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Binary Logistic Regression Analysis for Customers' Willingness to Clothing Rental

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Abstract

Nowadays, most research has focused on housing or car leasing, but only a few studies focus on leasing clothes. In fact, the consumer base for clothing rental has been formed and the clothing rental market has huge potential in the future. This article uses Company X as one of the new entrants in the clothing rental industry and uses factor analysis to classify element that affects clothing leasing. What's more, the impact of each element on consumers' willingness to rent clothing can be investigated through logistic regression. Based on the analysis, the study provides more cost-effective and efficient marketing strategies for Company X or the related clothing industry to apply. The analysis found that improving Company X rental clothing service, which includes the price of rental clothing and transportation services, can increase consumers' willingness to try the rental service. The secondary influencing factor is original product characteristic, which is positively correlated with consumer willingness. The least influential factor is product current condition, which contains product cleanness and quality, and these elements are negatively related to customers' willingness to try rental clothing. According to the findings, the paper offers three strategies to Company X, such as offering subscription service, increasing discounts, and selecting fast fashion brands with lower quality but more styles for rental. Eventually, the study hopes Company X can gain a higher market share in the emerging sector and increase consumer awareness of the clothing rental industry.

Keywords

Leasing Clothes; Clothing Rental Industry; Binary Logistic Regression.

1. Introduction

Company X is a clothing and home items retailer which is seeking for a new direction for its business. The sharing economy has been very popular in recent years, such as bike-sharing and car-sharing. However, these sharing industries have gradually hit a saturation point (Tu, 2018). Clothing rental as an innovative business model can not only extends the life of clothes, but also reduces material use and CO2 emissions (Chi-Ling, 2018). Survey conducted by Westfield Shopping Centre in London proposed that clothing rental would become a key future trend. Thus, clothing rental is expected to be the next hot spot in the sharing economy and Company X could consider this industry to grow its business in the future even though the company do not have experience in the sector. It is unsure that whether the clothing rental service will meet the needs of local consumers and how Company X can enter this new area more quickly.

Therefore, it is necessary to conduct a survey to check consumer intention before officially offering the service. Related questions in the questionnaire include basic consumer information and "Factors that are important for you to rent a clothing". Through factor analysis and logistics regression, specific questions can be addressed include: If Company X wants to offer clothing rental service, what key elements need to be focused on to attract consumers. In addition to

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this, the study can also explore different factors' impact on the probability of trying clothing rental.

The supply chain of the clothing rental industry can be roughly divided into 3 stages: selection and procurement, cleaning and repair, storage and transportation, etc. If Company X focus on all of them, there may be some problems such as inefficient use of funds. This study will classify element that affect clothing leasing and sort them in order of importance, so that can help Company X save costs and improve its market positioning by focusing on the factors that account for the largest share of inputs and outputs. Ultimately, recommendations will be given to help Company X make decisions on choosing the type of clothing to rent, the standard of cleaning, prices and shipping methods.

2. Methodology

2.1. Data Selection

The main objective of the study is to analyze the relationships between likelihood of renting clothes in the future and factors influencing clothing rental. Hence data should be selected according from two questions, “What factors are important for you to rent a clothing?” and “How likely are you to rent clothes in future?”

2.2. Data Preparation

Table 1. Asymmetry of probability distribution

Skewness	.385	.150
Kurtosis	-1.312	.298

Table 2. Table of Normality

Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
How likely are you to rent clothes in future?	.191	265	.000	.861	265	.000

a. Lilliefors Significance Correction

The data is fairly symmetrical (skewness 0.385< 1) and exhibits a small degree of kurtosis (-1.312<1). It proves that the quality of the data is high and the analysis is meaningful. Then, we need to exam data for multicollinearity to ensure that independent variables are not highly correlated.

Table 3. Table of Correlations

Correlations

		What factors are important for you to rent a clothing? - Regular sale price of the clothing	What factors are important for you to rent a clothing? - Rental price of the clothing	What factors are important for you to rent a clothing? - Quality of the clothing	What factors are important for you to rent a clothing? - Cleanness of the clothing	What factors are important for you to rent a clothing? - Characteristics of previous users of the clothing	What factors are important for you to rent a clothing? - Delivery and drop-off policy
What factors are important for you to rent a clothing? - Regular sale price of the clothing	Pearson Correlation	1	.570**	.554**	.500**	.568**	.531**
	Sig. (2-tailed)		.000	.000	.000	.000	.000
	N	265	265	265	265	265	265
What factors are important for you to rent a clothing? - Rental price of the clothing	Pearson Correlation	.570**	1	.607**	.573**	.413**	.635**
	Sig. (2-tailed)	.000		.000	.000	.000	.000
	N	265	265	265	265	265	265
What factors are important for you to rent a clothing? - Quality of the clothing	Pearson Correlation	.554**	.607**	1	.727**	.438**	.611**
	Sig. (2-tailed)	.000	.000		.000	.000	.000
	N	265	265	265	265	265	265
What factors are important for you to rent a clothing? - Cleanness of the clothing	Pearson Correlation	.500**	.573**	.727**	1	.391**	.595**
	Sig. (2-tailed)	.000	.000	.000		.000	.000
	N	265	265	265	265	265	265
What factors are important for you to rent a clothing? - Characteristics of previous users of the clothing	Pearson Correlation	.568**	.413**	.438**	.391**	1	.518**
	Sig. (2-tailed)	.000	.000	.000	.000		.000
	N	265	265	265	265	265	265
What factors are important for you to rent a clothing? - Delivery and drop-off policy	Pearson Correlation	.531**	.635**	.611**	.595**	.518**	1
	Sig. (2-tailed)	.000	.000	.000	.000	.000	
	N	265	265	265	265	265	265

**. Correlation is significant at the 0.01 level (2-tailed).

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According to the chart, most Pearson Correlations are above 0.5, which indicate excessive correlation between elements. Therefore, use KMO and Bartlett tests to determine whether it is possible to use factor analysis to reduce dimensionality.

Table 4. KMO and Bartlett's test

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.862
Bartlett's Test of Sphericity	Approx. Chi-Square	783.686
	df	15
	Sig.	.000

The KMO Measure of Adequacy (MSA) is 0.862 and the test is significant ($p<0.05$), indicating sufficient correlation to run the factor analysis.

What's more, in order to predict the probability of consumers' willingness to rent clothing depending on several independent variables, logistic regression methods are needed for analysis. However, independent variable needs to be continuous or categorical, and dependent variable should be binary or dummy-coded. In the case, both independent variables and dependent variables are continuous. So that we need to recode 7-point rating scales into binary dummy variables before running logistic regression analysis.

Recoded original "no likely rent clothes" into "0", and "likely rent clothes" recoded into "1". Eventually, the dependent variables have been transformed into binary variables.

Table 5. Dependent variable encoding

Dependent Variable Encoding

Original Value	Internal Value
no likely	0
likely	1

3. Analytic Procedures

Firstly, a factor analysis is required. Not only to identify the minimum number of factors that can lead to the correlation between a given set of rental clothing variables so that Company X can improve investment, but also reduce the correlation between elements and make preparations for logistic regression analysis (Sze, 2014).

The first step in running factor analysis is to determine the number of factors. There are four different methods, including priori determination, eigenvalue, scree plot, and percentage of variance. Considering each method has its shortcomings, we may choose both eigenvalue and screen plot methods to decide how many factors should be extracted. Then, use Rotated Component Matrix to help judge the interpretability of the given solution. Finally, it is important to examine the communalities table to judge the quality of the solution and find umbrella term for each factor.

Next, an analysis of binary logistic regression is needed. R square value in module summary table can show the percentage of the variation in the dependent variable that is explained by the independent variables. According to the classification model, observed respondents who really want to rent clothes can be compared with someone who predicted by the model. Also, a coefficient table can show the significance level of each of the independent variables as well as their coefficient in the regression equation. The level of significance is usually defined as 1%,

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5%, or 10% depending on the need of the study. Finally, use ROC curve to examine diagnostic ability of the binary classifier (Yang, 2018).

4. Data Display

4.1. Qualitative Variables

For categorical variables, we can use the summary table as well as pie Chart or bar chart to analyze. Pie Chart is a circular representation used if the variable is categorical and has limited number of categories. For example, when analyzing the likelihood of renting clothes, factors can be summarized and displayed using tables and graphs. A pie chart can be used to indicate the percentage of customers that whether there is any possibility for them rent clothes in future or not.

Bar Chart is a column representation of a variable. The height of the bars represents the percentage of the category. For example, through bar chart, the coefficient of Exp(B) in the coefficient table can be effectively visualized to show how much odds will change for every unit of independent change, and more intuitively indicating which part of influential factors has the highest return on investment.

What's more, through the simple conceptual model, it is more intuitive to show the logical order of the independent variables and dependent variable.

4.2. Quantitative Variables

Scatterplot can be used to study the relationship between any two numerical variables so that we can check linear or non-linear relationship.

5. Results

5.1. Descriptive Statistics Analysis

Table 6. Demographic Data

	Most	Least
Gender	Male(57.4%)	Female(42.6%)
Age	25-34(58.1%)	65-74(0.4%)
Place of living	Urban(47.9%)	Rural(14.3%)
Education rate	College graduates(60%)	Postgraduate(16.6%)
Ethnity rate	Caucasian(48.3%)	Other(1.9%)
Marital status	Married(58.5%)	Separated(0.8)
willingness to rent clothes	Neither likely nore unlikely(8.3%)	Extremely unlikely(32.1%)

According to the data display for demographic variables, the gender selection in sample was almost the same with 57.4% for male and 42.6% for female. Those participants were generally 25-34 years old, about 47.9% of the urban population, and had high level of education.

Table 7. Clothing Rental Experience

Some companies have now provided clothing rental service. Have you rent (as opposed to purchase) any clothing before?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	64	24.2	24.2	24.2
	No	201	75.8	75.8	100.0
	Total	265	100.0	100.0	

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Among the 265 respondents, 65 have tried clothing rental services, but 201 (75.8%) have never rented other people's clothing, which proves that the clothing rental industry is not popular in the current market.

Table 8. Clothing Rental Possibility

How likely are you to rent clothes in future?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Extremely unlikely	85	32.1	32.1	32.1
	Moderately unlikely	38	14.3	14.3	46.4
	Slightly unlikely	30	11.3	11.3	57.7
	Neither likely nor unlikely	22	8.3	8.3	66.0
	Slightly likely	33	12.5	12.5	78.5
	Moderately likely	34	12.8	12.8	91.3
	Extremely likely	23	8.7	8.7	100.0
	Total	265	100.0	100.0	

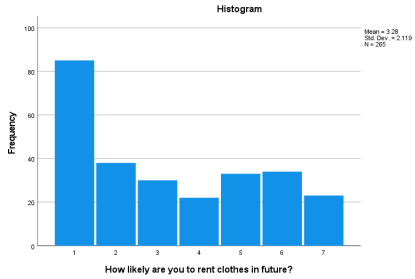

Figure 1. Histogram for Rental Possibility

In terms of the dependent variable, Fig. 7 shows that consumers who extremely unlikely to try clothing rental service account for the majority, so that most consumers are not willing to try to share clothes. In addition, we can also see that the total proportion of unlikely renting clothes is 57.7%, the proportion of likely is 34%, and the proportion of people who maintain a neutral attitude is 8.3%, which proves that there are still some customers who want to try. Hence, this rental clothing sector may get some space for sustainable development in the future.

5.2. Marketing Data Analysis

After data preparation and display, the analysis part is ready to be done. In the paper, we first use factor analysis to classify the factors that affect customers' intention to rent clothes.

First, the number of factors needs to be determined. Extracting too many factors may produce error variances, while extracting too few factors may lose valuable common variances. Therefore, appropriate criteria need to be chosen.

Table 9. Total variance explained table

Total Variance Explained

	Initial Eigenvalues			Extraction Sums of Squared Loadings		
Component	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	3.756	62.602	62.602	3.756	62.602	62.602
2	.738	12.297	74.899			
3	.476	7.925	82.824			
4	.448	7.470	90.293			
5	.315	5.247	95.540			
6	.268	4.460	100.000			

Extraction Method: Principal Component Analysis.

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According to the Total Variance Explained table, just 1 factor could be potentially extracted and this factor explained 62.6% of the original information. That may be unreasonable. Through the screen plot, we decide to choose 2-factor or 3-factor analysis. It is necessary to examine both 2 and 3-factor solution to decide which is more suitable.

Table 10. Two-Factor Solution

Rotated Component Matrix[a]

	Component 1	Component 2
What factors are important for you to rent a clothing? - Cleanness of the clothing	.869	
What factors are important for you to rent a clothing? - Quality of the clothing	.844	.265
What factors are important for you to rent a clothing? - Rental price of the clothing	.739	.354
What factors are important for you to rent a clothing? - Delivery and drop-off policy	.685	.460
What factors are important for you to rent a clothing? - Characteristics of previous users of the clothing		.913
What factors are important for you to rent a clothing? - Regular sale price of the clothing	.446	.714

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.[a]

a. Rotation converged in 3 iterations.

Table 11. Three-Factor Solution

Rotated Component Matrix[a]

	Component 1	Component 2	Component 3
What factors are important for you to rent a clothing? - Cleanness of the clothing	.881	.269	
What factors are important for you to rent a clothing? - Quality of the clothing	.813	.337	.251
What factors are important for you to rent a clothing? - Rental price of the clothing	.330	.876	
What factors are important for you to rent a clothing? - Delivery and drop-off policy	.464	.598	.355
What factors are important for you to rent a clothing? - Characteristics of previous users of the clothing	.209		.926
What factors are important for you to rent a clothing? - Regular sale price of the clothing	.242	.537	.617

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.[a]

a. Rotation converged in 5 iterations.

Through comparison, we check high cross-loading (>0.4) and low absolute factor loading (<0.5), and finally found that both factor solutions meet the requirements and there are no problematic items. At the same time, when looking for umbrella term for each factor, we found 3 -factor categorizes the elements more complete in this case, so that this solution makes more sense.

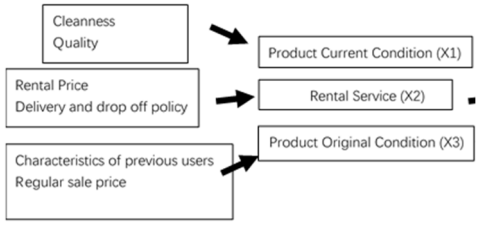

Figure 2. Clothing Rental components in Company X

The first component is measured by “Quality of the clothing” and “Cleanness of the clothing”. These are descriptions of the current status of the rental clothing products, so interpret component 1 as “Product current condition”.

The second component is measured by “Rental price of the clothing” and “Delivery and drop-off policy”, which all describe about the value Company X can add to the product, so we interpret component 2 as “Company X Rental Service”.

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The third component is measured by "Regular sale price of the clothing" and "Characteristics of previous users of the clothing", these variables all relate to the original information of the product, so interpret component 1 as "Product original condition". After that, communalities table need to be checked.

Table 12. Table of Communalities

Communalities

	Initial	Extraction
What factors are important for you to rent a clothing? - Regular sale price of the clothing	1.000	.728
What factors are important for you to rent a clothing? - Rental price of the clothing	1.000	.902
What factors are important for you to rent a clothing? - Quality of the clothing	1.000	.837
What factors are important for you to rent a clothing? - Cleanness of the clothing	1.000	.881
What factors are important for you to rent a clothing? - Characteristics of previous users of the clothing	1.000	.922
What factors are important for you to rent a clothing? - Delivery and drop-off policy	1.000	.698

Extraction Method: Principal Component Analysis.

The communalities above 0.5 is acceptable, so that the solution has a good fit and we do not remove any item. These three factors explained more than 82% of variance in our dataset, which is much better than 2-factor solution (74%).

Table 13. Total Variance Explained

Total Variance Explained

	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
Component	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	3.756	62.602	62.602	3.756	62.602	62.602	1.864	31.067	31.067
2	.738	12.297	74.899	.738	12.297	74.899	1.621	27.011	58.078
3	.476	7.925	82.824	.476	7.925	82.824	1.485	24.746	82.824
4	.448	7.470	90.293						
5	.315	5.247	95.540						
6	.268	4.460	100.000						

Extraction Method: Principal Component Analysis.

So far, the inductive analysis of the data elements has been completed, the next step is to explore different factors impact on the probability of trying clothing rental. Regression tends to estimate the relationships between a dependent variable and independent variables. There are two types of predictive model, estimation model and classification models. Linear regression is an estimation model and uses equations to show parameters' relationships (Heeringa et al., 2010). Logistic regression is one of a classification models to explain how variables contributes to outcomes. Comparing the two models, logistic regression is more in line with the needs of

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case research problems. The minimum sample size of the model is 25 * 3 = 75, which can meet the requirements for logistic regression.

Graphically, the simple conceptual model is as follows:

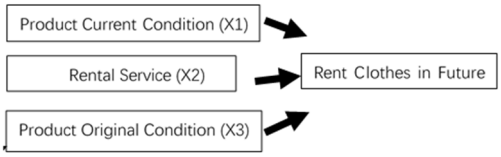

Figure 3. Conceptual Model

Formally, the logistic regression function would like this:

Log(p/(1-p)) = a+b1*Product Current Condition +b2*Company X Rental Service + b3 * Product Original Condition.

According to the Block 1: Method" Enter" output section, the whole logistic regression model can be evaluated.

Table 14. Model Summary

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	306.449[a]	.118	.163

a. Estimation terminated at iteration number 4 because parameter estimates changed by less than .001.

In the case, three independent variables account for 16.3% of the variance of the dependent variable "likely to rent clothes", which shows the good model fit of the model.

Table 15. Classification table

Classification Table[a]

			Predicted		
			Dummy_intention		Percentage Correct
	Observed		0	1	
Step 1	Dummy_intention	0	146	29	83.4
		1	60	30	33.3
	Overall Percentage				66.4

a. The cut value is .500

From the classification table, the model correctly predicts 146 out of 275 customers (83.4% of) customers who are unlikely to rent clothes. However, it may do not do well in predicting whether customers will try to rent clothes and the correct classification score is only 33.3%. In all, the overall accuracy of this logistic model (66.4%) is better than the random model which may only predict 50% of the cases.

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Table 16. Variables in the Equation table

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1[a]	REGR factor 1_product	-.272	.153	3.149	1	.076	.762
	REGR factor score 2 _Luna7	.608	.165	13.585	1	.000	1.837
	REGR factor score 3_clothing origianl condition	.573	.148	14.899	1	.000	1.774
	Constant	-.788	.145	29.486	1	.000	.455

a. Variable(s) entered on step 1: REGR factor 1_product , REGR factor score 2 _Luna7, REGR factor score 3_clothing origianl condition.

From the Variables in the Equation table, we know the values for the logistic regression. The first column labelled "B" shows that an increase by one unit in clothing current condition will make customers less likely to rent clothes. What's more, an increase by one unit in Company X rental service and clothing original condition will both make customers more likely to rent clothes.

According to the "Sig", both Company X rental service and clothing original condition are less than 0.05, so that these two factors are significant at the 5% level. Even though the significance of Product current condition is 0.076 (>0.05), it still significant at 10% level. In conclusion, Company X rental service and product original condition have significant positive impact in determining whether a customer will rent clothes, while product original condition may have little negative impact.

The sixth column Exp(B) indicates that how much odds will change for every unit of independent change. Thus, increasing Company X rental service by one unit, will make rent clothes 1.84 times more likely. An increase in clothing original condition by one unit will lead to 77.4% higher possibility of renting clothes, while an increase in clothing current condition by one unit will lead to 23.8% lower possibility of renting clothes.

Finally, we could use the Receiver Operating Characteristic (ROC) Curve to evaluate the performance of the model.

Table 17. Case Processing Summary

Case Processing Summary

Dummy_intention	Valid N (listwise)
Positive[a]	90
Negative	175

Larger values of the test result variable(s) indicate stronger evidence for a positive actual state.

a. The positive actual state is 1.

Table 18. Area Under the Curve

Area Under the Curve

Test Result Variable(s):

Area
.708

The test result variable(s): Predicted probability has at least one tie between the positive actual state group and the negative actual state group. Statistics may be biased.

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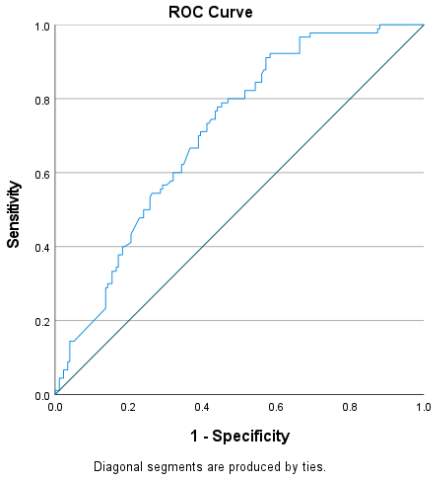

Figure 4. ROC Curve

The results show that 90 cases were classified as positive and 175 as negative. From the ROC curve, the area under the curve (AUC) is reported as 0.708 (>0.7), which can be evaluated as fair. Thus, the model will be considered as a fair predictor of whether customers will rent clothes, and the overall predictive accuracy of the model is better than a chance model.

6. Limitations

Even though logistic regression can not only classify factors, but also gives probabilities, it is tough to obtain complex relationships, such as how many respondents will change their opinions if Company X spend more on one of the factors (Jan Manďák, 2019).

7. Recommendations

Firstly, sort the elements from more important to less important which is obtained by logistic regression analysis. Company X can improve some factors with the highest ROI and then improve those with the lowest ROI (Xu, 2018).

Improving the Company X rental clothing service can increase consumers' willingness to try the service to a greater extent. This factor mainly includes improving the price of rental clothing and transportation services. Accordingly, Company X can run a subscription service, charging a fixed monthly fee and sending a certain number of products to users every month. The monthly rental fee can be divided into different levels, such as £69 per month for 2 items, or £99 per month for 4 items. The customers can change the goods at will every month and the transportation fee is exempted. Through this subscription method, consumers can use limited money to try different types of clothing and promote the Company X clothing brand. This method both takes rental service prices and transportation into consideration, so that increases user stickiness.

In addition, it can be seen that the original product characteristics of the product also have a great influence on whether consumers are willing to try. Therefore, it is suggested that Company X can deliberately increase the original price of the rented clothes, and then use eye-catching colors to highlight the current prices to attract more consumers' attention and increase consumers' willingness to rent clothes.

Although the impact is not as good as improving the Company X service and original product features, product current condition still can be served as a promotion for Company X. An appropriate selection of lower-quality clothing for renting would be more attractive for consumers to try. As the target audience is generally younger women, they tend to be more

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interested in the style of the clothing and are not overly concerned with whether the clothing is durable or high-end (Tanya Krishna, 2017). As a result, Company X needs to offer more fast fashion brands with new styles and low-quality clothing for rental.5.2 Action Plan.

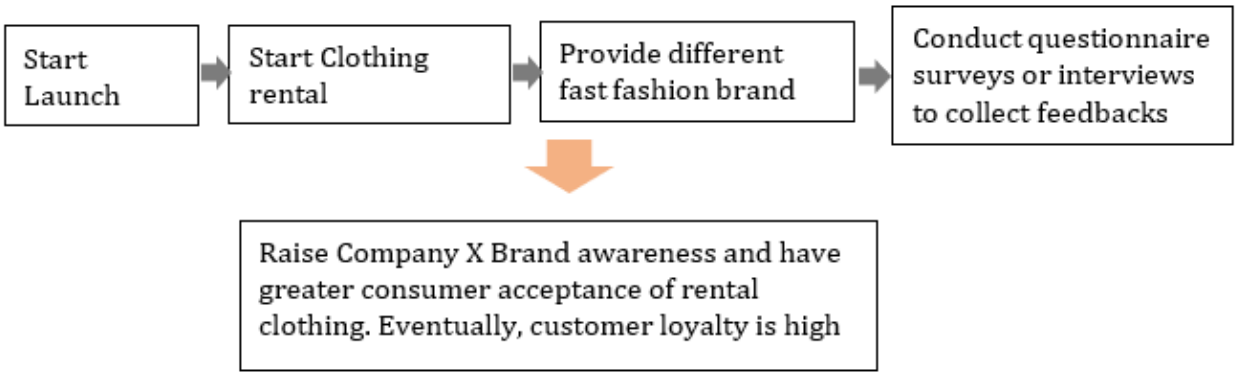

Figure 5. Framework of Recommendations

8. Measurement and Monitoring

Company X can use the key performance indicators (KPIs) to measure the effectiveness of Company X new marketing strategies (Francella, 2015). The possible metrics are as follows:

Table 19. Key Performance Indicators

	Stimulating Demand **REACH** Brand awareness	In Market **ACT** Consideration Stage	In Process **CONVERT** Decision Stage	Returning Customers **ENGAGE** Loyalty
Possible Metrics	• Website traffic, page views, • Video views	• Social media comments, likes, shares, inbound links	• Online sales, • Offline sales	• Percentage of content consumed by existing customers • Retention /Renewal rate

In the reach stage, KPIs can show the status of current and potential customers. In the act stage, comments and social media shares can show whether audiences are interacting with Company X. In addition, actual sales in convert stage shows that how much Company X earn after applying marketing activities. Eventually, the company can check customers loyalty through retention/ renewal rate.

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