
The Usage of Differential Calculus in Determination of Minimum Dimensions

Introduction:

Product packaging plays a salient role in influencing consumer decisions in purchasing a firm's products. This is because a product's appearance communicates many values such as the quality of the product and the company's values. Packaging is as important as the product itself as it serves as a crucial marketing and communicating tool. Since young, I have always been drawn to design my own utilities like my wardrobe cabinet and the packaging of the gifts that I hand out. Additionally, the thought of earning money on my own and what it takes to manage a business has been on my mind ever since I started engaging in second-hand businesses through a website called carousell.

Rationale

My inspiration for this investigation arose after showcasing special interests in designing and having to engage with small business dealings that sparked my interest in starting a business in the future. As such, I decided to explore the product packaging of food products that I am exposed to in day to day life since it was the most thought of commodity. Extensive research led me to find out that a lot of common household product packaging use excessive materials which causes difficulty when disposing them. It is said that the greater the number of materials used in packaging, the harder it is for recycling machines to separate them. I came across potato chips and decided to explore the math behind optimising the dimensions of packaging them.

Aim:

As a result, the main aim of my investigation is to design the product packaging for potato chips by using the least materials by minimising the surface area of the packagings. This is to ensure that lesser materials are being utilised in making the packaging and hence, reduce the negative impacts this has on the environment due to the aforementioned factors. In doing this, I will be employing differential calculus to analyze the dimensions of 3 different product packaging shapes and hence justify which option is the best.

Assumptions:

Assuming I am designing the product packaging of my potato chips brand, I would first have a few things in mind. Firstly, I would definitely be profit motivated but at the same time want the best for my customers. More importantly, assuming that my overall product is environmentally friendly, I would want to minimise the surface area of 3 different potato chip packaging, by employing optimization and calculus to consider the packaging design of the potato chips. With the aid of a fixed volume in differentiating the surface areas, I would also be able to determine the cost of producing each packaging. In order to account for the cost of materials, I shall assume that the packaging would cost \$0.015/cm², thus determining which type of packaging would give the smallest price. The volume I am assuming each packaging should take up is fixed to be 1000 cm³. Lastly, I shall assume that my potato chips are flat in shape so as to

minimise space.

In deciding which product packaging shape to choose, I needed to know which is more important to me — consumer's preference and interest, amount of space available for the chips, or the lowest cost? If I want to maximise consumers preference and interest, I would likely consider the square boxed packaging because it gives the chips enough space and makes it easier to eat the chips, although it is the second most costly to make. The benefits of the square packaging largely takes concerns the the consumers and makes it easier to construct the packaging since the dimensions are the same. However,if I take the cylindrical packaging with the smallest surface area, I would pay the least amount but have a lack of space. This may pose as a problem because the chips may not be able to fill the tube. The rectangular packaging would be the appeal the least because of its high production cost. Since I am producing a packaging design for my product, I would look at how to minimise cost and maximise profits. Hence to make my decision, I will select the square packaging with a slightly larger area and the one with a higher cost as compared to the cylindrical packaging. Although the cost of \$9.00 is not the lowest, it provides me with a more feasible packaging for my products and allows me to store my chips without having to worry about the lack of space. Moreover, as mentioned, it is important that I take care of my customers and look at how I package my products from their point of view as consumers.

Lastly, this IA has been a challenging but engaging experience as it allowed me to figure out how much thought is put into packaging products. Previously, I knew nothing about how producers make decisions on branding and packaging their products. In the past, I only knew the use of differential calculus in my math sums but having explored this IA, I was exposed to how people use differentiation in the real world. I believe this IA can be extended by the use of Implicit Differentiation. In my IA, I only focused on using explicit differentiation by setting a fixed variable. Implicit differentiation is an alternative method used to find the maximum or minimum value of a function and this may be an interesting avenue for further research on optimising product packaging by forming a new equation.