Advanced Time Series Analysis: Computer Exercise 2

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11 Oktober 2017

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Part 1

There are simulated $n = 3000$ where $\epsilon_t \sim \mathcal{N}(0,\, 1)$. ϵ_t is used as noise input for all simulations in part one.

The equation below shows the used parameters in the SETAR(2,1,1). Let us call eq. 1 and eq. 2 parameter set one (par_1).

$$a_0 = [0.125, -0.125] \tag{1}$$

$$a_1 = [0.6, -0.4] \tag{2}$$

Simulation of the SETAR(2,1,1)

The Self-Exciting Threshold AR (SETAR) model is given by eq. 3.

$$X_t = a_0^{(J_t)} + \sum_{i=1}^{k_{(J_t)}} a_i^{(J_t)} X_{t-i} + \epsilon^{(J_t)} \tag{3}$$

where J_t are regime processes. The complete model are defined in eq. 4.

$$X_t = \begin{Bmatrix} a_{0,1} + a_{1,1} X_{t-1} + \epsilon_t & for & X_{t-1} \leq 0 \\ a_{0,2} + a_{1,2} X_{t-1} + \epsilon_t & for & X_{t-1} > 0 \end{Bmatrix} \tag{4}$$

The model X_t (eq. 4) has been simulated with par_1. Its simulation is plotted in fig. **??**.

Estimate the parameters using conditional least squares

```
Setar <- function(par, model) {
    #
    e_mean <- rep(NA, length(model))
    #
    for (t in 2:length(model)) {
        if (model[t - 1] <= 0) {
            e_mean[t] <- par[1] + par[2] * model[t - 1]
        } else {
            e_mean[t] <- par[3] + par[4] * model[t - 1]
        }
    }
```

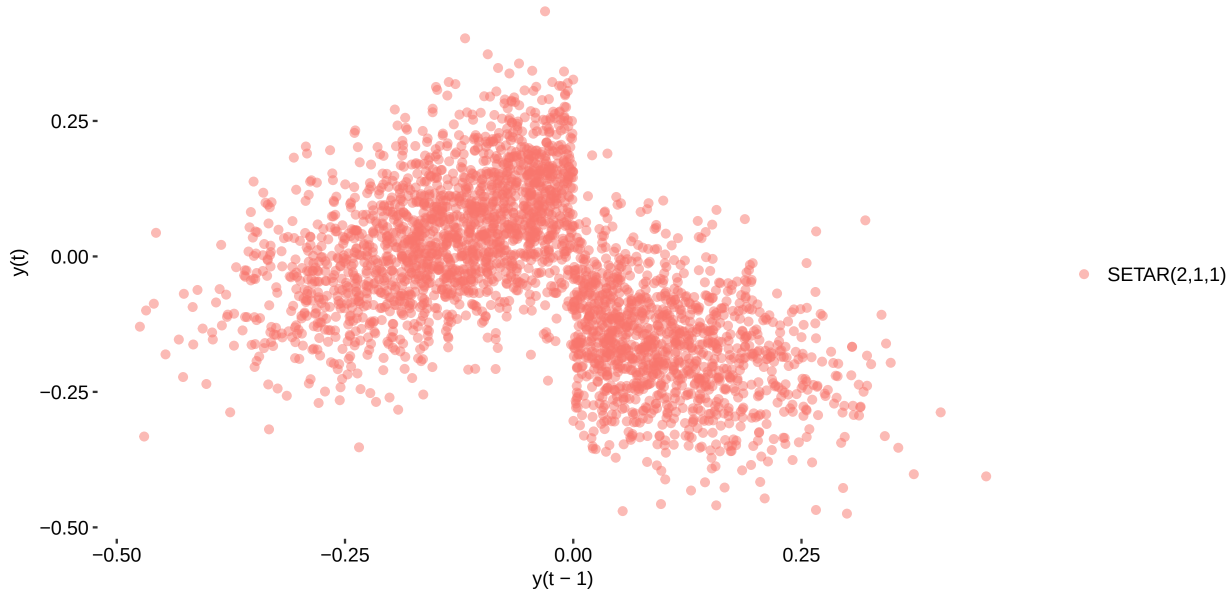
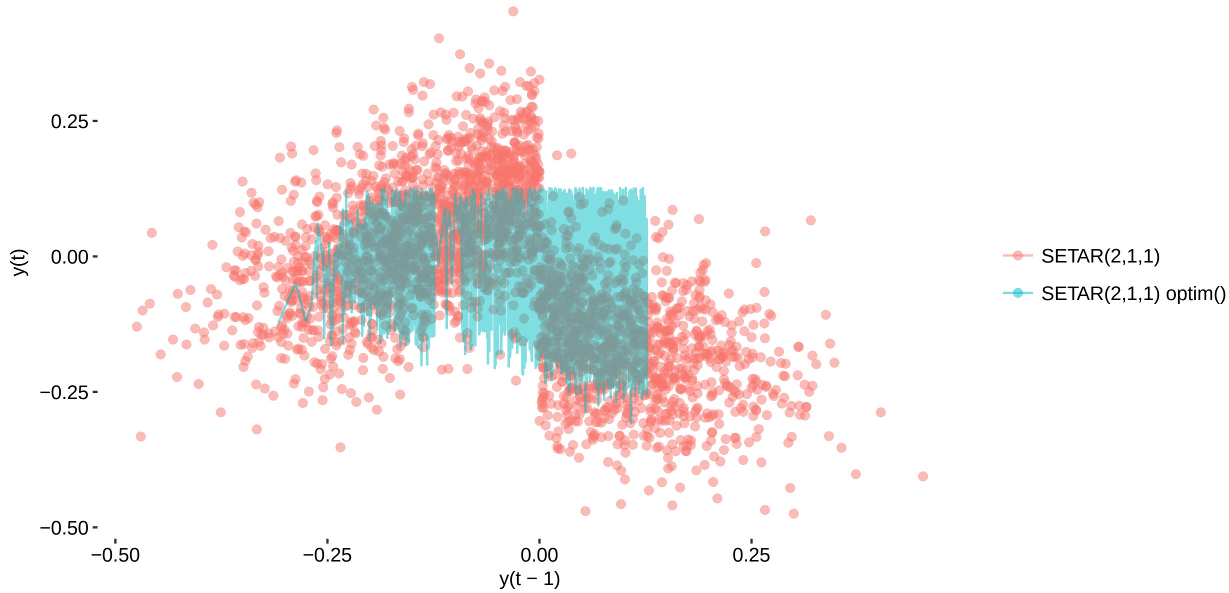


Figure 1: Two simulated SETAR(2,1,1) models using par_1 and par_2.

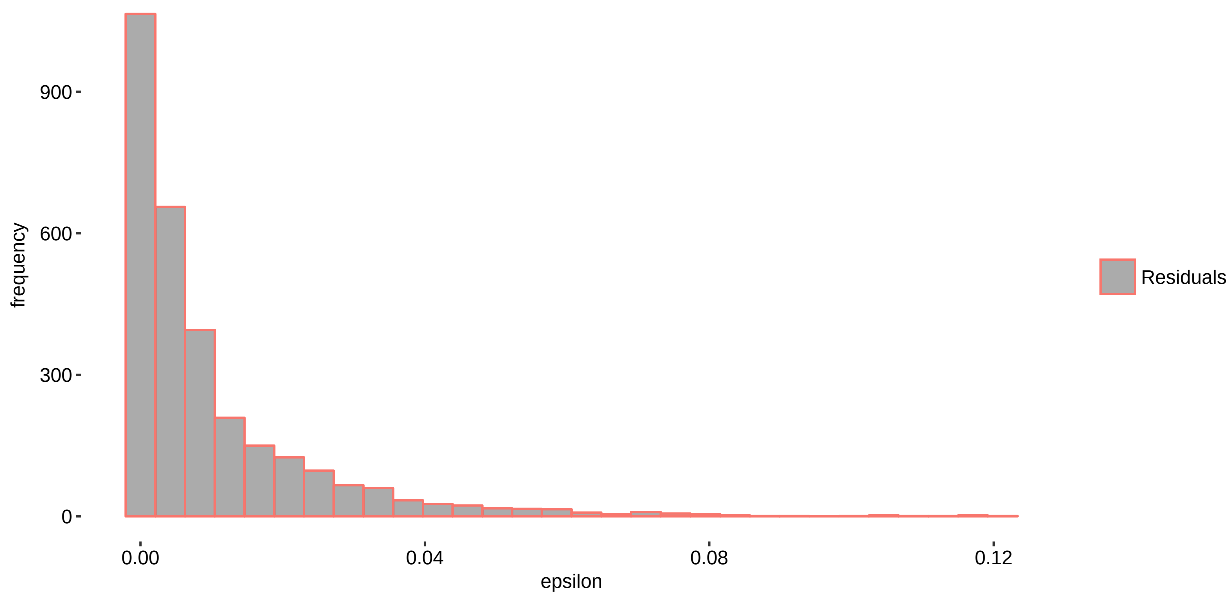
```
    #
    return(e_mean)
}


RSSSetar <- function(par, model) {
    # conditional mean
    e_mean <- Setar(par, model)

    ## Calculate and return the residuals
    return((model - e_mean)^2)
}


PESetar <- function(par, model) {
    # conditional mean
    e_mean <- Setar(par, model)

    ## Calculate and return the objective function value
    return(sum((model - e_mean)^2, na.rm = TRUE))
}
```



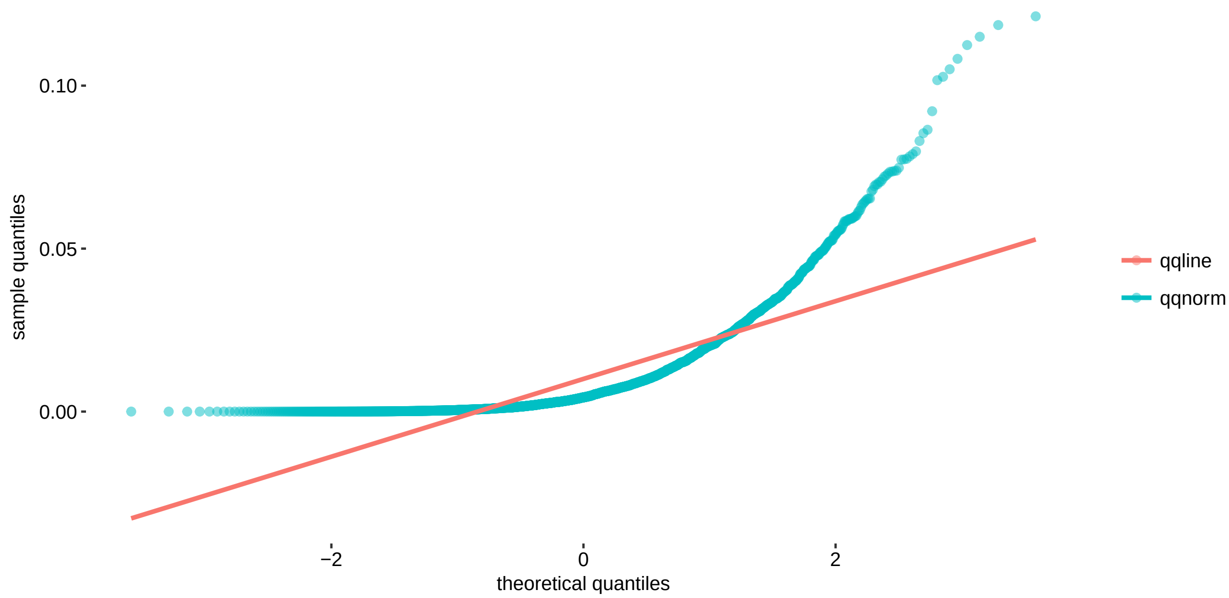
Analyses of the residuals

Distribution of the residuals

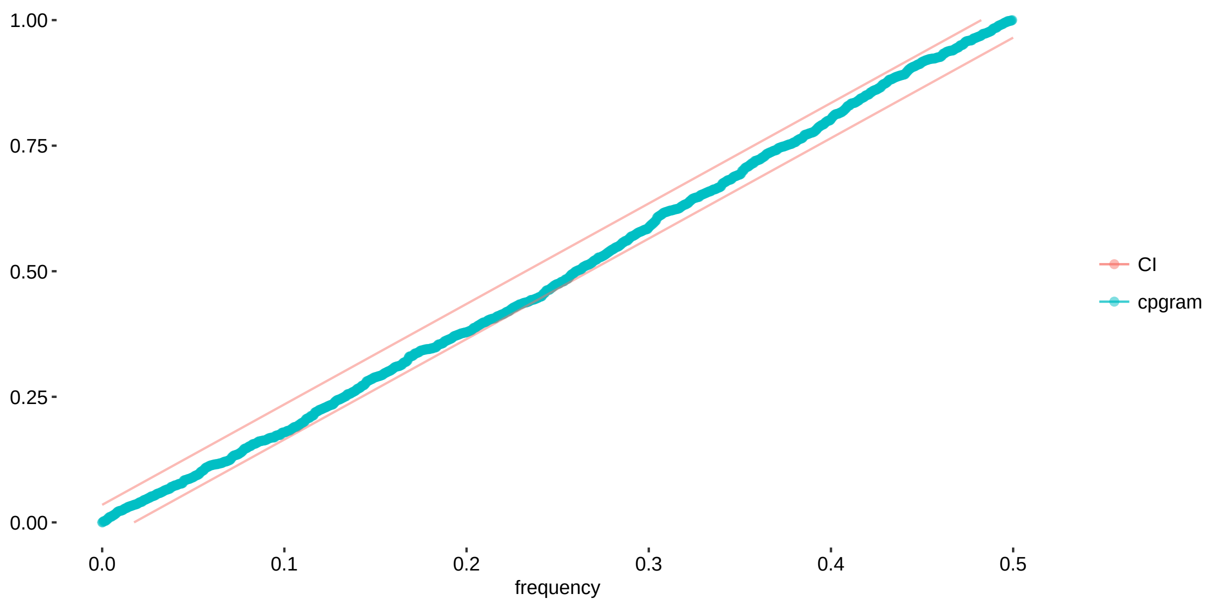
```
## `stat_bin()` using `bins = 30`. Pick better value with `binwidth`.
```



QQ plot



Cumulative Periodogram

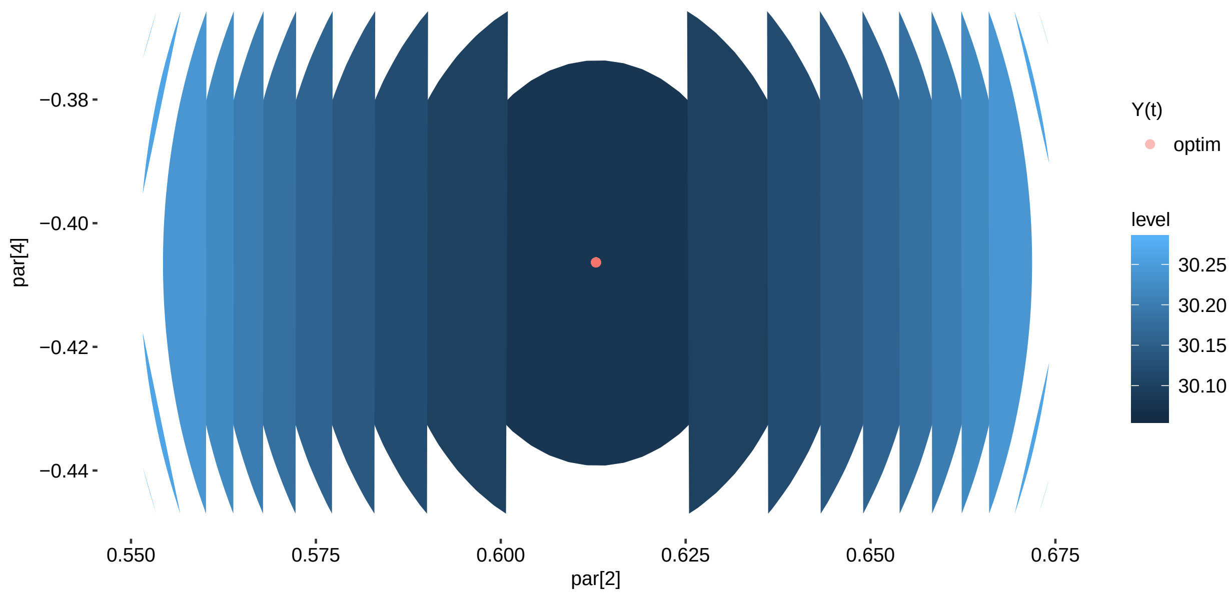


Part 2

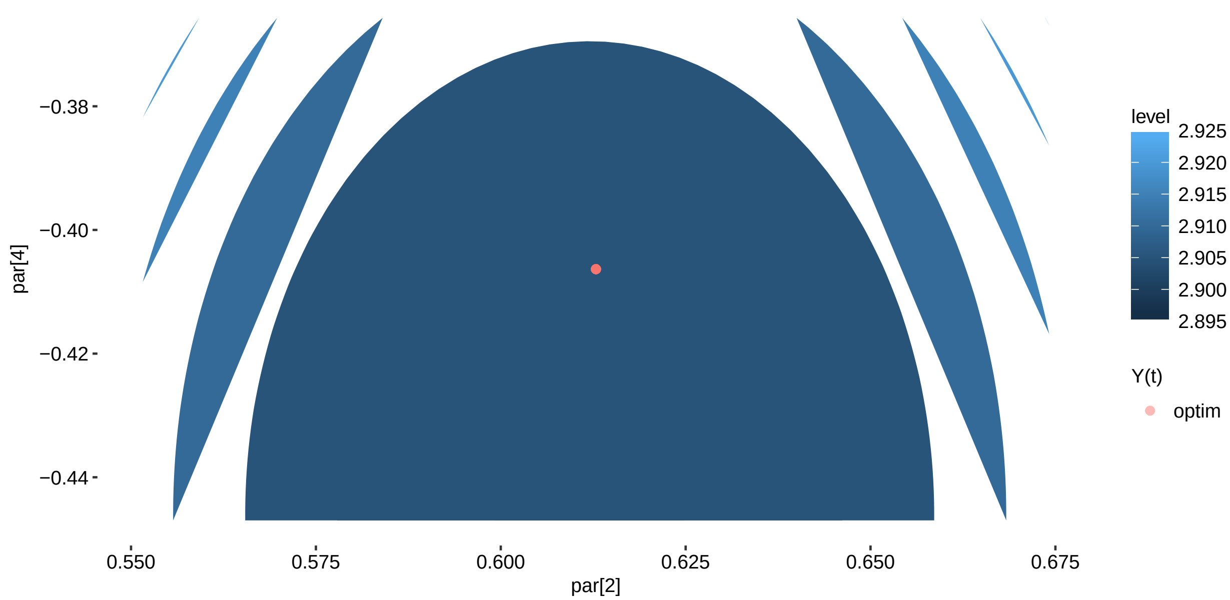
resolution 50 max_change_p 0.1

only change the slope par[2] and par [4]

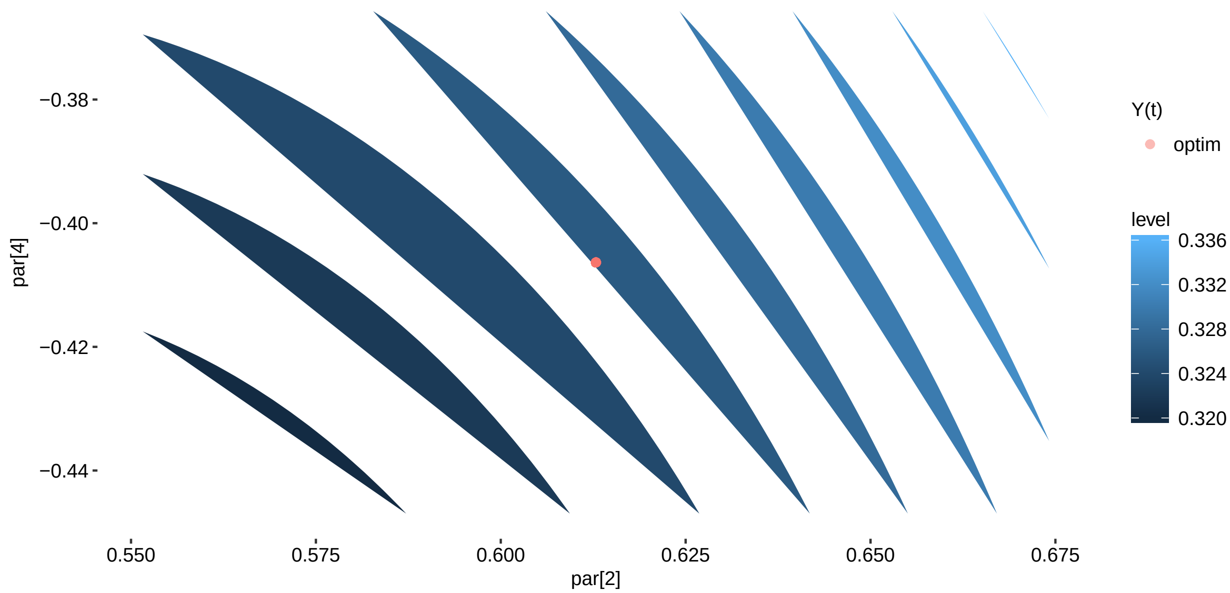
N = 1:3000



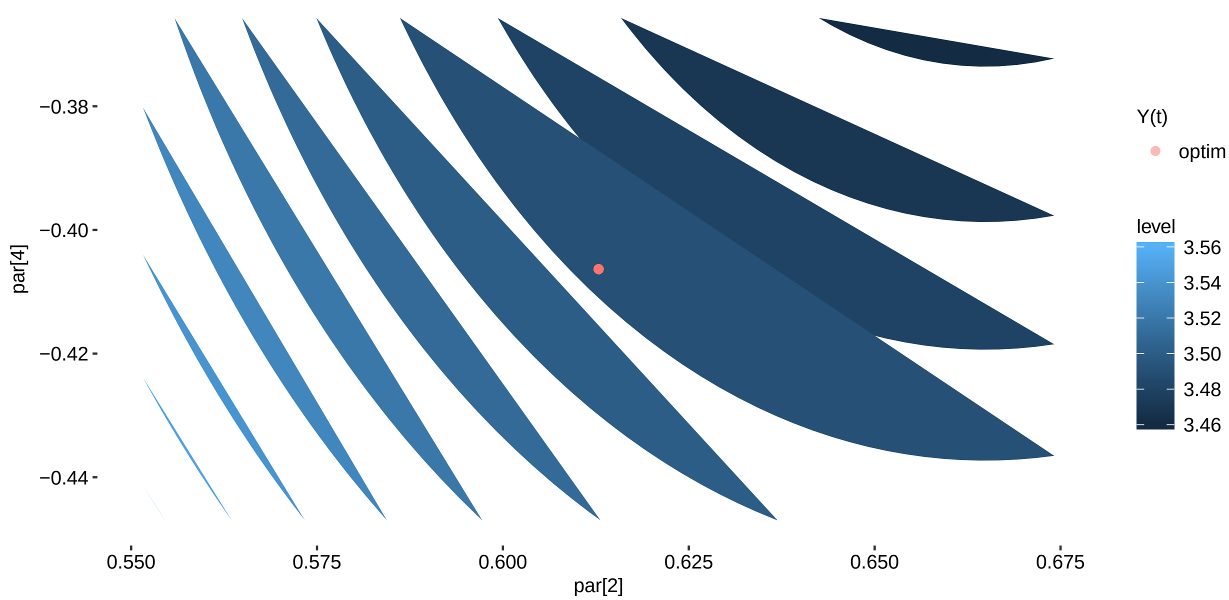
N = 1:300



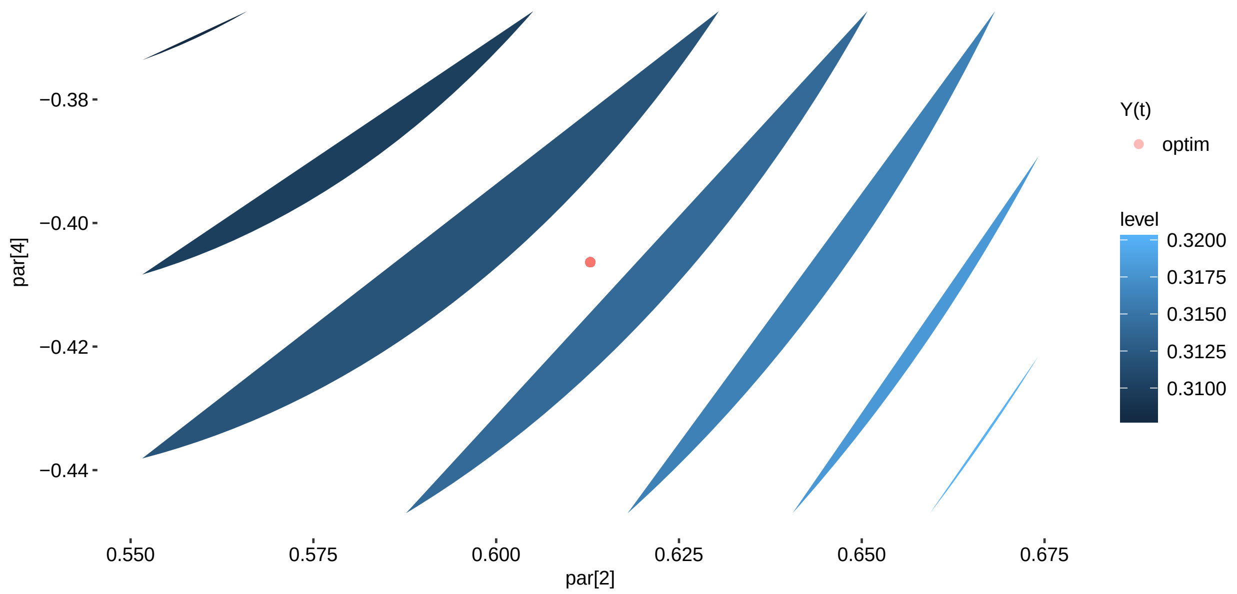
N = 1:30



N = 1001:1300



N = 1001:1030


Y(t)
optim
level
0.3200
0.3175
0.3150
0.3125
0.3100
−0.38
−0.40
−0.42
−0.44
par[4]
0.550
0.575
0.600
0.625
0.650
0.675
par[2]