EC226 Econometrics 1: Formula Sheet

Two Variable Regression Model: $Y_i = \alpha + \beta X_i + \epsilon_i$

Least Squares estimates: $b = \frac{\sum_i (X_i - \bar{X})(Y_i - \bar{Y})}{\sum_i (X_i - \bar{X})^2}$ $a = \bar{Y} - b\bar{X}$

Estimation of the error variance: $s_e^2 = \frac{RSS}{n-2} = \frac{\sum_i (Y_i - \bar{Y})^2 - b^2 \sum_i (X_i - \bar{X})^2}{n-2}$

Test on the regression slope coefficient: $H_0 : \beta = \beta_0$, $t = \frac{(b - \beta_0)}{s_b}$, where $s_b^2 = \frac{s_e^2}{\sum_i (X_i - \bar{X})^2}$

Standard error of prediction of Y_{n+1} given X_{n+1}: $se(Y_{n+1}) = s_e \sqrt{1 + \frac{1}{n} + \frac{(X_{n+1} - \bar{X})^2}{\sum_i (X_i - \bar{X})^2}}$

Multiple Regression Model: $Y_i = \alpha + \beta_1 X_{1i} + \beta_2 X_{2i} + ... + \beta_k X_{ki} + \epsilon_i$

Estimation of the error variance: $s_e^2 = \frac{RSS}{n-k-1} = \frac{\sum_i e_i^2}{n-k-1}$

R-squared: $R^2 = 1 - \frac{RSS}{TSS}$; R-bar-squared: $\bar{R}^2 = 1 - \frac{RSS/(n-k-1)}{TSS/(n-1)}$

Test on regression coefficients:

(i) Single coefficient is equal to some hypothesised value:

$H_0 : \beta_i = \beta_{i0}$, $t = \frac{(b_i - \beta_{i0})}{s_{b_i}} \sim t_{n-k-1}$

(ii) All slope coefficients are equal to zero:

$H_0 : \beta_1 = \beta_2 ... = \beta_k = 0$, $F = \frac{R^2}{1-R^2} . \frac{n-k-1}{k} \sim F_{k,n-k-1}$

(iii) A subset of coefficients are equal to zero:

$H_0 : \beta_1 = \beta_2 ... = \beta_j = 0$, $F = \frac{(RSS^R - RSS^U)}{RSS^u} . \frac{n-k-1}{j} \sim F_{j,n-k-1}$

(iv) The coefficients from some sub-set of observations are equal to those of some other sub-set of observations:

$H_0 : \alpha^1 = \alpha^2, \beta_1^1 = \beta_2^2 ... = \beta_k^1 = \beta_k^2$, $F = \frac{[RSS^R - (RSS^1 + RSS^2)]/(k+1)}{(RSS^1 + RSS^2)/[n-2(k+1)]} \sim F_{k+1,n-2(k+1)}$

Durbin-Watson Test statistic: $d = \frac{\sum_{t=2}^{n}(\hat{u_t} - \hat{u}_{t-1})^2}{\sum_{t=1}^{n}\hat{u}_t^2}$

Durbin's h-statistic: $h = \phi\sqrt{\frac{n}{1-ns_c^2}}$, where s_c^2 = Estimated variance of coefficient on lagged dependent variable and ϕ = Estimated 1st autocorrelation term.

Unit Root Tests:

ADF: $H_0 : \gamma = 0$, $H_1 : \gamma < 0$

Model A: $\Delta y_t = \gamma y_{t-1} + \sum_{j=1}^{q} \Delta y_{t-j} + \epsilon_t$

Model B: $\Delta y_t = \mu + \gamma y_{t-1} + \sum_{j=1}^{q} \Delta y_{t-j} + \epsilon_t$

Model C: $\Delta y_t = \mu + \alpha t + \gamma y_{t-1} + \sum_{j=1}^{q} \Delta y_{t-j} + \epsilon_t$

Test statistic: $\frac{\hat{\gamma}}{se(\hat{\gamma})}$ ∼MacKinnon critical values

Error Correction Model (ECM): $\Delta y_t = \alpha + \gamma_1 \Delta x_{t-1} + \alpha_1 \Delta y_{t-1} + \delta s_{t-1} + u_t$ where $s_t = y_t - (a + bx_t)$

Limited Dependent Variable Model:

Linear Probability Model: $Pr[Y_i = 1] = X_i'\beta$

Logit Model: $Pr[Y_i = 1] = F(X_i'\beta) = \frac{exp(X_i'\beta)}{1+exp(X_i'\beta)} = \Lambda(X_i'\beta)$

Probit Model: $Pr[Y_i = 1] = F(X_i'\beta) = \int_{-\infty}^{X_i'\beta} (2\pi)^{-\frac{1}{2}} exp(-z^2/2)dz = \Phi(X_i'\beta)$

Interpreting Coefficients: $\frac{\partial E(Y_i)}{\partial X_{ji}} = \frac{\partial F(X_i'\beta)}{\partial(X_i'\beta)}.\beta_j$

where $\frac{\partial F(X_i'\beta)}{\partial(X_i'\beta)} = f(X_i'\beta)$ and $f(X_i'\beta)$ is the pdf.

pdf for logit model: $f(X_i'\beta) = \lambda(X_i'\beta) = \Lambda(X_i'\beta)[1 - \Lambda(X_i'\beta)]$

pdf for probit model: $f(X_i'\beta) = \phi(X_i'\beta) = (2\pi)^{-\frac{1}{2}} exp(-z^2/2)$