1 Intro & CLR

nonexperimental
cross section data, time series data, panel/longitudinal data
dependent variable/regressand, independed variables/regressors/explanatory variables
random sampling
CLR 1.1 - Linearity: error term
CLR 1.2 - Strict Exogeneity: orthogonal
CLR 1.3 - Spherical Errors: conditional homoskedasticity
CLR 1.4 - Full Rank: no perfect collinearity
Nonlinearities: interaction terms, semilog model, loglinear model, translog model
Non-constancy of parameters: indicator/dummy variables, interaction terms
Fixed Regressors (non-experimental)

2 OLS Basics

OLS estimator of β
Fitted value, residual, projection matrix P, annihilator matrix M
Residuals orthogonal to data: $X'\hat{\varepsilon} = 0$
Simple (2 var) CLR: formulas for slope and intercept, R, and r
Goodness of fit, centered/uncentered R squared, coefficient of determination, multiple correlation coefficient, adjusted R^2, R bar squared SSR (Sum of Squared Residuals), TSS/SST (Total sum of squares, or total variation of the dependent variable), SSE (explained sum of squares)
perfect fit, no fit
partitioned form CLR, residual regression, double residual regression, Frisch-Waugh-Lovell theorem
demeaning, detrending, deseasonalizing

3 OLS Estimator Properties

$\hat{\beta}$ is: random variable, linear in Y, unbiased for β conditional on X (and also unconditionall), BLUE (Gauss-Markov Thm)
$\hat{\sigma^2}$ is: unbiased conditionally and unconditionally
Prediction error, Mean Square Error (MSE), Conditional Expectation Function (CEF)/Population Regression Function (PRF), Sample error

4 CNLR

CNLR 1.5 - Joint Normality: independence between errors and regressors
Standardized p-variate RV: Z
Spectral/Eigenvalue decomposition, Jordan decomposition
Interval Estimation, coverage probability, confidence level, confidence intervals, critical value
Confidence intervals/regions for $\Gamma\beta$ at $(1-\alpha)100\%$ confidence level for: Γ is $1 \times K$ or $N \times K$, and σ^2 known or unknown
Testing linear hypotheses: null, alternative, critical region, Type I/II Error, significance level, power function, test statistics: formulas for Z, t, W, F
Other formulas for F: SSR_u and SSR_r, restricted OLS, R^2_U and R^2_R, test of significance of the regression
Power functions of tests, non-central t and F, inapplicability of W_0 and F_0 to one-sided tests
Chow Test (aka Test of Structural Change)

5 Implications of Normality in CNLR

MLE's of β and σ^2
Fisher Information Matrix, Cramer-Rao lower bound (aka Information Inequality), $\hat{\beta_{OLS}}, \hat{\sigma^2_{OLS}}$ are BUE in CNLR
Asymptotic normality and efficiency of $\hat{\beta}_M L$ and $\hat{\sigma^2}_M L$.
Asymptotic Tests of Nonlinear Hypotheses under CNLR: Wald, LR, Lagrange Multiplier (Score) Tests (akak Trinity); Trinity for linear hypotheses; critical region sizes $W \geq LR \geq LM$

6 Relaxing CLR/CNLR Assumptions

Perfect collinearity, multicollinearity, condition number
Misspecification of Regression: short model, long model
Non-spherical errors, GLR, GLS, Aitken's Thm
Joint normality, generalized t and F (aka robust), WLS

7 Asymptotic OLS, WLS/FWLS

Weakly consistency, asymptotic normality of OLS, approximate inference
Asymptotic distribution of OLS under conditional homoskedasticity
Heteroskedasticity-robust/White/Eicker-White covariance matrix estimator
Testing linear and non-linear restrictions, testing conditional homoskedasticity
WLS, FWLS with Conditional heteroskedasticity
Best linear prediction/projection (BLP) conditional on X
Convergence: in distribution, almost sure, in probability, in n^{th} moment
Limit Theorems: Mann-Wald/Continuity, Slutsky, Delta-Method, Cramer-Wold Device
LLNs: for iid data, for inid data, for did data, for dnid data, for asymptotically uncorrellated data, for covariance stationary sequences, for martingale difference sequences
CLTs: for iid, for inid, for did, for dnid, for Cov. stationary, for Martingale difference

8 Extremum Estimators

sample objective function, parameter space, NLS, ML, GMM, CMD
consistency, uniform convergence in probability, identification condition, compact parameter spaces
ULLN, asmptotitic normality of $M-$ estimators for iid data
Nonlinear Regression Model (NRM): Assumptions 1-12, NLS, WNLS
log-likelihood, MLE, Kullback Leibler Information Criterion, Consistency of MLE with and without compactness of parameter space
likelihood equations, asymptotic normality and efficiency of consistent roots (aka local MLEs)
MLE difficulties: non-unique likelihood functions, nonexistence of roots, multiple solutions; sufficient conditions for uniqueness; invariance under reparameterization
Asymptotic equivalency of trinity for MLEs; Trinity for generic extremum estimators; proof of asymptotic distributions (appendix)
Optimization Algorithms: Newton-Raphson, quadratic hill climbing, BHHH, method of scoring, quasi-Newton, DFP, Gauss Newton, downhill simplex, simulated anneality
Asymptotic equivalence of generic LM and LR

9 QR Models

QR/Discrete choice/quantal/categorical model; binary response/threshold crossing, multinomial response
Models: Linear Probability, Probit, Logit, Log-Weibull, Type-I Extreme Value Unobservable (latent) variable, indicator function, identifical, observationally equivalent
Random utility interpretation
Estimation via NLS and WNLS, ML, Properties of MLE, odds ratio (OR)
Ordered and unordered models, MNL, IIA, Nested Logit Model (NML), Gumbel's Type B bivariate extreme-valued distribution, MNP