UNIVERSITI SAINS MALAYSIA

First Semester Examination
Academic Session 2005/2006

November 2005

MST 567 – Categorical Data Analysis
[Analisis Data Berkategori]

Duration : 3 hours
[Masa : 3 jam]

Please check that this examination paper consists of **SEVENTEEN** pages of printed material before you begin the examination.

*[Sila pastikan bahawa kertas peperiksaan ini mengandungi **TUJUH BELAS** muka surat yang bercetak sebelum anda memulakan peperiksaan ini].*

Instructions: Answer **all four** [4] questions.

*[**Arahan:** Jawab **semua empat** soalan].*

...2/-

1. The data in Table 1.1 relate to an investigation into satisfaction with housing conditions in Pulau Pinang. Residents of selected areas living in rented homes were questioned about their satisfaction and degree of contact with other residents. Information on the type of housing was also collected. The table shows numbers of respondents categorized by type of housing, contact and satisfaction level.

Table 1.1

	Contact with other residents					
	Low			High		
Satisfaction	Low	Medium	High	Low	Medium	High
Condominiums	65	54	100	34	47	100
Flats	130	76	111	141	116	191
Houses	67	48	62	130	105	105

In **Appendix A** is a SPSS output . Note carefully the data coding for the various classifications to answer this question.

(i) Give a complete specification of the distributional assumptions and the model which is being used in the SPSS analysis denoted as Model1.

(ii) The models which are summarized on the output were fitted to investigate the associations among the variables. It is claimed that Model 5 provides an adequate summary of the data and that there is no need to fit additional models. Explain why you agree or disagree that it provides an adequate summary and why you feel or do not feel that relevant information could be gained by fitting additional models.

(iii) Provide a 95% confidence interval for the parameter estimate corresponding to the variable CONTACT * SATISF2 in Model 2. What does this parameter represent and therefore what would be examined by a test that the parameter equals zero? What would be result of such a test?

(iv) Use a likelihood ratio test to compare Model 1 and Model 2. What can be learned from this test ?

(v) Why is the residual deviance for Model 6 equals zero ?

[100 marks]

1. *Data dalam Jadual 1.1 berkaitan dengan suatu penyelidikan kepuashatian terhadap suasana perumahan di Pulau Pinang. Residen dari kawasan-kawasan terpilih yang menyewa rumah telah ditanya tentang kepuashatian mereka dan tahap hubungan dengan residen lain. Maklumat tentang jenis rumah yang disewa juga telah dikutip. Jadual menunjukkan bilangan responden yang dikategorikan mengikut jenis rumah, tahap hubungan dan tahap kepuashatian.*

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Jadual 1.1

	Hubungan dengan residen lain					
	Rendah			*Tinggi*		
Kepuashatian	*Rendah*	*Seder-*	*Tinggi*	*Rendah*	*Seder-*	*Tinggi*
Kondominium	*65*	*54*	*100*	*34*	*47*	*100*
Flat	*130*	*76*	*111*	*141*	*116*	*191*
Rumah	*67*	*48*	*62*	*130*	*105*	*105*

***Lampiran A** yang disertakan merupakan output SPSS. Perhatikan dengan teliti kod data untuk beberapa pengkelasan bagi menjawab soalan ini.*

(i) Berikan spesifikasi lengkap anggapan-anggapan taburan dan model yang digunakan dalam output SPSS sebagai Model 1.

(ii) Model-model yang telah diringkaskan dalam output telah disuaikan untuk mengkaji kesekutuan dikalangan pembolehubah. Menurut saranan bahawa Model 5 memberi ringkasan yang cukup terhadap data dan tidak perlu lagi menyuaikan model-model tambahan. Terangkan mengapa anda bersetuju atau tidak bersetuju bahawa model itu meringkaskan data secukupnya dan mengapa anda merasakan atau tidak merasakan bahawa maklumat relevan boleh dimanfaatkan dengan menyuaikan model-model tambahan.

*(iii) Dirikan suatu selang keyakinan 95% untuk anggaran parameter sepadan kepada pembolehubah CONTACT*SATISFY2 dalam Model 2. Apakah parameter yang diwakilinya dan yang demikian apakah yang akan dikaji oleh suatu ujian yang parameter itu sama dengan sifar? Apakah keputusan ujian sedemikian?*

(iv) Gunakan suatu ujian nisbah kebolehjadian untuk membandingkan Model 1 dan Model 2. pakah yang boleh disimpulkan dari ujian tersebut?

(v) Apakah sebabnya diviance sisa bagi Model 6 sama dengan sifar ?

[100 markah]

2 (a) Past records have shown that the weekly sales of bicycles by a shop in a town are independent and follow a Poisson distribution with a mean rate of 1.5 bicycles per week. After the introduction of a special discount offer on the bicycles, the following sales are achieved over seven consecutive weeks. Weekly sales of bicycles: 2 3 2 1 3 2 1

(i) Apply exact tests of fit using X^2 and G statistics to test the hypothesis that the discount offer has had no effect.

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(ii) Compare the exact observed significance levels of the tests with approximate values obtained using the χ^2 approximation.

[55 marks]

(b) The estimated regression coefficients and associated standard errors for a multiple logistic regression model are presented in Table 2.1 using data from a prospective cohort study. There were 1229 deaths in this cohort of 6081 people. All covariates were assessed at the start of a follow –up .

(i) Use the output in Table 2.1 to estimate the odds ratio of death comparing 70 years old white subjects to 60 year old white subjects, after adjusting for all other covariates in the model.

(ii) Construct an hypothesis test to determine if the true odds ratio of death for current smokers relative to never smokers is 2.0, after adjusting for all other covariates in the model. Clearly state null and alternative hypotheses and provide a brief interpretation of your results.

(iii) Use the results from fitting a logistic regression model provided in Table 2.1 to estimate the probability of death for a 50 year old white woman who never smoked and who had a systolic blood pressure of 120 mm Hg.

Table 2.1
Results from Fitting a Logistic Regression Model Relating Death to Selected Risk Factors

Variable	Estimated Regression Coefficient	Estimated Standard Error
Sex (Male vs Female)	0.7424	0.0746
Race (Black vs White)	0.2986	0.1263
Age (years)	0.0988	0.0063
Age by Race Interaction	-0.0132	0.0146
Systolic Blood Pressure (mm)	0.0076	0.0014
Smoking Status		
Current vs Never Smoker	0.6319	0.0831
Former vs Never Smoker	0.1450	0.0942
Intercept	-3.6566	0.2151

[45 marks]

2 (a) *Rekod-rekod lampau menunjukkan bahawa jualan mingguan basikal sebuah kedai dalam suatu bandar adalah tak bersandar dan menurut suatu taburan Poisson dengan kadar min 1.5 basikal per minggu. Selepas promosi tawaran diskaun khas itu, jualan-jualan berikut telah dicapai untuk tujuh minggu berturut-turut..*
Jualan mingguan basikal: 2 3 2 1 3 2 1

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(i) *Gunakan ujian-ujian penyuaian tepat menggunakan statistik X^2 dan G untuk menguji hipotesis bahawa tawaran diskaun tidak mempunyai kesan.*

(ii) *Bandingkan aras keertian tercerap tepat bagi ujian-ujian tersebut dengan nilai-nilai hampiran yang diperolehi menggunakan penghampiran χ^2.*

[55 markah]

(b) *Anggaran pekali-pekali regresi dan ralat-ralat piawai berkaitan untuk model regresi logistik berganda yang disediakan dalam jadual 2.1 menggunakan data dari kajian kohot 'prospective' . Dalam kajian ini bilangan mati ialah 1229 dripada 6081 orang. Semua kovariat telah dinilai pada permulaan 'follow-up'.*

(i) *Gunakan output dalam Jadual 2.1 untuk menganggar nisbah ods kematian yang membandingkan kematian subjek berkulit putih berumur 70 tahun kepada subjek berkulit putih berumur 60 tahun, setelah diselaraskan semua kovariat dalam model.*

(ii) *Binakan suatu ujian hipotesis untuk menentukan sama ada nisbah ods sebenar kematian untuk perokok semasa relatif kepada tak pernah merokok ialah 2.0, setelah diselaraskan untuk semua kovariat dalam model. Nyatakan dengan jelas hipotesis nol dan alternatif dan berikan tafsiran ringkas keputusan anda.*

(iii) *Gunakan keputusan dari penyuaian model regresi logistik yang disediakan dalam Jadual 2.1 untuk menganggar kebarangkalian kematian wanita berkulit putih umur 50 tahun yang tak pernah merokok dan yang mempunyai tekanan darh sistolik 120 mm Hg.*

Jadual 2.1

Keputusan Penyuaian Suatu Model Regresi Logistic Berkaitan Kematian Dengan Beberapa Faktor Risiko Terpilih

Variable	*Estimated Regression Coefficient*	*Estimated Standard Error*
Sex (Male vs Female)	*0.7424*	*0.0746*
Race (Black vs White)	*0.2986*	*0.1263*
Age (years)	*0.0988*	*0.0063*
Age by Race Interaction	*-0.0132*	*0.0146*
Systolic Blood Pressure (mm)	*0.0076*	*0.0014*
Smoking Status		
Current vs Never Smoker	*0.6319*	*0.0831*
Former vs Never Smoker	*0.1450*	*0.0942*
Intercept	*-3.6566*	*0.2151*

[45 markah]

...6/-

3 (a) In an experiment, a subject was required to use a stilus to try to touch a silver spot placed on a black revolving disc. Attempts were made by the subject in successive runs of five revolutions of the disc followed by a short rest period. The distribution of number of contacts per run for 243 runs is shown below. Apply the ordinary goodness of fit statistic X^2 and the binomial dispersion statistic X_b^2 to test whether a binomial model is reasonable in this case.

Number of contacts out of 5 (x)	0	1	2	3	4	5
Observed Number of runs (O_x)	41	86	82	31	3	0

[45 marks]

(b) The table below was compiled for a secondary school from the 'Sijil Pelajaran Malaysia' exam results.

Grade	Year of Examination		
	2000	2001	2002
A	60	62	76
B	87	102	100
C	87	134	140
F	42	24	21

(i) Compute the likelihood ratio test statistic for a test of independence.

(ii) Partition the likelihood ratio test statistic into 6 independent 1 df components. What conclusions can you draw from these components ?

[55 marks]

3(a) Dalam suatu kajian , suatu subjek perlu menggunakan 'stilus' untuk mencuba menyentuh satu tanda perak yang diletakkan di atas cakera beputar hitam. Percubaan-percubaan telah dilakukan oleh subjek itu dalam larian berturutan lima revolusi cakera itu diikuti dengan rehat jangka pendek . Taburan bilangan sentuhan per larian untuk 243 larian seperti yang dipaparkan di bawah. Gunakan statistik penyuaian kebaikan biasa X^2 dan statistik serakan binomial X_b^2 untuk menguji sama ada model binomial berpatutan dalam kes ini.

Bilangan sentuhan daripada 5 (x)	*0*	*1*	*2*	*3*	*4*	*5*
Bilangan larian tercerap (O_x)	*41*	*86*	*82*	*31*	*3*	*0*

[45 markah]

...7/-

(b) *Jadual di bawah telah dikompilkan untuk suatu Sekolah Menengah yang diambil dari keputusan peperiksaan Sijil Pelajaran Malaysia .*

Gred	*Tahun Peperiksaan*		
	2000	*2001*	*2002*
A	*60*	*62*	*76*
B	*87*	*102*	*100*
C	*87*	*134*	*140*
F	*42*	*24*	*21*

(i) Hitungkan statistik ujian nisbah kebolehjadian untuk menguji ketakbersandaran.

(ii) Partisikan statistik ujian nisbah kebolehjadian kepada enam komponen takbersandar dengan 1 dk. Apakah kesimpulan yang anda boleh buat terhadap komponen-komponen tersebut ?

[55 markah]

4 (a) A series of n tests is performed on an individual in which the response is a pass or fail.It is suspected that the probability of a pass increases systematically and can be represented by the model $\log\{P_i/(1-P_i)\} = \alpha + \beta i$ where P_i is the probability of a pass in the i th test (i=1, 2, ... n) .

Let S denote the number of passes in the n tests and $T = \sum_{i=1}^{n} iY_i$ where $Y_i = 1$ if the individual passes the i th test and $Y_i = 0$ if he fails it. Show that $P(T = t \mid S = s) = c(s,t)e^{\beta t} / \sum_u c(s,u)e^{\beta u}$ where c(s,t) is the number of sequences of the n tests which would result in the specified values s and t and show that for the null case $\beta = 0$, $E(T \mid S = s) = \frac{1}{2}s(n+1)$

(b) By applying a normal approximation to the conditional distribution of T which has a variance of $\frac{1}{12}s(n-s)(n+1)$ when $\beta = 0$, test whether the following data show evidence of the probability of a pass increasing with the serial number of the test (P= Pass , F = Fail) :

Serial number of test (i)	1	2	3	4	5	6	7	8
Response	P	P	F	P	P	F	F	P

[100 marks]

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4 (a) *Suatu siri n ujian telah dijalankan terhadap individu dengan sambutan ialah lulus atau gagal. Adalah dijangkakan bahawa kebarangkalian memperoleh lulus meningkat secara bersistem dan boleh diwakili oleh model* $\log\{P_i/(1-P_i)\} = \alpha + \beta i$ *dengan* P_i *ialah kebarangkalian mendapat lulus pada ujian ke- i (i=1, 2, ... n).*

Biar S menandai bilangan lulus dalam n ujian dan $T = \sum_{i=1}^{n} iY_i$ *dengan* $Y_i = 1$ *jika individu ke-i lulus dalam ujian ke-i dan* $Y_i = 0$ *jika individu itu gagal. Tunjukkan bahawa*
$P(T = t \mid S = s) = c(s,t)e^{\beta t} / \sum_{u} c(s,u)e^{\beta u}$ *dengan c(s,t) ialah bilangan jujukan n ujian yang berkesudahan dengan nilai spesifikasi s dan t dan tunjukkan juga untuk kes nol* $\beta = 0$, $E(T \mid S = s) = \frac{1}{2}s(n+1)$

(b) *Dengan menggunakan penghampiran normal terhadap taburan bersyarat T yang variansnya ialah* $\frac{1}{12}s(n-s)(n+1)$ *bila* $\beta = 0$, *ujikan sama ada data berikut mempunyai bukti yang kebarangkalian lulus meningkat mengikut nombor siri ujian itu (P= lulus , F = Gagal) :*

Nombor siri ujian (i)	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*
Sambutan	*P*	*P*	*F*	*P*	*P*	*F*	*F*	*P*

[100 markah]

...9/-

LAMPIRAN A: GENERAL LOGLINEAR ANALYSIS (MODEL 1)

Data Information

```
        18 cases are accepted.
         0 cases are rejected because of missing data.
      1682 weighted cases will be used in the analysis.
        18 cells are defined.
         0 structural zeros are imposed by design.
         0 sampling zeros are encountered.
```

Variable Information

Factor	Levels	Value
SATISFY	3	
		1 SATISFYL
		2 SATISFYM
		3 SATISFYH
BUILDING	3	
		1 CONDO
		2 FLAT
		3 HOUSES
CONTACT	2	
		1 CONTACTL
		2 CONTACTH

Model and Design Information

Model: Poisson

Design: Constant + BUILDING + CONTACT + SATISFY

Correspondence Between Parameters and Terms of the Design

Parameter	Aliased	Term
1		Constant
2		[BUILDING = 1]
3		[BUILDING = 2]
4	x	[BUILDING = 3]
5		[CONTACT = 1]
6	x	[CONTACT = 2]
7		[SATISFY = 1]
8		[SATISFY = 2]
9	x	[SATISFY = 3]

Note: 'x' indicates an aliased (or a redundant) parameter.
These parameters are set to zero.

Convergence Information

```
Maximum number of iterations:           20
Relative difference tolerance:        .001
Final relative difference:      3.40842E-06
```

Maximum likelihood estimation converged at iteration 4.

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Goodness-of-fit Statistics

	Chi-Square	DF	Sig.
Likelihood Ratio	89.1005	12	7.E-14
Pearson	85.0657	12	4.E-13

Parameter Estimates

Parameter	Estimate	SE	Z-value	Asymptotic 95% CI Lower	Upper
1	4.7746	.0572	83.47	4.66	4.89
2	-.2566	.0666	-3.85	-.39	-.13
3	.3918	.0569	6.88	.28	.50
4	.0000	.	.	.	.
5	-.3068	.0493	-6.22	-.40	-.21
6	.0000	.	.	.	.
7	-.1654	.0571	-2.90	-.28	-.05
8	-.4055	.0611	-6.63	-.53	-.29
9	.0000	.	.	.	.

GENERAL LOGLINEAR ANALYSIS (MODEL 2)

Model and Design Information

Model: Poisson

Design: Constant + BUILDING + CONTACT + SATISFY + SATISFY*CONTACT

Correspondence Between Parameters and Terms of the Design

Parameter	Aliased	Term
1		Constant
2		[BUILDING = 1]
3		[BUILDING = 2]
4	x	[BUILDING = 3]
5		[CONTACT = 1]
6	x	[CONTACT = 2]
7		[SATISFY = 1]
8		[SATISFY = 2]
9	x	[SATISFY = 3]
10		[SATISFY = 1]*[CONTACT = 1]
11	x	[SATISFY = 1]*[CONTACT = 2]
12		[SATISFY = 2]*[CONTACT = 1]
13	x	[SATISFY = 2]*[CONTACT = 2]
14	x	[SATISFY = 3]*[CONTACT = 1]
15	x	[SATISFY = 3]*[CONTACT = 2]

Note: 'x' indicates an aliased (or a redundant) parameter.
These parameters are set to zero.

Convergence Information

Maximum number of iterations: 20

Relative difference tolerance: .001
Final relative difference: 5.83737E-06

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Maximum likelihood estimation converged at iteration 4.
Goodness-of-fit Statistics

	Chi-Square	DF	Sig.
Likelihood Ratio	83.9211	10	9.E-14
Pearson	82.5235	10	2.E-13

Parameter Estimates

Parameter	Estimate	SE	Z-value	Asymptotic 95% CI Lower	Upper
1	4.8017	.0622	77.24	4.68	4.92
2	-.2566	.0666	-3.85	-.39	-.13
3	.3918	.0569	6.88	.28	.50
4	.0000	.	.	.	.
5	-.3719	.0787	-4.73	-.53	-.22
6	.0000	.	.	.	.
7	-.2611	.0762	-3.43	-.41	-.11
8	-.3904	.0791	-4.94	-.55	-.24
9	.0000	.	.	.	.
10	.2200	.1153	1.91	-5.921E-03	.45
11	.0000	.	.	.	.
12	-.0373	.1246	-.30	-.28	.21
13	.0000	.	.	.	.
14	.0000	.	.	.	.
15	.0000	.	.	.	.

GENERAL LOGLINEAR ANALYSIS (MODEL 3)

Model and Design Information

Model: Poisson

Design: Constant + BUILDING + CONTACT + SATISFY + BUILDING*CONTACT

Correspondence Between Parameters and Terms of the Design

Parameter	Aliased	Term
1		Constant
2		[BUILDING = 1]
3		[BUILDING = 2]
4	x	[BUILDING = 3]
5		[CONTACT = 1]
6	x	[CONTACT = 2]
7		[SATISFY = 1]
8		[SATISFY = 2]
9	x	[SATISFY = 3]
10		[BUILDING = 1]*[CONTACT = 1]
11	x	[BUILDING = 1]*[CONTACT = 2]
12		[BUILDING = 2]*[CONTACT = 1]
13	x	[BUILDING = 2]*[CONTACT = 2]
14	x	[BUILDING = 3]*[CONTACT = 1]
15	x	[BUILDING = 3]*[CONTACT = 2]

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Note: 'x' indicates an aliased (or a redundant) parameter.
These parameters are set to zero.
Convergence Information

Maximum number of iterations: 20
Relative difference tolerance: .001
Final relative difference: 2.58513E-06

Maximum likelihood estimation converged at iteration 4.

Goodness-of-fit Statistics

	Chi-Square	DF	Sig.
Likelihood Ratio	49.7786	10	3.E-07
Pearson	48.5634	10	5.E-07

Parameter Estimates

Parameter	Estimate	SE	Z-value	Asymptotic 95% CI Lower	Upper
1	4.9070	.0620	79.17	4.79	5.03
2	-.6304	.0920	-6.85	-.81	-.45
3	.2758	.0719	3.84	.13	.42
4	.0000	.	.	.	.
5	-.6528	.0927	-7.04	-.83	-.47
6	.0000	.	.	.	.
7	-.1654	.0571	-2.90	-.28	-.05
8	-.4055	.0611	-6.63	-.53	-.29
9	.0000	.	.	.	.
10	.8434	.1367	6.17	.58	1.11
11	.0000	.	.	.	.
12	.3069	.1182	2.60	.08	.54
13	.0000	.	.	.	.
14	.0000	.	.	.	.
15	.0000	.	.	.	.

GENERAL LOGLINEAR ANALYSIS (MODEL 4)

Model and Design Information

Model: Poisson

Design: Constant + BUILDING + CONTACT + SATISFY + SATISFY*BUILDING

Correspondence Between Parameters and Terms of the Design

Parameter	Aliased	Term
1		Constant
2		[BUILDING = 1]
3		[BUILDING = 2]
4	x	[BUILDING = 3]
5		[CONTACT = 1]
6	x	[CONTACT = 2]
7		[SATISFY = 1]
8		[SATISFY = 2]
9	x	[SATISFY = 3]
10		[SATISFY = 1]*[BUILDING = 1]

...13/-

11		[SATISFY = 1]*[BUILDING = 2]
12	x	[SATISFY = 1]*[BUILDING = 3]
13		[SATISFY = 2]*[BUILDING = 1]
14		[SATISFY = 2]*[BUILDING = 2]
15	x	[SATISFY = 2]*[BUILDING = 3]
16	x	[SATISFY = 3]*[BUILDING = 1]
17	x	[SATISFY = 3]*[BUILDING = 2]
18	x	[SATISFY = 3]*[BUILDING = 3]

Note: 'x' indicates an aliased (or a redundant) parameter.
These parameters are set to zero.

Convergence Information

Maximum number of iterations: 20
Relative difference tolerance: .001
Final relative difference: 1.63477E-05

Maximum likelihood estimation converged at iteration 4.

Goodness-of-fit Statistics

	Chi-Square	DF	Sig.
Likelihood Ratio	54.9903	8	4.E-09
Pearson	54.9277	8	5.E-09

Parameter Estimates

Parameter	Estimate	SE	Z-value	Asymptotic 95% CI Lower	Upper
1	4.5665	.0802	56.97	4.41	4.72
2	.1803	.1048	1.72	-.03	.39
3	.5924	.0964	6.14	.40	.78
4	.0000	.	.	.	.
5	-.3068	.0493	-6.22	-.40	-.21
6	.0000	.	.	.	.
7	.1652	.1052	1.57	-.04	.37
8	-.0876	.1119	-.78	-.31	.13
9	.0000	.	.	.	.
10	-.8684	.1618	-5.37	-1.19	-.55
11	-.2735	.1344	-2.03	-.54	-.01
12	.0000	.	.	.	.
13	-.5956	.1656	-3.60	-.92	-.27
14	-.3654	.1451	-2.52	-.65	-.08
15	.0000	.	.	.	.
16	.0000	.	.	.	.
17	.0000	.	.	.	.
18	.0000	.	.	.	.

GENERAL LOGLINEAR ANALYSIS (MODEL 5)

Model and Design Information

Model: Poisson
Design: Constant + BUILDING + CONTACT + SATISFY + BUILDING*CONTACT + SATISFY*BUILDING + SATISFY*CONTACT

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Correspondence Between Parameters and Terms of the Design

Parameter	Aliased	Term
1		Constant
2		[BUILDING = 1]
3		[BUILDING = 2]
4	x	[BUILDING = 3]
5		[CONTACT = 1]
6	x	[CONTACT = 2]
7		[SATISFY = 1]
8		[SATISFY = 2]
9	x	[SATISFY = 3]
10		[BUILDING = 1]*[CONTACT = 1]
11	x	[BUILDING = 1]*[CONTACT = 2]
12		[BUILDING = 2]*[CONTACT = 1]
13	x	[BUILDING = 2]*[CONTACT = 2]
14	x	[BUILDING = 3]*[CONTACT = 1]
15	x	[BUILDING = 3]*[CONTACT = 2]
16		[SATISFY = 1]*[BUILDING = 1]
17		[SATISFY = 1]*[BUILDING = 2]
18	x	[SATISFY = 1]*[BUILDING = 3]
19		[SATISFY = 2]*[BUILDING = 1]
20		[SATISFY = 2]*[BUILDING = 2]
21	x	[SATISFY = 2]*[BUILDING = 3]
22	x	[SATISFY = 3]*[BUILDING = 1]
23	x	[SATISFY = 3]*[BUILDING = 2]
24	x	[SATISFY = 3]*[BUILDING = 3]
25		[SATISFY = 1]*[CONTACT = 1]
26	x	[SATISFY = 1]*[CONTACT = 2]
27		[SATISFY = 2]*[CONTACT = 1]
28	x	[SATISFY = 2]*[CONTACT = 2]
29	x	[SATISFY = 3]*[CONTACT = 1]
30	x	[SATISFY = 3]*[CONTACT = 2]

Note: 'x' indicates an aliased (or a redundant) parameter.
These parameters are set to zero.

Convergence Information

Maximum number of iterations: 20
Relative difference tolerance: .001
Final relative difference: 6.58402E-05

Maximum likelihood estimation converged at iteration 3.

Goodness-of-fit Statistics

	Chi-Square	DF	Sig.
Likelihood Ratio	6.7096	4	.1521
Pearson	6.7458	4	.1499

Parameter Estimates

Parameter	Estimate	SE	Z-value	Asymptotic 95% CI Lower	Upper

...15/-

1	4.7446	.0856	55.44	4.58	4.91
2	-.1913	.1211	-1.58	-.43	.05
3	.4817	.1046	4.61	.28	.69
4	.0000	.	.	.	.
5	-.7926	.1173	-6.76	-1.02	-.56
6	.0000	.	.	.	.
7	.0500	.1131	.44	-.17	.27
8	-.0984	.1189	-.83	-.33	.13
9	.0000	.	.	.	.
10	.8938	.1387	6.44	.62	1.17
11	.0000	.	.	.	.
12	.3191	.1188	2.69	.09	.55
13	.0000	.	.	.	.
14	.0000	.	.	.	.
15	.0000	.	.	.	.
16	-.9404	.1644	-5.72	-1.26	-.62
17	-.2984	.1350	-2.21	-.56	-.03
18	.0000	.	.	.	.
19	-.6030	.1678	-3.59	-.93	-.27
20	-.3679	.1454	-2.53	-.65	-.08
21	.0000	.	.	.	.
22	.0000	.	.	.	.
23	.0000	.	.	.	.
24	.0000	.	.	.	.
25	.3306	.1182	2.80	.10	.56
26	.0000	.	.	.	.
27	.0345	.1269	.27	-.21	.28
28	.0000	.	.	.	.
29	.0000	.	.	.	.
30	.0000	.	.	.	.

GENERAL LOGLINEAR ANALYSIS (MODEL 6)

Model and Design Information

Model: Poisson
Design: **Constant + BUILDING + CONTACT + SATISFY + BUILDING*CONTACT + SATISFY*BUILDING + SATISFY*CONTACT + SATISFY*BUILDING*CONTACT**

Correspondence Between Parameters and Terms of the Design

Parameter	Aliased	Term
1		Constant
2		[BUILDING = 1]
3		[BUILDING = 2]
4	x	[BUILDING = 3]
5		[CONTACT = 1]
6	x	[CONTACT = 2]
7		[SATISFY = 1]
8		[SATISFY = 2]
9	x	[SATISFY = 3]
10		[BUILDING = 1]*[CONTACT = 1]
11	x	[BUILDING = 1]*[CONTACT = 2]
12		[BUILDING = 2]*[CONTACT = 1]
13	x	[BUILDING = 2]*[CONTACT = 2]
14	x	[BUILDING = 3]*[CONTACT = 1]
15	x	[BUILDING = 3]*[CONTACT = 2]
16		[SATISFY = 1]*[BUILDING = 1]

...16/-

Model and Design Information

Model: Poisson
Design: Constant + BUILDING + CONTACT + SATISFY + BUILDING*CONTACT + SATISFY
*BUILDING + SATISFY*CONTACT + SATISFY*BUILDING*CONTACT

Correspondence Between Parameters and Terms of the Design

Parameter	Aliased	Term
1		Constant
2		[BUILDING = 1]
3		[BUILDING = 2]
4	x	[BUILDING = 3]
5		[CONTACT = 1]
6	x	[CONTACT = 2]
7		[SATISFY = 1]
8		[SATISFY = 2]
9	x	[SATISFY = 3]
10		[BUILDING = 1]*[CONTACT = 1]
11	x	[BUILDING = 1]*[CONTACT = 2]
12		[BUILDING = 2]*[CONTACT = 1]
13	x	[BUILDING = 2]*[CONTACT = 2]
14	x	[BUILDING = 3]*[CONTACT = 1]
15	x	[BUILDING = 3]*[CONTACT = 2]
16		[SATISFY = 1]*[BUILDING = 1]

These parameters are set to zero.

Convergence Information

Maximum number of iterations:	20
Relative difference tolerance:	.001
Final relative difference:	1.04390E-11

Maximum likelihood estimation converged at iteration 1.

Goodness-of-fit Statistics

	Chi-Square	DF	Sig.
Likelihood Ratio	.0000	0	.
Pearson	.0000	0	.

Parameter Estimates

Parameter	Estimate	SE	Z-value	Asymptotic 95% CI Lower	Upper
1	4.6540	.0976	47.69	4.46	4.85
2	-.0488	.1397	-.35	-.32	.23
3	.5983	.1215	4.92	.36	.84
4	.0000	.	.	.	.
5	-.5268	.1602	-3.29	-.84	-.21
6	.0000	.	.	.	.
7	.2136	.1312	1.63	-.04	.47
8	1.117E-14	.1380	8.096E-14	-.27	.27
9	.0000	.	.	.	.

...17/-

10	.5268	.2137	2.47	.11	.95
11	.0000	.	.	.	.
12	-.0159	.1997	-.08	-.41	.38
13	.0000	.	.	.	.
14	.0000	.	.	.	.
15	.0000	.	.	.	.
16	-1.2924	.2380	-5.43	-1.76	-.83
17	-.5171	.1719	-3.01	-.85	-.18
18	.0000	.	.	.	.
19	-.7550	.2243	-3.37	-1.19	-.32
20	-.4987	.1814	-2.75	-.85	-.14
21	.0000	.	.	.	.
22	.0000	.	.	.	.
23	.0000	.	.	.	.
24	.0000	.	.	.	.
25	-.1360	.2197	-.62	-.57	.29
26	.0000	.	.	.	.
27	-.2559	.2367	-1.08	-.72	.21
28	.0000	.	.	.	.
29	.0000	.	.	.	.
30	.0000	.	.	.	.
31	.7840	.3363	2.33	.12	1.44
32	.0000	.	.	.	.
33	.5975	.2780	2.15	.05	1.14
34	.0000	.	.	.	.
35	.0000	.	.	.	.
36	.0000	.	.	.	.
37	.3948	.3403	1.16	-.27	1.06
38	.0000	.	.	.	.
39	.3758	.3034	1.24	-.22	.97
40	.0000	.	.	.	.
41	.0000	.	.	.	.
42	.0000	.	.	.	.
43	.0000	.	.	.	.
44	.0000	.	.	.	.
45	.0000	.	.	.	.
46	.0000	.	.	.	.
47	.0000	.	.	.	.
48	.0000	.	.	.	.

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