Business 173c

BASIC BUSINESS CALCULATIONS

You are responsible for bringing a calculator to each class session and knowing how to use it correctly to perform the assigned problems. Use this document to test yourself to make sure you are using your calculator correctly.

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: \[(\text{End Value} - \text{Beginning Value}) / (\text{Absolute Value of Beginning Value})\]
   
   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)?
   \[(\$110 - \$100) / (\text{ABS} \$100)\]
   \[= \$10 / \$100\]
   \[= 10\%\]

   Simple Example 2, when Beginning Value is a negative number. On financial statements, a negative number is indicated with parentheses:
   Earnings last year were a loss of ($100) and earnings this year are a positive $100. What is the earnings growth rate?
   Solution:
   \[(\$100 - (-\$100)) / (\text{ABS} -\$100))\]
   \[= \$200 / \$100\]
   \[= 200\%\]

2. Calculating future values when you know percentage growth rate:
   
   Formula: \[\text{Beginning Value} \times (1 + \text{percentage growth, expressed as a decimal})\]
   
   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:
   \[\$100 \times (1 + 0.10)\]
   \[= \$100 \times 1.10\]
   \[= \$110\]

3. Calculating Average Annual Growth Rate over Multiple Periods; also known as Average Compound Growth Rate (ACGR)
   
   NOTE: this can be done on your calculator if you have an EXPONENT function.
   If your calculator does not have an exponent function, then it can be done on Excel. You will need to do this calculation on your calculator or Excel to do the cash flow forecast homework.
   Formula: \[(\text{Overall Percent Change} + 1) ^ {\frac{1}{\text{# Periods}}}) - 1\]
   
   Simple Example 1:
Earnings two years ago were $100 and earnings this year are $110. What is the average annual earnings growth rate?

Solution:
Step 1: Calculate OVERALL percent growth for the two year period using the formula above:
$$\frac{($110 - $100)}{(ABS$100)}$$
= $10 / $100
= 10% which is the same as 0.10 in decimal form

Step 2: Calculate AVERAGE ANNUAL growth rate:
$$\left(1.10 + 1\right)^{1/2} - 1$$
= 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 average annual growth is NOT 5% per year, it is slightly less.

Simple Example 2, when Beginning Value is a negative number, indicated with parentheses:
Earnings two years ago were a loss of ($100) and earnings this year are a positive $100. What is the earnings growth rate?

Solution:
Step 1: Calculate OVERALL percent growth for the two year period using the formula above:
$$\frac{($100 – (-$100))}{(ABS -$100)}$$
= $200 / $100
= 200% which is the same as 2.00 in decimal form

Step 2: Calculate AVERAGE ANNUAL growth rate:
$$\left(2.00 + 1\right)^{1/2} - 1$$
= 3.00 ^0.5 – 1
= 1.732051 – 1
= .732051 which is the same as 73.2051%

4. Calculating a future value when you know annual growth rate
Formula: Beginning Value x \[(1 + \text{growth rate expressed as a decimal}) ^ \# \text{ of growth periods}\]
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

5. Calculating Breakeven Point
Definition: # units you need to sell in order to “break even” i.e., gross profit = fixed cost.
Formula: Fixed Cost / Gross Profit Per Unit
Example: You sell bicycles for $500 each. Your COGS is $100 per bicycle. Your 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:
\[
\frac{240,000}{500 - 100} = 240,000 \div 400 = 600 \text{ bicycles}
\]

6. Debt Coverage Calculations
   a. 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:
      \[
      \frac{100 - 20 - 50}{5} = \text{EBIT of } 30
      \]
      \[
      \frac{30}{5} = 6x \text{ Interest Coverage Ratio}
      \]
   b. Fixed Payments Coverage Ratio
      Formula: EBITDA (Earnings Before Interest, Taxes, Depreciation & Amortization) / 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:
      \[
      \frac{100 - 20 - 46}{5} = \text{EBITDA of } 34
      \]
      \[
      \frac{34}{7} = 4.9x \text{ Fixed Payment Coverage Ratio}
      \]
   c. Calculating monthly Interest Payment for a NON-amortizing loan:
      Formula: (Principle x Annual Interest Rate) / 12
      Simple Example:
      You have borrowed $100,000 at an annual interest rate of 12%.
      What is your monthly Interest Payment?
      Solution:
      \[
      \frac{100,000 \times .12}{12} = \$12,000 / 12 \text{ months } = \$1,000
      \]
   d. Calculating monthly Fixed Payment (Interest + Principle) for an AMORTIZING loan:
      NOTE: this can be done on your calculator if you have TVM (Time Value of Money) functions. If your calculator doesn’t have TVM functions, then it can be done on Excel. You will need to do these calculations as part of the financing proposal assignment.
      ON FINANCIAL CALCULATOR:
      PV = Beginning Value, or total amount borrowed
FV = End Value: if the loan is fully amortizing (paid off during the course of the loan,) this equals Zero.
N = number of periods from beginning to end. 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 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. What is your monthly payment?
Input PV = $100,000
Input FV = $0
Input N = 60 (total months)
Input I = 1 (interest rate per month)
Solve for PMT = $2,224 monthly payment in principle and interest. This will appear as a negative number because it is a cash OUTFLOW for you.
$2,224 x 12 = $26,688 total principle and interest payments per year. You need this as the denominator in your Fixed Payments Coverage calculation.

e. Calculating average monthly Interest Payment for an AMORTIZING loan:
   **Formula:**
   \[(\text{Fixed Payment} \times \text{Total # Payments}) = \text{Total Payments to Lender}\]
   Total Payments to Lender – Principle Amount Borrowed = Total Interest Paid
   Total Interest Paid / Total # Months of Loan = Average Interest per Month

   **Simple Example:**
   In the example above, you calculated a monthly Fixed Payment of $2,224 for 5 years. What is your average monthly INTEREST payment?
   **Solution:**
   $2,224/month x 60 months = $133,440 total payments to lender
   $133,440 minus $100,000 borrowed = $33,440 total interest paid
   $33,440 divided by 60 months = $557.33 Average Interest Payment per Month
   You need this as the denominator in your Interest Coverage Ratio calculation.

Troubleshooting:

a. **If you get i = “ERROR” or “No Solution”:** it means you did not put in PV as a negative number and FV as a positive number. **You must learn how to input negative numbers on your calculator.** WARNING: do NOT use the “minus” key! You must use the “change value” key. On some calculators this is labelled “+/-”, on other calculators it is labelled “CHG”. **Learn your calculator’s buttons.**

b. **If you get PMT = $1,709:** it means your calculator setting for number of periods per year is wrong; this button may be called “NPER” or “P/YR” or something similar. Set it for 1 period per year. This is the only setting you should use during this course.

c. **If you do not see at least 4 decimal places:** it means your calculator setting for number of decimal places is wrong; this button may be called “FORMAT” or “DISPLAY.” Set it for 4 decimal places.
d. If you see a comma instead of a decimal point: it means your calculator is set to “international” display settings, figure out how to set it to U.S. format or you will get confusing results.

e. If you see the words “BEG” appear anywhere on your screen: it means your calculator is set to “beginning of period” payment calculation rather than the correct “end of period” setting: figure out how to set it to “end of period” or you will get INCORRECT results for all problems that involve Payments. This is the only setting you should use during this course. When it is set to “end of period,” it will not show the letters “BEG”.

f. If you get some other numerical result: it may mean that you did not properly clear the calculator before starting the problem. Figure out how to properly clear all fields on your calculator and do this before solving every problem.

EXTRA PRACTICE PROBLEMS:

1. Calculating Simple Overall Growth Rate or Percent Change

   **Formula:** \[ \frac{\text{End Value} - \text{Beginning Value}}{|\text{Absolute Value of Beginning Value}|} \]

   **Question**

   - This year you sold 520 rabbits at a price of $2 each. Next year you plan to sell 800 rabbits and increase prices by 50 cents per rabbit. What percent growth in sales are you expecting?
   - What will be the percent growth in sales if you sell 1,000 rabbits next year at a price of $3.00?
   - What will be the percent change in sales if your actual sales next year are only 400 rabbits at $2.50?
   - Your company had 1,400 employees last year but this year has laid off 300. What is your percent change in headcount?
   - 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?

   **Equation**

   - \[((800 \times 2.50) - (520 \times 2.00)) / (520 \times 2.00)\]
   - (you write the equation)
   - (520 \times 1.4) \times (2.00 \times 1.5)

   **Answer:**

   - 92.31%
   - 188.46%
   - (3.85%)
   - (21.43)%
   - 250.00%

2. Calculating future value when you know percentage growth:

   **Formula:** Beginning Value \times (1 + \text{percentage growth, expressed as a decimal})

   **Question**

   - 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?

   **Equation**

   - (520 \times 1.4) \times (2.00 \times 1.5)

   **Answer:**

   - $2,184
### What will your total sales be next year if you sell 80% more rabbits, but DECREASE prices by 50%?

$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 goal?

11 (10.8 rounded)

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### 3. Calculating Average Annual Growth Rate over Multiple Periods; also known as Average Compound Growth Rate (ACGR)

**Formula:** $(\text{Overall Percent Change } + 1) ^ {\left(\frac{1}{\text{# Periods}}\right)} - 1$

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<thead>
<tr>
<th>Question</th>
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<tbody>
<tr>
<td>Your healthcare costs have grown 60% over the past 3 years. What is the average annual growth rate?</td>
<td>$(0.60 + 1) ^ {\left(\frac{1}{3}\right)} - 1$</td>
<td>16.96%</td>
</tr>
<tr>
<td>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?</td>
<td></td>
<td>3.32%</td>
</tr>
<tr>
<td>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?</td>
<td></td>
<td>5.45%</td>
</tr>
<tr>
<td>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?</td>
<td></td>
<td>58.49%</td>
</tr>
<tr>
<td>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 semester?</td>
<td></td>
<td>12.69%</td>
</tr>
</tbody>
</table>

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### 4. Calculating a future value when you know annual growth rate

**Formula:** $\text{Beginning Value} \times \left(1 + \text{growth rate expressed as a decimal}\right)^{\text{# of growth periods}}$

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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?

\[ 5,000 \times (1 + 0.06)^{10} \]

\$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

5. Calculating Break Even Point

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

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<td>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?</td>
<td>This year: 100,000 / (20 - 5)</td>
<td>687 more t-shirts to break even</td>
</tr>
<tr>
<td>Prior break even: 500,000 / (40 - 5)</td>
<td></td>
<td>5,714</td>
</tr>
</tbody>
</table>

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

Prior break even: 500,000 / (40 - 5)                                    | 5,714                          |
many more units will you need to sell per year to avoid laying off any family members?

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?

\[
\frac{10,000}{(12 \times 40\%)} \div 365 = 6
\]

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?

\[
\frac{10,000}{40,000} = \frac{0.25}{meal} \text{ additional gross profit/unit needed to cover additional fixed costs}
\]

\[0.25 / 12.00 = 2.1\%\]

### 6. Debt Coverage Calculations

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

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

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<td>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)?</td>
<td>750,000 (- 225,000 - 200,000 - 22,000 = 303,000) EBIT</td>
<td>$808,000</td>
</tr>
<tr>
<td></td>
<td>303,000 / 5 = 60,600 maximum annual interest payment</td>
<td></td>
</tr>
<tr>
<td></td>
<td>60,600 / .075 = 808,000 maximum loan</td>
<td></td>
</tr>
<tr>
<td>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</td>
<td></td>
<td>$222,222</td>
</tr>
</tbody>
</table>
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, 6.75% interest-only (until paid off at the end of the year,) what is the biggest loan you can afford and still meet the TIE ratio minimum?

b. **Fixed Payments Coverage Ratio**

   **Formula:** EBITDA / Fixed Payment

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<td>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?</td>
<td>20,000 – 2000 – 4000 – 8000 – 2000 = 4000 EBITDA 4000 / 700 = 5.7</td>
<td>5.7x</td>
</tr>
<tr>
<td>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?</td>
<td></td>
<td>2.03x</td>
</tr>
</tbody>
</table>

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

   **Formula:** (Principle x Annual Interest Rate) / 12

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<td>You borrow $7,000 from your grandparents to pay for tuition this year. You will pay interest-only at the annual rate of 10% for the next 12 months, and then plan to pay them back entirely because you think you’ll have saved enough money by then. What is the monthly interest payment you’ll be paying your grandparents this year?</td>
<td>7000 x 0.10 = 700 / 12 = 58.33</td>
<td>$58.33</td>
</tr>
<tr>
<td>Your company has borrowed $30,000 on a working capital line of credit at an annual rate</td>
<td>$375</td>
<td></td>
</tr>
</tbody>
</table>
of 15%. You only have to pay the interest each month, but the loan must be paid back in full at the end of 12 months. What is your monthly interest payment?

d. 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

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| 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? | PV = 500,000  
FV = 0  
N = 60 months  
I = 1 per month  
Solve for PMT | $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 |

e. Calculating average monthly Interest Payment for an AMORTIZING loan:

**Formula:**  
\[
\text{Average Interest per Month} = \frac{\text{Total Interest Paid}}{\text{Total # Months of Loan}}
\]

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| You borrowed $7,725 to buy a used car. The paperwork says your monthly Payment is $235. It’s a 3 year fully amortizing loan at 6% annual interest. How much total interest are you paying over the life of the loan, and what does that equal on an average monthly basis? | 235 x 36 = 7725 \  
735 / 36 = $20.42 | $735 total;  
$20.42 avg/mo |
| Your credit card is maxed out with a balance of $5,000 and will be charging you 18% annual interest compounding monthly. Your minimum monthly payment is $100. You calculate that if you never use the card again and pay it off at the minimum monthly rate, it will take 94 months to get to zero balance. At the end of this time, how much total interest will you have paid and what does that average out to per month? |  | $4400 total;  
$46.81 avg/mo |