Application of Loglinear Modeling on Medical Data

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Abstract: - This paper makes use of log- linear model on the age, sex and blood group of staff In Akanu Ibiam Federal Polytechnic, Unwana. The model was used to study the association between these variables. Interactions between Age and Sex, Sex and Blood Group, Age and Blood Group in the fitted models were observed.

Key words: Hierarchical, log-linear, Interaction, Categorical.

I.

INTRODUCTION

The loglinear models otherwise called hierarchical models are fitted to the cell frequencies of a multi-way table in order to describe relationship among the categorical variables that form the table.

According to Oyejola 2003, the log-linear model expresses the logarithm of the expected cell frequency as a linear function of certain parameters in a manner similar to that of analysis of variance (ANOVA).

An important distinction; however between ANOVA and log-linear modeling is that in the latter, the focus is on the need to include interaction terms while in ANOVA, testing for main effects is often the primary interest. Log-linear goal is to see how few interactions are needed to estimate the cell frequencies. If there are no interaction terms then the factors are independent Angela Jeansonne (2002)

The pattern of association between the classificatory variables may be measured by computing some measures of association or by the fitting of a log-linear model. The multivariate generalization of Bartlett's work, beginning with the work of Roy and Kastenbaum (1956) form the basis of the log-linear approach to contingency tables though the pioneering work is given to Pearson and Yule.

Loglinear modeling (as in all Statistical modeling) is parsimony. Quite Often, modelers are faced with a problem of developing a model that is simple to interpret and smoothens rather than over fit the data.

II. ESTIMATION OF PARAMETERS

Two approaches are used in literature to estimate the parameters in the log-linear models; (1) minimum modified chi-square approach attributed to Grizzle etal (1969) and (2) minimum discrimination information approach. Both methods use maximum likelihood approach. For most contingency table problems, the minimum discrimination information approach yields maximum likelihood estimates.

Deming and Stephen (1940) describe the iterative proportional fitting algorithm for hierarchical log linear models, which is currently widely used. The Newton-Raphson method (Kennedy and Gentle, 1980) can also be used to obtain the estimates through iterative procedures.

III. LOG-LINEEAR MODEL

The models for contingency table data to be discussed in this section are very similar to those used for quantitative data, particularly in the analysis of variance. Such terms include main effects and interaction (First order, Second order etc.)

Suppose there is a multinomial sample of size n over the N=rc cells of a r x c contingency table. Under this scheme, the expected frequencies $\lambda_{ij} = np_{ij}$, where p_{ij} is the probability that an observation falls in category i of variable 1 and category j of variable 2, i = 1,....,r; j = 1,....,c.

Let n_{ii} be the corresponding observed frequencies under independence,

 $p_{ij} = p_i p_j \rightarrow \lambda_{ij} = n p_i p_j$ {note summing a subscript we replace by . (dot)}

 $log \lambda_{ij} = log n + log P_{i.} + log P_{.j} denoting the row variable by 1 and the column variable by 2, we have the general model for two-way category tables given as; log <math>\lambda_{ij} = \mu + \mu_{1(i)} + \mu_{12(ij)}$ where

 $\sum \mu_{1i} = \sum \mu_{2(i)} = \sum \mu_{12(i)} = 0$

Bishop, etal (1975) explained, that the μ -terms can be regarded as measures of departure from independence for the two variable arrangements. Assuming that λ_{ij} is the expected value of the independent Poisson random variables X and Y, the μ -terms can be estimated as follows:

We know that the Poisson joint mass function of λ_{ij} is

 $\pi_{ij} e^{-\lambda_{ij}} * \lambda_{ij}^{n_{ij}}$ $n_{ii}!$

is the kernel of the log likelihood is
$$\begin{split} L &= \sum_{ij} n_{ij} log \lambda_{ij} - \sum_{ij} log n_{ij}! \\ By substitution, we obtain \\ L &= \sum_{ij} n_{ij} (\mu + \mu_{1(i)} + \mu_{2(j)} + \mu_{12(ij)}) - \sum_{ij} exp(\mu + \mu_{1(i)} + \mu_{2(j)} + \mu_{12(ij)}) - \sum_{ij} log n_{ij}! \\ Minimizing the equation to zero \\ dL &= \sum_{ij} n_{ij} - \sum_{ij} exp(\mu + \mu_{1(i)} + \mu_{2(j)} + \mu_{12(ij)}) = 0 \\ du \\ Taking \quad \overline{\sum_{i} \mu_{1(i)}} &= \sum_{j} \mu_{2(j)} = \sum \mu_{12(ij)} = 0 ; \\ \sum_{ij} n_{ij} = \sum_{ij} e^{\mu} \\ \mu &= \sum log n_{ij} \\ rc \\ \end{split}$$

Minimizing with respect to $\mu_{1(i)}$ and $\mu_{2(j)}$ and setting the appropriate terms to zero, $\mu_{1(i)}$ and $\mu_{2(j)}$ can be written as $\mu_{1(i)} = \sum_{j} \log n_{ij}$

$\begin{array}{c} r - \mu \\ \mu_{2(j)} = \sum_{i} \log n_{ij} \\ r - \mu \\ \mu_{12(ij)} = \sum_{ij} \log n_{ij} - \mu - \mu_{1(i)} - \mu_{2(j)} \end{array}$

Extending the dimension to three, the model is $Log\lambda_{ijk} = \ \mu + \mu_{1(i)} + \ \mu_{2(j)} + \ \mu_{3(k)} + \mu_{12(ij)} + \ \mu_{13(ik)} + \ \mu_{23(jk)} + \ \mu_{123(ijk)}$ where $\sum \mu_{1(i)} = \sum \mu_{2(j)} = \sum \mu_{12(ij)} = 0;$ i =1,....,r j=1,....,c k =1,....,bc $\mu = \sum logn_{ijk}$ rcb Similarly $\sum logn_{ijk}$ $\mu_{1(i)} =$ Cb- µ $\sum logn_{ijk}$ $\mu_{2(j)} =$ rb- μ -and so on. Let t = Age, b = Blood group, and S = Sex $\lambda = \mu t_i b_j s_k t b_{ij} t s_{ik} b s_{ik} t b_{ijk}$ Taking Log $\lambda_{ijk} = \mu + t_i + b_j + s_k + tb_{ij} + ts_{ik} + bs_{jk} + tbs_{ijk} + e_{ijk}$ (where $\sum e_{ijk} = 0$) SPSS (17.0) for windows was used in this study. $\mu = Overall Mean$ $\mu_{1(i)} = i^{\text{th}}$ levels of tribe. $\mu_{2(j)} = j^{th} \text{ levels of blood group}$ $\mu_{3(k)} = k^{th} \text{ levels of sex}$ $\mu_{12(ij)}$ = Interaction between the ith level of tribe and jth level of blood group. and so on. The hierarchical modeling

Data:

AGE	SEX		BLOO	D GROU	J P	TOTAL
		А	В	AB	0	
0-30 YEARS	MALE	8	7	1	13	29
	FEMALE	11	4	1	11	27
31 YEARS-ABOVE	MALE	6	2	-	-	29
	FEMALE	4	2	-	9	15
TOTAL		29	15	2	54	100

SOURCE: Akanu Ibiam Federal Polytechnic Medical centre.

The test for partial association shows that these interactions are significant at 5% level.

General Loglinear

$\begin{array}{c c c c c c c c c c c c c c c c c c c $				(Cell Counts	and Residu	als		
$ \begin{array}{c c c c c c c c c c c c c c c c c c c $		AG	BLOODG	Observ	ved	Expected			
$ \begin{array}{c c c c c c c c c c c c c c c c c c c $	SEX	Е	ROUP	Count	%	Count	%	Residuals	Std. Residuals
A+ .000 .0% .253 .3% 933 .541 B+ .000 .0% .020 .2% .152 .389 AB+ .000 .0% .020 .0% .020	MALE		0+	.000	.0%	.535	.5%	535	732
$ \begin{array}{ c c c c c c c c c c c c c c c c c c c$		00	A+	.000	.0%	.293	.3%	293	541
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$			B+	.000	.0%	.152	.2%	152	389
$ \begin{array}{c c c c c c c c c c c c c c c c c c c $			AB+	.000	.0%	.020	.0%	020	142
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$			O+	.000	.0%	.535	.5%	535	732
$ \begin{array}{c c c c c c c c c c c c c c c c c c c $		00	A+	.000	.0%	.293	.3%	293	541
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$					l				389
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$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$			0+		1.0%	.268	.3%	.732	1.415
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B+ 1.000 1.0% .682 .7% .318 .385 AB+ .000 .0% .091 .1% 091 302 29. O+ .000 .0% 1.874 1.9% -1.874 -1.369					l				
AB+ .000 .0% .091 .1% 091 302 29. O+ .000 .0% 1.874 1.9% -1.874 -1.369					l				
29. O+ .000 .0% 1.874 1.9% -1.874 -1.369					l l				
00		20							
A+ 2.000 2.0% 1.025 1.0% .975 .963					l				
					l				
B+ 2.000 2.0% .530 .5% 1.470 2.01			B+	2.000	2.0%	.530	.5%	1.470	2.01

Application of Loglinear Modeling on Medical Data

	AB+	.000	.0%	.071	.1%	071	266
30.	0+	4.000	4.0%	2.944	3.0%	1.056	.615
00	A+	3.000	3.0%	1.611	1.6%	1.389	1.094
	B+	.000	.0%	.833	.8%	833	913
	AB+	.000	.0%	.111	.1%	111	333
31	0+	3.000	3.0%	1.606	1.6%	1.394	1.100
00	A+	1.000	1.0%	.879	.9%	.121	.129
	B+	.000	.0%	.455	.5%	455	674
	AB+	.000	.0%	.061	.1%	061	246
32.	0+	3.000	3.0%	1.874	1.9%	1.126	.823
00	A+	1.000	1.0%	1.025	1.0%	025	025
	B+	1.000	1.0%	.530	.5%	.470	.645
	AB+	.000	.0%	.071	.1%	071	266
33.	O+	4.000	4.0%	1.874	1.9%	2.126	1.553
00	A+	1.000	1.0%	1.025	1.0%	025	025
	B+	.000	.0%	.530	.5%	530	728
	AB+	.000	.0%	.071	.1%	071	266
34.	0+	2.000	2.0%	1.338	1.4%	.662	.572
00	A+	1.000	1.0%	.732	.7%	.268	.313
	B+	.000	.0%	.379	.4%	379	615
	AB+	.000	.0%	.051	.1%	051	225
35.	0+	2.000	2.0%	.803	.8%	1.197	1.330
00	A+	.000	.0%	.439	.4%	439	663
	B+	.000	.0%	.227	.2%	227	477
	AB+	.000	.0%	.030	.0%	030	174
36.	0+	1.000	1.0%	.803	.8%	.197	.220
00	A+	.000	.0%	.439	.4%	439	66
	B+	1.000	1.0%	.227	.2%	.773	1.62
	AB+	.000	.0%	.030	.0%	030	174
37.	O+	.000	.0%	.268	.3%	268	51
00	A+	.000	.0%	.146	.1%	146	38
	B+	.000	.0%	.076	.1%	076	27
_	AB+	.000	.0%	.010	.0%	010	10
	0+	1.000	1.0%	.268	.3%	.732	1.41:
00	A+	.000	.0%	.146	.1%	146	383
	B+	.000	.0%	.076	.1%	076	27:
_	AB+	.000	.0%	.010	.0%	010	10
	0+	1.000	1.0%	.535	.5%	.465	.63
00	A+	.000	.0%	.293	.3%	293	54
	B+	.000	.0%	.152	.2%	152	38
	AB+	.000	.0%	.020	.0%	020	142
	0+	.000	.0%	.268	.3%	268	51
00	A+	.000	.0%	.146	.1%	146	38
	B+	.000	.0%	.076	.1%	076	27:
_	AB+	.000	.0%	.010	.0%	010	10
	0+	.000	.0%	.268	.3%	268	517
00	A+	.000	.0%	.146	.1%	146	383
	B+	.000	.0%	.076	.1%	076	27
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	_	AB+	.000	.0%	.010	.0%	010	101
	42	0+	.000	.0%	.000	.0%	.000	.000
	00	A+	.000	.0%	.000	.0%	.000	.000
		B+	.000	.0%	.000	.0%	.000	.000
		AB+	.000	.0%	.000	.0%	.000	.000
	43. 00	0+	1.000	1.0%	.803	.8%	.197	.220
		A+	1.000	1.0%	.439	.4%	.561	.846
		B+	.000	.0%	.227	.2%	227	477
		AB+	.000	.0%	.030	.0%	030	174
		0+	.000	.0%	.000	.0%	.000	.000
	00	A+	.000	.0%	.000	.0%	.000	.000
		B+	.000	.0%	.000	.0%	.000	.000
		AB+	.000	.0%	.000	.0%	.000	.000
	45.	0+	1.000	1.0%	.535	.5%	.465	.635
	00	A+	1.000	1.0%	.293	.3%	.707	1.306
		B+	.000	.0%	.152	.2%	152	389
		AB+	.000	.0%	.020	.0%	020	142
	46.	0+	1.000	1.0%	.268	.3%	.732	1.415
	00	A+	.000	.0%	.146	.1%	146	383
		B+	.000	.0%	.076	.1%	076	275
		AB+	.000	.0%	.010	.0%	010	101
FEMALE	10	Ab+ 0+	.000	.0%	.535	.5%	535	732
ILWIALL	00	A+	2.000	2.0%	.293	.3%	1.707	3.154
		B+	.000	.0%	.152	.2%	152	389
		AB+	.000	.0%	.020	.0%	020	142
	20	0+	2.000	2.0%	.535	.5%	1.465	2.002
	00	A+	.000	.0%	.293	.3%	293	541
		B+	.000	.0%	.152	.2%	152	389
		AB+	.000	.0%	.020	.0%	020	142
	21.	0+	.000	.0%	.268	.3%	268	517
	00	A+	.000	.0%	.146	.1%	146	383
		B+	.000	.0%	.076	.1%	076	275
		AB+	.000	.0%	.010	.0%	010	101
		0+	.000	.0%	.268	.3%	268	517
	00	A+	.000	.0%	.146	.1%	146	383
		B+	.000	.0%	.076	.1%	076	275
		AB+	.000	.0%	.010	.0%	010	101
		0+	1.000	1.0%	1.071	1.1%	071	068
	00	A+	2.000	2.0%	.586	.6%	1.414	1.848
		B+	.000	.0%	.303	.3%	303	550
		AB+	.000	.0%	.040	.0%	040	201
		O+	2.000	2.0%	.803	.8%	1.197	1.336
	00	A+	.000	.0%	.439	.4%	439	663
		B+	.000	.0%	.227	.2%	227	477
		AB+	.000	.0%	.030	.0%	030	174
		O+	.000	.0%	.268	.3%	268	517
	00	A+	.000	.0%	.146	.1%	146	383
		B+	.000	.0%	.076	.1%	076	275
		AB+	.000	.0%	.010	.0%	010	101
	26.	0+	1.000	1.0%	2.141	2.2%	-1.141	780

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00	A+	3.000	3.0%	1.172	1.2%	1.828	1.689
00	B+	1.000	1.0%	.606	.6%	.394	.500
	AB+	.000	.0%	.081	.1%	081	284
27.	0+	.000	.0%	1.874	1.9%	-1.874	-1.369
00	A+	1.000	1.0%	1.025	1.0%	025	025
	B+	.000	.0%	.530	.5%	530	728
	AB+	1.000	1.0%	.071	.1%	.929	3.495
28.	O+	2.000	2.0%	2.409	2.4%	409	264
00	A+	.000	.0%	1.318	1.3%	-1.318	-1.148
	B+	2.000	2.0%	.682	.7%	1.318	1.590
	AB+	.000	.0%	.091	.1%	091	302
29.	0+	1.000	1.0%	1.874	1.9%	874	63
00	A+	2.000	2.0%	1.025	1.0%	.975	.96
	B+	.000	.0%	.530	.5%	530	72
	AB+	.000	.0%	.071	.1%	071	26
30.	0+	2.000	2.0%	2.944	3.0%	944	55
00	A+	1.000	1.0%	1.611	1.6%	611	48
	B+	1.000	1.0%	.833	.8%	.167	.18
	AB+	.000	.0%	.111	.1%	111	33
31.	O+	2.000	2.0%	1.606	1.6%	.394	.31
00	A+	.000	.0%	.879	.9%	879	93
	B+	.000	.0%	.455	.5%	455	67
	AB+	.000	.0%	.061	.1%	061	24
32.	0+	.000	.0%	1.874	1.9%	-1.874	-1.36
00	A+	2.000	2.0%	1.025	1.0%	.975	.96
	B+	.000	.0%	.530	.5%	530	72
	AB+	.000	.0%	.071	.1%	071	26
	O+	1.000	1.0%	1.874	1.9%	874	63
00	A+	1.000	1.0%	1.025	1.0%	025	02
	B+	.000	.0%	.530	.5%	530	72
	AB+	.000	.0%	.071	.1%	071	26
	0+	.000	.0%	1.338	1.4%	-1.338	-1.15
00	A+	1.000	1.0%	.732	.7%	.268	.31
	B+	1.000	1.0%	.379	.4%	.621	1.00
	AB+	.000	.0%	.051	.1%	051	22
	0+	1.000	1.0%	.803	.8%	.197	.22
00	A+	.000	.0%	.439	.4%	439	66
	B+	.000	.0%	.227	.2%	227	47
_	AB+	.000	.0%	.030	.0%	030	17
	O+	1.000	1.0%	.803	.8%	.197	.22
00	A+	.000	.0%	.439	.4%	439	66
	$\mathbf{B}+$.000	.0%	.227	.2%	227	47
	AB+	.000	.0%	.030	.0%	030	17
	0+	1.000	1.0%	.268	.3%	.732	1.41
00	A+	.000	.0%	.146	.1%	146	38
	B+	.000	.0%	.076	.1%	076	27
	AB+	.000	.0%	.010	.0%	010	10
	O+	.000	.0%	.268	.3%	268	51
00	A+	.000	.0%	.146	.1%	146	38
	$\mathbf{B}+$.000	.0%	.076	.1%	076	27
	AB+	.000	.0%	.010	.0%	010	10
39.	0+	1.000	1.0%	.535	.5%	.465	.63

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00	A+	.000	.0%	.293	.3%	293	541
	B+	.000	.0%	.152	.2%	152	389
	AB+	.000	.0%	.020	.0%	020	142
	0+	.000	.0%	.268	.3%	268	517
00	A+	.000	.0%	.146	.1%	146	383
	B+	1.000	1.0%	.076	.1%	.924	3.358
	AB+	.000	.0%	.010	.0%	010	101
	0+	1.000	1.0%	.268	.3%	.732	1.415
00	A+	.000	.0%	.146	.1%	146	383
	B+	.000	.0%	.076	.1%	076	275
	AB+	.000	.0%	.010	.0%	010	101
	0+	.000	.0%	.000	.0%	.000	.000
00	A+	.000	.0%	.000	.0%	.000	.000
	B+	.000	.0%	.000	.0%	.000	.000
	AB+	.000	.0%	.000	.0%	.000	.000
	0+	1.000	1.0%	.803	.8%	.197	.220
00	A+	.000	.0%	.439	.4%	439	663
	B+	.000	.0%	.227	.2%	227	477
	AB+	.000	.0%	.030	.0%	030	174
	0+	.000	.0%	.000	.0%	.000	.000
00	A+	.000	.0%	.000	.0%	.000	.000
	B+	.000	.0%	.000	.0%	.000	.000
	AB+	.000	.0%	.000	.0%	.000	.000
	0+	.000	.0%	.535	.5%	535	732
00	A+	.000	.0%	.293	.3%	293	541
	B+	.000	.0%	.152	.2%	152	389
	AB+	.000	.0%	.020	.0%	020	142
	0+	.000	.0%	.268	.3%	268	517
00	A+	.000	.0%	.146	.1%	146	383
	B+	.000	.0%	.076	.1%	076	275
	AB+	.000	.0%	.010	.0%	010	101

Goodness-of-Fit Tests

Likelihood Ratio 122.948 193 1 Bearson 153.003 103		Chi-Square	df	Sig.
Desizon 152,002 102	Likelihood Ratio	122.948	193	1.000
realson 155.005 195	Pearson	153.003	193	.985

a. Model: Poisson

b. Design: Constant + SEX + AGE + BLOODGROUP + SEX * AGE + SEX * BLOODGROUP + AGE * BLOODGROUP + SEX * AGE * BLOODGROUP

K-Way and Higher-Order Effects

		ĩ	8					
	-		Likelihood	Likelihood Ratio		Pearson		
	K	Df	Chi-Square	Sig.	Chi-Square	Sig.	Number of Iterations	
K-way and Higher Order	1	223	258.400	.052	315.061	.000	0	
Effects ^a	2	192	120.666	1.000	154.615	.978	2	
	3	81	23.260	1.000	18.183	1.000	4	
K-way Effects ^b	1	31	137.734	.000	160.445	.000	0	
	2	111	97.407	.818	136.432	.051	0	
	3	81	23.260	1.000	18.183	1.000	0	

df used for these tests have NOT been adjusted for structural or sampling zeros. Tests using these df may be conservative.

a. Tests that $k\mbox{-way}$ and higher order effects are zero.

Goodness-of-Fit Tests								
	Chi-Square	df	Sig.					
Likelihood Ratio 122.948 193 1.								
b. Tests that k-way effects	are zero.							

Partial Associations									
Effect	df	Partial Chi-Square	Sig.	Number of Iterations					
SEX*AGE	27	26.476	.492	2					
SEX*BLOODGROUP	3	2.068	.558	2					
AGE*BLOODGROUP	81	69.842	.807	2					
SEX	1	2.282	.131	2					
AGE	27	70.631	.000	2					
BLOODGROUP	3	64.821	.000	2					

,	-					95% Confider	nce Interval
fect	ıramete	Estimate	Std. Error	Z	Sig.	ower Bound	Jpper Bound
X*AGE*BLOOI	DG	.125	.831	.150	.880	-1.504	1.75
OUP		566	.713	795	.427	-1.963	.83
		.191	.834	.229	.819	-1.443	1.82
		680	.710	957	.339	-2.072	.7
		.238	.833	.286	.775	-1.394	1.8
		.191	.834	.229	.819	-1.443	1.8
		.336	.734	.457	.648	-1.104	1.7
		100	.835	120	.904	-1.737	1.5
		147	.836	176	.860	-1.786	1.4
)	214	.833	256	.798	-1.847	1.4
		100	.835	120	.904	-1.737	1.5
	2	.402	.738	.545	.586	-1.044	1.8
	;	.125	.585	.214	.831	-1.022	1.2
	ŀ	566	.685	827	.408	-1.909	.7
	ş	.191	.810	.236	.813	-1.397	1.7
	5	268	.575	466	.641	-1.395	.8
	7	.101	.821	.123	.902	-1.508	1.7
	3	.054	.822	.066	.948	-1.557	1.6
)	214	.833	256	.798	-1.847	1.4
)	100	.835	120	.904	-1.737	1.5
	L	.402	.738	.545	.586	-1.044	1.8
	2	.030	.531	.056	.955	-1.012	1.0
	}	281	.491	571	.568	-1.244	.6
	ł	.096	.536	.179	.858	955	1.1
	i	.390	.639	.611	.541	862	1.6
	5	301	.536	562	.574	-1.352	.7
	7	.201	.666	.302	.763	-1.105	1.5
	3	024	.468	050	.960	941	.8
)	.471	.672	.700	.484	847	1.7
)	381	.518	736	.462	-1.395	.6
	L	689	.685	-1.006	.315	-2.033	.6

Application of Loglinear Modeling on Medical Data

1 .027 .566 .053 .948 .1019 .945 2.037 1 .176 .437 .384 .01 .720 1.072 i .419 .500 .337 .403 .552 1.399 i .6087 .511 .171 .464 .1000 .915 i .407 .703 .579 .563 .971 1.788 j .189 .667 .238 .818 .4771 1.862 . .555 .538 .994 .200 .1.599 .519 . .2535 .538 .994 .200 .1.599 .519 . .2535 .538 .994 .200 .1.59 .519 . .2535 .538 .994 .202 .1.59 .519 . .223 .747 .1.131 .1.575 .202 .656 .977 . .407 .777 .1.88 .433 .1.404 .1.02 .242 . .027 .821 .	1		007	504	0.50	0.50	1.010	0.55
1 1.170 4.457 3.84 7.01 -7.20 1.072 5 4.419 5.00 3.37 4.03 -5.62 1.399 7 -0.867 5.11 -1.71 8.64 1.409 9.15 6 4.007 7.03 3.579 5.53 -9.71 1.785 7 -1.53 5.38 -9.94 3.00 4.589 5.19 2 -2.23 6.91 3.23 -4.74 4.131 1.766 3 -5.53 -5.53 -777 -4.85 -880 1.332 1 -100 5.99 -176 8.60 -4.215 1.014 5 -147 7.97 -1.85 8.83 -1.09 1.414 5 -6.22 .695 -897 3.00 -4.45 1.022 6 -0.22 .551 .00 8.41 -1.012 1.22 0 -115 .575 .00 8.41 -1.012 1.22 0 -1207 .821 .000 .821 .122 <th></th> <th>2</th> <th>027</th> <th>.506</th> <th>053</th> <th>.958</th> <th></th> <th></th>		2	027	.506	053	.958		
i .449 .500 .837 .403 .5.62 .1.399 i 001 .672 885 .371 .1.918 .715 i 087 113 717 86 990 915 i								
i 601 .672 895 .371 -1.918 .715 i 087 .511 171 .864 .1090 .915 i 180 .607 235 .815 171 1.322 j 535 .536 .994 .303 .1589 .516 j .223 .601 .323 .747 .1.131 .1576 j .336 .518 .648 .517 .680 .1.215 .1.14 j 100 .569 716 .860 .1.215 .1.14 j 107 571 461 022 135								
9 0.87 5.11 171 .8.64 -1.000 9.15 6 4.007 7.03 5.59 -5.63 971 1.785 9 .580 6.54 8.87 3.75 7.702 1.882 1 535 5.38 994 3.20 -1.58 5.18 2 2.23 .601 3.23 .747 -1.131 1.576 3 3.36 5.18 6.48 3.57 -6.03 1.352 4 -100 5.99 76 .60 1.215 1.014 5 617 .077 .636 -1.146 1.092 4 .605 .668 .994 .301 -6.15 1.974 7 .015 .575 .201 .844 -1.012 1.242 1 .027 .821 .033 .971 -1.36 1.939 4 .402 .711 .666 .506 1.922 1.681 5 .100 .812 .712 .666 .468 1.538								
1 4.07 7.03 5.79 5.65 -971 1.785 0 -1.89 807 -2.25 3.815 -1.771 1.302 0 5.53 5.88 -944 3.20 -1.589 5.19 1 2.23 .691 3.23 .747 -1.131 1.576 1 3.36 5.18 6.648 .547 -6.63 1.799 1 -1.07 7.97 -1.85 .853 -1.799 1.414 1 -0.07 5.97 -0.63 -0.477 3.92 -6.63 1.944 1 -6.23 .668 .994 .320 -6.645 1.974 1 -6.23 .668 .994 .320 -6.45 1.974 1 .623 .668 .994 .320 -6.45 1.974 1 .623 .658 .897 .300 1.421 1.222 1 .623 .658 .891 .403 .101 1.422 1 .1173 .575 .201 .441 <th></th> <th></th> <th></th> <th></th> <th></th> <th></th> <th></th> <th></th>								
1 189 807 235 .815 -1.771 1.392 0 .580 .664 .887 .375 .702 1.862 1 .535 .538 .994 .320 -1.85 .519 2 .223 .614 .517 .680 .1.131 .1.576 3 .366 .518 .648 .517 .680 .1.215 1.014 1 .100 .509 176 .860 .1.215 1.014 1 .665 .668 .944 .320 .645 1.974 1 .027 .571 .047 .963 .1.46 1.092 1 .027 .821 .033 .974 .1.38 .788 1 .027 .821 .033 .974 .1.367 .999 1 .027 .821 .033 .974 .1.367 .999 1 .027 .821 .033 .1.141 .1.636 .1.583 1 .1174 .835 .209 .835								
1 580 654 887 375 702 1.802 1 535 538 944 320 -1.589 5.19 1 2.23 6.91 323 7.47 4.13 1.576 1 100 569 176 8.60 1.215 1.014 5 665 6.68 9.94 3.20 645 1.974 6 6.65 6.68 9.94 3.20 645 1.974 6 6.65 6.68 9.94 3.01 645 1.974 7 0.07 7.71 633 675 3.01 414 6 6.25 6.95 807 3.02 663 1.583 1 077 8.21 033 .971 1.367 9.991 1 1.462 7.11 5.66 5.72 9.921 1.681 1 4.02 7.11 5.66 5.72 9.921								
1. 535 .538 994 .320 1.589 .519 1 .223 .691 .323 .747 -1.131 1.576 1 306 .518 .648 .517 -6.60 1.215 1.014 1 107 177 185 853 709 1.414 1 665 668								
2 2.23 .691 3.23 .747 1.131 1.576 3 3.36 .518 .648 .517 .680 1.352 4 .100 .569 .176 .860 .1215 1.014 5 .665 .668 .994 .330 .645 1.974 7 .027 .571 .047 .963 .1.46 1.922 5 .663 .699 .330 .1.46 1.922 6 .623 .605 .897 .370 .1.934 .738 0 .015 .575 .201 .841 .1.636 .1583 .1 .074 .822 .090 .929 .1.685 .1538 .2 .214 .588 .363 .717 .1.367 .999 5 .100 .812 .123 .902 .1.618 .1490 1.4 .400 .711 .566 .572 .999 .1.511 .1.766 5 .174 .835 .209 .835 .1.402)						
3								
i 100 509 176 860 1215 1.014 i 147 797 185 833 1.709 1.414 i 665 668 994 320 645 1.974 i 623 695 897 707 148 1.012 i 623 695 897 707 188 1636 i 027 821 033 974 1636 1883 i 074 822 090 929 1885 1338 i 074 822 090 929 1885 1338 i 010 812 123 902 1685 1338 i 100 812 123 902 1691 1499 i 402 711 566 572 992 1796 i 402 711 566 576 1462 1811 i 127 366 152 799 1511 1766 i 174 336 120 904 1737 1537 i 100 128 126 1606 1281 1462 1492 i 147 133 126 1661 1492 1611 1621 1691 i 167 1631 1631 1626								
i 147 797 185 855 1709 1.414 i 665 668 994 320 645 1.974 i 027 571 047 963 1.16 1.092 i 623 695 897 370 1.984 738 i 623 695 901 841 1.012 1.242 i 027 821 033 974 .1.636 1.538 10 115 122 900 929 .1.685 1.538 1 074 822 900 929 .1.685 1.538 1 100 812 123 902 169 1.499 1 100 124 133 104 1.775 151 1.766 1 107 336 734 457 460 1.492 137 1.651 1 107 336 126 1073 1.451 1.666 1492 </th <th></th> <th></th> <th></th> <th></th> <th></th> <th></th> <th></th> <th></th>								
i								
\cdot 623 695 897 370 1984 738 \cdot 115 575 01 841 1012 1242 \cdot 077 821 033 974 1.636 1583 \cdot 077 822 090 929 1.685 1538 \cdot 0774 822 090 929 1.681 1381 \cdot 100 812 123 902 1.691 1490 \cdot 100 121 665 665 692 992 \cdot 74 835 209 835 462 8111 \cdot 74 835 209 835 462 8111 \cdot 77 836 152 879 1737 757 \cdot 100 835 120 944 777 757 \cdot 107 836 126 786 777 757 \cdot 107 833 72 664 726 767 767 \cdot 767 783 757 767								
) .115 .575 .201 .841 .1.02 1.242) .027 .821 .033 .974 .1.635 1.583 . .074 .822 .090 .929 .1.685 1.538 2 .214 .588 363 .717 .1.367 .939 1 .100 .812 .123 .902 .1.691 .1490 1 .402 .711 .566 .506 .1.928 .951 5 .174 .835 .209 .835 .1.462 1.811 7 .127 .836 .152 .879 .1.511 1.766 5 .336 .734 .457 .648 .1.04 1.775 0 .100 .835 .120 .904 .1.737 1.537 1 076 .604 .126 .900 .1.261 1.109 2 037 .823 .045 .964 .1.572 1.694 1 010 .824 .012 .909 .1.621 <th></th> <th></th> <th></th> <th></th> <th></th> <th></th> <th></th> <th></th>								
) 027 .8.21 033 .9.74 .1.636 1.583								
1 214 .588 363 .7.17 -1.367 .939 3 100 .812 123 .902 .1.691 1.490 4 .402 .711 .566 .572 .992 1.796 5 488 .734 665 .506 .1.928 .951 5 174 .835 .209 .835 .1.462 1.811 7 .127 .836 .152 .879 .1.511 1.766 6 336 734 .457 .648 .1.04 1.775 0 100 .835 120 .904 .1.737 1.537 1 167 836 126 .904 .1.737 1.537 1 167 836 126 .904 .1.737 1.537 1 167 836 126 .904 .1.537 1.651 1 076 824 .012 .990 .1.626 1.606 1 061 333 .073 422)						
1 100 .812 123 .902 -1.691 1.490 1 .402 .711 .566 .572 .992 1.796 1 .488 .734 .665 .506 -1.928 .951 1 .174 .835 .209 .835 -1.462 1.811 1 .127 .836 .152 .879 -1.511 1.766 1 .127 .836 .120 .904 .1.737 1.537 1 .100 .835 .120 .904 .1.737 1.537 1 .176 .836 .176 .860 .1.786 1.492 1 .100 .835 .120 .904 .1.737 1.537 1 .177 .836 .126 .900 .1.616 .109 1 .101 .824 .012 .909 .1.626 1.606 1 .011 .824 .012 .909 .1.626 1.606 1 .011 .824 .012 .909 .1.626								
1 4.02 7.11 5.66 5.72 992 1.796 5 488 7.734 665 5.06 -1.928 9.951 5 1.174 .835 2.09 .835 -1.462 1.811 7 1.27 .836 .152 .879 -1.511 1.766 3 .336 .734 .457 .648 -1.104 1.775 0 100 .835 120 .904 -1.737 1.537 0 107 .836 .176 .860 -1.766 1.492 1 .076 .604 126 .900 -1.261 1.109 2 .037 .823 .045 .964 -1.577 1.651 1 .010 .824 .012 .990 -1.626 1.606 1 .011 .823 .029 .835 -1.462 1.811 1 .161 .833 .073 .942 -1.572 1.694 1 .422 .738 .572 .567 -1.								
i 488 .734 665 .506 .1.928 .951 i .174 .835 .209 .835 .1.462 1.811 i .127 .836 .152 .879 .1.511 1.766 i .336 .734 .457 .648 .1.04 1.775 i .336 .734 .457 .648 .1.04 1.737 i .336 .734 .457 .648 .1.04 1.775 i .336 .734 .457 .648 .1.04 1.797 i .001 .835 120 .900 .1.261 1.109 i .0076 .604 .126 .900 .1.626 1.606 i .0071 .823 .045 .964 .1.577 1.651 i .010 .824 .012 .990 .1.626 1.606 i .017 .835 .209 .835 .1.462 1.811 i .174 .835 .209 .335 .1.42								
5 .174 .835 .209 .835 .1.462 1.811 7 .127 .836 .152 .879 .1.511 1.766 5 .336 .734 .457 .648 .1.04 1.775 0 100 .835 120 .904 .1.737 1.537 0 147 .836 176 .860 .1.786 1.492 1 076 .604 126 .900 .1.261 1.109 2 .037 .823 .045 .964 .1.577 1.651 1 010 .824 012 .990 .1.626 1.606 1 061 .833 .073 .942 .1.572 1.694 1 061 .833 073 .942 .1.572 1.694 1 061 333 073 422 163 162 1.811 1 174 835 090 835 142 1.811 1 174 335 090								
1 1.127 .836 .152 .879 -1.511 1.766 3 .336 .734 .457 .648 -1.104 1.775 0 100 .835 120 .904 -1.737 1.537 0 147 .836 176 .860 -1.786 1.492 1 076 .604 126 .900 -1.261 1.109 2 .037 .823 .045 .964 -1.577 1.651 3 010 .824 012 .909 -1.626 1.606 4 .061 .833 .073 .942 -1.572 1.694 4 .061 .833 .073 .942 -1.572 1.694 5 .174 .835 .209 .835 -1.462 1.811 5 .422 .738 .567 -1.868 1.024 6 .423 .734 .665 .506 -1.928 .951 7 .488 .734 .665 .506 .152 1.								
3 336 734 457 648 104 1775 0 100 835 120 904 737 1537 0 147 836 176 800 176 1492 1								
) 100 .835 120 .904 -1.737 1.537) 147 .836 176 .860 -1.786 1.492 . 076 .604 126 .900 -1.261 1.109 . 076 .604 126 .900 -1.261 1.109 . 037 .823 .045 .964 -1.577 1.651 . 010 .824 .012 .990 -1.626 1.606								
) 147 .836 176 .860 -1.786 1.492 076 .604 .126 .900 -1.261 1.109 ! .037 .823 .045 .964 -1.577 1.651 ! .001 .824 .012 .990 -1.626 1.606 ! .061 .833 .073 .942 1.572 1.694 ! .061 .833 .073 .942 1.572 1.694 ! .061 .833 .073 .942 1.572 1.694 ! .174 .835 .209 .835 1.462 1.811 ! .422 .738 .572 .567 1.868 1.024 ! .488 .734 .665 .506 1.928 .951 ! .174 .835 .209 .835 .1462 1.811 ! .177 .836 .152 .879 .1.511 1.766 ! .037 .847 .044 .965 1.622 1.691								
076 604 126 900 1.61 1.109 037 823 045 964 1577 1.651 010 824 012 990 1626 1.606 <td< th=""><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th></th></td<>								
! .037 .823 .045 .964 -1.577 1.651 .010 .824 .012 .990 -1.626 1.606 .1 .061 .833 .073 .942 -1.572 1.694 .1 .061 .833 .073 .942 -1.572 1.694 .1 .174 .835 .209 .835 -1.462 1.811 .1 .422 .738 .572 .567 -1.868 1.024 .1 .488 .734 665 .506 -1.928 .951 .1 .174 .835 .209 .835 -1.462 1.811 .1 .488 .734 665 .506 -1.928 .951 .1 .127 .836 .152 .879 .1.511 1.766 .1 .037 .847 .044 .965 .1.622 1.696 .1 .010 .848 .012 .991 .1.671 1.651 .1 .149 .710 .633 .527 .942)						
1 010 .824 012 .990 -1.626 1.606 1 .061 .833 .073 .942 -1.572 1.694 1 .174 .835 .209 .835 -1.462 1.811 1 422 .738 572 .567 -1.868 1.024 1 488 .734 665 .506 -1.928 .951 3 .174 .835 .209 .835 -1.462 1.811 1 488 .734 665 .506 -1.928 .951 3 .174 .835 .209 .835 .1.462 1.811 1 167 162 161 1.766 162 1.811 1 174 835 090								
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i.174.835.209.835-1.4621.811i.422.738572.567.1.8681.024i.488.734665.506.1.928.951i.174.835.209.835.1.4621.811i.174.835.209.835.1.4621.811i.174.835.209.835.1.4621.811i.127.836.152.879.1.5111.766i.076.845.090.928.1.7321.579i.037.847.044.965.1.6221.696i.214.588363.717.1.367.939i.147.813.181.856.1.7401.446i147.813.181.856.1.7401.446i147.813.181.856.1.7401.446i076.845.090.928.1.7321.579i147.813.181.856.1.7401.446i076.845.090.928.1.7321.579i167.847.044.965.1.6221.696i147.813.181.1651.1.6211.696i147.843.012.991.1.6711.651i147.843.012.991.1.6711.651i148 <th></th> <th>}</th> <th></th> <th></th> <th></th> <th></th> <th></th> <th></th>		}						
i422.738572.567-1.8681.0247488.734665.506-1.928.9513.174.835.209.835-1.4621.8110.127.836.152.879-1.5111.7660.076.845.009.928.1.7321.5791.037.847.044.965.1.6221.6962.010.848.012.991.1.6711.6513.214.588363.717.1.367.9394.449.710.633.5279421.8405174.813181.856.1.7401.4465076.845090.928.1.7321.5797.037.847.044.965.1.6221.696616216761621.69616221.6966161161161161161		ŀ						
1488.734665.506-1.928.9513.174.835.209.835-1.4621.8110.127.836.152.879-1.5111.7660076.845090.928-1.7321.5791.037.847.044.965-1.6221.6962.010.848.012.991-1.6711.6513.214.588.363.717-1.367.9394.449.710.633.527.9421.8405147.813181.856.1.7401.4465076.845090.928.1.7321.5797.037.847.044.965.1.6221.6963.010.848.012.991.1.6711.651								
3.174.835.209.835-1.4621.811).127.836.152.879-1.5111.766)076.845.090.928-1.7321.579037.847.044.965-1.6221.696010.848.012.991-1.6711.651214.588.363.717-1.367.939144.588.363.527.9421.840147.813.181.856-1.7401.446037.847.004.965.1.6221.696037.847.044.965.1.6221.696037.847.044.965.1.6221.696037.848.012.991.1.6711.651								
).127.836.152.879-1.5111.766)076.845090.928-1.7321.579037.847.044.965-1.6221.696010.848.012.991-1.6711.651214.588.363.717-1.367.939449.710.633.527.9421.840147.813.181.856-1.7401.446037.847.004.965-1.6221.696037.847.044.965-1.6221.696010.848.012.991-1.6711.651								
)076.845090.928-1.7321.579037.847.044.965-1.6221.696010.848.012.991-1.6711.651214.588363.717-1.367.939449.710.633.527.9421.840147.813.181.856-1.7401.446037.847.004.965-1.6221.696037.847.044.965-1.6221.696010.848.012.991-1.6711.651								
037.847.044.965-1.6221.696010.848.012.991-1.6711.651214.588.363.717-1.367.939449.710.633.527.9421.840147.813.181.856-1.7401.446007.845.000.928.1.7321.579037.847.044.965-1.6221.696010.848.012.991-1.6711.651								
2010.848012.991-1.6711.6513214.588363.717-1.367.9394.449.710.633.5279421.8405147.813181.856-1.7401.4465076.845090.928-1.7321.5797.037.847.044.965-1.6221.6963010.848.012.991-1.6711.651)						
·214.588363.717-1.367.939·.449.710.633.5279421.840·.147.813.181.856-1.7401.446·.076.845.090.928-1.7321.579·.037.847.044.965-1.6221.696·.010.848.012.991-1.6711.651								
.449 .710 .633 .527 942 1.840 .5 147 .813 181 .856 -1.740 1.446 .5 076 .845 090 .928 -1.732 1.579 .7 .037 .847 .044 .965 -1.622 1.696 .5 010 .848 012 .991 -1.671 1.651								
5147.813181.856-1.7401.4465076.845090.928-1.7321.5797.037.847.044.965-1.6221.6963010.848012.991-1.6711.651		}						
5076.845090.928-1.7321.5797.037.847.044.965-1.6221.6963010.848012.991-1.6711.651								
' .037 .847 .044 .965 -1.622 1.696 ' 010 .848 012 .991 -1.671 1.651								
3010 .848012 .991 -1.671 1.651								
) .198 .721 .275 .783 -1.215 1.612								
)	.198	.721	.275	.783	-1.215	1.612

Application of Loglinear Modeling on Medical Data

)	.312	.723	.431	.666	-1.106	1.73
	285	.824	345	.730	-1.900	1.33
X*AGE	250	.465	538	.590	-1.161	.66
	250	.465	538	.590	-1.161	.66
	.088	.469	.188	.851	831	1.00
	.088	.469	.188	.851	831	1.00
	250	.421	594	.552	-1.075	.57
	113	.443	255	.799	982	.75
	.088	.469	.188	.851	831	1.00
	155	.343	452	.651	827	.51
	.290	.345	.839	.402	387	.96
)	.067	.359	.185	.853	638	.77
	.015	.387	.038	.969	745	.77
2	007	.356	019	.984	704	.69
}	.130	.414	.315	.753	682	.94
ŀ	.268	.390	.686	.493	497	1.03
;	.088	.394	.224	.823	684	.86
j	.015	.397	.037	.970	764	.79
1	.015	.443	.034	.973	854	.88
}	.088	.426	.208	.836	746	.92
)	186	.469	397	.691	-1.105	.73
)	.088	.469	.188	.851	831	1.00
	049	.448	109	.913	926	.82
2	186	.469	397	.691	-1.105	.73
	186	.469	397	.691	-1.105	.73
ļ	049	.489	100	.920	-1.007	.90
i	.088	.426	.208	.836	746	.92
į	049	.489	100	.920	-1.007	.90
1	.226	.448	.504	.614	652	1.10
X*BLOODGROUP	.076	.131	.582	.561	181	.33
1 22002 0110 01	037	.142	261	.794	316	.24
	.010	.148	.067	.947	281	.30
E*BLOODGROUP	610	.831	734	.463	-2.238	1.01
	.532	.713	.746	.456	865	1.92
	078	.834	094	.925	-1.712	1.55
	.195	.710	.274	.784	-1.197	1.58
	273	.833	328	.743	-1.905	1.35
	078	.834	094	.925	-1.712	1.55
	.003	.734	.005	.996	-1.436	1.44
	209	.835	250	.802	-1.846	1.42
	014	.836	017	.986	-1.653	1.62
)	546	.833	655	.512	-2.179	1.08
,	209	.835	250	.802	-1.846	1.42
	.535	.738	.725	.468	911	1.98
2	.214	.738	.725	.408	911	1.96
,	.214	.585 .685	.300	.707	-1.085	1.50
ŀ	353	.685 .810	.375 435	.663	-1.085 -1.941	1.59
) j	355 .607	.810	435 1.056	.003	-1.941 520	1.23
)						
1	410	.821	500	.617	-2.020	1.19
3	215	.822	262	.793	-1.827	1.39
,	546	.833	655	.512	-2.179	1.08

Application of Loglinear Modeling on Medical Data

)	209	.835	250	.802	-1.846	1.428
	.535	.738	.725	.468	911	1.981
2	240	.531	451	.652	-1.282	.802
}	.521	.491	1.060	.289	442	1.483
ł	.292	.536	.545	.586	759	1.342
j	492	.639	770	.441	-1.744	.760
j	.139	.536	.259	.795	911	1.189
7	215	.666	323	.746	-1.521	1.090
}	.449	.468	.959	.337	468	1.366
)	443	.672	659	.510	-1.760	.875
)	.557	.518	1.076	.282	458	1.572
	600	.685	876	.381	-1.944	.743
2	.797	.506	1.574	.116	195	1.789
}	.187	.666	.281	.779	-1.119	1.493
ŀ	.501	.457	1.096	.273	395	1.397
;	.457	.500	.913	.361	524	1.437
j	321	.672	478	.632	-1.638	.995
7	.787	.511	1.540	.124	215	1.790
}	104	.703	148	.882	-1.483	1.274
)	459	.807	568	.570	-2.040	1.123
)	155	.654	236	.813	-1.437	1.127
	.563	.538	1.047	.295	491	1.618
2	047	.691	067	.946	-1.400	1.307
;	.553	.518	1.066	.286	463	1.569
ŀ	.340	.569	.598	.550	774	1.455
;	563	.797	707	.479	-2.125	.998
5	217	.668	325	.745	-1.527	1.093
7	.414	.571	.725	.469	705	1.533
}	.059	.695	.085	.932	-1.302	1.421
)	.607	.575	1.056	.291	520	1.734
)	410	.821	500	.617	-2.020	1.199
L	215	.822	262	.793	-1.827	1.396
2	.278	.588	.473	.636	875	1.431
;	484	.812	596	.551	-2.074	1.107
ŀ	.260	.711	.366	.714	-1.133	1.654
;	.003	.734	.005	.996	-1.436	1.443
ý	209	.835	250	.802	-1.846	1.428
7	014	.836	017	.986	-1.653	1.625
}	.003	.734	.005	.996	-1.436	1.443
)	209	.835	250	.802	-1.846	1.428
)	014	.836	017	.986	-1.653	1.625
	.415	.604	.687	.492	769	1.600
2	346	.823	421	.674	-1.960	1.267
ţ	151	.824	184	.854	-1.767	1.464
ŀ	546	.833	655	.512	-2.179	1.087
į	209	.835	250	.802	-1.846	
ý	.535	.738	.725	.468	911	1.981
1	.003	.734	.005	.996	-1.436	
}	209	.835	250	.802	-1.846	
)	014	.836	017	.986	-1.653	
)	409	.845	484	.629	-2.064	
	072	.847	085	.932	-1.731	1.587
 	of Cointifi	. Deserval				59 D o c o

Application of Loglinear Modeling on Medical Data

	2	.123	.848	.145	.884	-1.538	1.784
	;	.278	.588	.473	.636	875	1.431
	ŀ	.066	.710	.092	.926	-1.326	1.457
	;	289	.813	355	.722	-1.882	1.304
	i	409	.845	484	.629	-2.064	1.247
	7	072	.847	085	.932	-1.731	1.587
	}	.123	.848	.145	.884	-1.538	1.784
)	134	.721	186	.853	-1.547	1.280
)	.203	.723	.280	.779	-1.215	1.621
		151	.824	184	.854	-1.767	1.464
X		.049	.084	.586	.558	115	.213
ЭE	-	195	.465	420	.674	-1.106	.715
		195	.465	420	.674	-1.106	.715
		259	.469	553	.580	-1.178	.660
		259	.469	553	.580	-1.178	.660
		.079	.421	.189	.850	746	.905
		058	.443	131	.896	927	.811
		259	.469	553	.580	-1.178	.660
		.533	.343	1.556	.120	139	1.205
		.491	.345	1.423	.155	185	1.168
)	.524	.359	1.458	.145	181	1.228
	ļ	.344	.387	.889	.374	415	1.104
	2	.597	.356	1.679	.093	100	1.295
	;	.185	.414	.447	.655	627	.997
	ł	.323	.390	.827	.408	442	1.088
	;	.290	.394	.736	.461	482	1.063
	5	.217	.397	.545	.585	562	.996
	7	058	.443	131	.896	927	.811
	}	.016	.426	.037	.971	819	.850
)	259	.469	553	.580	-1.178	.660
)	259	.469	553	.580	-1.178	.660
		122	.448	272	.786	999	.756
	2	259	.469	553	.580	-1.178	.660
	}	259	.469	553	.580	-1.178	.660
	ŀ	396	.489	811	.418	-1.355	.562
	i	.016	.426	.037	.971	819	.850
	5	396	.489	811	.418	-1.355	.562
	7	122	.448	272	.786	999	.756
.OODGROUP	-	.409	.131	3.119	.002	.152	.665
		.072	.142	.504	.614	207	.351
		123	.148	830	.406	414	.168

Backward Elimination Statistics

		Step Summary				
Step	a	Effects	Chi-Square ^c	df	Sig.	Number of Iterations
0	Generating Class ^b	SEX*AGE*BLOODGROUP	.000	0		
	Deleted Effect 1	SEX*AGE*BLOODGROUP	23.260	81	1.000	4
1	Generating Class ^b	SEX*AGE, SEX*BLOODGROUP, AGE*BLOODGROUP	23.260	81	1.000	
	Deleted Effect 1	SEX*AGE	26.476	27	.492	2
	2	SEX*BLOODGROUP	2.068	3	.558	2

Application of Loglinear Modeling on Medical Data

	_	3	AGE*BLOODGROUP	69.842	81	.807	2
2	Generating Class	3 ^b	SEX*AGE, SEX*BLOODGROUP	93.101	162	1.000	
	Deleted Effect	1	SEX*AGE	25.987	27	.519	2
		2	SEX*BLOODGROUP	1.578	3	.664	2
3	Generating Class	^b	SEX*AGE, BLOODGROUP	94.680	165	1.000	
	Deleted Effect	1	SEX*AGE	25.987	27	.519	2
		2	BLOODGROUP	64.821	3	.000	2
4	Generating Class	s ^b	BLOODGROUP, SEX, AGE	120.666	192	1.000	
	Deleted Effect	1	BLOODGROUP	64.821	3	.000	2
		2	SEX	2.282	1	.131	2
		3	AGE	70.631	27	.000	2
5	Generating Class	^b	BLOODGROUP, AGE	122.948	193	1.000	
	Deleted Effect	1	BLOODGROUP	64.821	3	.000	2
		2	AGE	70.631	27	.000	2
6	Generating Class	s ^b	BLOODGROUP, AGE	122.948	193	1.000	

a. At each step, the effect with the largest significance level for the Likelihood Ratio Change is deleted, provided the significance level is larger than .050.

b. Statistics are displayed for the best model at each step after step $0. \label{eq:best}$

c. For 'Deleted Effect', this is the change in the Chi-Square after the effect is deleted from the model.

Convergence Information^a

	0
Generating Class	BLOODGROUP, AGE
Number of Iterations	0
Max. Difference between Observed and Fitted Marginals	.000
Convergence Criterion	.250

a. Statistics for the final model after Backward Elimination.

Discussion:

The standardized residual show the presence of few outlier cells. The peason chi- Square test confirms that the following variables are indeed related (associated).

Age and Sex, Age and Blood Group and Sex and Blood Group.

The model showed that an interaction between age and blood group is significant, meaning one age dominates a particular blood group. Though this could be due to population from which the sample was taken. The age is dominated by working population.

There is also a relationship between blood group and sex, and finally the age and sex is significant too.

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	MEDICA	AL DATA	
S/N	SEX	AGE	BLOOD GROUP
1.	М	24	0+
2.	М	27	A^+
3.	F	26	A^+

APPENDIX

4	M	20	A +
4.	M	30	A ⁺ 0 ⁺
5.	F	33	
6.	F	35	0+
7.	F	26	
8.	M	30	0+
9.	M	28	0+
10.	М	35	0+
11.	F	28	0+
12.	М	36	B ⁺
13.	М	45	0
14.	F	23	0+
15.	F	30	A ⁺
16.	F	20	0^+
17.	F	19	A^+
18.	F	19	A^+
19.	F	23	A^+
20.	М	30	A^+
21.	М	28	A^+
22.	F	20	0^+
23.	М	35	0+
24.	М	32	0+
25.	М	46	0+
26.	М	32	\mathbf{B}^+
27.	М	21	0+
28.	M	33	0+
29.	F	28	B ⁺
30.	M	36	0+
31.	M	34	0+
32.	F	26	A ⁺
33.	F	27	A ⁺
34.	M	22	B ⁺
35.	F	40	B ⁺
36.	F	37	0 ⁺
30.	 М	25	0
38.	F	32	
			A ⁺ 0 ⁺
<u>39.</u>	F	28	
40.	F	28	B ⁺
41.	F	29	0+
42.	F	41	0+
43.	F	43	0+
44.	М	33	A^+
45.	F	29	\mathbf{A}^+
46.	F	39	0+
47.	F	31	0+
48.	F	24	0^+
49.	М	30	A^+
50.	М	32	A^+
51.	М	28	0^+
52.	М	33	0+
53.	М	31	A^+
54.	М	30	0+
55.	M	27	AB^+
56.	F	30	0 ⁺
57.	M	38	0+
58.	M	27	0+
<u>50.</u>	M	45	A ⁺
<u> </u>	M	43	0+
	141	5	0

61.	F	30	0+	
62.	F	34	B^+	
63.	F	27	AB^+	
64.	М	33	0^+	
65.	М	30	0+	
66.	F	31	0+	
67.	F	34	0^+ A^+ 0^+	
68.	М	28	0+	
69.	F	30	B ⁺	
70.	М	33	0^+	
71.	F	33	A^+	
72.	М	43	A^+	
73.	М	48	$\begin{array}{c} \mathbf{A}^+ \\ \mathbf{A}^+ \\ 0^+ \end{array}$	
74.	М	23	0^+	
75.	М	34	A ⁺ 0 ⁺	
76.	М	26	0^+	
77.	F	24	0^+	
78.	М	27	B^+	
79.	F	36	$\frac{\mathbf{B}^+}{0^+}$	
80.	М	31	0+	
81.	М	27	0+	
82.	М	30	0+	
83.	М	29	$\begin{array}{c} 0^+ \\ B^+ \end{array}$	
84.	М	26	A ⁺ 0 ⁺	
85.	М	31	0+	
86.	М	29	A ⁺ 0 ⁺	
87.	М	32	0+	
88.	М	31	0^+	
89.	F	26	0+	
90.	М	29	\mathbf{B}^+	
91.	F	32	\mathbf{A}^+	
92.	М	34	0+	
93.	М	29	A^+	
94.	F	29	A^+	
95.	М	28	$\begin{array}{c} \mathbf{A}^{+} \\ \mathbf{A}^{+} \\ \mathbf{B}^{+} \end{array}$	
96.	М	26	\mathbf{B}^+	
97.	F	23	$\begin{array}{c} A^+ \\ 0^+ \end{array}$	
98.	М	39	0+	
99.	М	32	0+	
100.	F	26	B ⁺	