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MATHEMATICAL MODELLING OF RISK IN PORTFOLIO OPTIMIZATION WITH MEAN-EXTENDED GINI APPROACH

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Abstract

Investors wish to minimize the risk and achieve the target rate of return in their investment. The mean-extended Gini model has been proposed in portfolio optimization to minimize the portfolio risk. The mean is used as the expected return of the investors and extended Gini is used as risk measure. The objective function of this model is to minimize the portfolio extended Gini. The objective of this paper is to construct the optimal portfolio by employing the mean-extended Gini model in Malaysia stock market. The data of this study consists of weekly return of 20 stocks that listed in Malaysia stock market. The mean-extended Gini model is solved with LINGO software in this study. The results of this study show that the composition of stocks in the optimal portfolio is different. Furthermore, the mean-extended Gini optimal portfolio will give the mean return at 0.001 and portfolio risk at 0.0201. This study is significant because the investors can minimize

the portfolio risk and achieve the target rate of return in Malaysia stock market with the mean-extended Gini model.

Keywords: Mean Return, Risk, Optimal Portfolio, Portfolio Composition, LINGO Software

1. Introduction

Investors wish to find the trade-off between the risk and return in their investment of assets. The investors desire to minimize the investment risk and maximize their return. Shalit and Yitzhaki [1] has introduced the extended Gini as a measure of risk. The mean-extended Gini (MEG) approach has been studied by the past researchers [2-5]. The mean-extended Gini model is an optimization model that used to construct the optimal portfolio. The objective of this paper is to construct the optimal portfolio by employing the mean-extended Gini model in Malaysia stock market. The rest of the paper is structured as follows. The next section describes the materials and methods applied in this study. Section 3 discusses about the empirical results of this study. Section 4 concludes the paper.

2. Material and Methods

2.1 Data

The data of this study comprises weekly return of 20 stocks that listed in Malaysia stock market. The period of this study covers from July 2011 until June 2016. Table 1 shows the name list of 20 stocks in this study with abbreviation.

Table 1: Name List of 20 Stocks with Abbreviation

Abbreviation	Name of Stocks
ASUPREM	Astral Supreme Berhad
AZRB	Ahmad Zaki Resources Berhad
BENALEC	Benalec Holdings Berhad
BPURI	Bina Puri Holdings Bhd

CRESBLD	Crest Builder Holdings Berhad
EKOVEST	Ekovest Berhad
FAJAR	Fajarbaru Builder Group Bhd
GADANG	Gadang Holdings Bhd
GAMUDA	Gamuda Berhad
HSL	Hock Seng Lee Berhad
IJM	IJM Corporation Berhad
JAKS	Jaks Resources Berhad
KEURO	Kumpulan Europlus Berhad
KIMLUN	Kimlun Corporation Berhad
MITRA	Mitrajaya Holdings Berhad
MUDAJYA	Mudajaya Group Berhad
MUHIBAH	Muhibbah Engineering (M) Bhd
PRTASCO	Protasco Berhad
PUNCAK	Puncak Niaga Holdings Berhad
WCT	WCT Holdings Berhad

2.2 Mean-Extended Gini Model

Figure 1 displays the construction process of the optimal portfolio with mean-extended Gini model.

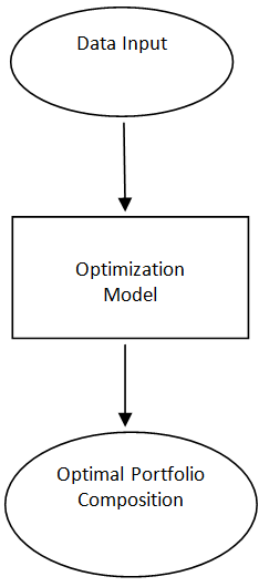

Figure 1. Construction Process of the Optimal Portfolio with Mean-Extended Gini Model

The mathematical model of mean-extended Gini (MEG) model is formulated as follows:

$$\text{Minimize } z = -\upsilon \sum_{i=1}^{n} w_i \operatorname{cov}\{x_i, [1 - F_p(p)]^{\upsilon - 1}\} \quad (1)$$

Subject to

$$E(p) = \sum_{i=1}^{n} w_i E(x_i) \quad (2)$$

$$\sum_{i=1}^{n} w_i = 1 \quad (3)$$

$$w_i \geq 0, i = 1, ..., n \quad (4)$$

where υ is a parameter determining the relative weight attributed to various portions of the probability distribution, $F_p(p)$ is the cumulative probability distribution of the portfolio returns p, w_i is the weight invested in asset i, x_i is the return of asset i. Objective function (1) minimizes the portfolio extended Gini. Constraint (2) implies that the investors can achieve the expected rate of return. Constraint (3) implies that the sum of weights of the assets equals to one. Constraint (4) implies that the weights of all the assets are positive.

The optimal portfolio is constructed by employing the mean-extended Gini model with the parameter, υ is set as 4 in this study. Besides that, the optimal portfolio composition for each stock will be generated in this study. The mean return and risk of the optimal portfolio will also be presented in this paper. The mean-extended Gini model is solved with LINGO software in this study.

3. Results and Discussions

Table 2 presents the stock selection of the mean-extended Gini (MEG) model.

Table 2: Stock Selection with Mean-Extended Gini Model

Stocks	Weights (%)
ASUPREM	0.96
AZRB	0.00
BENALEC	0.87

BPURI	0.00
CRESBLD	6.29
EKOVEST	13.88
FAJAR	0.00
GADANG	6.63
GAMUDA	30.52
HSL	13.14
IJM	9.73
JAKS	0.00
KEURO	6.55
KIMLUN	0.00
MITRA	0.00
MUDAJYA	0.00
MUHIBAH	0.00
PRTASCO	11.44
PUNCAK	0.00
WCT	0.00

As shown in Table 2, those stocks with positive values indicate that they are selected by the MEG model. The components of the optimal portfolio are ASUPREM, BENALEC, CRESBLD, EKOVEST, GADANG, GAMUDA, HSL, IJM, KEURO and PRTASCO. AZRB, BPURI, FAJAR, JAKS, KIMLUN, MITRA, MUDAJYA, MUHIBAH, PUNCAK and WCT are not invested in the optimal portfolio of the mean-extended Gini model because these stocks give the value 0.00%. Figure 2 displays the optimal portfolio composition of MEG model.

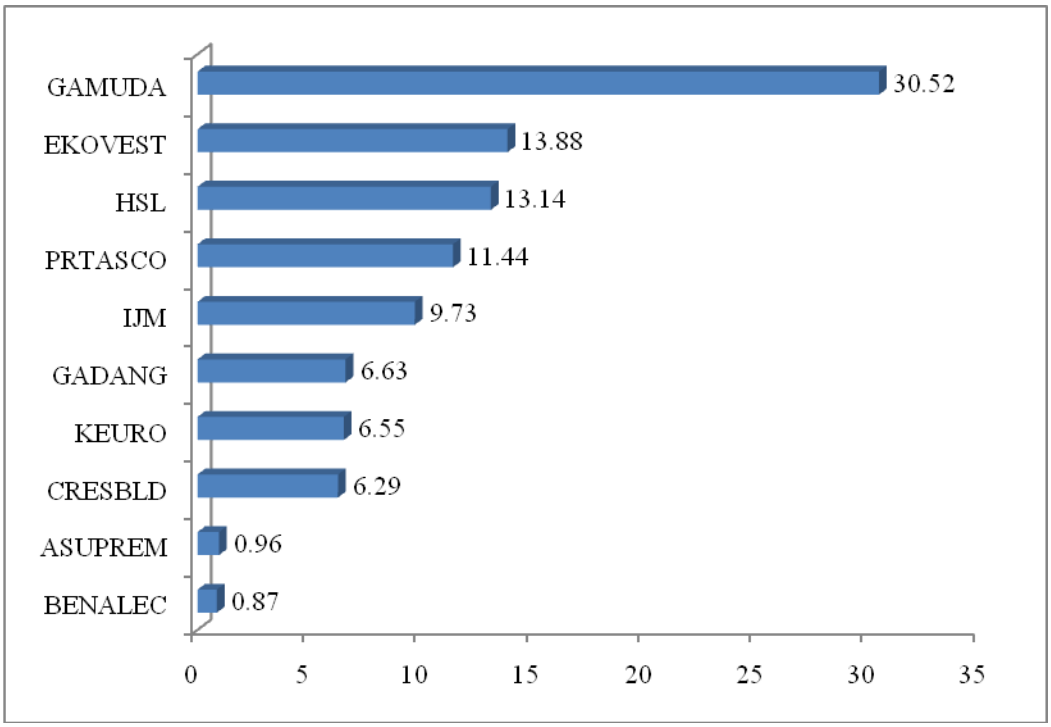

Figure 2: Optimal Portfolio Composition of MEG Model

As shown in Figure 2, based on the investment fund, the optimal portfolio consists of GAMUDA (30.52%), EKOVEST (13.88%), HSL (13.14%), PRTASCO (11.44%), IJM (9.73%), GADANG (6.63%), KEURO (6.55%), CRESBLD (6.29%), ASUPREM (0.96%) and BENALEC (0.87%). GAMUDA is the most dominant stock in the optimal portfolio whereas BENALEC is the smallest component in the optimal portfolio. Table 3 presents the portfolio mean return and risk of the mean-extended Gini model.

Table 3: Optimal Portfolio Mean Return and Risk of the Mean-Extended Gini Model

Optimal Portfolio	MEG
Portfolio Mean Return	0.0010
Portfolio Risk	0.0201

As reported in Table 3, the optimal portfolio of the mean-extended Gini model gives the portfolio mean return at 0.001 and portfolio risk at 0.0201. It indicates that the investors can achieve the target return at 0.001 with the minimum risk at 0.0201.

4. Conclusions

This paper discusses the mathematical modelling of risk for the investment in Malaysia stock market with the mean-extended Gini model. The optimal portfolio is constructed by employing the mean-extended Gini model in this study. The results of this study indicate that the mean-extended Gini model generates different composition of stocks in the optimal portfolio. Furthermore, the investors can get the target rate of return with minimum risk in Malaysia stock market. The future research of this study should be extended to the stocks in other countries besides Malaysia.

References

[1] Shalit, H. and Yitzhaki, S., 1984. Mean-Gini, portfolio theory, and the pricing of risky assets. Journal of Finance, 39: 1449–1468.

[2] Butterworth, D. and Holmes, P., 2005. The hedging effectiveness of U.K. stock index futures contracts using an Extended Mean Gini approach: Evidence for the FTSE 100 and FTSE mid250 contracts. Multinational Finance Journal, 9(3-4): 131-160.

[3] Shalit, H. and Greenberg, D., 2013. Hedging with stock index options: A Mean-Extended Gini approach. Journal of Mathematical Finance, 3: 119-129.

[4] Shalit, H. and Yitzhaki, S., 1989. Evaluating the Mean-Gini approach to portfolio selection. The International Journal of Finance, 1(2): 15-31.

[5] Shalit, H. and Yitzhaki, S., 2005. The Mean-Gini efficient frontier. The Journal of Financial Research, 28: 59–75.