# Psych 6136: Loglinear models tutorial

## Survival on the *Titanic*

This exercise examines the fitting of various loglinear models to data about survival on the *Titanic*, a 4-way table giving the cross-classification of 2201 passengers and crew, according to:

* Gender (G): M vs. F
* Age (A): Adult vs. Child
* Class (C): 1st, 2nd, 3rd, Crew
* Survival (S): Died vs. Survived

The data is obtained using data(Titanic). The R code for this exercise is contained in the file [titanic-loglin.R](../R/titanic-loglin.R) on the course web page if you get stuck. Some of this is shown inline below. You should experiment with other analyses, commands and plots.

1. Print a nice flattened version of the table, showing some variables along the rows and some across the columns. [Hint: see ?ftable and ?vcd::structable.]
2. One slight complication here is that there are 8 cells with zero frequencies. Four of these (male and female children in 1st and 2nd class who died) should be considered sampling zeros, but 4 (children among the crew) should probably be considered structural zeros (cells where data could not occur. In these analyses, you can treat these all as sampling zeros by adding a small number to each cell.

library(MASS) # for loglm()

library(vcd) # for mosaic, aka plot.loglm()

data(Titanic)

Titanic <- Titanic + 0.5 # adjust for 0 cells

1. As a baseline, for comparison with other models, fit the model of **mutual independence** among all four table variables.

titanic.mod0 <- loglm(~ Class + Age + Sex + Survived, data=Titanic)

1. It is natural to consider Survival as the natural **response** variable, and the remaining variables as explanatory. Therefore, all models should include the high-order term among age, gender and class. Therefore, the **minimal null model** is [AGC][S], which asserts that survival is jointly independent of Age, Sex and Class. Fit this model, and obtain a mosaic plot. Interpret the pattern of the residuals in this mosaic plot.

titanic.mod1 <- loglm(~ (Class \* Age \* Sex) + Survived, data=Titanic)

titanic.mod1

plot(titanic.mod1, main="Model [AGC][S]")

1. Fit a **main effects** model for survival, [AGC][AS][GS][CS], that includes an association of survival with each of age, gender and class. Is this an adequate fit? What does the pattern of residuals tell you about remaining associations?

titanic.mod2 <- loglm(~ (Class \* Age \* Sex) + Survived\*(Class + Age + Sex),

data=Titanic)

titanic.mod2

plot(titanic.mod2, main="Model [AGC][AS][GS][CS]")

Note that, rather than specifying a new model completely, you can use update() to add terms to an existing model. In the formula for update(), “.” stands for “what was there before.” The model titanic.mod2 could be obtained more simply as

titanic.mod2 <- update(titanic.mod1, . ~ . + Survived\*(Class+Age+Sex))

1. What model would you use to allow an **interaction** of Age and Gender in their effect on Survival? Fit this model as above, and obtain the mosaic plot. [Hint: update by adding Survived\*Age\*Sex, to obtain the model titanic.mod3.]
2. Compare the models using anova()

anova(titanic.mod0, titanic.mod1, titanic.mod2, titanic.mod3, test="chisq")

Give a brief summary of these models.