Algebraic Money-Making Functions

Year 10 – 2016-2017

Teacher Name: M. Akiode

Pupil Name:

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Timetable and Assignment Submission

Fill this in with your teacher.

Tutorial	Date	Time	Location
1			
2			
3			
4			
5			
6			

Homework Assignment	Description	Due Date
Tutorial 1		
Tutorial 2		
Tutorial 3		
Tutorial 4		
Tutorial 5		

Assignment Submission – Lateness and Plagiarism

Lateness	
Submission after:	10 marks deducted
Plagiarism	
Some plagiarism	10 marks deducted
Moderate plagiarism	20 marks deducted
Extreme plagiarism	Automatic fail

Course Mark Scheme

Key Skill	1st	2.2
Numerical analysis	▫ Simple calculations are consistently correct and well presented ▫ Complex calculations which have not been fully demonstrated are convincingly attempted and sometimes correct	☐ Simple calculations are well attempted and often correct. ☐ Complex calculations are attempted and some progress is made
Language and communication	☐ New and technical vocabulary is correctly and appropriately used. ☐ Writing is well structured and of an appropriate style for an academic document. ☐ Writing is clear, concise and engaging. ☐ Spelling, grammar and punctuation are almost perfect.	☐ Some new and technical vocabulary is used correctly and appropriately. ☐ Writing is poorly structured at times, and the style used is not always appropriate for an academic document. ☐ Writing lacks clarity at times or is not concise. ☐ Spelling, grammar and punctuation are weak in places.
Knowledge and understanding	▫ Pupil demonstrate strong evidence of understanding the concepts of cost-revenue-profit ▫ Pupil has an accurate understanding of the cost-revenue-profit analysis ▫ Pupil shows excellent sketching of graphs of the cost-revenue-profit analysis defined by simple equations ▫ Pupil demonstrate excellent insight of the break-even point.	☐ Pupil demonstrate limited understanding of the concepts of cost-revenue-profit ☐ Pupil shows basic understanding of the cost-revenue-profit analysis ☐ Pupil shows basic ability to sketch graphs of the cost-revenue-profit analysis defined by simple equations ☐ Pupil has a sound knowledge of the break-even point
Critical thinking	☐ Recognition is made of strengths and limitations of the explanations and calculations. ☐ Reflective appreciation of the purpose and scope of work is given	☐ Some attempt to discuss limitations of methods and calculations.
Research Skills	☐ A range of relevant and reliable sources has been used. ☐ Sources are referenced correctly and in the format explained in the course handbook. ☐ Unique arguments or conclusions are made, or unique sources used. ☐ Clear presentation of relevant and reliable information gathered.	☐ A limited range of sources has been used, and these may be unreliable. ☐ Sources are not always referenced correctly. ☐ Some effort has been made to provide unique arguments or conclusions, but these may lack rigour. ☐ Figures may be irrelevant, inappropriately used, or not labelled correctly. ☐ Information may not be relevant and clearly presented.

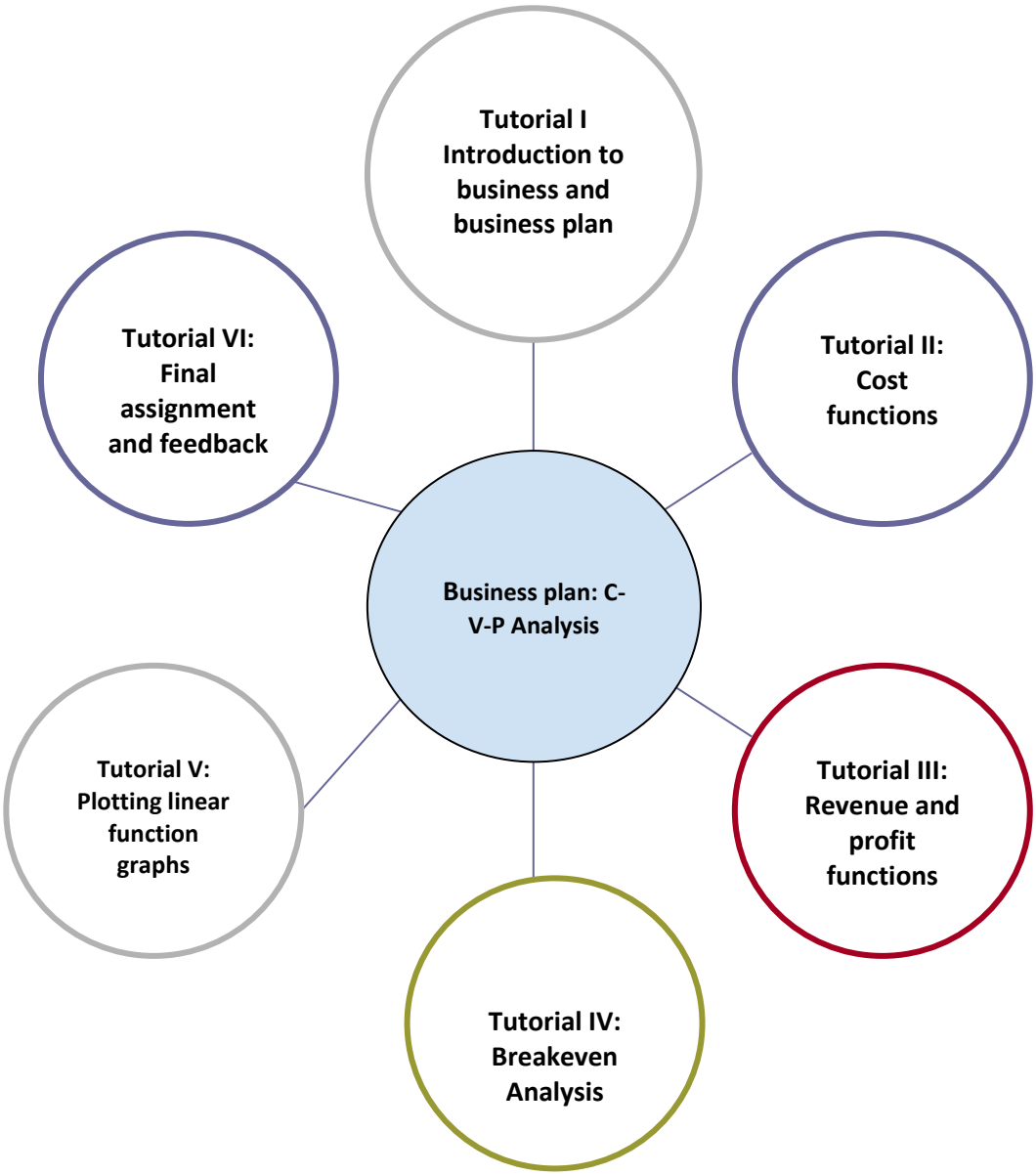
Course Rationale

The aim of this tutorial is to introduce students to how mathematical concepts are applied in a business plan. Business plans help entrepreneurs in accessing funds for their businesses. Entrepreneurship plays an important role in every society. It helps in creating new ideas, providing employment and financial rewards for the business owner as well as investors. With entrepreneurial skills, students irrespective of area of study can explore market opportunities for innovative ideas and products they generate e.g. science and technology patents. However, without adequate funding, this may not be possible.

Potential funders wish to see a business plan before deciding whether or not to invest in a business idea. Central to a business plan is the financial analysis such as a cost-volume-profit (C-V-P) analysis which is a technique used for identifying the breakeven point of a business. The information helps businesses plan their future activities. For example, an entrepreneur needs to plan the business and address issues such as: what it would cost to produce and sell products, whether the products can be made and sold profitably, estimates about future sales and when the business will make enough sales to cover its costs. Information about these aspects would help business owners plan their businesses better in order to achieve good results and show potential investors that the business is viable.

In this course, the pupils would research and write a business plan. In addition, this course builds on the knowledge of basic algebra and the pupils would learn how to construct cost-behaviour linear functions, plot the corresponding graphs and interpret the results.

Course Map


Tutorial I
Introduction to business and business plan
Tutorial II:
Cost functions
Tutorial III:
Revenue and profit functions
Tutorial IV:
Breakeven Analysis
Tutorial V:
Plotting linear function graphs
Tutorial VI:
Final assignment and feedback
Business plan: C-V-P Analysis

Glossary of Keywords

Word	Definition
Cost	Cost is the amount of money a business spends on the production of goods or services.
Price	Price is the amount of money that is exchanged for a product or a service.
Profit	Profit is the amount of money a business has left from selling its products, after it has deducted all its costs.
Start-up costs	Start-up costs are the initial costs that a business needs to pay out before it is able to make and sell its goods or provide its services.
Contribution margin	Contribution margin is the difference between revenue and variable cost.
Contribution margin per unit	Contribution margin per unit is the difference between the selling price and the variable cost per unit.
Cost driver	A unit of activity (unit of goods or services) that causes a change in the cost of an activity.

Tutorial 1 – Introduction

Objective 1: To understand the importance of business plan in financing a business.

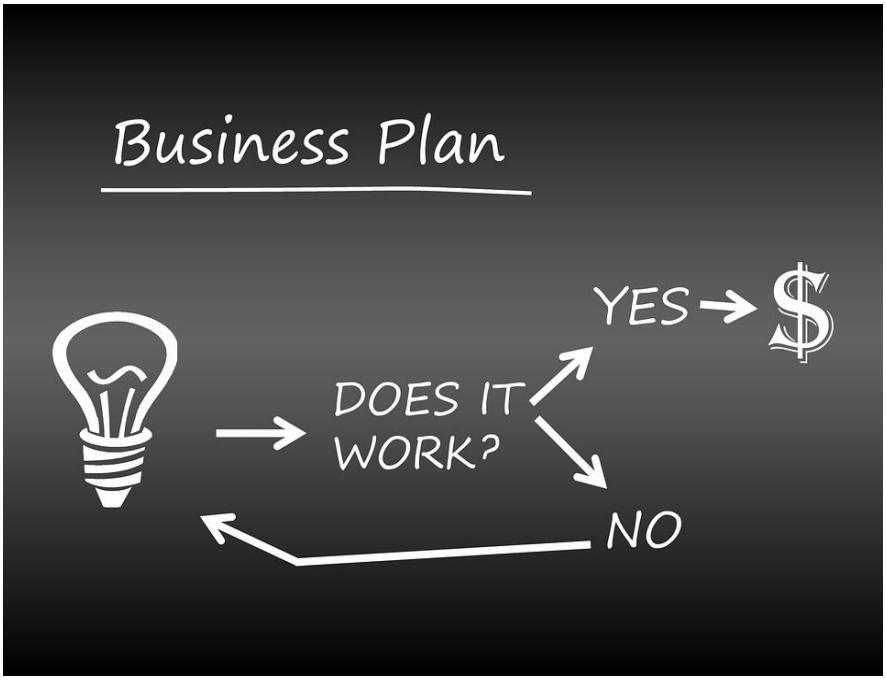
What is business?

A business is any organisation that produces or supplies goods or services. Entrepreneurs can base their business upon skills, qualifications or experience they gained from previous job or through a hobby. They usually start small but with a lot of hard work and by taking risks, a start-up business can become large and profitable.

How do I get funds for my business?

A significant characteristic of small businesses is that most are often short of cash. They cannot raise money for their business in the same way that large businesses can. Sometimes, the business owner seeks funds from banks and other investors.

A business owner who wants to borrow money from a bank or equity finance needs to: 1) establish a relationship of trust and respect of the investors. 2) present the investors with a business plan.



Source: Pixabay.com

What is a business plan?

A business plan is a document prepared by a business that describes the type of activities carried out by the business, its objectives and how it would achieve them. It also describes the market the business is in as well as the financial forecasts of the business.

A good business plan could be used to attract financial backers such as banks and equity investors. A good business plan should include detailed information and forecasts that are tailored according the audience. It should be long enough to cover the relevant areas of interest but short enough to maintain interest.

Banks are in the business of lending money and entrepreneurs or small business owners can get funds from the bank. However, banks are not in the risk business and there are conditions that must be met before a bank would lend to a small business. A business plan prepared for a bank should address how the loan can be repaid. Equity investors are institutions or individuals who lend money to a business and in return for a split of the equity of a business (as you will see in any episode of the Dragons' Den). Such investors expect the business plan to highlight the business opportunity and how the business intends to exploit this opportunity effectively as well as addressing the risks.

A Business Plan Format

A business plan is particular to a business and can vary from those of other businesses. However, business plans cover the following important areas:

Areas	Examples
Business details	Business name, address, legal form, business activity
Business aims and objectives	The goals of a business and ways it hopes to achieve them
Industry information	Size of industry, growth, competitors
The strength and weaknesses, opportunities and threats	● What the business is doing well ● What the business is not doing well ● Things competitors are not doing well that the business can take advantage of ● Things competitors are doing well that are disadvantages to the business
	Age group, lifestyle
Marketing strategy	Advertising, pricing
Financial highlights	**Costs, revenue, profit, break-even analysis**, cash flow forecast.

The Cost-Volume-Profit (C-V-P) analysis

The three elements of the C-V-P analysis are:

1. Cost: amount required for making a product or producing a service.
2. Volume: the number or units of products produces or hours of service provided.
3. Profit: the financial benefit that accrues to a business as a result of its revenue being higher than its cost.

In a business plan, the C-V-P analysis involves analysing how these elements behave when volume changes. Businesses also use the C-V-P analysis to identify important milestones such as the break-even point.

Homework 1 – Baseline Test

The homework for the first tutorial is a test to see your initial level of attainment in solving functions. These specific skills are required later in the course and the final assignment. Do not worry too much about doing 'well' or 'badly' on the test, it takes into account the fact that you may not be familiar with the subject area. It is designed to help you and your tutor identify where you are at the start of the programme and to help you measure your progress along the way.

Solve the following equations:

a) $2(x+5) = 16$
b) $2x - 3 = 6$
c) $5x + 3 = 2x + 9$
d) $2y = 6$
e) $2x - 2 = 14$
f) Make q the subject of the formula: $P = 2q + 10$
g) Make n the subject of the formula: $m = 5n - 21$
h) Make t the subject of formula: $4(t - 5) = w$
i) Simplify: $4a + 4b - a + b$
j) Simplify: $4x - y - x + 2x$

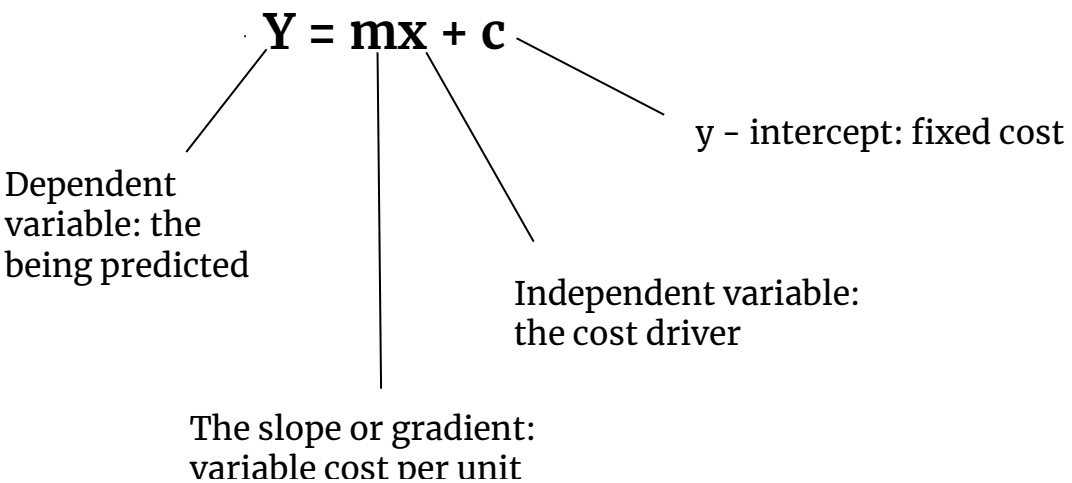
Tutorial 2 – Cost Functions

Objective 2: To describe the types of costs and write linear cost functions

What are the types of costs? How is a linear cost function written?
The linear cost equation is a mathematical expression which describes how costs change with changes in the level of an activity.

Assumptions:

- Cost behaviour can be represented by a linear equation of the level of activity that drives the cost.
- Changes in cost can be explained by changes in the level of activity.



The equation above expresses the relation between a dependent variable (the total cost) and the independent variables (total variable cost and total fixed cost). It shows that the total cost is dependent on the total variable and the total fixed cost i.e. TC = TVC + TFC is written as

y = mx + c

Cost Scenarios:
Baylis airline is considering the cost of lodging its crew members at Mace Hotel. The three alternatives are:

1. In plan A, each room costs £75 per night

   Y = £75x this is the slope of the straight line) ---------- can you describe a variable cost?

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2. In plan B rooms cost £2250 per month.

   Y = £2250 (here the slope is zero and £2250 is called the constant or intercept) ------ can you describe a fixed cost?

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3. In plan C for a room you pay £1000 per month plus £42 per night

   Y = mx + C

   Y =£42x + 1000 (This is an example of a mixed cost) ……. can you describe a mixed cost?

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Class Activity 2

Write the cost functions to represent the following:

Cost item	Cost function
1. It costs £5 to print up to 100 sheets plus 30p for additional sheets.	
2. Box used for packaging computers is £2.50 each	
3. The five salesmen are paid 5% commission plus a salary of £500 each.	
4. Factory monthly rent is £2,000	
5. The monthly salary of two directors is £10,000 each	
6. The taxi company charges £1.30 on entering the taxi plus £1.10 for each mile	

Homework 2

1. Classify the following costs under the right column

	Variable	**Mixed**	**Fixed**
a) Raw materials			
b) Telephone bills			
c) Monthly rent			
d) Business rate			
e) Executive salaries			
f) Salesmen commission			
g) Electricity bills			
h) Petrol for car			
i) Council tax charge			

2. Investigate two famous entrepreneurs and use the information to complete the table below.

Name of entrepreneur	Business name	Business location	Legal form	Business activity

Tutorial 3 – Revenue and Profit Functions

Lesson Objective:

- To understand the concepts of revenue and profit and to write the functions from word problems.
- To understand the relationship between revenue and profit.

Source: Pixabay.com

What is the Relationships between Revenue and Profit?

The revenue (or sales) represents total payment received for a sale or service. A business earns revenue over a period of time in which goods or services are delivered to customers. For example, the revenue made from selling particular good is dependent on the selling price (p) and the quantity or number of goods sold. This can be expressed as:

Revenue = Selling price x Quantity of product sold.

R = px (compare to y = mx)

Contribution is the price of an item less the variable cost per item. Contribution margin ratio (CMR) is the percentage by which selling price (or revenue) per unit exceed the variable cost per unit.

Profit is the amount of money a business has left from selling its products, after it has paid all its costs, such as raw materials. The profit function can be expressed as:

Profit = Total revenue - Total cost

Profit = $p\,x - mx - c$

Profit = $(p - m)\,x - c$

where

p = selling price

x = quantity of product sold (units of goods or services)

m = variable cost per unit

$(p - m)$ = contribution margin per unit

c = Total fixed cost

Class Activity 3

Nextboots wishes to increase the production of a new brand of winter boots for ladies. The forecast information is given as:

Selling price per boot = £400

Variable cost per boot = £150

Fixed costs related to boots production = £2,000,000

Target profit = £200,000

Estimated sales = 10,000 boots

1. Determine the quantity of boots needed to be sold in order to achieve the target profit.

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_____

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2. Find the contribution margin ratio

3. Calculate the total revenue needed to achieve the target profit.

Homework 3

Case Study (Keyhole Machining)

Source: Pixabay.com

Mr D walked into the Dragons' Den with the intention of securing funds from at least one of the four investors to help expand his business. He is a manufacturer of universal key kits for lifting manhole covers. The key is universal because it can open different types of manhole covers. He presented his projected profit for 2017 as £13,000. Each kit is sold for £400. Raw materials cost £200, the total hourly salary of the factory machine operator and other related factory expenses such as electricity cost £125. The factory yearly rent is £15,000 and council tax yearly bill is £5,000. He gave the following figures as his next year profit projection:

	£	£
Revenue (£400 x 1000)	400,000	400
Total variable cost (£325 x 1000)	377,000	377
Total contribution margin	13,000	13

Investor A questioned Mr D about how he got the numbers because they did not add up. Mr D replied, "it was not my intention to bring false figures". He had left the financials to an accountant but failed to check

for the correctness of the figures. Another potential investor B said, “that’s just blown it for me, I can’t invest so I’m out”. He pointed out that Mr D had enough time to check his figures with the accountant.

Investors A and B would not be investing in Mr D’s business. Investor C likes the business idea and thinks it has good potentials. She would fund Mr D’s business but on condition that he would work with a business partner who can handle the figures and run the business well.

(Case study inspired by The Dragons’ Den (2016): Dragons' Den: Series 14, Episode 2 - Startups.co.uk: Starting a …)

1. What mistakes were made by the accountant in calculating Mr D’s profit projection?

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2. What is the correct profit projection for Keyhole Machining?

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3. What skills are important for running a successful business?

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Tutorial 4 – Breakeven analysis

Lesson Objective:

- To understand the concepts of breakeven point and calculate it using algebraic method and plotting the corresponding graphs.

What is a Breakeven point?

Typically, new businesses do not make profit immediately they start. At breakeven point, a business is making neither a profit or a loss. The breakeven point shows the number of units that must be sold in order to recover all associated costs even though no profit is made. It indicates the point at which a product starts to generate profit. The breakeven point changes when costs changes and occur when the total cost is less that the total revenue. Revenue beyond the breakeven point is a profit.

The steps to finding the breakeven point in units and sales are as follows:

a. find the contribution margin per unit i.e. selling price - variable costs

b. calculate the contribution margin ratio i.e. $\frac{\text{1 - variable costs}}{\text{sales price}}$

c. breakeven point in units = $\frac{\text{fixed costs + profit}}{\text{contribution margin per unit}}$

d. breakeven point in sales = $\frac{\text{fixed costs + profit}}{\text{contribution margin ratio}}$

Class Activity 4

Calculate the breakeven points in units and sales for Nextboots (information on page 17).

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Homework 4

1. Complete the revenue, price and quantity table below:

Quantity	Price	Revenue
0	100	
1	90	
2		160
3		210
	60	240
	50	250
6		240
7		210
8	20	
9	10	
10	0	

2. Total cost is:

a) The total income of a business

b) The total expenses of a business

c) The total amount of goods sold by a business

d) The total amount of profit earned by a business

3. Another name for revenue is:

a) Turnover

b) Expenses

c) Overheads

d) Costs

4. Key hole Machining sells 10 units of manholes covers at £20 each. If the total costs are £150. How much profit is made?

a) A £50 profit is made

b) A £50 loss is made

c) A £20 profit is made

d) A £200 profit is made

5. Profit is calculated by:

a) Adding total costs to total revenue

b) Subtracting total revenue from total cost

c) Subtracting total cost from total revenue

d) Multiplying the quantity sold by price

6. When is a business making a profit?

a) When revenues are higher than costs

b) When revenues equal costs

c) When revenues are less than price

d) When revenues are less than costs

Tutorial 5 – Plotting Linear Function Graphs

Learning objective: to plot C-V-P graphs and identify breakeven point graphically.

Class Activity 5

The relationship between cost, revenue and level of activity can be represented graphically. Complete the table below and use it to:

1. Plot the variable costs, fixed costs, total cost and revenue graphs.
2. Locate the breakeven point.
3. Interpret the C-V-P graph.

Billing Enterprises has a fixed cost of £5,000 for plant and equipment. The variable costs are £6oo per unit of output. Selling price of each item sold is £750. Assume all items produced are sold in the period.

Level of output	Variable cost function: ……	Fixed cost function: …….	Total cost function: ……	Revenue function …….
0				
10				
20				
30				
40				

Homework 5

Final assignment

Imagine you are a manufacturing entrepreneur and wish to expand your level production.

a. Write a business plan to present your business to potential investors. In each section, discuss the rationale for presenting that information to investors. The total number of words should be between 1000 and 1500 words (not exceeding 10% of 1500).

In the financial analysis section of your business plan:

b. Use the basic data below to:

I. Complete the data table.

II. Use the completed data table to prepare the C-V-P graphs and identify the breakeven point in sales and unit.

III. Explain the meaning of the breakeven point for your business.

Basic data

	£	£
Sales price (unit)		**325**
Variable costs:		
material	50	
labour	90	
supplies	13	
utilities	9.50	
salesmen commission (10%)	32.50	
Total variable costs		**195**
Fixed costs:		
insurance	150	

rent	3900	
utilities	50	
cleanup	1100	
Total fixed costs		**5200**

Data table

Level of activity	**Revenue £**	**Variable cost £**	**Fixed cost £**	**Total cost £**	**Profit £**
0	**-**	**-**		**5,200**	**(5,200)**
10					
20					
30					
40					
50					
60					
70					
80					
90					
100					

The Deadline is:

……

Leave blank to fill in later, or put your deadline in here when you know it.

Final assignment guide.

- In tutorial 1 you researched two famous entrepreneurs and used the information to complete a table.

This final assignment builds on this and tests your research skills i.e. your ability to search for relevant information to prepare your business plan.

- The knowledge acquired in tutorials 2 -4 would help in completing the C-V-P analysis. - Draw the C-V-P graph using a spreadsheet e.g. Excel or google sheets. Paste the graph under the data table in your business plan.
- Insert the completed data table along with the C-V-P graph in your business plan.
- Use the business plan format in page 9 as a guide but be creative with your business plan.

Tutorial 6 – Final Assignment and Feedback

What is the Purpose of Tutorial 6?

- Reflect on skills learned on the programme with a view to encouraging resilience
- Receive feedback on final assignment

What are the key questions?

- What strengths have I demonstrated in my work and what areas of development are there left for me to address?
- What steps do I need to take to improve my academic output?

Activity 1 – Marking your own

Using the mark scheme, identify three things you did well and three things you could improve.

What went well?

1.

2.

3.

What could be improved?

1.

2.

3.

Activity 2 – Responding to feedback

Read through your feedback sheet and highlight on your assignment where you received positive feedback (one colour) and areas for improvement (different colour). You might find it helpful to annotate this with a brief comment or two.

Activity 3 – Looking Forwards: Think, Pair Share

1. Think about how you can use this feedback in your future school work.
2. Talk to your partner about how you both plan to make changes to your school work in the future as result of this feedback.
3. Share your ideas as a group.

_____

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References

1. ACCA (2016) Cost-Volume-Profit Analysis. Available at: http://www.accaglobal.com/uk/en/student/exam-support-resources/fundamentals-exams-study-resources/f5/technical-articles/CVP-analysis.html. Accessed [10/09/2016].
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4. Dragons' Den (2016) Dragons' Den: Series 14, Episode 2. Available at: Dragons' Den: Series 14, Episode 2 - Startups.co.uk: Starting a … Accessed [20/09/2016].
5. Mowen, M., Hansen, D.R. and Heitger, D.L. (2008) Cornerstones of Managerial Accounting, 3rd Edition. South-Western Cengage Learning: Mason.
6. Tycoon in Schools (2016) Teacher Resource (1). Available at: https://www.tycooninschools.com.

Appendix 1 – Referencing correctly

When you get to university, you will need to include references in the assignments that you write, so we would like you to start getting into the habit of referencing in your Brilliant Club assignment. This is really important, because it will help you to avoid plagiarism. Plagiarism is when you take someone else's work or ideas and pass them off as your own. Whether plagiarism is deliberate or accidental, the consequences can be severe. In order to avoid losing marks in your final assignment, or even failing, you must be careful to reference your sources correctly.

What is a reference?

A reference is just a note in your assignment which says if you have referred to or been influenced by another source such as book, website or article. For example, if you use the internet to research a particular subject, and you want to include a specific piece of information from this website, you will need to reference it.

Why should I reference?

Referencing is important in your work for the following reasons:

- It gives credit to the authors of any sources you have referred to or been influenced by.
- It supports the arguments you make in your assignments.
- It demonstrates the variety of sources you have used.
- It helps to prevent you losing marks, or failing, due to plagiarism.

When should I use a reference?

You should use a reference when you:

- Quote directly from another source.
- Summarise or rephrase another piece of work.
- Include a specific statistic or fact from a source.

How do I reference?

There are a number of different ways of referencing, and these often vary depending on what subject you are studying. The most important to thing is to be consistent. This means that you need to stick to the same system throughout your whole assignment. Here is a basic system of referencing that you can use, which consists of the following two parts:

A marker in your assignment: After you have used a reference in your assignment (you have read something and included it in your work as a quote, or re-written it your own words) you should mark this is in your text with the last name of the author and year e.g. Akiode (2016).

Bibliography: This is just a list of the references you have used but not cited in your assignment. In the bibliography, you list your references by the numbers you have used, and include as much information as you have about the reference. The list below gives what should be included for different sources.

Websites – Author and date (if possible), title of the web page, website address, [date you accessed it, in square brackets].

E.g. Dan Snow (2009), 'How did so many soldiers survive the trenches?', http://www.bbc.co.uk/guides/z3kgjxs#zg2dtfr [Accessed: 11 July 2014].

Books – Author, date published, title of book (in italics), pages where the information came from.

E.g. S. Dubner and S. Levitt, (2006) *Freakonomics*, 7-9.

Articles – Author's last name and initials (Year), 'title of the article' (with quotation marks), name of source e.g. *where the article comes from* (newspaper, journal etc.), volume (and number), pages.

E.g. Maev, K (2016) 'The lights to go out across the UK to mark First World War's centenary', Journal of Historical Innovation, 23 (4), pp. 4-5.

University Applications Guidance

For course choices and careers information: www.brightknowledge.org.uk

For information and statistics on universities and course: www.unistats.direct.gov.uk

For comprehensive information on universities, including rankings:

www.thecompleteuniversityguide.co.uk

PLEASE NOTE – The Researchers in Schools programme is designed to support the university applications process at your school. The work you complete for the programme should add to your schoolwork rather than detract from it. Please be aware of deadlines and try to manage your workload appropriately. If you are worried about the programme interfering with your schoolwork, then please speak to your teacher.