1. A glm with a canonical link and $\phi_i = \phi$ has sufficient statistic $S = X^T y$ (using the notation from class). Assume that $T$ is a goodness of fit statistic, such as the deviance or Pearson statistic. Assume $t_0$ is the observed value for $T$. If the slope parameters, $\beta$, are known, then a P-value for model fit is given by $P(T \geq t_0; \beta)$. Explain why $P(T \geq t_0 | S)$ is the uniform minimum variance unbiased estimator of $P$.

2. Suppose that $y_i$ is Poisson with $g(\mu_i) = \alpha + \beta x_i$ where $g$ is the link function and $x_i = 1$ for $i = 1, \ldots, n_a$ and $x_i = 0$ for $i = n_a + 1, \ldots, n_a + n_b$. That is, $x_i$, is a treatment indicator for two groups, A and B. Show that, regardless of the link function, the fitted means equal the two sample means.

3. Consider the class of binary glms where the link function satisfies $g\{\mu(x)\} = \Phi^{-1}\{\mu(x)\} = \alpha + \beta x$ where $\Phi(\cdot)$ is a distribution function and $\mu(x)$ is the Bernoulli mean. Let $\phi$ be the (assumed continuous) associated density. Show that the $x$ at which $\mu(x) = .5$ is $x = -\alpha/\beta$. Further show that the rate of change of $\mu(x)$ at this point is $\beta \phi(0)$. Illustrate that this is $.25 \beta$ for the logit link and $\beta/\sqrt{2\pi}$ for the probit link.


5. Give the title and a list of key references for your second year oral exam paper.