

Figure 4: Comparison between NUTS and our samplers for IRT model with diagonal metric adaptation (tuned by Rstan’s default setting): The x-axis in each plot corresponds to the desired accept probability  $\delta$  of the primal-dual averaging algorithm. The y-axis is the minimum ESS per gradient for each parameter group. ESS of samples of NUTS, eHMC, eHMCq and eHMCu is estimated by `ess` of R package `mcmcse`.

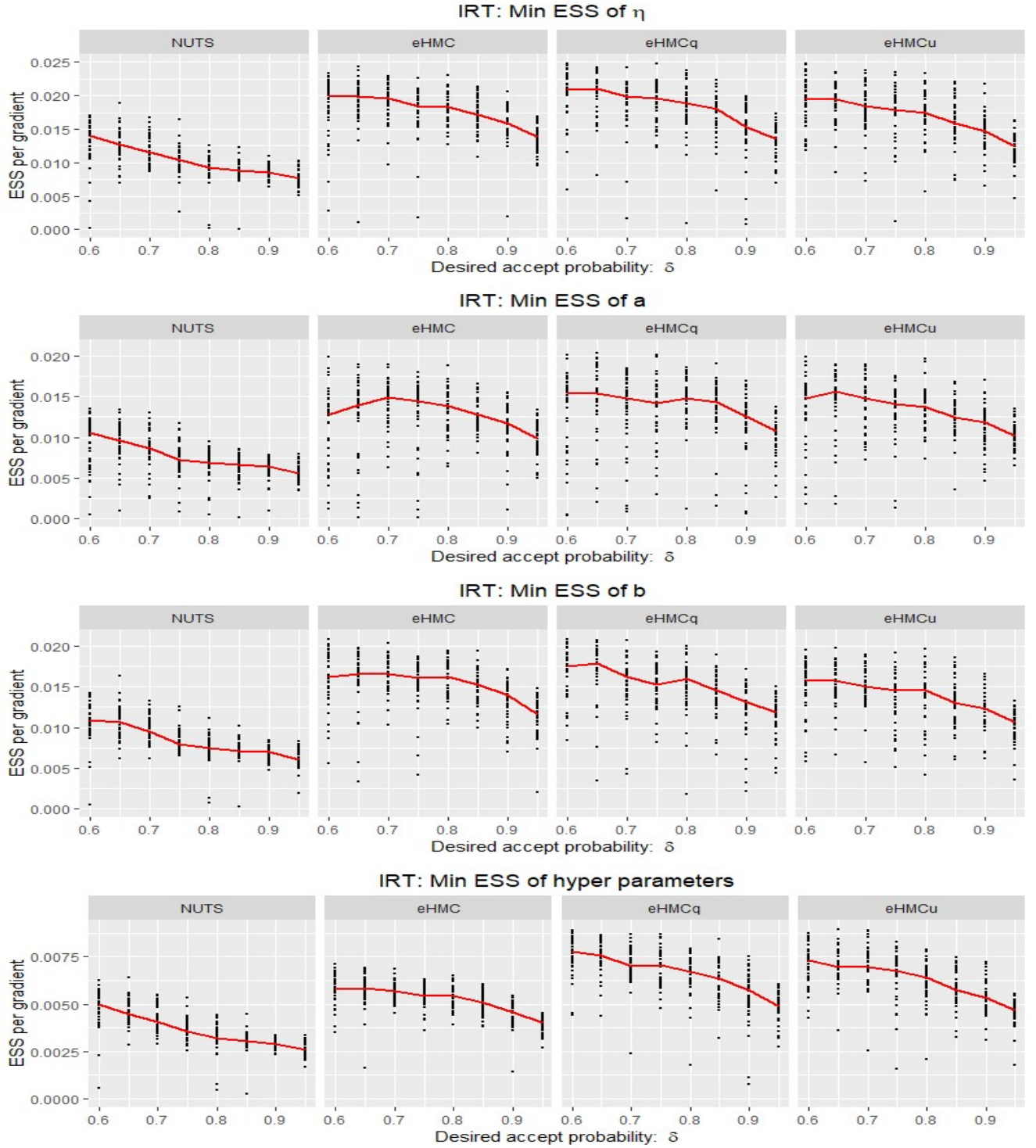


Figure 5: Comparison between NUTS and our samplers for IRT model with diagonal metric adaptation (tuned by Rstan's default setting): The x-axis in each plot corresponds to the desired accept probability  $\delta$  of the primal-dual averaging algorithm. The y-axis is the minimum ESS per gradient for each parameter group. ESS of samples of NUTS, eHMC, eHMCq and eHMCu is estimated by effectiveSize of R package coda.

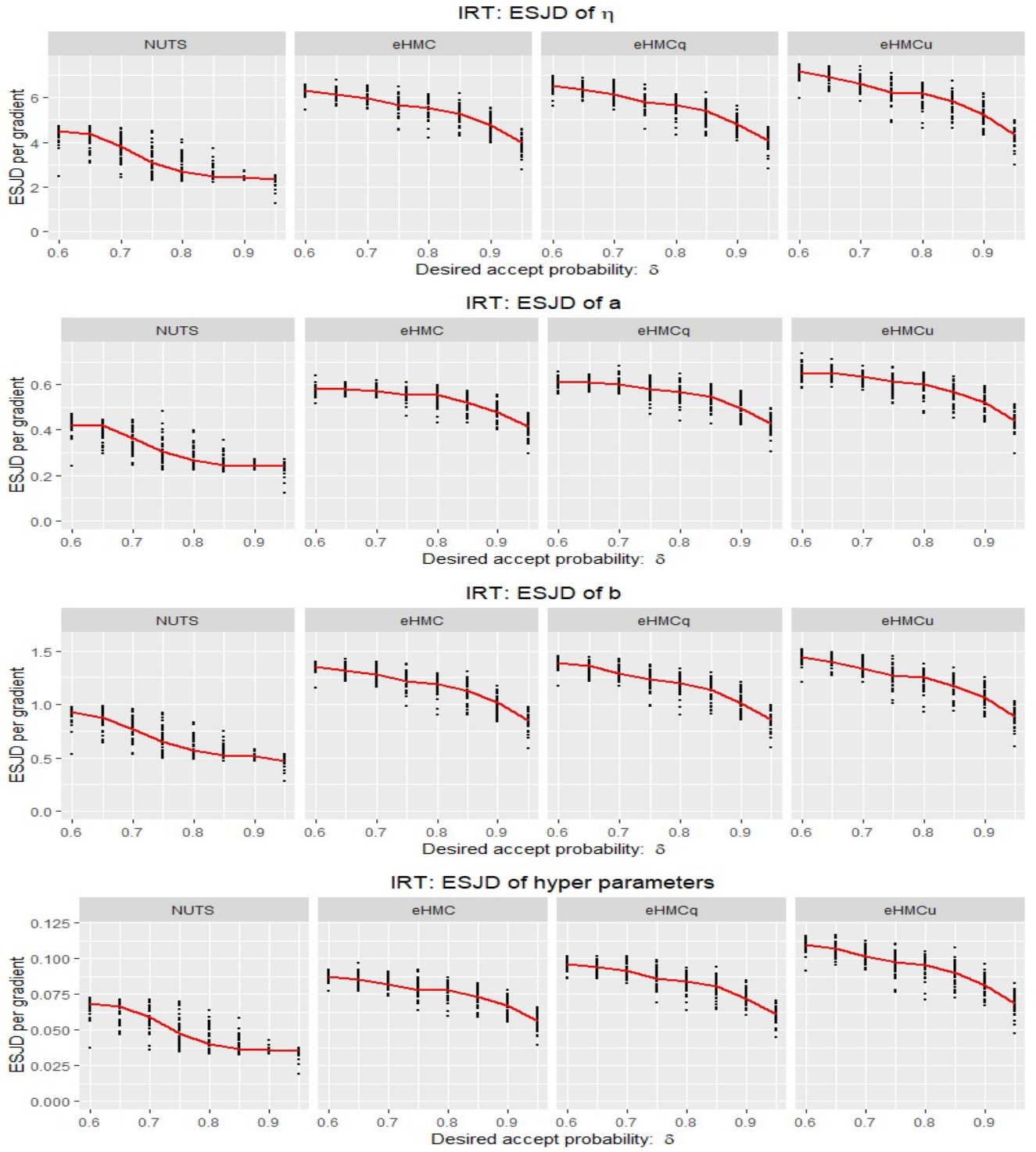


Figure 6: Comparison between NUTS and our samplers for IRT model with diagonal metric adaptation (tuned by `Rstan`'s default setting): The x-axis in each plot corresponds to the desired accept probability  $\delta$  of the primal-dual averaging algorithm. The y-axis is the ESJD per gradient for each parameter group.