# 1 Likelihood Ratio Test

- The likelihood ratio test is a test of the difference between -2LL for the full model with predictors and ?2LL for initial chi-square in the null model.
- When probability fails to reach the 5% significance level, we retain the null hypothesis that knowing the independent variables (predictors) has no increased effects (i.e. make no difference) in predicting the dependent.

# 2 Likelihood ratio test

- The likelihood-ratio test test discussed above to assess model fit is also the recommended procedure to assess the contribution of individual "predictors" to a given model.
- In the case of a single predictor model, one simply compares the deviance of the predictor model with that of the null model on a chi-square distribution with a single degree of freedom. If the predictor model has a significantly smaller deviance (c.f chi-square using the difference in degrees of freedom of the two models), then one can conclude that there is a significant association between the "predictor" and the outcome.
- Although some common statistical packages (e.g. SPSS) do provide likelihood ratio test statistics, without this computationally intensive test it would be more difficult to assess the contribution of individual predictors in the multiple logistic regression case.
- To assess the contribution of individual predictors one can enter the predictors hierarchically, comparing each new model with the previous to determine the contribution of each predictor.
- There is considerable debate among statisticians regarding the appropriateness of so-called "stepwise" procedures. They do not preserve the nominal statistical properties and can be very misleading.

# 3 The Likelihood Ratio Test

The likelihood ratio test to test this hypothesis is based on the likelihood function. We can formally test to see whether inclusion of an explanatory variable in a model tells us more about the outcome variable than a model that does not include that variable. Suppose we have to evaluate two models.

Model 1: $\text{logit}(\pi) = \beta_0 + \beta_1 X_1$

Model 2: $\text{logit}(\pi) = \beta_0 + \beta_1 X_1 + \beta_2 X_2$

Figure 1: Variables

Here, Model 1 is said to be nested within Model 2  all the explanatory variables in Model 1 (X1) are included in Model 2. We are interested in whether the additional explanatory variable in Model 2 ($X_2$) is required, i.e. does the simpler model (Model 1) fit the data just as well as the fuller model (Model 2). In other words, we test the null hypothesis that $\beta_2 = 0$ against the alternative hypothesis that $\beta_2 \neq 0$.