Spokes

Luis Ángel Rodríguez García

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Spokes

Sample on the $(\mathbb{S}^2)^{168}$ where $p = 2$, $r = 168$ and $n = 177$.

```r
load(paste(here("data-raw", "spokes"), "spokes.RData", sep = "/"))
n <- dim(dirs)[1]
p <- dim(dirs)[3]-1
r <- dim(dirs)[2]
spokes <- array(0, c(n, p+1, r))
for(i in seq_len(r)){
  spokes[,,i] <- dirs[,i,]
}

# Plot subjects for each spok
rgl::open3d()
```

```
## glX
##   1
```

```r
rgl::mfrow3d(nr = 12, nc = 14, sharedMouse = TRUE)
n <- 10
col <- rainbow(n, alpha=0.8)
for (i in 1:ncol(dirs)) {
  col_i <- col # ids_labs + 1
  rgl::plot3d(dirs[1:n, i, ], xlim = c(-1, 1), ylim = c(-1, 1), zlim = c(-1, 1),
              col = col_i, axes = FALSE, box = FALSE, xlab = "",
              ylab = "", zlab = "")
  rgl::spheres3d(0, 0, 0, radius = 1, col = "lightblue", lit = FALSE,
                 alpha = 0.5)
}
```

Let's calculate the rho parameters based on a perplexity of 30:

```r
rho_spokes_perp25 <- rho_optim_bst(spokes, 25)
```

```
## Time difference of 2.731538 mins
```

First, let's reduce to dimension $\mathbb{S}^1$ then $d = 1$ (circumference):

```r
res_pscsne <- psc_sne(spokes, d = 1, rho_psc_list = rho_spokes_perp25,
             colors = ifelse(ids_labs, 2, 1), num_iteration = 500, show_prog = T)
```

```
## It: 1; obj: 1.265e+01; abs: 0.000e+00; rel: 0.000e+00; norm: 2.585e-01; mom: 0.000e+00;
## best it: 1; best obj: 1.265e+01
```

```
## It: 2; obj: 1.215e+01; abs: 4.948e-01; rel: 3.913e-02; norm: 5.058e-01; mom: 4.316e+00;
```

```
## best it: 2; best obj: 1.215e+01
## It: 3; obj: 1.194e+01; abs: 2.063e-01; rel: 1.698e-02; norm: 6.375e-01; mom: 2.519e+00;
## best it: 3; best obj: 1.194e+01
## It: 4; obj: 1.179e+01; abs: 1.503e-01; rel: 1.258e-02; norm: 6.965e-01; mom: 1.164e+00;
## best it: 4; best obj: 1.179e+01
## It: 5; obj: 1.170e+01; abs: 9.448e-02; rel: 8.011e-03; norm: 7.486e-01; mom: 1.075e+00;
## best it: 5; best obj: 1.170e+01
## It: 6; obj: 1.164e+01; abs: 5.530e-02; rel: 4.726e-03; norm: 7.966e-01; mom: 8.008e-01;
## best it: 6; best obj: 1.164e+01
## It: 7; obj: 1.159e+01; abs: 5.352e-02; rel: 4.596e-03; norm: 8.421e-01; mom: 6.627e-01;
## best it: 7; best obj: 1.159e+01
## It: 8; obj: 1.156e+01; abs: 3.594e-02; rel: 3.101e-03; norm: 9.050e-01; mom: 6.845e-01;
## best it: 8; best obj: 1.156e+01
## It: 9; obj: 1.150e+01; abs: 5.734e-02; rel: 4.962e-03; norm: 9.757e-01; mom: 6.417e-01;
## best it: 9; best obj: 1.150e+01
## It: 10; obj: 1.143e+01; abs: 6.850e-02; rel: 5.958e-03; norm: 1.034e+00; mom: 6.165e-01;
## best it: 10; best obj: 1.143e+01
## It: 11; obj: 1.138e+01; abs: 4.878e-02; rel: 4.268e-03; norm: 1.084e+00; mom: 6.076e-01;
## best it: 11; best obj: 1.138e+01
## It: 12; obj: 1.135e+01; abs: 3.282e-02; rel: 2.884e-03; norm: 1.125e+00; mom: 6.110e-01;
## best it: 12; best obj: 1.135e+01
## It: 13; obj: 1.134e+01; abs: 1.259e-02; rel: 1.109e-03; norm: 1.168e+00; mom: 6.095e-01;
## best it: 13; best obj: 1.134e+01
## It: 14; obj: 1.135e+01; abs: 9.777e-03; rel: 8.625e-04; norm: 1.219e+00; mom: 5.962e-01;
## best it: 13; best obj: 1.134e+01
## It: 15; obj: 1.138e+01; abs: 3.364e-02; rel: 2.965e-03; norm: 1.279e+00; mom: 5.320e-01;
## best it: 13; best obj: 1.134e+01
## It: 16; obj: 1.142e+01; abs: 4.197e-02; rel: 3.689e-03; norm: 1.346e+00; mom: 4.649e-01;
## best it: 13; best obj: 1.134e+01
## It: 17; obj: 1.146e+01; abs: 3.661e-02; rel: 3.206e-03; norm: 1.418e+00; mom: 4.517e-01;
## best it: 13; best obj: 1.134e+01
## It: 18; obj: 1.147e+01; abs: 9.084e-03; rel: 7.929e-04; norm: 1.494e+00; mom: 4.630e-01;
## best it: 13; best obj: 1.134e+01
## It: 19; obj: 1.148e+01; abs: 1.852e-02; rel: 1.615e-03; norm: 1.570e+00; mom: 5.220e-01;
## best it: 13; best obj: 1.134e+01
## It: 20; obj: 1.151e+01; abs: 3.011e-02; rel: 2.621e-03; norm: 1.636e+00; mom: 3.804e-01;
## best it: 13; best obj: 1.134e+01
## It: 21; obj: 1.155e+01; abs: 3.885e-02; rel: 3.374e-03; norm: 1.688e+00; mom: 3.120e-01;
## best it: 13; best obj: 1.134e+01
## It: 22; obj: 1.160e+01; abs: 4.378e-02; rel: 3.790e-03; norm: 1.729e+00; mom: 2.643e-01;
## best it: 13; best obj: 1.134e+01
## It: 23; obj: 1.164e+01; abs: 4.570e-02; rel: 3.940e-03; norm: 1.763e+00; mom: 2.246e-01;
## best it: 13; best obj: 1.134e+01
## It: 24; obj: 1.169e+01; abs: 4.547e-02; rel: 3.905e-03; norm: 1.791e+00; mom: 1.917e-01;
## best it: 13; best obj: 1.134e+01
## It: 25; obj: 1.173e+01; abs: 4.370e-02; rel: 3.739e-03; norm: 1.814e+00; mom: 1.638e-01;
## best it: 13; best obj: 1.134e+01

## It: 26; obj: 1.177e+01; abs: 4.094e-02; rel: 3.490e-03; norm: 1.833e+00; mom: 1.400e-01;
## best it: 13; best obj: 1.134e+01
## It: 27; obj: 1.181e+01; abs: 3.764e-02; rel: 3.197e-03; norm: 1.849e+00; mom: 1.199e-01;
## best it: 13; best obj: 1.134e+01
## It: 28; obj: 1.185e+01; abs: 3.414e-02; rel: 2.890e-03; norm: 1.863e+00; mom: 1.030e-01;
## best it: 13; best obj: 1.134e+01
```

```
## It: 29; obj: 1.188e+01; abs: 3.066e-02; rel: 2.588e-03; norm: 1.874e+00; mom: 8.867e-02;
## best it: 13; best obj: 1.134e+01
## It: 30; obj: 1.190e+01; abs: 2.734e-02; rel: 2.302e-03; norm: 1.883e+00; mom: 7.659e-02;
## best it: 13; best obj: 1.134e+01
## It: 31; obj: 1.193e+01; abs: 2.426e-02; rel: 2.038e-03; norm: 1.891e+00; mom: 6.631e-02;
## best it: 13; best obj: 1.134e+01
## It: 32; obj: 1.195e+01; abs: 2.146e-02; rel: 1.799e-03; norm: 1.898e+00; mom: 5.755e-02;
## best it: 13; best obj: 1.134e+01
## It: 33; obj: 1.197e+01; abs: 1.894e-02; rel: 1.585e-03; norm: 1.904e+00; mom: 5.003e-02;
## best it: 13; best obj: 1.134e+01
## It: 34; obj: 1.198e+01; abs: 1.669e-02; rel: 1.395e-03; norm: 1.909e+00; mom: 4.358e-02;
## best it: 13; best obj: 1.134e+01
## It: 35; obj: 1.200e+01; abs: 1.470e-02; rel: 1.226e-03; norm: 1.913e+00; mom: 3.801e-02;
## best it: 13; best obj: 1.134e+01
## It: 36; obj: 1.201e+01; abs: 1.294e-02; rel: 1.078e-03; norm: 1.916e+00; mom: 3.321e-02;
## best it: 13; best obj: 1.134e+01
## It: 37; obj: 1.202e+01; abs: 1.139e-02; rel: 9.481e-04; norm: 1.919e+00; mom: 2.905e-02;
## best it: 13; best obj: 1.134e+01
## It: 38; obj: 1.203e+01; abs: 1.003e-02; rel: 8.340e-04; norm: 1.922e+00; mom: 2.544e-02;
## best it: 13; best obj: 1.134e+01
## It: 39; obj: 1.204e+01; abs: 8.831e-03; rel: 7.339e-04; norm: 1.924e+00; mom: 2.231e-02;
## best it: 13; best obj: 1.134e+01
## It: 40; obj: 1.205e+01; abs: 7.780e-03; rel: 6.461e-04; norm: 1.926e+00; mom: 1.958e-02;
## best it: 13; best obj: 1.134e+01
## It: 41; obj: 1.206e+01; abs: 6.858e-03; rel: 5.691e-04; norm: 1.928e+00; mom: 1.720e-02;
## best it: 13; best obj: 1.134e+01
## It: 42; obj: 1.206e+01; abs: 6.048e-03; rel: 5.016e-04; norm: 1.929e+00; mom: 1.513e-02;
## best it: 13; best obj: 1.134e+01
## It: 43; obj: 1.207e+01; abs: 5.336e-03; rel: 4.423e-04; norm: 1.931e+00; mom: 1.331e-02;
## best it: 13; best obj: 1.134e+01
## It: 44; obj: 1.207e+01; abs: 4.710e-03; rel: 3.903e-04; norm: 1.932e+00; mom: 1.173e-02;
## best it: 13; best obj: 1.134e+01
## It: 45; obj: 1.208e+01; abs: 4.159e-03; rel: 3.445e-04; norm: 1.933e+00; mom: 1.034e-02;
## best it: 13; best obj: 1.134e+01
## It: 46; obj: 1.208e+01; abs: 3.675e-03; rel: 3.043e-04; norm: 1.934e+00; mom: 9.115e-03;
## best it: 13; best obj: 1.134e+01
## It: 47; obj: 1.208e+01; abs: 3.248e-03; rel: 2.688e-04; norm: 1.934e+00; mom: 8.043e-03;
## best it: 13; best obj: 1.134e+01
## It: 48; obj: 1.209e+01; abs: 2.872e-03; rel: 2.376e-04; norm: 1.935e+00; mom: 7.101e-03;
## best it: 13; best obj: 1.134e+01
## It: 49; obj: 1.209e+01; abs: 2.540e-03; rel: 2.101e-04; norm: 1.936e+00; mom: 6.272e-03;
## best it: 13; best obj: 1.134e+01
## It: 50; obj: 1.209e+01; abs: 2.247e-03; rel: 1.859e-04; norm: 1.936e+00; mom: 5.542e-03;
## best it: 13; best obj: 1.134e+01

## It: 51; obj: 1.209e+01; abs: 1.989e-03; rel: 1.645e-04; norm: 1.937e+00; mom: 4.898e-03;
## best it: 13; best obj: 1.134e+01
## It: 52; obj: 1.210e+01; abs: 1.761e-03; rel: 1.456e-04; norm: 1.937e+00; mom: 4.331e-03;
## best it: 13; best obj: 1.134e+01
## It: 53; obj: 1.210e+01; abs: 1.559e-03; rel: 1.289e-04; norm: 1.937e+00; mom: 3.830e-03;
## best it: 13; best obj: 1.134e+01
## It: 54; obj: 1.210e+01; abs: 1.381e-03; rel: 1.141e-04; norm: 1.938e+00; mom: 3.389e-03;
## best it: 13; best obj: 1.134e+01
## It: 55; obj: 1.210e+01; abs: 1.223e-03; rel: 1.011e-04; norm: 1.938e+00; mom: 2.999e-03;
```

```
## best it: 13; best obj: 1.134e+01
## It: 56; obj: 1.210e+01; abs: 1.083e-03; rel: 8.955e-05; norm: 1.938e+00; mom: 2.654e-03;
## best it: 13; best obj: 1.134e+01
## It: 57; obj: 1.210e+01; abs: 9.601e-04; rel: 7.934e-05; norm: 1.938e+00; mom: 2.349e-03;
## best it: 13; best obj: 1.134e+01
## It: 58; obj: 1.210e+01; abs: 8.509e-04; rel: 7.031e-05; norm: 1.939e+00; mom: 2.080e-03;
## best it: 13; best obj: 1.134e+01
## It: 59; obj: 1.210e+01; abs: 7.542e-04; rel: 6.231e-05; norm: 1.939e+00; mom: 1.842e-03;
## best it: 13; best obj: 1.134e+01
## It: 60; obj: 1.210e+01; abs: 6.685e-04; rel: 5.523e-05; norm: 1.939e+00; mom: 1.631e-03;
## best it: 13; best obj: 1.134e+01
## It: 61; obj: 1.210e+01; abs: 5.927e-04; rel: 4.897e-05; norm: 1.939e+00; mom: 1.445e-03;
## best it: 13; best obj: 1.134e+01
## It: 62; obj: 1.211e+01; abs: 5.255e-04; rel: 4.341e-05; norm: 1.939e+00; mom: 1.280e-03;
## best it: 13; best obj: 1.134e+01
## It: 63; obj: 1.211e+01; abs: 4.659e-04; rel: 3.849e-05; norm: 1.939e+00; mom: 1.134e-03;
## best it: 13; best obj: 1.134e+01
## It: 64; obj: 1.211e+01; abs: 4.132e-04; rel: 3.413e-05; norm: 1.939e+00; mom: 1.005e-03;
## best it: 13; best obj: 1.134e+01
## It: 65; obj: 1.211e+01; abs: 3.664e-04; rel: 3.027e-05; norm: 1.939e+00; mom: 8.903e-04;
## best it: 13; best obj: 1.134e+01
## It: 66; obj: 1.211e+01; abs: 3.250e-04; rel: 2.684e-05; norm: 1.939e+00; mom: 7.890e-04;
## best it: 13; best obj: 1.134e+01
## It: 67; obj: 1.211e+01; abs: 2.882e-04; rel: 2.381e-05; norm: 1.939e+00; mom: 6.992e-04;
## best it: 13; best obj: 1.134e+01
## It: 68; obj: 1.211e+01; abs: 2.556e-04; rel: 2.111e-05; norm: 1.940e+00; mom: 6.197e-04;
## best it: 13; best obj: 1.134e+01
## It: 69; obj: 1.211e+01; abs: 2.267e-04; rel: 1.873e-05; norm: 1.940e+00; mom: 5.492e-04;
## best it: 13; best obj: 1.134e+01
## It: 70; obj: 1.211e+01; abs: 2.011e-04; rel: 1.661e-05; norm: 1.940e+00; mom: 4.868e-04;
## best it: 13; best obj: 1.134e+01
## It: 71; obj: 1.211e+01; abs: 1.784e-04; rel: 1.474e-05; norm: 1.940e+00; mom: 4.315e-04;
## best it: 13; best obj: 1.134e+01
## It: 72; obj: 1.211e+01; abs: 1.583e-04; rel: 1.307e-05; norm: 1.940e+00; mom: 3.825e-04;
## best it: 13; best obj: 1.134e+01
## It: 73; obj: 1.211e+01; abs: 1.404e-04; rel: 1.160e-05; norm: 1.940e+00; mom: 3.391e-04;
## best it: 13; best obj: 1.134e+01
## It: 74; obj: 1.211e+01; abs: 1.246e-04; rel: 1.029e-05; norm: 1.940e+00; mom: 3.006e-04;
## best it: 13; best obj: 1.134e+01
## It: 75; obj: 1.211e+01; abs: 1.105e-04; rel: 9.126e-06; norm: 1.940e+00; mom: 2.665e-04;
## best it: 13; best obj: 1.134e+01

## It: 76; obj: 1.211e+01; abs: 9.803e-05; rel: 8.096e-06; norm: 1.940e+00; mom: 2.362e-04;
## best it: 13; best obj: 1.134e+01
## It: 77; obj: 1.211e+01; abs: 8.697e-05; rel: 7.183e-06; norm: 1.940e+00; mom: 2.094e-04;
## best it: 13; best obj: 1.134e+01
## It: 78; obj: 1.211e+01; abs: 7.716e-05; rel: 6.372e-06; norm: 1.940e+00; mom: 1.857e-04;
## best it: 13; best obj: 1.134e+01
## It: 79; obj: 1.211e+01; abs: 6.846e-05; rel: 5.654e-06; norm: 1.940e+00; mom: 1.646e-04;
## best it: 13; best obj: 1.134e+01
## It: 80; obj: 1.211e+01; abs: 6.074e-05; rel: 5.016e-06; norm: 1.940e+00; mom: 1.460e-04;
## best it: 13; best obj: 1.134e+01
## It: 81; obj: 1.211e+01; abs: 5.389e-05; rel: 4.450e-06; norm: 1.940e+00; mom: 1.294e-04;
## best it: 13; best obj: 1.134e+01
```

```
## It: 82; obj: 1.211e+01; abs: 4.781e-05; rel: 3.949e-06; norm: 1.940e+00; mom: 1.148e-04;
## best it: 13; best obj: 1.134e+01
## It: 83; obj: 1.211e+01; abs: 4.242e-05; rel: 3.504e-06; norm: 1.940e+00; mom: 1.018e-04;
## best it: 13; best obj: 1.134e+01
## It: 84; obj: 1.211e+01; abs: 3.764e-05; rel: 3.109e-06; norm: 1.940e+00; mom: 9.022e-05;
## best it: 13; best obj: 1.134e+01
## It: 85; obj: 1.211e+01; abs: 3.340e-05; rel: 2.758e-06; norm: 1.940e+00; mom: 8.000e-05;
## best it: 13; best obj: 1.134e+01
## It: 86; obj: 1.211e+01; abs: 2.963e-05; rel: 2.447e-06; norm: 1.940e+00; mom: 7.094e-05;
## best it: 13; best obj: 1.134e+01
## It: 87; obj: 1.211e+01; abs: 2.629e-05; rel: 2.171e-06; norm: 1.940e+00; mom: 6.291e-05;
## best it: 13; best obj: 1.134e+01

## Warning in selectChildren(ac[!fin], -1): error 'No child processes' in select

## It: 88; obj: 1.211e+01; abs: 2.333e-05; rel: 1.927e-06; norm: 1.940e+00; mom: 5.578e-05;
## best it: 13; best obj: 1.134e+01
## It: 89; obj: 1.211e+01; abs: 2.070e-05; rel: 1.710e-06; norm: 1.940e+00; mom: 4.947e-05;
## best it: 13; best obj: 1.134e+01
## It: 90; obj: 1.211e+01; abs: 1.837e-05; rel: 1.517e-06; norm: 1.940e+00; mom: 4.387e-05;
## best it: 13; best obj: 1.134e+01
## It: 91; obj: 1.211e+01; abs: 1.630e-05; rel: 1.346e-06; norm: 1.940e+00; mom: 3.890e-05;
## best it: 13; best obj: 1.134e+01
## It: 92; obj: 1.211e+01; abs: 1.446e-05; rel: 1.194e-06; norm: 1.940e+00; mom: 3.450e-05;
## best it: 13; best obj: 1.134e+01
## It: 93; obj: 1.211e+01; abs: 1.283e-05; rel: 1.060e-06; norm: 1.940e+00; mom: 3.059e-05;
## best it: 13; best obj: 1.134e+01
## It: 94; obj: 1.211e+01; abs: 1.139e-05; rel: 9.404e-07; norm: 1.940e+00; mom: 2.713e-05;
## best it: 13; best obj: 1.134e+01
## It: 95; obj: 1.211e+01; abs: 1.010e-05; rel: 8.345e-07; norm: 1.940e+00; mom: 2.406e-05;
## best it: 13; best obj: 1.134e+01
## It: 96; obj: 1.211e+01; abs: 8.967e-06; rel: 7.405e-07; norm: 1.940e+00; mom: 2.134e-05;
## best it: 13; best obj: 1.134e+01
## It: 97; obj: 1.211e+01; abs: 7.957e-06; rel: 6.571e-07; norm: 1.940e+00; mom: 1.893e-05;
## best it: 13; best obj: 1.134e+01
## It: 98; obj: 1.211e+01; abs: 7.060e-06; rel: 5.831e-07; norm: 1.940e+00; mom: 1.679e-05;
## best it: 13; best obj: 1.134e+01
## It: 99; obj: 1.211e+01; abs: 6.265e-06; rel: 5.174e-07; norm: 1.940e+00; mom: 1.489e-05;
## best it: 13; best obj: 1.134e+01
## It: 100; obj: 1.211e+01; abs: 5.559e-06; rel: 4.591e-07; norm: 1.940e+00; mom: 1.320e-05;
## best it: 13; best obj: 1.134e+01

## It: 101; obj: 1.579e+00; abs: 1.053e+01; rel: 8.696e-01; norm: 2.014e-01; mom: 1.171e-05;
## best it: 101; best obj: 1.579e+00
## It: 102; obj: 1.521e+00; abs: 5.832e-02; rel: 3.694e-02; norm: 1.064e-01; mom: 6.630e+00;
## best it: 102; best obj: 1.521e+00
## It: 103; obj: 1.623e+00; abs: 1.022e-01; rel: 6.724e-02; norm: 1.195e-01; mom: 6.584e+00;
## best it: 102; best obj: 1.521e+00
## It: 104; obj: 1.776e+00; abs: 1.527e-01; rel: 9.413e-02; norm: 1.492e-01; mom: 6.015e+00;
## best it: 102; best obj: 1.521e+00
## It: 105; obj: 1.780e+00; abs: 4.730e-03; rel: 2.664e-03; norm: 1.923e-01; mom: 7.448e+00;
## best it: 102; best obj: 1.521e+00
## It: 106; obj: 1.835e+00; abs: 5.485e-02; rel: 3.081e-02; norm: 2.395e-01; mom: 8.138e+00;
## best it: 102; best obj: 1.521e+00
## It: 107; obj: 1.789e+00; abs: 4.606e-02; rel: 2.510e-02; norm: 2.773e-01; mom: 8.712e+00;
```

```
## best it: 102; best obj: 1.521e+00
## It: 108; obj: 1.750e+00; abs: 3.862e-02; rel: 2.159e-02; norm: 2.813e-01; mom: 9.142e+00;
## best it: 102; best obj: 1.521e+00
## It: 109; obj: 1.724e+00; abs: 2.615e-02; rel: 1.494e-02; norm: 2.645e-01; mom: 8.877e+00;
## best it: 102; best obj: 1.521e+00
## It: 110; obj: 1.732e+00; abs: 7.233e-03; rel: 4.195e-03; norm: 2.642e-01; mom: 8.817e+00;
## best it: 102; best obj: 1.521e+00
## It: 111; obj: 1.727e+00; abs: 4.417e-03; rel: 2.551e-03; norm: 2.651e-01; mom: 8.651e+00;
## best it: 102; best obj: 1.521e+00
## It: 112; obj: 1.719e+00; abs: 7.701e-03; rel: 4.459e-03; norm: 2.650e-01; mom: 8.643e+00;
## best it: 102; best obj: 1.521e+00
## It: 113; obj: 1.712e+00; abs: 7.313e-03; rel: 4.253e-03; norm: 2.649e-01; mom: 8.806e+00;
## best it: 102; best obj: 1.521e+00
## It: 114; obj: 1.731e+00; abs: 1.896e-02; rel: 1.108e-02; norm: 2.723e-01; mom: 8.663e+00;
## best it: 102; best obj: 1.521e+00
## It: 115; obj: 1.701e+00; abs: 3.018e-02; rel: 1.743e-02; norm: 2.653e-01; mom: 8.662e+00;
## best it: 102; best obj: 1.521e+00
## It: 116; obj: 1.721e+00; abs: 1.997e-02; rel: 1.174e-02; norm: 2.663e-01; mom: 8.688e+00;
## best it: 102; best obj: 1.521e+00
## It: 117; obj: 1.714e+00; abs: 6.569e-03; rel: 3.817e-03; norm: 2.577e-01; mom: 8.707e+00;
## best it: 102; best obj: 1.521e+00
## It: 118; obj: 1.726e+00; abs: 1.199e-02; rel: 6.997e-03; norm: 2.655e-01; mom: 8.628e+00;
## best it: 102; best obj: 1.521e+00
## It: 119; obj: 1.703e+00; abs: 2.372e-02; rel: 1.374e-02; norm: 2.574e-01; mom: 8.563e+00;
## best it: 102; best obj: 1.521e+00
## It: 120; obj: 1.742e+00; abs: 3.944e-02; rel: 2.316e-02; norm: 2.646e-01; mom: 8.447e+00;
## best it: 102; best obj: 1.521e+00
## It: 121; obj: 1.692e+00; abs: 5.025e-02; rel: 2.884e-02; norm: 2.618e-01; mom: 8.545e+00;
## best it: 102; best obj: 1.521e+00
## It: 122; obj: 1.703e+00; abs: 1.146e-02; rel: 6.775e-03; norm: 2.581e-01; mom: 8.606e+00;
## best it: 102; best obj: 1.521e+00
## It: 123; obj: 1.681e+00; abs: 2.208e-02; rel: 1.297e-02; norm: 2.537e-01; mom: 8.389e+00;
## best it: 102; best obj: 1.521e+00
## It: 124; obj: 1.714e+00; abs: 3.272e-02; rel: 1.946e-02; norm: 2.557e-01; mom: 8.556e+00;
## best it: 102; best obj: 1.521e+00
## It: 125; obj: 1.686e+00; abs: 2.811e-02; rel: 1.640e-02; norm: 2.554e-01; mom: 8.412e+00;
## best it: 102; best obj: 1.521e+00

## It: 126; obj: 1.712e+00; abs: 2.577e-02; rel: 1.529e-02; norm: 2.600e-01; mom: 8.487e+00;
## best it: 102; best obj: 1.521e+00
## It: 127; obj: 1.695e+00; abs: 1.692e-02; rel: 9.884e-03; norm: 2.605e-01; mom: 8.444e+00;
## best it: 102; best obj: 1.521e+00
## It: 128; obj: 1.714e+00; abs: 1.984e-02; rel: 1.171e-02; norm: 2.652e-01; mom: 8.444e+00;
## best it: 102; best obj: 1.521e+00
## It: 129; obj: 1.662e+00; abs: 5.239e-02; rel: 3.056e-02; norm: 2.681e-01; mom: 8.438e+00;
## best it: 102; best obj: 1.521e+00
## It: 130; obj: 1.697e+00; abs: 3.504e-02; rel: 2.108e-02; norm: 2.610e-01; mom: 8.554e+00;
## best it: 102; best obj: 1.521e+00
## It: 131; obj: 1.672e+00; abs: 2.525e-02; rel: 1.488e-02; norm: 2.577e-01; mom: 8.451e+00;
## best it: 102; best obj: 1.521e+00
## It: 132; obj: 1.689e+00; abs: 1.673e-02; rel: 1.001e-02; norm: 2.585e-01; mom: 8.505e+00;
## best it: 102; best obj: 1.521e+00
## It: 133; obj: 1.640e+00; abs: 4.831e-02; rel: 2.861e-02; norm: 2.536e-01; mom: 8.422e+00;
## best it: 102; best obj: 1.521e+00
```

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## It: 134; obj: 1.666e+00; abs: 2.607e-02; rel: 1.589e-02; norm: 2.460e-01; mom: 8.280e+00;
## best it: 102; best obj: 1.521e+00
## It: 135; obj: 1.648e+00; abs: 1.805e-02; rel: 1.083e-02; norm: 2.392e-01; mom: 8.227e+00;
## best it: 102; best obj: 1.521e+00
## It: 136; obj: 1.665e+00; abs: 1.634e-02; rel: 9.915e-03; norm: 2.432e-01; mom: 8.257e+00;
## best it: 102; best obj: 1.521e+00
## It: 137; obj: 1.638e+00; abs: 2.638e-02; rel: 1.585e-02; norm: 2.351e-01; mom: 8.291e+00;
## best it: 102; best obj: 1.521e+00
## It: 138; obj: 1.665e+00; abs: 2.646e-02; rel: 1.615e-02; norm: 2.373e-01; mom: 8.118e+00;
## best it: 102; best obj: 1.521e+00
## It: 139; obj: 1.631e+00; abs: 3.363e-02; rel: 2.020e-02; norm: 2.456e-01; mom: 8.038e+00;
## best it: 102; best obj: 1.521e+00
## It: 140; obj: 1.665e+00; abs: 3.405e-02; rel: 2.088e-02; norm: 2.506e-01; mom: 8.112e+00;
## best it: 102; best obj: 1.521e+00
## It: 141; obj: 1.641e+00; abs: 2.423e-02; rel: 1.455e-02; norm: 2.463e-01; mom: 8.182e+00;
## best it: 102; best obj: 1.521e+00
## It: 142; obj: 1.681e+00; abs: 4.062e-02; rel: 2.475e-02; norm: 2.481e-01; mom: 8.185e+00;
## best it: 102; best obj: 1.521e+00
## It: 143; obj: 1.685e+00; abs: 3.078e-03; rel: 1.830e-03; norm: 2.501e-01; mom: 8.252e+00;
## best it: 102; best obj: 1.521e+00
## It: 144; obj: 1.692e+00; abs: 7.365e-03; rel: 4.372e-03; norm: 2.554e-01; mom: 8.288e+00;
## best it: 102; best obj: 1.521e+00
## It: 145; obj: 1.653e+00; abs: 3.896e-02; rel: 2.303e-02; norm: 2.514e-01; mom: 8.245e+00;
## best it: 102; best obj: 1.521e+00
## It: 146; obj: 1.664e+00; abs: 1.072e-02; rel: 6.486e-03; norm: 2.431e-01; mom: 8.205e+00;
## best it: 102; best obj: 1.521e+00
## It: 147; obj: 1.628e+00; abs: 3.555e-02; rel: 2.137e-02; norm: 2.364e-01; mom: 8.181e+00;
## best it: 102; best obj: 1.521e+00
## It: 148; obj: 1.682e+00; abs: 5.386e-02; rel: 3.308e-02; norm: 2.486e-01; mom: 8.022e+00;
## best it: 102; best obj: 1.521e+00
## It: 149; obj: 1.666e+00; abs: 1.575e-02; rel: 9.365e-03; norm: 2.477e-01; mom: 8.178e+00;
## best it: 102; best obj: 1.521e+00
## It: 150; obj: 1.673e+00; abs: 6.279e-03; rel: 3.768e-03; norm: 2.547e-01; mom: 8.264e+00;
## best it: 102; best obj: 1.521e+00

## It: 151; obj: 1.666e+00; abs: 6.995e-03; rel: 4.182e-03; norm: 2.528e-01; mom: 8.288e+00;
## best it: 102; best obj: 1.521e+00
## It: 152; obj: 1.666e+00; abs: 5.414e-04; rel: 3.251e-04; norm: 2.478e-01; mom: 8.275e+00;
## best it: 102; best obj: 1.521e+00
## It: 153; obj: 1.649e+00; abs: 1.682e-02; rel: 1.009e-02; norm: 2.475e-01; mom: 8.267e+00;
## best it: 102; best obj: 1.521e+00
## It: 154; obj: 1.661e+00; abs: 1.169e-02; rel: 7.087e-03; norm: 2.545e-01; mom: 8.177e+00;
## best it: 102; best obj: 1.521e+00
## It: 155; obj: 1.653e+00; abs: 8.124e-03; rel: 4.891e-03; norm: 2.474e-01; mom: 8.249e+00;
## best it: 102; best obj: 1.521e+00
## It: 156; obj: 1.653e+00; abs: 2.339e-04; rel: 1.415e-04; norm: 2.494e-01; mom: 8.272e+00;
## best it: 102; best obj: 1.521e+00
## It: 157; obj: 1.648e+00; abs: 5.451e-03; rel: 3.297e-03; norm: 2.381e-01; mom: 8.176e+00;
## best it: 102; best obj: 1.521e+00
## It: 158; obj: 1.685e+00; abs: 3.717e-02; rel: 2.256e-02; norm: 2.479e-01; mom: 8.049e+00;
## best it: 102; best obj: 1.521e+00
## It: 159; obj: 1.652e+00; abs: 3.305e-02; rel: 1.962e-02; norm: 2.406e-01; mom: 8.135e+00;
## best it: 102; best obj: 1.521e+00
## It: 160; obj: 1.691e+00; abs: 3.892e-02; rel: 2.356e-02; norm: 2.438e-01; mom: 8.142e+00;
```

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## best it: 102; best obj: 1.521e+00
## It: 161; obj: 1.656e+00; abs: 3.415e-02; rel: 2.020e-02; norm: 2.485e-01; mom: 8.142e+00;
## best it: 102; best obj: 1.521e+00
## It: 162; obj: 1.678e+00; abs: 2.144e-02; rel: 1.294e-02; norm: 2.499e-01; mom: 8.216e+00;
## best it: 102; best obj: 1.521e+00
## It: 163; obj: 1.675e+00; abs: 3.250e-03; rel: 1.937e-03; norm: 2.514e-01; mom: 8.240e+00;
## best it: 102; best obj: 1.521e+00
## It: 164; obj: 1.678e+00; abs: 2.854e-03; rel: 1.704e-03; norm: 2.541e-01; mom: 8.364e+00;
## best it: 102; best obj: 1.521e+00
## It: 165; obj: 1.656e+00; abs: 2.177e-02; rel: 1.298e-02; norm: 2.418e-01; mom: 8.353e+00;
## best it: 102; best obj: 1.521e+00
## It: 166; obj: 1.715e+00; abs: 5.918e-02; rel: 3.574e-02; norm: 2.372e-01; mom: 8.082e+00;
## best it: 102; best obj: 1.521e+00
## It: 167; obj: 1.719e+00; abs: 4.272e-03; rel: 2.491e-03; norm: 2.475e-01; mom: 8.119e+00;
## best it: 102; best obj: 1.521e+00
## It: 168; obj: 1.712e+00; abs: 6.967e-03; rel: 4.052e-03; norm: 2.474e-01; mom: 8.214e+00;
## best it: 102; best obj: 1.521e+00
## It: 169; obj: 1.668e+00; abs: 4.420e-02; rel: 2.581e-02; norm: 2.459e-01; mom: 8.417e+00;
## best it: 102; best obj: 1.521e+00
## It: 170; obj: 1.716e+00; abs: 4.803e-02; rel: 2.879e-02; norm: 2.443e-01; mom: 8.273e+00;
## best it: 102; best obj: 1.521e+00
## It: 171; obj: 1.681e+00; abs: 3.495e-02; rel: 2.036e-02; norm: 2.452e-01; mom: 8.249e+00;
## best it: 102; best obj: 1.521e+00
## It: 172; obj: 1.692e+00; abs: 1.050e-02; rel: 6.247e-03; norm: 2.500e-01; mom: 8.379e+00;
## best it: 102; best obj: 1.521e+00
## It: 173; obj: 1.655e+00; abs: 3.652e-02; rel: 2.159e-02; norm: 2.444e-01; mom: 8.480e+00;
## best it: 102; best obj: 1.521e+00
## It: 174; obj: 1.694e+00; abs: 3.898e-02; rel: 2.355e-02; norm: 2.411e-01; mom: 8.159e+00;
## best it: 102; best obj: 1.521e+00
## It: 175; obj: 1.677e+00; abs: 1.743e-02; rel: 1.029e-02; norm: 2.410e-01; mom: 8.083e+00;
## best it: 102; best obj: 1.521e+00

## It: 176; obj: 1.667e+00; abs: 9.339e-03; rel: 5.570e-03; norm: 2.474e-01; mom: 8.173e+00;
## best it: 102; best obj: 1.521e+00
## It: 177; obj: 1.660e+00; abs: 7.259e-03; rel: 4.354e-03; norm: 2.404e-01; mom: 8.099e+00;
## best it: 102; best obj: 1.521e+00
## It: 178; obj: 1.676e+00; abs: 1.616e-02; rel: 9.732e-03; norm: 2.458e-01; mom: 8.056e+00;
## best it: 102; best obj: 1.521e+00
## It: 179; obj: 1.662e+00; abs: 1.461e-02; rel: 8.718e-03; norm: 2.446e-01; mom: 8.184e+00;
## best it: 102; best obj: 1.521e+00
## It: 180; obj: 1.684e+00; abs: 2.212e-02; rel: 1.331e-02; norm: 2.436e-01; mom: 8.027e+00;
## best it: 102; best obj: 1.521e+00
## It: 181; obj: 1.697e+00; abs: 1.285e-02; rel: 7.629e-03; norm: 2.415e-01; mom: 8.134e+00;
## best it: 102; best obj: 1.521e+00
## It: 182; obj: 1.716e+00; abs: 1.904e-02; rel: 1.122e-02; norm: 2.480e-01; mom: 8.145e+00;
## best it: 102; best obj: 1.521e+00
## It: 183; obj: 1.672e+00; abs: 4.393e-02; rel: 2.561e-02; norm: 2.571e-01; mom: 8.298e+00;
## best it: 102; best obj: 1.521e+00
## It: 184; obj: 1.662e+00; abs: 1.011e-02; rel: 6.047e-03; norm: 2.471e-01; mom: 8.361e+00;
## best it: 102; best obj: 1.521e+00
## It: 185; obj: 1.648e+00; abs: 1.391e-02; rel: 8.370e-03; norm: 2.367e-01; mom: 8.265e+00;
## best it: 102; best obj: 1.521e+00
## It: 186; obj: 1.688e+00; abs: 4.061e-02; rel: 2.465e-02; norm: 2.342e-01; mom: 8.058e+00;
## best it: 102; best obj: 1.521e+00
```

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## It: 187; obj: 1.686e+00; abs: 2.152e-03; rel: 1.275e-03; norm: 2.354e-01; mom: 8.142e+00;
## best it: 102; best obj: 1.521e+00
## It: 188; obj: 1.697e+00; abs: 1.136e-02; rel: 6.735e-03; norm: 2.435e-01; mom: 8.117e+00;
## best it: 102; best obj: 1.521e+00
## It: 189; obj: 1.675e+00; abs: 2.265e-02; rel: 1.335e-02; norm: 2.444e-01; mom: 8.272e+00;
## best it: 102; best obj: 1.521e+00
## It: 190; obj: 1.674e+00; abs: 5.815e-04; rel: 3.472e-04; norm: 2.460e-01; mom: 8.090e+00;
## best it: 102; best obj: 1.521e+00
## It: 191; obj: 1.679e+00; abs: 4.865e-03; rel: 2.906e-03; norm: 2.431e-01; mom: 8.219e+00;
## best it: 102; best obj: 1.521e+00
## It: 192; obj: 1.684e+00; abs: 4.425e-03; rel: 2.635e-03; norm: 2.400e-01; mom: 8.336e+00;
## best it: 102; best obj: 1.521e+00
## It: 193; obj: 1.694e+00; abs: 1.095e-02; rel: 6.503e-03; norm: 2.280e-01; mom: 8.137e+00;
## best it: 102; best obj: 1.521e+00
## It: 194; obj: 1.717e+00; abs: 2.273e-02; rel: 1.341e-02; norm: 2.310e-01; mom: 7.987e+00;
## best it: 102; best obj: 1.521e+00
## It: 195; obj: 1.709e+00; abs: 8.653e-03; rel: 5.039e-03; norm: 2.597e-01; mom: 8.114e+00;
## best it: 102; best obj: 1.521e+00
## It: 196; obj: 1.711e+00; abs: 2.418e-03; rel: 1.415e-03; norm: 2.536e-01; mom: 8.404e+00;
## best it: 102; best obj: 1.521e+00
## It: 197; obj: 1.692e+00; abs: 1.901e-02; rel: 1.111e-02; norm: 2.545e-01; mom: 8.605e+00;
## best it: 102; best obj: 1.521e+00
## It: 198; obj: 1.698e+00; abs: 6.334e-03; rel: 3.744e-03; norm: 2.503e-01; mom: 8.451e+00;
## best it: 102; best obj: 1.521e+00
## It: 199; obj: 1.682e+00; abs: 1.635e-02; rel: 9.630e-03; norm: 2.487e-01; mom: 8.360e+00;
## best it: 102; best obj: 1.521e+00
## It: 200; obj: 1.699e+00; abs: 1.672e-02; rel: 9.944e-03; norm: 2.409e-01; mom: 8.247e+00;
## best it: 102; best obj: 1.521e+00

## It: 201; obj: 1.695e+00; abs: 3.388e-03; rel: 1.995e-03; norm: 2.494e-01; mom: 8.241e+00;
## best it: 102; best obj: 1.521e+00
## It: 202; obj: 1.684e+00; abs: 1.099e-02; rel: 6.481e-03; norm: 2.459e-01; mom: 8.324e+00;
## best it: 102; best obj: 1.521e+00
## It: 203; obj: 1.670e+00; abs: 1.397e-02; rel: 8.294e-03; norm: 2.444e-01; mom: 8.471e+00;
## best it: 102; best obj: 1.521e+00
## It: 204; obj: 1.681e+00; abs: 1.041e-02; rel: 6.233e-03; norm: 2.422e-01; mom: 8.086e+00;
## best it: 102; best obj: 1.521e+00
## It: 205; obj: 1.655e+00; abs: 2.595e-02; rel: 1.544e-02; norm: 2.378e-01; mom: 8.138e+00;
## best it: 102; best obj: 1.521e+00
## It: 206; obj: 1.691e+00; abs: 3.593e-02; rel: 2.171e-02; norm: 2.402e-01; mom: 8.003e+00;
## best it: 102; best obj: 1.521e+00
## It: 207; obj: 1.680e+00; abs: 1.030e-02; rel: 6.093e-03; norm: 2.452e-01; mom: 8.259e+00;
## best it: 102; best obj: 1.521e+00
## It: 208; obj: 1.675e+00; abs: 5.070e-03; rel: 3.017e-03; norm: 2.537e-01; mom: 8.291e+00;
## best it: 102; best obj: 1.521e+00
## It: 209; obj: 1.674e+00; abs: 1.542e-03; rel: 9.207e-04; norm: 2.580e-01; mom: 8.434e+00;
## best it: 102; best obj: 1.521e+00
## It: 210; obj: 1.697e+00; abs: 2.308e-02; rel: 1.379e-02; norm: 2.460e-01; mom: 8.424e+00;
## best it: 102; best obj: 1.521e+00
## It: 211; obj: 1.647e+00; abs: 5.021e-02; rel: 2.959e-02; norm: 2.503e-01; mom: 8.327e+00;
## best it: 102; best obj: 1.521e+00
## It: 212; obj: 1.674e+00; abs: 2.764e-02; rel: 1.678e-02; norm: 2.460e-01; mom: 8.277e+00;
## best it: 102; best obj: 1.521e+00
## It: 213; obj: 1.663e+00; abs: 1.099e-02; rel: 6.561e-03; norm: 2.368e-01; mom: 8.284e+00;
```

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## best it: 102; best obj: 1.521e+00
## It: 214; obj: 1.681e+00; abs: 1.808e-02; rel: 1.087e-02; norm: 2.411e-01; mom: 8.140e+00;
## best it: 102; best obj: 1.521e+00
## It: 215; obj: 1.704e+00; abs: 2.300e-02; rel: 1.368e-02; norm: 2.486e-01; mom: 8.169e+00;
## best it: 102; best obj: 1.521e+00
## It: 216; obj: 1.705e+00; abs: 2.882e-04; rel: 1.691e-04; norm: 2.499e-01; mom: 8.255e+00;
## best it: 102; best obj: 1.521e+00
## It: 217; obj: 1.674e+00; abs: 3.063e-02; rel: 1.797e-02; norm: 2.551e-01; mom: 8.346e+00;
## best it: 102; best obj: 1.521e+00
## It: 218; obj: 1.717e+00; abs: 4.294e-02; rel: 2.565e-02; norm: 2.558e-01; mom: 8.327e+00;
## best it: 102; best obj: 1.521e+00
## It: 219; obj: 1.671e+00; abs: 4.553e-02; rel: 2.652e-02; norm: 2.602e-01; mom: 8.450e+00;
## best it: 102; best obj: 1.521e+00
## It: 220; obj: 1.705e+00; abs: 3.372e-02; rel: 2.018e-02; norm: 2.539e-01; mom: 8.433e+00;
## best it: 102; best obj: 1.521e+00
## It: 221; obj: 1.690e+00; abs: 1.540e-02; rel: 9.029e-03; norm: 2.474e-01; mom: 8.384e+00;
## best it: 102; best obj: 1.521e+00
## It: 222; obj: 1.704e+00; abs: 1.385e-02; rel: 8.196e-03; norm: 2.505e-01; mom: 8.452e+00;
## best it: 102; best obj: 1.521e+00
## It: 223; obj: 1.655e+00; abs: 4.838e-02; rel: 2.840e-02; norm: 2.489e-01; mom: 8.429e+00;
## best it: 102; best obj: 1.521e+00
## It: 224; obj: 1.685e+00; abs: 3.011e-02; rel: 1.819e-02; norm: 2.400e-01; mom: 8.404e+00;
## best it: 102; best obj: 1.521e+00
## It: 225; obj: 1.638e+00; abs: 4.750e-02; rel: 2.818e-02; norm: 2.333e-01; mom: 8.160e+00;
## best it: 102; best obj: 1.521e+00

## It: 226; obj: 1.666e+00; abs: 2.778e-02; rel: 1.696e-02; norm: 2.425e-01; mom: 8.118e+00;
## best it: 102; best obj: 1.521e+00
## It: 227; obj: 1.677e+00; abs: 1.183e-02; rel: 7.103e-03; norm: 2.422e-01; mom: 8.096e+00;
## best it: 102; best obj: 1.521e+00
## It: 228; obj: 1.714e+00; abs: 3.641e-02; rel: 2.171e-02; norm: 2.447e-01; mom: 8.077e+00;
## best it: 102; best obj: 1.521e+00
## It: 229; obj: 1.684e+00; abs: 2.966e-02; rel: 1.730e-02; norm: 2.547e-01; mom: 8.272e+00;
## best it: 102; best obj: 1.521e+00
## It: 230; obj: 1.716e+00; abs: 3.151e-02; rel: 1.871e-02; norm: 2.524e-01; mom: 8.461e+00;
## best it: 102; best obj: 1.521e+00
## It: 231; obj: 1.698e+00; abs: 1.785e-02; rel: 1.041e-02; norm: 2.559e-01; mom: 8.547e+00;
## best it: 102; best obj: 1.521e+00
## It: 232; obj: 1.706e+00; abs: 8.228e-03; rel: 4.846e-03; norm: 2.492e-01; mom: 8.360e+00;
## best it: 102; best obj: 1.521e+00
## It: 233; obj: 1.674e+00; abs: 3.164e-02; rel: 1.854e-02; norm: 2.423e-01; mom: 8.394e+00;
## best it: 102; best obj: 1.521e+00
## It: 234; obj: 1.703e+00; abs: 2.836e-02; rel: 1.694e-02; norm: 2.410e-01; mom: 8.296e+00;
## best it: 102; best obj: 1.521e+00
## It: 235; obj: 1.687e+00; abs: 1.538e-02; rel: 9.030e-03; norm: 2.457e-01; mom: 8.402e+00;
## best it: 102; best obj: 1.521e+00
## It: 236; obj: 1.681e+00; abs: 6.129e-03; rel: 3.632e-03; norm: 2.446e-01; mom: 8.326e+00;
## best it: 102; best obj: 1.521e+00
## It: 237; obj: 1.667e+00; abs: 1.388e-02; rel: 8.256e-03; norm: 2.435e-01; mom: 8.368e+00;
## best it: 102; best obj: 1.521e+00
## It: 238; obj: 1.709e+00; abs: 4.120e-02; rel: 2.471e-02; norm: 2.436e-01; mom: 8.203e+00;
## best it: 102; best obj: 1.521e+00
## It: 239; obj: 1.683e+00; abs: 2.524e-02; rel: 1.477e-02; norm: 2.415e-01; mom: 8.322e+00;
## best it: 102; best obj: 1.521e+00
```

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## It: 240; obj: 1.690e+00; abs: 6.653e-03; rel: 3.952e-03; norm: 2.417e-01; mom: 8.246e+00;
## best it: 102; best obj: 1.521e+00
## It: 241; obj: 1.699e+00; abs: 9.384e-03; rel: 5.552e-03; norm: 2.376e-01; mom: 8.354e+00;
## best it: 102; best obj: 1.521e+00
## It: 242; obj: 1.706e+00; abs: 6.149e-03; rel: 3.618e-03; norm: 2.490e-01; mom: 8.363e+00;
## best it: 102; best obj: 1.521e+00
## It: 243; obj: 1.672e+00; abs: 3.348e-02; rel: 1.963e-02; norm: 2.615e-01; mom: 8.524e+00;
## best it: 102; best obj: 1.521e+00
## It: 244; obj: 1.692e+00; abs: 1.955e-02; rel: 1.169e-02; norm: 2.549e-01; mom: 8.469e+00;
## best it: 102; best obj: 1.521e+00
## It: 245; obj: 1.657e+00; abs: 3.478e-02; rel: 2.056e-02; norm: 2.421e-01; mom: 8.434e+00;
## best it: 102; best obj: 1.521e+00
## It: 246; obj: 1.691e+00; abs: 3.363e-02; rel: 2.030e-02; norm: 2.428e-01; mom: 8.346e+00;
## best it: 102; best obj: 1.521e+00
## It: 247; obj: 1.692e+00; abs: 1.636e-03; rel: 9.679e-04; norm: 2.443e-01; mom: 8.262e+00;
## best it: 102; best obj: 1.521e+00
## It: 248; obj: 1.690e+00; abs: 2.593e-03; rel: 1.532e-03; norm: 2.478e-01; mom: 1.334e+01;
## best it: 102; best obj: 1.521e+00
## It: 249; obj: 1.643e+00; abs: 4.696e-02; rel: 2.780e-02; norm: 2.294e-01; mom: 1.330e+01;
## best it: 102; best obj: 1.521e+00
## It: 250; obj: 1.661e+00; abs: 1.880e-02; rel: 1.145e-02; norm: 2.243e-01; mom: 1.282e+01;
## best it: 102; best obj: 1.521e+00

## It: 251; obj: 1.663e+00; abs: 1.197e-03; rel: 7.207e-04; norm: 2.190e-01; mom: 1.288e+01;
## best it: 102; best obj: 1.521e+00
## It: 252; obj: 1.670e+00; abs: 7.421e-03; rel: 4.463e-03; norm: 2.231e-01; mom: 1.260e+01;
## best it: 102; best obj: 1.521e+00
## It: 253; obj: 1.698e+00; abs: 2.820e-02; rel: 1.689e-02; norm: 1.992e-01; mom: 1.250e+01;
## best it: 102; best obj: 1.521e+00
## It: 254; obj: 1.748e+00; abs: 5.002e-02; rel: 2.945e-02; norm: 1.987e-01; mom: 1.223e+01;
## best it: 102; best obj: 1.521e+00
## It: 255; obj: 1.752e+00; abs: 4.047e-03; rel: 2.315e-03; norm: 2.153e-01; mom: 1.274e+01;
## best it: 102; best obj: 1.521e+00
## It: 256; obj: 1.744e+00; abs: 8.762e-03; rel: 5.000e-03; norm: 2.362e-01; mom: 1.299e+01;
## best it: 102; best obj: 1.521e+00
## It: 257; obj: 1.699e+00; abs: 4.493e-02; rel: 2.577e-02; norm: 2.346e-01; mom: 1.325e+01;
## best it: 102; best obj: 1.521e+00
## It: 258; obj: 1.690e+00; abs: 8.778e-03; rel: 5.168e-03; norm: 2.291e-01; mom: 1.329e+01;
## best it: 102; best obj: 1.521e+00
## It: 259; obj: 1.681e+00; abs: 9.227e-03; rel: 5.460e-03; norm: 2.173e-01; mom: 1.291e+01;
## best it: 102; best obj: 1.521e+00
## It: 260; obj: 1.733e+00; abs: 5.198e-02; rel: 3.093e-02; norm: 2.189e-01; mom: 1.248e+01;
## best it: 102; best obj: 1.521e+00
## It: 261; obj: 1.729e+00; abs: 3.959e-03; rel: 2.285e-03; norm: 2.299e-01; mom: 1.268e+01;
## best it: 102; best obj: 1.521e+00
## It: 262; obj: 1.720e+00; abs: 9.073e-03; rel: 5.248e-03; norm: 2.396e-01; mom: 1.318e+01;
## best it: 102; best obj: 1.521e+00
## It: 263; obj: 1.704e+00; abs: 1.516e-02; rel: 8.816e-03; norm: 2.367e-01; mom: 1.316e+01;
## best it: 102; best obj: 1.521e+00
## It: 264; obj: 1.719e+00; abs: 1.445e-02; rel: 8.480e-03; norm: 2.350e-01; mom: 1.317e+01;
## best it: 102; best obj: 1.521e+00
## It: 265; obj: 1.695e+00; abs: 2.368e-02; rel: 1.378e-02; norm: 2.378e-01; mom: 1.325e+01;
## best it: 102; best obj: 1.521e+00
## It: 266; obj: 1.696e+00; abs: 1.082e-03; rel: 6.383e-04; norm: 2.468e-01; mom: 1.298e+01;
```

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## best it: 102; best obj: 1.521e+00
## It: 267; obj: 1.690e+00; abs: 6.257e-03; rel: 3.689e-03; norm: 2.405e-01; mom: 1.312e+01;
## best it: 102; best obj: 1.521e+00
## It: 268; obj: 1.709e+00; abs: 1.887e-02; rel: 1.117e-02; norm: 2.191e-01; mom: 1.291e+01;
## best it: 102; best obj: 1.521e+00
## It: 269; obj: 1.659e+00; abs: 4.941e-02; rel: 2.891e-02; norm: 2.355e-01; mom: 1.297e+01;
## best it: 102; best obj: 1.521e+00
## It: 270; obj: 1.652e+00; abs: 7.754e-03; rel: 4.672e-03; norm: 2.392e-01; mom: 1.302e+01;
## best it: 102; best obj: 1.521e+00
## It: 271; obj: 1.707e+00; abs: 5.515e-02; rel: 3.339e-02; norm: 2.350e-01; mom: 1.284e+01;
## best it: 102; best obj: 1.521e+00
## It: 272; obj: 1.687e+00; abs: 2.037e-02; rel: 1.193e-02; norm: 2.414e-01; mom: 1.302e+01;
## best it: 102; best obj: 1.521e+00
## It: 273; obj: 1.693e+00; abs: 6.423e-03; rel: 3.809e-03; norm: 2.539e-01; mom: 1.322e+01;
## best it: 102; best obj: 1.521e+00
## It: 274; obj: 1.670e+00; abs: 2.283e-02; rel: 1.348e-02; norm: 2.421e-01; mom: 1.315e+01;
## best it: 102; best obj: 1.521e+00
## It: 275; obj: 1.718e+00; abs: 4.821e-02; rel: 2.887e-02; norm: 2.388e-01; mom: 1.303e+01;
## best it: 102; best obj: 1.521e+00

## It: 276; obj: 1.683e+00; abs: 3.556e-02; rel: 2.069e-02; norm: 2.443e-01; mom: 1.320e+01;
## best it: 102; best obj: 1.521e+00
## It: 277; obj: 1.695e+00; abs: 1.228e-02; rel: 7.300e-03; norm: 2.372e-01; mom: 1.312e+01;
## best it: 102; best obj: 1.521e+00
## It: 278; obj: 1.672e+00; abs: 2.255e-02; rel: 1.331e-02; norm: 2.420e-01; mom: 1.313e+01;
## best it: 102; best obj: 1.521e+00
## It: 279; obj: 1.733e+00; abs: 6.008e-02; rel: 3.592e-02; norm: 2.497e-01; mom: 1.309e+01;
## best it: 102; best obj: 1.521e+00
## It: 280; obj: 1.696e+00; abs: 3.658e-02; rel: 2.111e-02; norm: 2.539e-01; mom: 1.310e+01;
## best it: 102; best obj: 1.521e+00
## It: 281; obj: 1.706e+00; abs: 9.550e-03; rel: 5.631e-03; norm: 2.502e-01; mom: 1.331e+01;
## best it: 102; best obj: 1.521e+00
## It: 282; obj: 1.679e+00; abs: 2.698e-02; rel: 1.582e-02; norm: 2.515e-01; mom: 1.323e+01;
## best it: 102; best obj: 1.521e+00
## It: 283; obj: 1.728e+00; abs: 4.970e-02; rel: 2.961e-02; norm: 2.571e-01; mom: 1.309e+01;
## best it: 102; best obj: 1.521e+00
## It: 284; obj: 1.711e+00; abs: 1.772e-02; rel: 1.025e-02; norm: 2.578e-01; mom: 1.332e+01;
## best it: 102; best obj: 1.521e+00
## It: 285; obj: 1.720e+00; abs: 9.062e-03; rel: 5.298e-03; norm: 2.663e-01; mom: 1.361e+01;
## best it: 102; best obj: 1.521e+00
## It: 286; obj: 1.684e+00; abs: 3.539e-02; rel: 2.058e-02; norm: 2.576e-01; mom: 1.355e+01;
## best it: 102; best obj: 1.521e+00
## It: 287; obj: 1.729e+00; abs: 4.485e-02; rel: 2.663e-02; norm: 2.613e-01; mom: 1.342e+01;
## best it: 102; best obj: 1.521e+00
## It: 288; obj: 1.710e+00; abs: 1.894e-02; rel: 1.095e-02; norm: 2.570e-01; mom: 1.358e+01;
## best it: 102; best obj: 1.521e+00
## It: 289; obj: 1.725e+00; abs: 1.495e-02; rel: 8.742e-03; norm: 2.594e-01; mom: 1.373e+01;
## best it: 102; best obj: 1.521e+00
## It: 290; obj: 1.685e+00; abs: 4.021e-02; rel: 2.331e-02; norm: 2.592e-01; mom: 1.361e+01;
## best it: 102; best obj: 1.521e+00
## It: 291; obj: 1.704e+00; abs: 1.909e-02; rel: 1.133e-02; norm: 2.651e-01; mom: 1.356e+01;
## best it: 102; best obj: 1.521e+00
## It: 292; obj: 1.680e+00; abs: 2.441e-02; rel: 1.433e-02; norm: 2.597e-01; mom: 1.358e+01;
## best it: 102; best obj: 1.521e+00
```

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## It: 293; obj: 1.695e+00; abs: 1.514e-02; rel: 9.016e-03; norm: 2.534e-01; mom: 1.347e+01;
## best it: 102; best obj: 1.521e+00
## It: 294; obj: 1.721e+00; abs: 2.656e-02; rel: 1.567e-02; norm: 2.517e-01; mom: 1.329e+01;
## best it: 102; best obj: 1.521e+00
## It: 295; obj: 1.714e+00; abs: 7.119e-03; rel: 4.136e-03; norm: 2.602e-01; mom: 1.343e+01;
## best it: 102; best obj: 1.521e+00
## It: 296; obj: 1.733e+00; abs: 1.899e-02; rel: 1.108e-02; norm: 2.611e-01; mom: 1.364e+01;
## best it: 102; best obj: 1.521e+00
## It: 297; obj: 1.716e+00; abs: 1.746e-02; rel: 1.007e-02; norm: 2.658e-01; mom: 1.360e+01;
## best it: 102; best obj: 1.521e+00
## It: 298; obj: 1.678e+00; abs: 3.720e-02; rel: 2.168e-02; norm: 2.532e-01; mom: 1.375e+01;
## best it: 102; best obj: 1.521e+00
## It: 299; obj: 1.677e+00; abs: 1.006e-03; rel: 5.996e-04; norm: 2.506e-01; mom: 1.367e+01;
## best it: 102; best obj: 1.521e+00
## It: 300; obj: 1.709e+00; abs: 3.126e-02; rel: 1.864e-02; norm: 2.391e-01; mom: 1.322e+01;
## best it: 102; best obj: 1.521e+00

## It: 301; obj: 1.704e+00; abs: 4.479e-03; rel: 2.621e-03; norm: 2.547e-01; mom: 1.345e+01;
## best it: 102; best obj: 1.521e+00
## It: 302; obj: 1.710e+00; abs: 5.682e-03; rel: 3.334e-03; norm: 2.562e-01; mom: 1.362e+01;
## best it: 102; best obj: 1.521e+00
## It: 303; obj: 1.676e+00; abs: 3.353e-02; rel: 1.961e-02; norm: 2.616e-01; mom: 1.362e+01;
## best it: 102; best obj: 1.521e+00
## It: 304; obj: 1.700e+00; abs: 2.380e-02; rel: 1.420e-02; norm: 2.524e-01; mom: 1.363e+01;
## best it: 102; best obj: 1.521e+00
## It: 305; obj: 1.680e+00; abs: 2.024e-02; rel: 1.190e-02; norm: 2.579e-01; mom: 1.340e+01;
## best it: 102; best obj: 1.521e+00
## It: 306; obj: 1.683e+00; abs: 2.678e-03; rel: 1.594e-03; norm: 2.498e-01; mom: 1.351e+01;
## best it: 102; best obj: 1.521e+00
## It: 307; obj: 1.673e+00; abs: 1.002e-02; rel: 5.953e-03; norm: 2.472e-01; mom: 1.340e+01;
## best it: 102; best obj: 1.521e+00
## It: 308; obj: 1.697e+00; abs: 2.421e-02; rel: 1.448e-02; norm: 2.360e-01; mom: 1.329e+01;
## best it: 102; best obj: 1.521e+00
## It: 309; obj: 1.681e+00; abs: 1.546e-02; rel: 9.111e-03; norm: 2.385e-01; mom: 1.299e+01;
## best it: 102; best obj: 1.521e+00
## It: 310; obj: 1.718e+00; abs: 3.703e-02; rel: 2.202e-02; norm: 2.409e-01; mom: 1.320e+01;
## best it: 102; best obj: 1.521e+00
## It: 311; obj: 1.683e+00; abs: 3.565e-02; rel: 2.075e-02; norm: 2.601e-01; mom: 1.325e+01;
## best it: 102; best obj: 1.521e+00
## It: 312; obj: 1.709e+00; abs: 2.638e-02; rel: 1.568e-02; norm: 2.461e-01; mom: 1.371e+01;
## best it: 102; best obj: 1.521e+00
## It: 313; obj: 1.653e+00; abs: 5.649e-02; rel: 3.305e-02; norm: 2.488e-01; mom: 1.362e+01;
## best it: 102; best obj: 1.521e+00
## It: 314; obj: 1.671e+00; abs: 1.876e-02; rel: 1.135e-02; norm: 2.319e-01; mom: 1.317e+01;
## best it: 102; best obj: 1.521e+00
## It: 315; obj: 1.636e+00; abs: 3.565e-02; rel: 2.133e-02; norm: 2.450e-01; mom: 1.319e+01;
## best it: 102; best obj: 1.521e+00
## It: 316; obj: 1.621e+00; abs: 1.496e-02; rel: 9.148e-03; norm: 2.228e-01; mom: 1.309e+01;
## best it: 102; best obj: 1.521e+00
## It: 317; obj: 1.620e+00; abs: 7.741e-04; rel: 4.776e-04; norm: 2.284e-01; mom: 1.257e+01;
## best it: 102; best obj: 1.521e+00
## It: 318; obj: 1.637e+00; abs: 1.740e-02; rel: 1.074e-02; norm: 2.210e-01; mom: 1.248e+01;
## best it: 102; best obj: 1.521e+00
## It: 319; obj: 1.599e+00; abs: 3.832e-02; rel: 2.340e-02; norm: 2.426e-01; mom: 1.243e+01;
```

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## best it: 102; best obj: 1.521e+00
## It: 320; obj: 1.600e+00; abs: 9.597e-04; rel: 6.001e-04; norm: 2.342e-01; mom: 1.278e+01;
## best it: 102; best obj: 1.521e+00
## It: 321; obj: 1.552e+00; abs: 4.769e-02; rel: 2.980e-02; norm: 2.357e-01; mom: 1.241e+01;
## best it: 102; best obj: 1.521e+00
## It: 322; obj: 1.541e+00; abs: 1.138e-02; rel: 7.328e-03; norm: 2.136e-01; mom: 1.246e+01;
## best it: 102; best obj: 1.521e+00
## It: 323; obj: 1.530e+00; abs: 1.052e-02; rel: 6.824e-03; norm: 2.149e-01; mom: 1.169e+01;
## best it: 102; best obj: 1.521e+00
## It: 324; obj: 1.555e+00; abs: 2.472e-02; rel: 1.615e-02; norm: 2.006e-01; mom: 1.174e+01;
## best it: 102; best obj: 1.521e+00
## It: 325; obj: 1.511e+00; abs: 4.457e-02; rel: 2.866e-02; norm: 1.931e-01; mom: 1.164e+01;
## best it: 325; best obj: 1.511e+00

## It: 326; obj: 1.569e+00; abs: 5.825e-02; rel: 3.856e-02; norm: 1.866e-01; mom: 1.163e+01;
## best it: 325; best obj: 1.511e+00
## It: 327; obj: 1.564e+00; abs: 4.927e-03; rel: 3.140e-03; norm: 1.940e-01; mom: 1.134e+01;
## best it: 325; best obj: 1.511e+00
## It: 328; obj: 1.560e+00; abs: 4.172e-03; rel: 2.668e-03; norm: 1.933e-01; mom: 1.180e+01;
## best it: 325; best obj: 1.511e+00
## It: 329; obj: 1.514e+00; abs: 4.546e-02; rel: 2.915e-02; norm: 1.890e-01; mom: 1.160e+01;
## best it: 325; best obj: 1.511e+00
## It: 330; obj: 1.542e+00; abs: 2.780e-02; rel: 1.836e-02; norm: 1.826e-01; mom: 1.152e+01;
## best it: 325; best obj: 1.511e+00
## It: 331; obj: 1.576e+00; abs: 3.353e-02; rel: 2.174e-02; norm: 1.815e-01; mom: 1.086e+01;
## best it: 325; best obj: 1.511e+00
## It: 332; obj: 1.558e+00; abs: 1.733e-02; rel: 1.100e-02; norm: 1.830e-01; mom: 1.121e+01;
## best it: 325; best obj: 1.511e+00
## It: 333; obj: 1.593e+00; abs: 3.513e-02; rel: 2.254e-02; norm: 1.832e-01; mom: 1.081e+01;
## best it: 325; best obj: 1.511e+00
## It: 334; obj: 1.648e+00; abs: 5.434e-02; rel: 3.410e-02; norm: 1.937e-01; mom: 1.123e+01;
## best it: 325; best obj: 1.511e+00
## It: 335; obj: 1.655e+00; abs: 6.861e-03; rel: 4.164e-03; norm: 2.150e-01; mom: 1.163e+01;
## best it: 325; best obj: 1.511e+00
## It: 336; obj: 1.618e+00; abs: 3.643e-02; rel: 2.202e-02; norm: 2.236e-01; mom: 1.245e+01;
## best it: 325; best obj: 1.511e+00
## It: 337; obj: 1.616e+00; abs: 1.863e-03; rel: 1.152e-03; norm: 2.281e-01; mom: 1.231e+01;
## best it: 325; best obj: 1.511e+00
## It: 338; obj: 1.671e+00; abs: 5.421e-02; rel: 3.354e-02; norm: 2.289e-01; mom: 1.242e+01;
## best it: 325; best obj: 1.511e+00
## It: 339; obj: 1.642e+00; abs: 2.893e-02; rel: 1.732e-02; norm: 2.261e-01; mom: 1.272e+01;
## best it: 325; best obj: 1.511e+00
## It: 340; obj: 1.598e+00; abs: 4.354e-02; rel: 2.652e-02; norm: 2.195e-01; mom: 1.288e+01;
## best it: 325; best obj: 1.511e+00
## It: 341; obj: 1.638e+00; abs: 3.963e-02; rel: 2.480e-02; norm: 2.083e-01; mom: 1.200e+01;
## best it: 325; best obj: 1.511e+00
## It: 342; obj: 1.634e+00; abs: 3.315e-03; rel: 2.024e-03; norm: 2.176e-01; mom: 1.213e+01;
## best it: 325; best obj: 1.511e+00
## It: 343; obj: 1.634e+00; abs: 2.363e-04; rel: 1.446e-04; norm: 2.382e-01; mom: 1.242e+01;
## best it: 325; best obj: 1.511e+00
## It: 344; obj: 1.650e+00; abs: 1.611e-02; rel: 9.859e-03; norm: 2.327e-01; mom: 1.277e+01;
## best it: 325; best obj: 1.511e+00
## It: 345; obj: 1.621e+00; abs: 2.929e-02; rel: 1.775e-02; norm: 2.276e-01; mom: 1.292e+01;
## best it: 325; best obj: 1.511e+00
```

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## It: 346; obj: 1.608e+00; abs: 1.344e-02; rel: 8.290e-03; norm: 2.073e-01; mom: 1.245e+01;
## best it: 325; best obj: 1.511e+00
## It: 347; obj: 1.615e+00; abs: 7.853e-03; rel: 4.885e-03; norm: 2.100e-01; mom: 1.222e+01;
## best it: 325; best obj: 1.511e+00
## It: 348; obj: 1.620e+00; abs: 4.694e-03; rel: 2.906e-03; norm: 2.159e-01; mom: 1.205e+01;
## best it: 325; best obj: 1.511e+00
## It: 349; obj: 1.587e+00; abs: 3.334e-02; rel: 2.058e-02; norm: 2.294e-01; mom: 1.231e+01;
## best it: 325; best obj: 1.511e+00
## It: 350; obj: 1.601e+00; abs: 1.425e-02; rel: 8.983e-03; norm: 2.225e-01; mom: 1.256e+01;
## best it: 325; best obj: 1.511e+00

## It: 351; obj: 1.569e+00; abs: 3.203e-02; rel: 2.001e-02; norm: 2.185e-01; mom: 1.234e+01;
## best it: 325; best obj: 1.511e+00
## It: 352; obj: 1.600e+00; abs: 3.065e-02; rel: 1.954e-02; norm: 2.141e-01; mom: 1.222e+01;
## best it: 325; best obj: 1.511e+00
## It: 353; obj: 1.561e+00; abs: 3.859e-02; rel: 2.412e-02; norm: 2.006e-01; mom: 1.227e+01;
## best it: 325; best obj: 1.511e+00
## It: 354; obj: 1.577e+00; abs: 1.607e-02; rel: 1.029e-02; norm: 1.898e-01; mom: 1.170e+01;
## best it: 325; best obj: 1.511e+00
## It: 355; obj: 1.592e+00; abs: 1.482e-02; rel: 9.397e-03; norm: 1.943e-01; mom: 1.142e+01;
## best it: 325; best obj: 1.511e+00
## It: 356; obj: 1.616e+00; abs: 2.384e-02; rel: 1.497e-02; norm: 2.079e-01; mom: 1.187e+01;
## best it: 325; best obj: 1.511e+00
## It: 357; obj: 1.573e+00; abs: 4.311e-02; rel: 2.668e-02; norm: 2.113e-01; mom: 1.212e+01;
## best it: 325; best obj: 1.511e+00
## It: 358; obj: 1.544e+00; abs: 2.838e-02; rel: 1.804e-02; norm: 2.105e-01; mom: 1.231e+01;
## best it: 325; best obj: 1.511e+00
## It: 359; obj: 1.556e+00; abs: 1.146e-02; rel: 7.423e-03; norm: 2.104e-01; mom: 1.155e+01;
## best it: 325; best obj: 1.511e+00
## It: 360; obj: 1.586e+00; abs: 3.013e-02; rel: 1.937e-02; norm: 1.977e-01; mom: 1.190e+01;
## best it: 325; best obj: 1.511e+00
## It: 361; obj: 1.563e+00; abs: 2.263e-02; rel: 1.427e-02; norm: 2.050e-01; mom: 1.128e+01;
## best it: 325; best obj: 1.511e+00
## It: 362; obj: 1.553e+00; abs: 1.011e-02; rel: 6.468e-03; norm: 2.066e-01; mom: 1.214e+01;
## best it: 325; best obj: 1.511e+00
## It: 363; obj: 1.578e+00; abs: 2.483e-02; rel: 1.599e-02; norm: 2.144e-01; mom: 1.121e+01;
## best it: 325; best obj: 1.511e+00
## It: 364; obj: 1.617e+00; abs: 3.923e-02; rel: 2.486e-02; norm: 2.174e-01; mom: 1.162e+01;
## best it: 325; best obj: 1.511e+00
## It: 365; obj: 1.591e+00; abs: 2.599e-02; rel: 1.607e-02; norm: 2.180e-01; mom: 1.206e+01;
## best it: 325; best obj: 1.511e+00
## It: 366; obj: 1.604e+00; abs: 1.287e-02; rel: 8.087e-03; norm: 2.062e-01; mom: 1.211e+01;
## best it: 325; best obj: 1.511e+00
## It: 367; obj: 1.616e+00; abs: 1.192e-02; rel: 7.432e-03; norm: 2.018e-01; mom: 1.166e+01;
## best it: 325; best obj: 1.511e+00
## It: 368; obj: 1.650e+00; abs: 3.384e-02; rel: 2.094e-02; norm: 2.062e-01; mom: 1.204e+01;
## best it: 325; best obj: 1.511e+00
## It: 369; obj: 1.611e+00; abs: 3.854e-02; rel: 2.336e-02; norm: 2.204e-01; mom: 1.212e+01;
## best it: 325; best obj: 1.511e+00
## It: 370; obj: 1.625e+00; abs: 1.411e-02; rel: 8.756e-03; norm: 2.253e-01; mom: 1.230e+01;
## best it: 325; best obj: 1.511e+00
## It: 371; obj: 1.600e+00; abs: 2.578e-02; rel: 1.586e-02; norm: 2.362e-01; mom: 1.214e+01;
## best it: 325; best obj: 1.511e+00
## It: 372; obj: 1.626e+00; abs: 2.663e-02; rel: 1.665e-02; norm: 2.379e-01; mom: 1.270e+01;
```

```
## best it: 325; best obj: 1.511e+00
## It: 373; obj: 1.630e+00; abs: 3.212e-03; rel: 1.975e-03; norm: 2.315e-01; mom: 1.269e+01;
## best it: 325; best obj: 1.511e+00
## It: 374; obj: 1.647e+00; abs: 1.712e-02; rel: 1.051e-02; norm: 2.238e-01; mom: 1.275e+01;
## best it: 325; best obj: 1.511e+00
## It: 375; obj: 1.624e+00; abs: 2.229e-02; rel: 1.354e-02; norm: 2.419e-01; mom: 1.283e+01;
## best it: 325; best obj: 1.511e+00
```
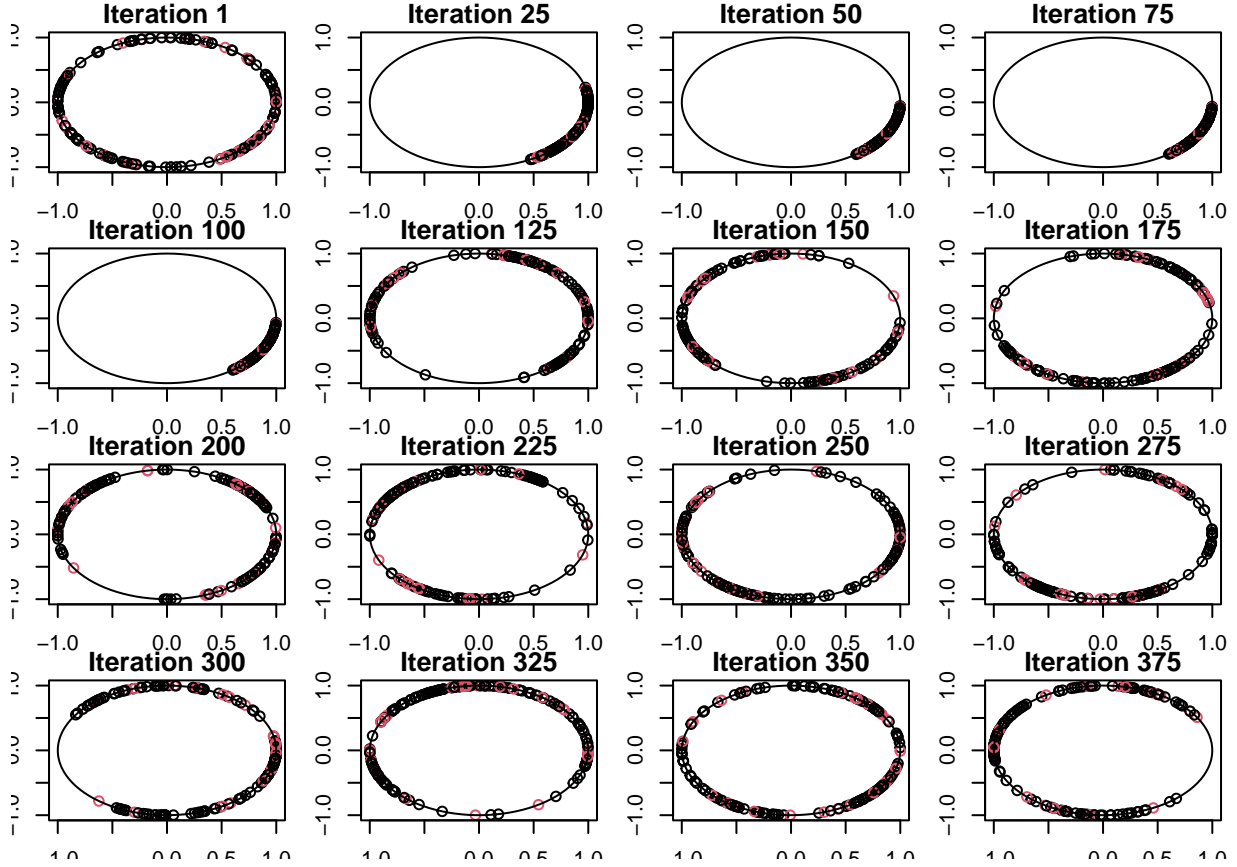


```
## It: 376; obj: 1.673e+00; abs: 4.879e-02; rel: 3.004e-02; norm: 2.379e-01; mom: 1.276e+01;
## best it: 325; best obj: 1.511e+00
## It: 377; obj: 1.589e+00; abs: 8.432e-02; rel: 5.040e-02; norm: 2.463e-01; mom: 1.313e+01;
## best it: 325; best obj: 1.511e+00
## It: 378; obj: 1.619e+00; abs: 2.986e-02; rel: 1.879e-02; norm: 2.302e-01; mom: 1.303e+01;
## best it: 325; best obj: 1.511e+00
## It: 379; obj: 1.594e+00; abs: 2.430e-02; rel: 1.501e-02; norm: 2.273e-01; mom: 1.272e+01;
## best it: 325; best obj: 1.511e+00
## It: 380; obj: 1.599e+00; abs: 4.838e-03; rel: 3.034e-03; norm: 2.221e-01; mom: 1.254e+01;
## best it: 325; best obj: 1.511e+00
## It: 381; obj: 1.574e+00; abs: 2.542e-02; rel: 1.590e-02; norm: 2.292e-01; mom: 1.231e+01;
## best it: 325; best obj: 1.511e+00
## It: 382; obj: 1.622e+00; abs: 4.864e-02; rel: 3.091e-02; norm: 2.177e-01; mom: 1.220e+01;
## best it: 325; best obj: 1.511e+00
## It: 383; obj: 1.603e+00; abs: 1.901e-02; rel: 1.172e-02; norm: 2.183e-01; mom: 1.216e+01;
## best it: 325; best obj: 1.511e+00
## It: 384; obj: 1.611e+00; abs: 7.752e-03; rel: 4.835e-03; norm: 2.317e-01; mom: 1.259e+01;
## best it: 325; best obj: 1.511e+00
## It: 385; obj: 1.586e+00; abs: 2.512e-02; rel: 1.559e-02; norm: 2.351e-01; mom: 1.242e+01;
```

```
## best it: 325; best obj: 1.511e+00
## It: 386; obj: 1.627e+00; abs: 4.099e-02; rel: 2.584e-02; norm: 2.180e-01; mom: 1.260e+01;
## best it: 325; best obj: 1.511e+00
## It: 387; obj: 1.602e+00; abs: 2.547e-02; rel: 1.566e-02; norm: 2.333e-01; mom: 1.255e+01;
## best it: 325; best obj: 1.511e+00
## It: 388; obj: 1.600e+00; abs: 1.845e-03; rel: 1.152e-03; norm: 2.327e-01; mom: 1.257e+01;
## best it: 325; best obj: 1.511e+00
## It: 389; obj: 1.590e+00; abs: 9.831e-03; rel: 6.146e-03; norm: 2.281e-01; mom: 1.238e+01;
## best it: 325; best obj: 1.511e+00
## It: 390; obj: 1.575e+00; abs: 1.477e-02; rel: 9.292e-03; norm: 2.144e-01; mom: 1.235e+01;
## best it: 325; best obj: 1.511e+00
## It: 391; obj: 1.585e+00; abs: 9.569e-03; rel: 6.075e-03; norm: 2.110e-01; mom: 1.200e+01;
## best it: 325; best obj: 1.511e+00
## It: 392; obj: 1.610e+00; abs: 2.552e-02; rel: 1.610e-02; norm: 2.160e-01; mom: 1.199e+01;
## best it: 325; best obj: 1.511e+00
## It: 393; obj: 1.611e+00; abs: 3.487e-04; rel: 2.165e-04; norm: 2.175e-01; mom: 1.228e+01;
## best it: 325; best obj: 1.511e+00
## It: 394; obj: 1.647e+00; abs: 3.623e-02; rel: 2.249e-02; norm: 2.293e-01; mom: 1.214e+01;
## best it: 325; best obj: 1.511e+00
## It: 395; obj: 1.623e+00; abs: 2.380e-02; rel: 1.445e-02; norm: 2.434e-01; mom: 1.277e+01;
## best it: 325; best obj: 1.511e+00
## It: 396; obj: 1.613e+00; abs: 9.914e-03; rel: 6.109e-03; norm: 2.190e-01; mom: 1.276e+01;
## best it: 325; best obj: 1.511e+00
## It: 397; obj: 1.578e+00; abs: 3.548e-02; rel: 2.200e-02; norm: 2.227e-01; mom: 1.264e+01;
## best it: 325; best obj: 1.511e+00
## It: 398; obj: 1.591e+00; abs: 1.353e-02; rel: 8.578e-03; norm: 2.123e-01; mom: 1.209e+01;
## best it: 325; best obj: 1.511e+00
## It: 399; obj: 1.575e+00; abs: 1.639e-02; rel: 1.030e-02; norm: 2.197e-01; mom: 1.200e+01;
## best it: 325; best obj: 1.511e+00
## It: 400; obj: 1.621e+00; abs: 4.641e-02; rel: 2.947e-02; norm: 2.174e-01; mom: 1.186e+01;
## best it: 325; best obj: 1.511e+00

## It: 401; obj: 1.587e+00; abs: 3.395e-02; rel: 2.094e-02; norm: 2.405e-01; mom: 1.222e+01;
## best it: 325; best obj: 1.511e+00
## It: 402; obj: 1.602e+00; abs: 1.472e-02; rel: 9.275e-03; norm: 2.285e-01; mom: 1.245e+01;
## best it: 325; best obj: 1.511e+00
## It: 403; obj: 1.558e+00; abs: 4.437e-02; rel: 2.770e-02; norm: 2.143e-01; mom: 1.238e+01;
## best it: 325; best obj: 1.511e+00
## It: 404; obj: 1.543e+00; abs: 1.477e-02; rel: 9.483e-03; norm: 1.994e-01; mom: 1.218e+01;
## best it: 325; best obj: 1.511e+00
## It: 405; obj: 1.539e+00; abs: 3.554e-03; rel: 2.304e-03; norm: 1.911e-01; mom: 1.128e+01;
## best it: 325; best obj: 1.511e+00
## It: 406; obj: 1.521e+00; abs: 1.859e-02; rel: 1.208e-02; norm: 1.865e-01; mom: 1.152e+01;
## best it: 325; best obj: 1.511e+00
## It: 407; obj: 1.537e+00; abs: 1.590e-02; rel: 1.045e-02; norm: 1.881e-01; mom: 1.110e+01;
## best it: 325; best obj: 1.511e+00
## It: 408; obj: 1.533e+00; abs: 3.264e-03; rel: 2.124e-03; norm: 1.958e-01; mom: 1.157e+01;
## best it: 325; best obj: 1.511e+00
## It: 409; obj: 1.550e+00; abs: 1.713e-02; rel: 1.117e-02; norm: 1.892e-01; mom: 1.122e+01;
## best it: 325; best obj: 1.511e+00
## It: 410; obj: 1.561e+00; abs: 1.018e-02; rel: 6.568e-03; norm: 1.797e-01; mom: 1.101e+01;
## best it: 325; best obj: 1.511e+00
## It: 411; obj: 1.598e+00; abs: 3.707e-02; rel: 2.376e-02; norm: 2.163e-01; mom: 1.105e+01;
## best it: 325; best obj: 1.511e+00
```

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## It: 412; obj: 1.615e+00; abs: 1.738e-02; rel: 1.088e-02; norm: 2.232e-01; mom: 1.190e+01;
## best it: 325; best obj: 1.511e+00
## It: 413; obj: 1.577e+00; abs: 3.834e-02; rel: 2.374e-02; norm: 2.161e-01; mom: 1.248e+01;
## best it: 325; best obj: 1.511e+00
## It: 414; obj: 1.580e+00; abs: 3.820e-03; rel: 2.423e-03; norm: 1.971e-01; mom: 1.188e+01;
## best it: 325; best obj: 1.511e+00
## It: 415; obj: 1.659e+00; abs: 7.831e-02; rel: 4.955e-02; norm: 1.925e-01; mom: 1.125e+01;
## best it: 325; best obj: 1.511e+00
## It: 416; obj: 1.656e+00; abs: 3.064e-03; rel: 1.847e-03; norm: 2.095e-01; mom: 1.167e+01;
## best it: 325; best obj: 1.511e+00
## It: 417; obj: 1.656e+00; abs: 1.591e-04; rel: 9.612e-05; norm: 2.347e-01; mom: 1.199e+01;
## best it: 325; best obj: 1.511e+00
## It: 418; obj: 1.635e+00; abs: 2.044e-02; rel: 1.234e-02; norm: 2.351e-01; mom: 1.285e+01;
## best it: 325; best obj: 1.511e+00
## It: 419; obj: 1.683e+00; abs: 4.796e-02; rel: 2.933e-02; norm: 2.362e-01; mom: 1.285e+01;
## best it: 325; best obj: 1.511e+00
## It: 420; obj: 1.646e+00; abs: 3.720e-02; rel: 2.210e-02; norm: 2.322e-01; mom: 1.278e+01;
## best it: 325; best obj: 1.511e+00
## It: 421; obj: 1.681e+00; abs: 3.495e-02; rel: 2.123e-02; norm: 2.366e-01; mom: 1.299e+01;
## best it: 325; best obj: 1.511e+00
## It: 422; obj: 1.657e+00; abs: 2.412e-02; rel: 1.435e-02; norm: 2.212e-01; mom: 1.298e+01;
## best it: 325; best obj: 1.511e+00
## It: 423; obj: 1.651e+00; abs: 6.140e-03; rel: 3.705e-03; norm: 2.247e-01; mom: 1.310e+01;
## best it: 325; best obj: 1.511e+00
## It: 424; obj: 1.640e+00; abs: 1.120e-02; rel: 6.786e-03; norm: 2.136e-01; mom: 1.272e+01;
## best it: 325; best obj: 1.511e+00
## It: 425; obj: 1.655e+00; abs: 1.557e-02; rel: 9.498e-03; norm: 2.321e-01; mom: 1.230e+01;
## best it: 325; best obj: 1.511e+00

## It: 426; obj: 1.675e+00; abs: 2.012e-02; rel: 1.216e-02; norm: 2.317e-01; mom: 1.284e+01;
## best it: 325; best obj: 1.511e+00
## It: 427; obj: 1.654e+00; abs: 2.150e-02; rel: 1.283e-02; norm: 2.453e-01; mom: 1.308e+01;
## best it: 325; best obj: 1.511e+00
## It: 428; obj: 1.655e+00; abs: 9.178e-04; rel: 5.549e-04; norm: 2.413e-01; mom: 1.328e+01;
## best it: 325; best obj: 1.511e+00
## It: 429; obj: 1.651e+00; abs: 3.920e-03; rel: 2.369e-03; norm: 2.419e-01; mom: 1.271e+01;
## best it: 325; best obj: 1.511e+00
## It: 430; obj: 1.662e+00; abs: 1.115e-02; rel: 6.752e-03; norm: 2.333e-01; mom: 1.292e+01;
## best it: 325; best obj: 1.511e+00
## It: 431; obj: 1.650e+00; abs: 1.163e-02; rel: 6.996e-03; norm: 2.341e-01; mom: 1.287e+01;
## best it: 325; best obj: 1.511e+00
## It: 432; obj: 1.647e+00; abs: 3.839e-03; rel: 2.326e-03; norm: 2.343e-01; mom: 1.273e+01;
## best it: 325; best obj: 1.511e+00
## It: 433; obj: 1.652e+00; abs: 5.112e-03; rel: 3.105e-03; norm: 2.403e-01; mom: 1.276e+01;
## best it: 325; best obj: 1.511e+00
## It: 434; obj: 1.652e+00; abs: 6.521e-04; rel: 3.948e-04; norm: 2.319e-01; mom: 1.293e+01;
## best it: 325; best obj: 1.511e+00
## It: 435; obj: 1.629e+00; abs: 2.310e-02; rel: 1.398e-02; norm: 2.385e-01; mom: 1.321e+01;
## best it: 325; best obj: 1.511e+00
## It: 436; obj: 1.619e+00; abs: 1.017e-02; rel: 6.244e-03; norm: 2.256e-01; mom: 1.296e+01;
## best it: 325; best obj: 1.511e+00
## It: 437; obj: 1.624e+00; abs: 4.508e-03; rel: 2.784e-03; norm: 2.259e-01; mom: 1.250e+01;
## best it: 325; best obj: 1.511e+00
## It: 438; obj: 1.638e+00; abs: 1.410e-02; rel: 8.683e-03; norm: 2.225e-01; mom: 1.253e+01;
```

```
## best it: 325; best obj: 1.511e+00
## It: 439; obj: 1.606e+00; abs: 3.204e-02; rel: 1.957e-02; norm: 2.318e-01; mom: 1.215e+01;
## best it: 325; best obj: 1.511e+00
## It: 440; obj: 1.578e+00; abs: 2.740e-02; rel: 1.707e-02; norm: 2.263e-01; mom: 1.269e+01;
## best it: 325; best obj: 1.511e+00
## It: 441; obj: 1.585e+00; abs: 6.473e-03; rel: 4.101e-03; norm: 2.236e-01; mom: 1.235e+01;
## best it: 325; best obj: 1.511e+00
## It: 442; obj: 1.576e+00; abs: 8.862e-03; rel: 5.592e-03; norm: 2.068e-01; mom: 1.241e+01;
## best it: 325; best obj: 1.511e+00
## It: 443; obj: 1.565e+00; abs: 1.045e-02; rel: 6.633e-03; norm: 1.898e-01; mom: 1.192e+01;
## best it: 325; best obj: 1.511e+00
## It: 444; obj: 1.548e+00; abs: 1.745e-02; rel: 1.115e-02; norm: 1.878e-01; mom: 1.201e+01;
## best it: 325; best obj: 1.511e+00
## It: 445; obj: 1.559e+00; abs: 1.063e-02; rel: 6.866e-03; norm: 1.973e-01; mom: 1.137e+01;
## best it: 325; best obj: 1.511e+00
## It: 446; obj: 1.592e+00; abs: 3.314e-02; rel: 2.126e-02; norm: 1.891e-01; mom: 1.187e+01;
## best it: 325; best obj: 1.511e+00
## It: 447; obj: 1.608e+00; abs: 1.643e-02; rel: 1.032e-02; norm: 1.883e-01; mom: 1.167e+01;
## best it: 325; best obj: 1.511e+00
## It: 448; obj: 1.627e+00; abs: 1.906e-02; rel: 1.185e-02; norm: 1.868e-01; mom: 1.181e+01;
## best it: 325; best obj: 1.511e+00
## It: 449; obj: 1.614e+00; abs: 1.364e-02; rel: 8.381e-03; norm: 2.119e-01; mom: 1.185e+01;
## best it: 325; best obj: 1.511e+00
## It: 450; obj: 1.586e+00; abs: 2.708e-02; rel: 1.678e-02; norm: 2.216e-01; mom: 1.250e+01;
## best it: 325; best obj: 1.511e+00

## It: 451; obj: 1.583e+00; abs: 3.155e-03; rel: 1.989e-03; norm: 2.122e-01; mom: 1.250e+01;
## best it: 325; best obj: 1.511e+00
## It: 452; obj: 1.595e+00; abs: 1.215e-02; rel: 7.671e-03; norm: 1.884e-01; mom: 1.205e+01;
## best it: 325; best obj: 1.511e+00
## It: 453; obj: 1.575e+00; abs: 2.028e-02; rel: 1.271e-02; norm: 1.949e-01; mom: 1.193e+01;
## best it: 325; best obj: 1.511e+00
## It: 454; obj: 1.592e+00; abs: 1.669e-02; rel: 1.060e-02; norm: 1.946e-01; mom: 1.216e+01;
## best it: 325; best obj: 1.511e+00
## It: 455; obj: 1.586e+00; abs: 6.063e-03; rel: 3.809e-03; norm: 2.031e-01; mom: 1.202e+01;
## best it: 325; best obj: 1.511e+00
## It: 456; obj: 1.597e+00; abs: 1.133e-02; rel: 7.146e-03; norm: 2.070e-01; mom: 1.226e+01;
## best it: 325; best obj: 1.511e+00
## It: 457; obj: 1.586e+00; abs: 1.151e-02; rel: 7.204e-03; norm: 2.199e-01; mom: 1.203e+01;
## best it: 325; best obj: 1.511e+00
## It: 458; obj: 1.589e+00; abs: 3.449e-03; rel: 2.175e-03; norm: 2.125e-01; mom: 1.235e+01;
## best it: 325; best obj: 1.511e+00
## It: 459; obj: 1.552e+00; abs: 3.692e-02; rel: 2.323e-02; norm: 2.162e-01; mom: 1.230e+01;
## best it: 325; best obj: 1.511e+00
## It: 460; obj: 1.580e+00; abs: 2.789e-02; rel: 1.797e-02; norm: 2.005e-01; mom: 1.232e+01;
## best it: 325; best obj: 1.511e+00
## It: 461; obj: 1.558e+00; abs: 2.209e-02; rel: 1.398e-02; norm: 1.968e-01; mom: 1.200e+01;
## best it: 325; best obj: 1.511e+00
## It: 462; obj: 1.587e+00; abs: 2.905e-02; rel: 1.864e-02; norm: 1.913e-01; mom: 1.219e+01;
## best it: 325; best obj: 1.511e+00
## It: 463; obj: 1.598e+00; abs: 1.056e-02; rel: 6.654e-03; norm: 2.007e-01; mom: 1.170e+01;
## best it: 325; best obj: 1.511e+00
## It: 464; obj: 1.585e+00; abs: 1.242e-02; rel: 7.773e-03; norm: 1.999e-01; mom: 1.220e+01;
## best it: 325; best obj: 1.511e+00
```

```
## It: 465; obj: 1.553e+00; abs: 3.234e-02; rel: 2.040e-02; norm: 2.118e-01; mom: 1.209e+01;
## best it: 325; best obj: 1.511e+00
## It: 466; obj: 1.586e+00; abs: 3.355e-02; rel: 2.160e-02; norm: 2.045e-01; mom: 1.219e+01;
## best it: 325; best obj: 1.511e+00
## It: 467; obj: 1.577e+00; abs: 9.162e-03; rel: 5.776e-03; norm: 2.124e-01; mom: 1.190e+01;
## best it: 325; best obj: 1.511e+00
## It: 468; obj: 1.576e+00; abs: 1.223e-03; rel: 7.756e-04; norm: 2.047e-01; mom: 1.234e+01;
## best it: 325; best obj: 1.511e+00
## It: 469; obj: 1.584e+00; abs: 7.587e-03; rel: 4.814e-03; norm: 2.197e-01; mom: 1.205e+01;
## best it: 325; best obj: 1.511e+00
## It: 470; obj: 1.583e+00; abs: 6.105e-04; rel: 3.855e-04; norm: 2.122e-01; mom: 1.226e+01;
## best it: 325; best obj: 1.511e+00
## It: 471; obj: 1.589e+00; abs: 5.562e-03; rel: 3.514e-03; norm: 2.061e-01; mom: 1.201e+01;
## best it: 325; best obj: 1.511e+00
## It: 472; obj: 1.601e+00; abs: 1.297e-02; rel: 8.165e-03; norm: 1.985e-01; mom: 1.197e+01;
## best it: 325; best obj: 1.511e+00
## It: 473; obj: 1.618e+00; abs: 1.680e-02; rel: 1.049e-02; norm: 2.115e-01; mom: 1.166e+01;
## best it: 325; best obj: 1.511e+00
## It: 474; obj: 1.665e+00; abs: 4.622e-02; rel: 2.856e-02; norm: 2.216e-01; mom: 1.223e+01;
## best it: 325; best obj: 1.511e+00
## It: 475; obj: 1.668e+00; abs: 3.622e-03; rel: 2.176e-03; norm: 2.371e-01; mom: 1.238e+01;
## best it: 325; best obj: 1.511e+00

## It: 476; obj: 1.649e+00; abs: 1.950e-02; rel: 1.169e-02; norm: 2.324e-01; mom: 1.279e+01;
## best it: 325; best obj: 1.511e+00
## It: 477; obj: 1.649e+00; abs: 7.366e-04; rel: 4.468e-04; norm: 2.307e-01; mom: 1.245e+01;
## best it: 325; best obj: 1.511e+00
## It: 478; obj: 1.673e+00; abs: 2.384e-02; rel: 1.446e-02; norm: 2.272e-01; mom: 1.244e+01;
## best it: 325; best obj: 1.511e+00
## It: 479; obj: 1.661e+00; abs: 1.175e-02; rel: 7.023e-03; norm: 2.363e-01; mom: 1.238e+01;
## best it: 325; best obj: 1.511e+00
## It: 480; obj: 1.687e+00; abs: 2.519e-02; rel: 1.516e-02; norm: 2.282e-01; mom: 1.258e+01;
## best it: 325; best obj: 1.511e+00
## It: 481; obj: 1.693e+00; abs: 6.349e-03; rel: 3.764e-03; norm: 2.432e-01; mom: 1.243e+01;
## best it: 325; best obj: 1.511e+00
## It: 482; obj: 1.711e+00; abs: 1.758e-02; rel: 1.038e-02; norm: 2.323e-01; mom: 1.256e+01;
## best it: 325; best obj: 1.511e+00
## It: 483; obj: 1.711e+00; abs: 2.856e-04; rel: 1.669e-04; norm: 2.241e-01; mom: 1.283e+01;
## best it: 325; best obj: 1.511e+00
## It: 484; obj: 1.679e+00; abs: 3.224e-02; rel: 1.884e-02; norm: 2.187e-01; mom: 1.280e+01;
## best it: 325; best obj: 1.511e+00
## It: 485; obj: 1.658e+00; abs: 2.071e-02; rel: 1.234e-02; norm: 2.309e-01; mom: 1.282e+01;
## best it: 325; best obj: 1.511e+00
## It: 486; obj: 1.651e+00; abs: 6.840e-03; rel: 4.126e-03; norm: 2.220e-01; mom: 1.247e+01;
## best it: 325; best obj: 1.511e+00
## It: 487; obj: 1.647e+00; abs: 4.024e-03; rel: 2.437e-03; norm: 2.310e-01; mom: 1.251e+01;
## best it: 325; best obj: 1.511e+00
## It: 488; obj: 1.654e+00; abs: 7.163e-03; rel: 4.349e-03; norm: 2.322e-01; mom: 1.287e+01;
## best it: 325; best obj: 1.511e+00
## It: 489; obj: 1.650e+00; abs: 3.991e-03; rel: 2.412e-03; norm: 2.174e-01; mom: 1.281e+01;
## best it: 325; best obj: 1.511e+00
## It: 490; obj: 1.652e+00; abs: 2.253e-03; rel: 1.365e-03; norm: 2.246e-01; mom: 1.284e+01;
## best it: 325; best obj: 1.511e+00
## It: 491; obj: 1.649e+00; abs: 3.378e-03; rel: 2.044e-03; norm: 2.273e-01; mom: 1.274e+01;
```

```
## best it: 325; best obj: 1.511e+00
## It: 492; obj: 1.659e+00; abs: 1.001e-02; rel: 6.067e-03; norm: 2.304e-01; mom: 1.285e+01;
## best it: 325; best obj: 1.511e+00
## It: 493; obj: 1.654e+00; abs: 5.269e-03; rel: 3.176e-03; norm: 2.348e-01; mom: 1.278e+01;
## best it: 325; best obj: 1.511e+00
## It: 494; obj: 1.689e+00; abs: 3.556e-02; rel: 2.150e-02; norm: 2.486e-01; mom: 1.285e+01;
## best it: 325; best obj: 1.511e+00
## It: 495; obj: 1.680e+00; abs: 9.443e-03; rel: 5.590e-03; norm: 2.450e-01; mom: 1.291e+01;
## best it: 325; best obj: 1.511e+00
## It: 496; obj: 1.695e+00; abs: 1.548e-02; rel: 9.213e-03; norm: 2.594e-01; mom: 1.344e+01;
## best it: 325; best obj: 1.511e+00
## It: 497; obj: 1.679e+00; abs: 1.676e-02; rel: 9.888e-03; norm: 2.450e-01; mom: 1.330e+01;
## best it: 325; best obj: 1.511e+00
## It: 498; obj: 1.670e+00; abs: 8.612e-03; rel: 5.130e-03; norm: 2.452e-01; mom: 1.347e+01;
## best it: 325; best obj: 1.511e+00
## It: 499; obj: 1.670e+00; abs: 1.699e-04; rel: 1.017e-04; norm: 2.487e-01; mom: 1.298e+01;
## best it: 325; best obj: 1.511e+00
## It: 500; obj: 1.692e+00; abs: 2.169e-02; rel: 1.299e-02; norm: 2.613e-01; mom: 1.320e+01;
## best it: 325; best obj: 1.511e+00
```


Iteration 400

Iteration 425

Iteration 450

Iteration 475
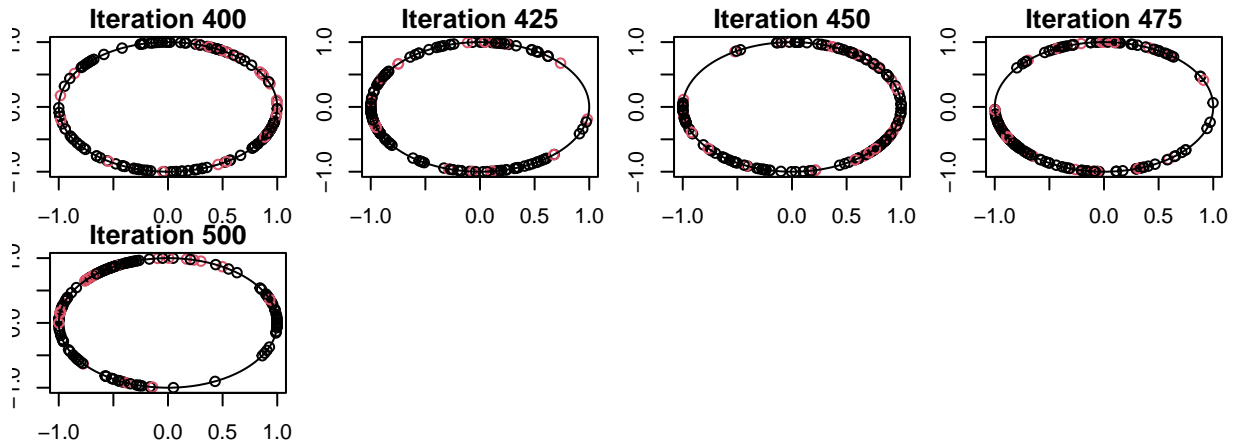
Iteration 500

Iteration 325
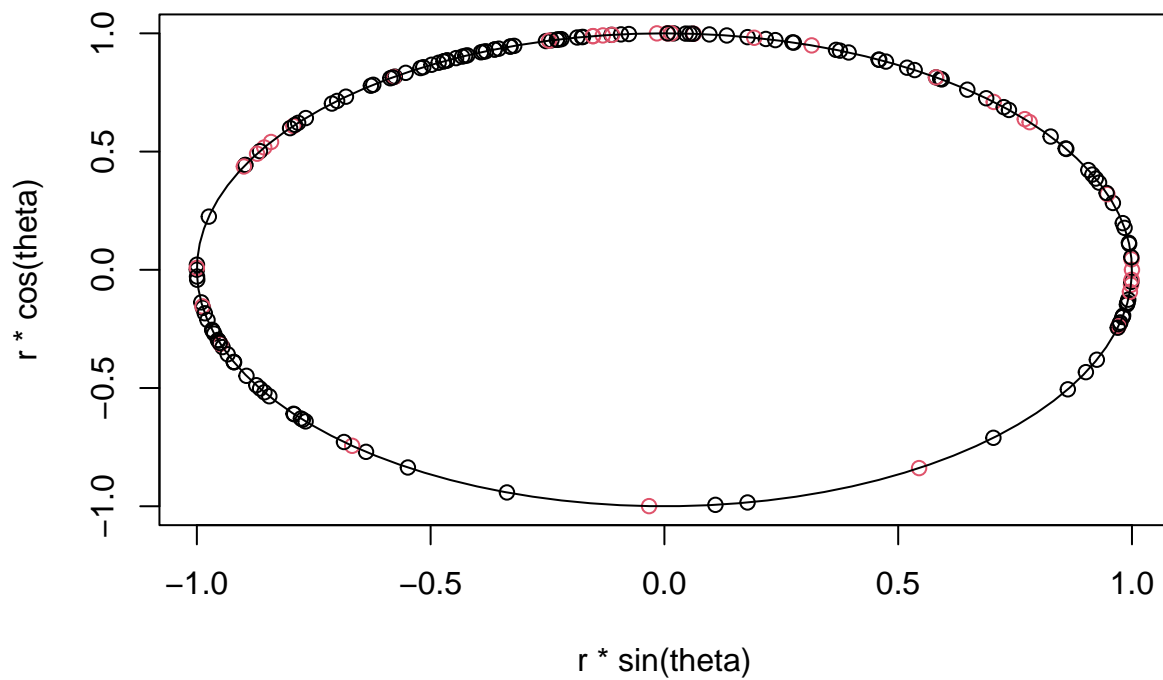

```
Y <- res_pscsne$best_Y
```

Let's apply the kernel means shift function to see what clusters identifies.

```
res_kms_dir_Y_1 <- kms_dir(x = Y, data = Y)
```

```
##   |                                                                       |
Y_rad <- DirStats::to_rad(Y)
r <- 1
theta <<- Y_rad
plot(r * sin(theta), r * cos(theta), col = res_kms_dir_Y_1$cluster,
     xlim = c(-max(r), max(r)), ylim = c(-max(r), max(r)))

polygon(max(r) * sin(seq(0,2 * pi, length.out = 100)),
        max(r) * cos(seq(0,2 * pi, length.out = 100)))
```
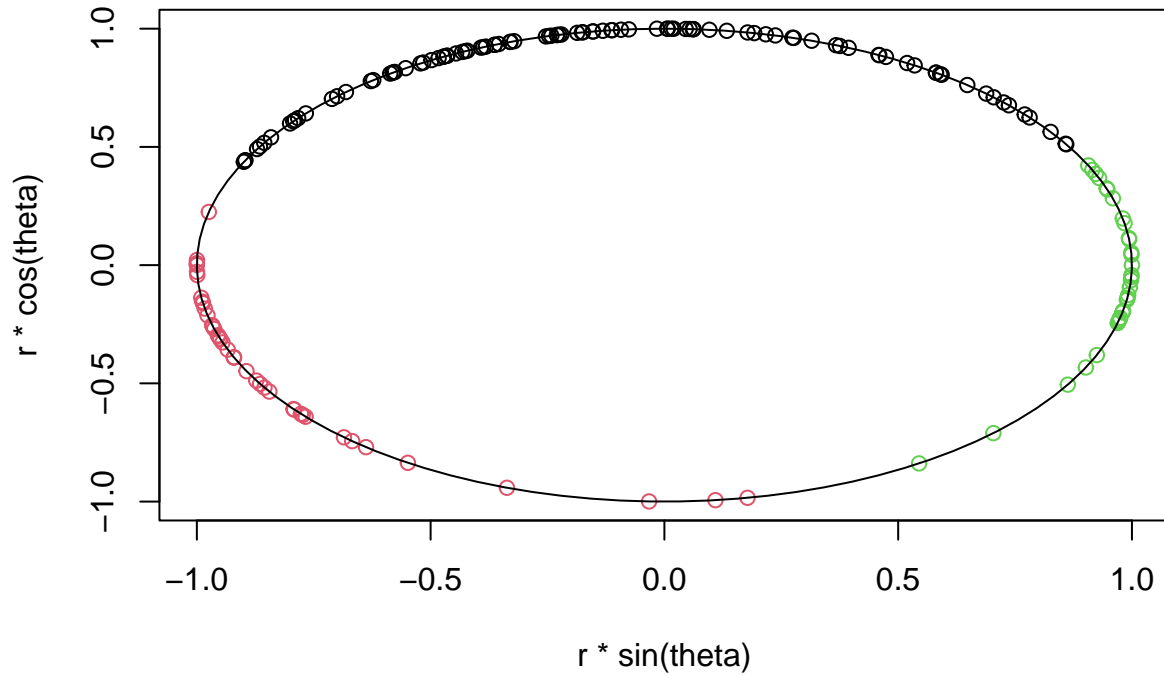
Now we are going to reduce to dimension $\mathbb{S}^2$ then $d = 2$ (sphere):

```
res_pscsne <- psc_sne(spokes, d = 2, rho_psc_list = rho_spokes_perp25,
            colors = ifelse(ids_labs, 2, 1), num_iteration = 500, show_prog = T)
```

```
## It: 1; obj: 1.468e+01; abs: 0.000e+00; rel: 0.000e+00; norm: 2.410e-01; mom: 0.000e+00;
## best it: 1; best obj: 1.468e+01
```

Iteration 1
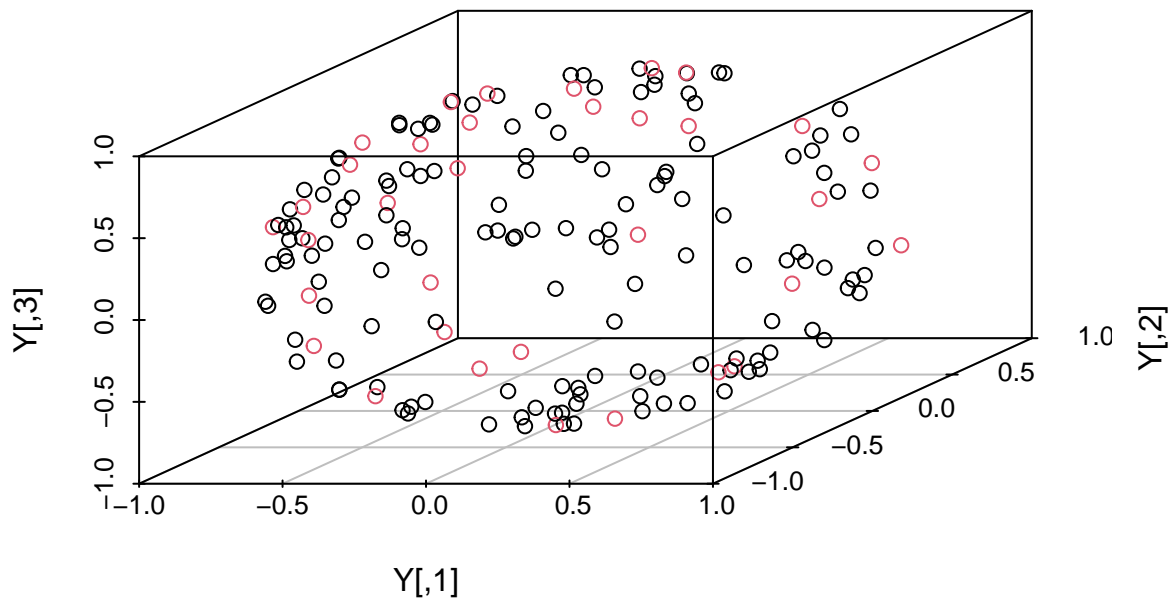

```
## It: 2; obj: 1.281e+01; abs: 1.872e+00; rel: 1.275e-01; norm: 4.983e-01; mom: 6.121e+00;
## best it: 2; best obj: 1.281e+01
## It: 3; obj: 1.148e+01; abs: 1.333e+00; rel: 1.041e-01; norm: 9.467e-01; mom: 5.246e+00;
```

```
## best it: 3; best obj: 1.148e+01
## It: 4; obj: 1.069e+01; abs: 7.923e-01; rel: 6.902e-02; norm: 1.343e+00; mom: 3.812e+00;
## best it: 4; best obj: 1.069e+01
## It: 5; obj: 1.032e+01; abs: 3.631e-01; rel: 3.398e-02; norm: 1.614e+00; mom: 2.364e+00;
## best it: 5; best obj: 1.032e+01
## It: 6; obj: 1.022e+01; abs: 1.032e-01; rel: 9.999e-03; norm: 1.771e+00; mom: 1.388e+00;
## best it: 6; best obj: 1.022e+01
## It: 7; obj: 1.020e+01; abs: 1.498e-02; rel: 1.466e-03; norm: 1.852e+00; mom: 7.186e-01;
## best it: 7; best obj: 1.020e+01
## It: 8; obj: 1.025e+01; abs: 4.533e-02; rel: 4.442e-03; norm: 1.915e+00; mom: 5.201e-01;
## best it: 7; best obj: 1.020e+01
## It: 9; obj: 1.032e+01; abs: 7.251e-02; rel: 7.075e-03; norm: 2.020e+00; mom: 4.646e-01;
## best it: 7; best obj: 1.020e+01
## It: 10; obj: 1.041e+01; abs: 8.431e-02; rel: 8.168e-03; norm: 2.183e+00; mom: 4.188e-01;
## best it: 7; best obj: 1.020e+01
## It: 11; obj: 1.049e+01; abs: 8.640e-02; rel: 8.302e-03; norm: 2.366e+00; mom: 3.812e-01;
## best it: 7; best obj: 1.020e+01
## It: 12; obj: 1.058e+01; abs: 9.012e-02; rel: 8.589e-03; norm: 2.552e+00; mom: 3.502e-01;
## best it: 7; best obj: 1.020e+01
## It: 13; obj: 1.068e+01; abs: 9.621e-02; rel: 9.091e-03; norm: 2.734e+00; mom: 3.225e-01;
## best it: 7; best obj: 1.020e+01
## It: 14; obj: 1.078e+01; abs: 1.053e-01; rel: 9.865e-03; norm: 2.911e+00; mom: 3.158e-01;
## best it: 7; best obj: 1.020e+01
## It: 15; obj: 1.090e+01; abs: 1.133e-01; rel: 1.050e-02; norm: 3.078e+00; mom: 3.178e-01;
## best it: 7; best obj: 1.020e+01
## It: 16; obj: 1.102e+01; abs: 1.188e-01; rel: 1.090e-02; norm: 3.233e+00; mom: 3.148e-01;
## best it: 7; best obj: 1.020e+01
## It: 17; obj: 1.114e+01; abs: 1.208e-01; rel: 1.096e-02; norm: 3.373e+00; mom: 3.033e-01;
## best it: 7; best obj: 1.020e+01
## It: 18; obj: 1.126e+01; abs: 1.178e-01; rel: 1.058e-02; norm: 3.495e+00; mom: 2.811e-01;
## best it: 7; best obj: 1.020e+01
## It: 19; obj: 1.136e+01; abs: 1.092e-01; rel: 9.698e-03; norm: 3.596e+00; mom: 2.499e-01;
## best it: 7; best obj: 1.020e+01
## It: 20; obj: 1.146e+01; abs: 9.626e-02; rel: 8.470e-03; norm: 3.675e+00; mom: 2.145e-01;
## best it: 7; best obj: 1.020e+01
## It: 21; obj: 1.154e+01; abs: 8.159e-02; rel: 7.119e-03; norm: 3.734e+00; mom: 1.799e-01;
## best it: 7; best obj: 1.020e+01
## It: 22; obj: 1.161e+01; abs: 6.729e-02; rel: 5.829e-03; norm: 3.778e+00; mom: 1.491e-01;
## best it: 7; best obj: 1.020e+01
## It: 23; obj: 1.166e+01; abs: 5.456e-02; rel: 4.699e-03; norm: 3.810e+00; mom: 1.230e-01;
## best it: 7; best obj: 1.020e+01
## It: 24; obj: 1.171e+01; abs: 4.386e-02; rel: 3.760e-03; norm: 3.833e+00; mom: 1.015e-01;
## best it: 7; best obj: 1.020e+01
## It: 25; obj: 1.174e+01; abs: 3.516e-02; rel: 3.003e-03; norm: 3.849e+00; mom: 8.391e-02;
## best it: 7; best obj: 1.020e+01
```

Iteration 25
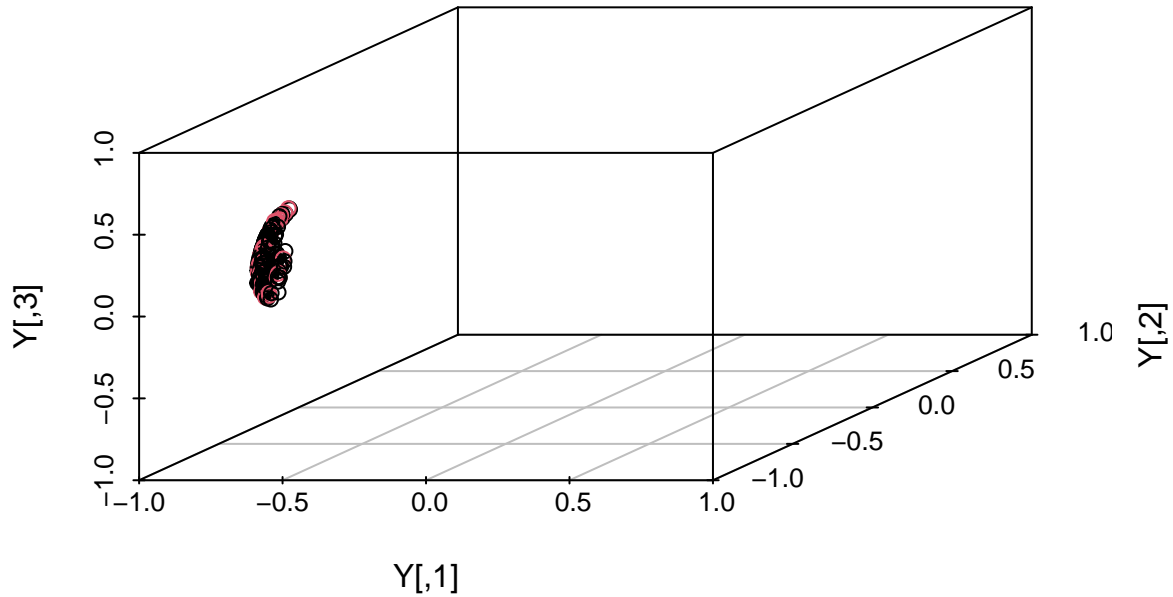

```
## It: 26; obj: 1.177e+01; abs: 2.825e-02; rel: 2.406e-03; norm: 3.862e+00; mom: 6.967e-02;
## best it: 7; best obj: 1.020e+01
## It: 27; obj: 1.179e+01; abs: 2.281e-02; rel: 1.938e-03; norm: 3.871e+00; mom: 5.816e-02;
## best it: 7; best obj: 1.020e+01
## It: 28; obj: 1.181e+01; abs: 1.855e-02; rel: 1.573e-03; norm: 3.878e+00; mom: 4.883e-02;
## best it: 7; best obj: 1.020e+01
## It: 29; obj: 1.183e+01; abs: 1.521e-02; rel: 1.288e-03; norm: 3.883e+00; mom: 4.125e-02;
## best it: 7; best obj: 1.020e+01
## It: 30; obj: 1.184e+01; abs: 1.260e-02; rel: 1.065e-03; norm: 3.887e+00; mom: 3.506e-02;
## best it: 7; best obj: 1.020e+01
## It: 31; obj: 1.185e+01; abs: 1.053e-02; rel: 8.891e-04; norm: 3.890e+00; mom: 2.998e-02;
## best it: 7; best obj: 1.020e+01
## It: 32; obj: 1.186e+01; abs: 8.885e-03; rel: 7.497e-04; norm: 3.893e+00; mom: 2.579e-02;
## best it: 7; best obj: 1.020e+01
## It: 33; obj: 1.187e+01; abs: 7.570e-03; rel: 6.383e-04; norm: 3.895e+00; mom: 2.232e-02;
## best it: 7; best obj: 1.020e+01
## It: 34; obj: 1.187e+01; abs: 6.508e-03; rel: 5.484e-04; norm: 3.897e+00; mom: 1.943e-02;
## best it: 7; best obj: 1.020e+01
## It: 35; obj: 1.188e+01; abs: 5.644e-03; rel: 4.753e-04; norm: 3.898e+00; mom: 1.701e-02;
## It: 36; obj: 1.188e+01; abs: 4.934e-03; rel: 4.153e-04; norm: 3.899e+00; mom: 1.498e-02;
## best it: 7; best obj: 1.020e+01
## It: 37; obj: 1.189e+01; abs: 4.346e-03; rel: 3.657e-04; norm: 3.900e+00; mom: 1.327e-02;
## best it: 7; best obj: 1.020e+01
## It: 38; obj: 1.189e+01; abs: 3.855e-03; rel: 3.242e-04; norm: 3.901e+00; mom: 1.181e-02;
## best it: 7; best obj: 1.020e+01
## It: 39; obj: 1.190e+01; abs: 3.441e-03; rel: 2.893e-04; norm: 3.902e+00; mom: 1.058e-02;
## best it: 7; best obj: 1.020e+01
## It: 40; obj: 1.190e+01; abs: 3.090e-03; rel: 2.597e-04; norm: 3.902e+00; mom: 9.524e-03;
## best it: 7; best obj: 1.020e+01
## It: 41; obj: 1.190e+01; abs: 2.789e-03; rel: 2.344e-04; norm: 3.903e+00; mom: 8.621e-03;
```

```
## best it: 7; best obj: 1.020e+01
## It: 42; obj: 1.190e+01; abs: 2.531e-03; rel: 2.126e-04; norm: 3.903e+00; mom: 7.844e-03;
## best it: 7; best obj: 1.020e+01
## It: 43; obj: 1.191e+01; abs: 2.306e-03; rel: 1.937e-04; norm: 3.904e+00; mom: 7.174e-03;
## best it: 7; best obj: 1.020e+01
## It: 44; obj: 1.191e+01; abs: 2.110e-03; rel: 1.772e-04; norm: 3.904e+00; mom: 6.594e-03;
## best it: 7; best obj: 1.020e+01
## It: 45; obj: 1.191e+01; abs: 1.939e-03; rel: 1.628e-04; norm: 3.904e+00; mom: 6.090e-03;
## best it: 7; best obj: 1.020e+01
## It: 46; obj: 1.191e+01; abs: 1.787e-03; rel: 1.500e-04; norm: 3.905e+00; mom: 5.651e-03;
## best it: 7; best obj: 1.020e+01
## It: 47; obj: 1.191e+01; abs: 1.653e-03; rel: 1.387e-04; norm: 3.905e+00; mom: 5.267e-03;
## best it: 7; best obj: 1.020e+01
## It: 48; obj: 1.192e+01; abs: 1.533e-03; rel: 1.287e-04; norm: 3.905e+00; mom: 4.928e-03;
## best it: 7; best obj: 1.020e+01
## It: 49; obj: 1.192e+01; abs: 1.426e-03; rel: 1.197e-04; norm: 3.906e+00; mom: 4.630e-03;
## best it: 7; best obj: 1.020e+01
## It: 50; obj: 1.192e+01; abs: 1.331e-03; rel: 1.116e-04; norm: 3.906e+00; mom: 4.365e-03;
## best it: 7; best obj: 1.020e+01
```

Iteration 50
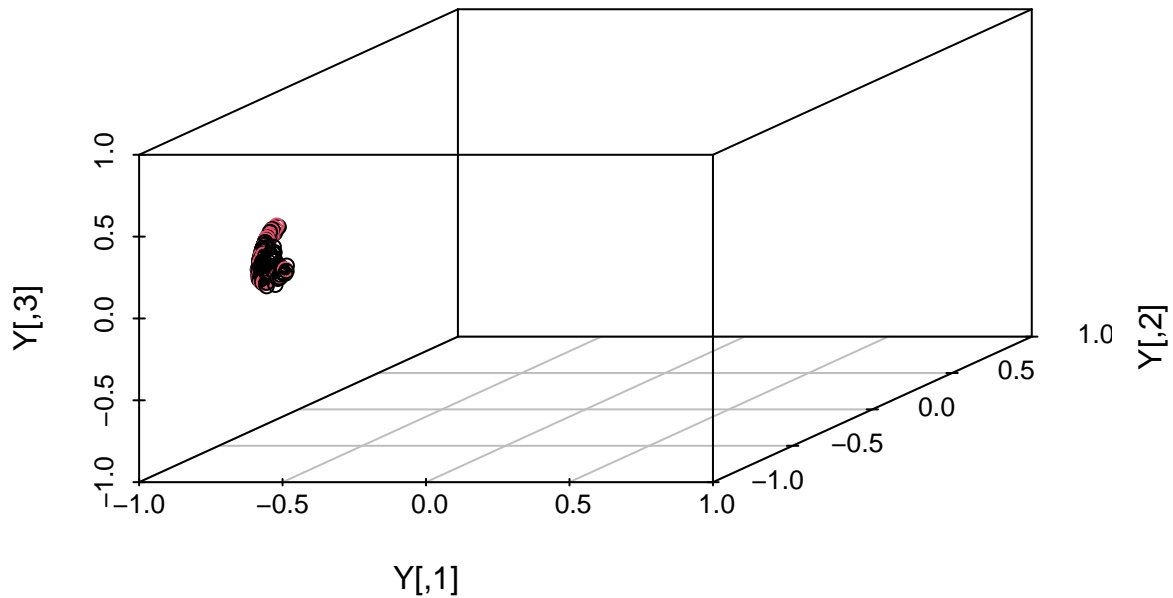

```
## It: 51; obj: 1.192e+01; abs: 1.244e-03; rel: 1.044e-04; norm: 3.906e+00; mom: 4.128e-03;
## best it: 7; best obj: 1.020e+01
## It: 52; obj: 1.192e+01; abs: 1.166e-03; rel: 9.784e-05; norm: 3.906e+00; mom: 3.917e-03;
## best it: 7; best obj: 1.020e+01
## It: 53; obj: 1.192e+01; abs: 1.096e-03; rel: 9.191e-05; norm: 3.906e+00; mom: 3.726e-03;
## best it: 7; best obj: 1.020e+01
## It: 54; obj: 1.192e+01; abs: 1.031e-03; rel: 8.651e-05; norm: 3.907e+00; mom: 3.553e-03;
## best it: 7; best obj: 1.020e+01
## It: 55; obj: 1.192e+01; abs: 9.729e-04; rel: 8.160e-05; norm: 3.907e+00; mom: 3.396e-03;
## best it: 7; best obj: 1.020e+01
## It: 56; obj: 1.193e+01; abs: 9.195e-04; rel: 7.711e-05; norm: 3.907e+00; mom: 3.252e-03;
## best it: 7; best obj: 1.020e+01
```

```
## It: 57; obj: 1.193e+01; abs: 8.705e-04; rel: 7.299e-05; norm: 3.907e+00; mom: 3.119e-03;
## best it: 7; best obj: 1.020e+01
## It: 58; obj: 1.193e+01; abs: 8.255e-04; rel: 6.922e-05; norm: 3.907e+00; mom: 2.997e-03;
## best it: 7; best obj: 1.020e+01
## It: 59; obj: 1.193e+01; abs: 7.841e-04; rel: 6.574e-05; norm: 3.907e+00; mom: 2.883e-03;
## best it: 7; best obj: 1.020e+01
## It: 60; obj: 1.193e+01; abs: 7.460e-04; rel: 6.254e-05; norm: 3.907e+00; mom: 2.778e-03;
## best it: 7; best obj: 1.020e+01
## It: 61; obj: 1.193e+01; abs: 7.107e-04; rel: 5.958e-05; norm: 3.907e+00; mom: 2.679e-03;
## best it: 7; best obj: 1.020e+01
## It: 62; obj: 1.193e+01; abs: 6.780e-04; rel: 5.683e-05; norm: 3.907e+00; mom: 2.586e-03;
## best it: 7; best obj: 1.020e+01
## It: 63; obj: 1.193e+01; abs: 6.476e-04; rel: 5.429e-05; norm: 3.908e+00; mom: 2.499e-03;
## best it: 7; best obj: 1.020e+01
## It: 64; obj: 1.193e+01; abs: 6.194e-04; rel: 5.192e-05; norm: 3.908e+00; mom: 2.417e-03;
## best it: 7; best obj: 1.020e+01
## It: 65; obj: 1.193e+01; abs: 5.931e-04; rel: 4.971e-05; norm: 3.908e+00; mom: 2.340e-03;
## best it: 7; best obj: 1.020e+01
## It: 66; obj: 1.193e+01; abs: 5.686e-04; rel: 4.766e-05; norm: 3.908e+00; mom: 2.266e-03;
## best it: 7; best obj: 1.020e+01
## It: 67; obj: 1.193e+01; abs: 5.457e-04; rel: 4.573e-05; norm: 3.908e+00; mom: 2.196e-03;
## best it: 7; best obj: 1.020e+01
## It: 68; obj: 1.193e+01; abs: 5.242e-04; rel: 4.393e-05; norm: 3.908e+00; mom: 2.130e-03;
## best it: 7; best obj: 1.020e+01
## It: 69; obj: 1.193e+01; abs: 5.041e-04; rel: 4.224e-05; norm: 3.908e+00; mom: 2.067e-03;
## best it: 7; best obj: 1.020e+01
## It: 70; obj: 1.193e+01; abs: 4.851e-04; rel: 4.065e-05; norm: 3.908e+00; mom: 2.006e-03;
## best it: 7; best obj: 1.020e+01
## It: 71; obj: 1.194e+01; abs: 4.673e-04; rel: 3.916e-05; norm: 3.908e+00; mom: 1.949e-03;
## best it: 7; best obj: 1.020e+01
## It: 72; obj: 1.194e+01; abs: 4.505e-04; rel: 3.775e-05; norm: 3.908e+00; mom: 1.894e-03;
## best it: 7; best obj: 1.020e+01
## It: 73; obj: 1.194e+01; abs: 4.347e-04; rel: 3.642e-05; norm: 3.908e+00; mom: 1.841e-03;
## best it: 7; best obj: 1.020e+01
## It: 74; obj: 1.194e+01; abs: 4.197e-04; rel: 3.516e-05; norm: 3.908e+00; mom: 1.791e-03;
## best it: 7; best obj: 1.020e+01
## It: 75; obj: 1.194e+01; abs: 4.055e-04; rel: 3.397e-05; norm: 3.908e+00; mom: 1.742e-03;
## best it: 7; best obj: 1.020e+01
```

Iteration 75
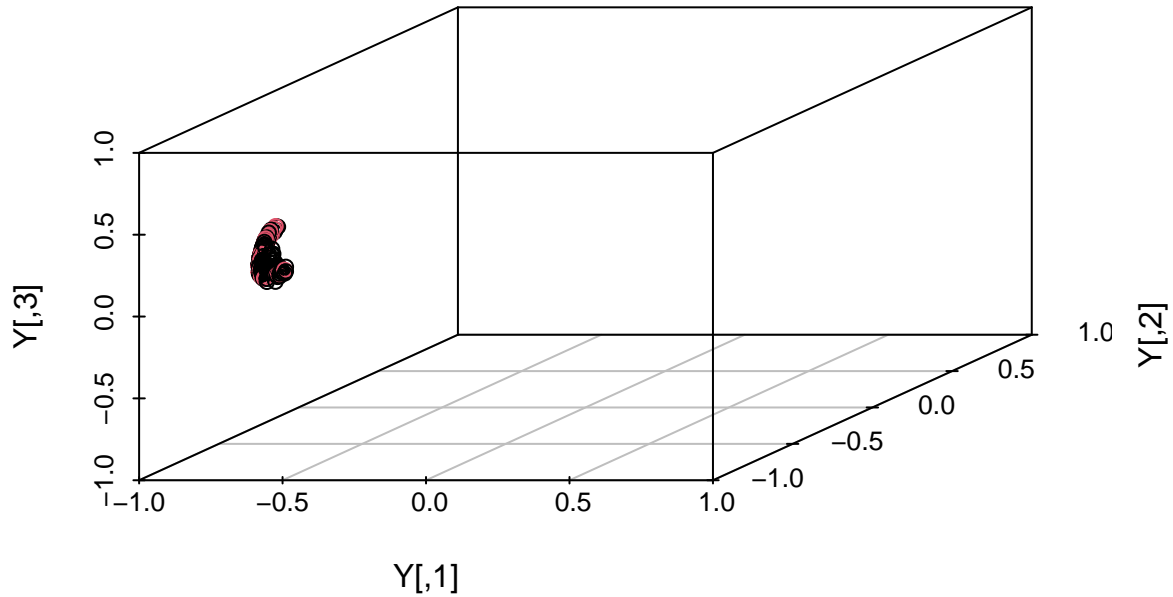

```
## It: 76; obj: 1.194e+01; abs: 3.920e-04; rel: 3.284e-05; norm: 3.908e+00; mom: 1.696e-03;
## best it: 7; best obj: 1.020e+01
## It: 77; obj: 1.194e+01; abs: 3.793e-04; rel: 3.177e-05; norm: 3.909e+00; mom: 1.651e-03;
## best it: 7; best obj: 1.020e+01
## It: 78; obj: 1.194e+01; abs: 3.672e-04; rel: 3.076e-05; norm: 3.909e+00; mom: 1.608e-03;
## best it: 7; best obj: 1.020e+01
## It: 79; obj: 1.194e+01; abs: 3.557e-04; rel: 2.979e-05; norm: 3.909e+00; mom: 1.567e-03;
## best it: 7; best obj: 1.020e+01
## It: 80; obj: 1.194e+01; abs: 3.447e-04; rel: 2.887e-05; norm: 3.909e+00; mom: 1.527e-03;
## best it: 7; best obj: 1.020e+01
## It: 81; obj: 1.194e+01; abs: 3.342e-04; rel: 2.800e-05; norm: 3.909e+00; mom: 1.489e-03;
## best it: 7; best obj: 1.020e+01
## It: 82; obj: 1.194e+01; abs: 3.243e-04; rel: 2.716e-05; norm: 3.909e+00; mom: 1.452e-03;
## best it: 7; best obj: 1.020e+01
## It: 83; obj: 1.194e+01; abs: 3.147e-04; rel: 2.636e-05; norm: 3.909e+00; mom: 1.417e-03;
## best it: 7; best obj: 1.020e+01
## It: 84; obj: 1.194e+01; abs: 3.056e-04; rel: 2.560e-05; norm: 3.909e+00; mom: 1.382e-03;
## best it: 7; best obj: 1.020e+01
## It: 85; obj: 1.194e+01; abs: 2.969e-04; rel: 2.487e-05; norm: 3.909e+00; mom: 1.349e-03;
## best it: 7; best obj: 1.020e+01
## It: 86; obj: 1.194e+01; abs: 2.886e-04; rel: 2.417e-05; norm: 3.909e+00; mom: 1.317e-03;
## best it: 7; best obj: 1.020e+01
## It: 87; obj: 1.194e+01; abs: 2.806e-04; rel: 2.350e-05; norm: 3.909e+00; mom: 1.287e-03;
## best it: 7; best obj: 1.020e+01
## It: 88; obj: 1.194e+01; abs: 2.729e-04; rel: 2.285e-05; norm: 3.909e+00; mom: 1.257e-03;
## best it: 7; best obj: 1.020e+01
## It: 89; obj: 1.194e+01; abs: 2.655e-04; rel: 2.224e-05; norm: 3.909e+00; mom: 1.228e-03;
## best it: 7; best obj: 1.020e+01
## It: 90; obj: 1.194e+01; abs: 2.585e-04; rel: 2.164e-05; norm: 3.909e+00; mom: 1.200e-03;
## best it: 7; best obj: 1.020e+01
## It: 91; obj: 1.194e+01; abs: 2.517e-04; rel: 2.107e-05; norm: 3.909e+00; mom: 1.173e-03;
```

```
## best it: 7; best obj: 1.020e+01
## It: 92; obj: 1.194e+01; abs: 2.451e-04; rel: 2.053e-05; norm: 3.909e+00; mom: 1.147e-03;
## best it: 7; best obj: 1.020e+01
## It: 93; obj: 1.194e+01; abs: 2.388e-04; rel: 2.000e-05; norm: 3.909e+00; mom: 1.122e-03;
## best it: 7; best obj: 1.020e+01
## It: 94; obj: 1.194e+01; abs: 2.328e-04; rel: 1.949e-05; norm: 3.909e+00; mom: 1.097e-03;
## best it: 7; best obj: 1.020e+01
## It: 95; obj: 1.194e+01; abs: 2.269e-04; rel: 1.900e-05; norm: 3.909e+00; mom: 1.073e-03;
## best it: 7; best obj: 1.020e+01
## It: 96; obj: 1.194e+01; abs: 2.213e-04; rel: 1.853e-05; norm: 3.909e+00; mom: 1.050e-03;
## best it: 7; best obj: 1.020e+01
## It: 97; obj: 1.194e+01; abs: 2.159e-04; rel: 1.807e-05; norm: 3.909e+00; mom: 1.028e-03;
## best it: 7; best obj: 1.020e+01
## It: 98; obj: 1.194e+01; abs: 2.106e-04; rel: 1.763e-05; norm: 3.909e+00; mom: 1.006e-03;
## best it: 7; best obj: 1.020e+01
## It: 99; obj: 1.194e+01; abs: 2.056e-04; rel: 1.721e-05; norm: 3.909e+00; mom: 9.851e-04;
## best it: 7; best obj: 1.020e+01
## It: 100; obj: 1.194e+01; abs: 2.007e-04; rel: 1.680e-05; norm: 3.909e+00; mom: 9.647e-04;
## best it: 7; best obj: 1.020e+01
```

Iteration 100
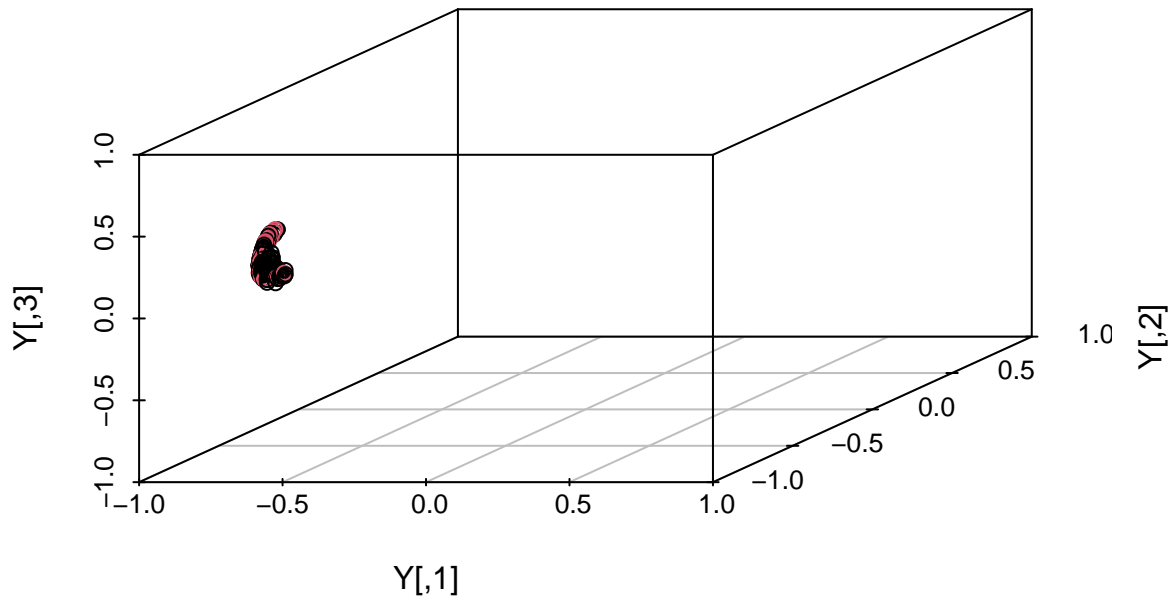

```
## It: 101; obj: 2.111e+00; abs: 9.833e+00; rel: 8.232e-01; norm: 3.980e-01; mom: 9.449e-04;
## best it: 101; best obj: 2.111e+00
## It: 102; obj: 2.645e+00; abs: 5.336e-01; rel: 2.528e-01; norm: 5.048e-01; mom: 8.026e+00;
## best it: 101; best obj: 2.111e+00
## It: 103; obj: 2.712e+00; abs: 6.724e-02; rel: 2.542e-02; norm: 9.386e-01; mom: 1.062e+01;
## best it: 101; best obj: 2.111e+00
## It: 104; obj: 2.526e+00; abs: 1.866e-01; rel: 6.881e-02; norm: 1.056e+00; mom: 1.026e+01;
## best it: 101; best obj: 2.111e+00
## It: 105; obj: 2.231e+00; abs: 2.941e-01; rel: 1.165e-01; norm: 1.160e+00; mom: 9.960e+00;
## best it: 101; best obj: 2.111e+00
## It: 106; obj: 2.226e+00; abs: 5.576e-03; rel: 2.499e-03; norm: 1.111e+00; mom: 9.255e+00;
## best it: 101; best obj: 2.111e+00
```

```
## It: 107; obj: 2.130e+00; abs: 9.540e-02; rel: 4.286e-02; norm: 1.100e+00; mom: 8.597e+00;
## best it: 101; best obj: 2.111e+00
## It: 108; obj: 2.259e+00; abs: 1.288e-01; rel: 6.045e-02; norm: 1.087e+00; mom: 8.470e+00;
## best it: 101; best obj: 2.111e+00
## It: 109; obj: 2.068e+00; abs: 1.916e-01; rel: 8.479e-02; norm: 1.119e+00; mom: 8.575e+00;
## best it: 109; best obj: 2.068e+00
## It: 110; obj: 2.250e+00; abs: 1.819e-01; rel: 8.800e-02; norm: 1.064e+00; mom: 8.489e+00;
## best it: 109; best obj: 2.068e+00
## It: 111; obj: 2.063e+00; abs: 1.861e-01; rel: 8.272e-02; norm: 1.115e+00; mom: 8.443e+00;
## best it: 111; best obj: 2.063e+00
## It: 112; obj: 2.298e+00; abs: 2.342e-01; rel: 1.135e-01; norm: 1.055e+00; mom: 8.489e+00;
## best it: 111; best obj: 2.063e+00
## It: 113; obj: 2.012e+00; abs: 2.855e-01; rel: 1.243e-01; norm: 1.128e+00; mom: 8.585e+00;
## best it: 113; best obj: 2.012e+00
## It: 114; obj: 2.328e+00; abs: 3.157e-01; rel: 1.569e-01; norm: 1.016e+00; mom: 8.613e+00;
## best it: 113; best obj: 2.012e+00
## It: 115; obj: 2.018e+00; abs: 3.099e-01; rel: 1.331e-01; norm: 1.124e+00; mom: 8.623e+00;
## best it: 113; best obj: 2.012e+00
## It: 116; obj: 2.339e+00; abs: 3.212e-01; rel: 1.592e-01; norm: 1.018e+00; mom: 8.623e+00;
## best it: 113; best obj: 2.012e+00
## It: 117; obj: 1.989e+00; abs: 3.500e-01; rel: 1.496e-01; norm: 1.115e+00; mom: 8.649e+00;
## best it: 117; best obj: 1.989e+00
## It: 118; obj: 2.394e+00; abs: 4.046e-01; rel: 2.034e-01; norm: 9.821e-01; mom: 8.610e+00;
## best it: 117; best obj: 1.989e+00
## It: 119; obj: 2.000e+00; abs: 3.942e-01; rel: 1.647e-01; norm: 1.110e+00; mom: 8.732e+00;
## best it: 117; best obj: 1.989e+00
## It: 120; obj: 2.402e+00; abs: 4.020e-01; rel: 2.011e-01; norm: 9.813e-01; mom: 8.713e+00;
## best it: 117; best obj: 1.989e+00
## It: 121; obj: 1.921e+00; abs: 4.805e-01; rel: 2.001e-01; norm: 1.099e+00; mom: 8.740e+00;
## best it: 121; best obj: 1.921e+00
## It: 122; obj: 2.424e+00; abs: 5.026e-01; rel: 2.616e-01; norm: 9.382e-01; mom: 8.670e+00;
## best it: 121; best obj: 1.921e+00
## It: 123; obj: 1.927e+00; abs: 4.972e-01; rel: 2.051e-01; norm: 1.075e+00; mom: 8.800e+00;
## best it: 121; best obj: 1.921e+00
## It: 124; obj: 2.424e+00; abs: 4.977e-01; rel: 2.583e-01; norm: 9.348e-01; mom: 8.786e+00;
## best it: 121; best obj: 1.921e+00
## It: 125; obj: 1.984e+00; abs: 4.404e-01; rel: 1.817e-01; norm: 1.054e+00; mom: 8.822e+00;
## best it: 121; best obj: 1.921e+00
```

Iteration 125
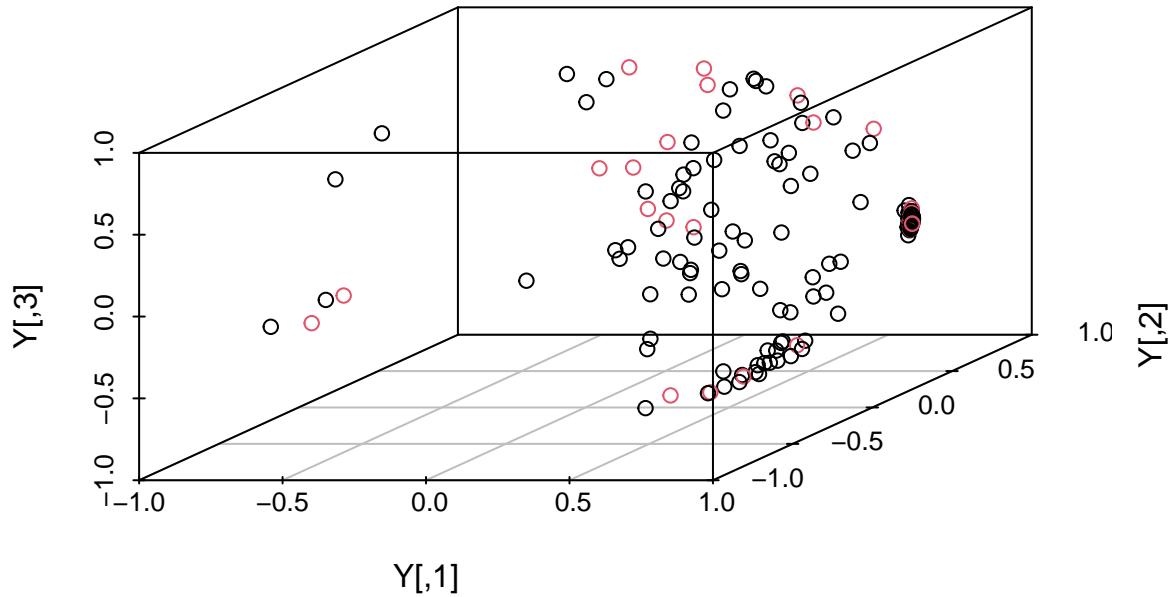

```
## It: 126; obj: 2.433e+00; abs: 4.487e-01; rel: 2.262e-01; norm: 9.457e-01; mom: 8.881e+00;
## best it: 121; best obj: 1.921e+00
## It: 127; obj: 1.967e+00; abs: 4.659e-01; rel: 1.915e-01; norm: 1.076e+00; mom: 8.817e+00;
## best it: 121; best obj: 1.921e+00
## It: 128; obj: 2.441e+00; abs: 4.746e-01; rel: 2.413e-01; norm: 9.459e-01; mom: 8.823e+00;
## best it: 121; best obj: 1.921e+00
## It: 129; obj: 1.937e+00; abs: 5.044e-01; rel: 2.066e-01; norm: 1.072e+00; mom: 8.832e+00;
## best it: 121; best obj: 1.921e+00
## It: 130; obj: 2.448e+00; abs: 5.111e-01; rel: 2.639e-01; norm: 9.341e-01; mom: 8.813e+00;
## best it: 121; best obj: 1.921e+00
## It: 131; obj: 1.947e+00; abs: 5.006e-01; rel: 2.045e-01; norm: 1.059e+00; mom: 8.828e+00;
## best it: 121; best obj: 1.921e+00
## It: 132; obj: 2.444e+00; abs: 4.971e-01; rel: 2.553e-01; norm: 9.306e-01; mom: 8.853e+00;
## best it: 121; best obj: 1.921e+00
## It: 133; obj: 1.951e+00; abs: 4.935e-01; rel: 2.019e-01; norm: 1.053e+00; mom: 8.840e+00;
## best it: 121; best obj: 1.921e+00
## It: 134; obj: 2.458e+00; abs: 5.072e-01; rel: 2.600e-01; norm: 9.302e-01; mom: 8.846e+00;
## best it: 121; best obj: 1.921e+00
## It: 135; obj: 1.947e+00; abs: 5.117e-01; rel: 2.081e-01; norm: 1.053e+00; mom: 8.850e+00;
## best it: 121; best obj: 1.921e+00
## It: 136; obj: 2.448e+00; abs: 5.012e-01; rel: 2.575e-01; norm: 9.271e-01; mom: 8.867e+00;
## best it: 121; best obj: 1.921e+00
## It: 137; obj: 1.966e+00; abs: 4.816e-01; rel: 1.967e-01; norm: 1.044e+00; mom: 8.866e+00;
## best it: 121; best obj: 1.921e+00
## It: 138; obj: 2.467e+00; abs: 5.005e-01; rel: 2.546e-01; norm: 9.279e-01; mom: 8.854e+00;
## best it: 121; best obj: 1.921e+00
## It: 139; obj: 1.949e+00; abs: 5.176e-01; rel: 2.099e-01; norm: 1.053e+00; mom: 8.852e+00;
## best it: 121; best obj: 1.921e+00
## It: 140; obj: 2.461e+00; abs: 5.119e-01; rel: 2.626e-01; norm: 9.272e-01; mom: 8.849e+00;
## best it: 121; best obj: 1.921e+00
## It: 141; obj: 1.949e+00; abs: 5.121e-01; rel: 2.081e-01; norm: 1.043e+00; mom: 8.886e+00;
```

```
## best it: 121; best obj: 1.921e+00
## It: 142; obj: 2.479e+00; abs: 5.298e-01; rel: 2.718e-01; norm: 9.203e-01; mom: 8.908e+00;
## best it: 121; best obj: 1.921e+00
## It: 143; obj: 1.939e+00; abs: 5.391e-01; rel: 2.175e-01; norm: 1.048e+00; mom: 8.893e+00;
## best it: 121; best obj: 1.921e+00
## It: 144; obj: 2.465e+00; abs: 5.259e-01; rel: 2.711e-01; norm: 9.211e-01; mom: 8.905e+00;
## best it: 121; best obj: 1.921e+00
## It: 145; obj: 1.935e+00; abs: 5.301e-01; rel: 2.150e-01; norm: 1.041e+00; mom: 8.882e+00;
## best it: 121; best obj: 1.921e+00
## It: 146; obj: 2.477e+00; abs: 5.416e-01; rel: 2.799e-01; norm: 9.133e-01; mom: 8.892e+00;
## best it: 121; best obj: 1.921e+00
## It: 147; obj: 1.935e+00; abs: 5.421e-01; rel: 2.189e-01; norm: 1.040e+00; mom: 8.892e+00;
## best it: 121; best obj: 1.921e+00
## It: 148; obj: 2.477e+00; abs: 5.418e-01; rel: 2.800e-01; norm: 9.125e-01; mom: 8.907e+00;
## best it: 121; best obj: 1.921e+00
## It: 149; obj: 1.937e+00; abs: 5.392e-01; rel: 2.177e-01; norm: 1.042e+00; mom: 8.884e+00;
## best it: 121; best obj: 1.921e+00
## It: 150; obj: 2.491e+00; abs: 5.532e-01; rel: 2.855e-01; norm: 9.040e-01; mom: 8.914e+00;
## best it: 121; best obj: 1.921e+00
```

Iteration 150
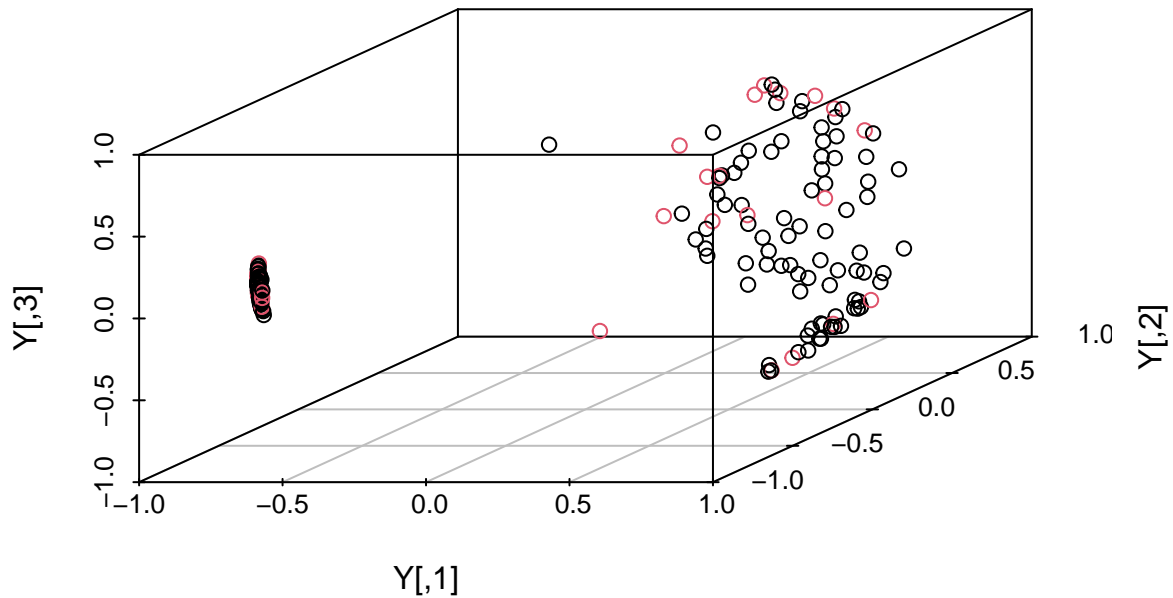

```
## It: 151; obj: 1.972e+00; abs: 5.187e-01; rel: 2.083e-01; norm: 1.046e+00; mom: 8.892e+00;
## best it: 121; best obj: 1.921e+00
## It: 152; obj: 2.477e+00; abs: 5.056e-01; rel: 2.564e-01; norm: 9.183e-01; mom: 8.940e+00;
## best it: 121; best obj: 1.921e+00
## It: 153; obj: 1.979e+00; abs: 4.983e-01; rel: 2.011e-01; norm: 1.037e+00; mom: 8.955e+00;
## best it: 121; best obj: 1.921e+00
## It: 154; obj: 2.484e+00; abs: 5.051e-01; rel: 2.552e-01; norm: 9.215e-01; mom: 9.014e+00;
## best it: 121; best obj: 1.921e+00
## It: 155; obj: 1.977e+00; abs: 5.074e-01; rel: 2.043e-01; norm: 1.038e+00; mom: 8.979e+00;
## best it: 121; best obj: 1.921e+00
## It: 156; obj: 2.468e+00; abs: 4.915e-01; rel: 2.486e-01; norm: 9.200e-01; mom: 9.000e+00;
## best it: 121; best obj: 1.921e+00
```

```
## It: 157; obj: 1.956e+00; abs: 5.121e-01; rel: 2.075e-01; norm: 1.043e+00; mom: 8.973e+00;
## best it: 121; best obj: 1.921e+00
## It: 158; obj: 2.476e+00; abs: 5.197e-01; rel: 2.657e-01; norm: 9.163e-01; mom: 8.969e+00;
## best it: 121; best obj: 1.921e+00
## It: 159; obj: 1.958e+00; abs: 5.180e-01; rel: 2.092e-01; norm: 1.033e+00; mom: 8.976e+00;
## best it: 121; best obj: 1.921e+00
## It: 160; obj: 2.473e+00; abs: 5.156e-01; rel: 2.634e-01; norm: 9.157e-01; mom: 8.982e+00;
## best it: 121; best obj: 1.921e+00
## It: 161; obj: 1.949e+00; abs: 5.241e-01; rel: 2.119e-01; norm: 1.034e+00; mom: 8.975e+00;
## best it: 121; best obj: 1.921e+00
## It: 162; obj: 2.479e+00; abs: 5.295e-01; rel: 2.716e-01; norm: 9.103e-01; mom: 8.989e+00;
## best it: 121; best obj: 1.921e+00
## It: 163; obj: 1.960e+00; abs: 5.190e-01; rel: 2.094e-01; norm: 1.032e+00; mom: 8.975e+00;
## best it: 121; best obj: 1.921e+00
## It: 164; obj: 2.474e+00; abs: 5.138e-01; rel: 2.622e-01; norm: 9.142e-01; mom: 8.994e+00;
## best it: 121; best obj: 1.921e+00
## It: 165; obj: 1.955e+00; abs: 5.187e-01; rel: 2.097e-01; norm: 1.035e+00; mom: 8.970e+00;
## best it: 121; best obj: 1.921e+00
## It: 166; obj: 2.485e+00; abs: 5.297e-01; rel: 2.710e-01; norm: 9.103e-01; mom: 8.981e+00;
## best it: 121; best obj: 1.921e+00
## It: 167; obj: 1.967e+00; abs: 5.180e-01; rel: 2.085e-01; norm: 1.033e+00; mom: 8.982e+00;
## best it: 121; best obj: 1.921e+00
## It: 168; obj: 2.475e+00; abs: 5.080e-01; rel: 2.583e-01; norm: 9.166e-01; mom: 9.009e+00;
## best it: 121; best obj: 1.921e+00
## It: 169; obj: 1.945e+00; abs: 5.298e-01; rel: 2.141e-01; norm: 1.037e+00; mom: 8.974e+00;
## best it: 121; best obj: 1.921e+00
## It: 170; obj: 2.480e+00; abs: 5.353e-01; rel: 2.753e-01; norm: 9.105e-01; mom: 8.977e+00;
## best it: 121; best obj: 1.921e+00
## It: 171; obj: 1.962e+00; abs: 5.183e-01; rel: 2.090e-01; norm: 1.033e+00; mom: 8.967e+00;
## best it: 121; best obj: 1.921e+00
## It: 172; obj: 2.472e+00; abs: 5.098e-01; rel: 2.598e-01; norm: 9.123e-01; mom: 9.009e+00;
## best it: 121; best obj: 1.921e+00
## It: 173; obj: 1.942e+00; abs: 5.301e-01; rel: 2.145e-01; norm: 1.037e+00; mom: 8.972e+00;
## best it: 121; best obj: 1.921e+00
## It: 174; obj: 2.482e+00; abs: 5.407e-01; rel: 2.785e-01; norm: 9.081e-01; mom: 8.964e+00;
## best it: 121; best obj: 1.921e+00
## It: 175; obj: 1.968e+00; abs: 5.142e-01; rel: 2.072e-01; norm: 1.033e+00; mom: 8.962e+00;
## best it: 121; best obj: 1.921e+00
```

Iteration 175
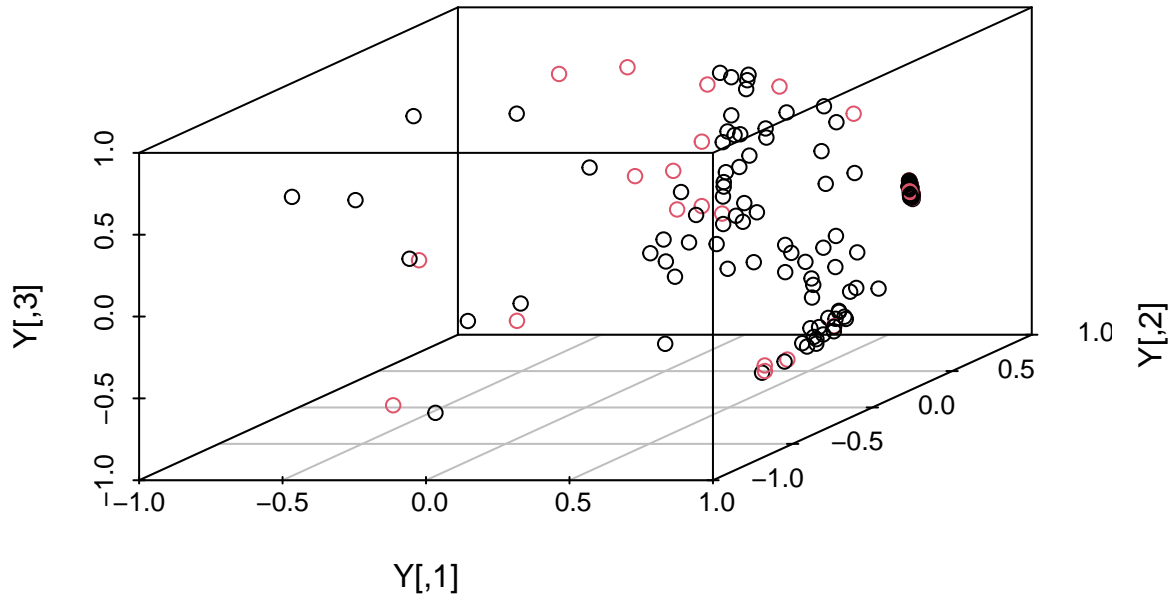

```
## It: 176; obj: 2.470e+00; abs: 5.018e-01; rel: 2.550e-01; norm: 9.131e-01; mom: 9.021e+00;
## best it: 121; best obj: 1.921e+00
## It: 177; obj: 1.937e+00; abs: 5.332e-01; rel: 2.159e-01; norm: 1.039e+00; mom: 8.975e+00;
## best it: 121; best obj: 1.921e+00
## It: 178; obj: 2.481e+00; abs: 5.442e-01; rel: 2.810e-01; norm: 9.077e-01; mom: 8.956e+00;
## best it: 121; best obj: 1.921e+00
## It: 179; obj: 1.965e+00; abs: 5.156e-01; rel: 2.078e-01; norm: 1.030e+00; mom: 8.962e+00;
## best it: 121; best obj: 1.921e+00
## It: 180; obj: 2.469e+00; abs: 5.041e-01; rel: 2.565e-01; norm: 9.128e-01; mom: 9.021e+00;
## best it: 121; best obj: 1.921e+00
## It: 181; obj: 1.937e+00; abs: 5.324e-01; rel: 2.156e-01; norm: 1.038e+00; mom: 8.971e+00;
## best it: 121; best obj: 1.921e+00
## It: 182; obj: 2.480e+00; abs: 5.425e-01; rel: 2.801e-01; norm: 9.085e-01; mom: 8.960e+00;
## best it: 121; best obj: 1.921e+00
## It: 183; obj: 1.971e+00; abs: 5.083e-01; rel: 2.050e-01; norm: 1.029e+00; mom: 8.960e+00;
## best it: 121; best obj: 1.921e+00
## It: 184; obj: 2.469e+00; abs: 4.981e-01; rel: 2.527e-01; norm: 9.163e-01; mom: 9.024e+00;
## best it: 121; best obj: 1.921e+00
## It: 185; obj: 1.938e+00; abs: 5.315e-01; rel: 2.152e-01; norm: 1.039e+00; mom: 8.972e+00;
## best it: 121; best obj: 1.921e+00
## It: 186; obj: 2.479e+00; abs: 5.414e-01; rel: 2.794e-01; norm: 9.100e-01; mom: 8.957e+00;
## best it: 121; best obj: 1.921e+00
## It: 187; obj: 1.974e+00; abs: 5.055e-01; rel: 2.039e-01; norm: 1.030e+00; mom: 8.962e+00;
## best it: 121; best obj: 1.921e+00
## It: 188; obj: 2.472e+00; abs: 4.978e-01; rel: 2.522e-01; norm: 9.162e-01; mom: 9.021e+00;
## best it: 121; best obj: 1.921e+00
## It: 189; obj: 1.946e+00; abs: 5.254e-01; rel: 2.126e-01; norm: 1.039e+00; mom: 8.974e+00;
## best it: 121; best obj: 1.921e+00
## It: 190; obj: 2.480e+00; abs: 5.333e-01; rel: 2.740e-01; norm: 9.121e-01; mom: 8.967e+00;
## best it: 121; best obj: 1.921e+00
## It: 191; obj: 1.967e+00; abs: 5.122e-01; rel: 2.066e-01; norm: 1.032e+00; mom: 8.961e+00;
```
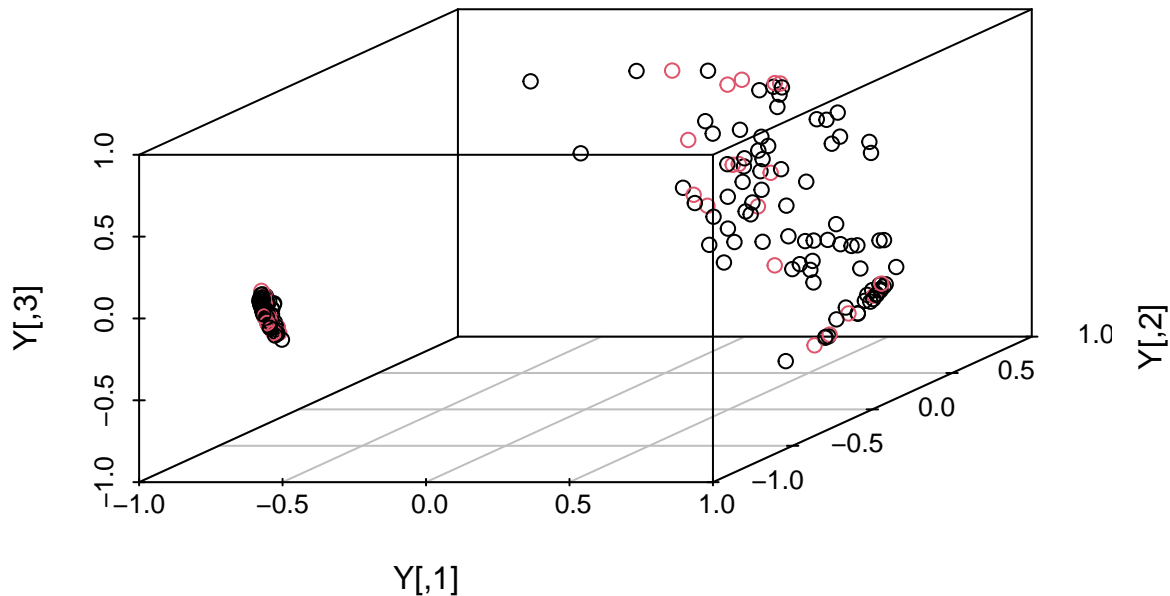
```
## best it: 121; best obj: 1.921e+00
## It: 192; obj: 2.472e+00; abs: 5.044e-01; rel: 2.564e-01; norm: 9.126e-01; mom: 9.017e+00;
## best it: 121; best obj: 1.921e+00
## It: 193; obj: 1.937e+00; abs: 5.345e-01; rel: 2.163e-01; norm: 1.040e+00; mom: 8.974e+00;
## best it: 121; best obj: 1.921e+00
## It: 194; obj: 2.483e+00; abs: 5.458e-01; rel: 2.818e-01; norm: 9.056e-01; mom: 8.957e+00;
## best it: 121; best obj: 1.921e+00
## It: 195; obj: 1.974e+00; abs: 5.085e-01; rel: 2.048e-01; norm: 1.031e+00; mom: 8.959e+00;
## best it: 121; best obj: 1.921e+00
## It: 196; obj: 2.475e+00; abs: 5.001e-01; rel: 2.533e-01; norm: 9.127e-01; mom: 9.026e+00;
## best it: 121; best obj: 1.921e+00
## It: 197; obj: 1.946e+00; abs: 5.289e-01; rel: 2.137e-01; norm: 1.041e+00; mom: 8.974e+00;
## best it: 121; best obj: 1.921e+00
## It: 198; obj: 2.485e+00; abs: 5.389e-01; rel: 2.770e-01; norm: 9.082e-01; mom: 8.960e+00;
## best it: 121; best obj: 1.921e+00
## It: 199; obj: 1.981e+00; abs: 5.034e-01; rel: 2.026e-01; norm: 1.031e+00; mom: 8.962e+00;
## best it: 121; best obj: 1.921e+00
## It: 200; obj: 2.469e+00; abs: 4.882e-01; rel: 2.464e-01; norm: 9.192e-01; mom: 9.029e+00;
## best it: 121; best obj: 1.921e+00
```

Iteration 200


```
## It: 201; obj: 1.932e+00; abs: 5.371e-01; rel: 2.175e-01; norm: 1.042e+00; mom: 8.973e+00;
## best it: 121; best obj: 1.921e+00
## It: 202; obj: 2.478e+00; abs: 5.457e-01; rel: 2.824e-01; norm: 9.065e-01; mom: 8.952e+00;
## best it: 121; best obj: 1.921e+00
## It: 203; obj: 1.972e+00; abs: 5.056e-01; rel: 2.040e-01; norm: 1.027e+00; mom: 8.962e+00;
## best it: 121; best obj: 1.921e+00
## It: 204; obj: 2.474e+00; abs: 5.019e-01; rel: 2.545e-01; norm: 9.154e-01; mom: 9.017e+00;
## best it: 121; best obj: 1.921e+00
## It: 205; obj: 1.944e+00; abs: 5.299e-01; rel: 2.142e-01; norm: 1.038e+00; mom: 8.977e+00;
## best it: 121; best obj: 1.921e+00
## It: 206; obj: 2.480e+00; abs: 5.352e-01; rel: 2.753e-01; norm: 9.104e-01; mom: 8.973e+00;
## best it: 121; best obj: 1.921e+00
```

```
## It: 207; obj: 1.972e+00; abs: 5.071e-01; rel: 2.045e-01; norm: 1.032e+00; mom: 8.962e+00;
## best it: 121; best obj: 1.921e+00
## It: 208; obj: 2.475e+00; abs: 5.021e-01; rel: 2.546e-01; norm: 9.146e-01; mom: 9.015e+00;
## best it: 121; best obj: 1.921e+00
## It: 209; obj: 1.945e+00; abs: 5.292e-01; rel: 2.139e-01; norm: 1.040e+00; mom: 8.977e+00;
## best it: 121; best obj: 1.921e+00
## It: 210; obj: 2.481e+00; abs: 5.357e-01; rel: 2.754e-01; norm: 9.100e-01; mom: 8.973e+00;
## best it: 121; best obj: 1.921e+00
## It: 211; obj: 1.973e+00; abs: 5.076e-01; rel: 2.046e-01; norm: 1.033e+00; mom: 8.962e+00;
## best it: 121; best obj: 1.921e+00
## It: 212; obj: 2.474e+00; abs: 5.006e-01; rel: 2.537e-01; norm: 9.140e-01; mom: 9.018e+00;
## best it: 121; best obj: 1.921e+00
## It: 213; obj: 1.946e+00; abs: 5.279e-01; rel: 2.134e-01; norm: 1.041e+00; mom: 8.977e+00;
## best it: 121; best obj: 1.921e+00
## It: 214; obj: 2.487e+00; abs: 5.405e-01; rel: 2.777e-01; norm: 9.079e-01; mom: 8.963e+00;
## best it: 121; best obj: 1.921e+00
## It: 215; obj: 1.978e+00; abs: 5.090e-01; rel: 2.047e-01; norm: 1.034e+00; mom: 8.962e+00;
## best it: 121; best obj: 1.921e+00
## It: 216; obj: 2.473e+00; abs: 4.954e-01; rel: 2.505e-01; norm: 9.155e-01; mom: 9.026e+00;
## best it: 121; best obj: 1.921e+00
## It: 217; obj: 1.938e+00; abs: 5.348e-01; rel: 2.163e-01; norm: 1.040e+00; mom: 8.974e+00;
## best it: 121; best obj: 1.921e+00
## It: 218; obj: 2.480e+00; abs: 5.422e-01; rel: 2.797e-01; norm: 9.068e-01; mom: 8.961e+00;
## best it: 121; best obj: 1.921e+00
## It: 219; obj: 1.972e+00; abs: 5.084e-01; rel: 2.050e-01; norm: 1.030e+00; mom: 8.961e+00;
## best it: 121; best obj: 1.921e+00
## It: 220; obj: 2.471e+00; abs: 4.985e-01; rel: 2.528e-01; norm: 9.152e-01; mom: 9.022e+00;
## best it: 121; best obj: 1.921e+00
## It: 221; obj: 1.939e+00; abs: 5.314e-01; rel: 2.151e-01; norm: 1.040e+00; mom: 8.973e+00;
## best it: 121; best obj: 1.921e+00
## It: 222; obj: 2.480e+00; abs: 5.413e-01; rel: 2.791e-01; norm: 9.085e-01; mom: 8.959e+00;
## best it: 121; best obj: 1.921e+00
## It: 223; obj: 1.975e+00; abs: 5.055e-01; rel: 2.038e-01; norm: 1.030e+00; mom: 8.962e+00;
## best it: 121; best obj: 1.921e+00
## It: 224; obj: 2.472e+00; abs: 4.967e-01; rel: 2.515e-01; norm: 9.157e-01; mom: 9.023e+00;
## best it: 121; best obj: 1.921e+00
## It: 225; obj: 1.940e+00; abs: 5.316e-01; rel: 2.151e-01; norm: 1.040e+00; mom: 8.974e+00;
## best it: 121; best obj: 1.921e+00
```

Iteration 225
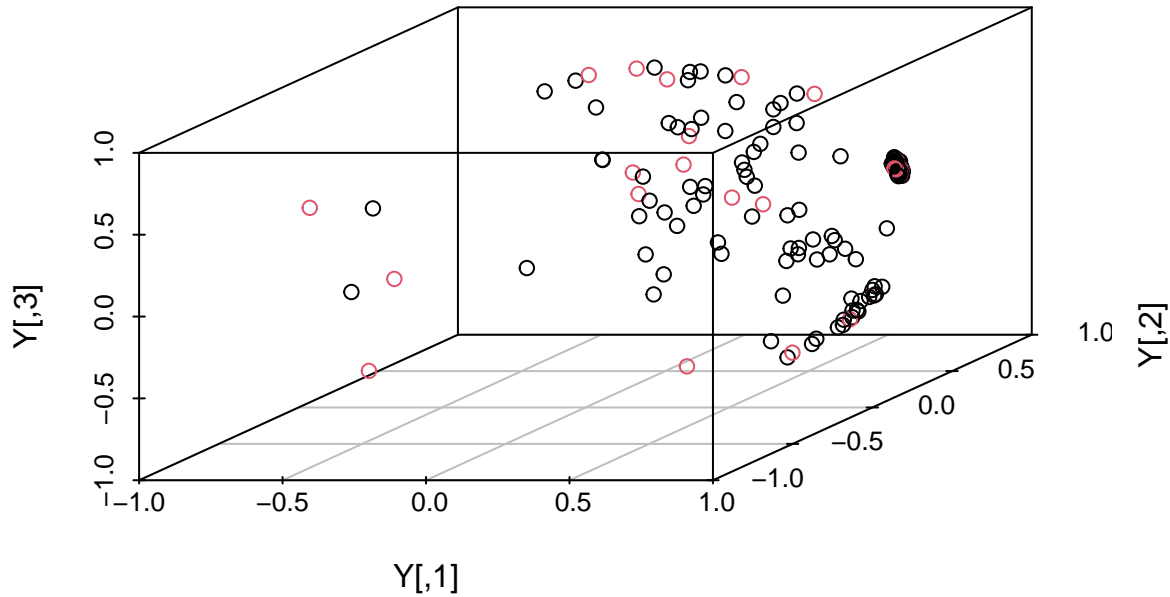

```
## It: 226; obj: 2.481e+00; abs: 5.408e-01; rel: 2.788e-01; norm: 9.087e-01; mom: 8.960e+00;
## best it: 121; best obj: 1.921e+00
## It: 227; obj: 1.975e+00; abs: 5.055e-01; rel: 2.037e-01; norm: 1.030e+00; mom: 8.961e+00;
## best it: 121; best obj: 1.921e+00
## It: 228; obj: 2.473e+00; abs: 4.980e-01; rel: 2.521e-01; norm: 9.150e-01; mom: 9.021e+00;
## best it: 121; best obj: 1.921e+00
## It: 229; obj: 1.949e+00; abs: 5.242e-01; rel: 2.120e-01; norm: 1.040e+00; mom: 8.974e+00;
## best it: 121; best obj: 1.921e+00
## It: 230; obj: 2.482e+00; abs: 5.332e-01; rel: 2.736e-01; norm: 9.109e-01; mom: 8.966e+00;
## best it: 121; best obj: 1.921e+00
## It: 231; obj: 1.977e+00; abs: 5.057e-01; rel: 2.037e-01; norm: 1.032e+00; mom: 8.961e+00;
## best it: 121; best obj: 1.921e+00
## It: 232; obj: 2.474e+00; abs: 4.977e-01; rel: 2.518e-01; norm: 9.146e-01; mom: 9.020e+00;
## best it: 121; best obj: 1.921e+00
## It: 233; obj: 1.941e+00; abs: 5.328e-01; rel: 2.153e-01; norm: 1.042e+00; mom: 8.975e+00;
## best it: 121; best obj: 1.921e+00
## It: 234; obj: 2.483e+00; abs: 5.416e-01; rel: 2.790e-01; norm: 9.074e-01; mom: 8.957e+00;
## best it: 121; best obj: 1.921e+00
## It: 235; obj: 1.972e+00; abs: 5.107e-01; rel: 2.057e-01; norm: 1.031e+00; mom: 8.960e+00;
## best it: 121; best obj: 1.921e+00
## It: 236; obj: 2.473e+00; abs: 5.009e-01; rel: 2.540e-01; norm: 9.128e-01; mom: 9.024e+00;
## best it: 121; best obj: 1.921e+00
## It: 237; obj: 1.944e+00; abs: 5.292e-01; rel: 2.140e-01; norm: 1.041e+00; mom: 8.973e+00;
## best it: 121; best obj: 1.921e+00
## It: 238; obj: 2.484e+00; abs: 5.400e-01; rel: 2.778e-01; norm: 9.077e-01; mom: 8.961e+00;
## best it: 121; best obj: 1.921e+00
## It: 239; obj: 1.983e+00; abs: 5.015e-01; rel: 2.019e-01; norm: 1.032e+00; mom: 8.961e+00;
## best it: 121; best obj: 1.921e+00
## It: 240; obj: 2.474e+00; abs: 4.910e-01; rel: 2.477e-01; norm: 9.179e-01; mom: 9.026e+00;
## best it: 121; best obj: 1.921e+00
## It: 241; obj: 1.940e+00; abs: 5.336e-01; rel: 2.157e-01; norm: 1.043e+00; mom: 8.974e+00;
```

```
## best it: 121; best obj: 1.921e+00
## It: 242; obj: 2.480e+00; abs: 5.397e-01; rel: 2.782e-01; norm: 9.098e-01; mom: 8.956e+00;
## best it: 121; best obj: 1.921e+00
## It: 243; obj: 1.970e+00; abs: 5.099e-01; rel: 2.057e-01; norm: 1.029e+00; mom: 8.963e+00;
## best it: 121; best obj: 1.921e+00
## It: 244; obj: 2.473e+00; abs: 5.034e-01; rel: 2.556e-01; norm: 9.139e-01; mom: 9.017e+00;
## best it: 121; best obj: 1.921e+00
## It: 245; obj: 1.941e+00; abs: 5.323e-01; rel: 2.152e-01; norm: 1.039e+00; mom: 8.975e+00;
## best it: 121; best obj: 1.921e+00
## It: 246; obj: 2.479e+00; abs: 5.387e-01; rel: 2.775e-01; norm: 9.093e-01; mom: 8.969e+00;
## best it: 121; best obj: 1.921e+00
## It: 247; obj: 1.969e+00; abs: 5.109e-01; rel: 2.060e-01; norm: 1.031e+00; mom: 8.960e+00;
## best it: 121; best obj: 1.921e+00
## It: 248; obj: 2.461e+00; abs: 4.921e-01; rel: 2.500e-01; norm: 9.135e-01; mom: 1.443e+01;
## best it: 121; best obj: 1.921e+00
## It: 249; obj: 1.921e+00; abs: 5.398e-01; rel: 2.193e-01; norm: 1.045e+00; mom: 1.428e+01;
## best it: 249; best obj: 1.921e+00
## It: 250; obj: 2.461e+00; abs: 5.403e-01; rel: 2.812e-01; norm: 9.020e-01; mom: 1.426e+01;
## best it: 249; best obj: 1.921e+00
```

Iteration 250
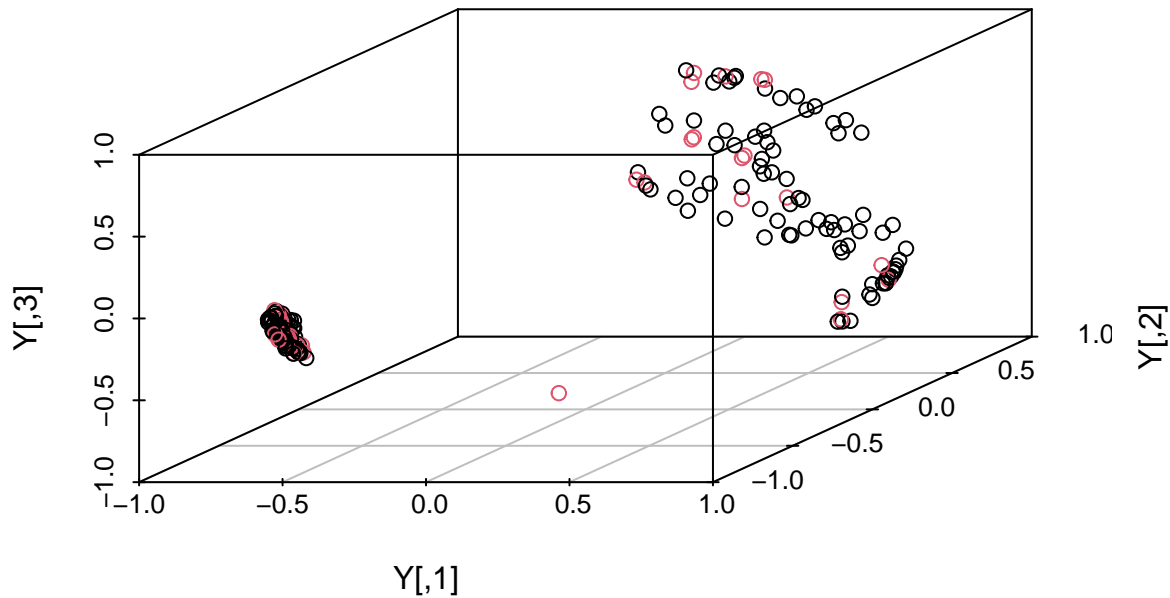

```
## It: 251; obj: 1.962e+00; abs: 4.993e-01; rel: 2.029e-01; norm: 1.022e+00; mom: 1.426e+01;
## best it: 249; best obj: 1.921e+00
## It: 252; obj: 2.464e+00; abs: 5.018e-01; rel: 2.557e-01; norm: 9.079e-01; mom: 1.435e+01;
## best it: 249; best obj: 1.921e+00
## It: 253; obj: 1.902e+00; abs: 5.614e-01; rel: 2.279e-01; norm: 1.042e+00; mom: 1.429e+01;
## best it: 253; best obj: 1.902e+00
## It: 254; obj: 2.461e+00; abs: 5.589e-01; rel: 2.938e-01; norm: 8.942e-01; mom: 1.423e+01;
## best it: 253; best obj: 1.902e+00
## It: 255; obj: 1.952e+00; abs: 5.092e-01; rel: 2.069e-01; norm: 1.017e+00; mom: 1.426e+01;
## best it: 253; best obj: 1.902e+00
## It: 256; obj: 2.464e+00; abs: 5.119e-01; rel: 2.622e-01; norm: 9.017e-01; mom: 1.437e+01;
## best it: 253; best obj: 1.902e+00
```

```
## It: 257; obj: 1.924e+00; abs: 5.401e-01; rel: 2.192e-01; norm: 1.035e+00; mom: 1.427e+01;
## best it: 253; best obj: 1.902e+00
## It: 258; obj: 2.465e+00; abs: 5.410e-01; rel: 2.812e-01; norm: 8.983e-01; mom: 1.428e+01;
## best it: 253; best obj: 1.902e+00
## It: 259; obj: 1.966e+00; abs: 4.990e-01; rel: 2.024e-01; norm: 1.024e+00; mom: 1.425e+01;
## best it: 253; best obj: 1.902e+00
## It: 260; obj: 2.465e+00; abs: 4.996e-01; rel: 2.541e-01; norm: 9.085e-01; mom: 1.437e+01;
## best it: 253; best obj: 1.902e+00
## It: 261; obj: 1.934e+00; abs: 5.311e-01; rel: 2.154e-01; norm: 1.042e+00; mom: 1.419e+01;
## best it: 253; best obj: 1.902e+00
## It: 262; obj: 2.479e+00; abs: 5.451e-01; rel: 2.818e-01; norm: 9.016e-01; mom: 1.412e+01;
## best it: 253; best obj: 1.902e+00
## It: 263; obj: 1.958e+00; abs: 5.211e-01; rel: 2.102e-01; norm: 1.031e+00; mom: 1.420e+01;
## best it: 253; best obj: 1.902e+00
## It: 264; obj: 2.474e+00; abs: 5.158e-01; rel: 2.634e-01; norm: 9.055e-01; mom: 1.428e+01;
## best it: 253; best obj: 1.902e+00
## It: 265; obj: 1.908e+00; abs: 5.666e-01; rel: 2.290e-01; norm: 1.039e+00; mom: 1.418e+01;
## best it: 253; best obj: 1.902e+00
## It: 266; obj: 2.475e+00; abs: 5.676e-01; rel: 2.976e-01; norm: 8.927e-01; mom: 1.414e+01;
## best it: 253; best obj: 1.902e+00
## It: 267; obj: 1.946e+00; abs: 5.290e-01; rel: 2.137e-01; norm: 1.027e+00; mom: 1.418e+01;
## best it: 253; best obj: 1.902e+00
## It: 268; obj: 2.472e+00; abs: 5.262e-01; rel: 2.704e-01; norm: 9.015e-01; mom: 1.428e+01;
## best it: 253; best obj: 1.902e+00
## It: 269; obj: 1.904e+00; abs: 5.681e-01; rel: 2.298e-01; norm: 1.039e+00; mom: 1.418e+01;
## best it: 253; best obj: 1.902e+00
## It: 270; obj: 2.477e+00; abs: 5.722e-01; rel: 3.005e-01; norm: 8.901e-01; mom: 1.413e+01;
## best it: 253; best obj: 1.902e+00
## It: 271; obj: 1.953e+00; abs: 5.237e-01; rel: 2.115e-01; norm: 1.024e+00; mom: 1.417e+01;
## best it: 253; best obj: 1.902e+00
## It: 272; obj: 2.476e+00; abs: 5.236e-01; rel: 2.681e-01; norm: 9.017e-01; mom: 1.430e+01;
## best it: 253; best obj: 1.902e+00
## It: 273; obj: 1.907e+00; abs: 5.699e-01; rel: 2.301e-01; norm: 1.034e+00; mom: 1.417e+01;
## best it: 253; best obj: 1.902e+00
## It: 274; obj: 2.482e+00; abs: 5.757e-01; rel: 3.020e-01; norm: 8.837e-01; mom: 1.420e+01;
## best it: 253; best obj: 1.902e+00
## It: 275; obj: 1.953e+00; abs: 5.291e-01; rel: 2.131e-01; norm: 1.022e+00; mom: 1.417e+01;
## best it: 253; best obj: 1.902e+00
```

Iteration 275
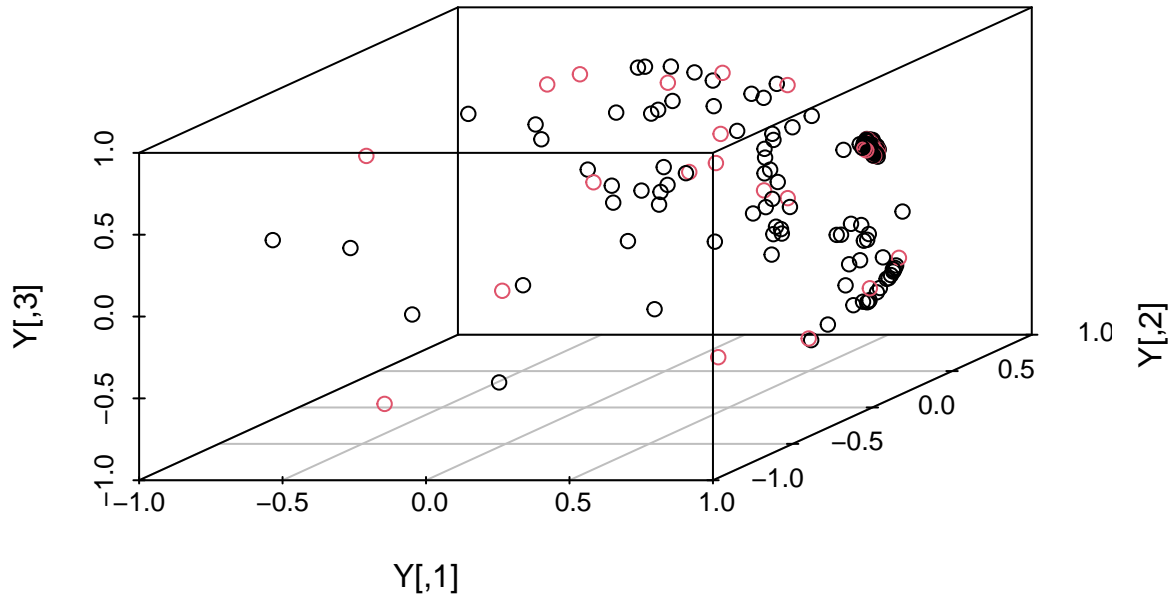

```
## It: 276; obj: 2.475e+00; abs: 5.214e-01; rel: 2.670e-01; norm: 8.983e-01; mom: 1.432e+01;
## best it: 253; best obj: 1.902e+00
## It: 277; obj: 1.918e+00; abs: 5.568e-01; rel: 2.250e-01; norm: 1.039e+00; mom: 1.417e+01;
## best it: 253; best obj: 1.902e+00
## It: 278; obj: 2.470e+00; abs: 5.517e-01; rel: 2.876e-01; norm: 8.941e-01; mom: 1.414e+01;
## best it: 253; best obj: 1.902e+00
## It: 279; obj: 1.934e+00; abs: 5.353e-01; rel: 2.168e-01; norm: 1.032e+00; mom: 1.419e+01;
## best it: 253; best obj: 1.902e+00
## It: 280; obj: 2.474e+00; abs: 5.394e-01; rel: 2.789e-01; norm: 9.009e-01; mom: 1.422e+01;
## best it: 253; best obj: 1.902e+00
## It: 281; obj: 1.928e+00; abs: 5.460e-01; rel: 2.207e-01; norm: 1.034e+00; mom: 1.418e+01;
## best it: 253; best obj: 1.902e+00
## It: 282; obj: 2.476e+00; abs: 5.480e-01; rel: 2.843e-01; norm: 8.952e-01; mom: 1.417e+01;
## best it: 253; best obj: 1.902e+00
## It: 283; obj: 1.928e+00; abs: 5.476e-01; rel: 2.212e-01; norm: 1.032e+00; mom: 1.418e+01;
## best it: 253; best obj: 1.902e+00
## It: 284; obj: 2.477e+00; abs: 5.492e-01; rel: 2.849e-01; norm: 8.948e-01; mom: 1.420e+01;
## best it: 253; best obj: 1.902e+00
## It: 285; obj: 1.927e+00; abs: 5.499e-01; rel: 2.220e-01; norm: 1.030e+00; mom: 1.418e+01;
## best it: 253; best obj: 1.902e+00
## It: 286; obj: 2.470e+00; abs: 5.422e-01; rel: 2.813e-01; norm: 8.932e-01; mom: 1.422e+01;
## best it: 253; best obj: 1.902e+00
## It: 287; obj: 1.946e+00; abs: 5.236e-01; rel: 2.120e-01; norm: 1.037e+00; mom: 1.420e+01;
## best it: 253; best obj: 1.902e+00
## It: 288; obj: 2.475e+00; abs: 5.288e-01; rel: 2.718e-01; norm: 9.036e-01; mom: 1.421e+01;
## best it: 253; best obj: 1.902e+00
## It: 289; obj: 1.935e+00; abs: 5.402e-01; rel: 2.183e-01; norm: 1.038e+00; mom: 1.419e+01;
## best it: 253; best obj: 1.902e+00
## It: 290; obj: 2.463e+00; abs: 5.285e-01; rel: 2.732e-01; norm: 8.988e-01; mom: 1.422e+01;
## best it: 253; best obj: 1.902e+00
## It: 291; obj: 1.922e+00; abs: 5.409e-01; rel: 2.196e-01; norm: 1.036e+00; mom: 1.417e+01;
```

```
## best it: 253; best obj: 1.902e+00
## It: 292; obj: 2.471e+00; abs: 5.490e-01; rel: 2.856e-01; norm: 8.940e-01; mom: 1.417e+01;
## best it: 253; best obj: 1.902e+00
## It: 293; obj: 1.921e+00; abs: 5.503e-01; rel: 2.227e-01; norm: 1.030e+00; mom: 1.418e+01;
## best it: 253; best obj: 1.902e+00
## It: 294; obj: 2.462e+00; abs: 5.414e-01; rel: 2.818e-01; norm: 8.906e-01; mom: 1.421e+01;
## best it: 253; best obj: 1.902e+00
## It: 295; obj: 1.899e+00; abs: 5.632e-01; rel: 2.287e-01; norm: 1.037e+00; mom: 1.415e+01;
## best it: 295; best obj: 1.899e+00
## It: 296; obj: 2.464e+00; abs: 5.653e-01; rel: 2.977e-01; norm: 8.832e-01; mom: 1.416e+01;
## best it: 295; best obj: 1.899e+00
## It: 297; obj: 1.951e+00; abs: 5.139e-01; rel: 2.085e-01; norm: 1.028e+00; mom: 1.426e+01;
## best it: 295; best obj: 1.899e+00
## It: 298; obj: 2.450e+00; abs: 4.990e-01; rel: 2.558e-01; norm: 9.024e-01; mom: 1.437e+01;
## best it: 295; best obj: 1.899e+00
## It: 299; obj: 1.954e+00; abs: 4.954e-01; rel: 2.022e-01; norm: 1.040e+00; mom: 1.417e+01;
## best it: 295; best obj: 1.899e+00
## It: 300; obj: 2.460e+00; abs: 5.058e-01; rel: 2.588e-01; norm: 9.100e-01; mom: 1.418e+01;
## best it: 295; best obj: 1.899e+00
```

Iteration 300
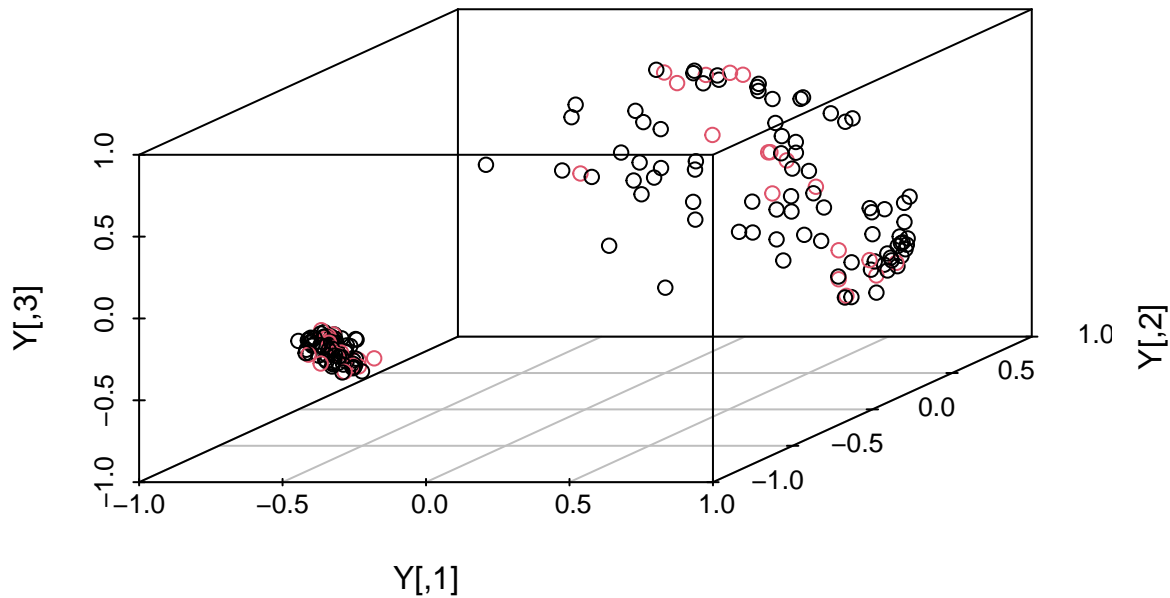

```
## It: 301; obj: 1.933e+00; abs: 5.265e-01; rel: 2.140e-01; norm: 1.042e+00; mom: 1.419e+01;
## best it: 295; best obj: 1.899e+00
## It: 302; obj: 2.452e+00; abs: 5.185e-01; rel: 2.681e-01; norm: 9.080e-01; mom: 1.417e+01;
## best it: 295; best obj: 1.899e+00
## It: 303; obj: 1.949e+00; abs: 5.034e-01; rel: 2.053e-01; norm: 1.035e+00; mom: 1.416e+01;
## best it: 295; best obj: 1.899e+00
## It: 304; obj: 2.468e+00; abs: 5.192e-01; rel: 2.665e-01; norm: 9.033e-01; mom: 1.420e+01;
## best it: 295; best obj: 1.899e+00
## It: 305; obj: 1.958e+00; abs: 5.097e-01; rel: 2.065e-01; norm: 1.035e+00; mom: 1.419e+01;
## best it: 295; best obj: 1.899e+00
## It: 306; obj: 2.453e+00; abs: 4.946e-01; rel: 2.526e-01; norm: 9.119e-01; mom: 1.422e+01;
## best it: 295; best obj: 1.899e+00
```

```
## It: 307; obj: 1.962e+00; abs: 4.906e-01; rel: 2.000e-01; norm: 1.038e+00; mom: 1.417e+01;
## best it: 295; best obj: 1.899e+00
## It: 308; obj: 2.481e+00; abs: 5.185e-01; rel: 2.643e-01; norm: 9.054e-01; mom: 1.420e+01;
## best it: 295; best obj: 1.899e+00
## It: 309; obj: 2.012e+00; abs: 4.683e-01; rel: 1.888e-01; norm: 1.047e+00; mom: 1.420e+01;
## best it: 295; best obj: 1.899e+00
## It: 310; obj: 2.451e+00; abs: 4.382e-01; rel: 2.177e-01; norm: 9.282e-01; mom: 1.416e+01;
## best it: 295; best obj: 1.899e+00
## It: 311; obj: 1.952e+00; abs: 4.987e-01; rel: 2.035e-01; norm: 1.052e+00; mom: 1.414e+01;
## best it: 295; best obj: 1.899e+00
## It: 312; obj: 2.460e+00; abs: 5.078e-01; rel: 2.602e-01; norm: 9.122e-01; mom: 1.411e+01;
## best it: 295; best obj: 1.899e+00
## It: 313; obj: 2.024e+00; abs: 4.356e-01; rel: 1.771e-01; norm: 1.041e+00; mom: 1.417e+01;
## best it: 295; best obj: 1.899e+00
## It: 314; obj: 2.443e+00; abs: 4.188e-01; rel: 2.069e-01; norm: 9.400e-01; mom: 1.421e+01;
## best it: 295; best obj: 1.899e+00
## It: 315; obj: 1.984e+00; abs: 4.592e-01; rel: 1.880e-01; norm: 1.056e+00; mom: 1.414e+01;
## best it: 295; best obj: 1.899e+00
## It: 316; obj: 2.474e+00; abs: 4.904e-01; rel: 2.472e-01; norm: 9.183e-01; mom: 1.411e+01;
## best it: 295; best obj: 1.899e+00
## It: 317; obj: 2.036e+00; abs: 4.380e-01; rel: 1.770e-01; norm: 1.038e+00; mom: 1.426e+01;
## best it: 295; best obj: 1.899e+00
## It: 318; obj: 2.463e+00; abs: 4.271e-01; rel: 2.098e-01; norm: 9.324e-01; mom: 1.424e+01;
## best it: 295; best obj: 1.899e+00
## It: 319; obj: 1.958e+00; abs: 5.054e-01; rel: 2.052e-01; norm: 1.057e+00; mom: 1.419e+01;
## best it: 295; best obj: 1.899e+00
## It: 320; obj: 2.458e+00; abs: 5.006e-01; rel: 2.557e-01; norm: 9.177e-01; mom: 1.412e+01;
## best it: 295; best obj: 1.899e+00
## It: 321; obj: 1.957e+00; abs: 5.014e-01; rel: 2.040e-01; norm: 1.042e+00; mom: 1.417e+01;
## best it: 295; best obj: 1.899e+00
## It: 322; obj: 2.471e+00; abs: 5.136e-01; rel: 2.624e-01; norm: 9.065e-01; mom: 1.419e+01;
## best it: 295; best obj: 1.899e+00
## It: 323; obj: 1.925e+00; abs: 5.453e-01; rel: 2.207e-01; norm: 1.043e+00; mom: 1.419e+01;
## best it: 295; best obj: 1.899e+00
## It: 324; obj: 2.458e+00; abs: 5.327e-01; rel: 2.767e-01; norm: 8.983e-01; mom: 1.417e+01;
## best it: 295; best obj: 1.899e+00
## It: 325; obj: 1.933e+00; abs: 5.247e-01; rel: 2.135e-01; norm: 1.027e+00; mom: 1.423e+01;
## best it: 295; best obj: 1.899e+00
```

Iteration 325
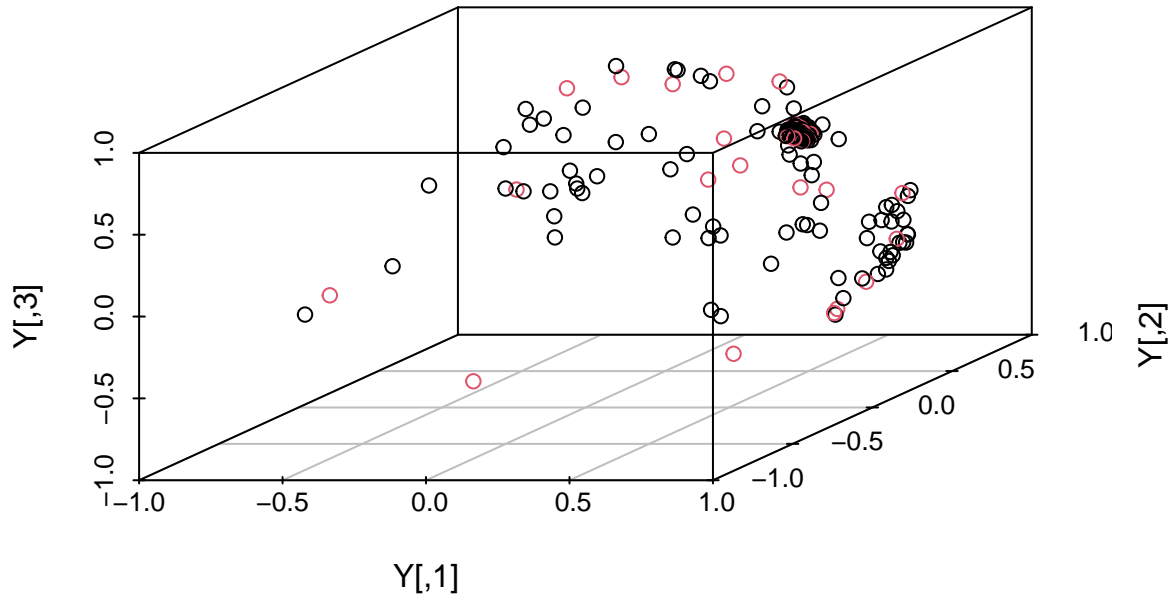

```
## It: 326; obj: 2.460e+00; abs: 5.270e-01; rel: 2.726e-01; norm: 8.928e-01; mom: 1.429e+01;
## best it: 295; best obj: 1.899e+00
## It: 327; obj: 1.951e+00; abs: 5.091e-01; rel: 2.069e-01; norm: 1.027e+00; mom: 1.425e+01;
## best it: 295; best obj: 1.899e+00
## It: 328; obj: 2.451e+00; abs: 4.994e-01; rel: 2.559e-01; norm: 9.055e-01; mom: 1.433e+01;
## best it: 295; best obj: 1.899e+00
## It: 329; obj: 1.980e+00; abs: 4.709e-01; rel: 1.921e-01; norm: 1.028e+00; mom: 1.425e+01;
## best it: 295; best obj: 1.899e+00
## It: 330; obj: 2.466e+00; abs: 4.859e-01; rel: 2.454e-01; norm: 9.069e-01; mom: 1.435e+01;
## best it: 295; best obj: 1.899e+00
## It: 331; obj: 1.952e+00; abs: 5.141e-01; rel: 2.085e-01; norm: 1.039e+00; mom: 1.426e+01;
## best it: 295; best obj: 1.899e+00
## It: 332; obj: 2.451e+00; abs: 4.993e-01; rel: 2.558e-01; norm: 9.061e-01; mom: 1.428e+01;
## best it: 295; best obj: 1.899e+00
## It: 333; obj: 1.963e+00; abs: 4.877e-01; rel: 1.990e-01; norm: 1.030e+00; mom: 1.428e+01;
## best it: 295; best obj: 1.899e+00
## It: 334; obj: 2.467e+00; abs: 5.038e-01; rel: 2.566e-01; norm: 9.028e-01; mom: 1.430e+01;
## best it: 295; best obj: 1.899e+00
## It: 335; obj: 1.965e+00; abs: 5.021e-01; rel: 2.035e-01; norm: 1.037e+00; mom: 1.425e+01;
## best it: 295; best obj: 1.899e+00
## It: 336; obj: 2.437e+00; abs: 4.716e-01; rel: 2.400e-01; norm: 9.153e-01; mom: 1.430e+01;
## best it: 295; best obj: 1.899e+00
## It: 337; obj: 1.944e+00; abs: 4.929e-01; rel: 2.023e-01; norm: 1.037e+00; mom: 1.425e+01;
## best it: 295; best obj: 1.899e+00
## It: 338; obj: 2.453e+00; abs: 5.089e-01; rel: 2.618e-01; norm: 9.027e-01; mom: 1.423e+01;
## best it: 295; best obj: 1.899e+00
## It: 339; obj: 1.961e+00; abs: 4.919e-01; rel: 2.006e-01; norm: 1.027e+00; mom: 1.427e+01;
## best it: 295; best obj: 1.899e+00
## It: 340; obj: 2.435e+00; abs: 4.742e-01; rel: 2.419e-01; norm: 9.129e-01; mom: 1.432e+01;
## best it: 295; best obj: 1.899e+00
## It: 341; obj: 1.991e+00; abs: 4.437e-01; rel: 1.822e-01; norm: 1.029e+00; mom: 1.425e+01;
```

```
## best it: 295; best obj: 1.899e+00
## It: 342; obj: 2.452e+00; abs: 4.608e-01; rel: 2.314e-01; norm: 9.209e-01; mom: 1.418e+01;
## best it: 295; best obj: 1.899e+00
## It: 343; obj: 1.981e+00; abs: 4.711e-01; rel: 1.921e-01; norm: 1.043e+00; mom: 1.418e+01;
## best it: 295; best obj: 1.899e+00
## It: 344; obj: 2.434e+00; abs: 4.528e-01; rel: 2.286e-01; norm: 9.279e-01; mom: 1.422e+01;
## best it: 295; best obj: 1.899e+00
## It: 345; obj: 1.975e+00; abs: 4.585e-01; rel: 1.884e-01; norm: 1.037e+00; mom: 1.417e+01;
## best it: 295; best obj: 1.899e+00
## It: 346; obj: 2.455e+00; abs: 4.796e-01; rel: 2.428e-01; norm: 9.195e-01; mom: 1.417e+01;
## best it: 295; best obj: 1.899e+00
## It: 347; obj: 1.975e+00; abs: 4.802e-01; rel: 1.956e-01; norm: 1.036e+00; mom: 1.416e+01;
## best it: 295; best obj: 1.899e+00
## It: 348; obj: 2.432e+00; abs: 4.572e-01; rel: 2.315e-01; norm: 9.259e-01; mom: 1.421e+01;
## best it: 295; best obj: 1.899e+00
## It: 349; obj: 1.962e+00; abs: 4.694e-01; rel: 1.930e-01; norm: 1.033e+00; mom: 1.416e+01;
## best it: 295; best obj: 1.899e+00
## It: 350; obj: 2.452e+00; abs: 4.898e-01; rel: 2.496e-01; norm: 9.148e-01; mom: 1.413e+01;
## best it: 295; best obj: 1.899e+00
```

Iteration 350
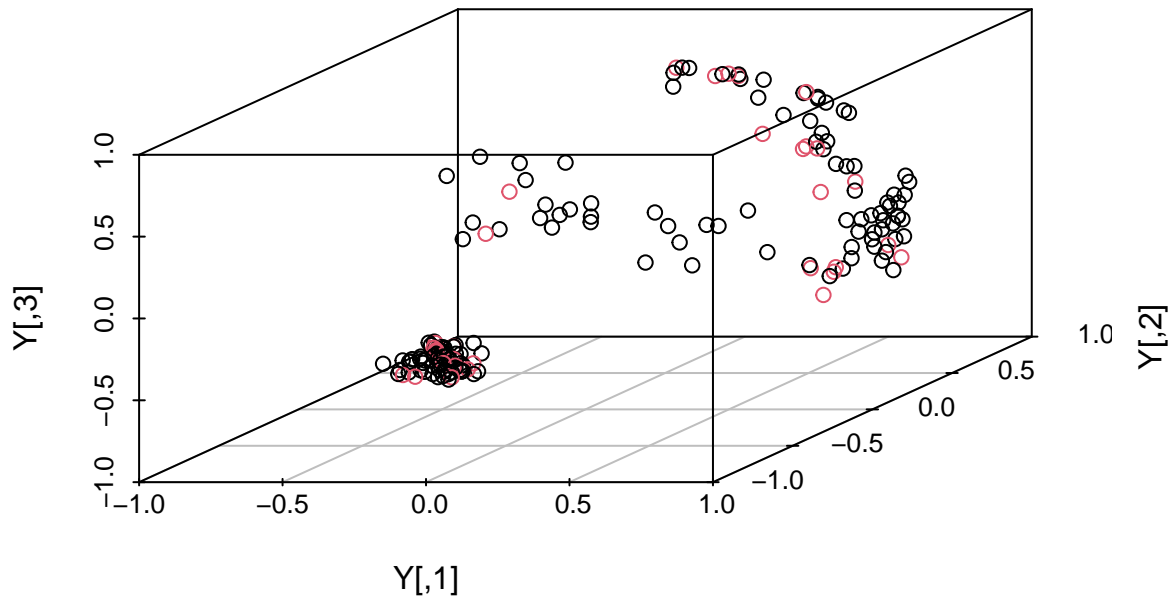

```
## It: 351; obj: 1.968e+00; abs: 4.842e-01; rel: 1.975e-01; norm: 1.036e+00; mom: 1.415e+01;
## best it: 295; best obj: 1.899e+00
## It: 352; obj: 2.426e+00; abs: 4.583e-01; rel: 2.329e-01; norm: 9.192e-01; mom: 1.421e+01;
## best it: 295; best obj: 1.899e+00
## It: 353; obj: 1.957e+00; abs: 4.688e-01; rel: 1.932e-01; norm: 1.030e+00; mom: 1.416e+01;
## best it: 295; best obj: 1.899e+00
## It: 354; obj: 2.444e+00; abs: 4.870e-01; rel: 2.488e-01; norm: 9.148e-01; mom: 1.413e+01;
## best it: 295; best obj: 1.899e+00
## It: 355; obj: 1.980e+00; abs: 4.645e-01; rel: 1.900e-01; norm: 1.031e+00; mom: 1.415e+01;
## best it: 295; best obj: 1.899e+00
## It: 356; obj: 2.432e+00; abs: 4.522e-01; rel: 2.284e-01; norm: 9.179e-01; mom: 1.423e+01;
## best it: 295; best obj: 1.899e+00
```

```
## It: 357; obj: 1.972e+00; abs: 4.606e-01; rel: 1.894e-01; norm: 1.026e+00; mom: 1.424e+01;
## best it: 295; best obj: 1.899e+00
## It: 358; obj: 2.447e+00; abs: 4.755e-01; rel: 2.412e-01; norm: 9.202e-01; mom: 1.422e+01;
## best it: 295; best obj: 1.899e+00
## It: 359; obj: 1.974e+00; abs: 4.726e-01; rel: 1.931e-01; norm: 1.026e+00; mom: 1.425e+01;
## best it: 295; best obj: 1.899e+00
## It: 360; obj: 2.439e+00; abs: 4.643e-01; rel: 2.351e-01; norm: 9.182e-01; mom: 1.429e+01;
## best it: 295; best obj: 1.899e+00
## It: 361; obj: 1.984e+00; abs: 4.546e-01; rel: 1.864e-01; norm: 1.023e+00; mom: 1.425e+01;
## best it: 295; best obj: 1.899e+00
## It: 362; obj: 2.445e+00; abs: 4.614e-01; rel: 2.325e-01; norm: 9.228e-01; mom: 1.425e+01;
## best it: 295; best obj: 1.899e+00
## It: 363; obj: 1.975e+00; abs: 4.706e-01; rel: 1.924e-01; norm: 1.025e+00; mom: 1.425e+01;
## best it: 295; best obj: 1.899e+00
## It: 364; obj: 2.436e+00; abs: 4.607e-01; rel: 2.333e-01; norm: 9.184e-01; mom: 1.426e+01;
## best it: 295; best obj: 1.899e+00
## It: 365; obj: 1.980e+00; abs: 4.556e-01; rel: 1.871e-01; norm: 1.020e+00; mom: 1.426e+01;
## best it: 295; best obj: 1.899e+00
## It: 366; obj: 2.447e+00; abs: 4.668e-01; rel: 2.357e-01; norm: 9.229e-01; mom: 1.424e+01;
## best it: 295; best obj: 1.899e+00
## It: 367; obj: 1.981e+00; abs: 4.661e-01; rel: 1.905e-01; norm: 1.020e+00; mom: 1.426e+01;
## best it: 295; best obj: 1.899e+00
## It: 368; obj: 2.439e+00; abs: 4.579e-01; rel: 2.312e-01; norm: 9.207e-01; mom: 1.429e+01;
## best it: 295; best obj: 1.899e+00
## It: 369; obj: 1.988e+00; abs: 4.505e-01; rel: 1.847e-01; norm: 1.020e+00; mom: 1.429e+01;
## best it: 295; best obj: 1.899e+00
## It: 370; obj: 2.446e+00; abs: 4.584e-01; rel: 2.306e-01; norm: 9.246e-01; mom: 1.425e+01;
## best it: 295; best obj: 1.899e+00
## It: 371; obj: 1.970e+00; abs: 4.767e-01; rel: 1.948e-01; norm: 1.020e+00; mom: 1.427e+01;
## best it: 295; best obj: 1.899e+00
## It: 372; obj: 2.446e+00; abs: 4.760e-01; rel: 2.417e-01; norm: 9.163e-01; mom: 1.428e+01;
## best it: 295; best obj: 1.899e+00
## It: 373; obj: 1.987e+00; abs: 4.589e-01; rel: 1.876e-01; norm: 1.015e+00; mom: 1.429e+01;
## best it: 295; best obj: 1.899e+00
## It: 374; obj: 2.439e+00; abs: 4.524e-01; rel: 2.277e-01; norm: 9.231e-01; mom: 1.431e+01;
## best it: 295; best obj: 1.899e+00
## It: 375; obj: 1.987e+00; abs: 4.523e-01; rel: 1.854e-01; norm: 1.024e+00; mom: 1.421e+01;
## best it: 295; best obj: 1.899e+00
```

Iteration 375
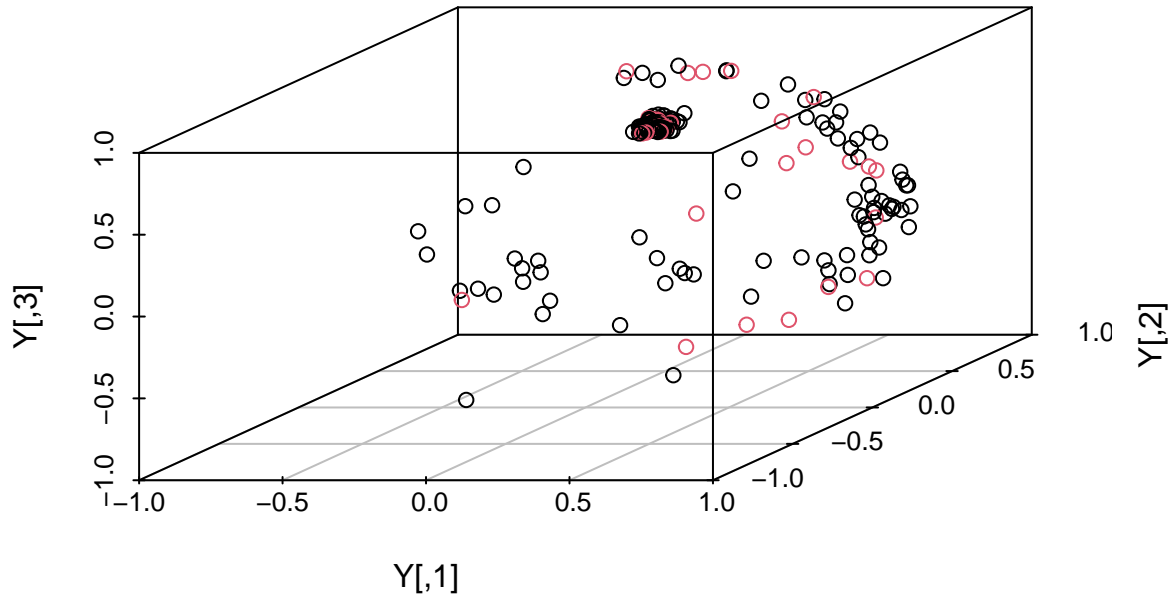

```
## It: 376; obj: 2.419e+00; abs: 4.321e-01; rel: 2.175e-01; norm: 9.224e-01; mom: 1.421e+01;
## best it: 295; best obj: 1.899e+00
## It: 377; obj: 1.975e+00; abs: 4.444e-01; rel: 1.837e-01; norm: 1.021e+00; mom: 1.421e+01;
## best it: 295; best obj: 1.899e+00
## It: 378; obj: 2.401e+00; abs: 4.261e-01; rel: 2.158e-01; norm: 9.294e-01; mom: 1.418e+01;
## best it: 295; best obj: 1.899e+00
## It: 379; obj: 1.975e+00; abs: 4.258e-01; rel: 1.773e-01; norm: 1.018e+00; mom: 1.415e+01;
## best it: 295; best obj: 1.899e+00
## It: 380; obj: 2.412e+00; abs: 4.370e-01; rel: 2.212e-01; norm: 9.223e-01; mom: 1.418e+01;
## best it: 295; best obj: 1.899e+00
## It: 381; obj: 1.983e+00; abs: 4.291e-01; rel: 1.779e-01; norm: 1.015e+00; mom: 1.420e+01;
## best it: 295; best obj: 1.899e+00
## It: 382; obj: 2.398e+00; abs: 4.150e-01; rel: 2.093e-01; norm: 9.351e-01; mom: 1.421e+01;
## best it: 295; best obj: 1.899e+00
## It: 383; obj: 1.978e+00; abs: 4.199e-01; rel: 1.751e-01; norm: 1.021e+00; mom: 1.415e+01;
## best it: 295; best obj: 1.899e+00
## It: 384; obj: 2.400e+00; abs: 4.217e-01; rel: 2.132e-01; norm: 9.257e-01; mom: 1.417e+01;
## best it: 295; best obj: 1.899e+00
## It: 385; obj: 1.972e+00; abs: 4.282e-01; rel: 1.784e-01; norm: 1.014e+00; mom: 1.421e+01;
## best it: 295; best obj: 1.899e+00
## It: 386; obj: 2.395e+00; abs: 4.230e-01; rel: 2.145e-01; norm: 9.299e-01; mom: 1.417e+01;
## best it: 295; best obj: 1.899e+00
## It: 387; obj: 1.974e+00; abs: 4.210e-01; rel: 1.758e-01; norm: 1.014e+00; mom: 1.415e+01;
## best it: 295; best obj: 1.899e+00
## It: 388; obj: 2.401e+00; abs: 4.279e-01; rel: 2.168e-01; norm: 9.252e-01; mom: 1.416e+01;
## best it: 295; best obj: 1.899e+00
## It: 389; obj: 1.973e+00; abs: 4.280e-01; rel: 1.782e-01; norm: 1.012e+00; mom: 1.420e+01;
## best it: 295; best obj: 1.899e+00
## It: 390; obj: 2.391e+00; abs: 4.172e-01; rel: 2.114e-01; norm: 9.257e-01; mom: 1.421e+01;
## best it: 295; best obj: 1.899e+00
## It: 391; obj: 1.987e+00; abs: 4.042e-01; rel: 1.691e-01; norm: 1.016e+00; mom: 1.414e+01;
```

```
## best it: 295; best obj: 1.899e+00
## It: 392; obj: 2.377e+00; abs: 3.908e-01; rel: 1.967e-01; norm: 9.316e-01; mom: 1.412e+01;
## best it: 295; best obj: 1.899e+00
## It: 393; obj: 1.964e+00; abs: 4.135e-01; rel: 1.740e-01; norm: 1.021e+00; mom: 1.406e+01;
## best it: 295; best obj: 1.899e+00
## It: 394; obj: 2.386e+00; abs: 4.218e-01; rel: 2.148e-01; norm: 9.234e-01; mom: 1.405e+01;
## best it: 295; best obj: 1.899e+00
## It: 395; obj: 1.983e+00; abs: 4.022e-01; rel: 1.686e-01; norm: 1.016e+00; mom: 1.409e+01;
## best it: 295; best obj: 1.899e+00
## It: 396; obj: 2.378e+00; abs: 3.949e-01; rel: 1.991e-01; norm: 9.321e-01; mom: 1.407e+01;
## best it: 295; best obj: 1.899e+00
## It: 397; obj: 2.006e+00; abs: 3.726e-01; rel: 1.567e-01; norm: 1.019e+00; mom: 1.408e+01;
## best it: 295; best obj: 1.899e+00
## It: 398; obj: 2.399e+00; abs: 3.931e-01; rel: 1.960e-01; norm: 9.325e-01; mom: 1.406e+01;
## best it: 295; best obj: 1.899e+00
## It: 399; obj: 1.981e+00; abs: 4.182e-01; rel: 1.743e-01; norm: 1.021e+00; mom: 1.413e+01;
## best it: 295; best obj: 1.899e+00
## It: 400; obj: 2.371e+00; abs: 3.902e-01; rel: 1.970e-01; norm: 9.326e-01; mom: 1.410e+01;
## best it: 295; best obj: 1.899e+00
```

Iteration 400
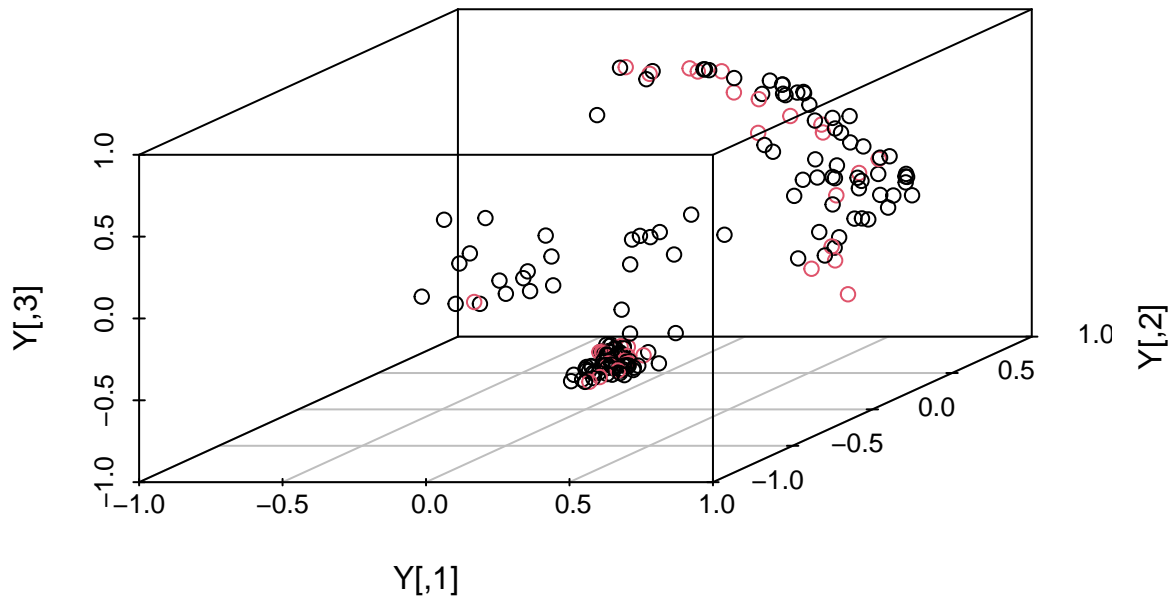

```
## It: 401; obj: 1.960e+00; abs: 4.104e-01; rel: 1.731e-01; norm: 1.023e+00; mom: 1.405e+01;
## best it: 295; best obj: 1.899e+00
## It: 402; obj: 2.378e+00; abs: 4.176e-01; rel: 2.130e-01; norm: 9.173e-01; mom: 1.405e+01;
## best it: 295; best obj: 1.899e+00
## It: 403; obj: 1.986e+00; abs: 3.920e-01; rel: 1.648e-01; norm: 1.012e+00; mom: 1.412e+01;
## best it: 295; best obj: 1.899e+00
## It: 404; obj: 2.380e+00; abs: 3.940e-01; rel: 1.984e-01; norm: 9.317e-01; mom: 1.406e+01;
## best it: 295; best obj: 1.899e+00
## It: 405; obj: 2.007e+00; abs: 3.731e-01; rel: 1.568e-01; norm: 1.016e+00; mom: 1.412e+01;
## best it: 295; best obj: 1.899e+00
## It: 406; obj: 2.383e+00; abs: 3.759e-01; rel: 1.873e-01; norm: 9.291e-01; mom: 1.415e+01;
## best it: 295; best obj: 1.899e+00
```

```
## It: 407; obj: 1.998e+00; abs: 3.848e-01; rel: 1.615e-01; norm: 1.014e+00; mom: 1.415e+01;
## best it: 295; best obj: 1.899e+00
## It: 408; obj: 2.396e+00; abs: 3.984e-01; rel: 1.994e-01; norm: 9.367e-01; mom: 1.406e+01;
## best it: 295; best obj: 1.899e+00
## It: 409; obj: 1.950e+00; abs: 4.466e-01; rel: 1.864e-01; norm: 1.027e+00; mom: 1.417e+01;
## best it: 295; best obj: 1.899e+00
## It: 410; obj: 2.364e+00; abs: 4.147e-01; rel: 2.127e-01; norm: 9.191e-01; mom: 1.413e+01;
## best it: 295; best obj: 1.899e+00
## It: 411; obj: 2.010e+00; abs: 3.540e-01; rel: 1.497e-01; norm: 1.009e+00; mom: 1.414e+01;
## best it: 295; best obj: 1.899e+00
## It: 412; obj: 2.355e+00; abs: 3.450e-01; rel: 1.716e-01; norm: 9.428e-01; mom: 1.409e+01;
## best it: 295; best obj: 1.899e+00
## It: 413; obj: 1.959e+00; abs: 3.965e-01; rel: 1.683e-01; norm: 1.015e+00; mom: 1.408e+01;
## best it: 295; best obj: 1.899e+00
## It: 414; obj: 2.367e+00; abs: 4.083e-01; rel: 2.084e-01; norm: 9.204e-01; mom: 1.409e+01;
## best it: 295; best obj: 1.899e+00
## It: 415; obj: 1.993e+00; abs: 3.744e-01; rel: 1.582e-01; norm: 1.013e+00; mom: 1.414e+01;
## best it: 295; best obj: 1.899e+00
## It: 416; obj: 2.369e+00; abs: 3.761e-01; rel: 1.887e-01; norm: 9.358e-01; mom: 1.417e+01;
## best it: 295; best obj: 1.899e+00
## It: 417; obj: 1.993e+00; abs: 3.757e-01; rel: 1.586e-01; norm: 1.015e+00; mom: 1.414e+01;
## best it: 295; best obj: 1.899e+00
## It: 418; obj: 2.380e+00; abs: 3.871e-01; rel: 1.942e-01; norm: 9.312e-01; mom: 1.414e+01;
## best it: 295; best obj: 1.899e+00
## It: 419; obj: 1.985e+00; abs: 3.949e-01; rel: 1.659e-01; norm: 1.017e+00; mom: 1.414e+01;
## best it: 295; best obj: 1.899e+00
## It: 420; obj: 2.368e+00; abs: 3.828e-01; rel: 1.928e-01; norm: 9.287e-01; mom: 1.421e+01;
## best it: 295; best obj: 1.899e+00
## It: 421; obj: 1.996e+00; abs: 3.721e-01; rel: 1.571e-01; norm: 1.013e+00; mom: 1.421e+01;
## best it: 295; best obj: 1.899e+00
## It: 422; obj: 2.367e+00; abs: 3.708e-01; rel: 1.858e-01; norm: 9.274e-01; mom: 1.418e+01;
## best it: 295; best obj: 1.899e+00
## It: 423; obj: 1.990e+00; abs: 3.767e-01; rel: 1.592e-01; norm: 1.019e+00; mom: 1.416e+01;
## best it: 295; best obj: 1.899e+00
## It: 424; obj: 2.357e+00; abs: 3.668e-01; rel: 1.843e-01; norm: 9.318e-01; mom: 1.412e+01;
## best it: 295; best obj: 1.899e+00
## It: 425; obj: 1.984e+00; abs: 3.732e-01; rel: 1.583e-01; norm: 1.017e+00; mom: 1.414e+01;
## best it: 295; best obj: 1.899e+00
```

Iteration 425
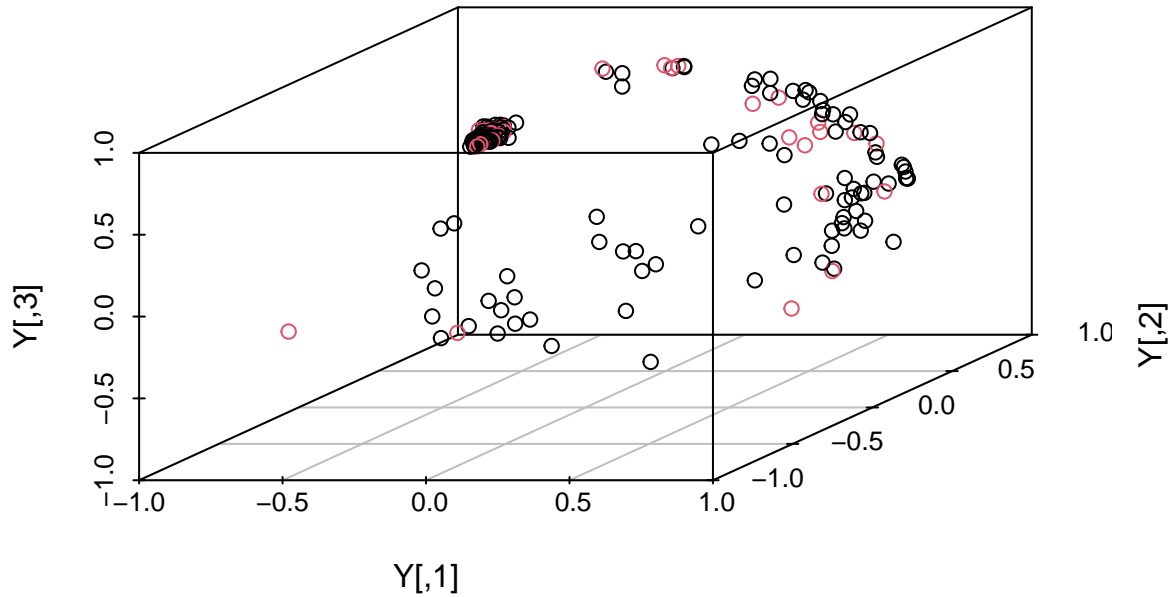

```
## It: 426; obj: 2.368e+00; abs: 3.846e-01; rel: 1.939e-01; norm: 9.259e-01; mom: 1.411e+01;
## best it: 295; best obj: 1.899e+00
## It: 427; obj: 1.980e+00; abs: 3.888e-01; rel: 1.642e-01; norm: 1.019e+00; mom: 1.416e+01;
## best it: 295; best obj: 1.899e+00
## It: 428; obj: 2.348e+00; abs: 3.686e-01; rel: 1.862e-01; norm: 9.281e-01; mom: 1.413e+01;
## best it: 295; best obj: 1.899e+00
## It: 429; obj: 1.993e+00; abs: 3.552e-01; rel: 1.513e-01; norm: 1.012e+00; mom: 1.413e+01;
## best it: 295; best obj: 1.899e+00
## It: 430; obj: 2.352e+00; abs: 3.586e-01; rel: 1.799e-01; norm: 9.266e-01; mom: 1.418e+01;
## best it: 295; best obj: 1.899e+00
## It: 431; obj: 1.996e+00; abs: 3.553e-01; rel: 1.511e-01; norm: 1.009e+00; mom: 1.417e+01;
## best it: 295; best obj: 1.899e+00
## It: 432; obj: 2.348e+00; abs: 3.522e-01; rel: 1.764e-01; norm: 9.295e-01; mom: 1.415e+01;
## best it: 295; best obj: 1.899e+00
## It: 433; obj: 1.980e+00; abs: 3.684e-01; rel: 1.569e-01; norm: 1.013e+00; mom: 1.417e+01;
## best it: 295; best obj: 1.899e+00
## It: 434; obj: 2.352e+00; abs: 3.717e-01; rel: 1.878e-01; norm: 9.200e-01; mom: 1.412e+01;
## best it: 295; best obj: 1.899e+00
## It: 435; obj: 2.021e+00; abs: 3.310e-01; rel: 1.408e-01; norm: 1.008e+00; mom: 1.416e+01;
## best it: 295; best obj: 1.899e+00
## It: 436; obj: 2.341e+00; abs: 3.205e-01; rel: 1.586e-01; norm: 9.379e-01; mom: 1.423e+01;
## best it: 295; best obj: 1.899e+00
## It: 437; obj: 1.989e+00; abs: 3.524e-01; rel: 1.505e-01; norm: 1.008e+00; mom: 1.413e+01;
## best it: 295; best obj: 1.899e+00
## It: 438; obj: 2.345e+00; abs: 3.566e-01; rel: 1.793e-01; norm: 9.141e-01; mom: 1.426e+01;
## best it: 295; best obj: 1.899e+00
## It: 439; obj: 2.029e+00; abs: 3.164e-01; rel: 1.349e-01; norm: 1.004e+00; mom: 1.431e+01;
## best it: 295; best obj: 1.899e+00
## It: 440; obj: 2.352e+00; abs: 3.233e-01; rel: 1.594e-01; norm: 9.339e-01; mom: 1.419e+01;
## best it: 295; best obj: 1.899e+00
## It: 441; obj: 2.002e+00; abs: 3.504e-01; rel: 1.490e-01; norm: 1.015e+00; mom: 1.427e+01;
```

```
## best it: 295; best obj: 1.899e+00
## It: 442; obj: 2.357e+00; abs: 3.550e-01; rel: 1.773e-01; norm: 9.228e-01; mom: 1.421e+01;
## best it: 295; best obj: 1.899e+00
## It: 443; obj: 1.999e+00; abs: 3.580e-01; rel: 1.519e-01; norm: 1.012e+00; mom: 1.429e+01;
## best it: 295; best obj: 1.899e+00
## It: 444; obj: 2.341e+00; abs: 3.419e-01; rel: 1.711e-01; norm: 9.251e-01; mom: 1.426e+01;
## best it: 295; best obj: 1.899e+00
## It: 445; obj: 2.021e+00; abs: 3.204e-01; rel: 1.369e-01; norm: 1.008e+00; mom: 1.421e+01;
## best it: 295; best obj: 1.899e+00
## It: 446; obj: 2.339e+00; abs: 3.184e-01; rel: 1.576e-01; norm: 9.271e-01; mom: 1.427e+01;
## best it: 295; best obj: 1.899e+00
## It: 447; obj: 2.016e+00; abs: 3.228e-01; rel: 1.380e-01; norm: 1.009e+00; mom: 1.423e+01;
## best it: 295; best obj: 1.899e+00
## It: 448; obj: 2.340e+00; abs: 3.242e-01; rel: 1.608e-01; norm: 9.254e-01; mom: 1.420e+01;
## best it: 295; best obj: 1.899e+00
## It: 449; obj: 2.017e+00; abs: 3.232e-01; rel: 1.381e-01; norm: 1.010e+00; mom: 1.426e+01;
## best it: 295; best obj: 1.899e+00
## It: 450; obj: 2.349e+00; abs: 3.315e-01; rel: 1.643e-01; norm: 9.220e-01; mom: 1.422e+01;
## best it: 295; best obj: 1.899e+00
```

Iteration 450
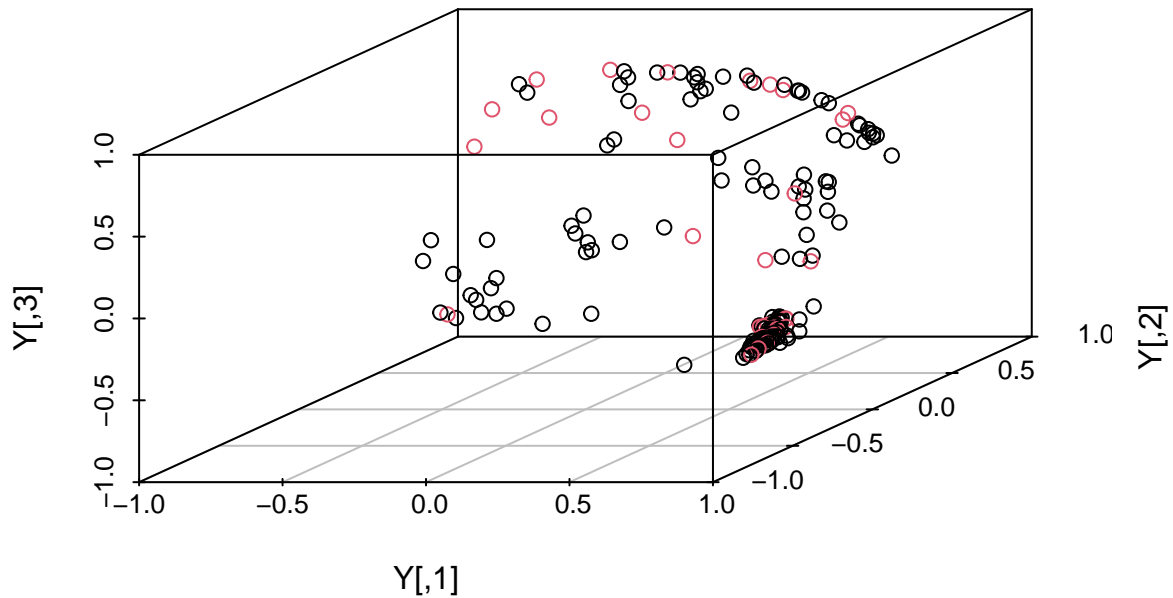

```
## It: 451; obj: 2.030e+00; abs: 3.191e-01; rel: 1.359e-01; norm: 1.012e+00; mom: 1.426e+01;
## best it: 295; best obj: 1.899e+00
## It: 452; obj: 2.348e+00; abs: 3.188e-01; rel: 1.571e-01; norm: 9.268e-01; mom: 1.423e+01;
## best it: 295; best obj: 1.899e+00
## It: 453; obj: 2.046e+00; abs: 3.025e-01; rel: 1.288e-01; norm: 1.014e+00; mom: 1.427e+01;
## best it: 295; best obj: 1.899e+00
## It: 454; obj: 2.359e+00; abs: 3.127e-01; rel: 1.528e-01; norm: 9.310e-01; mom: 1.423e+01;
## best it: 295; best obj: 1.899e+00
## It: 455; obj: 2.049e+00; abs: 3.098e-01; rel: 1.314e-01; norm: 1.020e+00; mom: 1.427e+01;
## best it: 295; best obj: 1.899e+00
## It: 456; obj: 2.349e+00; abs: 3.007e-01; rel: 1.468e-01; norm: 9.334e-01; mom: 1.425e+01;
## best it: 295; best obj: 1.899e+00
```

```
## It: 457; obj: 2.034e+00; abs: 3.159e-01; rel: 1.345e-01; norm: 1.022e+00; mom: 1.427e+01;
## best it: 295; best obj: 1.899e+00
## It: 458; obj: 2.343e+00; abs: 3.095e-01; rel: 1.522e-01; norm: 9.271e-01; mom: 1.422e+01;
## best it: 295; best obj: 1.899e+00
## It: 459; obj: 2.056e+00; abs: 2.871e-01; rel: 1.226e-01; norm: 1.012e+00; mom: 1.436e+01;
## best it: 295; best obj: 1.899e+00
## It: 460; obj: 2.340e+00; abs: 2.840e-01; rel: 1.381e-01; norm: 9.320e-01; mom: 1.425e+01;
## best it: 295; best obj: 1.899e+00
## It: 461; obj: 2.050e+00; abs: 2.899e-01; rel: 1.239e-01; norm: 1.012e+00; mom: 1.435e+01;
## best it: 295; best obj: 1.899e+00
## It: 462; obj: 2.335e+00; abs: 2.852e-01; rel: 1.391e-01; norm: 9.350e-01; mom: 1.430e+01;
## best it: 295; best obj: 1.899e+00
## It: 463; obj: 2.035e+00; abs: 2.999e-01; rel: 1.284e-01; norm: 1.013e+00; mom: 1.426e+01;
## best it: 295; best obj: 1.899e+00
## It: 464; obj: 2.323e+00; abs: 2.878e-01; rel: 1.414e-01; norm: 9.317e-01; mom: 1.422e+01;
## best it: 295; best obj: 1.899e+00
## It: 465; obj: 2.054e+00; abs: 2.687e-01; rel: 1.157e-01; norm: 1.011e+00; mom: 1.422e+01;
## best it: 295; best obj: 1.899e+00
## It: 466; obj: 2.341e+00; abs: 2.863e-01; rel: 1.394e-01; norm: 9.302e-01; mom: 1.425e+01;
## best it: 295; best obj: 1.899e+00
## It: 467; obj: 2.043e+00; abs: 2.979e-01; rel: 1.273e-01; norm: 1.017e+00; mom: 1.430e+01;
## best it: 295; best obj: 1.899e+00
## It: 468; obj: 2.306e+00; abs: 2.629e-01; rel: 1.287e-01; norm: 9.336e-01; mom: 1.423e+01;
## best it: 295; best obj: 1.899e+00
## It: 469; obj: 2.054e+00; abs: 2.515e-01; rel: 1.091e-01; norm: 1.000e+00; mom: 1.428e+01;
## best it: 295; best obj: 1.899e+00
## It: 470; obj: 2.329e+00; abs: 2.753e-01; rel: 1.341e-01; norm: 9.301e-01; mom: 1.422e+01;
## best it: 295; best obj: 1.899e+00
## It: 471; obj: 2.073e+00; abs: 2.562e-01; rel: 1.100e-01; norm: 1.009e+00; mom: 1.428e+01;
## best it: 295; best obj: 1.899e+00
## It: 472; obj: 2.319e+00; abs: 2.458e-01; rel: 1.186e-01; norm: 9.391e-01; mom: 1.423e+01;
## best it: 295; best obj: 1.899e+00
## It: 473; obj: 2.057e+00; abs: 2.617e-01; rel: 1.129e-01; norm: 1.016e+00; mom: 1.431e+01;
## best it: 295; best obj: 1.899e+00
## It: 474; obj: 2.328e+00; abs: 2.710e-01; rel: 1.317e-01; norm: 9.263e-01; mom: 1.430e+01;
## best it: 295; best obj: 1.899e+00
## It: 475; obj: 2.103e+00; abs: 2.257e-01; rel: 9.695e-02; norm: 1.000e+00; mom: 1.442e+01;
## best it: 295; best obj: 1.899e+00
```
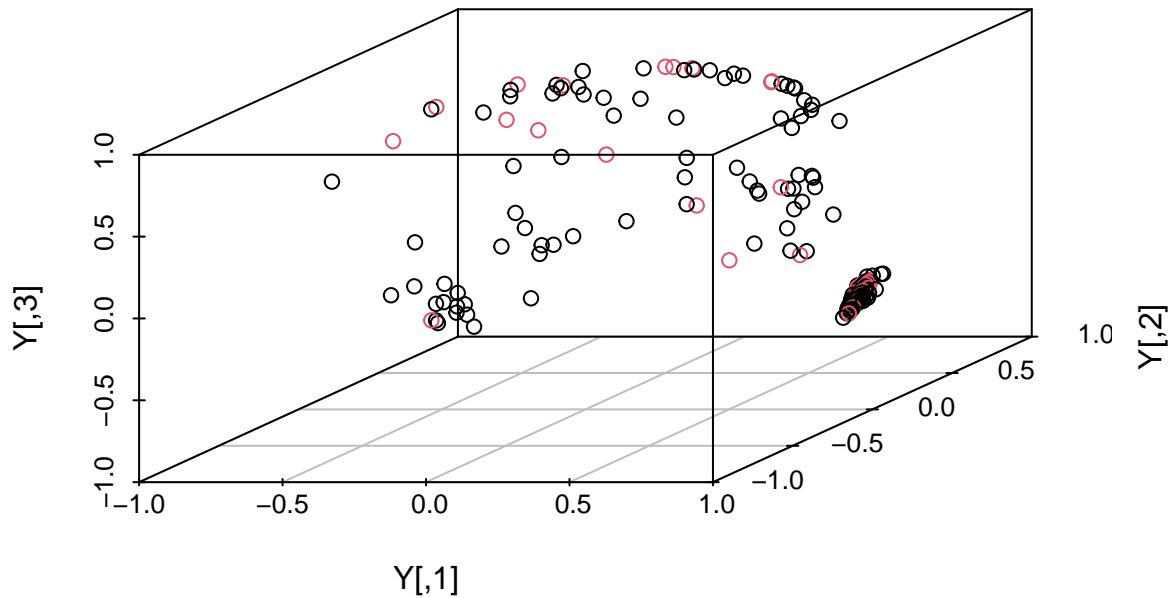
Iteration 475
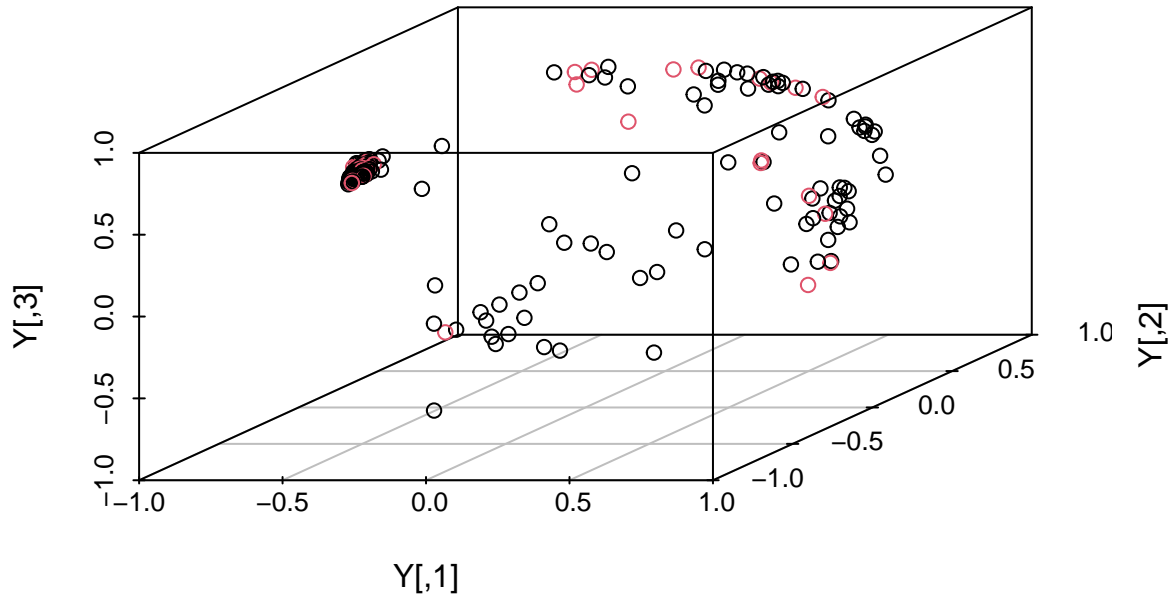

```
## It: 476; obj: 2.354e+00; abs: 2.519e-01; rel: 1.198e-01; norm: 9.409e-01; mom: 1.440e+01;
## best it: 295; best obj: 1.899e+00
## It: 477; obj: 2.076e+00; abs: 2.782e-01; rel: 1.182e-01; norm: 1.014e+00; mom: 1.450e+01;
## best it: 295; best obj: 1.899e+00
## It: 478; obj: 2.345e+00; abs: 2.688e-01; rel: 1.295e-01; norm: 9.304e-01; mom: 1.447e+01;
## best it: 295; best obj: 1.899e+00
## It: 479; obj: 2.107e+00; abs: 2.383e-01; rel: 1.016e-01; norm: 1.007e+00; mom: 1.455e+01;
## best it: 295; best obj: 1.899e+00
## It: 480; obj: 2.338e+00; abs: 2.310e-01; rel: 1.096e-01; norm: 9.440e-01; mom: 1.449e+01;
## best it: 295; best obj: 1.899e+00
## It: 481; obj: 2.083e+00; abs: 2.547e-01; rel: 1.089e-01; norm: 1.005e+00; mom: 1.453e+01;
## best it: 295; best obj: 1.899e+00
## It: 482; obj: 2.345e+00; abs: 2.615e-01; rel: 1.255e-01; norm: 9.328e-01; mom: 1.448e+01;
## best it: 295; best obj: 1.899e+00
## It: 483; obj: 2.098e+00; abs: 2.464e-01; rel: 1.051e-01; norm: 1.003e+00; mom: 1.457e+01;
## best it: 295; best obj: 1.899e+00
## It: 484; obj: 2.356e+00; abs: 2.582e-01; rel: 1.231e-01; norm: 9.360e-01; mom: 1.457e+01;
## best it: 295; best obj: 1.899e+00
## It: 485; obj: 2.094e+00; abs: 2.619e-01; rel: 1.112e-01; norm: 1.009e+00; mom: 1.461e+01;
## best it: 295; best obj: 1.899e+00
## It: 486; obj: 2.339e+00; abs: 2.444e-01; rel: 1.167e-01; norm: 9.367e-01; mom: 1.458e+01;
## best it: 295; best obj: 1.899e+00
## It: 487; obj: 2.105e+00; abs: 2.338e-01; rel: 9.996e-02; norm: 1.000e+00; mom: 1.457e+01;
## best it: 295; best obj: 1.899e+00
## It: 488; obj: 2.349e+00; abs: 2.440e-01; rel: 1.159e-01; norm: 9.378e-01; mom: 1.457e+01;
## best it: 295; best obj: 1.899e+00
## It: 489; obj: 2.101e+00; abs: 2.476e-01; rel: 1.054e-01; norm: 1.005e+00; mom: 1.460e+01;
## best it: 295; best obj: 1.899e+00
## It: 490; obj: 2.344e+00; abs: 2.428e-01; rel: 1.155e-01; norm: 9.365e-01; mom: 1.458e+01;
## best it: 295; best obj: 1.899e+00
## It: 491; obj: 2.102e+00; abs: 2.419e-01; rel: 1.032e-01; norm: 1.004e+00; mom: 1.458e+01;
```

```
## best it: 295; best obj: 1.899e+00
## It: 492; obj: 2.350e+00; abs: 2.480e-01; rel: 1.180e-01; norm: 9.338e-01; mom: 1.458e+01;
## best it: 295; best obj: 1.899e+00
## It: 493; obj: 2.104e+00; abs: 2.462e-01; rel: 1.048e-01; norm: 1.006e+00; mom: 1.459e+01;
## best it: 295; best obj: 1.899e+00
## It: 494; obj: 2.345e+00; abs: 2.410e-01; rel: 1.145e-01; norm: 9.349e-01; mom: 1.459e+01;
## best it: 295; best obj: 1.899e+00
## It: 495; obj: 2.105e+00; abs: 2.400e-01; rel: 1.023e-01; norm: 1.005e+00; mom: 1.459e+01;
## best it: 295; best obj: 1.899e+00
## It: 496; obj: 2.344e+00; abs: 2.389e-01; rel: 1.135e-01; norm: 9.337e-01; mom: 1.458e+01;
## best it: 295; best obj: 1.899e+00
## It: 497; obj: 2.128e+00; abs: 2.159e-01; rel: 9.209e-02; norm: 1.002e+00; mom: 1.459e+01;
## best it: 295; best obj: 1.899e+00
## It: 498; obj: 2.357e+00; abs: 2.290e-01; rel: 1.076e-01; norm: 9.403e-01; mom: 1.460e+01;
## best it: 295; best obj: 1.899e+00
## It: 499; obj: 2.135e+00; abs: 2.220e-01; rel: 9.421e-02; norm: 1.010e+00; mom: 1.462e+01;
## best it: 295; best obj: 1.899e+00
## It: 500; obj: 2.337e+00; abs: 2.020e-01; rel: 9.462e-02; norm: 9.471e-01; mom: 1.460e+01;
## best it: 295; best obj: 1.899e+00
```

Iteration 500

Iteration 295
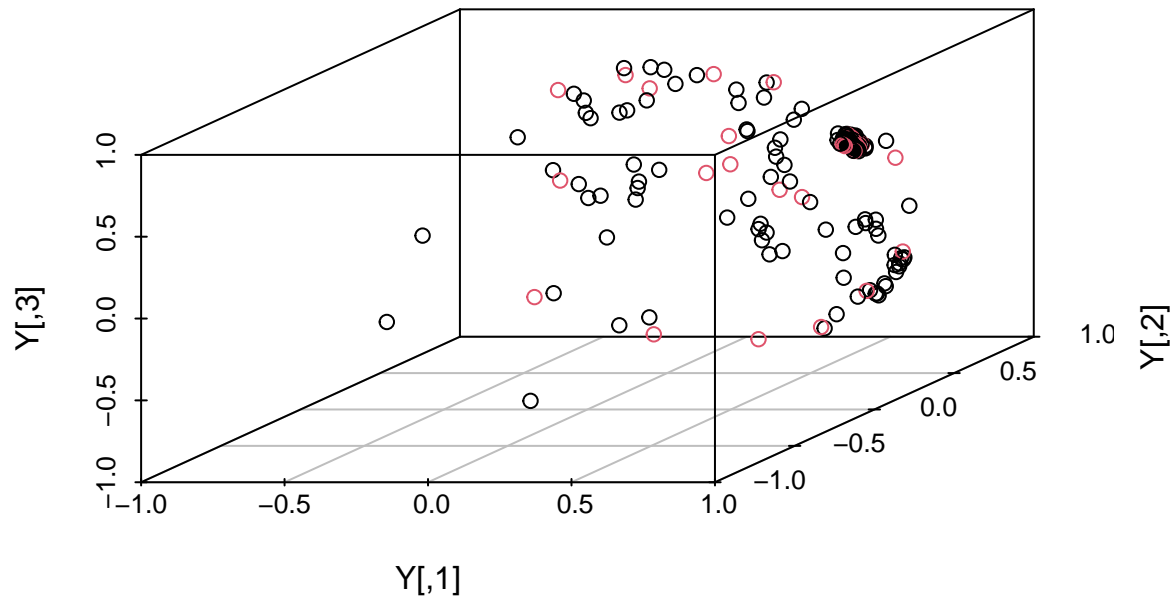

```
Y <- res_pscsne$best_Y
```

Let's do the same applying the kms onto the sphere.

```
res_kms_dir_Y <- kms_dir(x = Y, data = Y)
```

```
##   |                                                                     |
```

```
colors <- res_kms_dir_Y$cluster
scatterplot3d::scatterplot3d(Y, xlim = c(-1, 1), ylim = c(-1, 1), zlim = c(-1, 1),
                             color = colors)
```