```
> #================================
> #Exercise 1
> #================================
>
> #Mean and standard deviation of price by product choice
> colMeans(choicePrice)
       hhid      choice      PPk_Stk      PBB_Stk      PFl_Stk     PHse_Stk     PGen_Stk     PImp_Stk      PSS_Tub      PPk_Tub
2.125756e+06 3.242953e+00 5.184362e-01 5.432103e-01 1.015020e+00 4.371477e-01 3.452819e-01 7.807785e-01 8.250895e-01 1.077409e+00
     PFl_Tub     PHse_Tub
1.189376e+00 5.686734e-01
> apply(choicePrice, 2, sd)
       hhid      choice      PPk_Stk      PBB_Stk      PFl_Stk     PHse_Stk     PGen_Stk     PImp_Stk      PSS_Tub      PPk_Tub
1.426333e+04 2.587219e+00 1.505174e-01 1.203319e-01 4.289519e-02 1.188312e-01 3.516605e-02 1.146461e-01 6.121159e-02 2.972613e-02
     PFl_Tub     PHse_Tub
1.405451e-02 7.245500e-02
```

A2_code_emma_shin.R | ms

Filter

	X10	X1	V3	V4	V5	V6	V7	V8	V9	V10
1	0.3950783	0.1563758	0.05436242	0.1326622	0.0704698	0.01655481	0.07136465	0.04541387	0.05033557	0.00738255

A2_code_emma_shin.R | msbybin

Filter

	aboveaverage	belowaverage
1	0.356722499	0.4325519682
2	0.119058397	0.1928350287
3	0.110004527	0.0000000000
4	0.051607062	0.2118531623
5	0.000000000	0.1393188854
6	0.033046627	0.0004422822
7	0.127659574	0.0163644405
8	0.091896786	0.0000000000
9	0.101856043	0.0000000000
10	0.008148483	0.0066342326

A2_code_emma_shin.R | choicePrice_demos3

Filter

	choice	meanIncome	mean3_4	meanFs5	meanFamSize	meancollege	meanwhtcollar	meanretired
1	1	26.71291	0.5107588	0.13703284	3.174972	0.3176670	0.5702152	0.19932050
2	2	26.06581	0.5150215	0.11158798	3.101574	0.3133047	0.5436338	0.24034335
3	3	30.70988	0.2551440	0.08230453	2.481481	0.4526749	0.5432099	0.53086420
4	4	27.64334	0.5025295	0.19898820	3.470489	0.2934233	0.5919056	0.15345700
5	5	26.44444	0.5936508	0.20000000	3.692063	0.2730159	0.7142857	0.14603175
6	6	39.15541	0.2432432	0.31081081	3.175676	0.4324324	0.5675676	0.37837838
7	7	25.32132	0.4921630	0.06269592	2.890282	0.3228840	0.5768025	0.14733542
8	8	34.24877	0.6009852	0.05418719	3.093596	0.2561576	0.5714286	0.09852217
9	9	31.90000	0.3022222	0.04888889	2.386667	0.2755556	0.5777778	0.36000000
10	10	29.46970	0.3636364	0.54545455	4.424242	0.4545455	0.9393939	0.12121212

```
> #Optimize
> res1      = optim(start,fn=like_fun1,method="BFGS",control=list(trace=6,maxit=1000), choicePrice=choicePrice, ni=ni)
initial  value 28402.229400
iter  10 value 17848.948118
iter  20 value 14945.672095
iter  30 value 14352.725342
iter  30 value 14352.725151
iter  30 value 14352.725150
final  value 14352.725150
converged
> res1$par
 [1]  13.843798  12.834131  -8.690202  11.973683  10.659591  12.540735  14.454987 -20.317697   1.618491 -20.116352  -7.825768
```

```
> #Optimization
> res2      = optim(start,fn=like_fun2,method="BFGS",control=list(trace=6,maxit=1000), choicePrice_demos=choicePrice_demos, ni=ni)
initial  value 51813.484252
iter  10 value 47876.221089
iter  20 value 33304.787528
iter  30 value 23925.640262
iter  40 value 20581.864052
iter  50 value 18374.614497
iter  60 value 14400.353230
iter  70 value 12134.415928
iter  80 value 10695.618161
iter  90 value 10494.580080
final  value 10494.572980
converged
> res2$par
 [1]   0.822469003  -0.025389665  -1.546463090  -0.370816917  -0.868198000  -3.242454825  -0.714826306  -3.512352217  -1.713663451
[10]   2.888001334  -0.002990523   0.013500190   0.003753637  -0.001248542   0.028261803  -0.006689704 -10.107712543   0.016389121
[19]  -5.472730277
```

A2_code_emma_shin.R × | margcltbl ×

Filter

	V1	V2	V3	V4	V5	V6	V7	V8	V9	V10
1	-1.509934e+00	4.500909e-01	5.553227e-12	4.598664e-01	2.632678e-01	6.016091e-02	2.765484e-01	3.499860e-17	4.539085e-08	3.026285e-15
2	4.500909e-01	-9.297538e-01	2.488126e-12	2.090210e-01	1.211170e-01	2.699834e-02	1.225265e-01	1.520508e-17	2.020242e-08	1.167541e-15
3	5.553227e-12	2.488126e-12	-1.391085e-11	2.371715e-12	1.548891e-12	3.541358e-13	1.594758e-12	2.091491e-28	2.693749e-19	1.626931e-26
4	4.598664e-01	2.090210e-01	2.371715e-12	-9.230953e-01	1.097935e-01	2.819466e-02	1.162197e-01	1.348364e-17	1.791761e-08	1.016581e-15
5	2.632678e-01	1.211170e-01	1.548891e-12	1.097935e-01	-5.856359e-01	1.570769e-02	7.574979e-02	9.521644e-18	1.304346e-08	9.246039e-16
6	6.016091e-02	2.699834e-02	3.541358e-13	2.819466e-02	1.570769e-02	-1.472507e-01	1.618908e-02	1.963130e-18	2.660084e-09	1.387988e-16
7	2.765484e-01	1.225265e-01	1.594758e-12	1.162197e-01	7.574979e-02	1.618908e-02	-6.072335e-01	1.104200e-17	1.375680e-08	9.344137e-16
8	3.499860e-17	1.520508e-17	2.091491e-28	1.348364e-17	9.521644e-18	1.963130e-18	1.104200e-17	-8.621410e-17	1.982525e-24	1.240422e-31
9	4.539085e-08	2.020242e-08	2.693749e-19	1.791761e-08	1.304346e-08	2.660084e-09	1.375680e-08	1.982525e-24	-1.129712e-07	1.651010e-22
10	3.026285e-15	1.167541e-15	1.626931e-26	1.016581e-15	9.246039e-16	1.387988e-16	9.344137e-16	1.240422e-31	1.651010e-22	-7.208224e-15

A2_code_emma_shin.R × | margmlave ×

Filter

	V1	V2	V3	V4	V5	V6	V7	V8	V9	V10
1	0.3422369	-0.004435835	-0.0891952	-0.05219944	-0.06465048	-0.05711413	-0.05382609	-2.350558e-15	-0.0916004	1.253187e-07

```
> #Optimize
> res3      = optim(start,fn=like_fun3,method="BFGS",control=list(trace=6,maxit=1000), choicePrice_demos=choicePrice_demos, ni=ni)
initial  value 58229.987227
iter  10 value 46569.692424
iter  20 value 34518.305771
iter  30 value 33203.898951
iter  40 value 33142.367512
iter  50 value 31656.773781
iter  60 value 26885.508161
final  value 26719.554391
converged
> res3$par
 [1]  1.875897e+01 -7.122909e+01  1.023405e+02  1.686828e+01 -1.289714e+02 -1.392850e+00  1.946609e+01 -2.373910e-01  5.254705e+01
[10] -1.581827e+01 -7.332880e+00 -3.908911e+01 -9.418899e+01  3.249172e-03 -3.883528e+01 -2.371386e+00 -8.728779e-03 -2.550108e+00
[19] -3.647696e+01 -4.882567e+01
>
> beta_f = res3$par
> beta_f
 [1]  1.875897e+01 -7.122909e+01  1.023405e+02  1.686828e+01 -1.289714e+02 -1.392850e+00  1.946609e+01 -2.373910e-01  5.254705e+01
[10] -1.581827e+01 -7.332880e+00 -3.908911e+01 -9.418899e+01  3.249172e-03 -3.883528e+01 -2.371386e+00 -8.728779e-03 -2.550108e+00
[19] -3.647696e+01 -4.882567e+01
```

```
> #Optimize
> res4      = optim(start,fn=like_fun4,method="BFGS",control=list(trace=6,maxit=1000), choicePrice_demos2=choicePrice_demos2, ni=ni)
initial  value 56801.206785
final  value 36901.230466
converged
> res4$par
 [1]  22.1578719   1.8411461  -3.2024595  -4.0947735 -34.0348559  -3.9370309   9.1329409  -1.5953769  -0.3030949   2.6737184
[11] -12.8094913 -11.6878223  -2.6108230  -8.7636508  -4.7518737 -13.3664741  -2.5964737  -1.4459389
>
> beta_r = res4$par
> beta_r
 [1]  22.1578719   1.8411461  -3.2024595  -4.0947735 -34.0348559  -3.9370309   9.1329409  -1.5953769  -0.3030949   2.6737184
[11] -12.8094913 -11.6878223  -2.6108230  -8.7636508  -4.7518737 -13.3664741  -2.5964737  -1.4459389
```

```
> #Calculate likelihood
> like5 = sum(log(probc5))
> like5
[1] -37038.77
```

```
> #Calculate likelihood
> like6 = sum(log(probc6))
> like6
[1] -36901.23
>
> #================================
> #Test statistic calculation:
> #================================
>
> mmt = -2*(like5-like6)
> mmt
[1] 275.0719
```