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Analysis of Mark UP value decisions with a bidding strategy model to win projects in government auctions

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ABSTRACT

The purpose of this study is to create a bidding strategy to determine the optimum markup value and maximum expected profit to win a project auction. From the data selection results, 24 project tenders and 12 large qualification companies participated in the tender on the LPSE page of the Ministry of PUPR, which will be used as samples in this study. The bid strategy model used to calculate the optimum markup value and maximum expected profit are with 3 (three) bid strategy models, namely the Friedman Model, Gates Model, and Ackoff & Sasieni Model, and to calculate the probability of winning using the statistical approach method of multi discrete distribution, normal multi-distribution, and single normal distribution. From the results of testing models with optimal mark-ups for the 24 project tenders used in this study, the percentage for each bidding strategy model that has the potential to win the tender sequentially is the Friedman model by 80.56%, the Gates model by 61.11% and the Ackoff &; Sasieni model by 43.06%. So, it can be concluded that the Friedman model provides a fairly high chance of winning tenders in government projects within the Ministry of PUPR.

Introduction

Construction projects are currently increasing in line with the rapid growth of population, economy, industry, and tourism (Senduk, 2022). Rapid growth must be balanced with the government's development of infrastructure that supports community activities (Maharani, Hardiyati, & Subagyo, 2021). Infrastructure development in Indonesia is one of the factors that is increasing the role of the construction sector in the Indonesian economy. This can be seen from the large contribution of the construction sector to the Gross Domestic Product (GDP) of 5.23% in the second quarter of 2023. This causes the number of businesses in the construction sector to reach 203,403 companies in 2023, according to BPS 2023 data, so it can be interpreted that the market share and tight competition in the construction services sector are getting higher (Oo, Lim, & Runeson,

2023). In its implementation, contractors must be ready to face competition from other competitors when participating in auctions (Leśniak & Plebankiewicz, 2015). Therefore, it is necessary to anticipate the problems of a contractor company in facing competitive auctions where there are conditions in terms of decision-making to participate or not participate in the auction and how big the bid will be submitted; an appropriate bidding strategy is needed (Hardiyanti, Maharani, & Subagyo, 2022). The estimated markup value implemented in bidding for construction projects can be used as a reference in submitting bid prices; the approach model in calculating markups is a tool for contractors in developing bid strategies in facing competitive bidding system tenders so that the best chance of participating in tenders or getting the optimum chance to win the project (Pemayun, 2018). A wide variety of bid strategy models that can be used to define bid strategies (Ramdhan, 2021). This study will analyze the optimum markup value and maximum expected profit using 3 (three) bidding strategy models, namely the Friedman, Gates, and Ackoff &; Sasieni models, and using statistical approach methods of multi discrete distribution, multi normal distribution, and single normal distribution to calculate the probability of winning with case studies on government tenders found on the LPSE page of the Ministry of PUPR (Melisa & Johny, 2019).

In bidding, the contractor will have to place a competitive bid price, which means that the bid price cannot be submitted too high in the hope of getting a large profit or vice versa. The contractor cannot submit a bid price too low in the hope of winning the greater tender (Mahapatni & Dewi, 2020). There are many ways bidders try to win auctions by applying various strategies. Strategy is an effort that users can use to bring problems closer to real conditions. Some common strategies that are often used are:

1. Competitive strategy is the most ideal bidding strategy, assuming all competitors use an honest strategy in the competition.
2. Price lowering strategy is a strategy used by bidders to win auctions by lowering prices by getting minimal profits
3. A loss-making strategy aims to gain sympathy from the owner in the hope of getting the next project.
4. A payment strategy with leeway aims to provide the owner with leeway in terms of term payments.
5. The under-table negotiation strategy aims to obtain the value of the Owner Estimate in an informal setting.

Expected profit is the difference between the bid price and the estimated cost, so the bid price is the estimated cost of the project plus the markup. The greater the bid price, the less likely it is to become the lowest bidder, so this potential profit must be made optimal known as the expected maximum profit in order to be the lowest bidder (Citra, Wibowo, Malinda, & Apdeni, 2022). The value of Expected profit is obtained using the following equation:

E (P) = P x Mark up…….. (1)

Dimana :

E (P) = Expected profit
P = Probabilitas menang

Mark up

Markup is the difference between the bid price and the budget plan for work costs (direct costs) plus indirect costs. In addition, Markup is the bid price divided by the estimated cost in percent (Markup = Bid Price / Estimated Cost). The formula for finding the markup value is the bid price divided by the estimated cost in percent.

Mark up = (B-C)/C x 100% …….(2)

Where:

B = Bid Price
C = Direct Cost

Multi Discrete Distributed

Multi-discrete distribution is a histogram-shaped distribution in which data from each known competitor is calculated individually for the probability of winning. This calculation uses the ratio of each company, which is then grouped by the lowest ratio of each auction and the highest ratio of each auction. The probability seen using a histogram is the amount of data with certain markup limits divided by the total data of contractors who participated in the auction so that the opportunity is obtained.

Multi Normal Distribution

This method uses the equation

Z = (R – Mr) / Dr ……. (3)

where:

Z = Normal probability of a random variable
R = (1 + Mark up)
Mr = Mean Bid ratio from contractor data
Dr = Standard deviation from contractor cost quote

After Z is calculated, the probability of winning can be found in the normal distribution table, which can be seen in the statistical book by looking at the area on the right of the figure below.

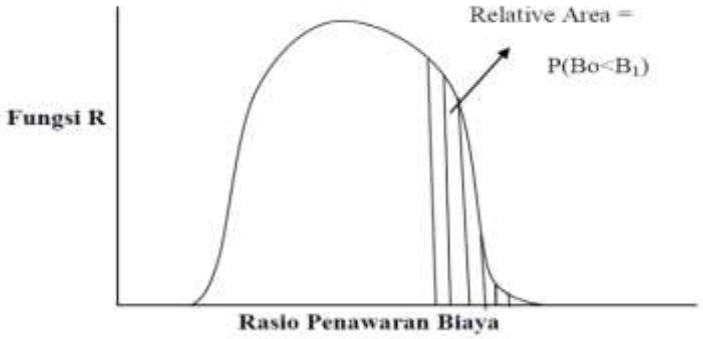

Figure 1 Cost quote normal distribution graph

Normal Single Distribution

The formula for calculating the probability of winning is the same as Equation 3. The difference with normal multi-distribution is that in a normal single distribution, the probability of winning is calculated against the average of all competitors (Average Bidders) or only on one bid data set, namely the lowest bid data set.

Method

Data Collection Methods

This study used primary data collection methods and secondary data. Primary data was obtained from the construction company PT Nindya Karya, which had bidding data in the period 2021 to 2023 on infrastructure projects with project values between IDR 100 billion and IDR 300 billion, as well as competitor bid data. Meanwhile, secondary data are data obtained from literature sources such as course materials, websites, the internet, scientific papers/journals, books, Electronic Procurement Services (LPSE) of the Ministry of PUPR, and other sources that have something to do with this research.

Data Processing Method with Statistical Approach

The initial step in data processing with statistical approach methods is to determine the method used, namely by using three methods: multi-discrete distribution method, normal multi-distribution, and normal single distribution. The data converted into ratios is then grouped from smallest ratio and largest ratio. After that, the mean, standard deviation, and variance for normal multi-distribution and normal single distribution, while discrete multi-distribution uses the initial ratio that has been analyzed, are found. The result of this data processing is the probability of each contractor winning. In the multi-discrete distribution method, a histogram or analysis from the Microsoft Excel program is used, which is the same. In contrast, in the multi-normal distribution method, a single normal distribution is used in the Z cumulative normal distribution table.

Bidding Strategy Model Data Processing Method

After finishing calculating all probability of winning using the statistical approach of multi-discrete distribution, multi-normal distribution, and single normal distribution, then the next step is to calculate the optimum Mark up and maximum Expected Profit using three bid strategy models, namely the Friedman model, Gates model, and Ackoff &; Sasieni model. After that, a comparison chart is made between the Expected Profit against the Mark of each model.

Model Testing With Optimum Mark-Up

The optimum markup obtained from the calculation process will be tested against the bid prices by seeing whether it will be lower (which means winning) or higher (meaning losing) than the lowest bid price. The bid hypothesis is obtained by multiplying the estimated cost of the contract by the markup of the calculation result and then comparing it with the lowest bid from the winning contractor. The data used in this test is the data of 24 project tenders used by the sample in this study, which will be tested for

bid value based on the optimum markup value; the model is then analyzed to determine which model provides a chance of winning as one of the decision-makers to submit price bids in an auction, especially within the Ministry of PUPR.

Results and Discussion

The bidding data collected is bidding data from 2021 to 2023, with an evaluation of the lowest price knockout auction, the auction of which has been completed and is available on the LPSE website of the Ministry of PUPR. The project provisions taken are projects with a budget ceiling value between Rp 100 billion to Rp 300 billion, followed by ≥ 3 (three) contractors with their active participation in ≥ 5 (five) tenders simultaneously. In the first phase of data collection, 32 projects were obtained, and the number of competitors was 66 large qualifying contractor companies. Then, a selection of bid data was carried out, with the provision that each project tender was followed by ≥ 3 (three) contractors who actively participated in ≥ 5 (five) tenders simultaneously. From the selection of data then collected and obtained, 24 projects with 12 competitors will be examined for bidding behavior.

Multi Discrete Distributed

The first step of this method is to calculate the direct cost of each tender in this study using the direct cost reference of PT Nindya Karya. After obtaining the direct cost, the ratio of supply to direct cost is calculated. After the ratio results are obtained, the ratio data is grouped by R-value with intervals of 0% to 60%. After that, it is done compulsively by reducing each data from the total data of each company. Furthermore, the probability of winning is calculated at each ratio by dividing the cumulative ratio by the total offer made by each company.

Multi Normal Distribution

The first step in this distribution analysis is to calculate the mean, standard deviation, and variance of each competitor, the results of which are presented in the table below.

Table 1
Mean Value, Standard Deviation, and Normal Multi Distribution Variance

NO	COMPETITORS	MEAN	TOTAL X (ΣX)	TOTAL X^2	STANDARD DEVIATION	VARIANT
1	PS1	1,218	29,222	35,717	0,0770	0,0059
2	PS2	1,242	12,421	15,573	0,1272	0,0162
3	PS3	1,305	14,350	18,847	0,1120	0,0125
4	PS4	1,268	6,342	8,084	0,0982	0,0096
5	PS5	1,268	19,014	24,266	0,1085	0,0118
6	PS6	1,246	7,475	9,336	0,0680	0,0046
7	PS7	1,220	6,099	7,500	0,1234	0,0152

8	PS8	1,228	6,142	7,585	0,1010	0,0102
9	PS9	1,285	6,423	8,334	0,1434	0,0206
10	PS10	1,197	5,987	7,202	0,0925	0,0086
11	PS11	1,179	10,607	12,593	0,1071	0,0115
12	PS12	1,151	8,058	9,325	0,0917	0,0084

To find the probability of winning in a normal multi-distribution, you must first find the value of Z (equation 3), which serves to determine the probability number in the normal distribution table.

Normal Single Distribution

The initial step in analyzing a single normal distribution is to calculate the mean, standard deviation, and variance against the highest ratio and the lowest ratio. The results of the analysis of the calculation of mean, standard deviation, and variance can be seen in the table below.

Table 2
Mean Value, Standard Deviation, and Single Variance of Normal Distribution

STATISTICAL RESULTS	2021-2023
1. Bid / Cost	
Mean	1,29362
Total X	31,04690
Total X^2	40,40303
Standard Deviation	0,10217
Variant	0,01044
2. Low Bid / Cost	
Mean	1,16536
Total X	27,96876
Total X^2	32,73465
Standard Deviation	0,07825
Variant	0,00612

The statistical results above are divided into two parts, namely bid/cost, and low bid/cost, where bid/cost is the highest cumulative ratio of the contractor's bid. In contrast, low bid/cost is cumulative of all the lowest ratios. The mean and standard deviation values used are bid/cost values. This is because it is possible in the hope of getting the largest ratio value to obtain a large Z value and will obtain a large probability value as well. The probability of winning with a single normal distribution is obtained from the cumulative distribution table Z, just like the normal multi-distribution.

Data Processing with Supply Strategy Model

a. Friedman's Strategy Model

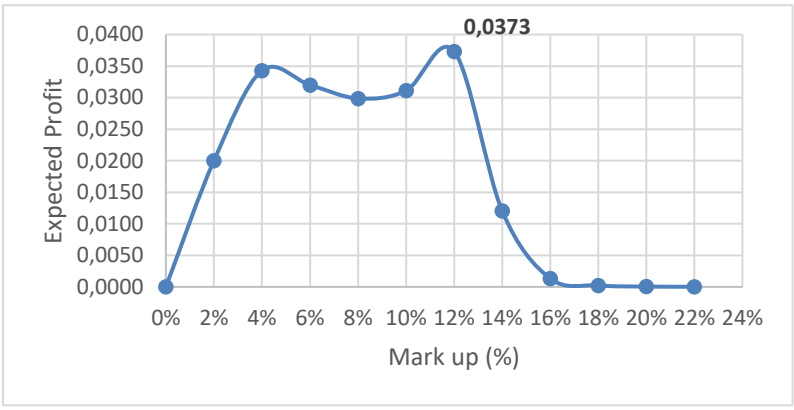

Figure 1 Relationship between expected profit and markup for discrete multi-distribution using the Friedman model

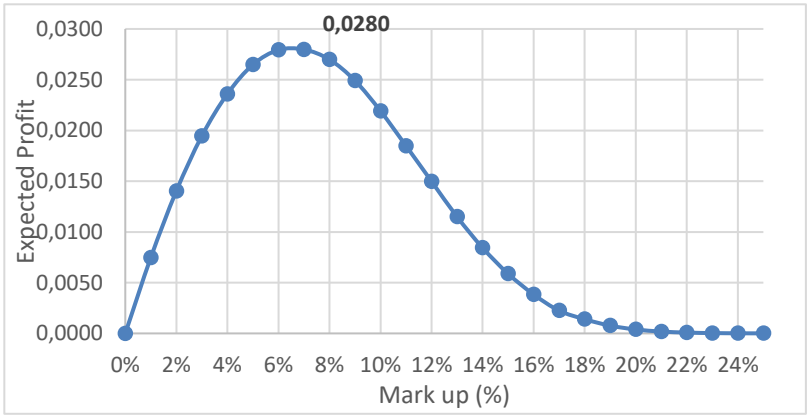

Figure 2 Relationship between Expected Profit and Mark Up for Multi-Normal Distribution using the Friedman Model

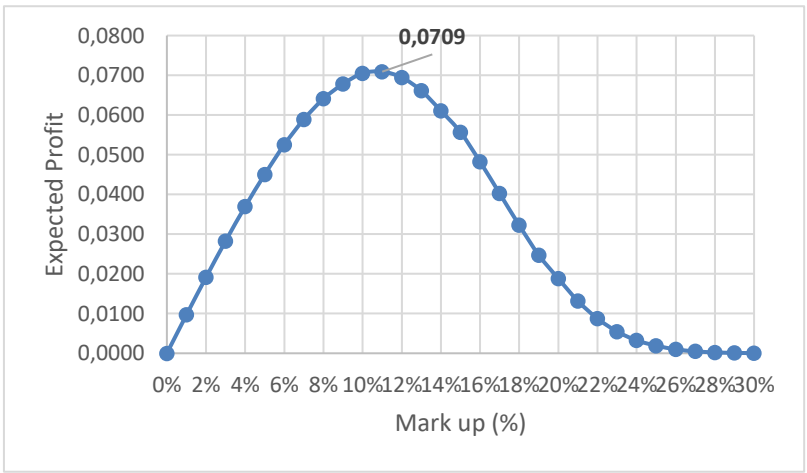

Figure 3 Relationship between Expected Profit and Mark Up for a Normal Single Distribution using the Friedman model

Model Strategi Gates

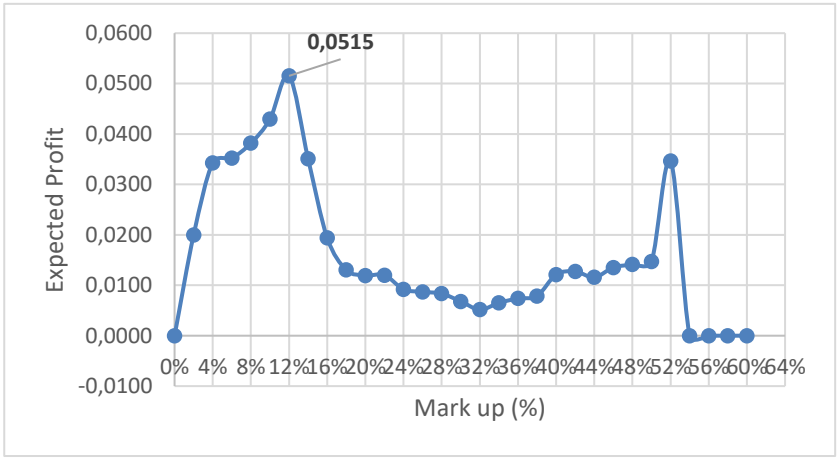

Figure 4
Relationship between Expected Profit and Mark-Up for Multi-Discrete Distribution Using Gates Model

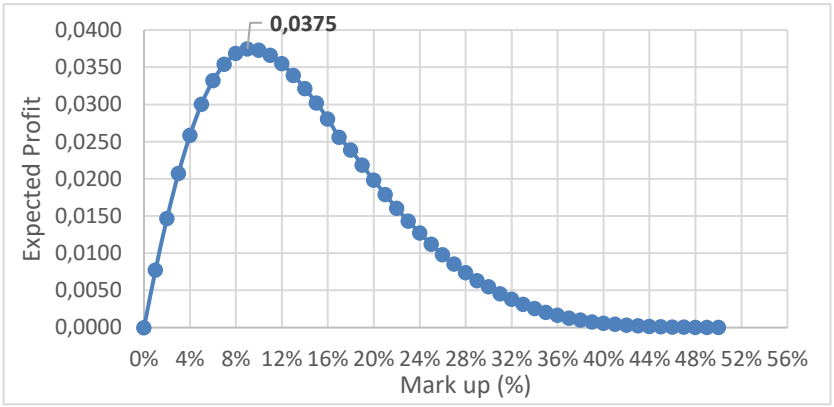

Figure 5 Relationship between Expected Profit and Mark Up for Multi-Normal Distribution using Gates Model

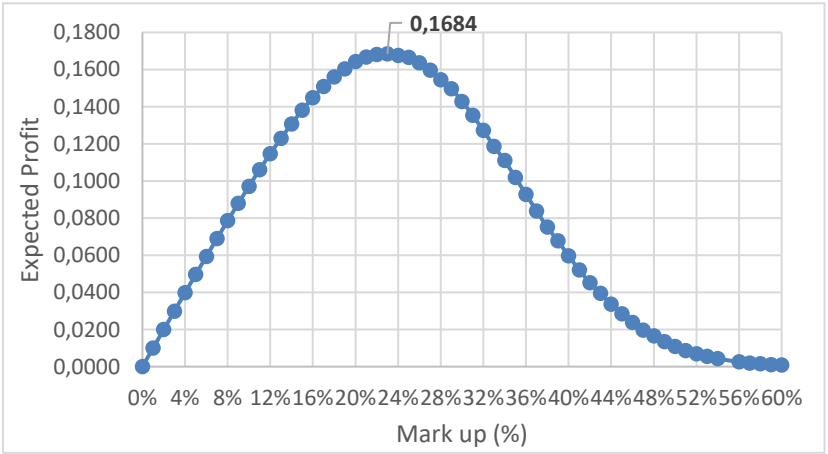

Figure 6 Relationship between Expected Profit and Mark Up for Normal Single Distribution using Gates Model

Analysis of Optimum Mark-Up and Maximum Expected Profit

From the overall analysis above, it is concluded that the optimum markup value with maximum expected profit for the three models is as follows:

Table 3
Optimum Mark Up Results and Maximum Expected Profit

Types of Distribution	Strategy Model	Mark Up Optimum	Expected Profit
Multi Discrete Distributed	Friedman	12,00%	0,0373
	Gates	12,00%	0,0515
	Ackoff & Sasieni	18,00%	0,1425
Multi Normal Distribution	Friedman	7,00%	0,0280
	Gates	9,00%	0,0375
	Ackoff & Sasieni	17,00%	0,1245
Normal Single Distribution	Friedman	11,00%	0,0709
	Gates	23,00%	0,1684
	Ackoff & Sasieni	17,00%	0,1245

Model Testing With Optimum Mark-Up

The markup obtained from the calculation analysis of the three methods above was tested against the bid price on 24 project tenders to see if the bid price obtained would be lower or higher than the lowest bid. From this test, it will be known whether you win or lose when using variations in the markup generated from the previous count analysis.

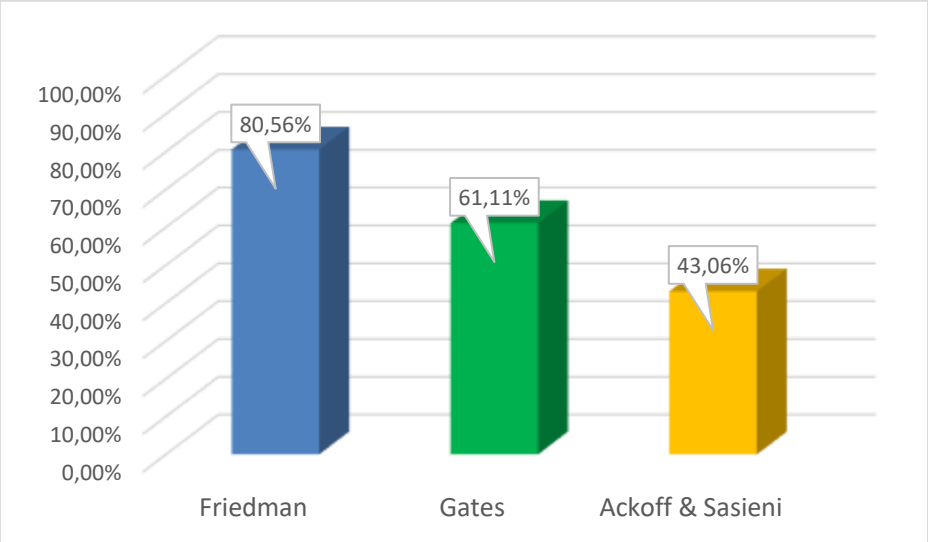

Figure 7 Percentage probability of winning the tender of each bidding strategy model

Conclusion

It can be seen from the results of the analysis with the Friedman model that produces the smallest markup of the three statistical approaches used, namely 12% for multi-discrete distribution with an expected profit of 0.0373, 7% for normal multi-distribution

with an expected profit of 0.0280 and 11% for a normal single distribution with an expected profit of 0.0709 The results of the analysis of the Gates model produce an optimum mark up of 12% for multi discrete distribution with an expected profit of 0.0515, 9% for normal multiple distributions with an expected profit of 0.0375, and 23% for normal single distributions with an expected profit of 0.1684. At the same time, the results of the analysis using the Ackoff & Sasieni model produced an optimum markup of 18% for multi-discrete distribution with an expected profit of 0.1425, 17% for normal multi-distribution with an expected profit of 0.1245 and 17% for a single normal distribution with an expected profit of 0.1245.

From the results of testing models with optimal mark-ups for the 24 project tenders used in this study, the percentage for each bidding strategy model that has the potential to win a fairly high tender sequentially is the Friedman model of 80.56%, the Gates model of 61.11% and the Ackoff & Sasieni model of 43.06%. So, it can be concluded that Friedman's model provides a fairly high chance of winning tenders in government projects within the Ministry of PUPR.

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