

# 程序代写代做 CS编程辅导



GARCH in mean

Structural Break in

Non-normality

Control for Volatility Proxies

Stochastic Volatility

Summary

WeChat: cstutorcs

Copyright ©Copyright University of New South Wales 2020. All rights reserved.

Course materials subject to Copyright

UNSW Sydney owns copyright in these materials (unless stated otherwise). The material is subject to copyright under Australian law and overseas under international treaties. The materials are provided for use by enrolled UNSW students. The materials, or any part, may not be copied, shared or distributed, in print or digitally, outside the course without permission. Students may only copy a reasonable portion of the material for personal research or study or for criticism or review. Under no circumstances may these materials be copied or reproduced for sale or commercial purposes without prior written permission of UNSW Sydney.

Statement on class recording

To ensure the free and open discussion of ideas, students may not record, by any means, classroom lectures, discussion and/or activities without the advance written permission of the instructor, and any such recording properly approved in advance can be used solely for the student's own private use.

WARNING: Your failure to comply with these conditions may lead to disciplinary action, and may give rise to a civil action or a criminal offence under the law.

THE ABOVE INFORMATION MUST NOT BE REMOVED FROM THIS MATERIAL.

<https://tutorcs.com>

# 程序代写代做 CS编程辅导



GARCH in mean

Structural Break in

Non-normality

Control for Volatility Proxies

Stochastic Volatility

Summary

WeChat: cstutorcs

Financial Econometrics  
**Assignment Project Exam Help**

Slides-13: Remaining Issues for GARCH and Alternative  
Models  
Email: tutorcs@163.com

QQ: 749389476  
Dr Rachida Olysse  
School of Economics<sup>1</sup>

<sup>1</sup> ©Copyright University of New South Wales 2020. All rights reserved. This copyright notice must not be removed from this material.



# 程序代写代做 CS编程辅导



GARCH in mean    Structural Break in  
○

Non-normality    Control for Volatility Proxies    Stochastic Volatility    Summary

Lecture Plan

WeChat: cstutorcs

Assignment Project Exam Help

Email: tutorcs@163.com

- Measure the risk premium effect: GARCH-M model
- Deal with structural break in volatility
- Seasonality and distributional assumptions
- Inclusion of other volatility measures
- SV models

QQ: 749389476

<https://tutorcs.com>

©Copyright University of New South Wales 2020. All rights reserved. This copyright notice must not be removed from this material

# 程序代写代做 CS编程辅导



GARCH in mean

Structural Break in

Non-normality

Control for Volatility Proxies

Stochastic Volatility

Summary

GARCH in mean

WeChat: cstutorcs

## Assignment Project Exam Help

- ▶ Risk premium effect: investing in a riskier asset should be rewarded by a higher expected return.
- ▶ In the context of a market index, investing in a riskier (more volatile) period should be rewarded by a higher expected return.
  - In AR(1)-GARCH, the mean equation  $y_t = c + \phi y_{t-1} + \mu_t$ : implies the **expected return**  $= y_t = c + \phi y_{t-1}$ , which is unrelated to the volatility or risk measure  $\sigma_t$ .
  - Motivation: investors should be rewarded for taking additional risk by obtaining a higher return
- ▶ **GARCH-M** is used to account for the risk premium

$$y_t = c + \delta \sigma_{t-1} + \mu_t \quad \mu_t | \Omega_{t-1} \sim N(0, \sigma_t^2)$$
$$\sigma_t^2 = \alpha_0 + \alpha_1 \mu_{t-1}^2 + \beta_1 \sigma_{t-1}^2,$$

where  $\delta$  **measures the risk premium effect.**

(See Lundblad (2007, JFE, p123-150) among others.)

# 程序代写代做 CS编程辅导



GARCH in mean

Structural Break in

Non-normality

Control for Volatility Proxies

Stochastic Volatility

Summary

## WeChat: cstutorcs

eg. NYSE composite return No evidence for the “risk premium” effect in any of GARCH(1,1), TGARCH/GJR and EGARCH.

## Assignment Project Exam Help

GARCH(1,1)

Email: tutorcs@163.com

GJR

EGARCH

Dependent Variable: RC  
Method: ML - ARCH (Marquardt) - Normal distribution  
Sample (adjusted): 3 1931  
Included observations: 1929 after adjustments  
Convergence achieved after 16 iterations  
Bollerslev-Wooldridge robust standard errors & covariance  
Variance backcast: OFF  
GARCH = C(4) + C(5)\*RESID(-1)^2 + C(6)\*GARCH(-1)

	Coefficient	Std. Error	t-Statistic	Prob.
@SQRT(GARCH)	0.076352	0.063905	1.194770	0.2322
C	0.016878	0.050651	0.333226	0.7390
AR(1)	0.103027	0.025309	4.070805	0.0000
Variance Equation				
C	0.013845	0.004594	3.013633	0.0026
RESID(-1)^2	0.120280	0.025125	4.787328	0.0000
GARCH(-1)	0.875387	0.021393	40.91840	0.0000

QQ: 749289476

Dependent Variable: RC  
Method: ML - ARCH (Marquardt) - Normal distribution

Sample (adjusted): 3 1931  
Included observations: 1929 after adjustments  
Convergence achieved after 16 iterations  
Bollerslev-Wooldridge robust standard errors & covariance  
Variance backcast: OFF  
GARCH = C(4) + C(5)\*RESID(-1)^2 + C(6)\*RESID(-1)^2\*(RESID(-1)<0)  
+ C(7)\*GARCH(-1)

	Coefficient	Std. Error	t-Statistic	Prob.
@SQRT(GARCH)	0.002775	0.065764	0.042196	0.9663
C	0.035056	0.049298	0.711105	0.4770
AR(1)	0.114460	0.024099	4.749571	0.0000
Variance Equation				
C	0.020172	0.004755	4.242354	0.0000
RESID(-1)^2	-0.003509	0.018165	-0.193186	0.8468
RESID(-1)^2*(RESID(-1)<0)	0.210087	0.036850	5.701133	0.0000
GARCH(-1)	0.882810	0.019965	44.21804	0.0000

Dependent Variable: RC

Method: ML - ARCH (Marquardt) - Normal distribution

Sample (adjusted): 3 1931  
Included observations: 1929 after adjustments  
Convergence achieved after 25 iterations  
Bollerslev-Wooldridge robust standard errors & covariance  
Variance backcast: OFF  
LOG(GARCH) = C(4) + C(5)\*ABS(RESID(-1)/@SQRT(GARCH(-1))) +  
C(6)\*RESID(-1)/@SQRT(GARCH(-1)) + C(7)\*LOG(GARCH(-1))

	Coefficient	Std. Error	z-Statistic	Prob.
@SQRT(GARCH)	0.039690	0.063637	0.623694	0.5328
C	-0.005688	0.048548	-0.117162	0.9067
AR(1)	0.118381	0.024124	4.907231	0.0000
Variance Equation				
C(4)	-0.116899	0.022248	-5.254378	0.0000
C(5)	0.139572	0.028321	4.928140	0.0000
C(6)	-0.157712	0.023699	-6.654686	0.0000
C(7)	0.963692	0.007856	122.6648	0.0000

# 程序代写代做 CS编程辅导



GARCH in mean

Structural Break in

Non-normality

Control for Volatility Proxies

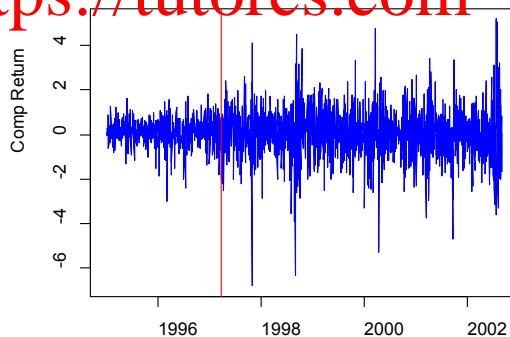
Stochastic Volatility

Summary

WeChat: cstutorcs  
Structural break in Volatility

- The composite return series appears to have a change in its volatility level.
- The change is permanent
- If ignored, it can result in
  - over-estimating the persistence measure ( $\alpha_1 + \beta_1$ );
  - making the unconditional variance estimate inconsistent;
  - reducing the quality of forecasts, and VaR.
- Important to detect and account for the structural break.

Email: tutorcs@163.com  
QQ: 749389476  
<https://tutorcs.com>



# 程序代写代做 CS编程辅导



GARCH in mean

Structural Break in

Non-normality

Control for Volatility Proxies

Stochastic Volatility

Summary

WeChat: cstutorcs  
Test for structural break

## Assignment Project Exam Help

- As the variance is closely related to squared returns, we may check the break in an AR model for the squared returns, using the CUSUM test.
- Model stability: Is its structure changes over time?

Email: tutorcs@163.com

- Recursive parameter estimates. Monitor changes in parameter estimates over time.

QQ: 749389476

$\{y_1, \dots, y_\tau\}, \{y_1, \dots, y_{\tau+1}\}, \dots, \{y_1, \dots, y_T\}$

$\hat{\beta}(\tau), \hat{\beta}(\tau+1), \hat{\beta}(T)$

- Recursive residuals:  $e_{\tau+1|\tau} = y_{\tau+1} - X_{\tau+1} \hat{\beta}(\tau)$

$\{y_1, \dots, y_\tau\}, \{y_1, \dots, y_{\tau+1}\}, \dots, \{y_1, \dots, y_\tau\}$

$e_{\tau+1|\tau}, e_{\tau+2|\tau+1}, e_{T|T-1}$

- If the model is stable/correct:  $w_{\tau+1|\tau} = \frac{e_{\tau+1|\tau}}{se(e_{\tau+1|\tau})} \sim N(0, 1)$

# 程序代写代做 CS编程辅导



GARCH in mean   Structural Break in | Non-normality   Control for Volatility Proxies   Stochastic Volatility   Summary

WeChat: cstutorcs  
Model stability test: CUSUM

CUSUM test (cumulative sum of standardised recursive residuals)

$$CUSUM_t = \sum_{\tau=K+1}^t w_{\tau+1|\tau}, \quad t = K+1, K+2, \dots, T-1$$

Email: tutorcs@163.com

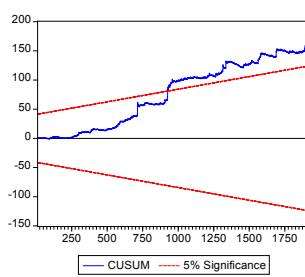
Reject stability if it goes outside the 95% bands.

Eviews: View/Stability Tests/Tests of Estimates after a linear regression is estimated  
QQ: 749389476

Test in volatility break: eg. AR(5) for the composite return squared:

$$r_t^2 = a_0 + a_1 r_{t-1}^2 + \dots + a_5 r_{t-5}^2 + \text{error}$$

CUSUM test rejects the null hypothesis of **no break**.



# 程序代写代做 CS编程辅导



GARCH in mean

Structural Break in

Non-normality

Control for Volatility Proxies

Stochastic Volatility

Summary

WeChat: cstutorcs  
Structural break in volatility

Find the break point Assignment Project Exam Help

- 1) Run the restricted regression (no break) and save the log likelihood as  $\ell_0$ .
- 2) Set  $\tau = .15T$  (15% trim). Define the break dummy as  $B_{t,\tau}$ , which is 0 for  $t < \tau$  and 1 for  $t \geq \tau$ .  
**QQ: 749389476**
- 3) Run the unrestricted regression
$$r_t^2 = a_0 + a_1 r_{t-1}^2 + \dots + a_5 r_{t-5}^2 + \psi B_{t,\tau} + \text{error}_t$$
and save the log likelihood  $\ell_\tau$  and  $LR_\tau = 2(\ell_\tau - \ell_0)$ .
- 4) Set  $\tau = \tau + 1$ . If  $\tau \leq .85T$  (15% trim), go to 3).  
Otherwise go to 5).
- 5) The break point is estimated as the  $\tau$  associated with the greatest  $LR_\tau$ .

It could be used as a test: the null of no break is rejected if  $\max LR > cv$ .

The cv for 15% trim is 8.85, see Andrews (1993, Etrca, p821-856).

©Copyright University of New South Wales 2020. All rights reserved. This copyright notice must not be removed from this material

# 程序代写代做 CS编程辅导



GARCH in mean   Structural Break in [ ] Non-normality   Control for Volatility Proxies   Stochastic Volatility   Summary

WeChat: cstutorcs  
Structural break in volatility

Assignment Project Exam Help

Find the break point

eg. AR(5) for the composite return squared:

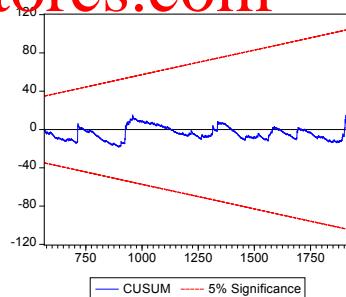
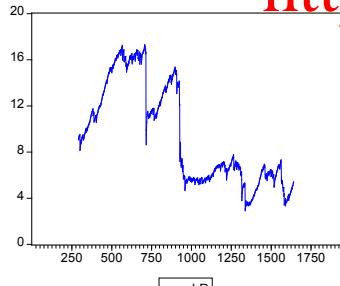
Email: tutorcs@163.com

$$r_t^2 = a_0 + a_1 r_{t-1}^2 + \dots + a_5 r_{t-5}^2 + \psi B_{t,\tau} + \text{error}_t$$

QQ: 749389476  
The break point = 566.

AR(5) with the break passes the CUSUM test

<https://tutorcs.com>



©Copyright University of New South Wales 2020. All rights reserved. This copyright notice must not be removed from this material

# 程序代写代做 CS编程辅导



GARCH in mean

Structural Break in

Non-normality

Control for Volatility Proxies

Stochastic Volatility

Summary

Break in volatility models

WeChat: cstutorcs  
Incorporating breaks in volatility models

## Assignment Project Exam Help

Incorporate a break in GARCH

Email: [cstutorcs@163.com](mailto:cstutorcs@163.com)

- Once the break point  $t_\tau$  is known and the break dummy  $B_{t,\tau}$  is defined, the break should be included in the conditional variance.  
**QQ: 749389476**
- GARCH(1,1) :  
$$\sigma_t^2 = \alpha_0 + \alpha_1 \mu_{t-1}^2 + \beta_1 \sigma_{t-1}^2 + \psi B_{t,\tau}$$
- TGARCH/GJR  
$$\sigma_t^2 = \alpha_0 + \alpha_1 \mu_{t-1}^2 + \gamma \mu_{t-1}^2 I_{t-1} + \beta_1 \sigma_{t-1}^2 + \psi B_{t,\tau}$$
- TGARCH/GJR :  
$$\ln(\sigma_t^2) = \alpha_0 + \alpha_1 |\nu_{t-1}| + \gamma \nu_{t-1} + \beta_1 \ln(\sigma_{t-1}^2) + \psi B_{t,\tau}$$

©Copyright University of New South Wales 2020. All rights reserved. This copyright notice must not be removed from this material

# 程序代写代做 CS编程辅导



GARCH in mean

Structural Break in

Non-normality

Control for Volatility Proxies

Stochastic Volatility

Summary

Seasonality: January Effect

## WeChat: cstutorcs Assignment Project Exam Help

Email: tutorcs@163.com

- Including a dummy in the variance equation,

- GARCH(1,1): **QQ: 749389476**  
 $\sigma_t^2 = \alpha_0 + \alpha_1 \mu_{t-1}^2 + \beta_1 \sigma_{t-1}^2 + \lambda J_t$
- GJR:  
 $\sigma_t^2 = \alpha_0 + \alpha_1 \mu_{t-1}^2 + \gamma \nu_{t-1} \mu_{t-1}^2 + \beta_1 \sigma_{t-1}^2 + \lambda J_t$
- EGARCH:  $\ln(\sigma_t^2) = \alpha_0 + \alpha_1 |\nu_{t-1}| + \gamma \nu_{t-1} + \beta_1 \ln(\sigma_{t-1}^2) + \lambda J_t$

where  $J_t$  is 1 if  $t$  is in January and 0 otherwise.

©Copyright University of New South Wales 2020. All rights reserved. This copyright notice must not be removed from this material

# 程序代写代做 CS编程辅导



GARCH in mean   Structural Break in   Non-normality   Control for Volatility Proxies   Stochastic Volatility   Summary

○

Non-normality

WeChat: cstutorcs

Assignment Project Exam Help

Email: tutorcs@163.com

## ■ Normality alternatives

- In our examples, normality is usually rejected owing to
  - heavy tails ( $Kurtosis > 3$ ) and
  - negative skewness
- in the distribution of the standardised shock  $\nu_t$ .
- Alternative distributions may be assumed
  - Student's  $t$ :  $t(n)$  with heavy tails but symmetry.  
 $t(n) \approx N(0, 1)$  when the df  $n \rightarrow \infty$
  - Mixture distributions: heavy tails and asymmetry.

QQ: 749389476

<https://tutorcs.com>

©Copyright University of New South Wales 2020. All rights reserved. This copyright notice must not be removed from this material

# 程序代写代做 CS编程辅导



GARCH in mean   Structural Break in

Non-normality   Control for Volatility Proxies   Stochastic Volatility

Summary

Student-t

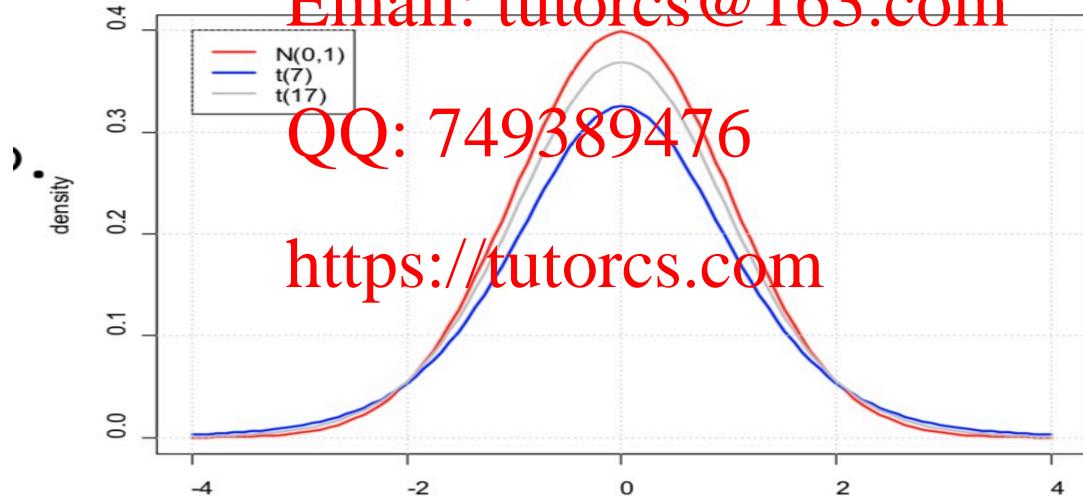
WeChat: cstutorcs

Assignment Project Exam Help

Email: tutorcs@163.com

QQ: 749389476

<https://tutorcs.com>



©Copyright University of New South Wales 2020. All rights reserved. This copyright notice must not be removed from this material

# 程序代写代做 CS编程辅导

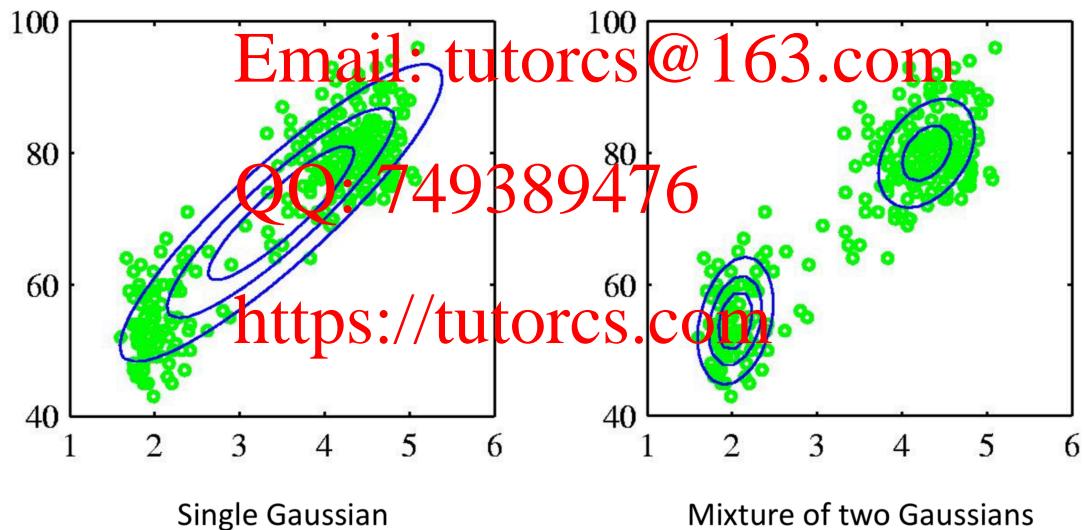


GARCH in mean   Structural Break in   Non-normality   Control for Volatility Proxies   Stochastic Volatility   Summary

○

WeChat: cstutorcs  
Mixture of two normals

Assignment Project Exam Help



©Copyright University of New South Wales 2020. All rights reserved. This copyright notice must not be removed from this material

# 程序代写代做 CS编程辅导



GARCH in mean   Structural Break in   Non-normality   Control for Volatility Proxies   Stochastic Volatility   Summary

WeChat: cstutorcs  
Mixture of gaussians

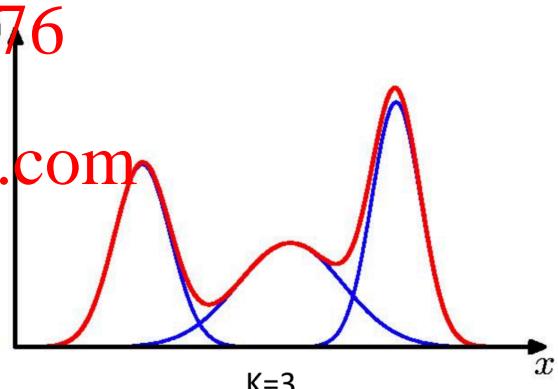
Assignment Project Exam Help

Combine simple models into a complex model:  
Email: [tutorcs@163.com](mailto:tutorcs@163.com)

$$p(\mathbf{x}) = \sum_{k=1}^K \pi_k \mathcal{N}(\mathbf{x} | \boldsymbol{\mu}_k, \boldsymbol{\Sigma}_k)$$

↑  
Component  
Mixing coefficient

$$\forall k : \pi_k \geq 0 \quad \sum_{k=1}^K \pi_k = 1$$



©Copyright University of New South Wales 2020. All rights reserved. This copyright notice must not be removed from this material

# 程序代写代做 CS编程辅导



GARCH in mean

Structural Break in

Non-normality

Control for Volatility Proxies

Stochastic Volatility

Summary

○

WeChat: cstutorcs  
Incorporate other volatility measures

## Assignment Project Exam Help

### ■ Range and implied volatility

Email: tutorcs@163.com

- In addition to  $\mu_{t-1}$  or  $\nu_{t-1}$ , other volatility measures may have predictive power for conditional variance.

QQ: 749389476

Typically, the range (100m(high/low)) and implied volatility (IV) are informative measures of volatility.

- For EGARCH we may specify

$\ln(\sigma_t^2) = \alpha_0 + \alpha_1 |\nu_{t-1}| + \gamma \nu_{t-1} + \beta_1 \ln(\sigma_{t-1}^2) + a_1 \text{rng}_{t-1} + a_2 \text{iv}_{t-1}$ ,

where the range (rng) and IV (iv) are included.

- It is good for 1-step ahead forecast. However, we need models for the range and IV to do multi-step ahead forecasts.

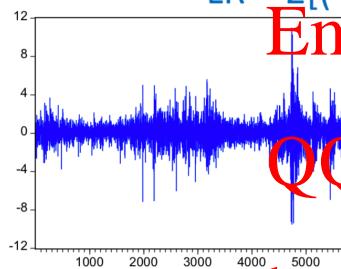
# 程序代写代做 CS编程辅导



GARCH in mean   Structural Break in   Non-normality   Control for Volatility Proxies   Stochastic Volatility   Summary

WeChat: cstutorcs  
Example: Range and Implied Volatility in EGARCH

Assignment Project Exam Help  
eg. SP500 return, range and VIX: 1990-01-02 to 2012-06-29

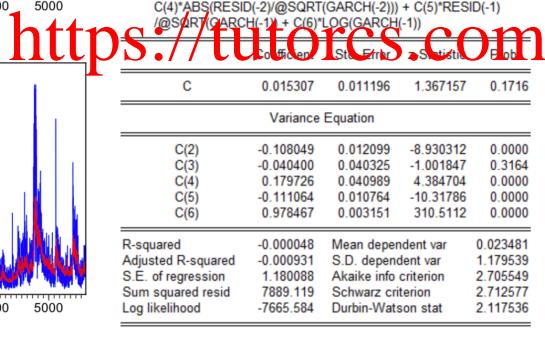


Dependent Variable: R  
Method: ML - ARCH (Marquardt) - Normal distribution  
Sample (adjusted): 2 5672  
Included observations: 5671 after adjustments  
Convergence achieved after 20 iterations  
Bollerslev-Wooldridge robust standard errors & covariance  
Variance backcast: ON  
 $\text{LOG}(\text{GARCH}) = C(2) + C(3)*\text{ABS}(\text{RESID}(-1))@\text{SQRT}(\text{GARCH}(-1)) +$   
 $C(4)*\text{ABS}(\text{RESID}(-2))@\text{SQRT}(\text{GARCH}(-2)) + C(5)*\text{RESID}(-1)$   
 $/@\text{SQRT}(\text{GARCH}(-1)) + C(6)*\text{LOG}(\text{GARCH}(-1)) + C(7)*\text{RNG}(-1)$   
 $+ C(8)*\text{VIX}(-1)$

Dependent Variable: R  
Method: ML - ARCH (Marquardt) - Normal distribution  
Sample (adjusted): 2 5672  
Included observations: 5671 after adjustments  
Convergence achieved after 21 iterations  
Bollerslev-Wooldridge robust standard errors & covariance  
Variance backcast: ON  
 $\text{LOG}(\text{GARCH}) = C(2) + C(3)*\text{ABS}(\text{RESID}(-1))@\text{SQRT}(\text{GARCH}(-1)) +$   
 $C(4)*\text{ABS}(\text{RESID}(-2))@\text{SQRT}(\text{GARCH}(-2)) + C(5)*\text{RESID}(-1)$   
 $/@\text{SQRT}(\text{GARCH}(-1)) + C(6)*\text{LOG}(\text{GARCH}(-1)) + C(7)*\text{RNG}(-1)$   
 $+ C(8)*\text{VIX}(-1)$

	Coefficient	Std. Error	z-Statistic	Prob.
C	0.013317	0.010704	1.244095	0.2135
<b>Variance Equation</b>				
C(2)	-0.365434	0.057308	-6.376625	0.0000
C(3)	-0.147432	0.039088	-3.771762	0.0002
C(4)	0.214592	0.037860	5.668000	0.0000
C(5)	-0.162571	0.016115	-10.08791	0.0000
C(6)	0.840658	0.024695	34.04156	0.0000
C(7)	0.045700	0.013780	3.316388	0.0009
C(8)	0.177244	0.038160	4.644800	0.0000
<b>R-squared</b>				
R-squared	-0.000048	Mean dependent var	0.023481	
Adjusted R-squared	-0.000931	S.D. dependent var	1.179539	
S.E. of regression	1.180088	Akaike info criterion	2.705549	
Sum squared resid	7889.119	Schwarz criterion	2.712577	
Log likelihood	-7665.584	Durbin-Watson stat	2.117536	
<b>R-squared</b>				
R-squared	-0.000074	Mean dependent var	0.023481	
Adjusted R-squared	-0.001310	S.D. dependent var	1.179539	
S.E. of regression	1.180312	Akaike info criterion	2.678683	
Sum squared resid	7889.326	Schwarz criterion	2.688055	
Log likelihood	-7587.407	Durbin-Watson stat	2.117481	

QQ: 749389476



# 程序代写代做 CS编程辅导



GARCH in mean

Structural Break in

Non-normality

Control for Volatility Proxies

Stochastic Volatility

Summary

WeChat: cstutorcs  
Stochastic volatility (SV) model: Latent Volatility

## Assignment Project Exam Help

- In GARCH type models, the shock  $\mu_{t-1}$  or  $\nu_{t-1}$  can be recovered from the mean equation. The conditional variance, as a function of  $\mu_{t-1}$  is "observable".
- In SV,

QQ: 749389476  
 $y_t = \mu + \sigma_t \nu_t,$

$$\ln(\sigma_t^2) = \alpha_0 + \beta_1 \ln(\sigma_{t-1}^2) + \eta_t, \quad \eta_t \sim \text{iid } N(0, \omega^2)$$

the conditional variance  $\sigma_t^2$  is latent (unobservable):

- there are two shocks:  $\nu_t$  and  $\eta_t$ . Often used in theoretical options pricing literature;
- it is difficult to estimate (likelihood evaluation is challenging)
- it is awkward for forecasting, as  $\sigma_t^2$  is conditional on an unobservable information set.

# 程序代写代做 CS编程辅导



GARCH in mean

Structural Break in

Non-normality

Control for Volatility Proxies

Stochastic Volatility

**Summary**

Summary

WeChat: cstutorcs

Assignment Project Exam Help

Email: tutorcs@163.com

- We have seen a variety of models for conditional volatility for univariate returns models
- Next... Multivariate Volatility models: Portfolio management, hedging strategies...

QQ: 749389476  
<https://tutorcs.com>