

Loans

After completing this section, students should be able to:

- Use a formula or a spreadsheet to find the monthly (or annual) payments, given the amount of money borrowed, the interest rate, and the time period of the loan.
- Use a formula or a spreadsheet to find the largest amount of money you can afford to borrow based on the monthly (or annual) payments you can afford to make, the interest rate, and the amount of time you have to pay it back.

Installment Loans

With an installment loan, you borrow money for a fixed period of time, called the term of the loan, and you make regular payments, usually monthly, to pay off the loan plus interest accumulated during that time.

Example. Suppose you want to buy a computer that costs \$1800, on a monthly installment loan that charges an APR of 10%, compounded monthly, over the course of 3 years. How much will you need to pay each month? Make a guess for the closest answer.

- A. \$50
- B. \$55
- C. \$60
- D. \$65

Try it on a google spreadsheet.

There is a formula for the monthly payment:

$$\text{Monthly payment} = \frac{(\text{Amount borrowed}) \cdot \frac{APR}{12} \left(1 + \frac{APR}{12}\right)^{12t}}{\left(\left(1 + \frac{APR}{12}\right)^{12t} - 1\right)}$$

If we generalize this formula to a loan that is paid in installments n times a year, we have:

Example. For the \$1800 loan with 10% APR over 3 years.

(a) Use the monthly payment formula to calculate the monthly payment needed for the \$1800 loan with 10% APR over 3 years.

(b) Verify that it works on the spreadsheet.

(c) How much money will you pay altogether by the end of 3 years?

(d) How much of that money is interest?

Example. You need to borrow \$8,000 so that you can attend college next fall. You get the loan at an APR of 9% to be paid off in quarterly installments over 4 years.

(a) What is your quarterly payment?

(b) What is the total of all payments?

(c) How much interest will be paid in all?

Example. My daughter wants to buy a car. Suppose she can afford monthly payments of \$150 per month for two years. The credit union is offering a loan at an APR of 3.75%. What price car should she be shopping for? Choose the closest answer (PollEv)

- A. \$1500
- B. \$3000
- C. \$6000
- D. \$12000

Mortgages

Example. The NC State Employees Credit Union (NCSECU) offers the following mortgage options on their website.

10-Year Term Fixed Rate Mortgage

+	2.95% (3.158% APR ¹) for 90% or less loan-to-value [†]	Calculate Payment and APR¹
+	3.25% (3.460% APR ¹) for 90.1% - 100% loan-to-value [†]	Calculate Payment and APR¹

15-Year Term Fixed Rate Mortgage

+	3.25% (3.394% APR ¹) for 90% or less loan-to-value [†]	Calculate Payment and APR¹
+	3.75% (3.897% APR ¹) for 90.1% - 100% loan-to-value [†]	Calculate Payment and APR¹

20-Year Term Fixed Rate Mortgage

+	3.75% (3.864% APR ¹) for 90% or less loan-to-value [†]	Calculate Payment and APR¹
+	4.25% (4.366% APR ¹) for 90.1% - 100% loan-to-value [†]	Calculate Payment and APR¹

Suppose you take out a loan for \$150,000, which is the entire purchase price of the house. How much money will you expect to pay in total if you take out a 10 year vs 15 year vs. 20 year mortgage with monthly payments?

Why do you think the interest rate is higher for the longer term loan?

Note that the NCSECU webpage mentions an APR as well as the loan interest rate. According to <https://www.mortgageloan.com/calculator/mortgage-apr-calculator>,

Mortgage APR is defined as the annualized cost of credit on a home loan. It is the interest rate that would produce the same monthly payment on your loan amount with no fees as you would pay if you rolled all your fees into the loan itself.

Example. Suppose you're borrowing \$200,000 on a 30-year fixed-rate mortgage at 4.75 percent. That would give you a monthly mortgage payment of \$1,043.29. Now suppose that you have \$6,000 in fees on this loan - or 3 percent.

If you roll that \$6,000 into the loan, you'd be borrowing \$206,000 at 4.75 percent interest, which would raise your monthly payment to \$1,074.59. To get the same monthly payment on \$200,000 (the actual loan amount), you'd need an interest rate of 5.008% - which is the APR.

Example. Based on the NCSECU's stated interest rates and APRs, what closing fees are they estimating on a \$150,000 mortgage?

Baseball Contracts

According to a CNN article from July 1, 2019,

- baseball player Bobby Banilla is still getting paid \$1.2 million a year from the NY Mets even though he hasn't played for them since 1999. (more specifically, \$1,193,248.20 a year.
 - These payments started in 2011 and will continue through 2035.
 - In 1999, they only owed him almost 6 million, and wanted to get rid of him, and instead of paying him outright, negotiated this deal, based on an 8% interest rate.
- (a) How much money will Banilla get paid in total with all of these annual payments of \$1.2 million.

(b) How can "almost 6 million" now, translate into this big a figure?

(c) Would you rather have gotten the almost 6 million in 1999 or the 1.2 million a year from 2011 through 2035? Why?

Powerball

For powerball, if you win, suppose you can take either \$22,000,000, in annual installments of \$733,333 for the next 30 years, or \$17,700,000 now.

(a) If we ignore taxes, which do you prefer?

(b) What if we consider taxes, and assume you will pay 24% federal tax and 5.499% state taxes, does that change your answer?

- (c) In fact, powerball does not pay equal payments. it starts with a smaller payment and increases by 5% each year. Does that change your answer?