**For this course you are responsible for knowing how to perform all of the following calculations on either a financial calculator or Excel, and bringing a financial calculator or Excel enabled device to every class to participate in exercises. Use this document to practice. IF YOU CANNOT GET THE CORRECT ANSWERS AFTER FOLLOWING THE INSTRUCTIONS AND TROUBLESHOOTING STEPS BELOW, YOU ARE RESPONSIBLE FOR COMING TO SEE ME ASAP DURING OFFICE HOURS. DO NOT WAIT UNTIL YOU HAVE TROUBLE ON HOMEWORKS OR TESTS.**

1. **Calculating Simple Overall Growth Rate or Percent Change**

**Formula:** (End Value – Beginning Value) / (Absolute Value of Beginning Value)

**Simple Example 1:**

*Earnings last year were $100 and earnings this year are $110. What is the earnings growth rate (what is the percent change in earnings)?*

*($110 - $100) / (ABS $100)*

*= $10 / $100*

*= 10%*

**Simple Example 2, when Beginning Value is a negative number**

*Earnings last year were a loss of ($100) and earnings this year are a positive $100. What is the earnings growth rate?*

*Solution:*

*($100 – (-$100)) / (ABS (-$100))*

*= $200 / $100*

*= 200%*

1. **Calculating future values when you know percentage growth rate:**

**Formula:** Beginning Value x (1 + percentage growth, expressed as a decimal)

**Simple Example:**

*The stock price is currently $100 and you expect it to grow 10% next year. What will the stock price be a year from now?*

*Solution:*

*$100 x (1 + 0.10)*

*= $100 x 1.10*

*= $110*

1. **Calculating Average Annual Growth Rate over Multiple Periods (ACGR)**

When you know the OVERALL growth rate of a measurement over several years, and you wish to calculate the average growth PER year, you use the Exponent Function on your calculator or Excel.

This can be done on your calculator if you have an Exponent button, which usually appears as **yx .** Learn how this button works: you know that 32 = 9. Figure out how to do that on your calculator.

This calculation can be done on Excel by using the **^** symbol which means “to the power of…”

For example: entering **= 3 ^ 2** on Excel will return the answer **9.**

**When you calculate ACGR, the Exponent you use is: (1 / # of years elapsed between the start year and the end year).** For example, if your sales in 2018 were 50% larger than your sales in 2014, you can calculate what was your average annual growth rate per year for each of the four elapsed years between the end of 2014 and the end of 2018 by using ¼ or 0.25 as the Exponent.

**Formula:** (Overall Percent Change + 1) ^ (1 / # Periods)) – 1

**Simple Example 1:**

*Profits in Year 1 were $100 and profits in Year 3 were $110. What is the average annual growth rate in profits during this period?*

*Solution:*

*Step 1: Calculate OVERALL percent growth for the two year period (uses first Basic Business Calc):*

*($110 - $100) / (ABS $100)*

*= $10 / $100*

*= 10% which is the same as 0.10 in decimal form*

*Step 2: Calculate AVERAGE ANNUAL growth rate:*

*(0.10 + 1) ^ (1/2) – 1*

*= 1.10 ^0.5 – 1*

*= 1.048809 – 1*

*= .048809 which is the same as 4.8809%*

*NOTE that due to the power of compounding, the ACGR is not 5% per year, it is slightly less.*

**Simple Example 2, when Beginning Value is a negative number, indicated with parentheses:**

*Profits in Year 1 were a loss of ($100) and profits in Year 3 were $100. What is the average annual growth rate in profits during this period?*

*Solution:*

*Step 1: Calculate OVERALL percent growth for the two year period using the formula above:*

*($100 – (-$100)) / (ABS (-$100))*

*= $200 / $100*

*= 200% which is the same as 2.00 in decimal form*

*Step 2: Calculate AVERAGE ANNUAL growth rate:*

*(2.00 + 1) ^ (1/2) – 1*

*= 3.00 ^0.5 – 1*

*= 1.732051 – 1*

*= .732051 which is the same as 73.2051%*

1. **Calculating a future value when you know annual growth rate**

**Formula:** Beginning Value x [ (1 + annual growth rate expressed as a decimal) ^ # of growth periods ]

**Simple Example:** *The stock price is currently $100 and you expect it to grow 10% per year for each of the next 5 years. What should the stock price equal five years from now?*

*Solution:*

*$100 x [ (1 + 0.10) ^ 5]*

*= $100 x [ 1.10 ^5 ]*

*= $100 x 1.61051*

*= $161.05*

*NOTE that due to the power of compounding, you cannot just multiply 10% x 5 years, which would result in a 50% total growth rate and a $150 stock price.*

1. **Calculating Breakeven Point**

**Definition:** # units you need to sell in order to “break even” i.e., your gross profit exactly equals your fixed cost. You just “cover your costs,” you don’t make any profit, or any loss.

**Formula:** Total Fixed Cost / Gross Profit Per Unit

**Example:** You sell bicycles for $500 each. Your COGS is $100 per bicycle. Your total annual fixed cost for administrative salaries, rent, insurance, and advertising is $240,000/year. How many bicycles do you need to sell to break even?

**Solution:**  
[ 240,000 / (500 – 100) ]

= 240,000 / 400  
= 600 bicycles

1. **Debt Coverage Calculations**
   1. **Interest Coverage Ratio, also called Times Interest Earned Ratio**

**Formula:** EBIT (Earnings Before Interest and Taxes) / Interest Expense

**Simple Example:**

*You have monthly Sales of $100, COGS of $20, and Fixed Costs of $50.*

*Your monthly Interest Expense is $5.*

*What is your Interest Coverage Ratio?*

*Solution:*

*$100 – $20 – $50 = EBIT of $30*

*$30 / $5 = 6x Interest Coverage Ratio*

* 1. **Fixed Payments Coverage Ratio**

“Fixed Payment” is what lenders call the amount you need to pay them each month, which includes BOTH interest AND some repayment of the debt.

**Formula:** EBITDA (Earnings Before Interest, Taxes, Depreciation & Amort.) / Fixed Payment

**Simple Example:**

*You have monthly Sales of $100, COGS of $20, and Fixed Costs of $50. Your Fixed Costs include Depreciation and Amortization of $4.*

*Your monthly Fixed Payment is $5 of Interest plus $2 of Principle Repayment.*

*What is your Fixed Payment Coverage Ratio?*

*Solution:*

*$100 – $20 – $46 = EBITDA of $34*

*$34 / $7 = 4.9x Fixed Payment Coverage Ratio*

* 1. **Calculating Interest Payment for a NON-amortizing loan:**

**Formula:**

(Principle x Annual Interest Rate)

**Simple Example:**

*You have borrowed $100,000 at an annual interest rate of 12%.*

*What is your annual Interest Payment?*

*Solution:*

*$100,000 x .12 = $12,000*

* 1. **Calculating monthly Fixed Payment (Interest + Principle) for an AMORTIZING loan:**

NOTE: this can be done easily on Excel, or on a financial calculator with TVM functions.

PV = Beginning Value, or total amount borrowed

FV = End Value: the amount you owe after you have paid off the loan. This equals Zero.

N = number of periods from beginning to end of the loan. Most loans require monthly payments, so this equals the length of the loan in months, not years.

I = interest rate per period. If loan requires annual payments, it equals the annual interest rate. If it requires monthly payments, this equals the annual interest rate divided by 12.

PMT = what you are solving for, the payment you have to make each month to the lender.

**Simple Example:**

*You borrow $100,000 on a five year, fully amortizing loan with 12% annual interest rate, requiring monthly payments. What is your monthly payment?*

*PV = $100,000*

*FV = $0*

*N = 60 (total months)*

*I = 1% (interest rate per month)*

**ON EXCEL:**

**Formula**: =PMT(I,N,PV,-FV) Note: input I as a decimal

**Example:**

*=PMT(.01,60,100000,0)*

*Solution = $2,224.44 monthly fixed payment (This appears as a negative number because it is a cash OUTFLOW for you.)*

**ON FINANCIAL CALCULATOR***:*

Input each variable PV, FV, N and I Note: input I as a whole number, not a decimal

*Solution: Solve for PMT = $2,224 monthly fixed payment. (This appears as a negative number because it is a cash OUTFLOW for you.)*

**EXTRA PRACTICE PROBLEMS:**

1. **Calculating Simple Overall Growth Rate or Percent Change**

**Formula:** (End Value – Beginning Value) / (Absolute Value of Beginning Value)

|  |  |  |
| --- | --- | --- |
| Question | Equation | Answer: |
| This year you sold 520 rabbits at a price of $2 each. Next year you plan to reduce the price to $1.75/rabbit and expect to sell 800 rabbits. What is your unit growth rate?  What is your percent price increase? | (800 – 520) / 520  (1.75 – 2)/ 2 | 53.85%  -12.5% |
| What will be your percent growth in total sales next year if you sell 1,000 rabbits next year at a price of $3.00? | (you write the equation) | 188.46% |
| What will be the percent change in total sales if your actual sales next year are only 400 rabbits at $2.50? |  | (3.85%) |
| Your company had 1,400 employees last year but this year has laid off 300. What is your percent change in headcount? |  | (21.43)% |
| Last year your company had a net loss of $(400,000). This year you had a net profit of $600,000. By what percent did profits improve? |  | 250.00% |

1. **Calculating future value when you know percentage growth:**

**Formula:** Beginning Value x (1 + percentage growth, expressed as a decimal)

|  |  |  |
| --- | --- | --- |
| Question | Equation | Answer: |
| This year you sold 520 rabbits at a price of $2 each. Next year you plan to sell 40% more rabbits and increase price per rabbit by 50%. What will your total sales be? | (520 x 1.4) x (2.00 x 1.5)  Units x Price | $2,184 |
| What would your total sales be next year if you sell 80% more rabbits than this year, but DECREASE prices by 50% from this year? |  | $936 |
| You own real estate worth $2mm and expect it to grow in value 20% per year for the next 2 years. What will it be worth in 2 years? |  | $2.88mm |
| Your team has a goal to increase sales 35%. Currently you sell 10 cellphones per week at $80/phone. How many phones do you need to sell per week to meet your goal? |  | 14 (13.5 rounded) |
| What if you raise price per phone by 25%: how many phones do you need to sell per week to meet your total sales goal? |  | 11 (10.8 rounded) |

1. **Calculating Average Annual Growth Rate over Multiple Periods;**

**also known as Average Compound Growth Rate (ACGR or CAGR)**

**Formula:** (Overall Percent Change + 1) ^ (1 / # Periods)) - 1

|  |  |  |
| --- | --- | --- |
| Question | Equation | Answer: |
| Your healthcare costs have grown 60% over the past 3 years. What is the average annual growth rate? | (0.60 + 1) ^ (1/3) - 1 | 16.96% |
| Inflation in Brazil was 48% last year. By what percent did the cost of living increase each month on average during the course of the year? |  | 3.32% |
| Your parents bought their home 10 years ago for $500,000. It is worth $850,000 today. What has been the average annual appreciation rate? |  | 5.45% |
| Your first year in business you had sales of $100,000. In your sixth year, your sales were $1mm. What has been your average annual growth rate in sales over 5 years? |  | 58.49% |
| The first week of school you sold 100 ice cream cones. The last week of the semester you sold 600. What was your average weekly increase in sales over the 15 week period? |  | 12.69% |

1. **Calculating a future value when you know annual growth rate**

**Formula:** Beginning Value x [ (1 + growth rate expressed as a decimal) ^ # of growth periods ]

|  |  |  |
| --- | --- | --- |
| Question | Equation | Answer: |
| You put $5,000 into an investment fund and expect it to appreciate on average 6% per year. How much should it be worth after 10 years? | 5,000 x [ (1 + .06) ^ 10 ] | $8,954 |
| You buy ten goldfish for your pond and expect them to multiply in number by 10% per month. How many will you have after 1 year? |  | 31 |
| The golf ball industry is currently $1b and expected to grow at a steady state of 3% per year. How big will it be 20 years from now? |  | $1.81b |
| You are a McDonald’s franchisee with 5 stores. You feel you can grow your number of stores 25% per year. How many stores will you have 10 years from now? |  | 46 |
| The population of North Dakota is 740,000 people and is shrinking at 1% per year. How many people will be there 10 years from now? |  | 669,242 |

1. **Calculating Break Even Point**

**Formula:** Breakeven # Units = Fixed Costs / (Price – COGS per Unit)

|  |  |  |
| --- | --- | --- |
| Question | Equation | Answer: |
| This year you have $100,000 in annual fixed costs. You sell T-shirts for $20 each and have COGS of $5 per t-shirt.  Next year you are going to add a part time salesperson so your fixed costs will go up to $125,000/year. You are also going to raise prices 10%. Your COGS will not change.  How many more t-shirts will you have to sell per year to breakeven under the new cost structure? | This year:  100,000 / (20 - 5)  Next year:  125,000 / (22 – 5) | 687 more t-shirts to break even |
| You have a very profitable business selling Mickey Mouse ears online. You sell the ears for $40/pair and your COGS is just $5/pair. You use the profits of this business to provide employment for your entire family and to pay for your home, which you use as the office and distribution facility, so you claim fixed costs of $500,000/year and operate at break even.  Suddenly a competitor appears who is charging $30/pair for the same product. You are in a price war and need to match this price. How many more units will you need to sell per year to avoid laying off any family members? | Prior break even:  500,000 / (40 – 5)  New break even:  500,000 / (30 – 5) | 5,714 |
| You run a taco truck with total fixed costs of $80,000/year. The average customer check is $12 and you have a 40% gross margin. Your insurance company suddenly raises your rates by $10,000/year for Terrorism Insurance.  How many more meals would you need to sell per day to cover this cost and maintain your profitability? | 10,000 / (12 x 40%) / 365 | 6 |
| Same business, different approach:  You run a taco truck with total fixed costs of $80,000/year. The average customer check is $12 and you have a 40% gross margin. You sell about 40,000 meals per year. Your insurance company suddenly raises your rates by $10,000/year for Terrorism Insurance.  By what percent do you need to increase prices to cover this cost and maintain your profitability? | $10,000 / 40,000 = $0.25/meal additional gross profit/unit needed to cover additional fixed costs  0.25 / 12.00 = ? percent | 2.1% |

**6. Debt Coverage Calculations**

1. **Interest Coverage Ratio, also called Times Interest Earned Ratio**

**Formula:** EBIT (Earnings Before Interest and Taxes) / Interest Expense

|  |  |  |
| --- | --- | --- |
| Question | Equation | Answer: |
| Your Taco Truck has annual sales of $750,000; a gross margin of 70%; fixed costs of $200,000/year excluding depreciation; and depreciation on truck and equipment of $22,000/year. You want to get a loan to buy more trucks. If interest rates on commercial truck financing are currently 7.5% and banks require a minimum 5x Interest Coverage Ratio, what’s the biggest loan you can afford based on the current financials (not including the income you will have after the new trucks are purchased, customized and deployed)? | 750,000 – 225,000 – 200,000 – 22,000 = 303,000 EBIT  303,000 / 5 = 60,600 maximum annual interest payment  60,600 / .075 = 808,000 maximum loan | $808,000 |
| You want to negotiate a one year working capital loan to cover inventory purchases for your women’s clothing business. Because of the riskiness of this type of business, the bank requires a 10x Interest Coverage Ratio. Your annual revenues are $1.2mm with a gross margin of 40% and fixed costs of $330,000. All your manufacturing is done overseas so you have no PP&E, therefore no depreciation. If the typical working capital loan is for 1 year at 6.75% interest, what is the biggest loan you can afford and still meet the TIE ratio minimum? |  | $222,222 |

1. **Fixed Payments Coverage Ratio**

**Formula:** EBITDA / Fixed Payment

|  |  |  |
| --- | --- | --- |
| Question | Equation | Answer: |
| You own and run a coffee and donut shop. You have monthly sales of $20,000, your COGS are 10% of sales, and your monthly fixed costs are $4000 for rent and utilities, $8000 for payroll and benefits, $2000 for marketing, insurance and miscellaneous overhead, and $1000 for depreciation. You have an SBA loan with a fixed monthly payment of $700. What is your Fixed Payments Coverage Ratio? | 20,000 – 2000 – 4000 – 8000 – 2000 = 4000 EBITDA  4000 / 700 = 5.7 | 5.7x |
| You want to open a mobile dog washing service, and need to buy and customize 6 large vans to use as the dogwashing units, for a total cost of $180,000 which you need to finance; you negotiate a 5 year amortizing loan with a monthly payment of $3700. You anticipate first year total revenues of $600,000; Gross Margin of 40%; operating expenses of $150,000; and Depreciation of $30,000. What is your Fixed Payments Coverage Ratio for the first year? |  | 2.03x |

1. **Calculating Interest Payment for a NON-amortizing loan:**

**Formula:** (Principle x Annual Interest Rate)

|  |  |  |
| --- | --- | --- |
| Question | Equation | Answer: |
| You borrow $7,000 from your grandparents to pay for tuition this year. You will pay interest-only at the annual rate of 10%, and then plan to pay them back entirely because you think you’ll have saved enough money by then. How much interest will you be paying your grandparents this year? | 7000 x 0.10 = 700 | $700 |
| Your company has borrowed $30,000 on a working capital line of credit at an annual rate of 15%. You only have to pay interest until you are ready to pay back the principal. What is your annual interest payment? |  | $4500 |

1. **Calculating monthly Fixed Payment (Interest + Principle) for an AMORTIZING loan:**

**ON FINANCIAL CALCULATOR:**

PV = Beginning Value, or total amount borrowed

FV = End Value: if the loan is fully amortizing, this equals Zero.

N = number of total payments due (if payments are due monthly, this is total months)

I = interest rate per payment period. If payments are monthly, this equals annual interest / 12

PMT = what you are solving for

**ON EXCEL: =PMT(rate,N,PV,FV)**

|  |  |  |
| --- | --- | --- |
| Question | Equation | Answer: |
| Chase Bank offers your business a $500,000 equipment loan at a rate of 12%, amortizing monthly over 5 years. What is your monthly Fixed Payment? | =PMT(.01,60,500000,0) | $11,122 |
| First Republic Bank offers you a $600,000 home mortgage at the rate of 4%/year amortizing monthly over 30 years. What is your monthly Fixed payment? |  | $2864.49 |