I

Likelihood of the Response Data

Production from system, s, in period t

$$prod_{st} \sim N(\hat{y}_{st}, \sigma)$$

II

Decomposition of Fitted Data

Intercept and slope that vary by system plus month-of-year dummies that control for seasonality and vary by county

$$\hat{y}_{st} = a_s + b_s months\_operation_{st} + \mathbf{mon}_{\mathbf{c}}$$

III

System level parameters and decomposition of slope term

Slope terms modelled with location parameter that is a linear function of system-level variables

$$a_s \sim N(\mu^a, \sigma^a)$$

$$b_s \sim N(\mu_s^b, \sigma_s^b)$$

$$\mathbf{mon}_{\mathbf{c}} \sim N(\mu^{mon}, \sigma^{mon})$$

$$\mu_s^b = \mu_l^{lease} + \mu_s^{sect} + \mu_m^{manuf} + \beta^{fy} first\_prod\_year_s + \beta^{size} csi\_rating_s + \beta^{cost} cost_s$$

IV

Meta-parameters

Regularizing higher level distributions

$$\mu^k \sim Cauchy(0,1) \quad k \in \{\text{lease, sect, manuf, a, mon}\}$$

$$\beta^i \sim Cauchy(0,1) \quad i \in \{\text{fy, size, cost}\}$$

$$\sigma_s^b \sim half-Cauchy(x_0, \gamma)$$

$$\sigma^f \sim half-Cauchy(0,5) \quad f \in \{a, \mu, \beta\}$$