```
> #Exercise 1
[1] "The number of students is 340823"
[1] "The number of schools is 640"
[1] "The number of programs is 32"
[1] "The number of choices is 5546"
[1] "The number of missing test score is 179887"
[1] "The number of Apply to the same school (different programs) is 5546"
[1] "The number of Apply to less than 6 choices is 18954"




> #Exercise 2
[1] "The answer for Exercise 2 is Choicescore"
> head(Choicescore, 20)
    schoolcode           choice      X score agey male
1        10101 10101Agriculture 230518   288   15    1
7        10101 10101Agriculture 230756   288   14    0
13       10101 10101Agriculture 230824   288   19    1
19       10101 10101Agriculture 230386   289   17    0
25       10101 10101Agriculture 230627   291   16    1
31       10101 10101Agriculture 230893   292   16    0
37       10101 10101Agriculture 230927   293   16    0
43       10101 10101Agriculture 230694   294   16    1
49       10101 10101Agriculture 230578   295   19    1
55       10101 10101Agriculture 230512   295   17    1
61       10101 10101Agriculture 230546   296   15    0
67       10101 10101Agriculture 230427   297   15    0
73       10101 10101Agriculture 230655   298   17    1
79       10101 10101Agriculture 230637   298   16    1
85       10101 10101Agriculture 230918   298   17    1
91       10101 10101Agriculture 230464   299   16    1
97       10101 10101Agriculture 230695   299   16    1
103      10101 10101Agriculture 230505   300   16    1
109      10101 10101Agriculture 230816   302   20    1
115      10101 10101Agriculture 230801   303   19    0
       choicepgm          jssdistrict rankplace cutoff
1    Agriculture    Accra Metropolitan         3    288
7    Agriculture    Accra Metropolitan         3    288
13   Agriculture    Accra Metropolitan         3    288
19   Agriculture          Kumasi Metro         1    288
25   Agriculture          Kumasi Metro         4    288
31   Agriculture     Ga West (Amasaman)         3    288
37   Agriculture                  Tema         4    288
43   Agriculture     Ga West (Amasaman)         4    288
49   Agriculture    Accra Metropolitan         2    288
55   Agriculture    Wassa West (Tarkwa)         3    288
61   Agriculture    Accra Metropolitan         3    288
67   Agriculture    Accra Metropolitan         1    288
73   Agriculture    Accra Metropolitan         1    288
79   Agriculture Mfantsiman (Saltpond)         2    288
85   Agriculture    Accra Metropolitan         4    288
91   Agriculture Mfantsiman (Saltpond)         2    288
97   Agriculture    Accra Metropolitan         4    288
103  Agriculture     Ga West (Amasaman)         3    288
```

```
109 Agriculture     Ga West (Amasaman)       1    288
115 Agriculture     Ga West (Amasaman)       2    288
    quality size                             schoolname
1   309.0889   45 EBENEZER SENIOR HIGH. SCHOOL, DANSOMAN
7   309.0889   45 EBENEZER SENIOR HIGH. SCHOOL, DANSOMAN
13  309.0889   45 EBENEZER SENIOR HIGH. SCHOOL, DANSOMAN
19  309.0889   45 EBENEZER SENIOR HIGH. SCHOOL, DANSOMAN
25  309.0889   45 EBENEZER SENIOR HIGH. SCHOOL, DANSOMAN
31  309.0889   45 EBENEZER SENIOR HIGH. SCHOOL, DANSOMAN
37  309.0889   45 EBENEZER SENIOR HIGH. SCHOOL, DANSOMAN
43  309.0889   45 EBENEZER SENIOR HIGH. SCHOOL, DANSOMAN
49  309.0889   45 EBENEZER SENIOR HIGH. SCHOOL, DANSOMAN
55  309.0889   45 EBENEZER SENIOR HIGH. SCHOOL, DANSOMAN
61  309.0889   45 EBENEZER SENIOR HIGH. SCHOOL, DANSOMAN
67  309.0889   45 EBENEZER SENIOR HIGH. SCHOOL, DANSOMAN
73  309.0889   45 EBENEZER SENIOR HIGH. SCHOOL, DANSOMAN
79  309.0889   45 EBENEZER SENIOR HIGH. SCHOOL, DANSOMAN
85  309.0889   45 EBENEZER SENIOR HIGH. SCHOOL, DANSOMAN
91  309.0889   45 EBENEZER SENIOR HIGH. SCHOOL, DANSOMAN
97  309.0889   45 EBENEZER SENIOR HIGH. SCHOOL, DANSOMAN
103 309.0889   45 EBENEZER SENIOR HIGH. SCHOOL, DANSOMAN
109 309.0889   45 EBENEZER SENIOR HIGH. SCHOOL, DANSOMAN
115 309.0889   45 EBENEZER SENIOR HIGH. SCHOOL, DANSOMAN
           sssdistrict     ssslong    ssslat
1   Accra Metropolitan -0.1971153 5.607396
7   Accra Metropolitan -0.1971153 5.607396
13  Accra Metropolitan -0.1971153 5.607396
19  Accra Metropolitan -0.1971153 5.607396
25  Accra Metropolitan -0.1971153 5.607396
31  Accra Metropolitan -0.1971153 5.607396
37  Accra Metropolitan -0.1971153 5.607396
43  Accra Metropolitan -0.1971153 5.607396
49  Accra Metropolitan -0.1971153 5.607396
55  Accra Metropolitan -0.1971153 5.607396
61  Accra Metropolitan -0.1971153 5.607396
67  Accra Metropolitan -0.1971153 5.607396
73  Accra Metropolitan -0.1971153 5.607396
79  Accra Metropolitan -0.1971153 5.607396
85  Accra Metropolitan -0.1971153 5.607396
91  Accra Metropolitan -0.1971153 5.607396
97  Accra Metropolitan -0.1971153 5.607396
103 Accra Metropolitan -0.1971153 5.607396
109 Accra Metropolitan -0.1971153 5.607396
115 Accra Metropolitan -0.1971153 5.607396


> #Exercise 3
[1] "The answer for Exercise 3 is the variable Distance in the dataframe
Dis"
> head(Dis, 20)
                          jssdistrict schoolcode
```

19679	Agona Swedru	30403
20031	Agona Swedru	30403
428	Abura/Asebu/Kwamankese (Abura Dunkwa)	30403
461	Abura/Asebu/Kwamankese (Abura Dunkwa)	30403
15	Abura/Asebu/Kwamankese (Abura Dunkwa)	30403
161	Abura/Asebu/Kwamankese (Abura Dunkwa)	30403
17	Abura/Asebu/Kwamankese (Abura Dunkwa)	30403
33	Abura/Asebu/Kwamankese (Abura Dunkwa)	30403
21640	Ajumako/Enyan/Essiam (Ajumako)	30403
21848	Ajumako/Enyan/Essiam (Ajumako)	30403
128201	Twifo Hemang (Twifo Praso)	30403
128284	Twifo Hemang (Twifo Praso)	30403
37302	Awutu/Efutu/Senya (Winneba)	30403
37395	Awutu/Efutu/Senya (Winneba)	30403
96339	Mfantsiman (Saltpond)	30403
96639	Mfantsiman (Saltpond)	30403
60	Abura/Asebu/Kwamankese (Abura Dunkwa)	30403
141	Abura/Asebu/Kwamankese (Abura Dunkwa)	30403
96923	Mfantsiman (Saltpond)	30403
97032	Mfantsiman (Saltpond)	30403

	choice	X	score	agey	male
19679	30403General Arts	179888	249	16	0
20031	30403General Arts	179888	249	16	0
428	30403Agriculture	179890	254	19	1
461	30403Agriculture	179890	254	19	1
15	30403Home Economics	179891	277	17	0
161	30403Home Economics	179891	277	17	0
17	30403General Arts	179892	236	16	0
33	30403General Arts	179892	236	16	0
21640	30403General Arts	179893	237	18	1
21848	30403General Arts	179893	237	18	1
128201	30403Agriculture	179894	262	16	0
128284	30403Agriculture	179894	262	16	0
37302	30403General Arts	179895	249	15	1
37395	30403General Arts	179895	249	15	1
96339	30403General Arts	179896	229	17	0
96639	30403General Arts	179896	229	17	0
60	30403General Arts	179897	219	18	1
141	30403General Arts	179897	219	18	1
96923	30403Agriculture	179898	227	17	0
97032	30403Agriculture	179898	227	17	0

	choicepgm	rankplace	cutoff	quality	size
19679	General Arts	5	208	242.0857	35
20031	General Arts	5	208	242.0857	35
428	Agriculture	2	219	241.9333	15
461	Agriculture	2	219	241.9333	15
15	Home Economics	4	215	248.3750	8
161	Home Economics	4	215	248.3750	8
17	General Arts	3	208	242.0857	35
33	General Arts	3	208	242.0857	35
21640	General Arts	1	208	242.0857	35
21848	General Arts	1	208	242.0857	35
128201	Agriculture	6	219	241.9333	15
128284	Agriculture	6	219	241.9333	15

```
37302        General Arts      5      208 242.0857      35
37395        General Arts      5      208 242.0857      35
96339        General Arts      1      208 242.0857      35
96639        General Arts      1      208 242.0857      35
60           General Arts      6      208 242.0857      35
141          General Arts      6      208 242.0857      35
96923        Agriculture       3      219 241.9333      15
97032        Agriculture       3      219 241.9333      15
                                       schoolname
19679          ABAKRAMPA SENIOR HIGH TECHNICAL
20031  <d8>?ABAKRAMPA SENIOR HIGH TECHNICAL
428    <d8>?ABAKRAMPA SENIOR HIGH TECHNICAL
461          ABAKRAMPA SENIOR HIGH TECHNICAL
15     <d8>?ABAKRAMPA SENIOR HIGH TECHNICAL
161          ABAKRAMPA SENIOR HIGH TECHNICAL
17           ABAKRAMPA SENIOR HIGH TECHNICAL
33     <d8>?ABAKRAMPA SENIOR HIGH TECHNICAL
21640        ABAKRAMPA SENIOR HIGH TECHNICAL
21848  <d8>?ABAKRAMPA SENIOR HIGH TECHNICAL
128201       ABAKRAMPA SENIOR HIGH TECHNICAL
128284 <d8>?ABAKRAMPA SENIOR HIGH TECHNICAL
37302        ABAKRAMPA SENIOR HIGH TECHNICAL
37395  <d8>?ABAKRAMPA SENIOR HIGH TECHNICAL
96339  <d8>?ABAKRAMPA SENIOR HIGH TECHNICAL
96639        ABAKRAMPA SENIOR HIGH TECHNICAL
60           ABAKRAMPA SENIOR HIGH TECHNICAL
141    <d8>?ABAKRAMPA SENIOR HIGH TECHNICAL
96923        ABAKRAMPA SENIOR HIGH TECHNICAL
97032  <d8>?ABAKRAMPA SENIOR HIGH TECHNICAL
                                 sssdistrict   ssslong
19679  Abura/Asebu/Kwamankese (Abura Dunkwa) -1.197088
20031  Abura/Asebu/Kwamankese (Abura Dunkwa) -1.197088
428    Abura/Asebu/Kwamankese (Abura Dunkwa) -1.197088
461    Abura/Asebu/Kwamankese (Abura Dunkwa) -1.197088
15     Abura/Asebu/Kwamankese (Abura Dunkwa) -1.197088
161    Abura/Asebu/Kwamankese (Abura Dunkwa) -1.197088
17     Abura/Asebu/Kwamankese (Abura Dunkwa) -1.197088
33     Abura/Asebu/Kwamankese (Abura Dunkwa) -1.197088
21640  Abura/Asebu/Kwamankese (Abura Dunkwa) -1.197088
21848  Abura/Asebu/Kwamankese (Abura Dunkwa) -1.197088
128201 Abura/Asebu/Kwamankese (Abura Dunkwa) -1.197088
128284 Abura/Asebu/Kwamankese (Abura Dunkwa) -1.197088
37302  Abura/Asebu/Kwamankese (Abura Dunkwa) -1.197088
37395  Abura/Asebu/Kwamankese (Abura Dunkwa) -1.197088
96339  Abura/Asebu/Kwamankese (Abura Dunkwa) -1.197088
96639  Abura/Asebu/Kwamankese (Abura Dunkwa) -1.197088
60     Abura/Asebu/Kwamankese (Abura Dunkwa) -1.197088
141    Abura/Asebu/Kwamankese (Abura Dunkwa) -1.197088
96923  Abura/Asebu/Kwamankese (Abura Dunkwa) -1.197088
97032  Abura/Asebu/Kwamankese (Abura Dunkwa) -1.197088
         ssslat    point_x  point_y Distance
19679  5.130001 -0.7552425 5.617353 45.40499
20031  5.130001 -0.7552425 5.617353 45.40499
428    5.130001 -1.1970884 5.130001  0.00000
```

```
461     5.130001 -1.1970884 5.130001  0.00000
15      5.130001 -1.1970884 5.130001  0.00000
161     5.130001 -1.1970884 5.130001  0.00000
17      5.130001 -1.1970884 5.130001  0.00000
33      5.130001 -1.1970884 5.130001  0.00000
21640   5.130001 -1.0053846 5.401725 22.96873
21848   5.130001 -1.0053846 5.401725 22.96873
128201  5.130001 -1.5597034 5.572999 39.52487
128284  5.130001 -1.5597034 5.572999 39.52487
37302   5.130001 -0.5086389 5.544896 55.41003
37395   5.130001 -0.5086389 5.544896 55.41003
96339   5.130001 -1.0064534 5.201528 14.03343
96639   5.130001 -1.0064534 5.201528 14.03343
60      5.130001 -1.1970884 5.130001  0.00000
141     5.130001 -1.1970884 5.130001  0.00000
96923   5.130001 -1.0064534 5.201528 14.03343
97032   5.130001 -1.0064534 5.201528 14.03343
```

```
> #Exercise 4
[1] "For 1st Rankplace"
[1] "The average of the cutoff is 281.666696851018"
[1] "The sd of the cutoff is 58.8290705689274"
[1] "The average of the Quality is 308.362561581667"
[1] "The sd of the Quality is 52.1712365763513"
[1] "The average of the Distance is 35.1811012348586"
[1] "The sd of the Distance is 52.8207408451784"
[1] "For 2nd Rankplace"
[1] "The average of the cutoff is 275.943484190162"
[1] "The sd of the cutoff is 51.1390749676321"
[1] "The average of the Quality is 301.936452507742"
[1] "The sd of the Quality is 44.5486524805607"
[1] "The average of the Distance is 34.0217710653266"
[1] "The sd of the Distance is 48.4151155841386"
[1] "For 3rd Rankplace"
[1] "The average of the cutoff is 261.26926286509"
[1] "The sd of the cutoff is 43.8014658133546"
[1] "The average of the Quality is 288.566888990669"
[1] "The sd of the Quality is 37.492231591051"
[1] "The average of the Distance is 28.6654303706568"
[1] "The sd of the Distance is 43.3276802542669"
[1] "For 4th Rankplace"
[1] "The average of the cutoff is 247.957375629723"
[1] "The sd of the cutoff is 37.6479586381162"
[1] "The average of the Quality is 276.922107837596"
[1] "The sd of the Quality is 31.7422473327192"
[1] "The average of the Distance is 22.8660114943869"
[1] "The sd of the Distance is 38.671561364868"
[1] "For 5th Rankplace"
[1] "The average of the cutoff is 211.090909090909"
```

```
[1] "The sd of the cutoff is 8.18112838937557"
[1] "The average of the Quality is 251.778416288314"
[1] "The sd of the Quality is 12.7789805612124"
[1] "The average of the Distance is 32.3881553859471"
[1] "The sd of the Distance is 30.5839074535372"
[1] "For 6th Rankplace"
[1] "The average of the cutoff is 211.181939353549"
[1] "The sd of the cutoff is 8.20046057879195"
[1] "The average of the Quality is 249.449253381274"
[1] "The sd of the Quality is 11.2054957202403"
[1] "The average of the Distance is 31.9538100119105"
[1] "The sd of the Distance is 29.7359428251178"
> #======================================
> Quantiles<- Dis[order(Dis$score, Dis$X),]
[1] "For 1st quantile"
[1] "The average of the cutoff is 216.727445079747"
[1] "The sd of the cutoff is 13.7504012401409"
[1] "The average of the Quality is 250.98769286784"
[1] "The sd of the Quality is 12.2768746968854"
[1] "The average of the Distance is 25.97192694149"
[1] "The sd of the Distance is 42.6813644020342"
[1] "For 2nd quantile"
[1] "The average of the cutoff is 228.874516582679"
[1] "The sd of the cutoff is 22.3503980789819"
[1] "The average of the Quality is 261.097918819516"
[1] "The sd of the Quality is 17.9526811040484"
[1] "The average of the Distance is 27.4219464315344"
[1] "The sd of the Distance is 45.9810011218846"
[1] "For 3rd quantile"
[1] "The average of the cutoff is 243.377261994572"
[1] "The sd of the cutoff is 32.1635880454268"
[1] "The average of the Quality is 273.609336668229"
[1] "The sd of the Quality is 26.5693976879494"
[1] "The average of the Distance is 28.7161280998983"
[1] "The sd of the Distance is 46.5872322494831"
[1] "For 4th quantile"
[1] "The average of the cutoff is 266.199677056391"
[1] "The sd of the cutoff is 52.0582572606955"
[1] "The average of the Quality is 293.943176433258"
[1] "The sd of the Quality is 45.4150688237614"
[1] "The average of the Distance is 31.1064247813155"
[1] "The sd of the Distance is 46.6952354382574"


> #Exercise 5
> head(Y, 20)
 [1]  1.9032843 -3.1350882  3.8277599  1.5970899  1.9943875
 [6]  4.5373519 -4.1700785 -4.7640866 -0.3120093 -2.4801004
[11] -1.9839194  0.9860258  2.1066723  1.9385475  0.8920039
[16]  3.2090729 -3.6149303 -1.3973371 -0.9666107 -3.7247639
> head(ydum, 20)
 [1] 1 0 1 1 1 1 0 0 1 0 0 1 1 1 1 1 0 0 0 0
```

```
> #Exercise 6
[1] "The correlation coefficient between Y and X1 is 0.209429106418655"
[1] "The regression coefficient between Y and X1 is 1.19218588123404"
[1] "The difference from 1.2 is -0.0078141187659575"
The regression result is Y= 2.550967 + 1.192186 X1+ -0.9046174 X2+
0.1099006 X3+e
The coefficients are 2.550967 1.192186 -0.9046174 0.1099006
The standard errors in this OLS are 0.04093615 0.01748154 0.002925907
0.02176734




> #Exercise 7
> #Probit Model=====================================
'log Lik.' -2161.466 (df=4)
   True parameter R: GLM : est R: own :se R: GLM :se
        2.5509674    2.9654092 0.10011006 0.10011170
X1      1.1921859    1.2343270 0.04458552 0.04463045
X2     -0.9046174   -0.9199287 0.01886599 0.01884960
X3      0.1099006    0.1354812 0.04694495 0.04705767

> #Logit Model=====================================
'log Lik.' -2167.151 (df=4)
   True parameter R: GLM : est R: own :se R: GLM :se
        2.5509674    5.3212472 0.18728370 0.10011170
X1      1.1921859    2.2190576 0.08304348 0.04463045
X2     -0.9046174   -1.6529784 0.03763265 0.01884960
X3      0.1099006    0.2439212 0.08434958 0.04705767
> #linear probability model=====================================
   True parameter      Probit       Logit          LPM
        2.5509674   2.9654092   5.3212472   0.89111066
X1      1.1921859   1.2343270   2.2190576   0.14521037
X2     -0.9046174  -0.9199287  -1.6529784  -0.10485191
X3      0.1099006   0.1354812   0.2439212   0.01078067

[1] "Conclusion: the positive and negative signal of coefficients are
same"
[1] "For the intercept, X1 and X2, all the three models hold 0.001
significant level"
[1] "But for X3, the Probit and Logit models hold 0.01 significant level.
But for LPM, the X3 is not significant."
```

```
> #Exercise 8
> # Probit Model
Marginal Effects:
        dF/dx  Std. Err.          z   P>|z|
X1  0.4924149  0.0177859  27.6857 < 2e-16 ***
X2 -0.3669907  0.0075174 -48.8187 < 2e-16 ***
X3  0.0539974  0.0186723   2.8918 0.00383 **
---
Signif. codes:
0 â€˜***â€™ 0.001 â€˜**â€™ 0.01 â€˜*â€™ 0.05 â€˜.â€™ 0.1 â€˜ â€™ 1

> # Logit Model
Marginal Effects:
        dF/dx  Std. Err.          z   P>|z|
X1  0.5547272  0.0207585  26.723 < 2e-16 ***
X2 -0.4132169  0.0093871 -44.020 < 2e-16 ***
X3  0.0608904  0.0209894   2.901 0.00372 **
---
Signif. codes:
0 â€˜***â€™ 0.001 â€˜**â€™ 0.01 â€˜*â€™ 0.05 â€˜.â€™ 0.1 â€˜ â€™ 1
```