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SAS/STAT(R) 13.1 User's Guide

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The BCHOICE Procedure (Experimental)

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Example 27.1 Alternative-Specific and Individual-Specific Effects

In many situations, a choice model that includes characteristics of both the alternatives and the individuals is needed for investigating consumer choice

Consider an example of travel demand. People are asked to choose among travel by auto, plane, or public transit (bus or train). The following SAS statements create the data set Travel. The variables AutoTime, PlanTime, and TranTime represent the total travel time that is required to get to a destination by using auto, plane, or public transit, respectively. The variable Age represents the age of each individual who is surveyed, and the variable Chosen contains each individual's choice of travel mode.

```
input AutoTime PlanTime TranTime Age Chosen $;
   AgeCtr=Age-34;
   datalines;
10.0 4.5 10.5 32 Plane
5.5 4.0 7.5 13 Auto
4.5 6.0 5.5 41 Transit
3.5 2.0 5.0 41 Transit
1.5 4.5 4.0 47 Auto
10.5 3.0 10.5 24 Plane
7.0 3.0 9.0 27 Auto
9.0 3.5 9.0 21 Plane
4.0 5.0 5.5 23 Auto
22.0 4.5 22.5 30 Plane
7.5 5.5 10.0 58 Plane
11.5 3.5 11.5 36 Transit
3.5 4.5 4.5 43 Auto
12.0 3.0 11.0 33 Plane
18.0 5.5 20.0 30 Plane
23.0 5.5 21.5 28 Plane
4.0 3.0 4.5 44 Plane
5.0 2.5 7.0 37 Transit
3.5 2.0 7.0 45 Auto
12.5 3.5 15.5 35 Plane
1.5 4.0 2.0 22 Auto
```

In this example, the AutoTime, PlanTime, and TranTime variables apply to the alternatives, whereas Age is a characteristic of the individuals. AgeCtr, a centered version of Age, is created by subtracting the sample's mean age from each individual's age. To study how the choice depends on both the travel time and age of the individuals, you need to incorporate both types of variables.

Before you invoke PROC BCHOICE to fit a choice logit model, you must arrange your data in such a way that there is one observation for each combination of individual and alternative. In this example, let Subject identify the individuals, let TrayTime represent the travel time for each mode of transportation, and let Choice have the value 1 if the alternative is chosen and 0 otherwise. The following SAS statements rearrange the data set Travel into a new data set, Travel2, and display the first nine observations:

```
data Travel2(keep=Subject Mode TravTime Age AgeCtr Choice);
   array Times[3] AutoTime PlanTime TranTime;
   array Allmodes[3] $ _temporary_ ('Auto' 'Plane' 'Transit');
   set Travel;
   Subject = n :
   do i = 1 to 3;
     Mode = Allmodes[i];
     TravTime = Times[i]:
     Choice = (Chosen ea Mode):
     output:
   end;
run;
proc print data=Travel2 (obs=20):
  by Subject;
   id Subject;
```

The data for the first nine observations is shown in Output 27.1.1

Output 27.1.1: Data for the First Nine Observations

```
☐ The IRT Procedure
The KDE Procedure
■ The KRIGE2D Procedure
III The LATTICE Procedure
III The LIFEREG Procedure
■ The LIFETEST Procedure
The LOESS Procedure
III The LOGISTIC Procedure
III The MCMC Procedure
The MDS Procedure
The MI Procedure
The MIANALYZE Procedure
III The MIXED Procedure
■ The MODECLUS Procedure
■ The MULTTEST Procedure
III The NESTED Procedure
III The NLIN Procedure
■ The NLMIXED Procedure
■ The NPAR1WAY Procedure
The ORTHOREG Procedure
III The PHREG Procedure
The PLAN Procedure
The PLM Procedure
III The PLS Procedure
■ The POWER Procedure
The Power and Sample Size
■ The PRINCOMP Procedure
III The PRINQUAL Procedure
III The PROBIT Procedure
■ The QUANTLIFE Procedure
■ The QUANTREG Procedure
■ The QUANTSELECT Procedure
III The REG Procedure
■ The ROBUSTREG Procedure
The RSREG Procedure
III The SCORE Procedure
III The SEQDESIGN Procedure
■ The SEQTEST Procedure
■ The SIM2D Procedure
III The SIMNORMAL Procedure
III The STDIZE Procedure
■ The STDRATE Procedure
■ The STEPDISC Procedure
☐ The SURVEYEREQ Procedure
III The SURVEYLOGISTIC Procedure
■ The SURVEYMEANS Procedure
■ The SURVEYPHREG Procedure
☐ The SURVEYREG Procedure
■ The SURVEYSELECT Procedure
■ The TPSPLINE Procedure
■ The TRANSREG Procedure
III The TREE Procedure
III The TTEST Procedure
■ The VARCLUS Procedure
■ The VARCOMP Procedure
```

☐ The VARIOGRAM Procedure

III Special SAS Data Sets

Sashelp Data Sets

Choice	TravTime	Mode	AgeCtr	Age	Subject
0	10.0	Auto	-2	32	1
1	4.5	Plane	-2	32	
0	10.5	Transit	-2	32	
Choice	TravTime	Mode	AgeCtr	Age	Subject
1	5.5	Auto	-21	13	2
0	4.0	Plane	-21	13	
0	7.5	Transit	-21	13	

Subject	Age	AgeCtr	Mode	TravTime	Choice
3	41	7	Auto	4.5	0
	41	7	Plane	6.0	0
	41	7	Transit	5.5	1

Notice that each subject in the data set *Travel* corresponds to a block of three observations in the data set *Travel*2, one for each travel alternative. The response variable *Choice* indicates the chosen alternative by the value 0; exactly one alternative is chosen. The following SAS statements invoke PROC BCHOICE to fit the choice logit model:

```
proc bchoice data=Travel2 seed=124;
  class Mode Subject / param=ref order=data;
  model Choice = Mode TravTime / choiceset=(Subject);
run:
```

The "Choice Sets Summary" table shows that there are 21 choice sets and that each consists of three alternatives and one chosen alternative (each subject chooses one out of the three travel modes). It seems that the data are arrayed correctly.

Output 27.1.2: Choice Sets Summary

in the second se					
		The	e BCHOICE Pro	cedure	
		С	hoice Sets Sun	nmary	
			Total	Chosen	
P	Pattern	Choice Sets	Alternatives		
	1	21	3	1	2

Summary statistics are shown in Output 27.1.3.

Output 27.1.3: PROC BCHOICE Posterior Summary Statistics

	Posterior Summaries and Intervals								
Parameter	N	Mean	Standard Deviation	95% HPE) Interval				
Mode Auto	5000	-0.1678	0.7440	-1.7017	1.2396				
Mode Plane	5000	-1.8794	1.2683	-4.6055	0.3801				
TravTime	5000	-0.5695	0.2047	-0.9943	-0.2328				

When *Transit* is the reference mode (normalized to 0), the part-worth (posterior mean) of *Auto*, which is negative, might reflect that driving is more inconvenient than traveling by bus or train, and the negative part-worth of *Plane* might reflect that traveling by plane is more expensive than traveling by bus or train. However, neither is statistically significant, because both the 95% HPD intervals have 0 in them. The posterior mean of *TravTime* is negative, and the estimate is significant. These results make sense because having to spend more time en route is often unfavorable.

To study the relationship between the choice of transportation and the age of people who make the choice, you need to create an interaction between AgeCtr and Mode. AgeCtr is not estimable by itself, because it is the same throughout a choice set for an individual. The following statements request the interaction between AgeCtr and Mode:

```
proc bchoice data=Travel2 seed=124;
  class Mode Subject / param=ref order=data;
  model Choice = Mode Mode*Agectr TravTime / choiceset=(Subject);
run:
```

Output 27.1.4: PROC BCHOICE Posterior Summary Statistics

The BCHOICE Procedure

Posterior Summaries and Intervals									
Parameter	N	Mean	Standard Deviation	95% HPD Interval					
Mode Auto	5000	-0.2634	0.7883	-1.8072	1.1395				
Mode Plane	5000	-2.8210	1.5370	-5.9228	-0.0686				
AgeCtr*Mode Auto	5000	-0.0986	0.0678	-0.2182	0.0350				
AgeCtr*Mode Plane	5000	0.0251	0.0775	-0.1268	0.1618				
TravTime	5000	-0.7608	0.2564	-1.2943	-0.3473				

The parameter estimate for *Mode Auto* reflects the part-worth of *Auto* for an individual of mean age (34 years old), whereas the parameter estimate for *Mode Plane* is the part-worth of *Plane* for an individual of mean age. There are two interaction effects: the first corresponds to the effect of a one-unit change in age on the probability of choosing *Auto* over *Transit*, and the second corresponds to the effect of a one-unit change in age on the probability of choosing *Plane* over *Transit*.

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