**Day 16 – Math Models Introduction to Banking Practice, Part 2**

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**NOTE: Use the notes from days 14-15 (last week) to answer these questions!**

1. What is the main cause of banks failing? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
2. Why do banks pay interest on money that's deposited in savings accounts? \_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
3. Why do sellers often charge interest when you make payments for a purchase instead of paying all of the money at one time? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
4. Why do banks charge interest on loans? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
5. Why do you think banks rarely pay interest on money in checking accounts? (Pro tip: Think about the reason they pay interest at all, and the difference between what people usually do with money in a savings account vs. money in a checking account.) \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
6. Why is it almost always better to buy things only when you actually have the money for them rather than paying it out over time or taking out a loan? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
7. What is a bank's true function? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Day 17 – Math Models Simple Interest**

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In the last lesson we talked a lot about interest. The numbers for payment + interest that I stated there were very rough estimates because it depends on several factors, beginning with what type of interest is being charged.

There are two general types of interest: simple and compounding. **Simple interest** means that the percentage of the total payment is simply added to that total, and that's what the person owes.

The formula for simple interest is **I = Prt**, where:

* I = the total amount of interest that will be paid
* P = principal,
* r = the interest rate per time period (usually month or year), and
* t = the term of the loan

The **principal** is the base amount of the total payment, like the $1000 Mrs. Barnett borrowed from the bank in our earlier example. The **interest rate** is the percentage added to a total payment for a purchase or a loan. It is always stated in terms of some time period, such as "per month" or "per year". The **term** of a loan is the number of the time periods stated in the interest rate (months, years, etc.) until the full payment is due. For example, if the interest rate is stated in years, such as 3% per year, then the term might be something like 5 years.

**Calculate the missing values in the problems below. (REMEMBER: A percent can be rewritten as a decimal amount by moving the decimal two places to the left − even if it's an imaginary decimal at the end of a whole number − and filling in any empty spaces with zeroes.) Show your work!**

1. **Marie borrowed $1500 to buy a laptop. The loan carried 6% simple interest per year for 2 years. How much did she really pay for the laptop?**

6% = 0.06 I = (1500)(0.06)(2)

= 180

Total payment = P + I = 1500 + 180 = $1680

1. **Mr. Medina wants to save his money but also wants to have some spending money each month. He has money in a savings account so he decides to use the interest it earns as his spending money. He wants to have about $100 of interest per month, his bank pays 0.09% simple interest per year, and he plans to take out money each month. What is the minimum amount of principal he needs to have in the bank for this plan to work?**

1 month = of a year, or 0.083 years

0.09% = .0009

100 = (P)(.0009)(.083)

100 = (P)(0.0000747)

0.0000747 0.0000747

P = $1,338,688.09

1. **You inherit $12,500 just before you start college. You'd like to invest it and have $15,000 in the account when you withdraw it in 30 years (the required period of the investment account). What simple interest rate will your account have to pay per year to make this plan work?**

interest = final amount - principal = 15000 − 12500 = $2500

2500 = (12500)(r)(30)

2500 = 375000r

375000 375000

r = 0.00667 = 0.0667%

**IMPORTANT:** The interest amounts in problems 2 and 3 (as well as some of the homework problems) could be misleading because some of those types of accounts don't pay simple interest. They pay compounding interest, which makes a much bigger difference to the outcome. It all varies from one account to another. These problems are provided only to illustrate how the formula is used, not to indicate amounts that you should expect in real life.

**Day 18 – Math Models Simple Interest Practice**

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**Calculate the missing values in the problems below. (REMEMBER: A percent can be rewritten as a decimal amount by moving the decimal two places to the left and filling in any empty spaces with zeroes.) Show your work!**

1. What will the total value of an investment of $5000 be if it has an interest rate of 7% per year and is invested for 20 years?
2. Ms. James won $4,250 in a raffle and decided to invest all of it. If she earned $1275 at a 5% per year interest rate, how long did she have the money invested?
3. Mr. Marshall made an investment 20 years ago and it's worth $130,000 dollars today. If his original investment was $50,000 what was the interest rate per year?
4. Christine got a student loan to go to college after high school. If she paid $750 in interest at a rate of 3% per year, how much was the original loan?

**Day 19 – Math Models Compounding Interest**

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Our last lesson was about simple interest; now we need to talk about compounding interest. Compounding interest is different because it **accrues**, which means it accumulates over time. You earn interest not only on the principal, but also on whatever other interest has already been added to the account over time.

So, for example, if you start with $50 and the first month you earn, say, $1.50 in interest, then the next month you're paid interest on $51.50 rather than just the original $50. At this interest rate, after another month of simple interest (just earning interest on the original $50), you would earn another $1.50. But with compounding interest, you would earn $1.55.

That might not seem like much of a difference, but it keeps accumulating every month and after 5 years, even if you didn't put any more principal in the account, you would have $140.00 with simple interest versus $294.58 (more than twice as much!) with compounding interest.

The formula for compounding interest is a bit more complicated than the one for simple interest but it's not hard if you follow the steps carefully. Pay close attention to the order of the steps in the notes and then do the homework problems the exact same way. The formula is:

**I = (P)(1 + r)t − P**

Notice that the term of the loan is an exponent in this formula. That's what makes it tricky but, again, just follow the steps and you'll be fine!

**Calculate the missing values in the problems below. Show your work!**

1. **If you put $4000 in an account that pays 6% interest compounded quarterly (four times per year), how much money will be in the account after 5 years?**

The interest compounds quarterly so the term is (5 years)(4 times per year) = 20

I = (4000)(1 + 0.06)20 − 4000

I = (4000)(1.006)20 − 4000 You must use a calculator for this step

I = (4000)(1.127) − 4000

I = 4508 − 4000 = $508

The total in the account will be I + P = 4000 + 508 = $4508

You might have noticed that the previous problem contained a seemingly unnecessary step: We had the total amount, then according to the formula we subtracted the principal to get just the interest, but then we had to add the two together again to get BACK to the total amount.

This happens because the formula is written to calculate the interest, not the total amount at the end. It's important that we use the formula as written most of the time because it won't work otherwise. However, IF you're doing a problem that asks for the total amount at the end of the process, you can leave the "−P" part off the end of the formula and you'll still get the right answer.

USE CAUTION IF YOU DO THIS! The end of the formula can ONLY be left off for THIS type of problem; if you make a mistake or forget to add it when you're doing a different type of problem, you will get the wrong answer! To me, it's easier to just always use the whole formula and if I occasionally end up doing one tiny extra step but I still get the right answer, that's better than making mistakes by not using it.

1. **How much principal would you need to deposit at 0.7% interest compounded monthly to earn $5000 in interest in 6 years?**

The term is (6 years)(12 months per year) = 72

5000 = (P)(1 + .007)72 − P

5000 = (P)(1.007)72 − P Use a calculator

5000 = (P)(1.652) − P

5000 = 1.652P − P

5000 = 0.652P

0.652 0.652

P = $7668.71

I've shown you how to do problems where we calculate the interest and the principal with compounding interest; you might have noticed that I didn't calculate the rate or the term, as I did with simple interest. That's because the exponent forces us to use math that's beyond the level of this course. You won't have to do those calculations unless you take finance-related math classes in college.

**Day 20 – Math Models Compound Interest Practice**

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Because these problems cannot be done without a calculator, and because some of you might not have access to one, you'll just be answering questions for your homework on this lesson.

1. Define the following terms in your own words.
2. Interest (on a loan) \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
3. Principal (of a loan) \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
4. Interest rate (Be sure to give a complete definition!) \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
5. Term (of a loan) \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
6. Accrue \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
7. Explain the difference between simple and compounding interest. Be specific and explain it as completely as you can. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
8. What can you do to make solving a complicated equation easier? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
9. What part of the compounding interest formula can (with caution!) be left out for SOME types of calculations? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
10. What part of the compounding interest formula makes the math much harder for certain types of calculations? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_