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GX5004

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HW4

1. In this exercise, you will work with Markov transition matrices to iterate a system forward through time. [3points]

   a.

```
> p%*%p
      [,1] [,2]  [,3]
[1,] 0.375  0.5 0.125
[2,] 0.250  0.5 0.250
[3,] 0.125  0.5 0.375

> p%^%5
         [,1] [,2]     [,3]
[1,] 0.265625  0.5 0.234375
[2,] 0.250000  0.5 0.250000
[3,] 0.234375  0.5 0.265625

> p%^%10
          [,1] [,2]      [,3]
[1,] 0.2504883  0.5 0.2495117
[2,] 0.2500000  0.5 0.2500000
[3,] 0.2495117  0.5 0.2504883

> p%^%25
     [,1] [,2] [,3]
[1,] 0.25  0.5 0.25
[2,] 0.25  0.5 0.25
[3,] 0.25  0.5 0.25
```

b.

```
> p%*%p
     [,1] [,2]  [,3]
[1,] 1.000 0.00 0.000
[2,] 0.375 0.25 0.375
[3,] 0.000 0.00 1.000
> p%^%5
         [,1]    [,2]     [,3]
[1,] 1.000000 0.00000 0.000000
[2,] 0.484375 0.03125 0.484375
[3,] 0.000000 0.00000 1.000000
> p%^%10
          [,1]         [,2]      [,3]
[1,] 1.0000000 0.0000000000 0.0000000
[2,] 0.4995117 0.0009765625 0.4995117
[3,] 0.0000000 0.0000000000 1.0000000
> p%^%25
     [,1]         [,2] [,3]
[1,]  1.0 0.000000e+00  0.0
[2,]  0.5 2.980232e-08  0.5
[3,]  0.0 0.000000e+00  1.0
```

in the limit, I think the matrix might looks like this:

1	0	0
0.5	0	0.5
0	0	1

keep iterating:

```
> p%^%100
     [,1]         [,2] [,3]
[1,]  1.0 0.000000e+00  0.0
[2,]  0.5 7.888609e-31  0.5
[3,]  0.0 0.000000e+00  1.0
> p%^%1000
     [,1]          [,2] [,3]
[1,]  1.0  0.000000e+00  0.0
[2,]  0.5 9.332636e-302  0.5
[3,]  0.0  0.000000e+00  1.0
> p%^%500000
     [,1] [,2] [,3]
[1,]  1.0    0  0.0
[2,]  0.5    0  0.5
[3,]  0.0    0  1.0
```

if a rat start in room B, there are 50% chance that ends in A and 50% chance ends in C but it will never be back in B again.

c. Markov transition probabilities

```
     A    B    C    D    E
A 1.00 0.00 0.00 0.00 0.00
B 0.25 0.50 0.25 0.00 0.00
C 0.00 0.25 0.50 0.25 0.00
D 0.00 0.00 0.25 0.50 0.25
E 0.00 0.00 0.00 0.50 0.50
```

```
> p%^%500000
  A B C D E
A 1 0 0 0 0
B 1 0 0 0 0
C 1 0 0 0 0
D 1 0 0 0 0
E 1 0 0 0 0
```

if a rat starts in room c, it'll ends in room A. Actually, no matter where it starts it will always end in room A.

We can say, after many times of experiment, the rat will always end in the room which is the absorbing state. (if the rat can move freely in other room.)

2. Download a revised version of the National Longitudinal Survey of Women (NLSW) data presented in class, called "union_pred.dta", from the course website. These data are formatted as a Stata dataset. [6points]

a.

```
> as.matrix(prop.table(prior,1))
          0         1
0 0.8761577 0.1238423
1 0.4286875 0.5713125
```

b.

```
> summary(lom)

Call:
glm(formula = union ~ year + age + grade + south + black + smsa +
    prior_union, family = binomial, data = data)

Deviance Residuals:
    Min       1Q   Median       3Q      Max
-1.7413  -0.5600  -0.4959  -0.3628   2.4232

Coefficients:
             Estimate Std. Error z value Pr(>|z|)
(Intercept) -2.296040   0.385301  -5.959 2.54e-09 ***
year        -0.011370   0.006686  -1.701  0.08903 .
age          0.023661   0.006152   3.846  0.00012 ***
grade        0.046393   0.007849   5.911 3.40e-09 ***
south       -0.662996   0.042135 -15.735  < 2e-16 ***
black        0.579656   0.043245  13.404  < 2e-16 ***
smsa         0.047586   0.043301   1.099  0.27179
prior_union  2.120996   0.037795  56.119  < 2e-16 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

(Dispersion parameter for binomial family taken to be 1)

    Null deviance: 23211  on 21765  degrees of freedom
Residual deviance: 18925  on 21758  degrees of freedom
AIC: 18941

Number of Fisher Scoring iterations: 4
```

c.

```
data1['prior_union']<-0

pred01<-predict(fit, data1)

pred00<-1-pred01
```

d.

```
data1['prior_union']<-1

pred01<-predict(fit, data1)

pred00<-1-pred01
```

e.

```
          0         1
0 0.8714181 0.1285819
1 0.4629799 0.5370201
```

f. converged:

```
          0         1
0 0.7826399 0.2173601
1 0.7826399 0.2173601
```

comparing to actual:

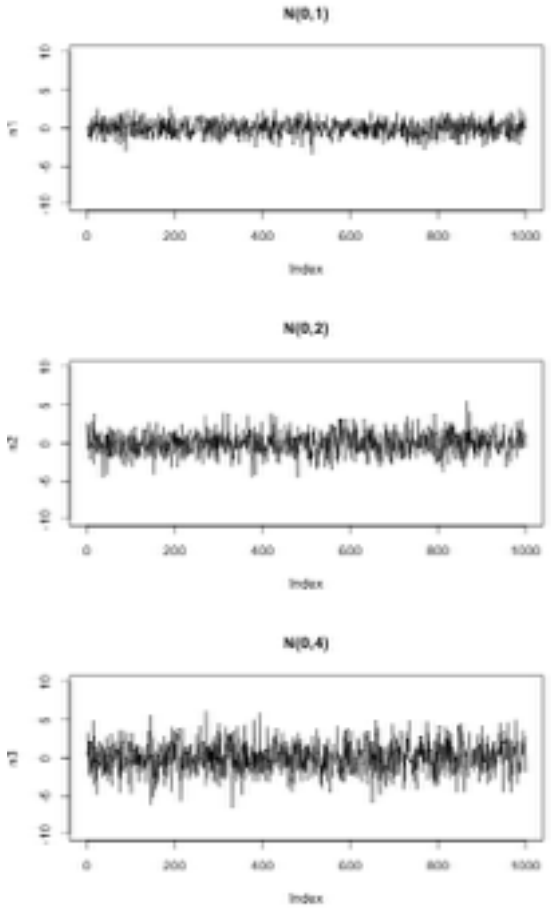
```
> prop.table(table(upred$union))

       0        1
0.7749701 0.2250299
```

the predict is quite the same with actual data.

g. Submit all code and results.

3. In this exercise, you will work with Gaussian white noise random variables. [3points]

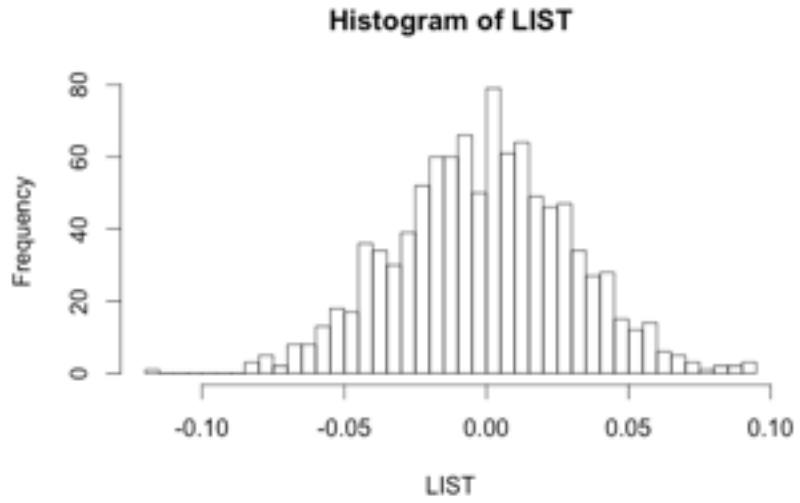
a.



b.

```
Call:
lm(formula = X1 ~ X2)

Residuals:
    Min      1Q  Median      3Q     Max
-3.0375 -0.6593 -0.0267  0.6774  3.3392

Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept) -0.05340    0.03160  -1.690   0.0913 .
X2          -0.03479    0.03173  -1.097   0.2731
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.9992 on 998 degrees of freedom
Multiple R-squared:  0.001204,  Adjusted R-squared:  0.0002027
F-statistic: 1.203 on 1 and 998 DF,  p-value: 0.2731
```

c.



d. Submit code and results.