VG441 Problem Set 1

Anna Li
Student ID: 518370910048

Problem 1

$$\theta^T X^T X \theta = \sum_i (X^T X)_{i,i} \theta_i^2 + \sum_{i \neq j} (X^T X)_{i,j} \theta_i \theta_j$$

$$\Rightarrow \frac{d(\theta^T X^T X \theta)}{d\theta_i} = 2(X^T X)_{i,i} \theta_i + \sum_{i \not= j} (X^T X)_{i,j} \theta_j + \sum_{i \not= j} (X^T X)_{j,i} \theta_j$$

Since $X^T X$ is symmetric, we could conclude that:

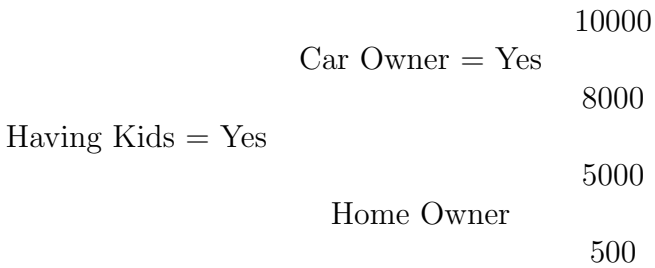
$$\Rightarrow \frac{d(\theta^T X^T X \theta)}{d\theta} = 2(X^T X)\theta$$

Problem 2

GBM

Iteration

In the first step, we get PR0, and start to calculate the deviance for each dimension.
Deviance of "Age >35" $= 1.21 \times 10^7$
Deviance of "Home Owner=Yes" $= 1.27 \times 10^7$
Deviance of "Car Owner=Yes" $= 2.85 \times 10^7$
Deviance of "Having Kids=Yes" $= 1.21 \times 10^7$
Therefore, we build the tree like:



In the second step, we get PR1, and start to calculate the deviance and find:
Deviance of "Age >35" $= 9.8 \times 10^6$
Deviance of "Home Owner=Yes" $= 2.3 \times 10^7$
Deviance of "Car Owner=Yes" $= 1.027 \times 10^7$
Deviance of "Having Kids=Yes" $= 9.8 \times 10^6$
Therefore, the tree is the same as the last stage

Results

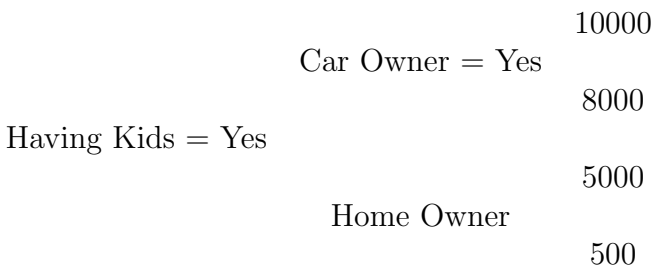
Finally, we run GBM o paper and get the table that:

F0	PR0	F1	PR1	F2	PR2
5875	4125	6287.5	3712.5	6658.75	3341.25
5875	-5375	5337.5	-4837.5	4853.75	-4353.75
5875	2125	5787.5	1912.5	6278.75	1721.25
5875	-875	6087.5	-787.5	5708.75	-708.75

XGBM

Iteration

In the first step, we get PR0, and start to calculate the ss for each dimension.
SS of "Age >35" $= 2.6 \times 10^7$
SS of "Home Owner=Yes" $= 2.16 \times 10^7$
SS of "Car Owner=Yes" $= 1.27 \times 10^7$
SS of "Having Kids=Yes" $= 2.6 \times 10^7$
Therefore, we build the tree like:



In the second step, we get PR1, and start to calculate the SS and find:
SS of "Age >35" $= 2.35 \times 10^7$
SS of "Home Owner=Yes" $= 1.96 \times 10^7$
SS of "Car Owner=Yes" $= 1.15 \times 10^7$
SS of "Having Kids=Yes" $= 2.35 \times 10^7$
Therefore, the tree is the same as the last stage

Results

Finally, we run XGBM o paper and get the table that:

F0	PR0	F1	PR1	F2	PR2
5875	4125	6081.25	3918.75	6277.1875	3722.8125
5875	-5375	5606.25	-5106.25	5350.9375	-4850.9375
5875	2125	5981.25	2018.75	6082.1875	1917.8125
5875	-875	5831.25	-831.25	5789.6875	-789.6875