Nonlinear Regression Model

September 28, 2021

1 Overview

This week I worked on implementing the non-linear model we discussed last time. Let g be whatever group we decide to calculate idleness for (Judge or County) and let i be our current observation, which is a judge-county combination. The non-linear model is:

$$\mu_g \text{Days}_i = \beta_P \text{Plea}_i + \beta_T \text{Trial}_i + \epsilon_i$$

Where we interpret μ_g to be the utilization of group g. I was having a hard time implementing this, so I asked Walter for advice, and he suggested that I define the function $f(\mu_g, \beta_P, \beta_T) = (\mu_g \text{Days}_i - \beta_P \text{Pleas}_i - \beta_T \text{Trials}_i)^2$ and that I use a standard nonlinear optimizer to minimize it. Walter mentioned that I might have convergence problems since the model is not identified (i.e. multiplying all of the coefficients by any constants would still make the equation hold). Following your advice, I set $\mu_g = 1$ for a judge/county that is not the most productive one. I just picked a one randomly, the baseline judge was Judge 41, and the baseline county was Aiken.

2 Results

The model runs and yields estimates of μ_g between 0 and 1 for all judges and counties, however, the estimates of β_T and β_P it gives seem unreasonable. The β_T estimates seem too low and the β_P estimates seem too high.

2.1 County Model

The results in this subsection correspond to the model: $\mu_c \text{Days}_i = \beta_P \text{Plea}_i + \beta_T \text{Trial}_i + \epsilon_i$. Where i is a judge-county combination and c is a county. The county model yields $\beta_T = 1.58$, which would imply that it takes a little over a day and a half to process a trial. The county model also yields $\beta_P = 0.02$, which would imply judges can process 50 pleas per day.

Table 1: County Model

Parameter	Estimate
Abbeville	0.16
Aiken	1.00
Allendale	0.01
Anderson	0.26
Bamberg	0.06
Barnwell	0.19
Beaufort	0.08
Berkeley	0.19
Calhoun	0.05
Charleston	0.16
Cherokee	0.24
Chester	0.07
Chesterfield	0.18
Clarendon	0.09
Colleton	0.07
Darlington	0.06
Dillon	0.04
Dorchester	0.37
Edgefield	0.08
Fairfield	0.19
Florence	0.17
Georgetown	0.21
Greenville	0.22
Greenwood	0.16
Hampton	0.04
Horry	0.24
Jasper	0.16
Kershaw	0.10
Lancaster	0.07
Laurens	0.13
Lee	0.15
Lexington	0.18
Marion	0.13
Marlboro	0.08
McCormick	0.05
Newberry	0.12
Oconee	0.15
Orangeburg	0.15
Pickens	0.14
Richland	0.18
Saluda	0.15
Spartanburg	0.27
Sumter	0.16
Union	0.14
Williamsburg	0.06
York	0.26
BetaP 2	0.02
BetaT	1.58

2.2 Judge Model

The results in this subsection correspond to the model: $\mu_j \text{Days}_i = \beta_P \text{Plea}_i + \beta_T \text{Trial}_i + \epsilon_i$. Where i is a judge-county combination and j is a judge. The judge model yields $\beta_T = 0.06$. The judge model also yields $\beta_P = 0.01$, which would imply judges can process 100 pleas per day.

Table 2: Judge Model

Parameter	Estimate
Judge 1	0.03
Judge 10	0.04
Judge 11	0.03
Judge 12	0.04
Judge 13	0.03
Judge 14	0.04
Judge 15	0.04
Judge 16	0.17
Judge 17	0.04
Judge 18	0.03
Judge 19	0.06
Judge 2	0.04
Judge 20	0.03
Judge 21	0.02
Judge 22	0.07
Judge 23	0.03
Judge 24	0.05
Judge 25	0.07
Judge 26	0.06
Judge 27	0.04
Judge 28	0.04
Judge 29	0.04
Judge 3	0.04
Judge 30	0.02
Judge 31	0.03
Judge 32	0.05
Judge 33	0.07
Judge 34	0.06
Judge 35	0.04
Judge 36	0.03
Judge 37	0.03
Judge 38	0.06
Judge 39	0.07
Judge 4	0.03
Judge 40	0.04
Judge 41	1.00
Judge 42	0.09
Judge 43	0.04
Judge 44	0.07
Judge 45	0.02
Judge 46	0.12
Judge 47	0.04
Judge 48	0.04
Judge 49	0.03
Judge 5	0.08
Judge 50	0.05
Judge 6	0.06
Judge 7	0.05
Judge 8	0.05
Judge 9	0.06
BetaP	0.01
BetaT	0.06