A Supermarket Docket Competition

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1 The Problem

Imagine that you are working for me at a mathematical consulting company. I have been approached by a marketing company on behalf of one of its clients. In the interests of confidentiality, I am not at liberty to reveal the identity of either the marketing company or its client. I shall refer to them as AA Marketing and Brand X Foods.

AA Marketing wishes our company to determine the value of prizes that Brand X Foods might be liable to pay in a competition that it is planning to conduct. The competition involves supermarket dockets. A diagram of a supermarket docket showing the relevant details is depicted on the attached sheet.

The competition works as follows. The backs of the rolls of paper which are used for printing supermarket dockets are used for a repeating series of advertisements. One of these advertisements is for Brand X Foods. If a shopper presents a docket in which the printout for a Brand X Food item on the front coincides with the advertisement for Brand X Foods on the back, then that shopper will win $50.00 for each such advertisement.

AA Marketing has supplied us with five measurements relevant to the competition. These are

1. The distance $B$ between the beginning of one Brand X Foods advertisement and the beginning of the next Brand X Foods advertisement on the back of a roll of docket paper (that is the “period” of the repeating series of advertisements). This distance is constant and is set at 1155mm.

2. The height $C$ of a Brand X Foods advertisement. This is constant and takes the value 35mm.
3. The baseline to baseline height $a$ of the printout a single item on the front of a shopping docket. This is constant and takes the value 5mm.

4. The length $\ell$ of non-item information on a single shopping docket. For the purposes of this project, you may take this to be constant with a value of 105mm.

5. The average length $d$ of the purchase item information on a shopping docket. The value of $d$ is 85mm.

The parameters in capital letters correspond to distances on the back of the docket and the parameters in lower case letters correspond to distances on the front of the docket.

In addition AA Marketing has advised us that one in 30 items is a Brand X Food item. Given this information, they want to know the amount of money Brand X Foods can expect to pay out per 59.5 metre docket roll.

To complete this project you need to undertake two tasks:

1. To work out whether any extra information is needed and, if so, ask for it.

2. To calculate how much money in prizes AA Marketing can expect to pay per 59.5 metre docket roll.

2 Discussion

In the mathematical consulting business, the client usually thinks that they have given you enough information to solve their problem when, almost always, they haven’t. The first task of a mathematical consultant is to ask themselves whether they have enough information. This is why you have two tasks:

- To work out what extra information, if any, is needed to solve the problem.

You should write this down and submit it to me in Room D of the Richard Berry Building. If I can, I will then supply you with the information that you ask for.
I believe that most of you should be able to complete this part well. I suggest that you approach it by thinking of things that can still vary, keeping all the parameters $B$, $C$, $a$, $\ell$ and $d$ constant. Once you have done this, try thinking about a few special cases to acquire some physical intuition about the problem.

- To answer the actual problem.

I will be very surprised if any of you have the mathematical knowledge to come up with a complete solution. However, there is considerable scope to come up with partial solutions. It is the quality of the mathematical thinking that goes into your partial solutions, and the insight that you gain, that we will be assessing in the MIT Challenge.