

4D: Loan payments, credit cards and mortgages

3-30-16

Suppose you borrow \$1,200 at an annual interest rate of APR = 12%
You owe $1\% \times \$1,200 = \12 at the end of the first month

If you paid *only* the \$12, you would still owe \$1,200.

If you hope to make progress in paying off a loan, you need to pay part of the principle as well as interest.

For example: Suppose you paid \$200 plus the current interest.

End of	Prior Princ	Int on PP	Pay to P	Total Pay	New P

Page 1

Suppose you paid \$200 plus the current interest.

P = Principal

End of	Prior Princ	Int on PP	Pay to P	Total Pay	New P
1	1,200	$.01(1200) = \$12$	200	212	$1200 - 200 = 1,000$
2	1,000	$.01(1000) = 10$	200	210	800
3	800	\$8	200	208	600
4	600	\$6	200	206	400
5	400	\$4	200	204	200
6	200	\$2	200	202	0

Loan Basics

- Principal is the amount of money owed at any particular time
- interest is charged on the loan principal
- loan term is the time you have to pay back the loan in full
- to pay off the loan, you must gradually pay down the principal.

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Installment loans

a loan that you pay off with equal regular payments (or amortized loan)

Suppose you wanted to pay off your \$1,200 loan with 6 equal monthly payments.
How much should you pay? Previous example was between \$202-\$212. The loan payment lies between their but it is not obvious.

LOAN CALCULATION FORMULA

$$PMT = \frac{P \times \left(\frac{APR}{N}\right)}{1 - \left(1 + \frac{APR}{N}\right)^{(-NY)}}$$

$$1,200 \times \left(\frac{.12}{12}\right) = \$207.06$$

N = # of pmt
12 periods in
a yr

Y = loan term
in yrs
6 months

- the interest due each month gradually decreases
- the amount paid toward principal each month gradually increases

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Ex1: Student Loan

Suppose you have student loans totaling \$7,500 when you graduate from college.
The interest rate is APR = 9%, and the loan term is 10 years. What are your monthly payments? How much will you pay over the lifetime of the loan? What is the total interest you will pay on the loan?

APR: $9\% = .09$

N: 12

Y: 10

P: $7,500$

PMT: $\$95.01$

$95.01(12)(10) = 11,401.20$

$11,401.20 - 7,500 = 3,901.20$

NOW YOU TRY: (monthly)

- A st loan of \$50,000 at an APR of 6% for 20 years.
- A mortgage of \$200,000 with an APR of 3.5% for 30 years

$\$358.22$

$\$85,972.80$

$35,972.80$

$PMT = ?$

$Total = ?$

$Interest = ?$

$\$898.09$

$\$323,312.40$

$\$123,312.40$

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EX2: Principal and interest payments

For the loan in example 1, calculate the portions of your payments that go to the principal and to interest during the first 3 months.

End of	Interest	Pymt to Princ	New Princ
1	$7500(.0075)$ \$56.25	$95.01 - 56.25$ \$38.76	$7,500 - 38.76$ \$7461.24
2	$7461.24(.0075)$ \$55.96	$95.01 - 55.96$ \$39.05	$7,461.24 - 39.05$ \$7422.19
3	55.67	\$39.34	7,382.85

APR: .09
N: 12
Y: 10
P: 7,500
PMT: 95.01

$.09/12 = .0075$
Interest for 1 month

Now you try

- A home mortgage of \$144,000 with a fixed APR of 6% for 30 years
- A home mortgage of \$125,000 with a fixed APR of 12% for 20 years

For each problem

- Calculate the monthly payment
- Determine the total amount paid over the term of the loan
- What percentage is paid toward the principal and the interest
- Find the first 3 months principal and interest

market watch
homework: stock market lookup
NYSE NAME SYMBOL
Ex 2
4-6-16

- find 5 more (different than what you have) stocks to invest in tomorrow
- Bring 2 credit card applications on Wednesday

EX3: Choice of Auto Loans

You need a \$6,000 loan to buy a used car. Your bank offers a 3-yr loan at 8%, a 4-yr loan at 9%, and a 5-yr loan at 10%. Calculate your monthly payments and total interest over the loan term with each option.

$P = 6,000$
 $N = 12$

$535.00 \rightarrow 600.00$

$$PMT = \frac{P \times \left(\frac{APR}{N}\right)}{1 - \left(1 + \frac{APR}{N}\right)^{(-NY)}}$$

3 yr loan	4-yr loan	5-yr loan
APR: 8% Y: 3	APR: 9% Y: 4	APR: 10% Y: 5
PMT = 188. ⁰² total Interest = 768. ⁷²	PMT = 149. ³¹ total Interest = 1,166. ⁸⁸	PMT = 127. ⁴⁸ total Interest = 1,648. ⁸⁰

Credit Cards

Loans differ from installment loans in that you are not required to pay off your balance in any set period of time. Instead you are making a minimum payment that generally covers all the interest but very little principal.

EX4: Credit Card Debt

Suppose you have a credit card balance of \$2,300 with an annual interest rate of 21%. You decide to pay off your balance over 1 year. How much will you need to pay each month? Assume you make no further credit card purchases.

APR: .21
P: 2,300
Y: 1
N: 12

$$PMT = \frac{P \times \left(\frac{APR}{N}\right)}{1 - \left(1 + \frac{APR}{N}\right)^{(-NY)}}$$

PMT: 214.¹⁶
TOTAL: 2,569.⁹²
INTEREST: 269.⁹²
WHAT % IS INTEREST: $\frac{269.92}{2569.92} = 10.5\%$

Now you try

FOR EACH PROBLEM ANSWER THE FOLLOWING QUESTIONS

- calculate your monthly payments
- when the card is paid off, how much will you have paid since Jan 1?
- What percentage of your total payment from part (b) is interest?

■ Suppose that on Jan 1 you have a balance of \$4,800 on a CC whose APR is 14%, which you want to pay off in 1 year. Assume that you make no additional charges to the card

■ You have a CC with a balance of \$5,000 and an APR of 19%, which you want to pay off in 4 years. No extra charges on the card.

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CLASSWORK PAGE 250

~~4-11-16~~

14, 16, 18, 20, 22, 24, 26, 28, 30, 32

~~2 Credit card applications due Wednesday
5 more stocks to invest in due Wednesday
Wednesday we are in the computer lab.~~

4-14-16

Work from the book is due today.
No late work will be accepted on this

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Computer Lab days

~~Thursday 4-7~~

~~Wednesday 4-13~~

~~Monday 4-18~~

Monday 4 - 25

thursday 4 - 28

Create portfolio

Thursday 5 - 12

Finish and turn in portfolio

Friday 5 - 13 **this is part of your final grade**

M- Wkst EX1-4
T- ?
W- Lab
TH- Quiz
F- ?

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Quiz 1

4-15-16

You may use your notes, calculator and previous work.

5 problems

show your work

due at the end of class

Be careful with your rounding
Money has 2 decimal places
% has 1 decimal

No phones out. I see you messing with your phone, you automatically get a zero

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Ex 5: A Deepening Hole

4-19-16

Paul has gotten into credit card trouble. He has a balance of \$9,500 and just lost his job. His credit card company charges interest of APR = 21%, compounded daily. Suppose the credit card company allows him to suspend his payments until he finds a new job -- but continues to charge interest. If it takes him a year to find a new job, how much will he owe when he starts his new job?

Because Paul is not making payments during the year, this is not a loan payment problem. Instead, it is a compound interest problem.

$$P = 9,500$$

$$N = 365$$

$$Y = 1$$

$$APR = 21\%$$

$$A = P \times \left(1 + \frac{APR}{n}\right)^{ny}$$

$$9,500 \left(1 + \frac{.21}{365}\right)^{365.1} = 11,719.23$$

$$\begin{array}{r} 11,719.23 \\ - 9,500.00 \\ \hline 2,219.23 \end{array}$$

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Credit Card debt

Assume you have a balance of \$1,200 on a credit card with an APR of 18%, or 1.5% per month. You start making monthly payments of \$200, but at the same time you charge and additional \$75 per month to the credit card. Assume that interest for a given month is based on the balance for the previous month.

Complete and extend the table to show your balance at the end of each month until the debt is paid off. How long does it take to pay off the credit card debt?

MONTH	PAYMENT	EXPENSES	INTEREST	NEW BALANCE
0				\$1,200
1	\$200	\$75	$1.5\% \times \$1,200 = \18	$\$1,200 - 200 + 75 + 18 = \$1,093$
2	\$200	\$75	16.40	984.40
3	\$200	\$75	14.77	874.17
4	\$200	\$75	13.11	762.28
5			11.43	648.71
6			9.73	533.44
7			8.00	416.44
8			6.25	297.69
9			4.47	177.16
10			2.66	54.82
11			0.82	-69.36

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Mortgages

4-20-16

PG 244

Mortgage - and installment loan designed specifically to finance a home

Down Payment - amount of \$ you must pay up front in order to be given a mortgage or other loan

Closing costs - fees you must pay in order to be given the loan.

Points - fee charges, where each point is 1% of the loan amount

Fixed rate mortgage - simplest type of home loan in which you are guaranteed the interest rate will not change over the life of the loan.

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Ex 6: Fixed rate payment option

You need a loan of \$100,000 to buy your new home. The bank offers a choice of a 30-year loan at an APR of 5% or a 15-year loan at 4.5%. **Compare your monthly payments and total loan cost under the two options.** Assume that the closing costs are the same in both cases and therefore do not affect the choice.

$P = \$100,000$	$N = 12$
30 yr	15 yr
APR: 5%	APR: 4.5%
$PMT = \$536.82$	$PMT = \$764.99$
Total: 193,255.20	Total: 137,698.20

pay \$230+ per month
\$56,000

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How would the payments be different with TODAY'S current rates?

CHASE
15-year loan 3.001% APR 30-year loan 3.591% APR

$$696.63 \rightarrow 124,313.40 \quad \text{PMT} = 454.14 \rightarrow 163,490.40$$

$$\text{total} =$$

$$P = 100,000$$

SECURITY SERVICE

YEAR	APR	
30	3.801%	$466.01 \rightarrow 167,763.60$
20	3.695%	$590.03 \rightarrow 141,607.20$
15	3.085%	$694.68 \rightarrow 125,042.40$
10	2.998%	$965.52 \rightarrow 115,862.40$

$$\text{PMT} = \frac{P \times \left(\frac{\text{APR}}{N}\right)}{1 - \left(1 + \frac{\text{APR}}{N}\right)^{-n \cdot y}}$$

EX 7: Closing Costs

4-26-16

Great Bank offers a \$100,000, 30-year, 5% fixed rate loan with closing costs of \$500 plus 1 point. Big Bank offers a lower rate of 4.75% on a 30-year loan, but with closing costs of \$1,000 plus 2 points. Evaluate the two options.

Great Bank

$$30 \text{ yr} \quad \$536.82$$

$$\text{APR } 5\%$$

$$\text{CC} = \$500$$

$$\text{Point} = 1 \quad \frac{500}{\$1,000} = \$1,500$$

Big Bank

$$30 \text{ yr} \quad \$521.65$$

$$\text{APR} = 4.75\%$$

$$\text{CC} = \$1,000 \quad \$1,000$$

$$\text{Points} = 2 = 2\% \quad \frac{\$2,000}{\$100,000} = 2\%$$

Now we must consider the difference in closing costs.

Big Bank charges an extra \$500 plus and extra 1 point which is \$1,000 on a \$100,000 loan.

Big Bank is going to cost you an extra \$1,500 up front, but saves you about \$15 per month in payments. We need to find how long it will take to recoup the extra \$1,500 you must put up front.

$$\frac{1500}{15} = 100 \text{ months} \approx 8 \text{ yrs } 4 \text{ ms}$$

Consider the following pairs of loan options for a \$120,000 mortgage. Calculate the monthly payment and total closing costs for each option. Explain which option you would choose and why.

- 30-year fixed rate at 4% with closing costs of \$1,200 and no points
 $\$572.90$ $\text{CC} = 1,200$
- 30-year fixed rate at 3.5% with closing costs of \$1,200 and 3 points
 $\$538.85$ $\text{CC} = \$3,600$ $2\% \text{ of } P$
 $\frac{2400}{34} = 70.59 \text{ months} \approx 6 \text{ yrs}$
- 30-year fixed rate at 4.5% with closing costs of \$1,200 and 1 point
 $\$608.02$ $\text{CC} = 2,400$
- 30-year fixed rate at 4.25% with closing costs of \$1,200 and 3 points
 $\$590.33$ $\text{CC} = 4,800$ $\frac{2400}{18} \approx 133 \text{ months} \approx 11 \text{ yrs}$

EX 8: An alternative Strategy

PG 248

4-27-16

An alternative strategy to the mortgage options in example 6 is to take the 30-yr loan at 5%, but to try to pay it off in 15 years by making larger payments than are required. To carry out this plan, how much would you have to pay each month? Discuss the pros and cons of this strategy.

30 year pmt: \$536.82 total: ~\$193,255

15 year pmt: \$764.99 total: ~\$137,698

P: 100,000
N: 12
APR: 5%
Y: 15

30yr loan paid in 15 yrs
PMT: \$790.79
~\$25 more
Pro: pay off faster less total than 30yr

Suppose you have a student loan of \$30,000 with an APR of 9% for 20 years.

a. What are your required monthly payments?

$$\begin{array}{r} \$10,000 \\ - \$15,000 \text{ at } 9\% \\ - \$5,000 \\ \hline \$269.92 \end{array}$$

b. Suppose you would like to pay the loan off in 10 years instead of 20. What monthly payments will you need to make?

$$\begin{array}{r} \$10,000 \\ - \$15,000 \text{ at } 9\% \\ - \$5,000 \\ \hline \$380.03 \end{array}$$

c. Compare the total amounts you'll pay over the loan term if you pay the loan off in 20 years versus 10 years.

$$\begin{array}{r} 20 \\ \hline 64,780.80 \\ 269.92(12)(20) \end{array} \quad \begin{array}{r} 10 \\ \hline 45,603.60 \end{array} \quad \begin{array}{r} \text{Save} \\ \$19,177.20 \end{array}$$

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EX 9: Rate Approximations for ARMs

You have a choice between a 30-yr fixed rate loan at 4% and an ARM with a first-yr rate of 3%. Neglecting compounding and changes in principal, estimate your monthly savings with the ARM during the first year on a \$100,000 loan. Suppose that the ARM rate rises to 5% by the third year. How will your payments be affected?

$$\begin{array}{l} 30\text{yr} \quad P: 100,000 \quad 30\text{-yr (ARM)} \\ \text{APR: } 4\% \quad (1\text{yr}) \text{ APR: } 3\% \\ \text{Interest for 1st yr} \\ .04(100,000) = \$4,000/12 = 333.33 \\ .03(100,000) = \$3,000/12 = 250.00 \\ \begin{array}{r} 333.33 \\ - 250.00 \\ \hline 83.33 \end{array} \text{ Save 1st yr w/ ARM} \\ \text{Changes to 5\%} \\ .05(100,000) = 5,000/12 = 416.67 \\ \begin{array}{r} 416.67 \\ - 333.33 \\ \hline 83.34 \end{array} \end{array}$$

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You have a choice between a 30-yr fixed rate loan at 4.5% and an adjustable rate mortgage (ARM) with a 1st-yr rate of 3%. Neglecting compounding and changes in principal, estimate your monthly savings with the ARM during the first year on a \$150,000 loan. Suppose that the ARM rate rises to 6.5% at the start of the third year. Approximately how much extra will you then be paying over what you would have paid if you had taken the fixed rate loan?

$$\begin{array}{l} \text{FIXED} \\ 562.50 \text{ month} \\ \text{save } 187.50 \rightarrow 1^{\text{st}} \text{ ARM } 375 \\ \text{save } 250 \rightarrow 3^{\text{rd}} \text{ ARM } 812.50 \end{array}$$

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Classwork pg 251 - 252

34, 36, 38, 40, 42, 44, 46, 48

This will take 2 days to work through. Use your time wisely as late work will not be accepted on this.

Show your work

Blank answers only get 1/2 credit when corrections are made.

No work shown will also only get 1/2 credit when corrections are made

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Classwork pg 251 - 252

34, 36, 38, 40, 42, 44, 46, 48

This will take 2 days to work through. Use your time wisely as late work will not be accepted on this and you will not receive more time to complete it.

Show your work

Blank answers only get 1/2 credit when corrections are made.

Any worksheet returned with no work shown will be return marked wrong and asked to show their work and only receive 1/2 credit.

The next day we meet, you will test on this.