DS223

Marketing Analytics

American University of Armenia

Homework 1

Bass Model

Ani Gumruyan

September 29, 2023

The first (and only) adaptive focus sunglasses, they allow you to look at the horizon, and with just a quick swipe along the frame, go back to checking your messages. You can see what you want, when you want. No progressives, no bifocals. Just one pair of revolutionary sunglasses that are putting practicality and style in a whole new light.

DeepOptics 32°N Adaptive Focus Sunglasses || Glasses

The **DeepOptics 32°N Adaptive Focus Sunglasses** can be viewed as a natural evolution of **Glasses**, as they take the basic concept of glasses and enhance with new features.

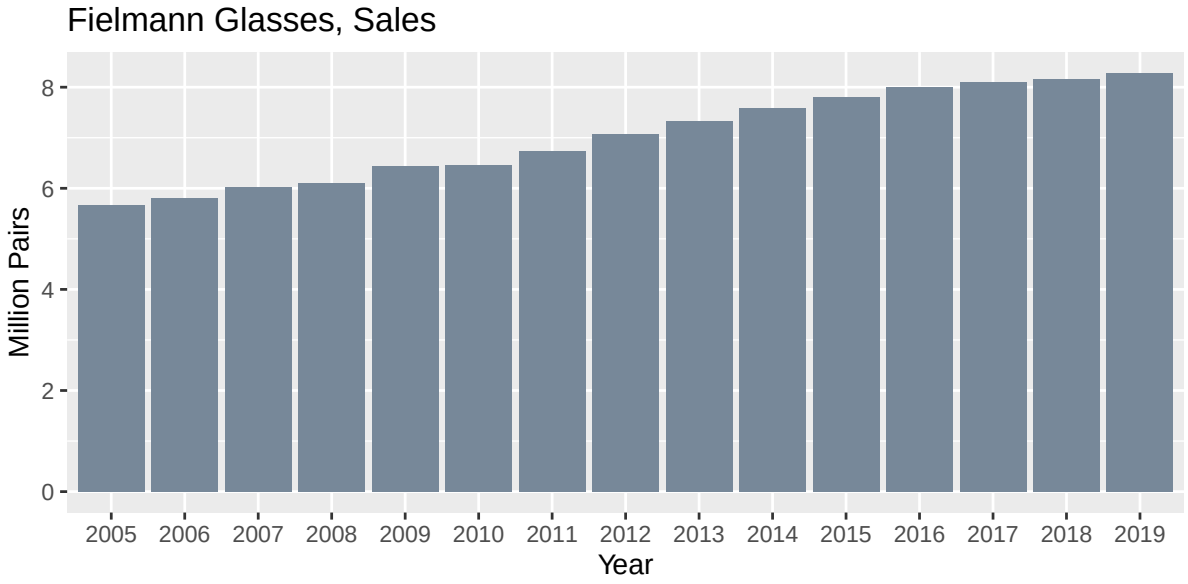
- ***Both inventions have a similar structure.*** Glasses typically consist of a frame with two lenses tailored to the individual's vision needs. The DeepOptics 32°N Adaptive Focus Sunglasses also have a frame with two lenses made of a special liquid crystal material.
- ***Both inventions address the same concern.*** Glasses were invented to help people with vision problems see better. The DeepOptics 32°N Adaptive Focus Sunglasses are a more advanced version of glasses that can dynamically switch focus between close and far distances.

The DeepOptics 32°N Adaptive Focus Sunglasses are still a relatively new product, but they have the potential to revolutionize the way people think about glasses. They are a more convenient and versatile solution for people with vision problems, and they carry the potential to replace traditional glasses.

Time Series Data on Glasses

Fielmann is a German optics company founded in 1972 by Günther Fielmann, headquartered in Hamburg, Germany. Fielmann is the largest optical retailer in Europe, with over 700 stores in 16 countries, selling a wide range of eyewear, including glasses, sunglasses, and contact lenses.

The time series data ***"Number of glasses sold by Fielmann from 2005 to 2019(in million pairs)"*** from Statista represents the annual unit sales of glasses by Fielmann in a span of 15 years with regional focus on Europe. Fielmann is a major player in the European optical industry, and thus its sales data can be viewed as a good indicator of the overall trend in the market.



Bass Model Parameter Estimation

Method 1: Non-linear Least Squares

```
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)))

summary(bass_m)
```

```
##
## Formula: sales ~ m * (((p + q)^2/p) * exp(-(p + q) * t))/(1 + (q/p) *
##     exp(-(p + q) * t))^2
##
## Parameters:
##    Estimate Std. Error t value Pr(>|t|)
## m 4.701e+02  9.158e+01   5.134 0.000248 ***
## p 1.133e-02  2.078e-03   5.453 0.000147 ***
## q 5.221e-02  5.725e-03   9.119 9.61e-07 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.1075 on 12 degrees of freedom
##
## Number of iterations to convergence: 9
## Achieved convergence tolerance: 7.576e-06
```

Method 2: Using Library "Diffusion"

```
diff_m = diffusion(sales)
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     0.0110      NA
## q - Coefficient of imitation      0.0511      NA
## m - Market potential            491.4593      NA
##
## sigma: 0.098
```

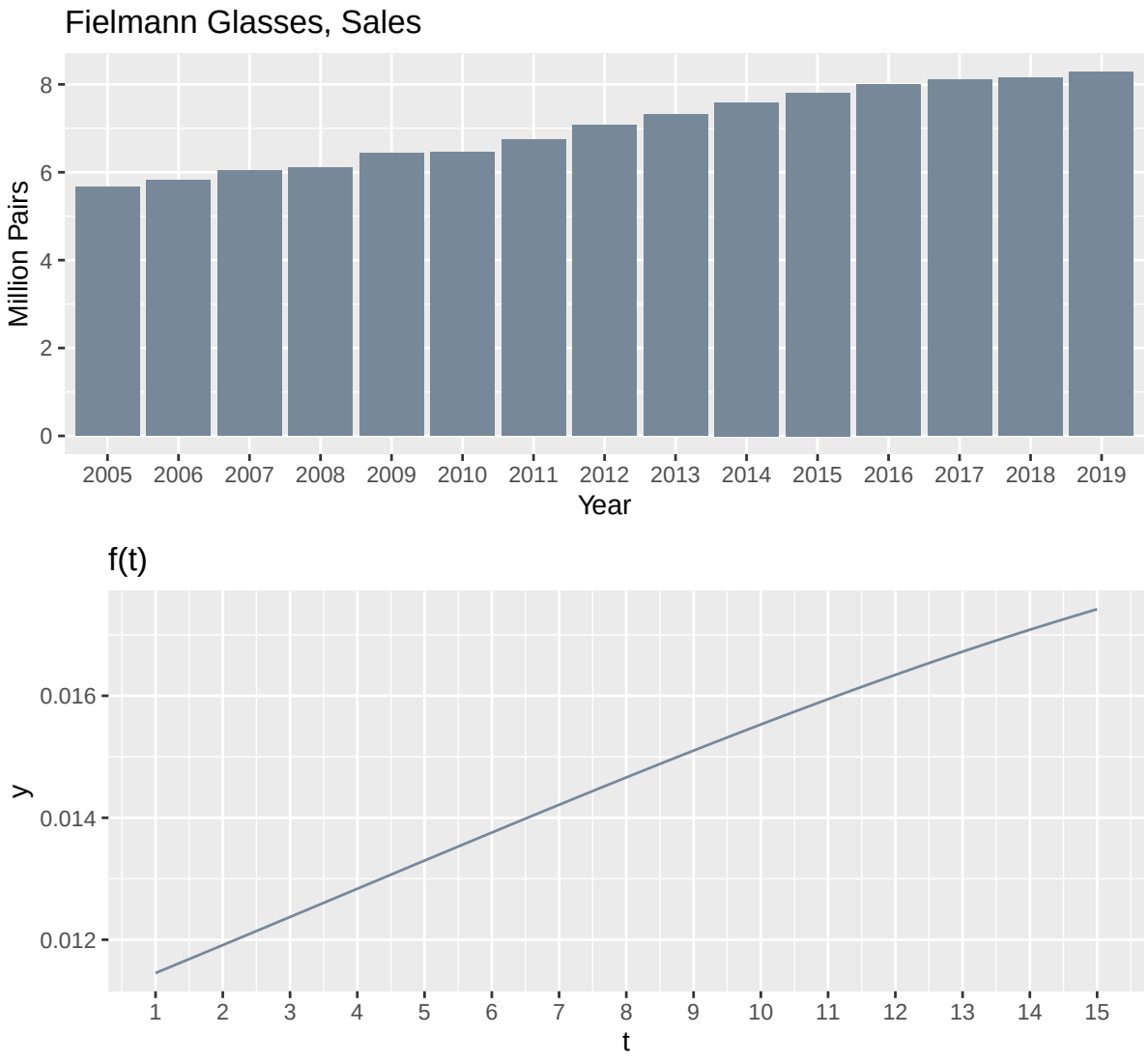
Parameter Estimates with respect to methods

	Method 1	Method 2	*Final Estimate (Rounded Means)*
m	470.15	491.45	*480.8*
p	0.011	0.011	*0.011*
q	0.052	0.051	*0.0515*

```
m <- round(mean(c(summary(bass_m)$coefficients[1], diff_m$w[3])), 2)
p <- round(mean(c(summary(bass_m)$coefficients[2], diff_m$w[1])), 3)
q <- round(mean(c(summary(bass_m)$coefficients[3], diff_m$w[2])), 3)
```

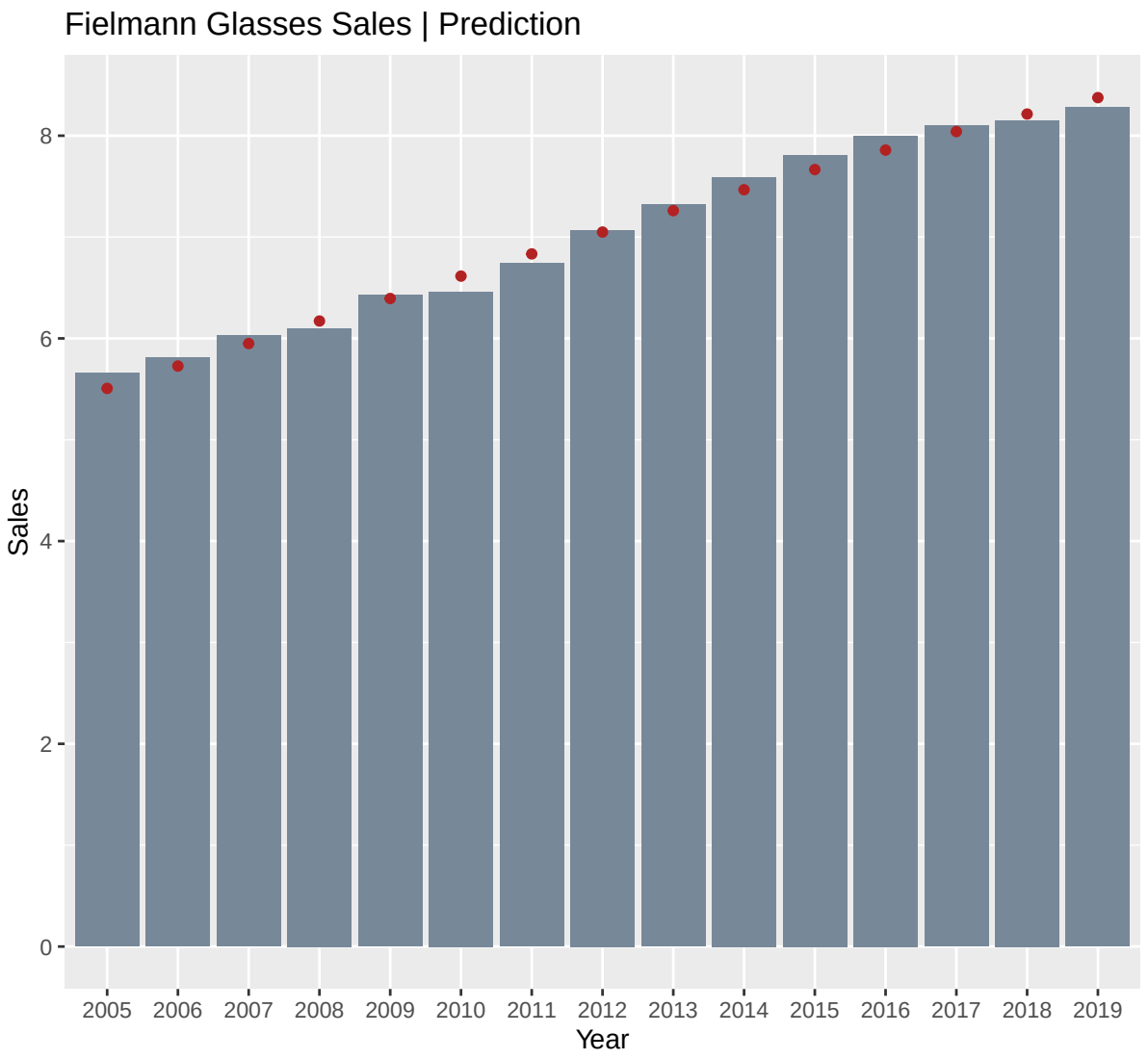
Visualizing f(t) with Finalized Parameter Estimates

```
time_ad <- ggplot(data.frame(t = c(1:15)), aes(t)) +
  stat_function(fun = bass.f, args = c(p = p, q = q),
                color = 'lightslategray') +
  scale_x_continuous(breaks = 1:15, labels = 1:15) +
  labs(title = 'f(t)')


ggarrange(fielmann_sales, time_ad, nrow = 2)
```



Prediction of the Model

```
data$PredSales <- bass.f(1:15, p = p, q = q) * m


ggplot(data = data, aes(x = Year, y = Sales)) +
  geom_bar(stat = 'identity', fill = 'lightslategray') +
    geom_point(mapping = aes(x = Year, y = PredSales),
               color = 'firebrick') +
      labs(title = 'Fielmann Glasses Sales | Prediction')
```



Estimation for the Number of Adopters

DeepOptics 32°N Sunglasses addresses the needs of people suffering from presbyopia, an age-related, irreversible gradual loss of the eye's ability to focus on nearby objects, which is usually occurring after the age of 45.

To adjust the market size for the estimation on DeepOptics 32°N Sunglasses, Fermi logic will be applied accordingly:

- **Population of the Region**

We will be sticking to Fielmann's operational region, including 16 countries of Europe, and according to Worldometers, the total population of the countries where Fielmann operates is approximately **447 million.**

- **Demographics of 45+**

Following DeepOptics focus on the population aged 45 or above, according to the World Health Organization, the portion of the population aged 45 or older in the countries where Fielmann operates is approximately **27.5%**.

- **Presbyopia**

The proportion of people aged 45 or older with presbyopia varies depending on a number of factors, including gender, and ethnicity. However, a study published in the journal Optometry and Vision Science points out that the overall prevalence of presbyopia in people aged 45 or older is approximately **83%**.

- **Interest in Product**

Noting the functional spectrum of the product resulting in relatively high pricing, in combination with styling, the rough estimate for the interest in the product among the adjusted population could be **20%.**

```r
Population_region <- 447000000
Percentage_45plus <- 0.275
Percentage_presbyopia <- 0.83
Fraction_interested <- 0.2

m <- Population_region * Percentage_45plus * Percentage_presbyopia
m_sunglasses <- m * Fraction_interested
```

```r
num_periods <- 5
estimations <- numeric(num_periods)
cumulative_sales_sunglasses <- 0

for (t in 1:num_periods) {
  next_period_sales <- bass.f(t, p = p, q = q) * m_sunglasses
  estimations[t] <- next_period_sales

  cumulative_sales_sunglasses <- c(cumulative_sales_sunglasses, cumulative_sales_sungl
}

for (i in 1:num_periods) {
  cat(sprintf("Period %d: %.2f\n", i, estimations[i]))
}
```

```
## Period 1: 233719.66
## Period 2: 243070.44
## Period 3: 252482.35
## Period 4: 261921.43
## Period 5: 271350.92
```

Resources

Optometry and vision science. (n.d.).

https://journals.lww.com/optvissci/pages/default.aspx

Population - Worldometer. (n.d.).

https://www.worldometers.info/population/

Statista. (2022, July 15). *Unit sales of glasses by Fielmann 2005-2019.*
https://www.statista.com/statistics/431160/fielmann-sales-volume-of-glasses/

Steinberg, D. (2022, November 10). Smart sunglasses. *Time.*

https://time.com/collection/best-inventions-2022/6229141/deepoptics-32n-adaptive-focus-sunglasses/

The first (and only) adaptive focus sunglasses. (n.d.). 32°N Glasses.

https://32northglasses.com/?sscid=91k7_12rom0&

World Health Organization (WHO). (2023, September 28).

https://www.who.int/