-04 9.140816e-03 -4.594343
                                                                              Down
## 115.039887020632 1.0379019
                                        3.761512e-04 9.140816e-03 -4.594343
                                                                               Down
## 581.04197099314_0.511918308333333
                                        3.833912e-04 9.288524e-03 -4.594345
                                                                               Down
## 342.11864296768 0.953329371666667
                                        3.947306e-04 9.529047e-03 -4.594349
                                                                               Down
## 130.889029011819_0.471908313333333
                                        3.957027e-04 9.529047e-03 -4.594349
                                                                              Down
## 322.08311076137 0.5341648
                                        4.071375e-04 9.774968e-03 -4.594352
                                                                               Down
## 239.059329577612_8.70046876666667
                                        4.149005e-04 9.931525e-03 -4.594354
                                                                                 Up
## 183.102294475077_3.2094392
                                        4.165138e-04 9.940382e-03 -4.594355
                                                                              Down
## 261.058700999247 0.534249266666667
                                        4.225610e-04 1.005469e-02 -4.594356
                                                                               Down
## 263.128300546935_3.82823868333333
                                        4.269177e-04 1.012821e-02 -4.594357
                                                                                 Up
## 632.950697679847_0.525352961666667
                                        4.374439e-04 1.034723e-02 -4.594360
                                                                                 Up
## 305.231151543877_7.23788075
                                        4.394090e-04 1.036305e-02 -4.594361
                                                                                 Uр
## 271.066866699721_2.45233543333333
                                        4.481737e-04 1.052200e-02 -4.594363
                                                                                 Up
## 157.011519071037_0.511976776666667
                                        4.487809e-04 1.052200e-02 -4.594363
                                                                               Down
## 244.137206255972_4.92533366666667
                                        4.524102e-04 1.057608e-02 -4.594364
                                                                               Down
## 560.329548215141_7.76749688333333
                                        4.625628e-04 1.078189e-02 -4.594367
                                                                               Down
## 519.404898354748_7.57665786666667
                                        4.669938e-04 1.085353e-02 -4.594368
                                                                               Down
## 447.13360644953_5.13201256666667
                                        4.801473e-04 1.112689e-02 -4.594371
                                                                                 Up
## 100.998509496279 0.49420928
                                        4.857793e-04 1.122487e-02 -4.594372
                                                                                 Up
                                                                              Down
## 570.367195948903_7.35276836666667
                                        4.939785e-04 1.138144e-02 -4.594374
## 257.075096631887 0.507587308333333
                                        5.026014e-04 1.150806e-02 -4.594376
                                                                                 Uр
## 176.04377042762_0.59616078
                                        5.034609e-04 1.150806e-02 -4.594376
                                                                                 Uр
## 441.357873474787_6.43457683333333
                                        5.037924e-04 1.150806e-02 -4.594376
                                                                                 Uр
## 391.070524804075_0.520907831666667
                                        5.109954e-04 1.163934e-02 -4.594378
                                                                               Down
## 402.973384926503 0.534258013333333
                                        5.137621e-04 1.166911e-02 -4.594379
                                                                                 Up
## 471.033070393692 0.516452605
                                        5.210960e-04 1.180216e-02 -4.594380
                                                                              Down
## 246.980709041655_0.574305275
                                        5.241806e-04 1.181871e-02 -4.594381
                                                                                 Up
                                        5.247833e-04 1.181871e-02 -4.594381
## 559.335531609584_7.76723818333333
                                                                               Down
## 230.04627250668_0.931972526666667
                                        5.365506e-04 1.203191e-02 -4.594384
                                                                               Down
## 517.389087674449_7.74219615
                                        5.372598e-04 1.203191e-02 -4.594384
                                                                               Down
## 346.259420717725_6.33654005
                                        5.451701e-04 1.217496e-02 -4.594385
                                                                                 Up
## 453.054775880156_0.516452058333333
                                        5.557274e-04 1.237616e-02 -4.594388
                                                                               Down
## 448.350652113176_8.16178413333333
                                        5.587558e-04 1.240903e-02 -4.594388
                                                                                 Up
## 255.107103762145_0.56074245
                                        5.670584e-04 1.255854e-02 -4.594390
                                                                               Down
## 191.019409725193_0.66448638
                                        5.704400e-04 1.259853e-02 -4.594391
                                                                               Down
## 520.407968492215_8.37645843333333
                                        5.895593e-04 1.298492e-02 -4.594394
                                                                               Down
## 491.373638408257_7.43323633333333
                                        5.930076e-04 1.302499e-02 -4.594395
                                                                               Down
## 135.044970351125 3.76167333333333
                                        5.952779e-04 1.303732e-02 -4.594396
                                                                                 Up
```

```
## 253.092436719322 0.582983916666667
                                       5.968305e-04 1.303732e-02 -4.594396
                                                                               Down
## 607.37186640867_7.76749563333333
                                        6.034512e-04 1.314603e-02 -4.594397
                                                                              Down
## 259.838844570753 0.429384221666667
                                        6.143790e-04 1.330604e-02 -4.594399
                                                                               Down
## 142.065866282417_2.73908725
                                        6.145705e-04 1.330604e-02 -4.594399
                                                                              Down
## 266.888220618387_4.700779
                                        6.157890e-04 1.330604e-02 -4.594399
                                                                              Down
## 150.039193186979 0.93982746
                                        6.213580e-04 1.339018e-02 -4.594400
                                                                              Down
## 340.795223537087 10.7665776666667
                                        6.427685e-04 1.381434e-02 -4.594404
                                                                               Down
## 560.346276211651_6.97834651666667
                                        6.496671e-04 1.392517e-02 -4.594406
                                                                               Down
## 449.363049572271_8.5336837
                                        6.596982e-04 1.410237e-02 -4.594407
                                                                               Down
## 291.625822748381_6.66714893333333
                                        6.649614e-04 1.417698e-02 -4.594408
                                                                               Down
## 346.955850327667_2.8113346
                                        6.726814e-04 1.430343e-02 -4.594410
                                                                                 Uр
## 174.930691592645_0.494167123333333
                                        6.831250e-04 1.443298e-02 -4.594411
                                                                               Down
## 199.850645190266_9.17423388333333
                                        6.840265e-04 1.443298e-02 -4.594412
                                                                                 Up
## 275.185967994439_4.19556563333333
                                        6.841902e-04 1.443298e-02 -4.594412
                                                                                 Up
## 447.093910196249_4.19746543333333
                                        6.970509e-04 1.466558e-02 -4.594414
                                                                               Down
## 317.088350774232_1.02424085
                                        7.033520e-04 1.475932e-02 -4.594415
## 563.031239942749_5.4850534
                                        7.081199e-04 1.482047e-02 -4.594416
                                                                               Down
## 424.350806746798 8.32836506666667
                                        7.199185e-04 1.502806e-02 -4.594417
                                                                               Down
## 451.140217530665_4.61089883333333
                                        7.239390e-04 1.506060e-02 -4.594418
                                                                               Down
## 485.002449780393 0.520895793333333
                                        7.252445e-04 1.506060e-02 -4.594418
                                                                               Down
## 128.035138798212_0.547539083333333
                                       7.340002e-04 1.520293e-02 -4.594420
                                                                              Down
## 504.299208435658 6.9303382
                                        7.385687e-04 1.524844e-02 -4.594420
                                                                                 Up
## 462.152812272524_7.02636651666667
                                        7.400119e-04 1.524844e-02 -4.594421
                                                                              Down
## 437.326490427146 6.8078098
                                        7.530508e-04 1.543859e-02 -4.594423
                                                                                 ďυ
## 227.066832278756 2.18310046666667
                                        7.531018e-04 1.543859e-02 -4.594423
                                                                               Down
## 279.196083914181_5.31414146666667
                                        7.553850e-04 1.544579e-02 -4.594423
                                                                               Down
## 128.891980439017_0.47190718
                                        7.787896e-04 1.588373e-02 -4.594426
                                                                               Down
## 321.99984586871_0.52529744
                                        7.876160e-04 1.602287e-02 -4.594428
                                                                                 Up
## 410.236409051967_6.25189416666667
                                        7.904961e-04 1.604065e-02 -4.594428
                                                                               Down
## 582.35665575415_6.72174493333333
                                        7.927231e-04 1.604512e-02 -4.594429
                                                                                 Up
## 84.9905893434853_5.44514216666667
                                        7.994446e-04 1.613545e-02 -4.594430
                                                                                 Up
## 143.991182388441_0.503839203333333
                                        8.012224e-04 1.613545e-02 -4.594430
                                                                                 Uр
## 179.071049997001_2.43536186666667
                                        8.093202e-04 1.625758e-02 -4.594431
                                                                                 Uр
## 435.251080550221_7.17227803333333
                                        8.144808e-04 1.632024e-02 -4.594432
                                                                               Down
## 204.085435437499_2.73912798333333
                                        8.337077e-04 1.666373e-02 -4.594434
                                                                                 Up
## 433.331472461125_7.60653135
                                        8.415499e-04 1.677853e-02 -4.594435
                                                                               Down
## 564.36632943854 7.37513206666667
                                        8.473369e-04 1.683045e-02 -4.594436
                                                                               Down
## 331.026651215046_0.587953633333333
                                        8.483640e-04 1.683045e-02 -4.594436
                                                                              Down
## 254.079568342645_1.02910113333333
                                        8.585465e-04 1.699030e-02 -4.594438
                                                                              Down
## 454.05818653847_0.512029271666667
                                        8.669715e-04 1.711466e-02 -4.594439
                                                                               Down
## 854.998470733975 0.51201433
                                        8.716467e-04 1.716457e-02 -4.594440
                                                                                Up
## 321.094983374227_3.46266333333333
                                        8.770783e-04 1.719159e-02 -4.594440
                                                                              Down
## 780.389195835203_4.58813746666667
                                        8.773195e-04 1.719159e-02 -4.594440
                                                                               Down
## 627.3486472457_6.71124596666667
                                        8.836235e-04 1.724650e-02 -4.594441
                                                                               Down
## 388.252122633399_6.52866846666667
                                        8.868472e-04 1.724650e-02 -4.594442
                                                                                 Uр
## 367.157738592297_4.61097691666667
                                        8.887433e-04 1.724650e-02 -4.594442
                                                                               Down
## 588.377697185511_7.76690518333333
                                        8.887502e-04 1.724650e-02 -4.594442
                                                                               Down
## 517.389169368824_6.9650631
                                        8.917967e-04 1.726372e-02 -4.594442
                                                                               Down
## 239.059303205615_8.1851936
                                        9.009118e-04 1.739804e-02 -4.594443
                                                                               Down
## 172.142173639148_5.01500333333333
                                        9.183975e-04 1.769298e-02 -4.594446
                                                                               Down
## 345.093591706597_2.74241551666667
                                        9.473223e-04 1.820635e-02 -4.594449
                                                                               Down
## 583.380165969123_7.7614356
                                        9.565270e-04 1.833917e-02 -4.594450
                                                                               Down
## 370.050781551221_0.5120412
                                        9.874506e-04 1.888677e-02 -4.594454
                                                                               Down
## 211.072059432217 2.25235586666667
                                        1.011320e-03 1.929714e-02 -4.594457
                                                                                 Up
```

```
## 293.996454371098 0.45402509
                                        1.016411e-03 1.930739e-02 -4.594457
                                                                               Down
## 190.042730176097_1.03359533333333
                                        1.016687e-03 1.930739e-02 -4.594457
                                                                              Down
## 388.028967474092 0.516477416666667
                                        1.019914e-03 1.932278e-02 -4.594458
                                                                               Down
## 467.313496426144_7.65697391666667
                                        1.047921e-03 1.980252e-02 -4.594461
                                                                                Up
## 200.972247981833_0.507554153333333
                                        1.050190e-03 1.980252e-02 -4.594461
                                                                               Down
## 340.256970882542 5.7676067
                                        1.056018e-03 1.986556e-02 -4.594462
                                                                               Down
## 452.922597909198 7.09735143333333
                                        1.061577e-03 1.992325e-02 -4.594462
                                                                                 Uр
## 179.045944279088_2.3277329
                                        1.068024e-03 1.999731e-02 -4.594463
                                                                                 Up
## 429.300234846659_6.13955156666667
                                        1.079975e-03 2.017384e-02 -4.594464
                                                                              Down
## 167.107483473686_4.71408523333333
                                        1.086862e-03 2.020830e-02 -4.594465
                                                                               Down
## 220.146482739773_7.85715903333333
                                        1.088992e-03 2.020830e-02 -4.594465
                                                                                Uр
## 580.343123512408_6.9738144
                                        1.089403e-03 2.020830e-02 -4.594465
                                                                               Down
## 425.116559671722_4.6109266
                                        1.146692e-03 2.118052e-02 -4.594471
                                                                               Down
                                        1.147113e-03 2.118052e-02 -4.594471
## 386.327152517358_8.68359803333333
                                                                               Down
## 165.018999886765_0.445083548333333
                                        1.156043e-03 2.129623e-02 -4.594472
                                                                               Down
## 531.368946950915_7.6853912
                                        1.199115e-03 2.203890e-02 -4.594476
                                                                               Down
## 219.033652733552_0.552815611666667
                                        1.208057e-03 2.215233e-02 -4.594477
                                                                               Down
## 343.061587923558 0.534241338333333
                                        1.219817e-03 2.231680e-02 -4.594478
                                                                                Up
## 511.399484317316_7.6596667
                                        1.222613e-03 2.231688e-02 -4.594479
                                                                              Down
## 214.048345333889_0.59629667
                                        1.231069e-03 2.242005e-02 -4.594480
                                                                                Up
## 521.335339957134_7.19554655
                                        1.237909e-03 2.249337e-02 -4.594480
                                                                              Down
## 305.054007201641_2.35424863333333
                                        1.243080e-03 2.253611e-02 -4.594481
                                                                               Down
## 263.072480888344_0.984304896666667
                                        1.250786e-03 2.262450e-02 -4.594481
                                                                                 Uр
## 462.330143667517 6.39880116666667
                                        1.265251e-03 2.283449e-02 -4.594483
                                                                              Down
## 389.030237935663 0.516477416666667
                                        1.276211e-03 2.298041e-02 -4.594484
                                                                               Down
## 164.835959745951_0.467428516666667
                                        1.279843e-03 2.299404e-02 -4.594484
                                                                               Down
## 397.29535111621_6.5506705
                                        1.288439e-03 2.304177e-02 -4.594485
                                                                               Down
## 221.092669488078_2.42094285
                                        1.288846e-03 2.304177e-02 -4.594485
                                                                               Down
## 217.029173882728_2.36322763333333
                                        1.291146e-03 2.304177e-02 -4.594485
                                                                                Up
## 797.040454532806_0.516419375
                                        1.306041e-03 2.325567e-02 -4.594486
                                                                               Down
## 129.055547019846_2.4171309
                                        1.332088e-03 2.366676e-02 -4.594489
                                                                                 Up
## 592.465620496018_10.7437656666667
                                        1.350546e-03 2.389249e-02 -4.594490
                                                                               Down
## 447.347544199865_7.95237636666667
                                        1.350770e-03 2.389249e-02 -4.594490
                                                                               Down
## 673.029827506306_5.61411565
                                        1.354104e-03 2.389859e-02 -4.594491
                                                                               Down
## 187.119683939626_0.5920609
                                        1.380587e-03 2.431231e-02 -4.594493
                                                                               Down
## 580.325178189657_6.72187563333333
                                        1.386090e-03 2.435558e-02 -4.594493
                                                                               Down
## 466.251865155667 4.3457209
                                        1.391698e-03 2.440050e-02 -4.594494
                                                                                 Up
## 567.026244153388_0.511993361666667
                                        1.427380e-03 2.497134e-02 -4.594497
                                                                               Down
## 435.310852732837_6.32468551666667
                                        1.437803e-03 2.508089e-02 -4.594498
                                                                                 Uр
## 249.041756178832_0.45896024
                                        1.439916e-03 2.508089e-02 -4.594498
                                                                              Down
## 250.188903198911 6.57744273333333
                                        1.483980e-03 2.579222e-02 -4.594501
                                                                               Down
## 239.015296491538_0.494203525
                                        1.492870e-03 2.583740e-02 -4.594502
                                                                                Up
## 341.205647082473_6.60951446666667
                                        1.493043e-03 2.583740e-02 -4.594502
                                                                               Down
## 147.029624534189_0.46290708
                                        1.531413e-03 2.644415e-02 -4.594505
                                                                               Down
## 370.340130728888_8.6217999
                                        1.545055e-03 2.662224e-02 -4.594506
                                                                               Down
## 239.066938088643_4.86277716666667
                                        1.553309e-03 2.670689e-02 -4.594507
                                                                                 Uр
## 227.100851444861_0.52980458
                                        1.573404e-03 2.699434e-02 -4.594508
                                                                              Down
## 253.144203386449_4.51303671666667
                                        1.585799e-03 2.714874e-02 -4.594509
                                                                               Down
                                        1.644700e-03 2.809695e-02 -4.594513
## 108.901739437113_0.4853056
                                                                               Down
## 134.864826676584_7.90719186666667
                                        1.652152e-03 2.812297e-02 -4.594514
                                                                                 Up
## 449.353061719769_8.1306466
                                        1.653258e-03 2.812297e-02 -4.594514
                                                                                 Uр
## 539.354100372836_7.19425115
                                        1.662624e-03 2.822225e-02 -4.594515
                                                                                 Uр
## 555.174135698687_4.19753483333333
                                        1.687518e-03 2.858413e-02 -4.594516
                                                                               Down
## 425.363064801066 8.6248575
                                        1.694731e-03 2.864561e-02 -4.594517
                                                                               Down
```

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## 343.076957142887_3.46258356666667
                                        1.721982e-03 2.904482e-02 -4.594519
                                                                               Down
## 148.049749352914_0.4643637
                                        1.727996e-03 2.908490e-02 -4.594519
                                                                              Down
## 300.199797904057 5.56135883333333
                                        1.765104e-03 2.964708e-02 -4.594522
                                                                               Down
## 555.348837705977_7.34397733333333
                                        1.769096e-03 2.965095e-02 -4.594522
                                                                              Down
## 579.340194216985_6.97838181666667
                                        1.772752e-03 2.965095e-02 -4.594522
                                                                               Down
## 583.255426366871 6.66650828333333
                                        1.790846e-03 2.989105e-02 -4.594523
                                                                                Up
## 468.376737065213 7.6443704
                                        1.830217e-03 3.048455e-02 -4.594526
                                                                              Down
## 435.251168827_6.97832821666667
                                        1.835499e-03 3.050897e-02 -4.594526
                                                                              Down
## 512.33509225414 6.44654053333333
                                        1.850996e-03 3.070272e-02 -4.594527
                                                                               Down
## 145.014049647751_0.454139886666667
                                        1.877578e-03 3.102026e-02 -4.594529
                                                                                 Up
## 421.154612437369_6.21583961666667
                                        1.877900e-03 3.102026e-02 -4.594529
                                                                                 Uр
## 341.232691428406_4.3782022
                                        1.898708e-03 3.129932e-02 -4.594530
                                                                               Down
## 91.0285304518966_0.51194555
                                        1.952288e-03 3.211635e-02 -4.594533
                                                                               Down
## 297.206578193849_4.71005813333333
                                        1.960690e-03 3.214081e-02 -4.594534
                                                                               Down
## 565.333737666703_6.7237465
                                        1.961815e-03 3.214081e-02 -4.594534
                                                                               Down
## 566.382176879121_8.0412896
                                        1.969983e-03 3.217276e-02 -4.594534
                                                                                 Uр
## 163.039780964354_0.988735146666667
                                        1.971814e-03 3.217276e-02 -4.594535
                                                                              Down
## 411.347353835031 8.31104453333333
                                        2.008411e-03 3.270315e-02 -4.594537
                                                                               Down
## 309.067546770422_0.520953921666667
                                        2.017616e-03 3.278626e-02 -4.594537
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## 412.350680032426_8.3137058
                                        2.022330e-03 3.279621e-02 -4.594537
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## 330.241627562093_7.61115731666667
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                                                                              Down
## 175.097235352923_3.05207353333333
                                        2.039239e-03 3.293681e-02 -4.594538
                                                                                 Up
## 323.168115441371_5.96978646666667
                                        2.048827e-03 3.302494e-02 -4.594539
                                                                              Down
## 556.325157361676_6.97397293333333
                                        2.062577e-03 3.314484e-02 -4.594540
                                                                               Down
## 161.045271854509 0.538723913333333
                                        2.064556e-03 3.314484e-02 -4.594540
                                                                               Down
## 163.039805416401_2.90090806666667
                                        2.069685e-03 3.316059e-02 -4.594540
                                                                               Down
## 319.925243298667_0.979998946666667
                                        2.075937e-03 3.319423e-02 -4.594541
                                                                                Up
## 227.128475205853_3.92274058333333
                                        2.100185e-03 3.348114e-02 -4.594542
                                                                               Down
## 606.240838210768_6.66494096666667
                                        2.105913e-03 3.348114e-02 -4.594542
                                                                               Down
## 457.235572525682_6.24178115
                                        2.110187e-03 3.348114e-02 -4.594542
                                                                               Down
## 263.037742212496_2.73904833333333
                                        2.110631e-03 3.348114e-02 -4.594543
                                                                               Down
## 215.03239330598_0.993302623333333
                                        2.136232e-03 3.382014e-02 -4.594544
                                                                               Down
## 392.288329577367_4.9614689
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## 232.889121742992_0.489679065
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## 413.199659282265_4.34026831666667
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## 368.161073486067_4.610971
                                        2.208698e-03 3.469262e-02 -4.594548
                                                                                Up
## 469.02832524769 0.516476193333333
                                        2.232402e-03 3.496000e-02 -4.594549
                                                                                 Uр
## 458.238943704624_6.23904143333333
                                        2.234467e-03 3.496000e-02 -4.594549
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## 981.797701170069_7.9522751
                                        2.271032e-03 3.536638e-02 -4.594551
                                                                               Down
## 263.012042503135_0.538575996666667
                                        2.272692e-03 3.536638e-02 -4.594551
                                                                                 Up
## 287.087952459897_2.1832042
                                        2.273711e-03 3.536638e-02 -4.594551
                                                                               Down
## 350.962373762262 0.507560046666667
                                        2.282148e-03 3.542868e-02 -4.594552
                                                                                Up
## 500.99514071031_5.65957051666667
                                        2.295145e-03 3.549958e-02 -4.594552
                                                                               Down
                                        2.295595e-03 3.549958e-02 -4.594552
## 483.06514846393_0.503130033333333
                                                                               Down
## 267.123326184618_3.2666745
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## 311.139664200358_3.7396125
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                                                                               Down
## 238.066829070002_0.596514666666667
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## 567.368037870413_7.76695113333333
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## 234.157550942642_7.15020953333333
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## 240.045408957285_0.957388381666667
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## 464.277600542921_6.76893933333333
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## 265.107714959008_3.91776793333333
                                        2.382271e-03 3.627858e-02 -4.594557
                                                                               Down
## 232.118506530217_3.18012993333333
                                        2.415047e-03 3.670779e-02 -4.594558
                                                                               Down
## 288.059702720773 2.7390603
                                        2.441392e-03 3.703781e-02 -4.594560
```

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## 318.854082744422 4.70545966666667
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## 391.285423850622_5.3811476
                                        2.486005e-03 3.757204e-02 -4.594562
                                                                              Down
## 189.09514898301 4.1389508
                                        2.523352e-03 3.806452e-02 -4.594563
                                                                                 Up
## 262.069170788452_0.984351501666667
                                        2.540223e-03 3.824686e-02 -4.594564
                                                                                 Uр
## 510.3451555857_7.76629138333333
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                                                                                 Uр
## 323.185796894586 3.90957471666667
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                                                                               Down
## 330.264601372864_7.25893696666667
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                                                                                 Up
## 187.108421527434_0.940534438333333
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                                                                               Down
## 394.988225726695_0.503131041666667
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                                                                                 Up
## 245.066595657717_3.85048473333333
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## 589.446790158258_8.15264243333333
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                                                                               Down
## 327.253606874179_5.70580303333333
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## 377.047095738194_2.739061
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## 387.02554035157_0.51647355
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## 223.953585307693_5.1229945
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## 173.031236116612_0.50748417
                                        2.790816e-03 4.109129e-02 -4.594575
                                                                                 Uр
## 151.02586978934_1.0732229
                                        2.801992e-03 4.118002e-02 -4.594576
                                                                              Down
## 368.975936919846 5.1720292
                                        2.818959e-03 4.135336e-02 -4.594576
                                                                               Down
## 433.235312125271_6.72158996666667
                                        2.844162e-03 4.164665e-02 -4.594578
                                                                                Up
## 439.060120378155_4.67348956666667
                                        2.854112e-03 4.171595e-02 -4.594578
                                                                              Down
## 147.031311822286_1.11635821666667
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                                                                              Down
## 241.056302411772_5.62344813333333
                                        2.913032e-03 4.237179e-02 -4.594580
                                                                               Down
## 125.017655139602_0.591934356666667
                                        2.918336e-03 4.237179e-02 -4.594581
                                                                               Down
## 481.352852295189 5.69197243333333
                                        2.920182e-03 4.237179e-02 -4.594581
                                                                                 ďυ
                                        2.952129e-03 4.275774e-02 -4.594582
## 315.07480137699 6.71327341666667
                                                                              Down
## 273.145176762379_4.0532999
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                                                                               Down
## 219.076909163111_1.7518328
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## 461.290241288155_4.3368842
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                                                                               Down
                                                                                Uр
## 282.038835255001_1.49204413333333
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## 116.972317995708_0.503031696666667
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## 399.326060345112_6.82069615
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## 198.975175703063_0.50755613
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## 447.251046385605_6.40246083333333
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## 248.972811866175_2.9865841
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## 235.071916995854_2.747981
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## 504.308127993645_6.72399665
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                                                                               Down
## 361.071257139131 2.74047355
                                        3.336882e-03 4.730207e-02 -4.594596
                                                                               Down
## 166.835302150062_0.466248083333333
                                        3.395674e-03 4.805030e-02 -4.594598
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## 185.11795943194_3.783942
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                                                                                 Uр
## 240.021836058225_0.980538053333333
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## 490.361328196301_7.2838782
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## 239.092146355606_3.46390245
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## 566.512844348606_8.54234651666667
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## 501.394398935572_10.747772
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## 351.21696598533_4.5923269
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## 179.045930791667_0.9930146
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## 397.220868415966_7.61821378333333
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## 290.052288744451_0.51642633
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## 296.951975947373_0.516452058333333
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## 121.943829981754_0.984621166666667
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## 316.166077960138_3.5362968
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## 183.002650449085_2.81432453333333
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## 481.235351874256_6.229216
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## 465.357645704998 7.68752518333333
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## 117.928500744822_9.03447673333333
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                                       3.994815e-03 5.468930e-02 -4.594618 Stable
## 415.296342465564 8.14196348333333
## 351.05607657802_0.458557913333333
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## 541.009250013953_5.5128437
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## 152.054356953484 2.25191203333333
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## 561.349415063125 6.97833756666667
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## 383.290935709693 5.9981847
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## 812.535270801321 6.8626283
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## 360.298401053985_9.11292433333333
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## 140.982763642547_10.4821176666667
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## 504.413425609638_10.7435676666667
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## 89.9956855993303_10.7752603333333
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## 487.29056246421_7.4063192
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## 391.285244642339_4.96134956666667
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## 468.37688807827_7.89374416666667
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## 500.277599695508 6.6930875
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                                       4.635937e-03 6.177385e-02 -4.594635 Stable
## 165.040105832678_0.469825931666667
## 569.364584604037_7.35281856666667
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## 183.102291823575_4.09981283333333
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## 216.965281362133_4.00180566666667
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## 369.047136025774_2.4521307
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## 581.364578311586_7.16627726666667
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## 306.025941019705_0.51651142
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## 439.30189095414_7.11370563333333
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## 444.983965473809_10.9621413333333
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## 356.190419389365_5.50079066666667
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## 124.016276965854_2.96233041666667
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## 164.035057282039_1.43438596666667
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## 178.814965059075 6.66431766666667
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## 143.034574413795_0.534430183333333
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## 415.193955702372_4.34074446666667
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## 591.462337436026_7.7856445
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## 221.066170325039 0.551727783333333
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## 535.399636143482_6.7958433
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## 338.055371822831_0.984471483333333
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## 205.009777127159_10.7034096666667
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## 313.078038733842_6.71554608333333
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## 345.204190214516_7.40647583333333
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## 316.77835718026_10.5889045
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## 134.864789854009_7.53017476666667
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## 347.222154142043 4.97484738333333
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## 263.953636305116_1.03341756666667
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## 428.135178851232_4.79926186666667
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## 216.853297619319 10.2314873333333
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## 249.185548765683_4.21059373333333
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## 113.035523174751_10.894945
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## 468.944907245454 0.54325595
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## 413.137871528724_2.80676646666667
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## 173.117944605493_3.10061073333333
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## 78.9511701029658 0.480827745
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## 91.0215984199487_5.62242893333333
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## 450.366434032409_8.53765813333333
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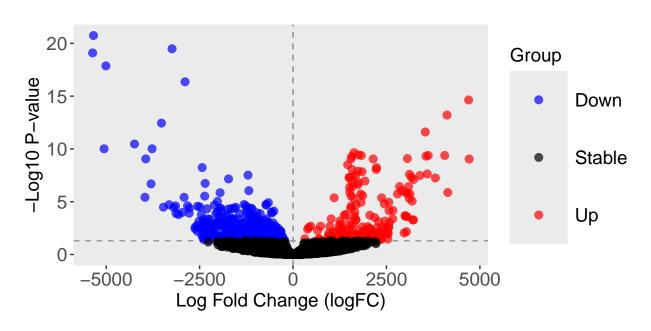
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                                       9.995968e-01 1.000000e+00 -4.595192 Stable
## 505.311150649179_6.72355315
                                       9.998180e-01 1.000000e+00 -4.595192 Stable
                                       9.998525e-01 1.000000e+00 -4.595192 Stable
## 365.031306232995 4.7091405
## 677.413450363744 7.8754834
                                       1.000000e+00 1.000000e+00 -4.595192 Stable
## 696.297654586899 6.78077953333333
                                       1.000000e+00 1.000000e+00 -4.595192 Stable
## 724.296672525038 5.47637796666667
                                       1.000000e+00 1.000000e+00 -4.595192 Stable
## 725.300037403398_5.47645233333333
                                       1.000000e+00 1.000000e+00 -4.595192 Stable
## 726.303820575997_5.47806873333333
                                       1.000000e+00 1.000000e+00 -4.595192 Stable
## 822.399089274727_6.58264146666667
                                       1.000000e+00 1.000000e+00 -4.595192 Stable
## 831.417384026492_6.96955376666667
                                       1.000000e+00 1.000000e+00 -4.595192 Stable
                                       1.000000e+00 1.000000e+00 -4.595192 Stable
## 834.436622661497_5.28448363333333
## 873.428101774753_7.790298
                                       1.000000e+00 1.000000e+00 -4.595192 Stable
## 874.432335907506_7.78953273333333
                                       1.000000e+00 1.000000e+00 -4.595192 Stable
table(temoutput$g)
##
##
     Down Stable
                     Uр
##
      379
           7421
                    195
library(ggplot2)
professional_colors <- c("blue", "black", "red")</pre>
ggplot(temoutput, aes(x=logFC, y=-log10(adj.P.Val))) +
  geom_hline(yintercept = -log10(0.05), linetype = 'dashed', size = 0.5, color = "grey60") +
  geom_vline(xintercept = c(-1,1), linetype = 'dashed', size = 0.5, color = "grey60") +
  geom_point(aes(color = g), size = 2.5, alpha = 0.7) +
  scale_color_manual(values = professional_colors) +
  labs(title = "Volcano Plot", x = "Log Fold Change (logFC)", y = "-Log10 P-value", colour = "Group") +
  # theme classic(base family = "Arial") +
  theme(
   text = element_text(size = 14),
   plot.title = element_text(size = 20, hjust = 0.5, margin = margin(b = 80, unit = "pt")),
    axis.title = element_text(size = 14),
   axis.text = element_text(size = 14),
   legend.position = "right",
   legend.title = element_text(size = 14),
   legend.text = element_text(size = 14),
   legend.key.size = unit(3, "lines"),
    # plot.margin = margin(1.5, 1, 1.5, 1, "cm"),
   panel.grid.major = element_blank(),
   panel.grid.minor = element_blank()
 )
## Warning: Using `size` aesthetic for lines was deprecated in ggplot2 3.4.0.
## i Please use `linewidth` instead.
## This warning is displayed once every 8 hours.
## Call `lifecycle::last_lifecycle_warnings()` to see where this warning was
## generated.
```

Volcano Plot



library(clusterProfiler)

```
##
## clusterProfiler v4.12.2 Learn more at https://yulab-smu.top/contribution-knowledge-mining/
##
## Please cite:
##
## S Xu, E Hu, Y Cai, Z Xie, X Luo, L Zhan, W Tang, Q Wang, B Liu, R Wang,
## W Xie, T Wu, L Xie, G Yu. Using clusterProfiler to characterize
## multiomics data. Nature Protocols. 2024, doi:10.1038/s41596-024-01020-z

##
## 'clusterProfiler'
## The following object is masked from 'package:stats':
##
## filter

library(org.Hs.eg.db)
```

stats4

AnnotationDbi

##

##

```
##
        BiocGenerics
##
##
      'BiocGenerics'
## The following object is masked from 'package:limma':
##
##
       plotMA
## The following objects are masked from 'package:stats':
##
##
       IQR, mad, sd, var, xtabs
## The following objects are masked from 'package:base':
##
##
       anyDuplicated, aperm, append, as.data.frame, basename, cbind,
##
       colnames, dirname, do.call, duplicated, eval, evalq, Filter, Find,
       get, grep, grepl, intersect, is.unsorted, lapply, Map, mapply,
##
##
       match, mget, order, paste, pmax, pmax.int, pmin, pmin.int,
##
       Position, rank, rbind, Reduce, rownames, sapply, setdiff, table,
       tapply, union, unique, unsplit, which.max, which.min
##
        Biobase
##
## Welcome to Bioconductor
##
##
       Vignettes contain introductory material; view with
##
       'browseVignettes()'. To cite Bioconductor, see
       'citation("Biobase")', and for packages 'citation("pkgname")'.
##
##
        IRanges
##
        S4Vectors
##
##
      'S4Vectors'
## The following object is masked from 'package:clusterProfiler':
##
##
       rename
## The following object is masked from 'package:tidyr':
##
##
       expand
## The following object is masked from 'package:utils':
##
##
       findMatches
## The following objects are masked from 'package:base':
##
##
       expand.grid, I, unname
```

```
##
##
      'IRanges'
## The following object is masked from 'package:clusterProfiler':
##
##
       slice
## The following object is masked from 'package:grDevices':
##
##
       windows
##
##
      'AnnotationDbi'
## The following object is masked from 'package:clusterProfiler':
##
       select
##
diffgene<-bitr(LC_gene$ID,fromType = "SYMBOL",toType = "ENTREZID",OrgDb = "org.Hs.eg.db")</pre>
## 'select()' returned 1:1 mapping between keys and columns
genes_entrez <- diffgene$ENTREZID</pre>
enrich_result <- enrichKEGG(gene = genes_entrez,</pre>
                             organism = "hsa",
                            keyType = "kegg",
                             pAdjustMethod = "holm",
                            pvalueCutoff = 0.05,
                            qvalueCutoff = 0.05)
## Reading KEGG annotation online: "https://rest.kegg.jp/link/hsa/pathway"...
## Reading KEGG annotation online: "https://rest.kegg.jp/list/pathway/hsa"...
data.frame(enrich_result)
##
                  category
                                                           subcategory
                                                                             ID
## hsa00980
                Metabolism Xenobiotics biodegradation and metabolism hsa00980
## hsa05204 Human Diseases
                                                     Cancer: overview hsa05204
## hsa00983
                Metabolism Xenobiotics biodegradation and metabolism hsa00983
## hsa00480
                Metabolism
                                      Metabolism of other amino acids hsa00480
## hsa00982
                Metabolism Xenobiotics biodegradation and metabolism hsa00982
## hsa05208 Human Diseases
                                                     Cancer: overview hsa05208
## hsa00140
                Metabolism
                                                     Lipid metabolism hsa00140
## hsa01230
                Metabolism
                                             Global and overview maps hsa01230
## hsa05418 Human Diseases
                                               Cardiovascular disease hsa05418
## hsa05207 Human Diseases
                                                     Cancer: overview hsa05207
## hsa05225 Human Diseases
                                               Cancer: specific types hsa05225
```

```
## hsa01200
                Metabolism
                                            Global and overview maps hsa01200
## hsa01524 Human Diseases
                                     Drug resistance: antineoplastic hsa01524
                                                   Description GeneRatio BgRatio
## hsa00980
                 Metabolism of xenobiotics by cytochrome P450
                                                                   12/40
                                                                          79/8843
## hsa05204
                        Chemical carcinogenesis - DNA adducts
                                                                   11/40 71/8843
## hsa00983
                              Drug metabolism - other enzymes
                                                                   11/40 81/8843
## hsa00480
                                       Glutathione metabolism
                                                                    9/40 58/8843
## hsa00982
                            Drug metabolism - cytochrome P450
                                                                    8/40 73/8843
## hsa05208 Chemical carcinogenesis - reactive oxygen species
                                                                   11/40 226/8843
## hsa00140
                                 Steroid hormone biosynthesis
                                                                    5/40 62/8843
## hsa01230
                                  Biosynthesis of amino acids
                                                                    5/40 75/8843
## hsa05418
                       Fluid shear stress and atherosclerosis
                                                                    6/40 141/8843
## hsa05207
                Chemical carcinogenesis - receptor activation
                                                                    7/40 215/8843
## hsa05225
                                     Hepatocellular carcinoma
                                                                    6/40 170/8843
## hsa01200
                                            Carbon metabolism
                                                                    5/40 116/8843
## hsa01524
                                     Platinum drug resistance
                                                                    4/40 75/8843
                  pvalue
                             p.adjust
                                            qvalue
## hsa00980 4.958715e-16 4.462843e-14 2.870835e-14
## hsa05204 7.670133e-15 6.826418e-13 2.220302e-13
## hsa00983 3.523384e-14 3.100578e-12 6.799514e-13
## hsa00480 2.747067e-12 2.389948e-10 3.976018e-11
## hsa00982 9.063815e-10 7.794881e-08 1.049494e-08
## hsa05208 2.870114e-09 2.439597e-07 2.769408e-08
## hsa00140 7.835129e-06 6.581509e-04 6.480182e-05
## hsa01230 2.001879e-05 1.661560e-03 1.448729e-04
## hsa05418 3.628795e-05 2.975612e-03 2.334313e-04
## hsa05207 4.290363e-05 3.475194e-03 2.483894e-04
## hsa05225 1.031465e-04 8.251722e-03 5.428764e-04
## hsa01200 1.624572e-04 1.283412e-02 7.837850e-04
## hsa01524 3.461547e-04 2.700006e-02 1.541579e-03
                                                                  geneID Count
## hsa00980 2950/1571/2944/1545/1544/2052/2952/1645/1553/7367/2946/1548
## hsa05204
                 2950/1571/2944/1545/1544/2052/2952/1553/7367/2946/1548
                                                                            11
## hsa00983
                 4353/2950/1571/2944/6240/6241/2952/7367/1066/2946/1548
                                                                            11
## hsa00480
                           2950/9588/2944/6240/6241/2952/2878/2946/2876
                                                                             9
## hsa00982
                                2950/1571/2944/1544/2952/7367/2946/1548
                                                                             8
## hsa05208
                 3162/3091/1571/2944/1545/1544/2052/1728/2952/1645/2946
                                                                            11
## hsa00140
                                               1571/1545/1544/1645/7367
                                                                             5
## hsa01230
                                               26227/2597/7167/29968/226
                                                                             5
## hsa05418
                                           2950/3162/2944/1728/2952/2946
                                                                             6
## hsa05207
                                     2944/1545/1544/2052/2952/7367/2946
                                                                             7
## hsa05225
                                           2950/3162/2944/1728/2952/2946
                                                                             6
## hsa01200
                                                                             5
                                               26227/2597/7167/29968/226
## hsa01524
                                                                             4
                                                     2950/2944/2952/2946
```

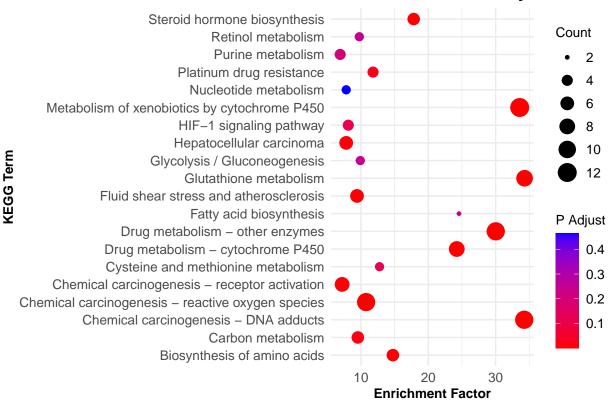
Input the differential mass spectrum features into the HMDB database for metabolite name matching, then match their associated genes in omicsnetwork. Perform enrichment analysis on these associated genes in the same way.

```
ek.rt <- data.frame(enrich_result@result)

ek.rt <- separate(data=ek.rt, col=GeneRatio, into = c("GR1", "GR2"), sep = "/") # GeneRatio 2 GR1 GR2
ek.rt <- separate(data=ek.rt, col=BgRatio, into = c("BR1", "BR2"), sep = "/") # BgRatio 2 BR1 BR2
ek.rt <- mutate(ek.rt, enrichment_factor = (as.numeric(GR1)/as.numeric(GR2))/(as.numeric(BR1)/as.numeri</pre>
```

```
ek.rt10 <- ek.rt %>% dplyr::filter(dplyr::row_number() >= 1,dplyr::row_number() <= as.numeric(20))
p1 <- ggplot(ek.rt10, aes(enrichment_factor, Description)) +</pre>
  geom point(aes(size=Count, color=p.adjust)) +
  scale_color_gradient(low="red", high="blue") +
  labs(color="P Adjust", size="Count", x="Enrichment Factor", y="KEGG Term", title="KEGG Enrichment Ana
  theme_minimal() +
  theme(
   text = element_text(size=10),
   axis.title = element_text(size=10, face="bold"),
   axis.text = element_text(size=10),
   legend.title = element_text(size=10),
   legend.text = element_text(size=10),
   axis.text.x = element_text(size = 10),
   axis.text.y = element_text(size = 10),
   plot.title = element_text(size=14, face="bold", hjust=0.5))
р1
```

KEGG Enrichment Analysis



```
p2 <- ggplot(ek.rt10, aes(x = enrichment_factor, y = reorder(Description, enrichment_factor))) +
    geom_bar(stat = "identity", aes(fill = p.adjust), width = 0.7) +
    scale_fill_gradient(low = "red", high ="blue", name = "P Adjust") +
    labs(size = "Count", x = "Enrichment Factor", y = "KEGG Term", title = "KEGG Enrichment Analysis") +
    theme_minimal() +
    theme(
        text = element_text(size = 10),</pre>
```

```
axis.title = element_text(size = 10, face = "bold"),
axis.text = element_text(size = 10),
legend.title = element_text(size = 10),
legend.text = element_text(size = 10),
axis.text.x = element_text(size = 10),
axis.text.y = element_text(size = 10),
plot.title = element_text(size = 14, face = "bold", hjust = 0.5)
)
p2
```

KEGG Enrichment Analysis

