HW1_16Jan

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Q1

```
df <- data.frame(
  y1_h1 = c(77.99, 22.39, 3.99, 2.995, NA, NA, NA, NA),
  y1_h2 = c(77.99, 22.39, 3.99, 2.995, NA, NA, NA, NA),
  y2_h1 = c(77.99, 22.39, 3.99, 2.995, NA, NA, NA, NA),
  y2_h2 = c(77.99, 22.39, 3.99, 2.995, NA, NA, NA, NA),
  y3_h1 = c(77.99, 22.39, 3.99, 2.995, NA, NA, NA, NA),
  y3_h2 = c(77.99, 22.39, 3.99, 2.995, NA, NA, NA, NA),
  y4_h1 = c(77.99, 22.39, 3.99, 2.995, NA, NA, NA, NA),
  y4_h2 = c(77.99, 22.39, 3.99, 2.995, NA, NA, NA, NA)
)

rownames(df) <- c("revenue", "product_cost", "marketing_cost",
"delivery_cost",
                  "profit", "customer_staying", "profit_with_attrition",
"present_value")

df["profit", ] <- df["revenue", ] - df["product_cost", ] -
df["marketing_cost", ] - df["delivery_cost", ]

print(df)
```

```
##                         y1_h1  y1_h2  y2_h1  y2_h2  y3_h1  y3_h2  y4_h1
y4_h2
## revenue                77.990 77.990 77.990 77.990 77.990 77.990 77.990
77.990
## product_cost           22.390 22.390 22.390 22.390 22.390 22.390 22.390
22.390
## marketing_cost          3.990  3.990  3.990  3.990  3.990  3.990  3.990
3.990
## delivery_cost           2.995  2.995  2.995  2.995  2.995  2.995  2.995
2.995
## profit                 48.615 48.615 48.615 48.615 48.615 48.615 48.615
48.615
## customer_staying           NA     NA     NA     NA     NA     NA     NA
NA
## profit_with_attrition      NA     NA     NA     NA     NA     NA     NA
NA
## present_value              NA     NA     NA     NA     NA     NA     NA
NA
```

```r
for (t in 1:8) {
  df["customer_staying", t] <- 1 - (0.05 * exp(-0.08 * t))
}

df['profit_with_attrition',] <- df['profit',] * df['customer_staying',]

for (t in 1:8) {
  df["present_value", t] <- df['profit_with_attrition',t]/((1 + 0.02)^t)
}

print(df)
```

```
##                            y1_h1      y1_h2      y2_h1      y2_h2
y3_h1
## revenue                77.9900000 77.9900000 77.9900000 77.9900000
77.990000
## product_cost           22.3900000 22.3900000 22.3900000 22.3900000
22.390000
## marketing_cost          3.9900000  3.9900000  3.9900000  3.9900000
3.990000
## delivery_cost           2.9950000  2.9950000  2.9950000  2.9950000
2.995000
## profit                 48.6150000 48.6150000 48.6150000 48.6150000
48.615000
## customer_staying        0.9538442  0.9573928  0.9606686  0.9636925
0.966484
## profit_with_attrition 46.3711349 46.5436515 46.7029043 46.8499132
46.985620
## present_value          45.4618970 44.7363048 44.0091898 43.2820780
42.556323
##                            y3_h2      y4_h1      y4_h2
## revenue                77.9900000 77.9900000 77.9900000
## product_cost           22.3900000 22.3900000 22.3900000
## marketing_cost          3.9900000  3.9900000  3.9900000
## delivery_cost           2.9950000  2.9950000  2.9950000
## profit                 48.6150000 48.6150000 48.6150000
## customer_staying        0.9690608  0.9714395  0.9736354
## profit_with_attrition 47.1108923 47.2265336 47.3332839
## present_value          41.8331241 41.1135395 40.3985021
```

```r
LTV <- sum(df["present_value", ])
cat("$", format(LTV, nsmall = 2), "\n")
```

```
## $ 343.391
```

Q2

```r
df_case_ii <- data.frame(
  y1_h1 = c(95.99, 22.39, 0, 5.99, NA, NA, NA, NA),
  y1_h2 = c(95.99, 22.39, 0, 5.99, NA, NA, NA, NA),
  y2_h1 = c(95.99, 22.39, 0, 5.99, NA, NA, NA, NA),
  y2_h2 = c(95.99, 22.39, 0, 5.99, NA, NA, NA, NA),
```

```r
  y3_h1 = c(95.99, 22.39, 0, 5.99, NA, NA, NA, NA),
  y3_h2 = c(95.99, 22.39, 0, 5.99, NA, NA, NA, NA),
  y4_h1 = c(95.99, 22.39, 0, 5.99, NA, NA, NA, NA),
  y4_h2 = c(95.99, 22.39, 0, 5.99, NA, NA, NA, NA)
)

rownames(df_case_ii) <- c("revenue", "product_cost", "marketing_cost",
"delivery_cost",
                          "profit", "rebuy_probability", "profit_with_rebuy",
"present_value")

df_case_ii["profit", ] <- df_case_ii["revenue", ] -
df_case_ii["product_cost", ] - df_case_ii["delivery_cost", ]

rebuy_probabilities <- seq(0.42, by = -0.03, length.out = 8)
df_case_ii["rebuy_probability", ] <- rebuy_probabilities

df_case_ii["profit_with_rebuy", ] <- df_case_ii["profit", ] *
df_case_ii["rebuy_probability", ]

for (t in 1:8) {
  df_case_ii["present_value", t] <- df_case_ii["profit_with_rebuy", t] / (1 +
0.02)^t
}

print(df_case_ii)
```

```
##                       y1_h1   y1_h2    y2_h1    y2_h2    y3_h1    y3_h2
y4_h1
## revenue           95.99000 95.9900 95.99000 95.99000 95.99000 95.99000
95.99000
## product_cost      22.39000 22.3900 22.39000 22.39000 22.39000 22.39000
22.39000
## marketing_cost     0.00000  0.0000  0.00000  0.00000  0.00000  0.00000
0.00000
## delivery_cost      5.99000  5.9900  5.99000  5.99000  5.99000  5.99000
5.99000
## profit            67.61000 67.6100 67.61000 67.61000 67.61000 67.61000
67.61000
## rebuy_probability  0.42000  0.3900  0.36000  0.33000  0.30000  0.27000
0.24000
## profit_with_rebuy 28.39620 26.3679 24.33960 22.31130 20.28300 18.25470
16.22640
## present_value     27.83941 25.3440 22.93575 20.61219 18.37094 16.20965
14.12606
##                       y4_h2
## revenue           95.99000
## product_cost      22.39000
## marketing_cost     0.00000
```

```
## delivery_cost      5.99000
## profit            67.61000
## rebuy_probability  0.21000
## profit_with_rebuy 14.19810
## present_value     12.11794
```

```
total_present_value_case_ii <- sum(df_case_ii["present_value", ])
cat("Total Present Value (Case II): $", format(total_present_value_case_ii,
nsmall = 2), "\n")
```

```
## Total Present Value (Case II): $ 157.5559
```

Q3

```
# Function to calculate TPV for subscription case with discount
# Logic: LTV of subscription case with discount >= LTV of non-subscription
case
# For LTV of subscription case with discount, Adjusted Revenue = Revenue (1 -
Discount)

calculate_tpv_with_discount <- function(discount) {
  # Adjust revenue in the subscription case
  df["revenue", ] <- 77.99 * (1 - discount)

  df["profit", ] <- df["revenue", ] - df["product_cost", ] -
df["marketing_cost", ] - df["delivery_cost", ]

  df["profit_with_attrition", ] <- df["profit", ] * df["customer_staying", ]

  for (t in 1:8) {
    df["present_value", t] <- df["profit_with_attrition", t] / (1 + 0.02)^t
  }

  return(sum(df["present_value", ], na.rm = TRUE))
}

# Binary search to find maximum discount
# We could also do this with a simple hit and trial and arrive at the
discount value

lower_bound <- 0
upper_bound <- 1
tolerance <- 1e-6

while ((upper_bound - lower_bound) > tolerance) {
  mid <- (lower_bound + upper_bound) / 2
  tpv_subscription <- calculate_tpv_with_discount(mid)

  if (tpv_subscription >= total_present_value_case_ii) {
    lower_bound <- mid # Discount is feasible
  } else {
```

```
    upper_bound <- mid # Discount is too high
  }
}

# Maximum discount
max_discount <- lower_bound * 100 # Convert to percentage

cat("Maximum Discount: ", format(max_discount, nsmall = 2), "%\n")

## Maximum Discount:  33.73413 %

## Maximum absolute Discount throughout lifetime: 0.33734 * 343.39 = $115.839
```

Q4

```
avg_ltv <- 0.37 * LTV + 0.63 * total_present_value_case_ii
print(avg_ltv)

## [1] 226.3149
```

Q5

The company can attract customers to the subscription service with the help of:

1. **Exclusive Benefits**: Offer subscribers perks like early access to new products, free delivery, or special add-ons that non-subscribers don't get.
2. **Loyalty Rewards**: Create a points-based system where subscribers earn rewards for their purchases, which they can redeem for discounts, free items, or premium services.
3. **Personalized Offers**: Use customer data to send tailored recommendations and offers that make subscribers feel valued and understood.
4. **Convenience Features**: Highlight the ease of subscription services, such as automatic renewals, hassle-free cancellations, or customizable delivery schedules.
5. **Community Building**: Create a sense of belonging by giving subscribers access to an exclusive community, such as discussion forums or events related to their interests.

Q6

We assumed that revenue, product costs, and delivery costs remain constant over time for both subscription and non-subscription cases. However, in reality, these factors are dynamic. Costs may increase due to inflation, supply chain disruptions, or unexpected inefficiencies, while revenue might fluctuate based on changes in customer demand, market trends, or competition. If costs rise faster than revenue or revenues decline, the subscription model could become significantly less profitable than anticipated.

Similarly, if churn is higher than expected, the lifetime value of subscribers will decrease, reducing the profitability of the subscription model. This could make the non-subscription case

more attractive. Often times, real-world churn rates are influenced by various factors like customer dissatisfaction, competitors, etc.

Moreover, the rebuy probability in the non-subscription case is modelled as a linearly decreasing variable over time. This factor is dependent on promotions, seasonal demand, or personal choices, so this oversimplification may also result in errors. If the actual rebuy probability is higher than predicted, the non-subscription model could outperform the subscription model in terms of total revenue.

Interestingly, we assumed that offering discounts would attract and retain more customers in the subscription model. However, this may not hold true if customers are not price-sensitive or if competitors offer better deals. In such cases, the non-subscription model might become the more viable option.

Overall, inaccuracies in these assumptions, especially around costs, customer behavior, and market conditions, could significantly alter the profitability comparison between the subscription and non-subscription models.

Q7

In my opinion, we cannot confidently say that "offering a subscription service leads to better profit". This assignment involved assumptions and simplified calculations to compare profits from subscription and non-subscription models. While we analysed the potential outcomes of these two options, the results are based on theoretical models, not real-world data. For example, we assumed constant costs, fixed churn rates, and predictable customer behaviours, but actual customer behavior can vary significantly.

Causality means we need clear evidence that offering a subscription service directly causes better profits. Since this assignment doesn’t include real-world testing or controlled experiments, we can only suggest possibilities, not causality. Offering a subscription might lead to better profits in some cases, but it depends on how customers respond and whether the assumptions hold true. Importantly, ensuring external factors, like market trends or competition, don’t skew the results, can be also quite challenging.