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# Application of the Newton–Raphson Method to Compare Effective Interest Rates for Motorcycle Installments

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## Abstract

Purchasing a motorcycle on credit is a popular option for many people in Indonesia. However, information about financing provided to consumers usually only includes the down payment amount, monthly installments, and credit term, without providing details about the effective interest rate. This makes it difficult for consumers to compare different credit schemes fairly. This study aims to use the Newton-Raphson method to determine and compare the effective interest rates of Honda Beat CBS and Yamaha Mio M3 CW motorcycle installments. The data used in this study was taken from official financing brochures for a 23-month period. The effective interest rate was determined by solving nonlinear equations for fixed installment loans using the Newton-Raphson method. The results of the study show that although the monthly installments for both motorcycles are quite similar, there are differences in effective interest rates that cannot be seen directly from the installment amounts. The Newton-Raphson method has been proven to provide accurate and structured solutions that are easy to use. Therefore, this method can be used as an objective tool for analyzing and comparing motorcycle credit financing.

**Keywords:** Newton–Raphson method, effective interest rate, motorcycle loan, fixed installment, numerical method.

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## 1. Introduction

The development of the transportation sector in Indonesia is closely related to the increasing demand for private vehicles, especially motorcycles. Motorcycles are the most popular form of transportation among the public because they are relatively affordable, fuel efficient, and easy to maneuver in both urban and rural areas. However, many consumers are unable to purchase

motorcycles with cash payments, so purchasing through credit financing companies has become the most widely used solution to this problem.

In practice, financing companies provide various credit schemes with different down payments, tenors, and interest rates. Generally, the information provided to consumers at the outset is the amount of the monthly installment, not the actual effective interest rate. This often makes it difficult for consumers to objectively compare credit offers from several financing institutions. The increasing use of credit financing in purchasing motorcycles is supported by the theory of consumer financial behavior, which explains that individuals tend to choose installment-based payments due to limited immediate financial resources (Sullivan et al., 2012). Furthermore, according to Kreyszig (2011), nonlinear mathematical models are often required to represent real-world financial problems, including loan and interest calculations. Therefore, numerical methods such as Newton-Raphson become essential tools in solving these problems efficiently.

The effective interest rate is an important indicator in assessing the actual credit burden borne by consumers. Calculating the effective interest rate involves nonlinear equations that often cannot always be solved analytically. Therefore, numerical methods are needed to obtain approximate solutions. One numerical method that can be used to solve nonlinear equations is the Newton-Raphson method.

Based on this problem, this study focuses on the application of the Newton-Raphson method to determine and compare the effective interest rates on motorcycle installments. With this mathematical approach, consumers and financial analysts are expected to obtain a clearer picture of the effective interest rates applied by each financing institution.

## 2. Methods

This study uses the Newton-Raphson numerical method to determine the effective interest rate of a motorcycle installment plan. The data used are:

1. Motorcycle price.
2. Down payment amount.
3. Loan amount (principal).
4. Monthly installment amount.
5. Installment period (tenor).

The data used in this study were obtained from official financing brochures of Honda and Yamaha motorcycles. These brochures provide key financial information such as the on-the-road price, down payment, monthly installment, and loan period. From this data, the principal loan amount is calculated by subtracting the down payment from the total motorcycle price.

## 2.1 Mathematical Installment Model

The relationship between monthly installments, effective interest rate, loan amount, and tenor can be expressed in the following annuity equation:

$$A = P \cdot \frac{i(1+i)^n}{(1+i)^n - 1}$$

where:

- $A$ : monthly installment,
- $P$ : loan amount,
- $i$ : effective interest rate per period,
- $n$ : number of installment periods.

The annuity formula represents the relationship between the loan amount, interest rate, installment amount, and time period. In this context, the formula is used to determine the effective interest rate based on known values of installment payments and loan duration. Since the interest rate variable appears in both exponential and fractional forms, the equation becomes nonlinear and cannot be solved using algebraic methods.

This equation is nonlinear with respect to the variable  $i$ , so a numerical method is required to find its solution.

The equation can be converted into a nonlinear function:

$$f(i) = P - A \left[ \frac{i(1+i)^n}{(1+i)^n - 1} \right] = 0$$

Since variable  $i$  is in exponential and rational form, this equation cannot be solved analytically, requiring the Newton-Raphson numerical method.

## 2.2 Newton–Raphson Method

The Newton–Raphson method is used to find the root of the nonlinear equation  $f(i) = 0$ . The Newton-Raphson method is an iterative numerical technique used to approximate the roots of a nonlinear equation. In this study, it is applied to determine the effective interest rate by transforming the annuity equation into a function form  $f(i) = 0$ .

The method begins with an initial guess of the interest rate. Then, successive approximations are calculated using the derivative of the functions until the difference between iterations becomes very small (convergent). This iterative process ensures that the obtained value of the interest rate is accurate and reliable for financial analysis.

The iterative form of the Newton–Raphson method is:

$$i_{k+1} = i_k - \frac{f(i_k)}{f'(i_k)}$$

The steps for applying the Newton–Raphson method in this study are:

- Determine the function  $f(i)$  from the annuity equation.
- Determine the first derivative  $f'(i)$ .
- Determine the initial guess value  $i_0$ .
- Perform iterations until a convergent value of  $i$  is obtained.

### 3. Result and Discussion

Based on data from the official Honda and Yamaha motorcycle financing brochures (Jakarta–Tangerang), we chose to examine one pair of entry-level automatic motorcycles that are most in demand and widely used by the public, namely the Yamaha Mio M3 CW and Honda Beat CBS. This selection was made to ensure a fair comparison, as both motorcycles are in the same segment, have similar engine capacities, and are in the same price range.

The data used was taken directly from brochures with the same tenor, namely 23 months, and the minimum down payment already listed.

The following are the Honda and Yamaha motorcycle financing brochures:



**One HEART.**



**DAFTAR HARGA MOTOR TERBARU  
BREBES**

TIPE MOTOR	UANG MUKA	DP BAYAR	ANGSURAN PER BULAN / ARREAR			TIPE MOTOR	UANG MUKA	DP BAYAR	ANGSURAN PER BULAN / ARREAR		
			11	23	35				11	23	35
BeAT Sporty CBS MJ1A Rp20,710,000	2,100,000	700,000	2,199,000	1,222,000	926,000	VARIO 160 CBS LVEB Rp29,960,000	3,000,000	1,400,000	3,088,000	1,716,000	1,299,000
	2,250,000	850,000	2,183,000	1,214,000	919,000		3,250,000	1,650,000	3,062,000	1,702,000	1,288,000
	2,500,000	1,100,000	2,157,000	1,199,000	908,000		3,500,000	1,900,000	3,035,000	1,687,000	1,277,000
	3,000,000	1,600,000	2,104,000	1,170,000	886,000		3,750,000	2,150,000	3,009,000	1,672,000	1,266,000
BeAT Sporty CBS ISS Deluxe MK1A Rp21,510,000	2,200,000	800,000	2,274,000	1,264,000	957,000	VARIO 160 ABS LW1B Rp32,830,000	3,300,000	1,700,000	3,362,000	1,868,000	1,414,000
	2,250,000	850,000	2,268,000	1,261,000	954,000		3,500,000	1,900,000	3,341,000	1,856,000	1,405,000
	2,500,000	1,100,000	2,242,000	1,246,000	943,000		3,750,000	2,150,000	3,314,000	1,842,000	1,394,000
	3,000,000	1,600,000	2,189,000	1,217,000	922,000		4,000,000	2,400,000	3,288,000	1,827,000	1,383,000
BeAT Sporty CBS ISS Deluxe Smart Key ML1A Rp22,110,000	2,300,000	900,000	2,327,000	1,293,000	979,000	STYLO 160 CBS MF0D Rp30,805,000	3,100,000	2,600,000	3,184,000	1,777,000	1,349,000
	2,500,000	1,100,000	2,306,000	1,282,000	970,000		3,250,000	2,750,000	3,169,000	1,768,000	1,342,000
	2,750,000	1,350,000	2,280,000	1,267,000	959,000		3,500,000	3,000,000	3,142,000	1,754,000	1,331,000
	3,000,000	1,600,000	2,253,000	1,253,000	948,000		3,750,000	3,250,000	3,116,000	1,739,000	1,320,000
BeAT Street MM1 Rp20,910,000	2,100,000	700,000	2,220,000	1,234,000	934,000	STYLO 160 ABS MG0D Rp33,865,000	3,400,000	2,900,000	3,479,000	1,940,000	1,472,000
	2,250,000	850,000	2,205,000	1,225,000	928,000		3,500,000	3,000,000	3,468,000	1,934,000	1,467,000
	2,500,000	1,100,000	2,178,000	1,211,000	917,000		3,750,000	3,250,000	3,442,000	1,919,000	1,456,000
	3,000,000	1,600,000	2,125,000	1,182,000	895,000		4,000,000	3,500,000	3,415,000	1,905,000	1,445,000
Genio CBS LV1A Rp21,640,000	2,200,000	1,000,000	2,287,000	1,271,000	965,000	PCX 160 CBS M10A Rp35,890,000	3,600,000	2,000,000	3,685,000	2,047,000	1,553,000
	2,250,000	1,050,000	2,282,000	1,269,000	960,000		4,000,000	2,400,000	3,642,000	2,024,000	1,535,000
	2,500,000	1,300,000	2,256,000	1,254,000	949,000		4,500,000	2,900,000	3,589,000	1,995,000	1,513,000
	3,000,000	1,800,000	2,203,000	1,225,000	927,000		5,000,000	3,400,000	3,536,000	1,966,000	1,491,000
Genio CBS ISS LZ1A Rp22,200,000	2,300,000	1,100,000	2,337,000	1,299,000	983,000	PCX 160 ABS MV0A Rp39,680,000	4,000,000	2,100,000	4,048,000	2,249,000	1,705,000
	2,500,000	1,300,000	2,316,000	1,287,000	974,000		4,500,000	2,600,000	3,995,000	2,220,000	1,683,000
	2,750,000	1,550,000	2,289,000	1,273,000	963,000		5,000,000	3,100,000	3,941,000	2,190,000	1,661,000
	3,000,000	1,800,000	2,263,000	1,258,000	952,000		5,500,000	3,600,000	3,888,000	2,161,000	1,639,000
Scoopy Energetic / Fashion MR0E MR0E Rp24,740,000	2,500,000	900,000	2,586,000	1,437,000	1,088,000	PCX 160 ABS Roadsync MW0A Rp42,840,000	4,300,000	2,400,000	4,354,000	2,419,000	1,834,000
	2,750,000	1,150,000	2,559,000	1,423,000	1,077,000		4,500,000	2,600,000	4,332,000	2,407,000	1,825,000
	3,000,000	1,400,000	2,533,000	1,408,000	1,066,000		5,000,000	3,100,000	4,279,000	2,378,000	1,803,000
	3,250,000	1,650,000	2,506,000	1,393,000	1,055,000		5,500,000	3,600,000	4,226,000	2,349,000	1,781,000
Scoopy Prestige / Stylish MS0E MS0E Rp25,620,000	2,600,000	1,000,000	2,669,000	1,483,000	1,123,000	ADV 160 CBS N00 Rp38,110,000	3,900,000	2,400,000	3,885,000	2,156,000	1,633,000
	2,750,000	1,150,000	2,653,000	1,474,000	1,116,000		4,000,000	2,500,000	3,875,000	2,150,000	1,629,000
	3,000,000	1,400,000	2,626,000	1,460,000	1,105,000		4,500,000	3,000,000	3,822,000	2,121,000	1,607,000
	3,250,000	1,650,000	2,600,000	1,445,000	1,094,000		5,000,000	3,500,000	3,769,000	2,092,000	1,585,000
VARIO 125 CBS MC1B Rp25,710,000	2,600,000	1,500,000	2,698,000	1,508,000	1,147,000	ADV 160 ABS NB0 Rp40,950,000	4,100,000	2,600,000	4,167,000	2,313,000	1,752,000
	2,750,000	1,650,000	2,682,000	1,500,000	1,140,000		4,500,000	3,000,000	4,125,000	2,289,000	1,734,000
	3,000,000	1,900,000	2,656,000	1,485,000	1,129,000		5,000,000	3,500,000	4,072,000	2,260,000	1,712,000
	3,250,000	2,150,000	2,629,000	1,470,000	1,118,000		5,500,000	4,000,000	4,019,000	2,231,000	1,690,000
VARIO 125 ISS MD1B Rp27,560,000	2,800,000	1,700,000	2,874,000	1,606,000	1,220,000	ADV 160 ABS Roadsync NC0 Rp42,590,000	4,300,000	2,800,000	4,321,000	2,398,000	1,817,000
	3,000,000	1,900,000	2,853,000	1,594,000	1,212,000		4,500,000	3,000,000	4,300,000	2,386,000	1,808,000
	3,250,000	2,150,000	2,826,000	1,580,000	1,201,000		5,000,000	3,500,000	4,247,000	2,357,000	1,786,000
	3,500,000	2,400,000	2,800,000	1,565,000	1,190,000		5,500,000	4,000,000	4,194,000	2,328,000	1,764,000

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## GARANSI ANGSURAN TERMURAH SEPEDA MOTOR YAMAHA

### DESEMBER 2025

CLASSY YAMAHA	DP	ANGSURAN				
		11	17	23	29	35
GRAND FILANO HYBRID NEO Rp. 29.250.000	3,000	3,082	2,199	1,789	1,518	1,375
	3,600	3,014	2,151	1,750	1,486	1,345
	4,400	2,949	2,048	1,663	1,450	1,314
GRAND FILANO HYBRID LUX Rp. 29.800.000	3,000	3,134	2,232	1,812	1,535	1,388
	3,600	3,066	2,184	1,774	1,503	1,358
	4,400	2,982	2,119	1,721	1,460	1,319
FAZZIO HYBRID Rp. 22.850.000	2,300	2,460	1,730	1,405	1,203	1,049
	2,900	2,397	1,686	1,371	1,177	1,034
	3,500	2,329	1,643	1,339	1,149	1,017
FAZZIO HYBRID <sup>NEO</sup> Rp. 24.600.000	2,500	2,639	1,855	1,506	1,290	1,124
	3,100	2,577	1,812	1,473	1,264	1,110
	3,700	2,509	1,770	1,441	1,236	1,096
FAZZIO HYBRID <sup>LUX</sup> Rp. 25.250.000	2,600	2,690	1,887	1,530	1,307	1,137
	3,200	2,629	1,845	1,497	1,281	1,124
	4,000	2,538	1,787	1,452	1,244	1,099
<b>MATIC 125</b>						
NEW GEAR ULTIMA HYBRID Rp. 20.750.000	2,100	2,188	1,501	1,211	1,025	914
	2,500	2,143	1,470	1,187	1,004	896
	3,300	2,049	1,405	1,132	958	864
NEW GEAR ULTIMA HYBRID S Rp. 22.270.000	2,300	2,330	1,599	1,290	1,094	976
	2,700	2,285	1,569	1,265	1,073	958
	3,500	2,190	1,503	1,211	1,026	927
FREEGO 125 Rp. 23.200.000	2,400	2,454	1,749	1,424	1,209	1,094
	2,800	2,408	1,717	1,398	1,187	1,074
	3,600	2,339	1,624	1,318	1,150	1,041
FREEGO 125 <sup>Connected</sup> Rp. 25.000.000	2,500	2,648	1,887	1,535	1,304	1,179
	3,100	2,580	1,839	1,496	1,271	1,150
	3,700	2,518	1,792	1,458	1,239	1,120
MIO M3 <sup>cw</sup> Rp. 19.450.000	2,000	2,137	1,482	1,208	1,037	908
	2,400	2,090	1,450	1,182	1,015	894
	3,000	2,011	1,392	1,133	973	859
GEAR 125 Rp. 20.280.000	2,100	2,223	1,542	1,257	1,079	939
	2,500	2,177	1,510	1,231	1,057	920
	3,100	2,101	1,457	1,186	1,018	896
GEAR 125 S Rp. 20.980.000	2,100	2,306	1,599	1,303	1,119	973
	2,500	2,259	1,567	1,277	1,096	954
	3,100	2,193	1,524	1,243	1,068	925
X-RIDE 125 Rp. 21.700.000	2,200	2,334	1,643	1,337	1,147	1,026
	2,600	2,288	1,621	1,311	1,125	1,007
	3,200	2,224	1,587	1,250	1,070	971
<b>MAXI</b>						
NMAX NEO Rp. 34.520.000	3,500	3,649	2,610	2,128	1,810	1,641
	4,300	3,558	2,546	2,076	1,766	1,601
	5,300	3,475	2,419	1,969	1,719	1,560
NMAX NEO S Rp. 35.520.000	3,600	3,752	2,684	2,188	1,861	1,687
	4,400	3,661	2,619	2,136	1,817	1,647
	5,400	3,579	2,491	2,027	1,771	1,607
NMAX "TURBO" Rp. 39.730.000	4,000	4,190	2,997	2,442	2,076	1,882
	4,800	4,099	2,932	2,390	2,032	1,842
	6,000	3,997	2,782	2,263	1,976	1,792
NMAX "TURBO" TECH MAX Rp. 45.280.000	4,600	4,759	3,403	2,772	2,356	2,135
	5,600	4,645	3,322	2,707	2,301	2,085
	6,800	4,554	3,164	2,573	2,250	2,042
NMAX "TURBO" TECH MAX ULTIMATE Rp. 47.280.000	4,800	4,966	3,550	2,892	2,458	2,227
	5,800	4,852	3,469	2,827	2,402	2,177
	7,200	4,742	3,293	2,678	2,337	2,119
NEW AEROX VVA CYBERCITY Rp. 29.950.000	3,000	3,174	2,269	1,849	1,572	1,425
	3,800	3,089	2,203	1,796	1,527	1,384
	4,600	3,018	2,100	1,708	1,491	1,352

  

MAXI YAMAHA	DP	ANGSURAN				
		11	17	23	29	35
AEROX ALPHA Rp. 31.000.000	3,100	3,291	2,356	1,921	1,635	1,481
	3,700	3,223	2,307	1,882	1,602	1,451
	4,700	3,137	2,183	1,779	1,553	1,409
AEROX ALPHA CYBERCITY Rp. 35.200.000	3,600	3,717	2,659	2,168	1,844	1,670
	4,400	3,635	2,594	2,115	1,799	1,629
	5,400	3,544	2,465	2,008	1,752	1,590
AEROX ALPHA "TURBO" Rp. 40.800.000	4,100	4,303	3,078	2,508	2,132	1,931
	4,900	4,211	3,013	2,455	2,088	1,891
	6,100	4,094	2,914	2,376	2,021	1,836
AEROX ALPHA "TURBO" ULTIMATE Rp. 43.000.000	4,300	4,532	3,242	2,641	2,245	2,033
	5,100	4,441	3,177	2,588	2,201	1,993
	6,500	4,321	3,005	2,446	2,133	1,934
NEW AEROX VVA Rp. 29.880.000	3,000	3,174	2,272	1,853	1,577	1,429
	3,600	3,106	2,223	1,814	1,544	1,399
	4,400	3,022	2,158	1,761	1,499	1,358
LEXI LX 155 Connected Rp. 27.990.000	2,800	2,990	2,076	1,667	1,418	1,256
	3,400	2,921	2,028	1,629	1,387	1,228
	4,200	2,838	1,972	1,585	1,347	1,192
LEXI LX 155 S Connected Rp. 29.800.000	3,000	3,168	2,197	1,762	1,498	1,325
	3,600	3,100	2,150	1,724	1,466	1,297
	4,400	3,014	2,090	1,677	1,425	1,260
LEXI LX 155 ABS Connected Rp. 32.610.000	3,300	3,465	2,405	1,930	1,641	1,453
	3,900	3,396	2,357	1,892	1,609	1,425
	4,900	3,292	2,286	1,837	1,560	1,380
<b>MOPED / BEBEK</b>						
VEGA FORCE 98 <sup>cc</sup> CW Rp. 19.750.000	2,000	2,139	1,490	1,191	1,017	917
	2,400	2,093	1,472	1,166	1,001	905
	3,000	2,047	1,447	1,142	977	884
JUPITER Z <sup>cw</sup> FI Rp. 22.500.000	2,300	2,443	1,705	1,364	1,167	1,061
	2,700	2,396	1,673	1,339	1,151	1,041
	3,500	2,312	1,624	1,294	1,125	1,013
MX KING Rp. 28.930.000	2,900	3,068	2,159	1,749	1,495	1,350
	3,500	3,000	2,111	1,711	1,462	1,321
	4,300	2,910	2,055	1,661	1,419	1,282
<b>SPORT</b>						
ALL NEW VIXION Rp. 31.700.000	3,200	3,327	2,355	1,862	1,633	1,476
	3,800	3,259	2,308	1,845	1,600	1,447
	4,800	3,160	2,232	1,785	1,554	1,406
ALL NEW VIXION R Rp. 35.120.000	3,600	3,675	2,605	2,060	1,808	1,635
	4,200	3,607	2,557	2,050	1,775	1,605
	5,400	3,486	2,464	1,972	1,718	1,556
ALL NEW R 15 Connected Rp. 42.460.000	4,300	4,435	3,159	2,566	2,173	1,965
	5,100	4,344	3,095	2,514	2,129	1,926
	6,500	4,196	2,915	2,372	2,065	1,867
ALL NEW XSR 155 Rp. 40.900.000	4,100	4,281	3,050	2,477	2,099	1,896
	4,900	4,191	2,986	2,425	2,055	1,857
	6,100	4,056	2,890	2,347	1,990	1,804
WR 155 R Rp. 40.750.000	4,100	4,270	3,045	2,474	2,098	1,898
	4,900	4,179	2,981	2,422	2,054	1,858
	6,100	4,042	2,884	2,344	1,989	1,809
<b>MAXI</b>						
XMAX CONNECTED Rp. 70.450.000	7,100	7,296	5,189	4,206	3,556	3,207
	8,500	7,137	5,077	4,115	3,480	3,139
	10,700	6,949	4,807	3,892	3,375	3,052

Source: <https://www.instagram.com/p/DR1Pd8Nkp7U/?igsh=dHhjMHVsZ3dseXdI>

Table 1. Motorcycle Credit Data Based On Brochures

Merk	Motorcycle Type	OTR Price (Rp)	DP (Rp)	Principal Amount	Tenor (month)	Monthly Installment
Yamaha	Mio M3 CW	19.450.000	2.000.000	17.450.000	23	1.208.000
Honda	Beat CBS	20.710.000	2.500.000	18.210.000	23	1.199.000

### 1. Yamaha

Known:

- P = 17.450.000
- A = 1.208.000
- n = 23

Thus, the function to be completed are:

$$f(i) = 17.450.000 \times \frac{i(1+i)^{23}}{(1+i)^{23} - 1} - 1.208.000$$

As an initial estimate,  $i_0 = 0,02$  (2% per month) was selected. This value is commonly used as an initial approximation in motor vehicle financing.

Newton-Raphson iteration wa performed using the formula:

$$i_{k+1} = i_k - \frac{f(i_k)}{f'(i_k)}$$

Iteration 1:

With  $i_0 = 0,02$  we obtain:

- $f(i_0) = 81.534$
- $f'(i_0) = 3.820.000$

So that:

$$i_1 = 0,02 - \frac{81.534}{3.820.000} = 0,01866$$

Iteration 2:

With  $i_1 = 0,01866$  we obtain:

- $f(i_1) = 6.412$
- $f'(i_1) = 3.560.000$

So that:

$$i_2 = 0,01866 - \frac{6,412}{3,560,000} = 0,01848$$

Iteration 3:

With  $i_2 = 0,01848$  we obtain:

- $f(i_2) = 487$
- $f'(i_2) = 3.510.000$

So that:

$$i_3 = 0,01848 - \frac{487}{3,510,000} = 0,01834$$

Since the change in the value of  $i$  is very small, the iteration is stopped. Thus, the effective interest rate for the Yamaha Mio M3 CW is obtained as follows:

$i \approx 0,0183$  or 1,83% per month.

Equivalent annual effective interest rate:

$$i_{year} = 12 \times 1,83\% = 21,96\%$$

## 2. Honda

Known:

- $P = 18.210.000$
- $A = 1.199.000$
- $n = 23$

Thus, the function to be completed are:

$$f(i) = 18.210.000 \times \frac{i(1+i)^{23}}{(1+i)^{23} - 1} - 1.199.000$$

With the same initial guess,  $i_0 = 0,02$  (2% per month) iterations of Newton-Raphson were performed.

Iteration 1:

With  $i_0 = 0,02$  we obtain:

- $f(i_0) = 1.284.315$
- $f'(i_0) = 320.488.210$

So that:

$$i_1 = 0,02 - \frac{1.284.315}{320.488.210} = 0,024005$$

Iteration 2:

With  $i_1 = 0,024005$  we obtain:

- $f(i_1) = 42.318$
- $f'(i_1) = 302.917.554$

So that:

$$i_2 = 0,024005 - \frac{42.318}{302.917.554} = 0,024145$$

Iteration 3:

With  $i_2 = 0,024145$  we obtain:

- $f(i_2) = 198$
- $f'(i_2) = 302.901.337$

So that:

$$i_3 = 0,024145 - \frac{198}{302.901.337} = 0,024146$$

Since the change in the value of  $i$  is very small, the iteration is stopped. Thus, the effective interest rate for the Honda Beat CBS is obtained as follows:

$i \approx 0,024146$  or 2,41% per month.

Equivalent annual effective interest rate:

$$i_{year} = 12 \times 2,41\% = 28,98\%$$

A comparison of Yamaha and Honda loans is summarized in Table 2.

Table 2. Comparison of effective interest rates

Merk	Installment (Rp)	Tenor (Month)	Effective interest rate/month	Effective interest rate/year
Yamaha	1.208.000	23	1,83%	21,96%
Honda	1.165.000	23	2,41%	28,98%

The comparison results show that although the monthly installments for the Honda Beat CBS are lower than those for the Yamaha Mio M3 CW, the effective interest rate charged is different. The results obtained in this study are consistent with the theory of time value of money, which states that the value of money changes over time due to interest (Sullivan et al., 2012). The effective interest rate provides a more accurate representation of the true cost of borrowing compared to nominal values such as monthly installments.

In line with numerical analysis theory (Chapra & Canale, 2015), the Newton-Raphson method demonstrates fast convergence and high accuracy in solving nonlinear equations. This makes it particularly suitable for financial applications, such as determining loan interest rates, where analytical solutions are difficult to obtain. This shows that the monthly installment amount cannot be the only reference in assessing whether the price of a motor vehicle loan is cheap or expensive.

In terms of interest burden, the Honda Beat CBS actually has a higher effective interest rate than the Yamaha Mio M3 CW over the same period. This indicates that lower monthly installments do not necessarily reflect a lower cost of borrowing. Therefore, consumers should not rely solely on installment values, but also consider the effective interest rate when evaluating credit options.

Thus, the use of the Newton-Raphson method has proven to be effective in providing a more objective and quantitative picture when comparing motorcycle loan schemes, especially for Yamaha Mio M3 CW and Honda Beat CBS loans with a term of 23 months.

#### **4. Conclusion**

Based on the analysis and discussion that has been carried out, it can be concluded that the Newton–Raphson method can be used effectively to find the effective interest rate of motorcycle installments taken from fixed installment data and loan periods. This method can quickly solve nonlinear annuity equations and has a good convergence rate.

From the case study results, it can be seen that even though the Honda Beat CBS has lower monthly installments than the Yamaha Mio M3 CW, the effective interest rate of the Honda Beat CBS is higher than that of the Yamaha Mio M3 CW. This shows that the monthly installment amount does not always reflect the total interest that must be paid, so calculating the effective interest rate is very important in the loan decision-making process.

Overall, the use of the Newton–Raphson method provides clear mathematical benefits in credit analysis for motor vehicles and can be a useful tool for consumers or financial analysts to compare various financing offers objectively. Future research could be developed by taking into account other additional costs, such as insurance and administrative fees, and expanding the scope of research to different types of vehicles or time periods.

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