MSIngarch

Thisis just a preliminary intro to using the functions for creating, simulating and fitting MS-INGARCH models.

All functions are gathered in the utils.R folder:

```
source("utils.R")
```

Creating a MSingarch specification

All functions requires a "MSingarch" specification. You need to choose the number regimes (m), the parameters (par) and the mean specification (mean_spec). The last one can be both "linear" and "log-linear".

Lets create a 2-regime linear and log-linear model:

```
modela <- MSingarch(m = 2,
                       par = list(a = c(0.2, 0.3),
                                 b = c(0.3, 0.5),
                                 d = c(3, 4),
                                 gamma = matrix(c(0.95, 0.05,0.05, 0.95),nrow = 2)),
                      mean_spec = "linear")

modelb <- MSingarch(m = 2,
                       par = list(a = c(0.2, 0.4),
                                 b = c(0.3, 0.4),
                                 d = c(1, 0.6),
                                 gamma = matrix(c(0.95, 0.05,0.05, 0.95),nrow = 2)),
                      mean_spec = "log-linear")
```

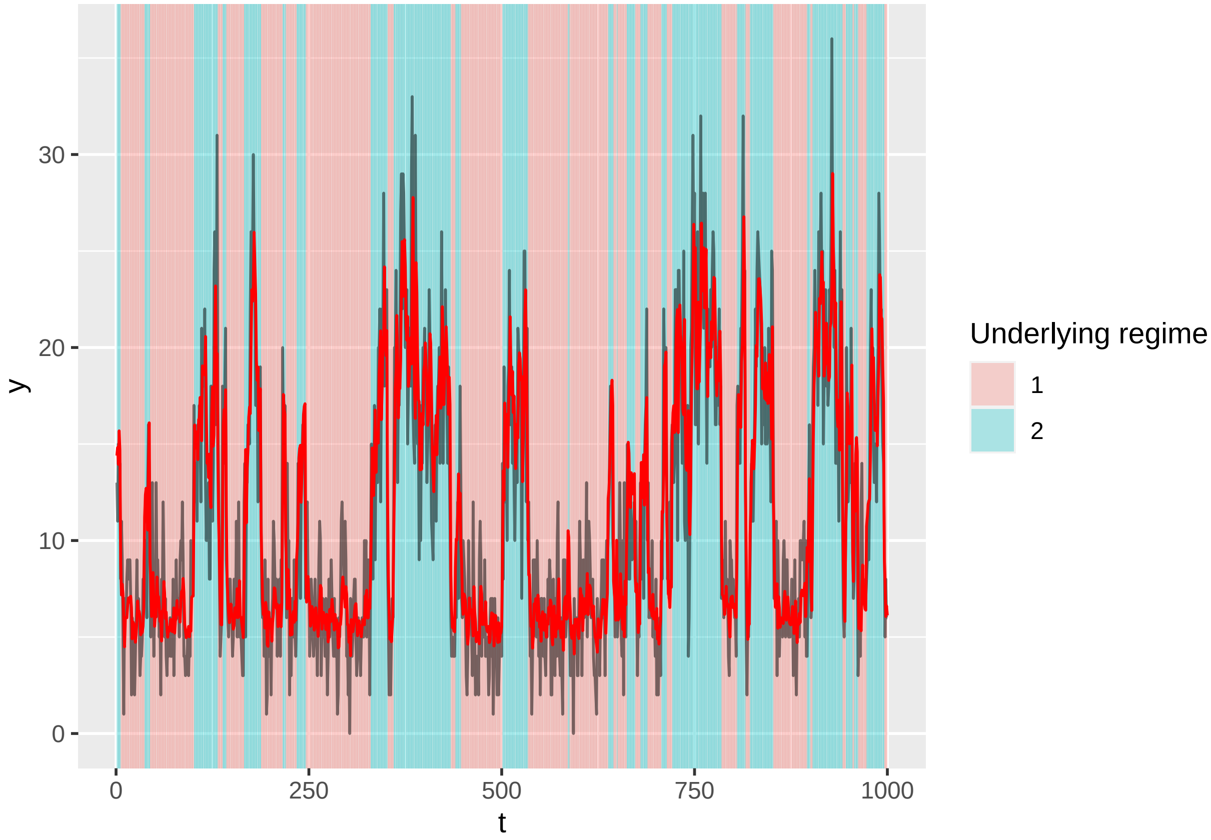
Simulation

To simulate you can use the `rMSingarch` function. You need to supply the sample size and the model you want to simulate from. Some options for initiation of mean process are available through the init_mean argument:

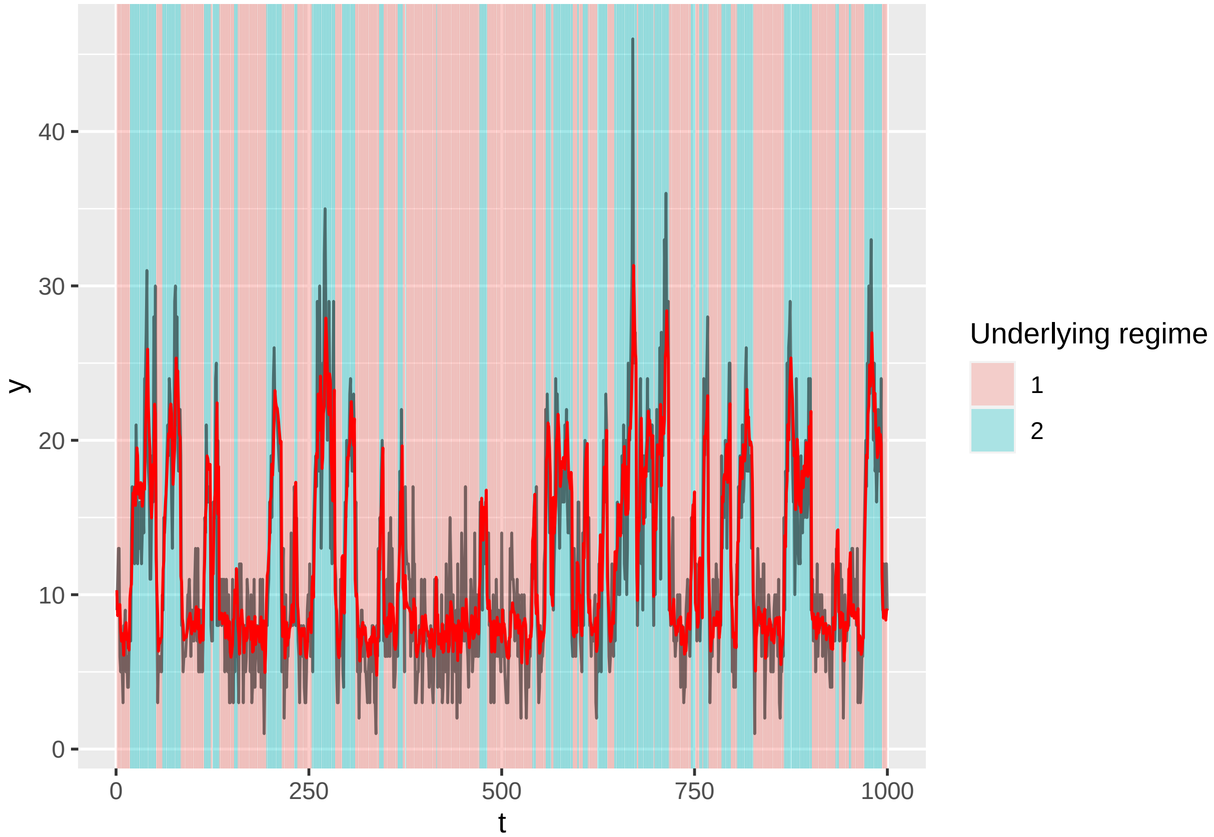
```
set.seed(1)
sima <- rMSingarch(n = 1000, model = modela)
simb <- rMSingarch(n = 1000, model = modelb)
```

You can plot the simulated time series along with the true underlying intensity (in red) and the true underlying regime using plot():

```
plot(sima)
```



```
plot(simb)
```



Estimating a model

The likelihood for the linear and log-linear model is coded up seperately (different constraints on parameters). It might be necessary to compile them once on your one computer (just uncomment the commented stuff below). Then load them.

```
library(TMB)
# compile("msingarch_linear.cpp")
# compile("msingarch_log_linear.cpp")
dyn.load(dynlib("msingarch_linear"))
dyn.load(dynlib("msingarch_log_linear"))
```

The likelihoods are wrapped in the function fitMSingarch, which needes datainput, modelinput, initial parameter values (init__par), and also initial values for the mean process (init__mean).

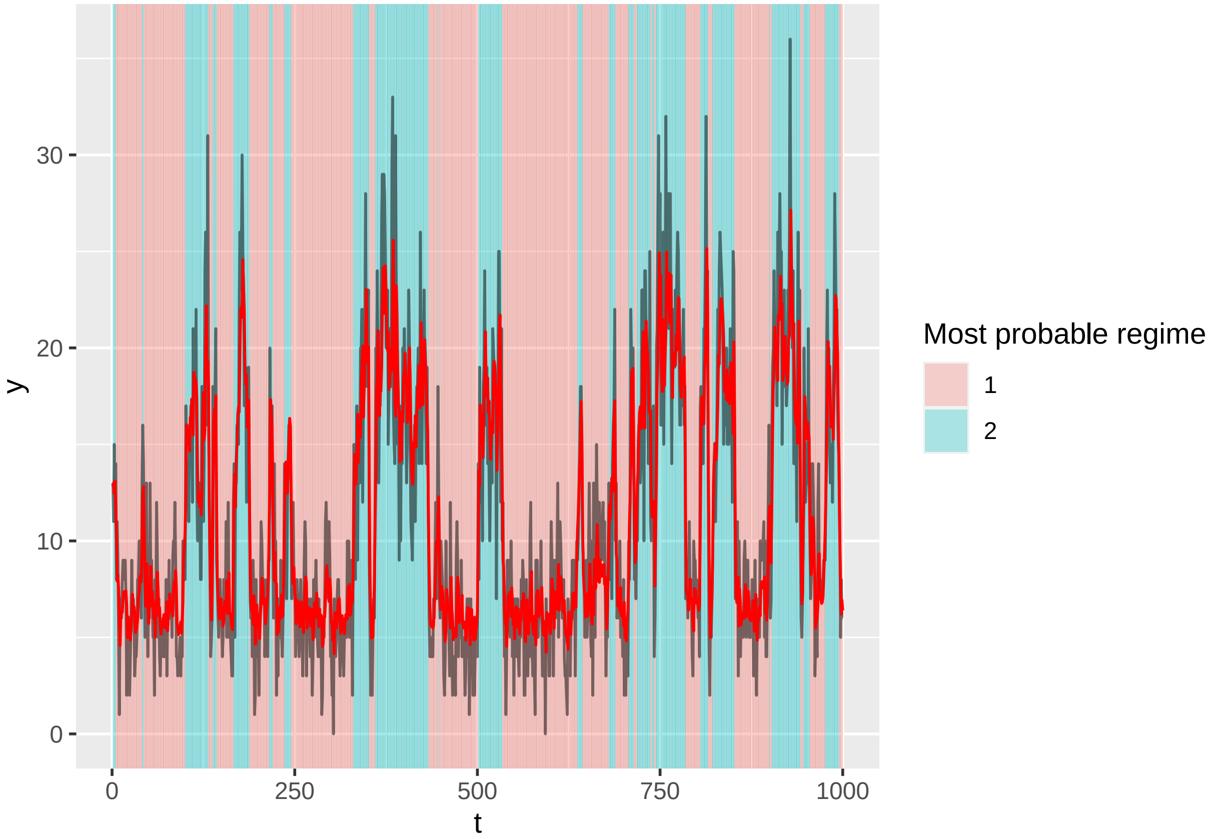
```
fita <- fitMSingarch(data = sima$y,
                     model = modela,
                     init_par = modela$par,
                     init_mean = sima$init_mean)
fita
```

```
## Model:
## 2 state MS-INGARCH model with linear mean specification
## Coefficients:
##         Estimate Std. Error
## a     0.14234475 0.09694242
## a     0.30111633 0.09710708
## b     0.33267080 0.04276251
## b     0.42077899 0.05907120
## d     3.35855815 0.53940213
## d     5.24678059 1.04741025
## gamma 0.95815659 0.01026765
## gamma 0.06104123 0.01444429
## gamma 0.04184341 0.01026765
## gamma 0.93895877 0.01444429
## delta 0.59329778 0.06897501
## delta 0.40670222 0.06897501
##
##  In-sample fit:
## AIC: 5395.344 BIC: 5434.606 MSE: 10.35289 MSE_sc: -0.0001938671
```

The function also aposteriori computes smoothing probabilities, i.e. the most probable regime and at time t, and an in-sample prediction. The the object can also be plotted:

```
plot(fita)
```

```
## Warning: Removed 1 rows containing missing values (geom_rect).
```



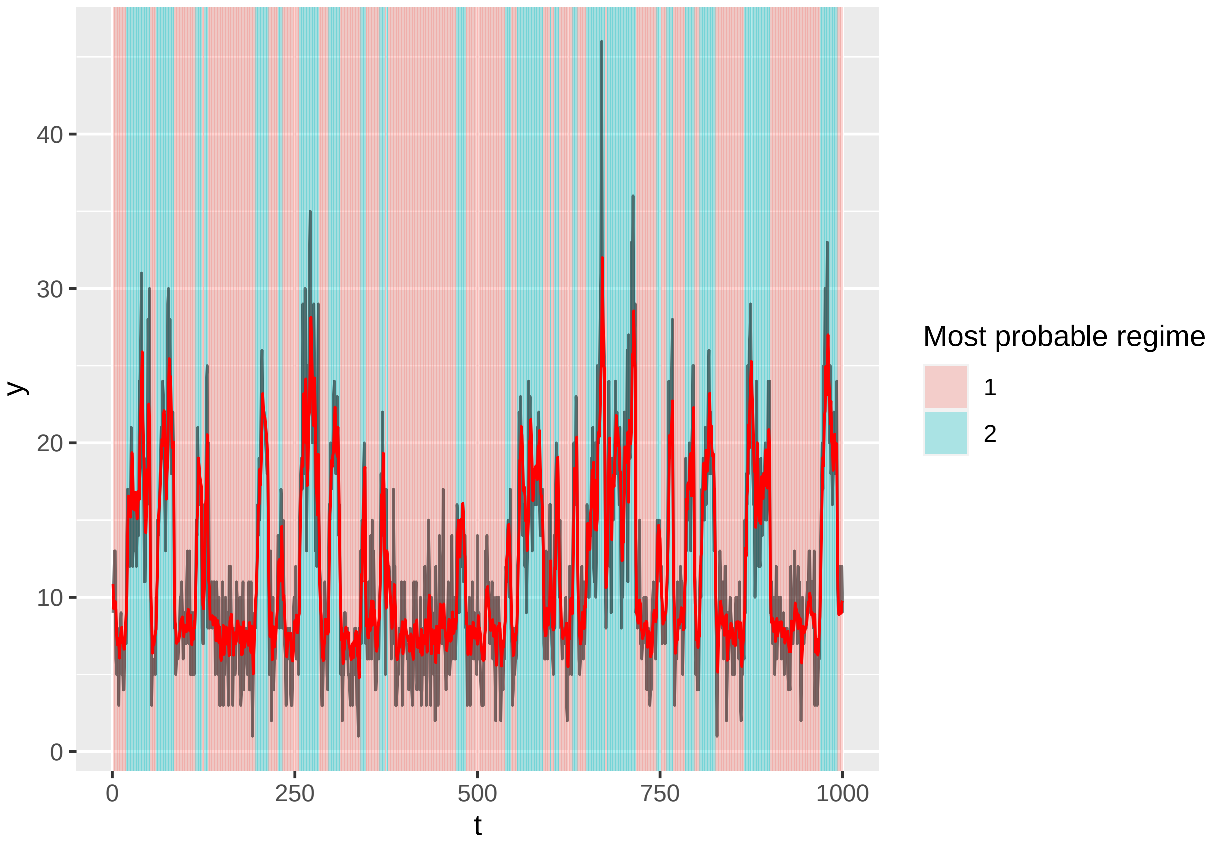
Similar for the log-linear model:

```
fitb <- fitMSingarch(data = simb$y,
                     model = modelb,
                     init_par = modelb$par,
                     init_mean = simb$init_mean)
fitb
```

```
## Model:
## 2 state MS-INGARCH model with log-linear mean specification
## Coefficients:
##         Estimate Std. Error
## a     0.23410118 0.10691397
## a     0.33217845 0.06130864
## b     0.28237306 0.04461722
## b     0.46216172 0.05451658
## d     0.95356481 0.18360003
## d     0.60250376 0.11457274
## gamma 0.94383637 0.01428460
## gamma 0.07645489 0.01656921
## gamma 0.05616363 0.01428460
## gamma 0.92354511 0.01656921
## delta 0.57650236 0.06447390
## delta 0.42349764 0.06447390
##
##  In-sample fit:
## AIC: 5494.735 BIC: 5533.997 MSE: 11.02745 MSE_sc: -0.0003166232
```

```r
plot(fitb)
```

```
## Warning: Removed 1 rows containing missing values (geom_rect).
```


y
t
Most probable regime