

11.5 – Home Ownership

We will discuss the effects of compound interest on mortgages (loans for houses).

Initial Expenses

- ▶ When you buy a house, you normally make a down payment, and take a mortgage for the remaining amount.
 pay cash
 borrow
- ▶ In addition to the down payment, you also have to pay closing costs (fees); these fees may be expressed in points. *(1 point = 1% of the mortgage)*

Example 1

- ▶ The purchase price of a home is \$225,000. A down payment of 20% is made. The bank charges \$500 in fees plus $2\frac{1}{2}$ points. Find the total of the down payment & the closing costs.

paying at least this much helps lower interest rate, avoid additional fees

- ▶ Down payment

$$\begin{aligned} 20\% \text{ of } \$225,000 &= \\ 0.20 (225,000) &= \$45,000 \end{aligned}$$

Example 1

- ▶ Find the total of the down payment & the closing costs.

- ▶ $2\frac{1}{2}$ points = 2.5 points = 2.5% of mortgage

mortgage = 225,000 - down payment = \$180,000
↳ amount you borrow

→ not 225,000!!!

⇒ 2.5% of 180,000 = $0.025(180,000) = \$4,500$

- ▶ Total costs = down payment + $2\frac{1}{2}$ points + 500
= 45,000 + 4,500 + 500
= \$50,000

Example 2

- ▶ You purchase a home and obtain a 30-year loan of \$180,000 at an annual interest rate of 4.375%.
 $A = 180,000$
 $r = 0.04375$

- ▶ (a) What is the mortgage payment? (Monthly payment formula)
 $n = 12$

$$PMT = A \left(\frac{\frac{r}{n}}{1 - \left(1 + \frac{r}{n}\right)^{-nt}} \right)$$

$$= 180,000 \left(\frac{\frac{0.04375}{12}}{1 - \left(1 + \frac{0.04375}{12}\right)^{-360}} \right) = \boxed{\$898.71}$$

If this, you can't afford mortgage!

Example 2

- ▶ You purchase a home and obtain a 30-year loan of \$180,000 at an annual interest rate of 4.375%.
- ▶ (b) What is the total of the payments over the life of the loan?

$$\begin{aligned}\text{total paid} &= (\text{PMT})(n)(t) \\ &= (\$898.71)(12)(30) \\ &= \boxed{\$323,535.60}\end{aligned}$$

MUCH higher than 180,000!

Example 2

- ▶ You purchase a home and obtain a 30-year loan of \$180,000 at an annual interest rate of 4.375%.
- ▶ (c) Find the total amount of **interest** paid on the loan.

$$\begin{aligned} \text{total interest} &= \overset{\text{total}}{323,535.60} - \overset{\text{original}}{180,000} \\ &= \boxed{\$143,535.60} \\ &\quad \hookrightarrow \text{wasted \$!} \end{aligned}$$

Main Point 1

Also applies to student loans!

- ▶ To save time & money, pay **more** than the monthly payment!
- ▶ In the previous example, if we paid \$100 extra each month, we would pay off the loan in ~25 years and save over \$30,000 in interest!
- ▶ In the previous example, if we paid \$1000 extra each month, we would pay off the loan in under 10 years and save about **\$103,000** in interest!!!

Example 3

- ▶ You purchase a home for \$150,000 and obtain a 20-year mortgage at 8.5% after making a down payment of 20%.
- ▶ Of the first month's mortgage payment, how much is interest & how much is applied to the principal?

→ how much was actually borrowed

1. Find the mortgage amount.

$$\begin{aligned} \text{down payment} &= 0.20(150,000) = 30,000 \\ \text{mortgage} &= 150,000 - 30,000 = \$120,000 \quad A = \underline{\underline{120,000}} \end{aligned}$$

Example 3 (Acadly)

- ▶ You purchase a home for \$150,000 and obtain a 20-year mortgage at 8.5% after making a down payment of 20%.

2. Find the monthly payment.

$$PMT = 120,000 \left(\frac{\frac{0.085}{12}}{1 - \left(1 + \frac{0.085}{12}\right)^{-12 \cdot 20}} \right)$$

$= \$1041.39$ \rightarrow split into principal & interest

Example 3

- ▶ You purchase a home for \$150,000 and obtain a 20-year mortgage at 8.5% after making a down payment of 20%.

3. Find the interest after 1 month.

Interest after 1 month: Prt

$$= 120,000(0.085)\left(\frac{1}{12}\right)$$

$$= \boxed{\$850}$$

$$\begin{aligned} (P &= 120,000; \\ r &= 0.085; \\ t &= \frac{1}{12}) \end{aligned}$$

Amount applied to principal: $\text{PMT} - \text{interest}$

$$= 1041.39 - 850 =$$

$$\boxed{\$191.39}$$

MUCH less!

Example 4

- After making payments of \$898.71 for 6 years on your 30-year loan at 4.375%, you decide to sell your home. What is the **loan payoff?**

$$\text{PMT} = 898.71$$

$$30 - 6 = 24 \text{ years left} \Rightarrow k = 24(12) = 288$$

$$r = 0.04375$$

$$A = \text{PMT} \left(\frac{1 - \left(1 + \frac{r}{n}\right)^{-k}}{\frac{r}{n}} \right)$$
$$= 898.71 \left(\frac{1 - \left(1 + \frac{0.04375}{12}\right)^{-288}}{\frac{0.04375}{12}} \right) = \$160,077.63$$

Your home needs to sell for at least this much!

Other Expenses

- ▶ In addition to your mortgage, you also have to make monthly property tax & insurance payments.

Example 5

- ▶ You have a mortgage payment of \$898.71, an **annual** property tax bill of \$944 and an **annual** insurance premium of \$1462. Find the total **monthly** payment.

$$\begin{array}{r} \text{mortgage} + \text{property tax} + \text{insurance} = \\ 898.71 + \frac{944}{12} + \frac{1462}{12} = \\ \boxed{\$1099.21} \end{array}$$

\leftarrow monthly payments \leftarrow

Example 6

down payment

- ▶ You have saved \$35,000 for a down payment, and you want to make a minimum down payment of 20%. What is the maximum price you can afford for a home? (Good thing to know!)

$$\text{down payment} = 20\% \text{ of price of home}$$

0.20

$$35,000 = 0.20 (\text{price of home})$$

$$\text{price of home} = \frac{35,000}{0.20} = \underline{\underline{\$175,000}}$$

Main Point 2

- ▶ Just because you CAN borrow money doesn't mean you SHOULD.
- ▶ Borrowed money is not free money! *Interest!*
- ▶ Try **saving ahead** to a goal, instead of going into debt.

Example (Acadly Review)

11.2

$$P = 8000$$

$$r = 0.02$$

- If you leave \$8000 in an account earning 2% interest, compounded quarterly, how much money will be in the account after 3 years?

$$n = 4$$

Compound Amount Formula

$$t = 3$$

$$A = P \left(1 + \frac{r}{n} \right)^{nt}$$

$$= 8000 \left(1 + \frac{0.02}{4} \right)^{4 \cdot 3}$$

$$12$$

$$= \boxed{8493.42}$$

Example (Acadly Review) 11.3

$$A = 18,000$$

- You buy a Honda Civic for a total price of \$18,000 (**including taxes and fees**), and finance that amount for 10 years with a 6.4% interest rate. Find the **monthly payment**.

$$t = 10$$

$$r = 0.064$$

$$n = 12$$

Payment Formula

$$\text{PMT} = A \left(\frac{\frac{r}{n}}{1 - \left(1 + \frac{r}{n}\right)^{-nt}} \right) = 18,000 \left(\frac{\frac{0.064}{12}}{1 - \left(1 + \frac{0.064}{12}\right)^{-12 \cdot 10}} \right) = \boxed{\$203.47}$$

Example (Acadly Review) 11.5

- ▶ You buy a \$220,000 home with a down payment of 15%. Find the amount of the down payment and the mortgage amount.

$$\begin{aligned} \text{down payment} &= 15\% \text{ of } 220,000 \\ \text{cash} &= 0.15(220,000) \\ &= \boxed{\$33,000} \end{aligned}$$

$$\begin{aligned} \text{mortgage} &= \text{amount borrowed} \\ \text{borrowed} &= 220,000 - 33,000 \\ \text{(leftover)} &= \boxed{\$187,000} \end{aligned}$$