Another approach

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Current challenges

So far, I have not been able to really find a good approach that works consistently. Brian and I had originally discussed fixing both ρ and α in the simulation study, because when they're fixed to the true values, we can outperform spatial probit and logit. There appears to be some challenges when trying to estimate α using the pairwise likelihood, but it would appear that the pairwise likelihood does a reasonably good job estimating the bandwidth term ρ. I've been spending time trying to better understand how this will impact the results from the MCMC, and overall, I think the impact of fixing α (even if the value is not correct) will be minimal.

The role of α

One of the roles of α in the conditional likelihood for the MCMC (i.e. conditional on knowing θ) is to allow for more variability in the positive stable random variables. As $\alpha \to 0$, $\text{var}(A) \nearrow$, and as $\alpha \to 1$, the density converges to a point mass at 1. In the binary framework, I do not think it is important that we get the actual intensity of the A terms correct. However, we do want to ensure that we can maintain the relative intensities of the knots. While running some test cases of MCMC, it seems as if $\alpha = 0.5$ would result in a sequence of knots like $\{1, 4, 5, 2, 8\}$ whereas $\alpha = 0.2$ would result in a sequence of knots like $\{100, 400, 500, 200, 800\}$.

Goal

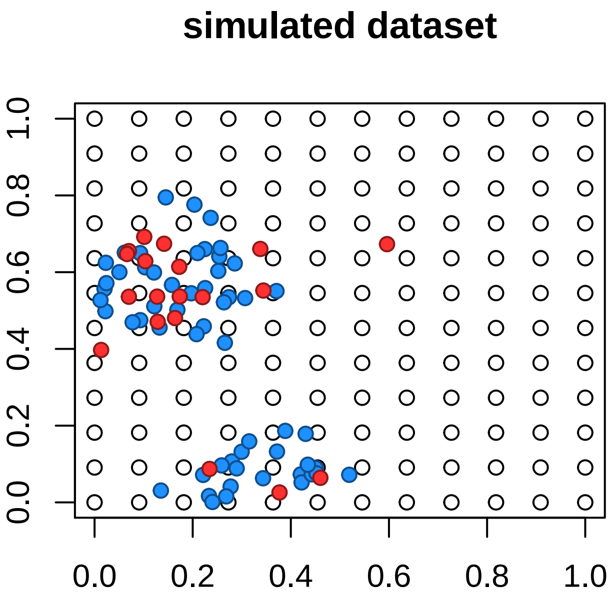
This document explores two changes to how we're conducting the analysis. The first change is to fix α and ρ to the estimates from the pairwise composite likelihood. To estimate rho, we do a grid search using `optim` at 5 different values of ρ based on knot spacing. Then we take the value for ρ that minimizes the negative log pairwise composite likelihood (PCL). The second change is to try a new candidate distribution for the β and ξ terms. Initially, we just used a random walk metropolis step for each term. In this update, we are using a candidate distribution based on the estimates and hessian matrix from the PCL. We will be drawing candidates for β and ξ using a multivariate t distribution with $\nu = 15$ degrees of freedom that has been shifted to $(\widehat{\beta}, \widehat{xi}$, and has dispersion matrix H^{-1} where H is the hessian matrix from the PCL. Although there may be some concerns about fully exploring the posterior density, Brian and I thought this would be a reasonable way to work around convergence issues that present themselves when using a random walk.

Setting 1:

$\alpha = 0.35, \pi = 0.05, \rho = 0.15$

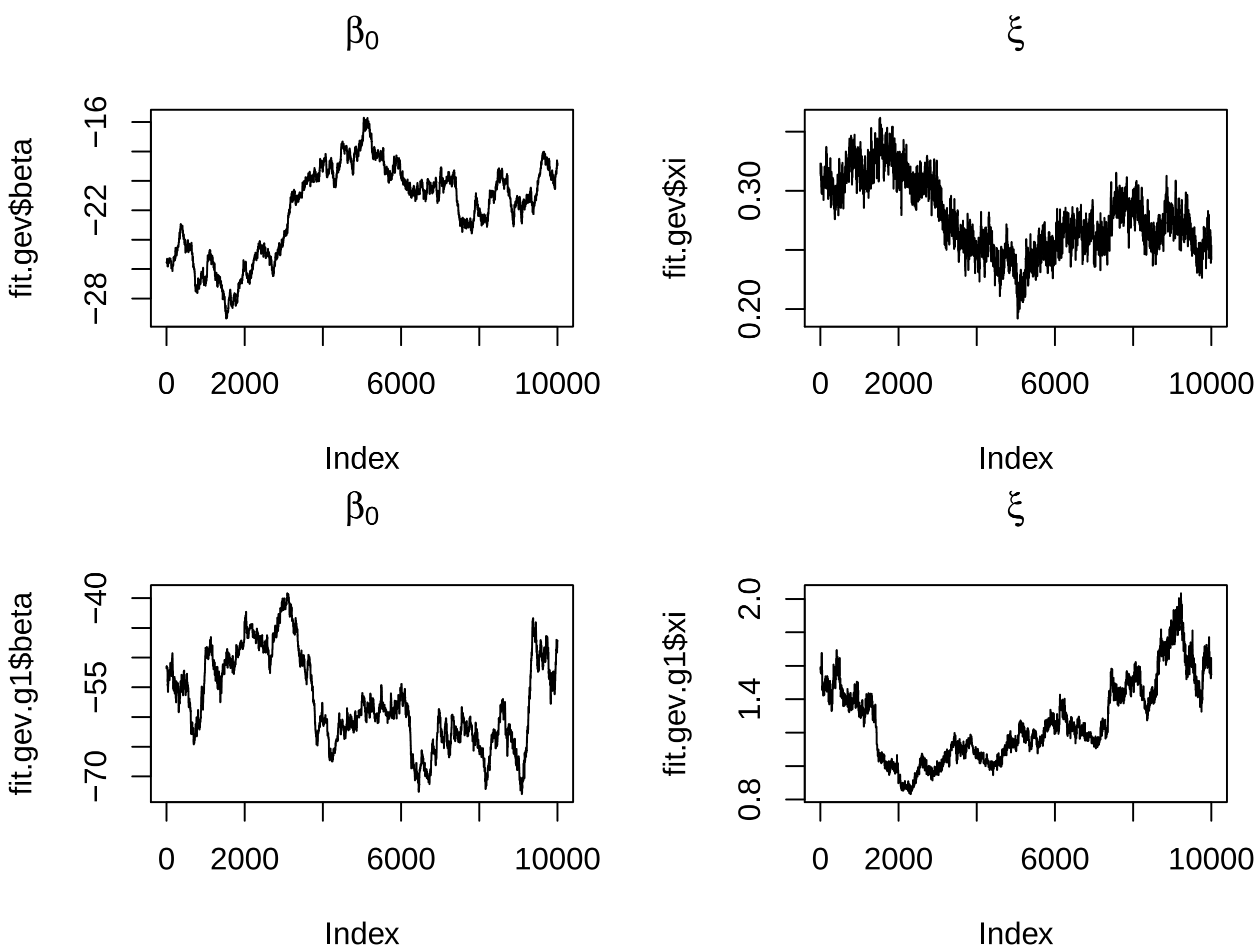
Dataset 1

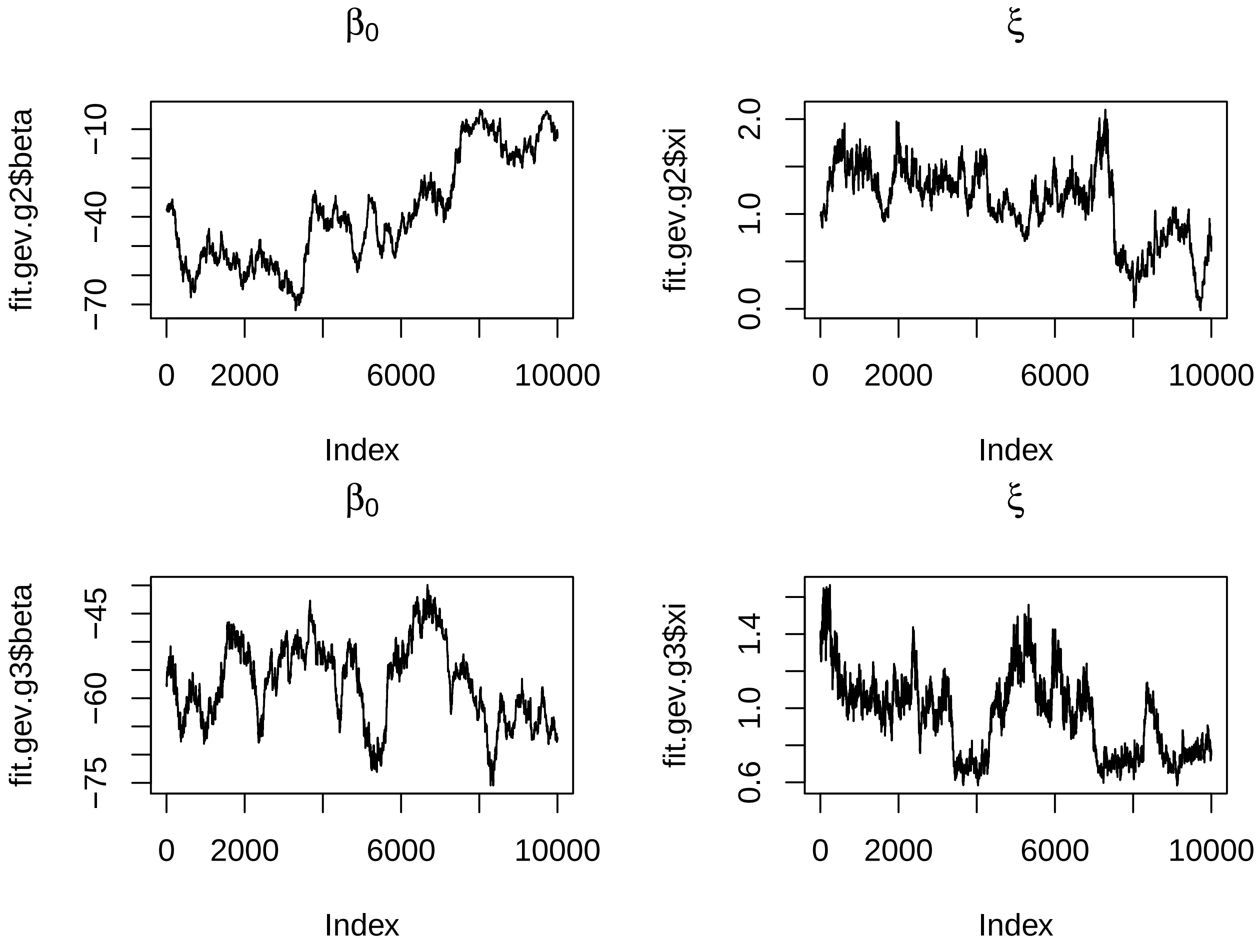
From the pairwise likelihood, we'll be using $\rho = -2.078$. The estimates for the other parameters are $\widehat{\alpha} = 1.286$, $\widehat{\xi} = -2.078$, and $\widehat{\beta}_0 = 0.094$.



MCMC Results

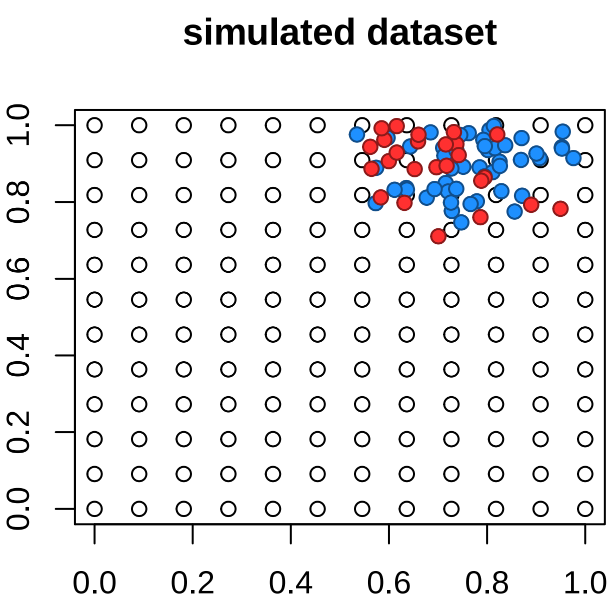
Here are the iteration plots from the GEV model. The true values are $\beta_0 = -4.659$, and $\xi = 0.25$. This is using $\widehat{\alpha}$ and $\widehat{\rho}$ from the PCL fit.





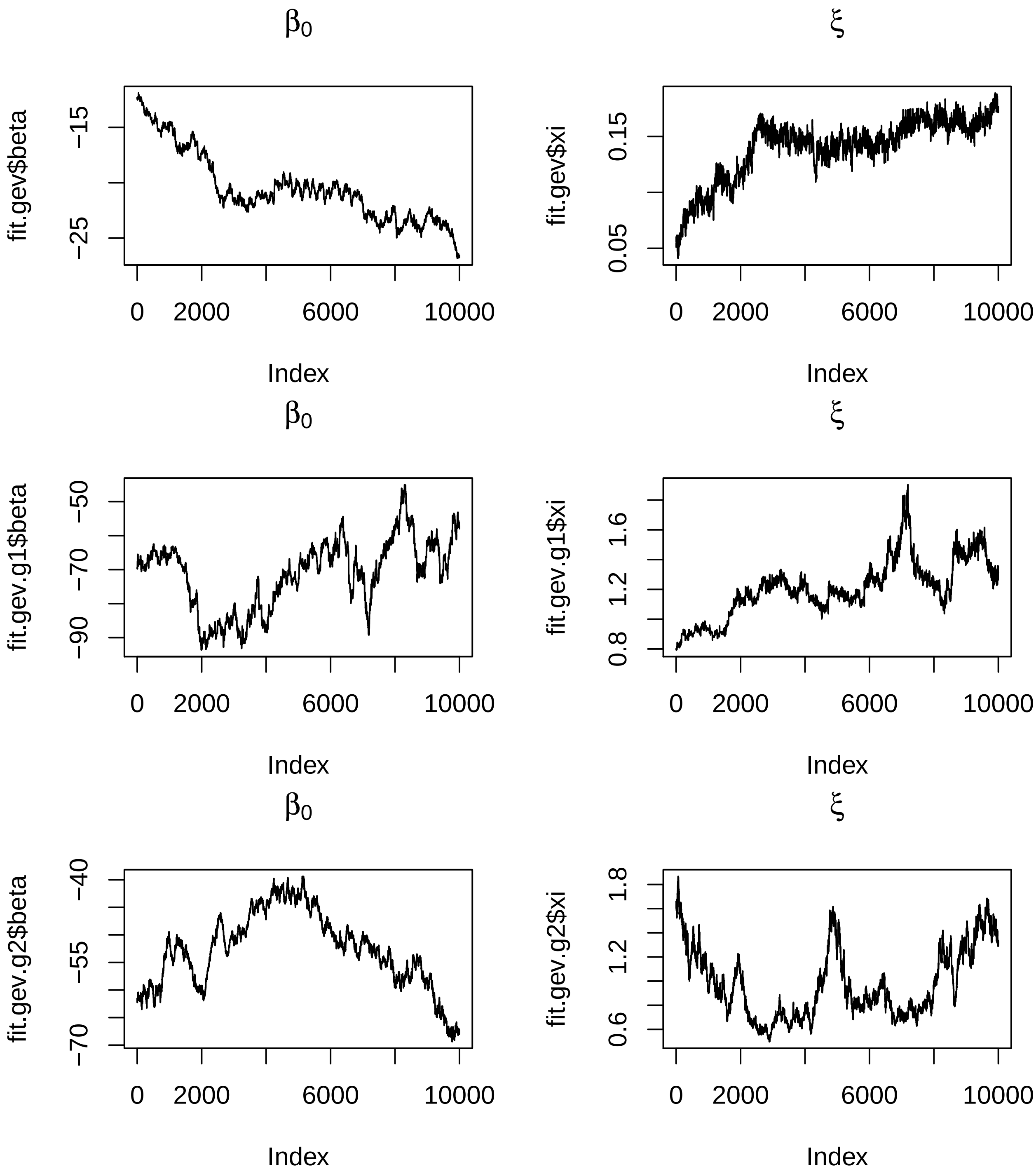
Dataset 2

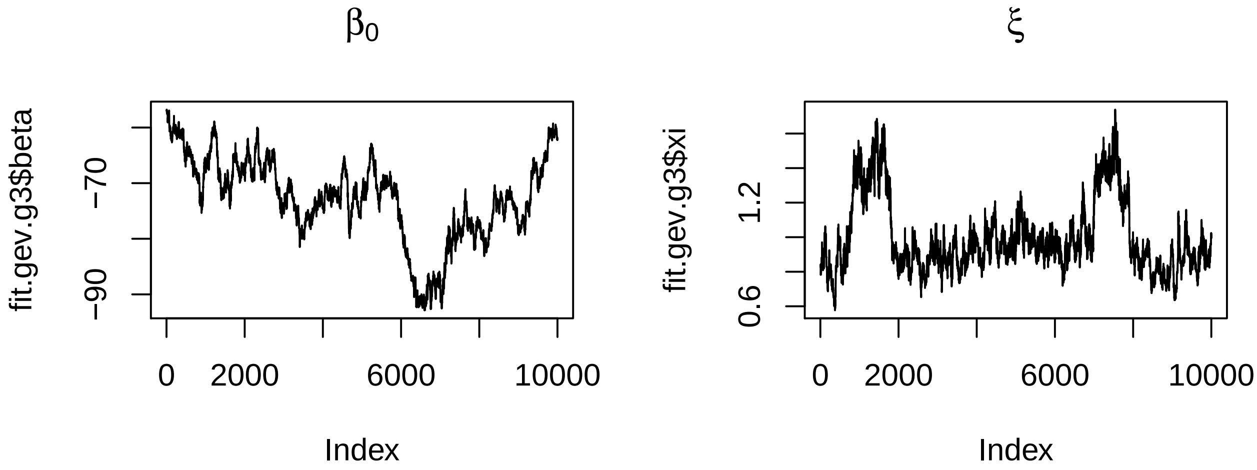
From the pairwise likelihood, we'll be using $\rho = -1.9099$. The estimates for the other parameters are $\widehat{\alpha} = -0.335$, $\widehat{\xi} = -1.91$, and $\widehat{\beta}_0 = 0.009$.



MCMC Results

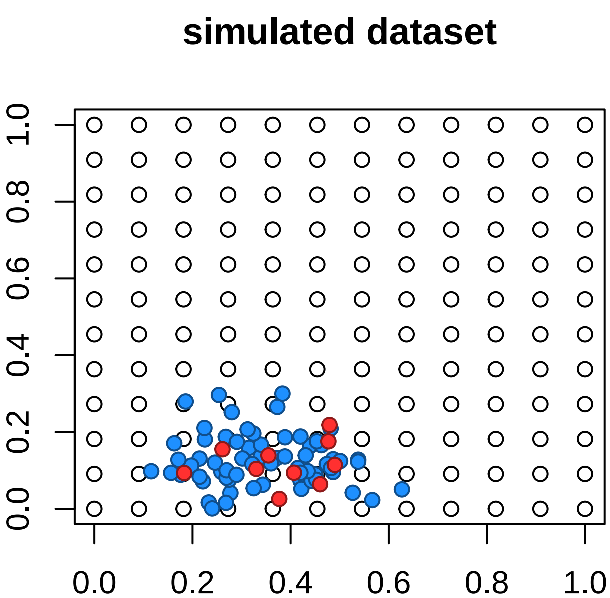
Here are the iteration plots from the GEV model. The true values are $\beta_0 = -8.085$, and $\xi = 0.25$. This is using $\widehat{\alpha}$ and $\widehat{\rho}$ from the PCL fit.





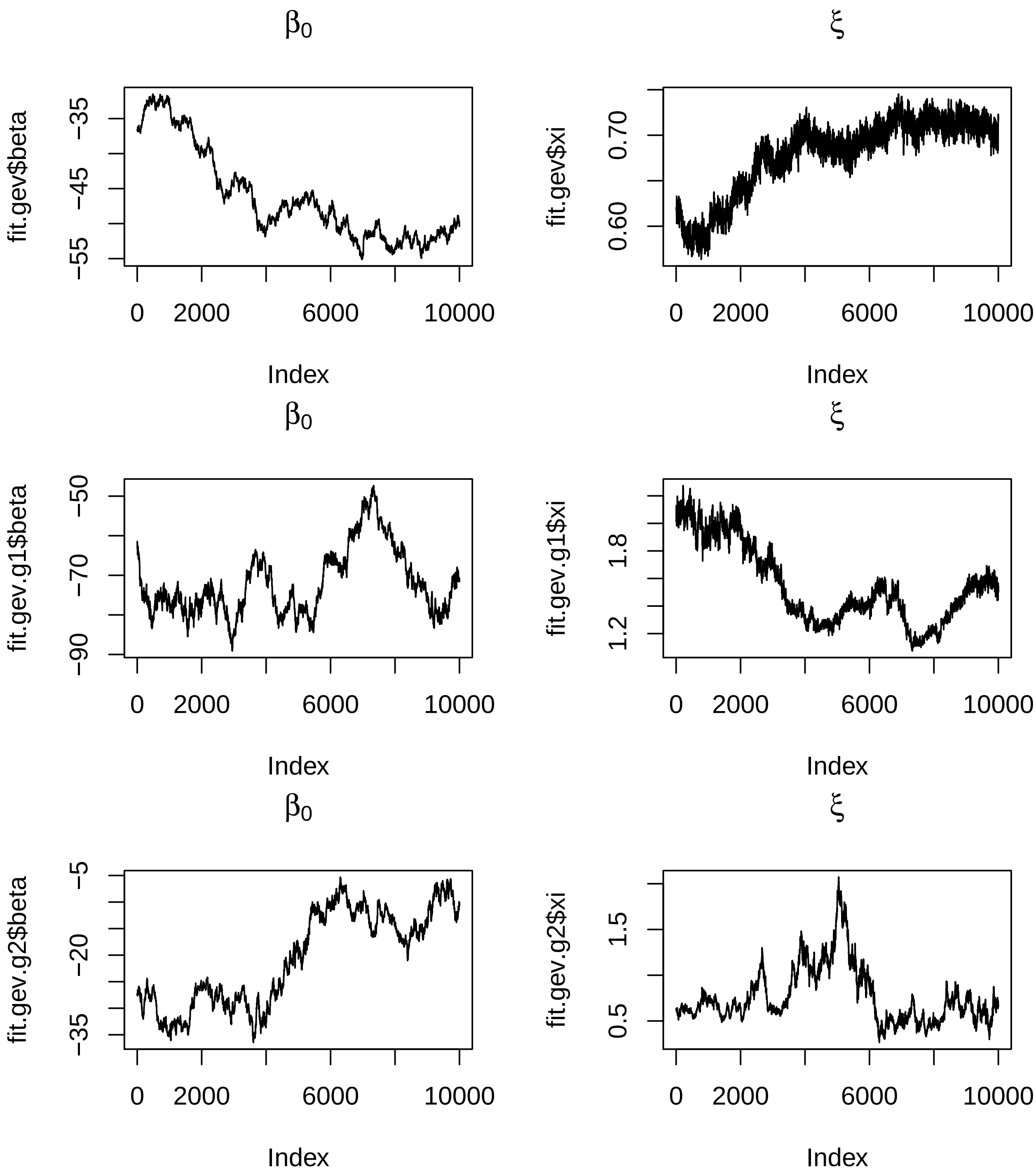
Dataset 3

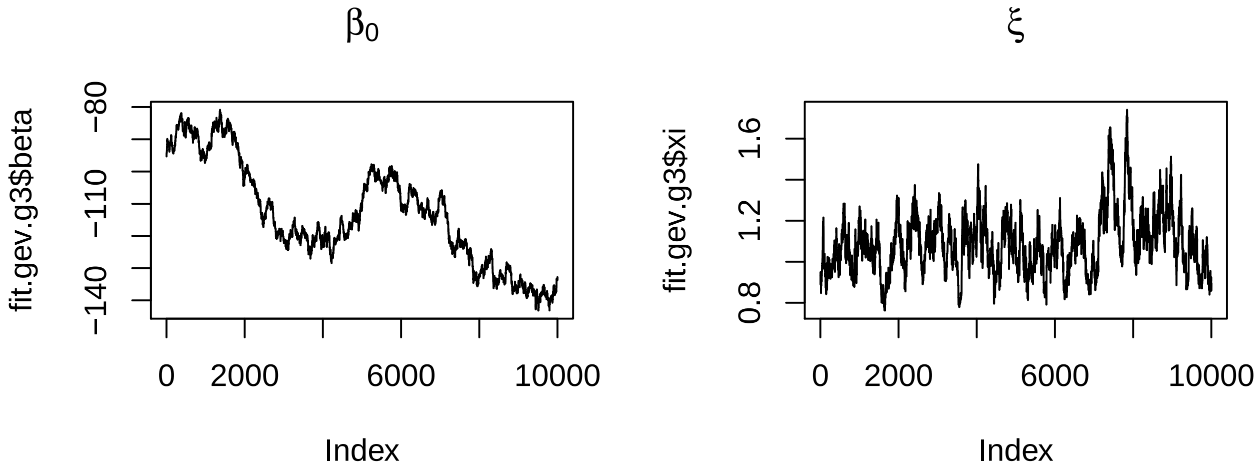
From the pairwise likelihood, we'll be using $\rho = -1.9583$. The estimates for the other parameters are $\widehat{\alpha} = -0.422$, $\widehat{\xi} = -1.958$, and $\widehat{\beta}_0 = 0.116$.



MCMC Results

Here are the iteration plots from the GEV model. The true values are $\beta_0 = -13.444$, and $\xi = 0.25$. This is using $\widehat{\alpha}$ and $\widehat{\rho}$ from the PCL fit.


β0
fit.gev$beta
−55
−45
−35
0
2000
6000
10000
Index
ξ
fit.gev$xi
0.60
0.70
0
2000
6000
10000
Index
β0
fit.gev.g1$beta
−90
−70
−50
0
2000
6000
10000
Index
ξ
fit.gev.g1$xi
1.2
1.8
0
2000
6000
10000
Index
β0
fit.gev.g2$beta
−35
−20
−5
0
2000
6000
10000
Index
ξ
fit.gev.g2$xi
0.5
1.5
0
2000
6000
10000
Index



Brier Scores

The brier scores are

Logit 1-1: 0.0481

Probit 1-1: 0.0359

GEV 1-1: 0.0412

GEV 1-1-g1: 0.0356

GEV 1-1-g2: 0.0352

GEV 1-1-g3: 0.0352

The brier scores are

Logit 2-1: 0.0304

Probit 2-1: 0.0261

GEV 2-1: 0.0412

GEV 2-1-g1: 0.0214

GEV 2-1-g2: 0.0223

GEV 2-1-g3: 0.0312

The brier scores are

Logit 3-1: 0.0181

Probit 3-1: 0.019

GEV 3-1: 0.0271

GEV 3-1-g1: 0.0191

GEV 3-1-g2: 0.0177

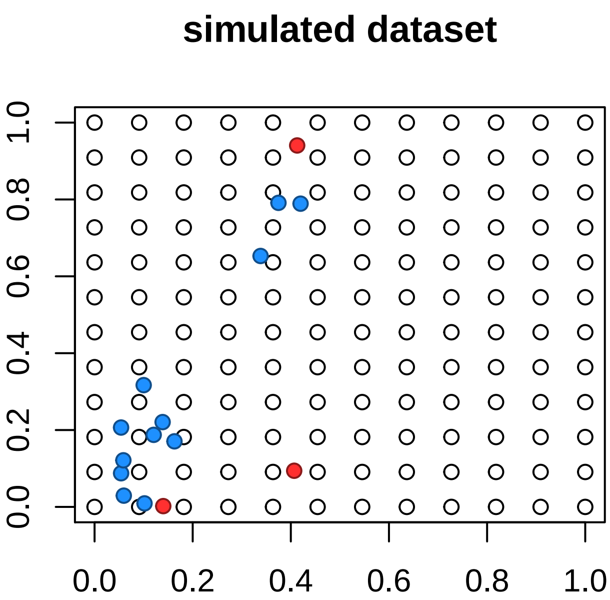
GEV 3-1-g3: 0.0186

Setting 2:

$\alpha = 0.35, \pi = 0.01, \rho = 0.15$

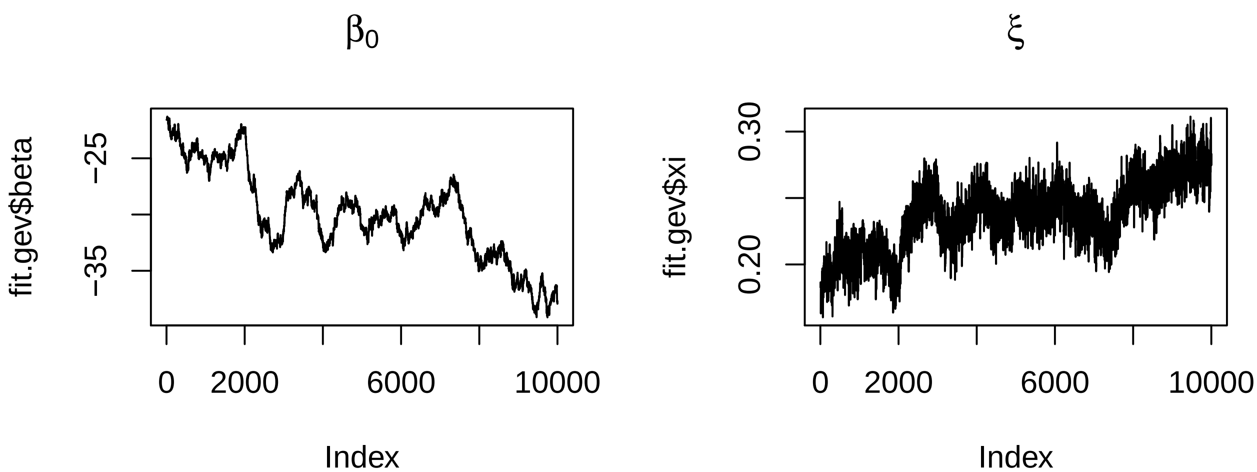
Dataset 1

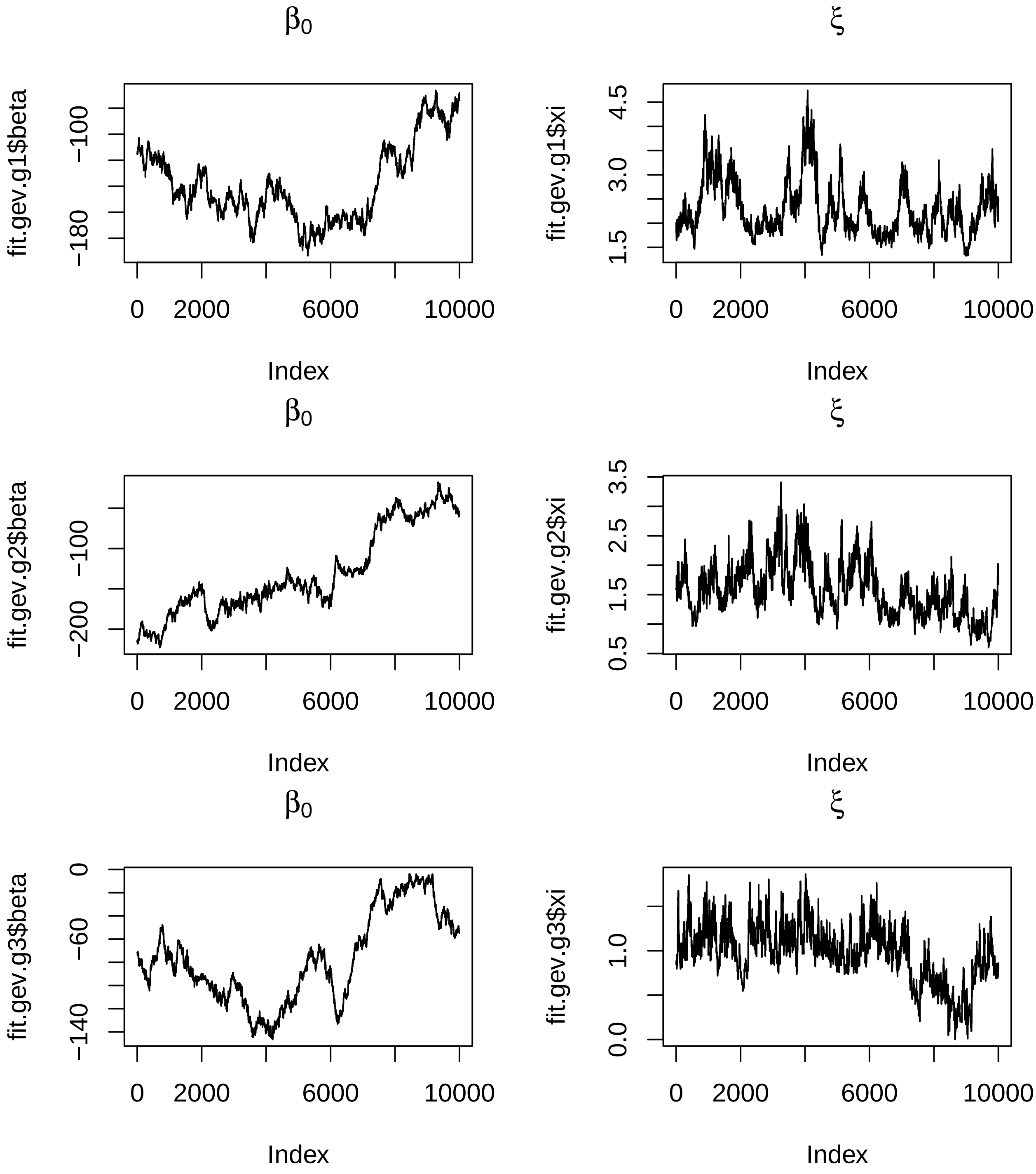
From the pairwise likelihood, we'll be using $\rho = -2.1173$. The estimates for the other parameters are $\widehat{\alpha} = 2.348$, $\widehat{\xi} = -2.117$, and $\widehat{\beta}_0 = -0.097$.



MCMC Results

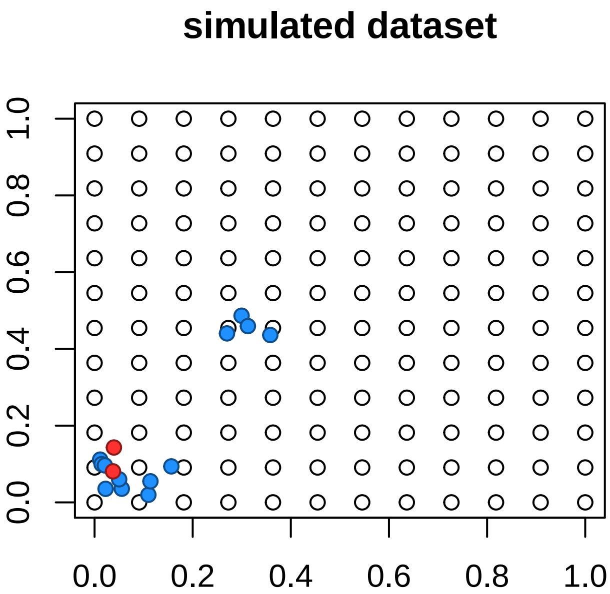
Here are the iteration plots from the GEV model. The true values are $\beta_0 = -2.939$, and $\xi = 0.25$. This is using $\widehat{\alpha}$ and $\widehat{\rho}$ from the PCL fit.





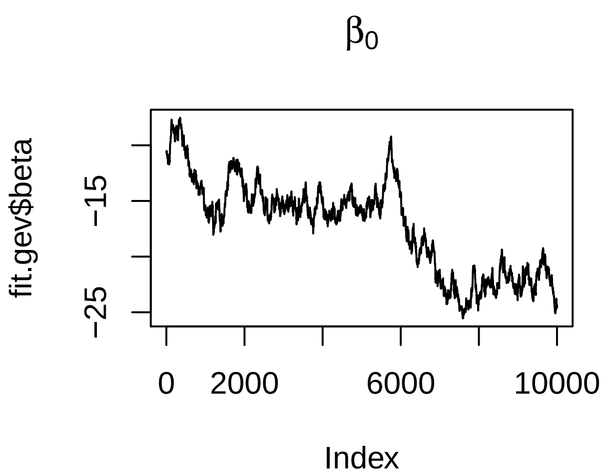
Dataset 2

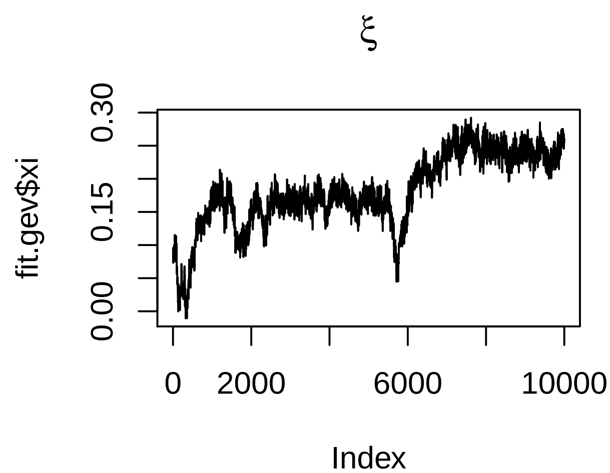
From the pairwise likelihood, we'll be using $\rho = -2.3054$. The estimates for the other parameters are $\widehat{\alpha} = 1.362$, $\widehat{\xi} = -2.305$, and $\widehat{\beta}_0 = -0.082$.

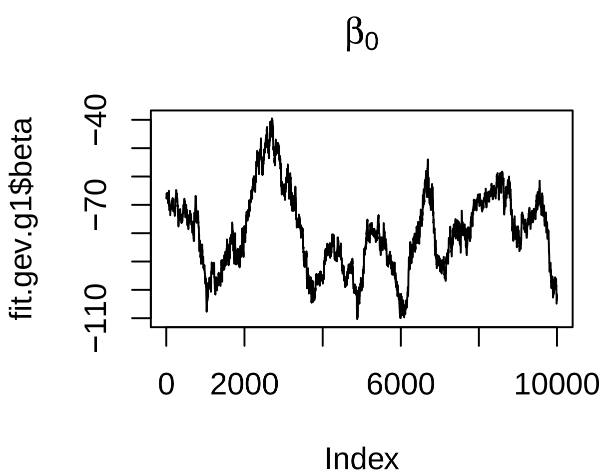


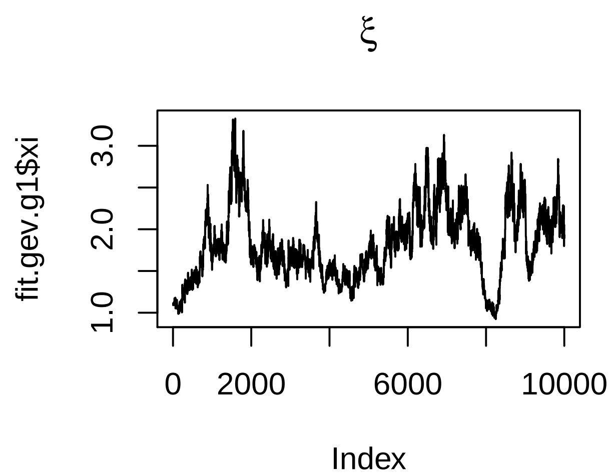
MCMC Results

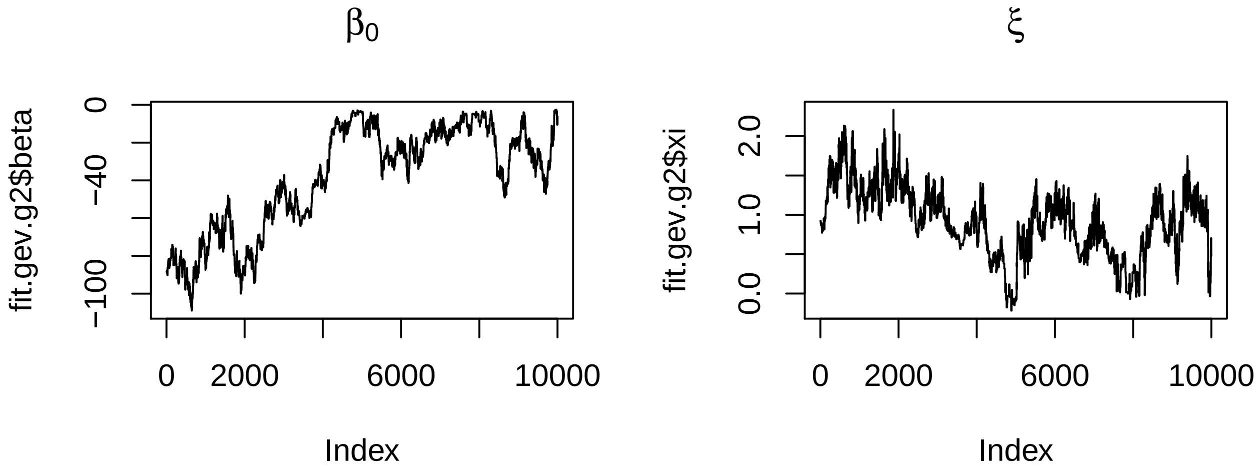
Here are the iteration plots from the GEV model. The true values are $\beta_0 = -3.889$, and $\xi = 0.25$. This is using $\widehat{\alpha}$ and $\widehat{\rho}$ from the PCL fit.

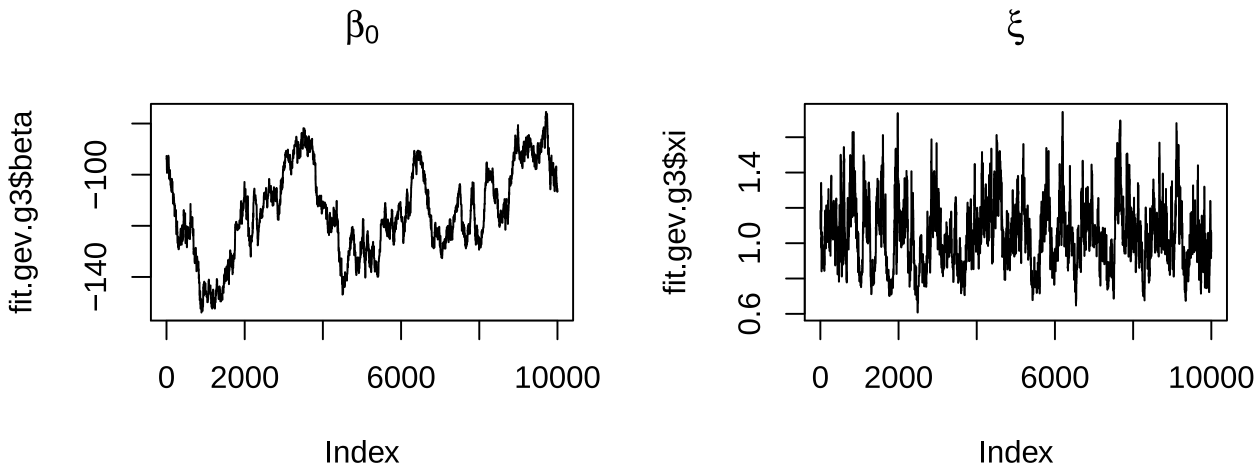






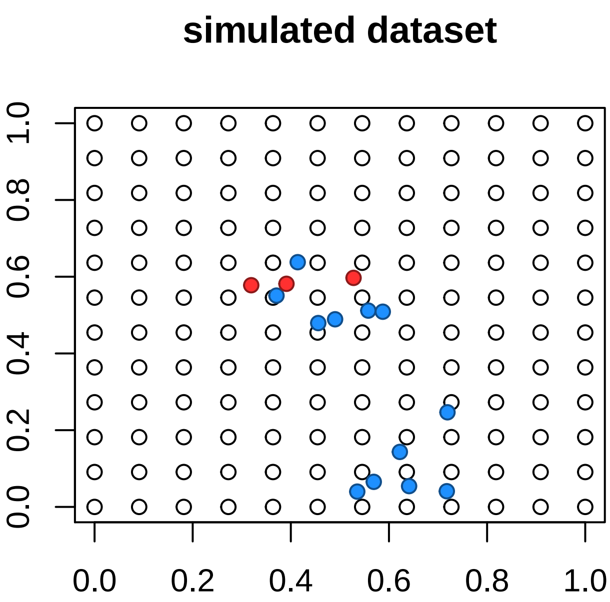






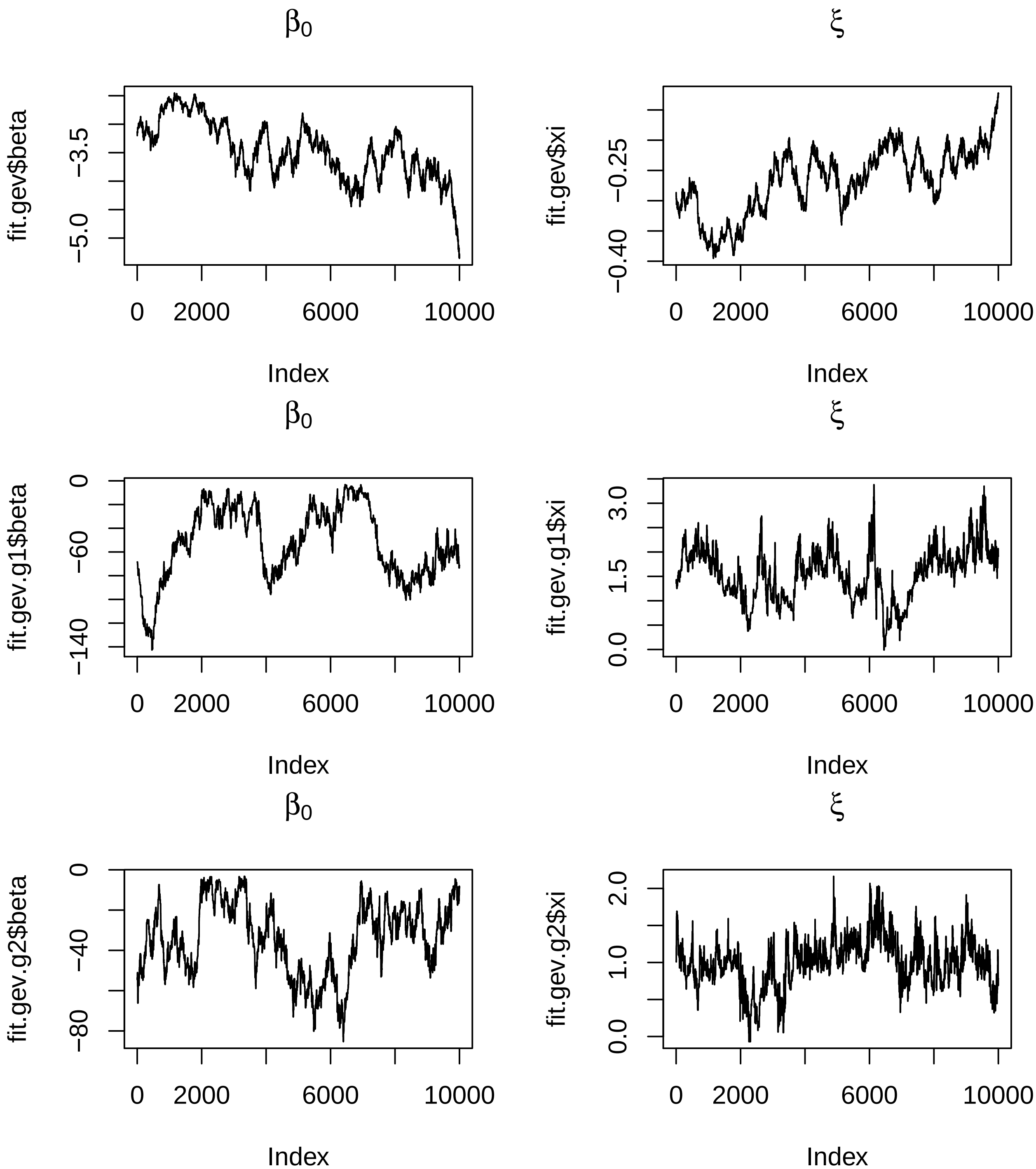
Dataset 3

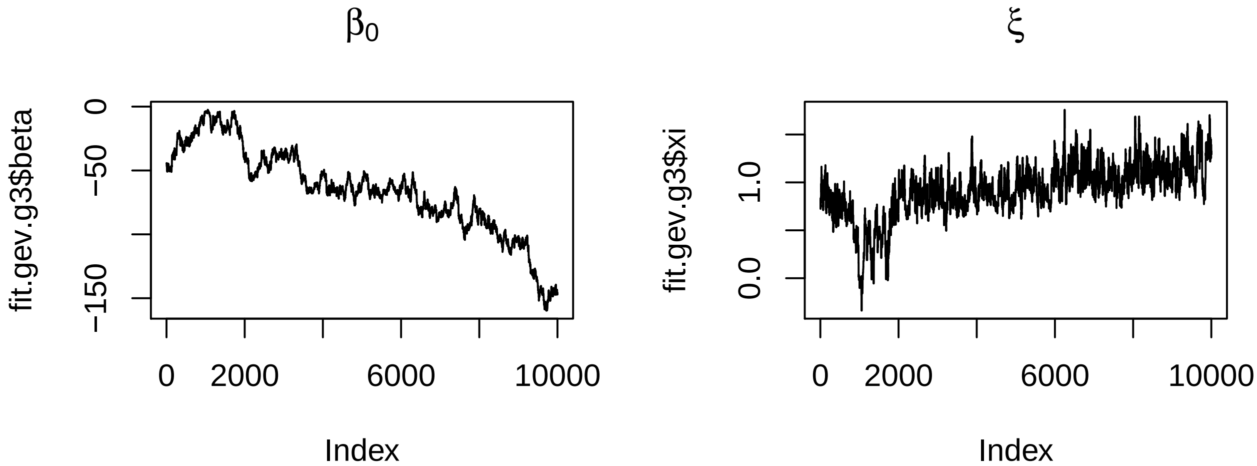
From the pairwise likelihood, we'll be using $\rho = -2.7994$. The estimates for the other parameters are $\widehat{\alpha} = 21.214$, $\widehat{\xi} = -2.799$, and $\widehat{\beta}_0 = -0.085$.



MCMC Results

Here are the iteration plots from the GEV model. The true values are $\beta_0 = -4.791$, and $\xi = 0.25$. This is using $\widehat{\alpha}$ and $\widehat{\rho}$ from the PCL fit.





Brier Scores

The brier scores are

Logit 1-2: 8.14

Probit 1-2: 8.52

GEV 1-2: 8

GEV 1-2-g1: 8.55

GEV 1-2-g2: 8.54

GEV 1-2-g3: 8.16

The brier scores are

Logit 2-2: 5.34

Probit 2-2: 3.61

GEV 2-2: 5.33

GEV 2-2-g1: 4.48

GEV 2-2-g2: 4.11

GEV 2-2-g3: 4.18

The brier scores are

Logit 3-2: 7.95

Probit 3-2: 7.77

GEV 3-2: 8

GEV 3-2-g1: 8.26

GEV 3-2-g2: 8.07

GEV 3-2-g3: 7.96