

Homework 9

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Research question

Our research question is: Does the impact of rewards (in the form of likes) on tweeting rate decrease as habit strength (as measured by prior tweeting frequency) increases?

Variables

- `tdiff_pmcs`: Time difference between a tweet and the immediately preceding tweet (person-mean centered and scaled)
- `likes_24hours_pmcs`: Number of likes received in the past 24 hours (person-mean centered and scaled)
- `likes_24hours_pms`: Person-mean number of likes received in the past 24 hours (scaled)
- `avg_day_cs`: Habit strength - Average number of tweets per day (centered and scaled)

Variable Summary

```
datasummary_skim(x %>% select(tdifff_pmcs, likes_24hours_pmcs, likes_24hours_pms, avg_day_cs))
```

Model

Let $Y = \text{tdiff_pmcs}$

$\text{likes} = \text{likes_24hours_pmcs}$





$\text{avg_likes} = \text{likes_24hours_pms}$

$\text{habit} = \text{avg_day_cs}$

$$y_{ij} = \beta_{0j} + \beta_{1j}\text{likes}_{ij} + e_{ij}$$

$$\beta_{0j} = \gamma_{00} + \gamma_{01}\text{habit}_j + \gamma_{02}\text{avg_likes} + \mu_{0j}$$

$$\beta_{1j} = \gamma_{10} + \gamma_{11}\text{habit}_j + \mu_{1j}$$

	Unique (#)	Missing (%)	Mean	SD	Min	Median	Max	
<code>tdiff_pmcs</code>	13175	0	0.0	1.0	-4.4	-0.1	3.7	
<code>likes_24hours_pmcs</code>	1577	2	0.0	1.0	-2.7	-0.3	19.0	
<code>likes_24hours_pms</code>	173	0	0.2	1.0	0.0	0.0	7.4	
<code>avg_day_cs</code>	209	0	0.0	1.0	-1.6	-0.2	2.0	

Priors

$$\gamma_{00} \sim N(0, 1)$$

$$\gamma_{01} \sim N(0, 1)$$

$$\gamma_{02} \sim N(0, 1)$$

$$\gamma_{10} \sim N(0, 1)$$

$$\gamma_{11} \sim N(0, 1)$$

$$e_{ij} \sim t_4^+(0, 3)$$

$$\mu_{0j} \sim t_4^+(0, 3)$$

$$\mu_{1j} \sim t_4^+(0, 3)$$

Results

```
m1 <- brm(tdiff_pmcs ~ likes_24hours_pmcs * avg_day_cs + likes_24hours_pms + (1 | subject),
  prior = c(
    prior(normal(0, 1), class = 'Intercept'),
    prior(normal(0, 1), class = 'b'),
    prior(student_t(4, 0, 3), class = 'sd'),
    prior(student_t(4, 0, 3), class = 'sigma')
  ),
  data = x, family = gaussian(link = "identity"),
  cores = numcor, seed = 1,
  file = 'Twitter Main Analysis.rds')

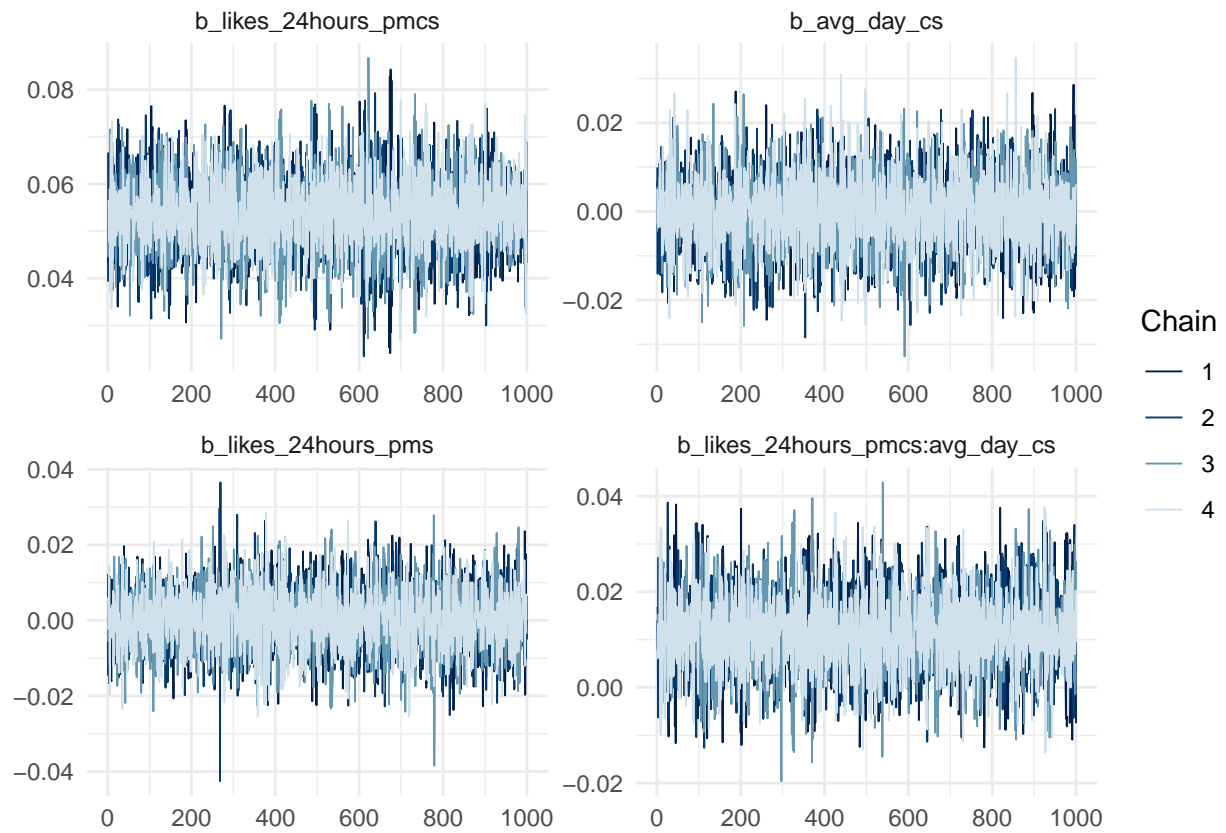
# Uncomment to read bayesian model results from .rds file

m1 <- readRDS('Twitter Main Analysis.rds')
```

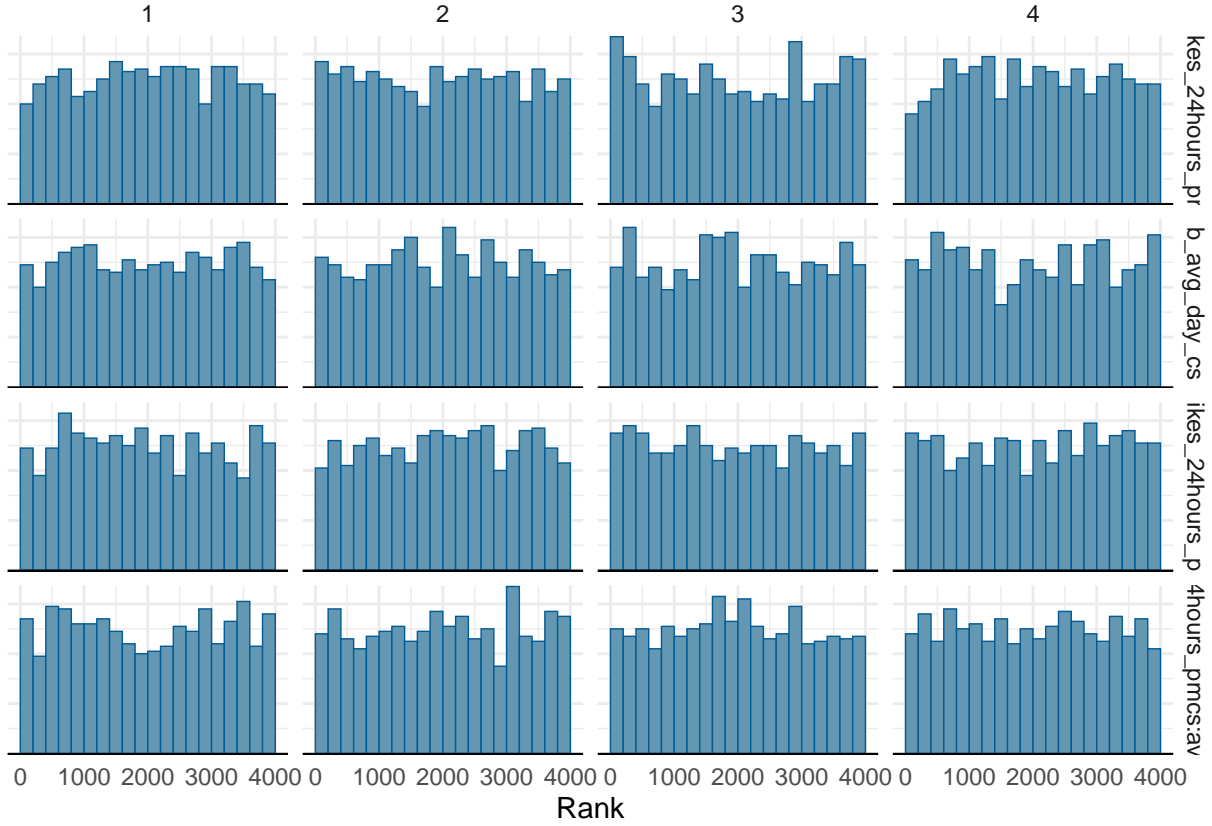
Convergence

The plots below suggest that the models do converge, and are suitable to estimate the desired effects.

```
mcmc_trace(m1, pars = c('b_likes_24hours_pmcs', 'b_avg_day_cs', 'b_likes_24hours_pms',
  'b_likes_24hours_pmcs:avg_day_cs'))
```



```
mcmc_rank_hist(m1, pars = c('b_likes_24hours_pmcs', 'b_avg_day_cs', 'b_likes_24hours_pms',
                             'b_likes_24hours_pmcs:avg_day_cs'))
```



Posterior distribution of key parameters

```
sum_m1 <- as_draws_df(m1) %>%
  summarize_draws() %>%
  filter(variable %in% c('b_intercept',
                        'b_likes_24hours_pms', 'b_avg_day_cs', 'b_likes_24hours_pms',
                        'b_likes_24hours_pms:avg_day_cs'))

sum_m1 %>%
  knitr::kable(digits = 3)
```

variable	mean	median	sd	mad	q5	q95	rhat	ess_bulk	ess_tail
b_likes_24hours_pms	0.054	0.054	0.008	0.008	0.040	0.068	1.001	9788.886	2717.732
b_avg_day_cs	0.000	0.000	0.009	0.009	-0.015	0.014	1.000	8989.524	3090.495
b_likes_24hours_pms	0.000	0.000	0.009	0.008	-0.014	0.014	1.000	9325.825	2809.565
b_likes_24hours_pms:avg_day_cs	0.011	0.012	0.009	0.008	-0.003	0.026	1.001	11247.509	2816.381

Discussion

Based on the results, we do see a positive β effect of likes over the past 24 hours on users' latency to tweet again. However, we do not see effects of prior tweeting rates on latency in our model, nor we do not see an interaction effect between reward and habit strength in predicting tweet frequency.