R Notebook

```
library(dplyr)
```

```
##
## Attaching package: 'dplyr'

## The following objects are masked from 'package:stats':
##
##     filter, lag

## The following objects are masked from 'package:base':
##
##     intersect, setdiff, setequal, union
```

```
library(ggplot2)
library(ggpubr)
library(diffusion)
library(tinytex)
```

Homework 1 1. Go to the list, choose an innovation, and put the link of the selected product

Innovation: Nothing Phone (1) Link: https://time.com/collection/best-inventions-2022/6229115/nothing-phone-1/

2. Think about look-alike innovation from the past. When you pick one, give your justifications in 1-2 paragraphs.

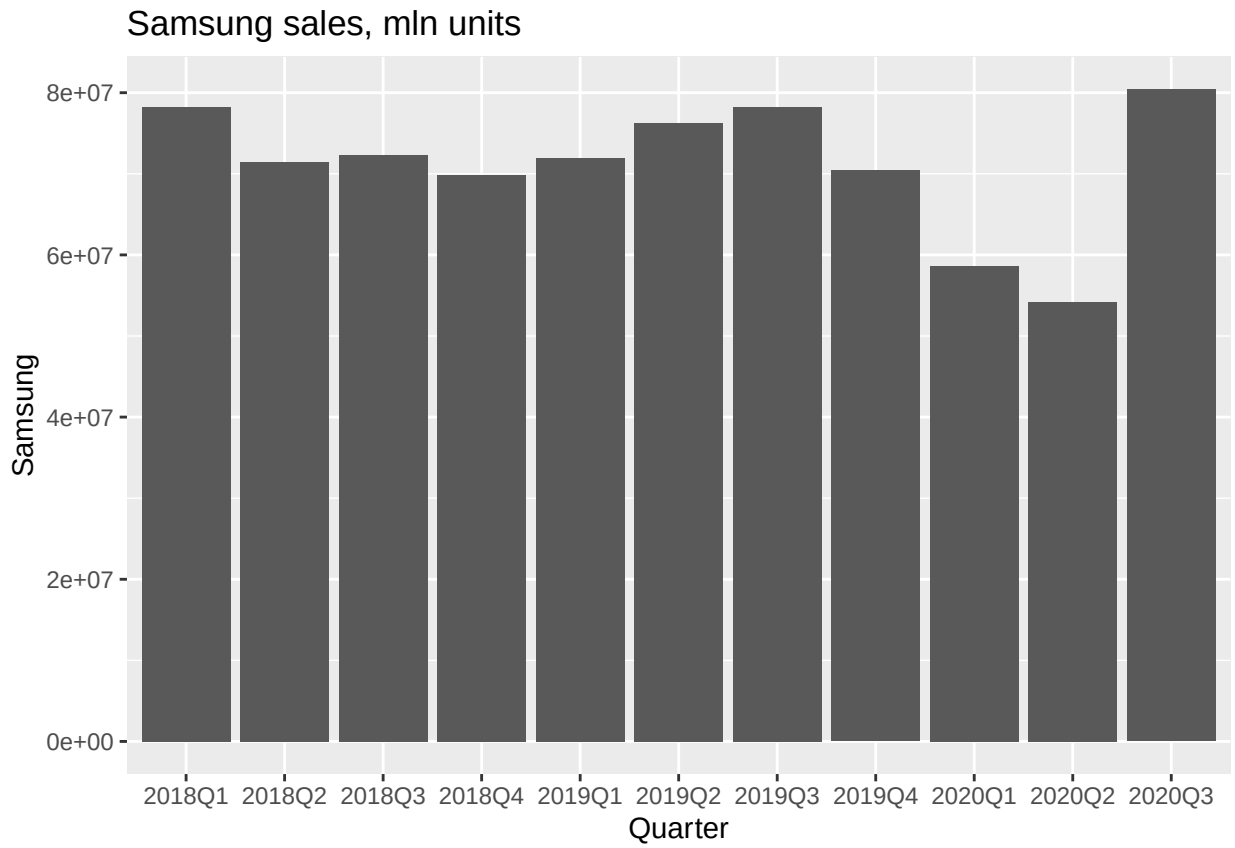
The product that I chose is "Nothing Phone(1)". Having a design reminiscent of the iPhone and featuring a customized version of the Android operating system, what sets Phone (1) apart is its distinctive "glyph interface." The phone's transparent back panel enables the use of 900 LEDs to produce illuminated patterns that synchronize with music, notifications, and vibrations. Users have the ability to personalize these flashing glyph patterns, making them serve functions such as identifying incoming callers.. So I decided to choose my look-alike model to be Samsung phones. So I decided to take Samsung phones as the predecessor of "Nothing Phone(1)" and make predictions on it.

3. Go to Statista (the University provides access to it) and find a time series that approximates the look-alike innovation. (the University provides access to it under AUA WIFI.) or find a time series matching the look-alike innovation. Give your justification by 1-3 paragraphs. You can also use any other available resource for the data; remember to provide a reference.

```
smart = read.csv('gss.csv', fileEncoding="UTF-8-BOM")
samsung <- select(smart, Quarter, Samsung)
samsung
```

```
##    Quarter  Samsung
## 1   2018Q1 78200000
## 2   2018Q2 71500000
## 3   2018Q3 72300000
## 4   2018Q4 69800000
## 5   2019Q1 72000000
## 6   2019Q2 76300000
## 7   2019Q3 78200000
## 8   2019Q4 70400000
## 9   2020Q1 58600000
## 10  2020Q2 54200000
## 11  2020Q3 80400000
```

```
ggplot(data = samsung, aes(x = Quarter, y = Samsung))+
geom_bar(stat = 'identity') +
ggtitle('Samsung sales, mln units')
```



According to the plot above the Samsung sales decreased in the last quarter of 2018 and in the middle of 2020. It can be influenced by many factors like economic conditions, market saturation and so on. Now let's go on and see how this data can help to make predictions on a new product.

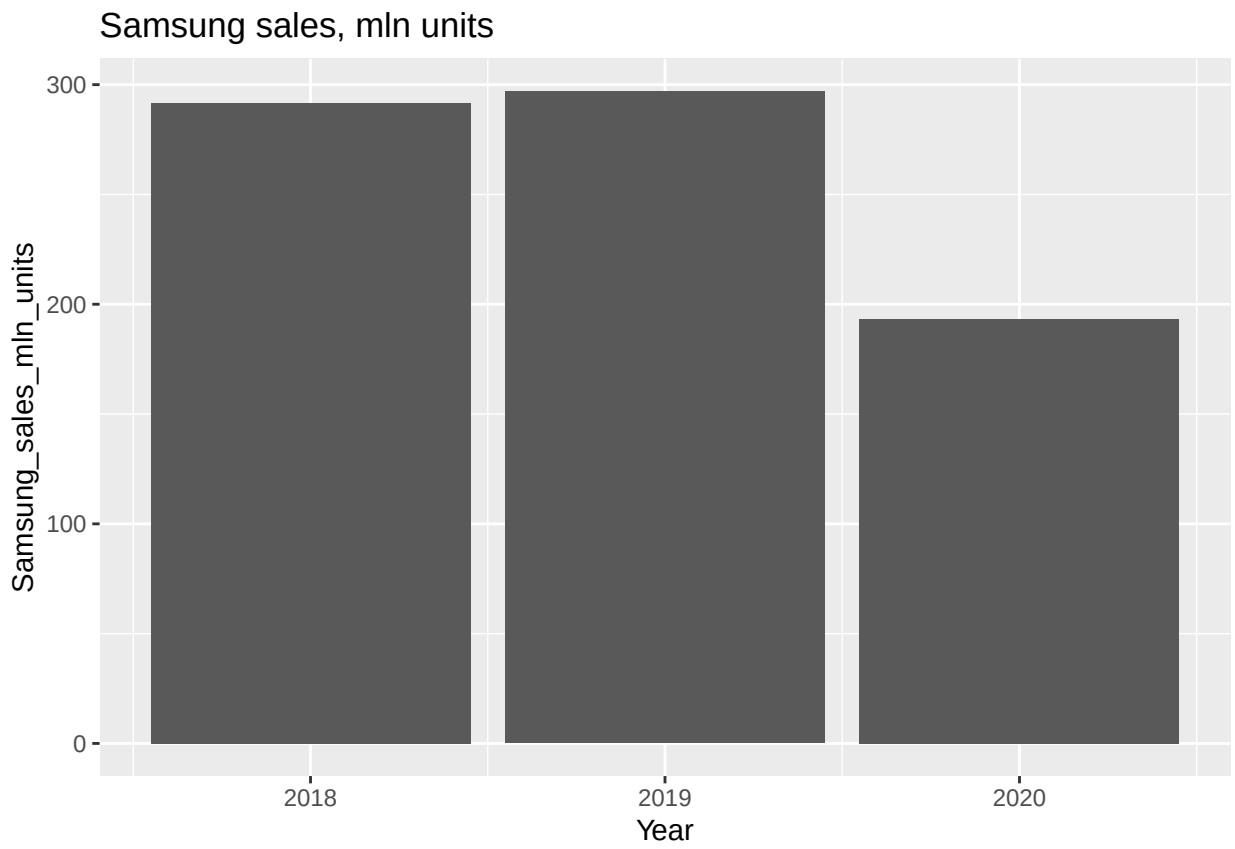
```
Samsung_sales_mln_units <- c(sum(smart$Samsung[1:4])/1000000, sum(smart$Samsung[5:8])/1000000, sum(smar
df <- data.frame(Year=c(2018,2019,2020),Samsung_sales_mln_units)
df
```

```
##   Year Samsung_sales_mln_units
```

```
## 1 2018                    291.8
## 2 2019                    296.9
## 3 2020                    193.2
```

4. Estimate Bass model parameters for the look-alike innovation.

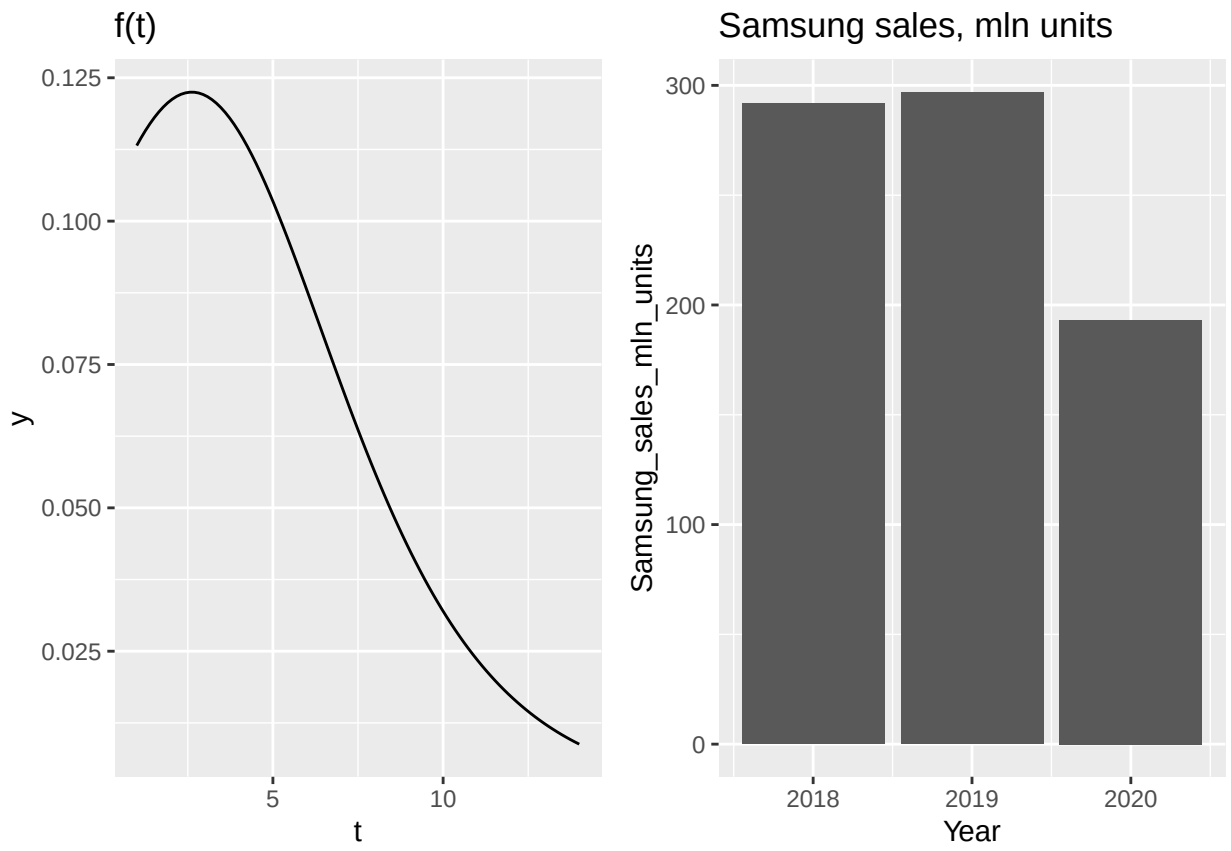
```
ggplot(data = df, aes(x = Year, y = Samsung_sales_mln_units)) +
geom_bar(stat = 'identity') +
ggtitle('Samsung sales, mln units')
```




```
bass.f <- function(t,p,q){
((p+q)**2/p)*exp(-(p+q)*t)/
(1+(q/p)*exp(-(p+q)*t))**2
}

bass.F <- function(t,p,q){
(1-exp(-(p+q)*t))/
(1+(q/p)*exp(-(p+q)*t))
}
```

```
time_ad = ggplot(data.frame(t = c(1:14)), aes(t)) +
stat_function(fun = bass.f, args = c(p=0.1, q=0.25)) +
labs(title = 'f(t)')

sm_sales = ggplot(data = df, aes(x = Year, y = Samsung_sales_mln_units)) +
```

```
geom_bar(stat = 'identity') + ggtitle('Samsung sales, mln units')

ggarrange(time_ad, sm_sales)
```




```
diff_m = diffusion(df$Samsung_sales_mln_units)
p=round(diff_m$w,4)[1]
q=round(diff_m$w,4)[2]
m=round(diff_m$w,4)[3]
diff_m
```

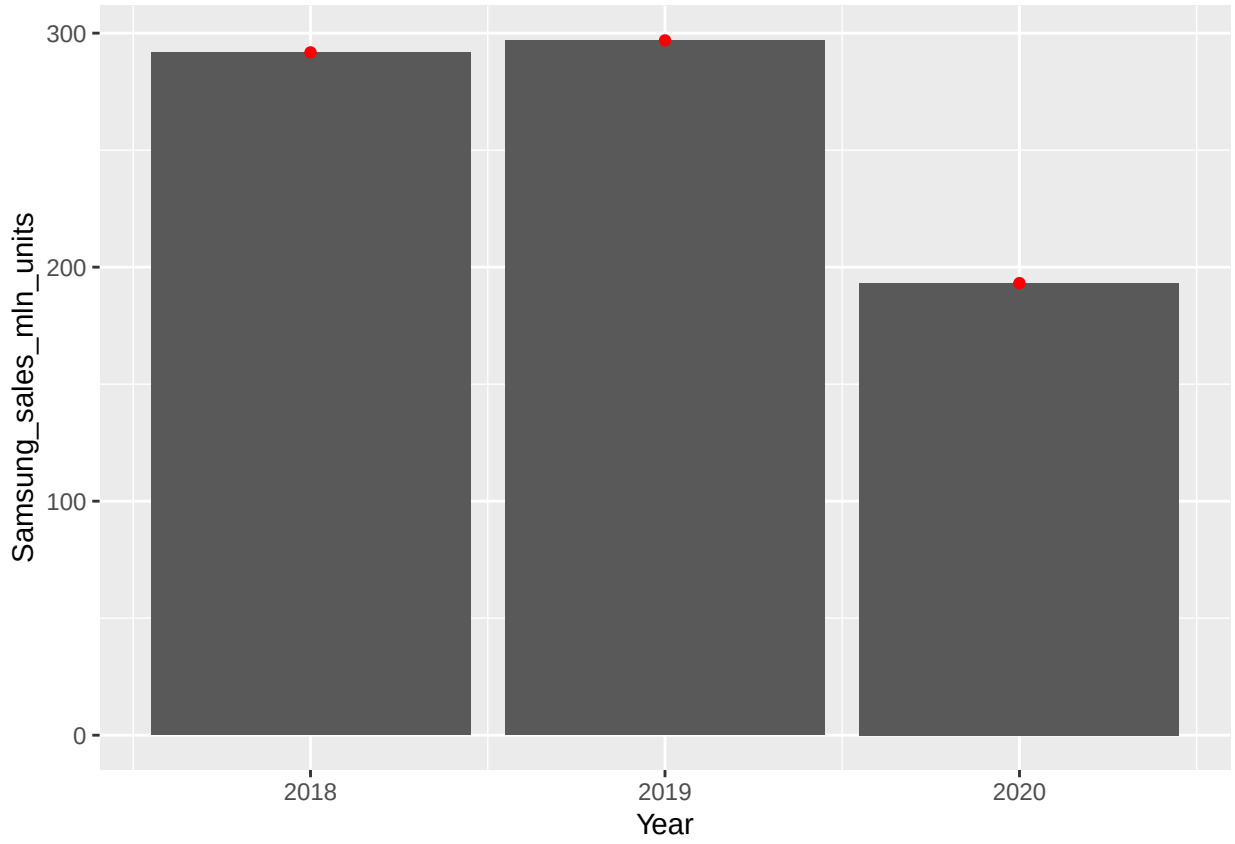
```
## bass model
##
## Parameters:
##                               Estimate p-value
## p - Coefficient of innovation   0.2626      NA
## q - Coefficient of imitation    0.7508      NA
## m - Market potential          933.4705      NA
##
## sigma: 3e-04
```

```
data.frame(Predicted=log(q/p)/(p+q),
Actual=which.max(df$Samsung_sales_mln_units))
```

```
##   Predicted Actual
## q  1.036617      2
```

5. Make predictions of the diffusion of the innovation you chose at stage 1

```
df$pred_sales = bass.f(1:3, p = 0.005, q = 0.369)*933.4705
ggplot(data = df, aes(x = Year, y = Samsung_sales_mln_units)) +
geom_bar(stat = 'identity') +
geom_point(mapping = aes(x=Year, y=Samsung_sales_mln_units), color = 'red')
```



6.Estimate the number of adopters by period. Thus, you will need to estimate the potential market share. You can use Fermi's logic here as well.

To me this phone offers opportunities that do not really solve problems but are fancier than Apple and Samsung models. So estimating on a country level Armenia has population of 3 million and around 20% of it are youngsters aged 16-30, so the number of people that are possibly interested in this product(Market potential) is around 600000.

```
M <- 36000
t = c(1:3)
Armenian_Adopters <- ((((p+q)**2/p)*exp(-(p+q)*t))/(1+(q/p)*exp(-(p+q)*t))**2) *M
Armenian_Adopters
```

```
## [1] 12306.387  9787.228  5210.833
```

References 1. Lindzon, J. (2022, November 10). Innovative smartphone design. Time. https://time.com/collection/best-inventions-2022/6229115/nothing-phone-1/

2. Global Phone Sales By Company Samsung Apple Huawei. (2021, January 13). Kaggle. https://www.kaggle.com/datasets/andrewtgraham/global-phone-sales-by-company-samsung-apple-huawei

3.Statista. (2023, July 21). Age structure in Armenia 2021. https://www.statista.com/statistics/440546/age-structure-in-armenia/