Problem Set 7 (actually 4) on GARCH and VaR
Econ 40357 Financial Econometrics
University of Notre Dame
Professor Nelson Mark
Fall 2019 (actually 2020)

Problems 1-5 are about estimating the GARCH model, and using it to compute value-at-risk. Use the sheet PS04_A in Eviews workfile ps04.wf1. It contains daily market returns stated in **percent**. The returns variable is called 'mkt)'.

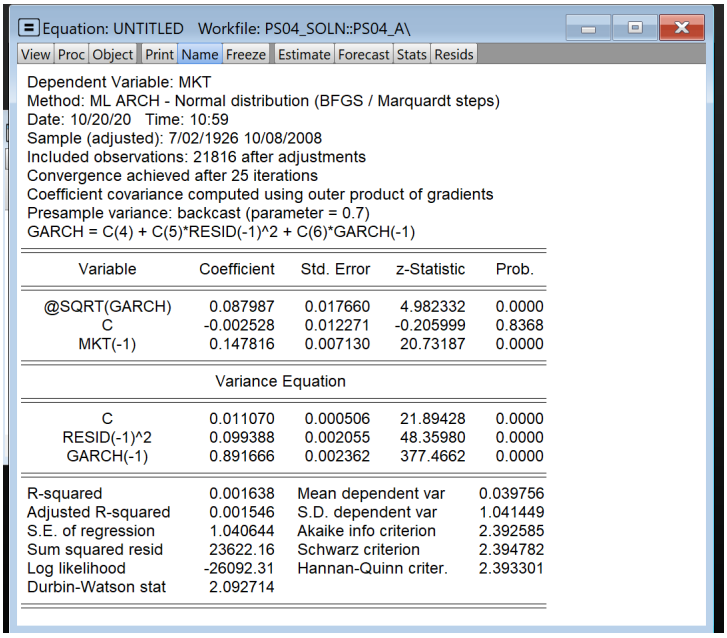
1. Let r_t be the market return. Estimate the GARCH(1,1)-M model,

$$r_t = a_0 + a_1 r_{t-1} + b\sigma_t + u_t$$

where

$$\sigma_t^2 = \alpha_0 + \alpha_1 u_{t-1}^2 + \beta\sigma_{t-1}^2$$

over the sample "@first 10/8/2008". Show the estimation output and interpret (tell a story about) your estimation results.



Equation: UNTITLED Workfile: PS04_SOLN::PS04_A\

View | Proc | Object | Print | Name | Freeze | Estimate | Forecast | Stats | Resids

Dependent Variable: MKT
Method: ML ARCH - Normal distribution (BFGS / Marquardt steps)
Date: 10/20/20 Time: 10:59
Sample (adjusted): 7/02/1926 10/08/2008
Included observations: 21816 after adjustments
Convergence achieved after 25 iterations
Coefficient covariance computed using outer product of gradients
Presample variance: backcast (parameter = 0.7)
GARCH = C(4) + C(5)*RESID(-1)^2 + C(6)*GARCH(-1)

Variable	Coefficient	Std. Error	z-Statistic	Prob.
@SQRT(GARCH)	0.087987	0.017660	4.982332	0.0000
C	-0.002528	0.012271	-0.205999	0.8368
MKT(-1)	0.147816	0.007130	20.73187	0.0000
Variance Equation				
C	0.011070	0.000506	21.89428	0.0000
RESID(-1)^2	0.099388	0.002055	48.35980	0.0000
GARCH(-1)	0.891666	0.002362	377.4662	0.0000

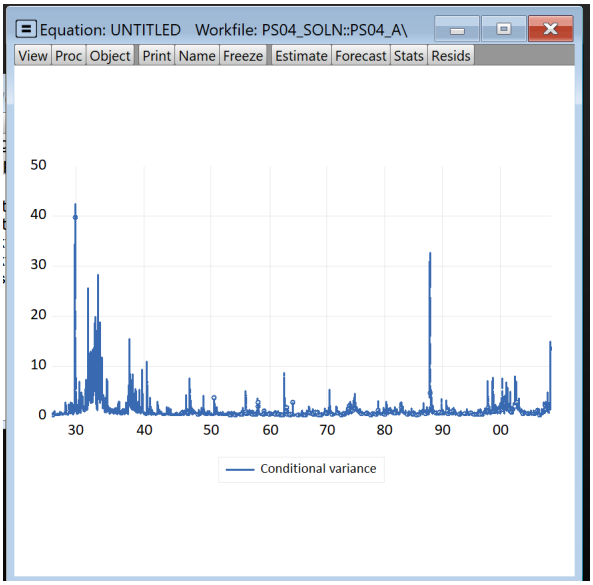
R-squared	0.001638	Mean dependent var	0.039756
Adjusted R-squared	0.001546	S.D. dependent var	1.041449
S.E. of regression	1.040644	Akaike info criterion	2.392585
Sum squared resid	23622.16	Schwarz criterion	2.394782
Log likelihood	-26092.31	Hannan-Quinn criter.	2.393301
Durbin-Watson stat	2.092714		

`AR(1) and GARCH-M model. Positive AR(1) coefficient means high returns today predicts high returns tomorrow. High volatility today predicts high returns.`

Do your estimates support the efficient markets hypothesis?

`No.`

2. Show a plot, and tell a story to your clients, about the estimated GARCH process.

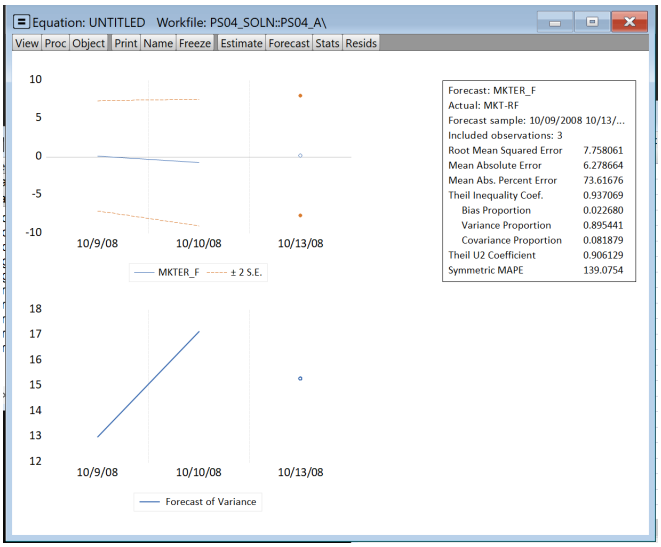


`Periods of high variance were during the Great Depression, beginning of WWII, October 1987, Global Financial Crisis.`

3. Generate static forecasts of the excess return and the conditional variance over the period 10/09/2008 to 10/13/2008.

   Ask to insert actuals for out-of-sample observations.

   Report the forecasted return and forcasted GARCH from 10/09/2008 to 10/13/2008.



	MKTER_F	GARCH_F
10/9/08	0.106035318	12.99690394
10/10/08	-0.750588395	17.14105895
10/13/08	0.179454867	15.30011986

4. Using your 'forecasts' of the market return and conditional variance, compute the one-day 5% value-at-risk of a \$1M investment in the market portfolio on 10/9/2008. (I would use Excel for this question)

Returns are stated in percent so divide the forecasted return and standard deviation by 100.

$$r^* = \frac{0.106035318}{100} - \frac{\sqrt{12.99690394}}{100}(1.65) = -5.842\,4 \times 10^{-2}$$

There's a 5 percent chance that the return on 10/9/2008 is less than or equal to r^*, and the VaR is $\left(-5.842\,4 \times 10^{-2}\right)\left(1 \times 10^{6}\right) = -58,424$.

5. Compute the forecasted one-day 5% value-at-risk of the \$1M investment on 10/10/2008.

$$\begin{aligned} r^* &= \frac{-0.750588395}{100} - \frac{\sqrt{17.14105895}}{100}(1.65) = -7.581\,9 \times 10^{-2} \\ VaR &= \left(-7.581\,9 \times 10^{-2}\right)\left(1 \times 10^{6}\right) = -75,819. \end{aligned}$$

Use sheet PS04_B for the remainder of the problem set. These are monthly historical data. dy is the dividend yield, gr is the gross return on the S&P index, p is the price of the index, and pd is the price-divdend ratio (1/dy).

6. Regress the one-month ahead gross return on the current dividend yield. Show your estimation results, and interpret.

Equation: UNTITLED Workfile: PS04_SOLN::PS04_B\

View | Proc | Object | Print | Name | Freeze | Estimate | Forecast | Stats | Resids

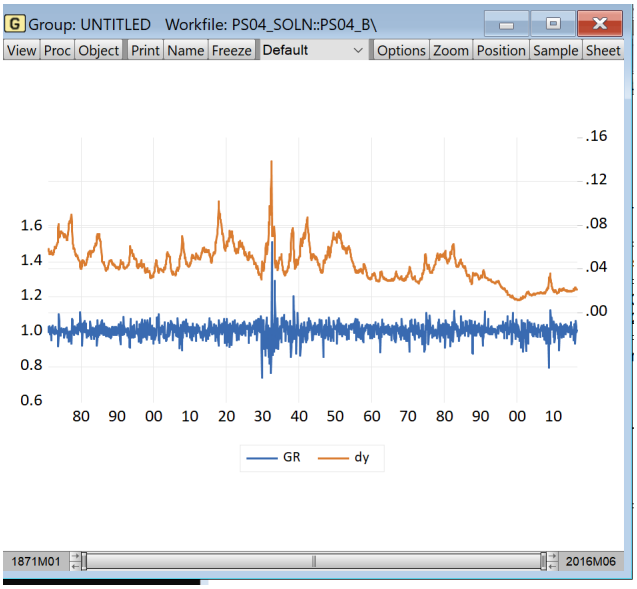
Dependent Variable: GR(1)
Method: Least Squares
Date: 10/20/20 Time: 12:07
Sample (adjusted): 1871M01 2016M05
Included observations: 1745 after adjustments
HAC standard errors & covariance (Bartlett kernel, Newey-West fixed bandwidth = 8.0000)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
DY	0.051753	0.099823	0.518449	0.6042
C	1.005745	0.004199	239.5083	0.0000

R-squared	0.000458	Mean dependent var	1.008015
Adjusted R-squared	-0.000116	S.D. dependent var	0.040794
S.E. of regression	0.040797	Akaike info criterion	-3.559294
Sum squared resid	2.900973	Schwarz criterion	-3.553031
Log likelihood	3107.484	Hannan-Quinn criter.	-3.556979
F-statistic	0.798015	Durbin-Watson stat	1.437472
Prob(F-statistic)	0.371811	Wald F-statistic	0.268789
Prob(Wald F-statistic)	0.604211		

DY is insignificantly positive.

7. Plot the one-month ahead gross return and the current dividend yield.



8. Regress the 96-month ahead gross return on the current dividend yield. Show your estimation results and interpret.

Equation: EQ8 Workfile: PS04_SOLN::PS04_B\

View | Proc | Object | Print | Name | Freeze | Estimate | Forecast | Stats | Resids

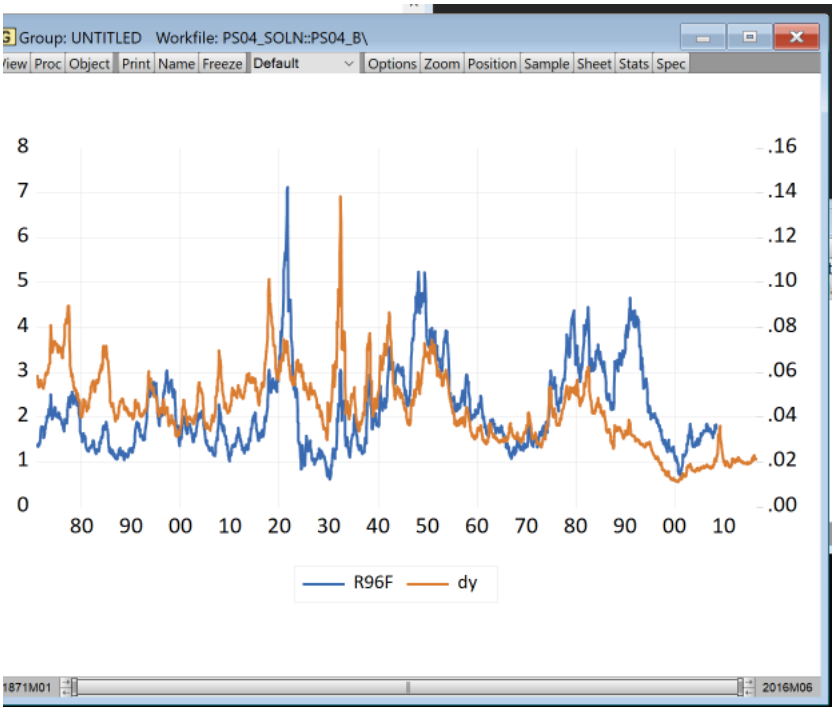
Dependent Variable: R96(96)
Method: Least Squares
Date: 10/20/20 Time: 12:09
Sample (adjusted): 1871M01 2008M06
Included observations: 1650 after adjustments
HAC standard errors & covariance (Bartlett kernel, Newey-West fixed bandwidth = 8.0000)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	1.292760	0.148741	8.691341	0.0000
DY	19.52521	3.512865	5.558200	0.0000

R-squared	0.112298	Mean dependent var	2.174337
Adjusted R-squared	0.111759	S.D. dependent var	0.956302
S.E. of regression	0.901281	Akaike info criterion	2.631213
Sum squared resid	1338.684	Schwarz criterion	2.637769
Log likelihood	-2168.751	Hannan-Quinn criter.	2.633643
F-statistic	208.4787	Durbin-Watson stat	0.015433
Prob(F-statistic)	0.000000	Wald F-statistic	30.89359
Prob(Wald F-statistic)	0.000000		

`DY is significantly positive, and large in magnitude.`

9. Plot the 96-month ahead gross return and the current dividend yield.



Recession $\rightarrow$ high d/P, low P, predicts high future returns, because of low tolerance for risk in recession, high returns offered to induce people to hold these assets