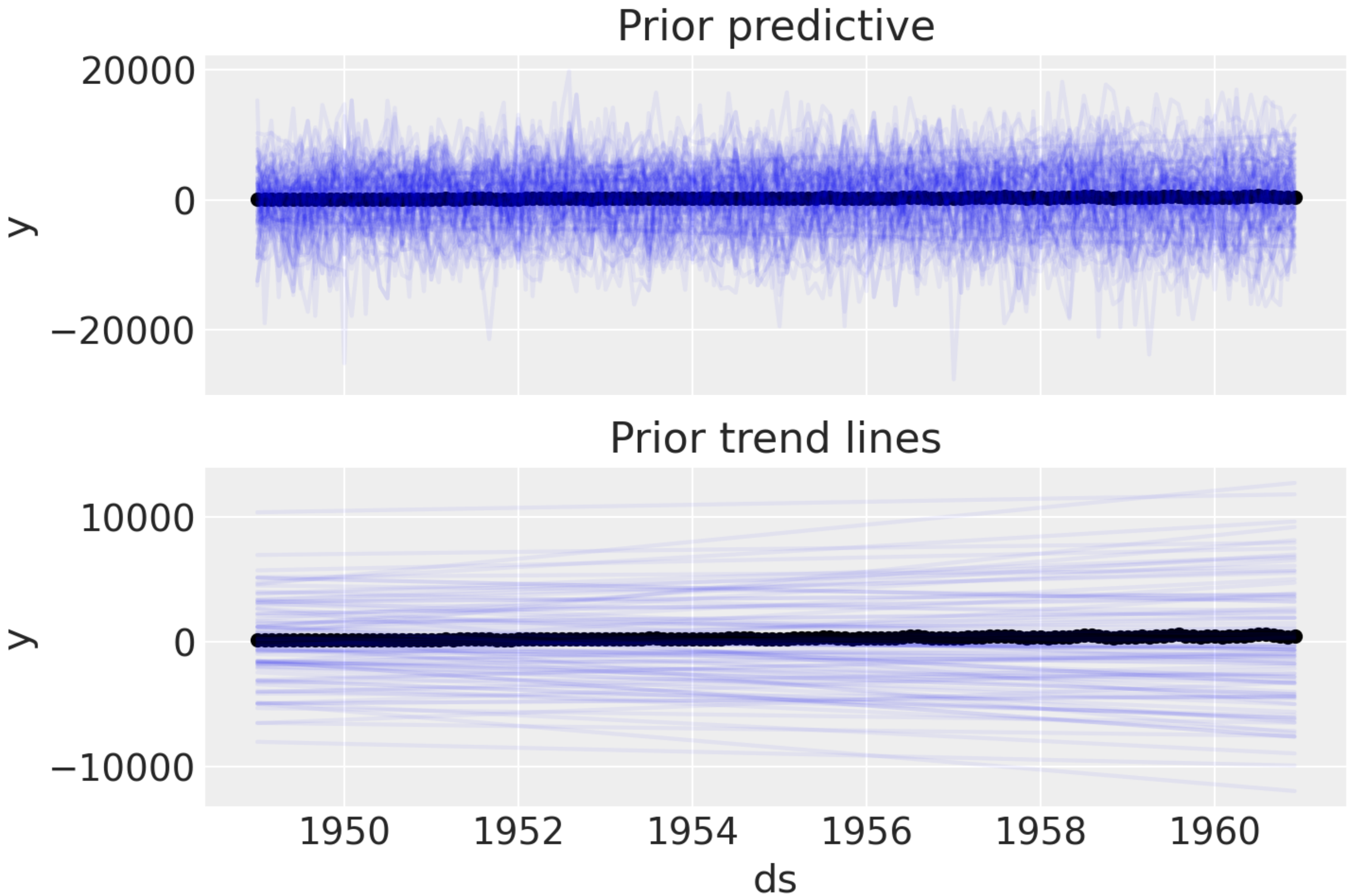
Bayesian Statistics and Modeling
Part II

Time series modeling with `pymc3`

Based on this example

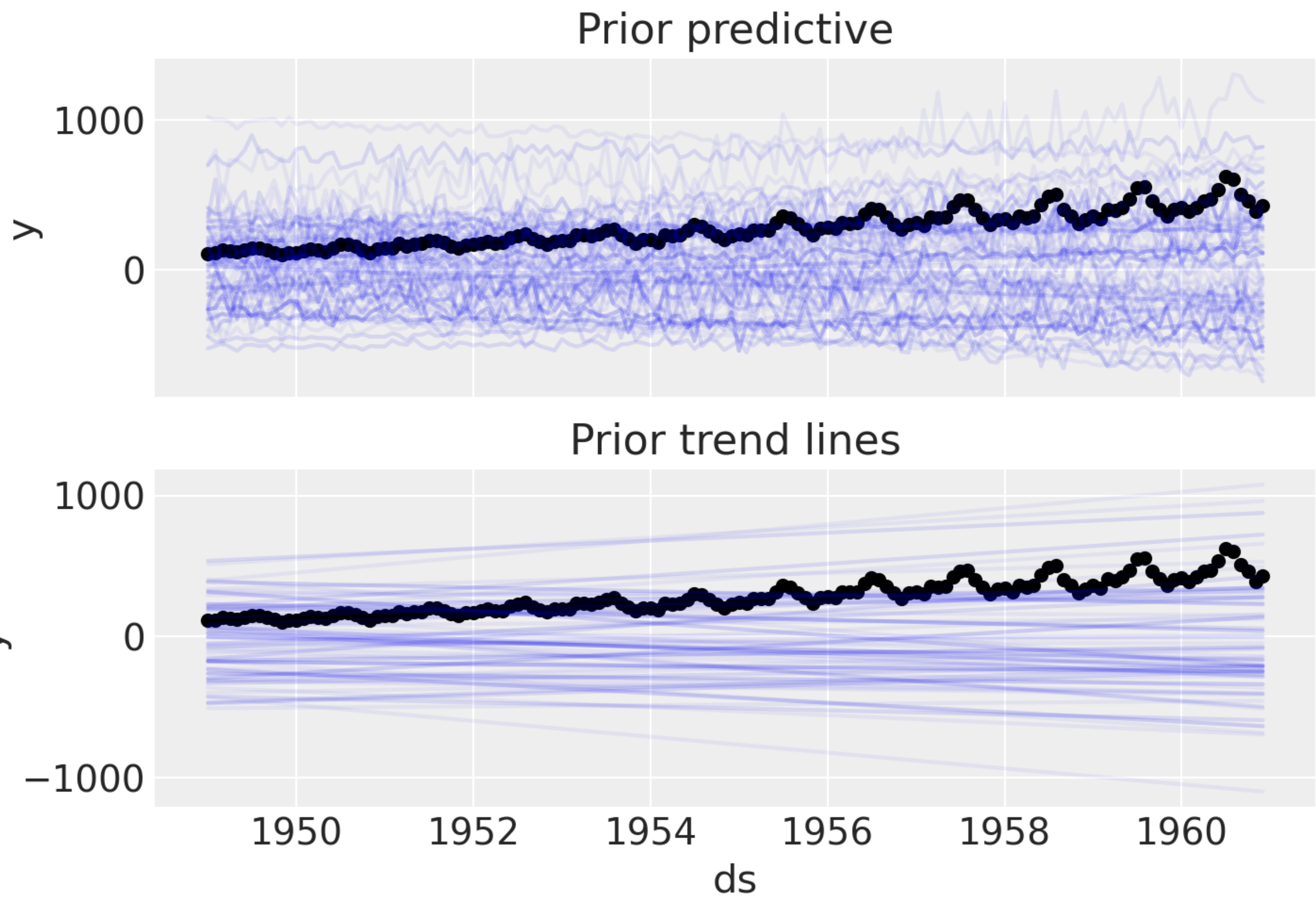
Prior predictions (WHAT??)



Prior predictions (WHAT??)

- Look at a large array of possible "reasonable" outcomes given our assumptions about the data
- Gives us an idea of whether our priors make sense
- In this case, we want to make some corrections

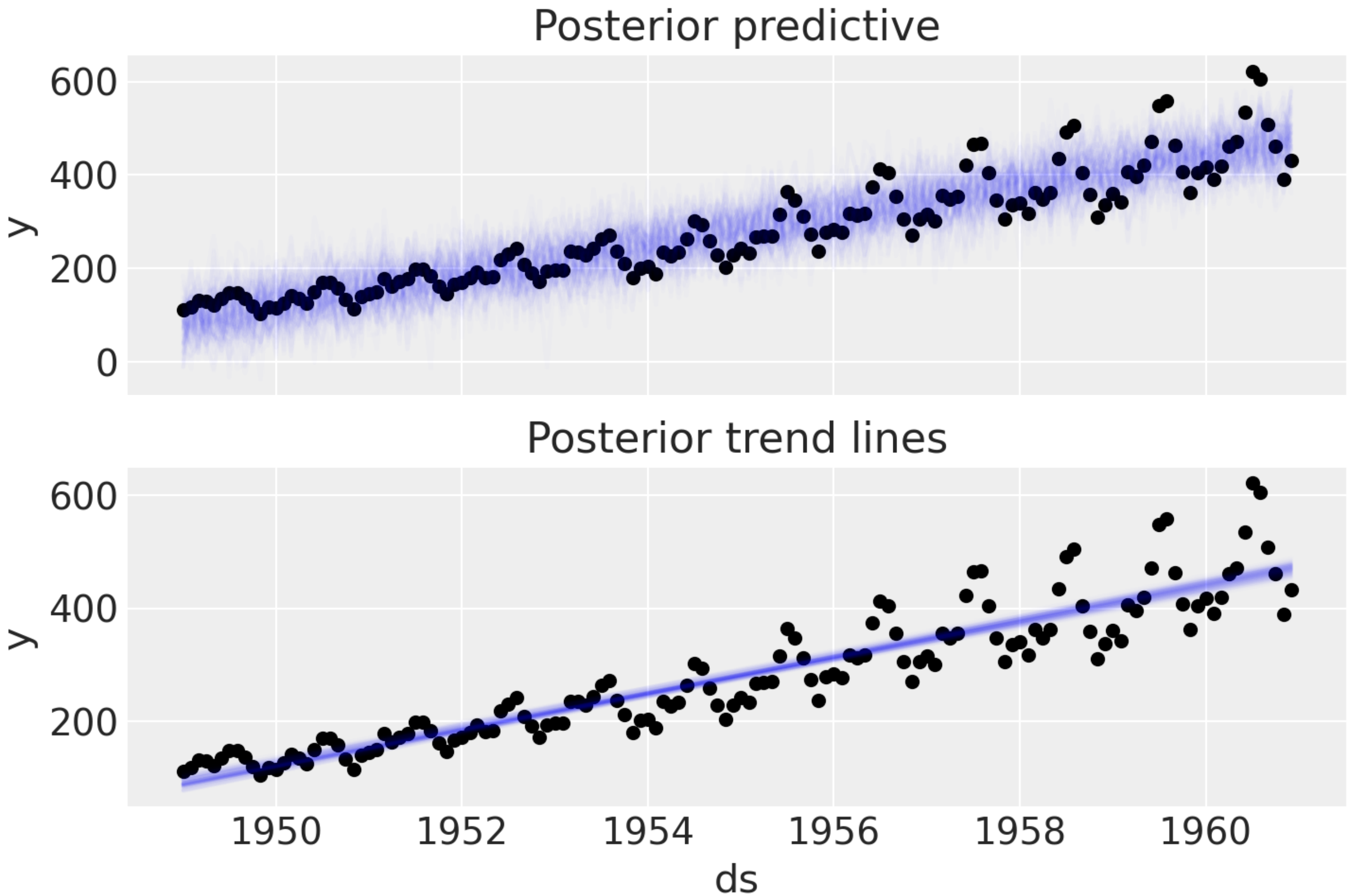
Updated priors



Posterior predictions

- Incorporate our actual data and then compare our model to observed outcomes
- Decide if we think that our model can make reasonable predictions

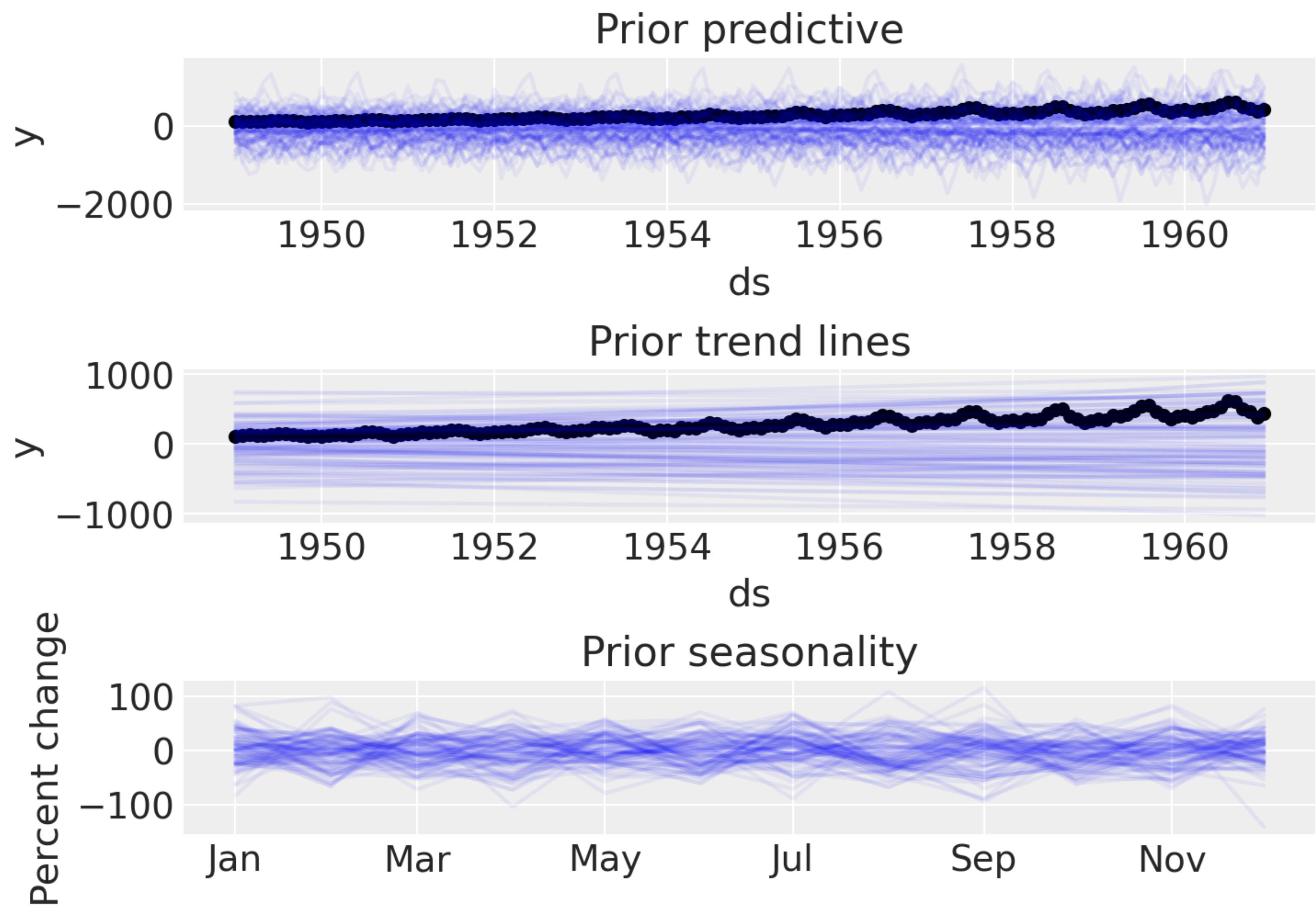
Posterior predictions



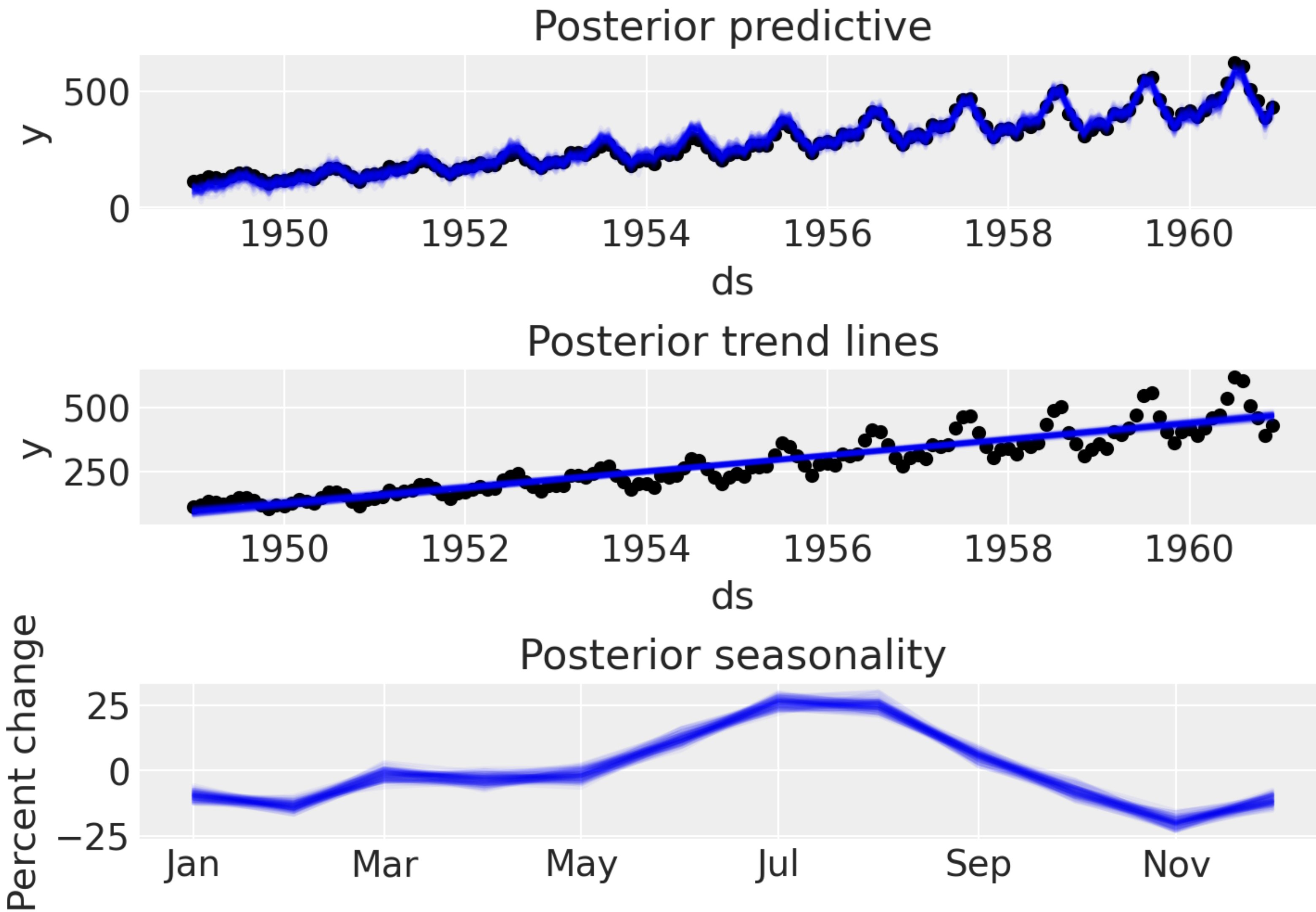
Adding seasonality

We add a group of periodic functions (fourier features) to function as our "seasonality splines" (if we think of our model as a GAM). They will get stretched or weighted based on observations.

Seasonal priors

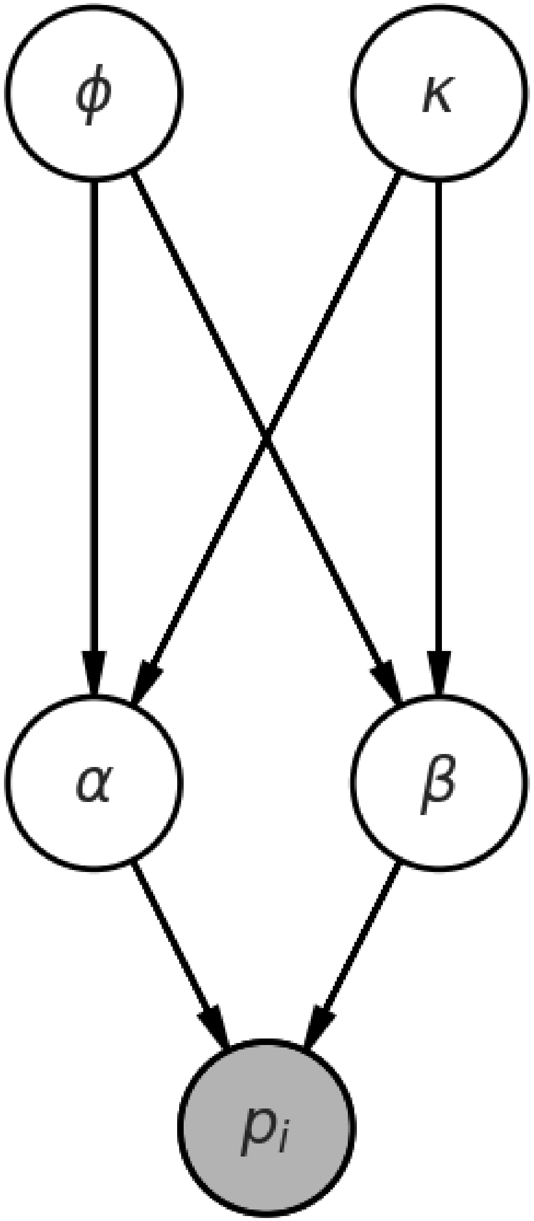


Seasonal posteriors

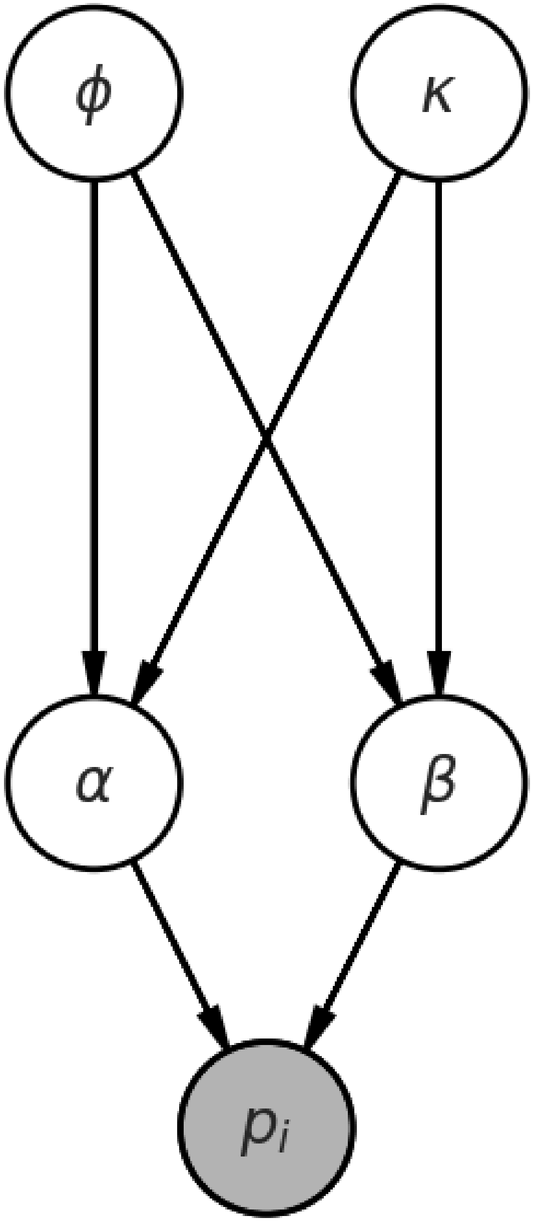


Modeling baseball outcomes

A revised/updated version of this tutorial

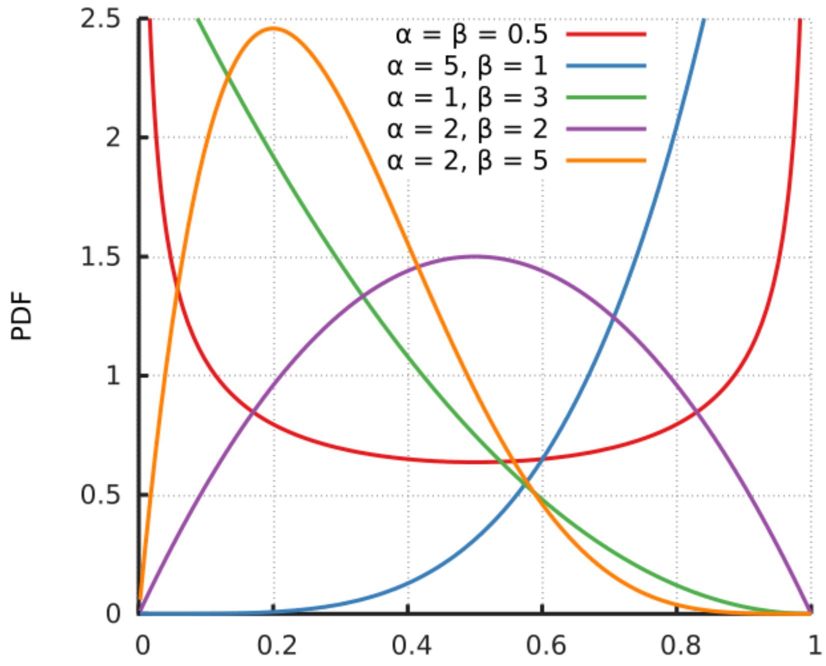


- ϕ (phi) - Our population-level expectation of batting average
- κ (kappa) - Population variance in batting average
- α, β - Parameters of our beta distribution
- p_i - Individual batting average



$$\alpha = \phi \cdot \kappa$$

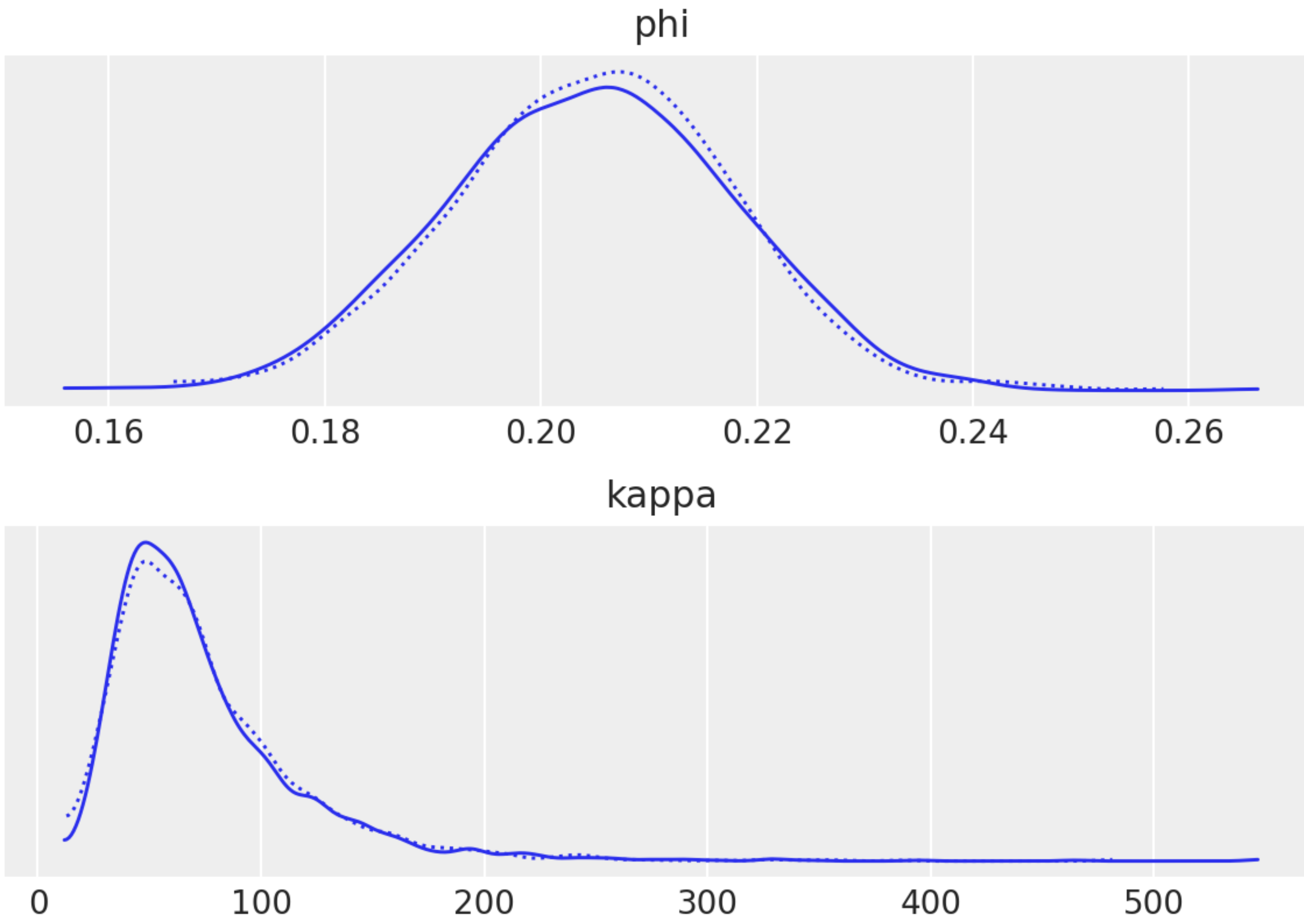
$$\beta = (1 - \phi) \cdot \kappa$$



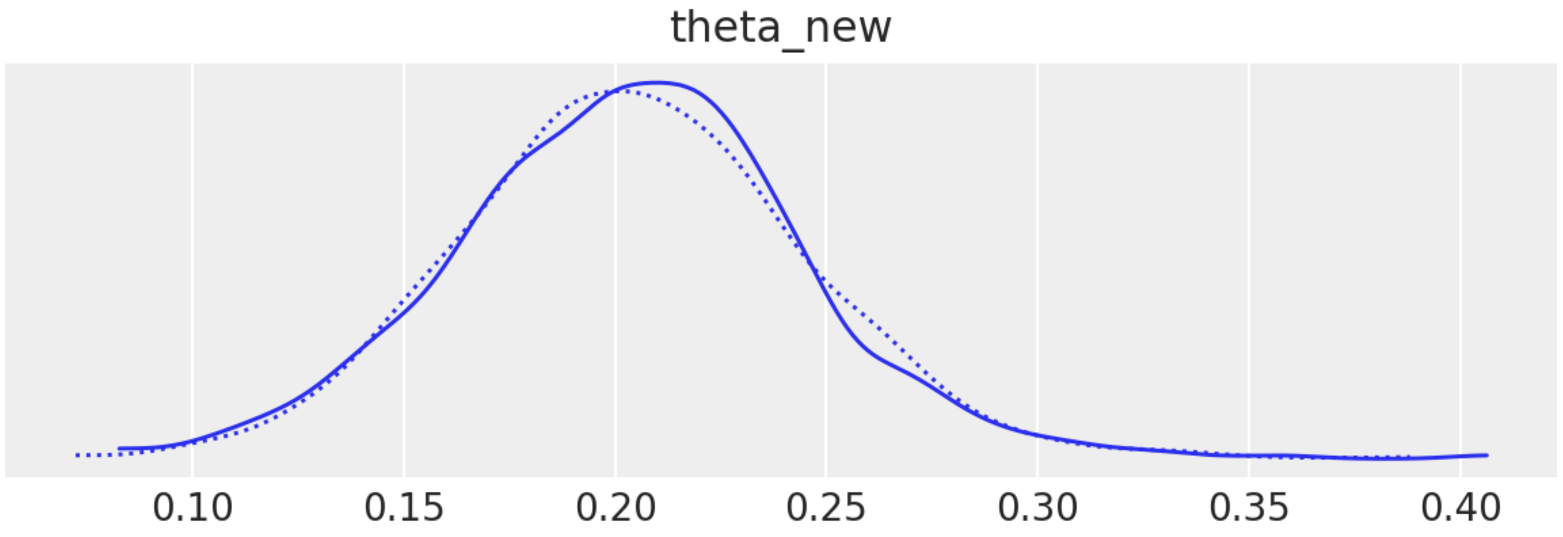
Beta distribution

- Used where there are binary outcomes (hit or no hit)
- Tilts toward 1 or 0 based on observed outcomes and concentration of those outcomes

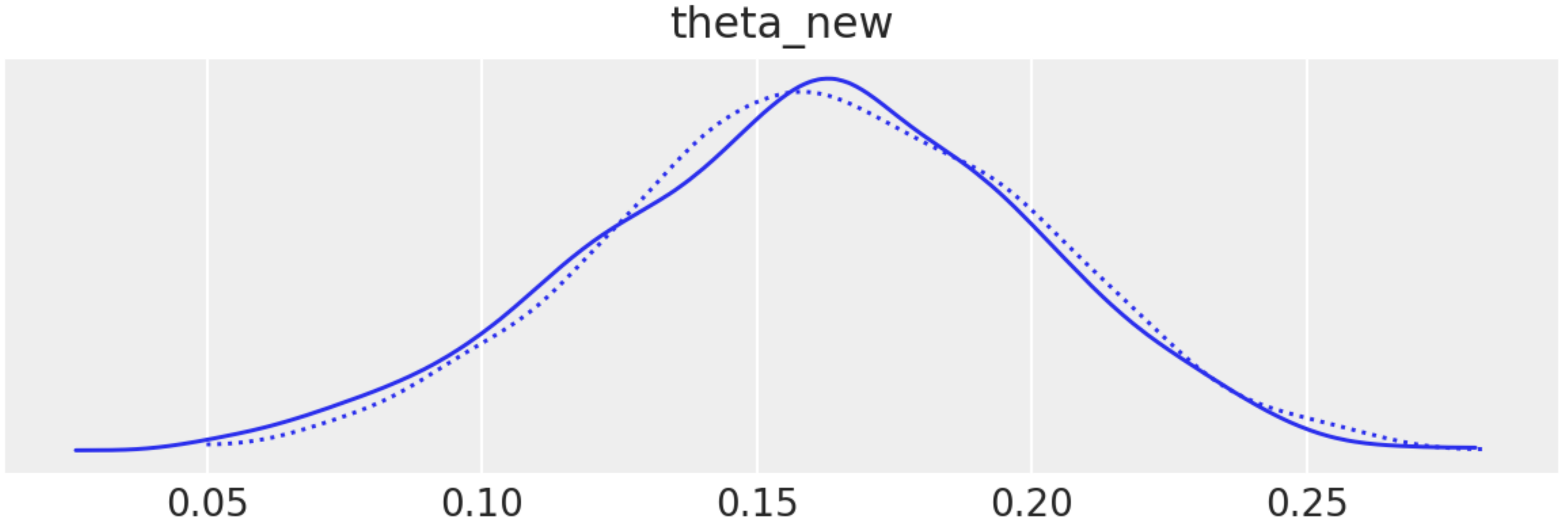
Population values



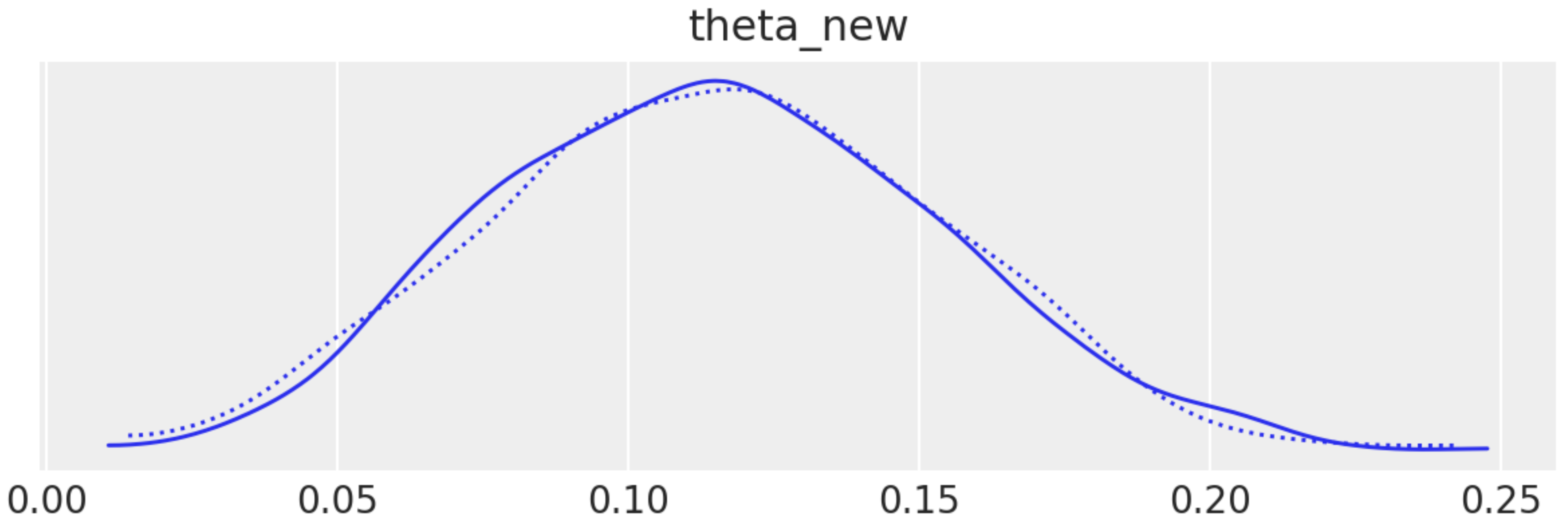
Player with 4 at-bats, no hits



Player with 25 at-bats, no hits



Player with 50 at-bats, no hits



Mariners 2021