Closing Thurs: 6.5

6.5 Loans

A loan is an **ordinary** annuity from the bank's perspective; the bank invests a large ***present value*** in your home or car or education, and then withdraws payments, with interest, from you. We know this formula!

$$P = R\frac{1-(1+i)^{-n}}{i}$$

P = starting loan balance
R = loan payment
r = yearly rate,
m = compoundings/payments per year
i = r/m = rate at each compounding
n = mt = total payments

The process of repaying the principal and interest in equal payments is called amortization.

Example:
Sarah purchases a $350,000 home with a down payment of $75,000 and a mortgage loan for the rest at 5%, compounded monthly amortized over 30 years.

(a) What is the starting loan balance?
(b) What are the monthly payments?
(c) What is the total amount Sarah pays for the house? (*i.e.* total over the "life of the loan")
(d) How much interest does she pay?

Don't need to write this down

Amortization (Payment) Schedule
for Sarah's example:

i = 0.05/12 = 0.004166…

For each monthly statement, the bank computes interest by multiplying i times the unpaid balance. That part of your payments is interest, the rest is subtracted from the principal

Month	Payment	Interest	Principal	Unpaid Balance
0				**$275,000.00**
1	**$1,476.26**	$1,145.83	$330.43	**$274,669.57**
2	**$1,476.26**	$1,144.46	$331.80	**$274,337.77**
3	**$1,476.26**	$1,143.07	$333.19	**$274,004.58**
4	**$1,476.26**	$1,141.69	$334.57	**$273,670.01**
5	**$1,476.26**	$1,140.29	$335.97	**$273,334.04**
6	**$1,476.26**	$1,138.89	$337.37	**$272,996.67**
7	**$1,476.26**	$1,137.49	$338.77	**$272,657.90**

Chapter 6 Summary

1. Are there regular payments?
   (a) NO: it's a LUMP SUM problem.
   (b) YES: it's an ANNUITY problem.

2(a) For LUMP SUM, does it say:
   (i) ``simple interest"?
   (ii) ``compound continuously"?
   (iii) ``compounded m times a year"?

2(b) For ANNUITIES,
   (i) payments at BEGINNING or END?
   (ii) balance GROWING or SHRINKING?

Special notes on Annuities:

1. First compute
   $i = r/m$ = rate used at each period.
   $n = mt$ = total number of payments

2. Note:
   $R \cdot n$ = total amount paid.

For FV questions
   Total interest $= F - R \cdot n$

For PV questions
   Total interest $= R \cdot n - P$

3. Loans are present value, ordinary annuities. If there is a down payment on a loan, then
   P = original value – down payment