Longitudinal Data Analysis II

PSYC 575

October 6, 2020 (updated: 18 October 2020)

Learning Objectives

- Describe the difference between analyzing trends vs. analyzing **dynamics** with longitudinal data
- Run analyses with **time-varying predictors** (i.e., level-1 predictors)
- Interpret and plot results

Example

The Cognition, Health, and Aging Project

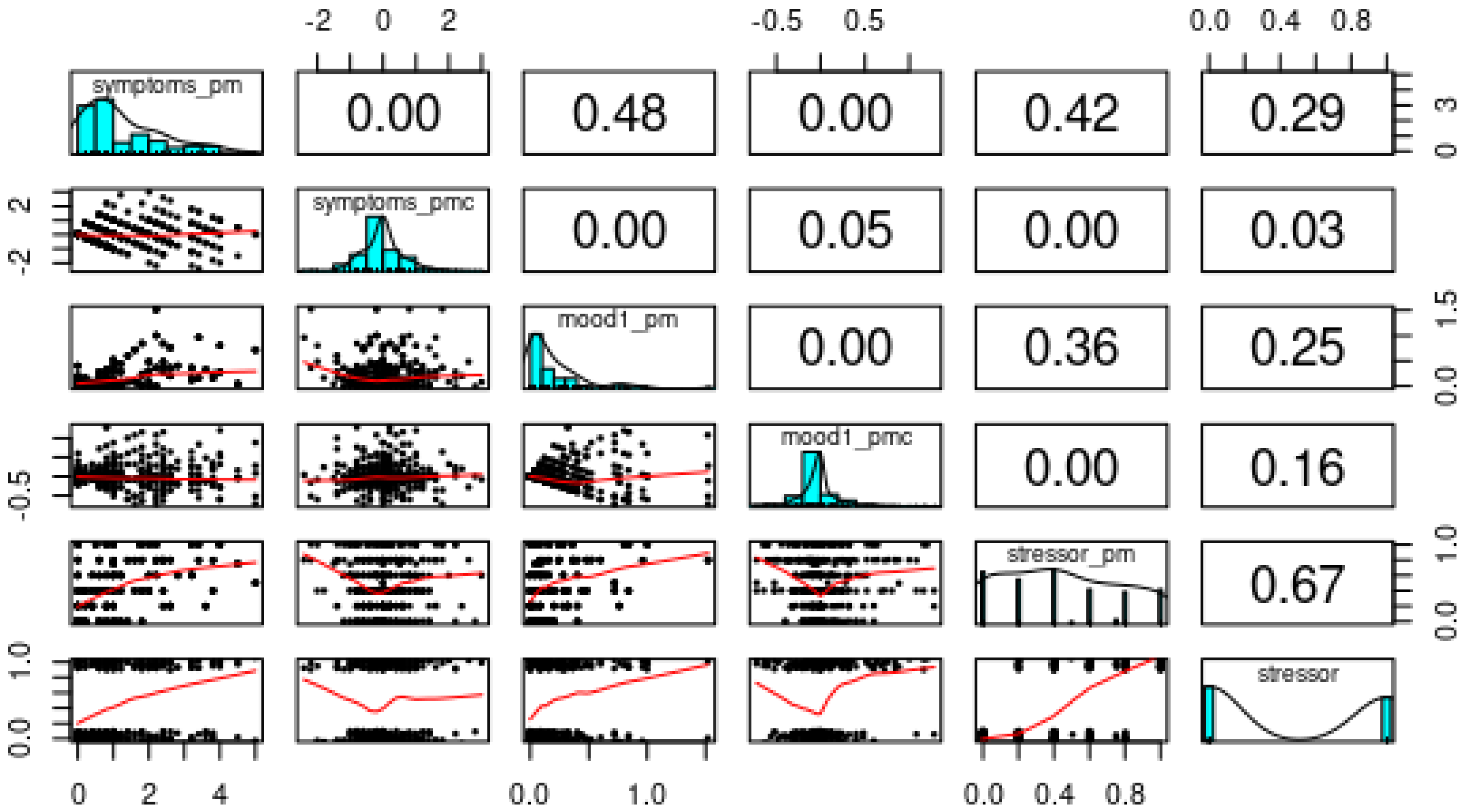
- The first wave of the CHAP
- Six observations over a two-week period
  - Sessions 2-6
- baseage: *M* = 80.13 (*SD* = 6.11)

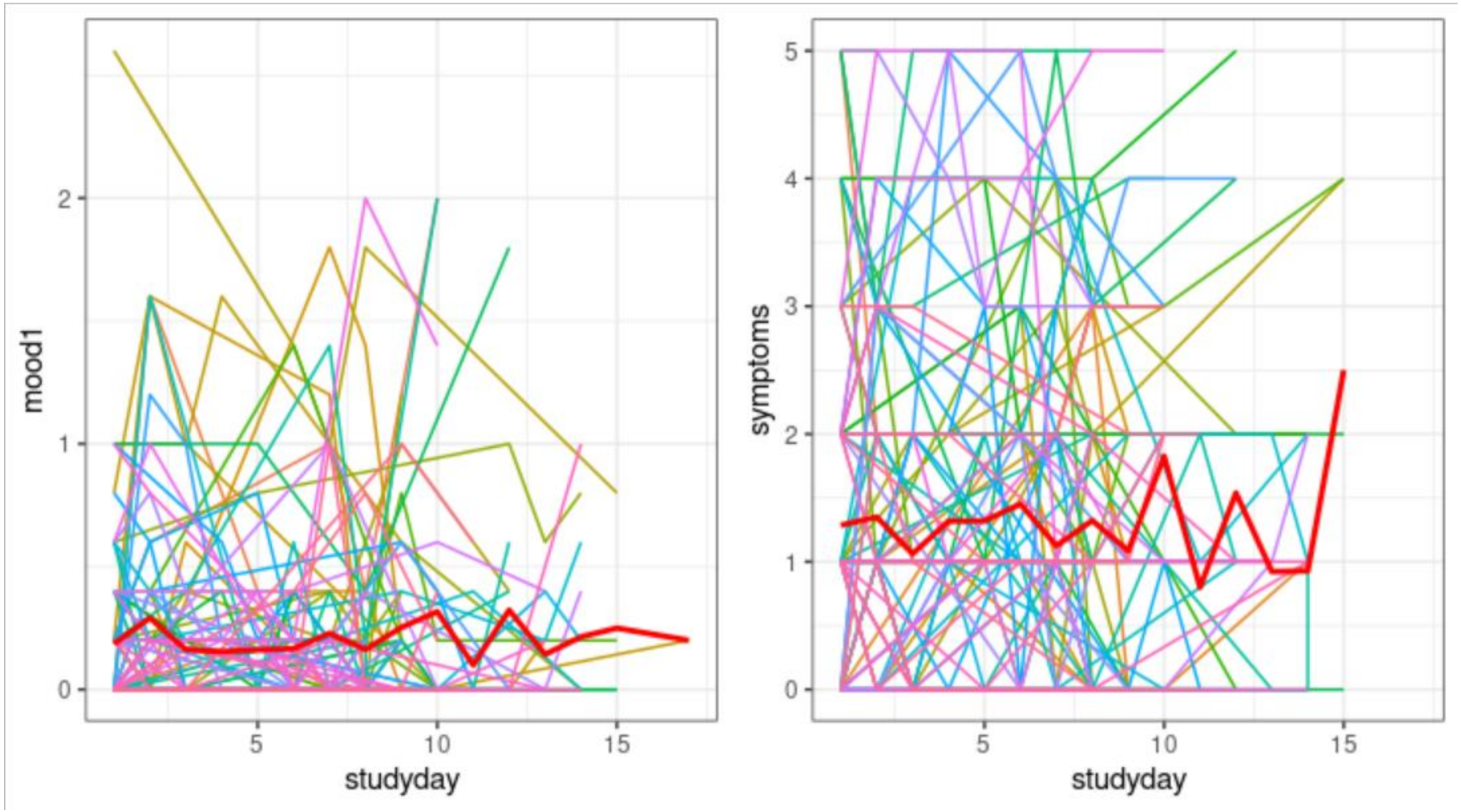
Time-Varying Covariates

- Variables at the within-person level that changes over time
- Need cluster-mean/person-mean centering
  - Between-person/within-person effects
- `Symptoms`: Number of physical symptoms in the past 24 hours
  - Max = 5
- `Mood`: Daily report negative mood (1 – 5)
  - `Mood1`: center at 1 (0 – 4)
- Stressor: Presence of a daily stressor (0 = stressor-free day; 1 = stressor day)

Decomposition of Effects

- Very important for some variables with longitudinal data
  - But not for the “time” variable
  - May not be meaningful for other measures of time (e.g., age)
- Trait: Person mean, time-invariant (in some sense)
- State: Deviation (fluctuation) from person mean, time-varying


symptoms_pm
symptoms_pmc
mood1_pm
mood1_pmc
stressor_pm
stressor
0.00
0.48
0.00
0.42
0.29
0.00
0.05
0.00
0.03
0.00
0.36
0.25
0.00
0.16
0.67
-2 0 2
-0.5 0.5
0.0 0.4 0.8
0 3
-2 2
0.0 1.5
-0.5
0.0 1.0
0.0 1.0
0 2 4
0.0 1.0
0.0 0.4 0.8


mood1
2
1
0
5
10
15
studyday
symptoms
5
4
3
2
1
0
5
10
15
studyday

Describing Fluctuations

- TIME may not be a predictor (unless a stable trend is expected)
- The interest is in the momentary changes

Model 1

Model Equations

Level 1:

$$\text{symptoms}_{ti} = \beta_{0i} + \beta_{1i}\text{mood1\_pmc}_{ti} + e_{ti}$$

Level 2:

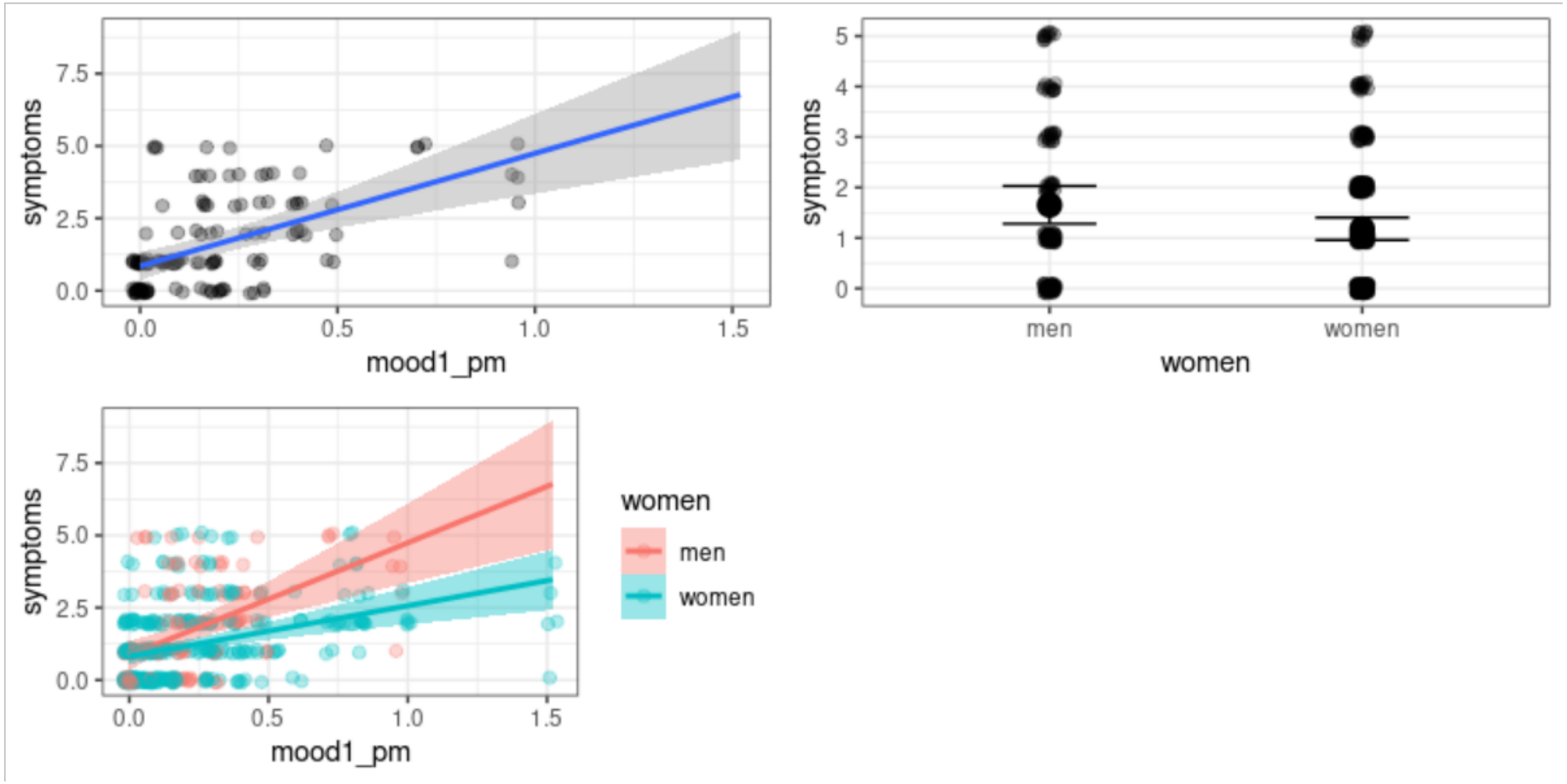
$$\beta_{0i} = \gamma_{00} + \gamma_{01}\text{mood1\_pm}_i + \gamma_{02}\text{women}_i + \gamma_{03}\text{mood1\_pm}_i \times \text{women}_i + u_{0i}$$
$$\beta_{1i} = \gamma_{10} + \gamma_{11}\text{women}_i + u_{1i}$$

Fixed Effects (with **brms**)

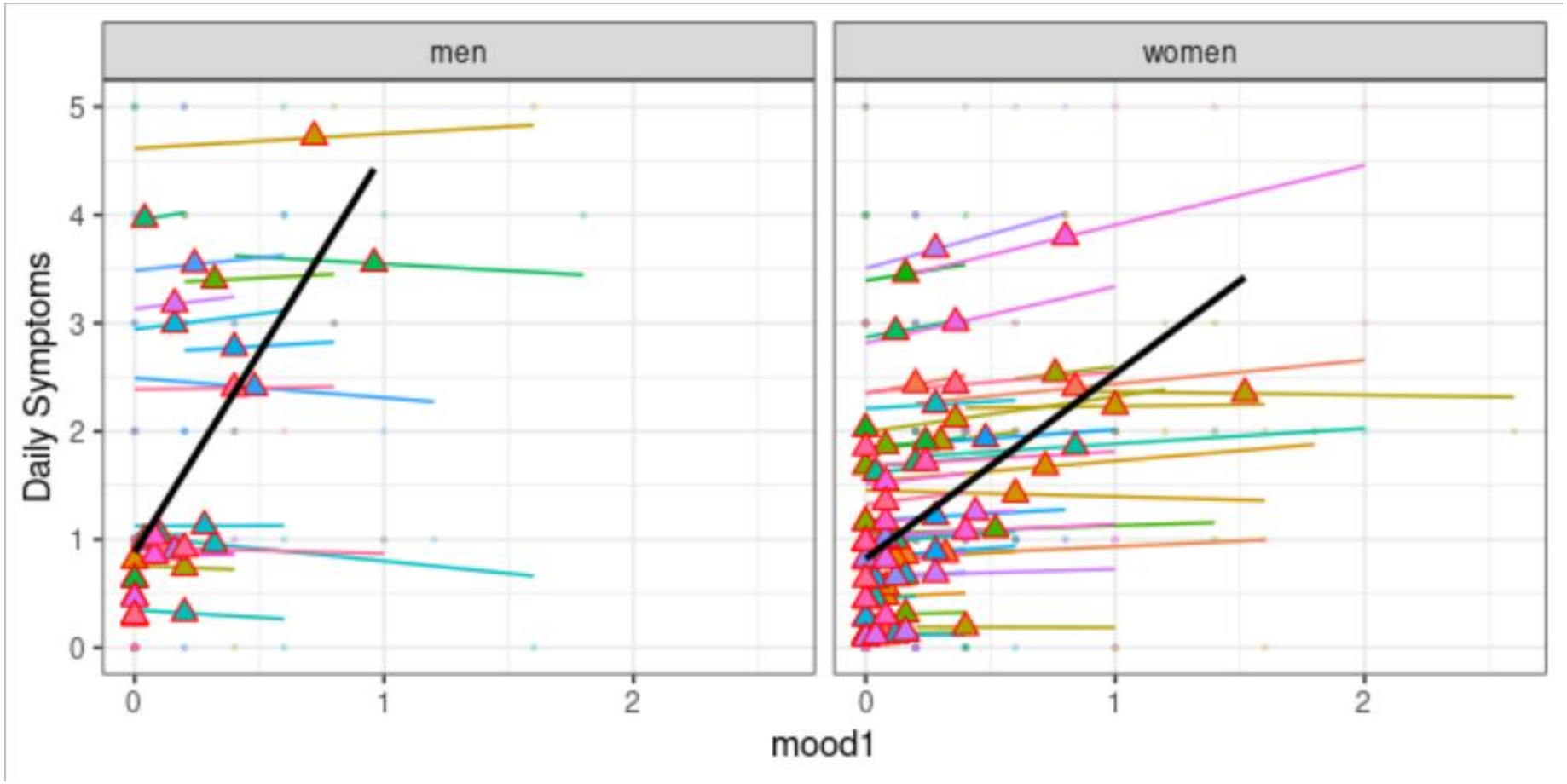
	Estimate	Est.Error	l-95% CI	u-95% CI	Rhat	Bulk_ESS	Tail_ESS
Intercept	0.85	0.25	0.35	1.34	1.00	566	1119
mood1_pm	3.89	0.83	2.22	5.52	1.00	639	1101
mood1_pmc	0.02	0.29	-0.56	0.58	1.00	1713	2261
womenwomen	-0.03	0.29	-0.58	0.54	1.00	566	1183
mood1_pm:womenwomen	-2.15	0.91	-3.87	-0.31	1.00	655	1189
mood1_pmc:womenwomen	0.15	0.33	-0.52	0.80	1.00	1681	2128

Note the between-person and the within-person effects are drastically different

conditional_effects(m1)



Between/Within Effects

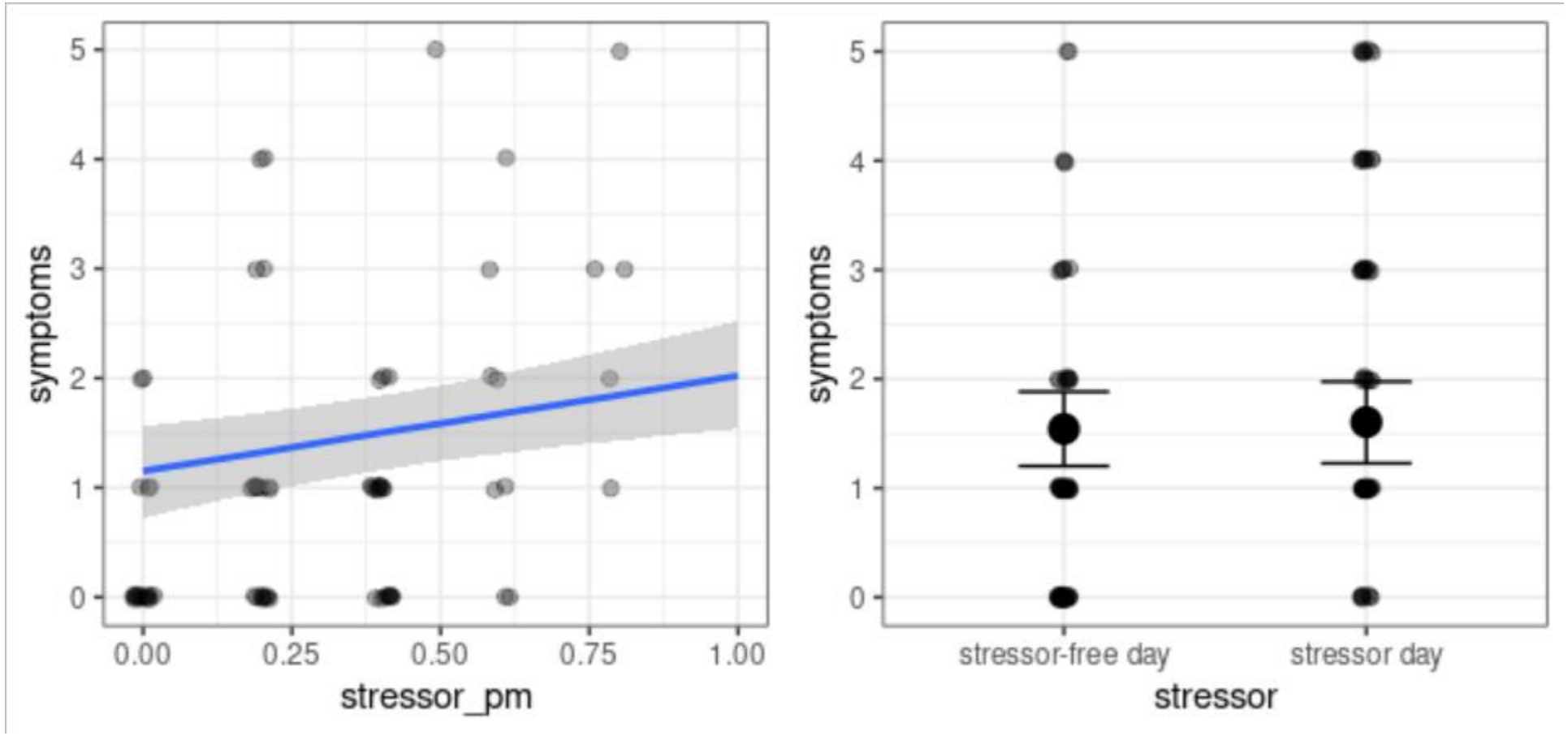


Model 2

Add `stressor` to the Equation

- A time-varying binary variable
- `stressor_pm` (person mean): Average stress level of a person (over the study period)
- However, the deviation from the person mean is harder to interpret
  - E.g., `stressor_pmc` = 0.8?
  - Methodologists do not agree how to treat it, but for this example we'll keep the binary lv-1 variable
  - ➔ Contextual & within-person

Contextual and Within-Person Effects



Contextual Effect

```
Population-Level Effects:
                    Estimate Est.Error l-95% CI u-95% CI Rhat Bulk_ESS Tail_ESS
...
stressor_pm             0.88      0.30     0.28     1.46 1.00      992     1343
stressorstressorday     0.06      0.10    -0.13     0.26 1.00     3029     3013
```

- On a stressor day (or a stressor-free day), a person who is one unit higher on average stress level reported on average 0.88 more symptoms, 95% CI [0.28, 1.46].

Topics Not Covered

- Comparable metric across time
  - Vertical scaling/Longitudinal measurement invariance
- Lag relationship/cross-lagged/autoregressive model (but see the bonus handout)
- Parallel-process model
- Missing data handling
- Multiple cohort design