Assigment 1

Fernando Martin

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Exercise 1

Report the following statistics . Number of students There are 340823 students . Number of schools there are 641 unique schools . Number of programs There are 33 unique programs . Number of choices (school,program There are 2545 number of choices . Missing test score According to R, there are 179887 test scores missing . Apply to the same school (different programs) 116430 apply to the same school . Apply to less than 6 choices 18954 students applied to less than 6 schools

Exercise 2

Exercise 2 Data Create a school level dataset, where each row corresponds to a (school,program) with the following variables: . the district where the school is located . the latitude of the district . the longitude of the district . cutoff (the lowest score to be admitted) . quality (the average score of the students admitted) . size (number of students admitted)

```
# schoolcode        choice       ID    score agey  male    choicepgm        jssdistrict      rankplace           rank
#  10101      10101Agriculture 230518   288   15    1     Agriculture     Accra Metropolitan      3          10101Agriculture
#  10101      10101Agriculture 230518   288   15    1     Agriculture     Accra Metropolitan      3          10101Agriculture
#  10101      10101Agriculture 230518   288   15    1     Agriculture     Accra Metropolitan      3          10101Agriculture
#  10101      10101Agriculture 230518   288   15    1     Agriculture     Accra Metropolitan      3          10101Agriculture
#  10101      10101Agriculture 230518   288   15    1     Agriculture     Accra Metropolitan      3          10101Agriculture
#  10101      10101Agriculture 230518   288   15    1     Agriculture     Accra Metropolitan      3          10101Agriculture
#  10101      10101Agriculture 230518   288   15    1     Agriculture     Accra Metropolitan      3          10101Agriculture
#  10101      10101Agriculture 230518   288   15    1     Agriculture     Accra Metropolitan      3          10101Agriculture
#  10101      10101Agriculture 230518   288   15    1     Agriculture     Accra Metropolitan      3          10101Agriculture
#  10101      10101Agriculture 230518   288   15    1     Agriculture     Accra Metropolitan      3          10101Agriculture
#  10101      10101Agriculture 230518   288   15    1     Agriculture     Accra Metropolitan      3          10101Agriculture
#  10101      10101Agriculture 230518   288   15    1     Agriculture     Accra Metropolitan      3          10101Agriculture
#  10101      10101Agriculture 230756   288   14    0     Agriculture     Accra Metropolitan      3          10101Agriculture
#  10101      10101Agriculture 230756   288   14    0     Agriculture     Accra Metropolitan      3          10101Agriculture
#  10101      10101Agriculture 230756   288   14    0     Agriculture     Accra Metropolitan      3          10101Agriculture
#  10101      10101Agriculture 230756   288   14    0     Agriculture     Accra Metropolitan      3          10101Agriculture
#  10101      10101Agriculture 230756   288   14    0     Agriculture     Accra Metropolitan      3          10101Agriculture
#  10101      10101Agriculture 230756   288   14    0     Agriculture     Accra Metropolitan      3          10101Agriculture
#  10101      10101Agriculture 230756   288   14    0     Agriculture     Accra Metropolitan      3          10101Agriculture
#  10101      10101Agriculture 230756   288   14    0     Agriculture     Accra Metropolitan      3          10101Agriculture
```

```
# cutoff_Low to Top   quality_Average   Score size_Number of Admission    X.y                  schoolname
#       288              309.0889                45                      3247
#       288              309.0889                45                      3560
#       288              309.0889                45                      6031
#       288              309.0889                45                      3881
#       288              309.0889                45                      408       EBENEZER SENIOR HIGH. SCHOOL, DANSOMAN
#       288              309.0889                45                      2881
#       288              309.0889                45                      328       EBENEZER SENIOR HIGH. SCHOOL, DANSOMAN
#       288              309.0889                45                      453       EBENEZER SENIOR HIGH. SCHOOL, DANSOMAN
#       288              309.0889                45                      590       EBENEZER SENIOR HIGH. SCHOOL, DANSOMAN
#       288              309.0889                45                      552       EBENEZER SENIOR HIGH. SCHOOL, DANSOMAN
#       288              309.0889                45                      3887
#       288              309.0889                45                      472       EBENEZER SENIOR HIGH. SCHOOL, DANSOMAN
#       288              309.0889                45                      3247
#       288              309.0889                45                      3560
#       288              309.0889                45                      6031
#       288              309.0889                45                      3881
#       288              309.0889                45                      408       EBENEZER SENIOR HIGH. SCHOOL, DANSOMAN
#       288              309.0889                45                      2881
#       288              309.0889                45                      328       EBENEZER SENIOR HIGH. SCHOOL, DANSOMAN
#       288              309.0889                45                      453       EBENEZER SENIOR HIGH. SCHOOL, DANSOMAN
```

```
#    sssdistrict          ssslong       ssslat
#    Accra Metro             NA           NA
#    Accra Metro             NA           NA
#    Accra Metro             NA           NA
#    Accra Metro             NA           NA
#    Accra Metropolitan  -0.1971153    5.607396
#    Accra Metro             NA           NA
#    Accra Metropolitan  -0.1971153    5.607396
#    Accra Metropolitan  -0.1971153    5.607396
#    Accra Metropolitan  -0.1971153    5.607396
#    Accra Metropolitan  -0.1971153    5.607396
#    Accra Metro             NA           NA
#    Accra Metropolitan  -0.1971153    5.607396
#    Accra Metro             NA           NA
#    Accra Metro             NA           NA
#    Accra Metro             NA           NA
#    Accra Metro             NA           NA
#    Accra Metropolitan  -0.1971153    5.607396
#    Accra Metro             NA           NA
#    Accra Metropolitan  -0.1971153    5.607396
#    Accra Metropolitan  -0.1971153    5.607396
```

Exercise 3

Exercise 3 Distance . Using the formula that appears on the original problem set where ssslong and ssslat are the coordinates of the district of the school (students apply to), while jsslong and jsslat are the coordinates of the junior high school, calculate the distance between junior high school, and senior high school

I couldn't do this exercise. Even though I managed to implement the formula (in the code this can be checked) I obtained a value of 0 for all the variables, which I was not able to solve after a lot of trouble. My best guess is that I didn't use the correct variables, as there was not any variable within the 3 datasets called "jsslong" ot "jsslat", so I had to improvise

Exercise 5 Data creation After setting a seed, construct the following objects . X1: vector of 10,000 draws from a uniform distribution with range 1:3. . X2: vector of 10,000 draws from a gamma distribution with shape 3 and scale 2 . X3: vector of 10,000 draws from a binomial distribution (one trial) with probability 0.3 . e: vector of 10,000 draws from a normal distribution with mean 2 and sd 1. Create the variables . Y = 0.5 + 1.2X1 ??? 0.9X2 + 0.1X3 + e . Ydum = 1 if Y > Y, 0, otherwise

I created the objects, as can be seen in the code

Exercise 6 OLS

. Calculate the correlation between Y and X1. How different is it from 1.2?

```
> i <- 1:10000
>
> a <- sum( (x1[i] - mean(x1) ) * y[i] - mean(y) )
>
>
> b <- sum( (x1[i] - mean(x1) )^2* ( (y[i] - mean(y) ))^2 )
>
> corr <- a/b
> corr
[1] 0.2284761
>
```

Figure 1:

. We are interested in the outcome of the regression of Y on X where X = (1, X1, X2, X3).

. Calculate the coefficients on this regression.

. Calculate the standard errors using the standard formulas of the OLS.

Exercise 7 Discrete choice

We consider the determinants of ydum. . Write and optimize the probit, logit, and the linear probability model. You can use pre-programmed optimization packages.

Estimated coefficients after the optimization process (which can be seen in the code attached)

logit

```
> XI <- cbind(1,x1,x2,x3)
> solve( (t(XI)%*%XI) ) %*% t(XI)%*%y
           [,1]
     2.51026482
x1   1.19620554
x2  -0.90116969
x3   0.09615993
>
```

Figure 2:

```
> SD_x1 <- sqrt(sum((x1-mean(x1))^2/(length(x1))))
> SE_X1 <- SD_x1 / sqrt(length(x1))
> SD_x1
[1] 0.5736748
> SE_X1
[1] 0.005736748
>
>
> SD_x2 <- sqrt(sum((x2-mean(x2))^2/(length(x2))))
> SE_X2 <- SD_x2 / sqrt(length(x2))
> SD_x2
[1] 3.45925
> SE_X2
[1] 0.0345925
>
>
> SD_x3 <- sqrt(sum((x3-mean(x3))^2/(length(x3))))
> SE_X3 <-SD_x3 / sqrt(length(x3))
> SD_x3
[1] 0.4617912
> SE_X3
[1] 0.004617912
>
```

Figure 3:

```
     R: own : est R: own :se
[1,]      14.20413 0.10007811
[2,]      31.48076 0.04292123
[3,]      18.40643 0.01858996
[4,]      16.97045 0.04647619
```

Figure 4:

probit

	R: own : est	R: own :se
[1,]	3.04275965	0.10007811
[2,]	1.17236062	0.04292123
[3,]	-0.90546664	0.01858996
[4,]	-0.01124962	0.04647619

Figure 5:

linear probability model

	R: own : est	R: own :se
[1,]	2.4907098	0.0122266976
[2,]	1.1976226	0.0052249307
[3,]	-0.8970514	0.0008658574
[4,]	0.0875850	0.0065300621

Figure 6:

. Interpret and compare the estimated coefficients. How significant are they?

Probit, logit and lpm coefficients can be interpreted as the change in probability of ydum being equal to one as the independent variable changes by 1 unit, keeping everything else constant (For example, in the probit model X1 can be interpreted as: an extra unit of X1, keeping everything else constant, increases the chances of the dependent variable being equal to one by 1,17%).

Regarding significance, I carry out multiple likelihood ratio tests for every model (due to its high number I do not include all the results here, but it can be seen in the test). Regardless of the distribution and likelihood used, results are constant among the three specifications: the intercept, X1 and X2 are significant at the 0.001 level, while X3 is not significant at all.

Exercise 8 Marginal Effects

We consider the determinants of ydum. . Compute the marginal effect of X on Y according to the probit and logit models. . Compute the standard error of the marginal effects.

Probit

	V1	marginal.effect	standard.error
x1	x1	0.144	0.003
x2	x2	-0.111	0
x3	x3	-0.001	0.003

>

Figure 7:

Logit

	V1	marginal.effect	standard.error
x1	x1	0.144	0.002
x2	x2	-0.111	0
x3	x3	-0.001	0.003

Figure 8: