Mortgage Repayment Simulation Report

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Discussion:

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2. Key findings
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   b) Results
   c) Implementation in MAPLE
   d) Conclusion

Discussion/Analysis:

1.Background Information:

This project models the repayment of a $500,000 mortgage at a fixed annual interest rate of 6 percent over 30 years. A differential equation was solved to determine the required annual payment, which was then converted into a monthly amount for simulation. The code applies daily interest and subtracts monthly payments, first assuming they occur on the last day of each month and then on the fifteenth day. Comparing these scenarios shows how payment timing affects the accumulation of interest and the final balance of the loan over the full term.

2. Key findings:

a) Method:

A differential equation representing the mortgage balance under continuous compounding and annual payments was solved to calculate the annual payment required. This annual amount was converted into an equivalent monthly payment, and a simulation was conducted using daily compounding. The simulation was repeated under two scenarios: payments applied on the last day of each month, and payments applied on the fifteenth day of each month.

b) Results:

Solving the differential equation produced an annual payment of approximately $35,941, equivalent to monthly payments of about $2,995. When payments were made on the last day of each month, the loan concluded with a remaining balance of roughly $7,005 after 30 years. When payments were made on the fifteenth day of each month, the loan ended with a balance of approximately –$649, reflecting a slightly more aggressive payoff.

c) Implementation in MAPLE:

The code begins by defining the key parameters of the problem: the initial mortgage balance, the annual interest rate, and the payment amount. The interest rate is converted into a daily rate to reflect daily compounding, and the annual payment is divided into equal monthly payments. A list of days in each month is used to simulate the passage of time across the 30-year term. Nested loops are employed to update the balance each day by adding accrued interest and subtracting payments on the specified day of the month. This structure allows the simulation to capture both the cumulative effect of daily compounding and the impact of payment timing on the overall loan balance.

d) Conclusion:

The findings demonstrate that the timing of monthly payments influences the final loan balance under daily compounding. Payments made earlier in the month reduce accumulated interest and bring the mortgage payoff closer to exact completion, whereas later payments allow more interest to accrue and leave a small outstanding balance.