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Least Square Method Analysis for Sales Prediction in the Re-Evaluation of Feasibility Study for Housing Development Project in Malang

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Abstract: Feasibility studies are essential tools used to assess the viability and potential success of a project or investment. These studies provide critical information that helps stakeholders make informed decisions by analyzing various factors such as costs, benefits, risks, and potential returns. One specific type of project that often undergoes feasibility evaluation is housing development. In many cases, the feasibility assessment of housing projects is typically conducted by estimating the number of units sold without necessarily examining actual sales data. This approach can lead to inaccuracies and misguided conclusions. To address this gap, our research aims to re-evaluate the investment feasibility of ongoing housing projects by incorporating actual sales data and predicting future sales figures. By doing so, we can provide a more accurate and reliable assessment of the project's viability. The findings from this re-evaluation indicate that the investment in housing development remains highly feasible. Key financial metrics support this conclusion: the project has a Payback Period (PP) of just 0.55 years, meaning the initial investment is recovered in a little over half a year. Additionally, the Net Present Value (NPV) stands at Rp 103,917,111,414, reflecting the project's substantial profitability. Furthermore, the Internal Rate of Return (IRR) is an impressive 81.73%, far exceeding typical investment benchmarks. Lastly, the Benefit-Cost Ratio (BCR) of 1.53 demonstrates that the benefits of the project significantly outweigh the costs, confirming its overall financial soundness. These results underscore the importance of using comprehensive data analysis in feasibility studies to ensure accurate and effective investment decisions.

Keywords: Feasibility study; Forecasting; Housing projects; Investment

Introduction

Population growth in Indonesia tends to increase from year to year. Based on data provided by the World Bank, Indonesia had a population of 273.5 million people in 2020.(Atik, 2020) This number increased by 0.73 percent compared to 2019. The increase in the population will certainly correlate with the increase in basic human needs consisting of clothing, food, and shelter. According (Maslow, 1970),(Azzam et al., 2022) the need for a home or shelter is one of the motivations for the development of higher life, in other words, that a home is essentially a container for humans or families to carry out their Live The need for housing has been increasing over time, as seen from the increasing percentage of home ownership status over the past few years. (Ilyas & Wagey, 2020) (Sianturi et al., 2020) Especially for housing needs in the city of Malang as indicated in Table 1. The data shows that the need for home ownership status has been increasing in recent years, indicating an increase in housing needs in the city of Malang.

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Table 1. The homeownership rate from 2020 to 2022

Ownership Status of the Occupied Building	Percentage of Households by Ownership Status of the Occupied Building in Malang City (Percent (%))		
	2020	2021	2022
Owned	63.36	65.76	80.47
Rent	25.67	20.47	8.14
Free Rent	10.78	13.38	10.16
Official residence	0.2	0.39	1.23
Others	0	0	0
Total	100	100	100

(Source: Badan Pusat Statistik)

Aside from being a primary necessity, homes also serve as a lifestyle statement and reflect the identity of their occupants. This has become an allure for developers to compete in creating housing projects with features that can attract the interest of the public. Therefore, PT. xxx TBK, as a national-scale luxury housing developer, offers a housing project that caters to the needs of the community in the Malang Raya region. Situated on an initial 32-hectare land in Malang, this project targets upper-middle-class clients.(Febriyan et al., 2017)(Idris, 2022) Naturally, before commencing the construction, a feasibility study of the housing development project is necessary. Hence, as an entrepreneur, one must evaluate the feasibility of the project to determine if it is worth pursuing.(Susanti & Maini, 2019)(Umum & Indonesia, 1998)

This research will conduct a feasibility study related to housing projects based on existing sales data. The assessment of feasibility study is important to be conducted post-COVID pandemic to evaluate whether this project remains viable for investment. The study begins by collecting data on the number of sales for each type of house, then projections of sales will be carried out based on this data. Subsequently, projections of future sales will be assessed based on economic and technical feasibility indicators. The results of the research will indicate whether this project remains feasible to proceed with or not.(Amalia et al., 2022)(Messah et al., 2015)

Method

The research on the re-evaluation of investment feasibility in a housing project in Malang is carried out in four main stages. These stages can be outlined in the points: Technical feasibility study; Calculation of Capital Costs; Calculation of Sales Predictions and Revenue Forecasts; Re-evaluation of financial feasibility.

The first stage involves assessing the feasibility of the housing project from a technical perspective, where the research focuses on evaluating the compliance of the development plans with government regulations. If all the planning meets the standards set by the government, then the permit to develop the housing project will be issued. The second stage is calculating the capital costs involved in the housing investment to determine the total required capital and the unit price of the houses, in addition to calculating the potential profits from this investment. The third stage is predicting house sales by collecting historical data. This stage differentiates this research from other feasibility studies because it evaluates revenue from actual sales and future predictions. In the final or fourth stage, financial analysis is conducted based on the sales predictions using indicators such as Net Present Value (NPV), Internal Rate of Return (IRR), Payback Period, and Benefit-Cost Ratio (BCR).

Result and Discussion

Based on the results of the conducted research, the following findings were obtained.

Technical Feasibility Study of the Development Project

The technical calculation is conducted by analyzing the site plan that has been prepared since the first phase.(Azaria et al., 2020) This is done to determine whether the housing development has implemented planning in accordance with the standards set by the government or not. Several assessment indicators are as follows: Effective Land Area; Building Coverage Ratio for Houses; Building Coverage Ratio for Residential Area; Floor Area Ratio; Green Open Space Ratio; Building setback line; Lot width; Number of lots; Population and housing density.(SALSABILLA, 2015)(Zaini et al., 2021)(Riskijah & others, 2021)

Based on the technical feasibility indicators according to government regulations, the results obtained are as shown in the following Table 2.

Table 2. Results of technical feasibility study

Assessment Criteria	Calculation Result	Simple Settlement Requirements	Description
Effective Land Area	40.96%	If the planned area is 25-100ha, the maximum effective land area is 60%	Compliant
Building Coverage Ratio (BCR) for Houses	61.90%	The BCR value for houses is set at a maximum of 60% of the lot area	Non-compliant

Assessment Criteria	Calculation Result	Simple Settlement Requirements	Description
Building Coverage Ratio (BCR) for Residential Area	41.23%	The BCR value for row houses is 50-70% of the total area	Compliant as the built area is smaller than the requirement
Floor Area Ratio (FAR)	0.61	For non-stacked houses, the FAR value must be less than 1	Compliant as it's less than 1
Green Open Space Ratio (GOSR)	76%	The GOSR for urban areas is 50% of the total area	Compliant as the green area is larger than required
Building Setback Line	4.5 m	The setback line must be at least half the width of the street in the area	Compliant as the required setback line is 4.5m, while it's 5m according to the plan, thus meeting the requirement
Lot Width	7 m	Lot width should not be less than 6 m	Compliant as the minimum lot width is 7 meters
Number of Lots per Hectare	24 units/ha	Number of lots: 100 units < Number of Lots < 65 units	Compliant as the number of lots per hectare is less than the minimum requirement
Housing and Population Density	300 people/ha	Housing and population density for urban areas is between 101 to 300 people/ha	Compliant as it doesn't exceed the density limit

Sales Forecasting

The least squares method is a mathematical approach used to model the relationship between independent and dependent variables in a dataset. In the context of predicting sales for each type of house, this method provides a strong framework for identifying patterns and trends that can be used as the basis for more accurate predictions.

As a housing development that constructs houses using an indent method, the new development initiates construction once orders are received from buyers. Based on the data approach obtained, the sales data and predicted sales results are as follows.

Table 3. Sales data and sales forecast for type A houses

Years	Month	Sales (Y)	Value (x)	X.Y	X^2	Forecast
2021	January	0	–17	0	289	1.07
2021	February	0	–15	0	225	1.04
2021	March	1	–13	–13	169	1.01
2021	April	2	–11	–22	121	0.99
2021	May	1	–9	–9	81	0.96
2021	June	4	–7	–28	49	0.93
2021	July	0	–5	0	25	0.90
2021	August	0	–3	0	9	0.88
2021	September	1	–1	–1	1	0.85
2021	October	2	1	2	1	0.82
2021	November	1	3	3	9	0.79
2021	December	0	5	0	25	0.76
2022	January	0	7	0	49	0.74
2022	February	0	9	0	81	0.71
2022	March	1	11	11	121	0.68
2022	April	0	13	0	169	0.65
2022	Mei	2	15	30	225	0.62
2022	June	0	17	0	289	0.60
n	18	15		–27	1938	

The calculations from each sales data from Table 3 are used as the basis for determining the coefficient values A and B in the least square method equation.(Prambudi et al., 2021)(Wibowo et al., 2021) As an example, the calculation is performed on the coefficient calculation in type A houses with the following calculation:

$$a = \frac{\sum Y}{n} = \frac{15}{18} = 0.833$$
$$b = \frac{\sum XY}{\sum X^2} = \frac{-27}{1938} = -0.0139$$

So, the equation base on previous value will be:

$$Y = a + bx = 0.833 - 0.0139\,x \quad (1)$$

Based on this formula, if the prediction is made in the third year, or in month x = 36, then the predicted sales for this type of house are Y = 0.833–0.0139(36) = 1.33 units. This calculation will copy to al type of houses and here is the result.

Table 4. Sales data and sales forecast for all type houses

YERS	A	B	C	D	E	F	G
2021	12.00	9.00	9.00	5.00	5.00	12.00	12.00
2022	5.99	8.92	5.22	4.26	2.10	10.37	1.99
2023	2.98	6.73	9.79	4.41	0.00	6.28	0.00
Total	20.9	24.66	24.0	13.6	7.1	28.6	13.9
Rounding	21	25	25	14	8	29	14
House Stock Plan	27	22	16	24	15	40	19
Deviation	6	-3	-9	10	7	11	5

Financial Feasibility Study of the Development Project

Income from Forecast Results

The forecasting calculations from the sales data indicate that there are several types of houses projected to have buyers exceeding the stock, while others are predicted not to be sold according to the planned stock within a 3-year development plan.(Umar, 2001)(Sururi & Agustapraja, 2020) This is a common occurrence in a business or enterprise because not all stock items have the same buyer interest.(Ramadhan et al., 2022)(Rastra, 2012) Considering this different demand trend, a recalculation of the total revenue to be obtained from the forecast results is:

Table 5. The calculation of income from forecast results

House Type	Forecast Sales	Price	Total
A	21.00	1,433,000,000	30,093,000,000
B	25.00	1,634,000,000	40,850,000,000
C	25.00	2,272,000,000	56,800,000,000
D	14.00	2,646,000,000	37,044,000,000
E	8.00	3,794,000,000	30,352,000,000
F	29.00	4,060,000,000	117,740,000,000
G	14.00	5,415,000,000	75,810,000,000
Total Revenue			388,689,000,000

Forecast Cash Flow

After conducting an analysis of the income and expenses based on the least square prediction analysis, the next step is to create a cash flow analysis. This analysis is obtained by combining the income and expense values into a single calculation table. This cash flow calculation will be useful in helping to determine the investment feasibility for this housing development project. (Sinaga, 2023)(Rumengan et al., 2019)In this calculation, since the investment interest is calculated on an annual basis, a cash flow recap calculation is done for 3 years, which can be seen in the following calculations.(Syafira et al., 2022)(Oktavian, 2020)

Table 6. Annual cash flow calculation

Years	Outcome (Rp)	Income (Rp)
0	111,262,775,000	0
1	54,932,800,000	198,250,000,000
2	30,647,207,981	107,122,954,936
3	20,356,445,545	74,670,378,741

Payback Period (PP)

The Payback Period analysis is used to calculate how long it will take to recover the investment. Below is the Payback Period calculation.

Table 7. Payback period calculation (in million)

Year	Cash Out (Rp)	Cash In (Rp)	Net Cash (Rp)	Cumulative
0	111,262,	-	(111,262)	(111,262)
1	54,932	198,250	143,317	32,054
2	30,647	107,122	76,475	108,530
3	20,356	74,670	54,313	162,844

The Payback Period calculation uses the formula

PP = (n-1) + [Cf- $\sum_i^{n-1} An$](1/An)

=(1-1)+[111,262,775,000–32,054,425,000] (1/143,317,200,000)

= 0.55 year

Therefore, assuming the public facilities are ready and the land sales proceed, the project will break even in approximately 0.55 months.

Net Present Value (NPV)

Net present value is the net difference between the present value of expenditures and revenues. To determine that a project is feasible, it needs to have a value greater than zero. Additionally, the interest rate used is 4% for this thesis.

$$\text{NPV} = \sum PV\ in - \sum PV\ out$$
$$\text{NPV} = 315{,}566{,}220{,}263 - 199{,}233{,}944{,}261$$
$$\text{NPV} = 116{,}332{,}276{,}002$$

Since the NPV value is positive or greater than zero, it can be stated that this housing development project is feasible and profitable to undertake.

Benefit Cost Ratio (BCR)

The next feasibility study indicator used is the Benefit Cost Ratio (BCR). This indicator is a further calculation from the NPV, where the total income is divided by the outcome.

The BCR calculation at a 4% interest rate yields a value of:

BCR = (356,045,225,835) / (210,513,950,789) = 1.69

The BCR value indicates a value above zero, thus the project or investment can be concluded as feasible.

Internal Rate of Return (IRR)

The Internal Rate of Return (IRR) is obtained when the Net Cash PV is equal to 0. It can be calculated using trial and error. The Minimum Acceptable Rate of Return (MARR) for this study is 16%. If the IRR value exceeds the MARR value, it can be stated that the calculation for this housing project is sufficiently feasible to be implemented.

Table 8. Internal Rate of Return (IRR) calculation (in million)

	16%		82%	
Year	Diconto Factor	Present Value (PV)	Diconto Factor	Present Value (PV)
0	1.00	(111,262)	1.00	(111,262)
1	0.86	123,549	0.55	78,745
2	0.74	56,833	0.30	23,087
3	0.64	34,796	0.17	9,009
	Total	103,917	Total	(419)

The calculation in Table 8 is done by trial and error to find the IRR (i2) interest rate value until the NPV reaches 0. The IRR calculation is obtained as follows:

IRR = i1 + (i2 - i1) * NPV1 / (NPV1 - NPV2)

IRR = 0.82 + (0.82 - 0.16) * (103,917,111,414) / (103,917,111,414 - (-419,920,456)) = 81.73%

In the above calculation, it is known that NPV = 0 is obtained when IRR = 81.73%. Therefore, because IRR > MARR, it can be concluded that this development project is sufficiently profitable and feasible to be implemented.

Conclusion

The housing project in this research meets all technical construction requirements and government regulations.(Putri et al., 2022) Based on historical sales data, the sales forecast for the next 1.5 years predicts the following unit sales: Aspial (6 units), Agate (11 units), Ametrine (15 units), Amethyst (7 units), Azurite (1 unit), Azurite split (11 units), and Alexandrite (1 unit). Then, for financial feasibility, based on the sales predictions, indicates a Payback Period (PP) of 0.55 years, a Net Present Value (NPV) of IDR 103,917,111,414, an Internal Rate of Return (IRR) of 81.73%, and a Benefit Cost Ratio (BCR) of 1.53. All these indicators confirm that the investment in this housing project is feasible.

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Author Contributions

The authors made substantial contributions to the conception and design of the study. The authors took responsibility for data analysis, interpretation, and discussion of results. The authors read and approved the final manuscript.

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Conflicts of Interest

The authors declare that there is no conflict of interest.

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