

- Topic 17. Model mis-specification
 - Minimal set of Assumptions for Feasibility of Estimation (MAFE) versus DGP
 - Recall that we first considered the distinction between **MAFE and DGP** in Topic 9
 - Hence, please treat **Topic 9** as an introduction to Topic 17
 - The pages below detail further now the results available under mis-specification
 - (Please note that even though the table was necessarily split into multiple pages for practical reasons, it is in reality just a rather large **14 × 11 matrix!**)

Estimator	Notation	Under Complications	Extends to
1.	$\hat{\beta}_{OLS}$	<i>A2Nonlinear.additiveError</i>	$\rightarrow \hat{\beta}_{NLLS}$
2.	$\hat{\beta}_{LAD}$		
3.	$\hat{\beta}_{Lstar}$		
4.	$\hat{\beta}_{GMM}$	<i>A3EndogenousX/ExogenousW</i>	$\rightarrow \hat{\beta}_{IVE}$
5a.	$\hat{\beta}_{IGLS}$		
5b.	$\hat{\beta}_{FGLS}$		
6.	$\hat{\beta}_{MLE}$	<i>Multiple</i>	$\rightarrow \hat{\beta}_{FIMLE}$
7.	$\hat{\beta}_{IVE}$	<i>A2Nonlinear.AdditiveError</i>	$\rightarrow \hat{\beta}_{NLIVE}$

Topic 17: Model Misspecification — True DGP (11) and Minimal Feasibility Assumptions (14)

4.7 *Understanding and Detecting Model Misspecification: Minimal Feasibility Assumptions vs. True DGP*

Fundamental Concepts

4.8 Fourteen Minimal Feasibility Assumptions (A-N) vs. Eleven True DGP (I-XI):

MINIMAL SPECIFICATION (Estimator Defined/Calculable)	VS		TRUE DGP
$\longrightarrow$ TRUE DGP $\longrightarrow$	(I) A1+ A2linear+ A3Rmi	...	(XI) A1 : $\rho(W) = \rho(X) = k$ + A2 : $y = X_A \beta_A + X_B \beta_B + \epsilon$ + A3 : X_A exog., W exog + A4 (GM or Omega) $W = W(Z), \#Z \geq k$
ESTIMATOR ↓minimal Specification↓			
A : OLS			
B : LAD			
C : GMM linear ≡ OLS identically			
D : (a) IGLS.ar1 (b) FGLS.ar1			
⋮			
J : MLE.iid.Logistic			
K : MLE.iid.Laplace/DE ≡ LAD identically			
L : MLE.iid.Cauchy			
M : MLE.Ω.Gaussian (a) ≡ IGLS(Ω) identically (b) = FGLS(Ω̂)			
N : IVE A1 + A2linear : $y = X\beta + \epsilon$ + A3W : $W = W(Z)$ exog (validity) relevance etc.			

KEY QUESTIONS for each cell				
→ TRUE DGP → 	...	DGP (??)	...	
ESTIMATOR ↓minimal Specification↓				
⋮				
Estimator (??)		Unbiased? BLUE/BUE? ~ N(.,.)? Gaussian? ≈ N(.,.)? CUAN? Best CUAN? Coincides with another estimator?		
⋮				

$\dots \quad \dots \quad \dots \quad \dots \quad \dots \quad \dots$ $\xrightarrow{\text{TRUE DGP}} \xrightarrow{\text{DGP}}$	(I) A1+A2linear+ A3Rmi	(II) A1+A2linear+ A3Rmi+A4GM	(III) A1+A2linear+ A3Rmi+ A4 Ω ar1
ESTIMATOR ↓minimal Specification↓			
$A :$ OLS $A1 : \rho(X) = k < S$	Unbiased	BLUE & CUAN	Unb & CUAN
$B :$ LAD $A1 : \rho(X) = k < S$	Biased	Biased & CUAN	Biased & CUAN
$C :$ GMM linear A1+A2linear+A3Rsr $\equiv$ OLS identically	=OLS	=OLS	=OLS
$D :$ (a)IGLS.ar1 (b)FGLS.ar1 A1+A2lin+A3Rmi+A4 Ω ar1 same	(a) U; (b) Biased	(a) U&CUAN (b) Bsd & CUAN	(a) BLUE & BL CUAN (b) Bsd & BL CUAN
$E :$ (a) IGLS.ma1 (b) FGLS.ma1 A1+A2lin+A3Rmi+A4 Ω ma1 same	(a) U; (b) Biased	(a) U&CUAN (b) Bsd & CUAN	(a) U&CUAN (b) Bsd & CUAN
$F :$ (a) IGLS.htrsk.Mrlbn (b) FGLS.Mrlbn A1+A2lin+A3Rmi+A4 Ω Mrlbn same	(a) U; (b) Biased	(a) U&CUAN (b) Bsd & CUAN	(a) U&CUAN (b) Bsd & CUAN
$G :$ GMM nonlinear additive A1+A2nonlinear_additive+ A3rsru: $E[x_s \cdot (y_s - g(x'_s\beta))] = 0$	Biased	Biased & Incons?	Biased & Incons?
$H :$ NLLS nonlinear additive A1+A2nonlinear_additive: $y_s = g(x_s, \beta) + \epsilon_s$	Biased	Biased & Incons?	Biased & Incons?
$I :$ MLE.GM(iid).Gaussian $\equiv$ OLS identically	=OLS	=OLS	=OLS
$J :$ MLE.iid.Logistic	Biased	Biased & CUAN?	Biased & CUAN?
$K :$ MLE.iid.Laplace/DE $\equiv$ LAD identically	=LAD	=LAD	=LAD
$L :$ MLE.iid.Cauchy	Biased	Biased & CUAN?	Biased & CUAN?
$M :$ MLE. Ω .Gaussian (a) $\equiv IGLS(\Omega)$ identically;(b)=FGLS($\hat{\Omega}$)	Biased	(a) U&CUAN (b) CUAN	(a) U&CUAN Best if (b) CUAN Used Ω -True Ω
$N :$ IVE A1+A2linear: $y = X\beta + \epsilon$ +A3W:W=W(Z) exog (validity) relevance: $W'X$ is $k \times k$, rank=k, high correlations between W and X	Biased	Biased & CUAN	Biased & CUAN

$\dots \quad \dots \quad \dots \quad \dots \quad \dots \quad \dots$ $\longrightarrow$ TRUE DGP $\longrightarrow$	(IV) A1+A2linear+ A3Rmi+ A4 Ω ma1	(V) A1+A2linear+ A3Rmi+ A4 Ω het.Mrlbn	(VI) A1+ A2: $y_s = g(x_s, \beta) + \epsilon_s$ A3Rsru+A4GMiid
ESTIMATOR ↓minimal Specification↓			
A : OLS A1: $\rho(X) = k < S$	Unb & CUAN	Unb & CUAN	Biased & Inconsistent?
B : LAD A1: $\rho(X) = k < S$	Biased & CUAN	Biased & CUAN	Biased & Inconsistent?
C : GMM linear A1+A2linear+A3Rsru ≡OLS identically	=OLS	=OLS	=OLS
D : (a) IGLS.ar1 (b) FGLS.ar1 A1+A2lin+A3Rmi+A4 Ω ar1 same	(a) U&CUAN (b) Bsd & CUAN	(a) U&CUAN (b) Bsd & CUAN	Biased & Inconsistent?
E : (a) IGLS.ma1 (b) FGLS.ma1 A1+A2lin+A3Rmi+A4 Ω ma1 same	(a) BLUE & BL CUAN (b) Bsd & BL CUAN	(a) U&CUAN (b) Bsd & CUAN	Biased & Inconsistent?
F : (a) IGLS.htrsk.Mrlbn (b) FGLS.Mrlbn A1+A2lin+A3Rmi+A4 Ω Mrlbn same	(a) U&CUAN (b) Bsd & CUAN	(a) BLUE & BL CUAN (b) Bsd & BL CUAN	Biased & Inconsistent?
G : GMM nonlinear additive A1+A2nonlinear_additive+ A3rsru: $E[x_s \cdot (y_s - g(x'_s, \beta))] = 0$	Biased & Incons?	Biased & Incons?	Biased and CUAN
H : NLLS nonlinear additive A1+A2nonlinear_additive: $y_s = g(x_s, \beta) + \epsilon_s$	Biased & Incons?	Biased & Incons?	Biased and CUAN
I : MLE.GM(iid).Gaussian ≡OLS identically	=OLS	=OLS	=OLS
J : MLE.iid.Logistic	Biased & CUAN?	Biased & CUAN?	Biased and Inconsistent?
K : MLE.iid.Laplace/DE ≡LAD identically	=LAD	=LAD	=LAD
L : MLE.iid.Cauchy	Biased & CUAN?	Biased & CUAN?	Biased and Inconsistent?
M : MLE. Ω .Gaussian (a) $\equiv IGLS(\Omega)$ identically;(b)=FGLS($\hat{\Omega}$)	(a) U&CUAN Best if (b) CUAN ' Used Ω -True Ω	(a) U&CUAN Best if (b) CUAN ' Used Ω -True Ω	Biased and Inconsistent?
N : IVE A1+A2linear: $y = X\beta + \epsilon$ +A3W : $W = W(Z)$ exog (validity) relevance: $W'X$ is $k \times k$, rank=k, high correlations between W and X	Biased & CUAN	Biased & CUAN	Biased and Inconsistent?

$\dots \quad \dots \quad \dots \quad \dots \quad \dots \quad \dots$ $\longrightarrow$ TRUE DGP $\longrightarrow$	(VII) A1+A2lin+ A3Rmi+ A4GM(iid)+ A5Gaussian	(VIII) A1+A2lin+ A3Rmi+ A4GMiid+ A5Logistic	(IX) A1+A2lin+ A3Rmi+ A4GMiid+ A5Lapl/DE
ESTIMATOR $\downarrow$ minimal Specification $\downarrow$			
$A :$ OLS $A1 : \rho(X) = k < S$	BUE & Best CUAN	BLUE & CUAN Not Best CUAN	BLUE & CUAN Not Best CUAN
$B :$ LAD $A1 : \rho(X) = k < S$	Biased & CUAN	Bsd & CUAN Not Best CUAN	Biased Best CUAN
$C :$ GMM linear A1+A2linear+A3Rsru $\equiv$ OLS identically	=OLS	=OLS	=OLS
$D :$ (a) IGLS.ar1 (b) FGLS.ar1 A1+A2lin+A3Rmi+A4 Ω ar1 same	(a) Unb & CUAN (b) Bsd & CUAN	(a) Not Best LUE Not Best CUAN	(a) Not Best LUE Not Best CUAN
$E :$ (a) IGLS.ma1 (b) FGLS.ma1 A1+A2lin+A3Rmi+A4 Ω ma1 same	(a) Unb & CUAN (b) Bsd & CUAN	(a) Not Best LUE Not Best CUAN	(a) Not Best LUE Not Best CUAN
$F :$ (a) IGLS.ltrsk.Mrlbn (b) FGLS.Mrlbn A1+A2lin+A3Rmi+A4 Ω Mrlbn same	(a) Unb & CUAN (b) Bsd & CUAN	(a) Not Best LUE Not Best CUAN	(a) Not Best LUE Not Best CUAN
$G :$ GMM nonlinear additive A1+A2nonlinear_additive+ A3rsru: $E[x_s \cdot (y_s - g(x'_s \beta))] = 0$	Bsd and Incons?	Bsd & Incons?	Bsd & Incons?
$H :$ NLLS nonlinear additive A1+A2nonlinear_additive: $y_s = g(x_s, \beta) + \epsilon_s$	Bsd and Incons?	Bsd & Incons?	Bsd & Incons?
$I :$ MLE.GM(iid).Gaussian $\equiv$ OLS identically	=OLS	=OLS	=OLS
$J :$ MLE.iid.Logistic	Bsd & CUAN	Bsd & Best CUAN	Bsd and CUAN
$K :$ MLE.iid.Laplace/DE $\equiv$ LAD identically	=LAD	=LAD	=LAD
$L :$ MLE.iid.Cauchy	Bsd & CUAN	Bsd & CUAN	Bsd and CUAN?
$M :$ MLE. Ω .Gaussian (a) $\equiv IGLS(\Omega)$ identically; (b)=FGLS($\hat{\Omega}$)	Bsd & CUAN	see IGLS/FGLS	see IGLS/FGLS
$N :$ IVE A1+A2linear: $y = X\beta + \epsilon$ +A3W:W=W(Z) exog (validity)	Bsd & CUAN	Bsd and CUAN	Bsd and CUAN

$\dots \quad \dots \quad \dots \quad \dots \quad \dots \quad \dots$ $\longrightarrow$ TRUE DGP $\longrightarrow$	(X) A1+A2lin+ NB1:A3fi+ NB2:iid errors+ iid.A5Cauchy	(XI) A1: $\rho(W)=\rho(X)=k$ +A2: $y = X_A\beta_A + X_B\beta_B + \epsilon$ +A3: X_A exog., W exog +A4 (GM or Omega) $W=W(Z), \#Z \geq k$
ESTIMATOR ↓minimal Specification↓		
$A :$ OLS A1: $\rho(X) = k < S$	Bsd & Inconsistent	Bsd & Inconsistent
$B :$ LAD A1: $\rho(X) = k < S$	Bsd & CUAN	Bsd & Inconsistent
$C :$ GMM linear A1+A2linear+A3Rsru ≡OLS identically	=OLS	=OLS
$D :$ (a)IGLS.ar1 (b)FGLS.ar1 A1+A2lin+A3Rmi+A4Ω _{ar1} same	Bsd & Inconsistent	Bsd & Inconsistent
$E :$ (a)IGLS.ma1 (b)FGLS.ma1 A1+A2lin+A3Rmi+A4Ω _{ma1} same	Bsd & Inconsistent	Bsd & Inconsistent
$F :$ (a)IGLS.htrsk.Mrlbn (b)FGLS.Mrlbn A1+A2lin+A3Rmi+A4Ω _{Mrlbn} same	Bsd & Inconsistent	Bsd & Inconsistent
$G :$ GMM nonlinear additive A1+A2nonlinear_additive+ A3rsru: $E[x_s \cdot (y_s - g(x'_s\beta))] = 0$	Bsd & Inconsistent	Bsd & Inconsistent
$H :$ NLLS nonlinear additive A1+A2nonlinear_additive: $y_s = g(x_s, \beta) + \epsilon_s$	Bsd & Inconsistent	Bsd & Inconsistent
$I :$ MLE.GM(iid).Gaussian ≡OLS identically	=OLS	=OLS
$J :$ MLE.iid.Logistic	Bsd & Inconsistent	Bsd & Inconsistent
$K :$ MLE.iid.Laplace/DE ≡LAD identically	=LAD	=LAD
$L :$ MLE.iid.Cauchy	Bsd & Best CUAN	Bsd & Inconsistent
$M :$ MLE.Ω.Gaussian (a)≡IGLS(Ω) _i identically;(b)=FGLS($\hat{\Omega}$)	Bsd & Inconsistent	Bsd & Inconsistent
$N :$ IVE A1+A2linear: $y = X\beta + \epsilon$ +A3W:W=W(Z) exog (validity) relevance: $W'X$ is $k \times k$, rank=k.	Bsd & Inconsistent	Biased & CUAN With optimal W^* , Best CUAN in GMM class