1. Using GLIM for individual binary data with a logistic link function, discuss the distribution of the deviance statistic.

2. Suppose $P_i$ are continuous random variables independently distributed on $(0, 1)$ with $E(P_i) = \pi_i$ and $\text{Var}(P_i) = \phi \pi_i (1 - \pi_i)$. Assume that the random variable $Y_i | P_i = p_i$ has a $\text{Bin}(m_i, p_i)$ distribution. Show that $E(Y_i) = m_i \pi_i$ and $\text{Var}(Y_i) = \nu_i w_i^{-1}$ where $\nu_i = m_i \pi_i (1 - \pi_i)$, and $w_i^{-1} = 1 + \phi (m_i - 1)$.

3. Derive the details of the method of maximum likelihood estimation for the loglinear model for count data under the assumption of the following distributions: (a) Poisson, and (b) negative binomial.

**Ungraded extra learning activity that need not be turned in:**

1*. Review the use of PROC Genmod in SAS for the following regression models: (a) binary, (b) grouped binary, (c) binomial, (d) Poisson, and (e) negative binomial.