**In this document, the main files related to 2D-GARCH model are introduced**

1. **Two dimensional GARCH models**

**1.1.2D-GARCH**

**For modeling using 2D-GARCH model use garchfitt2**

**Used in sections 2-1, 3-1-2, 4-1,4-3, 5-2,6-2) of book**

function [coefficients,hh,e] = **garchfitt2**(spec,y,X);

inputs:

* + spec: [r1,r2,m1,m2,p1,p2,q1,q2]: r1,r2,m1,m2: degree of 2D-ARMA model (if doesn’t use ARMA model set 0 0 0 0, p1,p2,q1,q2: degree of 2D-GARCH model usually [1 1 1 1], so spec is usually [0 0 0 0 1 1 1 1];
  + y : 2-D data that should be modeled using 2D-GARCH
  + X=[]
* Important Outputs:
  + Coefficients: coefficients of fitted 2D-GARCH model
  + hh: conditional standard deviation

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**1.2 . 2D-GARCH-M (2D-GARCH-mixture)**

**For modeling using 2D-GARCH mixture model use garchfitt2\_mixture**

**Used in sections 2-3,4-2, 4-5-1, 5-4-1, 6-4-2 of book**

function [coefficients,hh, hh1, hh2, e] = garchfitt2\_mixture(spec,y,X);

inputs:

* + spec: [r1,r2,m1,m2,p1,p2,q1,q2]: r1,r2,m1,m2: degree of 2D-ARMA model (if doesn’t use ARMA model set 0 0 0 0, p1,p2,q1,q2: degree of 2D-GARCH mixture model usually [1 1 1 1], so spec is usually [0 0 0 0 1 1 1 1]; number of mixture is set to 2:
  + y : 2-D data that should be modeled using 2D-GARCH
  + X=[]
* Important Outputs:
  + Coefficients: coefficients of fitted 2D-GARCH models
  + hh1: conditional standard deviation of first 2D-GARCH model in the mixture
  + hh2: conditional standard deviation of second 2D-GARCH model in the mixture
  1. **2D-GARCH-GG (generalized Gaussian) model**

**For modeling using 2D-GARCH-GG model use garchfitt2\_GG (supposing 2d input data is noisy)**

**Used in sections 2-2,4-4, 5-4-1,6-4-2 of the book**

function [coefficients,hh,e] = garchfitt2\_GG(spec,y,v,X);

inputs:

* + spec: [r1,r2,m1,m2,p1,p2,q1,q2]: r1,r2,m1,m2: degree of 2D-ARMA model (if doesn’t use ARMA model set 0 0 0 0, p1,p2,q1,q2: degree of 2D-GARCH-GG model usually [1 1 1 1], so spec is usually [0 0 0 0 1 1 1 1];
  + y : 2-D data that should be modeled using 2D-GARCH-GG
  + v: variance of noise (noise of input data)
  + X=[]
* Important Outputs:
  + Coefficients: coefficients of fitted 2D-GARCH-GG model
  + hh: conditional standard deviation

**For modeling using 2D-GARCH-GG model use garchfitt2\_GG (supposing 2d input data is clean (no noise)**

**Used in sections 2-2,4-4, 5-4-1,6-4-2 of the book**

function [coefficients,hh,e] = garchfitt2\_GG\_nonoise(spec,y,X);

inputs:

* + spec: [r1,r2,m1,m2,p1,p2,q1,q2]: r1,r2,m1,m2: degree of 2D-ARMA model (if doesn’t use ARMA model set 0 0 0 0, p1,p2,q1,q2: degree of 2D-GARCH-GG model usually [1 1 1 1], so spec is usually [0 0 0 0 1 1 1 1];
  + y : 2-D data that should be modeled using 2D-GARCH-GG
  + X=[]
* Important Outputs:
  + Coefficients: coefficients of fitted 2D-GARCH-GG model
  + hh: conditional standard deviation