Multivariate forecasting

```
library(tidyverse)
source("multivariate_forecasting.R")
source("initialization_functions.R")
source("constrained_gls.R")
source("mle.R")
```

We will make a synthetic data set of 5 weeks of call volume from 2 streams, assuming each day is divided into 4 time intervals.

```
set.seed(101)

df <- tibble(
  stream = rep(1:2, each = 5*7*4),
  call_volume = rpois(5*7*4*2, 5),
  wd = rep(1:7, 5*4*2),
  d = rep(1:(5*7), each = 4) %>% rep(2),
  t = rep(1:4, 5*7*2)
)
```

```
head(df)
```

```
## # A tibble: 6 x 5
##   stream call_volume    wd     d     t
##    <int>       <int> <int> <int> <int>
## 1      1           4     1     1     1
## 2      1           2     2     1     2
## 3      1           6     3     1     3
## 4      1           6     4     1     4
## 5      1           3     5     2     1
## 6      1           4     6     2     2
```

See the code in `multivariate_forecasting.R` for the function's documentation.

```
rslt <- multivariate_forecasting(
  df = df,
  horizon = 7*4, # Forecast for one week into the future
  max_iter = 100,
  algo = "NLOPT_LD_LBFGS",
  verbose = FALSE
)
```

```
names(rslt)
```

```
## [1] "df_pred"        "step1_converge" "step2_converge" "params"
```

The forecasts are given in a data frame, which can be accessed through the `df_pred` component of the resulting list.

```
head(rslt$df_pred)
```

```
## # A tibble: 6 x 3
```

```
##   stream     h  pred
##    <int> <dbl> <dbl>
## 1      1     1  4.59
## 2      1     2  9.78
## 3      1     3  7.23
## 4      1     4  4.13
## 5      2     1  6.95
## 6      2     2  5.37
```

The estimated parameters of the model can be accessed through the `params` component of the resulting list.

```
rslt$params
```

```
## $u_vec
##  [1]  6.427732  9.026046 13.710092  8.306091  7.345450 13.580851  8.530100
##  [8]  6.512017  9.788499 11.980518  7.374042  7.840107 10.740966  9.162202
## [15]  7.161124 12.255330 11.752739  9.020679  9.222474 12.193621 10.117783
## [22]  6.338288  9.409495 12.171137  5.710152  7.423597  9.842172  8.634144
## [29]  8.486634 10.465970 10.621383  7.562415  8.270617 11.563342  9.357856
## [36]  9.821236  8.349387 12.741277 17.436184  8.181774  7.016943 10.549427
## [43]  9.222829  9.578110 19.310081 18.791874  5.101258  4.649011  8.843526
## [50]  9.125084  7.421736 16.630934 18.816015  6.735884  5.805697  8.548179
## [57]  8.436411  8.234729 14.740997 16.909507  6.545689  4.708576  8.478793
## [64]  8.784134  8.083699 15.238003 17.939529  7.264677  6.990094  8.799336
##
## $sigma
##             [,1]        [,2]
## [1,]  0.15266676 -0.01684533
## [2,] -0.01684533  0.16162424
##
## $f_vec
##  [1] 0.2862000 0.1816609 0.2687047 0.2634345 0.1908554 0.3476814 0.1642484
##  [8] 0.2972148 0.2816007 0.1837966 0.3421425 0.1924603 0.2801390 0.2262979
## [15] 0.1427727 0.3507904 0.2158746 0.3106509 0.2682608 0.2052137 0.2979540
## [22] 0.1988311 0.2340992 0.2691157 0.1870058 0.3355603 0.2217479 0.2556861
## [29] 0.2411845 0.3676041 0.1116135 0.2795979 0.1400686 0.2667439 0.4699693
## [36] 0.1232181 0.3147165 0.1362787 0.2668362 0.2821686 0.2553368 0.3358756
## [43] 0.1495950 0.2591926 0.3220222 0.2845729 0.2519703 0.1414347 0.1384943
## [50] 0.2851505 0.2428720 0.3334832 0.3821851 0.1418276 0.2447471 0.2312402
##
## $alpha
##  [1]  7.125476 11.023637  9.050935  9.205472 10.239292  6.370958 12.680138
##  [8]  9.093801 13.647962  8.806898  9.157447  8.407895 15.779068  7.661085
##
## $A
##            [,1]      [,2]
## [1,] 0.02929485 0.1335140
## [2,] 0.09048679 0.2492743
##
## $omega
##          [,1]     [,2]
## [1,] 1.584162 1.133168
## [2,] 1.133168 3.417986
```