Table Placeholders

Methods

Table 1: Linear Model Simulation: data generating models, parameter values, and mis-specifications.

Data Generating Model	Parameters	Mis-specified Model
$X_i \sim N(0,1)$ $\mu_{i,j} = X_i\beta$ $y_{i,j} \sim N(\mu_{i,j}, \sigma_y)$	$\beta = (4, -5)$ $\sigma_y = 1$	Data simulated with lognormal overdispersion: $\mu_{i,j} = X_i\beta + exp(\epsilon)$ $\epsilon \sim N(0,1)$ Data fit to model without drift term

Table 2: Mixed Model Simulation: data generating models, parameter values, and mis-specifications.

Data Generating Model	Parameters	Mis-specified Model
$X_i \sim N(0,1)$ $u_j \sim N(0, \sigma_u)$ $\mu_{i,j} = X_i\beta + u_j$ $y_{i,j} \sim N(\mu_{i,j}, \sigma_y)$	$\beta = (4, -8)$ $\sigma_u = 2$ $\sigma_y = 0.5$	Data simulated with covariate term Data fit to model without covariate term
$X_i \sim Unif(-0.5, 0.5)$ $u_j \sim N(0, \sigma_u)$ $\mu_{i,j} = X_i\beta + u_j$ $y_{i,j} \sim N(\mu_{i,j}, \sigma_y)$	$\beta = (4, -8)$ $\sigma_u = 2$ $\sigma_y = 0.5$	Data simulated with covariate term Data fit to model without covariate term
$u_j \sim N(0, \sigma_u)$ $\mu_{i,j} = exp(\beta_0 + u_j)$ $y_{i,j} \sim Tweedie(\mu_{i,j}, \phi, p)$	$\beta = 1.5$ $\sigma_u = 1.4$ $\phi = 1.4$ $p = 1.2$	Data simulated with random effect term Data fit to model without random effect term

Table 3: Randomwalk Simulation: data generating models, parameter values, and mis-specifications.

Data Generating Model	Parameters	Mis-specified Model
$\mu_i = u_{i-1} + a$	$a = 0.75$	
$u_i \sim N(\mu_i, \tau)$	$\tau = 1$	Data simulated with drift term, a Data fit to model without drift term
$y_i \sim N(u_i, \sigma)$	$\sigma = 1$	

Table 4: Spatial Simulation: data generating models, parameter values, and mis-specifications.

Data Generating Model	Parameters	Mis-specified Model
	spatial range = 50	
$\omega \sim GMRF(Q[\kappa, \sigma^2_\omega])$	$\kappa = \sqrt{8}/50$	
$\eta_i = \beta_0 + \omega_i$	$\sigma^2_\omega = 1$	Data simulated with $\exp(\omega_i)$
$y \sim N(\eta, \sigma_y)$	$\beta_0 = 1$	Data fit to model without covariate term
	$\sigma_y = 1$	
	spatial range = 50	
$\omega \sim GMRF(Q[\kappa, \sigma^2_\omega])$	$\kappa = \sqrt{8}/50$	
$\eta_i = \beta_0 + \omega_i$	$\sigma^2_\omega = 2$	Data simulated with random effect term
$y \sim Pois(exp(\eta))$	$\beta_0 = 0.5$	Data fit to model without random effect term

Results

Simple Linear Model

Table 5: Simple Linear Model. Type I error rates and Power evaluated for each analytical and simulation method for theoretical residuals. Results are partitioned out by residual type (top to bottom).

	Overdispersion	
method	Type I Error	Power
Pearson	0.044	1
one-step Generic	0.044	1
one-step Gaussian	0.044	1
full Gaussian	0.044	1
cdf	0.044	1
Unconditional ecdf, Not Rotated	0.034	1
Conditional ecdf, Not Rotated	0.034	1

Table 6: Simple Linear Model. Type I error rates and Power evaluated for each analytical and simulation method for estimated residuals. Results are partitioned out by residual type (top to bottom).

	Overdispersion	
method	Type I Error	Power
Pearson	0	0.962
one-step Generic	0	0.962
one-step Gaussian	0	0.962
full Gaussian	0	0.962
cdf	0	0.962
Unconditional ecdf, Not Rotated	0	0.960
Conditional ecdf, Not Rotated	0	0.960

Simple Mixed Model

Table 7: Simple Mixed Model. Type I error rates and Power evaluated for each analytical and simulation method for theoretical residuals. Results are partitioned out by model mis-specification (from left to right) and residual type (top to bottom).

	GLMM - Drop RE		LMM - Missing X Normal		LMM - Missing X Uniform	
method	Type I Error	Power	Type I Error	Power	Type I Error	Power
Unconditional ecdf, Not Rotated	0.986	0.038	1.000	1	1.000	1
Conditional ecdf, Not Rotated	0.032	0.042	0.050	1	0.050	1
Pearson	NA	NA	0.052	1	0.052	1
one-step Generic	NA	NA	0.046	1	0.046	1
one-step Gaussian	NA	NA	0.046	1	0.046	1
full Gaussian	NA	NA	0.046	1	0.046	1
cdf	NA	NA	0.046	1	0.046	1
Unconditional ecdf, Rotated	NA	NA	0.994	1	0.994	1
Conditional ecdf, Rotated	NA	NA	0.996	1	0.996	1

Table 8: Simple Mixed Model. Type I error rates and Power evaluated for each analytical and simulation method for estimated residuals. Results are partitioned out by model mis-specification (from left to right) and residual type (top to bottom).

	GLMM - Drop RE		LMM - Missing X Normal		LMM - Missing X Uniform	
method	Type I Error	Power	Type I Error	Power	Type I Error	Power
Unconditional ecdf, Not Rotated	0.692	0.646	0.904	0.072	0.896	0.074
Conditional ecdf, Not Rotated	0.000	0.648	0.002	0.208	0.000	0.778
Pearson	NA	NA	0.000	0.204	0.000	0.792
one-step Generic	NA	NA	0.040	0.270	0.034	0.912
one-step Gaussian	NA	NA	0.040	0.270	0.034	0.912
full Gaussian	NA	NA	0.040	0.270	0.034	0.912
cdf	NA	NA	0.040	0.270	0.034	0.912
Unconditional ecdf, Rotated	NA	NA	1.000	1.000	1.000	1.000
Conditional ecdf, Rotated	NA	NA	1.000	0.996	0.998	1.000

Randomwalk

Table 9: Randomwalk Model. Type I error rates and Power evaluated for each analytical and simulation method for theoretical residuals. Results are partitioned out by model mis-specification (from left to right) and residual type (top to bottom).

	mu0	
method	Type I Error	Power
Pearson	0.040	0.040
one-step Generic	0.042	1.000
one-step Gaussian	0.042	1.000
full Gaussian	0.042	1.000
cdf	0.044	1.000
Unconditional ecdf, Rotated	0.060	1.000
Unconditional ecdf, Not Rotated	0.988	1.000
Conditional ecdf, Rotated	0.058	0.066
Conditional ecdf, Not Rotated	0.048	0.036

Table 10: Randomwalk Model. Type I error rates and Power evaluated for each analytical and simulation method for estimated residuals. Results are partitioned out by model mis-specification (from left to right) and residual type (top to bottom).

	mu0	
method	Type I Error	Power
Pearson	0.132	1
one-step Generic	0.000	1
one-step Gaussian	0.000	1
full Gaussian	0.000	1
cdf	0.000	1
Unconditional ecdf, Rotated	0.000	1
Unconditional ecdf, Not Rotated	0.998	1
Conditional ecdf, Rotated	0.084	1
Conditional ecdf, Not Rotated	0.120	1

Spatial

Table 11: Spatial Model. Type I error rates and Power evaluated for each analytical and simulation method for theoretical residuals. Results are partitioned out by model mis-specification (from left to right) and residual type (top to bottom).

	GLMM - Drop RE	
method	Type I Error	Power
Pearson	0.630	1
one-step Generic	0.032	1
cdf	0.046	1
Unconditional ecdf, Rotated	0.592	1
Unconditional ecdf, Not Rotated	0.782	1
Conditional ecdf, Rotated	0.142	1
Conditional ecdf, Not Rotated	0.038	1

Table 12: Spatial Model. Type I error rates and Power evaluated for each analytical and simulation method for estimated residuals. Results are partitioned out by model mis-specification (from left to right) and residual type (top to bottom).

	GLMM - Drop RE		LMM - Lognormal RE	
method	Type I Error	Power	Type I Error	Power
Pearson	0.976	1.000	0.174	0.670
one-step Generic	0.020	0.990	0.014	0.356
cdf	0.010	0.990	0.032	0.370
Unconditional ecdf, Rotated	0.378	0.998	0.026	0.332
Unconditional ecdf, Not Rotated	0.474	0.978	0.248	0.620
Conditional ecdf, Rotated	0.292	0.994	0.126	0.624
Conditional ecdf, Not Rotated	0.506	0.980	0.188	0.674
one-step Gaussian	NA	NA	0.014	0.356
full Gaussian	NA	NA	0.014	0.356