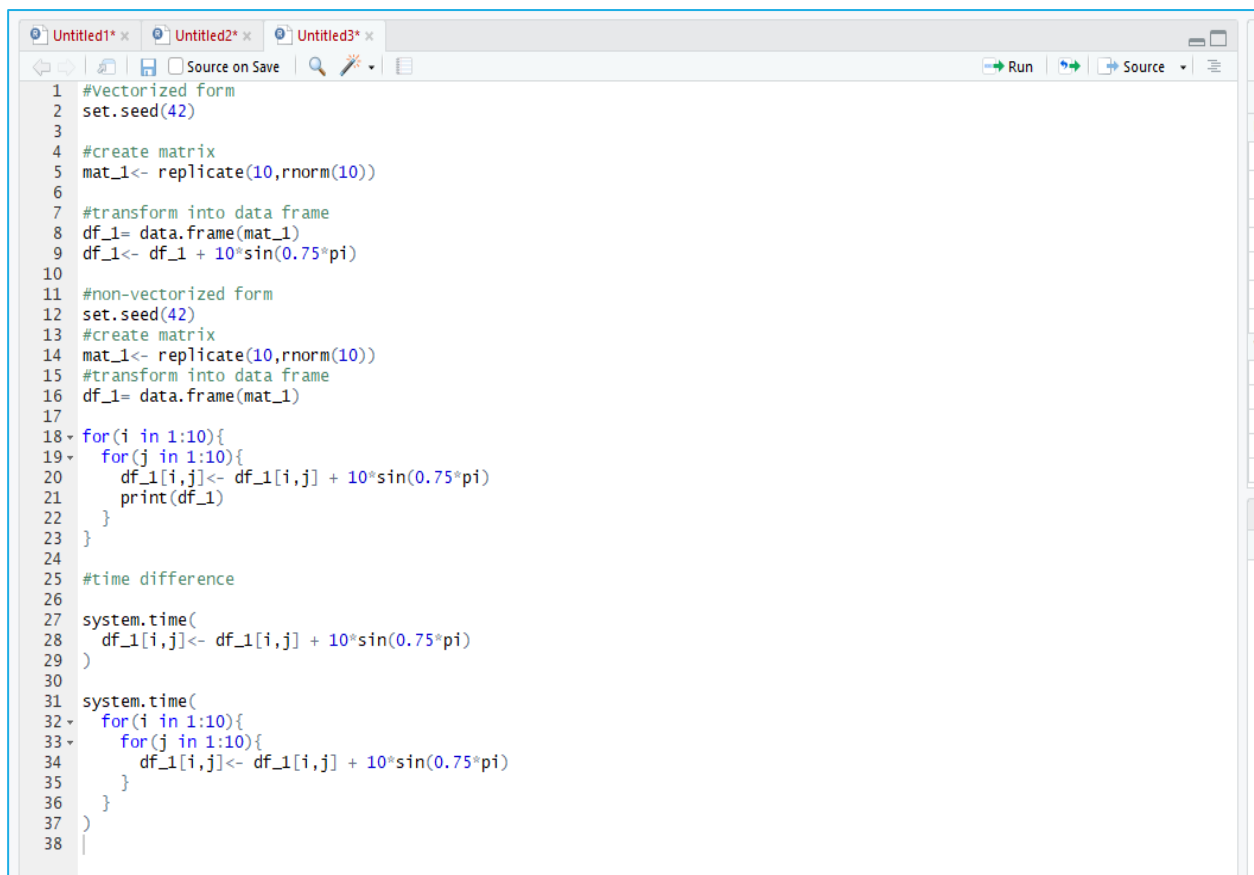


# SESSION 3 – ASSIGNMENT 3.2

Date: 29<sup>th</sup> December 2018

1. Create an  $m \times n$  matrix with `replicate(m, rnorm(n))` with  $m=10$ , column vectors of  $n=10$  elements each, constructed with `rnorm(n)`, which creates random normal numbers.
  - Then we transform it into a dataframe (thus 10 observations of 10 variables) and perform an algebraic operation on each element using a nested for loop: at each iteration, every element referred by the two indexes is incremented by a sinusoidal function, compare the vectorized and non-vectorized form of creating the solution and report the system time differences.



```
1 #Vectorized form
2 set.seed(42)
3
4 #create matrix
5 mat_1<- replicate(10,rnorm(10))
6
7 #transform into data frame
8 df_1= data.frame(mat_1)
9 df_1<- df_1 + 10*sin(0.75*pi)
10
11 #non-vectorized form
12 set.seed(42)
13 #create matrix
14 mat_1<- replicate(10,rnorm(10))
15 #transform into data frame
16 df_1= data.frame(mat_1)
17
18 for(i in 1:10){
19   for(j in 1:10){
20     df_1[i,j]<- df_1[i,j] + 10*sin(0.75*pi)
21     print(df_1)
22   }
23 }
24
25 #time difference
26
27 system.time(
28   df_1[i,j]<- df_1[i,j] + 10*sin(0.75*pi)
29 )
30
31 system.time(
32   for(i in 1:10){
33     for(j in 1:10){
34       df_1[i,j]<- df_1[i,j] + 10*sin(0.75*pi)
35     }
36   }
37 )
38 |
```

```

> #Vectorized form
> set.seed(42)
> #create matrix
> mat_1<- replicate(10,rnorm(10))
> #transform into data frame
> df_1= data.frame(mat_1)
> df_1<- df_1 + 10*sin(0.75*pi)
> #non-vectorized form
> set.seed(42)
> #create matrix
> mat_1<- replicate(10,rnorm(10))
> #transform into data frame
> df_1= data.frame(mat_1)
> |

```

1	8.44202626	8.3759375	6.7644292	7.52651794	7.2770664	7.39299308	6.7038332	6.02794887	8.58377482	8.46318419
2	-0.56469817	2.2866454	-1.7813084	0.70483734	-0.3610573	-0.78383894	0.1852306	-0.09018639	0.25792144	-0.47617392
3	0.36312841	-1.3888607	-0.1719174	1.03510352	0.7581632	1.57572752	0.5818237	0.62351816	0.08844023	0.65034856
4	0.63286260	-0.2787888	1.2146747	-0.60892638	-0.7267048	0.64289931	1.3997368	-0.95352336	-0.12089654	1.39111046
5	0.40426832	-0.1333213	1.8951935	0.50495512	-1.3682810	0.08976065	-0.7272921	-0.54282881	-1.19432890	-1.11078888
6	-0.10612452	0.6359504	-0.4304691	-1.71700868	0.4328180	0.27655075	1.3025426	0.58099650	0.61199690	-0.86079259
7	1.51152200	-0.2842529	-0.2572694	-0.78445901	-0.8113932	0.67928882	0.3358481	0.76817874	-0.21713985	-1.13173868
8	-0.09465904	-2.6564554	-1.7631631	-0.85090759	1.4441013	0.08983289	1.0385061	0.46376759	-0.18275671	-1.45921400
9	2.01842371	-2.4404669	0.4600974	-2.41420765	-0.4314462	-2.99309008	0.9207286	-0.88577630	0.93334633	0.07998255
10	-0.06271410	1.3201133	-0.6399949	0.03612261	0.6556479	0.28488295	0.7208782	-1.09978090	0.82177311	0.65320434
	x1	x2	x3	x4	x5	x6	x7	x8	x9	x10
1	8.44202626	8.3759375	6.7644292	7.52651794	7.2770664	7.39299308	6.7038332	6.02794887	8.58377482	8.46318419
2	-0.56469817	2.2866454	-1.7813084	0.70483734	-0.3610573	-0.78383894	0.1852306	-0.09018639	0.25792144	-0.47617392
3	0.36312841	-1.3888607	-0.1719174	1.03510352	0.7581632	1.57572752	0.5818237	0.62351816	0.08844023	0.65034856
4	0.63286260	-0.2787888	1.2146747	-0.60892638	-0.7267048	0.64289931	1.3997368	-0.95352336	-0.12089654	1.39111046
5	0.40426832	-0.1333213	1.8951935	0.50495512	-1.3682810	0.08976065	-0.7272921	-0.54282881	-1.19432890	-1.11078888
6	-0.10612452	0.6359504	-0.4304691	-1.71700868	0.4328180	0.27655075	1.3025426	0.58099650	0.61199690	-0.86079259
7	1.51152200	-0.2842529	-0.2572694	-0.78445901	-0.8113932	0.67928882	0.3358481	0.76817874	-0.21713985	-1.13173868
8	-0.09465904	-2.6564554	-1.7631631	-0.85090759	1.4441013	0.08983289	1.0385061	0.46376759	-0.18275671	-1.45921400
9	2.01842371	-2.4404669	0.4600974	-2.41420765	-0.4314462	-2.99309008	0.9207286	-0.88577630	0.93334633	0.07998255
10	-0.06271410	1.3201133	-0.6399949	0.03612261	0.6556479	0.28488295	0.7208782	-1.09978090	0.82177311	0.65320434
	x1	x2	x3	x4	x5	x6	x7	x8	x9	x10
1	8.44202626	8.3759375	6.7644292	7.52651794	7.2770664	7.39299308	6.7038332	6.02794887	8.58377482	8.46318419
2	6.50636964	9.3577132	-1.7813084	0.70483734	-0.3610573	-0.78383894	0.1852306	-0.09018639	0.25792144	-0.47617392
3	0.36312841	-1.3888607	-0.1719174	1.03510352	0.7581632	1.57572752	0.5818237	0.62351816	0.08844023	0.65034856
4	0.63286260	-0.2787888	1.2146747	-0.60892638	-0.7267048	0.64289931	1.3997368	-0.95352336	-0.12089654	1.39111046
5	0.40426832	-0.1333213	1.8951935	0.50495512	-1.3682810	0.08976065	-0.7272921	-0.54282881	-1.19432890	-1.11078888
6	-0.10612452	0.6359504	-0.4304691	-1.71700868	0.4328180	0.27655075	1.3025426	0.58099650	0.61199690	-0.86079259
7	1.51152200	-0.2842529	-0.2572694	-0.78445901	-0.8113932	0.67928882	0.3358481	0.76817874	-0.21713985	-1.13173868
8	-0.09465904	-2.6564554	-1.7631631	-0.85090759	1.4441013	0.08983289	1.0385061	0.46376759	-0.18275671	-1.45921400
9	2.01842371	-2.4404669	0.4600974	-2.41420765	-0.4314462	-2.99309008	0.9207286	-0.88577630	0.93334633	0.07998255
10	-0.06271410	1.3201133	-0.6399949	0.03612261	0.6556479	0.28488295	0.7208782	-1.09978090	0.82177311	0.65320434
	x1	x2	x3	x4	x5	x6	x7	x8	x9	x10
1	8.44202626	8.3759375	6.7644292	7.52651794	7.2770664	7.39299308	6.7038332	6.02794887	8.58377482	8.46318419
2	6.50636964	9.3577132	5.2897594	0.70483734	-0.3610573	-0.78383894	0.1852306	-0.09018639	0.25792144	-0.47617392
3	0.36312841	-1.3888607	-0.1719174	1.03510352	0.7581632	1.57572752	0.5818237	0.62351816	0.08844023	0.65034856
4	0.63286260	-0.2787888	1.2146747	-0.60892638	-0.7267048	0.64289931	1.3997368	-0.95352336	-0.12089654	1.39111046
5	0.40426832	-0.1333213	1.8951935	0.50495512	-1.3682810	0.08976065	-0.7272921	-0.54282881	-1.19432890	-1.11078888
6	-0.10612452	0.6359504	-0.4304691	-1.71700868	0.4328180	0.27655075	1.3025426	0.58099650	0.61199690	-0.86079259
7	1.51152200	-0.2842529	-0.2572694	-0.78445901	-0.8113932	0.67928882	0.3358481	0.76817874	-0.21713985	-1.13173868
8	-0.09465904	-2.6564554	-1.7631631	-0.85090759	1.4441013	0.08983289	1.0385061	0.46376759	-0.18275671	-1.45921400
9	2.01842371	-2.4404669	0.4600974	-2.41420765	-0.4314462	-2.99309008	0.9207286	-0.88577630	0.93334633	0.07998255
10	-0.06271410	1.3201133	-0.6399949	0.03612261	0.6556479	0.28488295	0.7208782	-1.09978090	0.82177311	0.65320434
	x1	x2	x3	x4	x5	x6	x7	x8	x9	x10
1	8.44202626	8.3759375	6.7644292	7.52651794	7.2770664	7.39299308	6.7038332	6.02794887	8.58377482	8.46318419
2	6.50636964	9.3577132	5.2897594	0.70483734	-0.3610573	-0.78383894	0.1852306	-0.09018639	0.25792144	-0.47617392
3	0.36312841	-1.3888607	-0.1719174	1.03510352	0.7581632	1.57572752	0.5818237	0.62351816	0.08844023	0.65034856
4	0.63286260	-0.2787888	1.2146747	-0.60892638	-0.7267048	0.64289931	1.3997368	-0.95352336	-0.12089654	1.39111046
5	0.40426832	-0.1333213	1.8951935	0.50495512	-1.3682810	0.08976065	-0.7272921	-0.54282881	-1.19432890	-1.11078888
6	-0.10612452	0.6359504	-0.4304691	-1.71700868	0.4328180	0.27655075	1.3025426	0.58099650	0.61199690	-0.86079259
7	1.51152200	-0.2842529	-0.2572694	-0.78445901	-0.8113932	0.67928882	0.3358481	0.76817874	-0.21713985	-1.13173868
8	-0.09465904	-2.6564554	-1.7631631	-0.85090759	1.4441013	0.08983289	1.0385061	0.46376759	-0.18275671	-1.45921400
9	2.01842371	-2.4404669	0.4600974	-2.41420765	-0.4314462	-2.99309008	0.9207286	-0.88577630	0.93334633	0.07998255
10	-0.06271410	1.3201133	-0.6399949	0.03612261	0.6556479	0.28488295	0.7208782	-1.09978090	0.82177311	0.65320434
	x1	x2	x3	x4	x5	x6	x7	x8	x9	x10

Console	Terminal
8 -0.09465904 -2.6564554 -1.7631631 -0.85090759 1.4441013 0.08983289 1.0385061 0.46376759 -0.18275671 -1.45921400	
9 2.01842371 -2.4404669 0.4600974 -2.41420765 -0.4314462 -2.99309008 0.9207286 -0.88577630 0.93334633 0.07998255	
10 -0.06271410 1.3201133 -0.6399949 0.03612261 0.6556479 0.28488295 0.7208782 -1.09978090 0.82177311 0.65320434	
x1 x2 x3 x4 x5 x6 x7 x8 x9 x10	
1 8.44202626 8.3759375 6.7644292 7.52651794 7.2770664 7.39299308 6.7038332 6.02794887 8.58377482 8.46318419	
2 6.50636964 9.3577132 5.2897594 7.77590515 6.7100105 6.28722887 0.1852306 -0.09018639 0.25792144 -0.47617392	
3 0.36312841 -1.3888607 -0.1719174 1.03510352 0.7581632 1.57572752 0.5818237 0.62351816 0.08844023 0.65034856	
4 0.63286260 -0.2787888 1.2146747 -0.60892638 -0.7267048 0.64289931 1.3997368 -0.95352336 -1.12089654 1.39111046	
5 0.40426832 -0.1333213 1.8951935 0.50495512 -1.3682810 0.08976065 -0.7272921 -0.54282881 -1.19432890 -1.11078888	
6 -0.10612452 0.6359504 -0.4304691 -1.71700868 0.4328180 0.27655075 1.3025426 0.58099650 0.61199690 -0.86079259	
7 1.51152200 -0.2842529 -0.2572694 -0.78445901 -0.8113932 0.67928882 0.3358481 0.76817874 -0.21713985 -1.13173868	
8 -0.09465904 -2.6564554 -1.7631631 -0.85090759 1.4441013 0.08983289 1.0385061 0.46376759 -0.18275671 -1.45921400	
9 2.01842371 -2.4404669 0.4600974 -2.41420765 -0.4314462 -2.99309008 0.9207286 -0.88577630 0.93334633 0.07998255	
10 -0.06271410 1.3201133 -0.6399949 0.03612261 0.6556479 0.28488295 0.7208782 -1.09978090 0.82177311 0.65320434	
x1 x2 x3 x4 x5 x6 x7 x8 x9 x10	
1 8.44202626 8.3759375 6.7644292 7.52651794 7.2770664 7.39299308 6.7038332 6.02794887 8.58377482 8.46318419	
2 6.50636964 9.3577132 5.2897594 7.77590515 6.7100105 6.28722887 0.1852306 -0.09018639 0.25792144 -0.47617392	
3 0.36312841 -1.3888607 -0.1719174 1.03510352 0.7581632 1.57572752 0.5818237 0.62351816 0.08844023 0.65034856	
4 0.63286260 -0.2787888 1.2146747 -0.60892638 -0.7267048 0.64289931 1.3997368 -0.95352336 -1.12089654 1.39111046	
5 0.40426832 -0.1333213 1.8951935 0.50495512 -1.3682810 0.08976065 -0.7272921 -0.54282881 -1.19432890 -1.11078888	
6 -0.10612452 0.6359504 -0.4304691 -1.71700868 0.4328180 0.27655075 1.3025426 0.58099650 0.61199690 -0.86079259	
7 1.51152200 -0.2842529 -0.2572694 -0.78445901 -0.8113932 0.67928882 0.3358481 0.76817874 -0.21713985 -1.13173868	
8 -0.09465904 -2.6564554 -1.7631631 -0.85090759 1.4441013 0.08983289 1.0385061 0.46376759 -0.18275671 -1.45921400	
9 2.01842371 -2.4404669 0.4600974 -2.41420765 -0.4314462 -2.99309008 0.9207286 -0.88577630 0.93334633 0.07998255	
10 -0.06271410 1.3201133 -0.6399949 0.03612261 0.6556479 0.28488295 0.7208782 -1.09978090 0.82177311 0.65320434	
x1 x2 x3 x4 x5 x6 x7 x8 x9 x10	
1 8.44202626 8.3759375 6.7644292 7.52651794 7.2770664 7.39299308 6.7038332 6.02794887 8.58377482 8.46318419	
2 6.50636964 9.3577132 5.2897594 7.77590515 6.7100105 6.28722887 0.1852306 -0.09018639 0.25792144 -0.47617392	
3 0.36312841 -1.3888607 -0.1719174 1.03510352 0.7581632 1.57572752 0.5818237 0.62351816 0.08844023 0.65034856	
4 0.63286260 -0.2787888 1.2146747 -0.60892638 -0.7267048 0.64289931 1.3997368 -0.95352336 -1.12089654 1.39111046	
5 0.40426832 -0.1333213 1.8951935 0.50495512 -1.3682810 0.08976065 -0.7272921 -0.54282881 -1.19432890 -1.11078888	
6 -0.10612452 0.6359504 -0.4304691 -1.71700868 0.4328180 0.27655075 1.3025426 0.58099650 0.61199690 -0.86079259	
7 1.51152200 -0.2842529 -0.2572694 -0.78445901 -0.8113932 0.67928882 0.3358481 0.76817874 -0.21713985 -1.13173868	
8 -0.09465904 -2.6564554 -1.7631631 -0.85090759 1.4441013 0.08983289 1.0385061 0.46376759 -0.18275671 -1.45921400	
9 2.01842371 -2.4404669 0.4600974 -2.41420765 -0.4314462 -2.99309008 0.9207286 -0.88577630 0.93334633 0.07998255	
10 -0.06271410 1.3201133 -0.6399949 0.03612261 0.6556479 0.28488295 0.7208782 -1.09978090 0.82177311 0.65320434	
x1 x2 x3 x4 x5 x6 x7 x8 x9 x10	
1 8.44202626 8.3759375 6.7644292 7.52651794 7.2770664 7.39299308 6.7038332 6.02794887 8.58377482 8.46318419	
2 6.50636964 9.3577132 5.2897594 7.77590515 6.7100105 6.28722887 0.1852306 -0.09018639 0.25792144 -0.47617392	
3 0.36312841 -1.3888607 -0.1719174 1.03510352 0.7581632 1.57572752 0.5818237 0.62351816 0.08844023 0.65034856	
4 0.63286260 -0.2787888 1.2146747 -0.60892638 -0.7267048 0.64289931 1.3997368 -0.95352336 -1.12089654 1.39111046	
5 0.40426832 -0.1333213 1.8951935 0.50495512 -1.3682810 0.08976065 -0.7272921 -0.54282881 -1.19432890 -1.11078888	
6 -0.10612452 0.6359504 -0.4304691 -1.71700868 0.4328180 0.27655075 1.3025426 0.58099650 0.61199690 -0.86079259	
7 1.51152200 -0.2842529 -0.2572694 -0.78445901 -0.8113932 0.67928882 0.3358481 0.76817874 -0.21713985 -1.13173868	
8 -0.09465904 -2.6564554 -1.7631631 -0.85090759 1.4441013 0.08983289 1.0385061 0.46376759 -0.18275671 -1.45921400	
9 2.01842371 -2.4404669 0.4600974 -2.41420765 -0.4314462 -2.99309008 0.9207286 -0.88577630 0.93334633 0.07998255	
10 -0.06271410 1.3201133 -0.6399949 0.03612261 0.6556479 0.28488295 0.7208782 -1.09978090 0.82177311 0.65320434	
x1 x2 x3 x4 x5 x6 x7 x8 x9 x10	
1 8.44202626 8.3759375 6.7644292 7.52651794 7.2770664 7.39299308 6.7038332 6.02794887 8.58377482 8.46318419	
2 6.50636964 9.3577132 5.2897594 7.77590515 6.7100105 6.28722887 0.1852306 -0.09018639 0.25792144 -0.47617392	
3 0.36312841 -1.3888607 -0.1719174 1.03510352 0.7581632 1.57572752 0.5818237 0.62351816 0.08844023 0.65034856	
4 0.63286260 -0.2787888 1.2146747 -0.60892638 -0.7267048 0.64289931 1.3997368 -0.95352336 -1.12089654 1.39111046	
5 0.40426832 -0.1333213 1.8951935 0.50495512 -1.3682810 0.08976065 -0.7272921 -0.54282881 -1.19432890 -1.11078888	
6 -0.10612452 0.6359504 -0.4304691 -1.71700868 0.4328180 0.27655075 1.3025426 0.58099650 0.61199690 -0.86079259	
7 1.51152200 -0.2842529 -0.2572694 -0.78445901 -0.8113932 0.67928882 0.3358481 0.76817874 -0.21713985 -1.13173868	
8 -0.09465904 -2.6564554 -1.7631631 -0.85090759 1.4441013 0.08983289 1.0385061 0.46376759 -0.18275671 -1.45921400	
9 2.01842371 -2.4404669 0.4600974 -2.41420765 -0.4314462 -2.99309008 0.9207286 -0.88577630 0.93334633 0.07998255	
10 -0.06271410 1.3201133 -0.6399949 0.03612261 0.6556479 0.28488295 0.7208782 -1.09978090 0.82177311 0.65320434	
x1 x2 x3 x4 x5 x6 x7 x8 x9 x10	

Console	Terminal
10 -0.06271410 1.3201133 -0.6399949 0.03612261 0.6556479 0.28488295 0.7208782 -1.09978090 0.82177311 0.65320434	
x1 x2 x3 x4 x5 x6 x7 x8 x9 x10	
1 8.44202626 8.3759375 6.7644292 7.52651794 7.2770664 7.39299308 6.7038332 6.02794887 8.58377482 8.46318419	
2 6.50636964 9.3577132 5.2897594 7.77590515 6.7100105 6.28722887 0.1852306 -0.09018639 0.25792144 -0.47617392	
3 0.36312841 -1.3888607 -0.1719174 1.03510352 0.7581632 1.57572752 0.5818237 0.62351816 0.08844023 0.65034856	
4 0.63286260 -0.2787888 1.2146747 -0.60892638 -0.7267048 0.64289931 1.3997368 -0.95352336 -1.12089654 1.39111046	
5 0.40426832 -0.1333213 1.8951935 0.50495512 -1.3682810 0.08976065 -0.7272921 -0.54282881 -1.19432890 -1.11078888	
6 -0.10612452 0.6359504 -0.4304691 -1.71700868 0.4328180 0.27655075 1.3025426 0.58099650 0.61199690 -0.86079259	
7 1.51152200 -0.2842529 -0.2572694 -0.78445901 -0.8113932 0.67928882 0.3358481 0.76817874 -0.21713985 -1.13173868	
8 -0.09465904 -2.6564554 -1.7631631 -0.85090759 1.4441013 0.08983289 1.0385061 0.46376759 -0.18275671 -1.45921400	
9 2.01842371 -2.4404669 0.4600974 -2.41420765 -0.4314462 -2.99309008 0.9207286 -0.88577630 0.93334633 0.07998255	
10 -0.06271410 1.3201133 -0.6399949 0.03612261 0.6556479 0.28488295 0.7208782 -1.09978090 0.82177311 0.65320434	
x1 x2 x3 x4 x5 x6 x7 x8 x9 x10	
1 8.44202626 8.3759375 6.7644292 7.52651794 7.2770664 7.39299308 6.7038332 6.02794887 8.58377482 8.46318419	
2 6.50636964 9.3577132 5.2897594 7.77590515 6.7100105 6.28722887 0.1852306 -0.09018639 0.25792144 -0.47617392	
3 0.36312841 -1.3888607 -0.1719174 1.03510352 0.7581632 1.57572752 0.5818237 0.62351816 0.08844023 0.65034856	
4 0.63286260 -0.2787888 1.2146747 -0.60892638 -0.7267048 0.64289931 1.3997368 -0.95352336 -1.12089654 1.39111046	
5 0.40426832 -0.1333213 1.8951935 0.50495512 -1.3682810 0.08976065 -0.7272921 -0.54282881 -1.19432890 -1.11078888	
6 -0.10612452 0.6359504 -0.4304691 -1.71700868 0.4328180 0.27655075 1.3025426 0.58099650 0.61199690 -0.86079259	
7 1.51152200 -0.2842529 -0.2572694 -0.78445901 -0.8113932 0.67928882 0.3358481 0.76817874 -0.21713985 -1.13173868	
8 -0.09465904 -2.6564554 -1.7631631 -0.85090759 1.4441013 0.08983289 1.0385061 0.46376759 -0.18275671 -1.45921400	
9 2.01842371 -2.4404669 0.4600974 -2.41420765 -0.4314462 -2.99309008 0.9207286 -0.88577630 0.93334633 0.07998255	
10 -0.06271410 1.3201133 -0.6399949 0.03612261 0.6556479 0.28488295 0.7208782 -1.09978090 0.82177311 0.65320434	
x1 x2 x3 x4 x5 x6 x7 x8 x9 x10	
1 8.44202626 8.3759375 6.7644292 7.52651794 7.2770664 7.39299308 6.7038332 6.02794887 8.58377482 8.46318419	
2 6.50636964 9.3577132 5.2897594 7.77590515 6.7100105 6.28722887 0.1852306 -0.09018639 0.25792144 -0.47617392	
3 0.36312841 -1.3888607 -0.1719174 1.03510352 0.7581632 1.57572752 0.5818237 0.62351816 0.08844023 0.65034856	
4 0.63286260 -0.2787888 1.2146747 -0.60892638 -0.7267048 0.64289931 1.3997368 -0.95352336 -1.12089654 1.39111046	
5 0.40426832 -0.1333213 1.8951935 0.50495512 -1.3682810 0.08976065 -0.7272921 -0.54282881 -1.19432890 -1.11078888	
6 -0.10612452 0.6359504 -0.4304691 -1.71700868 0.4328180 0.27655075 1.3025426 0.58099650 0.61199690 -0.86079259	
7 1.51152200 -0.2842529 -0.2572694 -0.78445901 -0.8113932 0.67928882 0.3358481 0.76817874 -0.21713985 -1.13173868	
8 -0.09465904 -2.6564554 -1.7631631 -0.85090759 1.4441013 0.08983289 1.0385061 0.46376759 -0.18275671 -1.45921400	
9 2.01842371 -2.4404669 0.4600974 -2.41420765 -0.4314462 -2.99309008 0.9207286 -0.88577630 0.93334633 0.07998255	
10 -0.06271410 1.3201133 -0.6399949 0.03612261 0.6556479 0.28488295 0.7208782 -1.09978090 0.82177311 0.65320434	
x1 x2 x3 x4 x5 x6 x7 x8 x9 x10	

Console	Terminal
3	7.434196 5.682207 6.899150 8.106171 7.829231 8.646795 7.6528915 7.694586 7.1595080 7.7214164
4	7.039304 6.792279 6.899150 8.106171 7.829231 8.646795 7.6528915 7.694586 7.1595080 7.7214164
5	7.475336 6.937746 8.966261 7.576023 7.027877 1.60828 3.43776 6.528239 5.8767389 5.9602789
6	9.694943 7.707018 6.640599 5.354059 5.03886 7.347619 8.373610 6.52604 7.6830647 6.2102752
7	8.582590 6.786815 6.813798 6.286609 6.259675 7.50357 7.406916 7.839247 6.8539280 5.9393291
8	6.976409 4.41612 5.307905 6.220160 8.515169 1.66901 8.109574 7.534835 6.888311 5.6118538
9	0.084942 4.630061 7.531165 4.658680 6.639622 4.077978 7.991796 6.185292 8.004414 7.1510504
10	7.008354 8.391181 6.431073 7.107190 7.726716 7.355951 7.791946 5.971287 8.004414 7.1510504
x1	x2 x3 x4 x5 x6 x7 x8 x9 x10
1	8.442026 8.375937 6.764429 7.526518 7.277066 7.392993 6.703833 6.027949 8.5837748 8.4631842
2	6.506370 9.357713 5.289759 7.775905 6.710011 6.287229 7.256298 6.980881 7.328892 6.594899
3	7.434196 5.682207 6.899150 8.106171 7.829231 8.646795 7.652892 7.694586 7.1595080 7.7214164
4	7.039304 6.792279 6.899150 8.106171 7.829231 8.646795 7.6528915 7.694586 7.1595080 7.7214164
5	7.475336 6.937746 8.966261 7.576023 7.027877 1.60828 3.43776 6.528239 5.8767389 5.9602789
6	9.694943 7.707018 6.640599 5.354059 5.03886 7.347619 8.373610 6.52604 7.6830647 6.2102752
7	8.582590 6.786815 6.813798 6.286609 6.259675 7.50357 7.406916 7.839247 6.8539280 5.9393291
8	6.976409 4.41612 5.307905 6.220160 8.515169 1.66901 8.109574 7.534835 6.888311 5.6118538
9	0.084942 4.630061 7.531165 4.658680 6.639622 4.077978 7.991796 6.185292 8.004414 7.1510504
10	7.008354 8.391181 6.431073 7.107190 7.726716 7.355951 7.791946 5.971287 8.004414 7.1510504
x1	x2 x3 x4 x5 x6 x7 x8 x9 x10
1	8.442026 8.375937 6.764429 7.526518 7.277066 7.392993 6.703833 6.027949 8.5837748 8.4631842
2	6.506370 9.357713 5.289759 7.775905 6.710011 6.287229 7.256298 6.980881 7.328892 6.594899
3	7.434196 5.682207 6.899150 8.106171 7.829231 8.646795 7.652892 7.694586 7.1595080 7.7214164
4	7.039304 6.792279 6.899150 8.106171 7.829231 8.646795 7.6528915 7.694586 7.1595080 7.7214164
5	7.475336 6.937746 8.966261 7.576023 7.027877 1.60828 3.43776 6.528239 5.8767389 5.9602789
6	9.694943 7.707018 6.640599 5.354059 5.03886 7.347619 8.373610 6.52604 7.6830647 6.2102752
7	8.582590 6.786815 6.813798 6.286609 6.259675 7.50357 7.406916 7.839247 6.8539280 5.9393291
8	6.976409 4.41612 5.307905 6.220160 8.515169 1.66901 8.109574 7.534835 6.888311 5.6118538
9	0.084942 4.630061 7.531165 4.658680 6.639622 4.077978 7.991796 6.185292 8.004414 7.1510504
10	7.008354 8.391181 6.431073 7.107190 7.726716 7.355951 7.791946 5.971287 8.004414 7.1510504
x1	x2 x3 x4 x5 x6 x7 x8 x9 x10
1	8.442026 8.375937 6.764429 7.526518 7.277066 7.392993 6.703833 6.027949 8.5837748 8.4631842
2	6.506370 9.357713 5.289759 7.775905 6.710011 6.287229 7.256298 6.980881 7.328892 6.594899
3	7.434196 5.682207 6.899150 8.106171 7.829231 8.646795 7.652892 7.694586 7.1595080 7.7214164
4	7.039304 6.792279 6.899150 8.106171 7.829231 8.646795 7.6528915 7.694586 7.1595080 7.7214164
5	7.475336 6.937746 8.966261 7.576023 7.027877 1.60828 3.43776 6.528239 5.8767389 5.9602789
6	9.694943 7.707018 6.640599 5.354059 5.03886 7.347619 8.373610 6.52604 7.6830647 6.2102752
7	8.582590 6.786815 6.813798 6.286609 6.259675 7.50357 7.406916 7.839247 6.8539280 5.9393291
8	6.976409 4.41612 5.307905 6.220160 8.515169 1.66901 8.109574 7.534835 6.888311 5.6118538
9	0.084942 4.630061 7.531165 4.658680 6.639622 4.077978 7.991796 6.185292 8.004414 7.1510504
10	7.008354 8.391181 6.431073 7.107190 7.726716 7.355951 7.791946 5.971287 8.004414 7.1510504
x1	x2 x3 x4 x5 x6 x7 x8 x9 x10
1	8.442026 8.375937 6.764429 7.526518 7.277066 7.392993 6.703833 6.027949 8.5837748 8.4631842
2	6.506370 9.357713 5.289759 7.775905 6.710011 6.287229 7.256298 6.980881 7.328892 6.594899
3	7.434196 5.682207 6.899150 8.106171 7.829231 8.646795 7.652892 7.694586 7.1595080 7.7214164
4	7.039304 6.792279 6.899150 8.106171 7.829231 8.646795 7.6528915 7.694586 7.1595080 7.7214164
5	7.475336 6.937746 8.966261 7.576023 7.027877 1.60828 3.43776 6.528239 5.8767389 5.9602789
6	9.694943 7.707018 6.640599 5.354059 5.03886 7.347619 8.373610 6.52604 7.6830647 6.2102752
7	8.582590 6.786815 6.813798 6.286609 6.259675 7.50357 7.406916 7.839247 6.8539280 5.9393291
8	6.976409 4.41612 5.307905 6.220160 8.515169 1.66901 8.109574 7.534835 6.888311 5.6118538
9	0.084942 4.630061 7.531165 4.658680 6.639622 4.077978 7.991796 6.185292 8.004414 7.1510504
10	7.008354 8.391181 6.431073 7.107190 7.726716 7.355951 7.791946 5.971287 8.004414 7.1510504
x1	x2 x3 x4 x5 x6 x7 x8 x9 x10



```
Console Terminal x
~/
0 6.964943 7.707018 6.640599 5.354059 7.503886 7.347619 8.373610 7.652064 7.683065 6.2102752
7 8.582590 6.786815 6.813798 6.286609 6.259675 7.750357 7.406916 7.839247 6.853928 5.9393291
8 6.976409 4.414612 5.307905 6.220160 8.515169 7.160901 8.109574 7.534835 6.888311 5.6118538
9 9.089492 4.630601 7.531165 4.656860 6.639622 4.077978 7.991796 6.185292 8.004414 7.1510504
10 7.008354 8.391181 6.431073 7.107190 7.726716 7.355951 7.791946 5.971287 7.892841 0.6532043
    x1      x2      x3      x4      x5      x6      x7      x8      x9      x10
1 8.442026 8.375937 6.764429 7.526518 7.277066 7.392993 6.703833 6.027949 8.583775 8.463184
2 6.506370 9.357713 5.289759 7.775905 6.710011 6.287229 7.256298 6.980881 7.328989 6.594894
3 7.434196 5.682207 6.899150 8.106171 7.829231 8.646795 7.652892 7.694586 7.159508 7.721416
4 7.703930 6.792279 8.285743 6.462141 6.344363 7.713967 8.470805 6.117544 6.950171 8.462178
5 7.475336 6.937746 8.966261 7.576023 5.702787 7.160828 6.343776 6.528239 5.876739 5.960279
6 6.964943 7.707018 6.640599 5.354059 7.503886 7.347619 8.373610 7.652064 7.683065 6.210275
7 8.582590 6.786815 6.813798 6.286609 6.259675 7.750357 7.406916 7.839247 6.853928 5.939329
8 6.976409 4.414612 5.307905 6.220160 8.515169 7.160901 8.109574 7.534835 6.888311 5.611854
9 9.089492 4.630601 7.531165 4.656860 6.639622 4.077978 7.991796 6.185292 8.004414 7.151050
10 7.008354 8.391181 6.431073 7.107190 7.726716 7.355951 7.791946 5.971287 7.892841 7.724272
> system.time(
+   df_1[i,j]<- df_1[i,j] + 10*sin(0.75*pi)
+ )
    user  system elapsed
      0      0      0
> system.time(
+   for(i in 1:10){
+     for(j in 1:10){
+       df_1[i,j]<- df_1[i,j] + 10*sin(0.75*pi)
+     }
+   }
+ )
    user  system elapsed
    0.02    0.00    0.02
> |
```

