

Modeling of relative Yield, P-Uptake and P-Balance

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```
RES <- readRDS("data/RES.rds")
Dmlr <- RES$nlme.coef.mrg
Dmlr$soil_0_20_P_CO2_log[is.infinite(Dmlr$soil_0_20_P_CO2_log)] <- NA
Dmlr$soil_0_20_P_AAE10_log
```

[1]	NA	3.0773123	NA	2.9069011	NA	2.9601051	NA
[8]	2.9069011	NA	3.9815491	NA	3.7954892	3.5973123	NA
[15]	NA	3.5890591	NA	4.4485164	NA	4.2541933	3.9926809
[22]	NA	NA	4.4578296	1.8870696	2.1162555	2.3321439	2.2300144
[29]	2.4069451	2.3321439	2.3887628	NA	2.1972246	1.8245493	NA
[36]	2.3795461	2.4849066	2.3223877	2.3418058	2.3418058	2.1400662	2.2925348
[43]	0.8329091	1.9878743	1.7047481	2.9069011	1.7047481	1.1939225	1.7917595
[50]	NA	1.6292405	1.7749524	2.6461748	1.4586150	NA	1.9878743
[57]	2.1282317	2.1162555	1.8870696	2.1162555	3.1441523	3.4111477	3.2425924
[64]	NA	3.1863526	3.4045252	3.1945831	3.1863526	3.1045867	NA
[71]	2.7850112	2.7972813	2.9014216	2.8449094	2.8094027	2.7850112	3.2580965
[78]	3.0007198	2.4069451	2.6026897	2.8033604	2.6026897	2.5726122	2.7663191
[85]	2.7343675	NA	2.9069011	2.8903718	NA	3.0587071	2.9069011
[92]	2.9069011	3.1045867	2.8390785	2.6741486	3.3809947	4.2017031	4.3907386
[99]	4.3000028	4.0412953	NA	4.1697612	4.0656021	4.2640873	4.0656021
[106]	3.1822118	2.6461748	3.3809947	3.0540012	NA	3.0726933	3.0955776
[113]	2.6461748	3.0056826	NA	3.4873751	3.5945688	3.7424202	3.8044378
[120]	3.5945688	3.4531571	4.0412953	3.6480575	2.7013612	2.7472709	2.8507065
[127]	2.7472709	NA	2.6100698	2.4069451	2.6390573	2.7013612	3.1223649
[134]	2.8622009	NA	2.9123507	3.1223649	2.8507065	3.0106209	3.0492730
[141]	2.1860513	2.9391619	2.9014216	2.9652731	2.9391619	2.8903718	3.1570004
[148]	NA	3.1045867	3.1570004	2.7972813	2.4336134	2.8033604	2.7146947
[155]	2.3608540	2.2407097	2.7146947	2.3702437	NA	3.4468079	3.2580965

[162] NA 3.4011974 3.3534067 3.3141860 3.0056826 3.5055574 3.2580965
 [169] 3.1986731 3.5025499 3.3741687 3.4812401 NA 3.3741687 3.3741687
 [176] 3.4750672 3.3393220 NA 3.6163088 3.4719665 3.6988298 3.6788291
 [183] 3.4242627 3.5496174 3.5496174 3.2542430 NA 2.7343675 3.1223649
 [190] 2.8390785 2.8033604 2.7343675 2.8390785 3.1267605 2.7972813 3.2771447
 [197] 3.5973123 NA 3.5751507 3.5695327 3.5695327 3.8712010 3.1441523
 [204] 3.6163088 4.0741419 3.7352858 3.8329798 3.9039908 3.6584202 3.6635616
 [211] 3.6635616 3.7376696 NA 3.8133070 3.6963515 3.6963515 3.7954892
 [218] 3.5890591 NA 3.9512437 3.9160150 3.7773481 NA 3.6737658
 [225] 3.8372995 3.7447871 3.6813512 3.6838669 3.4307562 3.7954892 3.6838669
 [232] 2.9338569 2.4765384 2.7911651 2.7725887 2.6741486 2.9338569 2.7725887
 [239] 2.5649494 NA 2.6741486 2.6672282 2.9123507 2.6878475 2.7013612
 [246] 2.9704145 NA 2.6878475 2.6390573 2.9123507 2.7600099 2.8213789
 [253] 3.0540012 2.8903718 3.2228678 3.0252911 NA 3.2228678 3.2695689
 [260] 3.0106209 3.0106209 2.7911651 NA 2.4510051 2.4423470 2.2823824
 [267] 2.5416020 2.6461748 2.2823824 2.7911651 2.4510051 3.5174978 3.6609943
 [274] 3.9019727 3.4843123 NA 3.4078419 3.4372078 3.9019727 3.6323091
 [281] 3.4078419 3.4499875 3.6813512 3.3741687 3.2733640 3.3286267 NA
 [288] 3.3877744 3.6813512 3.3741687 3.4307562 4.1541846 3.5263605 3.5467397
 [295] NA 4.1541846 3.8649314 3.4339872 3.6296601 3.5263605 3.8372995
 [302] 3.0955776 3.2386785 3.4594663 3.2386785 3.3178158 3.4339872 3.1484534
 [309] 3.6712245 3.6712245 NA 3.7062281 3.6349511 3.6428355 3.7977339
 [316] 4.2766661 NA 3.6349511 3.7424202 4.2766661 3.8607297 3.6712245
 [323] NA 3.4339872 3.7208625 3.7352858 3.6323091 3.9569964 3.5174978
 [330] 3.4339872 3.9569964 3.4688560 4.1125119 3.5204608 3.6661225 3.6082116
 [337] 3.7887248 3.4688560 4.1125119 NA 3.6270041 4.0758411 4.0621657
 [344] 4.1447208 NA 3.9627161 3.9926809 3.9627161 4.1447208 4.2556127
 [351] 4.0360090 2.9856819 2.5095993 3.0301337 NA 3.0301337 2.7013612
 [358] 2.7212954 2.8094027 2.6810215 2.9856819 2.9177707 2.7408400 NA
 [365] 2.8213789 2.9177707 3.0155349 2.9549103 2.5572273 2.9549103 2.9014216
 [372] 3.5263605 NA 3.6136170 3.4563167 3.2958369 3.4563167 3.6216707
 [379] 3.5234150 3.5263605 3.3286267 2.9014216 2.9391619 2.7663191 2.9391619
 [386] 2.6246686 2.8390785 2.5014360 2.7663191 NA 3.1696856 4.1383614
 [393] NA 3.8501476 4.1141472 4.0342406 4.1141472 4.1383614 3.9759363
 [400] 3.9239516 4.2253728 3.9180051 NA 3.8351420 4.2061840 3.9796817
 [407] 3.9376908 3.8774316 4.2061840 3.9852735 3.9852735 3.6686767 3.5723456
 [414] 3.6686767 3.2228678 3.5695327 3.3568971 3.2347492 NA 3.5582011
 [421] 3.5723456 3.7037681 4.2106450 3.6054978 3.8066625 3.8416005 3.7013020
 [428] 3.8066625 4.2106450 NA 3.5582011 4.3832759 4.6288867 4.3502779
 [435] 4.2499228 4.3956830 4.3832759 4.3254563 NA 4.6288867 4.3385971
 [442] 4.3770141 4.5358201 4.3081110 4.2282925 NA 4.3515674 4.3515674
 [449] 4.5358201 4.5174313 4.4601444 4.2668963 4.1972019 4.2456340 4.3294167
 [456] 4.3993753 4.3993753 4.2456340 4.2668963 NA 4.1287460 3.9702919

```
[463] 3.7376696 3.9702919 4.0758411 3.9039908 4.0656021 4.1972019      NA
[470] 3.9473901 4.1972019
```

```
# d <- RES$data
```

Setup

```
library(mlr3verse, quietly = TRUE)

mse <- msrs(c("regr.mse"))

if (!interactive())
  lgr::get_logger("mlr3")$set_threshold("warn")

get_benchi_table <- function(tasks, nfolds = 5) {
  set.seed(123)
  learners <- lrns(c("regr.featureless", "regr.lm", "regr.xgboost", "regr.ranger"))
  learners$regr.xgboost$param_set$set_values(
    eta = 0.04,
    nrounds = 300,
    max_depth = 2
  )

  benchi <- xfun::cache_rds({
    benchmark(benchmark_grid(
      tasks,
      learners,
      rsmp("cv", folds = nfolds)
    ))
  },
  file = "benchmark.rds",
  dir = "cache/",
  hash = list(tasks, nfolds)
)

res <- tidyr::pivot_wider(benchi$aggregate(mse),
  id_cols = task_id,
  names_from = learner_id,
  values_from = regr.mse
) |> as.data.frame()
```

```

rownames(res) <- res$task_id
res <- res[, -1]
colnames(res) <- gsub("regr.", "", colnames(res))
stopifnot(any(colnames(res) == "featureless"))
res <- 1 - res / res$featureless
res[, -1, drop = FALSE] |> round(3)
}

```

Testing prediction quality using

- Linear models
- Random forests (default parameters)
- XGBoost (with parameter tuning)

Weather Variables:

```

[1] "anavg_temp" "ansum_prec" "juvdev_prec" "juvdev_sun" "ansum_sun"
[6] "juvdev_temp"

```

Phosphor Variable sets:

Response Variables

```

Y_vars <- c("Ymain_rel", "annual_P_uptake", "annual_P_balance")

```

With Weather data

TODO: Group - cross validation

```

\ (nam){
  mytsk <- as_task_regr(
    Dmlr[complete.cases(Dmlr$Ymain_rel), c(y, Weather_vars, P_var_sets[[nam]], "Site")],
    target = y,
    id = nam)
  mytsk$set_col_roles("Site", "group")
  mytsk
}

```

Algorithm learns to predict location from weather since we do not do stratified cross-validation (leaving out locations).

Ymain_rel

```
y <- "Ymain_rel"
lapply(names(P_var_sets), \(nam) as_task_regr(
  Dmlr[complete.cases(Dmlr[,c("Ymain_rel",Weather_vars,P_var_sets$AAE10_CO2_kPS)])],c(y, We
  target = y,
  id = nam)) |>
get_benchi_table() |> knitr::kable()
```

	lm	xgboost	ranger
onlyweather	0.138	0.544	0.542
k	0.107	0.553	0.505
PS	0.195	0.572	0.596
kPS	0.141	0.570	0.618
AAE10	0.255	0.605	0.598
CO2	0.200	0.645	0.638
AAE10_CO2	0.222	0.651	0.647
AAE10_CO2_kPS	0.197	0.663	0.625
CO2_kPS	0.183	0.663	0.627

	lm	xgboost	ranger
onlyweather	0.201	0.518	0.520
k	0.186	0.476	0.487
PS	0.234	0.603	0.585
kPS	0.265	0.569	0.555
AAE10	0.294	0.530	0.582
CO2	0.259	0.569	0.578
AAE10_CO2	0.288	0.515	0.594
AAE10_CO2_kPS	0.347	0.596	0.607
CO2_kPS	0.275	0.530	0.575

annual_P_uptake

```
y <- "annual_P_uptake"
lapply(names(P_var_sets), \(nam) as_task_regr(
  Dmlr[complete.cases(Dmlr[,c("Ymain_rel",Weather_vars,P_var_sets$AAE10_CO2_kPS)])],c(y, We
  target = y,
```

```
id = nam)) |>
get_benchi_table() |> knitr::kable()
```

	lm	xgboost	ranger
onlyweather	0.414	0.784	0.782
k	0.380	0.763	0.766
PS	0.397	0.757	0.816
kPS	0.434	0.777	0.814
AAE10	0.489	0.822	0.834
CO2	0.472	0.797	0.846
AAE10_CO2	0.468	0.852	0.855
AAE10_CO2_kPS	0.488	0.796	0.819
CO2_kPS	0.457	0.808	0.840

	lm	xgboost	ranger
onlyweather	0.468	0.649	0.648
k	0.456	0.564	0.609
PS	0.477	0.594	0.617
kPS	0.459	0.560	0.474
AAE10	0.503	0.619	0.621
CO2	0.481	0.615	0.642
AAE10_CO2	0.484	0.566	0.580
AAE10_CO2_kPS	0.465	0.528	0.423
CO2_kPS	0.487	0.536	0.428

annual_P_balance

```
y <- "annual_P_balance"
lapply(names(P_var_sets), \(nam) as_task_regr(
  Dmlr[complete.cases(Dmlr[,c("Ymain_rel",Weather_vars,P_var_sets$AAE10_CO2_kPS)])],c(y, Wea
  target = y,
  id = nam)) |>
get_benchi_table() |> knitr::kable()
```

	lm	xgboost	ranger
onlyweather	0.027	0.103	0.102
k	0.045	0.565	0.243
PS	0.627	0.864	0.774
kPS	0.639	0.837	0.860
AAE10	0.392	0.597	0.561
CO2	0.490	0.707	0.695
AAE10_CO2	0.471	0.760	0.732
AAE10_CO2_kPS	0.630	0.852	0.827
CO2_kPS	0.645	0.881	0.866

	lm	xgboost	ranger
onlyweather	0.011	0.120	0.121
k	-0.008	0.313	0.127
PS	0.310	0.647	0.608
kPS	0.282	0.609	0.617
AAE10	0.225	0.510	0.524
CO2	0.225	0.532	0.591
AAE10_CO2	0.225	0.546	0.585
AAE10_CO2_kPS	0.335	0.617	0.596
CO2_kPS	0.302	0.626	0.631

Without Weather data

```
if("onlyweather" %in% names(P_var_sets))
  P_var_sets <- P_var_sets[-1]
```

xgboost & ranger are no good in this setting since only very few variables available

Ymain_rel

```
y <- "Ymain_rel"
lapply(names(P_var_sets), \(nam) as_task_regr(
  Dmlr[complete.cases(Dmlr[,c("Ymain_rel",Weather_vars,P_var_sets$AAE10_CO2_kPS)])],c(y, P_
  target = y,
  id = nam)) |>
get_benchi_table() |> knitr::kable()
```

	lm	xgboost	ranger
k	-0.010	0.058	-0.008
PS	0.035	-0.018	-0.124
kPS	0.024	0.001	-0.060
AAE10	0.124	0.064	-0.107
CO2	0.092	-0.009	-0.137
AAE10_CO2	0.116	0.082	0.095
AAE10_CO2_kPS	0.117	0.109	0.069
CO2_kPS	0.051	-0.032	-0.044

	lm	xgboost	ranger
k	-0.005	-0.200	-0.312
PS	0.060	-0.141	-0.221
kPS	0.054	-0.343	-0.353
AAE10	0.099	0.104	-0.009
CO2	0.068	-0.086	-0.226
AAE10_CO2	0.073	0.067	0.064
AAE10_CO2_kPS	0.072	-0.045	-0.059
CO2_kPS	0.023	-0.168	-0.196

annual_P_uptake

```

y <- "annual_P_uptake"
lapply(names(P_var_sets), \(nam) as_task_regr(
  Dmlr[complete.cases(Dmlr[,c("Ymain_rel",Weather_vars,P_var_sets$AAE10_CO2_kPS)])],c(y, P_var_sets[,nam]),
  target = y,
  id = nam)) |>
get_benchi_table() |> knitr::kable()

```

	lm	xgboost	ranger
k	-0.028	-0.103	-0.170
PS	0.012	-0.024	-0.123
kPS	0.064	-0.152	-0.199
AAE10	0.065	-0.129	-0.254
CO2	0.058	-0.078	-0.176
AAE10_CO2	0.070	-0.012	-0.058
AAE10_CO2_kPS	0.099	-0.066	-0.008

	lm	xgboost	ranger
CO2_kPS	0.095	-0.059	-0.083

	lm	xgboost	ranger
k	-0.006	-0.265	-0.434
PS	-0.006	-0.278	-0.485
kPS	-0.006	-0.225	-0.317
AAE10	0.021	-0.139	-0.398
CO2	0.005	-0.126	-0.276
AAE10_CO2	0.017	-0.194	-0.310
AAE10_CO2_kPS	0.020	-0.229	-0.363
CO2_kPS	-0.054	-0.206	-0.295

annual_P_balance

```

y <- "annual_P_balance"
lapply(names(P_var_sets), \(nam) as_task_regr(
  Dmlr[complete.cases(Dmlr[,c("Ymain_rel",Weather_vars,P_var_sets$AAE10_CO2_kPS)])],c(y, P_var_sets[nam]),
  target = y,
  id = nam)) |>
get_benchi_table() |> knitr::kable()

```

	lm	xgboost	ranger
k	0.016	0.499	0.629
PS	0.598	0.695	0.666
kPS	0.598	0.681	0.667
AAE10	0.338	0.288	0.224
CO2	0.438	0.436	0.401
AAE10_CO2	0.447	0.495	0.498
AAE10_CO2_kPS	0.594	0.703	0.700
CO2_kPS	0.589	0.686	0.680

	lm	xgboost	ranger
k	0.011	0.175	0.160
PS	0.309	0.274	0.178

	lm	xgboost	ranger
kPS	0.305	0.279	0.244
AAE10	0.147	0.062	-0.102
CO2	0.189	0.170	0.085
AAE10_CO2	0.192	0.062	0.015
AAE10_CO2_kPS	0.313	0.235	0.201
CO2_kPS	0.313	0.274	0.243

```
cor(Dmlr$annual_P_balance, Dmlr$PS) # 0.54389
```

```
[1] 0.5611764
```

```
cor(Dmlr$fert_P_tot, Dmlr$PS) # 0.48236
```

```
[1] 0.5455537
```

```
cor(Dmlr$annual_P_uptake, Dmlr$PS) # 0.070678
```

```
[1] 0.09920453
```

We did manage to have high predictive power for weather. This could also be due to our regression models recovering location&year from it and hence still overfitting on the test set.

Without Weather data we only managed for annual balance to get some predictive power (30%). Since we the balance is uptake - fert_P, this means that we mostly predicted fert_P. Interestingly PS is best to predict this quantity

Legacy Code

```
# Get parameter estimates for XGBoost
t <- as_task_regr(
  subset(Dmlr[complete.cases(Dmlr$annual_P_balance)],
    select = c("annual_P_balance", P_var_sets$AAE10_CO2_kPS#, Weather_vars
  )),
  target = "annual_P_balance"
)
```

```

l <- lrn("regr.xgboost",
  nrounds = 500 # More iterations due to lower learning rate
)

# Create search space
ps <- ps(
  max_depth = p_int(2, 4),
  eta = p_dbl(0.001, 0.3, tags = "logscale")
)

# Setup tuning
instance <- ti(
  task = t,
  learner = l,
  resampling = rsmp("cv", folds = 3),
  measure = msr("regr.mse"),
  terminator = trm("none"),
  search_space = ps
)

# Grid search
tuner <- mlr3tuning::tnr("grid_search")
tuner$optimize(instance)
instance$result

```

Ymain_rel max_depth eta learner_param_vals x_domain regr.mse 1: 2 0.067444 <list[5]>
<list[2]> 177.18

P uptake max_depth eta learner_param_vals x_domain regr.mse 1: 2 0.034222 <list[5]>
<list[2]> 137.41

annual_P_balance max_depth eta learner_param_vals x_domain regr.mse 1: 2 0.034222
<list[5]> <list[2]> 145.21

```

# nlme.coef$kPS <- nlme.coef$k * nlme.coef$PS
#
#
# nlme.coef.mrg <- merge(nlme.coef,allP[allP$year>=2017,],by = "uid")
# # add log-transformed versions
# Dmlr$kPS_log <- log(Dmlr$kPS)
# Dmlr$PS_log <- log(Dmlr$PS)
# Dmlr$soil_0_20_P_AAE10_log <- log(Dmlr$soil_0_20_P_AAE10)
# Dmlr$soil_0_20_P_CO2_log <- log(Dmlr$soil_0_20_P_CO2)

```

```
#
# Dmlr$k

subset(Dmlr, select = c("Ymain_rel", P_var_sets$AAE10_CO2_kPS, Weather_vars))
```

	Ymain_rel	soil_0_20_P_AAE10_log	soil_0_20_P_CO2_log	PS_log	k
1	178.42	NA	NA	-2.7715938	0.10467464
2	NA	3.0773123	-1.386294361	-2.7715938	0.10467464
3	179.72	NA	NA	-3.0042091	0.12262173
4	NA	2.9069011	-1.771956842	-3.0042091	0.12262173
5	190.64	NA	NA	-2.7693913	0.10448023
6	NA	2.9601051	-1.469675970	-2.7693913	0.10448023
7	178.51	NA	NA	-2.9077724	0.11568444
8	NA	2.9069011	-1.514127733	-2.9077724	0.11568444
9	210.05	NA	NA	-2.3473051	0.12628437
10	NA	3.9815491	-0.843970070	-2.3473051	0.12628437
11	209.45	NA	NA	-2.1364490	0.11502207
12	NA	3.7954892	-0.941608540	-2.1364490	0.11502207
13	NA	3.5973123	-0.941608540	-2.6235787	0.09040112
14	215.86	NA	NA	-2.6235787	0.09040112
15	218.63	NA	NA	-2.6642037	0.08666599
16	NA	3.5890591	-1.171182982	-2.6642037	0.08666599
17	219.32	NA	NA	-1.3169035	0.08586286
18	NA	4.4485164	-0.105360516	-1.3169035	0.08586286
19	234.23	NA	NA	-1.5753641	0.08620806
20	NA	4.2541933	-0.527632742	-1.5753641	0.08620806
21	NA	3.9926809	-0.562118918	-1.7576162	0.08640235
22	232.41	NA	NA	-1.7576162	0.08640235
23	238.82	NA	NA	-1.5768721	0.08620766
24	NA	4.4578296	-0.248461359	-1.5768721	0.08620766
25	65.60	1.8870696	-1.469675970	-2.9145147	0.20191085
26	72.33	2.1162555	-1.237874356	-2.9145147	0.20191085
27	84.81	2.3321439	-1.272965676	-2.9145147	0.20191085
28	NA	2.2300144	-1.469675970	-2.9145147	0.20191085
29	NA	2.4069451	-1.171182982	-2.9145147	0.20191085
30	NA	2.3321439	-1.272965676	-2.9145147	0.20191085
31	92.91	2.3887628	-1.237874356	-2.9145147	0.20191085
32	189.25	NA	NA	-2.9145147	0.20191085
33	NA	2.1972246	-1.078809661	-2.9145147	0.20191085
34	69.17	1.8245493	-1.347073648	-2.6264148	0.23310593

35	167.07	NA	NA	-2.6264148	0.23310593
36	NA	2.3795461	-1.108662625	-2.6264148	0.23310593
37	106.32	2.4849066	-1.171182982	-2.6264148	0.23310593
38	82.00	2.3223877	-1.021651248	-2.6264148	0.23310593
39	NA	2.3418058	-1.108662625	-2.6264148	0.23310593
40	84.97	2.3418058	-1.108662625	-2.6264148	0.23310593
41	NA	2.1400662	-1.386294361	-2.6264148	0.23310593
42	NA	2.2925348	-0.941608540	-2.6264148	0.23310593
43	74.25	0.8329091	-1.832581464	-3.3408312	0.15014993
44	89.08	1.9878743	-1.514127733	-3.3408312	0.15014993
45	NA	1.7047481	-1.660731207	-3.3408312	0.15014993
46	NA	2.9069011	-1.237874356	-3.3408312	0.15014993
47	81.01	1.7047481	-1.660731207	-3.3408312	0.15014993
48	NA	1.1939225	-2.207274913	-3.3408312	0.15014993
49	NA	1.7917595	-1.609437912	-3.3408312	0.15014993
50	194.54	NA	NA	-3.3408312	0.15014993
51	66.00	1.6292405	-1.272965676	-3.3408312	0.15014993
52	NA	1.7749524	-1.469675970	-3.8896385	0.13492618
53	79.31	2.6461748	-1.237874356	-3.8896385	0.13492618
54	NA	1.4586150	-2.207274913	-3.8896385	0.13492618
55	149.91	NA	NA	-3.8896385	0.13492618
56	92.33	1.9878743	-1.237874356	-3.8896385	0.13492618
57	NA	2.1282317	-1.469675970	-3.8896385	0.13492618
58	NA	2.1162555	-1.386294361	-3.8896385	0.13492618
59	74.44	1.8870696	-1.347073648	-3.8896385	0.13492618
60	80.85	2.1162555	-1.386294361	-3.8896385	0.13492618
61	91.33	3.1441523	-0.248461359	-1.4927360	0.11739091
62	NA	3.4111477	-0.198450939	-1.4927360	0.11739091
63	NA	3.2425924	-0.314710745	-1.4927360	0.11739091
64	203.81	NA	NA	-1.4927360	0.11739091
65	91.61	3.1863526	-0.198450939	-1.4927360	0.11739091
66	109.20	3.4045252	-0.314710745	-1.4927360	0.11739091
67	NA	3.1945831	-0.198450939	-1.4927360	0.11739091
68	NA	3.1863526	-0.198450939	-1.4927360	0.11739091
69	63.16	3.1045867	-0.385662481	-1.4927360	0.11739091
70	198.18	NA	NA	-2.1350669	0.17309044
71	NA	2.7850112	-0.673344553	-2.1350669	0.17309044
72	NA	2.7972813	-0.843970070	-2.1350669	0.17309044
73	NA	2.9014216	-0.356674944	-2.1350669	0.17309044
74	68.61	2.8449094	-0.634878272	-2.1350669	0.17309044
75	73.44	2.8094027	-0.733969175	-2.1350669	0.17309044
76	78.32	2.7850112	-0.673344553	-2.1350669	0.17309044
77	101.92	3.2580965	-0.510825624	-2.1350669	0.17309044

78	NA	3.0007198	-0.562118918	-2.1350669	0.17309044
79	80.26	2.4069451	-1.171182982	-2.2181329	0.17801699
80	95.57	2.6026897	-0.941608540	-2.2181329	0.17801699
81	NA	2.8033604	-0.843970070	-2.2181329	0.17801699
82	NA	2.6026897	-0.941608540	-2.2181329	0.17801699
83	NA	2.5726122	-1.237874356	-2.2181329	0.17801699
84	72.56	2.7663191	-2.525728644	-2.2181329	0.17801699
85	NA	2.7343675	-0.673344553	-2.2181329	0.17801699
86	190.38	NA	NA	-2.2181329	0.17801699
87	107.85	2.9069011	-0.867500568	-2.2181329	0.17801699
88	NA	2.8903718	-0.867500568	-2.2067423	0.17736688
89	204.59	NA	NA	-2.2067423	0.17736688
90	52.11	3.0587071	-0.579818495	-2.2067423	0.17736688
91	NA	2.9069011	-0.733969175	-2.2067423	0.17736688
92	93.51	2.9069011	-0.733969175	-2.2067423	0.17736688
93	72.61	3.1045867	-0.916290732	-2.2067423	0.17736688
94	NA	2.8390785	-0.941608540	-2.2067423	0.17736688
95	69.74	2.6741486	-0.941608540	-2.2067423	0.17736688
96	NA	3.3809947	-0.385662481	-2.2067423	0.17736688
97	62.97	4.2017031	0.765467842	-0.9083699	0.23219455
98	90.42	4.3907386	0.636576829	-0.9083699	0.23219455
99	NA	4.3000028	0.652325186	-0.9083699	0.23219455
100	90.11	4.0412953	0.239016900	-0.9083699	0.23219455
101	222.79	NA	NA	-0.9083699	0.23219455
102	NA	4.1697612	0.604315967	-0.9083699	0.23219455
103	94.15	4.0656021	0.494696242	-0.9083699	0.23219455
104	NA	4.2640873	0.559615788	-0.9083699	0.23219455
105	NA	4.0656021	0.494696242	-0.9083699	0.23219455
106	NA	3.1822118	-0.198450939	-1.6359640	0.15615814
107	97.94	2.6461748	-0.733969175	-1.6359640	0.15615814
108	104.41	3.3809947	-0.342490309	-1.6359640	0.15615814
109	81.58	3.0540012	-0.510825624	-1.6359640	0.15615814
110	204.59	NA	NA	-1.6359640	0.15615814
111	NA	3.0726933	-0.634878272	-1.6359640	0.15615814
112	85.44	3.0955776	-1.171182982	-1.6359640	0.15615814
113	NA	2.6461748	-0.733969175	-1.6359640	0.15615814
114	NA	3.0056826	-0.478035801	-1.6359640	0.15615814
115	195.84	NA	NA	-1.3788326	0.17699689
116	76.88	3.4873751	-0.105360516	-1.3788326	0.17699689
117	NA	3.5945688	0.231111721	-1.3788326	0.17699689
118	83.33	3.7424202	-0.105360516	-1.3788326	0.17699689
119	NA	3.8044378	0.165514438	-1.3788326	0.17699689
120	87.03	3.5945688	0.231111721	-1.3788326	0.17699689

121	47.89	3.4531571	-0.051293294	-1.3788326	0.17699689
122	NA	4.0412953	0.425267735	-1.3788326	0.17699689
123	NA	3.6480575	0.048790164	-1.3788326	0.17699689
124	125.95	2.7013612	-1.272965676	-3.3238864	0.22062441
125	66.48	2.7472709	-1.514127733	-3.3238864	0.22062441
126	83.27	2.8507065	-0.994252273	-3.3238864	0.22062441
127	NA	2.7472709	-1.272965676	-3.3238864	0.22062441
128	139.69	NA	NA	-3.3238864	0.22062441
129	NA	2.6100698	-1.771956842	-3.3238864	0.22062441
130	NA	2.4069451	-1.609437912	-3.3238864	0.22062441
131	132.89	2.6390573	-1.171182982	-3.3238864	0.22062441
132	NA	2.7013612	-1.272965676	-3.3238864	0.22062441
133	NA	3.1223649	-1.108662625	-3.2178905	0.18943117
134	75.56	2.8622009	-1.237874356	-3.2178905	0.18943117
135	140.99	NA	NA	-3.2178905	0.18943117
136	NA	2.9123507	-1.966112856	-3.2178905	0.18943117
137	117.88	3.1223649	-1.108662625	-3.2178905	0.18943117
138	NA	2.8507065	-1.347073648	-3.2178905	0.18943117
139	65.52	3.0106209	-1.386294361	-3.2178905	0.18943117
140	91.54	3.0492730	-1.078809661	-3.2178905	0.18943117
141	NA	2.1860513	-1.386294361	-3.2178905	0.18943117
142	NA	2.9391619	-1.237874356	-3.6548744	0.28439752
143	65.33	2.9014216	-1.609437912	-3.6548744	0.28439752
144	NA	2.9652731	-1.469675970	-3.6548744	0.28439752
145	133.86	2.9391619	-1.237874356	-3.6548744	0.28439752
146	NA	2.8903718	-2.120263536	-3.6548744	0.28439752
147	77.26	3.1570004	-1.108662625	-3.6548744	0.28439752
148	132.58	NA	NA	-3.6548744	0.28439752
149	NA	3.1045867	-1.347073648	-3.6548744	0.28439752
150	93.11	3.1570004	-0.941608540	-3.6548744	0.28439752
151	89.10	2.7972813	-1.272965676	-3.3755708	0.21679430
152	NA	2.4336134	-2.407945609	-3.3755708	0.21679430
153	86.78	2.8033604	-1.609437912	-3.3755708	0.21679430
154	NA	2.7146947	-1.386294361	-3.3755708	0.21679430
155	NA	2.3608540	-1.514127733	-3.3755708	0.21679430
156	54.11	2.2407097	-1.237874356	-3.3755708	0.21679430
157	126.90	2.7146947	-1.386294361	-3.3755708	0.21679430
158	NA	2.3702437	-1.237874356	-3.3755708	0.21679430
159	117.94	NA	NA	-3.3755708	0.21679430
160	NA	3.4468079	-0.916290732	-2.3555262	0.34791259
161	NA	3.2580965	-0.994252273	-2.3555262	0.34791259
162	135.70	NA	NA	-2.3555262	0.34791259
163	109.78	3.4011974	-0.693147181	-2.3555262	0.34791259

164	87.36	3.3534067	-1.078809661	-2.3555262	0.34791259
165	NA	3.3141860	-0.733969175	-2.3555262	0.34791259
166	NA	3.0056826	-0.916290732	-2.3555262	0.34791259
167	90.60	3.5055574	-0.693147181	-2.3555262	0.34791259
168	145.89	3.2580965	-0.994252273	-2.3555262	0.34791259
169	NA	3.1986731	-0.867500568	-2.4402754	0.30702495
170	92.78	3.5025499	-0.673344553	-2.4402754	0.30702495
171	139.72	3.3741687	-0.798507696	-2.4402754	0.30702495
172	NA	3.4812401	-1.108662625	-2.4402754	0.30702495
173	151.13	NA	NA	-2.4402754	0.30702495
174	79.12	3.3741687	-1.108662625	-2.4402754	0.30702495
175	NA	3.3741687	-0.798507696	-2.4402754	0.30702495
176	94.92	3.4750672	-0.579818495	-2.4402754	0.30702495
177	NA	3.3393220	-0.941608540	-2.4402754	0.30702495
178	153.12	NA	NA	-2.5704141	0.25060055
179	87.56	3.6163088	-0.693147181	-2.5704141	0.25060055
180	NA	3.4719665	-0.798507696	-2.5704141	0.25060055
181	92.11	3.6988298	-0.634878272	-2.5704141	0.25060055
182	NA	3.6788291	-1.108662625	-2.5704141	0.25060055
183	NA	3.4242627	-0.867500568	-2.5704141	0.25060055
184	138.29	3.5496174	-0.733969175	-2.5704141	0.25060055
185	NA	3.5496174	-0.733969175	-2.5704141	0.25060055
186	77.97	3.2542430	-1.272965676	-2.5704141	0.25060055
187	125.74	NA	NA	-2.8188200	0.16133292
188	NA	2.7343675	-0.941608540	-2.8188200	0.16133292
189	96.55	3.1223649	-1.171182982	-2.8188200	0.16133292
190	137.97	2.8390785	-1.108662625	-2.8188200	0.16133292
191	90.00	2.8033604	-0.843970070	-2.8188200	0.16133292
192	NA	2.7343675	-1.078809661	-2.8188200	0.16133292
193	NA	2.8390785	-1.108662625	-2.8188200	0.16133292
194	96.80	3.1267605	-0.798507696	-2.8188200	0.16133292
195	NA	2.7972813	-1.771956842	-2.8188200	0.16133292
196	NA	3.2771447	-0.510825624	-2.0165660	0.29038401
197	NA	3.5973123	-0.385662481	-2.0165660	0.29038401
198	148.44	NA	NA	-2.0165660	0.29038401
199	NA	3.5751507	-0.510825624	-2.0165660	0.29038401
200	NA	3.5695327	-0.478035801	-2.0165660	0.29038401
201	134.81	3.5695327	-0.478035801	-2.0165660	0.29038401
202	88.53	3.8712010	-0.430782916	-2.0165660	0.29038401
203	84.67	3.1441523	-0.776528789	-2.0165660	0.29038401
204	58.00	3.6163088	-0.400477567	-2.0165660	0.29038401
205	117.78	4.0741419	-0.094310679	-1.8173600	0.22557569
206	92.53	3.7352858	-0.733969175	-1.8173600	0.22557569

207	NA	3.8329798	-0.579818495	-1.8173600	0.22557569
208	97.18	3.9039908	-0.385662481	-1.8173600	0.22557569
209	NA	3.6584202	-0.478035801	-1.8173600	0.22557569
210	132.12	3.6635616	-0.527632742	-1.8173600	0.22557569
211	NA	3.6635616	-0.527632742	-1.8173600	0.22557569
212	NA	3.7376696	-0.430782916	-1.8173600	0.22557569
213	140.29	NA	NA	-1.8173600	0.22557569
214	91.44	3.8133070	-0.274436846	-1.6506135	0.13768829
215	137.66	3.6963515	-0.478035801	-1.6506135	0.13768829
216	NA	3.6963515	-0.478035801	-1.6506135	0.13768829
217	NA	3.7954892	-0.446287103	-1.6506135	0.13768829
218	NA	3.5890591	-0.400477567	-1.6506135	0.13768829
219	123.83	NA	NA	-1.6506135	0.13768829
220	90.98	3.9512437	-0.162518929	-1.6506135	0.13768829
221	98.28	3.9160150	-0.446287103	-1.6506135	0.13768829
222	NA	3.7773481	-0.314710745	-1.6506135	0.13768829
223	119.84	NA	NA	-1.7109028	0.06500092
224	92.34	3.6737658	-0.693147181	-1.7109028	0.06500092
225	94.74	3.8372995	-0.510825624	-1.7109028	0.06500092
226	108.89	3.7447871	-0.356674944	-1.7109028	0.06500092
227	NA	3.6813512	-0.162518929	-1.7109028	0.06500092
228	NA	3.6838669	-0.579818495	-1.7109028	0.06500092
229	NA	3.4307562	-0.693147181	-1.7109028	0.06500092
230	NA	3.7954892	-0.673344553	-1.7109028	0.06500092
231	132.91	3.6838669	-0.579818495	-1.7109028	0.06500092
232	NA	2.9338569	-0.941608540	-3.0602039	0.22808615
233	98.67	2.4765384	-1.272965676	-3.0602039	0.22808615
234	98.64	2.7911651	-1.021651248	-3.0602039	0.22808615
235	NA	2.7725887	-0.941608540	-3.0602039	0.22808615
236	108.37	2.6741486	-1.108662625	-3.0602039	0.22808615
237	90.23	2.9338569	-0.941608540	-3.0602039	0.22808615
238	NA	2.7725887	-1.108662625	-3.0602039	0.22808615
239	94.74	2.5649494	-1.469675970	-3.0602039	0.22808615
240	123.40	NA	NA	-3.0602039	0.22808615
241	NA	2.6741486	-1.108662625	-3.0602039	0.22808615
242	NA	2.6672282	-1.021651248	-2.9064446	0.20616803
243	81.61	2.9123507	-1.078809661	-2.9064446	0.20616803
244	115.94	2.6878475	-1.108662625	-2.9064446	0.20616803
245	NA	2.7013612	-1.237874356	-2.9064446	0.20616803
246	83.91	2.9704145	-1.078809661	-2.9064446	0.20616803
247	156.85	NA	NA	-2.9064446	0.20616803
248	NA	2.6878475	-1.108662625	-2.9064446	0.20616803
249	89.10	2.6390573	-1.469675970	-2.9064446	0.20616803

250	NA	2.9123507	-1.078809661	-2.9064446	0.20616803
251	82.03	2.7600099	-1.237874356	-2.9064446	0.20616803
252	104.22	2.8213789	-1.078809661	-2.6081966	0.15273297
253	NA	3.0540012	-0.673344553	-2.6081966	0.15273297
254	NA	2.8903718	-1.108662625	-2.6081966	0.15273297
255	NA	3.2228678	-0.941608540	-2.6081966	0.15273297
256	83.28	3.0252911	-0.916290732	-2.6081966	0.15273297
257	152.86	NA	NA	-2.6081966	0.15273297
258	93.87	3.2228678	-0.941608540	-2.6081966	0.15273297
259	92.86	3.2695689	-1.347073648	-2.6081966	0.15273297
260	NA	3.0106209	-1.078809661	-2.6081966	0.15273297
261	113.04	3.0106209	-1.078809661	-2.6081966	0.15273297
262	NA	2.7911651	-1.237874356	-2.5903371	0.14899842
263	164.73	NA	NA	-2.5903371	0.14899842
264	NA	2.4510051	-1.171182982	-2.5903371	0.14899842
265	NA	2.4423470	-0.127833372	-2.5903371	0.14899842
266	96.24	2.2823824	-1.514127733	-2.5903371	0.14899842
267	104.70	2.5416020	-1.237874356	-2.5903371	0.14899842
268	97.49	2.6461748	-1.021651248	-2.5903371	0.14899842
269	NA	2.2823824	-1.078809661	-2.5903371	0.14899842
270	91.95	2.7911651	-1.237874356	-2.5903371	0.14899842
271	110.14	2.4510051	-1.171182982	-2.5903371	0.14899842
272	100.00	3.5174978	-0.527632742	-2.0944336	0.19984180
273	98.85	3.6609943	-0.400477567	-2.0944336	0.19984180
274	92.15	3.9019727	-0.174353387	-2.0944336	0.19984180
275	86.47	3.4843123	-0.562118918	-2.0944336	0.19984180
276	133.02	NA	NA	-2.0944336	0.19984180
277	NA	3.4078419	-0.446287103	-2.0944336	0.19984180
278	NA	3.4372078	-0.342490309	-2.0944336	0.19984180
279	NA	3.9019727	-0.174353387	-2.0944336	0.19984180
280	NA	3.6323091	-0.162518929	-2.0944336	0.19984180
281	107.57	3.4078419	-0.446287103	-2.0944336	0.19984180
282	NA	3.4499875	-0.385662481	-1.6439616	0.10705720
283	NA	3.6813512	-0.301105093	-1.6439616	0.10705720
284	NA	3.3741687	-0.248461359	-1.6439616	0.10705720
285	96.38	3.2733640	-0.400477567	-1.6439616	0.10705720
286	94.92	3.3286267	-0.400477567	-1.6439616	0.10705720
287	134.75	NA	NA	-1.6439616	0.10705720
288	NA	3.3877744	-0.105360516	-1.6439616	0.10705720
289	92.53	3.6813512	-0.301105093	-1.6439616	0.10705720
290	140.42	3.3741687	-0.248461359	-1.6439616	0.10705720
291	100.00	3.4307562	-0.198450939	-1.6439616	0.10705720
292	NA	4.1541846	-0.127833372	-2.1715576	0.21193823

293	NA	3.5263605	-0.385662481	-2.1715576	0.21193823
294	113.27	3.5467397	-0.430782916	-2.1715576	0.21193823
295	160.75	NA	NA	-2.1715576	0.21193823
296	95.02	4.1541846	-0.127833372	-2.1715576	0.21193823
297	NA	3.8649314	-0.020202707	-2.1715576	0.21193823
298	97.18	3.4339872	-0.673344553	-2.1715576	0.21193823
299	NA	3.6296601	-0.430782916	-2.1715576	0.21193823
300	126.25	3.5263605	-0.385662481	-2.1715576	0.21193823
301	96.34	3.8372995	-0.139262067	-2.1715576	0.21193823
302	99.28	3.0955776	-0.733969175	-2.0030331	0.18423357
303	NA	3.2386785	-0.634878272	-2.0030331	0.18423357
304	104.28	3.4594663	-0.430782916	-2.0030331	0.18423357
305	119.16	3.2386785	-0.634878272	-2.0030331	0.18423357
306	NA	3.3178158	-0.673344553	-2.0030331	0.18423357
307	NA	3.4339872	-0.094310679	-2.0030331	0.18423357
308	102.07	3.1484534	-0.673344553	-2.0030331	0.18423357
309	NA	3.6712245	-0.478035801	-2.0030331	0.18423357
310	94.25	3.6712245	-0.478035801	-2.0030331	0.18423357
311	158.67	NA	NA	-2.0030331	0.18423357
312	NA	3.7062281	-0.210721031	-1.5511331	0.13120470
313	NA	3.6349511	0.019802627	-1.5511331	0.13120470
314	100.75	3.6428355	-0.162518929	-1.5511331	0.13120470
315	96.66	3.7977339	0.039220713	-1.5511331	0.13120470
316	93.30	4.2766661	0.357674444	-1.5511331	0.13120470
317	161.09	NA	NA	-1.5511331	0.13120470
318	130.60	3.6349511	0.019802627	-1.5511331	0.13120470
319	108.69	3.7424202	-0.040821995	-1.5511331	0.13120470
320	NA	4.2766661	0.357674444	-1.5511331	0.13120470
321	NA	3.8607297	0.343589704	-1.5511331	0.13120470
322	NA	3.6712245	0.122217633	-1.2221855	0.10473925
323	157.02	NA	NA	-1.2221855	0.10473925
324	NA	3.4339872	-0.162518929	-1.2221855	0.10473925
325	99.69	3.7208625	0.048790164	-1.2221855	0.10473925
326	NA	3.7352858	0.277631737	-1.2221855	0.10473925
327	85.16	3.6323091	0.076961041	-1.2221855	0.10473925
328	97.51	3.9569964	-0.040821995	-1.2221855	0.10473925
329	111.65	3.5174978	-0.094310679	-1.2221855	0.10473925
330	128.34	3.4339872	-0.162518929	-1.2221855	0.10473925
331	NA	3.9569964	-0.040821995	-1.2221855	0.10473925
332	NA	3.4688560	-0.235722334	-1.2647377	0.13141530
333	NA	4.1125119	0.148420005	-1.2647377	0.13141530
334	93.42	3.5204608	-0.385662481	-1.2647377	0.13141530
335	NA	3.6661225	0.009950331	-1.2647377	0.13141530

336	88.06	3.6082116	-0.235722334	-1.2647377	0.13141530
337	NA	3.7887248	-0.040821995	-1.2647377	0.13141530
338	130.43	3.4688560	-0.235722334	-1.2647377	0.13141530
339	94.44	4.1125119	0.148420005	-1.2647377	0.13141530
340	169.15	NA	NA	-1.2647377	0.13141530
341	106.17	3.6270041	-0.210721031	-1.2647377	0.13141530
342	NA	4.0758411	0.239016900	-1.2757306	0.21076772
343	106.02	4.0621657	-0.051293294	-1.2757306	0.21076772
344	NA	4.1447208	-0.198450939	-1.2757306	0.21076772
345	158.15	NA	NA	-1.2757306	0.21076772
346	133.49	3.9627161	-0.105360516	-1.2757306	0.21076772
347	100.42	3.9926809	-0.105360516	-1.2757306	0.21076772
348	NA	3.9627161	-0.105360516	-1.2757306	0.21076772
349	94.25	4.1447208	-0.198450939	-1.2757306	0.21076772
350	NA	4.2556127	0.300104592	-1.2757306	0.21076772
351	96.86	4.0360090	0.076961041	-1.2757306	0.21076772
352	91.63	2.9856819	-1.272965676	-3.8181685	0.18211399
353	86.01	2.5095993	-1.660731207	-3.8181685	0.18211399
354	69.73	3.0301337	-1.272965676	-3.8181685	0.18211399
355	164.56	NA	NA	-3.8181685	0.18211399
356	NA	3.0301337	-1.272965676	-3.8181685	0.18211399
357	NA	2.7013612	-1.660731207	-3.8181685	0.18211399
358	104.08	2.7212954	-1.237874356	-3.8181685	0.18211399
359	NA	2.8094027	-1.272965676	-3.8181685	0.18211399
360	80.08	2.6810215	-1.771956842	-3.8181685	0.18211399
361	NA	2.9856819	-1.272965676	-3.8181685	0.18211399
362	67.05	2.9177707	-1.609437912	-3.7414147	0.22288952
363	NA	2.7408400	-1.609437912	-3.7414147	0.22288952
364	153.73	NA	NA	-3.7414147	0.22288952
365	81.18	2.8213789	-1.832581464	-3.7414147	0.22288952
366	NA	2.9177707	-1.609437912	-3.7414147	0.22288952
367	61.28	3.0155349	-1.771956842	-3.7414147	0.22288952
368	NA	2.9549103	-1.609437912	-3.7414147	0.22288952
369	NA	2.5572273	-1.832581464	-3.7414147	0.22288952
370	66.34	2.9549103	-1.609437912	-3.7414147	0.22288952
371	94.25	2.9014216	-1.469675970	-3.7414147	0.22288952
372	75.10	3.5263605	-1.108662625	-3.8931747	0.14517478
373	166.64	NA	NA	-3.8931747	0.14517478
374	NA	3.6136170	-0.693147181	-3.8931747	0.14517478
375	NA	3.4563167	-1.108662625	-3.8931747	0.14517478
376	NA	3.2958369	-1.660731207	-3.8931747	0.14517478
377	129.31	3.4563167	-1.108662625	-3.8931747	0.14517478
378	110.97	3.6216707	-0.867500568	-3.8931747	0.14517478

379	94.92	3.5234150	-1.347073648	-3.8931747	0.14517478
380	NA	3.5263605	-1.108662625	-3.8931747	0.14517478
381	98.91	3.3286267	-1.469675970	-3.8931747	0.14517478
382	88.90	2.9014216	-1.469675970	-3.6735278	0.26166020
383	NA	2.9391619	-1.386294361	-3.6735278	0.26166020
384	NA	2.7663191	-1.469675970	-3.6735278	0.26166020
385	65.52	2.9391619	-1.386294361	-3.6735278	0.26166020
386	NA	2.6246686	-1.966112856	-3.6735278	0.26166020
387	64.66	2.8390785	-1.832581464	-3.6735278	0.26166020
388	NA	2.5014360	-1.771956842	-3.6735278	0.26166020
389	75.85	2.7663191	-1.469675970	-3.6735278	0.26166020
390	165.68	NA	NA	-3.6735278	0.26166020
391	71.26	3.1696856	-1.272965676	-3.6735278	0.26166020
392	86.78	4.1383614	0.067658648	-2.0697768	0.21782370
393	153.64	NA	NA	-2.0697768	0.21782370
394	106.63	3.8501476	-0.478035801	-2.0697768	0.21782370
395	NA	4.1141472	0.009950331	-2.0697768	0.21782370
396	NA	4.0342406	0.190620360	-2.0697768	0.21782370
397	135.27	4.1141472	0.009950331	-2.0697768	0.21782370
398	NA	4.1383614	0.067658648	-2.0697768	0.21782370
399	NA	3.9759363	-0.446287103	-2.0697768	0.21782370
400	100.10	3.9239516	-0.072570693	-2.0697768	0.21782370
401	114.85	4.2253728	-0.235722334	-2.0697768	0.21782370
402	105.43	3.9180051	-0.478035801	-2.3967665	0.21384349
403	162.91	NA	NA	-2.3967665	0.21384349
404	NA	3.8351420	-0.693147181	-2.3967665	0.21384349
405	97.89	4.2061840	0.173953307	-2.3967665	0.21384349
406	99.69	3.9796817	-0.235722334	-2.3967665	0.21384349
407	109.77	3.9376908	-0.579818495	-2.3967665	0.21384349
408	NA	3.8774316	-0.072570693	-2.3967665	0.21384349
409	NA	4.2061840	0.173953307	-2.3967665	0.21384349
410	145.25	3.9852735	-0.301105093	-2.3967665	0.21384349
411	NA	3.9852735	-0.301105093	-2.3967665	0.21384349
412	88.12	3.6686767	-0.634878272	-2.6575735	0.21147919
413	129.95	3.5723456	-0.798507696	-2.6575735	0.21147919
414	NA	3.6686767	-0.634878272	-2.6575735	0.21147919
415	97.83	3.2228678	-1.272965676	-2.6575735	0.21147919
416	NA	3.5695327	-1.171182982	-2.6575735	0.21147919
417	108.05	3.3568971	-0.733969175	-2.6575735	0.21147919
418	NA	3.2347492	-0.994252273	-2.6575735	0.21147919
419	168.54	NA	NA	-2.6575735	0.21147919
420	108.65	3.5582011	-0.994252273	-2.6575735	0.21147919
421	NA	3.5723456	-0.798507696	-2.6575735	0.21147919

422	NA	3.7037681	-0.385662481	-2.6521244	0.21152273
423	NA	4.2106450	0.418710335	-2.6521244	0.21152273
424	NA	3.6054978	-0.634878272	-2.6521244	0.21152273
425	117.23	3.8066625	-0.356674944	-2.6521244	0.21152273
426	110.24	3.8416005	-0.356674944	-2.6521244	0.21152273
427	102.63	3.7013020	-0.634878272	-2.6521244	0.21152273
428	NA	3.8066625	-0.356674944	-2.6521244	0.21152273
429	81.61	4.2106450	0.418710335	-2.6521244	0.21152273
430	168.54	NA	NA	-2.6521244	0.21152273
431	109.17	3.5582011	-0.579818495	-2.6521244	0.21152273
432	NA	4.3832759	0.190620360	-1.4624073	0.18550740
433	89.46	4.6288867	0.703097511	-1.4624073	0.18550740
434	NA	4.3502779	-0.094310679	-1.4624073	0.18550740
435	113.99	4.2499228	-0.174353387	-1.4624073	0.18550740
436	98.22	4.3956830	0.438254931	-1.4624073	0.18550740
437	131.88	4.3832759	0.190620360	-1.4624073	0.18550740
438	NA	4.3254563	0.262364264	-1.4624073	0.18550740
439	166.55	NA	NA	-1.4624073	0.18550740
440	NA	4.6288867	0.703097511	-1.4624073	0.18550740
441	106.02	4.3385971	0.076961041	-1.4624073	0.18550740
442	NA	4.3770141	0.683096845	-1.2422076	0.13496530
443	99.62	4.5358201	0.900161350	-1.2422076	0.13496530
444	111.18	4.3081110	0.488580015	-1.2422076	0.13496530
445	103.50	4.2282925	0.067658648	-1.2422076	0.13496530
446	177.90	NA	NA	-1.2422076	0.13496530
447	NA	4.3515674	0.451075619	-1.2422076	0.13496530
448	143.00	4.3515674	0.451075619	-1.2422076	0.13496530
449	NA	4.5358201	0.900161350	-1.2422076	0.13496530
450	113.35	4.5174313	0.678033543	-1.2422076	0.13496530
451	NA	4.4601444	0.357674444	-1.2422076	0.13496530
452	NA	4.2668963	0.165514438	-1.5757798	0.20749743
453	134.86	4.1972019	-0.105360516	-1.5757798	0.20749743
454	NA	4.2456340	0.254642218	-1.5757798	0.20749743
455	NA	4.3294167	0.703097511	-1.5757798	0.20749743
456	89.85	4.3993753	0.963174318	-1.5757798	0.20749743
457	NA	4.3993753	0.963174318	-1.5757798	0.20749743
458	132.21	4.2456340	0.254642218	-1.5757798	0.20749743
459	114.85	4.2668963	0.113328685	-1.5757798	0.20749743
460	163.00	NA	NA	-1.5757798	0.20749743
461	92.89	4.1287460	0.076961041	-1.5757798	0.20749743
462	125.60	3.9702919	0.425267735	-2.1617951	0.28873132
463	NA	3.7376696	-0.274436846	-2.1617951	0.28873132
464	NA	3.9702919	0.425267735	-2.1617951	0.28873132

465	110.14		4.0758411	0.717839793	-2.1617951	0.28873132
466	128.47		3.9039908	0.398776120	-2.1617951	0.28873132
467	107.89		4.0656021	0.536493371	-2.1617951	0.28873132
468	NA		4.1972019	0.457424847	-2.1617951	0.28873132
469	177.56		NA	NA	-2.1617951	0.28873132
470	NA		3.9473901	0.542324291	-2.1617951	0.28873132
471	81.03		4.1972019	0.457424847	-2.1617951	0.28873132
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1	-5.028492	13.3	1784.4	-0.22	-0.02	2195.9
2	-5.028492	NA	NA	NA	NA	NA
3	-5.102860	13.3	1784.4	-0.22	-0.02	2195.9
4	-5.102860	NA	NA	NA	NA	NA
5	-5.028149	13.3	1784.4	-0.22	-0.02	2195.9
6	-5.028149	NA	NA	NA	NA	NA
7	-5.064662	13.3	1784.4	-0.22	-0.02	2195.9
8	-5.064662	NA	NA	NA	NA	NA
9	-4.416524	13.3	1784.4	-0.22	-0.02	2195.9
10	-4.416524	NA	NA	NA	NA	NA
11	-4.299080	13.3	1784.4	-0.22	-0.02	2195.9
12	-4.299080	NA	NA	NA	NA	NA
13	-5.027077	NA	NA	NA	NA	NA
14	-5.027077	13.3	1784.4	-0.22	-0.02	2195.9
15	-5.109897	13.3	1784.4	-0.22	-0.02	2195.9
16	-5.109897	NA	NA	NA	NA	NA
17	-3.771907	13.3	1784.4	-0.22	-0.02	2195.9
18	-3.771907	NA	NA	NA	NA	NA
19	-4.026356	13.3	1784.4	-0.22	-0.02	2195.9
20	-4.026356	NA	NA	NA	NA	NA
21	-4.206357	NA	NA	NA	NA	NA
22	-4.206357	13.3	1784.4	-0.22	-0.02	2195.9
23	-4.027868	13.3	1784.4	-0.22	-0.02	2195.9
24	-4.027868	NA	NA	NA	NA	NA
25	-4.514444	11.3	725.8	-0.38	0.42	2019.7
26	-4.514444	10.1	1035.6	0.23	0.22	1960.0
27	-4.514444	10.5	993.9	-0.25	0.44	1862.4
28	-4.514444	NA	NA	NA	NA	NA
29	-4.514444	10.7	870.9	-0.35	0.18	1886.0
30	-4.514444	10.5	993.9	-0.25	0.44	1862.4
31	-4.514444	11.2	752.6	-0.36	-0.02	2105.7
32	-4.514444	11.3	1060.6	-0.26	0.14	1721.4
33	-4.514444	9.5	1029.7	0.23	0.13	1692.1
34	-4.082677	11.3	725.8	-0.38	0.42	2019.7
35	-4.082677	11.3	1060.6	-0.26	0.14	1721.4

36	-4.082677	10.7	870.9	-0.35	0.18	1886.0
37	-4.082677	11.2	752.6	-0.36	-0.02	2105.7
38	-4.082677	10.1	1035.6	0.23	0.22	1960.0
39	-4.082677	10.5	993.9	-0.25	0.44	1862.4
40	-4.082677	10.5	993.9	-0.25	0.44	1862.4
41	-4.082677	NA	NA	NA	NA	NA
42	-4.082677	9.5	1029.7	0.23	0.13	1692.1
43	-5.236952	11.3	725.8	-0.38	0.42	2019.7
44	-5.236952	11.2	752.6	-0.36	-0.02	2105.7
45	-5.236952	10.5	993.9	-0.25	0.44	1862.4
46	-5.236952	9.5	1029.7	0.23	0.13	1692.1
47	-5.236952	10.5	993.9	-0.25	0.44	1862.4
48	-5.236952	NA	NA	NA	NA	NA
49	-5.236952	10.7	870.9	-0.35	0.18	1886.0
50	-5.236952	11.3	1060.6	-0.26	0.14	1721.4
51	-5.236952	10.1	1035.6	0.23	0.22	1960.0
52	-5.892666	9.5	1029.7	0.23	0.13	1692.1
53	-5.892666	11.2	752.6	-0.36	-0.02	2105.7
54	-5.892666	NA	NA	NA	NA	NA
55	-5.892666	11.3	1060.6	-0.26	0.14	1721.4
56	-5.892666	10.1	1035.6	0.23	0.22	1960.0
57	-5.892666	10.7	870.9	-0.35	0.18	1886.0
58	-5.892666	10.5	993.9	-0.25	0.44	1862.4
59	-5.892666	11.3	725.8	-0.38	0.42	2019.7
60	-5.892666	10.5	993.9	-0.25	0.44	1862.4
61	-3.634982	10.1	1035.6	0.23	0.22	1960.0
62	-3.634982	10.7	870.9	-0.35	0.18	1886.0
63	-3.634982	NA	NA	NA	NA	NA
64	-3.634982	11.3	1060.6	-0.26	0.14	1721.4
65	-3.634982	10.5	993.9	-0.25	0.44	1862.4
66	-3.634982	11.2	752.6	-0.36	-0.02	2105.7
67	-3.634982	9.5	1029.7	0.23	0.13	1692.1
68	-3.634982	10.5	993.9	-0.25	0.44	1862.4
69	-3.634982	11.3	725.8	-0.38	0.42	2019.7
70	-3.889008	11.3	1060.6	-0.26	0.14	1721.4
71	-3.889008	10.5	993.9	-0.25	0.44	1862.4
72	-3.889008	NA	NA	NA	NA	NA
73	-3.889008	9.5	1029.7	0.23	0.13	1692.1
74	-3.889008	11.3	725.8	-0.38	0.42	2019.7
75	-3.889008	10.1	1035.6	0.23	0.22	1960.0
76	-3.889008	10.5	993.9	-0.25	0.44	1862.4
77	-3.889008	11.2	752.6	-0.36	-0.02	2105.7
78	-3.889008	10.7	870.9	-0.35	0.18	1886.0

79	-3.944009	11.3	725.8	-0.38	0.42	2019.7
80	-3.944009	10.5	993.9	-0.25	0.44	1862.4
81	-3.944009	10.7	870.9	-0.35	0.18	1886.0
82	-3.944009	10.5	993.9	-0.25	0.44	1862.4
83	-3.944009	NA	NA	NA	NA	NA
84	-3.944009	10.1	1035.6	0.23	0.22	1960.0
85	-3.944009	9.5	1029.7	0.23	0.13	1692.1
86	-3.944009	11.3	1060.6	-0.26	0.14	1721.4
87	-3.944009	11.2	752.6	-0.36	-0.02	2105.7
88	-3.936277	NA	NA	NA	NA	NA
89	-3.936277	11.3	1060.6	-0.26	0.14	1721.4
90	-3.936277	10.1	1035.6	0.23	0.22	1960.0
91	-3.936277	10.5	993.9	-0.25	0.44	1862.4
92	-3.936277	10.5	993.9	-0.25	0.44	1862.4
93	-3.936277	11.2	752.6	-0.36	-0.02	2105.7
94	-3.936277	10.7	870.9	-0.35	0.18	1886.0
95	-3.936277	11.3	725.8	-0.38	0.42	2019.7
96	-3.936277	9.5	1029.7	0.23	0.13	1692.1
97	-2.368550	11.3	725.8	-0.38	0.42	2019.7
98	-2.368550	11.2	752.6	-0.36	-0.02	2105.7
99	-2.368550	NA	NA	NA	NA	NA
100	-2.368550	10.1	1035.6	0.23	0.22	1960.0
101	-2.368550	11.3	1060.6	-0.26	0.14	1721.4
102	-2.368550	9.5	1029.7	0.23	0.13	1692.1
103	-2.368550	10.5	993.9	-0.25	0.44	1862.4
104	-2.368550	10.7	870.9	-0.35	0.18	1886.0
105	-2.368550	10.5	993.9	-0.25	0.44	1862.4
106	-3.492850	10.7	870.9	-0.35	0.18	1886.0
107	-3.492850	10.5	993.9	-0.25	0.44	1862.4
108	-3.492850	11.2	752.6	-0.36	-0.02	2105.7
109	-3.492850	11.3	725.8	-0.38	0.42	2019.7
110	-3.492850	11.3	1060.6	-0.26	0.14	1721.4
111	-3.492850	NA	NA	NA	NA	NA
112	-3.492850	10.1	1035.6	0.23	0.22	1960.0
113	-3.492850	10.5	993.9	-0.25	0.44	1862.4
114	-3.492850	9.5	1029.7	0.23	0.13	1692.1
115	-3.110456	11.3	1060.6	-0.26	0.14	1721.4
116	-3.110456	11.3	725.8	-0.38	0.42	2019.7
117	-3.110456	10.5	993.9	-0.25	0.44	1862.4
118	-3.110456	11.2	752.6	-0.36	-0.02	2105.7
119	-3.110456	NA	NA	NA	NA	NA
120	-3.110456	10.5	993.9	-0.25	0.44	1862.4
121	-3.110456	10.1	1035.6	0.23	0.22	1960.0

122	-3.110456	9.5	1029.7	0.23	0.13	1692.1
123	-3.110456	10.7	870.9	-0.35	0.18	1886.0
124	-4.835180	10.2	1063.5	-0.25	0.28	1758.6
125	-4.835180	10.8	1013.6	-0.45	-0.24	1768.3
126	-4.835180	11.2	1047.7	-0.08	0.50	2022.8
127	-4.835180	10.6	980.7	-0.25	0.35	1890.3
128	-4.835180	11.2	1210.1	-0.35	0.13	1742.3
129	-4.835180	NA	NA	NA	NA	NA
130	-4.835180	9.3	1390.5	0.52	0.07	1589.4
131	-4.835180	9.9	1076.4	-0.10	0.19	1748.2
132	-4.835180	10.2	1063.5	-0.25	0.28	1758.6
133	-4.881620	10.2	1063.5	-0.25	0.28	1758.6
134	-4.881620	9.9	1076.4	-0.10	0.19	1748.2
135	-4.881620	11.2	1210.1	-0.35	0.13	1742.3
136	-4.881620	NA	NA	NA	NA	NA
137	-4.881620	10.2	1063.5	-0.25	0.28	1758.6
138	-4.881620	10.6	980.7	-0.25	0.35	1890.3
139	-4.881620	10.8	1013.6	-0.45	-0.24	1768.3
140	-4.881620	11.2	1047.7	-0.08	0.50	2022.8
141	-4.881620	9.3	1390.5	0.52	0.07	1589.4
142	-4.912257	10.2	1063.5	-0.25	0.28	1758.6
143	-4.912257	10.8	1013.6	-0.45	-0.24	1768.3
144	-4.912257	9.3	1390.5	0.52	0.07	1589.4
145	-4.912257	10.2	1063.5	-0.25	0.28	1758.6
146	-4.912257	NA	NA	NA	NA	NA
147	-4.912257	11.2	1047.7	-0.08	0.50	2022.8
148	-4.912257	11.2	1210.1	-0.35	0.13	1742.3
149	-4.912257	10.6	980.7	-0.25	0.35	1890.3
150	-4.912257	9.9	1076.4	-0.10	0.19	1748.2
151	-4.904377	11.2	1047.7	-0.08	0.50	2022.8
152	-4.904377	NA	NA	NA	NA	NA
153	-4.904377	10.8	1013.6	-0.45	-0.24	1768.3
154	-4.904377	10.2	1063.5	-0.25	0.28	1758.6
155	-4.904377	10.6	980.7	-0.25	0.35	1890.3
156	-4.904377	9.9	1076.4	-0.10	0.19	1748.2
157	-4.904377	10.2	1063.5	-0.25	0.28	1758.6
158	-4.904377	9.3	1390.5	0.52	0.07	1589.4
159	-4.904377	11.2	1210.1	-0.35	0.13	1742.3
160	-3.411330	NA	NA	NA	NA	NA
161	-3.411330	10.2	1063.5	-0.25	0.28	1758.6
162	-3.411330	11.2	1210.1	-0.35	0.13	1742.3
163	-3.411330	9.9	1076.4	-0.10	0.19	1748.2
164	-3.411330	10.8	1013.6	-0.45	-0.24	1768.3

165	-3.411330	10.6	980.7	-0.25	0.35	1890.3
166	-3.411330	9.3	1390.5	0.52	0.07	1589.4
167	-3.411330	11.2	1047.7	-0.08	0.50	2022.8
168	-3.411330	10.2	1063.5	-0.25	0.28	1758.6
169	-3.621102	9.3	1390.5	0.52	0.07	1589.4
170	-3.621102	9.9	1076.4	-0.10	0.19	1748.2
171	-3.621102	10.2	1063.5	-0.25	0.28	1758.6
172	-3.621102	NA	NA	NA	NA	NA
173	-3.621102	11.2	1210.1	-0.35	0.13	1742.3
174	-3.621102	10.8	1013.6	-0.45	-0.24	1768.3
175	-3.621102	10.2	1063.5	-0.25	0.28	1758.6
176	-3.621102	11.2	1047.7	-0.08	0.50	2022.8
177	-3.621102	10.6	980.7	-0.25	0.35	1890.3
178	-3.954309	11.2	1210.1	-0.35	0.13	1742.3
179	-3.954309	9.9	1076.4	-0.10	0.19	1748.2
180	-3.954309	9.3	1390.5	0.52	0.07	1589.4
181	-3.954309	11.2	1047.7	-0.08	0.50	2022.8
182	-3.954309	NA	NA	NA	NA	NA
183	-3.954309	10.6	980.7	-0.25	0.35	1890.3
184	-3.954309	10.2	1063.5	-0.25	0.28	1758.6
185	-3.954309	10.2	1063.5	-0.25	0.28	1758.6
186	-3.954309	10.8	1013.6	-0.45	-0.24	1768.3
187	-4.643105	11.2	1210.1	-0.35	0.13	1742.3
188	-4.643105	9.3	1390.5	0.52	0.07	1589.4
189	-4.643105	10.8	1013.6	-0.45	-0.24	1768.3
190	-4.643105	10.2	1063.5	-0.25	0.28	1758.6
191	-4.643105	9.9	1076.4	-0.10	0.19	1748.2
192	-4.643105	10.6	980.7	-0.25	0.35	1890.3
193	-4.643105	10.2	1063.5	-0.25	0.28	1758.6
194	-4.643105	11.2	1047.7	-0.08	0.50	2022.8
195	-4.643105	NA	NA	NA	NA	NA
196	-3.253117	9.3	1390.5	0.52	0.07	1589.4
197	-3.253117	10.6	980.7	-0.25	0.35	1890.3
198	-3.253117	11.2	1210.1	-0.35	0.13	1742.3
199	-3.253117	NA	NA	NA	NA	NA
200	-3.253117	10.2	1063.5	-0.25	0.28	1758.6
201	-3.253117	10.2	1063.5	-0.25	0.28	1758.6
202	-3.253117	11.2	1047.7	-0.08	0.50	2022.8
203	-3.253117	10.8	1013.6	-0.45	-0.24	1768.3
204	-3.253117	9.9	1076.4	-0.10	0.19	1748.2
205	-3.306459	9.9	1076.4	-0.10	0.19	1748.2
206	-3.306459	10.8	1013.6	-0.45	-0.24	1768.3
207	-3.306459	NA	NA	NA	NA	NA

208	-3.306459	11.2	1047.7	-0.08	0.50	2022.8
209	-3.306459	9.3	1390.5	0.52	0.07	1589.4
210	-3.306459	10.2	1063.5	-0.25	0.28	1758.6
211	-3.306459	10.2	1063.5	-0.25	0.28	1758.6
212	-3.306459	10.6	980.7	-0.25	0.35	1890.3
213	-3.306459	11.2	1210.1	-0.35	0.13	1742.3
214	-3.633376	9.9	1076.4	-0.10	0.19	1748.2
215	-3.633376	10.2	1063.5	-0.25	0.28	1758.6
216	-3.633376	10.2	1063.5	-0.25	0.28	1758.6
217	-3.633376	NA	NA	NA	NA	NA
218	-3.633376	10.6	980.7	-0.25	0.35	1890.3
219	-3.633376	11.2	1210.1	-0.35	0.13	1742.3
220	-3.633376	11.2	1047.7	-0.08	0.50	2022.8
221	-3.633376	10.8	1013.6	-0.45	-0.24	1768.3
222	-3.633376	9.3	1390.5	0.52	0.07	1589.4
223	-4.444257	11.2	1210.1	-0.35	0.13	1742.3
224	-4.444257	10.8	1013.6	-0.45	-0.24	1768.3
225	-4.444257	11.2	1047.7	-0.08	0.50	2022.8
226	-4.444257	9.9	1076.4	-0.10	0.19	1748.2
227	-4.444257	9.3	1390.5	0.52	0.07	1589.4
228	-4.444257	10.2	1063.5	-0.25	0.28	1758.6
229	-4.444257	10.6	980.7	-0.25	0.35	1890.3
230	-4.444257	NA	NA	NA	NA	NA
231	-4.444257	10.2	1063.5	-0.25	0.28	1758.6
232	-4.538236	11.2	900.8	-0.46	-0.09	1855.8
233	-4.538236	10.6	972.1	-0.19	0.05	1828.8
234	-4.538236	10.3	919.3	-0.25	0.18	1748.3
235	-4.538236	9.6	1072.9	0.21	0.14	1674.8
236	-4.538236	10.9	856.3	-0.03	0.55	1974.4
237	-4.538236	11.2	900.8	-0.46	-0.09	1855.8
238	-4.538236	NA	NA	NA	NA	NA
239	-4.538236	11.4	836.8	-0.21	0.43	2078.9
240	-4.538236	11.5	1097.9	-0.26	0.11	1745.3
241	-4.538236	10.9	856.3	-0.03	0.55	1974.4
242	-4.485508	9.6	1072.9	0.21	0.14	1674.8
243	-4.485508	11.2	900.8	-0.46	-0.09	1855.8
244	-4.485508	10.9	856.3	-0.03	0.55	1974.4
245	-4.485508	NA	NA	NA	NA	NA
246	-4.485508	10.3	919.3	-0.25	0.18	1748.3
247	-4.485508	11.5	1097.9	-0.26	0.11	1745.3
248	-4.485508	10.9	856.3	-0.03	0.55	1974.4
249	-4.485508	11.4	836.8	-0.21	0.43	2078.9
250	-4.485508	11.2	900.8	-0.46	-0.09	1855.8

251	-4.485508	10.6	972.1	-0.19	0.05	1828.8
252	-4.487261	10.6	972.1	-0.19	0.05	1828.8
253	-4.487261	9.6	1072.9	0.21	0.14	1674.8
254	-4.487261	NA	NA	NA	NA	NA
255	-4.487261	11.2	900.8	-0.46	-0.09	1855.8
256	-4.487261	10.3	919.3	-0.25	0.18	1748.3
257	-4.487261	11.5	1097.9	-0.26	0.11	1745.3
258	-4.487261	11.2	900.8	-0.46	-0.09	1855.8
259	-4.487261	11.4	836.8	-0.21	0.43	2078.9
260	-4.487261	10.9	856.3	-0.03	0.55	1974.4
261	-4.487261	10.9	856.3	-0.03	0.55	1974.4
262	-4.494157	11.2	900.8	-0.46	-0.09	1855.8
263	-4.494157	11.5	1097.9	-0.26	0.11	1745.3
264	-4.494157	10.9	856.3	-0.03	0.55	1974.4
265	-4.494157	NA	NA	NA	NA	NA
266	-4.494157	11.4	836.8	-0.21	0.43	2078.9
267	-4.494157	10.6	972.1	-0.19	0.05	1828.8
268	-4.494157	10.3	919.3	-0.25	0.18	1748.3
269	-4.494157	9.6	1072.9	0.21	0.14	1674.8
270	-4.494157	11.2	900.8	-0.46	-0.09	1855.8
271	-4.494157	10.9	856.3	-0.03	0.55	1974.4
272	-3.704663	10.6	972.1	-0.19	0.05	1828.8
273	-3.704663	10.3	919.3	-0.25	0.18	1748.3
274	-3.704663	11.2	900.8	-0.46	-0.09	1855.8
275	-3.704663	11.4	836.8	-0.21	0.43	2078.9
276	-3.704663	11.5	1097.9	-0.26	0.11	1745.3
277	-3.704663	10.9	856.3	-0.03	0.55	1974.4
278	-3.704663	NA	NA	NA	NA	NA
279	-3.704663	11.2	900.8	-0.46	-0.09	1855.8
280	-3.704663	9.6	1072.9	0.21	0.14	1674.8
281	-3.704663	10.9	856.3	-0.03	0.55	1974.4
282	-3.878354	NA	NA	NA	NA	NA
283	-3.878354	11.2	900.8	-0.46	-0.09	1855.8
284	-3.878354	10.9	856.3	-0.03	0.55	1974.4
285	-3.878354	10.6	972.1	-0.19	0.05	1828.8
286	-3.878354	11.4	836.8	-0.21	0.43	2078.9
287	-3.878354	11.5	1097.9	-0.26	0.11	1745.3
288	-3.878354	9.6	1072.9	0.21	0.14	1674.8
289	-3.878354	11.2	900.8	-0.46	-0.09	1855.8
290	-3.878354	10.9	856.3	-0.03	0.55	1974.4
291	-3.878354	10.3	919.3	-0.25	0.18	1748.3
292	-3.723018	11.2	900.8	-0.46	-0.09	1855.8
293	-3.723018	10.9	856.3	-0.03	0.55	1974.4

294	-3.723018	10.6	972.1	-0.19	0.05	1828.8
295	-3.723018	11.5	1097.9	-0.26	0.11	1745.3
296	-3.723018	11.2	900.8	-0.46	-0.09	1855.8
297	-3.723018	9.6	1072.9	0.21	0.14	1674.8
298	-3.723018	11.4	836.8	-0.21	0.43	2078.9
299	-3.723018	NA	NA	NA	NA	NA
300	-3.723018	10.9	856.3	-0.03	0.55	1974.4
301	-3.723018	10.3	919.3	-0.25	0.18	1748.3
302	-3.694584	10.6	972.1	-0.19	0.05	1828.8
303	-3.694584	10.9	856.3	-0.03	0.55	1974.4
304	-3.694584	10.3	919.3	-0.25	0.18	1748.3
305	-3.694584	10.9	856.3	-0.03	0.55	1974.4
306	-3.694584	NA	NA	NA	NA	NA
307	-3.694584	9.6	1072.9	0.21	0.14	1674.8
308	-3.694584	11.4	836.8	-0.21	0.43	2078.9
309	-3.694584	11.2	900.8	-0.46	-0.09	1855.8
310	-3.694584	11.2	900.8	-0.46	-0.09	1855.8
311	-3.694584	11.5	1097.9	-0.26	0.11	1745.3
312	-3.582130	NA	NA	NA	NA	NA
313	-3.582130	10.9	856.3	-0.03	0.55	1974.4
314	-3.582130	11.4	836.8	-0.21	0.43	2078.9
315	-3.582130	10.3	919.3	-0.25	0.18	1748.3
316	-3.582130	11.2	900.8	-0.46	-0.09	1855.8
317	-3.582130	11.5	1097.9	-0.26	0.11	1745.3
318	-3.582130	10.9	856.3	-0.03	0.55	1974.4
319	-3.582130	10.6	972.1	-0.19	0.05	1828.8
320	-3.582130	11.2	900.8	-0.46	-0.09	1855.8
321	-3.582130	9.6	1072.9	0.21	0.14	1674.8
322	-3.478467	NA	NA	NA	NA	NA
323	-3.478467	11.5	1097.9	-0.26	0.11	1745.3
324	-3.478467	10.9	856.3	-0.03	0.55	1974.4
325	-3.478467	10.3	919.3	-0.25	0.18	1748.3
326	-3.478467	9.6	1072.9	0.21	0.14	1674.8
327	-3.478467	10.6	972.1	-0.19	0.05	1828.8
328	-3.478467	11.2	900.8	-0.46	-0.09	1855.8
329	-3.478467	11.4	836.8	-0.21	0.43	2078.9
330	-3.478467	10.9	856.3	-0.03	0.55	1974.4
331	-3.478467	11.2	900.8	-0.46	-0.09	1855.8
332	-3.294130	10.9	856.3	-0.03	0.55	1974.4
333	-3.294130	11.2	900.8	-0.46	-0.09	1855.8
334	-3.294130	11.4	836.8	-0.21	0.43	2078.9
335	-3.294130	9.6	1072.9	0.21	0.14	1674.8
336	-3.294130	10.6	972.1	-0.19	0.05	1828.8

337	-3.294130	NA	NA	NA	NA	NA
338	-3.294130	10.9	856.3	-0.03	0.55	1974.4
339	-3.294130	11.2	900.8	-0.46	-0.09	1855.8
340	-3.294130	11.5	1097.9	-0.26	0.11	1745.3
341	-3.294130	10.3	919.3	-0.25	0.18	1748.3
342	-2.832729	9.6	1072.9	0.21	0.14	1674.8
343	-2.832729	11.4	836.8	-0.21	0.43	2078.9
344	-2.832729	11.2	900.8	-0.46	-0.09	1855.8
345	-2.832729	11.5	1097.9	-0.26	0.11	1745.3
346	-2.832729	10.9	856.3	-0.03	0.55	1974.4
347	-2.832729	10.3	919.3	-0.25	0.18	1748.3
348	-2.832729	10.9	856.3	-0.03	0.55	1974.4
349	-2.832729	11.2	900.8	-0.46	-0.09	1855.8
350	-2.832729	NA	NA	NA	NA	NA
351	-2.832729	10.6	972.1	-0.19	0.05	1828.8
352	-5.521291	10.9	856.3	-0.03	0.55	1974.4
353	-5.521291	10.6	972.1	-0.19	0.05	1828.8
354	-5.521291	11.2	900.8	-0.46	-0.09	1855.8
355	-5.521291	11.5	1097.9	-0.26	0.11	1745.3
356	-5.521291	11.2	900.8	-0.46	-0.09	1855.8
357	-5.521291	NA	NA	NA	NA	NA
358	-5.521291	10.3	919.3	-0.25	0.18	1748.3
359	-5.521291	9.6	1072.9	0.21	0.14	1674.8
360	-5.521291	11.4	836.8	-0.21	0.43	2078.9
361	-5.521291	10.9	856.3	-0.03	0.55	1974.4
362	-5.242494	11.2	900.8	-0.46	-0.09	1855.8
363	-5.242494	9.6	1072.9	0.21	0.14	1674.8
364	-5.242494	11.5	1097.9	-0.26	0.11	1745.3
365	-5.242494	10.6	972.1	-0.19	0.05	1828.8
366	-5.242494	11.2	900.8	-0.46	-0.09	1855.8
367	-5.242494	11.4	836.8	-0.21	0.43	2078.9
368	-5.242494	10.9	856.3	-0.03	0.55	1974.4
369	-5.242494	NA	NA	NA	NA	NA
370	-5.242494	10.9	856.3	-0.03	0.55	1974.4
371	-5.242494	10.3	919.3	-0.25	0.18	1748.3
372	-5.822992	11.2	900.8	-0.46	-0.09	1855.8
373	-5.822992	11.5	1097.9	-0.26	0.11	1745.3
374	-5.822992	9.6	1072.9	0.21	0.14	1674.8
375	-5.822992	10.9	856.3	-0.03	0.55	1974.4
376	-5.822992	NA	NA	NA	NA	NA
377	-5.822992	10.9	856.3	-0.03	0.55	1974.4
378	-5.822992	10.3	919.3	-0.25	0.18	1748.3
379	-5.822992	11.4	836.8	-0.21	0.43	2078.9

380	-5.822992	11.2	900.8	-0.46	-0.09	1855.8
381	-5.822992	10.6	972.1	-0.19	0.05	1828.8
382	-5.014236	10.6	972.1	-0.19	0.05	1828.8
383	-5.014236	11.2	900.8	-0.46	-0.09	1855.8
384	-5.014236	10.9	856.3	-0.03	0.55	1974.4
385	-5.014236	11.2	900.8	-0.46	-0.09	1855.8
386	-5.014236	9.6	1072.9	0.21	0.14	1674.8
387	-5.014236	11.4	836.8	-0.21	0.43	2078.9
388	-5.014236	NA	NA	NA	NA	NA
389	-5.014236	10.9	856.3	-0.03	0.55	1974.4
390	-5.014236	11.5	1097.9	-0.26	0.11	1745.3
391	-5.014236	10.3	919.3	-0.25	0.18	1748.3
392	-3.593846	11.2	900.8	-0.46	-0.09	1855.8
393	-3.593846	11.5	1097.9	-0.26	0.11	1745.3
394	-3.593846	10.6	972.1	-0.19	0.05	1828.8
395	-3.593846	10.9	856.3	-0.03	0.55	1974.4
396	-3.593846	9.6	1072.9	0.21	0.14	1674.8
397	-3.593846	10.9	856.3	-0.03	0.55	1974.4
398	-3.593846	11.2	900.8	-0.46	-0.09	1855.8
399	-3.593846	NA	NA	NA	NA	NA
400	-3.593846	10.3	919.3	-0.25	0.18	1748.3
401	-3.593846	11.4	836.8	-0.21	0.43	2078.9
402	-3.939277	10.6	972.1	-0.19	0.05	1828.8
403	-3.939277	11.5	1097.9	-0.26	0.11	1745.3
404	-3.939277	NA	NA	NA	NA	NA
405	-3.939277	11.2	900.8	-0.46	-0.09	1855.8
406	-3.939277	10.3	919.3	-0.25	0.18	1748.3
407	-3.939277	11.4	836.8	-0.21	0.43	2078.9
408	-3.939277	9.6	1072.9	0.21	0.14	1674.8
409	-3.939277	11.2	900.8	-0.46	-0.09	1855.8
410	-3.939277	10.9	856.3	-0.03	0.55	1974.4
411	-3.939277	10.9	856.3	-0.03	0.55	1974.4
412	-4.211202	11.2	900.8	-0.46	-0.09	1855.8
413	-4.211202	10.9	856.3	-0.03	0.55	1974.4
414	-4.211202	11.2	900.8	-0.46	-0.09	1855.8
415	-4.211202	10.6	972.1	-0.19	0.05	1828.8
416	-4.211202	NA	NA	NA	NA	NA
417	-4.211202	10.3	919.3	-0.25	0.18	1748.3
418	-4.211202	9.6	1072.9	0.21	0.14	1674.8
419	-4.211202	11.5	1097.9	-0.26	0.11	1745.3
420	-4.211202	11.4	836.8	-0.21	0.43	2078.9
421	-4.211202	10.9	856.3	-0.03	0.55	1974.4
422	-4.205547	9.6	1072.9	0.21	0.14	1674.8

423	-4.205547	11.2	900.8	-0.46	-0.09	1855.8
424	-4.205547	NA	NA	NA	NA	NA
425	-4.205547	10.9	856.3	-0.03	0.55	1974.4
426	-4.205547	10.3	919.3	-0.25	0.18	1748.3
427	-4.205547	11.4	836.8	-0.21	0.43	2078.9
428	-4.205547	10.9	856.3	-0.03	0.55	1974.4
429	-4.205547	11.2	900.8	-0.46	-0.09	1855.8
430	-4.205547	11.5	1097.9	-0.26	0.11	1745.3
431	-4.205547	10.6	972.1	-0.19	0.05	1828.8
432	-3.147068	10.9	856.3	-0.03	0.55	1974.4
433	-3.147068	11.2	900.8	-0.46	-0.09	1855.8
434	-3.147068	NA	NA	NA	NA	NA
435	-3.147068	10.6	972.1	-0.19	0.05	1828.8
436	-3.147068	10.3	919.3	-0.25	0.18	1748.3
437	-3.147068	10.9	856.3	-0.03	0.55	1974.4
438	-3.147068	9.6	1072.9	0.21	0.14	1674.8
439	-3.147068	11.5	1097.9	-0.26	0.11	1745.3
440	-3.147068	11.2	900.8	-0.46	-0.09	1855.8
441	-3.147068	11.4	836.8	-0.21	0.43	2078.9
442	-3.244945	9.6	1072.9	0.21	0.14	1674.8
443	-3.244945	11.2	900.8	-0.46	-0.09	1855.8
444	-3.244945	10.3	919.3	-0.25	0.18	1748.3
445	-3.244945	10.6	972.1	-0.19	0.05	1828.8
446	-3.244945	11.5	1097.9	-0.26	0.11	1745.3
447	-3.244945	10.9	856.3	-0.03	0.55	1974.4
448	-3.244945	10.9	856.3	-0.03	0.55	1974.4
449	-3.244945	11.2	900.8	-0.46	-0.09	1855.8
450	-3.244945	11.4	836.8	-0.21	0.43	2078.9
451	-3.244945	NA	NA	NA	NA	NA
452	-3.148416	NA	NA	NA	NA	NA
453	-3.148416	10.6	972.1	-0.19	0.05	1828.8
454	-3.148416	10.9	856.3	-0.03	0.55	1974.4
455	-3.148416	9.6	1072.9	0.21	0.14	1674.8
456	-3.148416	11.2	900.8	-0.46	-0.09	1855.8
457	-3.148416	11.2	900.8	-0.46	-0.09	1855.8
458	-3.148416	10.9	856.3	-0.03	0.55	1974.4
459	-3.148416	11.4	836.8	-0.21	0.43	2078.9
460	-3.148416	11.5	1097.9	-0.26	0.11	1745.3
461	-3.148416	10.3	919.3	-0.25	0.18	1748.3
462	-3.404054	10.9	856.3	-0.03	0.55	1974.4
463	-3.404054	NA	NA	NA	NA	NA
464	-3.404054	10.9	856.3	-0.03	0.55	1974.4
465	-3.404054	10.3	919.3	-0.25	0.18	1748.3

466	-3.404054	10.6	972.1	-0.19	0.05	1828.8
467	-3.404054	11.4	836.8	-0.21	0.43	2078.9
468	-3.404054	11.2	900.8	-0.46	-0.09	1855.8
469	-3.404054	11.5	1097.9	-0.26	0.11	1745.3
470	-3.404054	9.6	1072.9	0.21	0.14	1674.8
471	-3.404054	11.2	900.8	-0.46	-0.09	1855.8

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466	0.43

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469	1.50
470	-0.28
471	0.30

Methods

we used machine learning methods to assess how much information different sets of variables (c.f. `P_var_sets`) have each on the dependent variable (Puptake, Y-rel, P-balance), how redundant this information is. The machine learning methods to quantify the predictive power of different variable sets are: i) ordinary least squares (OLS) as a baseline; ii) XGBoost (gradient boosting with tree-based models and hyperparameter tuning for learning rate and tree depth) (arxiv:1603.02754); iii) Random Forests (with default parameters) (doi:10.1023/A:1010933404324). Computations were performed using the `mlr3` framework (doi:10.21105/joss.01903). Performance was measured as percentage of explained variance on hold-out data via 5-fold cross-validation, calculated as $(1 - \text{MSE}/\text{Variance}(y))$, where MSE represents mean squared error.

We tried adjusting for weather variables but it seems that the ML-methods rather reconstruct the site-specific patterns....