

Covid in Japan

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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 .

S_t, I_t $TC_t (n)$,
:

```
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"
```

```
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...  
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)

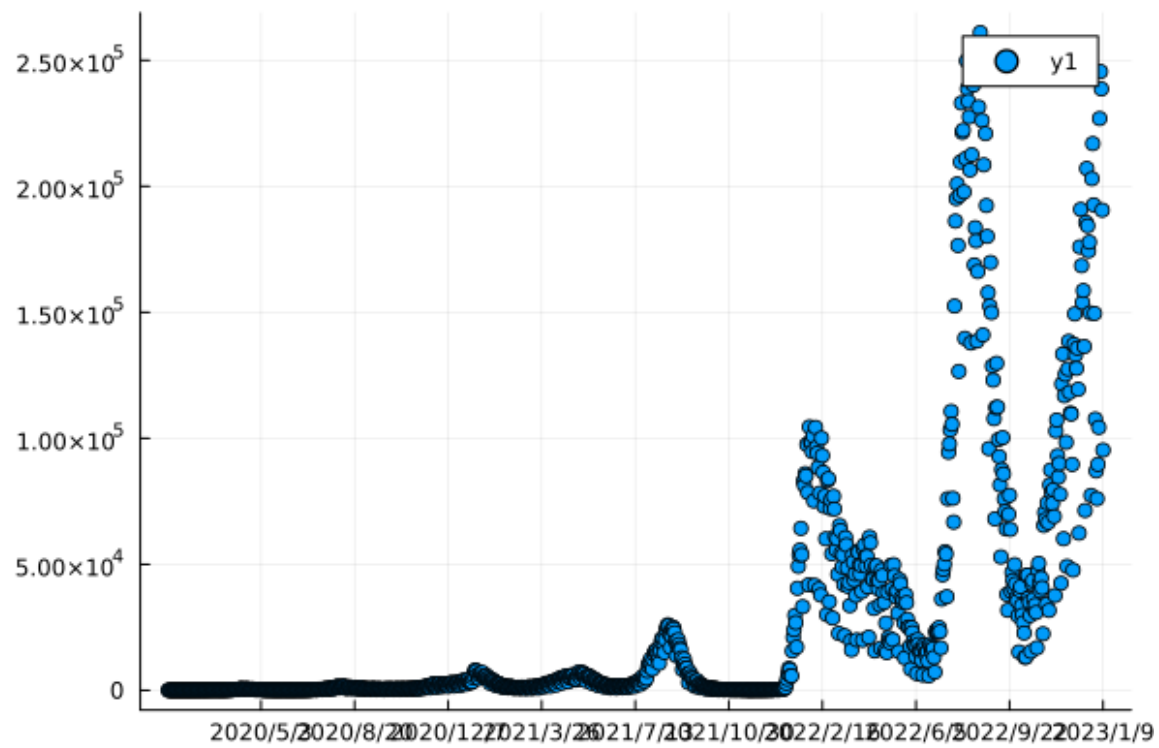
```

| | 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 .

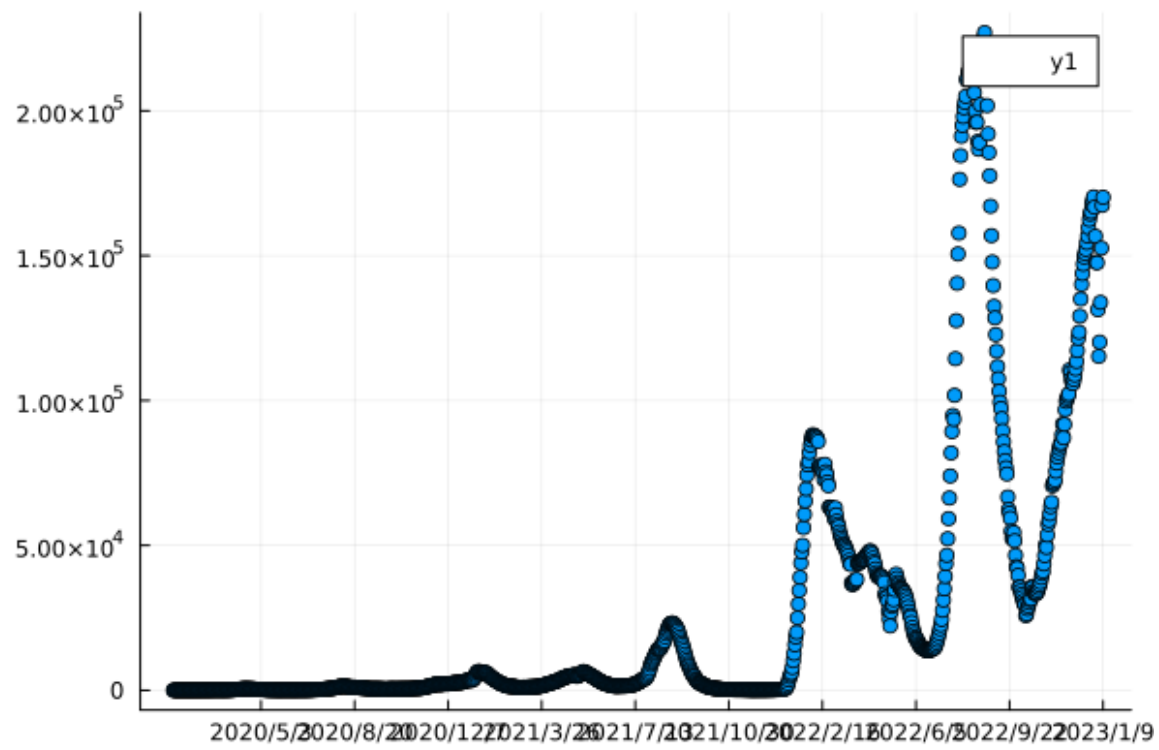
4

4.1 raw data 7

TC_t . TC_t . () , . 7 :

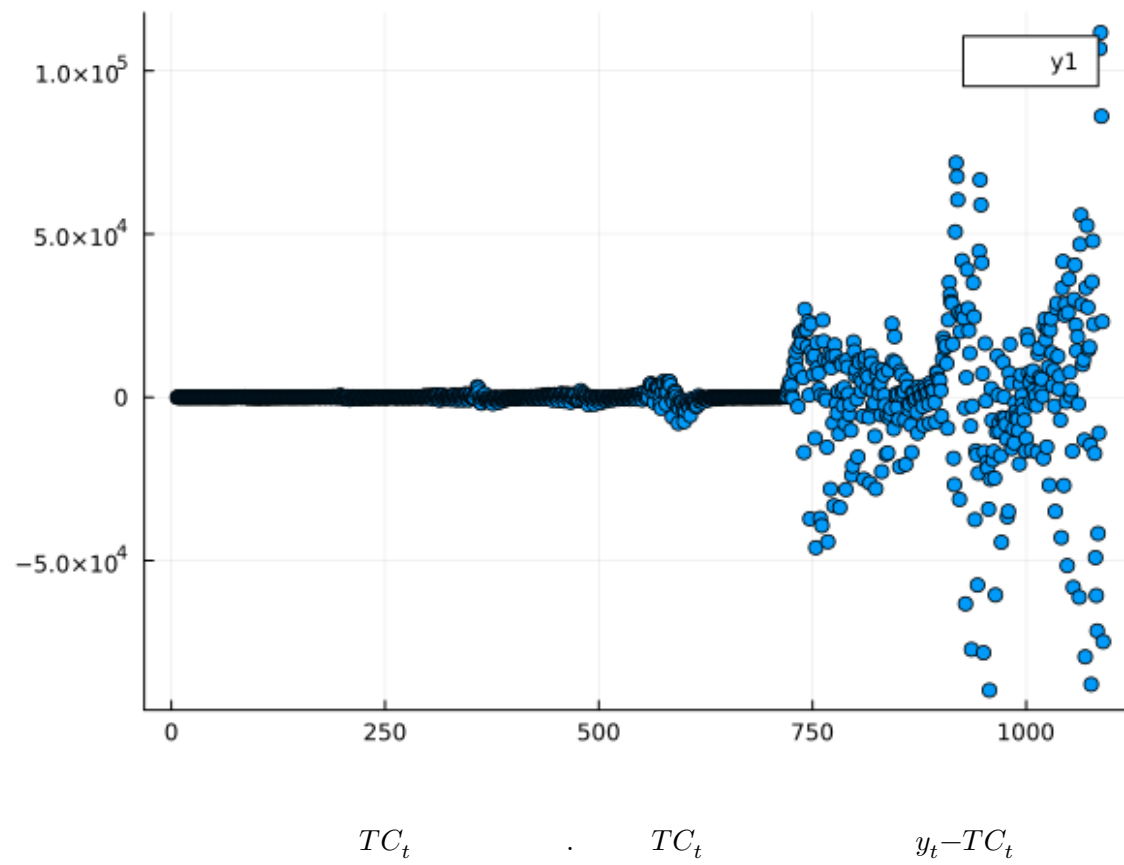
```
df.weekly_ave=sma(df.ALL, n=7);
```

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



raw data :

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



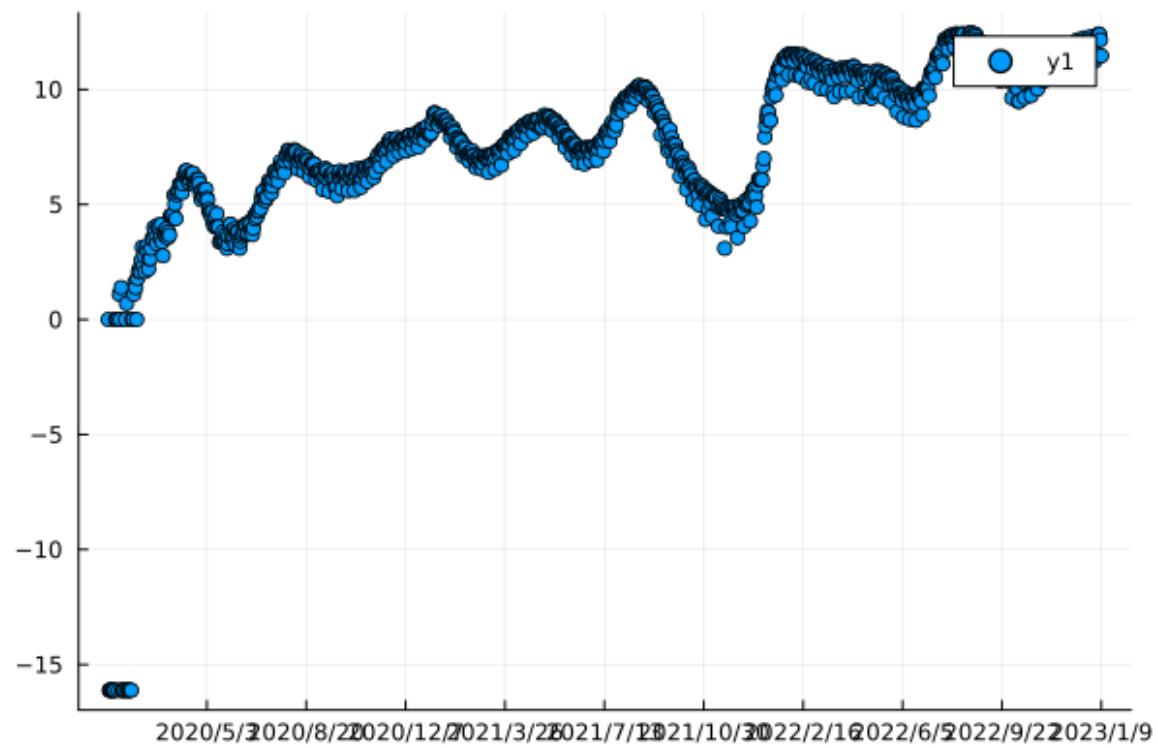
4.2 7

. 0 ϵ .

```
= 0.0000001;

df.log_all=log.(df.ALL .* );

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

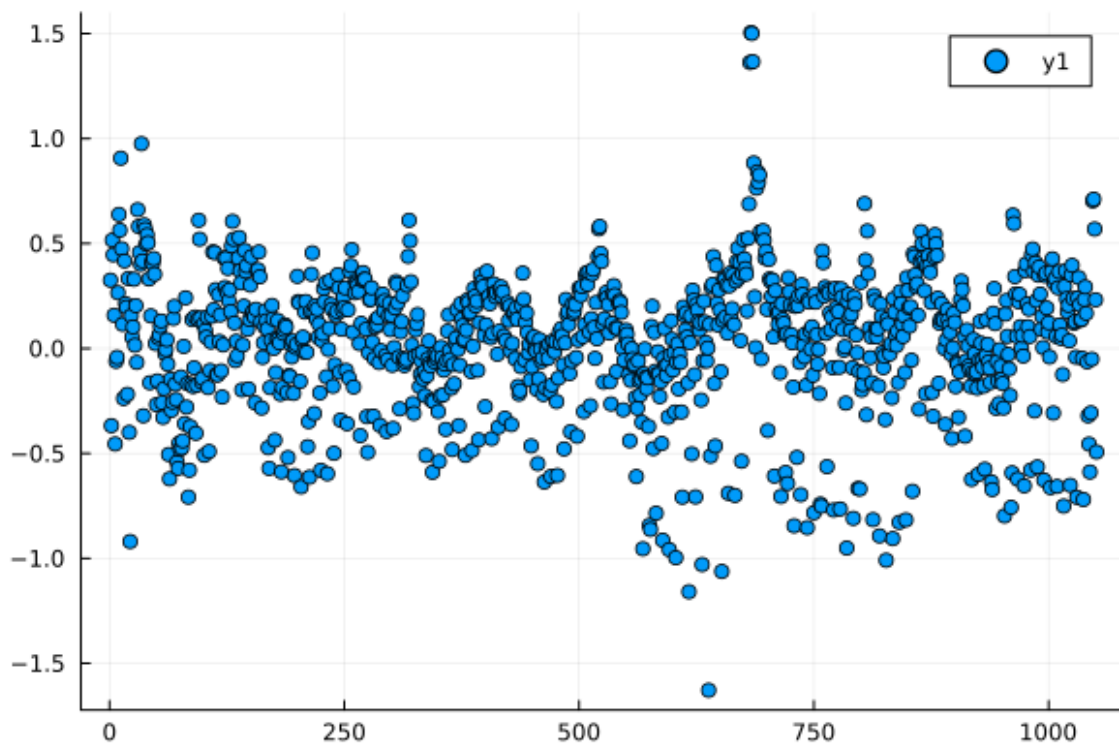


6

.
:

```
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
```

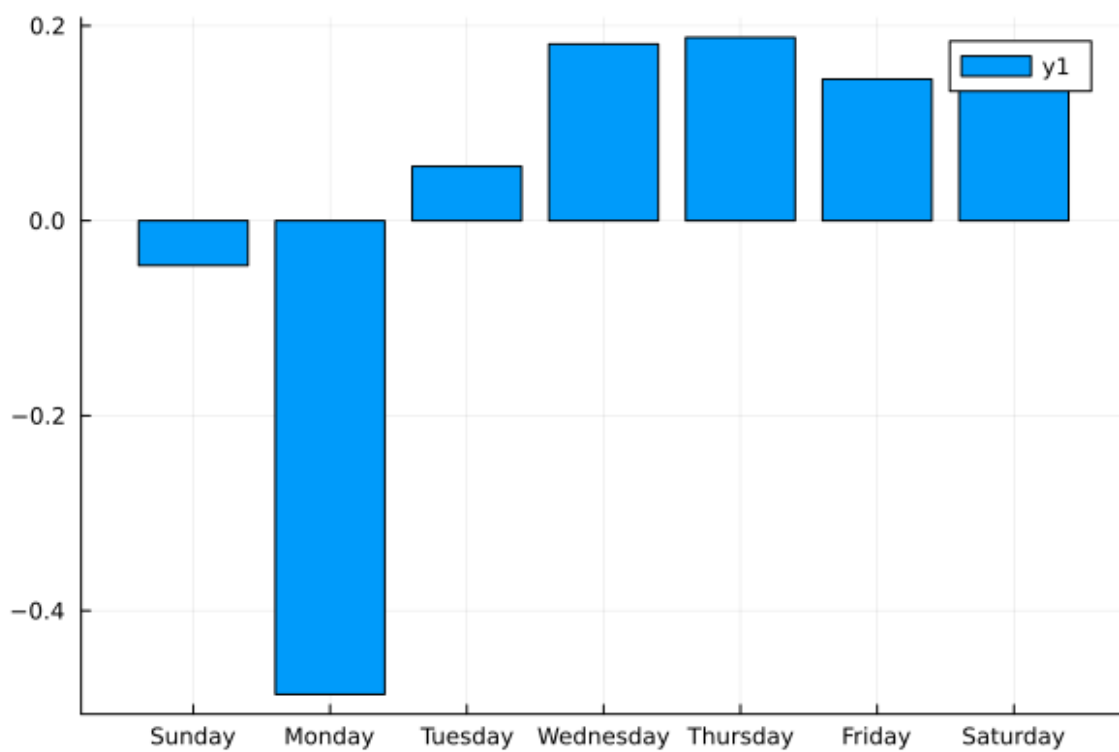
```
Dates.dayname(Date(df.Date[40], dateformat"y/m/d"))
```

"Monday"

```
40      S 1      .
```

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

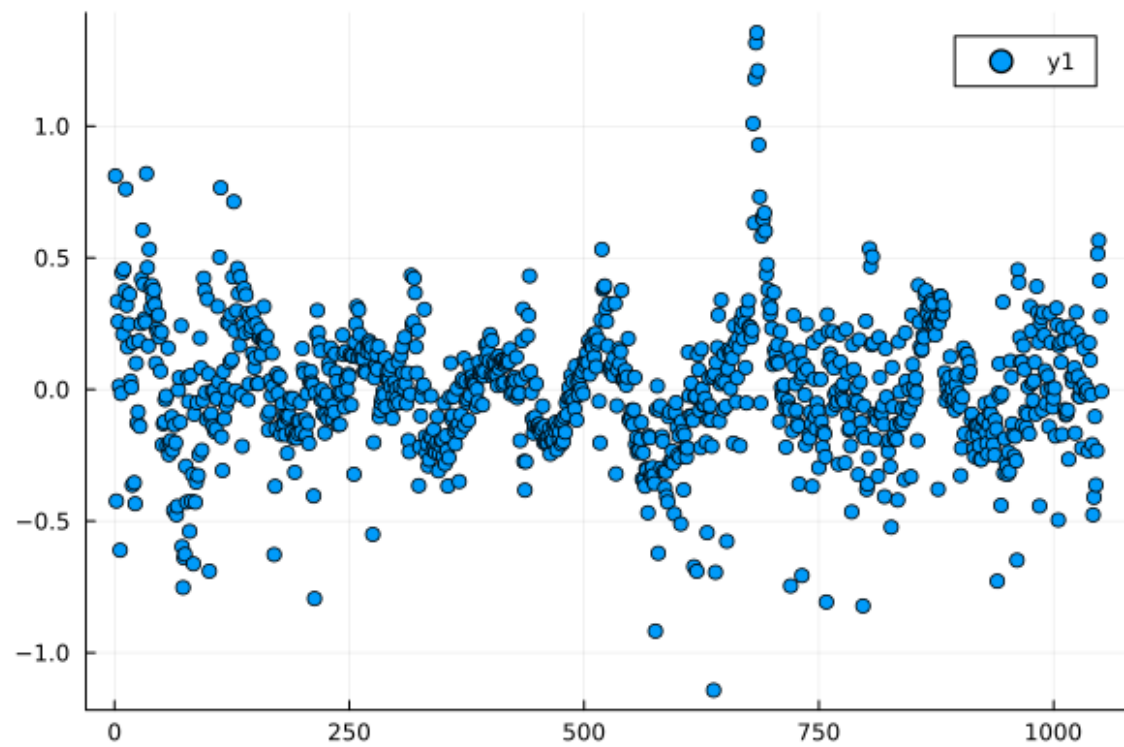
```
plot(dow,S,seriestype = :bar)
```



I_t

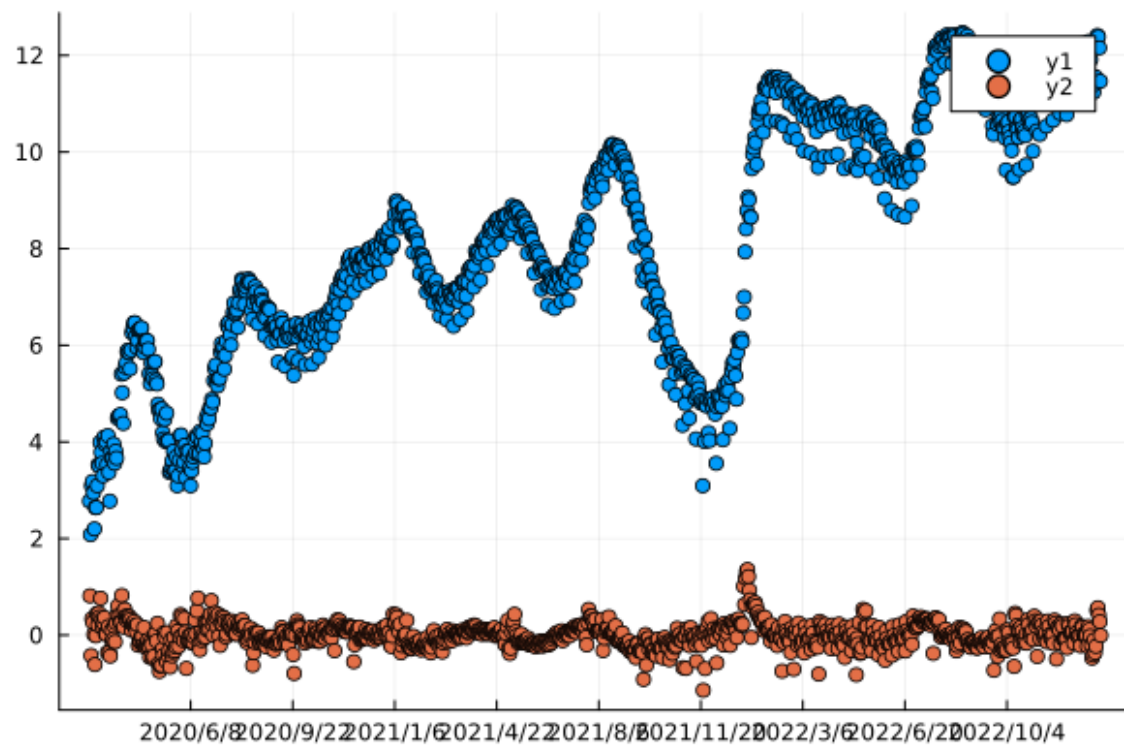
```
I=zeros(length(df.ALL)-39)
for (i,n) in enumerate((df.log_diff )[40:end])
    I[i]=n-S[i%7+1]
end
```

```
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)
```



$$\log(y_t) \quad I_t \quad . \quad TC_t \quad .$$

4.3

$$TC_t \quad .$$

4.3.1

$$\left(\begin{array}{c} \cdot \\ \cdot \end{array} \right) \quad \cdot \quad \begin{array}{c} 1 \\ 0 \end{array} \quad \cdot \quad \cdot \quad ,$$

```
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)
```

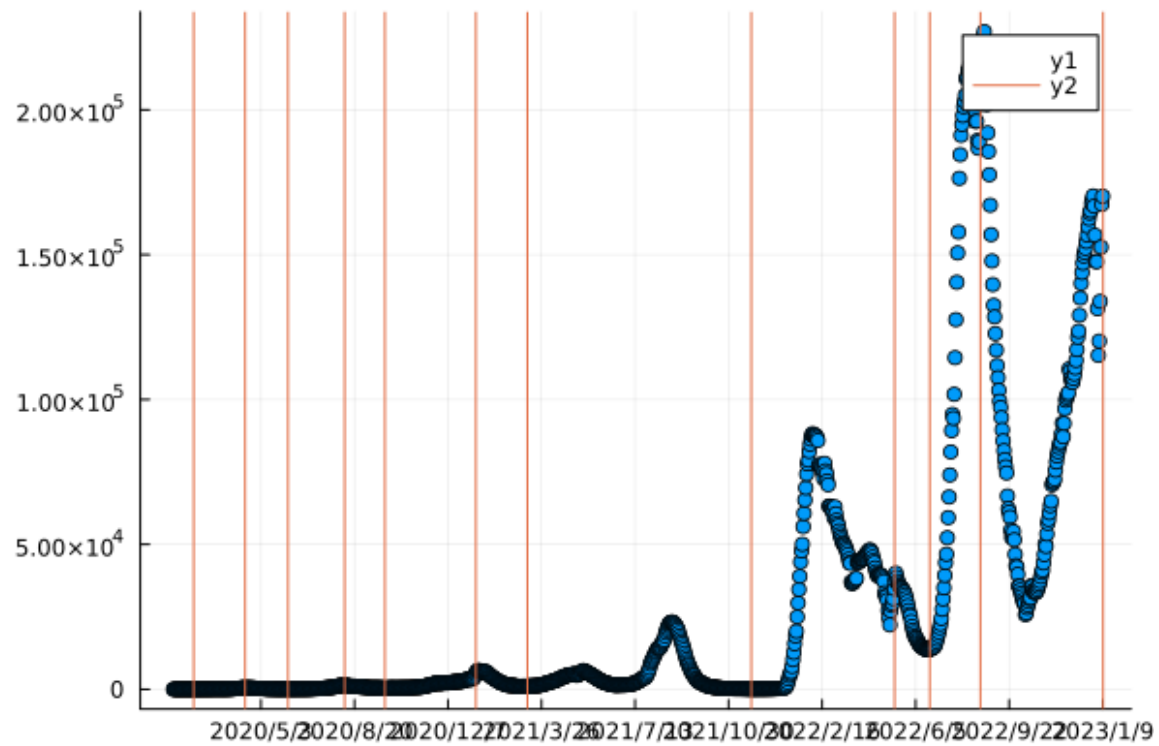
947 888

359 253

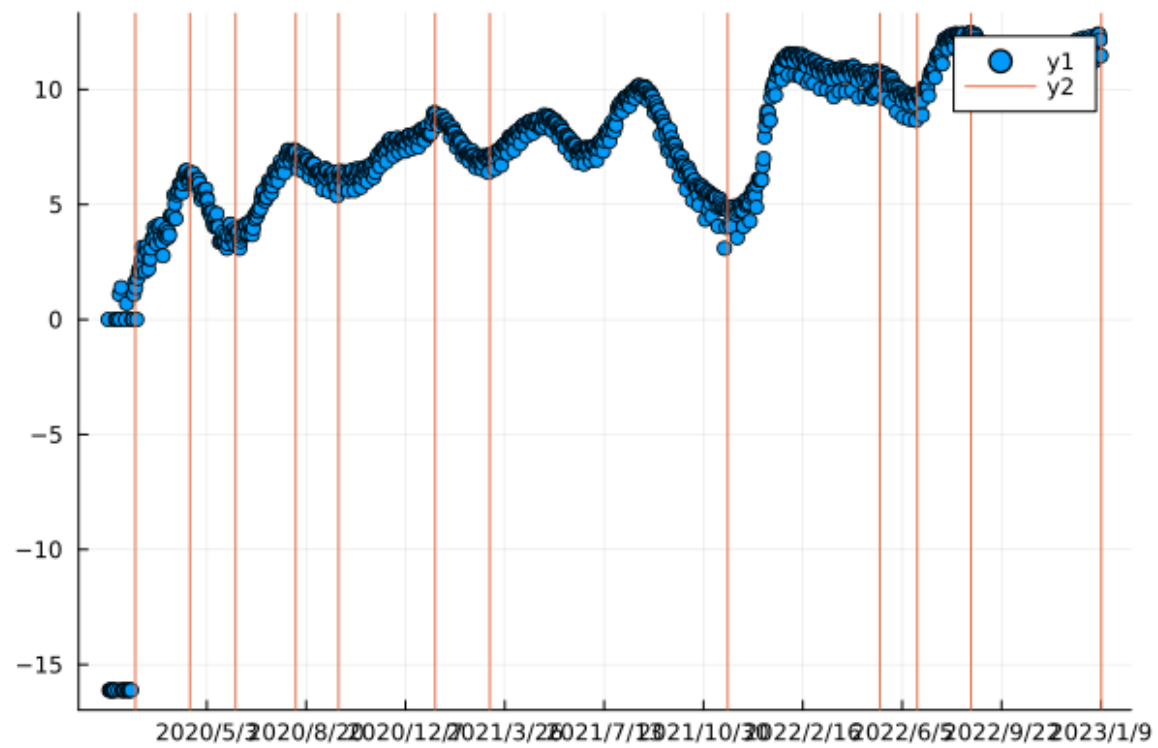
12-element Vector{Int64}:

30
90
140
206
253
359
419
680
847
888
947
1090

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



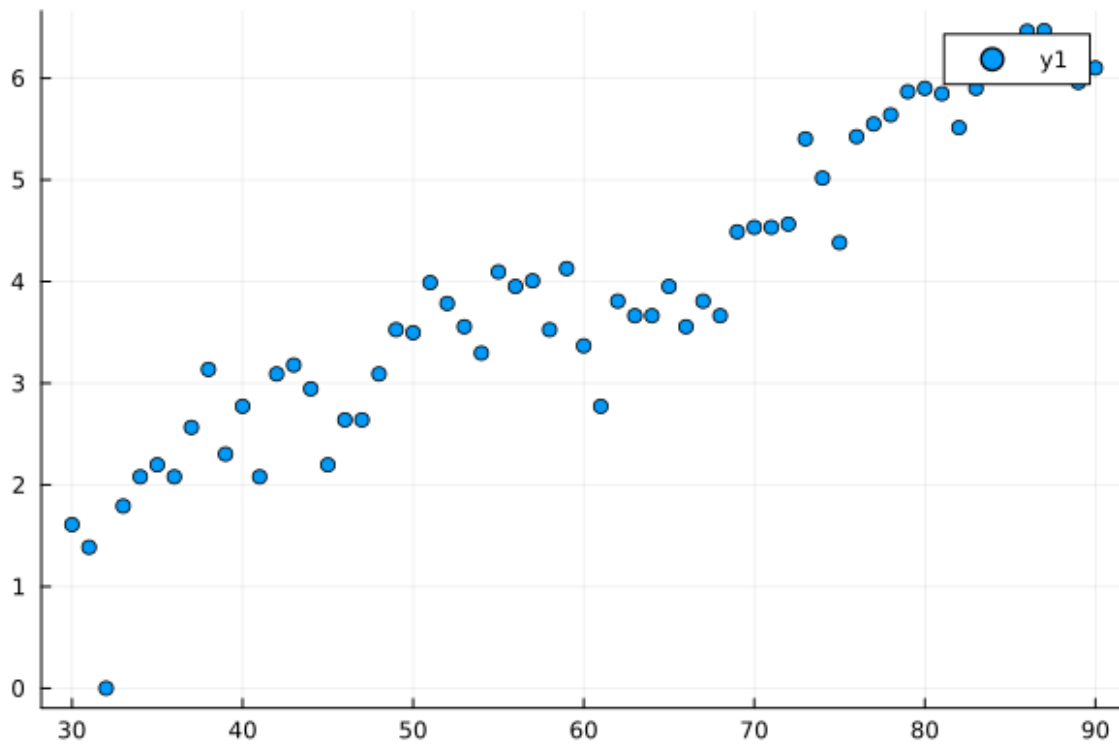
```
plot(df.Date, df.log_all, seriestype = :scatter)  
vline!(period)
```



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)
```

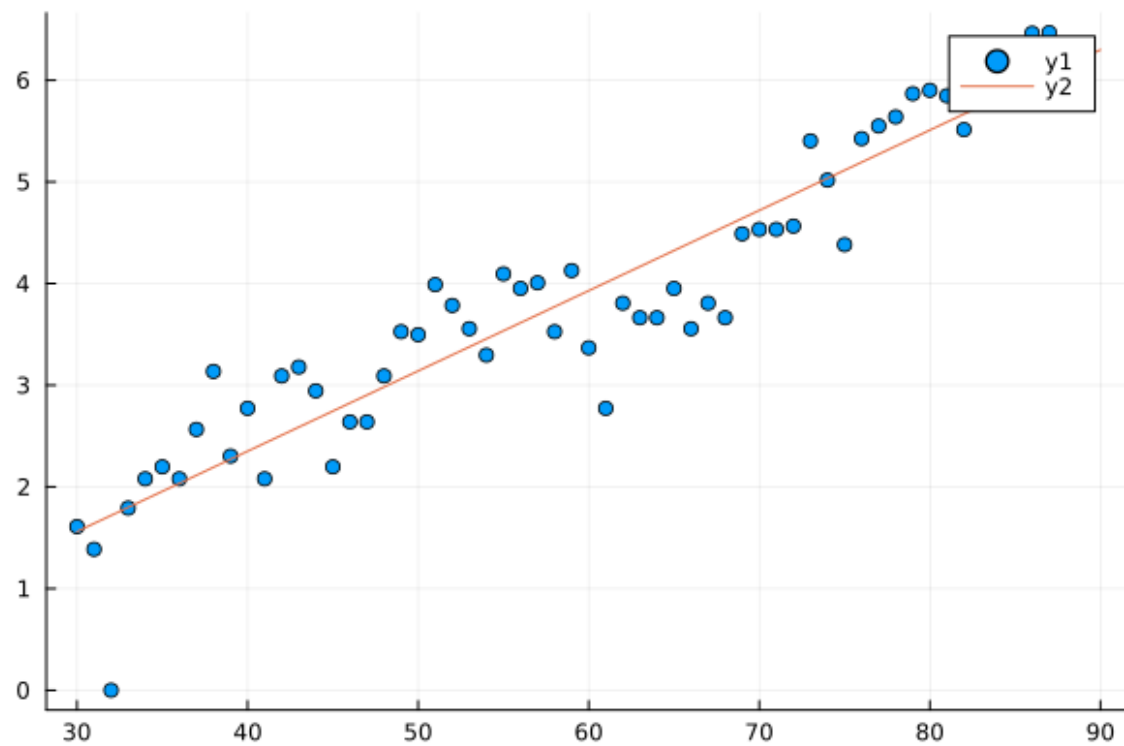
```
StatsModels.TableRegressionModel{LinearModel{GLM.LmResp{Vector{Float64}}}, GLM.DensePredChol{
```

```
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 |

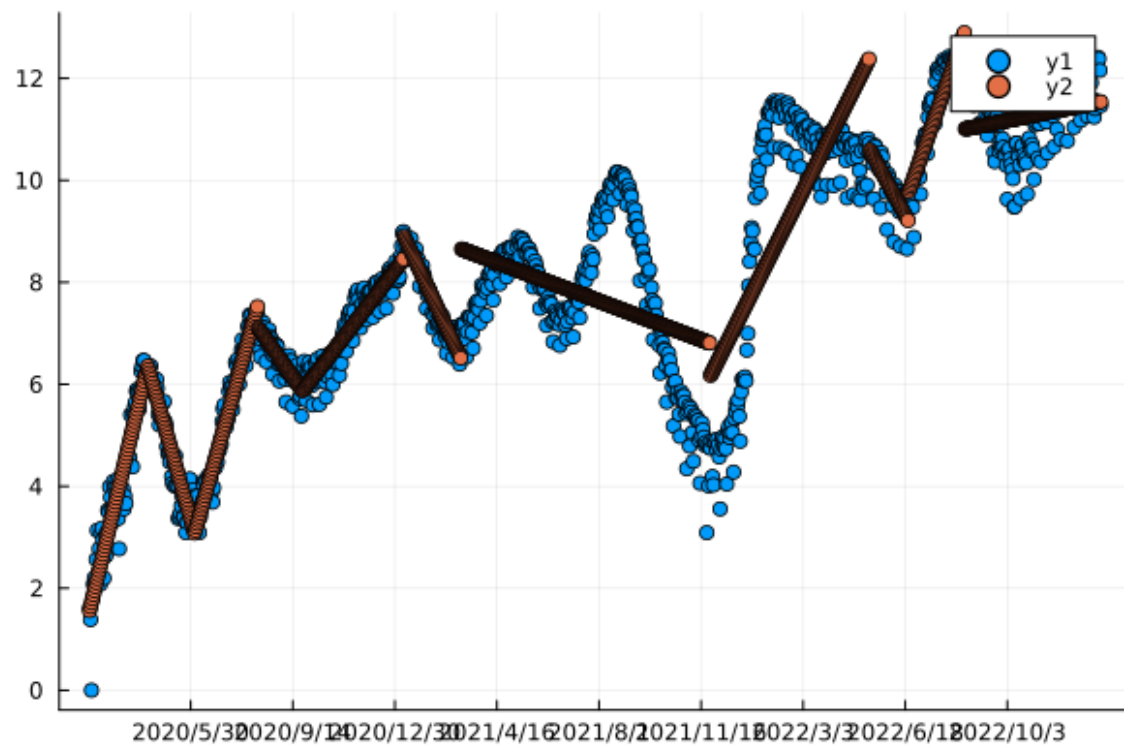
```
plot(period[i]:period[i+1]-1,df.log_all[period[i]:period[i+1]-1], seriestype = :scatter)
plot!(data.X,predict(ols))
```

:

```
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
```

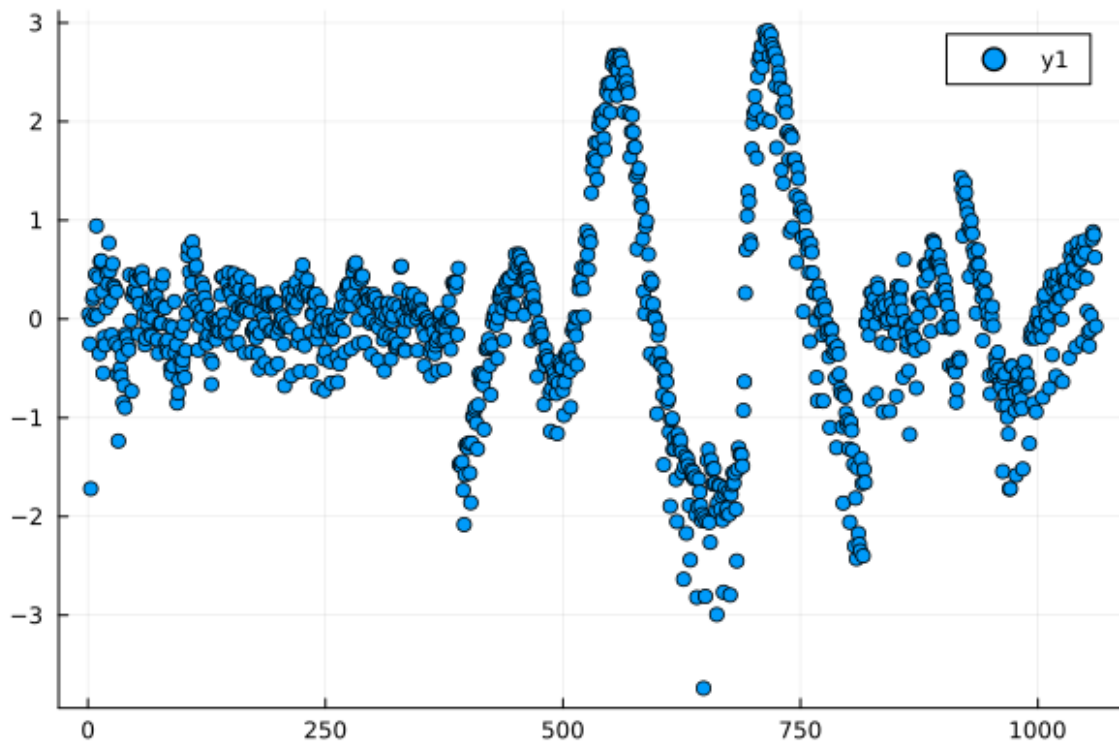
```
plot(df.Date[period[1]:end], df.log_all[period[1]:end], seriestype = :scatter)
plot!(df.Date[period[1]:end],pred,seriestype = :scatter)
```



$$TC_t = S_t, I_t$$

```
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}:

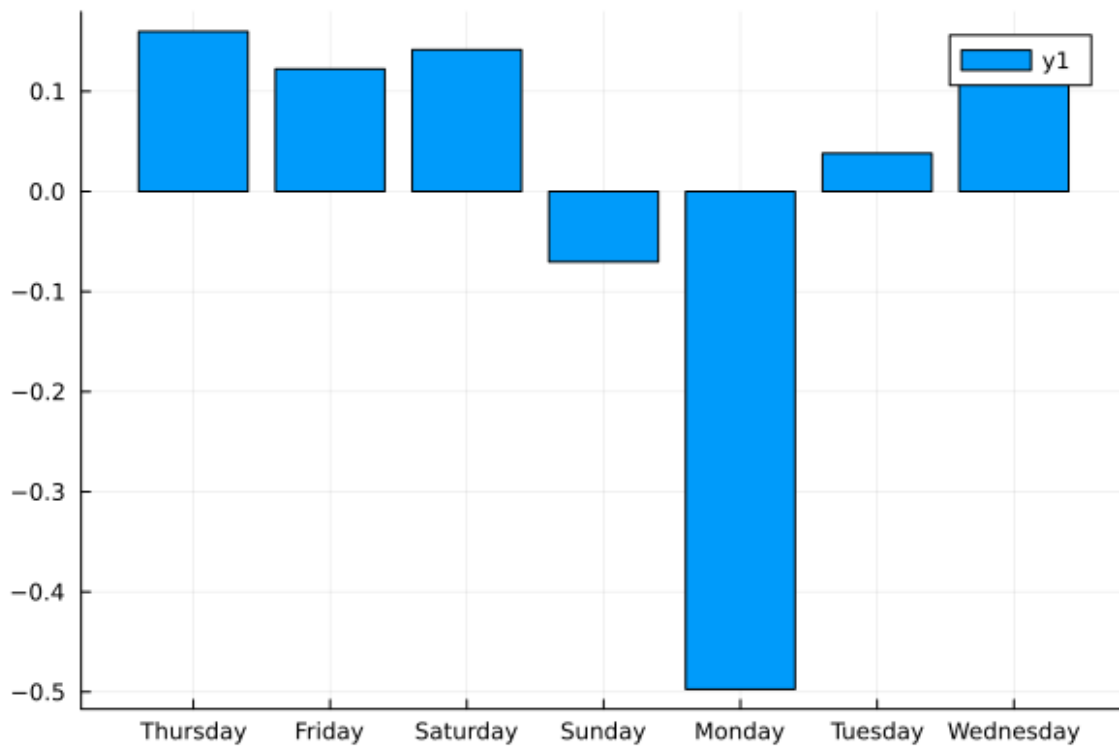
```
0.1597298156141544
0.1224051792494716
0.14164292461164305
-0.07029766752689469
-0.4973507234395729
0.03803188451298746
0.14337600662335104
```

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

"Friday"

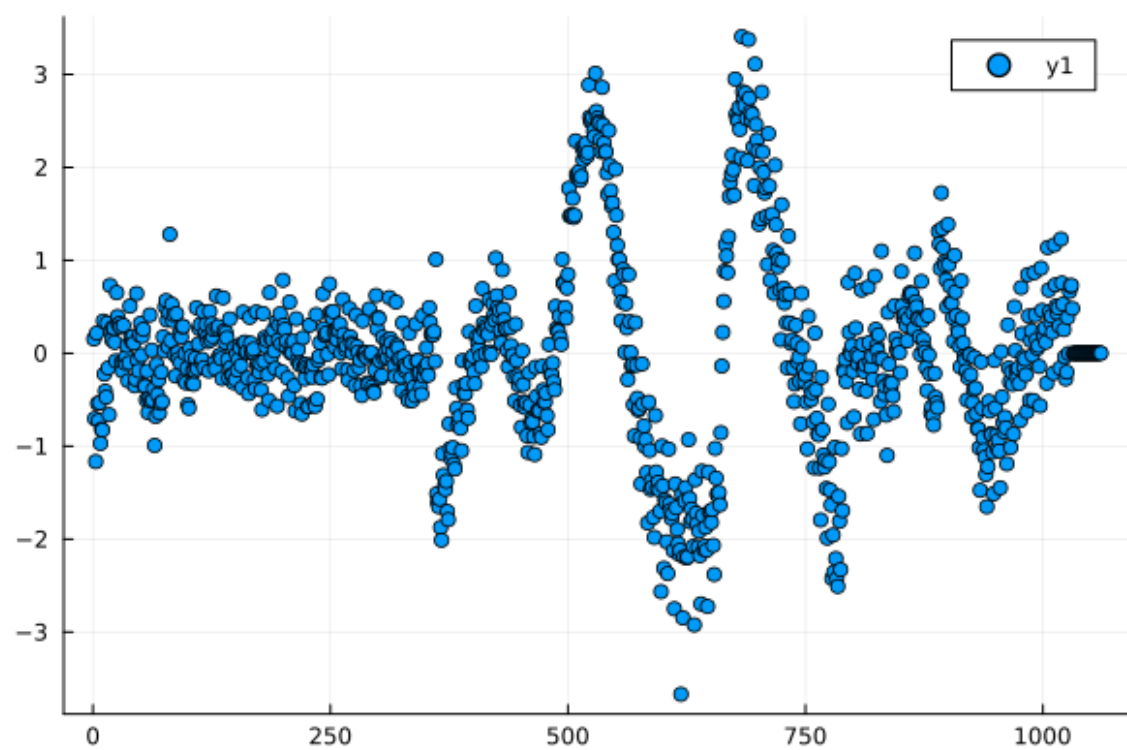
```
dow=[Dates.dayname(Date(df.Date[period[1]+i], dateformat"y/m/d")) for i=-1:5];
```

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



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

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



TC_t

5

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