Covid in Japan

Masaya Kameyama

Table of contents

1 “Covid in Japan”

“ . 1.7.3 . y_t 7 , y_t 7 , y_t .” - toc: false - branch: master - badges: true - comments: true - categories: [julia, covid, statistics] - hide: false - search_exclude: true

2

y_t 3 :

$$y_t = TC_t + S_t + I_t$$

TC_t , S_t , I_t . TC_t , S_t , I_t .

, ( ) . TC_t (n), S_t , I_t . .

:

```
versioninfo()
```

```
Julia Version 1.8.4
Commit 00177ebc4fc (2022-12-23 21:32 UTC)
Platform Info:
  OS: macOS (arm64-apple-darwin21.5.0)
  CPU: 8 × Apple M1
  WORD_SIZE: 64
  LIBM: libopenlibm
  LLVM: libLLVM-13.0.1 (ORCJIT, apple-m1)
  Threads: 1 on 4 virtual cores
```

3

:

```
p=[
"CSV",
"DataFrames",
"Plots",
"Statistics",
"Indicators",
"StatsPlots",
"GLM",
"HTTP",
"Dates"]
```

```
9-element Vector{String}:
 "CSV"
 "DataFrames"
 "Plots"
 "Statistics"
 "Indicators"
 "StatsPlots"
 "GLM"
 "HTTP"
 "Dates"
```

```julia
import Pkg; Pkg.add.(p)
```

```
   Updating registry at `~/.julia/registries/General.toml`
  Resolving package versions...
 No Changes to `~/.julia/environments/v1.8/Project.toml`
 No Changes to `~/.julia/environments/v1.8/Manifest.toml`
  Resolving package versions...
 No Changes to `~/.julia/environments/v1.8/Project.toml`
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  Resolving package versions...
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  Resolving package versions...
 No Changes to `~/.julia/environments/v1.8/Project.toml`
 No Changes to `~/.julia/environments/v1.8/Manifest.toml`
  Resolving package versions...
 No Changes to `~/.julia/environments/v1.8/Project.toml`
 No Changes to `~/.julia/environments/v1.8/Manifest.toml`
```

```
9-element Vector{Nothing}:
 nothing
 nothing
 nothing
 nothing
 nothing
 nothing
 nothing
 nothing
 nothing
```

```
using CSV
using DataFrames
using Plots
Plots.gr(fmt = :png)
using Statistics
using Indicators
using StatsPlots
using GLM
using HTTP
using Dates
```

. .

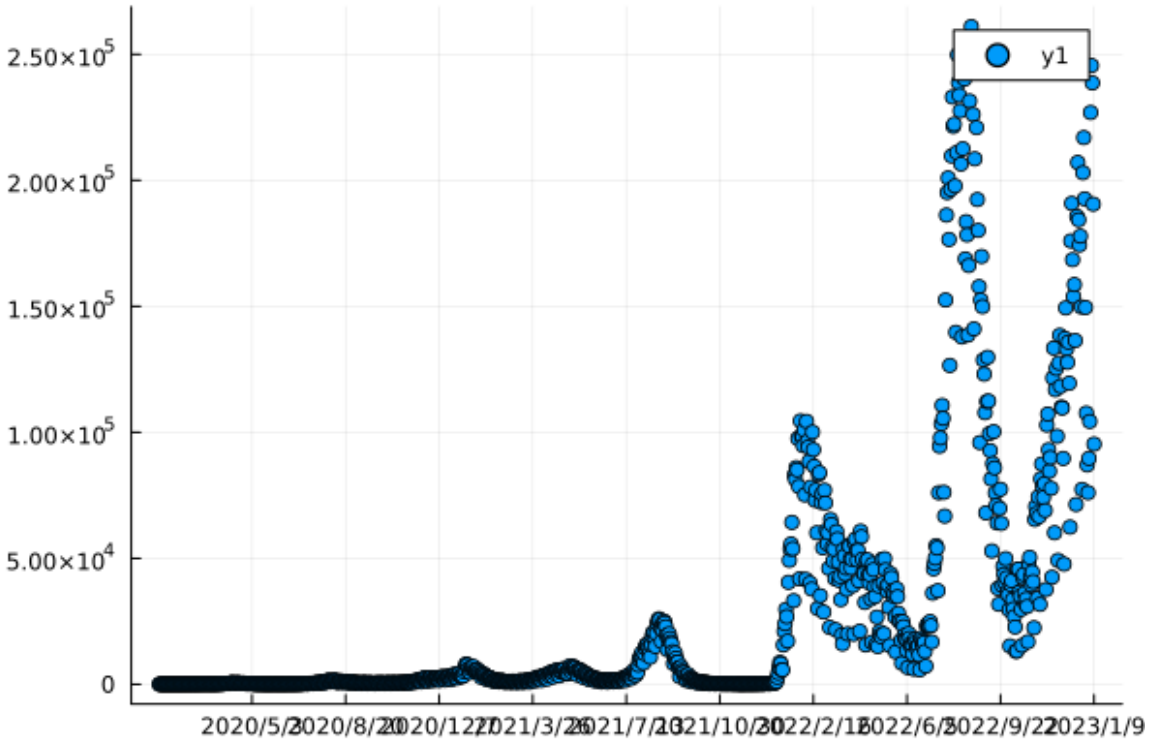
```
res = HTTP.get("https://covid19.mhlw.go.jp/public/opendata/newly_confirmed_cases_daily.csv
```

```
df = CSV.read(res.body,DataFrame);
```

```
last(df,10)
```

	Date	ALL	Hokkaido	Aomori	Iwate	Miyagi	Akita	Yamagata	Fukushima	
	String15	Int64	Int64	Int64	Int64	Int64	Int64	Int64	Int64	
1	2022/12/31	107621	2377	808	787	1893	498	653	1343	...
2	2023/1/1	87042	2077	690	651	1715	359	506	1263	...
3	2023/1/2	76015	1833	557	624	1450	344	518	1038	...
4	2023/1/3	89643	2235	696	932	1903	440	498	1372	...
5	2023/1/4	104304	2500	730	920	2028	498	753	1607	...
6	2023/1/5	226904	5582	1792	2009	3458	1316	1235	3335	...
7	2023/1/6	245542	5713	1791	1521	3960	1114	1481	3102	...
8	2023/1/7	238654	5352	1511	1558	3802	957	1224	3005	...
9	2023/1/8	190538	3363	989	925	3010	666	822	2176	...
10	2023/1/9	95308	1584	612	566	1642	346	352	1063	...

```
plot(df.Date, df.ALL,seriestype = :scatter)
```



.

3.1

- 2022/01/04 6 .
- 2022/01/11 6 .

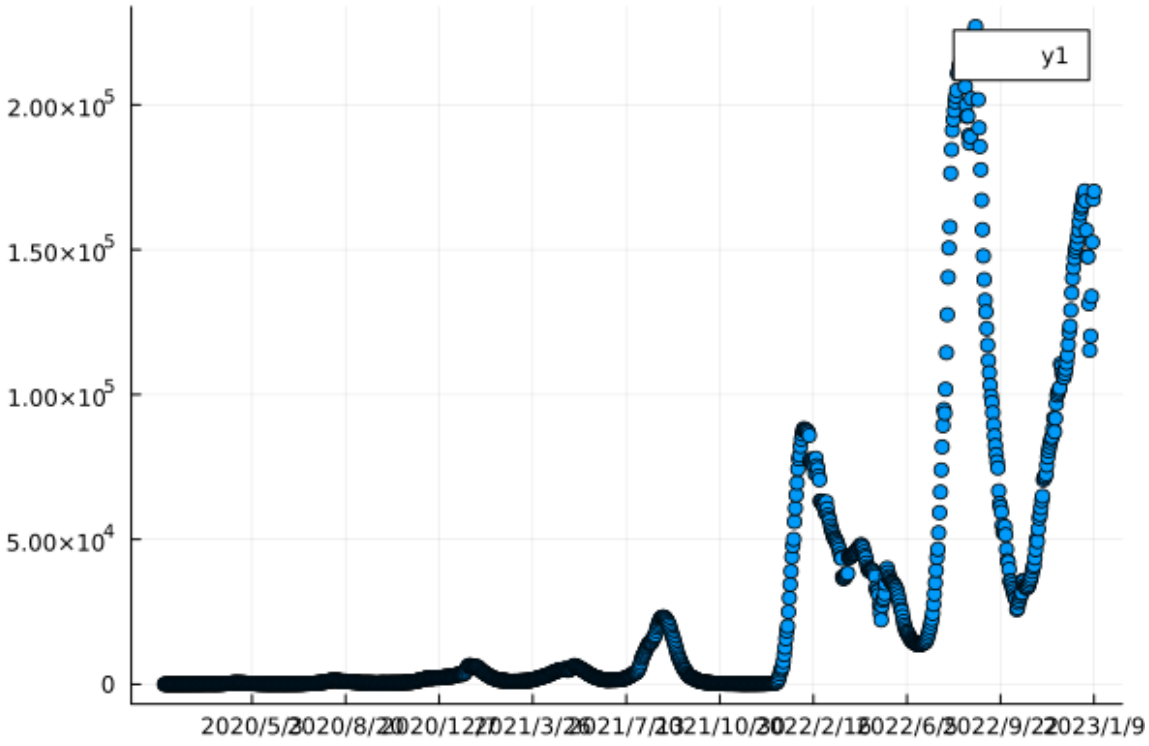
4

4.1 raw data 7

TC_t . TC_t . ( ) , . 7 :

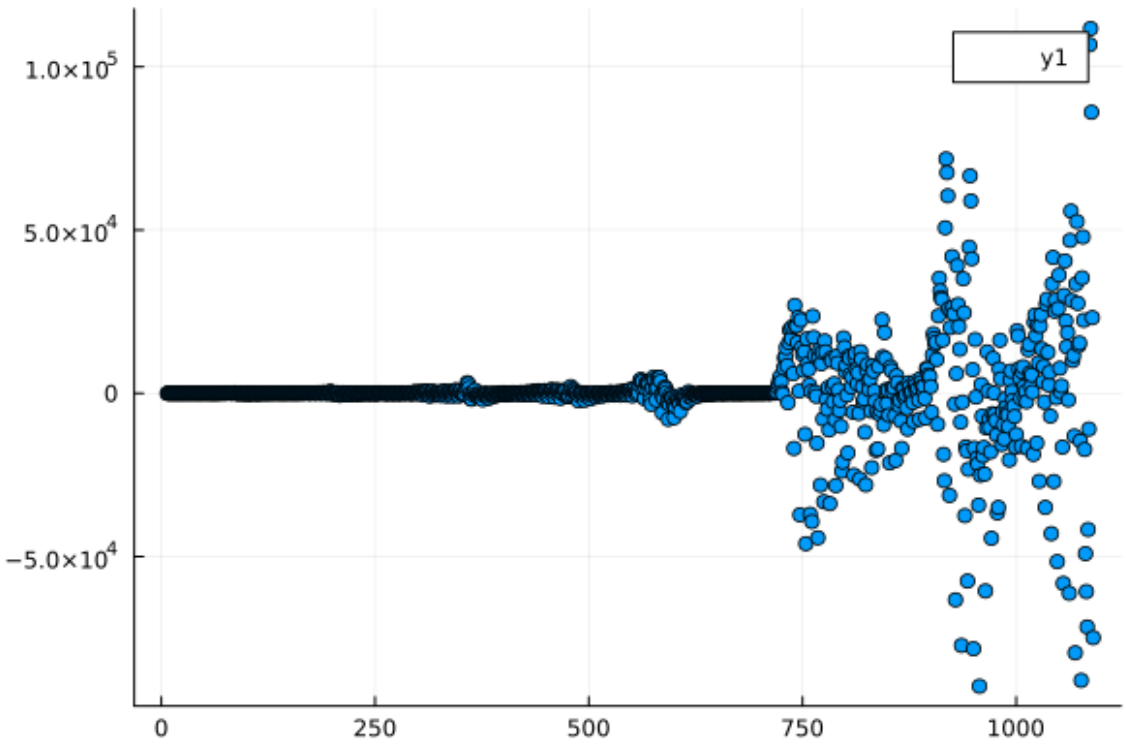
```
df.weekly_ave=sma(df.ALL, n=7);
```

```
plot(df.Date, df.weekly_ave, seriestype = :scatter)
```



raw data :

```
plot(df.ALL .- df.weekly_ave, seriestype = :scatter)
```



TC_t . TC_t $y_t - TC_t$.

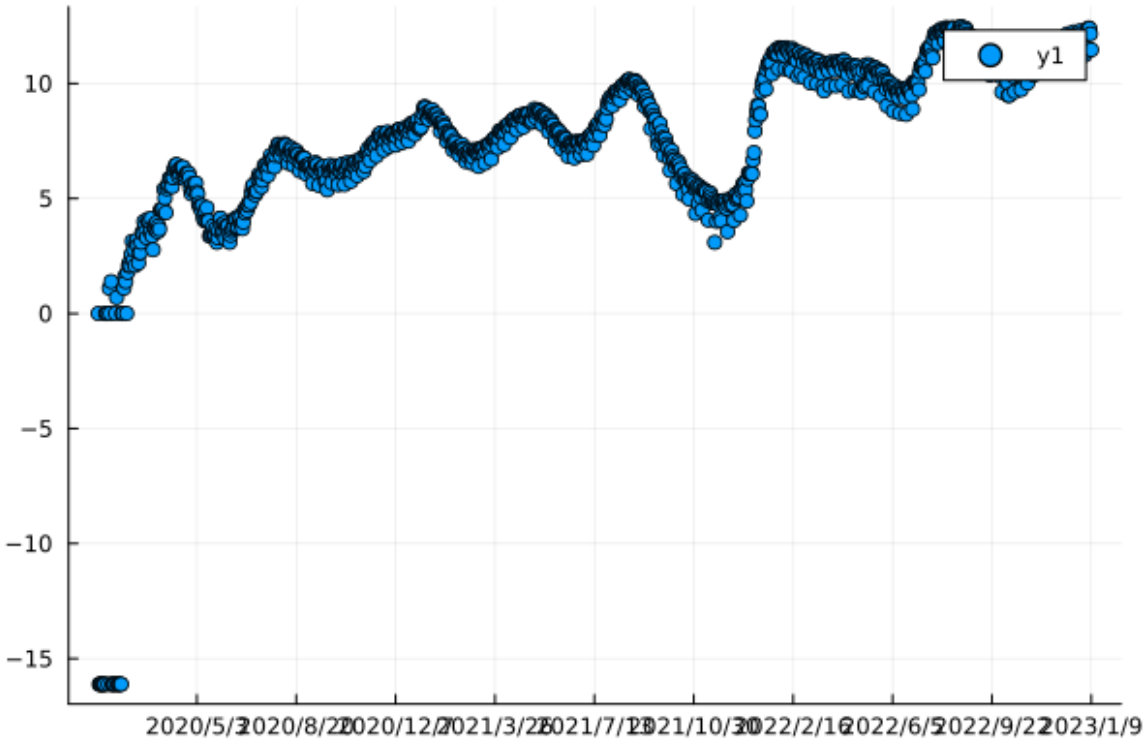
4.2 7

. 0 ϵ .

```
  = 0.0000001;
```

```
df.log_all=log.(df.ALL .+  );
```

```
plot(df.Date, df.log_all, seriestype = :scatter)
```

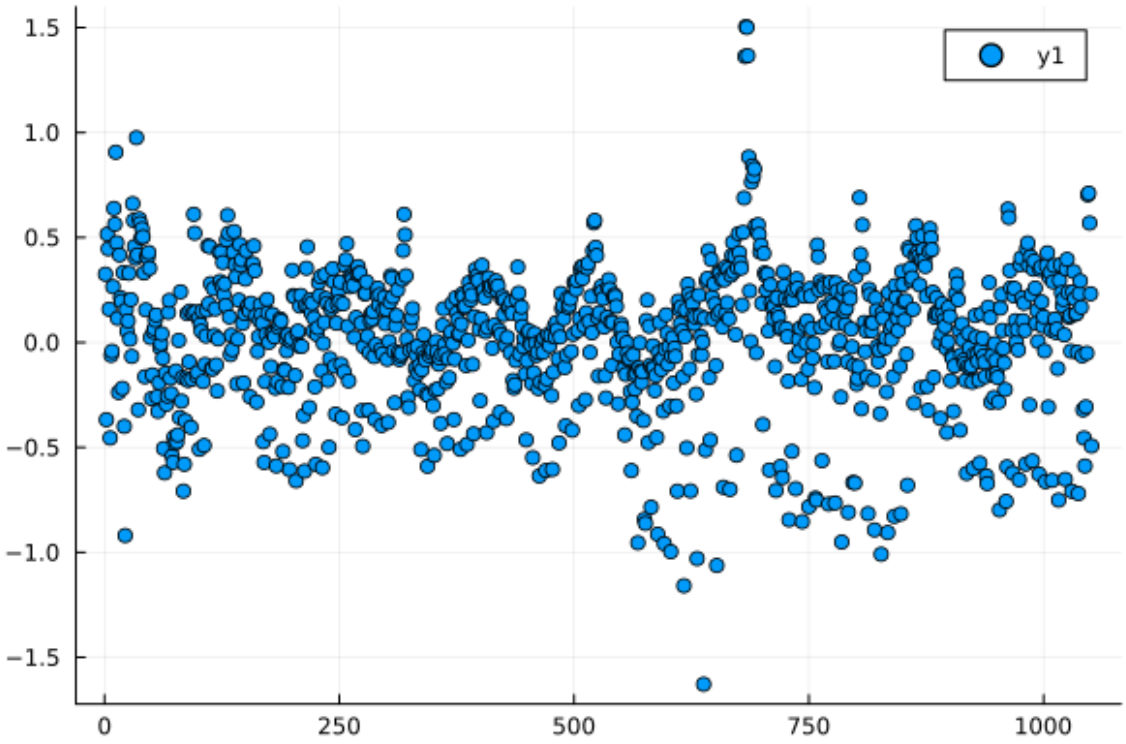


6 .

:

```
df.log_weekly_ave = sma(df.log_all, n=7);
df.log_diff = df.log_all .- df.log_weekly_ave;
```

```
plot((df.log_diff )[40:end], seriestype = :scatter)
```



-1.5~1 . 39 0 . .

S_t . S .

```
sum_n=zeros(7)
count_day_of_week=zeros(Int,7)
for (i, n) in enumerate((df.log_diff )[40:end])
    sum_n[i%7+1]+=n
    count_day_of_week[i%7+1]+=1
 end
```

```
S = sum_n ./ count_day_of_week
```

```
7-element Vector{Float64}:
 -0.0458947770756838
 -0.48588728064630987
  0.055816830757215156
  0.18126518762346477
  0.1879316238881742
  0.1451808639178051
  0.15539502298303573
```

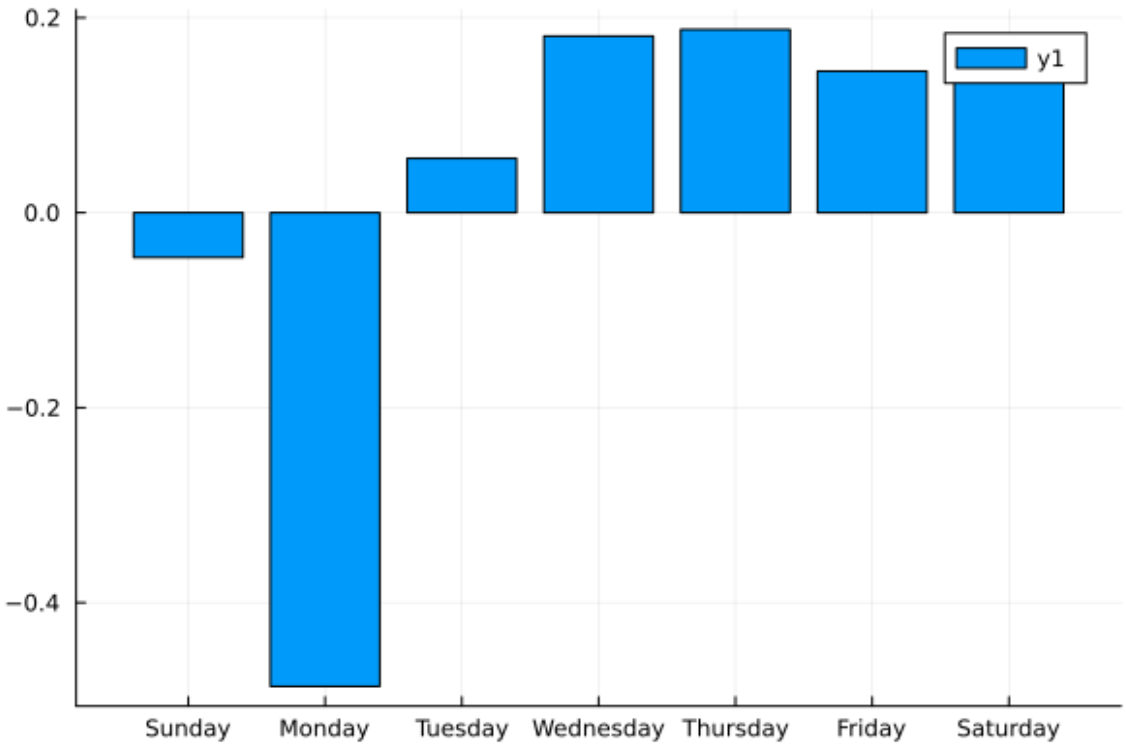
```
Dates.dayname(Date(df.Date[40], dateformat"y/m/d"))
```

"Monday"

40 S 1 .

```
dow=[Dates.dayname(Date(df.Date[40+i], dateformat"y/m/d")) for i=-1:5];
```

```
plot(dow,S,seriestype = :bar)
```

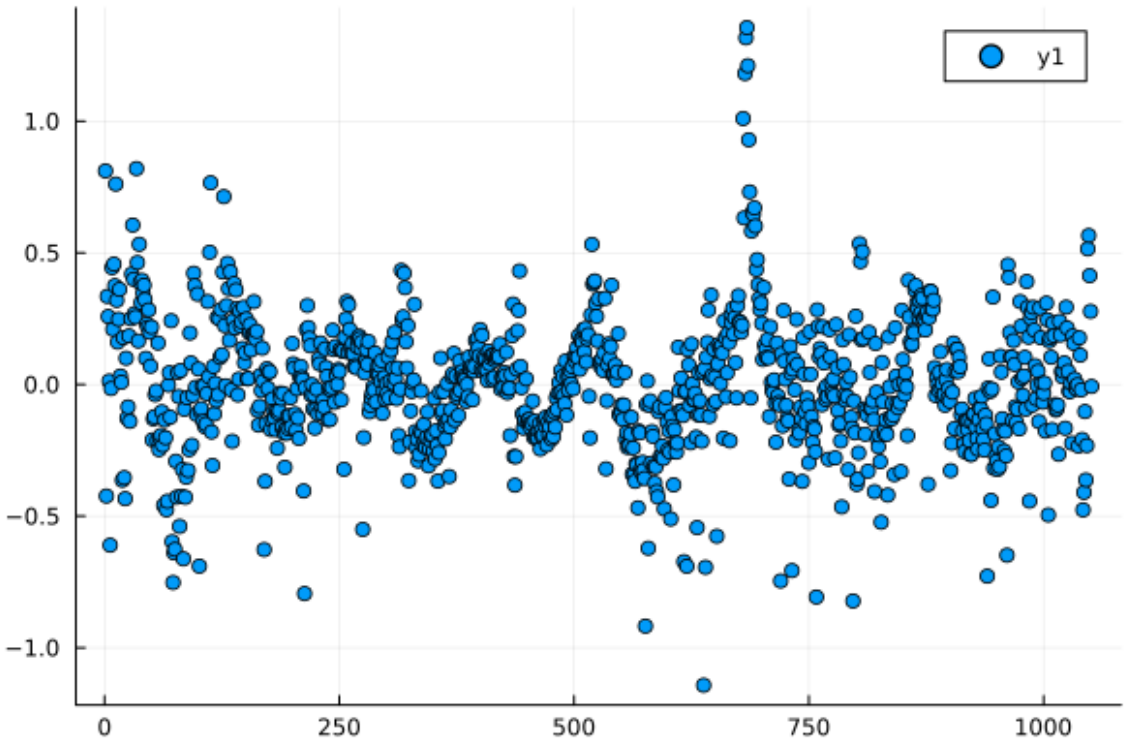


, .

I_t .

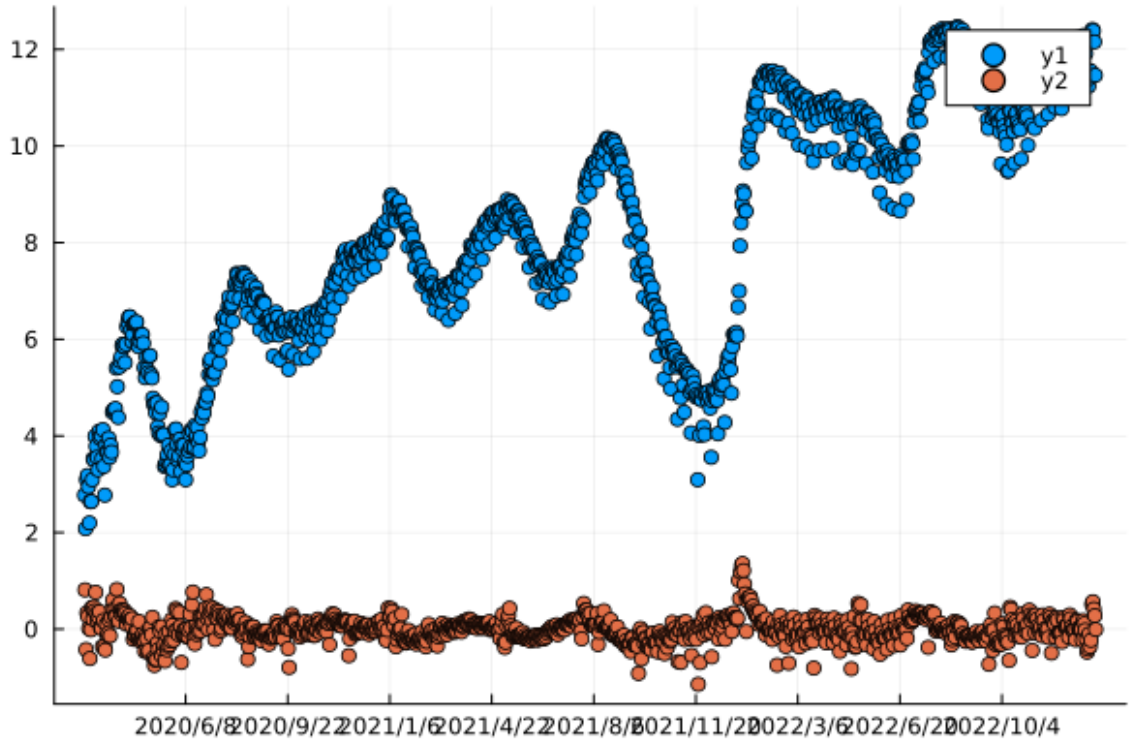
```
I=zeros(length(df.ALL)-39)
for (i,n) in enumerate((df.log_diff )[40:end])
    I[i]=n-S[i%7+1]
end
```

```
plot(I, seriestype = :scatter)
```



TC_t . I_t . 5 .

```
plot(df.Date[40:end], df.log_all[40:end], seriestype = :scatter)
plot!(I, seriestype = :scatter)
```



$log(y_t)$ I_t . TC_t .

4.3

TC_t .

4.3.1

. (. 1 0 . ,
. .)

```
function minima(array,i,r)
    res=i-r+findmin(array[max(i-r,1):i])[2]
    while res!=i
        i=res
        res=i-r+findmin(array[max(i-r,1):i])[2]
    end
    return res
end
```

```
minima (generic function with 1 method)
```

```
function maxima(array,i,r)
    res=i-r+findmax(array[max(i-r,1):i])[2]
    while res!=i
        i=res
        res=i-r+findmax(array[max(i-r,1):i])[2]
    end
    return res
end
```

```
maxima (generic function with 1 method)
```

```
function extremes(array,r)
    i_max=findmax(array)[2]
    res=[i_max]
    i=i_max
    i_min=1
    while i-r>0 && i !=i_min
        i_min=minima(array,i_max,r)
        println(i," ",i_min)
        i_max=maxima(array,i_min,r)
        push!(res,i_min)
        push!(res,i_max)
        i=i_min
    end
    return res
end
```

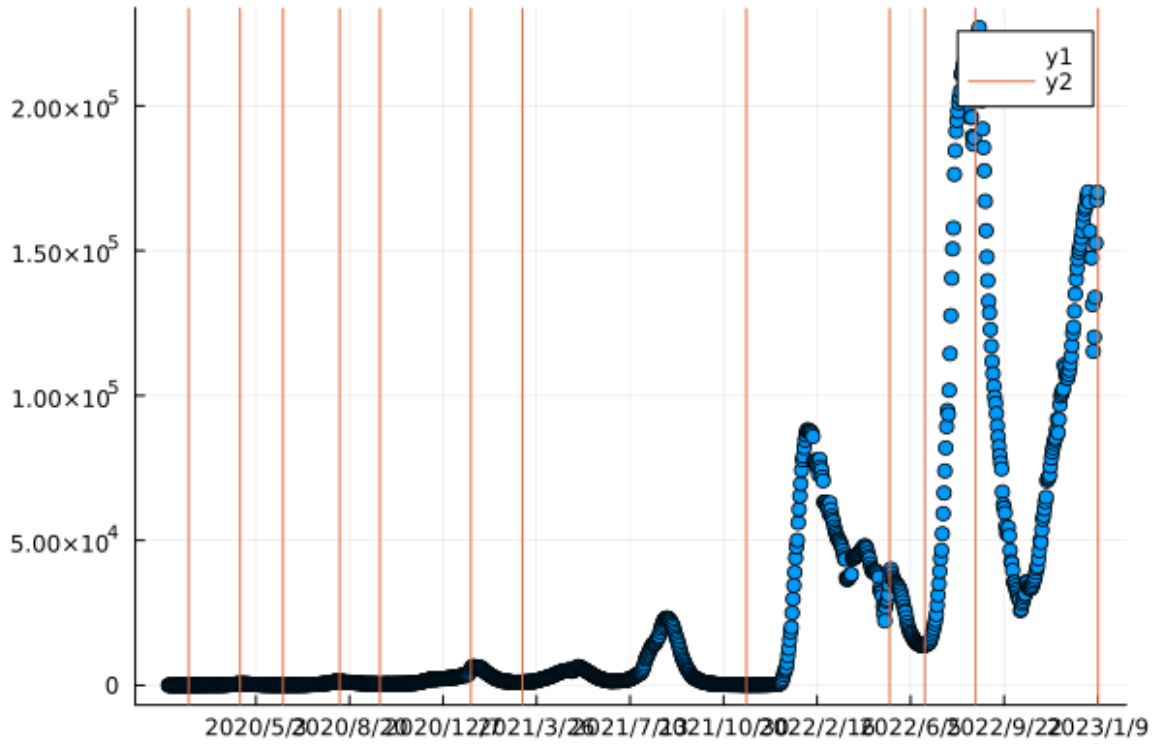
```
extremes (generic function with 1 method)
```

```
period=extremes(df.ALL, 20)
append!(period,extremes(df.ALL[1:480], 15))
unique!(period)
push!(period,minima(df.ALL,450,10))
append!(period,[30,90,140,680,length(df.ALL)])
sort!(period)
```

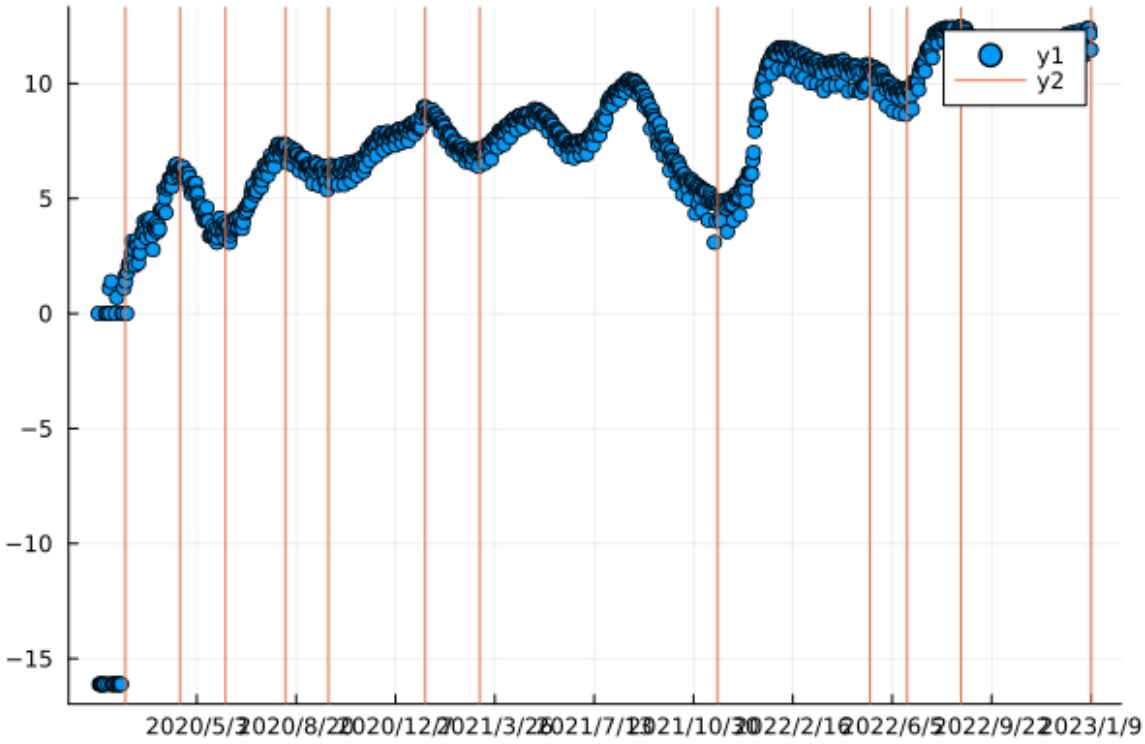
```
947 888
359 253
```

```
12-element Vector{Int64}:
   30
   90
  140
  206
  253
  359
  419
  680
  847
  888
  947
 1090
```

```
plot(df.Date, df.weekly_ave,seriestype = :scatter)
vline!(period)
```



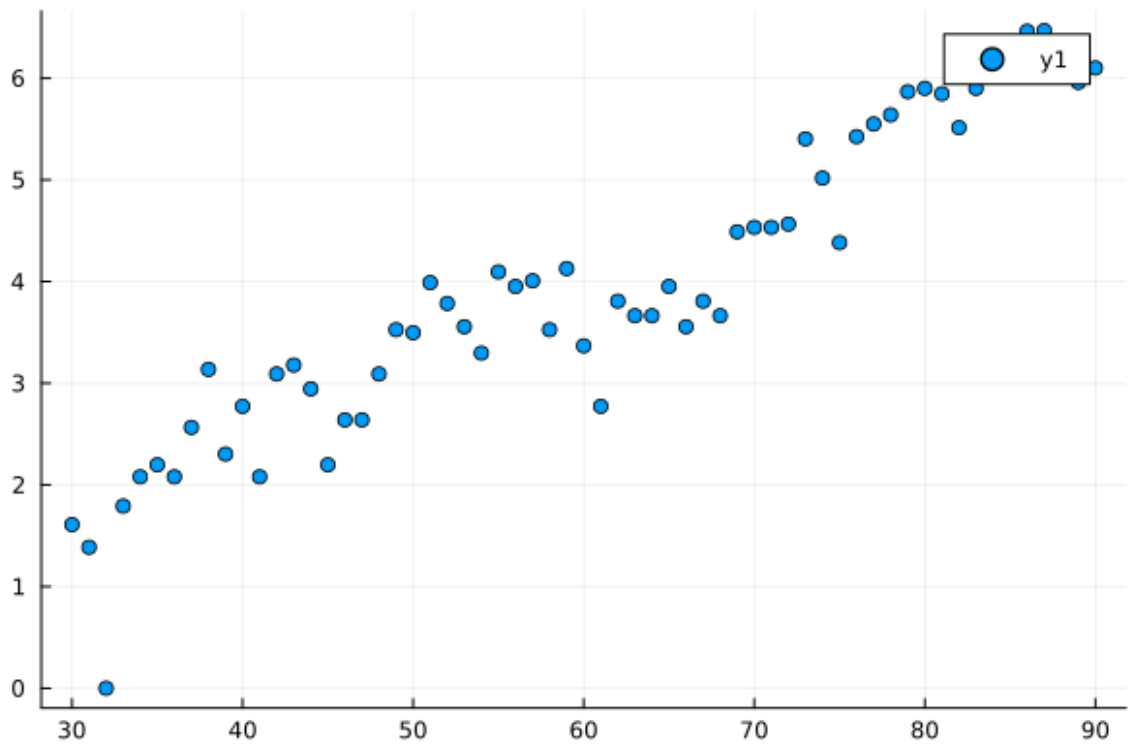

```
plot(df.Date, df.log_all, seriestype = :scatter)
vline!(period)
```



4.3.2

. GLM .

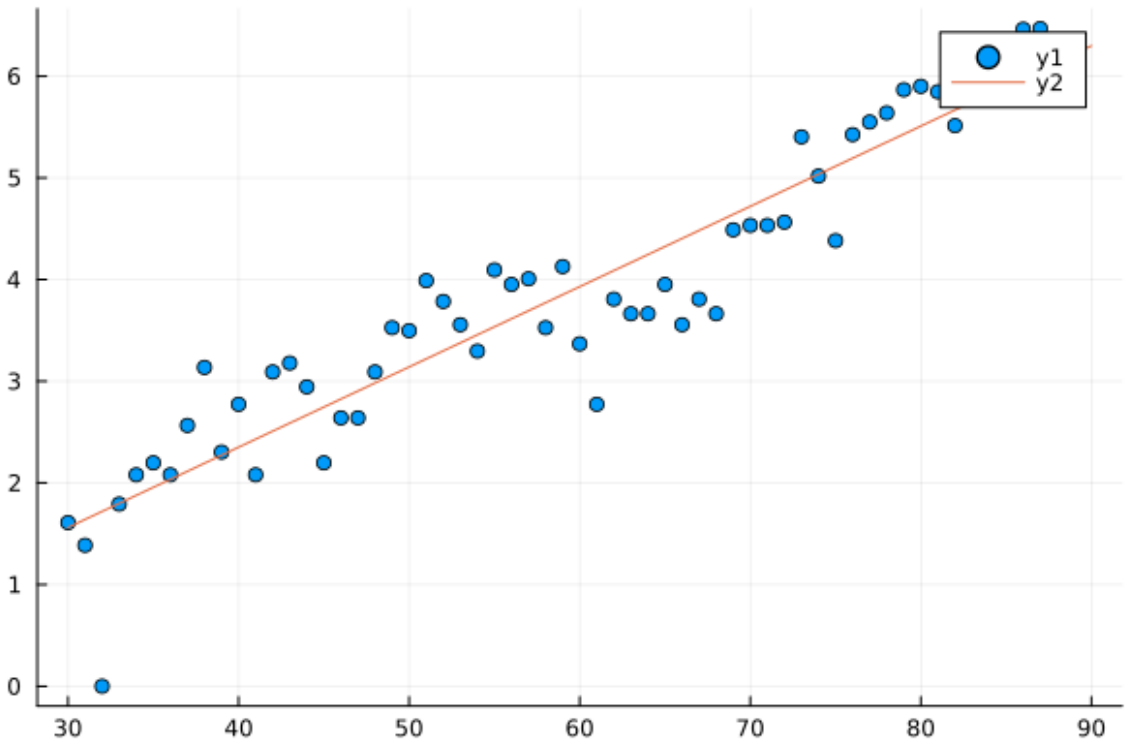
```
plot(period[1]:period[2],df.log_all[period[1]:period[2]], seriestype = :scatter)
```




```
i=1
data = DataFrame(X=period[i]:period[i+1], Y=df.log_all[period[i]:period[i+1]])
ols = lm(@formula(Y ~ X), data)
```

```
StatsModels.TableRegressionModel{LinearModel{GLM.LmResp{Vector{Float64}}, GLM.DensePredChol{

Y ~ 1 + X

Coefficients:

                 Coef.  Std. Error      t  Pr(>|t|)   Lower 95%   Upper 95%

(Intercept)  -0.807003   0.22738     -3.55    0.0008  -1.26199    -0.352016
X             0.0789489  0.00363634  21.71    <1e-29   0.0716726   0.0862252
```

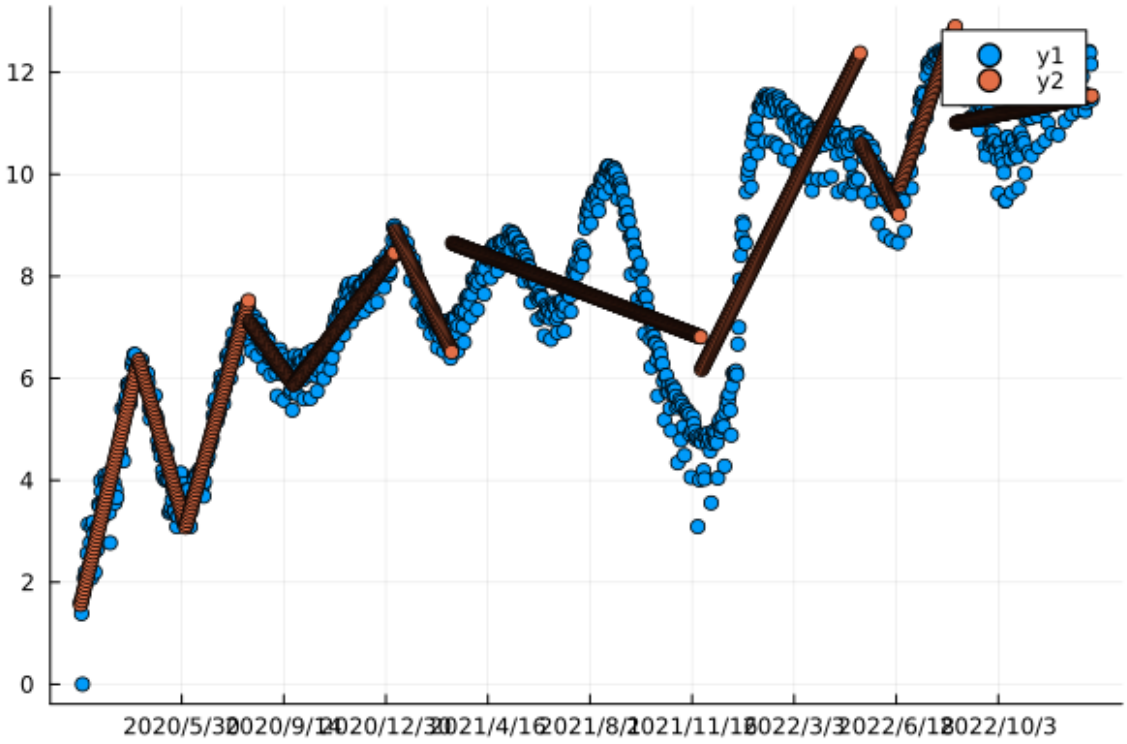
```
plot(period[i]:period[i+1]-1,df.log_all[period[i]:period[i+1]-1], seriestype = :scatter)
plot!(data.X,predict(ols))
```



:

```
pred=predict(ols)
for i=2:length(period)-1
    data = DataFrame(X=period[i]:period[i+1]-1, Y=df.log_all[period[i]:period[i+1]-1])
    ols = lm(@formula(Y ~ X), data)
    append!(pred,predict(ols))
end
```

```
plot(df.Date[period[1]:end], df.log_all[period[1]:end], seriestype = :scatter)
plot!(df.Date[period[1]:end],pred,seriestype = :scatter)
```

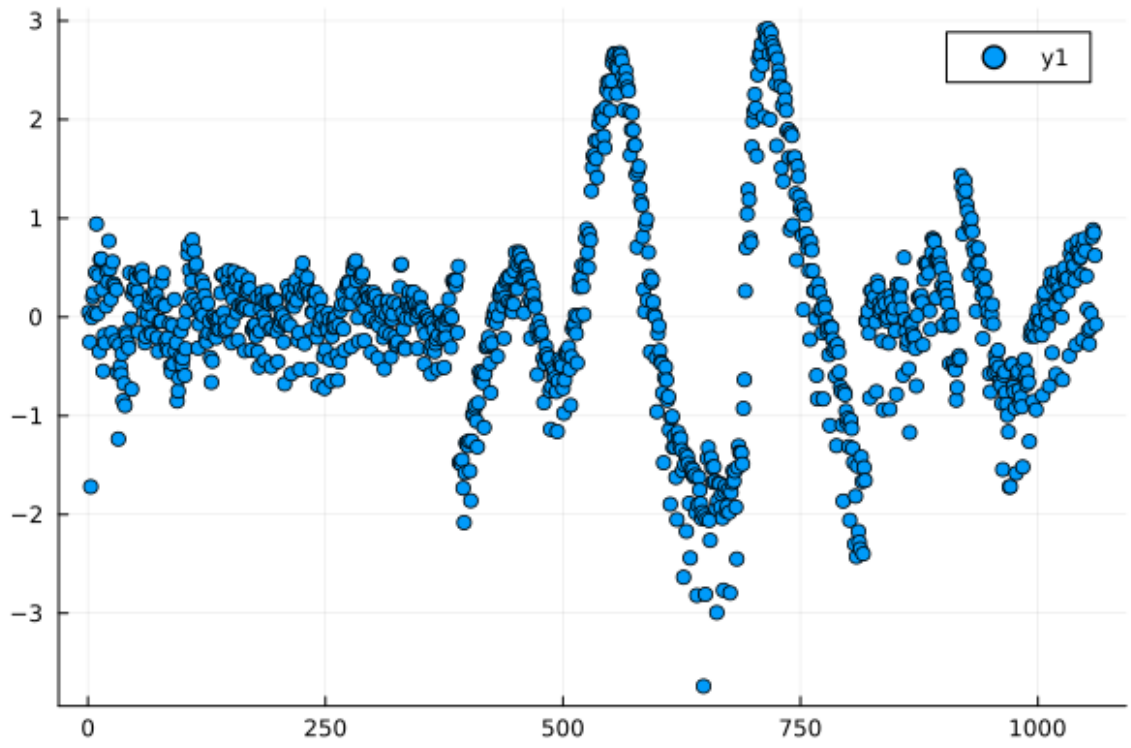


.

TC_t S_t, I_t .

```
diff= df.log_all[period[1]:end] .- pred;
```

```
plot(diff, seriestype = :scatter)
```




```
sum_n=zeros(7)
count_day_of_week=zeros(Int,7)
for (i, n) in enumerate(diff)
    sum_n[i%7+1]+=n
    count_day_of_week[i%7+1]+=1
 end
```

```
S2 = sum_n ./ count_day_of_week
```

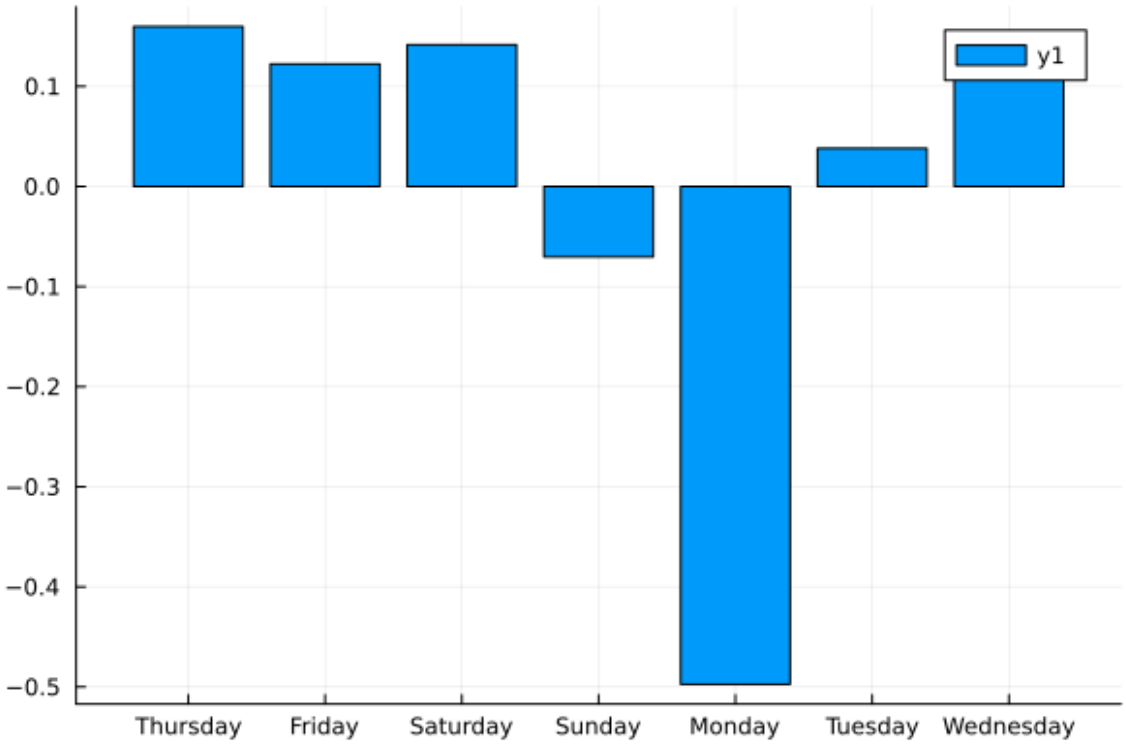
```
7-element Vector{Float64}:
  0.1597298156141544
  0.1224051792494716
  0.14164292461164305
 -0.07029766752689469
 -0.4973507234395729
  0.03803188451298746
  0.14337600662335104
```

```
Dates.dayname(Date(df.Date[period[1]], dateformat"y/m/d"))
```

```
"Friday"
```

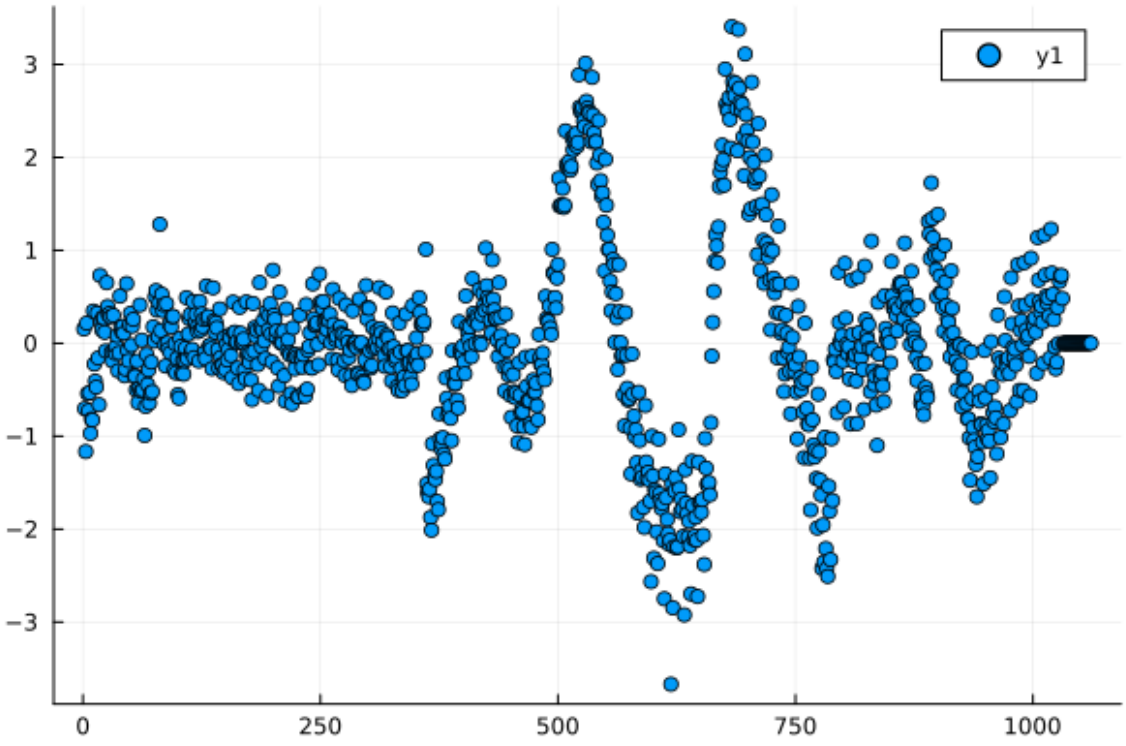
```
dow=[Dates.dayname(Date(df.Date[period[1]+i], dateformat"y/m/d")) for i=-1:5];
```

```
plot(dow,S2,seriestype = :bar)
```




```
I2=zeros(length(df.ALL)-period[1]+1)
for (i,n) in enumerate((diff )[period[1]:end])
    I2[i]=n-S2[i%7+1]
end
```

```
plot(I2, seriestype = :scatter)
```



. TC_t .

5

(1) , (2) , (3) .