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PLANNING REVIEW ARTICLES

Tittle	. 'MONTE CARLO' SIMULATION PREDICTING ON THE MOVEMENT OF INVESTMENTS – DURING THE COVID PANDEMIC IN INDONESIA

REVIEW ARTICLES

Please give examination on each of the section on table below

General Comments	Overall is good, but need some addition on here and there, especially within introduction section
Abstract	Good
Introduction	Still lacking some arguments regarding the urgency of using the designated model instead of using another model that exist. And the purpose of the study is still vague
Method	Could be better if there is comparison with another model
Result & Discussion	Good
Conclusion & Recommendation	Since the purpose is still vague, the conclusion is also affected by it
References	

ASSESTMENT SUMMARY
(please check the boxes)

ASSESSMENT INDICATORS	Very Good	Good	Fair	Poor
Originality	☐	☐	☒	☐
Scholarly	☒	☐	☐	☐
Technical Quality	☐	☒	☐	☐
Appearance	☐	☐	☒	☐
Depth of the Research	☐	☐	☒	☐

ASSESTMENT SUMMARY

Reviewer Recommendation

☒ Accepted with minor revisions
☐ Accepted with major revisions
☐ Suggested to sent it to other journals such as:
☐ Rejected with the reason:

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'Monte Carlo' Simulation' Predicting on the Movement of Investments – During the Covid Pandemic in Indonesia

Info Article

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Keywords:
rate of return; investments; ~~Monte Carlo simulation~~MCS; probability distribution; Indonesia; covid-19.

Abstract

No one knows exactly what will happen in the future, so it draws the attention of scholars to predict it and, of course, it makes all considerations to expect it. The movement of the net asset value (NAV) of mutual fund products (MFP) whether high or low in the Covid-19 pandemic conditions in 2020. ~~By using the Monte Carlo simulation in predicting the rate of return on mutual fund investments (MFI) provides a choice of the average mutual fund return (MFR) request required by investors~~. With the support of the Monte Carlo Simulation (MCS), this study intends to predict the rate of return on mutual fund investment (MFI) providing a choice of the average demand for return on mutual funds (MFR) that investors need. Analysis of the prediction of NAV movements and the rate of return on MFI in 55 MFP with a trial frequency of 48 times, we get an estimate of the average demand for MFR of 37 out of 100 cumulative numbers of probability distributions. The result is 77.08 percent, and an estimated average MFR in Indonesia during the 2020 Covid-19, the simulation got was IDR 421,954. The contribution resulted in a vital discovery of NAV in Indonesia in response to the economic recession affected by Covid-19. The weaknesses of this study also become implications, evaluations, and various developments for the escalation of subsequent findings.

Prediksi Simulasi 'Monte Carlo' untuk Pergerakan Investasi – Selama Pandemi Covid di Indonesia

Abstrak

Tidak ada yang tahu persis kejadian di masa depan, sehingga menyedot perhatian dari para cendikiawan untuk memprediksi itu dan tentu menjadi segala pertimbangan untuk mengantisipasinya. Pergerakan nilai aset bersih (NAV) produk reksa dana (MFP) baik tinggi maupun rendah dalam kondisi pandemi Covid-19 tahun 2020. Dengan ~~menggunakan~~

~~simulasi~~ dukungan Simulasi-Monte Carlo (MCS),~~dalam memprediksi tingkat pengembalian investasi reksa dana (MFI) memberikan pilihan rata-rata permintaan pengembalian reksa dana (MFR) yang dibutuhkan investor.~~ studi ini bermaksud untuk memprediksi tingkat pengembalian investasi reksa dana (MFI) memberikan pilihan rata-rata permintaan pengembalian reksa dana (MFR) yang dibutuhkan investor. *Analisis prediksi pergerakan NAV dan tingkat pengembalian MFI di 55 MFP dengan frekuensi percobaan 48 kali, kami mendapatkan perkiraan rata-rata permintaan MFR 37 dari 100 jumlah kumulatif distribusi probabilitas. Hasilnya 77,08 persen, dan perkiraan rata-rata MFR di Indonesia selama Covid-19 2020, simulasi yang didapat adalah Rp421.954.* Kontribusi menghasilkan penemuan vital terhadap NAV di Indonesia sebagai respon dari resesi ekonomi yang terdampak oleh Covid-19. Kelemahan di studi ini sekaligus menjadi implikasi , evaluasi, dan perkembangan variatif bagi eskalasi penemuan berikutnya.

JEL Classification: G31, D25, C15, C25

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INTRODUCTION

Nowadays, many mutual fund investors wish to get high returns by using various sophisticated techniques and methods (Azis et al., 2021). In this research, the simulation method approach has been applied Lee et al. (2014) to evaluate the trend of changes in the NAV of mutual funds, then determine the weights in the valuation function to select the right equity mutual fund (EMF) portfolio that can maximize of MFI return. Meanwhile, the contribution and special urgency in this research is to develop this method through MCS in conditions of economic recession because of global shocks, such as Covid-19. In addition, Lee et al. (2014) apply a GEP-based program, where this technique has weaknesses and needs to be improved by focusing on one period through a trend each month.

Comment [A1]: What is the urgency of doing this research, especially using the base model fro lee et al (2014)?

~~In mutual funds, the investment manager manages the funds placed in securities and realizes profits or losses, as well as receives dividends or interest, which are recorded in NAV. NAV is the amount of publicly managed funds collected in a mutual fund entrusted to an investment company manager (Mohanti & Priyan, 2018). Since being introduced in 1976, mutual funds have always progressed well, as can see from the total NAV, the number of mutual funds, and investment units that continued to grow throughout the year. The participation unit itself has a definition as a unit of investment ownership in mutual funds.~~

~~The development of the number of mutual funds over the last 5 years, namely from 2015 to 2020, has experienced a significant increase where the number of mutual funds in 2015 was 1091 and in 2020 it has reached 2219 mutual funds. NAV generated by many mutual funds also increased from year to year. In 2015 the NAV of mutual funds was IDR 271,969.00 billion, in 2016 it was IDR 338,749.81 billion, in 2017 it was IDR 457,506.57 billion, in 2018 it was IDR 505,390.30 billion, in 2019 it was IDR~~

~~542,196.36 billion, and in 2020 it continued to increase to reach IDR 573,542.15 billion. Meanwhile, mutual fund participation units in 2015 182,980,302,630.53 skyrocketed to 435,143,042,392.00 in 2020. This shows that the public's attractiveness to mutual funds is quite high because mutual funds can provide greater returns than the market if investors choose mutual funds correctly according to their objectives the investment~~.

It tasked investment managers with managing mutual funds, where the placement of securities in mutual funds serves to realize and predict the amount of loss or gain. In addition, an important purpose is to receive interest or dividends that are recorded in the NAV. As extra information, NAV is the amount of funds managed by the public whose ownership is from mutual fund collection and entrusted to investment company managers (Mohanti & Priyan, 2018). Since its inception in 1976, mutual funds have grown rapidly, although there have been difficulties. However, if you look at the current total NAV, the amount of investment and participation units is increasing from time to time. They define unit participation as several investment holdings in a mutual fund.

Muhammad et al. (2021) and Rapini et al. (2021) have evaluated the development of mutual funds in Indonesia during 2015-2020. Within these 5 periods, the number has increased explicitly. In 2015, it was 1,091, but skyrocketed to 2,219 in the last 2020. Interestingly, NAV, which is a product of mutual funds, also increased. Especially in 2015, the NAV of mutual funds generated a fantastic value of IDR 271,969 billion and continued to increase until its peak in 2020 amounted to IDR 573,542.15 billion. The fund investment confirmed this 2015, a unit which also skyrocketed for 2020 at the level of IDR 435,143,042,392. Whereas in 2015, the value was only around IDR 182,980,302,630.53. From this picture, it implies that the attractiveness of customers to mutual funds is getting more enthusiastic. The mutual fund market has provided yields that are higher if investors are more careful about choosing investment decisions based on their goals.

The type of mutual fund studied is EMF with various considerations and EMF have volatility (Livingston et al. 2019) higher than other types of mutual funds. The achievement of optimal mutual funds investment return in this study using the ~~Monte Carlo simulation~~MCS~~ method~~. Many researchers have used the ~~Monte Carlo~~MCS approach (Amédée-Manesme et al., 2013; Gimpelevich, 2011; Piranfar & Masood, 2012; Li et al., 2020), but the objectivity of this study is different. This objectivity research is to emphasize the selection of maximum MFI returns as showed by changes in the monthly NAV of MFP managed by investment managers. ~~Monte Carlo simulation~~The MCS for much other company management has used ~~Monte Carlo simulation~~MCS as a tool for deciding (Chou, 2011; Ng et al., 2007; León & Vaello-Sebastià, 2010; Casari, 2008; Castañeda & Reus, 2019; Nadarajah & Secomandi, 2017).

We conducted this research to achieve a maximum return decision at a certain point after going through the experimental frequency. Tüzüntürk et al. (2015) emphasized that the basic difference between this forecast and the others is that the three types include time and nature, the presence or absence of random variables, and based on random variables. Referring to the first provision, there are two simulations (dynamic and static). Dynamic simulation is a model that is influenced by the time of

Comment [A2]: Beside the usage of monte ca method from previous studies, what is the distinction from this model with other forecastin model that exist?

Comment [A3]: Is there any predictions on wh you will achieve in the results of this study which related with you research goal?

observation. This simulation is good from static simulation, which applies to describe a certain process or system that is not visible by time and events at a certain time. MCS is very suitable for static simulation. The second provision refers to the presence or absence of random variables. MCS is more prominent for simulations based on probabilistic or stochastic basis, which can represent certain events that contain elements of uncertainty (Takagi et al., 2018). Then, MCS is irrelevant to circumstances that are certain to occur (normal). Third, based on random variables such as mixed, discrete, continuous, and empirical simulations, SCM highlights conditions that can simulated with empirical data as a basis (Balogh et al., 2013). Mixed simulation only predicts a process that has discrete system components. Discrete simulation focuses on discrete (systematic) parts and continuous simulation, which highlights any changes in the state of the variables. In a continuous simulation, it has the potential to add or subtract components as needed (inconsistent).

Another important review comes from Davies et al. (2014). Of the three criteria, only one stood out and met the criteria, namely MCS. This model can represent object, time series, and causal. It aimed the case at the premise, when the forecast related to changes in other variables over a certain period. Causality interprets a high correlation and concludes an event is not completely random.

Until now, multivariate regression such as MCS is often used to evaluate causality. Because of its multivariate form, the test is workable to apply with MCS such as the Chi test or partial test (eg Vasu, 1978; Roy & Hobert, 2019). Thus, our consideration is appropriate with the application of SCM referring to these three criteria. This is certainly under case studies in unexpected situations such as disasters (Covid-19) and supporting through mature empirical probability projections.

We summarize the structure of the paper into four parts. The background, phenomena, and supporting literature presented in the introduction (first session). For the second session, the data and method illustrate the study technique. In the third session, there are main findings and discussion. The conclusion refers to the empirical results in the fourth session.

Review of Literature

~~A mutual fund portfolio is a grouping of financial assets such as stocks, bonds, and cash equivalents, and their fund counterparts, including exchange-traded mutual funds and closed-end funds (Tjahjono et al., 2003). EMF is a mutual fund that invests at least 80 percent of its managed portfolio into equity securities, while 20 percent is invested in other mutual fund instruments (Yu & Huang, 2013). Equity stock securities provide higher yield potential as capital gains through the growth of stock prices. Stock securities also provide other results as dividends. Stock mutual funds (SMF) provide the highest level of return and risk compared to other types of mutual funds. Larger equity stocks have higher returns because of higher risk exposure (Driessen et al., 2012).~~

~~The purpose of investing in EMF is to be free from the hassle of investing in equity stocks such as managing stocks, choosing the right stocks, limited time to control stock performance from time to time, wanting to get dividends, investors~~

~~wanting to get capital gains on such large stock price increases (Voynarenko et al., 2021). Returns got from EMF investments will be more optimal if carried out in a long-term period.~~

~~Simulation is a major change in operations research topics. Simulation offers an alternative to finding solutions to complex problems that analytical models (Chou, 2011; Wee et al., 2020) cannot solve as most other researchers have done with different variations of objectivity. Simulation has an understanding as a method for carrying out experiments with models of proper systems. Simulating means duplicating the features, shapes, and characteristics of the proper system. The basic idea of simulation is to use multiple devices to imitate proper systems to study and interpret the properties, behavior, and operations characteristics (Melouk et al., 2014).~~

Tjahjono et al. (2003) define a mutual fund portfolio as a grouping of financial assets such as partner funds, cash, bonds, and stocks. The four elements include mutual funds that are traded in closed fund markets and stock exchanges. On the one hand, Yu & Huang (2013) highlight EMF, which is defined as a mutual fund as an investment activity in a portfolio (at least 80 percent) collected by equity securities. Meanwhile, the remaining 20 percent invested through other mutual fund instruments. These securities provide potential shares that are large and are capital gains with the support of stock price growth. Securities from shares also have the potential to provide other results, such as dividends. Equity mutual funds, or SMF for short, have contributed to the highest risk and rate of return compared to other mutual funds. With high equity shares, guaranteeing returns and certainty that is not too risky because of promising exposure (Driessen et al., 2012).

The main purpose of capitalization in EMF is the ease of investing in equity shares. These freedoms include dividends, control over stock performance, getting capital gains, stock accuracy, stock management, and stock period. Voynarenko et al. (2021) project that an enormous increase in stock prices will have short-term and long-term effects. The return on EMF investment, of course, will run optimally if it continues to be evaluated gradually.

Wee et al. (2020) and Chou (2011) have offered significant topics in operations research. With the support of comprehensive simulations, alternative solutions emerge to answer complex problems. In fact, in the past, analytical models could not solve what most academics have explored, although with varying degrees of objectivity. The importance of simulation is useful to support the relevant methods in an experiment and it applies this through the right systems and models. Melouk et al. (2014) explain that the right form, system characteristics, and features become the basic foundation for transforming ideas into several devices. With the adoption and adaptation of reliable systems, it interprets and learning about the operating characteristics and behavior properties.

~~We can use simulations besides operational research methods, especially in financial operations used to solve stochastic problems (Chou, 2011; Ng, 2007; Casari, 2008; Castañeda & Reus, 2009; Nadarajah & Secomandi, 2017; Yu & Huang, 2013; Buchner, 2015; Rossi & Spazzini, 2010; Chen & Huang, 2008; Tompkins & D'Ecclesia, 2006; Chen & Huang, 2012; Vagnani, 2009; Acebes et al., 2015; Raggi & Bordignon,~~

~~2006; Melouk et al., 2014; Wee et al., 2020). Simulation can represent dynamic behavior (Casari, 2008; Yu & Huang, 2013; Lai, 2018; Neaime, 2015; Ferrer et al., 2016; Tompkins & D'Ecclesia, 2006; Ghodrati & Zahiri, 2014) from a system into a model, this simulation aims to evaluate a system model numerically (Casari, 2008; Nadarajah & Secomandi, 2017; Yu & Huang, 2013; Driessen et al., 2012; Rossi & Spazzini, 2010; Lai, 2018; Sanford & Martin, 2005; Denault & Simonato, 2017; Chen & Huang, 2008; Ghodrati & Zahiri, 2014; Chen & Huang, 2012; Raggi & Bordignon, 2006; Yang, 2005; Melouk et al., 2014; Li et al., 2020; Wi et al., 2020; Kang et al., 2012) and data is collected to estimate the true model characteristics and the simulation approach supports sensitive analysis by allowing rapid changes to the model logic and data. Simulation is designing a logical model (Lai, 2018) mathematics (Chou, 2011; Nadarajah & Secomandi, 2017; Rossi & Spazzini, 2010; Vagnani, 2009; Melouk et al., 2014) of an actual system and experimenting with models built on computers (Goda, 2017).~~

~~Another definition of simulation is a technique of imitating operations or processes that occur in a system with the help of computer devices (Nadarajah & Secomandi, 2017; Neaime, 2015) and based on certain assumptions so that the system can be studied scientifically. Different objectives and criteria may have different measurement scales. Solving this problem means designing or selecting the best answer among the options. Multi-criteria decision-making is a choice, which relates to the decision-making process in which there are differences and are inconsistent.~~

Stochastic problems for operational research reviewed by Castaneda & Reus (2009), Chou, 2011, Yu & Huang (2013), Casari (2008), Nadarajah & Secomandi (2017), Rossi & Spazzini (2010), Chen & Huang (2008), Tompkins & D'Ecclesia (2006), Ng (2007), Vagnani (2009), Acebes et al. (2015), Buchner (2015), Raggi & Bordignon (2006), Melouk et al. (2014), Wee et al. (2020), and Chen & Huang (2012) where there are differences from several other methods that are also applied to financial operations. In that way, the simulation also represents dynamic behavior in a system into a new model and aims to identify the system numerically (Yu & Huang, 2013; Ferrer et al., 2016, Casari, 2008; Neaime, 2015; Lai, 2018; Ghodrati & Zahiri, 2014; Tompkins & D'Ecclesia, 2006).

As quoted from Denault & Simonato (2017), Li et al. (2020), Melouk et al. (2014), Sanford & Martin (2005), Nadarajah & Secomandi (2017), Raggi & Bordignon (2006), Kang et al. (2012), Chen & Huang (2012), Casari (2008), Yu & Huang (2013), Driessen et al. (2012), Rossi & Spazzini (2010), Lai (2018), Chen & Huang (2008), Ghodrati & Zahiri (2014), Yang (2005), and Wi et al. (2020) that the data that has been collected is followed by a series of investigations in predicting the characteristics of a more realistic model. The useful simulation technique supports sensitivity that enables fast dynamics throughout the data and model logic. It can actually experiment with logical models designed with mathematical simulations of the system with through models designed in computer software (Goda, 2017; Melouk et al., 2014; Chou, 2011; Vagnani, 2009; Lai, 2018; Rossi & Spazzini, 2010; Nadarajah & Secomandi, 2017).

An actual process also characterized a simulation or imitating the operation of a system with the support of a particular device. Referring to limited assumptions, the system reaches scientifically and rigorously studies (Neaime, 2015; Nadarajah &

Secomandi, 2017). Various criteria and expectations, allowing for different scales or dimensions. We expect his presence to solve the problem by choosing the best option and designing alternative options. From here, decision making is a constructive authority that applies to the final decision, even though it begins with differences and debates in the consistency of answers.

METHODOLOGY AND DATA

In this case, it limited the study to the period of the Covid-19 in Indonesia. So we carried the review in this study out 12 months from the beginning of the pandemic period (March 2020 to February 2021). With indications that at the beginning of the Covid-19 pandemic, the capital market experienced significant fluctuations (Haryanto, 2016; Wong et al., 2021; Nugroho & Stoffers). Since the pandemic, the Composite Stock Price Index could not return to its original position, which is around the level of 5,942 in March 2020. The sharpest decline occurred in April, where the index was at its lowest level throughout the year at 3,937 (Safitri, 2020). Therefore, this research is focused on the pandemic.

The population in this study is EMF that has publicly published in the Indonesia Financial Services Authority (OJK) and active during the research period March 2020 to February 2021, totaling 273 of EMF. Researchers chose this period because in the 2020 period Indonesia experienced an economic crisis triggered by the Covid-19 pandemic so that we can use this as a research reference (for example: Azis et al., 2021; Rahmayani & Oktavilia, 2021).

The secondary data used in this study got by using the documentation method on data from collecting, recording, and reviewing documents on financial data during the research period (March 2020 to February 2021). It carried data collection out through: Pasardana.com website to get the NAV and a list of research samples.

Table 1. Sampling Criteria of EMF

Sampling Criteria	Number of Samples
Conventional SMF registered with OJK and actively operating during the research period	273
EMF with managed funds below IDR 500 billion	(215)
SMF that do not have complete data during the study period	(3)
EMF were selected as samples based on the Bareksa.com site	55

(*Source:* Author's)

All simulations require good planning and organization (Geni et al., 2018). The following steps must be taken by managers to carry out the simulation process are: (1) Determine the probability distribution for the important variables, (2) Calculate the cumulative distribution for each variable in step 1, (3) Determine intervals of random numbers for each variable, (4) Generate random numbers, and (5) State a series of simulations from several experiments.

RESULT AND DISCUSSION

The movement of the average NAV of 55 MFP for the observation period starting from January to December 2020 is relatively stable, there are only a few MFP that have very high NAV, so there is a very high gap between the NAV of MFP in Indonesia.

Changes in the monthly NAV movement of MFP impact the MFI return. Changes in the notable increase in NAV mean a notable change in the investment return of each investor. In Figure 1, the graph of the return movement of 55 MFP that became the sample of this study was relatively stable during the Covid-19 that hit nationally and internationally.

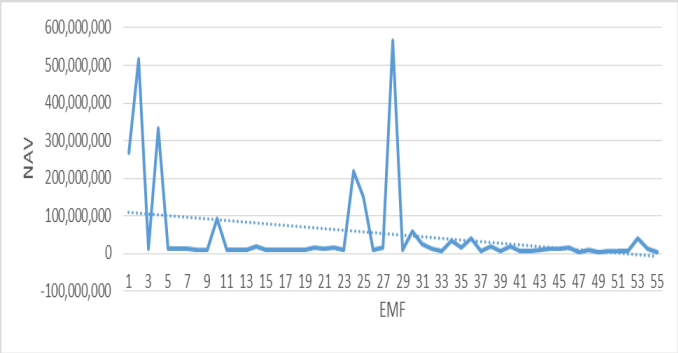

Figure 1. Average NAV of MFP for the Jan-Dec, 2020 (*Source:* output data)

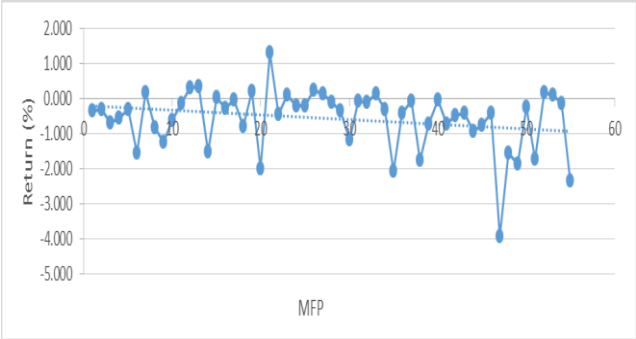

Figure 2. Return Movement of MFP for the Jan-Dec, 2020 (*Source:* output data)

A sign increasing in MFR comes from an increase in the NAV of equity funds. The EMF portfolio has a composition of 80 percent shares and 20 percent bonds or 20 percent money market products or it can be a mixture of the two, namely bonds and deposits, this optimal composition of mutual funds can maximize the increase in MFI returns that are managed by professional investment managers and reliable.

Figure 2, showed a linear line that decreases but is not as sharp as the decline in equity funds investment that occurred during the 2020 that hit globally, this happened because the composition of this stock mutual fund was at 20 percent bonds or 20 percent deposits. There are MFP that have the lowest point of -4.00 in EMF investment returns. This can happen because the effect of the composition of the stock mutual fund portfolio has a negative impact which has decreased significantly because of the impact of the global pandemic.

The stochastic volatility in the increase (decrease) in MFI returns relative to the case of constant volatility can be seen from the skewness line, where the IR skewness is equal to -1,542/0,322 = -4,788 <2 (see Table 2). This means that the Investment Return data widens with the level of the data tilt to the right, investment returns during the Covid-19 in 2020 are relatively small, this is showed by the small NAV volatility because of the decline in securities instruments in the mutual fund portfolio, on average, relatively decreasing.

Table 2. Descriptive Statistical of IR and NAV

Information			Statistic	Bootstrap			
				Bias	Std. Error	95% Confidence Interval	
						Lower	Upper
N	Valid	IR	55	0	0	55	55
		NAV	55	0	0	55	55
	Missing	IR	0	0	0	0	0
		NAV	0	0	0	0	0
Mean		IR	-547.4000	-2.5086	114.9442	-794.4724	-346.4965
Mode		IR	-3944.00[a]				
Std. Deviation		IR	843.87393	-11.60537	132.58455	572.26872	1095.36605
Variance		IR	712123.207	-1891.172	224032.239	327491.487	1199826.822
Skewness		IR	-1.542	0.185	0.597	-2.480	-0.217
Std. Error of Skewness		IR	0.322				
Kurtosis		IR	4.076	-0.969	2.451	-0.382	8.750
Std. Error of Kurtosis		IR	0.634				
Minimum		IR	-3944.00				
Maximum		IR	1328.00				

a. Multiple modes exist. The smallest value is shown
b. Unless otherwise noted, bootstrap results are based on 1000 bootstrap samples

(*Source:* output data)

Intuitively, a negative correlation produces a very high variance of 712123,207 when MFR fall, and this leads to the fat left tail of the probability density. They associate the right tail with low variance and do not spread outward. The fat left tail reduces MFR, while the fat left tail increased NAV. MFR benefit from the fact that we concentrate the mass distribution of NAV in the lower right of negative skewness, while small MFR suffer because the NAV of MFP is small. It can be seen that the movement of the average return of mutual funds is small or decreased by -547,400 during the 2020 in Indonesia, this standard deviation of 843,87393 shows that the distribution of data in a sample, which looks at how close the data is to The mean or average of the sample is quite wide, this is because the minimum value of MFR of -

3.944 is much smaller than the average and the maximum value of MFR of 1.328 is much greater than the average return of the mutual fund.

Table 3 displays the NAV simulation with an experimental frequency of 48 times by the researchers, the frequency of monthly NAV gains that decreased very high occurred only once in early January to February 2020, the frequency of decreasing monthly NAV gains which often occurred was 12 times with a NAV value of -0.23 occurred in May 2020. In August 2020 there were MFP that increased drastically very high with a frequency of 76 times. We got random number intervals after the cumulative probability distribution calculated. The random number interval will group several NAV based on the cumulative distribution of the probability of the MFI return.

Table 3. Investment Return Simulation with a Frequency of 48 Times

Time-Freq.	IR	Freq.	Return Probability Distribution	Cumulative Probability Distribution	Random Number Interval	Simulation Result IR	IR
1	-0.43	1	0.002	0.00	0.0 – 0.08	0	0
2	-0.28	1	0.002	0.00		0	0
3	-0.27	1	0.002	0.01		1	547.4
4	-0.25	1	0.002	0.01		0	0
5	-0.23	12	0.018	0.03		3	1642.2
6	-0.22	11	0.017	0.04		4	2189.6
7	-0.21	11	0.017	0.06		1	547.4
8	-0.20	5	0.008	0.07		2	1094.8
9	-0.19	2	0.003	0.07		0	0
10	-0.18	1	0.002	0.07		0	0
11	-0.17	5	0.008	0.08		2	1094.8
12	-0.13	2	0.003	0.08		0	0
13	-0.12	7	0.011	0.09	0.09 – 0.23	0	0
14	-0.11	1	0.002	0.09		0	0
15	-0.10	15	0.023	0.12		0	0
16	-0.09	21	0.032	0.15		2	1094.8
17	-0.08	3	0.005	0.15		0	0
18	-0.07	5	0.008	0.16		2	1094.8
19	-0.06	2	0.003	0.16		0	0
20	-0.05	1	0.002	0.16		0	0
21	-0.04	17	0.026	0.19		1	547.4
22	-0.03	14	0.021	0.21		1	547.4
23	-0.02	14	0.021	0.23		0	0
24	-0.01	9	0.014	0.25	0.24 – 0.91	2	1094.8
25	-0.01	1	0.002	0.25		0	0
26	0.00	14	0.021	0.27		0	0
27	0.01	41	0.062	0.33		0	0
28	0.02	52	0.079	0.41		2	1094.8
29	0.03	45	0.068	0.48		0	0
30	0.04	57	0.086	0.56		0	0
31	0.05	67	0.101	0.67		4	2189.6
32	0.06	76	0.115	0.78		1	547.4
33	0.07	48	0.073	0.85		0	0
34	0.08	21	0.032	0.88		1	547.4
35	0.09	11	0.017	0.90		0	0
36	0.10	7	0.011	0.91		4	2189.6
37	0.11	15	0.023	0.93	0.92 – 1.00	1	547.4
38	0.12	24	0.036	0.97		0	0

39	0.13	4	0.006	0.98		1	547.4
40	0.14	4	0.006	0.98		0	0
41	0.15	5	0.008	0.99		2	1094.8
42	0.16	1	0.002	0.99		0	0
43	0.17	1	0.002	0.99		0	0
44	0.18	1	0.002	1.00		0	0
45	0.18	1	0.002	1.00		0	0
46	0.26	1	0.002	1.00		0	0
47	0.33	1	0.002	1.00		0	0
48	0.84	1	0.002	1.00		0	0

(*Source:* output data)

This simulation random number interval set from 0.00 to the 12th experimental frequency, then we set the maximum random number interval according to the cumulative probability distribution of the IR simulation data, as shown in Table 2 that the random number interval divided into four groups. The first group 0.00-0.08, second group 0.09-0.23, third group 0.24-0.91, and fourth group 0.92-1.00.

From the simulation results, we find that the estimated average of MFR request is 37 divided by 48 trial frequencies; the result is 0.77083, and the estimated average of MFR in Indonesia during the 2020 is got from the number of simulated IRs of 20253.8 divided by 48 experimental frequencies is 421,954.

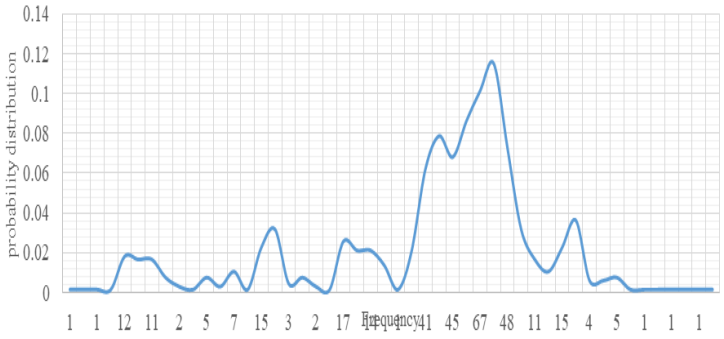

Figure 3. Probability Distribution of MFI Return in Jan-Dec, 2020 (*Source:* output data)

From Figure 3, in terms of the construction of MFI returns, assuming that parametric or empirical methods are used to calculate the NAV of MFP, such as the quote part of the cumulative probability distribution graph for MFI returns, which is best determined by the ~~Monte Carlo simulation~~MCS, that the frequency of occurrence of values The MFI return is 76 times with a probability distribution of 11.5 percent, which is better than the frequency of occurrence of the MFI return value of 1 time with a probability distribution of 0.2 percent. There is a possibility of an increase of 0.2 percent to 11.5 percent because the NAV range of MFP among several mutual fund companies has a very large NAV.

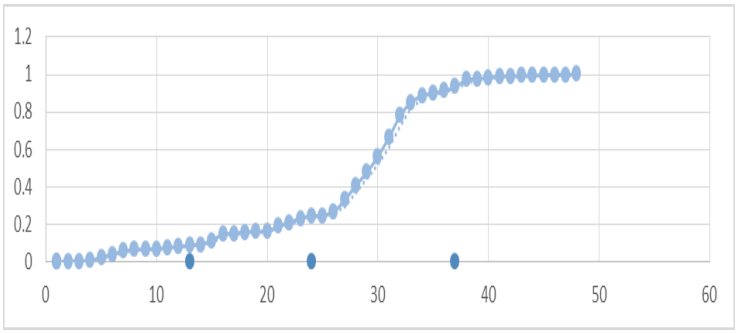

Figure 4. Random Number Interval and Cumulative Probability Distribution of MFI Return in Jan-Des, 2020 (*Source:* output data)

It divided the random number interval into the first group (0.00-0.08), second group (0.09-0.23), third group (0.24-0.91), and fourth group (0.92-1.00). The movement of the cumulative probability distribution at the random number interval of 0.00-0.008 is relatively stable increasing, the movement of the cumulative probability distribution at the next random number interval is 0.0- 0.23 and the random number interval is 0.91-1.00 more increased but not as sharp as a drastic increase in the random number interval of 0.24-0.91. At random number intervals in groups 1, 2, and 4, the cumulative probability distribution movement is relatively stable increasing because in the cumulative distribution the probability of MFI returns is relatively small because of the decrease in NAV of MFP that occurred during the 2020 in Indonesia, but in group 3 with a random number interval of 0.24-0.91 has a sharp cumulative probability distribution movement that increases drastically, this is because of changes in MFI returns at a very high probability cumulative distribution number interval which is also caused by the NAV of certain MFP which are in great demand by the investor community (see Figure 4).

In Figure 5, the frequency of occurrence of the minimum number of MFI return values is between 0-30 times having a low probability cumulative distribution movement, it differs from the frequency of occurrence of the maximum number of MFI return values between 60-80 having a cumulative distribution movement high probability, the movement of the cumulative distribution of medium probability occurs at the frequency of occurrence of MFI return values between 30-60 times.

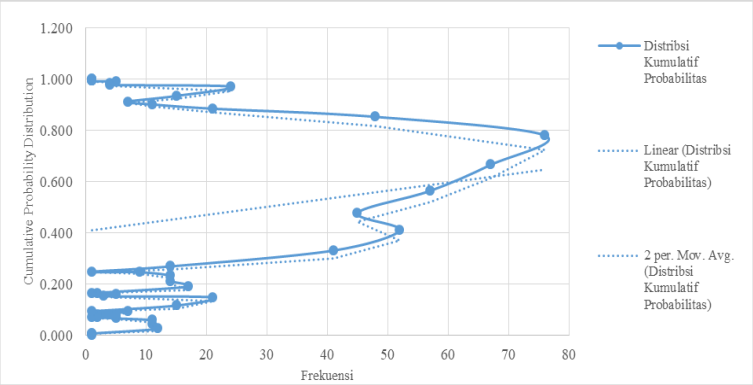

Figure 5. Cumulative Probability Distribution of MFI Return in Jan-Dec, 2020 (*Source:* output data)

~~The linearity of the moving average of the cumulative distribution of moving probability increases steadily at random number intervals, the estimated average of MFR request is 0.77083 and the estimated average of MFR in Indonesia during the Covid-19 problem in 2020 is 421.954.~~

~~The basic concept of the simulation method is to generate a vector of correlated normal variables, turning them into uniform variables with the help of the cumulative probability distribution function (Chou, 2011; Ng, 2007; Rossi & Spazzini, 2010; Ferrer, 2016; Yang, 2005; Li et al., 2020; Wee et al., 2020), then input the variables into their respective marginal distributions by the inverse transformation method. From the model results, and offers valuable information about the possibility of implementing alternative MFI returns at or below the NAV of certain MFP. However, the MFI return model does not consider complex stochastic and dependency processes. In addition, this approach focuses on the present value in choosing the best alternative long-term scenario and is not appropriate for determining the actual investment return of mutual funds with uncertainty.~~

As a result, the average linearity value moves to a random number interval. Initially, there was indeed a cumulative distribution that led to the average demand for MFR reaching 0.77083 and we expect this to continue to increase to 421.954 during Covid-19 in 2020.

The experiment of the combination carried out by Li et al. (2020), Yang (2005), Rossi & Spazzini (2010), Wee et al. (2020), Ng (2007), Ferrer (2016), and Chou (2011) bring up new creative ideas to generate normal and correlated variable vectors in changing components to become more uniform through the cumulative probability distribution function. A brilliant perspective emerges by including variables with an inverse transformation technique on the marginal distribution of each item. Considering these findings, we offer valuable information regarding alternatives in implementing MFI returns under a certain MFP and NAV. Therefore, MFI returns do not consider complex dependencies and stochastic processes. This approach has concentrated on long-term scenarios and best efforts, so it is not appropriate if

investment returns determined by the element of uncertainty and actual mutual funds.

CONCLUSION AND RECOMMENDATION

We are trying to estimate the NAV movement and MFI returns for Indonesia because of the pandemic with a ~~Monte Carlo method~~MCS. We observed 213 samples in the time span of March 2020–February 2021.

Predicting the ideal level of MFI return required by their investors for investment managers of mutual fund companies is an important thing to consider in managing the net asset level of the MFP they manage. This will have a long-term impact on maintaining the movement of the NAV of MFP to move relatively stable and increase, which increases the rate of return on MFI.

By using the ~~Monte Carlo approach~~MCS, MFI return simulation helps investment managers or their investors determine the choice of an average MFR request of 77.08 percent with an estimated average MFR in Indonesia during the 2020 pandemic period of 421,954. After a choice made using the ~~Monte Carlo simulation~~MCS ~~method~~ approach in the Covid-19 conditions, it provided a decision for mutual fund investors to maintain or take action on buying or selling investment products offered by investment managers at a certain NAV level, and a consideration of decisions for investment managers to achieve the target required by their investors at a certain NAV level by controlling the management of the securities composition of a mutual fund portfolio products.

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