BASS model

2023-09-29

Product choice - Color enhancing sunglasses.

Color-Enhancing Compared to conventional sunglasses, sunglasses have an exceptional selling advantage. They are a way of enhancing the perception of colors, creating exceptional product in the eye wear market. These sunglasses enhance the vibrancy and clarity of the colors around you while protecting your eyes from harmful UV rays, Whether you're hiking through a forest, sitting on the beach, or simply enjoying a day in the park.

Closest available alternative - Plano Sunglasses

The closest available alternative for color - enhancing sunglasses are glasses of Luxottica brand. We have worldwide sales data of the brand from 2007 to 2020. The was no data about sales of polarized sunglasseswhich is closer alternative for colorized glasses that's why I decided to choose whole brand sales to make predictions on.

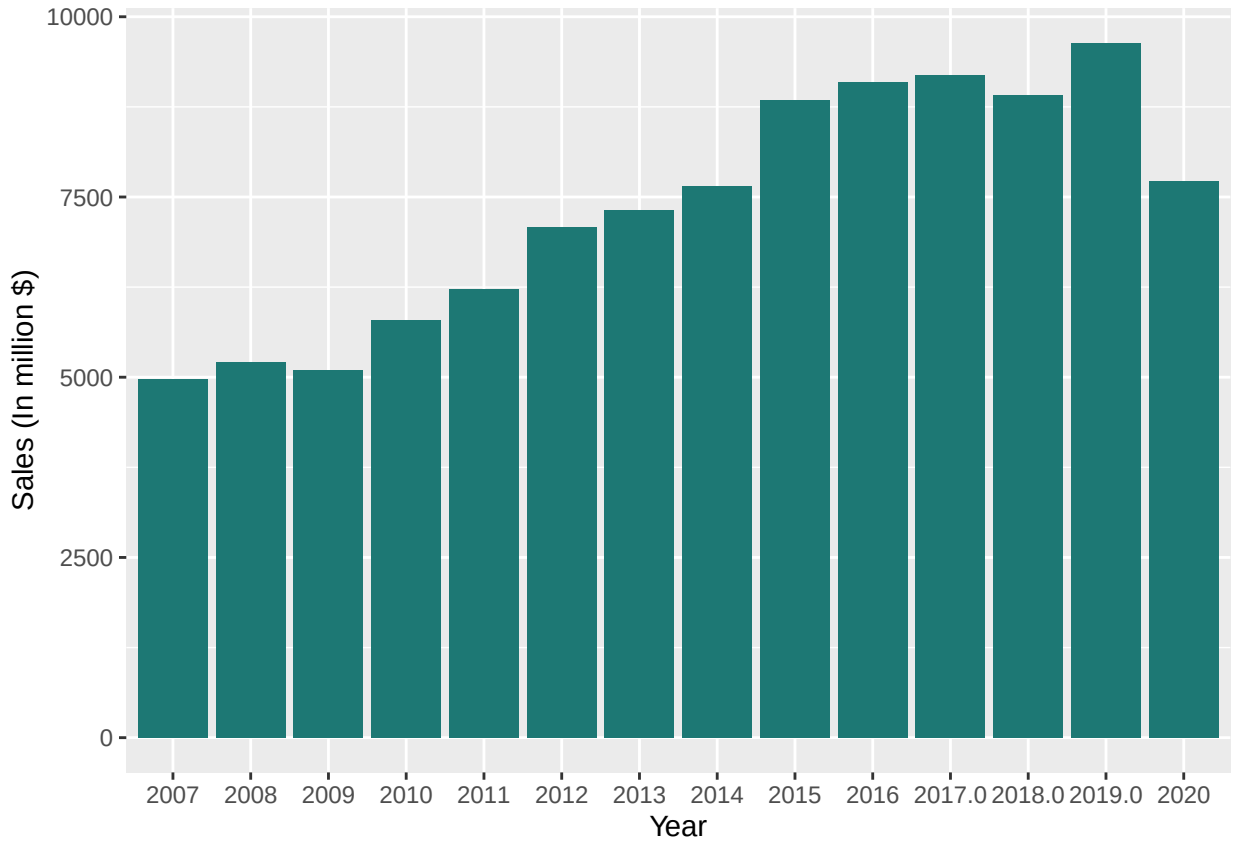
```
library(readxl)
library(ggplot2)

data  = read_excel("lux_glasses.xlsx")
data
```

```
## # A tibble: 14 x 2
##    Year   Sales
##    <chr>  <dbl>
##  1 2007    4966
##  2 2008    5202
##  3 2009    5094
##  4 2010    5798
##  5 2011    6222
##  6 2012    7086
##  7 2013    7313
##  8 2014    7652
##  9 2015    8837
## 10 2016    9086
## 11 2017.0  9184
## 12 2018.0  8914
## 13 2019.0  9638
## 14 2020    7715
```

We have 7 year data of sales of plano sunglasses. We can see that from 2011-2017 sales increase.

```
ggplot(data = data, aes(x = Year, y = Sales)) +
  geom_bar(fill = '#1D7874', stat = 'identity') + ylab("Sales (In million $)")
```



Diffusion Library

```
library(diffusion)
parameters <- diffusion(data$Sales)
p<-parameters$w['p']
q<-parameters$w['q']
m<-parameters$w['m']
```

```
parameters
```

```
## bass model
##
## Parameters:
##                                 Estimate p-value
## p - Coefficient of innovation     0.0205      NA
## q - Coefficient of imitation      0.1336      NA
## m - Market potential          205093.9814      NA
##
## sigma: 476.945
```

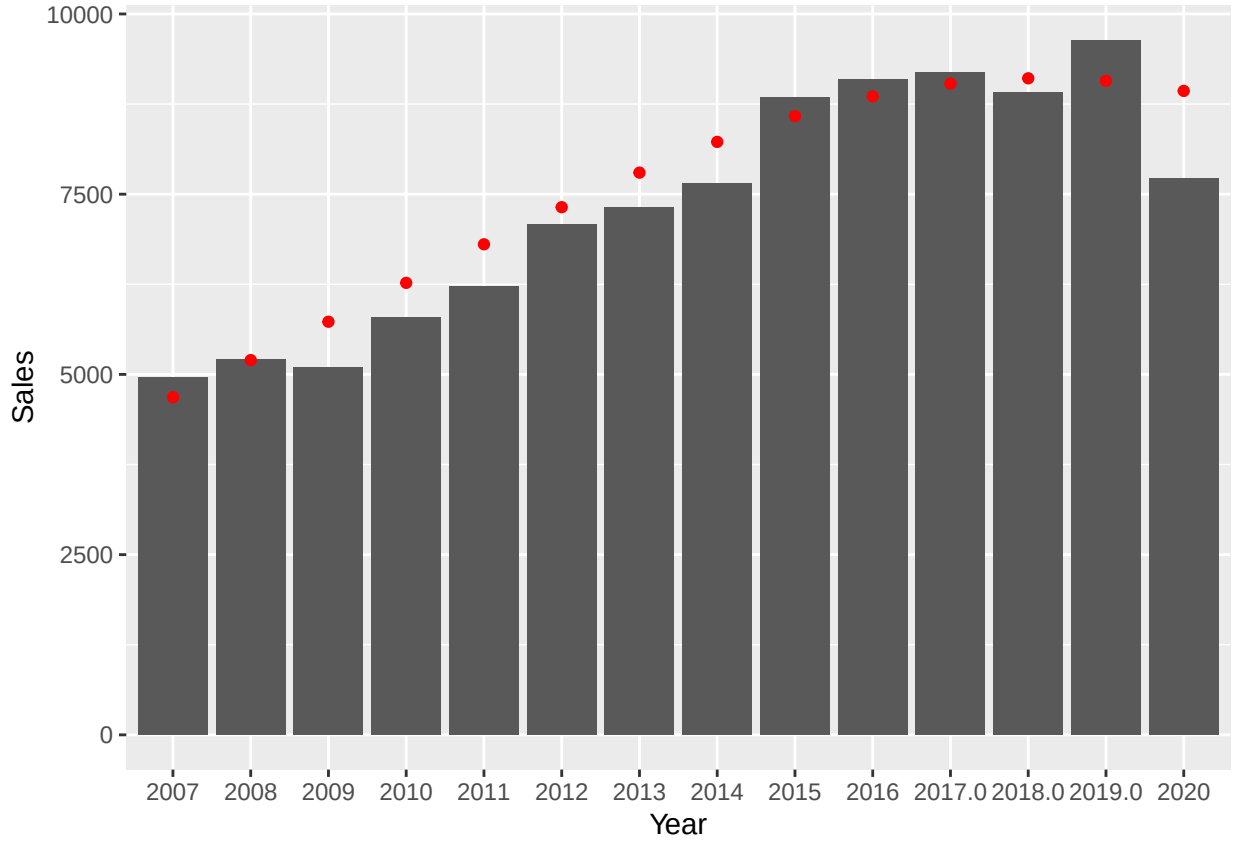
the Bass Diffusion Model estimates suggest that the innovation has the potential for substantial growth in the market. However, the slow initial adoption rate (low p) should be taken into account when planning marketing and adoption strategies. The influence of imitation (high q) can work in favor of the innovation's adoption once it gains momentum.

```
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))
}
```

The visualization of our predictions show quite good results however we will try another prediction method.

```
data$prediction <- bass.f(1:14, p = p, q = q)*m
ggplot(data = data, aes(x = Year, y = Sales)) + geom_bar(stat = 'identity') +
  geom_point(aes(x=Year, y = prediction), col = 'red')
```



Non-Linear Leasy Squares (NLS)

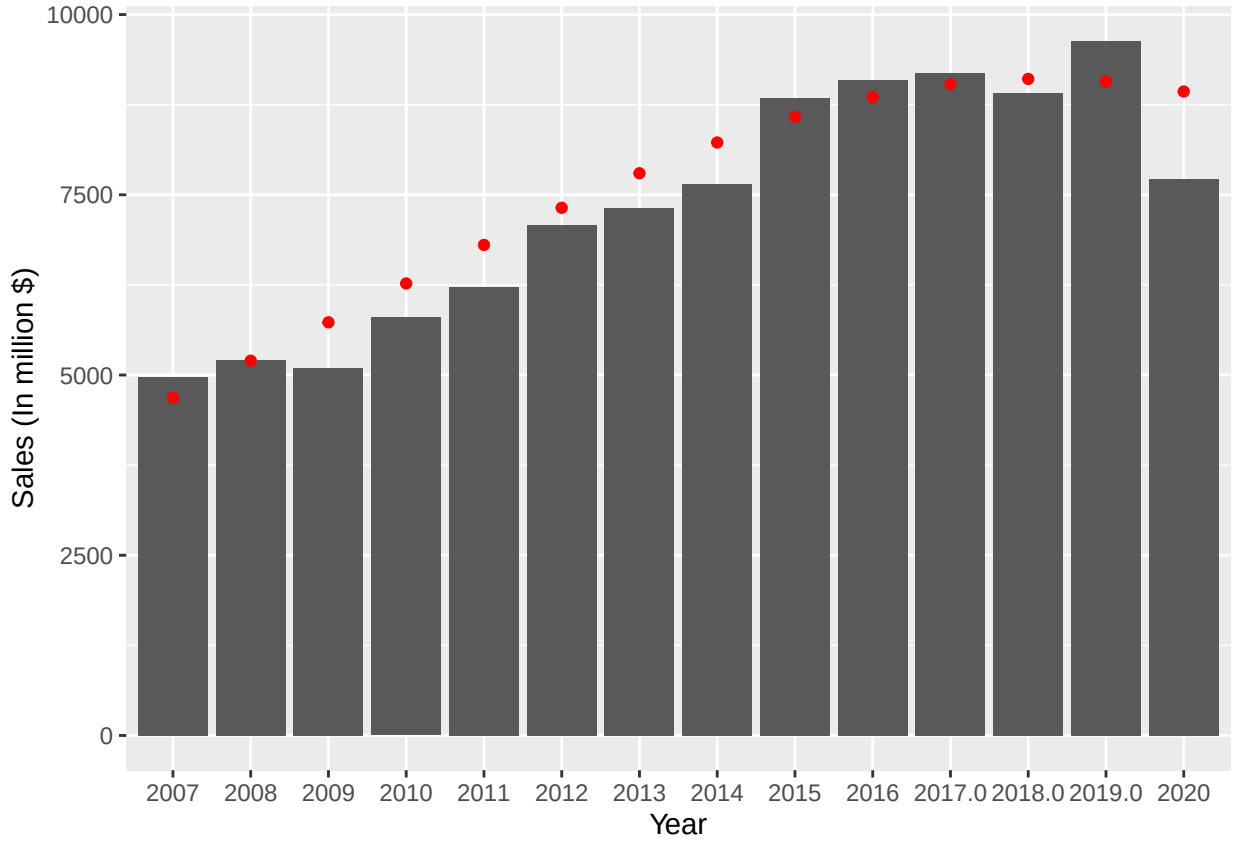
```
sales = data$Sales
t = 1:length(sales)
bass_m = nls(sales ~ m*(((p+q)**2/p)*exp(-(p+q)*t))/(1+(q/p)*exp(-(p+q)*t))**2,
```

```
start=c(list(m=sum(sales),p=0.02,q=0.4)), control = list(maxiter=5000, tol = 8))
bass_m
```

```
## Nonlinear regression model
##   model: sales ~ m * (((p + q)^2/p) * exp(-(p + q) * t))/(1 + (q/p) *     exp(-(p + q) * t))^2
##    data: parent.frame()
##         m         p         q
## 102707.00      0.02      0.40
##  residual sum-of-squares: 157589240
##
## Number of iterations to convergence: 0
## Achieved convergence tolerance: 3.476
```

```
 m <- bass_m$m$getPars()['m']
p <- bass_m$m$getPars()['p']
q <- bass_m$m$getPars()['q']
```

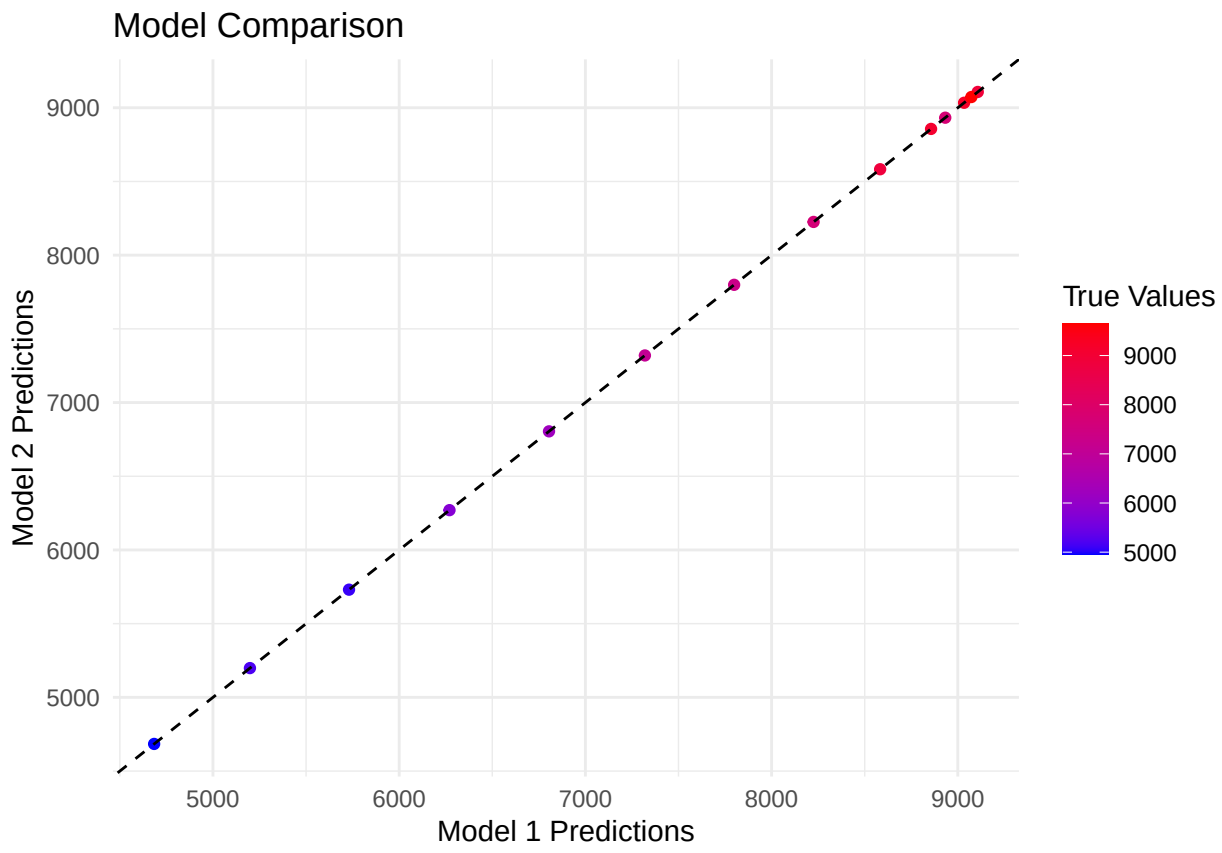
```
data$prediction2 <- bass.f(1:14, p = p, q = q)*m
ggplot(data = data, aes(x = Year, y = Sales)) +
geom_bar(stat = 'identity') + ylab("Sales (In million $)") +
  geom_point(aes(x=Year, y = prediction), col = 'red')
```



We can see that second method gave the same results as first one. To have better look lets visualize the outputs.

```r
# Create a data frame with predictions and true values
comparison_data <- data.frame(
  Model1 = data$prediction,
  Model2 = data$prediction,
  TrueValues = data$Sales
)

ggplot(data = comparison_data, aes(x = Model1, y = Model2)) +
  geom_point(aes(color = TrueValues)) +
  geom_abline(intercept = 0, slope = 1, linetype = "dashed") +  # Add a diagonal line for reference
  labs(
    title = "Model Comparison",
    x = "Model 1 Predictions",
    y = "Model 2 Predictions",
    color = "True Values"
  ) +
  scale_color_gradient(low = "blue", high = "red") +  # Customize color scale
  theme_minimal()
```



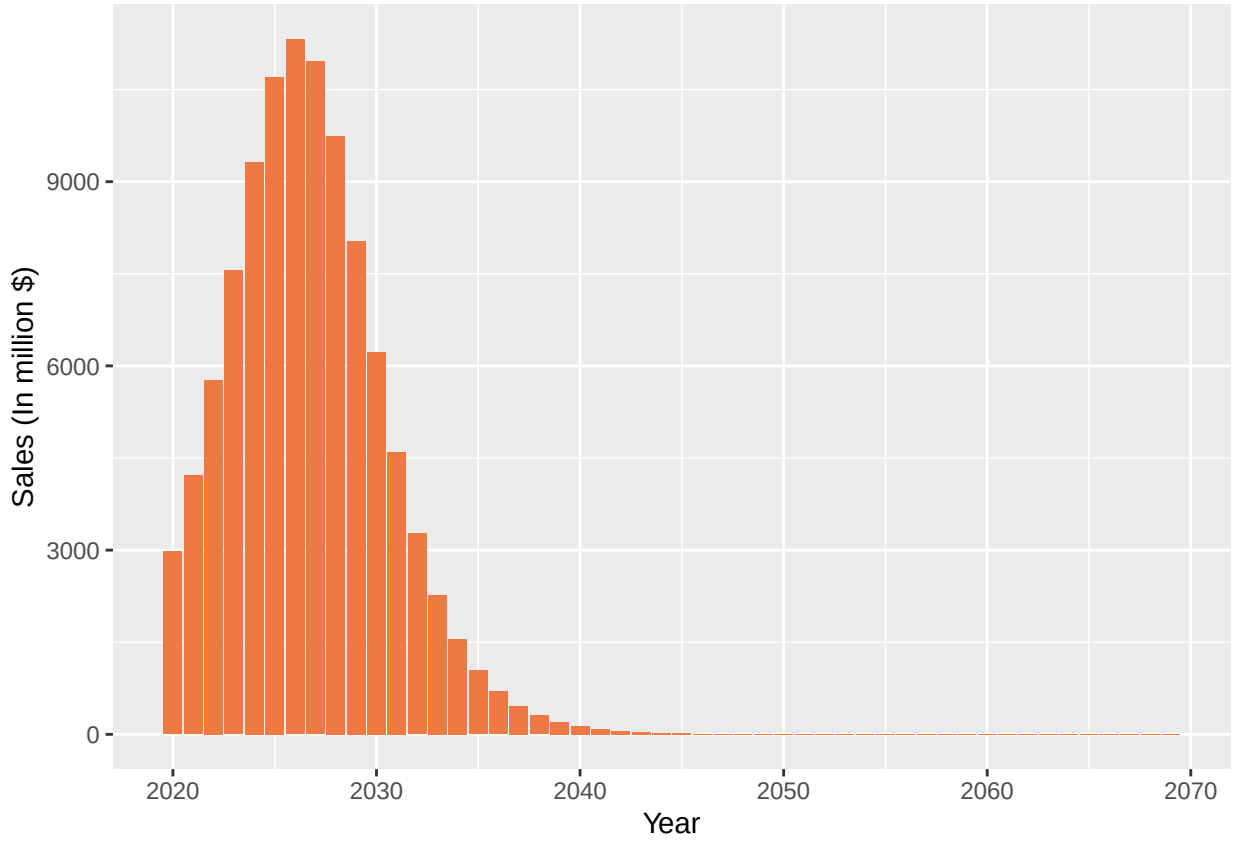
Predictions

```r
years_ahead <- 50
innovation_prediction <- bass.f(1:years_ahead, p = p, q = q)*m
```

```
years <- seq(from = 2020, to = 2019 + years_ahead, by = 1)
innovation_data <- data.frame(Year = years, Sales = innovation_prediction)
```

Now lets make predictions 50 years ahead.

```
ggplot(data = innovation_data, aes(x = Year, y = Sales)) +
 geom_bar(stat='identity', fill = 'sienna2') + ylab("Sales (In million $)")
```



Now lets find peak of our sales.

```
innovation_data[which.max(innovation_data$Sales),]
```

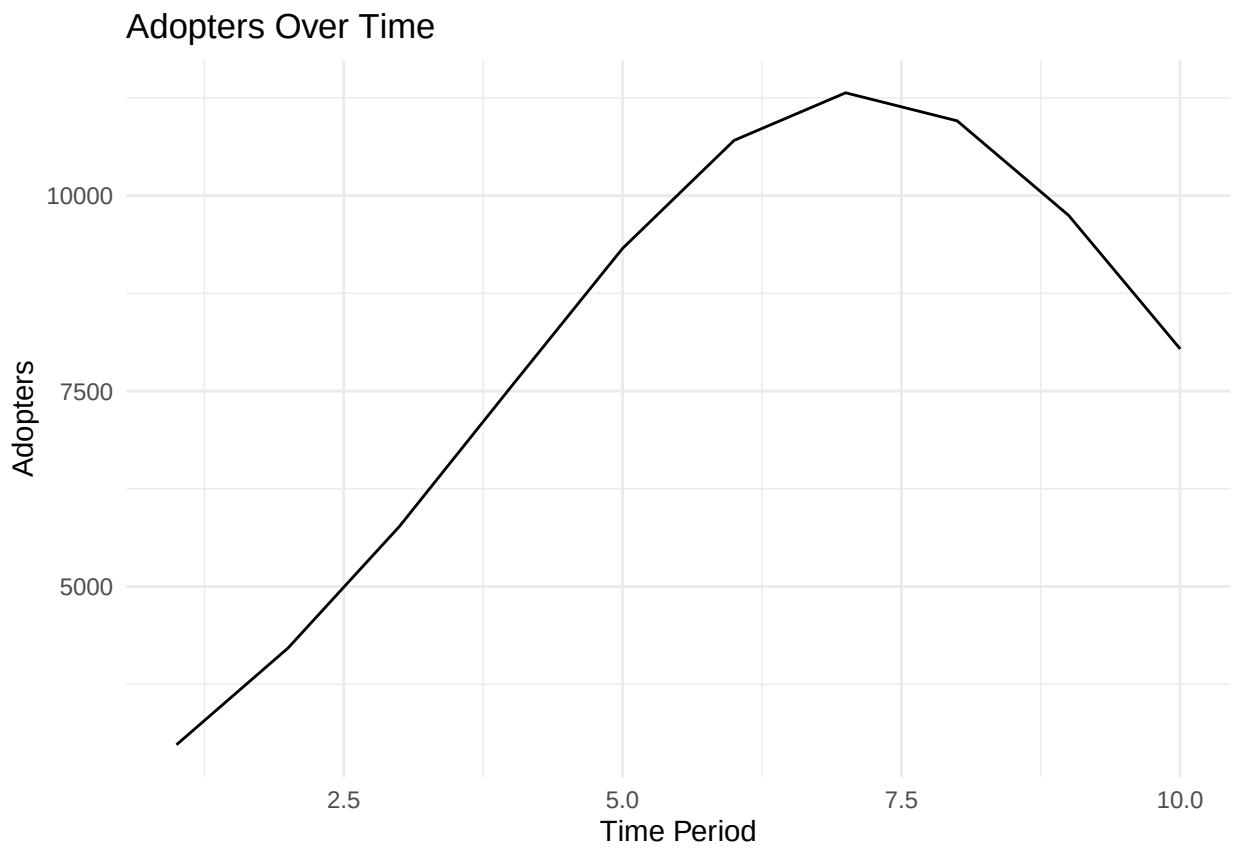
```
##   Year    Sales
## 7 2026 11314.66
```

```
# Assuming you have the parameters p, q, and m already estimated
t_periods <- 1:10  # Adjust the number of periods as needed
adopters_by_period <- bass.f(t_periods, p, q) * m

adopters_data <- data.frame(
  Period = t_periods,
  Cumulative_Adopters = adopters_by_period
)

# Create a line plot
```

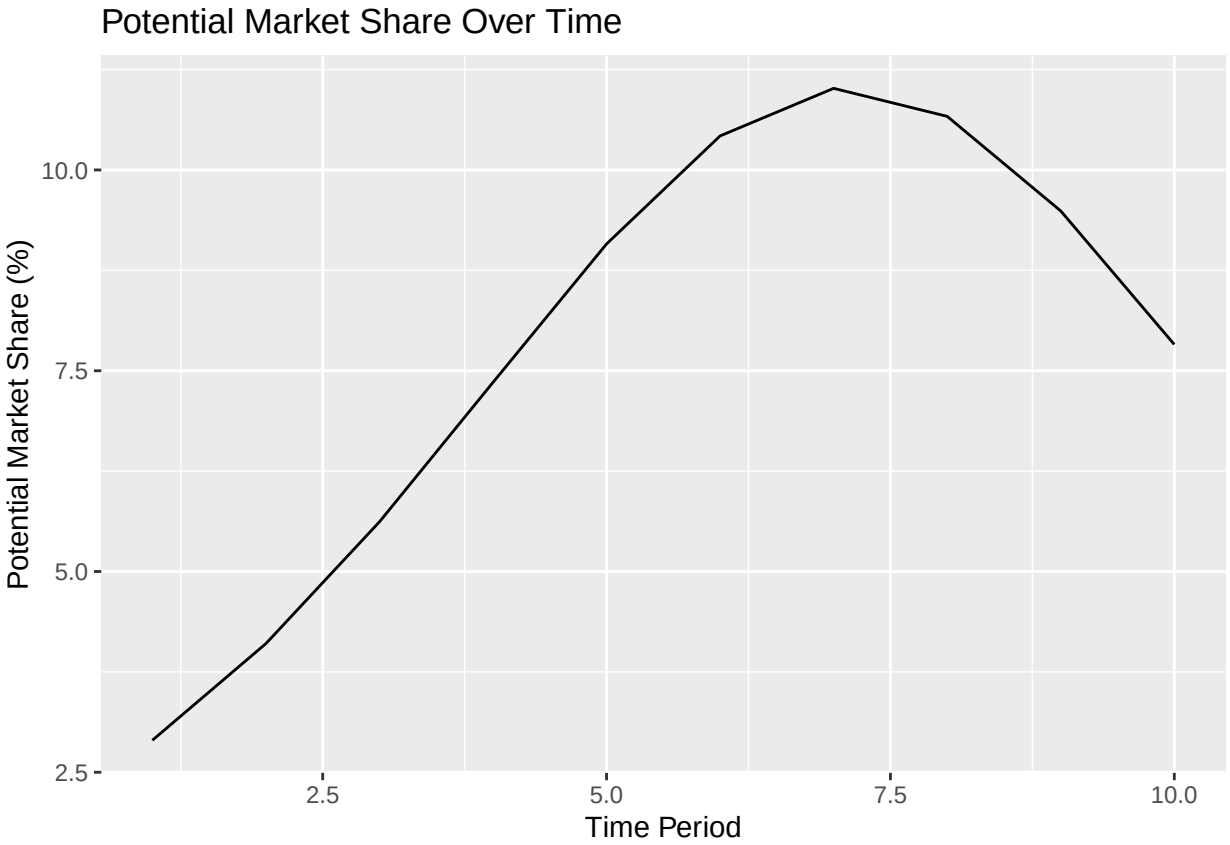
```r
ggplot(data = adopters_data, aes(x = Period, y = Cumulative_Adopters)) +
  geom_line() +
  labs(
    title = "Adopters Over Time",
    x = "Time Period",
    y = "Adopters"
  ) +
  theme_minimal()
```




```r
potential_market_share <- adopters_by_period / m

market_share_data <- data.frame(
  Period = t_periods,
  Potential_Market_Share = potential_market_share * 100  # Multiply by 100 to represent as a percentage
)

# Create a line plot for potential market share
ggplot(data = market_share_data, aes(x = Period, y = Potential_Market_Share)) +
  geom_line() +
  labs(
    title = "Potential Market Share Over Time",
    x = "Time Period",
    y = "Potential Market Share (%)"
  )
```



References

Statista Research Department (Sep 28, 2022). Global revenues of Luxottica from 2007 to 2020. https://www.statista.com/statistics/241567/global-net-sales-of-luxottica/