CRAN packages comparison

1 DiffusionRgqd

Uses the cumulant truncation procedure developed by Varughese (2013), whereby the transition density can be approximated over arbitrarily large transition horizons for a suitably general class of non-linear diffusion models.

Generalized quadratic diffusions (GQD) are the specific class of SDEs with quadratic drift and diffusion terms:

$$
\begin{aligned}
dX_t &= \mu(X_t,t)dt + \sigma(X_t,t)dW_t, \text{ where} \\
\mu(X_t,t) &= G_0(t) + G_1(t)X_t + G_2(t)X_t^2, \text{ and} \\
\sigma(X_t,t) &= Q_0(t) + Q_1(t)X_t + Q_2(t)X_t^2
\end{aligned}
$$

For purposes of inference the drift and diffusion terms - and consequently the transitional density - are assumed to be dependent on a vector of parameters, θ. For example, an Ornstein-Uhlenbeck model with SDE:

$$dX_t = \theta_1(\theta_2 - X_t) + \sqrt{\theta_3^2} dW_t \tag{1}$$

```
G0=function(t){theta[1]*theta[2]}
G1=function(t){-theta[1]}
Q0=function(t){theta[3]*theta[3]}
```

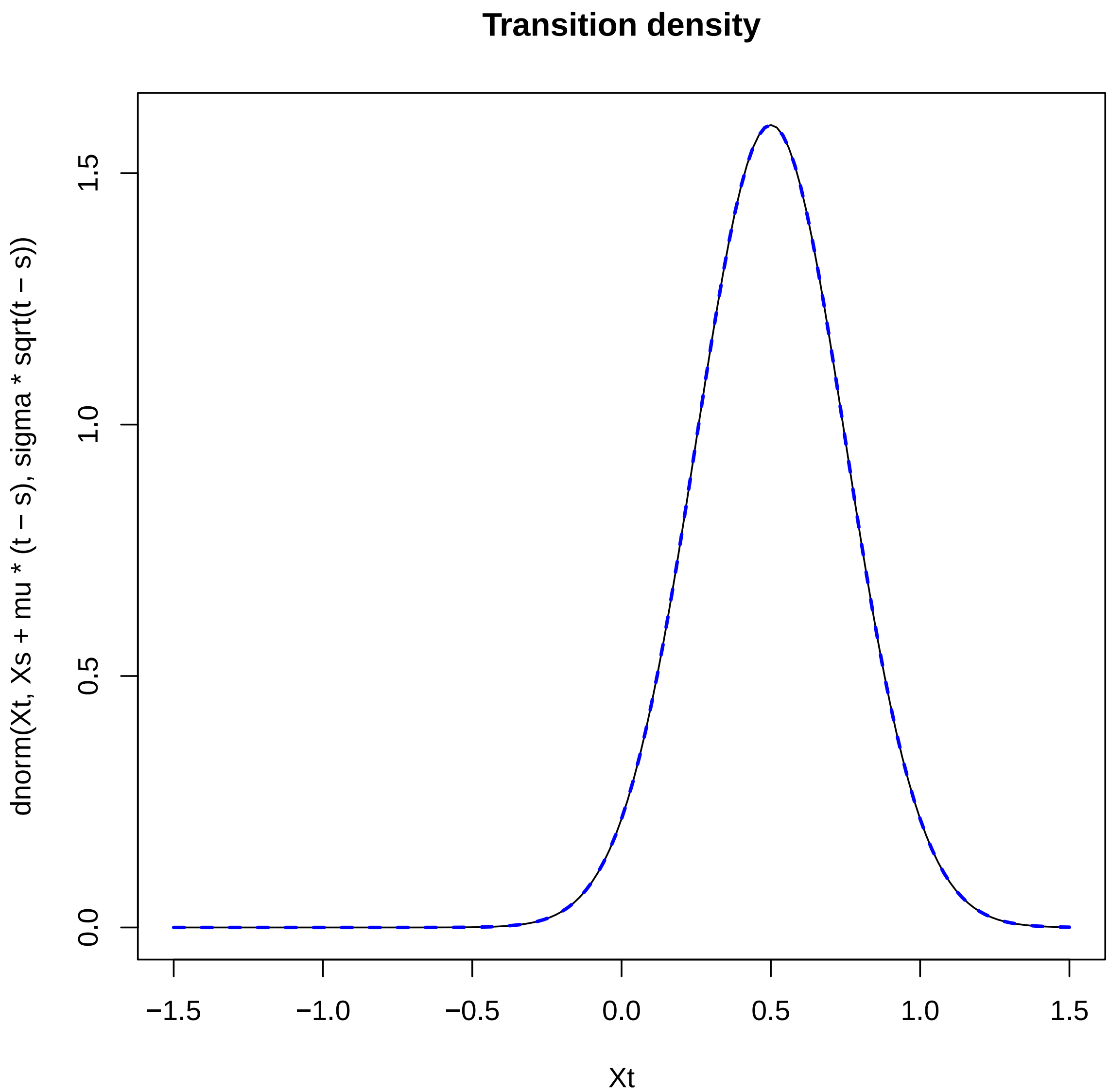
For a constant drift, diffusion SDE, with given initial condition X_s:

$$dX_t = \mu dt + \sigma dW_t \tag{2}$$

The distribution at time t of the process X_t is $\mathcal{N}(X_t, X_s + \mu(t-s), \sigma^2(t-s))$

```
Xs <- 0                  # Initial state
Xt <- seq(-3/2,3/2,1/50)# Possible future states
s  <- 0                  # Starting time
t  <- 1                  # Final time
mu    <- 0.5             # Drift parameter
sigma <- 0.25            # Diffusion coefficient

library(DiffusionRgqd)
# Remove any existing coefficients:
GQD.remove()

## [1] "Removed :  G0 G1 Q0"

# Define the model coefficients:
G0 <- function(t){mu}
Q0 <- function(t){sigma^2}

# Calculate the transitional density:
BM <- GQD.density(Xs,Xt,s,t)
```

```r
##
## ================================================================
##                  Generalized Quadratic Diffusion (GQD)
## ================================================================
## _____________________ Drift Coefficients ________________________
## G0 : mu
## G1
## G2
## ___________________ Diffusion Coefficients _____________________
## Q0 : sigma^2
## Q1
## Q2
## __________________ Distribution Approximant ____________________
## Density approx. : Saddlepoint
## P               :
## alpha           :
## Trunc. Order    : 4
## Dens.  Order    : 4
## =================================================================

# Plot the transitional density:
plot(dnorm(Xt, Xs+mu*(t-s), sigma*sqrt(t-s))~Xt, main = 'Transition density', type = 'l')
lines(BM$density[,100]~BM$Xt, col = 'blue', lty = 'dashed', lwd = 2)
```


Transition density
dnorm(Xt, Xs + mu * (t − s), sigma * sqrt(t − s))
Xt
0.0
0.5
1.0
1.5
−1.5
−1.0
−0.5
0.0
0.5
1.0
1.5