Mr. Hassan Uwajimara has purchased his home for $187,500. He made a 20% down payment and borrowed 80% from the County Plantation Bank at 5% nominal annual interest rate compounded monthly. He had to pay 2 points (each point equals 1% of the loan amount) to obtain this low interest rate, as well as 1% of the loan amount for closing/loan origination costs, at the time of the home purchase, and those amounts were just added to his loan outstanding balance. The loan is amortized over 30 years and level monthly payments are made at the end of each month. There is a 2% penalty on any principal balance repaid early. At the end of the second year, Mr. Uwajimara wins the Powerball lottery and becomes a multimillionaire. He decides to pay off his loan, regardless of any penalties. Calculate the effective annual rate of return earned by the County Plantation Bank on their investment in Mr. Uwajimara’s loan.

A. 7.77%  B. 6.68%  C. 6.25%  D. 5.95%  E. 5.65%

Solution.
Mr. Uwajimara is borrowing 80% of $187,500, i.e., $150,000, and pays fees totaling 3% of $150,000, i.e., $4,500, for a total of $154,500. This is, however, not the total capital outlay by the County Plantation Bank, as they only put up $150,000. The bank receives for that, for two years, monthly payments of \( \frac{154,500}{360 \times \frac{5\%}{12}} = \$829.39 \), a repayment of the loan balance of \( \frac{154,500}{360 \times \frac{5\%}{12}} \cdot a_{336 \times \frac{5\%}{12}} \approx \$149,824.50 \) after two years, and a penalty of 2% of $149,824.50, equal to $2,996.49, at the same time. So the bank invests $150,000 and receives $829.30 monthly for two years, and $149,824.50 + $2,996.49 = $152,820.99 at the end of those two years. Let \( j \) be the monthly effective interest rate corresponding to the effective annual rate of return we are looking for. Then

\[
150,000.00 = 829.39a_{\frac{2\times 12}{12}} + 152,820.99v_{j}^{24},
\]

and this is solved, using a financial calculator, to

\[
j = 0.00625797 = 0.625797\%.
\]

This gives the annual effective interest rate of

\[
(1 + 0.00625795)^{12} - 1 = 0.07773473 \approx 7.77\%.
\]

Answer A.