

Consulting Report on Mortgage Rates: Find Your Perfect Home**Prepared for:** Prime Mortgage and Company**Prepared by:** Brookes Consulting

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Abstract:

In everyone's life, there comes a point in time where one will need a home to live in, aside from the home they were raised in. Purchasing a home will most likely be the biggest investment and financial decision people will have to make. This leads to the overall idea of a mortgage loan. Mortgages are beneficial as it is a long term investment that can yield equity growth as well as tax deductions. Many can't just buy a house outright, which catalyzes the use of a mortgage loan so that it can be affordable and paid back over the specified loan term. The principal is what is being borrowed and agreed to pay back, however, interest is the cost of borrowing the principal which is paid to the lender/bank.

This report will aim to analyze the strengths and pros that Primary Mortgage and Company partnering with Brookes Consulting will bring. With this partnership, we will be able to see the advantages that Primary Mortgage and Company will potentially experience and in return be able to offer confidence and trust in customers to gain more potential borrowers in the future.

Through the partnership with Brookes Consulting, and the growing customer trust gained through Primary Mortgage and Company's honest and transparent work, it will only continue to increase borrowers appreciation, understanding, and satisfaction. In return, potential borrowers will be able to continue to approach the biggest investment of their lives with full confidence and no ounce of hesitation. Borrowers will understand how a mortgage works, what factors play into the loan, and ultimately which program will best suit their needs and wants to yield the best rates compared to other companies.

Introduction:

The goal of Brookes Consulting is to work with Prime Mortgage and Company in efforts to obtain the greatest number of potential possible borrowers. Through the utilization of charts, readable figures of information, and summaries of overall costs in regards to mortgages. When a mortgage loan is created, there are many different factors and characteristics that play an important role in determining profit. Some of these characteristics are the principal amount, annual interest, length of the loan term, and the monthly payment. With full understanding of these characteristics, one can develop an understanding of what the most optimal factor is in order to maximize or increase profitability.

This report will provide borrowers and potential borrowers with the knowledge to identify advantages and disadvantages of certain types of loans. Borrowers will be equipped with confidence to make the best decision for their particular personal financial situation. Through partnership with Brookes Consulting, it will give borrowers the confidence they need, allowing them to outweigh the pros and cons of their current financial situation, and ultimately choose what type of loan best suits their future.

The mortgage characteristics discussed above can be utilized in mortgage formulas which will aid in determining the monthly payments. For instance, the formula includes the principal amount (P), annual percentage rate (r), and number of months (n). These three factors can be applied to the formula to find the monthly payment (x). Once x is calculated, it is now easy to visually understand and analyze which factors may be benefiting to more profit or potentially decreasing profit. With that knowledge in mind, each variable can be changed one at a time while the others remain constant.

This will help to ultimately see which variable holds the most influence on returning the highest profit for the borrower.

Regarding this formula, it can be calculated through Python to increase optimal efficiency and accuracy. Programming will also allow an easier visual representation of how each variable plays its role in affecting the resulting profit. Utilizing this tool, will overall help the customer to make a decision while having full confidence in that decision.

According to Bank Rate, the most common mortgage currently in the market is a conventional 30 year fixed loan with a 6.78% APR (Ostrowski, bankrate.com). For our particular example, we will assume a conventional 30 year fixed \$300,000.00 loan with 7% APR. In other words, $n=360$ months, $r=.07/12$, and $P=300,000$. Applying the variables that we discussed previously to these characteristics will allow us to identify, analyze, and formulate the effects they will have on the total profitability.

Data and Method:

We must develop a formula that we can use to apply the principal amount (P), annual percentage rate (r), and number of months (n) to solve for our x , the monthly payment. As stated earlier, this will allow for comparison and the ability to compare/contrast the profitability based on different payment options and rates. Thus, as shown below, the formula will allow us to plug in our specified values into each variable to calculate the monthly payment:

$$x = \frac{P((1+r)^n)*r}{((1+r)^n-1)}$$

$$P_k = P(1 + r)^k + x \frac{1 - (1 + r)^k}{r}$$

The equation shown above represents the kth monthly payment as it is a recursive formula. This is the principal remaining each month. So basically this recursive formula is derived from plugging in different k values, where $k=1,2,3,\dots,n$.

In regards to our particular example, we can use $n=360$ months for the 30 year term, $r=.07/12$ for the 7% APR(.07/12 months), and $P=300,000$ for the principal amount. If we use the provided formula, we will obtain a monthly mortgage payment = \$1995.91 over the duration of the 30 year term. Now given that we have all the variables and we need to calculate our monthly mortgage, we can modify each variable one at a time to see how it affects the overall profitability, and to also see the different monthly payments that result. For example, let's change our annual interest rate and make a table of different rates to see how it affects the monthly payments.

Annual Percentage Rate (APR %)	Monthly Mortgage Payment (\$)
7.50%	\$ 2097.6435256583295
7.25%	\$ 2046.5288401685702
7%	\$ 1995.907485537547
6.75%	\$ 1945.794289704647
6.50%	\$ 1896.204070478896
6.25%	\$ 1847.1516012791838

Although this table and process of testing for different interest rates may seem trivial or self explanatory, it only makes logical sense that as the rates go down, we see

a decline in the monthly payments, and vice versa when the rates go up past our given 7% APR. Of course from a business perspective, the higher the interest rates are the greater the profitability will be. In the results section, we will do further analysis and see how profitability can be affected by changing the loan term duration.

Results:

Regarding profitability once again, it is important to understand how much will go to the bank overall. In other words, we need to figure out how much percent will go to pay the principal amount, and how much percent will go towards paying interest. Being said, to accomplish this we can total the amount of monthly payments owed over the entire loan period. So for instance, we calculated our monthly payment to be \$1995.91 over a 30 year period. To calculate the total amount of monthly payments we can multiply the period by the monthly payment: $\$1995.91 \times 360 \text{ months} = \$718,526.69$. In result, we have found that the entire payment made will be \$718,526.69. Next, if we subtract our principal ($P = 300,000$) from the total calculated we can find the total profitability that the bank will make. Thus, we can show the calculation: $\$718,526.69 - \$300,000 = \$418,526.69$. Therefore, we can conclude that \$418,526.69 will be owed to the bank. Likewise, as stated previously in the 'Data and Method' section, as the APR increases, so will the borrower's monthly payments, which of course results in greater profitability to the bank and lender. Once again, the amount owed on the principal is the interest paid to the lender/bank, so if you logically think about it, as the amount owed on the principal increases, it is only reasonable that the profit going to the banks will continue to go up, showing a clear correlation between the two variables.

As discussed earlier in the 'Data and Method' section, the length of the loan and duration plays a big role in the profitability as well. For example, every borrower has a different preference, personal financial situation, which makes for different types of loans. Regardless if a conventional 30 year loan is the most common, some borrowers will look into and gravitate to other options like conforming loans, non conforming loans, and even different loan periods such as 10 years, 15 years, 30 years, etc. So with that being said, this is another factor that must be taken into consideration as options for borrowers, future potential borrowers, as well as the banks and lenders who are gaining profit from the transaction.

To analyze how different lengths of loan play a role into profitability, we can input different values for the variable (n) in terms of months. Below is a table that shows a 10, 15, and 30 year period with its corresponding payments to show the sensitivity analysis.

	10 (years) or 120 (months)	15 (years) or 180 (months)	30 (years) or 360(months)
Monthly Payment	\$3,483.25	\$2,696.48	\$1,995.91
Total Payment Over Entire Period	\$417,990.00	\$ 485,366.40	\$718,526.69
Interest Paid to Bank/Lender	\$117,990.00	\$185,366.40	\$418,526.69
Extra Earned on 15 and 30 years		(\$185,366.40 - \$117,990.00) = \$67,376.40	(\$418,526.69 - \$185,366.40) = \$233,160.29

Referring back to the chart, it is evident to see that as the duration period increases, the monthly payment for the borrower will decrease, however, the total

payment over the entire period will increase. Now, in regards to profitability and interest paid to the bank/lender, it will increase as the duration period of the loan increases. The last section on the chart shows the difference between the different durations and the returns that the banks make. Ultimately, from a bank standpoint, it is clear that the longer the term, the more they will make from the borrower's mortgage. Therefore, a 30 year term will give them the most profit in the end. It only makes sense then that a bank would offer low interest rates alongside longer payment periods. In result, it'll attract potential customers with the lower interest rate, and in return it'll bring the bank/lenders more profit.

Below is my provided code done in Python. It shows the derivation of our original monthly recursive formula. In addition, I showed the code for my calculations to obtain the monthly payments, while testing for different interest rates. I also showed the code for my calculations to obtain the monthly payments, while testing for different loan duration periods. Lastly, I provided pictures of my written derivation to obtain our monthly recursive formula.

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Equations used for Consulting Report

$$x = \frac{P((1+r)^n)r}{((1+r)^n - 1)}$$

$$P_k = P(1+r)^k + x \frac{1-(1+r)^k}{r}$$

```
In [5]: #Mortgage Calculation from textbook chapter 4
P = 300000
r = 0.07/12 #annual percentage rate (APR) 7% per month = 0.07 per yr/12 = 0.0058333333
n = 360
x = P*((1+r)**n)*r/((1+r)**n-1)
print("mortgage payment per month= $", x)
```

mortgage payment per month= \$ 1995.907485537547

```
In [7]: P = 300000
r = 0.075/12
n = 360
x = P*((1+r)**n)*r/((1+r)**n-1)
print("mortgage payment per month= $", x)
```

```
P = 300000
r = 0.0725/12
n = 360
x = P*((1+r)**n)*r/((1+r)**n-1)
print("mortgage payment per month= $", x)
```

```
P = 300000
r = 0.07/12
n = 360
x = P*((1+r)**n)*r/((1+r)**n-1)
print("mortgage payment per month= $", x)
```

```
P = 300000
r = 0.0675/12
n = 360
x = P*((1+r)**n)*r/((1+r)**n-1)
print("mortgage payment per month= $", x)
```

```
P = 300000
r = 0.065/12
n = 360
x = P*((1+r)**n)*r/((1+r)**n-1)
print("mortgage payment per month= $", x)
```

```
P = 300000
r = 0.0625/12
n = 360
x = P*((1+r)**n)*r/((1+r)**n-1)
print("mortgage payment per month= $", x)
```

mortgage payment per month= \$ 2097.6435256583295

mortgage payment per month= \$ 2046.5288401685702

mortgage payment per month= \$ 1995.907485537547

mortgage payment per month= \$ 1945.794289704647

mortgage payment per month= \$ 1896.204070478896

mortgage payment per month= \$ 1847.1516012791838

```
In [9]: ► P = 300000
r = 0.07/12
n = 360
x = P*((1+r)**n)*r/((1+r)**n-1)
print("mortgage payment per month= $", x)

P = 300000
r = 0.07/12
n = 180
x = P*((1+r)**n)*r/((1+r)**n-1)
print("mortgage payment per month= $", x)

P = 300000
r = 0.07/12 |
n = 120
x = P*((1+r)**n)*r/((1+r)**n-1)
print("mortgage payment per month= $", x)

mortgage payment per month= $ 1995.907485537547
mortgage payment per month= $ 2696.484812557275
mortgage payment per month= $ 3483.2543765587125
```

Modeling Mortgage Payment

Mortgage - Pay a loan on a house

P - Principal (How much you borrow)

n - (How long you want to borrow)

usually, payments are monthly

r - interest rate

$x = ?$

Monthly Payment

$$P_1 = \underbrace{P}_{\text{Principal}} + \underbrace{Pr}_{\substack{\text{Principal} \\ \times \\ \text{interest} \\ \text{rate}}} - \underbrace{x}_{\text{Monthly payment}} = P(1+r) - x$$

2nd Month

$$P_2 = P_1(1+r) - x$$

$$P_2 = (P(1+r) - x)(1+r) - x$$

$$= P(1+r)^2 - (1+r)x - x$$

3rd Month $\Rightarrow P_3 = P_2(1+r) - x$

$$= (P(1+r)^2 - (1+r)x - x)(1+r) - x$$

$$= P(1+r)^3 - (1+r)^2x - (1+r)x - x$$

kth month $P_k = P(1+r)^k - (1+r)^{k-1}x - \dots - (1+r)^2x - (1+r)x - x$

$$= P(1+r)^k - x \frac{1-(1+r)^k}{1-(1+r)}$$

$$= P(1+r)^k + x \frac{1-(1+r)^k}{r}$$

So \Rightarrow

$$x = \frac{P(1+r)^n r}{(1+r)^n - 1}$$

(monthly payment)

Remember This!

Conclusion:

Based on the results calculated above, it is reasonable to conclude that for a conventional fixed rate mortgage, a longer term such as a 30 year term seemed to be the most ideal and best option, bringing the most profitability. In conclusion, these resources provided above will ultimately bring awareness, transparency, and most importantly confidence to borrowers and future potential borrowers. Borrowers can rely on getting a multitude of different options in order to consider each of them and to make their final decision based on what works best for that particular individual.

Regarding pros and cons of the method discussed above, I believe that once again a positive is that borrowers will be brought full transparency as well as supporting resources to help build their confidence to make the best decision for their biggest investment. Possible negative characteristics of the method is that some borrowers may or may not be as proficient in mathematics so maybe the equations can become a little overwhelming. However, on the other hand, a positive that can come out of that is they can fully utilize the tables and charts to get a better visual understanding of the process and calculations. Furthermore, sensitivity and/or risk analysis can provide optimal understanding to borrowers as they will be able to see the entire process depending on which options they are comparing. An in depth analysis and understanding of that analysis will only equip borrowers with trust in the bank/lender. Furthermore, this will also continue to attract more and more potential borrowers with interest in Prime Mortgage and Company for their mortgage. With that being said, Brookes Consulting is eager to continue to provide you with all the necessary information, resources, and

reliability to continue to gain future borrowers who are eager and searching to get a mortgage loan.

References:

Ostrowski. "Mortgage Rates: Compare Today's Rates." *Bankrate*. Web. 09 Apr. 2023.

<https://www.bankrate.com/mortgages/mortgage-rates/>