ASSESSMENT 1

INDIVIDUAL COURSEWORK 2023/ 24

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MSc FinTech and Business Analytics

Predictive Analysis for Decision Making

Module Code: FNCE044W

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1 a) From the graphs provided, the main properties of the data and the stationarity can be concluded as follows:

1) lm_t (logarithm of money)

When we access this graph we can easily say that this lograthm graph follows a trend and there is no mean reversion
∴ We can say that the logarithm of money is non stationary

2) lo_t (logarithms of output)

Upon acessement of this graph it is fair to say that this graph also has a trend and no mean reversion to the equilibrium.

∴ We can say that logarithm of order is non sationary as well.

3) lp_t (logarithm of price)

Acessing logarithm of price graph tells us that it follows a trend as well leading to the conclusion that it displays non stationarity as well.

4) r_t (interest rate)

The interest rate graph does not show us a clear trend so when we take the logarithm of the interest rate we might identify a trend and the ACF for the graph will fall leading us to conclude that the interest rate is also non stationary.

1b) The mathematical model that can be expressed from Table 1 is as follows:

$$lm_t = \beta_0 + \beta_1 r_t + \beta_2 lp_t + \beta_3 lo_t + \varepsilon_t$$

where

lm_t is the logarithm of money
r_t is the interest rate
lp_t is the logrithm of price
lo_t is the logarithm of order
ε_t is the residul error term

The main assumptions in the matematical expression for explainatory variables are:

(i) The set of variables that are chosen are linearly indipendent. Violating this assumption may lead to rise in multicolinearity which further leads to our OLS estimator to be inefficient. Formally this assumption is also called as X being a full column rank

(ii) The set of variables are assumed to be fixed and non random. This implies that explainatory variables are uncontrolled with the errors.
Violating this assumption may lead to or result in endogeniety. This implies the OLS estimator is no longer unbaised and consistant.
This can be expressed in the form of equation as;
$E[X/u] = E[X] = X$

1 c) Since we have not been provided with the ~~t-value of~~ coefficient of r_t. Lets calculate the coefficient of r_t first before interpretation of the coefficients.

We can calculate the coefficient of r_t using the formula

$$t\text{value} = \frac{\hat{\beta}_{r_t}}{Se(r_t)}$$

where

$\hat{\beta}_{rt}$ is the coefficient of r_t

$Se(r_t)$ is the standard error of r_t

t value is the t value of r_t

$$\therefore \hat{\beta}_{r_t} = t\text{value} \times Se(r_t)$$

$$= -26.01 \times 0.001$$

$$= -0.026$$

$\therefore$ We can interpret that:

(i) -0.026 is the estimated effect of the rise in interest rate on the demand of money. As the interest rate increases by 1% the demand for money decreases by a factor of -0.026.

(ii) 0.961 is the estimated effect of increase in price on the demand for money. It is estimated to be positively related. Therefore we can say the higher the prices the more is the demand for money.

(iii) 0.439 is the estimated average of US goods and services output impact on demand for money. As the output increases by a factor of 1, the demand for money increases by a factor of 0.439.

(iv) 0.416 is the demand for money supply even when all the other factors are kept constant.

For each coefficient we have the following hypothesis to test

$H_0 : \beta_i = 0$

$H_1 : \beta_i \neq 0$

where $i = 0, 1, 2, 3$

Since we are given $\alpha = 5\%$.

For all the values of Z_i (critical values),

$$|Z_i| = 1.96 \quad (Z_{\alpha/2} = 1.96)$$

where $|Z_i|$ can be calculated by the given formula:

$$|\hat{Z}_i| = \left|\frac{\hat{\beta}_i - \beta_i}{Se(\hat{\beta}_i)}\right| \sim |Z_{\alpha/2}|$$

Rejection rule:

For rejecting H_0 $|\hat{Z}_i| > |Z_{\alpha/2}|$

After calculating the critical values $|Z_i|$ for all the explainatory variables (ie. $Z_{r_t} = 26.01$, $Z_{lp_t} = 68.6$, $Z_{lo_t} = 17.56$).

We can certainly say that we can reject H_0 for all the explainatory variables as all of them have a p value $= 0.000$ and their $|Z_i| > 1.96$.

1 d) The joint significance hypothesis can be expressed as follows:

$H_0: \beta_1 = \beta_2 = \beta_3 = 0$

H_1: at least 1 $\beta_i \neq 0$

where $i = 1, 2, 3$

Failing to reject H_0 implies model is jointly insignificant.

Rejecting the H_0 implies the model is jointly significant (ie H_1)

The decision rule is as follows:

Reject the null hypothesis H_0, if

$$F > F^{\alpha}_{(\gamma, df)}$$

where α is significance level

γ is number of restrictions

df is degrees of freedom

k is number of slopes

$$df = N - (k+1)$$

where N is the sample size

K is the number of slopes

and F can be calculated as:

$$F = \frac{(RRSS - URSS)/\gamma}{URSS/df}$$

where RRSS is Restricted Sum of Squared residuals

URSS is Unrestricted Sum of Squared residuals

r is the number of restrictions

df is the degrees of freedom

$\therefore$ for our given problem

$$F = \frac{(249.548 - 1.754)/3}{1.754/476}$$

$$= 22445.1087$$

$(df = N-(k+1)$
$= 480 - (3+1)$
$= 476)$

$\because F > F^{5\%}_{(3,476)} \cong 2.623$

We reject the null hypothesis and conclude the model is jointly significant.

The coefficient of determination (R^2) suggests that about 99.2% of the variations are explained by the model. Still with such high value of R^2 we should also keep in mind that there could be a possiblity of ~~overf~~ ovefitting.

e) Based on the economists suggestions we formulate the hypothesis as follows:

$H_0: \beta_2 = 2\beta_3$ or $\beta_2 - 2\beta_3 = 0$

H_1: H_0 is false

Our unrestricted Model is as follows (URM):

$$lm_t = \beta_0 + \beta_1 r_t + \beta_2 lp_t + \beta_3 lo_t + \varepsilon_t$$

Whereas the restricted model provided by the economists is (RM):

$$lm_t = \beta_0 + \beta_1 r_t + \beta_2 lp_t + 0.5\beta_2 lo_t + \varepsilon_t$$

We are provided with the values of URSS and RRSS (ie URSS = 1.754 and RRSS = 1.760)

$$\therefore F = \frac{(RRSS - URSS)/\gamma}{URSS/df} \qquad \because \gamma = 1 \text{ \& } df = N-(K+1) = 480-(2+1) = 477$$

$$= \frac{1.760 - 1.754/1}{1.754/477}$$

$$= 1.628$$

$\because$ The decision rule states

Reject the H_0 if $F > (F^{5\%}_{([illegible],474)}) \cong 8.524$

$\therefore$ We cannot reject H_0 since F is not grater ~~that~~ than the critical value.

1 f) i) Unit roots are reffered to a charecteristic of time series where the series is non stationary due to the presence of a root which is equal to 1 in the autoregressive model of the series

Consider the Data Generating Process (DGP) for a process y_t:

$$y_t = \rho y_{t-1} + u_t \quad \text{with } -1 \leq \rho \leq 1$$

where u_t is the white noise and ρ is the persistance term. If $\rho = 1$ the process y_t becomes a Random Walk Process and y_t contains a unit root.

The main implication of the process y_t or the process which contains a unit root is that the process will never converge to a long run level or equilibrium.

In content of the estimated model in Table 1. If the variables exibit unit roots, the models estimations and inferences could be unreliable and will become necessary to establish, that the model is cointigrated before proceeding with the analysis.

1 f) ii) The Augumented Dickey Fuller (ADF) test is a statistical test that checks whether a series has a unit root. The steps involved to perform ADF Test is as follows:

Step 1: Identify the Form

ADF proposes three (DGPs)

a) y_t is a random walk (no constant or trend)

$$\Delta y_t = \delta y_{t-1} + \sum_{i=1}^{k} \theta_i \Delta y_{t-i} + u_t$$

b) y_t is a random walk with drift (with constant)

$$\Delta y_t = \beta_1 + \delta y_{t-1} + \sum_{i=1}^{k} \theta_i \Delta y_{t-i} + u_t$$

c) y_t is a random walk with drift around a stochastic trend (with drift and trend)

$$\Delta y_t = \beta_1 + \beta_2 t + \delta y_{t-1} + \sum_{i=1}^{k} \theta_i \Delta y_{t-i} + u_t$$

where k is the lag lenght in each equation

Step 2: Identify for unit root with ADF

$H_0: \delta = 0 \Rightarrow$ unit root

$H_1: \delta < 0 \Rightarrow$ No unit root

step 3: Identify stationarity using KPSS

$H_0: \delta < 0 \Rightarrow$ stationarity

$H_1: \delta = 0 \Rightarrow$ unit root

step 4: Conclude the results

(i) Reject H_0 for ADF and fail to reject H_0 for KPSS for both tests to conclude stationarity

(ii) For both tests Reject H_0 if $P < \alpha$, where α is the level of significance (ie 5%)

(iii) and fail to reject H_0 when $P \geq \alpha$

1 f) iii) The ADF test statistic is compared to the critical value at the 1%, 5%, 10% significance levels.

If the test statistics is grater than the critical value at a given significance level, we reject the null hypothesis of a unit root, indicating that the series is stationary

If the test statistics is less than the critical value, we fail to reject the null hypothesis, suggesting the presence of a unit root.

Now lets analyze each variable :

i) r_t : Test statistic : -2.612

Critical Value : -2.334 (1%), -1.648 (5%), -1.203 (10%)

Conclusion : Reject the null hypothesis H_0, the series is stationary

(ii) lm_t : Test Statistics : 0.048

Critical Value : -2.334 (1%), -1.648 (5%), -1.203 (10%)

Conclusion : Fail to reject the null hypothesis, ~~ideal~~ indicating the presence of a unit root.

(iii) lp_t : Test Statistics : -0.258

Critical Value : -2.334 (1%), -1.648 (5%), -1.203 (10%)

Conclusion : Fail to reject the null hypothesis, indicating the presence of a unit root.

(iv) lo_t : Test statistics : -0.909

Critical Value : -2.334 (1%), -1.648 (5%), -1.203 (10%)

Conclusion : Fail to reject the null hypothesis, indicating the presence of a unit root.

1 g) The Durbin Watson value given in the table: -0.122

Interpretation of the Durbin Watson Statestic

The hyopesis:

H_0 : No positive first-order autocorrelation

H_1 : Positive first order autocorrelation

The decision can be taken as:

- Value approximately 2 indicates → no autucorrelation
- Value < 2 indicates – positive correlation
- Value > 2 indicates – negative correlation

∴ The DW statestic < 2, We can clearly say that there is a positive correlation in the residuals, voilating the assumption of the indipendent errors which could impact the validity of statestical inferences fron the model.

Therefore we can conclude that from the Durbin Watson test results, that there is proof of positive first order autocorrelation in the errors and the problem needs to be fixed before further analysis.

2 a) i) Given that $\varepsilon_t \sim iid(0, \sigma^2)$

$y_t = \varepsilon_t + \theta_1 \varepsilon_{t-1} + \theta_2 \varepsilon_{t-2}$

<u>Mean</u>

$E[y_t] = E[\epsilon_t] + \theta_1 E[\epsilon_{t-1}] + \theta_2 E[\epsilon_{t-2}]$

$\because$ ϵ_t is iid, ~~for~~ for all values of ϵ_t the mean is same

$\therefore$ $E[y_t] = 0 + \theta_1(0) + \theta_2(0)$
$= 0$

<u>Varience</u>

$Var[y_t] = Var[\epsilon_t] + \theta_1^2 Var[\epsilon_{t-1}] + \theta_2^2 Var[\epsilon_{t-2}]$

similarly since ϵ_t is iid all the ϵ_t varience values are same

$\therefore$ $Var[y_t] = \sigma^2 + \theta_1^2 \sigma^2 + \theta_2^2 \sigma^2$
$= \sigma^2(1 + \theta_1^2 + \theta_2^2)$

<u>Covarience</u>

$Cov[y_t, y_{t-1}] = E[(y_t - E[y_t])(y_{t-1} - E[y_{t-1}])]$
$= E[\epsilon_t \epsilon_{t-1} + \theta_1 \epsilon^2_{t-1} + \theta_2 \epsilon_{t-1} \epsilon_{t-2}]$
$= E[\epsilon_t \epsilon_{t-1}] + \theta_1 E[\epsilon^2_{t-1}] + \theta_2 E[\epsilon_{t-1} \epsilon_{t-2}]$
$= 0 + \theta_1 \sigma^2 + 0$

$Cov[y_{t-1}, y_{t-2}] = E[(y_t - E[y_t])(y_{t-2} - E[y_{t-2}])]$
$= E[\epsilon_t \epsilon_{t-2} + \theta_1 \epsilon_{t-1} \epsilon_{t-2} + \theta_2 \epsilon^2_{t-2}]$
$= E[\epsilon_t \epsilon_{t-2}] + \theta_1 E[\epsilon_{t-1} \epsilon_{t-2}] + \theta_2 E[\epsilon^2_{t-2}]$
$= 0 + \theta_1 0 + \theta_2 \sigma^2$
$= \theta_2 \sigma^2$

2 a) ii) $\epsilon_t \sim iid(0, \sigma^2)$

$$\omega_t = \omega_{t-1} + \epsilon_t$$

where $\omega_0 = 0$

using recursive substitution we can say that

$$\omega_1 = \omega_0 + \epsilon_1$$
$$\omega_2 = \omega_1 + \epsilon_2 = \omega_0 + \epsilon_1 + \epsilon_2$$
$$\omega_3 = \omega_2 + \epsilon_3 = \omega_0 + \epsilon_1 + \epsilon_2 + \epsilon_3$$

$\therefore \quad \omega_t = \omega_0 + \epsilon_1 + \epsilon_2 + \cdots + \epsilon_{t-1} + \epsilon_t$

since $\omega_0 = 0$

$$\omega_t = \epsilon_1 + \epsilon_2 + \cdots + \epsilon_{t-1} + \epsilon_t$$

$\therefore$ Mean

$$E[\omega_t] = E[\epsilon_1 + \epsilon_2 + \epsilon_3 + \cdots + \epsilon_{t-1} + \epsilon_t]$$
$$= E[\epsilon_1] + E[\epsilon_2] + \cdots + E[\epsilon_{t-1}] + E[\epsilon_t]$$

Since ϵ_t follows $iid(0, \sigma^2)$ therfore $E[\epsilon_t] = 0$

$\therefore E[\omega_t] = 0$

Varience

$$Var[\omega_t] = Var[\epsilon_1 + \epsilon_2 + \cdots + \epsilon_{t-1} + \epsilon_t]$$
$$= Var[\epsilon_1] + Var[\epsilon_2] + \cdots + Var[\epsilon_{t-1}] + Var[\epsilon_t]$$

since ϵ_t follows $iid(0, \sigma^2)$ therefore $Var[\epsilon_t] = \sigma^2$

$\therefore \quad Var[\omega_t] = \sigma^2 + \sigma^2 + \cdots + \sigma^2 + \sigma^2$
$$= t\sigma^2$$

Covarience

$$Cov[\omega_t, \omega_{t-j}] = E[(\omega_t - E[\omega_t])(\omega_{t-j} - E[\omega_{t-j}])]$$

if $j = 0$

$$Cov[\omega_t, \omega_{t-j}] = E[(\omega_t - E[\omega_t])(\omega_t - E[\omega_t])]$$
$$= E[\omega_t^2] = Var(\omega_t) = t\sigma^2$$

if $j \neq 0$

$$Cov[\omega_t, \omega_{t-j}] = E[(\omega_t - E[\omega_t])(\omega_{t-j} - E[\omega_{t-j}])]$$

$= E[w_t]\, E[w_{t-j}]$

$= 0$

$\therefore$ Covarience

$$Cov[w_t, w_{t-j}] = \begin{cases} t\sigma^2 & \text{if } j=0 \\ 0 & \text{if } j \neq 0 \end{cases}$$

2 b) $y_t = \epsilon_t + \theta_1 \epsilon_{t-1} + \theta_2 \epsilon_{t-2}$

The process y_t is weakly stationary. This can be concluded from the derieved expression of mean, varience and covarience of y_t.

The mean is constant and equal to 0. indipendent of time t
The varience is constant and equal to $\sigma^2(1+\theta_1^2+\theta_2^2)$. indipendent of time t.
The coveriences $Cov(y_t, y_{t-j})$ depends only on the lag j, not on the time t
Therefore, these properties satisfy the defination of weak stationarity where all mean, varience and covariences do not depend on tince.

$\omega_t = \omega_{t-1} + \epsilon_t$

The process w_t is not weakly stationary. This can be concluded from the derieved values of mean, varience and covariences of ω_t.

The mean is constant and equal to 0. indipendent of t.
The varience $Var(\omega_t)$ is however dependent on time t, since $Var(\omega_t) = t\sigma^2$ which voilates the requirement for weak stationarity.
The covarience $Cov(\omega_t, \omega_{t-j})$ dependson time t, not just the lag j, again vailating the requirement of weak stationarity.

Therefore we can conclude that the process ω_t is not weak stationary.

2 c) i) Detect first order autocorrelation using Durbin Walson (DW) test (given DW - 1.20)

Hypothesis

Null hypothesis

H_0 : $\rho = 0$ first order autocorrelation does not exist in the model

Alternate Hypothesis

H_1 : $\rho \neq 0$ There is evidence of first order autocorrelaton in the model.

The critical values derived from the DW statistics table is as follows:

$\alpha = 5\%$

$K = 2$

$N = 90$

$\therefore d_L = 1.61$, $d_u = 1.70$

The following interpretation can be used to test the hypothesis.

$0 - 1.61 (d_L)$ → Reject H_0 (Positive autocorrelation)

$1.61 (d_L) - 1.70 (d_u)$ → cannot conclude

$1.70 (d_u) - 2.3 (4 - d_u)$ → Do not reject H_0

$2.3 - 2.39 (4 - d_L)$ → Cannot conclude

$2.39 - 4$ → Reject H_0 (Negative correlation)

The DW value 1.20 lies between $0 - 1.61 (d_L)$ denoting positive correlation, therefore we reject H_0 showing evidence of first order autocorrelating in the model.

2c) ii) We are given that

$$\hat{b}_t = \underset{(0.84)}{0.49} - \underset{(0.27)}{0.27}p_t + \underset{(0.71)}{0.22}y_t$$

$R^2 = 0.28$, $DW = 1.20$, $LM(2) = 7.42$

where b_t is demand for Text books

p_t is price of a book

y_t is total level of income.

LM Test can be done using the following steps:

1) Hypothesis

H_0 : Autocorrelation of 2^{nd} order does not exist in the model

H_1 : There is evidence of 2^{nd} order autocorrelation in the model

2) Residuals Calculation

for every observation in the model the residuals $\hat{u}_t$

$\hat{u}_t = b_t - \hat{b}_t$

3) Auxilary regression

We perform the regression using the residuals $\hat{u}_t$ as the dependent variable againt the original explianatory variables (p_t & y_t) and the lagged residuals ($\hat{u}_{t-1}, \hat{u}_{t-2}$)

$$\hat{u}_t = \beta_0 + \beta_1 p_t + \beta_2 y_t + \rho_1 \hat{u}_{t-1} + \rho_2 \hat{u}_{t-2} + \epsilon_t$$

From this regression we derive the cofficient of determination R^2

4) Deriving the LM statestices value

The LM statestics can be calculated as

$LM = R^2 \times n$

where LM is given 7.42

5) Deriving the critical values using chi square distribution

The LM statestics follow Chi-Square distribution, with degrees of freedom equal to the number of lags which in our case is 2. With a 5% significance level, the critical value from the chi-square distribution with two degrees of freedom is 5.99.

6) Decision rule and Conclusion

As the LM is higher as compared to the critical value (ie LM: 7.42 > Critical value: 5.99), therefore we reject the null hypothesis (H_0). It indicates that the model exhibits 2nd order autocorrelation.

3a) i) Given

URM

$$\hat{y}_t = 2.3 + 0.2x_{1i} - 6.14x_{2i} - 0.01x_{3i} + 1.5x_{4i}$$

RM

$$\hat{y}_t = 2.6 + 0.25x_{1i} - 6.14x_{2i}$$

The joint significance hypothesis are:

$H_0: \beta_3 = \beta_4 = 0$

$H_1:$ at least 1 of β_3 or $\beta_4 \neq 0$

Failing to reject the null hypothesis, implies model is jointly insignificant.

Rejecting the null hypothesis, implies the model is jointly significant.

The decision rule is as follows:

Reject the null hypothesis H_0, if

$$F > F^{\alpha}_{(r, df)}$$

where F can be calculated as

$$F = \frac{(RRSS - URSS)/r}{URSS/df}$$

$$= \frac{(0.70 - 0.60)/2}{0.60/47}$$

$$= 3.937$$

$$\because F < F^{5\%}_{(2,47)} \cong 19.48$$

Therefore we fail to reject the null hypothesis and conclude that the model is jointly insignificant

3a)ii) To access whether the financial firms have average ROE, we use a dummy variable in the equation, that can be explained by the following steps:

- Define the dummy variable

  $D_{financial} = 0$ for non financial firms

  $D_{financial} = 1$ for financial firms

- Define the model with dummy variable

  $\hat{y}_t = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \cdots + \beta_K D_{financial} + \epsilon_t$

- Define hypothesis

  $H_0 : \beta_K = 0$ → financial firms do not have higher ROE compared to non financial firms

  $H_1 : \beta_K > 0$ → financial firms have higher average ROE than non financial firms.

- Model Estimation & Mean consideration

  Model's coefficient are calculated using regression. The coefficient β_K of the dummy variable measures average difference between the average ROE between financial and non financial firms, while the other parameters remain constant. The pvalue associated with the ~~coefficient~~ β_K will show pre-determined significance level (<0.05), based on which we can determine whether to reject or accept H_0

  Mean is higher: This will tell us that the financial firms have higher average ROE compared to non financial firms. We reject the null hypothesis H_0

Mean is lower : This will tell us that the model is ~~insignific~~ insignificant and financial firms have lower or similar average ROE compared to non financial firms. Accept the H_0.

3 b) In order to test the presence of 4^{th} order ARCH effects in stock market index, the ARCH LM Test proposed by Engle shell can be applied, which we can do by following the below steps.

i) Conditional mean specification

A regression or ARIMA model is run to fit the return (R_t), thus obtaining the residuals $\hat{\varepsilon}_t$.

(ii) Auxilary regression

Residual obtained from the regression above are squared to estimate the varience followed by regressing the squared residuals on their own past values. it can be denoted by the expression below:

$$\hat{\varepsilon}_t^2 = a_1\hat{\varepsilon}_{t-1}^2 + a_2\hat{\varepsilon}_{t-2}^2 + a_3\hat{\varepsilon}_{t-3}^2 + a_4\hat{\varepsilon}_{t-4}^2 + u_t$$

(iii) hypothesis

$H_0: a_1 = a_2 = a_3 = a_4 = 0$ → No ARCH effects are peresent

$H_1: a_i \neq 0$ → ARCH effect exists in atleast one i (1, 2, 3, 4)

(iv) Statestic & Distribution

The LM statestic can be calculated where $LM = nR^2$

It follows a chi-square (χ^2) distribution with 4 degrees of freedom reffering to the number of lagged squared residual in the regression

v) Decision Rule and conclusion

In this we will compare χ^2 value with LM statestics at 5% significance levels.

If LM > critical value → Reject H_0, 4^{th} arch effect is present

If LM ≤ critical value → fail to reject H_0, no evidence of 4^{th} arch effect in stock market index returns.

3 c i) $\hat{y}_t = 0.75$ → conditional mean

$$\hat{\sigma}_t^2 = 1.76 + 0.07 u_{t-1}^2 + 0.24 \sigma_{t-1}^2 + 0.87 u_{t-1}^2 I_{t-1}$$

The last term in the equation captures the asymetric effect in the market, if positive, the impact of bad news and good news is different.

Good news → $0.07 u_{t-1}^2 + 0.87 u_{t-1}^2 \times 0$

∴ The magnitude of the shock is 0.07

Bad news → $0.07 u_{t-1}^2 + 0.87 u_{t-1}^2 \times 1$

∴ The magnitude of the shock is 0.94

Interpretation

The assymmetric effect is significant satestically. Also positive shock is 0.07 and negetive shock is 0.94. therefore when we have a positive news we have a restricted volatility and during negetive news it has a gratel ~~sucep~~ susceptibility to unfavourable occurences.

3c ii) The estimated coefficient of 0.24 for the lagged conditional varience (σ^2_{t-1}) in a GARCH model can be interpretted as shown in the GARCH effect, or the persistance of shocks to volatility. This view is consistant with the measurement of the impact of volatility from earlier eras on the volatily of the FTSE 100 index in the current time.

0.24 is the persistence of the ~~scho~~ shock or GARCH effect. The closer to 1 the higher is the persistance, as the shock lasts for a longer time.

Hence in this case the shock is moderately persistant.

3 c(iii)

Given

$\sigma^2_{t-1} = 0.74$

$\hat{u}_{t-1} = \pm 0.5$

For positive shock $\hat{u}_{t-1} = 0.5$

For negetive shock $\hat{u}_{t-1} = -0.5$

σ^2_t for good news

$I_{t-1} = 0, \hat{u}_{t-1} = 0.5$

$\sigma^2 = 1.76 + 0.07(0.5)^2 + 0.24(0.74)$

$= 1.955$

<u>Interpretation</u>

There is a volatility of 1.955 in the market due to good news

σ^2_t for bad news

$I_{t-1} = 1, \hat{u}_{t-1} = -0.5$

$\sigma^2 = 1.76 + 0.07(-0.5)^2 + 0.24(0.74) + 0.87(-0.5)^2(1)$

$= 2.176$

<u>Interpretation</u>

There is a volatity of 2.176 in the market due to a bad news.