Exercise 1 Data Description

Average and dispersion in product characteristics (price)

```
> average=apply(allprice,2,mean)
> print(average)
  PPk_Stk   PBB_Stk   PFl_Stk  PHse_Stk  PGen_Stk  PImp_Stk   PSS_Tub   PPk_Tub
0.5184362 0.5432103 1.0150201 0.4371477 0.3452819 0.7807785 0.8250895 1.0774094
  PFl_Tub  PHse_Tub
1.1893758 0.5686734
>
> #Dispersion in product characteristics (price)
> dispersion <- diag(var(allprice))
> print(dispersion)
     PPk_Stk      PBB_Stk      PFl_Stk     PHse_Stk     PGen_Stk     PImp_Stk
0.0226554865 0.0144797566 0.0018399974 0.0141208621 0.0012366513 0.0131437214
     PSS_Tub      PPk_Tub      PFl_Tub     PHse_Tub
0.0037468593 0.0008836431 0.0001975293 0.0052497277
```

Market share (choice frequency) and market share by product characteristics

	marketshare <dbl>
PPk_Stk	176.6
PBB_Stk	69.9
PFl_Stk	24.3
PHse_Stk	59.3
PGen_Stk	31.5
PImp_Stk	7.4
PSS_Tub	31.9
PPk_Tub	20.3
PFl_Tub	22.5
PHse_Tub	3.3

1-10 of 10 rows

Illustrate the mapping between observed attributes and choices

	hhid	choice	Income	Fs3_4	Fs5.	Fam_Size	college	whtcollar	retired
109	2101378	1	12.5	0	1	5	0	1	0
111	2101378	1	12.5	0	1	5	0	1	0
115	2101378	1	12.5	0	1	5	0	1	0
117	2101378	1	12.5	0	1	5	0	1	0
118	2101378	1	12.5	0	1	5	0	1	0
198	2102152	1	12.5	0	1	5	0	0	0
199	2102152	1	12.5	0	1	5	0	0	0
200	2102152	1	12.5	0	1	5	0	0	0
201	2102152	1	12.5	0	1	5	0	0	0
202	2102152	1	12.5	0	1	5	0	0	0
203	2102152	1	12.5	0	1	5	0	0	0
289	2103721	1	12.5	0	0	2	1	1	0
290	2103721	1	12.5	0	0	2	1	1	0
291	2103721	1	12.5	0	0	2	1	1	0
372	2104455	1	12.5	1	0	4	1	1	0
436	2106195	1	12.5	1	0	3	0	1	0
437	2106195	1	12.5	1	0	3	0	1	0
438	2106195	1	12.5	1	0	3	0	1	0
439	2106195	1	12.5	1	0	3	0	1	0
441	2106195	1	12.5	1	0	3	0	1	0
499	2106567	1	12.5	0	0	2	0	0	1
500	2106567	1	12.5	0	0	2	0	0	1
561	2107698	1	12.5	0	0	2	0	1	0

It shows that people with higher income will choose brand with higher price.

Exercise 2 First Model

Propose a model specifification

We can use Conditional logit model.

Interpret the coeffiffifficient on price

```
[1] -0.9543113  1.2969413 -1.7173310 -2.9039724 -1.5152702  0.2517523  1.4648614
[8]  2.3574933 -3.8966146 -6.6565577
```

The first through ninth terms are intercepts.
-6.65 means that if brand's price increases, the demand of this brand will decrease.

Exercise 3 Second Model

Propose a model specifification.

We can use Multinomial logit model.

Interpret the coeffiffifficient on family

```
  [1] -0.003156338  0.014507166  0.003980338 -0.001328126  0.030527384 -0.007002723
  [7]  0.022807121  0.017661767  0.010698254 -0.843545649 -2.397656003 -1.199428121
 [13] -1.688616844 -4.137055731 -1.529169108 -2.846055103 -2.573291074 -4.279712751
```

-0.84 ~ -4.279 are intercepts.
-0.003 ~ 0.0107 , -0.003 means that if income increases, the demand of the first choice will decrease. Same thing with other numbers.

Exercise 4 Marginal Effffects

(*I*)

	V1	V2	V3	V4	V5	V6	V7	V8	V9	V10
me_1	-0.005445123	0.0257883274	-0.002369137	0.0093607645	0.0012362530	-0.0047487142	-0.0097322916	-2.660125e-03	-0.0099320814	-0.0014978724
me_2	0.009441594	-0.0245109415	-0.000733189	0.0109781919	0.0033886871	0.0007139751	0.0015043232	8.066422e-04	-0.0022713999	0.0006821166
me_3	-0.003052725	-0.0039661740	0.003974207	-0.0033627107	-0.0016207354	0.0009496521	0.0024570433	9.808530e-04	0.0032920827	0.0003485076
me_4	0.005430990	-0.0019480329	0.001021167	-0.0084423676	0.0072759930	0.0006231949	-0.0041844119	-1.749300e-03	0.0025010528	-0.0005282851
me_5	-0.005001979	-0.0044114959	0.005240391	-0.0045305572	-0.0018993181	0.0010527309	0.0048465905	2.543472e-04	0.0041854229	0.0002638679
me_6	-0.000491919	-0.0013467361	0.001110464	-0.0007926256	-0.0003632848	0.0003699668	0.0003805465	1.869490e-04	0.0007791040	0.0001675357
me_7	0.008613176	0.0069350729	-0.014000196	0.0047601420	-0.0001714568	0.0012668334	-0.0009180520	-1.361555e-03	-0.0054080124	0.0002840482
me_8	-0.004738241	0.0031729439	0.002063896	-0.0035410825	-0.0040360370	-0.0002702457	0.0020691270	2.297484e-03	0.0027509550	0.0002312007
me_9	-0.003666668	-0.0008142912	0.003147927	-0.0037813006	-0.0030375824	0.0001950433	0.0028837401	1.183046e-03	0.0037776213	0.0001124649
me_10	-0.001086302	0.0010876174	0.000545847	-0.0006397423	-0.0007768236	-0.0001526322	0.0006985302	6.146215e-05	0.0003270326	-0.0000649895

For each x in the single box, it means that one unit increase in product V's price will increase x in the probability to buy the product V. For example, in the single box of V1-me_1, -0.005445123 means one unit increase in product 1's price will decrease 0.005445123 in the probability to buy the product 1.

(*II*)

```
              [,1]
 [1,] -0.0010504137
 [2,] -0.0009016311
 [3,]  0.0006266867
 [4,]  0.0001660472
 [5,] -0.0002794477
 [6,]  0.0004431356
 [7,] -0.0006821378
 [8,]  0.0008861440
 [9,]  0.0007338590
[10,]  0.0000577577
```

-0.0010504 means that one unit change increase in income will decrease 0.0010504 in the probability of choosing the first choice. Same thing with other numbers.

Exercise 5 IIA

Denote by β_f the estimated coeffiffifficients

```
 [1] -6.659699884 -0.004333800  0.014258958  0.004025557 -0.001264787  0.029710007 -0.009327126  0.021914644
 [9]  0.016902350  0.008674428 -0.838705945  0.891148169 -1.826370582 -2.871247434 -2.454001559  0.498968897
[17]  0.805453868  1.866785193 -4.140083624
```

Denote by β_r the estimated parameters

```
 [1]  2.059202266  0.016721323  0.006614508  0.001215756  0.032891379 -0.003689518  0.025468878  0.020231747
 [9]  0.012479752 -1.470467400 -1.261403167 -0.565696438 -2.812995853 -1.139907155 -2.511165831 -2.759864325
[17] -4.705006196
```