

# Higher Dimensional Datasets, version 10

## Load packages.

```
In [1]: require(data.table)
        require(deSolve)
        require(magrittr)
        require(randtoolbox)
```

```
Loading required package: data.table
Loading required package: deSolve
Loading required package: magrittr
Loading required package: randtoolbox
Loading required package: rngWELL
This is randtoolbox. For an overview, type 'help("randtoolbox")'.
```

## Function to generate simulations.

```

In [2]: # Create a multivariate function with specified properties:
#       tmax: maximum time
#       multiplicities: number of correlations each parameter has
#       degrees: polynomial degree of each parameter
#       dimension: the dimension of the output
#       returns a multivariate function of the vector of parameters and t
ime
makeGenerator <- function(multiplicities, degrees, dimension) {

  single <- function(degree) {
    x0 <- runif(1)
    z0 <- runif(1)
    function(x) {
      if (x < x0)
        0
      else
        z0 * (x - x0)^degree
    }
  }

  locations <- lapply(multiplicities, function(m) sample(1:dimension, m, replace=TRUE))
  functions <- lapply(degrees, single)

  start <- runif(dimension, -0.25, 0.75)
  coefs <- matrix(runif(dimension^2, -0.25, 0.75), dimension, dimension)
  shift <- matrix(runif(dimension^2, -0.25, 0.75), dimension, dimension)

  function(x, ts) {
    z <- rep(0, dimension)
    for (i in 1:length(locations))
      for (j in locations[[i]])
        z[j] <- z[j] + functions[[i]](x[i])
    ode(start, ts, function(t, y, params) {list((coefs %*% y) * z
* (1 - ((shift %*% y) * z)))})
  }
}

```

## Reproducible random numbers.

```

In [3]: RNGkind("Mersenne-Twister", "Inversion", "Rejection")

```

```

In [4]: set.seed(46)

```

## Create and save timeseries.

```
In [5]: n <- 10000
```

```
In [6]: ts <- seq(0, 3, 0.2)
ts
```

```
0 0.2 0.4 0.6 0.8 1 1.2 1.4 1.6 1.8 2 2.2 2.4 2.6 2.8 3
```

```
In [7]: for (m in c(3, 20))
  for (k in c(3, 20))
    if (m != 3 || k != 3) {
      f.multiplicities <- sample(1:5, m, replace=TRUE)
      f.degrees <- sample(0:3, m, replace=TRUE)
      f <- makeGenerator(f.multiplicities, f.degrees, k)
      xs <- sobol(n, m)
      colnames(xs) <- paste("x", 1:m, sep="")
      rownames(xs) <- 1:n
      ys <- NULL
      for (i in 1:n) {
        x <- xs[i, ]
        if (m == 3)
          y <- f(x, 10 * ts)
        else
          y <- f(x, ts)
        ys <- rbind(ys, data.table(case=i, y))
      }
      xs <- data.table(case = 1:n, xs)
      colnames(ys) <- c("case", "time", paste("y", 1:k, sep=""))
    })
  write.table(xs, file=paste("xs-", m, "x", k, "-v10.csv",
sep=""), sep=",", quote=FALSE, row.names=FALSE)
  write.table(ys, file=paste("ys-", m, "x", k, "-v10.csv",
sep=""), sep=",", quote=FALSE, row.names=FALSE)
}
```

```
In [8]: fread("ys-3x20-v10.csv") %>% summary
```

case	time	y1	y2
Min. : 1	Min. : 0.0	Min. : -0.2229	Min. : 0.02939
1st Qu.: 2501	1st Qu.: 7.5	1st Qu.: -0.2229	1st Qu.: 0.02939
Median : 5000	Median : 15.0	Median : -0.2229	Median : 0.02939
Mean : 5000	Mean : 15.0	Mean : -0.2229	Mean : 0.02939
3rd Qu.: 7500	3rd Qu.: 22.5	3rd Qu.: -0.2229	3rd Qu.: 0.02939
Max. : 10000	Max. : 30.0	Max. : -0.2229	Max. : 0.02939
y3	y4	y5	y6
Min. : 0.1046	Min. : -0.1258	Min. : 0.1668	Min. : 0.1705
1st Qu.: 0.1046	1st Qu.: -0.1258	1st Qu.: 0.1668	1st Qu.: 0.1705
Median : 0.1046	Median : -0.1258	Median : 0.1668	Median : 0.1705
Mean : 0.1046	Mean : -0.1258	Mean : 0.1668	Mean : 0.1709
3rd Qu.: 0.1046	3rd Qu.: -0.1258	3rd Qu.: 0.1668	3rd Qu.: 0.1705
Max. : 0.1046	Max. : -0.1258	Max. : 0.1668	Max. : 0.3275
y7	y8	y9	y10
Min. : -0.07119	Min. : 0.5788	Min. : 0.2749	Min. : 0.7372
1st Qu.: -0.07119	1st Qu.: 0.5788	1st Qu.: 0.2749	1st Qu.: 0.7372
Median : -0.07119	Median : 0.5788	Median : 0.2749	Median : 0.7372
Mean : -0.07096	Mean : 0.5788	Mean : 0.4511	Mean : 0.7372
3rd Qu.: -0.07119	3rd Qu.: 0.5788	3rd Qu.: 0.3791	3rd Qu.: 0.7372
Max. : 0.02512	Max. : 0.5788	Max. : 3.0931	Max. : 0.7372
y11	y12	y13	y14
Min. : 0.4623	Min. : 0.04645	Min. : 0.09504	Min. : 0.2806
1st Qu.: 0.4623	1st Qu.: 0.04645	1st Qu.: 0.09504	1st Qu.: 0.2806
Median : 0.4623	Median : 0.04645	Median : 0.09504	Median : 0.2806
Mean : 0.4623	Mean : 0.04676	Mean : 0.09504	Mean : 0.2811
3rd Qu.: 0.4623	3rd Qu.: 0.04645	3rd Qu.: 0.09504	3rd Qu.: 0.2806
Max. : 0.4623	Max. : 0.14906	Max. : 0.09504	Max. : 0.3003
y15	y16	y17	y18
Min. : 0.4125	Min. : 0.2917	Min. : 0.0911	Min. : -0.02132
1st Qu.: 0.4125	1st Qu.: 0.2917	1st Qu.: 0.0911	1st Qu.: -0.02132
Median : 0.4125	Median : 0.2917	Median : 0.0911	Median : -0.02132
Mean : 0.4125	Mean : 0.2917	Mean : 0.0911	Mean : -0.02132
3rd Qu.: 0.4125	3rd Qu.: 0.2917	3rd Qu.: 0.0911	3rd Qu.: -0.02132
Max. : 0.4125	Max. : 0.2917	Max. : 0.0911	Max. : -0.02132
y19	y20		
Min. : -0.03287	Min. : 0.5407		
1st Qu.: -0.03287	1st Qu.: 0.5407		
Median : -0.03287	Median : 0.5407		
Mean : -0.03287	Mean : 0.6351		
3rd Qu.: -0.03287	3rd Qu.: 0.5818		
Max. : -0.03287	Max. : 2.5931		

```
In [9]: fread("ys-20x3-v10.csv") %>% summary
```

case	time	y1	y2
Min. : 1	Min. :0.00	Min. :0.4993	Min. :0.4195
1st Qu.: 2501	1st Qu.:0.75	1st Qu.:0.6134	1st Qu.:0.5818
Median : 5000	Median :1.50	Median :0.8127	Median :0.8661
Mean : 5000	Mean :1.50	Mean :0.9544	Mean :0.9165
3rd Qu.: 7500	3rd Qu.:2.25	3rd Qu.:1.1833	3rd Qu.:1.2168
Max. :10000	Max. :3.00	Max. :2.9487	Max. :1.9985

y3

Min. : -1.00688
1st Qu.: 0.02767
Median : 0.10449
Mean : 0.06336
3rd Qu.: 0.14834
Max. : 0.52410

```
In [10]: fread("ys-20x20-v10.csv") %>% summary
```

case	time	y1	y2
Min. : 1	Min. :0.00	Min. :-11.1354	Min. :-3.99301
1st Qu.: 2501	1st Qu.:0.75	1st Qu.: 0.2260	1st Qu.: -0.91340
Median : 5000	Median :1.50	Median : 0.3583	Median :-0.41890
Mean : 5000	Mean :1.50	Mean : 0.3625	Mean :-0.48365
3rd Qu.: 7500	3rd Qu.:2.25	3rd Qu.: 0.4959	3rd Qu.: 0.06929
Max. :10000	Max. :3.00	Max. : 2.0042	Max. : 2.49500
y3	y4	y5	y6
Min. :0.5752	Min. :-4.0103	Min. :-0.372126	Min. :-6.16
1st Qu.:0.6035	1st Qu.: 0.4131	1st Qu.: -0.098232	1st Qu.: -0.57
Median :0.6217	Median : 0.5349	Median : 0.003534	Median :-0.01
Mean :0.7131	Mean : 0.5122	Mean : 0.052012	Mean :-0.34
3rd Qu.:0.7603	3rd Qu.: 0.7352	3rd Qu.: 0.167168	3rd Qu.: 0.08
Max. :1.6130	Max. :26.6816	Max. : 0.809911	Max. : 2.23
y7	y8	y9	y10
Min. :0.4848	Min. :-0.24560	Min. :-3.2654	Min. :0.5720
1st Qu.:0.4848	1st Qu.: -0.20817	1st Qu.: 0.3487	1st Qu.:0.5720
Median :0.4848	Median :-0.02356	Median : 0.4815	Median :0.5869
Mean :0.5243	Mean : 0.15453	Mean : 0.5258	Mean :0.6743
3rd Qu.:0.5094	3rd Qu.: 0.34993	3rd Qu.: 0.6762	3rd Qu.:0.6825
Max. :1.3364	Max. : 4.56972	Max. : 1.3579	Max. :2.0605
y11	y12	y13	y14
Min. :-2.4188	Min. :0.1320	Min. :-0.24258	Min. :-4.065
1st Qu.: 0.5490	1st Qu.:0.1320	1st Qu.: -0.01273	1st Qu.: 0.048
Median : 0.7178	Median :0.1320	Median :-0.01273	Median : 0.177
Mean : 0.7117	Mean :0.1381	Mean : 0.06004	Mean : 0.301
3rd Qu.: 0.8412	3rd Qu.:0.1354	3rd Qu.: 0.09370	3rd Qu.: 0.486
Max. : 5.0888	Max. :0.2896	Max. : 0.77432	Max. : 1.837
y15	y16	y17	y18
Min. :0.1428	Min. :-2.9651	Min. :-0.63421	Min. :0.2926
1st Qu.:0.1447	1st Qu.: -0.2468	1st Qu.: 0.05400	1st Qu.:0.3333
Median :0.1905	Median :-0.2113	Median : 0.08051	Median :0.4319
Mean :0.2784	Mean :-0.2694	Mean : 0.09200	Mean :0.4785
3rd Qu.:0.3495	3rd Qu.: -0.1137	3rd Qu.: 0.10599	3rd Qu.:0.5804
Max. :1.5073	Max. : 0.3458	Max. : 0.44155	Max. :1.6578
y19	y20		
Min. :-1.1064	Min. :-0.01253		
1st Qu.: 0.2657	1st Qu.: 0.13335		
Median : 0.4146	Median : 0.19258		
Mean : 0.3399	Mean : 0.27743		
3rd Qu.: 0.4431	3rd Qu.: 0.39444		
Max. : 3.2463	Max. : 1.84681		