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MARKETING ANALYTICS

HOMEWORK 1

The inovation i chose is Humane Ai Pin which is new inovation that is going to replace the smartphone, once attaches to your clothing it becomes AI-powered personal assistant. The intention of this inovation is to rethink the smartphone which will be ahuge step in the sphere of gadgets. And for this reason the similar product that i chose is the gigant of 2000s in the sphere of creating mobile phones and smartphones the Nokia.If you need visuals, a tiny projector beams them straight onto the palm of your outstretched hand. The pin is planned to launch Nov. 9

The similarity is the mindset of the customers that are going to buy tyhis product this are people who like to try new thing sand try the inovations.

```
library(readxl)
library(knitr)
library(readxl)
library(ggplot2)
library(ggpubr)
library(diffusion)
```

```
file_path <- "datanokia.xlsx"

data_sheet <- read_excel(file_path, sheet = "Data")
```

```
## New names:
## * `` -> `...2`
```

```
data_sheet
```

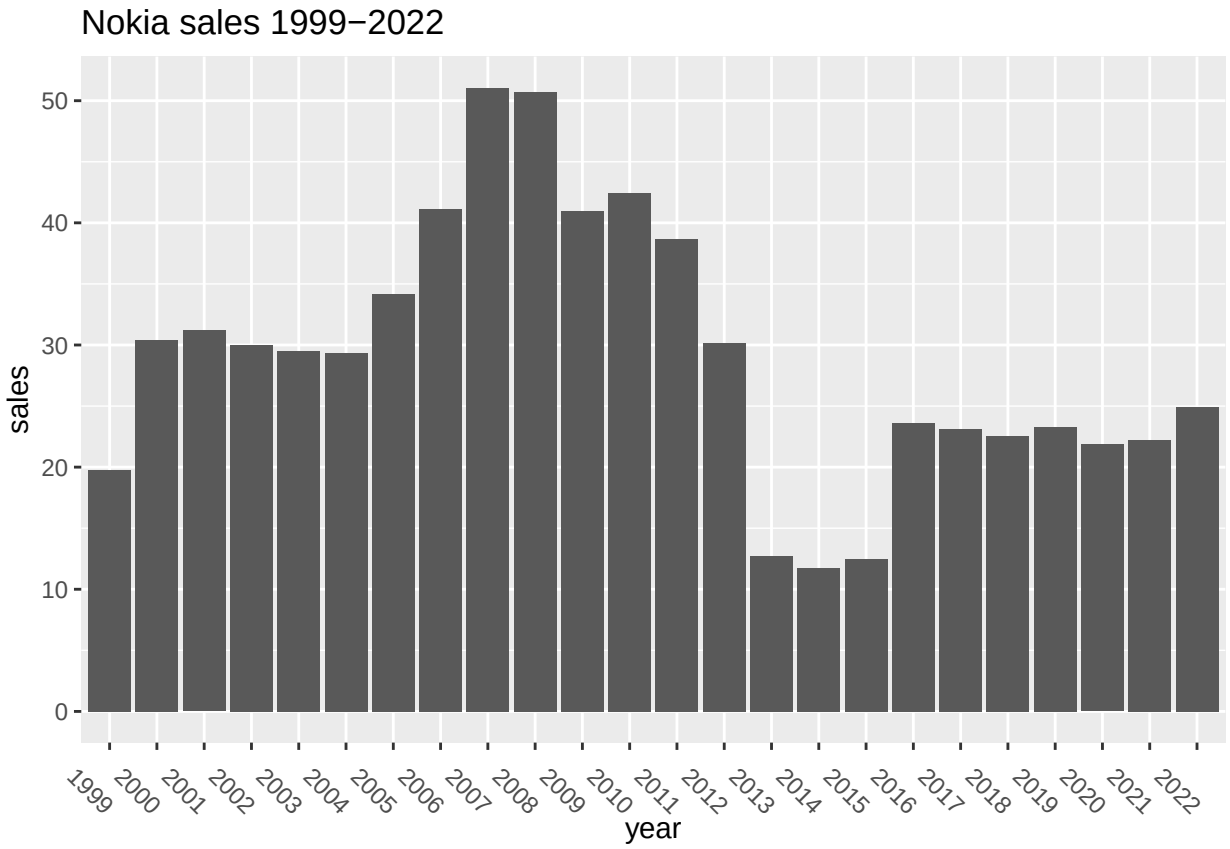
```
## # A tibble: 26 x 2
##    `Nokia net sales worldwide 1999-2022`                              ...2
##    <chr>                                                             <dbl>
##  1 Nokia net sales worldwide from 1999 to 2022 (in billion euros)     NA
##  2 <NA>                                                               NA
##  3 1999                                                               19.8
##  4 2000                                                               30.4
##  5 2001                                                               31.2
##  6 2002                                                               30.0
##  7 2003                                                               29.5
##  8 2004                                                               29.4
##  9 2005                                                               34.2
## 10 2006                                                               41.1
## # i 16 more rows
```

```
data_sheet <- data_sheet[-c(1, 2), ]

data_sheet
```

```
## # A tibble: 24 x 2
##    `Nokia net sales worldwide 1999-2022`  ...2
##    <chr>                                <dbl>
```

```
##  1 1999                                  19.8
##  2 2000                                  30.4
##  3 2001                                  31.2
##  4 2002                                  30.0
##  5 2003                                  29.5
##  6 2004                                  29.4
##  7 2005                                  34.2
##  8 2006                                  41.1
##  9 2007                                  51.1
## 10 2008                                  50.7
## # i 14 more rows
```

```r
colnames(data_sheet) <- c("year", "sales")
function_sales = ggplot(data = data_sheet, aes(x = year, y = sales)) +
  geom_bar(stat = 'identity') +
  ggtitle('Nokia sales 1999-2022') +
  theme(axis.text.x = element_text(angle = -45, vjust = 0.5, hjust=1))

function_sales
```



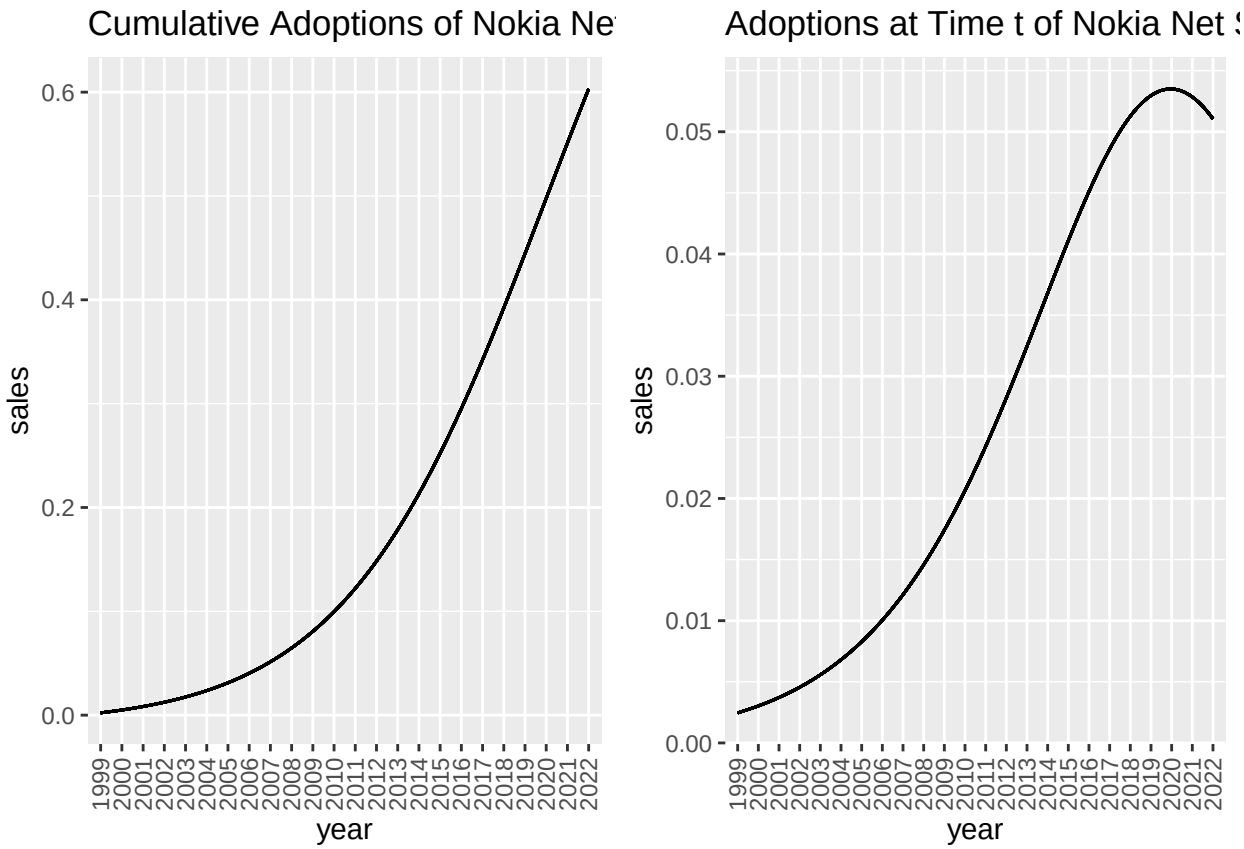

```r
#bass function
bass.f <- function(t,p,q){
((p+q)^2/p)*exp(-(p+q)*t)/
(1+(q/p)*exp(-(p+q)*t))^2
}
```

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

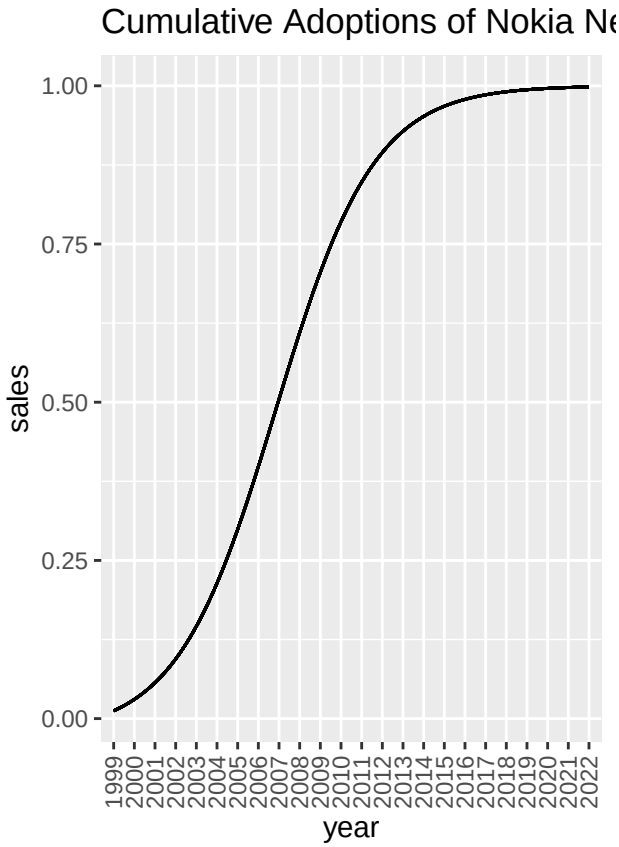
```r
diffusion_model <- diffusion(data_sheet$sales)

p_value <- round(diffusion_model$w, 4)[1]  # Coefficient of innovation
q_value <- round(diffusion_model$w, 4)[2]  # Coefficient of imitation
m_value <- round(diffusion_model$w, 4)[3]  # Market potential

print(diffusion_model)
```

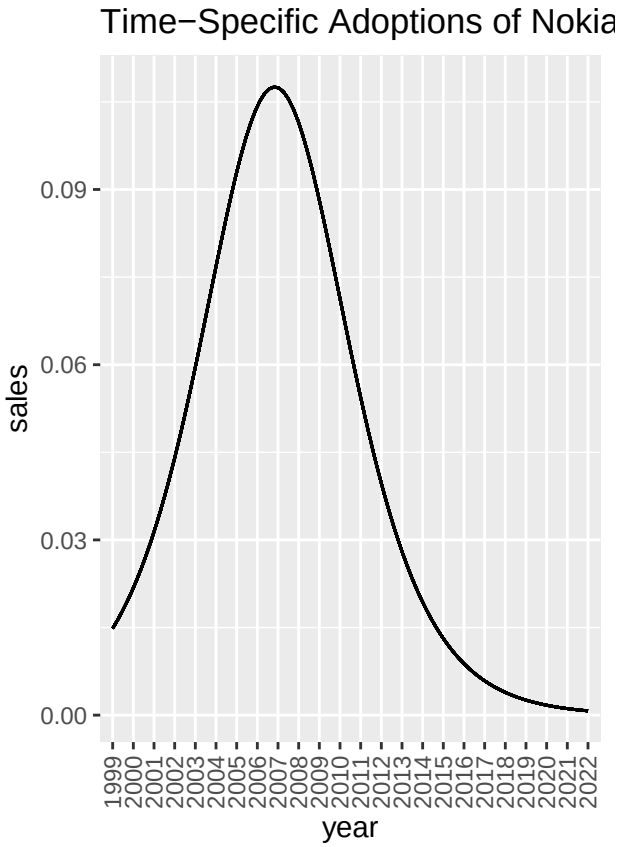
```
## bass model
##
## Parameters:
##                                Estimate p-value
## p - Coefficient of innovation    0.0314      NA
## q - Coefficient of imitation     0.1464      NA
## m - Market potential           723.4842      NA
##
## sigma: 8.448
```

```r
cumulative_adoption_plot <- ggplot(data = data_sheet, aes(x = year, y = sales)) +
  stat_function(fun = bass.F, args = list(p = 0.002, q = 0.21)) +
  labs(title = 'Cumulative Adoptions of Nokia Net Sales') +
  theme(axis.text.x = element_text(angle = 90, vjust = 0.5, hjust=1))

time_specific_adoption_plot <- ggplot(data = data_sheet, aes(x = year, y = sales)) +
  stat_function(fun = bass.f, args = list(p = 0.002, q = 0.21)) +
  labs(title = 'Adoptions at Time t of Nokia Net Sales') +
  theme(axis.text.x = element_text(angle = 90, vjust = 0.5, hjust=1))

suppressWarnings({
  ggarrange(cumulative_adoption_plot, time_specific_adoption_plot, ncol = 2)
})
```




```r
# Create a plot for cumulative adoptions based on the Bass model, with updated variable names
cumulative_adoption_nokia_plot <- ggplot(data = data_sheet, aes(x = year, y = sales)) +
  stat_function(fun = bass.F, args = list(p = 0.01, q = 0.41)) +
  labs(title = 'Cumulative Adoptions of Nokia Net Sales') +
  theme(axis.text.x = element_text(angle = 90, vjust = 0.5, hjust=1))

# Create a plot for time-specific adoptions based on the Bass model, with updated variable names
time_specific_adoption_nokia_plot <- ggplot(data = data_sheet, aes(x = year, y = sales)) +
  stat_function(fun = bass.f, args = list(p = 0.01, q = 0.41)) +
  labs(title = 'Time-Specific Adoptions of Nokia Net Sales') +
  theme(axis.text.x = element_text(angle = 90, vjust = 0.5, hjust=1))

# Arrange the updated cumulative and time-specific adoption plots side by side, suppressing any warning
suppressWarnings({
  ggarrange(cumulative_adoption_nokia_plot, time_specific_adoption_nokia_plot, ncol = 2)
})
```





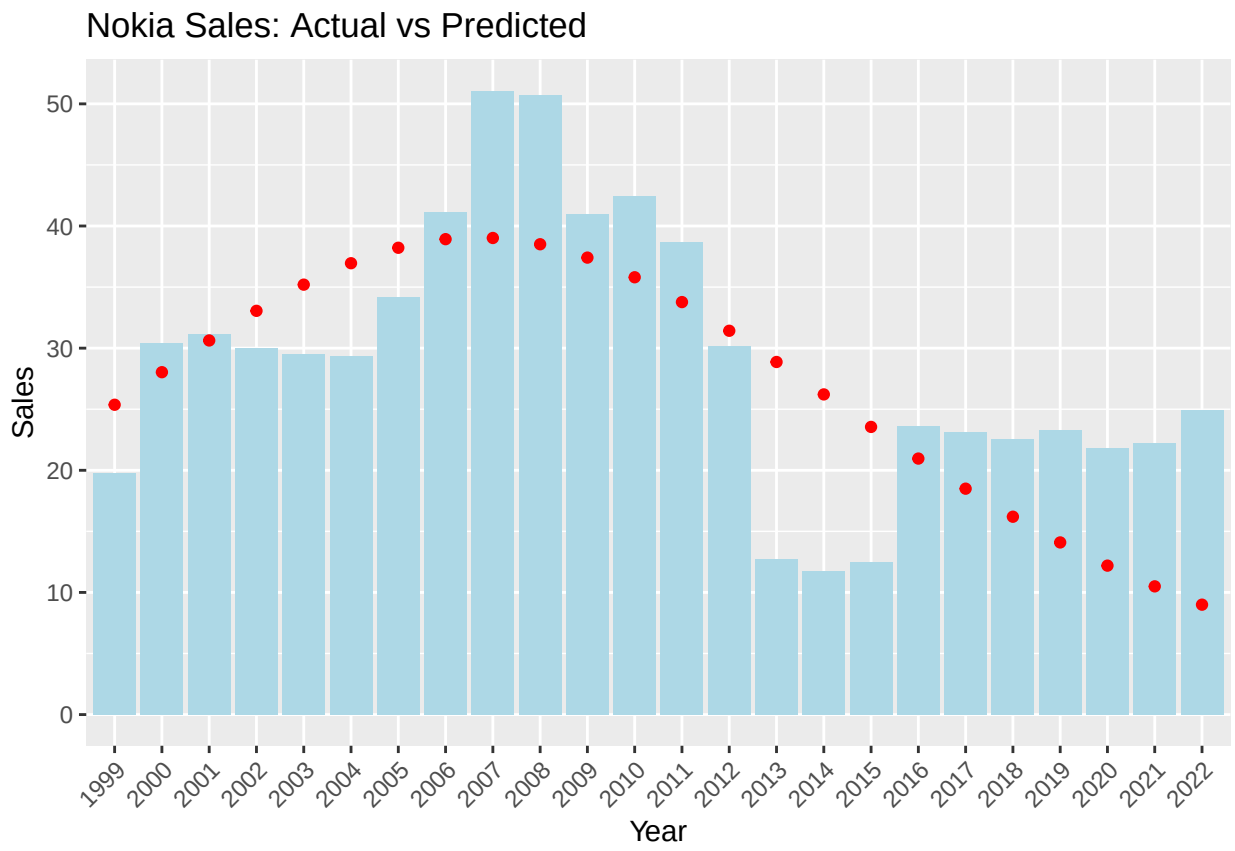

```r
sales_data <- data_sheet$sales

time_sequence <- 1:length(sales_data)

bass_model_fit <- nls(sales_data ~ m * (((p + q)^2 / p) * exp(-(p + q) * time_sequence)) /
                      (1 + (q / p) * exp(-(p + q) * time_sequence))^2,
                      start = list(m = sum(sales_data), p = 0.02, q = 0.4),
                      control = nls.control(maxiter = 100, minFactor = 1/1024, printEval = TRUE, warnOnly
```

```
##   It.   1, fac=           1, eval (no.,total): ( 1,  1): new dev = 2519.96
##   It.   2, fac=           1, eval (no.,total): ( 1,  2): new dev = 1739.33
##   It.   3, fac=           1, eval (no.,total): ( 1,  3): new dev = 1678.8
##   It.   4, fac=           1, eval (no.,total): ( 1,  4): new dev = 1674.73
##   It.   5, fac=           1, eval (no.,total): ( 1,  5): new dev = 1674.16
##   It.   6, fac=           1, eval (no.,total): ( 1,  6): new dev = 1674.08
##   It.   7, fac=           1, eval (no.,total): ( 1,  7): new dev = 1674.07
##   It.   8, fac=           1, eval (no.,total): ( 1,  8): new dev = 1674.07
##   It.   9, fac=           1, eval (no.,total): ( 1,  9): new dev = 1674.07
##   It.  10, fac=           1, eval (no.,total): ( 1, 10): new dev = 1674.07
##   It.  11, fac=           1, eval (no.,total): ( 1, 11): new dev = 1674.07
##   It.  12, fac=           1, eval (no.,total): ( 1, 12): new dev = 1674.07
```

```r
# Print the fitted model summary
summary(bass_model_fit)
```

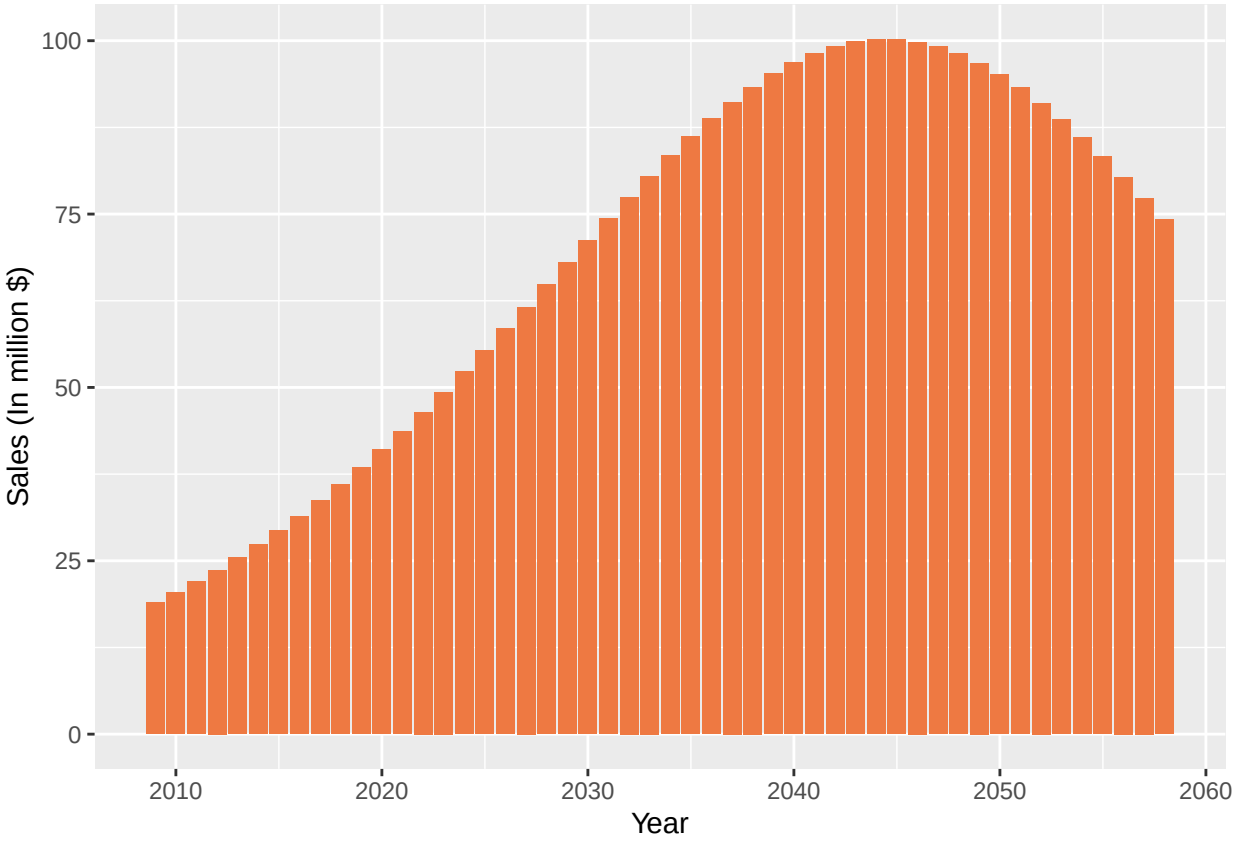
```
##
## Formula: sales_data ~ m * (((p + q)^2/p) * exp(-(p + q) * time_sequence))/(1 +
##     (q/p) * exp(-(p + q) * time_sequence))^2
##
## Parameters:
##    Estimate Std. Error t value Pr(>|t|)
## m 7.816e+02  6.858e+01  11.398 1.87e-10 ***
## p 3.005e-02  4.975e-03   6.040 5.40e-06 ***
## q 1.271e-01  3.117e-02   4.078 0.000539 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 8.928 on 21 degrees of freedom
##
## Number of iterations to convergence: 12
## Achieved convergence tolerance: 6.23e-06
```

```r
# Use the estimated parameters to predict sales
data_sheet$pred_sales <- bass.f(1:length(data_sheet$year), p = 0.0314, q = 0.1464) * 723.4842

# Now, we plot the actual sales and the predicted sales
library(ggplot2)
sales_plot <- ggplot(data = data_sheet, aes(x = year)) +
  geom_bar(aes(y = sales), stat = 'identity', fill = "lightblue") + # Actual sales
  geom_point(aes(y = pred_sales), color = 'red') + # Predicted sales
  ggtitle("Nokia Sales: Actual vs Predicted") +
  theme(axis.text.x = element_text(angle = 45, hjust = 1)) +
  labs(y = "Sales", x = "Year")

# Print the plot
print(sales_plot)
```




```
years <- seq(from = 2009, to = 2008 + 50, by = 1)

innovation_prediction <- bass.f(1:50, p = 3.825e-03, q = 7.929e-02) * 4.602e+03

innovation_data <- data.frame(Year = years, Sales = innovation_prediction)
```

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



Here is the link for the time series data for Nokia sales https://www.statista.com/statistics/267819/nokias-net-sales-since-1999/.