Chapter 17 - Log-Linear Analysis

17.1 Possible models for data on idiomatic communication.

$\ln(F_{ij}) = \lambda$	Equiprobability
$\ln(F_{ij}) = \lambda + \lambda^F$	Conditional equiprobability on Function
$\ln(F_{ij}) = \lambda + \lambda^I$	Conditional equiprobability on Inventor
$\ln(F_{ij}) = \lambda + \lambda^F + \lambda^I$	Independence
$\ln(F_{ij}) = \lambda + \lambda^F + \lambda^I + \lambda^{FI}$	Saturated model

17.3 Lambda values for the complete (saturated) model.

a. $\lambda = 2.8761 = \text{mean of } \ln(\text{cell}_{ij})$

b. $\lambda^{\text{Inventor}} = .199 \;\; .540 \;\; -.739$

The effect for "female partner" is .199, indicating that the ln(frequencies in row 1) are slightly above average.

c. $\lambda^{\text{Function}} = -.632 \;\; .260 \;\; .222 \;\; -.007 \;\; .097 \;\; -.667 \;\; .303 \;\; -.029 \;\; .452$

The effect of Confrontation is -.632. Confrontation contributes somewhat less than its share of idiosyncratic expressions.

d.
$$\lambda^{\text{Inventor * Function}} = \begin{matrix} .196 & -.039 & \ldots & .249 & .028 \\ -.481 & .038 & \ldots & .250 & .259 \\ .286 & .001 & \ldots & -.500 & -.287 \end{matrix}$$

The unique effect of cell_{11} is .196. It contributes slightly more than would be predicted from the row and column totals above.

17.5 For females the odds in favor of a direct hit are 6.00, whereas for males they are only 2.8125. This leaves an odds ratio of 6.00/2.8125 = 2.1333. A female's odds of a direct hit are 2.1333 times those of a male.

17.7 Letting S represent Satisfaction, G represent Gender, and V represent Validity, and with 0.50 added to all cells because of small frequencies, the optimal model is

$$\ln(Fij) = \lambda + \lambda^G + \lambda^S + \lambda^V + \lambda^{SV}$$

For this model $\chi 2 = 4.53$ on 5 *df*; $p = .4763$

An appropriate model for these data must take into account differences due to Satisfaction, Gender, and Validity. It must also take into account differences associated with a Satisfaction × Validity interaction. However, there are not relationships involving any of the other interactions.

17.9 Compare statistics from alternative designs:

Examine the pattern of changes in the alternative designs. Although the marginal frequencies stay constant from design to design, the chi-square tests on those effects, the values of λ, and the tests on λ change as variables are added. This differs from what we see in the analysis of variance, where sums of squares remain unchanged as we look at additional independent variables (all other things equal).

17.11 Odds of being classed as adult delinquent.

Odds delinquent:

Normal Testosterone, Low SES	=	190/1104 = .1721
High Testosterone, Low SES	=	62/140 = .4429
Normal Testosterone, High SES	=	53/1114 = .0476
High Testosterone, High SES	=	3/70 = .0429

17.13 Optimal model for Dabbs and Morris (1990) Testosterone data.

The following is an SPSS program and the resulting output. The optimal model that results is one including all main effects and first order interactions, but not the three-way interactions. The value of $\chi 2$ for this model is 3.52 on 1 *df*, for p = .0607. If any main effect or interaction were dropped from the model, the $\chi 2$ would be significant.

(*Note:* To reproduce the following results using SPSS, choose **Loglinear/Model Selection**.)

```
* * * * * * * *  H I E R A R C H I C A L   L O G   L I N E A R  * * * * * * * *

Tests that K-way and higher order effects are zero.

         K     DF   L.R. Chisq    Prob  Pearson Chisq    Prob   Iteration

         3      1        3.518   .0607          2.986   .0840           3
         2      4      185.825   .0000        218.034   .0000           2
         1      7     4085.232   .0000       4653.105   .0000           0

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```

```
Tests that K-way effects are zero.

        K     DF   L.R. Chisq    Prob  Pearson Chisq    Prob   Iteration

        1      3     3899.407   .0000       4435.071   .0000           0
        2      3      182.306   .0000        215.048   .0000           0
        3      1        3.518   .0607          2.986   .0840           0

 Note: For saturated models   .500 has been added to all observed cells.
 This value may be changed by using the CRITERIA = DELTA subcommand.

* * * * * * * *  H I E R A R C H I C A L   L O G   L I N E A R * * * * * * * *

Backward Elimination (p = .050) for DESIGN 1 with generating class

  Delinque*SES*Testoste
 Likelihood ratio chi square =      .00000    DF = 0  P =  .

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If Deleted Simple Effect is                 DF   L.R. Chisq Change    Prob  Iter

 Delinque*SES*Testoste                       1               3.518   .0607     3

Step 1

  The best model has generating class

      Delinque*SES
      Delinque*Testoste
      SES*Testoste
  Likelihood ratio chi square =     3.51837    DF = 1  P =  .061

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If Deleted Simple Effect is                 DF   L.R. Chisq Change    Prob  Iter
 Delinque*SES                                1              98.559   .0000     2
 Delinque*Testoste                           1              24.380   .0000     2
 SES*Testoste                                1              31.678   .0000     2

  The best model has generating class
      Delinque*SES
      Delinque*Testoste
      SES*Testoste
  Likelihood ratio chi square =     3.51837    DF = 1  P =  .061
```

17.15 The complete solution for Pugh's (1984) data would take pages to present. Pugh selected the model that includes Fault*Verdict and Gender*Moral*Verdict. This is the same model that SPSS HILOGLINEAR selected. This model has a χ^2 = 8.42on 10 df, with an associated probability of .599. Adding Gender moved us from a model with Fault*Verdict and Moral*Verdict to one with a Fault*Verdict and the three-way interaction of Gender, Moral, and Verdict.

```
* * * * * * * *  H I E R A R C H I C A L   L O G   L I N E A R  * * * * * * * *

DESIGN 1 has generating class

    Gender*Moral*Fault*Verdict
Backward Elimination (p = .050) for DESIGN 1 with generating class

  Gender*Moral*Fault*Verdict
 Likelihood ratio chi square =      .00000    DF = 0  P =  .

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If Deleted Simple Effect is                 DF   L.R. Chisq Change    Prob  Iter
 Gender*Moral*Fault*Verdict                 2               4.554   .1026     4

Step 1
  The best model has generating class
      Gender*Moral*Fault
      Gender*Moral*Verdict
      Gender*Fault*Verdict
      Moral*Fault*Verdict
  Likelihood ratio chi square =     4.55447    DF = 2  P =  .103

                    SOME OUTPUT HAS BEEN OMITTED

Step 5
  The best model has generating class
      Gender*Moral*Verdict
      Moral*Fault
      Fault*Verdict
  Likelihood ratio chi square =     5.86071    DF = 8  P =  .663
- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
If Deleted Simple Effect is                 DF   L.R. Chisq Change    Prob  Iter
 Gender*Moral*Verdict                       2              12.372   .0021     4
 Moral*Fault                                2               2.556   .2785     2
 Fault*Verdict                               1              36.990   .0000     2

Step 6
  The best model has generating class
      Gender*Moral*Verdict
      Fault*Verdict
  Likelihood ratio chi square =     8.41706    DF = 10  P =  .588

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If Deleted Simple Effect is                 DF   L.R. Chisq Change    Prob  Iter
 Gender*Moral*Verdict                       2              12.372   .0021     3
 Fault*Verdict                               1              37.351   .0000     2

Step 7
  The best model has generating class
      Gender*Moral*Verdict
      Fault*Verdict
  Likelihood ratio chi square =     8.41706    DF = 10  P =  .588
```