

AB Final Exercise A: Data from Ishii (1994)

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*****
***** Copenhagen satisfaction and housing conditions study *****
***** Housing: A=Tower blocks, B=Apartments, C=Houses *****
***** Contact: 0=Low, 1=High (contact with residents) *****
***** Satisfaction (with housing conditions): *****
***** 0=Low, 1=Medium, 2=High *****
***** Count is the number of residents *****
*****
data one;
  do housing='A', 'B', 'C';      housea=(housing='A'); houseb=(housing='B');
  do satisfac=0,1,2;            sat0=(satisfac=0); sat1=(satisfac=1);
  do contact=0,1;
    input count @@; output;
  end; end; end; datalines;
65 34 54 47 100 100 130 141 76 116 111 191 67 130 48 105 62 104
;
proc print; run;

```

Obs	housing	housea	houseb	satisfac	sat0	sat1	contact	count
1	A	1	0	0	1	0	0	65
2	A	1	0	0	1	0	1	34
3	A	1	0	1	0	1	0	54
4	A	1	0	1	0	1	1	47
5	A	1	0	2	0	0	0	100
6	A	1	0	2	0	0	1	100
7	B	0	1	0	1	0	0	130
8	B	0	1	0	1	0	1	141
9	B	0	1	1	0	1	0	76
10	B	0	1	1	0	1	1	116
11	B	0	1	2	0	0	0	111
12	B	0	1	2	0	0	1	191
13	C	0	0	0	1	0	0	67
14	C	0	0	0	1	0	1	130
15	C	0	0	1	0	1	0	48
16	C	0	0	1	0	1	1	105
17	C	0	0	2	0	0	0	62
18	C	0	0	2	0	0	1	104

```

proc glm data=one;
  class housing satisfac;
  model count=housing satisfac contact housing*satisfac housing*contact
    satisfac*contact;
run;

```

```

The GLM Procedure
Class Level Information
Class          Levels  Values
housing          3    A B C
satisfac          3    0 1 2
Number of Observations Read      18
Number of Observations Used      18

```

Dependent Variable: count

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	13	26656.94444	2050.53419	7.77	0.0307
Error	4	1055.33333	263.83333		

Corrected Total	17	27712.27778				
	R-Square	Coeff Var	Root MSE	count	Mean	
	0.961918	17.39280	16.24295	93.38889		
Source	DF	Type I SS	Mean Square	F Value	Pr > F	
housing	2	11593.44444	5796.72222	21.97	0.0070	
satisfac	2	4118.11111	2059.05556	7.80	0.0416	
contact	1	3612.50000	3612.50000	13.69	0.0208	
housing*satisfac	4	2944.22222	736.05556	2.79	0.1721	
contact*housing	2	3862.33333	1931.16667	7.32	0.0461	
contact*satisfac	2	526.33333	263.16667	1.00	0.4452	
Source	DF	Type III SS	Mean Square	F Value	Pr > F	
housing	2	3440.88889	1720.44444	6.52	0.0551	
satisfac	2	1800.22222	900.11111	3.41	0.1366	
contact	1	3612.50000	3612.50000	13.69	0.0208	
housing*satisfac	4	2944.22222	736.05556	2.79	0.1721	
contact*housing	2	3862.33333	1931.16667	7.32	0.0461	
contact*satisfac	2	526.33333	263.16667	1.00	0.4452	

```
proc glm data=one;
  class housing satisfac;
  model count=housing satisfac contact housing*contact /solution;
run;
```

The GLM Procedure						
Class Level Information						
	Class	Levels	Values			
	housing	3	A B C			
	satisfac	3	0 1 2			
	Number of Observations Read			18		
	Number of Observations Used			18		
Dependent Variable: count						
Source	DF	Sum of Squares	Mean Square	F Value	Pr > F	
Model	7	23186.38889	3312.34127	7.32	0.0028	
Error	10	4525.88889	452.58889			
Corrected Total	17	27712.27778				
	R-Square	Coeff Var	Root MSE	count	Mean	
	0.836683	22.78016	21.27414	93.38889		
Source	DF	Type I SS	Mean Square	F Value	Pr > F	
housing	2	11593.44444	5796.72222	12.81	0.0017	
satisfac	2	4118.11111	2059.05556	4.55	0.0394	
contact	1	3612.50000	3612.50000	7.98	0.0180	
contact*housing	2	3862.33333	1931.16667	4.27	0.0457	
Source	DF	Type III SS	Mean Square	F Value	Pr > F	
housing	2	3440.88889	1720.44444	3.80	0.0592	
satisfac	2	4118.11111	2059.05556	4.55	0.0394	
contact	1	3612.50000	3612.50000	7.98	0.0180	
contact*housing	2	3862.33333	1931.16667	4.27	0.0457	
	Standard					
Parameter		Estimate	Error	t Value	Pr > t	
Intercept		76.94444444 B	14.18275775	5.43	0.0003	
housing	A	14.00000000 B	17.37025981	0.81	0.4390	
housing	B	46.66666667 B	17.37025981	2.69	0.0228	

housing	C	0.00000000	B	.	.	.
satisfac	0	-16.83333333	B	12.28262850	-1.37	0.2005
satisfac	1	-37.00000000	B	12.28262850	-3.01	0.0131
satisfac	2	0.00000000	B	.	.	.
contact		54.00000000	B	17.37025981	3.11	0.0111
contact*housing A		-66.66666667	B	24.56525701	-2.71	0.0218
contact*housing B		-10.33333333	B	24.56525701	-0.42	0.6829
contact*housing C		0.00000000	B	.	.	.

NOTE: The X'X matrix has been found to be singular, and a generalized inverse was used to solve the normal equations. Terms whose estimates are followed by the letter 'B' are not uniquely estimable.

```
proc genmod data=one;
  model count=housea houseb sat0 sat1 contact housea*sat0 housea*sat1 housea*contact
    houseb*sat0 houseb*sat1 houseb*contact sat0*contact sat1*contact/
    dist=poi predicted residuals;
run;
```

The GENMOD Procedure

Model Information

Data Set	WORK.ONE
Distribution	Poisson
Link Function	Log
Dependent Variable	count
Number of Observations Read	18
Number of Observations Used	18

Criteria For Assessing Goodness Of Fit

Criterion	DF	Value	Value/DF
Deviance	4	6.8930	1.7233
Scaled Deviance	4	6.8930	1.7233
Pearson Chi-Square	4	6.9323	1.7331
Scaled Pearson X2	4	6.9323	1.7331
Log Likelihood		6089.1063	

Algorithm converged.

Analysis Of Parameter Estimates

Parameter	DF	Estimate	Standard Error	Wald 95% Confidence Limits	Chi-Square	Pr > ChiSq
Intercept	1	3.9490	0.1120	3.7295 4.1684	1243.61	<.0001
housea	1	0.7061	0.1343	0.4429 0.9692	27.65	<.0001
houseb	1	0.8047	0.1248	0.5600 1.0493	41.56	<.0001
sat0	1	0.3848	0.1308	0.1284 0.6412	8.65	0.0033
sat1	1	-0.0595	0.1417	-0.3373 0.2183	0.18	0.6747
contact	1	0.7883	0.1174	0.5581 1.0184	45.07	<.0001
housea*sat0	1	-0.9456	0.1645	-1.2680 -0.6232	33.05	<.0001
housea*sat1	1	-0.6085	0.1679	-0.9377 -0.2794	13.13	0.0003
housea*contact	1	-0.8906	0.1387	-1.1625 -0.6187	41.21	<.0001
houseb*sat0	1	-0.3040	0.1352	-0.5689 -0.0391	5.06	0.0245
houseb*sat1	1	-0.3737	0.1455	-0.6588 -0.0886	6.60	0.0102
houseb*contact	1	-0.3162	0.1189	-0.5492 -0.0832	7.08	0.0078
sat0*contact	1	-0.3282	0.1182	-0.5599 -0.0966	7.71	0.0055
sat1*contact	1	-0.0322	0.1269	-0.2810 0.2165	0.06	0.7995
Scale	0	1.0000	0.0000	1.0000 1.0000		

NOTE: The scale parameter was held fixed.

Observation Statistics						
Observation	count	Pred Reschi	Xbeta Resdev	Std StResdev	HessWgt StReschi	Resraw Reslik
1	65	59.994744 0.6462041	4.094257 0.6375174	0.1126728 1.3058051	59.994744 1.3235976	5.005256 1.3193784
2	34	39.005256 -0.801428	3.6636964 -0.819556	0.1274296 -1.353536	39.005256 -1.323598	-5.005256 -1.334652
3	54	53.892982 0.0145777	3.9870003 0.0145729	0.1171145 0.0285352	53.892982 0.0285446	0.1070179 0.0285422
4	47	47.107018 -0.015592	3.852422 -0.015598	0.1220412 -0.028555	47.107018 -0.028545	-0.107018 -0.028548
5	100	105.11227 -0.49864	4.6550291 -0.502767	0.0887615 -1.212762	105.11227 -1.202809	-5.112274 -1.204526
6	100	94.887726 0.5248184	4.5526944 0.5202086	0.0923709 1.1922439	94.887726 1.2028091	5.1122739 1.2008049
7	130	125.77143 0.3770529	4.8344662 0.3749691	0.0809484 0.8941431	125.77143 0.899112	4.2285674 0.8982402
8	141	145.22857 -0.350887	4.9783088 -0.352611	0.0764002 -0.903529	145.22857 -0.899112	-4.228567 -0.899786
9	76	75.222278 0.0896708	4.3204474 0.0895169	0.099682 0.1781264	75.222278 0.1784325	0.7777216 0.1783552
10	116	116.77772 -0.071969	4.7602723 -0.072049	0.0846769 -0.178631	116.77772 -0.178433	-0.777722 -0.178465
11	111	116.00629 -0.46481	4.7536444 -0.468214	0.0830601 -1.047811	116.00629 -1.040191	-5.006289 -1.041717
12	191	185.99371 0.3670851	5.2257129 0.3654566	0.0686071 1.0355765	185.99371 1.0401913	5.006289 1.0396177
13	67	76.233823 -1.057567	4.3338052 -1.080072	0.0992134 -2.161838	76.233823 -2.116792	-9.233823 -2.128125
14	130	120.76618 0.8402507	4.7938563 0.8298705	0.0835209 2.0906418	120.76618 2.1167922	9.2338234 2.1126933
15	48	48.88474 -0.12654	3.8894653 -0.126925	0.1167408 -0.219694	48.88474 -0.219028	-0.88474 -0.21925
16	105	104.11526 0.0867078	4.6454986 0.0865854	0.0899973 0.2187189	104.11526 0.219028	0.8847395 0.2189796
17	62	51.881437 1.4047946	3.9489611 1.3624854	0.1119801 2.3048969	51.881437 2.3764707	10.118563 2.3517083
18	104	114.11856 -0.947198	4.7372379 -0.961739	0.0858531 -2.412955	114.11856 -2.376471	-10.11856 -2.382304

```

proc logistic data=one;
  weight count;
  model satisfac=contact housea houseb/lackfit;
  output out=two predicted=predicted;
run;

```

The LOGISTIC Procedure	
Model Information	
Data Set	WORK.ONE
Response Variable	satisfac
Number of Response Levels	3
Weight Variable	count
Model	cumulative logit
Optimization Technique	Fisher's scoring
Number of Observations Read	18
Number of Observations Used	18
Sum of Weights Read	1681
Sum of Weights Used	1681
Response Profile	

Ordered Value	satisfac	Total Frequency	Total Weight
1	0	6	567.00000
2	1	6	446.00000
3	2	6	668.00000

Probabilities modeled are cumulated over the lower Ordered Values.

Model Convergence Status

Convergence criterion (GCONV=1E-8) satisfied.

Score Test for the Proportional Odds Assumption

Chi-Square	DF	Pr > ChiSq
4.8476	3	0.1833

Model Fit Statistics

Criterion	Intercept Only	Intercept and Covariates
AIC	3652.878	3620.286
SC	3654.658	3624.738
-2 Log L	3648.878	3610.286

Testing Global Null Hypothesis: BETA=0

Test	Chi-Square	DF	Pr > ChiSq
Likelihood Ratio	38.5912	3	<.0001
Score	38.3383	3	<.0001
Wald	37.6629	3	<.0001

Analysis of Maximum Likelihood Estimates

Parameter	DF	Estimate	Standard Error	Wald Chi-Square	Pr > ChiSq
Intercept 0	1	-0.2611	0.1036	6.3517	0.0117
Intercept 1	1	0.8513	0.1056	65.0053	<.0001
contact	1	-0.2525	0.0929	7.3936	0.0065
housea	1	-0.7362	0.1267	33.7810	<.0001
houseb	1	-0.2352	0.1055	4.9719	0.0258

Odds Ratio Estimates

Effect	Point Estimate	95% Wald Confidence Limits	
contact	0.777	0.648	0.932
housea	0.479	0.374	0.614
houseb	0.790	0.643	0.972

Association of Predicted Probabilities and Observed Responses

Percent Concordant	41.7	Somers' D	0.000
Percent Discordant	41.7	Gamma	0.000
Percent Tied	16.7	Tau-a	0.000
Pairs	108	c	0.500

```
proc print; run;
```

Obs	housing	housea	houseb	satisfac	sat0	sat1	contact	count	_LEVEL_	predicted
1	A	1	0	0	1	0	0	65	0	0.26947
2	A	1	0	0	1	0	0	65	1	0.52876
3	A	1	0	0	1	0	1	34	0	0.22273
4	A	1	0	0	1	0	1	34	1	0.46572
5	A	1	0	1	0	1	0	54	0	0.26947
6	A	1	0	1	0	1	0	54	1	0.52876
7	A	1	0	1	0	1	1	47	0	0.22273
8	A	1	0	1	0	1	1	47	1	0.46572
9	A	1	0	2	0	0	0	100	0	0.26947
10	A	1	0	2	0	0	0	100	1	0.52876
11	A	1	0	2	0	0	1	100	0	0.22273
12	A	1	0	2	0	0	1	100	1	0.46572
13	B	0	1	0	1	0	0	130	0	0.37840
14	B	0	1	0	1	0	0	130	1	0.64933
15	B	0	1	0	1	0	1	141	0	0.32107
16	B	0	1	0	1	0	1	141	1	0.58991
17	B	0	1	1	0	1	0	76	0	0.37840
18	B	0	1	1	0	1	0	76	1	0.64933
19	B	0	1	1	0	1	1	116	0	0.32107
20	B	0	1	1	0	1	1	116	1	0.58991
21	B	0	1	2	0	0	0	111	0	0.37840
22	B	0	1	2	0	0	0	111	1	0.64933
23	B	0	1	2	0	0	1	191	0	0.32107
24	B	0	1	2	0	0	1	191	1	0.58991
25	C	0	0	0	1	0	0	67	0	0.43508
26	C	0	0	0	1	0	0	67	1	0.70084
27	C	0	0	0	1	0	1	130	0	0.37434
28	C	0	0	0	1	0	1	130	1	0.64539
29	C	0	0	1	0	1	0	48	0	0.43508
30	C	0	0	1	0	1	0	48	1	0.70084
31	C	0	0	1	0	1	1	105	0	0.37434
32	C	0	0	1	0	1	1	105	1	0.64539
33	C	0	0	2	0	0	0	62	0	0.43508
34	C	0	0	2	0	0	0	62	1	0.70084
35	C	0	0	2	0	0	1	104	0	0.37434
36	C	0	0	2	0	0	1	104	1	0.64539