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Knowledge Learning of Replacement Judgment
Using Word-of-mouth Data

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Abstract

The pandemic caused by COVID-19 has also affected the camera industry, and various events have been cancelled. In addition, the recent improvement in the performance of cameras installed in smartphones has reduced the demand for replacement cameras, as it is easy to take pictures without carrying a camera.

For customers, online word-of-mouth is what they refer to when purchasing a product. This data is important not only for customers, but also for companies.

In this research, we will use online word-of-mouth data and focus not only on numerical data but also on textual data and use text mining to learn knowledge about the decision to replace a camera.

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1. Introduction

The pandemic caused by COVID-19, which began in 2020, has affected a variety of industries. The camera industry is one of the industries that have been affected. Because of the pandemic, camera-related events have been cancelled all over the world, and in Japan, major camera magazines have stopped publishing. On the other hand, the

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performance of cameras installed in smartphones has been improving year by year, and as a result, the number of camera shipments has been decreasing worldwide. In Japan, in 2005, people were replacing their cameras after less than three years. However, people are now replacing their cameras after more than six years. The extension of the replacement period will cause some companies to suffer in business. Olympus, despite having a history of more than 80 years, went into financial trouble and was transferred to an investment fund in 2021.

The only way for the camera industry to survive is to attract users with a different position from that of the cameras in smartphones. For example, there will be no camera that can match the ease of the camera in a smartphone. Therefore, SLR cameras, with their high price points, high profit margins, and differentiation from cameras in smartphones, will become one of the most important products for the camera industry. Another useful source of information for users when purchasing a product is review sites, which contain word-of-mouth written by people who have purchased the product. Customers check these review sites before purchasing a product. And this content is not only important for users, but also for companies.

Therefore, in this study, we will focus on the data of Canon’s DSLR cameras to learn the knowledge about the decision to replace the product.

2. Background

The camera industry is not doing well, at least not now. Not only are events being cancelled or discontinued due to pandemics, but the number of years between replacement is increasing due to the impact of improved smartphone performance.

2.1. Impact of COVID-19 on the camera industry

The pandemic caused by COVID-19 has affected a variety of industries\(^{[1-3]}\). The camera industry is one of them. Many people around the world have been restricted in their activities since March of 2020. It has become difficult for people to travel freely, and they have fewer opportunities to go out and take pictures.

Every year, the camera industry has held events in Japan, Germany, and various other countries to introduce new camera products and photography methods. However, due to the difficulty in attracting people, CP+2020, the most famous event in Japan, was cancelled and CP+2021 was held only online. And in Germany, the famous photokina event ended its 70-year history.

In addition, many magazines with long histories have ceased publication on after another. In Japan, the three major camera magazines have all ceased publication. Motor Magazine’s Cameraman ceased publication with its May 2020 issue. Asahi Shinbun’s Asahi Camera ceased publication with its July 2020 issue. And most recently, Nippon Camera ceased publication with its May 2021 issue.

2.2. Improved camera performance of smartphones

According to the statistics released by the Camera & Imaging Products Association, the number of cameras shipped has been decreasing\(^{[4]}\). According to World Wide’s monthly shipment data for interchangeable lens cameras, even when comparing the latest data with the pre-pandemic data, shipments of interchangeable lens cameras are decreasing. Next, we checked the data on integrated lens cameras. According to World Wide’s monthly data on shipments of integrated-lens cameras, shipments of integrated lens cameras have been declining, even when comparing the most recent data with the pre-pandemic data. The rate of decrease is low for both models, and the rate of decrease is lower for interchangeable lens cameras than for cameras with built-in lens.

In addition, according to the Cabinet Office’s Survey of Consumer Sentiment, the replacement status of digital cameras shows that the replacement period is growing every year\(^{[5]}\). In 2005, people replaced their digital cameras after 2.9 years, but in 2010, it was more than four years. Today, more than six years have passed before the replacement. In other words, they used to replace their cameras after about three years, but now they have owned their cameras for more than twice as long as are replacing them. Next, we checked the reasons for replacing digital
cameras. According to Trends in Replacement Status of Major Durable Consumer Good, most of the reasons for replacement of digital cameras can be divided into failure and top items. In addition to replacement due to breakdowns, it shows that customers replace their products when new products are introduced with new functions[6].

Furthermore, as the performance of smartphone cameras has improved and cameras are no longer selling well, there have been cases of companies that have been in the business for many years transferring their camera business. Olympus starts its camera business in 1936 and had a history of more than 80 years. In recent years, the company had been performing poorly and had been strengthening its pricey, high performance single lens camera and interchangeable lens product. However, its performance did not improve, and the company was transferred to an investment fund.

2.3. Previous research on the impact of word of mouth

With the purchase of products online and the development of social media, there is a lot of word-of-mouth out there. There are many studies that use word-of-mouth to understand purchase motivation and customer characteristics.

Shabnam’s study conducted an empirical experiment to examine the impact of word-of-mouth on customer purchase intentions[7]. The results showed that the brand image, not the expertise of the reviewer, influenced purchase intention. Next, Bogdan’s study examines the impact of word-of-mouth on online purchases of digital products[8]. The results showed that the expertise of the reviewers influenced their willingness to purchase. In addition, according to Chevalier, there are case studies examining the impact of book reviews on sales at Amazon and Barnesandnovel[9]. It was found that most of the reviews were written relatively early after the release of the book, and that the earlier the reviews were written, the more voluminous and longer the text was. Finally, Hashimoto is researching ways to quantify product features from word-of-mouth data[10]. For the major camera manufacturers in Japan, he proposes a method to quantify the added value provided by the manufacturer and the user response and explains the differences between them. Most of the major manufacturers form value into their products based on the needs of users. However, Sony was found to be forming value by having users accept its proposals.

Thus, there are many studies that use word-of-mouth. However, there are no studies that use word-of-mouth data on SLR cameras to study product replacement. Therefore, in this study, we decided to use word-of-mouth data on SLR cameras to learn knowledge about product replacement decisions.

3. Product Purchase Site Review

In recent years, many product information websites have been posting reviews from customers who have purchased the product as well as details about the product.

3.1. Review Information

In this study, we used data from 998 cases of 22 models of DSLR cameras listed on the Canon website in the US. https://www.usa.canon.com/internet/portal/us/home/products/list/cameras/eos-dslr-and-mirrorless-cameras/dslr/eos-dslr-cameras

As shown in Fig.1, product reviews contain a variety of information. These are user name, location, number of previous reviews and number of previous votes, length of time the product has been used, expertise level, number of years the user has been a Canon customer, replacement of the product, score rating, data of description, word-of-mouth, which is an opinion of the product.

In this study, we decided to handle and analyze not only numerical data, but also textual data. And this data was obtained by web scraping.
3.2. Numerical Data Results

First, we checked the overall evaluation. The results are shown in Table 1, which shows that the largest number of customers gave Rank 5, 74.75% of the total, and the next largest number of customers gave Rank 4, 12.42% of the total. When Rank 5 and Rank 4, which are considered as very good and generally good, are combined, 87.17% of the total customers rated it as good. Although there is a bias in the data, this is because customers have researched the product, liked it, and purchased it.

| Rank | Count | Rate  |
|------|-------|-------|
| 5    | 746   | 74.75%|
| 4    | 124   | 12.42%|
| 3    | 52    | 5.21% |
| 2    | 26    | 2.61% |
| 1    | 50    | 5.01% |

Next, we examined their experience in using the products they had purchased. The results are shown in Table 2. The largest number of respondents wrote reviews within one month of purchase, and when combined with those who wrote reviews within three months, the total was 61.82%. In other words, more than half of the respondents wrote their reviews within three months of purchase.

| Period                  | Count | Rate  |
|-------------------------|-------|-------|
| Less than 1 month       | 375   | 37.58%|
| 1 to 3 months           | 242   | 24.25%|
| 3 to 6 months           | 114   | 11.42%|
| 6 to 12 months          | 129   | 12.93%|
| More than 1 year        | 134   | 13.43%|
| No Value                | 4     | 0.40% |

The next step was to confirm the duration as a Canon customer, the results are shown in Table 3. Looking at the results of the period as a Canon customer, we found that there were no outstanding results, and that the results were distributed roughly in the 20% range for all periods of use.
Table 3. Results of the period as a Canon customer

| Period          | Count | Rate  |
|-----------------|-------|-------|
| Less than 1 year| 178   | 17.84%|
| 1 to 5 years    | 202   | 20.24%|
| 6 to 10 years   | 215   | 21.54%|
| 11 to 20 years  | 183   | 18.34%|
| More than 20 years | 214 | 21.44%|
| No Value        | 6     | 0.60% |

Since we were able to obtain data on the expert level, we checked the content of the data. The results are shown in Table 4. Checking the results, it was found that Advanced Amateur accounted for the highest percentage of 39.78%, followed by Hobbyist or Enthusiast level users accounting for 28.46%. One thing to keep in mind is that this level is assigned by the customer based on their own evaluation. Therefore, even if a customer is Hobbyist, he or she may choose to be Advanced Amateur.

Table 4. Results of the Expertise Level

| Level              | Count | Rate  |
|--------------------|-------|-------|
| Professional or Expert | 229   | 22.95%|
| Advanced Amateur   | 397   | 39.78%|
| Hobbyist / Enthusiast | 284 | 28.46%|
| Casual User        | 80    | 8.02% |
| No Value           | 8     | 0.80% |

Next, we checked the most important information we wanted to know about this time: product replacement. The results are shown in Table 5. The results show that a large number of customers selected “Yes” for product replacement, accounting for 67.23%.

Table 5. Results of Product Replacement

| Replacement | Count | Rate  |
|-------------|-------|-------|
| Yes         | 671   | 67.23%|
| No          | 327   | 32.77%|

Table 5 shows that the percentage of people who replace their products exceeds 67%, so we examined the Overall Evaluation of those who replace their products and the length of time they have been a Canon customer. The results are shown in Table 6. Each evaluation resulted in a high percentage of more than 20 years at Rank 5, which is considered the best. The highest percentage of 1 to 5 years was 92.37% for the total score of 5 or 4, which is considered a good evaluation. On the other hand, for the total of scores of 1 or 2, the highest percentage was 11 to 20 years, which was 12.95%.
Table 6. Results of the Overall Evaluation and the period of Canon customer

| Replacement=Yes | 5     | 4     | 3     | 2     | 1     |
|-----------------|-------|-------|-------|-------|-------|
| Less than 1 year| 75.00%| 11.25%| 7.50% | 2.50% | 3.75% |
| 1 to 5 years    | 78.63%| 13.74%| 3.05% | 0.00% | 4.58% |
| 6 to 10 years   | 73.91%| 16.15%| 2.48% | 1.24% | 6.21% |
| 11 to 20 years  | 68.35%| 12.23%| 6.47% | 7.19% | 5.76% |
| More than 20 years| 82.17%| 7.64% | 4.46% | 3.82% | 1.91% |
| No Value        | 33.33%| 0.00% | 33.33%| 0.00% | 33.33%|

Finally, we examined the price and Expertise Level of those who replaced the product. The results are shown in Table 7. We focused on the values that accounted for more than 10% of each Expertise Level. As a result, it was found that Professional or Expert and Advanced Amateur were replaced at the high-price range, while Hobbyist / Enthusiast and Casual User were replaced at the low-price range.

Table 7. Results of Price and Expertise Level

| Replacement = Yes | Professional or Expert | Advanced Amateur | Hobbyist/Enthusiast | Casual User |
|-------------------|------------------------|------------------|---------------------|-------------|
| 399.99            | 0.00%                  | 2.80%            | 5.79%               | 7.50%       |
| 549.99            | 1.34%                  | 6.64%            | 12.11%              | 35.00%      |
| 699.99            | 3.36%                  | 5.59%            | 12.63%              | 15.00%      |
| 799.99            | 4.03%                  | 9.44%            | 15.26%              | 20.00%      |
| 899.99            | 2.01%                  | 5.94%            | 10.53%              | 7.50%       |
| 1099              | 8.05%                  | 12.59%           | 7.89%               | 5.00%       |
| 1199              | 2.68%                  | 2.10%            | 2.11%               | 2.50%       |
| 1299              | 3.36%                  | 2.45%            | 0.00%               | 0.00%       |
| 1399              | 8.05%                  | 6.29%            | 6.84%               | 2.50%       |
| 1449              | 0.00%                  | 0.35%            | 0.53%               | 0.00%       |
| 1499              | 4.70%                  | 3.15%            | 1.58%               | 0.00%       |
| 1649              | 1.34%                  | 1.40%            | 1.05%               | 2.50%       |
| 1699              | 20.13%                 | 17.83%           | 12.11%              | 2.50%       |
| 1799              | 11.41%                 | 10.14%           | 7.37%               | 0.00%       |
| 2499              | 20.13%                 | 9.79%            | 3.68%               | 0.00%       |
| 2559              | 2.01%                  | 1.40%            | 0.00%               | 0.00%       |
| 5999              | 7.38%                  | 2.10%            | 0.53%               | 0.00%       |

From these results, the overall evaluation tends to be higher because users like and purchase the products. In addition, more than half of the users who wrote reviews did so within three months of purchasing the product. In terms of Expertise Level based on users’ self-assessment, amateurs are the most common. Users who are replacing their product account for just under 70% of the total. And when we checked the overall evaluation and Canon Customer history of the users who are replacing their products, we found that the users with the highest percentage of good evaluations have been Canon customers for 1 to 5 years. Next, we checked the price and Expertise Level of the replacement products of the users who are replacing their products and found a trend in the high-price range and the low-price range. On the other hand, when we checked the price and Expertise Level of the users, we found that the Expertise Level of Advanced Amateur and Hobbyist may be ambiguous because the users evaluate themselves.
4. Replacement Decisions using Text Mining

In order to learn what users know when they make a purchase, we performed text mining on word-of-mouth data. For text mining, KH Coder Version3.Beta.03a was used. For this study, we have registered 54 stop words and 10 pickup words.

4.1. Relationship between history of Canon Customer and positive keywords

From Table 6, it was found that the percentage of evaluations differed depending on the history of Canon Customer. Therefore, we compared words from 1 to 5 years, when the percentage of good evaluation was high, and words from 11 to 20 years, when the percentage of bad evaluations was high, among users who replaced their products. For these words, we focused on verbs, adjectives, and adverbs.

Table 8. Results of extracting the positive words from the top 30 words

| 1 to 5 years     | 11 to 20 years   |
|------------------|------------------|
| Great            | Great            |
| Love             | Good             |
| Amazing          | Better           |
| Recommend        | Love             |
| Good             | Best             |
| Best             | Easy             |
| Easy             |                  |
| Perfect          |                  |
| Nice             |                  |

Table 8 shows the results of extracting the positive words from each of the top 30 words. As a result, we found 9 words in 1 to 5 years, and 6 words in 11 to 20 years. Taken together with the results in Table 6, the comparison with Canon’s customer history shows that users who have been using the camera for 1 to 5 years use more positive words than users who have been using it for 11 to 20 years. The relationship between overall evaluation and word-of-mouth is relevant in Canon DSLR camera reviews.

4.2. Relationship between replacement and Customer Review

We conducted a correspondence analysis to understand relationship between replacement and customer reviews. When performing correspondence analysis, we extracted only verbs, adjectives, and adverbs in order to extract only words that express emotion. we performed two types of correspondence analysis. Fig. 2-a shows the results of the correspondence analysis between the overall evaluation and word-of-mouth, and Fig. 2-b shows the results of the correspondence analysis between the initial usage history of the product and word-of-mouth.
The results of Fig. 2-a show that there tends to be many positive words such as “Excellent”, “Amazing”, “Happy” and “Perfect” around the overall evaluation of 5. The results of Fig. 2-b show that the words “Replace” and “Learn” are around 1 to 3 months, indicating that users are replacing or learning. Table 1, 2 and these correspondence analysis results show that users use positive words when they have a high overall rating, and in terms of usage history, users who wrote reviews within 3 months are more likely to do so, while users who wrote reviews within 1 to 3 months are learning.

4.3. Relationship between Review and Expertise Level

We checked to see what level of people were reading the word-of-mouth. The first thing we did was to extract word rankings of up to 100 for both users who had replaced their products and those who had not. We used all the words in this extraction, not just verbs, adjectives, and adverbs. Table 9 shows the words included only in the list of users who replaced their products and the words included only in the list of users who did not replace their products.

| Replace = Yes | Replace = No |
|---------------|--------------|
| Upgrade       | Noise        |
| Rebel         | Capability   |
| Review        | Level        |
| Card          | Little       |
| Day           | Beginner     |
| Result        | Issue        |
| Upgrade       | Problem      |
| Sharp         | Professional |
| II            | Landscape    |
| L             | Range        |
| Option        |              |
What is characteristic of this result is the keyword “Review” included in only Yes. When we checked the content, we found that users were buying products after reading reviews. In order to find out the level of users who purchase products after reading reviews, we examined the Expertise Level of the data including “Review”. The results are shown in Table 10.

Table 10. Expertise Level results including “Review”

| Level                   | Count | Rate  |
|-------------------------|-------|-------|
| Professional or Expert  | 15    | 6.55% |
| Advanced Amateur        | 33    | 8.31% |
| Hobbyist / Enthusiast   | 10    | 3.52% |
| Casual User             | 1     | 1.25% |
| No Value                | 1     | 12.50%|

Table 10 shows that Professional or Expert and Advanced Amateur users are more likely than Hobbyist and Casual users to read reviews when purchasing a new product.

4.4. Comparison of high-price range and low-price range

From Table 7, we found that the expertise level of the users purchasing the products differed between the high-price range and the low-price range. Therefore, we categorized the products into the high-price range and the low-price range and extracted the words. Table 11 shows the results of extracting words that appear only in the high-price range or only in the low-price range among the top 50 words in each word ranking. We used all the words in this extraction, not just verbs, adjectives, and adverbs. And the high-price range will be cameras priced at $1,699 and above, and the low-price range will be cameras priced up to $1,099.

Table 11. Word Ranking for High-price range and Low-price range

| High-price range       | Low-price range |
|------------------------|-----------------|
| 6D Easy                | Easy            |
| ISO                    | Learn           |
| Need                   | Recommend       |
| Full frame             | First           |
| Point                  | Purchase        |
| Focus                  | DSLR            |
| Body                   | Rebel           |
| Focus                  | Amazing         |
| Picture quality        | Mode            |
| 7d mark II             | Best            |
| Many                   | Start           |
| Build                  | Setting         |
| GPS                    | Beginner        |
| High                   | Thing           |
| Sensor                 | Lot             |
| Button                 | Perfect         |
| price                  |                 |
These results show that in the high-price range, words about functions such as Full Frame, Picture Quality, GPS, and Sensor appeared. In the low-price range, words about usability and price appeared, such as Easy, Start, Setting and Price.

5. Conclusion

From this study, we have learned from our knowledge that there are several characteristics of users who replace their Canon DSLR cameras. From 3.2, we learned that the overall evaluation of users who write reviews is very high and that they tend to write reviews within three months of getting the product. And from Table 5, we found that 67.23% of the total users have replaced their products, and many users have replaced. From 4.1, we also found that users with shorter Canon customer history tended to write more positive keywords. From 4.2, we found that among the users who replaced their products, those with the highest overall rating of 5 wrote positive keywords in their reviews. In addition, we found that users who had purchased a product for one to three months wrote the keyword “Learn” in their word-of-mouth. This result indicates that users do not write reviews until they fully understand the product but write reviews while they are learning about the product. In 4.3, we found that users who belonged to the high Expertise level “Professional” and “Advanced Amateur” were more likely to read reviews before making a purchase.4.4 shows that there is a difference depending on the price of the product, with more reviews about functions in the high-price range, and more reviews about usability and price in the low-price range. These finding indicate that in order to get people to purchase new products or replace them in the future for Canon’s SLR cameras, it is necessary to change the approach at each level. Specifically, it was found that the approach needs to be changed for those who purchase high priced products at high expertise level and those who purchase low priced products at low expertise level.

We will container to study non-Canon DSLRs and other cameras to see how changing the approach is optimal for replacement.

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