



## Review Article

# Designing push notifications based on customer segmentation using the RFM technique

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## ABSTRACT

The dramatic growth of e-commerce has pushed retailers to find new marketing channels in order to attract customer's attention. Push notification, especially the ones from an application (app), facilitates the communication between retailers and customers because of its ease of use. Several studies have reported push notifications efficiency to nudge customers to make an online purchase, and the parameters of its design that affect a customer's perception about its purchasing behavior. This study focuses on how to deploy more effective direct marketing campaigns via push notifications based on the customer purchasing behavior. For this study, the big Turkish retail company's app users who received push notifications in a specific time period were taken into consideration. RFM Model was used with Python programming for the segmentation, then what kind of app push notifications can be sent to those segments were designed.

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## INTRODUCTION

In a competitive marketing environment, retailers and marketers have been trying to communicate with customers from different kind of channels, aiming to reach them anywhere and anytime. Therefore, mobile direct marketing is in marketers' focus of interest, and push notifications have been prominent with its ease of use. Push notifications are powerful tool for the branded apps to draw attention for promotional campaigns of the respective brands. Designing this mobile direct marketing (MDM) channel properly based on the segmentation of customers purchasing behavior requires will allow branded app owners to deliver more effective MDM campaigns to increase sales performance. The designing process requires strategically structured push notification sending plan.

There are several studies about effectiveness of push notifications and how they can be personalized for users. Viderisa, Santoso and Isal (2019) conducted research to find key factors that determine user's desires to open push notification and to improve user's experiences when receiving push notifications [1]. Surveys and contextual interviews were made, and User-Centered Design and a mixed-method approach were used. One of the studies was made by Kim et al. (2020), which resulted the importance of push notification [2]. The findings indicated that push notifications were useful for motivating people to take action in an intended way and personalization of the push notifications could increase the impact created on the users. While the use of mobile in marketing practice is growing dramatically and mobile apps play a central and critical role in stimulating purchases, the literature is limited and is evolving

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gradually [3,4]. This limitation on the literature is also seen on the branded apps and push notifications subjects on the topic about their uniqueness, and persuasive impact as a marketing channel [5].

In this study, it is aimed to make segmentation based on customers' prior purchasing behaviors and identify how app push notifications can be designed based on this segmentation. One of the known branded-app, which has been owned by a big Turkish retail company, was in focus, and the users who received notifications in a specific time period were taken into consideration and segmented. RFM technique, a powerful method, was applied with Python programming to identify groups of customers based on recency, frequency and monetary parameters for special treatment. The average purchase amount per cart had also been analyzed to search whether a customer tends to buy less frequently if it has a big amount of spending per cart, and some examples of push notification design had been presented.

## LITERATURE REVIEW

The number of mobile users has been growing rapidly. According to Global System for Mobile Communications' report for 2021, also known as The GSM Association, with an expected average annual growth rate of 1.8% between 2020 and 2025 will bring the percentage of mobile subscribers from 67% to 70% of the population. Regarding the mobile internet usage, according to the GSMA (2021), with an expected average annual growth rate of 4.3% between 2020-2025 will bring the percentage of mobile subscribers from 51% to 60% of the population. The increasing number of mobile internet users have accelerated to the increase of mobile adaption. This situation is valid for Turkey as well. According to Turkey Statistical Institute (2021), there are 99 people out of 100 who use mobile phone in the last three months, and the usage of the internet has increased from 71% to 81% of the total population for the last four years. This growth also reflects on the numbers of mobile apps, that is a software downloadable to a device, which are becoming ubiquitous on all mobile operating systems and encourage users to spend an increasing amount of time on their phones [6]. According to Statista (2022), the number of annual mobile app downloads has been growing worldwide from 2016 to 2021 and it was 230 billion in 2021. All these indicators of growth in markets for mobile devices and apps enabled an increasing importance in the business landscape of mobile marketing, the set of marketing initiatives that use mobile devices as the vehicles of communication [7].

Marketers began to create so-called branded apps, apps that display a brand identity in the name of the app and the appearance of a brand logo or icon, to increase the attention of users toward the sponsoring brand [5, 8]. Nowadays, the MDM allows retailers to reach potential and current

customers with meaningful and relevant messages anytime and anywhere, through asynchronous interactions with mobile devices through several different channels, including email, SMS or mobile apps push notifications. Companies have been trying to leverage their results and have durable communication with their customers by creating new marketing campaigns on these channels. Among the MDM channels mentioned above, mobile push notification is one of the rising trend parallel to the increasing number of branded apps. These notifications are basically defined as short messages invoked by mobile apps that show up on the device's home or lock screen. They alert users and may lead them directly to the landing page of the app after a tap on the message. Push notifications enable marketers to directly interact with their customers [9], to drive specific behaviors on customers in the short-term [10].

According to the study made by Viderisa, Santoso and Isal (2019), contents of the push notifications, time and frequency of receipt are the key determining factors for user's desires to open push notification and to improve user's experiences when receiving push notifications [1]. Based on the results, a prototype had been designed in a high-fidelity form and was subsequently evaluated using the Usability Testing method. The evaluation showed that the task success rate of the prototype is 88.3 percent. Kim et al. (2020) presented the importance of push notifications by using them to reveal the effectiveness of energy efficiency in the residential sector [2]. The findings indicated that the energy efficiency advice sent via push notifications reduced electricity consumption by 1.3%, which was statistically significant. Furthermore, the opening ratio of push notifications had improved 1.2 and 1.3 times, with personalized sentences and timing of the push notifications, respectively.

According to O'Brien et al. (2022), most recommender systems are myopic, that is they optimize based on the immediate response of the user [11]. The authors point out that myopic systems can be misaligned with the true objective in terms of creating long term user satisfaction. In their study, mobile push notifications, where the long-term effects of recommender system decisions can be particularly strong, are focused. For example, sending too many or irrelevant notifications may annoy a user and cause them to disable notifications. However, a myopic system will always choose to send a notification since negative effects occur in the future. This is typically mitigated using heuristics. However, heuristics can be hard to reason about or improve, require retuning each time the system is changed, and may be suboptimal. To counter these drawbacks, they describe a method for maximizing long-term value (LTV) by using model-based reinforcement learning (RL) to make decisions about whether to send push notifications. They model the effects of sending a notification on the user's future behavior. They indicate that by optimizing decisions about push notifications they are able to send less notificati-

ons and obtain a higher open rate than the baseline system, while generating the same level of user engagement on the platform as the existing, heuristic-based, system.

The analysis of customer data to extract value for both businesses and customers matters in today's competitive e-commerce environment. In this context, grouping customers with similar attributes, also known as customer segmentation, is a useful way which allows marketers to designate better-tailored marketing strategies. There are variety of approaches for customer segmentation but the ones which are easy to adapt are favored in this fast changing world.

Table 1 summarizes some of the techniques applied for customer segmentation in the literature over the past decade. As can be seen from the Table 1, RFM technique is a well-known and frequently used customer segmentation tool in literature. RFM analysis groups customers based on the three parameters as called recency, frequency, and monetary. This technique is easy to implement and it can be used with other clustering tools as well as by itself for segmentation. For example, the studies of Coussement, Bossche and Bock (2014) and Dursun and Caber (2016) show that customers who purchased recently, frequently, and spent large amounts of money are more likely to respond to direct mailings, and therefore, represent more attractive prospects for future marketing campaigns [12, 13]. Cho and Moon (2013) proposed a customized recommendation system using weighted frequent pattern mining. Customer profiling is performed to find the potential customers using the RFM model [14].

Sheshasaayee and Logeshwari (2017) designed a new integrated approach by segmentation with the RFM and LTV (Life Time Value) methods [15]. They used a two-phase approach with the first phase being the statistical approach and the second phase is to perform clustering. They aim to perform K-means clustering after the two-phase model and then use a neural network to enhance their segmentation. Some might think that the RFM Technique is not descriptive enough. Therefore, they prefer to apply a clustering method along with the RFM Model. For example, in the study made for Digikala Online Retail Company in 2018, R+FM model is used, containing a dynamic RFM Model and K-Means. An SMS campaign was run after creating

segments and preparing appropriate strategic approaches to them. As a result of this study, it is shown that the effectiveness of campaign can be improved with this segmentation model.

In our study, it is aimed to make segmentation via RFM technique by considering customers' prior purchasing behaviors and to identify how app push notifications can be designed by using the characteristics of customer segments. Therefore, this study intends to contribute by increasing the literature on these topics.

## METHODOLOGY

In this study, segmentation was made for the big Turkish retail company's app users based on RFM Model variables; recency, frequency and monetary. It was aimed to analyze its customers' prior purchasing behaviors and make segmentation, then identify how app push notification can be structured according to these segments to increase the positive influence of push notifications on their purchase behavior for online shopping. For this study quantitative dataset was used. This dataset consists of the customer IDs who received push notifications over its mobile application between 1<sup>st</sup> of Jan and 1<sup>st</sup> of May in 2022 as well as the number of days took from each customer's last purchase until 1<sup>st</sup> of May, the total number of purchases made, and the total amount of money spent in these four months. The data were taken directly from the data repository which is already exists, with SQL, therefore they are called secondary and non-probability sampling. Also, since there is a time window, this study is cross-sectional.

This research has descriptive feature as needed for the nature of RFM technique and since prior dataset without controlling any variable was used. 387,367 customer IDs were collected between 1<sup>st</sup> of Jan and 1<sup>st</sup> of May and segmented into eight groups in this study. Recency, frequency, monetary scores, also known as RFM, was used for segmenting the customers. RFM Analysis Table shown in Figure 1 was used for the scoring. Python programming language was used in order to apply RFM technique to increase reliability and speed of this analysis.

**Table 1.** Techniques Applied for Customer Segmentation

Authors	Year of Publication	Used Technique(s)
Namvar, Khakabimamaghani, Gholamian [16]	2011	RFM, Demographic Features, and LTV method
Cho and Moon [14]	2013	RFM analysis
Coussement, Bossche, & Bock [12]	2014	RFM analysis, logistic regression and decision trees
Cho, Kim, Moon, Park & Ryu [17]	2015	FRAT (Frequency, Recency, Amount and Type of merchandise or service) analysis
Dursun & Caber [13]	2016	RFM analysis
Sheshasaayee and Logeshwari [15]	2017	RFM analysis and LTV method
Christy, Umamakeswari, Priyatharsini & Neyaa [18]	2021	RFM analysis, K-means and Fuzzy C-Means algorithms



Figure 1. RFM Analysis Table.

**RFM Analysis**

To start the analysis, the recency values of each customer were calculated by subtracting the last transaction date from 1<sup>st</sup> of May. Thereafter, each customer was scored for their recency, frequency, and monetary values. These three scores were written side by side to find the RFM score, and then all customers were assigned into a segment. Eight groups were obtained in total. However, ten segments are shown in Figure 1, therefore it can be concluded that there were no “New Customers” nor “Promising” group members among the push notification receivers for this company. The summary table consisting of average and maximum recency, frequency and monetary values of each segment is presented in Table 2.

According to the analysis made, the most of the push notification receivers, which is about 29% of the total population, have “Hibernating” segment characteristics, while just 4% of the customers represent “Can’t Loose” segment. “Hibernating” customers have low scores for recency, frequency, and monetary values, therefore having the big size of “Hibernating” segment does not draw a good picture for the company. However luckily “Loyal”, “Champions”, and “Potential Loyalists” segments comes after “Hibernating” segment respectively in terms of their sizes. They are desirable segments for the company. The details of how many customers in each segment is shared in Figure 2.

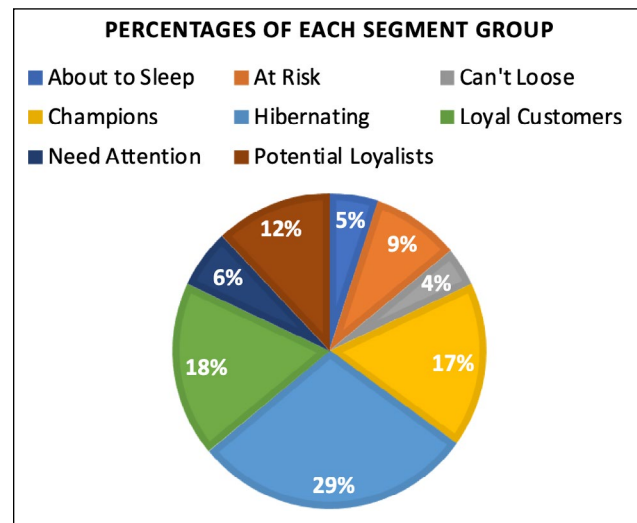


Figure 2. The Segments’ Sizes.

Apart from the recency, frequency, and monetary values, it is need to consider how much money a customer spends per shopping to have better insights about customer spending habits, and make an effective decision.

In order to investigate whether a customer tends to buy less frequently because of making a big purchase once in a while, the plots of the Average Frequency Values and the Average Values per Cart are presented in Figure 3 and Figure 4. As it is seen in the figures, the segments who make purchases frequently have lower amount of per cart values. This supports the idea that evaluating customers based on just frequency is not enough.

After the groups of customers were established, various strategies for designing of push notifications are listed below based on the groups’ characteristics:

**Hibernating:** They have dramatically low frequency value, so a push notification emphasizing that it has been a while since they have not made a purchase can be sent. The items that they purchased in their last transaction and the similar ones can be offered in that push notification. Also, free shipping offers requiring a less amount of pur-

Table 2. Average Recency, Frequency and Monetary Values for the Segments

Segment	Count	Recency		Frequency		Monetary	
		Mean	Max.	Mean	Max.	Mean	Max.
About to Sleep	21178	31.37	42	1.02	2	284.44	49950.0
At Risk	35686	58.96	119	3.41	7	853.73	21401.97
Can't Loose	1764	57.87	116	12.45	201	2996.91	59983.5
Champions	66850	2.52	6	13.56	278	3791.43	124762.55
Hibernating	115479	79.38	120	1.21	2	282.41	12584.69
Loyal Customers	73315	18.55	42	7.98	226	2237.88	179254.87
Need Attention	26473	30.64	42	2.44	3	671.01	30485.0
Potential Loyalists	46622	9.55	19	1.86	3	495.87	33717.0

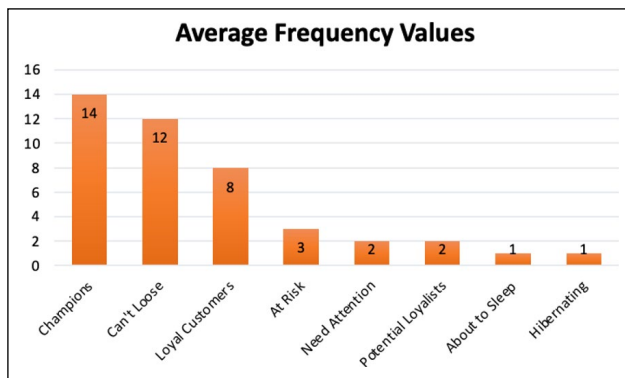


Figure 3. Average Frequency Values of Each Segment.

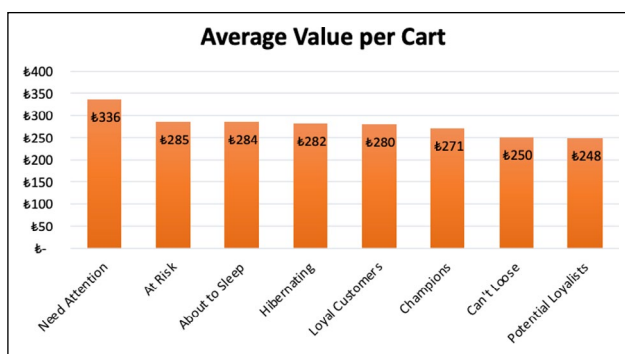


Figure 4. Average Value per Cart.

chase amount can be another solution to attract them for another shopping.

**Loyal Customers:** They visit the company's app regularly, therefore preserving their relationship with the app is the key. The company should try to make them even more satisfied, and use personalized communication in push notifications. Fewer products but the ones that they are interested in should be proposed. The customers should be encouraged to share their feedbacks as they are relatively likely to do so after being asked. A push notification which directs to a short survey in the app when it is clicked, can be sent to get their opinions about what kind of campaigns they would be interested in.

**Champions:** They have high scores for all the RFM parameters, so they deserve to be treated special, which means that something extra what the other customers do not get, can be offered to them. For example, limited series of products or special discounts to make them feel valued can be offered. If some brands want to introduce their new products via the company's app platform, a push notification informing "Champions" about this new release can be sent to them first. Similar with the "Loyal Customers", personalized communication should be used, and their feedbacks should be asked. Champions can be ambassadors for the company, therefore it should motivate them to share good experiences about the products or services via word to mouth marketing with other people.

**Potential Loyalists:** They have potential to be "Loyalists", in fact their recency scores are better than "Loyalists", but the other two RFM parameters should be improved. Their recency value is pretty low which is 10, therefore they can be called as the recent customers. Up-selling strategy can be used in a push notification to increase their monetary values. Offering personalized recommendations and designing a push notification that introduces the company's loyalty program help keeping them engaged in the app. Motivating them to increase the number of items in their cart by showing them cross-selling recommendations can be a good strategy.

**At Risk:** Their average spending per shopping is good enough that cannot be ignored. They are needed to be motivated to purchase more frequently with offering products based on their prior purchasing behaviors, and time-limited campaigns can be useful to nudge them.

**Need Attention:** The company needs to give a reason to those customers to choose its products or services over its competitors, because currently they are probably considering from whom should they buy a product next. Time-limited promotional campaigns can be sent to those customers with showing countdown in the heading of a push notification. Product recommendations based on the added products to their cart or their prior purchases can be made with personalized push notification. The company should show to this segment all the important advantages of choosing its app. When a campaign happens special for the company, this segment should get the priority. The company should inform them via app push notification by emphasizing that this campaign is unique for the company's customers.

**About to Sleep:** Offering discounts and personalized app push notifications may lead them to make another purchase and revive their interest.

**Can't Loose:** While they continue to buy products from this company, they also have a tendency to purchase from its competitors. Discounts and gift campaigns can be prepared for them. The campaign should involve recommendations based on their previous activity, consisting of both items purchased and items viewed. There is a high probability to get high return from the company's investing in them. The company should approach them with the new and popular products they had been previously interested in. Often these customers have some negative experience based on which they stop buying from the company. Therefore, the company should observe their purchasing behavior closely and prepare tailored push notifications based on their feedbacks. The company can collect their opinions by the app and, give them a gift if they respond.

### Push Notification Designs

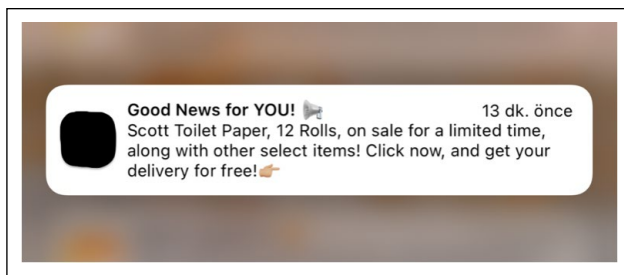
Designing tailored push notifications for each segment might be costly for the company, therefore it can be good to focus on the big segments at first. In this case, they are "Hi-

berinating”, “Loyal”, “Champions”, “Potential Loyalists”, and “At Risk”. A few examples of push notification designs that can be sent to these segments are presented below.

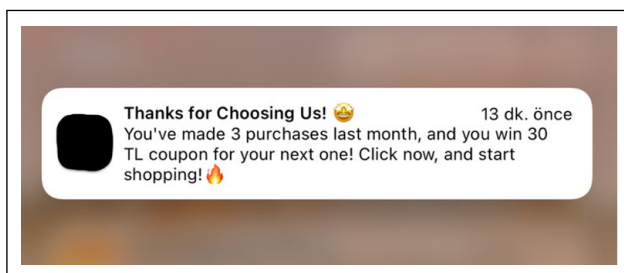
Push notification design in Figure 5 is for “Hibernating” and “At Risk” customers. It nudges them to do shopping once it’s seen by the app users. This notification promotes an item that was purchased before, it offers limited-time campaign and free-shipping.

“Champions” and “Loyal Customers” are valuable for the company because they are already repeat customers, therefore they deserve to be rewarded for their prior purchases. A push notification in Figure 6, which points out their purchasing behavior and let them know that they win a gift for this behavior is designed to help the company to retain them.

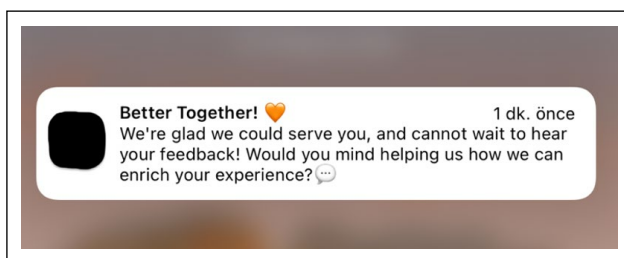
The company can get useful feedbacks from “Potential Loyalists”, “Champions” and “Loyal Customers” segments by using a push notification design in Figure 7. It should encourage those customers to share their opinion, and try to incorporate them to the process of designing a better customer experience for the online shopping on the app.



**Figure 5.** Push Notification for “Hibernating” and “At Risk” Customers.



**Figure 6.** Example Push Notification for Champions and Loyal Customers.



**Figure 7.** Example Push Notification for “Champions”, “Loyal”, and “Potential Loyalist” Customers.

## CONCLUSION

This study aimed to make segmentation of the branded app users based on their prior purchasing behaviors according to the RFM Model’s parameters, and identify how a push notification can be designed effectively for those segments specifically. Based on the quantitative analysis of the branded app users, the customers have been segmented into eight groups, the evaluation was made for each segment, and some examples for push notification designs were presented. As a result of the segmentation, it can be concluded that the majority of the company’s app users have made purchases rarely, and their last transaction times were not recent. They are called “Hibernating.” Luckily, the most desirable segments such as “Loyal Customers”, “Champions”, and “Potential Loyalists” are following them with the highest number of members. Based on these results, the marketers should focus on moving customers from all the other segments to these three. This transformation takes time and required tailored approach related with the segments’ behaviors. Since all the segments have their own spending characteristics, they should receive push notifications which pretend like a pill to their needs. Reviving “Hibernating” customers, and rewarding “Champions” and “Loyal Customers” can be a good start for this company. A loyalty program can be prepared as well to engage the users.

The segmentation was made specifically for the dataset used in the time window of this study, but it can be improved with using bigger dataset for future researches. The RFM Model looks at the three specific factors which means that this method may be excluding other variables which are equally, or more, important such as spending values per cart, products purchased, prior campaign responses, demographic details etc. Also, this model does not tend to reveal causes of customer purchasing behavior, therefore more advanced customer segmentation techniques that are based on predictive analytics technologies can be more powerful to determine why a customer has not made a purchase frequently, recently and with a big amount of spending. There are various studies about push notification in mobile direct marketing and the RFM technique for segmentation in the literature, but this study specifically is the one which examined customer purchasing behavior on the branded mobile application based on the RFM parameters and focused on designing a push notification which directs customer to shopping.

## AUTHORSHIP CONTRIBUTIONS

The author conceived and designed the analysis, collected the data, contributed data and analysis tools, performed the analysis and wrote the paper.

## DATA AVAILABILITY STATEMENT

Due to the nature of this research, owner of the data used in this study, did not agree for their data to be shared publicly, so supporting data is not available.

## CONFLICT OF INTEREST

The author declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

## ETHICS

There are no ethical issues with the publication of this manuscript.

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