Econ 512: Financial Econometrics and Volatility Models
HW 2

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Due: Monday 5/3/2010

1 Reading

1. Zivot, E. (2008). "Practical Issues in the Analysis of Univariate GARCH Models," *Handbook of Financial Time Series* (available on class webpage).

2. Zivot, E., and Wang, J. (2006). *Modeling Financial Time Series with S-PLUS, Second Edition*. Chapters 7 and 13.

3. Jondeau, E., Poon, S.-H., and Rockinger, M. (2006), *Financial Modeling Under Non-Gaussian Distributions*, Chapters 4-6.

4. Taylor, S.J. (2005), *Asset Price Dynamics, Volatility, and Prediction*. Chapters 9 and 10.

2 Part I: Empirical Problems

Consider the daily returns on Microsoft and the S&P 500 that we have been using in the class examples. These are available in the S+FinMetrics module and are posted in Excel files on the class webpage (for use in other software programs). You may use any software you like (e.g. Eviews, Matlab, Ox, R, Stata, S-PLUS) but I recommend using either Eviews, R or S-PLUS. The GARCH modeling tools in Eviews and S-PLUS are very extensive and quite similar. The tools available in R are less extensive and less tested. For those using S-PLUS, you will find the example script files on the homework page very useful.

1. In this exercise, you will estimate asymmetric GARCH models for the daily returns on Microsoft and the S&P 500. First, estimate a GARCH(1,1) model with normal errors for the each series and use this as the benchmark. Next, estimate

the following models, assuming normal errors, for each series: EGARCH(1,1), TGARCH(1,1), and PGARCH(1,1,1). Verify that the appropriate stationarity conditions are satisfied. Are the leverage coefficients significant and of the proper sign? Which model has the lowest BIC value?

2. In this exercise, you will estimate asymmetric GARCH models for the daily returns on Microsoft and the S&P 500 with Student-t distributed errors. First, estimate a GARCH(1,1) model with Student-t errors (where you estimate the degrees of freedom) for the each series and use this as the benchmark. Next, estimate the following models, assuming Student-t errors, for each series: EGARCH(1,1), TGARCH(1,1), and PGARCH(1,1,1). Verify that the appropriate stationarity conditions are satisfied. Are the leverage coefficients significant and of the proper sign? Which model has the lowest BIC value? Do the models with Student-t errors fit better than the models with normal errors?

3. Using the estimated models, compute h-step-ahead volatility forecasts for $h = 1, \ldots, 100$ days and plot these on the same graph. Are the forecasts similar? Why or why not? Which forecasts converge faster to the unconditional volatility?

4. In this exercise you will compute 1% and 5% daily and weekly (5-day) VaR estimates for Microsoft and the S&P 500 using a variety of methods. Assume you have an initial \$1M investment in Microsoft and a \$1M investment in the S&P 500 index. First, compute unconditional VaR estimates (reported as \$ loss) using full sample estimates from the normal distribution, the Student's t distribution, and the empirical quantiles (aka historical simulation). Next, compute conditional VaR estimates based on the fitted GARCH(1,1) models with normal and Student's t errors from exercises 1 and 2.

5. In this exercise you will estimate some bivariate GARCH(1,1) models for the daily returns on Microsoft and the S&P 500. First, estimate an EWMA covariance model with an estimated values of λ. Plot the conditional volatilities and correlations. Do the correlations seem to increase or decrease when conditional volatility is high? What is the correlation between conditional volatility and conditional correlation? Next, estimate DVEC(1,1) and BEKK(1,1) models. Compare the conditional volatilities and correlations with those from the EWMA. Finally, compute h-step ahead conditional correlation forecasts for $h = 1, \ldots, 100$ days. Are these forecasts similar across models?