Homework 1 on Bass Model

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Introduction

This markdown file is for the *Homework 1 of the Marketing Analytics - Fall 2023* course. The goal of the homework is to use Bass Model, which is a technique to estimate Market Entry activities. For example, if someone wants to create new product, but has no financial resources to explore market, it is a good choice to use Bass Model to estimate market potential and number of adopters of the new product over time. The main steps of using the model includes choosing new innovation, then find look-alike product from the past, estimate innovation and imitation rates (p,q). In next steps each part of the assignment will be implemented and explained with visuals and texts.

Step 1: Innovation selection

I visited TIME magazine to choose one of the interesting innovations of the year. As I am very interested in AI and Robotics, I found a product which attracted me a lot. The product name is **An AI 3D Printer: Bambu Lab X1 3D Printer**. Now there are many 3D printers in the world, but the mentioned product is different from existing ones as it provides magical improvements to users due to its AI powered system. It is possible to print in sixteen various colors with this product twice as fast as existing printers. Another advancement is that users can control the AI 3D Printer with its mobile app remotely. To create the innovation it took approximately two years from founders, but as a result the product idea became very popular and successful.

Step 2: Look-alike Innovation selection

The first thing that came to my mind thinking about look-alike innovation from past for AI 3D Printer, of course, are the usual printers that use paper to print and create contexts. I did research to collect information about history of printers. Here are some points that I underlined:

- Printing is very old, during 3500 BC, people used cylinder seals to certify documents. Next comes woodblock printing, during which people used wood blocks with specific designs to press onto paper.
- In the 19th century, Charles Babbage designed the first computer printer. However, this mechanical printer became available in 2000 by the Science Museum in London.
- In 1968 Japanese company Epson created first electronic printer, EP-101.
- In 1969 Gary Starkweather, an engineer at Xerox invented the first laser printer.

I selected the **Laser Printers** as a look-alike innovation from past for AI 3D Printer Innovation. First laser printers, Xerox 9700 were introduced by Xerox company. Laser printers after short time became popular and widely used by people as they were providing speed, high quality and high-volume results. The printers used laser beam to print text and graphics on paper. There are some types of laser printers. One type includes the printers which can only print in white and black, there are also colorful printers which can print in four colors:

cyan, magenta, yellow, black. However, during time, as technologies evolve, emails and e-books became highly used by people, the usage of printers declined. And here comes my selection of the first step, AI 3D Printer, which presents 3D modeling that is the next stage for laser printers. Using similar technique as laser printers, 3D printers give chance users to create physical objects. In case of AI 3D Printer, it provides further advantages, including twice faster speed, 16 colors and remote control over the system, which proves that this product is real improvement of past laser printers.

Step 3: Look-alike Innovation Sales dataset extraction

In this stage I tried to search some datasets of laser printers in the website statista. After the research I found out that there are no appropriate data for some specific types of printers or specific company's printers in the website. Then I decided not to focus on some specific company product but try to find general sales dataset of printers of some country.

I separated three possible choices for data. The first one was good as it included longer period of time series with which will be more interesting to work, however the sales included not only printers but also scanners and multifunctional devices. So, considering that my target was printers I avoided this data. The second possible data was showing Samsung's laser printer sales, which was appropriate for my case, however as data included short period I also avoided this one. Finally, I chose the dataset that included the number of printers sold in Brazil between 2014 and 2020.

The selected dataset is also good one, as it shows yearly printers sales in million units. Of course, the data is not worldwide, but it gives local information about printer sales in Brazil.

Step 4: Bass model parameters estimation

Here is what the data looks like; the printer sales in million units are shown from 2014 to 2020 in Brazil:

Year	Sales
2014	3.30
2015	2.50
2016	1.81
2017	2.19
2018	2.36
2019	2.40
2020	2.20

Here is the barplot of the sales:

Yearly printer sales in Brazil
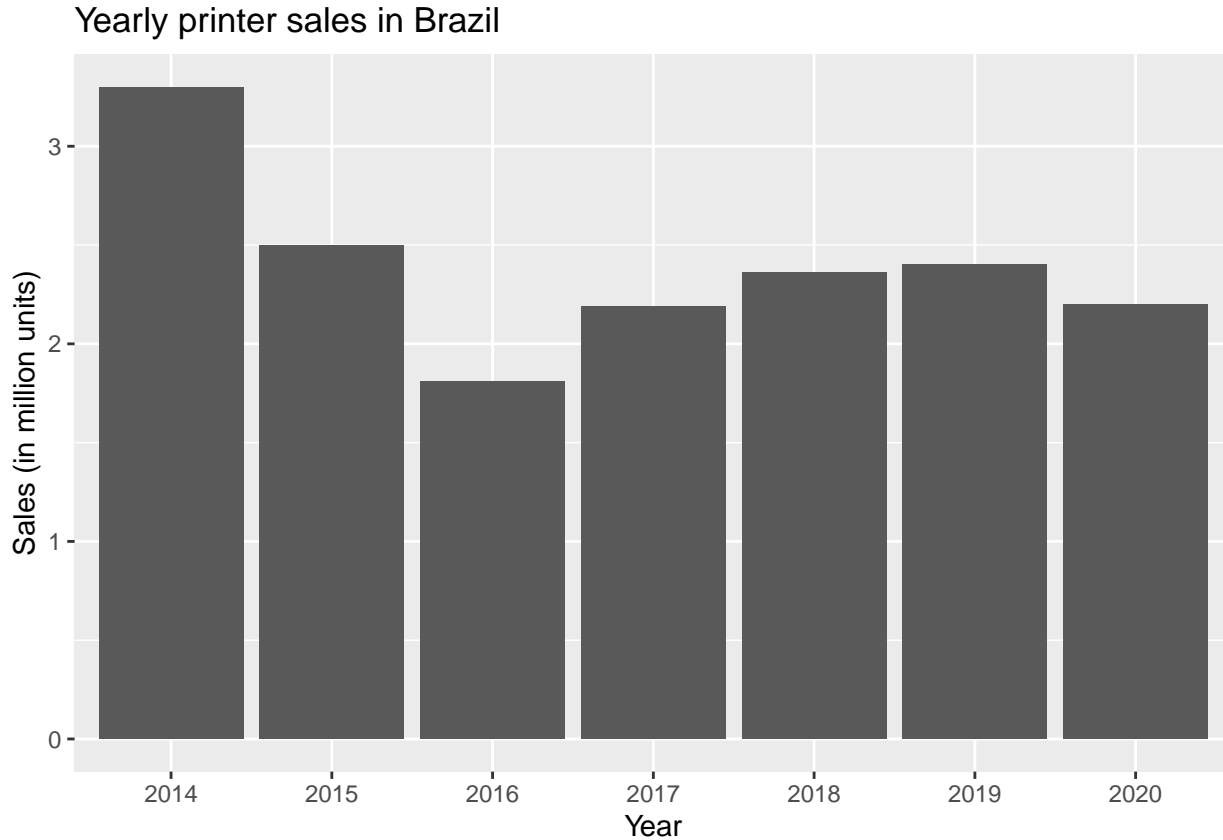
Let us use diffusion library to estimate Bass model parameters:

```
## bass model
##
## Parameters:
##                                Estimate p-value
## p - Coefficient of innovation   0.0523     NA
## q - Coefficient of imitation    0.0000     NA
## m - Market potential           53.8462     NA
##
## sigma: 0.3625
```

Coefficient of innovation(p) is approximately 0.05. This shows the rate by which new users or innovators adopt the innovation. Innovators are people who are ready to buy the product by just knowing about the product from advertisements or product info.

Coefficient of imitation(q) is 0. This shows the rate by which imitators adopt the innovation. In our case as it is 0, it means we do not have imitators in the model, which is not good. Imitators are people who start buying the product by seeing others experiments with the product.

Market potential(m) shows the total number of people that can buy the product, aka number of adopters in the market.

I am going to use the above estimated parameters during next steps. . .

Modeling f(t) - the fraction of the total market that adopts at time t and F(t) - the fraction of the total market that has adopted up to and including time t:

Printers – cumulative adoptions

Printers – adoptions at time t
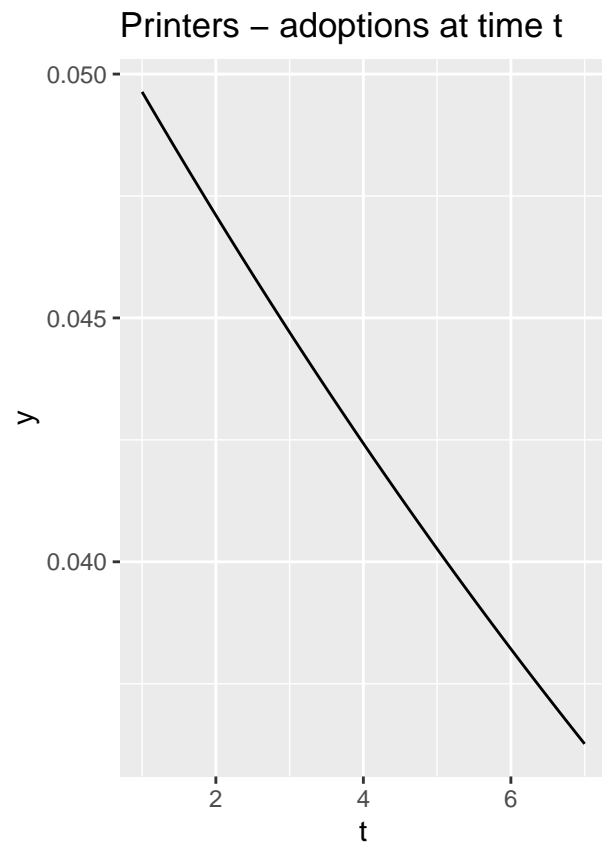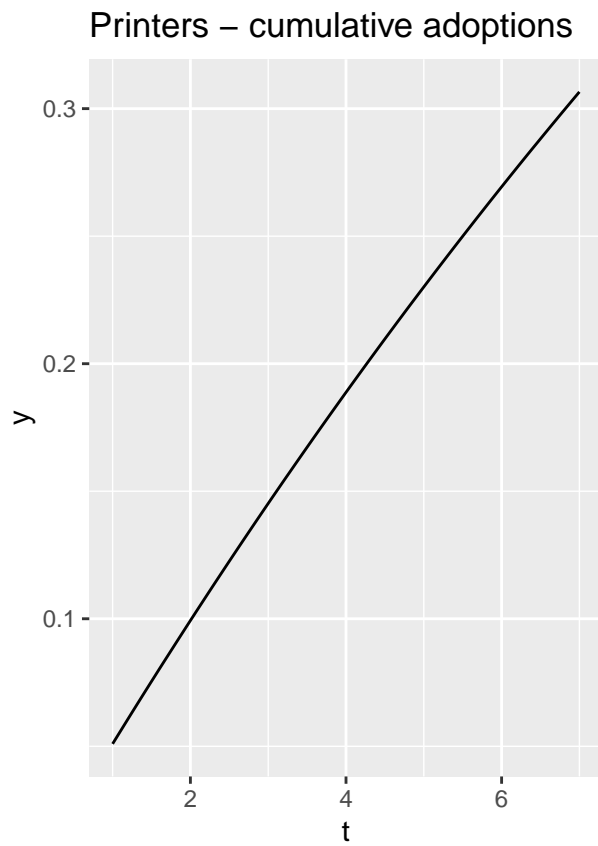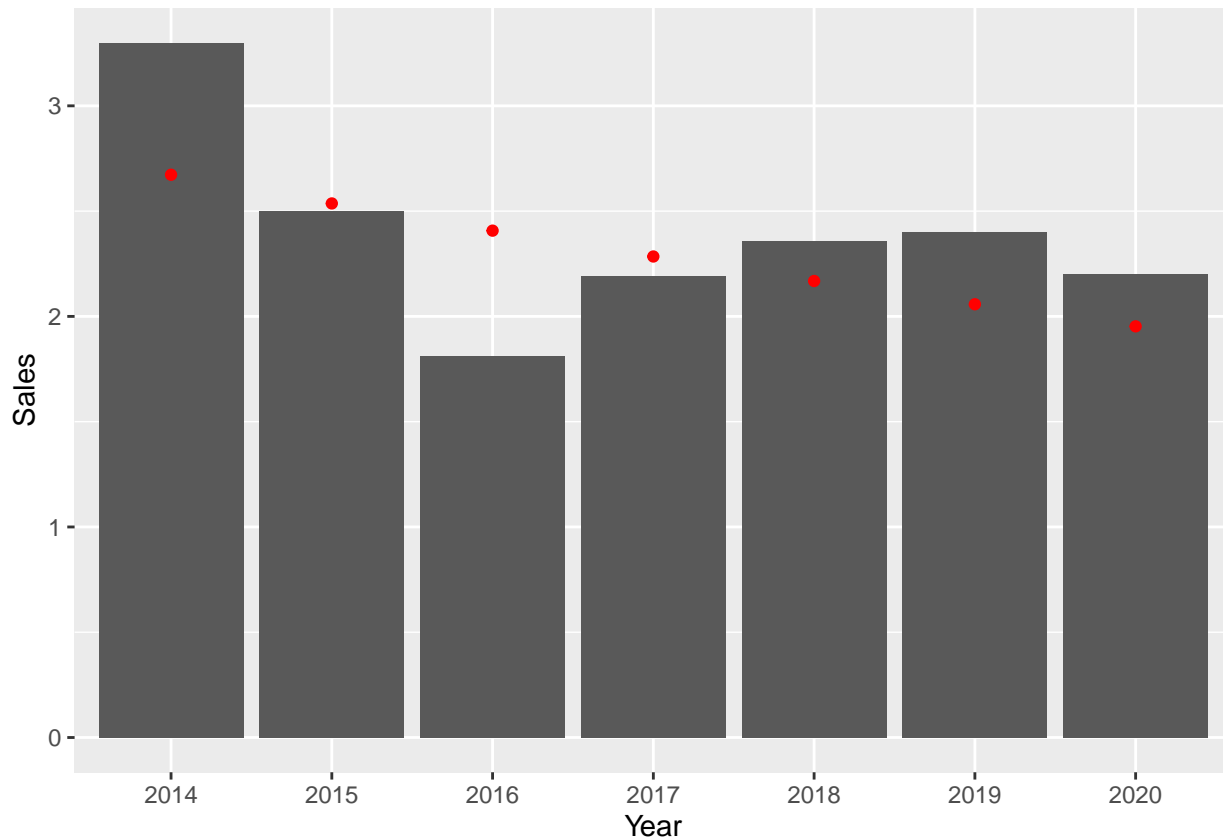
Visualizing f(t):
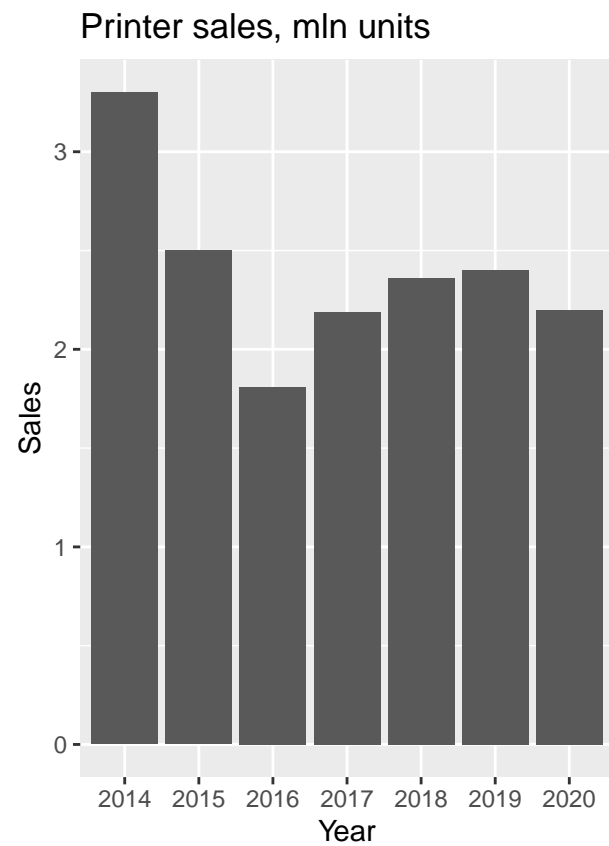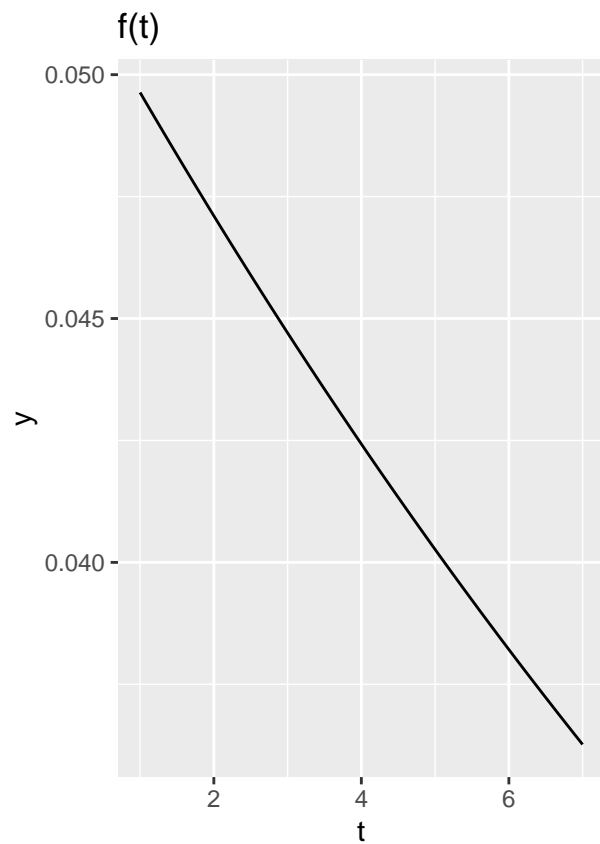
As we can see the estimation is not as good, yes it grasped the main trend, however it is not showing minor

fluctuations of the barplot.

Step 5: Predictions of the diffusion of the innovation

Making predictions by multiplying f (t) by m:

As we can see from above prediction results, they are rather good. The red points are close to the peaks of bars. Of course, result is not perfect, but is not very bad too.

Step 6: Potential market share estimation using Fermi's logic

Now let us try to estimate the number of adopters for AI 3D Printer product worldwide. I will use Fermi estimation, which is a method by which one can approximately estimate potential market for products. To do estimation for my selected product, I will consider the following facts:

- The world population is approximately 8 billion.

- Mainly the target market will include industries and professionals from fields like design, technology and manufacturing. There are globally 507K graphic designers, 300 million employees in Manufacturing sector. As there was no specific number of employees of IT field, I will take approximately 250 million employees. Of, course the numbers are approximated as even numbers taken from the Internet do not include all the employees. So, we can approximately say that our target market is 10% of whole population.

- We should consider that from the above mentioned professionals, only the ones will buy the product which have the resources and need to create AI based 3D objects. I think from the beginning their number will not be so high, as the prices will be high, however let us consider that 5% of them will adopt the product.

- So final estimate for AI 3D Printer adopters (m) will be equal to 8 bilion's 10 percent and then its 5 percent: 40 million people.

Sources

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