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THE ROLE OF STATISTICS IN DECISION MAKING

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Abstract

In everyday life, every human being is faced with problems where he must make decisions. Starting from simple things such as deciding to extend the morning sleep time with all the risks that will be faced, to difficult and even complex things. These decisions can be personal or social or short-term or long-term that inevitably must be decided. This study uses the literature review method and in discussing several theories used, case studies are conducted. Every decision-making will always face four conditions, namely Certainty, Uncertainty, Risk and Conflict. The EV value is obtained from the multiplication of Payoff with its probability. The largest EV value is the decision that must be taken. The EOL results show that the lowest is C, so stock C can be recommended for purchase by investors such as case 1. From the EVPI value of 108,056, the cost for analysts is 21,611, investors still get additional profit of Rp86,445 compared to if investors do not get perfect information. A high EV value is the best decision. (b) paying attention to the best opportunity loss (expected opportunity loss – EOL). The value with the lowest EOL is the best decision, (c) paying attention to perfect information (expected value of perfect information – EVPI). EVPI pays attention to the perfect information factor so that it can optimize the level of profit..

Keywords: *Decision Making, Risk, EOL, EVPI*

Introduction

In everyday life, every human being is faced with problems where he must make decisions. Starting from simple ones such as deciding to extend the time to sleep in the morning with all the risks that will be faced, to difficult and even complex things. These decisions can be personal or social or short-term or long-term which inevitably must be decided, even not making a decision is part of the decision itself.

In the field of decision making, statistics has a very important role where from the early days of human civilization such as grouping objects, or the existence of the game "astragali" in ancient Egypt, even the Roman emperor Claudius (10 BC - 54 AD) has written a book entitled "How to Win with Dice". Along with its development, statistics has developed a new branch of statistics, namely statistical decision theory.

This science has developed since the 1950s inspired or pioneered since the 18th century by Thomas Bayes, so many people call statistical decision theory as Bayesian statistics. This statistic focuses on the decision-making process which is different from classical statistics which focuses on parameter estimation and statistics such as applying arithmetic mean values, measures of spread, confidence intervals and hypothesis testing.

Method

This study uses a literature review method and in discussing several theories used, a case study is conducted. Every decision-making will always face four conditions, namely Certainty, Uncertainty, Risk and Conflict. Decision theory in statistics is related to risk and uncertainty. Decisions with certainty conditions occur when all information used as the basis for decisions is available and valid or the information is perfect and unbiased. Decisions in uncertain conditions indicate a condition where a decision does not have perfect information and the probability of an event is unknown. Decisions in risky conditions occur when a decision does not have perfect information, but has the possibility or probability of an event occurring. Decisions in conflict conditions are decisions where there are two or more interests.

Result

Decision making under risk means that there is information but it is not perfect and there is a probability of two events. The risk in question is the probability of the event. In making risky decisions there are steps that must be taken, namely:

1. Wheezingidentification of various alternatives that exist and are feasible for a decision
2. Assess a probability for each existing alternative.
3. Compiling the results orpayoff for all existing alternatives
4. Make decisions based on the best results

Case Example 1:

Suppose we have Rp 10,000,000,- and want to invest by buying shares. There are 3 company shares studied, namely share A, share B and share C. Here is the payoff matrix of the three shares:

Table 1. Payoff Matrix of the three stocks

Code Share	Price Shares (Rp)	Amount Share	Condition	Good	Condition	Bad
			Dividend per lb	Total dividends	Dividend per lb	Total Divide

A	9000	1111	400	444.444	250	277,778
B	18,500	541	2000	1,080,081	300	162.162
C	30,000	333	4.463	1,487,667	185	61,667

Based on the matrix, if we buy stock A, we will get 1,111 shares, stock B 541 shares and stock C 333 shares. In good conditions, stock A provides a dividend of Rp 400 with a total dividend of Rp. 444,444, stock B provides a dividend of Rp 541 with a total dividend of Rp 1,080,081 and stock C provides a dividend of Rp 333 with a total dividend of Rp 1,487,667. While in bad conditions, stock A provides a dividend per share of Rp 250 with a total dividend of Rp 277,778, stock B provides a dividend per share of Rp 300 with a total dividend of Rp 162,162 and stock C provides a dividend per share of Rp 185 with a total dividend of Rp 61,667.

A. Expected Value

Related to case example 1, how should we decide? Stock A, stock B or stock C that we will buy? The criteria commonly used in statistics is to calculate the expected value (EV). EV is a weighted average of the payoff for each alternative with the probability of each event. The decision taken is the decision with the highest EV value because the goal is maximum profit.

EV = Payoff x Probability of an event

Table 1. EV for case 1

Share	Good (P=0.5)	Bad (P=0.5)	EV Calculation	EV Value
A	444.444	2777.778	(444.444x0.5)+(277.778x0.5)	361.111
B	1,081,081	162.162	(1,081,081x0.5)+(162,162x0.5)	621,622
C	1,487,667	61,667	(1,487,667x0.5)+(61,667x0.5)	774,667

The probability of a good or bad event is 0.5 each as in the binomial distribution. The EV value is obtained by multiplying the Payoff by its probability. The largest EV value is the decision that must be taken. Based on the table, the highest EV value is Stock C so the decision taken is to buy stock C.

B. Expected Opportunity Loss

In addition to the EV criteria, there is another criterion, namely expected opportunity loss (EOL). EOL has the principle of minimizing losses caused by choosing a particular alternative, or choosing an alternative that is not the best. EOL is calculated for each event by first identifying the best action for each event. The best result or payoff is given a value of 0,

while the results of other events are calculated by subtracting the best result from the results of that event. The EOL value is the multiplication of opportunity loss by the probability of each event. The best decision from EOL is the lowest value. The EOL formula can be expressed as follows:

EOL = Opportunity Loss x Probability of an Event

Case Example 2

Based on case example 1. Calculate the EOL and what is the best investment.

Solution:

Table 2. Calculation for EOL

Share	OL good (P = 0.5)	Poor OL (P = 0.5)	EV Calculation	EOL Value
A	1,487,667 – 444,444 = 1,043,223	277,778 – 277,778 = 0	(1,043,223 x 0.5) + (0 x 0.5)	521,612
B	1,487,667 – 1,081,081 = 406,586	277,778 – 162,162 = 115,616	(406,586 x 0.5) + (115,616 x 0.5)	261.101
C	1,487,667 – 1,487,667 = 0	277,778 – 61,667 = 216,111	(0 x 0.5) + (216,111 x 0.5)	108,056

The OL value for the best alternative is zero, so the OL of good condition is C = 0, and the worst condition A is also equal to 0. For other alternatives by subtracting the best value from the value of the alternative. for A, Rp1,043,223 is obtained from Rp1,487,667 - 444,444, for B Rp406,586 is obtained from Rp1,487,667 - 1,081,081. for OL of bad condition the calculation is done in the same way.

The EOL value is the multiplication of probability with the OL value. The EOL result shows the lowest is C, then stock C can be recommended to be purchased by investors as in case 1.

C. Expected Value of Perfect Information

Expected value of perfect information (EVPI) is an extension of EV and EOL. Investors like case 1 before buying shares must consider how the share price moves over time. It is not necessary to buy shares C all the time, perhaps by combining, for example, buying shares C in good condition and if C is in bad condition, it can move to B or A. So perfect information

allows investors to maximize profits from all events. Perfect information is defined as follows:

The expected value of perfect information is the difference between the maximum return under conditions of certainty and the maximum return under conditions of uncertainty.

Case Example 3

In case examples 1 and 2 we get the investment choice is C in both good and bad conditions. If the investor thinks normally and has perfect information, then he will choose the best condition, namely the highest result in both good and bad conditions. Calculate the EVPI value using the following table:

Table 3. Simulation conditions

Share	Good (P = 0.5)	Bad (P = 0.5)
A	444.444	277,778
B	1,081,081	162.162
C	1,487,667	61,667

Solution:

Under conditions of imperfect information, the investment choice is C with expected value (EV): EV = (1,487,667 x 0.5) + (61,667 x 0.5) = 774,667

If there is perfect information, then in good conditions, stock C which gives the best results can be selected. However, in bad conditions, stock C is not the best stock to choose. Therefore, in perfect information, and in bad conditions, stock A gives the best results compared to B and C. The optimal combination of stocks with perfect information conditions is C for good conditions and A for bad conditions, and the EV value is calculated as follows: EVif = (1,487,667 x 0.5) + (277,778 x 0.5) = 822,723

The profit if the information is perfect is Rp 822,723 and if the information is imperfect it is only Rp 774,667. The difference between the profit from perfect and imperfect information is the expected value of perfect information (EVPI). The EVPI value is as follows:

EVPI = 822,723 – 774,667 = 108,056

This EVPI value strengthens the argument that information is important and valuable. If an investor without information only gets a profit of Rp 774,667, then with perfect information it becomes Rp 822,723. This difference of Rp 108,056 is what drives the development of new professions, namely stock market analysts and financial analysts. These

analysts always update information, so that they can provide optimal results for investors. These analysts mostly join securities companies or financial consultants. Analysts also charge investors for their information or analysis. If the analyst charges a fee of 20% of the profit, then the investor does not lose either. From the EVPI value of Rp 108,056, the cost for the analyst = 0.2 x 108,056 = 21,611, while the investor still gets an additional profit of Rp 86,445 (108,056 - 21,611) compared to if the investor does not get perfect information from the analyst.

Conclusion

Every decision always has environmental conditions of certainty, uncertainty, risk, and conflict. Every decision has elements consisting of (a) feasible actions or alternatives, (b) State of nature that describes future conditions, and (c) results or payoffs from each alternative. Decision making in a risky atmosphere takes into account: (a) expected value (EV). A high EV value is the best decision. (b) paying attention to the best opportunity loss (expected opportunity loss - EOL). The value with the lowest EOL is the best decision, (c) paying attention to perfect information (expected value of perfect information - EVPI). EVPI takes into account the perfect information factor so that it can optimize the level of profit.

References

Adiningsih, Sri, 2001, Statistik, BPFE-Yogyakarta..

Anto, Dajan, 1996, Pengantar Metode Statistik, Jilid II, LP3ES..

Mulyono, Sri, 1991, Statistika untuk Ekonomi, Lembaga Penerbit FEUI, Jakarta. Sudjana, 1989, Metode Statistika, Torsito Bandung.

Suharyadi dan Purwanto, 2009, Statitika Untuk Ekonomi dan Keuangan Modern, Edisi 2.Salemba Empat