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University of New South Wales

School of Economics

Financial Econometrics

Tutorial 7

1. (Value at Risk)

The following GARCH(1,1) model has been estimated (such that the parameters are treated as known), using the historical return series $\{y_t\}$ of a portfolio up to date T :

$$y_t = c + \varepsilon_t, \quad \varepsilon_t | \Omega_{t-1} \sim ?(0, \sigma_t^2),$$

$$\sigma_t^2 = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \beta_1 \sigma_{t-1}^2, \quad t = 1, \dots, T,$$

where Ω_{t-1} is the information set at $t-1$ and “ $?(0, \sigma_t^2)$ ” is an unknown distribution with mean zero and variance σ_t^2 . Suppose that the portfolio's market value at T was \$10m. How would you calculate the 99% value-at-risk for the period from T to $T+1$? Assume that parameters, ε_T and σ_T^2 are known or already estimated.

2. (GARCH-in-mean model)

Consider the following GARCH-M model

$$y_t = c + \delta \sigma_t^2 + \varepsilon_t, \quad \varepsilon_t | \Omega_{t-1} \sim N(0, \sigma_t^2),$$

$$\sigma_t^2 = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \beta_1 \sigma_{t-1}^2, \quad \alpha_0 > 0, \quad \alpha_1 \geq 0, \quad \beta_1 \geq 0, \quad \alpha_1 + \beta_1 < 1,$$

where y_t is the return of a portfolio and Ω_{t-1} is the information set at $t-1$.

- (a) Why would the conditional variance σ_t^2 be included in the mean equation? What would be the sign of the parameter δ ?
- (b) Find $E(y_t | \Omega_{t-1})$ and $E(y_t)$.

3. (EGARCH-model)

Consider the constant conditional mean - EGARCH model

$$y_t = c + \varepsilon_t, \quad \varepsilon_t | \Omega_{t-1} \sim N(0, \sigma_t^2),$$

$$\ln(\sigma_t^2) = \alpha_0 + \alpha_1 |v_{t-1}| + \gamma v_{t-1} + \beta_1 \ln(\sigma_{t-1}^2), \quad v_{t-1} = \varepsilon_{t-1} / \sigma_{t-1}$$

- (a) What are the benefits of this formulation in comparison to GARCH(1,1) model.
- (b) Which sign do we expect for γ and why?
- (c) Compute one-period ahead optimal forecast of y and form 95% confidence bounds.

4. Computing Exercise

(GARCH, extensions and VaR, maybe useful for the project)

This question is based on the data contained in the Excel file *SHARE.XLS*. The file contains daily data on the S&P500 from the 2nd of January, 1998 to the 10th of December, 2001 comprising a total of 994 observations. The S&P500 index is designated *PRICE* in the file. Generate the series for the percentage log return as: $R = 100 * (\log(PRICE) - \log(PRICE(-1)))$.

- (a) Show a graph of the empirical distribution or CDF for R . What is the percentage daily return which cuts off 1% of the left-tail of the empirical distribution? (Or, what is the 1% quantile of the return distribution?).

- (b) Assume the mean equation for returns is $R = c + \varepsilon_{t-1}$ and the variance equation for returns is a GARCH(1,1). Estimate the model using the first 900 observations. (We leave the last 94 observations for use in an out-of-sample forecast exercise). Are the sign restrictions for the GARCH specification satisfied? Present a graph of the conditional standard deviation. Comment on the estimation results.

- (c) Repeat (b) for GJR model [Use the same clicks as (b) but select **1** for Threshold order], and EGARCH model [Use the same clicks as (b) but select **EGARCH** for Model]. Compare the results and decide which model you prefer, which will be used for the questions below.

- (d) For the preferred model, present a histogram and summary statistics of the standardized residuals. Compare and comment the distributions of the residuals and the standardized residuals. What is the 1% quantile of the standardized residuals?

(e) With the preferred model, generate forecasts for returns and for the conditional standard deviation of returns for the out-of-sample observations 901-994.

Do the forecasts of the conditional variance show “mean-reverting” behavior?

(f) Suppose a portfolio manager holds a position of ten million dollars (\$10m) in the market portfolio given by the S&P500. Calculate the daily empirical 99% Conditional-Value-at-Risk of this portfolio for observation 901. (To do this, you will need to look at the entries for series RF and VF at observation 901. You will also need to use your answers to parts (d) and (e)).

Assignment Project Exam Help

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