

```

> #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"

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> #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

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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

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

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jssdistrict schoolcode
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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
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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"
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[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

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> #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  $Y = 2.550967 + 1.192186 X_1 - 0.9046174 X_2 + 0.1099006 X_3 + e$ 
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."

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> #Exercise 8
> # Probit Model
Marginal Effects:

              mfx              se
(Intercept)  1.18300217 0.039944053
X1           0.49241485 0.017785916
X2          -0.36699070 0.007517426
X3           0.05404803 0.018727880

> # Logit Model
Marginal Effects:

              mfx              se
(Intercept)  1.3302225 0.046832316
X1           0.5547272 0.020758477
X2          -0.4132169 0.009387141
X3           0.0609762 0.021085805

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