

SVAPLSseq: An R package to correct for hidden sources of variability in differential gene expression studies based on RNAseq data

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1 Overview

The R package *SVAPLSseq* contains functions that are intended for the extraction and correction of different types of hidden biological and technical variables that could potentially generate latent heterogeneity in RNAseq data on gene expression. The complexity of the sequencing workflow creates a number of technical artefacts along with the inherent biological variability stemming from the unknown gene and sample profiles. The package aims to provide the users with a flexible and generalized framework to identify these hidden effects and adjust for them in order to re-estimate the primary signals of group-specific differential gene expression with higher power and accuracy. The underlying method operates by implementing a non-linear partial least squares regression algorithm on two multivariate random matrices constructed from the data. To that end two methodological variants are provided in this package: (1) Unsupervised SVAPLSseq and (2) Supervised SVAPLSseq. Both these variants yield a set of surrogate variables that are then tested for statistical significance in order to detect the important signatures of latent variability in the data. The package also provides an added functionality

in terms of incorporating these extracted signatures in a linear regression framework and estimating the group- specific differential expression effects. For this purpose two different options are provided: (a) Wald test that uses the R packages “edgeR” and “limma” and (b) Likelihood ratio test.

This document provides a tutorial to use the package for:

- Formatting the data for use in the package.
- Extracting the signatures of the hidden effects in the data.
- Using the estimated hidden effect signatures to detect the truly differentially expressed genes.

2 Formatting the data for use in the package

The starting step for using the package is to set up the RNAseq expression data in an appropriate format. The input data should be in the form of either a count matrix object or a 'SummarizedExperiment' or a 'DGEList' object. The object will contain a feature matrix that will list the features (genes/transcripts) along the rows and samples along the columns. This matrix will contain the read count values for the features corresponding to the different samples. In addition, a separate factor variable should be designed that will keep track of the group each sample belongs to (e.g. “treated” and “untreated”, “Normal” and “Cancer”). This variable will enable the estimation of the primary signal for group-specific differential expression of the features.

```
> library(SummarizedExperiment)
> library(SVAPLSseq)
> library(edgeR)
> data(sim.dat)
> dat = SummarizedExperiment(assays = SimpleList(counts = sim.dat))
> dat = DGEList(counts = sim.dat)
> sim.dat[1:6, c(1:3, 11:13)]
```

| | [,1] | [,2] | [,3] | [,4] | [,5] | [,6] |
|------|------|------|------|------|------|------|
| [1,] | 180 | 180 | 183 | 594 | 555 | 585 |
| [2,] | 278 | 275 | 269 | 357 | 359 | 350 |
| [3,] | 182 | 196 | 205 | 439 | 454 | 444 |
| [4,] | 438 | 430 | 345 | 2818 | 2790 | 2888 |
| [5,] | 238 | 226 | 215 | 1413 | 1452 | 1471 |
| [6,] | 156 | 158 | 180 | 486 | 527 | 455 |

3 Extracting the signatures of the hidden effects in the data

The package contains a function `svplsSurr` that extracts the signatures of latent variability (surrogate variables) in the data by using a multivariate non-linear partial least squares (NPLS) algorithm

(Boulesteix and Strimmer 2007). The function takes the original read count matrix of feature expression values along with a factor variable indicating the group of each sample as input. Moreover, it allows the user to specify a certain number of surrogate variables (`max.surrs`) that will be extracted from the data. These variables are further tested for statistical significance to generate an optimal set of significant surrogate variables capturing the latent variation in the data. The function returns a matrix with these variables along the columns and a vector containing the proportions of the total variance in the data space that are explained by them.

The function provides the user with two methodological variants: (1) The Unsupervised SVAPLSseq and (2) The Supervised SVAPLSseq. Details on these two variants and their usage on an RNAseq gene expression data are provided below:

3.1 The Unsupervised SVAPLSseq

This version of the method regresses the primary signal corrected residual matrix on the original gene expression data matrix via NPLS. The estimated scores in the data space are considered as the surrogate variables that are further tested for statistical significance. Setting the `controls` argument of the function to `NULL` starts this version.

```
> data(sim.dat)
> group = as.factor(c(rep(1, 10), rep(-1, 10)))
> sim.dat.se = SummarizedExperiment(assays = SimpleList(counts = sim.dat))
> sim.dat.dg = DGEList(counts = sim.dat)
> sv <- svplsSurr(dat = sim.dat, group = group, max.surrs = 3, controls = NULL)
> sv <- svplsSurr(dat = sim.dat.se, group = group, max.surrs = 3, controls = NULL)
> sv <- svplsSurr(dat = sim.dat.dg, group = group, max.surrs = 3, controls = NULL)
> print(sv)
```

An object of class "svplsSurr"

Slot "surr":

| | Comp 1 | Comp 2 | Comp 3 |
|----|------------|------------|-----------|
| 1 | -40.926156 | -0.8084875 | 4.224341 |
| 2 | -40.055960 | -0.4950606 | 3.898370 |
| 3 | -42.367566 | -1.5554843 | 5.060546 |
| 4 | -42.233553 | -1.3974685 | 4.856386 |
| 5 | -41.106307 | -0.9151236 | 4.329619 |
| 6 | 7.970834 | 17.1226899 | -1.939348 |
| 7 | 12.782978 | 18.5159304 | -1.274102 |
| 8 | 4.759267 | 16.2514642 | -2.199716 |
| 9 | 7.035339 | 16.7946280 | -1.952845 |
| 10 | 11.272798 | 18.0598937 | -1.490734 |
| 11 | -9.475664 | -9.6107729 | -6.147861 |
| 12 | -8.877108 | -9.4874725 | -6.302462 |
| 13 | -8.538197 | -9.4380389 | -6.117937 |

```
14 -6.817952 -9.4635581 -6.029625
15 -10.096205 -9.4816131 -6.184044
16 40.686615 -6.9212112 3.270012
17 38.179231 -7.1881869 2.481356
18 43.294054 -6.5935848 4.070858
19 38.161401 -7.1118876 2.432756
20 46.352152 -6.2766559 5.014430
```

Slot "prop.vars":

```
Comp 1      Comp 2      Comp 3
0.87480779 0.10710424 0.01808797
```

> *surr(sv)*

```
Comp 1      Comp 2      Comp 3
1 -40.926156 -0.8084875 4.224341
2 -40.055960 -0.4950606 3.898370
3 -42.367566 -1.5554843 5.060546
4 -42.233553 -1.3974685 4.856386
5 -41.106307 -0.9151236 4.329619
6 7.970834 17.1226899 -1.939348
7 12.782978 18.5159304 -1.274102
8 4.759267 16.2514642 -2.199716
9 7.035339 16.7946280 -1.952845
10 11.272798 18.0598937 -1.490734
11 -9.475664 -9.6107729 -6.147861
12 -8.877108 -9.4874725 -6.302462
13 -8.538197 -9.4380389 -6.117937
14 -6.817952 -9.4635581 -6.029625
15 -10.096205 -9.4816131 -6.184044
16 40.686615 -6.9212112 3.270012
17 38.179231 -7.1881869 2.481356
18 43.294054 -6.5935848 4.070858
19 38.161401 -7.1118876 2.432756
20 46.352152 -6.2766559 5.014430
```

> *prop.vars(sv)*

```
Comp 1      Comp 2      Comp 3
0.87480779 0.10710424 0.01808797
```

3.2 The Supervised SVAPLSseq

In this variant a submatrix of the original gene expression data is first created corresponding to a set of available control probes that do not have any differential expression between the two groups. Hence, this submatrix is only expected to contain the signatures of the hidden effects in the data. This matrix is

then regressed on the original data to extract the surrogate variables for the underlying latent variation. This variant is called by setting the `controls` argument of the function to the collection of the control probes.

```
> data(sim.dat)
> controls = c(1:nrow(sim.dat)) > 400
> group = as.factor(c(rep(1, 10), rep(-1, 10)))
> sim.dat.se = SummarizedExperiment(assays = SimpleList(counts = sim.dat))
> sim.dat.dg = DGEList(counts = sim.dat)
> sv <- svplsSurr(dat = sim.dat, group = group, max.surrs = 3, controls = controls)
> sv <- svplsSurr(dat = sim.dat.se, group = group, max.surrs = 3, controls = controls)
> sv <- svplsSurr(dat = sim.dat.dg, group = group, max.surrs = 3, controls = controls)
> print(sv)
```

An object of class "svplsSurr"

Slot "surr":

| | Comp 1 | Comp 2 | Comp 3 |
|----------|------------|-----------|-------------|
| Sample1 | -31.926628 | -3.208735 | -0.03536976 |
| Sample2 | -31.272906 | -2.904747 | -0.14619953 |
| Sample3 | -32.891642 | -3.941770 | 0.28247933 |
| Sample4 | -32.853971 | -3.871881 | 0.26042255 |
| Sample5 | -31.989481 | -3.260728 | 0.03723828 |
| Sample6 | 5.474165 | 3.098831 | 0.45612324 |
| Sample7 | 9.194147 | 2.585913 | 0.63804992 |
| Sample8 | 3.014986 | 3.316163 | 0.58915161 |
| Sample9 | 4.717672 | 3.192498 | 0.62023566 |
| Sample10 | 8.012877 | 2.745850 | 0.59885841 |
| Sample11 | -7.207680 | 3.575643 | -0.52382734 |
| Sample12 | -6.747954 | 3.643430 | -0.53557381 |
| Sample13 | -6.530576 | 3.560833 | -0.51574318 |
| Sample14 | -5.160810 | 3.581938 | -0.44025060 |
| Sample15 | -7.682810 | 3.548411 | -0.66007413 |
| Sample16 | 32.286081 | -3.013467 | -0.12416276 |
| Sample17 | 30.302523 | -2.336366 | 0.07454508 |
| Sample18 | 34.293006 | -3.629939 | -0.22964625 |
| Sample19 | 30.285908 | -2.312349 | 0.04708990 |
| Sample20 | 36.683092 | -4.369528 | -0.39334663 |

Slot "prop.vars":

| | Comp 1 | Comp 2 | Comp 3 |
|--------------|--------------|--------------|--------|
| 0.9800041257 | 0.0196787967 | 0.0003170775 | |

```
> surr(sv)
```

| | Comp 1 | Comp 2 | Comp 3 |
|---------|------------|-----------|-------------|
| Sample1 | -31.926628 | -3.208735 | -0.03536976 |
| Sample2 | -31.272906 | -2.904747 | -0.14619953 |

```
Sample3 -32.891642 -3.941770 0.28247933
Sample4 -32.853971 -3.871881 0.26042255
Sample5 -31.989481 -3.260728 0.03723828
Sample6 5.474165 3.098831 0.45612324
Sample7 9.194147 2.585913 0.63804992
Sample8 3.014986 3.316163 0.58915161
Sample9 4.717672 3.192498 0.62023566
Sample10 8.012877 2.745850 0.59885841
Sample11 -7.207680 3.575643 -0.52382734
Sample12 -6.747954 3.643430 -0.53557381
Sample13 -6.530576 3.560833 -0.51574318
Sample14 -5.160810 3.581938 -0.44025060
Sample15 -7.682810 3.548411 -0.66007413
Sample16 32.286081 -3.013467 -0.12416276
Sample17 30.302523 -2.336366 0.07454508
Sample18 34.293006 -3.629939 -0.22964625
Sample19 30.285908 -2.312349 0.04708990
Sample20 36.683092 -4.369528 -0.39334663
```

```
> prop.vars(sv)
```

```
Comp 1      Comp 2      Comp 3
0.9800041257 0.0196787967 0.0003170775
```

4 Using the estimated hidden effect signatures to detect the truly differentially expressed genes

The package contains another function `svplsTest` that incorporates the significant surrogate variables estimated by the function `svplsSurr` inside a regression framework in order to test for the genes that are truly differentially expressed between the two groups. The function provides the user with two testing options: (1) Wald test based on the regression coefficients of the primary signal effects (group effects) after incorporating the surrogate variables in a linear model and (2) Likelihood ratio test (LRT) comparing two different regression models: one containing primary signal effects as well as the surrogate variables and the other including only the surrogate variables. A list is returned as the output that contains the genes detected to be differentially expressed between the two groups (`sig.genes`, the uncorrected pvalues from the test (`pvs.unadj`) and the corresponding FDR adjusted pvalues (`pvs.adj`).

```
> data(sim.dat)
> group = as.factor(c(rep(1, 10), rep(-1, 10)))
> sv = svplsSurr(dat = sim.dat, group = group)
> surr = surr(sv)
> sim.dat.se = SummarizedExperiment(assays = SimpleList(counts = sim.dat))
> sim.dat.dg = DGEList(counts = sim.dat)
```

```
> fit = svplsTest(dat = sim.dat, group = group, surr = surr, test = "Wald")
> fit = svplsTest(dat = sim.dat.se, group = group, surr = surr, test = "Wald")
> fit = svplsTest(dat = sim.dat.dg, group = group, surr = surr, test = "Wald")
> sig.genes(fit)

[1] "13" "73" "210" "211" "246" "267" "311" "321" "347" "368" "371" "381" "395" "925"

> pvs.unadj(fit)
```

| | | | | | |
|--------------|--------------|--------------|--------------|--------------|--------------|
| 1 | 2 | 3 | 4 | 5 | 6 |
| 3.014261e-01 | 4.796025e-01 | 5.695433e-01 | 5.758314e-01 | 4.261951e-02 | 6.291970e-01 |
| 7 | 8 | 9 | 10 | 11 | 12 |
| 1.533013e-02 | 6.196252e-01 | 1.585284e-01 | 1.960720e-01 | 5.620965e-01 | 7.506645e-01 |
| 13 | 14 | 15 | 16 | 17 | 18 |
| 1.890925e-04 | 8.812975e-01 | 2.491662e-02 | 1.997496e-01 | 5.494928e-01 | 2.095962e-02 |
| 19 | 20 | 21 | 22 | 23 | 24 |
| 9.132696e-01 | 3.131585e-01 | 9.642487e-01 | 5.550774e-01 | 7.823371e-01 | 3.202374e-01 |
| 25 | 26 | 27 | 28 | 29 | 30 |
| 5.675575e-01 | 5.193929e-01 | 2.382217e-01 | 1.976546e-01 | 2.453857e-02 | 6.833366e-01 |
| 31 | 32 | 33 | 34 | 35 | 36 |
| 4.526750e-03 | 6.219588e-01 | 1.403786e-01 | 7.446261e-01 | 8.480906e-02 | 2.533287e-01 |
| 37 | 38 | 39 | 40 | 41 | 42 |
| 2.730402e-01 | 8.705380e-01 | 2.433785e-02 | 2.147033e-01 | 4.715889e-01 | 3.950975e-02 |
| 43 | 44 | 45 | 46 | 47 | 48 |
| 7.593842e-01 | 8.685858e-01 | 5.710237e-02 | 4.327231e-01 | 4.897303e-01 | 8.494247e-02 |
| 49 | 50 | 51 | 52 | 53 | 54 |
| 3.104139e-01 | 3.953672e-01 | 9.172999e-01 | 1.029676e-01 | 5.626289e-02 | 5.507234e-01 |
| 55 | 56 | 57 | 58 | 59 | 60 |
| 5.156423e-01 | 5.030969e-01 | 6.445932e-01 | 3.592109e-01 | 9.821898e-01 | 5.316723e-01 |
| 61 | 62 | 63 | 64 | 65 | 66 |
| 6.741478e-02 | 7.597194e-03 | 1.742699e-01 | 5.670300e-02 | 2.644249e-01 | 6.520203e-01 |
| 67 | 68 | 69 | 70 | 71 | 72 |
| 6.741126e-01 | 7.182892e-03 | 4.843172e-01 | 1.575505e-02 | 2.804980e-01 | 4.324877e-02 |
| 73 | 74 | 75 | 76 | 77 | 78 |
| 2.258966e-04 | 8.881456e-01 | 7.150193e-01 | 7.246354e-03 | 8.185911e-01 | 1.176236e-01 |
| 79 | 80 | 81 | 82 | 83 | 84 |
| 5.764380e-01 | 1.788935e-01 | 2.019131e-01 | 1.432802e-01 | 5.817406e-01 | 5.763965e-01 |
| 85 | 86 | 87 | 88 | 89 | 90 |
| 4.099495e-02 | 1.020773e-01 | 2.031208e-01 | 5.394007e-01 | 2.360643e-01 | 6.553808e-01 |
| 91 | 92 | 93 | 94 | 95 | 96 |
| 6.651853e-03 | 1.708780e-01 | 2.755178e-01 | 1.242173e-03 | 8.823303e-01 | 6.499922e-01 |
| 97 | 98 | 99 | 100 | 101 | 102 |
| 9.177030e-01 | 7.521183e-01 | 8.321848e-03 | 1.277577e-02 | 6.959816e-01 | 9.236069e-01 |
| 103 | 104 | 105 | 106 | 107 | 108 |
| 4.463025e-03 | 2.337050e-01 | 4.521204e-01 | 2.114998e-02 | 6.837446e-01 | 9.975591e-01 |
| 109 | 110 | 111 | 112 | 113 | 114 |

| | | | | | |
|--------------|--------------|--------------|--------------|--------------|--------------|
| 9.355124e-01 | 4.782297e-02 | 3.432122e-01 | 1.980548e-01 | 1.994431e-01 | 9.224227e-01 |
| 115 | 116 | 117 | 118 | 119 | 120 |
| 8.396360e-03 | 7.358687e-01 | 2.456568e-01 | 1.191554e-02 | 1.710796e-02 | 9.121816e-01 |
| 121 | 122 | 123 | 124 | 125 | 126 |
| 1.651429e-01 | 4.507083e-02 | 2.631089e-02 | 1.455229e-01 | 3.602302e-01 | 7.472321e-01 |
| 127 | 128 | 129 | 130 | 131 | 132 |
| 6.659646e-01 | 5.856624e-01 | 2.980434e-01 | 8.899840e-01 | 2.597737e-01 | 4.344713e-01 |
| 133 | 134 | 135 | 136 | 137 | 138 |
| 9.686205e-01 | 3.068335e-01 | 2.267240e-02 | 2.810722e-01 | 8.748837e-01 | 4.837649e-01 |
| 139 | 140 | 141 | 142 | 143 | 144 |
| 5.188322e-01 | 1.230208e-03 | 7.708964e-01 | 7.279723e-03 | 3.714957e-01 | 2.562310e-01 |
| 145 | 146 | 147 | 148 | 149 | 150 |
| 2.881637e-01 | 9.201401e-03 | 1.570499e-02 | 3.769022e-01 | 6.547095e-01 | 3.330224e-02 |
| 151 | 152 | 153 | 154 | 155 | 156 |
| 6.194566e-02 | 7.850738e-01 | 6.167033e-02 | 4.899539e-02 | 2.340495e-02 | 9.378677e-03 |
| 157 | 158 | 159 | 160 | 161 | 162 |
| 1.085890e-03 | 6.372875e-03 | 1.513101e-02 | 3.424752e-01 | 4.030207e-01 | 2.316368e-01 |
| 163 | 164 | 165 | 166 | 167 | 168 |
| 2.050591e-01 | 9.981873e-01 | 7.010178e-01 | 7.853664e-01 | 1.074607e-02 | 7.945379e-01 |
| 169 | 170 | 171 | 172 | 173 | 174 |
| 7.350670e-01 | 1.941206e-01 | 1.526000e-01 | 1.154233e-02 | 7.954814e-02 | 7.972488e-02 |
| 175 | 176 | 177 | 178 | 179 | 180 |
| 4.193635e-01 | 8.479089e-01 | 1.678819e-01 | 3.632338e-01 | 1.981754e-01 | 6.890816e-01 |
| 181 | 182 | 183 | 184 | 185 | 186 |
| 2.679278e-02 | 5.371849e-01 | 5.378731e-01 | 1.443694e-01 | 1.865869e-02 | 1.212830e-01 |
| 187 | 188 | 189 | 190 | 191 | 192 |
| 8.597783e-01 | 8.276049e-01 | 4.558031e-01 | 5.920464e-01 | 5.624297e-01 | 4.231607e-01 |
| 193 | 194 | 195 | 196 | 197 | 198 |
| 4.755165e-01 | 7.701399e-01 | 5.340620e-01 | 4.302948e-01 | 6.628691e-01 | 3.247952e-01 |
| 199 | 200 | 201 | 202 | 203 | 204 |
| 5.667435e-01 | 6.863541e-01 | 7.700647e-02 | 2.857562e-01 | 6.609133e-01 | 1.427450e-02 |
| 205 | 206 | 207 | 208 | 209 | 210 |
| 1.427111e-01 | 9.579575e-01 | 5.090425e-01 | 9.084815e-01 | 5.926177e-01 | 6.227310e-04 |
| 211 | 212 | 213 | 214 | 215 | 216 |
| 1.211629e-04 | 7.972167e-03 | 4.328486e-01 | 1.490321e-01 | 4.105117e-01 | 1.286076e-01 |
| 217 | 218 | 219 | 220 | 221 | 222 |
| 4.511548e-01 | 8.971585e-01 | 9.417585e-01 | 1.207143e-03 | 6.832578e-01 | 3.377431e-01 |
| 223 | 224 | 225 | 226 | 227 | 228 |
| 5.634313e-01 | 1.171892e-01 | 8.091100e-01 | 8.342700e-01 | 2.249621e-01 | 4.163084e-02 |
| 229 | 230 | 231 | 232 | 233 | 234 |
| 4.353725e-01 | 5.618317e-01 | 8.364380e-01 | 9.541648e-01 | 2.124681e-01 | 7.827780e-01 |
| 235 | 236 | 237 | 238 | 239 | 240 |
| 2.277823e-01 | 7.960302e-01 | 3.329818e-01 | 3.219657e-02 | 2.809008e-01 | 1.442074e-01 |
| 241 | 242 | 243 | 244 | 245 | 246 |
| 9.708559e-01 | 3.211792e-01 | 1.022415e-01 | 3.737944e-01 | 9.463642e-01 | 5.739411e-05 |

| | | | | | |
|--------------|--------------|--------------|--------------|--------------|--------------|
| 247 | 248 | 249 | 250 | 251 | 252 |
| 3.551511e-03 | 8.102844e-01 | 5.950282e-01 | 5.399978e-02 | 1.219517e-01 | 1.621688e-02 |
| 253 | 254 | 255 | 256 | 257 | 258 |
| 3.062092e-02 | 6.520014e-01 | 6.549634e-01 | 4.391680e-01 | 1.121206e-01 | 5.049483e-02 |
| 259 | 260 | 261 | 262 | 263 | 264 |
| 3.657969e-01 | 6.060412e-01 | 3.139200e-01 | 5.569980e-01 | 8.818397e-01 | 2.250581e-02 |
| 265 | 266 | 267 | 268 | 269 | 270 |
| 3.285575e-01 | 8.955073e-03 | 9.866340e-07 | 3.022918e-01 | 2.320209e-02 | 7.519378e-01 |
| 271 | 272 | 273 | 274 | 275 | 276 |
| 7.875097e-01 | 4.445122e-01 | 1.743715e-01 | 1.116445e-02 | 1.411827e-01 | 4.718807e-01 |
| 277 | 278 | 279 | 280 | 281 | 282 |
| 6.653047e-01 | 6.333764e-02 | 3.314076e-01 | 2.568518e-01 | 7.891735e-01 | 2.374489e-01 |
| 283 | 284 | 285 | 286 | 287 | 288 |
| 3.895449e-01 | 3.276284e-01 | 7.082934e-01 | 2.366130e-01 | 7.186317e-01 | 6.187758e-01 |
| 289 | 290 | 291 | 292 | 293 | 294 |
| 4.856183e-01 | 7.964545e-01 | 9.372287e-02 | 1.778966e-03 | 6.055129e-02 | 7.313456e-01 |
| 295 | 296 | 297 | 298 | 299 | 300 |
| 2.304326e-02 | 2.187624e-01 | 1.684374e-01 | 2.630169e-01 | 7.940024e-01 | 4.787256e-01 |
| 301 | 302 | 303 | 304 | 305 | 306 |
| 2.058437e-02 | 8.267972e-01 | 5.770612e-01 | 1.599661e-03 | 5.063473e-01 | 7.766337e-01 |
| 307 | 308 | 309 | 310 | 311 | 312 |
| 1.750777e-03 | 9.618564e-01 | 2.389263e-02 | 1.057180e-01 | 4.995911e-06 | 2.657109e-01 |
| 313 | 314 | 315 | 316 | 317 | 318 |
| 1.028845e-03 | 8.304688e-01 | 6.485786e-01 | 1.608580e-02 | 7.247144e-01 | 1.616595e-02 |
| 319 | 320 | 321 | 322 | 323 | 324 |
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    991          992          993          994          995          996
5.630242e-01 2.951324e-03 8.463025e-01 2.849525e-01 2.714801e-02 9.687314e-01
    997          998          999          1000
3.665491e-01 8.940815e-01 3.339776e-01 2.760381e-01

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> pvs.adj(fit)
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0.874498145 0.955420023 0.961141314 0.961141314 0.377760757 0.971482416 0.231669683
      8      9     10     11     12     13     14
0.971482416 0.714119766 0.768267766 0.960723638 0.971482416 0.021010282 0.985325509
     15     16     17     18     19     20     21
0.289728182 0.768267766 0.960723638 0.278289155 0.987645908 0.881207506 0.987645908
     22     23     24     25     26     27     28
0.960723638 0.973145579 0.881207506 0.961141314 0.960723638 0.807531097 0.768267766
     29     30     31     32     33     34     35
0.288689087 0.971482416 0.137174228 0.971482416 0.694083663 0.971482416 0.556876250
     36     37     38     39     40     41     42
0.825174980 0.849348037 0.981440843 0.288689087 0.785306877 0.953294254 0.369249965
     43     44     45     46     47     48     49
0.971482416 0.981440843 0.444708100 0.929550617 0.955420023 0.556876250 0.881207506
     50     51     52     53     54     55     56
0.918335243 0.987645908 0.605691920 0.444708100 0.960723638 0.960723638 0.960723638

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| | | | | | | |
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| 57 | 58 | 59 | 60 | 61 | 62 | 63 |
| 0.971482416 | 0.900277974 | 0.996068481 | 0.960723638 | 0.488512902 | 0.180885566 | 0.732921676 |
| 64 | 65 | 66 | 67 | 68 | 69 | 70 |
| 0.444708100 | 0.836787727 | 0.971482416 | 0.971482416 | 0.177554225 | 0.955420023 | 0.231669683 |
| 71 | 72 | 73 | 74 | 75 | 76 | 77 |
| 0.853459414 | 0.379375188 | 0.022589656 | 0.985680037 | 0.971482416 | 0.177554225 | 0.977101396 |
| 78 | 79 | 80 | 81 | 82 | 83 | 84 |
| 0.657114932 | 0.961141314 | 0.745389755 | 0.769396818 | 0.694083663 | 0.963146723 | 0.961141314 |
| 85 | 86 | 87 | 88 | 89 | 90 | 91 |
| 0.376100488 | 0.604979428 | 0.769396818 | 0.960723638 | 0.807531097 | 0.971482416 | 0.175048761 |
| 92 | 93 | 94 | 95 | 96 | 97 | 98 |
| 0.732921676 | 0.849348037 | 0.062108646 | 0.985325509 | 0.971482416 | 0.987645908 | 0.971482416 |
| 99 | 100 | 101 | 102 | 103 | 104 | 105 |
| 0.186585774 | 0.229784305 | 0.971482416 | 0.987645908 | 0.137174228 | 0.803688065 | 0.938009157 |
| 106 | 107 | 108 | 109 | 110 | 111 | 112 |
| 0.278289155 | 0.971482416 | 0.998910167 | 0.987645908 | 0.405279387 | 0.885835104 | 0.768267766 |
| 113 | 114 | 115 | 116 | 117 | 118 | 119 |
| 0.768267766 | 0.987645908 | 0.186585774 | 0.971482416 | 0.816135656 | 0.220658074 | 0.240957253 |
| 120 | 121 | 122 | 123 | 124 | 125 | 126 |
| 0.987645908 | 0.727501825 | 0.387666788 | 0.291225839 | 0.696281882 | 0.900575536 | 0.971482416 |
| 127 | 128 | 129 | 130 | 131 | 132 | 133 |
| 0.971482416 | 0.964297024 | 0.874027701 | 0.985680037 | 0.829948036 | 0.930283112 | 0.987645908 |
| 134 | 135 | 136 | 137 | 138 | 139 | 140 |
| 0.881207506 | 0.285426214 | 0.853459414 | 0.985229339 | 0.955420023 | 0.960723638 | 0.062108646 |
| 141 | 142 | 143 | 144 | 145 | 146 | 147 |
| 0.971482416 | 0.177554225 | 0.908185867 | 0.828377154 | 0.857630050 | 0.195389111 | 0.231669683 |
| 148 | 149 | 150 | 151 | 152 | 153 | 154 |
| 0.910296457 | 0.971482416 | 0.320213831 | 0.463889424 | 0.973145579 | 0.463889424 | 0.410479342 |
| 155 | 156 | 157 | 158 | 159 | 160 | 161 |
| 0.285426214 | 0.195389111 | 0.062108646 | 0.172239875 | 0.231669683 | 0.885835104 | 0.918335243 |
| 162 | 163 | 164 | 165 | 166 | 167 | 168 |
| 0.801511295 | 0.771217169 | 0.998910167 | 0.971482416 | 0.973145579 | 0.219307456 | 0.973145579 |
| 169 | 170 | 171 | 172 | 173 | 174 | 175 |
| 0.971482416 | 0.768267766 | 0.699999812 | 0.220658074 | 0.546060844 | 0.546060844 | 0.921678078 |
| 176 | 177 | 178 | 179 | 180 | 181 | 182 |
| 0.979802909 | 0.729166229 | 0.905819861 | 0.768267766 | 0.971482416 | 0.291225839 | 0.960723638 |
| 183 | 184 | 185 | 186 | 187 | 188 | 189 |
| 0.960723638 | 0.694083663 | 0.255598505 | 0.662780940 | 0.979802909 | 0.977101396 | 0.938626319 |
| 190 | 191 | 192 | 193 | 194 | 195 | 196 |
| 0.966749924 | 0.960723638 | 0.923931690 | 0.955420023 | 0.971482416 | 0.960723638 | 0.929362482 |
| 197 | 198 | 199 | 200 | 201 | 202 | 203 |
| 0.971482416 | 0.881207506 | 0.961141314 | 0.971482416 | 0.546060844 | 0.855557365 | 0.971482416 |
| 204 | 205 | 206 | 207 | 208 | 209 | 210 |
| 0.231669683 | 0.694083663 | 0.987645908 | 0.960723638 | 0.987645908 | 0.966749924 | 0.044480787 |
| 211 | 212 | 213 | 214 | 215 | 216 | 217 |

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| 0.019491028 | 0.185399225 | 0.929550617 | 0.696772424 | 0.918335243 | 0.680463299 | 0.938009157 |
| 218 | 219 | 220 | 221 | 222 | 223 | 224 |
| 0.987645908 | 0.987645908 | 0.062108646 | 0.971482416 | 0.883417512 | 0.960723638 | 0.657114932 |
| 225 | 226 | 227 | 228 | 229 | 230 | 231 |
| 0.977101396 | 0.979435637 | 0.786580773 | 0.376496427 | 0.930283112 | 0.960723638 | 0.979435637 |
| 232 | 233 | 234 | 235 | 236 | 237 | 238 |
| 0.987645908 | 0.783917199 | 0.973145579 | 0.793497269 | 0.973145579 | 0.881207506 | 0.318363375 |
| 239 | 240 | 241 | 242 | 243 | 244 | 245 |
| 0.853459414 | 0.694083663 | 0.987645908 | 0.881207506 | 0.604979428 | 0.908185867 | 0.987645908 |
| 246 | 247 | 248 | 249 | 250 | 251 | 252 |
| 0.011478823 | 0.121983933 | 0.977101396 | 0.967525518 | 0.431998257 | 0.662780940 | 0.231669683 |
| 253 | 254 | 255 | 256 | 257 | 258 | 259 |
| 0.312458323 | 0.971482416 | 0.971482416 | 0.934399896 | 0.642756738 | 0.417312619 | 0.907299710 |
| 260 | 261 | 262 | 263 | 264 | 265 | 266 |
| 0.971482416 | 0.881207506 | 0.960723638 | 0.985325509 | 0.285426214 | 0.881207506 | 0.194675489 |
| 267 | 268 | 269 | 270 | 271 | 272 | 273 |
| 0.000986634 | 0.874498145 | 0.285426214 | 0.971482416 | 0.973145579 | 0.934904404 | 0.732921676 |
| 274 | 275 | 276 | 277 | 278 | 279 | 280 |
| 0.220658074 | 0.694083663 | 0.953294254 | 0.971482416 | 0.469167700 | 0.881207506 | 0.828377154 |
| 281 | 282 | 283 | 284 | 285 | 286 | 287 |
| 0.973145579 | 0.807531097 | 0.916749183 | 0.881207506 | 0.971482416 | 0.807531097 | 0.971482416 |
| 288 | 289 | 290 | 291 | 292 | 293 | 294 |
| 0.971482416 | 0.955420023 | 0.973145579 | 0.579859080 | 0.071158658 | 0.463889424 | 0.971482416 |
| 295 | 296 | 297 | 298 | 299 | 300 | 301 |
| 0.285426214 | 0.785407644 | 0.729166229 | 0.836787727 | 0.973145579 | 0.955420023 | 0.278167103 |
| 302 | 303 | 304 | 305 | 306 | 307 | 308 |
| 0.977101396 | 0.961141314 | 0.069550488 | 0.960723638 | 0.973145579 | 0.071158658 | 0.987645908 |
| 309 | 310 | 311 | 312 | 313 | 314 | 315 |
| 0.287863007 | 0.614639823 | 0.002497956 | 0.838204600 | 0.062108646 | 0.978560840 | 0.971482416 |
| 316 | 317 | 318 | 319 | 320 | 321 | 322 |
| 0.231669683 | 0.971482416 | 0.231669683 | 0.786245689 | 0.990720705 | 0.006651754 | 0.722115304 |
| 323 | 324 | 325 | 326 | 327 | 328 | 329 |
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| 0.857754835 | 0.915027126 | 0.971482416 | 0.898442745 | 0.971482416 | 0.971482416 | 0.312458323 |
| 344 | 345 | 346 | 347 | 348 | 349 | 350 |
| 0.971482416 | 0.957541286 | 0.971482416 | 0.023069864 | 0.971482416 | 0.966749924 | 0.679612272 |
| 351 | 352 | 353 | 354 | 355 | 356 | 357 |
| 0.696772424 | 0.977101396 | 0.550652003 | 0.063069535 | 0.650949016 | 0.321373697 | 0.745630391 |
| 358 | 359 | 360 | 361 | 362 | 363 | 364 |
| 0.881207506 | 0.971482416 | 0.767957983 | 0.971482416 | 0.971482416 | 0.463889424 | 0.139440640 |
| 365 | 366 | 367 | 368 | 369 | 370 | 371 |
| 0.081327072 | 0.785407644 | 0.981440843 | 0.021010282 | 0.971482416 | 0.987645908 | 0.033794544 |

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|-------------|-------------|-------------|-------------|-------------|-------------|-------------|
| 372 | 373 | 374 | 375 | 376 | 377 | 378 |
| 0.987645908 | 0.698219486 | 0.816135656 | 0.971482416 | 0.966749924 | 0.760278947 | 0.696772424 |
| 379 | 380 | 381 | 382 | 383 | 384 | 385 |
| 0.728924220 | 0.783917199 | 0.010420715 | 0.960723638 | 0.987645908 | 0.312458323 | 0.569228505 |
| 386 | 387 | 388 | 389 | 390 | 391 | 392 |
| 0.874498145 | 0.981119026 | 0.960723638 | 0.853459414 | 0.987645908 | 0.694083663 | 0.716308382 |
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| 0.881207506 | 0.971482416 | 0.024893801 | 0.922184489 | 0.377760757 | 0.671417923 | 0.960723638 |
| 400 | 401 | 402 | 403 | 404 | 405 | 406 |
| 0.231669683 | 0.971482416 | 0.979802909 | 0.971482416 | 0.987645908 | 0.971482416 | 0.971482416 |
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| 0.969145551 | 0.918335243 | 0.900277974 | 0.961141314 | 0.955420023 | 0.865503880 | 0.987645908 |
| 456 | 457 | 458 | 459 | 460 | 461 | 462 |
| 0.960723638 | 0.971482416 | 0.987645908 | 0.977101396 | 0.971482416 | 0.987645908 | 0.987645908 |
| 463 | 464 | 465 | 466 | 467 | 468 | 469 |
| 0.971482416 | 0.777227965 | 0.981440843 | 0.908185867 | 0.938009157 | 0.973145579 | 0.961141314 |
| 470 | 471 | 472 | 473 | 474 | 475 | 476 |
| 0.971482416 | 0.918335243 | 0.987645908 | 0.849348037 | 0.694083663 | 0.483876927 | 0.987645908 |
| 477 | 478 | 479 | 480 | 481 | 482 | 483 |
| 0.987645908 | 0.987645908 | 0.230496040 | 0.881207506 | 0.739025096 | 0.853459414 | 0.979435637 |
| 484 | 485 | 486 | 487 | 488 | 489 | 490 |
| 0.786580773 | 0.971482416 | 0.881207506 | 0.960723638 | 0.755093360 | 0.694083663 | 0.671417923 |
| 491 | 492 | 493 | 494 | 495 | 496 | 497 |
| 0.816541774 | 0.874498145 | 0.928224593 | 0.604979428 | 0.960723638 | 0.694083663 | 0.821639951 |
| 498 | 499 | 500 | 501 | 502 | 503 | 504 |
| 0.977101396 | 0.811970466 | 0.987645908 | 0.908185867 | 0.849348037 | 0.997795708 | 0.546060844 |
| 505 | 506 | 507 | 508 | 509 | 510 | 511 |
| 0.918335243 | 0.971482416 | 0.987645908 | 0.979802909 | 0.977101396 | 0.971482416 | 0.971482416 |
| 512 | 513 | 514 | 515 | 516 | 517 | 518 |
| 0.971482416 | 0.987645908 | 0.703404851 | 0.884576704 | 0.987645908 | 0.883417512 | 0.987645908 |
| 519 | 520 | 521 | 522 | 523 | 524 | 525 |
| 0.785407644 | 0.828377154 | 0.732921676 | 0.694083663 | 0.938009157 | 0.971482416 | 0.881207506 |
| 526 | 527 | 528 | 529 | 530 | 531 | 532 |

| | | | | | | |
|-------------|-------------|-------------|-------------|-------------|-------------|-------------|
| 0.987645908 | 0.987645908 | 0.987645908 | 0.960723638 | 0.971482416 | 0.987645908 | 0.881207506 |
| 533 | 534 | 535 | 536 | 537 | 538 | 539 |
| 0.786245689 | 0.961141314 | 0.971482416 | 0.910296457 | 0.971482416 | 0.918335243 | 0.960723638 |
| 540 | 541 | 542 | 543 | 544 | 545 | 546 |
| 0.777227965 | 0.714119766 | 0.971482416 | 0.987645908 | 0.987645908 | 0.732921676 | 0.980607100 |
| 547 | 548 | 549 | 550 | 551 | 552 | 553 |
| 0.977101396 | 0.985325509 | 0.960723638 | 0.998023998 | 0.987645908 | 0.955420023 | 0.160337782 |
| 554 | 555 | 556 | 557 | 558 | 559 | 560 |
| 0.955420023 | 0.431998257 | 0.387666788 | 0.828377154 | 0.981440843 | 0.318609936 | 0.977101396 |
| 561 | 562 | 563 | 564 | 565 | 566 | 567 |
| 0.696772424 | 0.960723638 | 0.163663100 | 0.960723638 | 0.768267766 | 0.987645908 | 0.977101396 |
| 568 | 569 | 570 | 571 | 572 | 573 | 574 |
| 0.881207506 | 0.642756738 | 0.753443761 | 0.929550617 | 0.985325509 | 0.971482416 | 0.910545435 |
| 575 | 576 | 577 | 578 | 579 | 580 | 581 |
| 0.918335243 | 0.960723638 | 0.979802909 | 0.694083663 | 0.291225839 | 0.291225839 | 0.821639951 |
| 582 | 583 | 584 | 585 | 586 | 587 | 588 |
| 0.971482416 | 0.069041388 | 0.971482416 | 0.971482416 | 0.971482416 | 0.732921676 | 0.918335243 |
| 589 | 590 | 591 | 592 | 593 | 594 | 595 |
| 0.971482416 | 0.971482416 | 0.960723638 | 0.960723638 | 0.987645908 | 0.918335243 | 0.843436340 |
| 596 | 597 | 598 | 599 | 600 | 601 | 602 |
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| 603 | 604 | 605 | 606 | 607 | 608 | 609 |
| 0.881207506 | 0.971482416 | 0.335358498 | 0.987645908 | 0.987645908 | 0.971482416 | 0.318363375 |
| 610 | 611 | 612 | 613 | 614 | 615 | 616 |
| 0.971482416 | 0.944296301 | 0.955420023 | 0.971482416 | 0.977101396 | 0.881207506 | 0.786245689 |
| 617 | 618 | 619 | 620 | 621 | 622 | 623 |
| 0.971482416 | 0.971482416 | 0.960723638 | 0.556876250 | 0.971482416 | 0.573981959 | 0.987645908 |
| 624 | 625 | 626 | 627 | 628 | 629 | 630 |
| 0.556876250 | 0.973145579 | 0.955420023 | 0.985680037 | 0.971482416 | 0.987645908 | 0.979802909 |
| 631 | 632 | 633 | 634 | 635 | 636 | 637 |
| 0.971482416 | 0.422197328 | 0.971482416 | 0.987645908 | 0.971482416 | 0.971482416 | 0.934904404 |
| 638 | 639 | 640 | 641 | 642 | 643 | 644 |
| 0.955420023 | 0.915027126 | 0.971482416 | 0.857630050 | 0.971482416 | 0.997795708 | 0.881207506 |
| 645 | 646 | 647 | 648 | 649 | 650 | 651 |
| 0.971482416 | 0.908185867 | 0.816135656 | 0.694083663 | 0.969145551 | 0.971482416 | 0.987645908 |
| 652 | 653 | 654 | 655 | 656 | 657 | 658 |
| 0.960723638 | 0.694083663 | 0.556876250 | 0.786245689 | 0.979802909 | 0.967525518 | 0.998910167 |
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| 666 | 667 | 668 | 669 | 670 | 671 | 672 |
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| 0.961141314 | 0.865503880 | 0.760278947 | 0.971482416 | 0.918335243 | 0.727501825 | 0.997795708 |
| 680 | 681 | 682 | 683 | 684 | 685 | 686 |
| 0.315981643 | 0.971482416 | 0.971482416 | 0.977101396 | 0.971482416 | 0.664924913 | 0.425141341 |

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|-------------|-------------|-------------|-------------|-------------|-------------|-------------|
| 687 | 688 | 689 | 690 | 691 | 692 | 693 |
| 0.971482416 | 0.960723638 | 0.971482416 | 0.987645908 | 0.977101396 | 0.546060844 | 0.971482416 |
| 694 | 695 | 696 | 697 | 698 | 699 | 700 |
| 0.971482416 | 0.979802909 | 0.961141314 | 0.971482416 | 0.881207506 | 0.886526168 | 0.978560840 |
| 701 | 702 | 703 | 704 | 705 | 706 | 707 |
| 0.694083663 | 0.895674825 | 0.895674825 | 0.977101396 | 0.918335243 | 0.231669683 | 0.849348037 |
| 708 | 709 | 710 | 711 | 712 | 713 | 714 |
| 0.597014623 | 0.973145579 | 0.950874611 | 0.936799204 | 0.785407644 | 0.974874576 | 0.767957983 |
| 715 | 716 | 717 | 718 | 719 | 720 | 721 |
| 0.979802909 | 0.883417512 | 0.996068481 | 0.987645908 | 0.853459414 | 0.920968340 | 0.573981959 |
| 722 | 723 | 724 | 725 | 726 | 727 | 728 |
| 0.971482416 | 0.865503880 | 0.977101396 | 0.081327072 | 0.885835104 | 0.979435637 | 0.998910167 |
| 729 | 730 | 731 | 732 | 733 | 734 | 735 |
| 0.629028520 | 0.971482416 | 0.971482416 | 0.920968340 | 0.662780940 | 0.463889424 | 0.819363669 |
| 736 | 737 | 738 | 739 | 740 | 741 | 742 |
| 0.997795708 | 0.960723638 | 0.971482416 | 0.918335243 | 0.971482416 | 0.933176207 | 0.979802909 |
| 743 | 744 | 745 | 746 | 747 | 748 | 749 |
| 0.971482416 | 0.987645908 | 0.613708222 | 0.785306877 | 0.971482416 | 0.971482416 | 0.569141838 |
| 750 | 751 | 752 | 753 | 754 | 755 | 756 |
| 0.987645908 | 0.960723638 | 0.971482416 | 0.890467849 | 0.934904404 | 0.971482416 | 0.987645908 |
| 757 | 758 | 759 | 760 | 761 | 762 | 763 |
| 0.896809199 | 0.920968340 | 0.849348037 | 0.987645908 | 0.307054769 | 0.927208509 | 0.987645908 |
| 764 | 765 | 766 | 767 | 768 | 769 | 770 |
| 0.973145579 | 0.604979428 | 0.971482416 | 0.997795708 | 0.987645908 | 0.934904404 | 0.997795708 |
| 771 | 772 | 773 | 774 | 775 | 776 | 777 |
| 0.558270210 | 0.960723638 | 0.900277974 | 0.312458323 | 0.955420023 | 0.255598505 | 0.727501825 |
| 778 | 779 | 780 | 781 | 782 | 783 | 784 |
| 0.961141314 | 0.955420023 | 0.915027126 | 0.971482416 | 0.960723638 | 0.971482416 | 0.121983933 |
| 785 | 786 | 787 | 788 | 789 | 790 | 791 |
| 0.569141838 | 0.881207506 | 0.960723638 | 0.979802909 | 0.969145551 | 0.973145579 | 0.971482416 |
| 792 | 793 | 794 | 795 | 796 | 797 | 798 |
| 0.987645908 | 0.971482416 | 0.662780940 | 0.971482416 | 0.973145579 | 0.961141314 | 0.987645908 |
| 799 | 800 | 801 | 802 | 803 | 804 | 805 |
| 0.769396818 | 0.376496427 | 0.881207506 | 0.987645908 | 0.971482416 | 0.881207506 | 0.955420023 |
| 806 | 807 | 808 | 809 | 810 | 811 | 812 |
| 0.546060844 | 0.853459414 | 0.971482416 | 0.971482416 | 0.773748256 | 0.971482416 | 0.955420023 |
| 813 | 814 | 815 | 816 | 817 | 818 | 819 |
| 0.985680037 | 0.977101396 | 0.971482416 | 0.960723638 | 0.923931690 | 0.768267766 | 0.973145579 |
| 820 | 821 | 822 | 823 | 824 | 825 | 826 |
| 0.971482416 | 0.977101396 | 0.598569723 | 0.979802909 | 0.969145551 | 0.918335243 | 0.985680037 |
| 827 | 828 | 829 | 830 | 831 | 832 | 833 |
| 0.771217169 | 0.960723638 | 0.971482416 | 0.979802909 | 0.220658074 | 0.971482416 | 0.973145579 |
| 834 | 835 | 836 | 837 | 838 | 839 | 840 |
| 0.971482416 | 0.376100488 | 0.987645908 | 0.979802909 | 0.979802909 | 0.803688065 | 0.971482416 |
| 841 | 842 | 843 | 844 | 845 | 846 | 847 |

| | | | | | | |
|-------------|-------------|-------------|-------------|-------------|-------------|-------------|
| 0.960723638 | 0.960723638 | 0.694083663 | 0.950874611 | 0.971482416 | 0.696772424 | 0.814846007 |
| 848 | 849 | 850 | 851 | 852 | 853 | 854 |
| 0.387666788 | 0.987645908 | 0.979435637 | 0.971482416 | 0.966749924 | 0.987645908 | 0.974874576 |
| 855 | 856 | 857 | 858 | 859 | 860 | 861 |
| 0.985325509 | 0.987645908 | 0.881207506 | 0.971482416 | 0.971482416 | 0.971482416 | 0.964297024 |
| 862 | 863 | 864 | 865 | 866 | 867 | 868 |
| 0.998910167 | 0.971482416 | 0.979802909 | 0.987645908 | 0.971482416 | 0.971482416 | 0.960723638 |
| 869 | 870 | 871 | 872 | 873 | 874 | 875 |
| 0.920968340 | 0.971482416 | 0.960723638 | 0.874498145 | 0.918335243 | 0.881207506 | 0.662780940 |
| 876 | 877 | 878 | 879 | 880 | 881 | 882 |
| 0.955420023 | 0.918335243 | 0.973145579 | 0.971482416 | 0.971482416 | 0.971482416 | 0.961141314 |
| 883 | 884 | 885 | 886 | 887 | 888 | 889 |
| 0.918335243 | 0.960723638 | 0.985325509 | 0.934904404 | 0.881207506 | 0.960723638 | 0.960723638 |
| 890 | 891 | 892 | 893 | 894 | 895 | 896 |
| 0.732921676 | 0.291225839 | 0.785407644 | 0.915027126 | 0.979802909 | 0.546060844 | 0.987170893 |
| 897 | 898 | 899 | 900 | 901 | 902 | 903 |
| 0.487881308 | 0.410479342 | 0.971482416 | 0.960723638 | 0.971482416 | 0.960723638 | 0.979802909 |
| 904 | 905 | 906 | 907 | 908 | 909 | 910 |
| 0.955420023 | 0.979802909 | 0.927208509 | 0.918335243 | 0.881207506 | 0.971482416 | 0.960723638 |
| 911 | 912 | 913 | 914 | 915 | 916 | 917 |
| 0.971482416 | 0.836787727 | 0.961141314 | 0.979802909 | 0.977101396 | 0.444708100 | 0.971482416 |
| 918 | 919 | 920 | 921 | 922 | 923 | 924 |
| 0.971482416 | 0.696772424 | 0.642756738 | 0.974874576 | 0.955420023 | 0.908185867 | 0.748834667 |
| 925 | 926 | 927 | 928 | 929 | 930 | 931 |
| 0.019491028 | 0.953294254 | 0.950874611 | 0.694083663 | 0.318363375 | 0.987645908 | 0.979802909 |
| 932 | 933 | 934 | 935 | 936 | 937 | 938 |
| 0.979802909 | 0.908185867 | 0.971482416 | 0.960723638 | 0.955420023 | 0.973145579 | 0.971482416 |
| 939 | 940 | 941 | 942 | 943 | 944 | 945 |
| 0.987645908 | 0.971482416 | 0.938009157 | 0.973145579 | 0.973145579 | 0.987645908 | 0.231669683 |
| 946 | 947 | 948 | 949 | 950 | 951 | 952 |
| 0.977101396 | 0.985680037 | 0.960723638 | 0.971482416 | 0.960723638 | 0.971482416 | 0.971482416 |
| 953 | 954 | 955 | 956 | 957 | 958 | 959 |
| 0.821639951 | 0.971482416 | 0.908185867 | 0.916749183 | 0.964297024 | 0.918335243 | 0.918335243 |
| 960 | 961 | 962 | 963 | 964 | 965 | 966 |
| 0.546060844 | 0.938626319 | 0.220658074 | 0.987645908 | 0.979802909 | 0.755093360 | 0.971482416 |
| 967 | 968 | 969 | 970 | 971 | 972 | 973 |
| 0.881207506 | 0.987645908 | 0.971482416 | 0.771217169 | 0.955420023 | 0.768954459 | 0.953294254 |
| 974 | 975 | 976 | 977 | 978 | 979 | 980 |
| 0.960723638 | 0.786245689 | 0.934904404 | 0.971482416 | 0.971482416 | 0.955420023 | 0.971482416 |
| 981 | 982 | 983 | 984 | 985 | 986 | 987 |
| 0.971482416 | 0.768267766 | 0.556876250 | 0.971482416 | 0.971482416 | 0.996068481 | 0.231669683 |
| 988 | 989 | 990 | 991 | 992 | 993 | 994 |
| 0.973145579 | 0.971482416 | 0.920968340 | 0.960723638 | 0.105404445 | 0.979802909 | 0.855557365 |
| 995 | 996 | 997 | 998 | 999 | 1000 | |
| 0.291914137 | 0.987645908 | 0.907299710 | 0.987170893 | 0.881207506 | 0.849348037 | |

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