GGT Methods

Methods and Equations

The model presented below comes from the GGT application in which the authors estimate hospital quality measures. The authors assume that quality depends on patient mortality, a standard assumption for hospital quality calculations. However, GGT make the important note that patients may "select" into which hospital to attend, which would bias the hospital quality measures if not accurately controlled for. Thus, GGT define a model to allow for unobserved patient characteristics which are correlated with hospital choice and patient mortality.

We include a brief explanation of the model here to show which variables and parameters are referenced in the calling of the GGT Stata function.

The binary individual outcome equation: $m_i{*} = c_i{'}\beta + x_i{'}\gamma + \varepsilon_i$ (equation (1) in GGT)

Here, m_i* is the latent outcome variable for the observed binary variable m_i. This is patient mortality in the GGT application. The outcome variable depends on individual characteristics, x_i, and which organization the individual chooses, c_i (hospital choice in GGT).

The organization choice model is: $c_i{*} = Z_i\alpha + \eta_i$ (equation (3) in GGT)

Here, c_i* is the latent choice vector for the observed choice vector c_i where c_{ij}=1 if patient i chose organization j and 0 for all other vector entries. The individual choice is allowed to depend on individual-organization characteristic matrix, Z_i, such as distance to hospital in GGT.

Selection is modeled as follows: $\varepsilon_i = \eta_i{'}\delta + \xi_i$ (equation (5) in GGT)

Here, GGT allow the error term in the organization choice equation to be correlated with the error term in the binary outcome equation with the parameter, δ.

The GGT Stata function estimates the latent observations and parameters (m_i* c_i*, α, β, γ, δ) through MCMC methods. The first 10,000 draws are eliminated as burn in. Then, using the remaining draws, the mean and variance of the organization quality measures (β-adjusted by the selection correction) are calculated and displayed as output on the Stata screen.

Because the process uses Bayesian inference, the estimation of the model depends not only on the necessary model variables, but also the prior distributions for each parameter. See section 2.2. of GGT for more information on prior distributions.

- Following GGT, the estimation method assumes independent prior distributions for α, γ, and δ. For these parameters, we assume mean 0 for each prior and allow user options for prior variances.

- For the parameter, β, we again follow GGT and use hyperpriors to allow correlation between organizations based on organization characteristics. β can be written as the sum of organization dummies and organization category dummies. For example, in GGT, there are four hospital ownership categories, k={1,2,3,4}, four hospital size categories, l={1,2,3,4}, and 144 unique hospitals, j. Thus, $\beta_j=p_k+s_l+u_j$ where p_k=1 if hospital j is in ownership category k, s_l=1 if hospital j is in size category l, and u_j=1 for hospital j. We assume p,s,u are jointly Normal with mean,0, and mutually independent, but allow dependence within each organization characteristic through definition of hyper-prior distributions. Specifically, assume p,s,and u have variance τ_p^2, τ_s^2, and τ_u^2 respectively, with a hyper-prior distribution defined as $\underline{s}^2 / \tau_{p,s,u}^2 \sim \chi^2(\underline{v})$, allowing user options for $\underline{s}^2$ and $\underline{v}$.

Technical Notes: Users may notice some slight differences in the above description of prior distributions from that in GGT Section 2.2. These do not change the model but do make the Stata code more tractable. We describe these changes below.

- We remove the constant term, β_1, from the linear equation defining β_j. Instead, we combine this constant term with constant term in γ. Thus, users should not specify a different prior variance for β_1 and should keep in mind that this term will be included γ.
- Within each parameter, we request users to specify a single value for prior variances. For example, suppose γ is the coefficient for two variables, illness severity and age. This Stata code allows users to specify σ_γ^2 in the prior distribution: $\begin{pmatrix} \gamma_1 \\ \gamma_2 \end{pmatrix} \sim N\left[\begin{pmatrix} 0 \\ 0 \end{pmatrix}, \begin{pmatrix} \sigma_\gamma^2 & 0 \\ 0 & \sigma_\gamma^2 \end{pmatrix}\right]$. Since we do not allow σ_γ^2 to differ by elements γ, users should modify/rescale variables if desired to fit into this framework.
- We do not allow non-zero elements in the off-diagonal prior variance specifications.