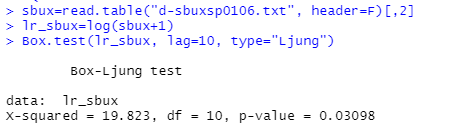
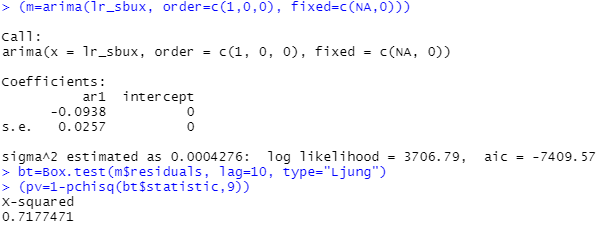
Q1:

1. Applying Ljung-Box Test on the log returns of Starbucks stock , was rejected and thus there is serial correlation.

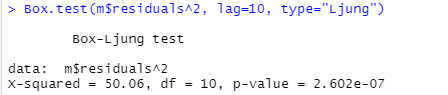


1. Since has serial correlation, AR(1) model was fitted to remove the serial dependence.



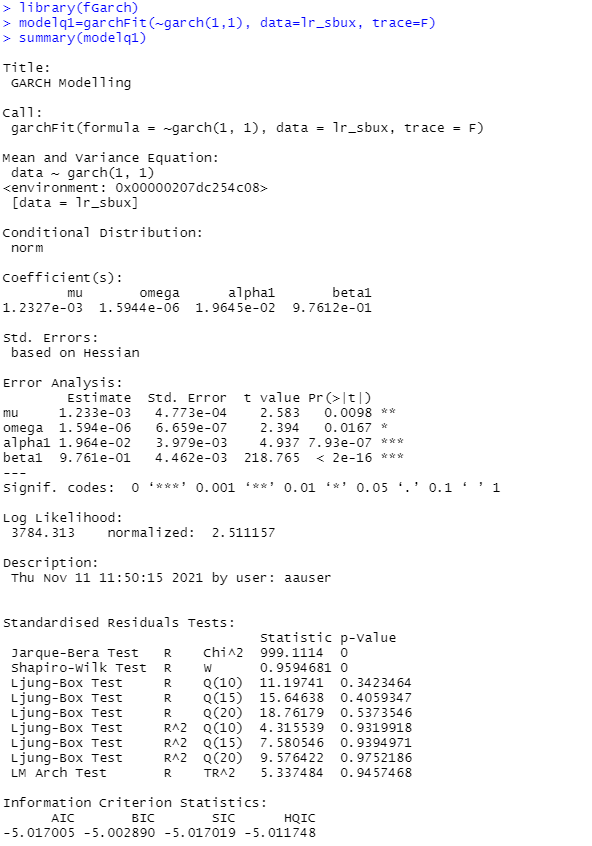
The residuals is given by

The ARCH effect of was tested by applying Ljung-Box Test on . was rejected and thus there is ARCH effect in the log returns of Starbucks stock.



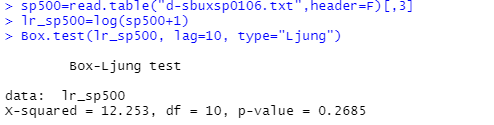
1. GARCH(1,1) model was fitted on . Results of the Ljung-Box Test on the standardized residuals and standardized squared residuals show that the model is adequate. The fitted model is:

, and

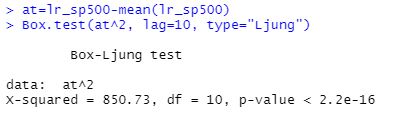


Q2:

1. Applying Ljung-Box Test on the log returns of S&P index , was not rejected and thus there is no serial correlation.

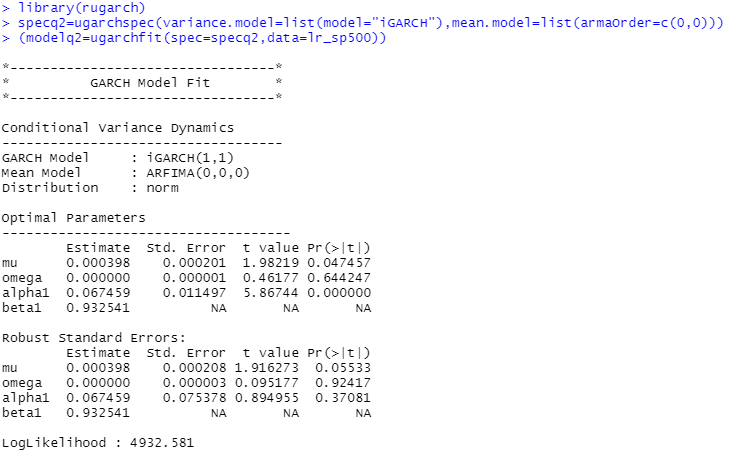


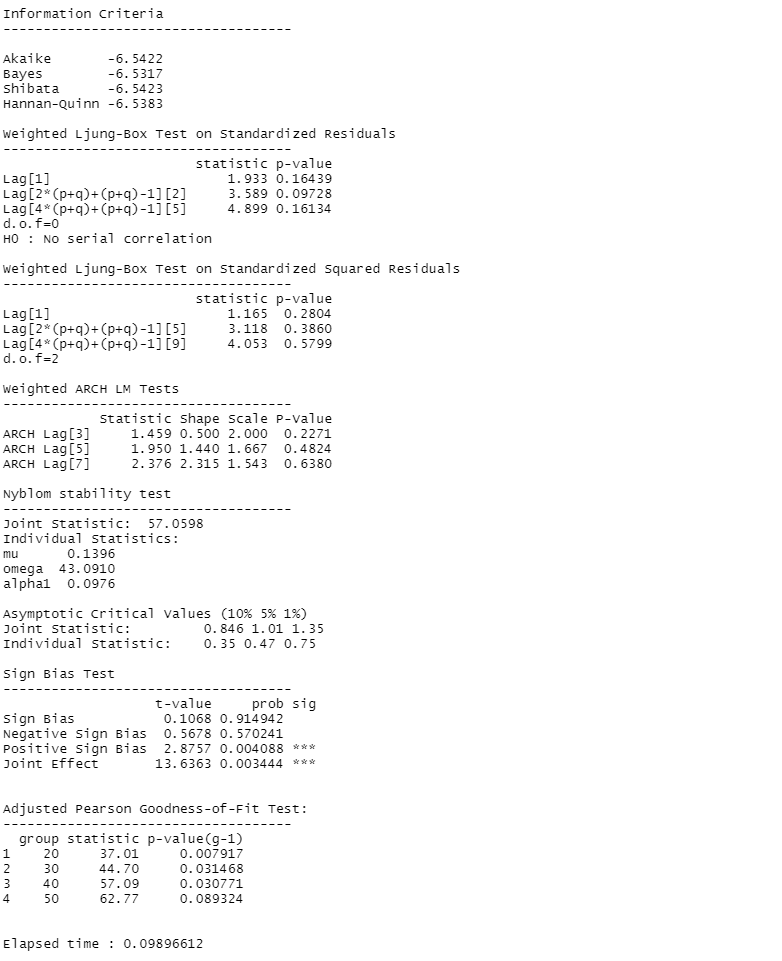
1. The ARCH effect of was tested by applying Ljung-Box Test on . was rejected and thus there is ARCH effect in the log returns of Starbucks stock.

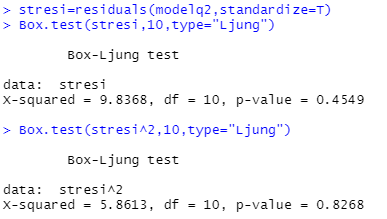


1. IGARCH(1,1) model was fitted on . Results of the Ljung-Box Test on the standardized residuals and standardized squared residuals show that the model is adequate. The fitted model is:

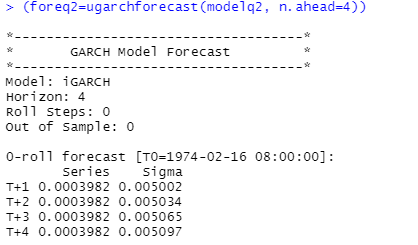
, and







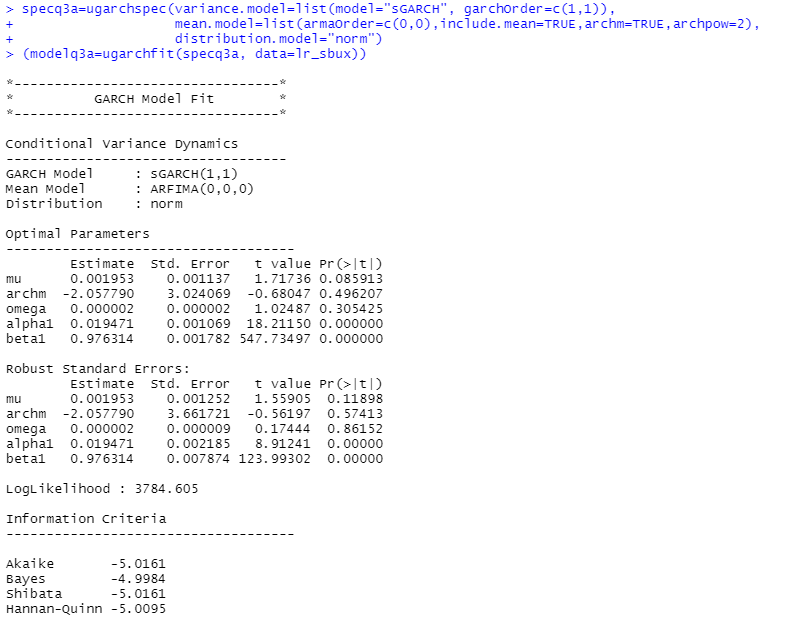
1. The 1- to 4-step ahead forecast for have the same value: 0.0003982, and the 1-step forecasting interval is given by:

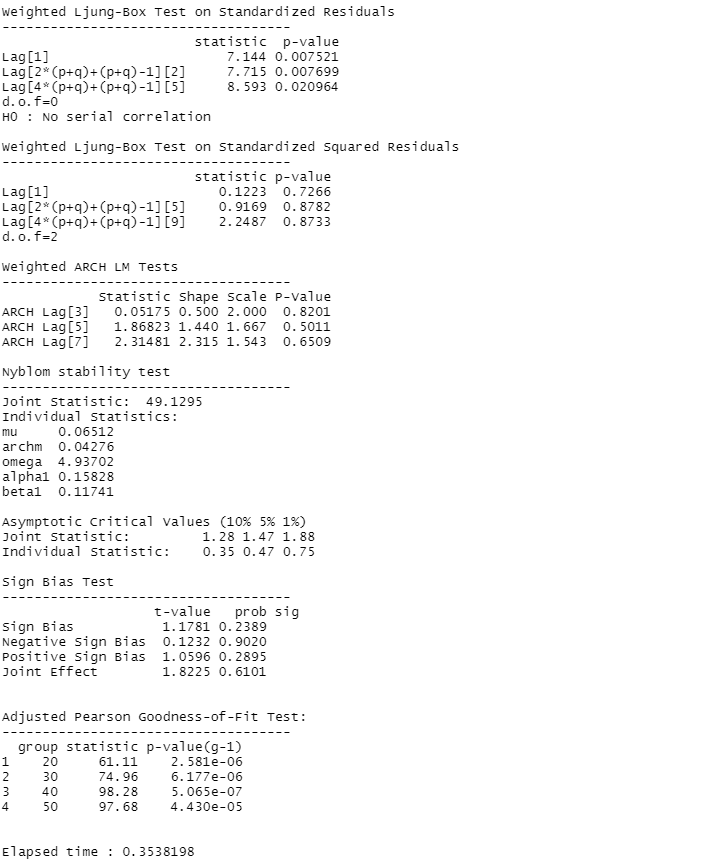


Q3:

1. GARCH(1,1)-M model was fitted on the log returns of Starbucks stock . The fitted model is:

, and





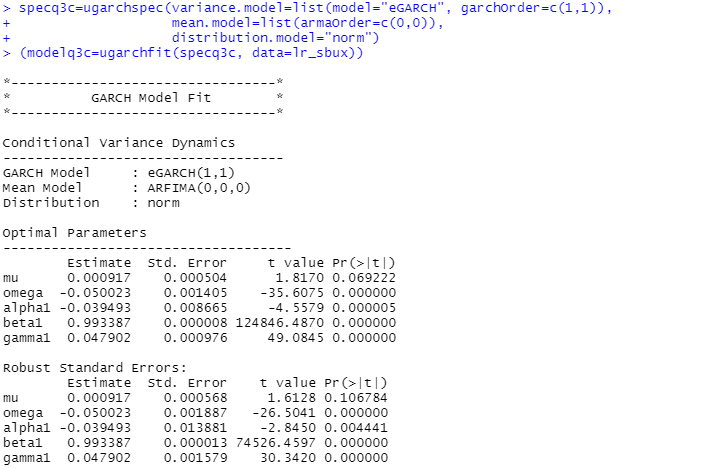
1. As the p-value=0.496207 is large, the ARCH-in-mean parameter is not significant at the 5% level.
2. EGARCH(1,1) model was fitted on with R package “rugarch”. The model is in the form:

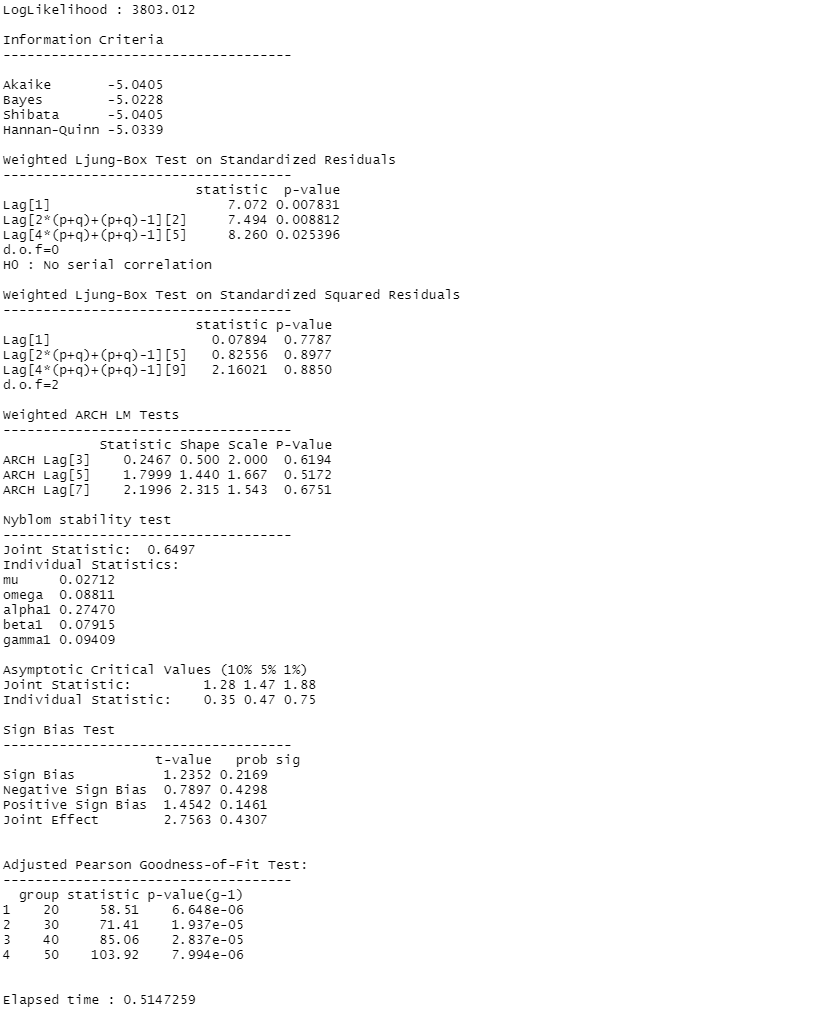
, and

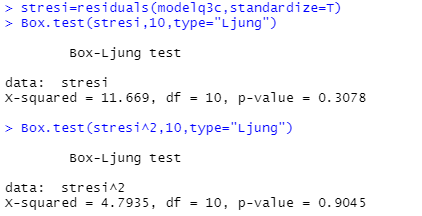
Note that , and , we have

Results of the Ljung-Box Test on the standardized residuals and standardized squared residuals show that the model is adequate. The fitted model is:

, and



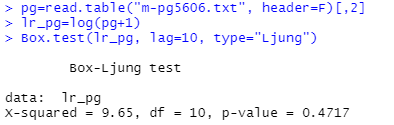




1. As the p-value of the leverage parameter () is very small, the leverage parameter is significant.

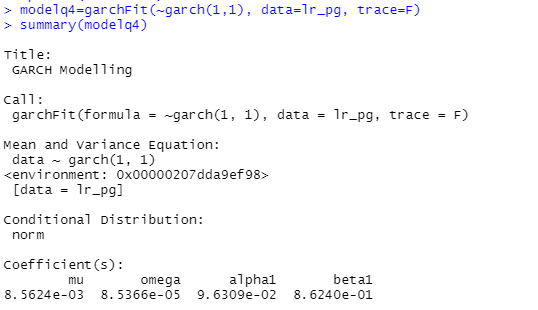
Q4:

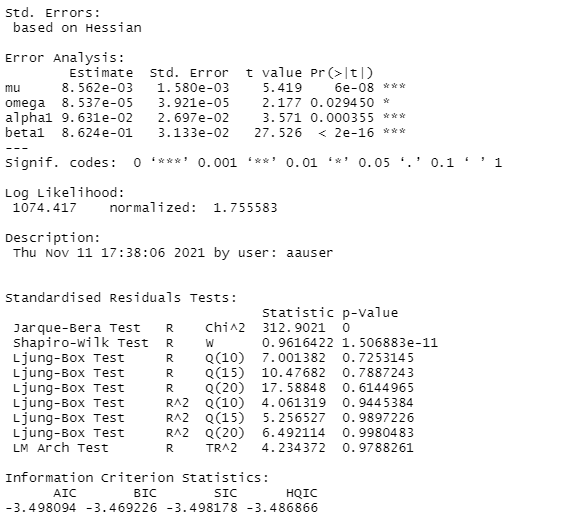
1. Applying Ljung-Box Test on the log returns of PG stock , was not rejected and thus there is no serial correlation.



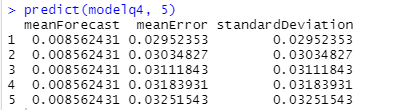
1. GARCH(1,1) model was fitted on . Results of the Ljung-Box Test on the standardized residuals and standardized squared residuals show that the model is adequate. The fitted model is:

, and



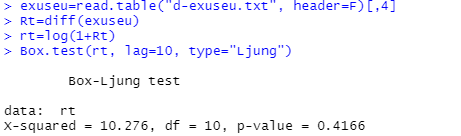


1. The 1- to 5-step ahead forecast for have the same value: 0.008562431, and the 1-step forecasting interval is given by:

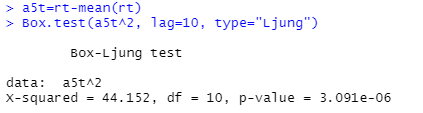


Q5:

1. Applying Ljung-Box Test on the log returns series , was not rejected and thus there is no serial correlation.

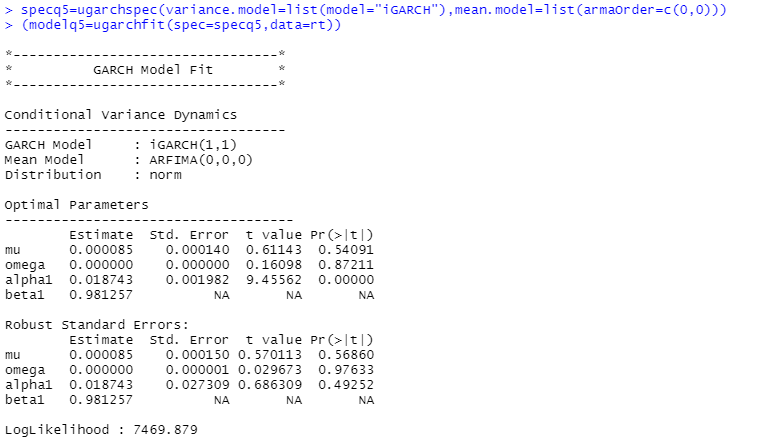


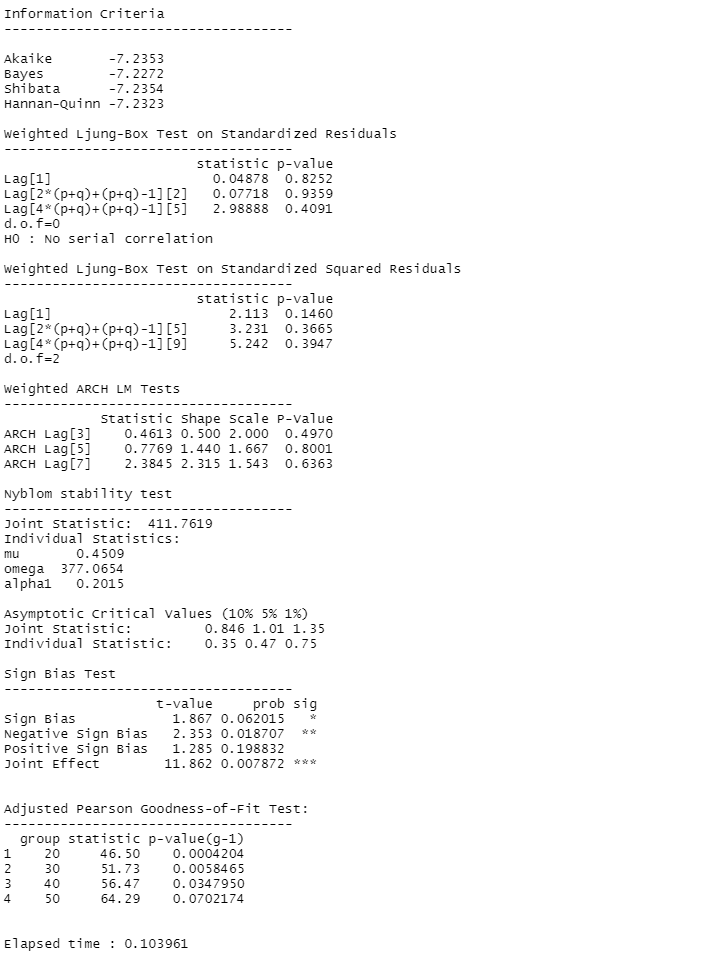
1. The ARCH effect of was tested by applying Ljung-Box Test on . was rejected and thus there is ARCH effect in the log return series.

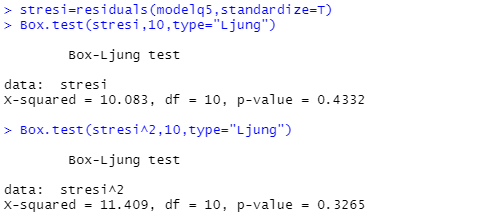


1. IGARCH(1,1) model was fitted on . Results of the Ljung-Box Test on the standardized residuals and standardized squared residuals show that the model is adequate. The fitted model is:

, and







1. The 1- to 4-step ahead forecast for have the same value: 0.00008539, and the 1-step forecasting interval is given by:

