RELIABLE GOLD PRICE PREDICTOR

INVENTOR: SITI ROSLINDAR YAZIZ
FACULTY: FACULTY OF INDUSTRIAL SCIENCES & TECHNOLOGY, UNIVERSITI MALAYSIA PAHANG, 26300 GAMBANG, PAHANG, MALAYSIA
EMAIL: roslindar@ump.edu.my
CO-INVENTORS: ROSLINAZAIRIMAH ZAKARIA, MAIZAH HURA AHMAD

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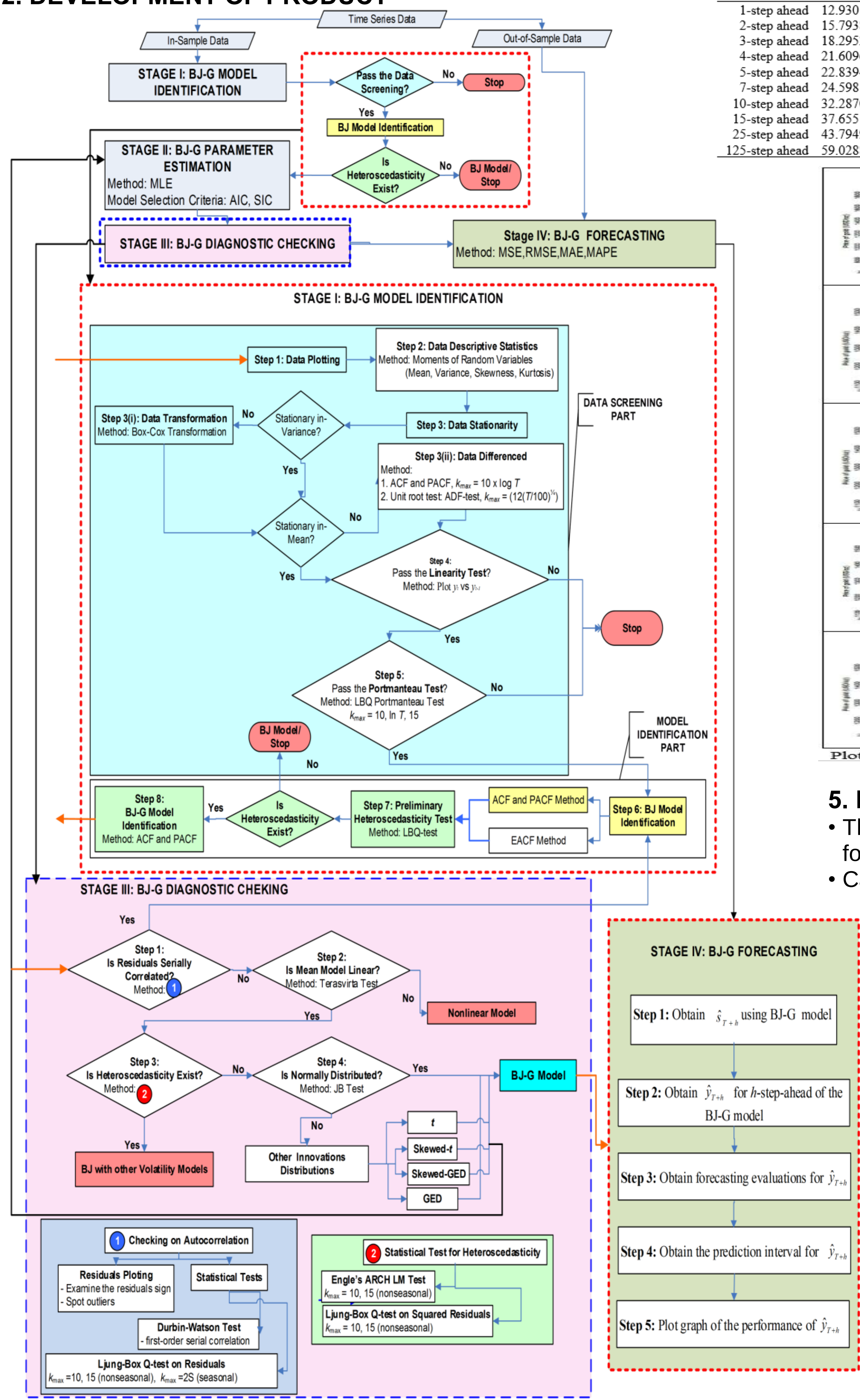
1. PRODUCT DESCRIPTION

- The hybrid Box-Jenkins – GARCH (BJ-G) model has been shown to be a reliable model in forecasting gold price.
- A **comprehensive algorithm using BJ-G** model is proposed to forecast gold price.
- Daily world gold price is used in testing the forecasting performance of the proposed algorithm.

2. DEVELOPMENT OF PRODUCT



3. MATERIALS/DATA

Duration	Number of Data	In-Sample data	Out-of-Sample Data
22/12/2008 - 17/12/2013	1250	22/12/2008 - 24/6/2013	25/6/2013-17/12/2013

Model: ARIMA(0,1,0) - GARCH(1,1) using *t* innovations

$$\hat{s}_{T+h} = 0.0007 + \hat{a}_{T+h}$$

$$\hat{a}_{T+h} = \hat{\sigma}_{T+h}\,\hat{\varepsilon}_{T+h}$$

$$\hat{\sigma}^2_{T+h} = 2.50\times10^{-6} + 0.0345\hat{a}^2_T + 0.9474\hat{\sigma}^2_T \text{ and } \hat{\varepsilon}_{T+h} \sim t^{*}_{4.81}$$

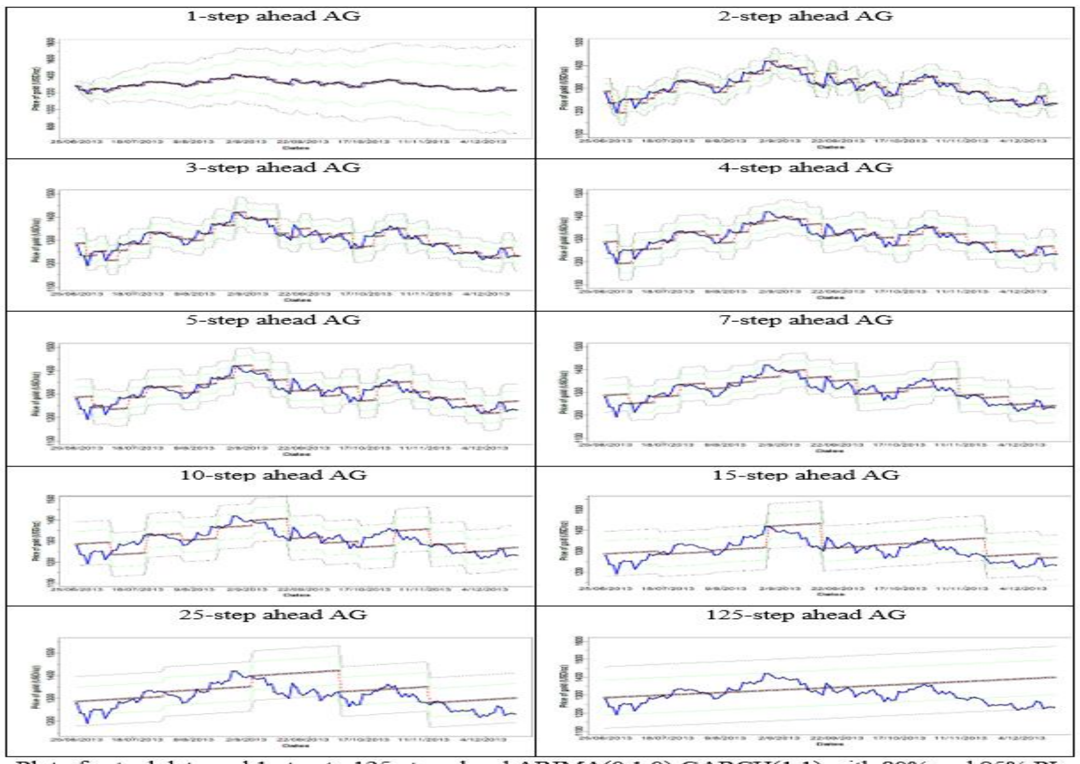
4. PRODUCT CHARACTERISATION

Table 1: Forecast evaluation with prediction interval for the considered forecast horizon

Forecast Horizon	Forecast Evaluation			Number of Data Outside Prediction Interval	
	MAE	RMSE	MAPE	80%	95%
1-step ahead	12.9301	17.8764	0.9956	1	0
2-step ahead	15.7938	21.3297	1.2132	20	1
3-step ahead	18.2953	24.4472	1.4098	25	2
4-step ahead	21.6096	28.3663	1.6716	20	1
5-step ahead	22.8394	28.9304	1.7647	22	1
7-step ahead	24.5981	30.1233	1.8941	17	2
10-step ahead	32.2870	40.1970	2.4859	15	0
15-step ahead	37.6551	46.2091	2.9068	21	3
25-step ahead	43.7949	53.0116	3.3840	36	4
125-step ahead	59.0288	76.2116	4.6135	23	2

Table 2: Actual price and the 10-step ahead forecast price using ARIMA-GARCH

Date	Actual Price (USD/Oz)	Forecast Price (USD/Oz)	Prediction Interval 80%	Prediction Interval 95%
25 June 2013	1279.00	1287.62	(1228.12,1347.12)	(1183.37,1391.87)
26 June 2013	1236.25	1288.49	(1228.99,1347.99)	(1184.24,1392.74)
27 June 2013	1232.75	1289.36	(1229.86,1348.86)	(1185.11,1393.61)
28 June 2013	**1192.00**	1290.23	(1230.74,1349.73)	(1185.99,1394.48)
1 July 2013	1242.75	1291.11	(1231.61,1350.61)	(1186.86,1395.36)
2 July 2013	**1252.50**	1291.98	(1232.48,1351.48)	(1187.73,1396.23)
3 July 2013	1292.85	1188.60	(1233.36,1352.35)	(1188.60,1397.10)
4 July 2013	1293.73	1189.48	(1234.23,1353.23)	(1189.48,1397.98)
5 July 2013	1294.46	1190.35	(1235.11,1354.10)	(1190.35,1398.85)
8 July 2013	1295.48	1191.23	(1235.98,1354.98)	(1191.23,1399.73)



Plot of actual data and 1-step to 125-step ahead ARIMA(0,1,0)-GARCH(1,1) with 80% and 95% PIs

5. PRODUCT OUTCOME

- The proposed algorithm of BJ-G provides a well-structured procedure in forecasting gold price.
- Case study: The forecasting results are good up to 10-days ahead.

6. POTENTIAL MARKET

- Develop **web page** and interactive software (**apps**) in forecasting gold price.
- Gold investors and companies that involve in trading gold (Public Gold, Ar-Rahnu system).
- Applicable for any **univariate highly volatile time series** (i.e. stock price, unit trust, latex price, palm oil prices, commodity price, etc.) at different frequency (i.e. weekly, monthly, quarterly, yearly).

7. MARKET DEMAND

GOLD DEMAND (IN TONNES)		
TOP NATIONS	2017	2016
China	953.3	915
India	726.9	666.1
US	161.5	211.8
Germany	116.7	121.1
Turkey	93.6	70.1
Thailand	75.4	81.5
Iran	63.7	36.1
Indonesia	58.8	59.5
S Arabia	55.6	60.2
Vietnam	53.9	58.3
WORLD TOTAL	3164.6	3102.2

Source : World Gold Council

9. PATENT/COPYRIGHT

1. Patent of "Forecasting Gold Price based on Box-Jenkins – GARCH's (BJ-G) Algorithms" is submitted on March 2018 (IP2018XXXX)
2. Copyright of "Forecasting Malaysia Gold Price using Hybrid ARIMA with Symmetric GARCH Modeling (Backward ARIMA-GARCH in Forecasting Gold Price for Malaysia Market)" 2015.

10. AWARDS

1. Gold Medal, in CITREX 2018 for of "Forecasting Gold Price based on Box-Jenkins – GARCH's Algorithms".
2. Gold Medal, in CITREX 2015 for "Forecasting Malaysia Gold Price using Hybrid ARIMA with Symmetric GARCH Modeling".
3. Gold Medal, in CITREX 2014 for "Modeling Gold Price using Hybrid of Box-Jenkins - GARCH"

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8. PUBLICATIONS

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2. **Yaziz, S. R.**, Azizan, N. A., Ahmad, M. H. and Zakaria, R. "Modeling Gold Price using ARIMA – TGARCH", Applied Mathematical Sciences (2016), 10(28), 1391-1402. (Scopus Indexed)
3. **Yaziz, S.R.**, Azizan, N.A., Ahmad, M.H., Zakaria, R., Agrawal, M. and Boland, J. "Preliminary Analysis on Hybrid Box-Jenkins – GARCH Modeling in Forecasting Gold Price", AIP Conference Proceedings 1643 (2015), p289-297. (ISI Indexed)
4. Ahmad, M. H, Pung, Y. P., **Yaziz, S. R** and Miswan, N. H." Forecasting Malaysian Gold Using a Hybrid of ARIMA and GJR-GARCH Models", Applied Mathematical Sciences, Vol. 9 (2015), no. 30, 1491 – 1501. (Scopus Indexed)
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6. **Yaziz, S.R.**, Azizan, N.A., Ahmad, M.H., Zakaria, R., Agrawal, M. and Boland, J. "Innovations in the ARIMA-GARCH modeling in forecasting gold price", ICMSA2014, 14-16 October 2014, Terengganu. e-ISBN 978-967-0524-67-2, p650-658.
7. **Yaziz, S.R.**, Azizan, N.A., Zakaria, R. and Ahmad, M. H. "Modeling Malaysia Gold Price using hybrid of ARIMA and Symmetric GARCH-type models", ICCEMS2014 (Indexed by ProQuest)
8. **Yaziz, S. R.**, Azizan, N. A., Zakaria, R. and Ahmad, M. H. "The performance of hybrid ARIMA-GARCH modeling in forecasting gold price". MODSIM2013. Adelaide. Australia. p1201-1207. (ISI Indexed)