Marketing_HW1_Veronika_Khachatryan

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

1. Choose an innovation from the list.

Samsung Galaxy Z-Flip 5. Because of the lack of appropriate data on specifically Galaxy Z-flip 5, the analyses are done on the overall Foldable smartphones.

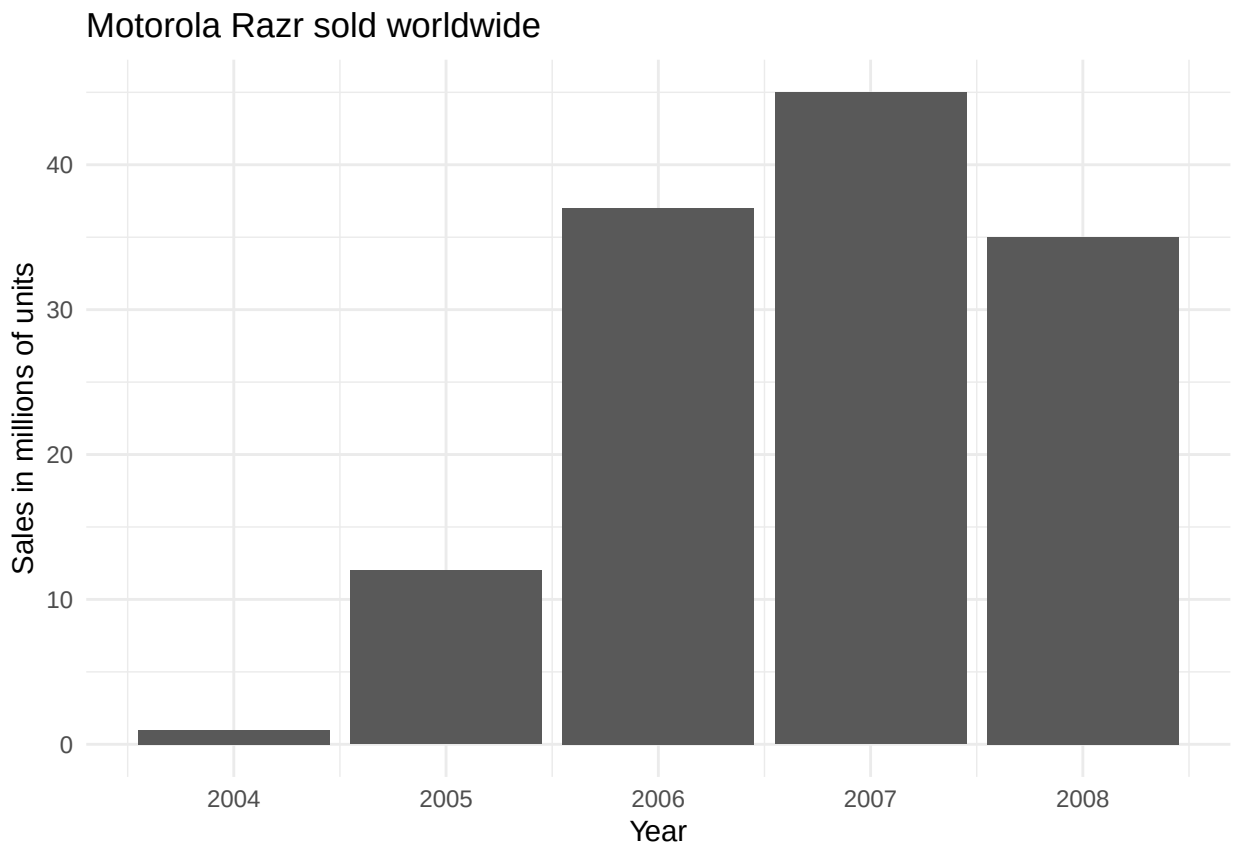
2. Identify a similar innovation from the past.

In 2004, similar, and actual the first Foldable smartphones were invented by Motorola company, the Motorola Razr. Like the Samsung Galaxy Z Flip5, the Razr V3 was a flip phone that revolutionized mobile design with its sleek, compact form factor.It is similar by technology to Samsung Galaxy flip, as both phones are foldable(functionality) and each of them were remarkable innovations on their release years(market impact).

3. Find historical data.

There was no historical data on Motorla Razr, as it was introduced a long time ago. I have created an artificial dataframe for it in the codes using the reference links I found about approximate sale numbers of Razr.

```
years <- c(2004, 2005, 2006, 2007, 2008)
units_sold <- c(1, 12, 37, 45, 35) # in millions

# I found that 2006 cumulative was 50 mln, and 2008 cumulative - 130 mln. Based on
# these, the numbers are approximated.

motorola_data <- data.frame(Year = years, Units_Sold = units_sold)
t = 1:length(units_sold)

motorola_data <- data.frame(Year = years, Units_Sold = units_sold)
t = 1:length(units_sold)

ggplot(motorola_data, aes(x=Year, y=units_sold))+
  geom_bar(stat="identity")+
  theme_minimal()+
  labs(title="Motorola Razr sold worldwide",
       y= "Sales in millions of units" )
```



4. Estimate Bass Model parameters.

```
bass_m = nls(units_sold ~ m*(((p+q)^2/p)*exp(-(p+q)*t))/
(1+(q/p)*exp(-(p+q)*t))^2,
start=c(list(m=sum(units_sold),p=0.02,q=0.4)))

sum <- summary(bass_m)

m_motorola <- sum$coefficients[1, 1]
p_motorola <- sum$coefficients[2, 1]
q_motorola <- sum$coefficients[3, 1]

q_motorola
```

```
## [1] 1.214665
```

```
p_motorola
```

```
## [1] 0.009063925
```

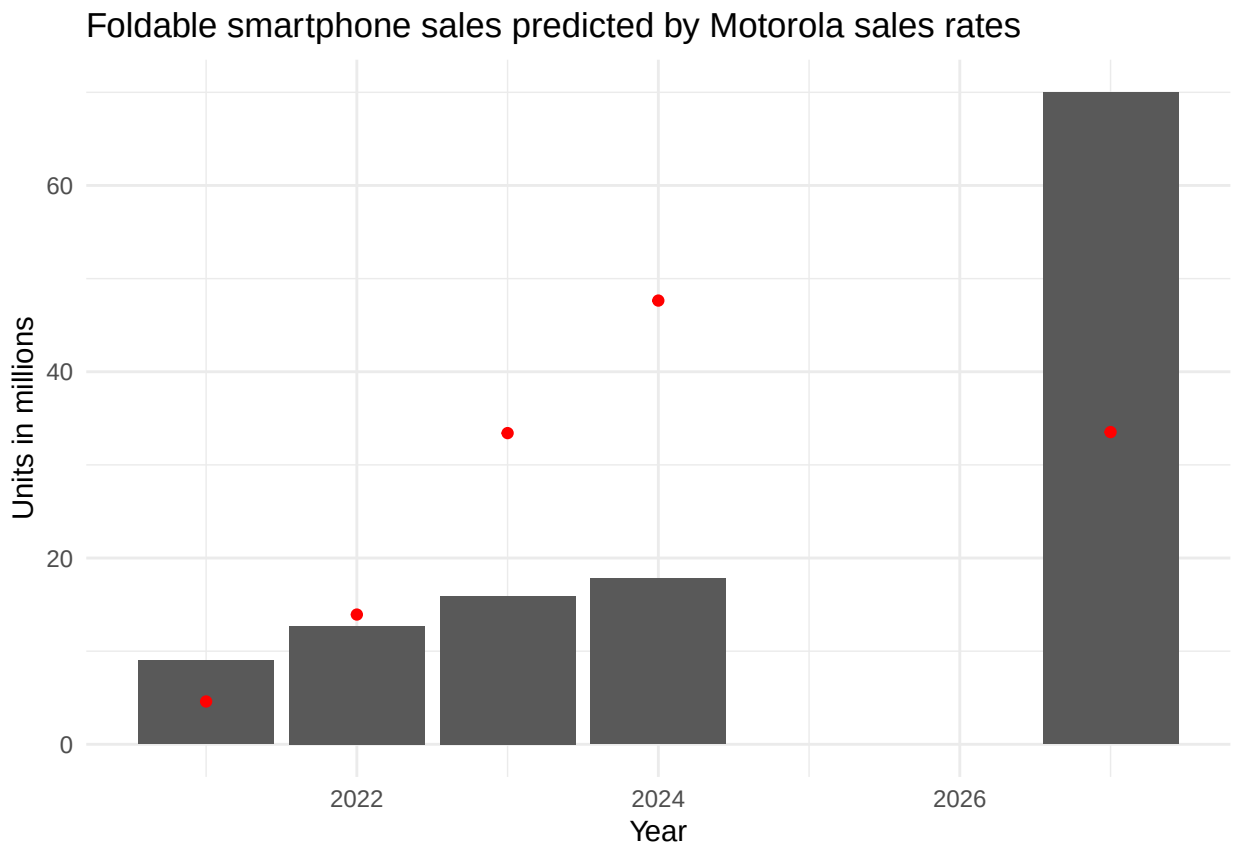
```
m_motorola
```

```
## [1] 154.5751
```

The innovation rate of Motorola is ~0.09 with imitation rate ~1.21, meaning that when the product entered the market, there were no that much "risk-takers".

5. Predict the diffusion of the innovation selected in step 1.

```
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))
}

# foldable smartphones
year <- c(2021, 2022, 2023, 2024, 2027)
units_shipped <- c(9, 12.72, 15.9, 17.8, 70) # in millions

foldable_phones <- data.frame(year, units_shipped)

foldable_phones$Prediction = bass.f(1:nrow(foldable_phones), p = p_motorola, q = q_motorola)*m_motorola

ggplot(foldable_phones, aes(x = year, y = units_shipped)) +
    geom_bar(stat = 'identity') +
    geom_point(mapping = aes(x=year, y=Prediction), color = 'red')+
    labs(title="Foldable smartphone sales predicted by Motorola sales rates", x="Year", y="Units in mil
  theme_minimal()
```



6. Choose a scope (global or country-specific). Decide whether to analyze the diffusion worldwide or within a specific country. Justify your choice with references or data.

The diffusion analyses are global as both datas - Motorola and Foldable smartphone sales are given on worldwide scale.

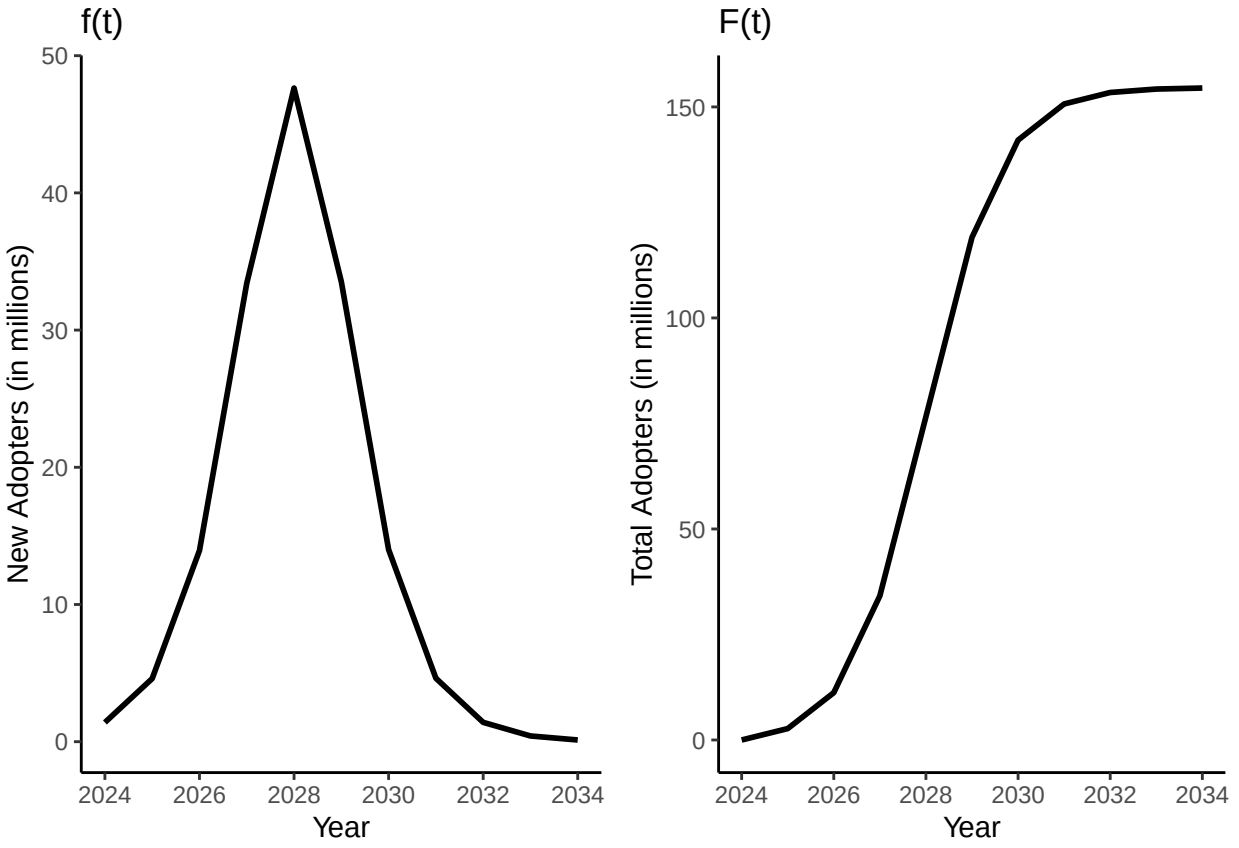
7. Estimate the number of adopters by period. Using your Bass model parameters, estimate the number of adopters of the innovation over time. If necessary, use Fermi's logic to make rough estimations in the absence of concrete data.

```
# Time period (e.g., over 20 years)
time <- seq(0, 10, by = 1)

new_adopters <- m_motorola * bass.f(time, p_motorola, q_motorola)
cumulative_adopters <- m_motorola * bass.F(time, p_motorola, q_motorola)

adoption_data <- data.frame(
  Year = 2024 + time,
  New_Adopters = new_adopters,
  Total_Adopters = cumulative_adopters
)

ft <- ggplot(adoption_data, aes(x = Year, y = New_Adopters)) +
  geom_line(color = "black", size = 1) +
  ggtitle("f(t)") +
```

```
  xlab("Year") + ylab("New Adopters (in millions)")+
  theme_classic()
```

```
## Warning: Using ‘size‘ aesthetic for lines was deprecated in ggplot2 3.4.0.
## i Please use ‘linewidth‘ instead.
## This warning is displayed once every 8 hours.
## Call ‘lifecycle::last_lifecycle_warnings()‘ to see where this warning was
## generated.
```

```
Ft <- ggplot(adoption_data, aes(x = Year, y = Total_Adopters)) +
  geom_line(color = "black", size = 1) +
  ggtitle("F(t)") +
  xlab("Year") + ylab("Total Adopters (in millions)")+
  theme_classic()


ggarrange(ft, Ft)
```



The graphs make pretty much sense, because most of the trendy products are contemporary, and we can see from the graph that based on the historical data of Motorola flip-phones, the foldable smartphone sales will decrease in 2028. However, cumulatively, the number of sales will pass 150 million in 2034.