

**SHORT-TERM FORECAST OF GOLD PRICE USING GENERALIZED
AUTOREGRESSIVE CONDITIONAL HETEROSCEDASTIC
MODELS**

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To my beloved hubby, family and friends.

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ABSTRACT

Gold is used in many industries and it is popular as a good investment. However, its price can fluctuate widely. There are many mathematical models that can be used to forecast gold prices. In this study, the Generalised Autoregressive Conditional Heteroscedastic (GARCH) and Autoregressive Integrated Moving Average (ARIMA) models are developed to produce short term forecasts of gold prices. GARCH model is developed due to its ability to capture the volatility by the non-constant of conditional variance while forecasts produced by the ARIMA model are used as a benchmark. Comparison of forecasts produced by GARCH and ARIMA models are based on two performance measures: mean absolute percentage error (MAPE) and root mean square error (RMSE). In this study, analyses are done by using Minitab and E-Views software. In general, it can be concluded that the GARCH model is a potential method for forecasting trading day data of gold prices.

ABSTRAK

Emas digunakan dalam banyak industry dan terkenal sebagai pelaburan yang baik. Walau bagaimanapun, harga emas adalah sentiasa berubah. Model matematik kerap digunakan dalam telahan harga emas. Dalam kajian ini, model Autoregresi Umum Bersyarat Heteroskedastik (GARCH) dan Autoregresi Terkamir Purata Bergerak (ARIMA) akan di bangunkan untuk menghasilkan telahan jangka pendek bagi harga emas. Model GARCH dibangunkan kerana ia boleh menguasai volatility melalui varians bersyarat yang tidak tetap sementara telahan yang dihasilkan oleh model ARIMA digunakan sebagai penanda aras. Perbezaan telahan yang dihasilkan daripada model GARCH dan ARIMA adalah berdasarkan kepada dua ukuran pencapaian: peratus purata ralat mutlak (MAPE) dan punca kuasa dua purata ralat (RMSE). Dalam kajian ini, analisis dijalankan dengan menggunakan sofwer Minitab dan E-views. Secara amnya, dapat disimpulkan bahawa model GARCH adalah kaedah yang boleh digunakan untuk penelahan harga emas.

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LIST OF SYMBOL

t	-	<i>time</i>
σ_t^2	-	conditional variance
p	-	lag order of the autoregressive
q	-	lag order of the moving average
d	-	difference of model
α	-	parameter equation
β	-	parameter equation
$\phi_p(B)$	-	autoregressive operator of order p
$\theta_q(B)$	-	moving average operator of order q
y_t	-	equation in time
μ	-	mean
δ	-	delta
$(1 - B)^d$	-	dth difference
a_t	-	shock at time t
B	-	backward shift operator
μ_t	-	conditional mean
ε_t	-	residual error
l_t	-	likelihood of ε_t .
π	-	pi
S	-	skewness
n	-	number of observations
K	-	kurtosis
\bar{x}	-	sample mean
$\hat{\sigma}^2$	-	variance
Q	-	portmanteau test

- T - number of observations in portmanteau test
- $\log\sigma_t^2$ - log conditional variance
- γ - gamma
- y_{T+l} - forecast of a t time

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CHAPTER 1

INTRODUCTION

1.1 Introduction

Sequences of data points is a time series, typically the measurement at successful times spaced at uniform time intervals. Time series analysis comprises of methods for analyzing time series data in order to get meaningful statistics and other characteristics of the data. Many types of data are collected over time such as stock prices, sales volumes, interest rates, and quality measurements.

Forecasting is a planning tool which helps management to deal with the uncertainty of the future. Forecasts or estimation are made for several days, weeks, months or years ahead using models such as Box-Jenkins, neural network and fuzzy models. In time series forecasting, the model used to forecast future events are based on known past events to predict data points before they are measured. This requirement has maintained a high rate of activity in various research fields dedicated to temporal prediction methodologies. Two important application domains are financial markets and environmental systems. Predicting such systems has been attempted for decades but it remains such a challenging task for a wide array of modeling paradigms. Modeling real world systems is a demanding task where many factors must be taken into account.

Price forecasting has become a very valuable tool in the currently abruptly change of deregulation in gold markets. The companies that trade in gold markets make extensive use of price prediction to see future investments. Price forecasting includes cost forecasting and forecasting the components that make up the price. In competitive markets, prices are less predictable and forecasting prices involves understanding the uncertainties surrounding the drivers of price as well as results of forecasting models.

In gold forecasting, financial data is used to predict the price of gold in market where it is subjected to uncertainties. Today, forecasting of gold price is made by collecting data that describe its current price in market. Then, physically-based mathematical models are used to determine how the price of gold is expected to change in the future.

In financial time series the emphasis has been given on forecasting the volatility or the time-varying conditional variance of the series under studied. Volatility forecasts are important for many financial decisions made by policy makers, option traders and investors. The ARCH class of models, pioneered by Engle in 1982 (Ser-Huang Poon, 2005) and generalized by Bollerslev in 1986 (Ser-Huang Poon, 2005), is by far the most popular class of econometric models for describing a series with time-varying conditional variance.

1.2 Background of the Study

Gold prices are posted on daily trading days, which are weekdays except major holidays. There are consequently about 255 trading days each year. A forecasted price can be produced for every day of the year but gold prices are given only on trading days. The “missing” gold prices can be ignored or the price in weekend is assumed to be the same with the price on Friday. The value of gold price in the market is volatile where the variance is not constant. Volatility is one of the most important concepts in the whole of the finance field. Measuring volatility by the standard deviation variance of returns is often used as a crude measure of the total risk in financial assets. Many values in risk models used for measuring market risk require the forecast of the volatility parameters.

All pricing models for financial options require a volatility estimate or forecast as an input. One of the purposes for studying the forecast of gold prices it to attract more new investment money since such activity is reducing. The recent global turmoil has reaffirmed the significance of gold as a safe and good investment alternative. Other precious metals such as platinum have not been able to take the position of gold, due to its high value and price volatility. In addition to retail

investors, central banks, institutions and pension funds also take large positions in gold and drive its prices.

In the case of volatile market conditions and a weakening currency, people start replacing their dollar investments with gold. This ensures that the investors do not lose their purchasing power by the day. The demand for gold is increasing and this consequently drives the prices of gold to go up. Gold prices are not dependent upon the political or economic conditions. Natural calamities, political disturbances or wartime have also been reported not to affect the value of gold. In other words, the value of gold is always increasing regardless of what is happening around the world.

1.3 Statement of the problem

The recent global turmoil has reaffirmed the significance of gold as a safe and good investment alternative. As the price of gold is highly volatile throughout the time and volatility forecasts are important for many financial decisions, this study will explore the following question:

Setting a Box-Jenkins model as the benchmark model, does GARCH model perform better as a method for forecasting gold prices, which is of high volatility.

1.4 Objectives of the Study

The objectives of the study are stated as follows:

- (i) To explore volatility by using GARCH models.
- (ii) To develop ARCH, GARCH, Box-Jenkins models for gold prices
- (iii) To forecast gold prices using ARCH, GARCH and Box-Jenkins models.
- (iii) To compare the forecasting performances of the ARCH, GARCH and Box-Jenkins models in forecasting gold prices.

1.5 Scope of the Study

The scopes and limitations of this study are as follows. This research will investigate a generalized autoregressive conditional heteroscedastics(GARCH) model and will use the data of gold prices. The results of Box- Jenkins model will be used as a benchmark. The forecasting performances of the models will be evaluated using mean absolute percentage error (MAPE) and root mean square error (RMSE).

1.6 Significance of the Study

Since the gold market is highly volatile, the estimation of the time series model must be able to detect its volatility. This study will determine the precise Box-Jenkins and GARCH models for forecasting the volatility of gold prices. The process will be done with the aid of software. As a result of this study, models and software that can be used to forecast volatile time series can be proposed. The ability to forecast gold price will greatly affect the financial market of gold.

1.7 Summary

The purpose of this study is to conduct a study on handling the volatility of time series data using Generalised autoregressive conditional heteroscedastics (GARCH). For this purpose, the data used is gold prices. Chapter 1 discusses the research framework. It begins with the introduction to gold prices and the background of the study. The objectives, scope and the significance of this study are also presented.

In chapter 2, forecasting and time series are presented. The discussion starts with gold forecasting in general. Development in time series analysis and technical advances of the methodology are also discussed. Chapter 3 begins with a discussion on the types of time series models. In this chapter, the research methodology of the

current study is also described. Chapter 4 presents analyse of the data of the research. Chapter 5 discusses the results of study and chapter 6 is the conclusion.

CHAPTER II

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