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Exercise 1

Average and dispersion in product characteristics.

```
> print(dispersion)
     PPk_Stk      PBB_Stk      PFl_Stk     PHse_Stk     PGen_Stk     PImp_Stk      PSS_Tub      PPk_Tub
0.0226554865 0.0144797566 0.0018399974 0.0141208621 0.0012366513 0.0131437214 0.0037468593 0.0008836431
     PFl_Tub     PHse_Tub
0.0001975293 0.0052497277
> average=apply(as.matrix(choiceprice[,3:12]),2,mean)
> print(average)
  PPk_Stk   PBB_Stk   PFl_Stk  PHse_Stk  PGen_Stk  PImp_Stk   PSS_Tub   PPk_Tub   PFl_Tub  PHse_Tub
0.5184362 0.5432103 1.0150201 0.4371477 0.3452819 0.7807785 0.8250895 1.0774094 1.1893758 0.5686734
> #Market share, and market share by choiceprice characteristics
```

Market share, and market share by product characteristics.

Market share by choice frequency(not include price)

```
> share_choicefrequency
        pk_stk    bb_stk     fl_stk   hse_stk   gen_stk
[1,] 0.3950783 0.1563758 0.05436242 0.1326622 0.0704698
        imp_stk     ss_tub     pk_tub     fl_tub
[1,] 0.01655481 0.07136465 0.04541387 0.05033557
        hse_tub
[1,] 0.00738255
```

Market share by choice frequency(include price)

```
> share_market
        pk_stk    bb_stk     fl_stk    hse_stk    gen_stk
[1,] 0.3164004 0.1230866 0.09887261 0.09316123 0.04474122
        imp_stk     ss_tub     pk_tub    fl_tub
[1,] 0.02247123 0.09984262 0.08753436 0.1075665
         hse_tub
[1,] 0.006323178
```

choice frequency by price bins: below average, over average

```
> share_pricebins
                pk_stk     bb_stk     fl_stk    hse_stk    gen_stk     imp_stk
overaverage  0.1762864 0.05883669 0.01185682 0.06621924 0.03131991 0.004026846
belowaverage 0.2187919 0.09753915 0.04250559 0.06644295 0.03914989 0.012527964
                ss_tub     pk_tub      fl_tub     hse_tub
overaverage  0.04474273 0.02595078 0.044742729 0.003803132
belowaverage 0.02662192 0.01946309 0.005592841 0.003579418
> View(share_pricebins)
```

Illustrate the mapping between observed attributes and choices.

	hhid	choice	Income	Fs3_4	Fs5.	Fam_Size	college	whtcollar	retired
1	2100016	1	32.5	0	0	2	1	0	1
2	2100016	1	32.5	0	0	2	1	0	1
3	2100016	1	32.5	0	0	2	1	0	1
4	2100016	1	32.5	0	0	2	1	0	1
5	2100016	1	32.5	0	0	2	1	0	1
6	2100016	4	32.5	0	0	2	1	0	1
7	2100016	1	32.5	0	0	2	1	0	1
8	2100024	1	17.5	1	0	3	1	1	1
9	2100024	4	17.5	1	0	3	1	1	1
10	2100024	1	17.5	1	0	3	1	1	1
11	2100024	4	17.5	1	0	3	1	1	1
12	2100024	8	17.5	1	0	3	1	1	1
13	2100024	4	17.5	1	0	3	1	1	1
14	2100024	3	17.5	1	0	3	1	1	1
15	2100024	1	17.5	1	0	3	1	1	1

With higher income, it's more likely for people to choose higher price brand.

Exercise 2

We are interested in the effect of price on demand. Propose a model specification.

To consider the effect of price, we can use Conditional logit model

Interpret the coeffcient on price.

```
 [1] -6.6566340 -0.9543259  1.2969965 -1.7173298 -2.9040264 -1.5153021  0.2517927  1.4648942  2.3575437
[10] -3.8966267
>
```

-6.65 means that if price of brand(2-10) increases, the demand of choosing this product decrease, the demand of choosing alternatives will increase.

-0.95 ~ -3.89 are intercepts.

Exercise 3

We are interested in the e ect of family income on demand

family income varies among individuals are not the alternatives, use Multinomial logit model

Interpret the coe cient on family

```
 [1] -0.003156338  0.014507166  0.003980338 -0.001328126  0.030527384 -0.007002723  0.022807121  0.017661767
 [9]  0.010698254 -0.843545649 -2.397656003 -1.199428121 -1.688616844 -4.137055731 -1.529169108 -2.846055103
[17] -2.573291074 -4.279712751
```

For -0.003 ~ 0.0107 are beta, for example, -0.003 means that if income increases, the demand of choosing the first choice will decrease.

-0.84 ~ -4.279 are intercepts.

Exercise 4

Model 1

	V1	c2	c3	c4	c5	c6	c7	c8	c9	c10
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

Element in table

For example, in me_1 – v1:

-0.00544 means that one unit increase in the price of product 1 will decrease 0.00544 in the probability to buy the product 1

Model2

```
                [,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
```

For example, -0.0010504 means that one unit change increase in family income will decrease 0.0010504 in the probability of choosing first choice compared with other 9 choices

Exercise 5

Beta_f

```
> beta_f
 [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
```

Beta_r

Remove choice 1

```
> beta_r
 [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
```

MTT

MTT is 7821.209

MTT > the critical value of chi_square, reject the null hypothesis that the two results are the same.