

Real Estate Math Review Worksheet

Unit Outline

- Using a Simple Calculator
- Math Refresher
 - Fractions, Decimals, and Percentages
- Percentage Problems
 - Commission Problems
 - Loan Problems
- Straight-Line Appreciation/Depreciation and Compounded Interest
- Capitalization Rate
- Percentage Leases
- Measurement
- Linear Measurement
- Measurement Conversions
- Measurement Problems
- Prorating Problems
- Mill Rate Problems

Reading Assignments (please note which version of the text you are using)

VanEd Presents: Modern Real Estate Practice, 18th edition

- Math FAQs, pg 460 (453 in the 18th Edition text)

Modern Real Estate Practice, 18th edition

At the end of this unit, the student will be able to:

- Use a simple calculator
- Compute fraction, decimal and percentage problems
- Explain capitalization rate
- Discuss percentage leases
- Work out measurement problems
- Compute prorations and mill rate problems

Section 8: Real Estate Math Review

Introduction
Using a Simple Calculator
Math Refresher
Fractions, Decimals, and Percentages
Percentage Problems
Commission Problems
Loan Problems

Straight-Line Appreciation/Depreciation and Compounded Interest
Capitalization Rate
Percentage Leases

Measurement
Linear Measurement
Measurement Conversions
Measurement Problems
Prorating Problems
Mill Rate Problems

Introduction

For some people, when they hear the word math, there is a feeling of anxiety. This section introduces the math skills needed to be successful in real estate and removes that anxious feeling for those who have it.

Using a Calculator

When you are in the business you will either be using a financial calculator or a computer spreadsheet to calculate most math scenarios. However, when you take the state exam, all you will need is the simple calculator that comes with your computer. The following math calculations will be based on using the simple calculator that comes with your computer.

Before we begin, play with the calculator on your computer.

For those using Microsoft Windows 98, 2000, ME or XP:
To open Calculator, click **Start**, point to **All Programs**, point to **Accessories**, and then click **Calculator**.

You might not be familiar with the use of * and /. * means to multiply and the / means to divide. For the purpose of this section these notations will be used.

Example: $4 * 4 = 16$ (four times four) and $4 / 4 = 1$ (four divided by four).

You can also store a number in the calculator memory.

- Click **MS** to store the displayed number,
- Click **MR** to recall a stored number,
- Click **MC** to clear the memory,
- Click **M+** to add the displayed number to the number already in memory,
- Click **MR** to see the new number.

Math Refresher

Fractions, Decimals and Percentages

Fractions

A fraction is written as follows: $4/5$ (four fifths) with the 4 being called the Numerator and the 5 being called the Denominator. A proper fraction is less than the whole (less than 100%) or less than 1.

Decimals

When you look at the above fraction you could say 4 divided by 5. A decimal is the product of the division. If you divide 4 by 5 you get .8 which is the decimal number. If someone says, convert $\frac{4}{5}$ (four-fifths) to a decimal number, divide the numerator by the denominator. Remember, all decimals are less than one and have a decimal point (.) in front of them, which is important when you enter a decimal into your calculator. First enter the decimal point and then the number.

Example: Using Fractions or Decimals

How much do you get if you receive $\frac{4}{5}$ of \$800?

The answer of 640 can be found two ways: You can multiply $\$800 * \frac{4}{5}$ or you can multiply \$800 by .8.

To multiple fractions, multiply the Numerators and the Denominators. Remember if you have a whole number, like 800, it is the same as the fraction $\frac{800}{1}$. So you get $(800 * 4) / (5 * 1) = \frac{3200}{5} = 640$.

Using your calculator either way is easy. Try them both.

SPECIAL NOTE: When you see the word “of” in a math problem it means times. Thus the statement $\frac{4}{5}$ of \$800 means $\frac{4}{5} * 800$.

Dividing Decimals using the calculator removes all those wonderful long division problems where you had to track the decimal point. On your calculator divide .895 by .65. You should get 1.38. Now reverse it and divide .65 by .895 and you get .73. The calculator has placed the decimal in the correct place.

Percentages

Percent (%) could be said to be just another way of showing a decimal. It means per hundred or per hundred parts. The decimal .65 could also be stated as 65%. So lets look more closely at the decimal point. The placement after the decimal point has meaning.

.1 is $\frac{1}{10}$

.01 is $\frac{1}{100}$

.001 is $\frac{1}{1000}$ and so on.

So .65 is $\frac{65}{100}$ or 65 hundredths. Since percent is always based on the hundredth position, .1 as a percent is 10% or $\frac{10}{100}$. The decimal .678 ($\frac{678}{1000}$) as a percent would be 67.8%

Two simple rules:

1. To convert a decimal to a percent, move the decimal two places to the right and add the % sign.
2. To convert a percent to a decimal, move the decimal point two places to the left and drop the % sign.

To multiply a %, first convert it to a decimal and then multiply.

Example: What is 43% of 95. Change to $.43 * 95 = 40.85$.

So let's look at a little word problem. You have 6 acres of land and plan to sell 2 acres. What percent will you have left? First, you need to know what you have left, which is 4 acres. (6 acres – 2 acres = 4 acres). So now the question really is, what % of 6 acres is 4 acres? The formula would be $Y * 6 = 4$. To get Y by itself, you divide both sides by 6 which looks like: $Y * 6/6 = 4/6$ $Y * 1 = 4/6$ $Y = 4/6$

If you divide 4 by 6 you get $Y = .666$ and $.666$ is 66.6%. Notice we divided 6 on both sides of the = sign.

This brings us to the point, how to solve percentage problems. There are three formulas that are important for solving all percentage problems.

1. TOTAL * RATE = PART
2. PART / RATE = TOTAL
3. PART / TOTAL = RATE

Example:

$TOTAL * (RATE / RATE) = PART / RATE$ is the same as $TOTAL = PART / RATE$

$(TOTAL / TOTAL) * RATE = PART / TOTAL$ is the same as $RATE = PART / TOTAL$

Note: Formulas 2 and 3 are created by equally dividing both sides of the equation so you really only need to memorize $TOTAL * RATE = PART$.

Another way to remember these formulas is to think:

- If PART is unknown Multiply.
- If PART is known Divide.
- When you divide, always enter PART into the calculator first.

The T-BAR Method

Many people do not feel comfortable with the 3 formula methods to solve percentage problems. So another way is to visualize a T as follows:



Using the T-Bar method insert the known figures in the correct places. Multiply if **the line** between the figures is vertical to get the unknown, and divide if **the line** between the figures is horizontal to get the unknown. If dividing, always input PART first into the calculator.

Example: Mary bought a home for \$150,000, which was 20% less than the asking price. What was the asking price?

$$\begin{array}{r|l} \$150,000 & \\ \hline \text{TOTAL} & .80 \end{array}$$

You are searching for an answer that is larger than \$150,000 so you are solving to find the total. The line is horizontal between \$150,000 and .80 so divide 150,000 by .8. Total asking price is \$ 187,500.

Why did we use .80 instead of .20?

Since Mary got it for 20% less than the asking price, she paid 80% of the asking price.
 $100\% - 20\% = 80\%$.

Five Steps to Solving Word Problems

Word Problems can be confusing so here are 5 steps you should take to help solve the problems:

1. **Read** the whole problem before you do anything.
2. **Analyze** what the problem is asking and what facts are being given. From the facts given, determine what facts are needed to answer the problem, as there is usually more information and/or numbers given than you need. Then determine the order that the facts will be needed (first, second, etc.) to match the number of steps required in the problem.
3. **Choose** the correct formula and write down the steps it will take to solve the problem.
4. **Insert** the facts and calculate the answer.
5. **Check** your answer to make sure you keyed the numbers into the calculator correctly and make sure you did all the steps.

We use math in our every day life and just don't think about it. When driving you probably think to yourself, "I need to be there at 7 pm and since it is 6:18 I have 42 minutes. I have 30 miles to go and since I am going 55 miles an hour I have plenty of time, even if I hit a few stop lights on the way as I need just 30+ minutes."

How much time do you really need? 33 minutes if no stoplights?

Use your calculator to get the answer.

First you need to figure out how far you can go in one minute. Next you will divide how far you need to go by the distance traveled in one minute.

55 miles per hour / 60 minutes per hour gives you miles per minute. $55 / 60 = .917$. You are going 0.917 miles per minute. Now divide 30 miles / 0.917 miles per minute = 32.72 rounded up to 33 minutes.

What math will you encounter when you are a real estate agent besides getting there on time?

Percentage Problems & Commission Problems

You like to get paid, so you will want to figure out what your commission is going to be.

Example:

1. You sell a house for \$150,000 and your commission is 6%. How much do you earn? Nice, except your company probably gets the 60% and you only get 40% of what the company gets. Using your calculator lets figure this out.

Total * Rate = Part: $\$150,000 * .06 = \$9,000$. Company gets \$9,000.

Total * Rate = Part: $\$9,000 * .40 = \$3,600$. You get \$3,600 from the company.

Using the T-Bar Method

$$\begin{array}{r|l} \text{Part} & \\ \hline \text{Total} & | \text{Rate} \end{array} \quad \begin{array}{r|l} \text{Part ? (9000)} & \\ \hline 150,000 & | .06 \end{array} \quad \begin{array}{r|l} \text{Part? (3600)} & \\ \hline 9,000 & | .4 \end{array}$$

Simple enough. Now what is your percent of the total sale?

Part / Total = Rate: $\$3,600 / \$150,000 = .024$ or 2.4%

Using the T-Bar Method

$$\begin{array}{r|l} \text{Part} & \\ \hline \text{Total} & | \text{Rate} \end{array} \quad \begin{array}{r|l} 3,600 & \\ \hline 150,000 & | \text{Rate ? (2.4\%)} \end{array}$$

Commission as a Ratio: You may be asked, "What is your commission on a 4:10 split?" The colon (:) means ratio and that you are getting 4 of every 10 which can also be written as 4/10. When you see it as a fraction it is easier to understand. 4/10 is 40%. So if the commission is \$9,000 and you have a ratio 4:10 you would get 40% or \$3,600.

If you have a 2:3 split on a commission amount of \$9,000, what is the company's share? Since you receive 2/3, the company receives the remaining portion or 1/3 (1:3 is their ratio). $\$9,000 * 1/3 = 9,000/3 = \$3,000$.

2. Sellers want to know how much they will get if they sell their house. After discussing what you think the sales price could be, subtract estimated closing costs, mortgage balance payoff, and the commission to estimate the seller's net proceeds. No problem!

What if the seller wants to net \$150,000 **after** the commission of 6% is deducted? To get the correct answer you must first ask the question, what % of the sales price is \$150,000? This figure represents the Part and is less than the Total. The sales price (Total) is 100% of the money. Your commission is 6% of the money. That leaves 94% of the money for the seller. So \$150,000 represents 94% of the sales price. Now we are ready.

$$\text{Part} / \text{Rate} = \text{Total: } \$150,000 / .94 = \$159,574.47$$

Using the T-Bar Method

| | |
|--------------|------------------------|
| <u>Part</u> | <u>150,000</u> |
| Total Rate | Total? (159,574) .94 |

3. Now let's see what happens to commissions when there is a listing broker and brokerage company and a different selling broker and brokerage company. Listing company A lists the home for \$200,000. Company A is charging 5.5% and has stated they will pay selling brokerage company B a commission of 2.8% of the sales price. The listing broker gets 40% of company A's share of the total commission, and the selling broker gets 70% of company B's share of the total selling commission. The broker from Company B will make what percentage more than the broker from Company A?

$$\text{Total Commission} = 200,000 * 5.5\% = 11,000.$$

$$\text{Company A's gross commission} = (5.5\% - 2.8\%) * 200,000 = .027 * 200,000 = \$5,400$$

$$\text{Company B's gross commission} = 2.8\% * 200,000 = .028 * 200,000 = \$5,600$$

$$\text{Company A's broker's commission} = .4 * 5,400 = \$2,160 \text{ (company } \$3,240)$$

$$\text{Company B's broker's commission} = .7 * 5,600 = \$3,920 \text{ (company } \$1,680)$$

In order to answer the percentage problem of B's greater share you must first determine the total commissions earned by both brokers by adding the individual commissions: \$2,160 + 3,920 = 6,080. Calculate each broker's share of the \$6,080.

$$\text{Part} / \text{Total} = \text{Rate } 2,160 / 6,080 = .3553 \text{ and } 3,920 / 6,080 = .6447$$

| | |
|--------------|--------------------------------|
| <u>Part</u> | <u>2160</u> |
| Total Rate | 6,080 Rate (.3553 or 35.53%) |

| | |
|--------------|--------------------------------|
| <u>Part</u> | <u>3920</u> |
| Total Rate | 6,080 Rate (.6447 or 64.47%) |

Then subtract B's percent from A's percent to find the greater percentage that was earned.
 $64.47\% - 35.53\% = 28.94\%$

Loan Problems

Loan to Value Ratio

What happens when the buyer needs to get financing for a home purchase? First you have to determine the Loan-to-Value Ratio (LTV). $\text{Loan} / \text{Value} = \text{Ratio}$

If the buyer wants to put down 10% he is hoping the lender will allow a LTV of 90% of the value of the home. LTV is based on the lesser of the sale price or the appraised amount. If the purchase price is \$250,000 and the appraisal is \$245,000 what is the loan amount?

$$\text{Value} * \text{Rate} = \text{Loan} \quad \$245,000 * .90 = \$220,500$$

$$\frac{\text{Loan}}{\text{Value} \mid \text{Rate}} \quad \frac{\text{Loan? (220,500)}}{245,000 \mid .90}$$

$$\text{Value} \mid \text{Rate} \quad 245,000 \mid .90$$

Computing Annual Interest

If the interest rate is 6% on the above \$220,500 loan, what is the annual interest paid the first year?

$$\text{Total} * \text{Rate} = \text{Part} \quad \$220,500 * .06 = \$13,230$$

$$\frac{\text{Part}}{\text{Total} \mid \text{Rate}} \quad \frac{\text{Part? (13,230)}}{220,500 \mid .06}$$

$$\text{Total} \mid \text{Rate} \quad 220,500 \mid .06$$

(NOTE: A common mistake when using the calculator is entering .6 instead of .06 for 6 percent; Don't forget that .6 = 60%)

Monthly Principal and Interest Payments

If you do not have a calculator that amortizes monthly PI (principal + interest) payments, you can create a personal table that shows payments based on \$1,000 amortized for 30 years as seen in Table 1. There are published tables or you can just call your favorite lender to get the current interest rate payment for \$1000.

| | | Interest Rate | PI Payment |
|-------------|------------|---------------|------------|
| Loan Amount | \$1,000.00 | 5.50% | 5.68 |
| | | 5.75% | 5.84 |
| | | 6.00% | 6.00 |
| | | 6.25% | 6.16 |

Table 1

What would be the PI payment on a \$220,000 loan at an interest rate of 5.75%?

Divide the loan amount by 1000 to determine how many "thousands" are being borrowed. (Or, move the decimal point three places to the left). The buyer wants to borrow 220 "thousands" of dollars. Since we know how much the payment is for \$1,000, multiply the number of thousands being borrowed by the payment for \$1,000 to get the total payment for a \$220,000 loan.

$$220,000 / 1000 = 220, \quad 220 * 5.84 = \$1,284.80 \text{ monthly payment.}$$

$$\frac{\text{Part}}{\text{Total} \mid \text{Rate}} \quad \frac{\text{Part? (1,284.80)}}{(220,000 / 1000) = 220 \mid 5.84}$$

$$\text{Total} \mid \text{Rate} \quad (220,000 / 1000) = 220 \mid 5.84$$

Looking Smart.

If you know the current payment for \$1,000 for today's interest rate, you can really look intelligent to your client by figuring their approximate payment in your head. Example: You are showing homes in the \$350,000 range and today's current 30-year mortgage rate is 5.75%. You memorized the payment of \$5.84 per thousand before you start showing homes. You could say, "If you want to buy this home and get a \$300,000 loan, your monthly PI payment would be around \$1,750" (\$584 for every 100,000). In your head think $500 * 3 = 1500$ and $\$84 + \$84 + \$84 = 252 = 1500 + 252 = 1752$. Or just say, "your payment will be less than \$1800." ($600 * 3$).

Figuring Discount Points

A discount point is 1% of the loan amount. If your buyer needs to pay 5 points to get the interest rate he needs to qualify, your buyer will be paying 5% of the loan amount.

Example: Buyer wants to get a \$220,000 loan. The current interest rate at 0 discount points is 6%. Buyer needs to get an interest rate of 5.5% in order to qualify for the loan. The lender tells the buyer that he can give him the 5.5% interest rate for 4 points. How much must the buyer pay the lending company for the 5.5% loan?

| <u>Point's Cost</u> | <u>Point's Cost?(\$8,800)</u> |
|---------------------|-------------------------------|
| Loan Points | 220,000 4.0% |

If the buyer can qualify for the 6% loan (and not pay the points), how many years would it take for the buyer to get back the cost of the 4 points? In other words, would it be smart to take the 6% loan or pay the points. Helping your buyers understand the comparative cost of points can be very important in their decision process.

Example Comparison of 6% loan versus 5.5% loan and 4 points: Using Table 1 above, figure the payments for both the 6% loan and the 5.5% loan. Then subtract the payment of the 5.5% loan from the payment of the 6% loan to get the monthly payment difference. Divide the payment difference into the amount paid for points. This will give you the total months needed for the buyer to make payments to break even.

Cost of Points = \$8,800

Payment for 6% loan = $\$6 * (220,000 / 1000) = \$1,320$

Payment for 5.5% loan = $\$5.68 * (220,000 / 1000) = \$1,249.60$

Difference in payment = $\$1,320 - \$1,249.60 = \$70.40$

Number of months to break even = $\$8,800 / 70.40 = 125$ months or 10.42 years.

Remember: Every month he keeps the loan after the break-even point the buyer has saved money by paying discount points. If the buyer pays off the loan before the break-even point, the buyer loses money. The question always is, "How long do you plan to stay in the home AND NOT REFINANCE?"

Lenders look at two different qualifying ratios (guidelines) to determine if they want to loan money.

The first ratio (Front-End-Ratio) is based on gross monthly income to determine maximum monthly PITI (Principal, Interest, Taxes and Insurance).

$$\frac{\text{Maximum monthly PITI}}{\text{Gross Monthly Income} \mid \text{Rate}}$$

The second ratio (Back-End-Ratio) is based on PITI plus additional total monthly expenses that include monthly payments for auto loans and credit card debt, etc.

$$\frac{\text{Maximum Total Monthly Debt}}{\text{Gross Monthly Income} \mid \text{Rate}}$$

Example 1: Buyer applies for a \$150,000 loan at 6% with a PITI payment of \$1,107 a month. Borrower earns \$75,000 a year with a monthly debt of \$600. The lender's guideline is Front-End-Ratio of 29% and Back-End-Ratio of 36%. Will the buyer get his loan?

$$\text{Front-End-Ratio} \quad \frac{\text{Maximum monthly PITI ? } (\$1,812.50)}{(75,000 / 12) \mid .29}$$

$$\text{Back-End-Ratio} \quad \frac{\text{Maximum Total Monthly Debt ? } (\$2,250)}{(6,250) \mid .36}$$

The answer is YES. Front-End-Ratio of \$1,812.50 is greater than his PITI of \$1,107, and his maximum total monthly debt of \$2,250 is greater than \$1,707 (PITI of \$1,107 + debt of \$600).

Depending on the loan-to-value ratios, qualifying ratio guidelines can be flexible. The higher the LTV the more the lender is risking so the ratios tend to be conservative. A qualifying ratio that is higher than the guideline can sometimes be acceptable if there are compensating factors, like a very high credit score.

Example 2: A buyer who earns \$85,000 a year was given a loan in the amount of \$250,000 with a PITI payment of \$2,000 a month. When the buyer applied for the loan, the buyer's additional monthly debt was \$800 dollars a month. What was the minimum rate for the Front-End-Ratio and what was minimum rate for the Back-End-Ratio?

$$\text{Front-End-Ratio} \quad \frac{\$2,000}{(85,000 / 12) \mid \text{Rate? } 28.24\%}$$

$$\text{Back-End-Ratio} \quad \frac{2,800}{\$7,083.33 \mid \text{Rate } 39.53\%}$$

Figuring Profit and Loss

Profit and loss is pretty straightforward. Sales Price – Cost = Profit: If Cost is greater than Sales Price you have a loss.

How is percentage of profit determined? Understanding the percentage of profit is essential in comparing different investments.

Profit

Cost | Percentage of profit

Example: In 1998 an item was purchased for \$200,000 and in 2001 the item was sold for \$280,000. What was the percentage of profit?

$$\frac{(280,000-200,000)}{200,000}$$

200,000 | Percentage of profit? $80,000 / 200,000 = .4$ (40%)

If there were any costs associated with the sale, the \$80,000 would be decreased by the selling costs and the percent of profit would be less.

In real estate you do not just buy, hold, and then sell. Instead, you buy, collect rent, and pay expenses during the holding period, and then sell. The profit or loss during the holding period would be added or subtracted from the gross profit received at the time of sale, creating a net profit. Other decisions which can affect the net profit of buying and selling real estate are the IRS depreciation rules, tax write-off benefits, and whether or not the cash flow from the property is being re-invested during the holding period.

Figuring Straight-Line Appreciation/Depreciation

Straight-line appreciation or straight-line depreciation is the constant percentage increase or decrease in value over a period of time.

Example of straight-line appreciation: If you paid \$100,000 for a property and the property increases yearly at 7.143%, what is the annual increase of value after one year and what is the property worth after 7 years?

| | |
|----------------------------|--|
| <u>Annual Appreciation</u> | <u>Annual Appreciation? (\$7,143)</u> |
| Cost Yearly Rate | 100,000 7.143% |

Annual appreciation rate * number of years = Number of years appreciation rate

$$7.143\% * 7 = 50\%$$

100% cost + annual appreciation rate = number of years value as a percent

$$100\% + 50\% = 150\%$$

| | |
|--|------------------------------------|
| <u>Total Appreciated Value for 7 years</u> | <u>Value - 7 years?(\$150,000)</u> |
| Cost Value as Percent | 100,000 150% |

Now look at the problem in reverse.

If you paid 100,000 for a property, and after 7 years the property was worth \$150,000, what was the yearly percentage increase?

First, determine the percentage increase in value.

$$\frac{\text{Total Appreciated Value}}{\text{Cost}} = \frac{150,000}{100,000} = \text{Rate? (1.50 or 150\%)}$$

Now you need the annual appreciation rate. Annual appreciation rate = number of years value as a rate – 100%

Since the 150% includes the original cost (original cost =100%), subtract the 100% to get the percentage increase of 50%. Determine the yearly increase by dividing 50% by 7 years.

$$\frac{\text{Percent Increase}}{\text{Years}} = \frac{50\%}{7} = \text{Yearly Rate? (7.1\%)}$$

This is quite different from investing \$100,000 and saying it shall increase by 7.1% with the **interest being compounded (earned interest add to investment)**.

| Year | Value | Appreciation % | Appreciation Amount | End of Year Amount |
|------|---------|----------------|---------------------|--------------------|
| 1 | 100,000 | 0.071 | 7100 | 107,100 |
| 2 | 107,100 | 0.071 | 7604.1 | 114,704 |
| 3 | 114,704 | 0.071 | 8143.9911 | 122,848 |
| 4 | 122,848 | 0.071 | 8722.214468 | 131,570 |
| 5 | 131,570 | 0.071 | 9341.491695 | 140,912 |
| 6 | 140,912 | 0.071 | 10004.73761 | 150,917 |
| 7 | 150,917 | 0.071 | 10715.07398 | 161,632 |

Notice that instead of \$150,000, after 7 years the investment is \$161,632. If the investment of \$100,000 were invested at 6% compounded yearly it would grow to slightly over \$150,000 (see chart below). When comparing real estate investment to other types of investments you will usually be comparing investments based on compounded interest rates.

Notice that you can create your own interest-compounded chart with the simple calculator by calculating each line one at a time. End-of-year investment (investment + interest) is carried forward as next year's investment.

| Year | Value | Appreciation % | Appreciation Amount | End of Year Amount |
|------|---------|----------------|---------------------|--------------------|
| 1 | 100,000 | 0.06 | 6000 | 106,000 |
| 2 | 106,000 | 0.06 | 6360 | 112,360 |
| 3 | 112,360 | 0.06 | 6741.6 | 119,102 |
| 4 | 119,102 | 0.06 | 7146.096 | 126,248 |
| 5 | 126,248 | 0.06 | 7574.86176 | 133,823 |
| 6 | 133,823 | 0.06 | 8029.353466 | 141,852 |
| 7 | 141,852 | 0.06 | 8511.114674 | 150,363 |

Example of Straight Line Depreciation

If you paid \$100,000 for a property, and the property decreases yearly at 7.143%, what is the annual decrease of value after one year and what is the property worth after 7 years?

| | |
|----------------------------|---------------------------------------|
| <u>Annual Depreciation</u> | <u>Annual Depreciation? (\$7,143)</u> |
| Cost Yearly Rate | 100,000 7.143% |

Annual Depreciation Rate * number of years = Number of Years Depreciation Rate

$$7.143\% * 7 = 50\%$$

100% Cost - Annual Depreciation Rate = Number of Years Value as a percent

$$100\% - 50\% = 50\%$$

| | |
|--|---------------------------------------|
| <u>Total depreciated Value for 7 years</u> | <u>Value after 7 years?(\$50,000)</u> |
| Cost Value as Percent | 100,000 50% |

Using Capitalization Rate to determine Value for income-producing properties.

Real estate markets have a current market rate of return known as the capitalization rate, (CAP rate). The CAP rate is created by dividing the average annual net operating income (NOI) of a specific market by the average market value.

To find **NOI** you adjust the **Annual Gross Income** for vacancies and bad debt to get the **effective gross income**. Then you subtract the **annual operating expenses** from the effective gross income to get NOI.
 $NOI = (\text{Annual Gross Income} - \text{Vacancies and bad debt}) - \text{annual operating expenses}$.
 However, debt expense (mortgage payments) and depreciation are not included as operating expenses.

To determine the value of a single property you divide the annual NOI by the CAP Rate: $\text{Annual NOI} / \text{CAP Rate} = \text{Value}$

$$\frac{\text{NOI}}{\text{Value} | \text{CAP Rate}}$$

Example: An apartment building has 12 units with each unit being rented at \$1,200 a month. The annual vacancies and bad debit are 5% of the annual income. The annual operating expenses are \$50,000. The capitalization rate for similar apartment buildings in the area is 9%. What is the value of the apartment building?

$$\text{Total Rents} = (1200 * 12) * 12 = \$172,800$$

$$\text{Vacancy and Bad Debts} = 172,800 * .05 = \$8,640$$

$$\text{NOI} = (172,800 - 8,640) - 50,000 = \$114,160$$

$$\underline{114,160}$$

Value? | .09

$$114,160 / .09 = \$1,268,444$$

Determining Monthly Rent using a percentage lease.

A percentage lease can be structured in many ways.

1. The rent could be a % of gross monthly income.
2. The rent could be a % of gross monthly income plus a monthly base rent.
3. The rent could be a % of gross monthly income or a base monthly rent, which ever is greater.

Example 1: A hardware store's lease states that the rent shall be \$1.50 a square foot plus 5% of the gross income. The store uses 3,000 square feet and December's monthly income was \$45,000. What was December's rent?

$$\text{Square Foot Rent} = 3,000 * 1.5 = \$4,500$$

$$\text{Percentage Rent} = 45,000 * .05 = \$2,250$$

$$\text{Total Rent} = \$6,750.$$

Example 2: A hardware store's December rent was \$8,000. The store pays a minimum base rent of \$5,000 plus 3% of gross income. What is the gross income for December?

$$\text{Percentage Rent} = \$8,000 - \$5,000 = \$3,000.$$

$$\underline{\text{Percentage Rent}}$$

$$\text{Gross Income} | \text{Lease Percentage} \quad \$3,000 / .03 = \$100,000$$

Measurement

Linear Measurement: Measurement of a line. All of the following are real estate terms for measuring total length.

1. Per foot,
2. per linear foot,
3. per running foot,
4. per board foot (Length of a piece of wood),
5. per front foot (Frontage Foot or Length of Street Side of Lot).

Measurement Conversions
Linear Measurement

12 inches = 1 foot

Inches / 12 = Feet

Feet * 12 = Inches

36 inches = 1 yard

Inches / 36 = Yards

Yards * 36 = Inches

3 feet = 1 yard

Feet / 3 = Yards

Yards * 3 = Feet

5,280 feet = 1 mile

Feet / 5280 = Miles

Miles * 5,280 = Feet

16 ½ feet = 1 rod

Feet / 16.5 = Rods

Rods * 16.5 = Feet

320 rods = 1 mile

Rods / 320 = Miles

Miles * 320 = Rods

Area Measurements

144 square inches = 1 square foot

Square Inches / 144 = Square Feet

Square Feet * 144 = Square Inches

43,560 square feet = 1 acre

Square Feet / 43,560 = Acres

Acres * 43,560 = Square Feet

1,296 square inches = 1 square yard

Square Inches / 1,296 = Square Yard

Square Yards * 1,296 = Square Inches

640 acres = 1 section = 1 square mile

Acres / 640 = Sections (Square Miles)

Sections (Square Miles) * 640 = Acres

9 square feet = 1 square yard

Square Feet / 9 = Square Yard

Square Yards * 9 = Square Feet

Volume Measurements

1,728 cubic inches = 1 cubic foot

Cubic Inches / 1728 = Cubic Feet

Cubic Feet * 1,728 = Cubic Inches

46,656 cubic inches = 1 cubic yard

Cubic Inches / 46,656 = Cubic Yards

Cubic Yards * 46,656 = Cubic Inches

27 cubic feet = 1 cubic yard

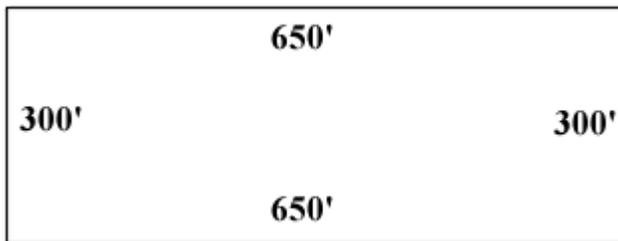
Cubic Feet / 27 = Cubic Yards

Cubic Yards * 27 = Cubic Feet

Measurement Problems

Area of a square, rectangle or trapezoid: Length * Height = Area

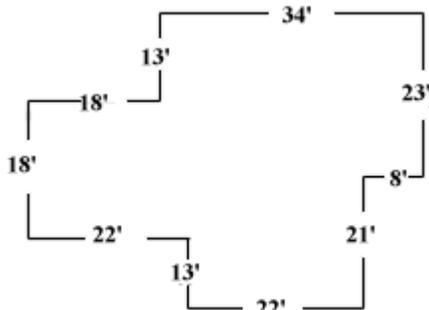
If a piece of land measured 650' X 300' what is the area of the land? If you wanted to fence the land, how many linear running feet are there?



AREA = 195,000 square feet **or**
AREA = 21,667 square yards **or**
AREA = 4.48 acre

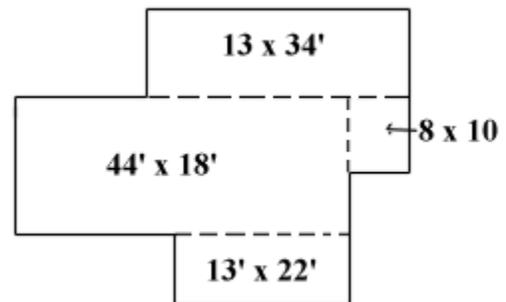
Linear Running Feet = 1900'

When you measure the exterior of a home it may have a variety of sides, as seen below in the picture on the left. To determine the total square feet of the home you will need to break it into small rectangles, as seen below in the picture on the right. Compute the areas of each small rectangle, and then add up all the areas.



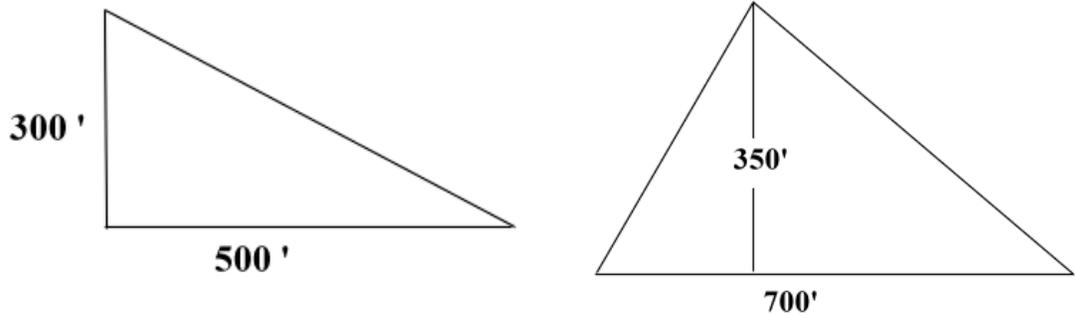
Total
Square
Feet:

$$(13 * 34 = 442) + (44 * 18 = 792) + (8 * 10 = 80) + (13 * 22 = 286) \\ = 1600 \text{ Total Square Feet}$$



If it cost \$30 a square yard to carpet the above home, what would be the total cost?
(Total square feet / 9) * Cost per square yard = (1600 / 9) * 30 = \$5,333

Area of a Triangle: (Base * Height) / 2



For the two triangles above, we have left to right :

$$(300 * 500) / 2 = 75,000 \text{ square feet}$$

$$(350 * 700) / 2 = 122,500 \text{ square feet}$$

Cubic Volume of a Box (Length * Width * Height = Cubic Volume)

Example: How much concrete will be needed for a parking area that is 25 feet wide, 40 feet long, and 3 ½ inches high?

First convert 3 ½ inches to feet. $3.5 / 12 = .291667$

Then $25 * 40 * .291667 = 291.67$ cubic feet or $291.67 / 27 = 10.80$ cubic yards.

Prorating Problems

Prorate means “to divide proportionately.” In real estate we prorate the buyer’s and seller’s income and expenses, which include items like interest on loans, property taxes, homeowner fees, and rents collected. Prorations are either between the Buyer and Seller or Buyer and Broker or Seller and Broker. Prorations are posted as Debits (taking money from a person) and Credits (giving money to a person).

When prorating calculate the number of days owed for the expense, interest, or rents. The days are based on either a **banker’s year** (also called a statutory year) which consists of 30 days in every month (360 days on the National part of the exam) or a calendar year (365 days on the State part of the exam). Calendar Leap Year would be 366 days. When you are given a proration problem, you will be told which calendar to use.

NOTE: Day of closing, closing date, and settlement date are just different ways to say the same thing.

In prorations problems you will be told whether to prorate **through** the day of closing or **to** the day of closing. When **prorating through** the day of closing, **the seller is responsible** for the day of closing. When **prorating to** the day of closing, the **buyer is responsible** for the day of closing.

How to Calculate the Prorated Amount

1. First determine whether the number of days is based on the month, quarter, or year. (Remember to check the problem to see if it is using the banker's year or calendar year).
2. Calculate the number of days owed.
3. Calculate the amount of the expense or income per day. If it is an annual amount, it is divided by the total days in the year. If it is a monthly amount, it is divided by the total days in the month.
4. Multiply the amount per day by the number of days owed.

Four simple rules for calculating number of days owed:

1. Own TO day of Closing: Closing Date (-) 1 day.
2. Own FROM day of Closing: Closing Date (-) 1 subtracted from Total days in month.

Example: Seller owns "TO" and Buyer owns "From" with closing on June 17 (30 day month)

Seller owns 16 days (17 - 1) and Buyer owns 14 days (30 - (17 - 1)).

3. Own Through day of Closing: Closing Date.
4. Own After day of Closing: Closing Date subtracted from total days in month.

Example: Seller owns "Through" and Buyer owns "After" with closing on June 17 (30-day month).

Seller owns 17 days and Buyer owns 13 days (30 - 17).

Prorating Interest on Loans

Interest is almost always paid in arrears (paid at the end of the period). In other words, when you make your mortgage payment on the first of the month, you are paying the interest portion for the previous month.

To prorate interest on a loan the daily interest owed must first be calculated.

For a new loan:

Annual Interest = Principal * Interest Rate.

Daily Interest = Annual Interest / Days in Year

NOTE: Some people prefer to first determine the daily interest rate (annual rate / 365) and then multiply the daily interest rate times the Principle amount.

For a Loan Assumption:

Annual Interest = Principal * Interest Rate.

Monthly Interest = Annual Interest / 12

Daily Interest = Monthly Interest / **Actual Days in Month**

New Loan Closing: Prorating interest owed by buyer for closing month.

Since the interest is paid in arrears, the first payment on the loan will not occur until a full month has passed. Most lenders will want the loan payments to be due on the 1st of each month. If closing occurs during the month, **the lender will collect the daily interest for remaining days in the closing month.** Then the loan payment calendar starts with the following month.

Example: Closing date is June 17. Buyer owes the lender interest for 14 days in June. Loan calendar starts July 1 with first payment due August 1. July interest is included and paid with the August 1 payment. $(\text{Principal} * \text{Interest Rate}) / 365 = \text{Daily Interest Rate}$

Example: Closing Date is June 17, loan amount \$150,000, and interest rate 5%.

Remaining Days = 14

Annual Interest = $(150,000 * 5\%) = 7,500$

Daily Interest = $7,500 / 365 = 20.547945$

June Interest = $14 * 20.547945 = \$287.67$

DEBIT Buyer \$287.67

Loan Assumption: Buyer owns closing day.

Seller's original loan of \$250,000 at 6% is being assumed. The loan closing date is August 12. The last payment made by the seller was August 1st. The principal balance after the August payment is \$232,635.

Days owned by seller = $(12-1) = 11$

Annual interest = $(232,635 * 6\%) = 13,958.10$

Monthly interest = $13,958.10 / 12 = 1,163.175$

Daily interest = $1,163.175 / 31 = 37.521774$

Reminder: Daily interest = $(\text{annual interest} / 12 / \text{number of days in closing month})$

Prorated interest = $\text{daily interest} * \text{number of days seller owned during the closing month}$

Prorated July interest = $11 * 37.521774 = \$412.74$

Debit Seller and Credit Buyer \$412.74

Reminder: When buyer makes the September payment they will be paying all of the August interest. The seller owes buyer for the days the seller owned the property in August.

Prorating Homeowner Fees

When working with homeowner's fees, there are three things to look for.

1. When are they due?
2. Have they been paid?
3. Are the fees monthly, quarterly or annually?

1. If Seller pays fees due in advance, buyer owes seller buyer's portion of the month.
2. If Seller does not pay fees that are due in advance, seller owes buyer seller's portion of the month.
3. If fees are paid in arrears, Seller owes Buyer seller's portion of the month.

Prorations for homeowner's fees are usually based on the calendar month.

Example: \$100 a month is due in advance. The Seller paid \$100 on July 1 for the month of July and closing is on July 10.

Days in Month = 31

Buyer's portion of month = $31 - (10 - 1) = 22$ days

Daily Fee = $100 / 31 = 3.225806$

DEBIT Buyer = $22 * 3.225806 = \$70.97$

Example: \$100 a month is due in advance with closing on July 15. Seller did not pay and closing agent has been instructed to collect the fee and pay the homeowner's association.

Days in Month = 31

Seller's portion of month = $15 - 1 = 14$ days

Buyer's Portion of the month = $31 - (15-1) = 31 - 14 = 17$

Daily Fee = $100 / 31 = 3.225806$

DEBIT Seller = $14 * 3.225806 = \$45.16$

DEBIT Buyer = $17 * 3.225806 = \$54.84$

Example: On January 1, Seller has paid in advance the yearly homeowner's dues of \$350. Closing is on May 12. Using a banker's calendar, what is owed by the buyer?

Monthly Fee = $350 / 12 = 29.166667$

May daily fee = $29.166667 / 30 = 0.972222$

Number of Months pre-paid by Seller = 7 and part of May.

Number of Days in May owed by buyer = $31 - (12 - 1) = 20$.

$$\text{DEBIT Buyer} = (7 * 29.166667) + (20 * 0.972222) = \$223.61$$

Proration of Rents

When working with rents, like homeowner dues, there are three things to look for.

1. When are they due?
2. Have they been paid by tenant and received by seller?
3. Are the rents monthly, quarterly or annually?

Example: Settlement Date is March 12. Rents are due on the 1st of the month and the seller has collected the rent of \$950 on March 1st.

$$\text{Monthly Rent} = \$950$$

$$\text{Daily Rent} = 950 / 31 = 30.645161$$

$$\text{Buyer's portion of month} = 31 - (12 - 1) = 20$$

$$\text{Daily Rent owed Buyer} = 20 * 30.645161 = \$612.90$$

$$\text{DEBIT Seller and Credit Buyer} \$612.90$$

Proration of Property Taxes

When prorating property taxes (taxes) there are 4 main points.

1. The yearly taxes are paid in arrears.
2. Proration is based on a 365-day year unless stated otherwise. On the general portion of the state exam, however, they will state that you should prorate taxes using a 360-day year (every month has 30 days) and seller will be responsible for the day of closing.
3. Proration of taxes for the current year are based on the preceding year's taxes unless stated otherwise.
4. Seller owes buyer for seller's portion of the current year (and past year's taxes if not paid).

Example of New Loan using a 365-day year: The previous year's taxes of \$3,550 have not been paid. Closing date is February 9. What are the total taxes owed by Seller?

$$\text{Previous year's taxes} = \$3,550.$$

$$\text{Daily tax} = \$3,550 / 365 = 9.726027$$

$$\text{Number of days owned by seller} = 31 + 8 = 39 \text{ days}$$

$$\text{Seller's portion of current year's taxes} = 39 * 9.726027 = \$379.32$$

$$\text{DEBIT Seller} = 3,550 + 379.32 = \$3,929.32$$

Note: If sellers had a loan on the property, the sellers will get a check from their lender after closing for the tax escrow held by their lender.

Example of New Loan using a 360-day year: The previous year's taxes of \$3,550 have not been paid. Closing date is February 9. What are the total taxes owed by Seller?

Previous year's taxes = \$3,550.

Monthly tax = $\$3,550 / 12 = \295.833333

Daily tax = $\$295.833333 / 30 = 9.861111$

Seller owes for 1 month + 9 days = $\$295.833333 + (9.861111 * 9 = 88.7500) = \384.58

DEBIT Seller = $\$3,550 + \$384.58 = \$3,934.58$

Loan Assumption: The calculations are the same for a loan assumption as with a new loan with one very big addition. When a loan is assumed **the tax escrow held by the lender must first be credited to the Seller and debited to the Buyer. This will change the final figure the seller must pay.**

Example of Loan Assumption: The previous year's taxes of \$3,550 have not been paid. Closing date is February 9. The lender's tax escrow is \$4,133.56. What are the total taxes owed by Seller?

Previous year's taxes = \$3,550.

Daily tax = $\$3,550 / 365 = 9.726027$

Number of days owned by seller = $31 + 8 = 39$ days

Seller's Portion of current years taxes = $39 * 9.726027 = \$379.32$

DEBIT Seller = $3,550 + 379.32 = \$3,929.32$

CREDIT Seller = $\$4,133.56$

Credit exceeds debit = $4,133.56 - 3,929.32 = \$204.24$

Proration of hazard insurance: It is very rare for a buyer to assume a seller's hazard insurance policy. Hazard insurance premiums cover a year, but unlike property taxes, the insurance begins and ends at a specific period of time. So if the insurance begins on October 16 it ends on October 15 the following year. The assumption would be based on a 365-day year with the year being October 16 to October 15.

Example: Closing date is January 3 and the hazard insurance of \$490 paid by seller covers the property for one year starting on October 16. What does the buyer owe the seller at time of closing?

Daily Rate = $490 / 365 = 1.342466$

Days owned by seller = Oct-16, Nov-30, Dec-31, Jan-2 = 79

Days owned by buyer = $365 - 79 = 286$

Buyer Owes $286 * 1.342466 = 383.95$

DEBIT Buyer and CREDIT Seller $\$383.95$

MILL RATE

Real property tax liens are created using the mill levy. The mill levy (mill rate) is multiplied times your assessed valuation. Assessed valuation is your proportional share of the total area property values.

Mill Rate = Budget needs of the community divided by total property assessed values.

The formula is $\frac{\text{Community Budget Needs}}{\text{Total property assessed values}}$ | Mill Rate

Example: The total assessed value of property in a county is \$800,000,000. The budget needs of the county are \$5,000,000. What is the mill rate?

$$5,000,000 / 800,000,000 = .00625 \text{ or } 6.25 \text{ mills}$$

Assessed Valuation

$\frac{\text{Total Assessed Properties}}{\text{Single Property value}}$ | Assessed Valuation

Example: Your property is worth \$300,000. The assessed valuation for your county is 800,000,000. What is your assessed valuation?

$$800,000,000 / 300,000 = \$2,666.66$$

Mill Levy

The mill rate is expressed in tenths of a cent per dollar or **1 mill = \$.001 for every dollar.**

Example: 60 mills = .06

The formula is $\frac{\text{Property Taxes}}{\text{Assessed Valuation}}$ | Mill Rate

Example: If your mill rate was 38 mills and your assessed valuation was \$38,000 what would be your property taxes? $38,000 * .038 = \$1,444$

Example: If your property taxes are \$2,500 and the mill rate is 30 mills what is your assessed valuation? $2,500 / .030 = \$83,333$

In this Guide, We Reviewed How to:

- Use a simple calculator
- Compute fraction, decimal and percentage problems
- Explain capitalization rate
- Discuss percentage leases
- Work out measurement problems
- Compute prorations and mill rate problems

Learn more at <https://www.vaned.com/blog/real-estate-math/>