

Lab Activity: JavaScript

1 Introduction

In this lab activity you will create a JavaScript program, based on what has been discussed in class. Let's take this opportunity to create a program that does something useful that you can use at some point in your lives. Since most of you will be buying a house, let's create a Mortgage Calculator. This calculator can be used to estimate your monthly mortgage payments, based on standard information, such as borrowed money (aka principal), annual interest rate, loan period, and down payment.

This program should also show how much of your mortgage monthly payment goes to interest, how much goes toward the principal, and how much is the principal value, month-by-month in a graph form.

2 Mortgage Theory

Want to figure out how much your monthly mortgage payment will be? For the mathematically inclined, here's a formula to help you calculate mortgage payments manually:

Equation for mortgage payments

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

Where:

- M is the monthly mortgage payments
- P is the principal loan amount
- r is your **monthly** interest rate. Lenders provide you with an **annual** rate, so you'll need to divide that figure by 12 (the number of months in a year) to get the monthly rate. If your interest rate is 5 percent, your monthly rate would be 0.004167 (0.05/12=0.004167).
- n is the number of payments over the loan's lifetime. Multiply the number of years in your loan term by 12 (the number of months in a year) to get the number of payments for your loan. For example, a 30-year fixed mortgage would have 360 payments (30x12=360)

Example: Imagine that the house you are interested in is listed for \$600,000.00. The lender asks you to put a down payment of at least \$100,000.00. The annual interest rate is 5% and the loan period is 30 years.

In this situation, the principal loan amount (P) is the difference between Sales price minus down payment, what is \$600,000.00 - \$100,000.00 = \$500,000.00.

The monthly interest rate (r) is 0.05 / 12 = 0.004167

The number of payments (n) is 30 * 12 = 360

Therefore, the monthly mortgage payment (M) is calculated as follows:

$$M = 500,000.00 \frac{0.004167(1 + 0.004167)^{360}}{(1 + 0.004167)^{360} - 1}$$

$$M = \$ 2,684.11$$

So, every month you will pay \$ 2,684.11. A portion of this payment goes to the interest rate, and the rest goes toward the principal. The percentage that goes towards the interest rate decreases over time, while the percentage that goes to the principal increases over time.

How to calculate principal and interest:

- Principal = purchase price - down payment
- Monthly interest = (principal × interest rate) ÷ 12 months
- Monthly principal = monthly mortgage payment - interest payment = monthly principal payment

For this example, the Figure below shows how the vary over time.

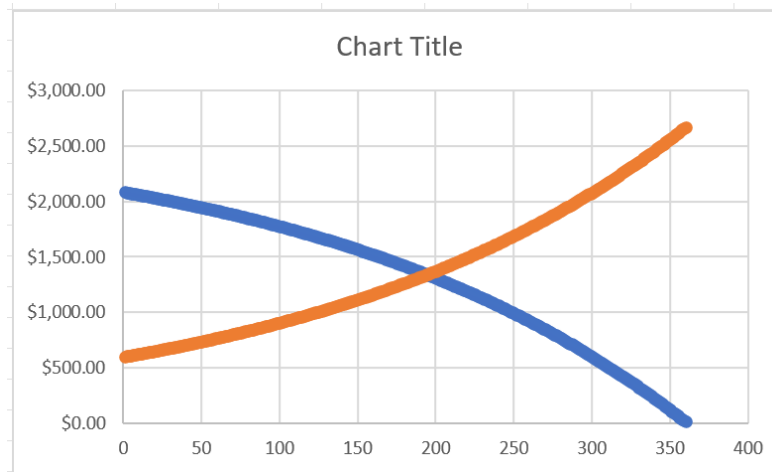


Figure 1: Monthly payments towards the interest rate and principal over time

And the amount of money that you still owe to the lender can be shown in Figure 2.

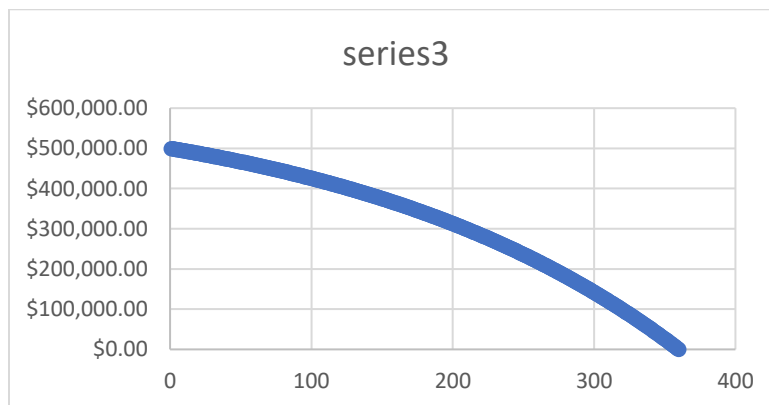


Figure 2: Principal value over time

3 The expected webpage contents

Figure 3 shows what is the expected contents of your webpage application.

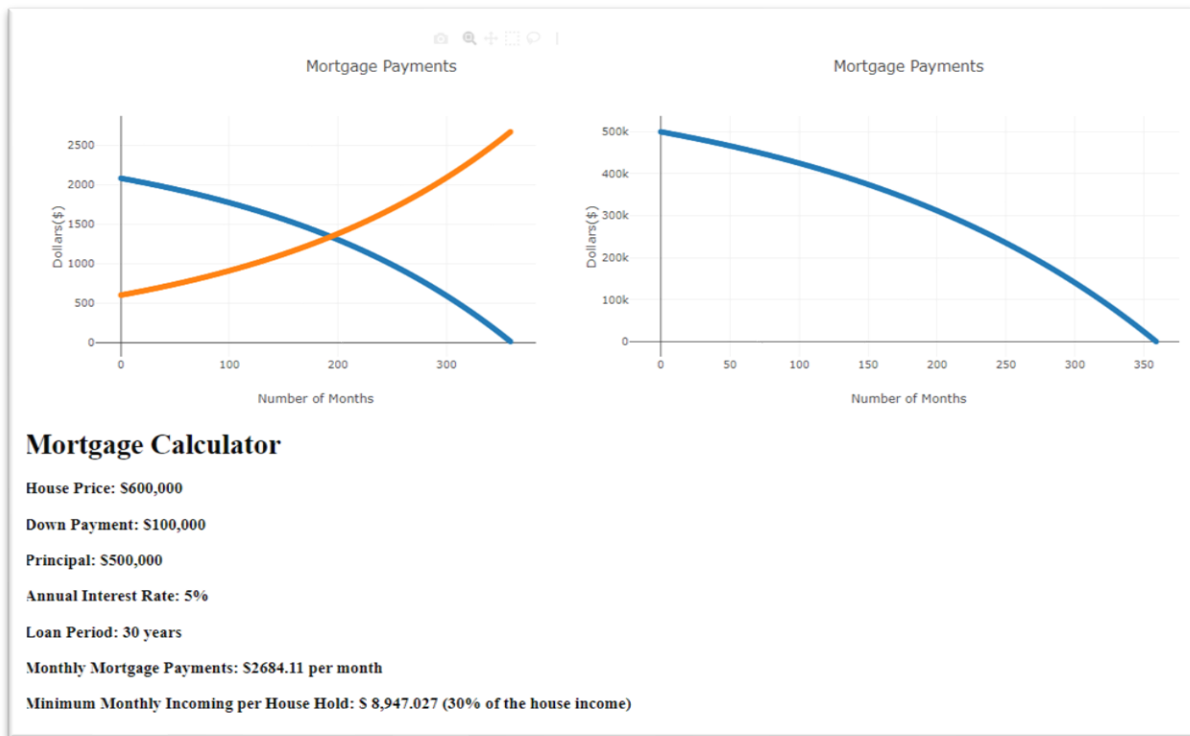


Figure 3: The Mortgage Calculator Webpage

4 General Program Structure

You could implement your program in any way. However, I want to “force” you to create a program that uses lots of JavaScript functions. With this in mind, I am giving you a skeleton of your main program and you just need to “fill the blanks”.

The JavaScript functions should be created in a separate file, such as `/static/js/main_javascript.js`. In this file you should also create the main driver function that calls the other functions, as we discussed in class.

The main html program shall have the following structure:

```
<html lang="en">
<head>
  <meta charset="UTF-8">
  <meta name="viewport" content="width=device-width, initial-scale=1.0">
  <title>Document</title>
  <!-- defining all the JavaScript functions used in this project -->
  <script type="text/javascript" src="./static/js/main-style.js"></script>
  <script src="https://cdn.plot.ly/plotly-latest.min.js"></script>
</head>
<body>
  <div id="monthlyInterestRateAndPrincipalPayments" style="width:80%;
margin:auto;"></div>
  <div id="monthlyPrincipalValues" style="width:80%; margin:auto;"></div>
  <!-- running the main_driver method -->
  <script type="text/javascript"> main_driver() </script>
</body>
</html>
```

And the JavaScript file skeleton is shown below:

```

function plotMortgageCurves(// add input parameters here as needed) {
    let plottingArrays = getLoanPaymentValues(principal, monthlyPayment,
        annualInterestRate, loanPeriod); // see note #6
    plotValues(plottingArrays); // see note #7
}

function main_driver() {
    let loanInformation = getLoanInformation(); // See Note #1
    let housePrice = loanInformation[0];
    let downPayment = loanInformation[1];
    let annualInterestRate = loanInformation[2];
    let loanPeriodInYears = loanInformation[3];

    // derived data from loan information
    let principal_P = // your code here; // See note #2
    let montlyInterestRate_r = // your code here // See note #3;
    let totalNumberOfPayments_n = // your code here // See note #4

    let monthlyMortgagePayments_M = computeMontlyMortgagePayments(principal_P,
        montlyInterestRate_r, totalNumberOfPayments_n);
    displayResults(housePrice, downPayment, annualInterestRate, loanPeriodInYears,
        monthlyMortgagePayments_M); // see note #5
    plotMortgageCurves(principal_P, annualInterestRate,
        monthlyMortgagePayments_M, loanPeriodInYears);
}

```

Notes:

- 1) getLoanInformation method requires no input and it returns an array of values containing:
 - house price
 - down payment
 - annual interest rate (percentage)
 - loan period (years)
- 2) principal value P is the difference between house price and down payment
- 3) you need to convert annual interest rate to monthly interest rate and make it a fractional number, not a percent one
- 4) total number of payments is the total number of years multiplied by 12 months
- 5) You will need to create the method displayResults based on this call, meaning, it has some input variables, it does not return anything, but display the mortgage information as shown in Figure
- 6) The function getLoanPaymentValues shall return an array of 4 arrays:
 - First array: containing the payment number (1, 2, ..., 360)
 - Second array: monthly amount of money that goes towards Interest rate
 - Third array: monthly amount of money that goes towards the principal
 - Fourth array: monthly outstanding principal value (how much you still own the lender)
- 7) The function plotValues uses the arrays discussed in Note #6 and the Plotly library (as discussed in class) to plot the curves shown in Figure 3. To plot two curves in a single plot area, you can do as shown below:

```

// Define Data
const datal = [{
    x: xArray,
    y: interestMonthlyPayments,
    mode: "markers",
    name: "Interest Monthly Payment"
},
{
    x: xArray,
    y: principalMonthlyPayments,
    mode: "markers",
    name: "Principal Monthly Payment"
}

```

```
}  
];
```

5 Quick Data Analysis

Using your mouse (hover the plots), how much of your monthly payment is going to the loan interest and how much is going to the principal for the 100th payment (around 8 years) and 300th payment (around 25 years)?

For the 100th mortgage payment of \$2,684.00, \$1,773.00 is going towards interest, and \$910.00 towards the principal (See Figure 4).

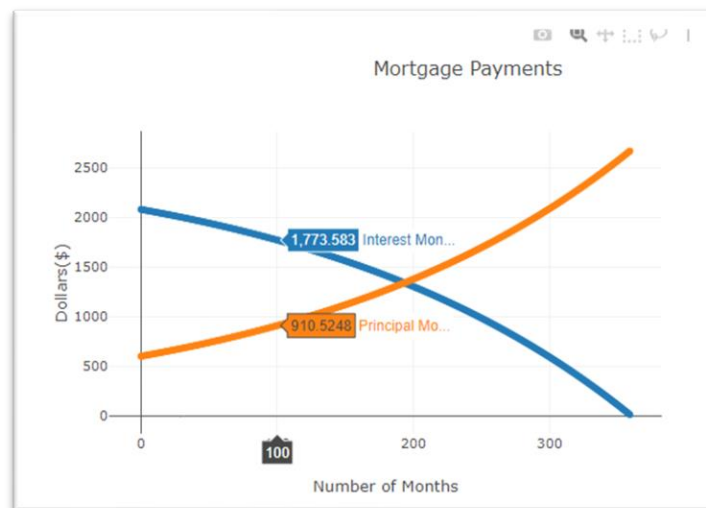


Figure 4: Payments throughout the years

Are you a person that accepts challenges? If you instead of paying only the required monthly loan payment (M), you pay an additional \$100.00 every single month (M+\$100.00) in how many years will you finish paying your loan? Hint, you will need to modify just a little bit your `getLoanPaymentValues` method.

6 The Excel Spreadsheet

To test your program, you can compare the results of what your program is calculating with the values provided in the Excel Spreadsheet found in the course Syllabus. Try different values for principal, interest rate, loan term (15 or 30 years).