MATH 301 Homework 3
Due: Sunday 9/26, 11:59pm; submission on Moodle under Discussion Forum

1. In class we talked about Monte Carlo simulation and the role of S, the number of simulations, in the context of the gamma-Poisson conjugate model fitted to the bike sharing dataset. We used $S = 1000$ in class. Try values of $S = \{10, 100, 1000, 10000\}$, calculate the approximated mean and variance of Gamma$(22928, 501)$, and compare them to the analytical solutions of 57.2470 and 0.2281. Comment on the effect of S on the accuracy of the approximations.

2. In class, we discussed that when the prior statements are not provided in brm() function, default priors will be used. Use the get_prior() function from the brms package to check out what default priors are used in this case (you can type in the console ?get_prior to access the help function). Use this default prior choice and perform the same Bayesian inference, including prediction. Report your findings and discuss the influence of the two priors in our Poisson regression model with temperature as the predictor variable.

3. Consider a Poisson regression model with two predictor variables: temperature and season. Note that season is a categorical predictor variable, which requires a slope for each level and the use of as.factor(season) syntax. First visualize their relationships (e.g., color-coded scatterplot) and discuss your conjecture of the usefulness of each predictor. Use brms with default priors to perform MCMC estimation and check MCMC diagnostics. Summarize the posterior estimation of each parameter and check the predictions. Discuss whether the predictions have improved compared to a Poisson regression model with only one predictor variable, the temperature.

Be prepared to discuss these questions in class on Monday 9/27.