Econ 7010 Final Exam Formula Sheet

Standard regression model	$y = X\boldsymbol{\beta} + \boldsymbol{\epsilon}$
OLS estimator	$\boldsymbol{b} = (X'X)^{-1} X'\boldsymbol{y}$
Residual vector	$\boldsymbol{e} = (\boldsymbol{y} - \hat{\boldsymbol{y}}) = \boldsymbol{y} - X\boldsymbol{b}$
Estimator of error variance	$s^2 = (e'e) / (n-k)$
Covariance matrix for random vector, $\boldsymbol{x}$	$V(\boldsymbol{x}) = E\left[(\boldsymbol{x} - E(\boldsymbol{x}))(\boldsymbol{x} - E(\boldsymbol{x}))'\right]$
Covariance matrix for errors	$V(\boldsymbol{\epsilon}) = \sigma^2 I_n$
"Residual maker" matrix	$M_X = I_n - X(X'X)^{-1} X'$
Deviations-from-means matrix	$M_i = I - \frac{1}{n}\boldsymbol{i}\boldsymbol{i}'$
Projection matrix	$P_X = X(X'X)^{-1} X'$
R-squared	$R^2 = \frac{\widehat{\boldsymbol{y}}' M_i \widehat{\boldsymbol{y}}}{\boldsymbol{y}' M_i \boldsymbol{y}} = 1 - \frac{\boldsymbol{e}'\boldsymbol{e}}{\boldsymbol{y}' M_i \boldsymbol{y}}$
t-statistic	$t_i = (b_i - \beta_i) / (\text{ s.e. } (b_i)) \sim t_{n-k}$
Confidence interval	$[b_i - t_c \text{ s.e. } (b_i) \quad , \quad b_i + t_c \text{ s.e. } (b_i)]$
Wald test statistic	$W = (R\boldsymbol{b} - \boldsymbol{q})' \left[R(X'X)^{-1} R'\right]^{-1} (R\boldsymbol{b} - \boldsymbol{q})/s^2$
F-statistic	$F = \left\{(R\boldsymbol{b} - \boldsymbol{q})' \left[R(X'X)^{-1} R'\right]^{-1} (R\boldsymbol{b} - \boldsymbol{q})/J\right\} / s^2$
	$= [(\boldsymbol{e}^{*\prime}\boldsymbol{e}^* - \boldsymbol{e}'\boldsymbol{e}) / J] / [(\boldsymbol{e}'\boldsymbol{e}) / (n-k)]$
	$= \left[\left(R^2 - R_*^2\right) / J\right] / \left[\left(1 - R^2\right) / (n-k)\right]$
Restricted Least Squares estimator	$\boldsymbol{b}_* = \boldsymbol{b} - (X'X)^{-1} R' \left[R(X'X)^{-1} R'\right]^{-1} (R\boldsymbol{b} - \boldsymbol{q})$
IV estimator (just-identified)	$\hat{\beta}_{IV} = (Z'X)^{-1} Z'\boldsymbol{y}$
IV estimator (over-identified)	$\hat{\beta}_{IV} = \left[X'Z(Z'Z)^{-1} Z'X\right]^{-1} X'Z(Z'Z)^{-1} Z'\boldsymbol{y}$
Hausman test statistic	$H = (\boldsymbol{b}_{IV} - \boldsymbol{b})' \left[\hat{V}(\boldsymbol{b}_{IV}) - \hat{V}(\boldsymbol{b})\right]^{-1} (\boldsymbol{b}_{IV} - \boldsymbol{b})$
Generalized least squares estimator	$\widehat{\boldsymbol{\beta}}_{\text{GLS}} = \left[X'\Sigma^{-1}X\right]^{-1} X'\Sigma^{-1}\boldsymbol{y} = \left[X'\Omega^{-1}X\right]^{-1} X'\Omega^{-1}\boldsymbol{y}$
Autoregressive (1) process	$\epsilon_t = \rho\epsilon_{t-1} + u_t \quad ; \quad u_t \sim \text{ i.i.d. } N\left[0, \sigma_u^2\right] \quad ; \quad \lvert\rho\rvert < 1$
Moving average (1) process	$\epsilon_t = u_t + \phi u_{t-1} \quad ; \quad u_t \sim \text{ i.i.d. N } \left[0, \sigma_u^2\right]$