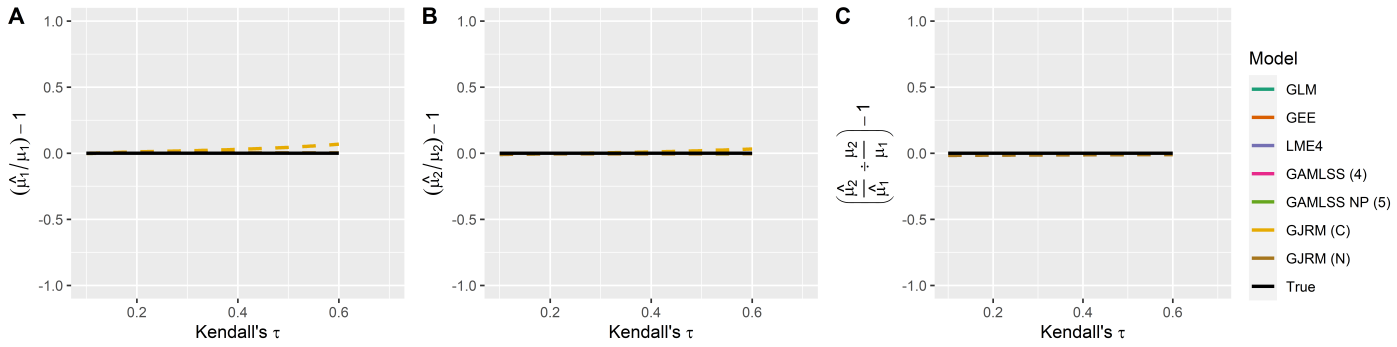
Summary:

- Simulations run and models fit for Bivariate Normal (5 parameters), Compound Poisson (3 parameters) and Bivariate Gamma (4 parameters)
- Common themes:
  - **Fit Criteria:** GAMLSS (4) model consistently provides the highest log likelihoods, but lowest BIC due to high parameterisation. By AIC, the GAMLSS (4) model is generally slightly most preferred, followed by the GJRMs
  - **Bias:** Both the GAMLSS (4) and LME4 GLMMs provide biased estimates for the time 1 parameter for the Poisson and Gamma distributions, while providing unbiased estimates of the second parameter.
    - Interestingly, the GLM is highly robust to the different distributional shapes, consistently no bias across the simulations..
    - The GJRMs only present bias in the case of the bivariate Gamma where the copula is mis-specified as Normal when it is in fact highly skewed
  - **Error:** For the Bivariate Normal, the GLMMs generally seem to show a slightly closer standard error to the True value than the other models, even with the known bias for the first parameter. For the non-normal distributions, however, the GLMMs both exhibited significantly lower standard error than the True value, particularly for higher values of tau, while the GJRMs provide estimates close to the True value.
  - Note that the GEE and non-parametric random effect GAMLSS model generally lie somewhere between the other models, with no comparative advantages.

Multivariate Normal

Bias

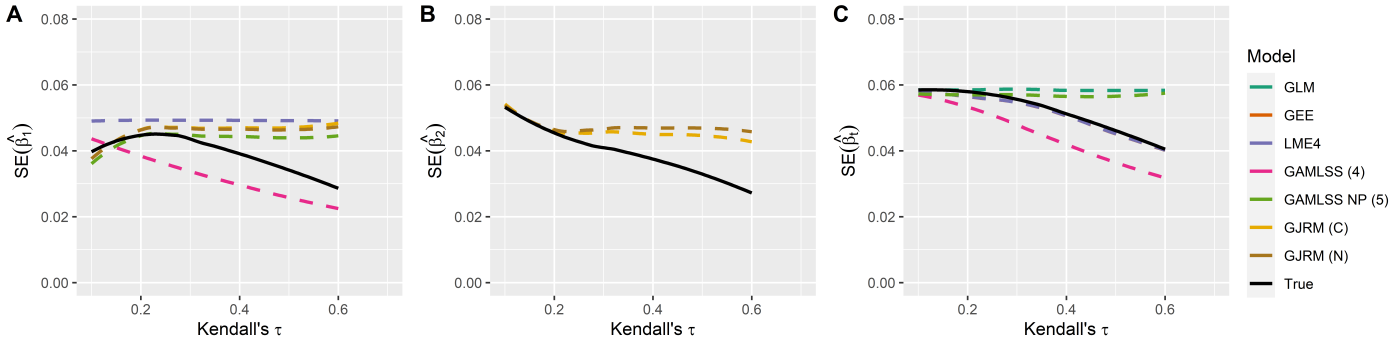
- All models unbiased except GJRM (C) with slight bias for high tau



Error

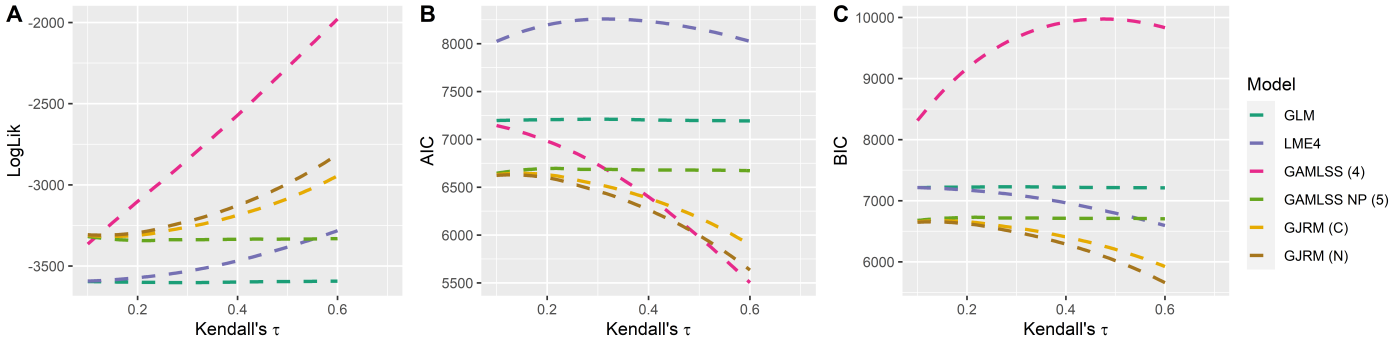
- GJRM doesn't follow downward trend of true SE for parameters for higher tau

- GAMLSS (4) follows the downward trend for time 1 and time 2 but is slightly underestimating true SE
- LME4 is perfect at time 2, but similar to GJRM for time 1 in not following the downward trend



Log Likelihood, AIC and BIC

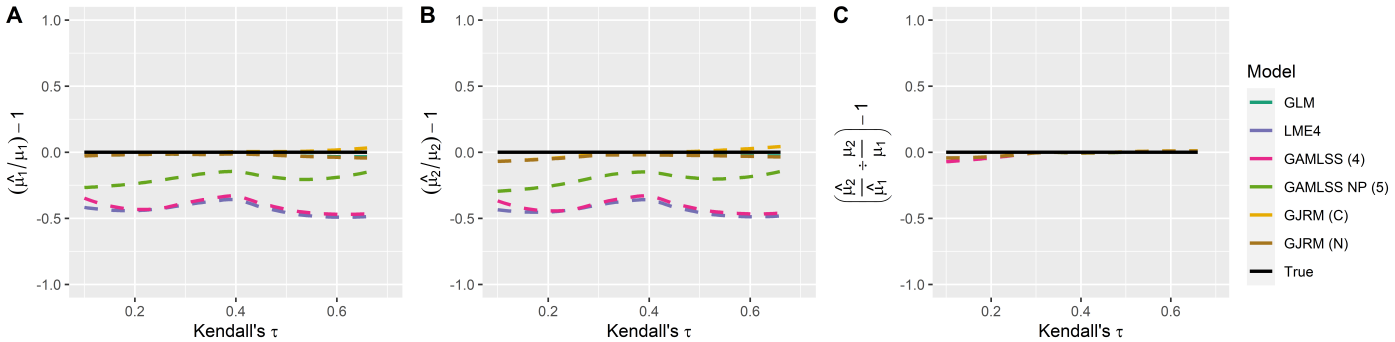
- GAMLSS (4) overwhelmingly best fit by log likelihood but is penalised for its high parameterisation and is highest BIC across the board, with the GJRMs providing the lowest BIC
- By AIC, GJRM is preferred model for low tau and GAMLSS (4) for high tau



Compound Poisson (NB marginals)

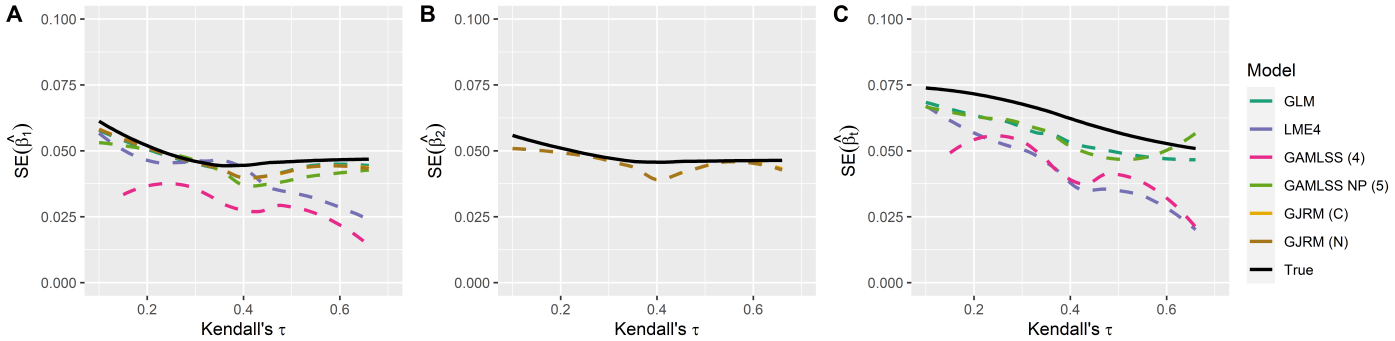
Bias

- All GLMMs provide biased estimates for time 1 (LME4, GAMLSS (4), GAMLSS NP) and unbiased estimates for time 2 parameter
- GJRM and GLM unbiased across the range



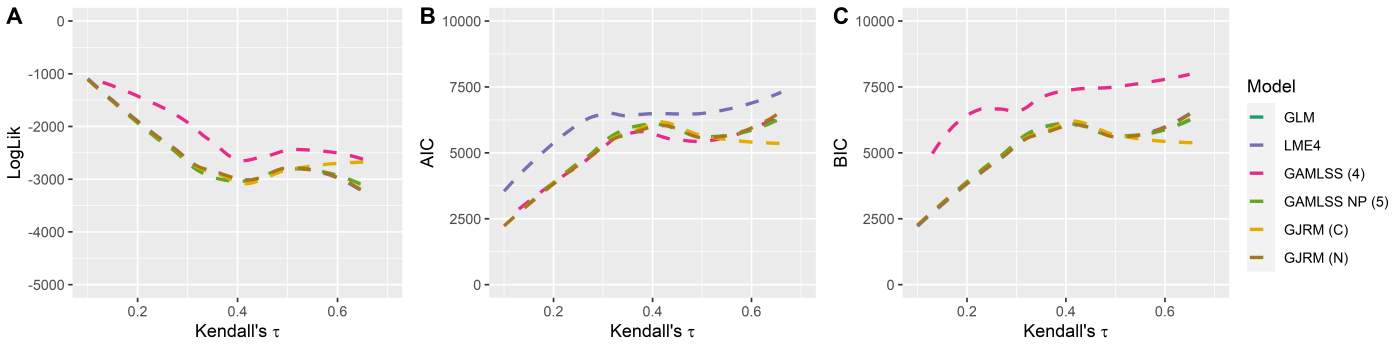
Error

- Broadly error looks pretty good from all models at time 1
- LME4 and GAMLSS (4) are underestimating true SE for high tau for both parameters, and GAMLSSNP and GLM overestimating for time 2 but it's pretty close



Log Likelihood, AIC and BIC

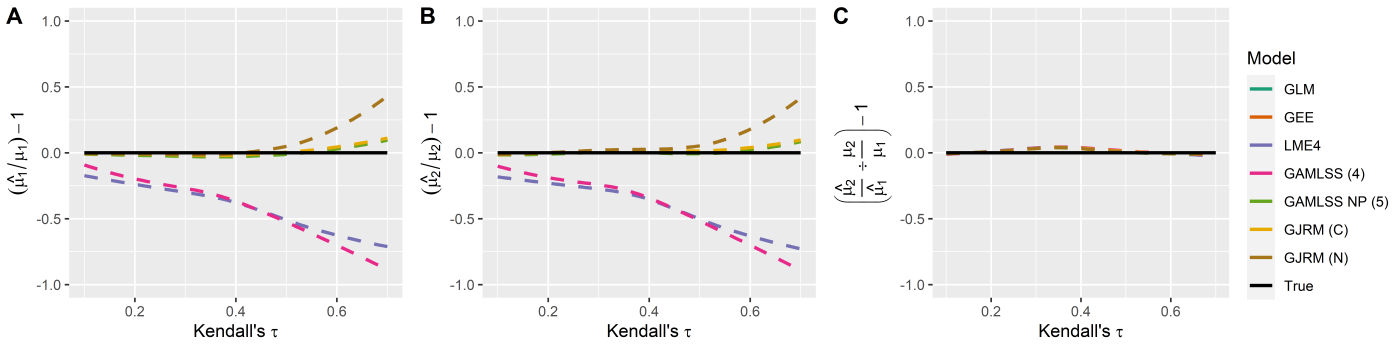
- Similar to normal, gamlss (4) is preferred by LogLik and least preferred by BIC
- All models are very comparable on AIC except for LME 4 which skews higher for this dataset



Multivariate Gamma

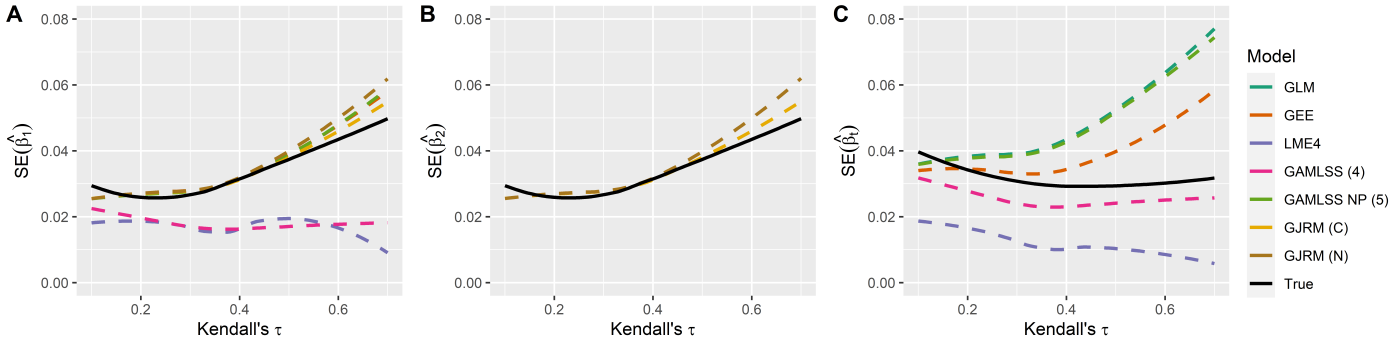
Bias

- LME4 & GAMLSS highly biased for high tau at time 1
- GJRM (N) is biased for high tau at time 1 and time 2
- GJRM (C), GLM, GAMLSS NP unbiased across the board



Error

- GJRMs closely follow error at time 1 and time 2
- GAMLSS (4) is closest for time 2 parameter but highly underestimating for time 1 error
- LME4 underestimating for both time 1 and time 2
- GLM, GEE, GAMLSS NP close at time 1 but highly overestimating for time 2



Log Likelihood, AIC and BIC

- GAMLSS (4) has the highest Log Likelihood but by far least preferred by BIC
- Interestingly, based on AIC here we would select the GAMLSS (4) model for almost any value of tau