

When is the most Effective Time to Post on Instagram to Increase Engagement Rate?

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ABSTRACT

In recent years, determining the most effective time to post on Instagram for increased engagement has become a central concern for digital marketers. Despite its significance, research on this topic remains limited. This study adopts an exploratory research approach to analyze Instagram posts from selected Western countries (Europe and America) and Iranian businesses. The data were collected during the period from February 21, 2022, to March 21, 2022, employing web scraping tools. Classification algorithms, including XGBoost, K-NN, SVM, and Linear Regression, are employed for modeling, with results favoring the XGBoost method for accuracy. The study reveals optimal posting times between 12 and 3 pm for Western Countries businesses and 9 and 12 am for Iranian businesses. Furthermore, it suggests Sunday as the best day for posting in the West, contrasting with Thursday in Iran. In summary, this research underscores the differing ideal posting times in Iran and the West, emphasizing the challenge of constructing a uniform model for all countries.

Keywords— Instagram, Content Marketing, Optimal Posting Times, Engagement Rate, Insight

1. Introduction

In recent years, buying and selling goods and services have not been as easy as in the past, and there is presently a fierce competition between businesses to acquire a larger market share. Some studies [1-4] indicate that even most of the businesses that did not have a positive outlook on online sales and services have gradually gravitated towards this direction in the past two years. The escalating prevalence of social media usage has elevated social media marketing to a extensively researched domain within the field of business research. However, a noteworthy gap exists concerning the discourse on post timing, a subject consistently deliberated among content creators and social network marketers, yet insufficiently addressed in academic research. Despite the abundant online resources dedicated to this topic, its significance has not been adequately explored in scholarly papers. Noteworthy studies, such as those conducted by Hejun and Liehuang [5] and Doyle, Su, and Kunkel [6], affirm the indirect influence of posting times on enhancing engagement rates on social media platforms.

In this study, the following questions are addressed:

- RQ1: In order to achieve the highest engagement rate on Instagram, when is the most effective time to post?
- RQ2: Are the most effective times to post on Instagram the same for Western Countries and Iranian businesses?
- RQ3: Which day is the most effective day to post on Instagram in order to achieve the highest engagement rate?
- RQ4: Are the most effective day to post on Instagram the same for Western Countries and Iranian businesses?
- RQ5: Are regular Instagram postings associated with an increased engagement rate?

This research was conducted on the Instagram pages of several Western Countries and Iranian businesses. Since Iranian region, culture, and official holidays differ from Western Countries regions, this study can be useful in answering the question of whether the best time to post is the same in different countries. A qualitative exploratory analysis of Instagram posts in a number of selected businesses



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in Western Countries and Iran was undertaken in order to achieve the objectives. Using this analysis, the factors affecting engagement rates were identified and the optimal post times were determined.

2. Literature Review

There are a few research and empirical studies about the most effective time on social media. Nevertheless, many studies investigated user engagement rate on social media [7-11]. Some studies investigated engagement rate in influencer marketing [11-13]. Engagement rate is a key indicator of social media effectiveness [14]. Social media engagement can be achieved by utilizing active and passive communication [15]. A social media user's engagement influences the virality of information [16]. A user engagement rate is determined by determining how many people react to a post in a particular way, such as by "liking" or commenting [17]. Ward [18] believed user engagement can be measured through the number of likes and the number of comments on a post. Pradhan et al. recently investigated how social media influencers affect consumers engagement [19].

The main focus of De Maio' study [3] was on the identification of the best posting times on Twitter. The researchers used text analysis techniques to investigate the annotations of tweets and the concepts of the contents according to the frequency of postings over time. This is an approach implemented based on the K-NN model which is used to estimate users representing users' pages according to their interests.

The purpose of the research of Yew et al. [4] was to analyze the insight levels of Instagram influencers' accounts and their engagement rates. This analysis was carried out on quantitative data, and some formulas were presented based on the numbers of followers, likes, and comments to measure Instagram insight. The researchers collected the data in a one-year period (i.e., from August 2013 - July 2014) and analyzed them based on their formulas. The noteworthy output of this research project was the presentation of five algorithms which can be used to compute the amount of different engagement rates on Instagram.

In another study, Arora et al. [1] Proposed an approach to calculate engagement rates in popular social media platforms including Facebook, Twitter, and Instagram. This study, using regression techniques and procedures, introduced a set of characteristics used to determine impacts on customers. More specifically, basic machine learning algorithms including ordinary least squares, K-NN regression, and regression models were

adapted to compute a cumulative impact index score.

Wahid et al. [20] investigated the most effective posting times on Instagram to increase content attraction. The research was based on the data of 2958 posts representing Indonesian food brands. Regression analysis was done to predict the numbers of likes and comments. The results showed that the most effective days to post contents are Monday, Tuesday, Wednesday, Thursday, and Friday in Indonesia.

The main focus of Abinowi [21] was on Instagram. This study sought to arrive at a strategy to analyze the most optimal posting times and the meanings of the contents in the advertisements that were published on Instagram. The area investigated was the Nagasaki Karwang region. The researchers analyzed the data using the apriori method. According to the data, it was determined that the effective time of advertising is 7-10 p.m., when 63% of users were interested in advertising. Also, fashion proved to be more popular among women.

Yu et al. [22] emphasized that the maximum influence of marketing needs related to sending information to users on social medias not only depends on the number of users but it will also have a direct impact itself. This leads to the growth and visibility of a business. The researchers also emphasized the fact that the early adaptors should be identified, analyzed, and categorized. Therefore, they calculated correlations by means of time series and regression methods to estimate the main stimuli and factors leading to the attraction of users. The innovation of these researchers resided in their use of the concept of "topology-based diversity" in the area of instant messaging.

In yet another study, Salehudin et al. [23] analyzed the impact of online creative learning on the ability of users to create new products in a technology and learning media course. This study also determined the level of user experience in media processing through the Canva application in Android. Furthermore, it should be noted that this research project adopted a quantitative approach, using a quasi-experimental research model and was limited to a certain number of Indonesian students. For better evaluation, the scores were classified and labeled.

Li et al. [24] investigated the relationship between user features and rejection of rumors in the five main categories of rumors. The information belonging to 58807 users of Sinaweibo was collected for five rumor-denying microblogs for model training and feature analysis. The XGBoost algorithm was used in this analysis.

3. Theoretical basis and Hypotheses

Development

At first of this section, the basic concepts of Instagram, then the theories and hypotheses will be discussed.

3.1 Basic concepts

Instagram: Instagram is a social media for sharing photos and videos, which was founded by Kevin Systrom and Mike Krieger and is now owned by Meta (formerly known as Facebook). This application allows its users to publish their photos and videos on other social networks such as Facebook, Twitter, Tumblr and Flickr. Users can also apply virtual reality filters to their images. The video publishing limit on Instagram is 60 seconds, and in recent years, videos can be published up to a maximum of 20 minutes.

In fact, Instagram and some other social networks have caused the elimination of expenses such as renting a shop or store, large investment at the beginning of the business, and even eliminating the overhead and taxes, etc.

What is clear is that the space against of Instagram is not only a fun and entertainment network, but also a platform for doing business activities; since there is no legal and official authority to manage the exchanges made on Instagram, the amount of turnover resulting from the exchange of goods and services on this platform cannot be calculated. However, the estimates made by Beta Research Center have shown; the only income from advertising and information by Instagram influencers in a year is about 16 thousand billion dollars.

Post: Every new photo or video uploaded on Instagram becomes a post. All posts are displayed on the user's Instagram profile page, and all available posts are displayed on the user's home (feed) page.

Follower: When someone follows you, he/she will be added to your followers. On the other hand, when you follow someone's account, you will be added to the followers of her/his account.

Comment: When you want to express your opinion about a post, it is enough to leave a comment under the same post. Pay attention that these comments can be seen by everyone and it is possible to reply your comment.

Like: If a post gets someone's attention and wants to show his/her interest, it is enough to click the heart under that post.

Insight, Interaction and Engagement rate: The insight rate of a post, in terms of likes and comments

is called the interaction. In addition, an engagement rate is calculated based on the parameters (i.e. sum of interaction features).

Business Account: To access advanced tools on Instagram, it is enough to create a business account to access special features in business account's dashboard that personal accounts do not have access to.

3.2 Theories and Research Questions

This research seeks to identify the optimal timing for Instagram posts with the objective of maximizing engagement rates. While extant research has explored various aspects of optimizing online content visibility, a notable gap exists in the understanding of the specific influence of posting times on Instagram engagement. This study aims to address this gap by providing critical insights into the temporal dynamics of audience activity on Instagram and their impact on engagement metrics.

In previous studies [1, 4, 24], supervised machine learning approaches have been welcomed by researchers in order to solve the business intelligence problem in social medias. In the last few years, a number of bloggers or influencers, based on their experiences, have published articles on the Internet about the best time to post on Instagram. In contrast, a supervised machine learning method has not yet been applied to the analysis of posting times on Instagram for improving engagement rates for online businesses.

In the present study, we attempted to identify the effective factors, inspired by approach of Yew et al. [4], and then employing of supervised machine learning approaches in [1] and [24], to figure out the best time to post on Instagram.

The following questions are examined in this research:

RQ1: In order to achieve the highest engagement rate on Instagram, when is the best time to post?

The experience of content producers indicates that posting on Instagram increases engagement rate. On the Internet and Instagram, a large amount of content has been published, which reflects the experiences of content producers in regards to the best times to post in Instagram. Despite this, original research on the most effective times to post on Instagram in order to increase engagement rates is rare.

RQ2: Are the most effective times to post on Instagram the same for Western Countries and Iranian businesses?

We are attempting to answer the question whether the most effective times to post are the same in different countries with different cultures. In

particular, Iran in the Middle East region has a different culture from the West, and the weekend is on Friday. Is the engagement rate based on the time of posting the same for Iranian and Western Countries users on Instagram?

RQ3: Which day is the most effective day to post on Instagram in order to achieve the highest engagement rate?

A controversial topic among digital marketers is what day is best to post on Instagram. There are some individuals who do not accept this issue at all. Some individuals agree with the principle of the matter, but disagree on which day is more appropriate. This issue, however, has been addressed in a limited number of research papers.

RQ4: Are the most effective day to post on Instagram the same for Western Countries and Iranian businesses?

Following RQ4, can a single pattern be provided for the best day to post in all countries? Does the best day to post in the west correspond to the best day to post in a country such as Iran, which is located in a different region with a different cultural background? Previous works have not provided a clear answer to this question.

RQ5: Are regular Instagram postings associated with increased engagement rate?

Many content producers have published comments and opinions on the Internet and Instagram regarding the effect of posting on a regular schedule on engagement rates. We address this issue beside RQ1 and RQ2.

Even though several studies have been conducted in response to the above questions with different objectives, these three questions have not been addressed together in previous studies. Further, there is a lack of research that addresses the above 3 questions in relation to the impact of posting time on Instagram. The following section discusses the research methodology.

4. Research methodology

As mentioned previously, the purpose of this research was to find the most optimal times to post contents on Instagram. Figure 1 shows the general steps of the present research method.

4.1 Data Collection

Given the fact that prior to conducting this research there was no standard dataset suitable for the present research purposes, it was essential to prepare a specific dataset. Therefore, data extraction from Instagram was done using web scraping methods. The following section provides a more

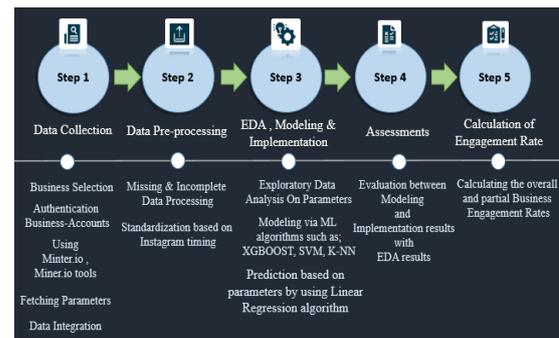


Figure. 1. General steps of present study

detailed description of how the necessary data was collected.

Selecting a desired group of businesses

A number of criteria were taken into account when selecting businesses.

- *These criteria were as follows:*

a) *Detecting that the numbers of followers, likes, and comments of a business account were not fake:* This was accomplished by using HypeAuditor (**NB:** At the time of data collection, the selected businesses did not have any fake data, but this may not hold true in the future.)

b) *Determining the authenticity and validity of the business accounts:* By clicking on the 3-point button next to the business accounts, one can see the time the business account started and its authenticity.

c) *Specifying the amount of business activity:* Some businesses may not publish even one post in a week to introduce and guide their customers. These businesses were removed from the selected list. The goal was to select and include businesses that had more interaction in terms of publishing contents and guiding their followers through Instagram features such as stories, posts, and the Q & A box.

d) Recording characteristics of selected businesses and their names:

- Their activities in different time periods (that is, posting in different time periods during the day);
- The real numbers of followers, likes, and comments;
- Interacting with followers (putting a Q & A box on Instagram, providing automatic responses through bots on Instagram direct, as well as activating the ticketing section on the website);
- Having an Instagram blue tick (**NB:** Currently, it is only the Western Countries

businesses and influencers that have received the blue tick.);

- Having a website for selling and supplying products; and
- Having multiple communication channels to interact with customers and other businesses.

The names of the selected Iranian businesses (with their fields) are as follows:

Ibolak (cloths), AldoGallery (bag, shoes, accessories), RastarAccessory (accessories), Cadenza.ir (bag and shoes), Khaneh_Shokolati (chocolate and coffee)

The names of the selected Western Countries businesses (with their fields) are as follows:

FentyBeauty (beauty and cosmetics), Sephora (beauty, skin and cosmetics), bhCosmetics (cosmetics), EgoOfficial (shoes and bag), TheBodyShop (skin products)

- Extracting the amount of likes and comments of business posts in a period of 30 days (1 month):

In the present study, two tools (i.e., minter.io and miner.io) were used to extract the necessary data, which followed a similar approach as the research conducted by Yew [4]. The dataset was established from 2/21/2022 to 3/21/2022, which is equivalent to a period of one month (30 days). This period observed the lowest number of holidays and special events compared to the other time periods. A total of 17,276,390 likes and 95,162 comments for Western Countries businesses and 7,452,974 likes and 70,705 comments for Iranian businesses were extracted from a total of 2,000 posts published by the business accounts of online active-businesses on Instagram.

- Integrating the extracted data:

The extracted data were integrated according to the Iranian or Western Countries type of businesses. In other words, Iranian businesses were integrated into one dataset, and Western Countries businesses were integrated into another dataset according to certain features, so they would be ready for the next step, i.e., the pre-processing of the data. The summary of the data specifications is highlighted in Table 1.

4.2 Data pre-processing

After extracting and collecting the data according to the like and comment parameters, the cells which were incomplete were filled with the average of the target records. Next, based on the time period provided by the Instagram dashboard as shown in Figure 2, the numbers of likes and comments were categorized for separate 3-hour periods. Figure 2 shows an example of the number of comments on Fridays in the 3-hour periods. The

Table 1. Data statistics Summary

Type of Business	Name of Businesses	Number of records	Number of Followers	Time period for collecting data	Number of likes	Number of comments	Number of insights
Western European	TheBodyShop EgoOfficial bhCosmetics Sephora FentyBeauty	2100	41.5 M	1 month (30 days)	17276390	95162	17371552
Iranian	Khaneh_Shokolati Cadenza RastarAccessory AldoGallery Ibolak	1200	3.97 M	1 month (30 days)	7452974	70705	7523679



Figure. 2. Instagram time periods

concept of insight is the degree of engagement with insight[4, 25].The amount of insight provides to the account owner an overview of the parameters affecting the published posts.

In order to train the model, labels were created using Like, Comment, and Insight parameters. For labeling each record, the research method [23] was employed. More specifically, after calculating the daily average values of insight, they were labeled in three types. In both Iranian and Western Countries businesses, the labeling method was the same, and the only difference was the number of labels in each category. This was based on the number of likes and comments during each hour of the day.

First type: The labels were defined in three categories, i.e., unsuitable, good, and suitable which were based on the value of insight and were named Time Status.

Second type: Similarly, the labels were defined in three categories (that is 0, 1, 2) which respectively had the same meaning as the first type categories and were named Label. This was mainly used for modeling this type.

Third type: The values used were either 0 or 1. If the insight value of the considered record was less than the daily insight average, the label 0 was applied, but if it was greater than the daily insight average, the label 1 was applied. The name used for this type was B-Label.

4.3 Analysis and modeling

For the purposes of this research, parts of the research methods used in studies [1] and [24], as well as the research approach [4], were used for data

extraction. A correlation analysis was conducted in this step to identify the appropriate parameters by examining the correlation between like, comment, and insight parameters. The second step involved evaluating the accuracy of the results using machine learning classification algorithms such as SVM, K-NN, and XGBOOST. Thirdly, using the Linear Regression algorithm, the researchers predicted insight values over a period of time and days. The accuracy of the predict results was then compared with the results obtained from the exploratory analysis.

4.4 Assessment

Up until this step, exploratory analysis had been done, and XGBOOST, K-NN, SVM, together with the Linear Regression classification algorithms, had been used to model the identified parameters. For further evaluation, the effective parameters were predicted through Linear Regression algorithms, and the results were compared with one another.

Final step: Calculation of engagement rate

Various methods have been proposed to calculate the engagement rate. In this research, Equ(1) was used to calculate this rate, which was also used in research study[4].

$$\text{Engagement Rate (\%)} = \frac{\text{(sum of parameters)}}{\text{total followers} * 1000}$$

Parameters: Likes + Comments (1)

5. Findings

5.1 Results of exploratory analysis

First, the correlation indices between the parameters were computed to identify the effective parameters. According to Figure 3, in both Western Countries and Iranian businesses, the correlation of insight and like parameters was higher than other parameters. These two parameters also observed a slight difference. Because the insight parameter value was the calculated sum of the other two parameters (like and comment), choosing insight could lead to improved results. Therefore, the selection of the insight parameter for modeling was more favorable.

After checking the correlation of the parameters and identifying the effective parameters, we analyzed the insight parameter values in terms of days and time periods. As shown in Figure 4, the maximum insight value for Iranian businesses is on Thursday. After Thursday, with a relatively large difference, Wednesday, Tuesday, and Monday are also suitable days for posting in Iran. Additionally, engagement rates were highest between 9am and 12am. In addition to this period, the periods of 3-6pm and 12-3pm are also good times to post to Iran.



Figure 3. Evaluation of correlations between parameters

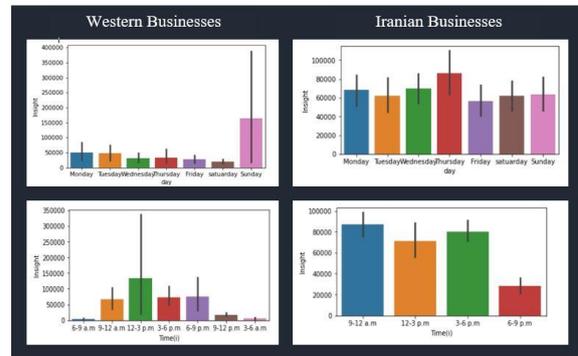


Figure 4. Evaluation of parameter results of interaction levels in terms of days and time periods

Based on Figure 4, Sunday is the best day for Instagram posting in Western Countries businesses. During the week, the impact of posting on Sunday varies widely from the rest of the week in Western Countries businesses. The best time to post for West business is between 12 and 3pm. Subsequently, 6-9, 3-6pm and 9-12am are good times to post, but do not result in the same effect as 9-12.

5.2 classification results

As can be seen in Figure 5, the accuracy results of the algorithms after modeling was evaluated both separately and side by side visually. The most effective parameter that was identified in the exploratory analysis step was the insight parameter. Therefore, this parameter was considered an input for classification algorithms in terms of day and time period. In both types of business (Iranian and Western European), The XGBOOST algorithm reached the highest accuracy, compared to the other algorithms. Moreover, in Western Countries businesses, the SVM algorithm and in Iranian businesses the K-NN algorithm observed the highest accuracy. Also, it can be concluded that the insight parameter in the previous stage, i.e., exploratory analysis, was chosen correctly because the obtained results had the desired accuracy.

5.3 results of Linear Regression

After analyzing the parameters and modeling them, the Linear Regression algorithm was employed for prediction purposes over the insight parameter. The results are described in two parts: a) predicting time periods and b) predicting days. The

points marked with an asterisk are the values predicted by the machine. For better viewing, the predicted points are displayed with arrows.

a) *Predicating time periods*

Figure 6 shows the prediction results of the Linear Regression algorithm in terms of time periods. In this figure, the x-axis is the time period and the y-axis is the value of insight.

b) *Forecasting days*

Figure 7 shows the prediction results of the Linear Regression algorithm by day. In this figure, the x-axis represents the days of the week and the y-axis is the value of Insight.

As can be seen in Figures 6 and 7, the results of sections A and B of Linear Regression predictions are similar to the results of the exploratory analysis. As a result of regression modeling, the exploratory analysis results are also confirmed.

5.4 engagement rate measurement

One of the important sections of the present study was measuring the engagement rates. As mentioned in the research method section, the two parameters of like and comment were important and influential parameters. Formula (1) was once computed separately for each business and in general for all Iranian businesses and Western Countries businesses.

According to Figure 8, FentyBeauty and ibolak reached the highest engagement rates among Western Countries and Iranian businesses, respectively, as the engagement rate calculated for these two businesses was higher than the engagement rate of all businesses and their averages.

6. Discussion

Based on the findings, the answers to the research questions are presented in this section.

RQ1: In order to achieve the highest engagement rate on Instagram, when is the most effective time to post?

The most important result obtained, as the main goal of this research, was the identification of optimal time periods for posting in order to improve the engagement rate. Based on Figure 9, the optimal posting time for Western Countries businesses is between 12 and 3 p.m. Following the 12-3 period, which is by far the best post time in Western Countries business, the 9-12 period in the morning and the 3-6 and 6-9 in the evening do not show much difference. For Iranian businesses, however, the morning hours between 9 and 12 are ideal for daily posting. In Iran, although 9-12 am is the most effective time for posting, there is not a great deal of difference between the top three timeslots. In Iran,

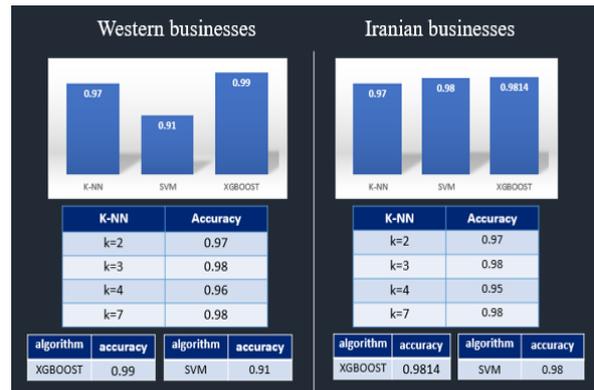


Figure 5. Evaluation of results of modeling classification algorithms

therefore, the hours of 3-6 and 6-9 in the evening are not bad for posting.

RQ2: Are the most effective times to post on Instagram the same for Western Countries and Iranian businesses?

As indicated by the results and explanations of RQ1, there is neither a positive nor negative answer to this question. There are similarities and differences between Iranian and Western Countries businesses. For example, in general and without looking at the order, the most optimal time periods were the

Same for Iranian and Western Countries businesses. As a matter of order of importance, Iranian and Western Countries businesses have different best posting times.

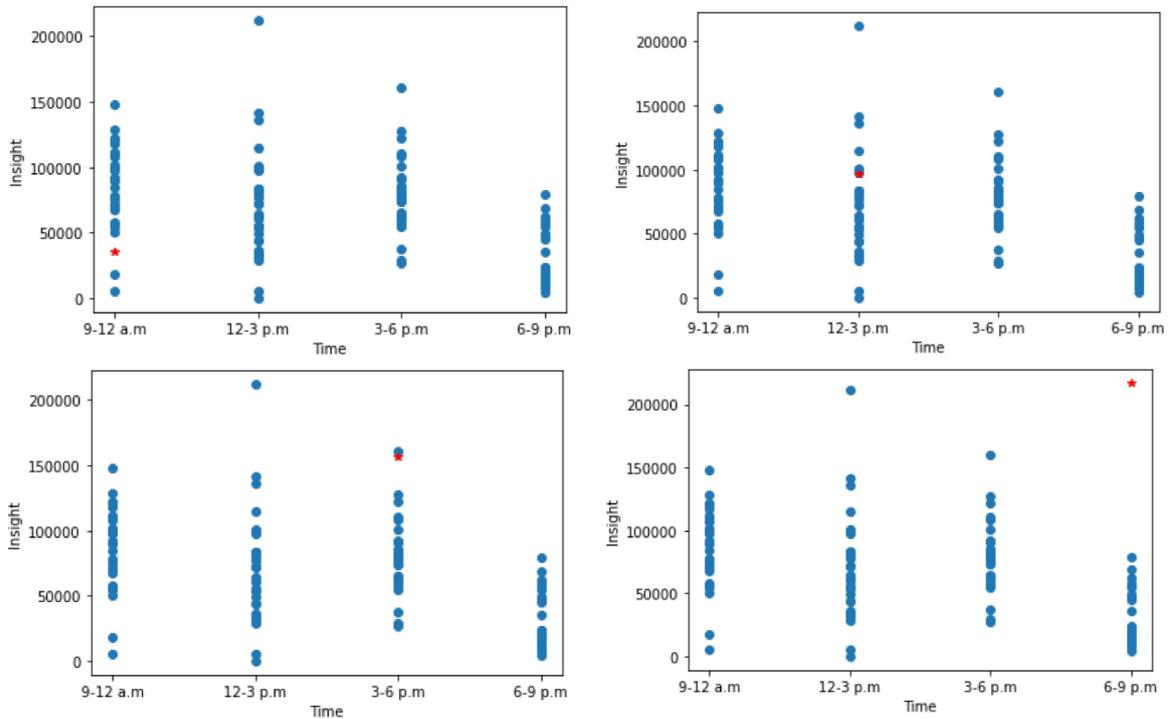
RQ3: Which day is the most effective day to post on Instagram in order to achieve the highest engagement rate?

According to Figure 4, Thursday is the most effective day for posting in Iran. However, in the West, Sunday is the most effective day for posting.

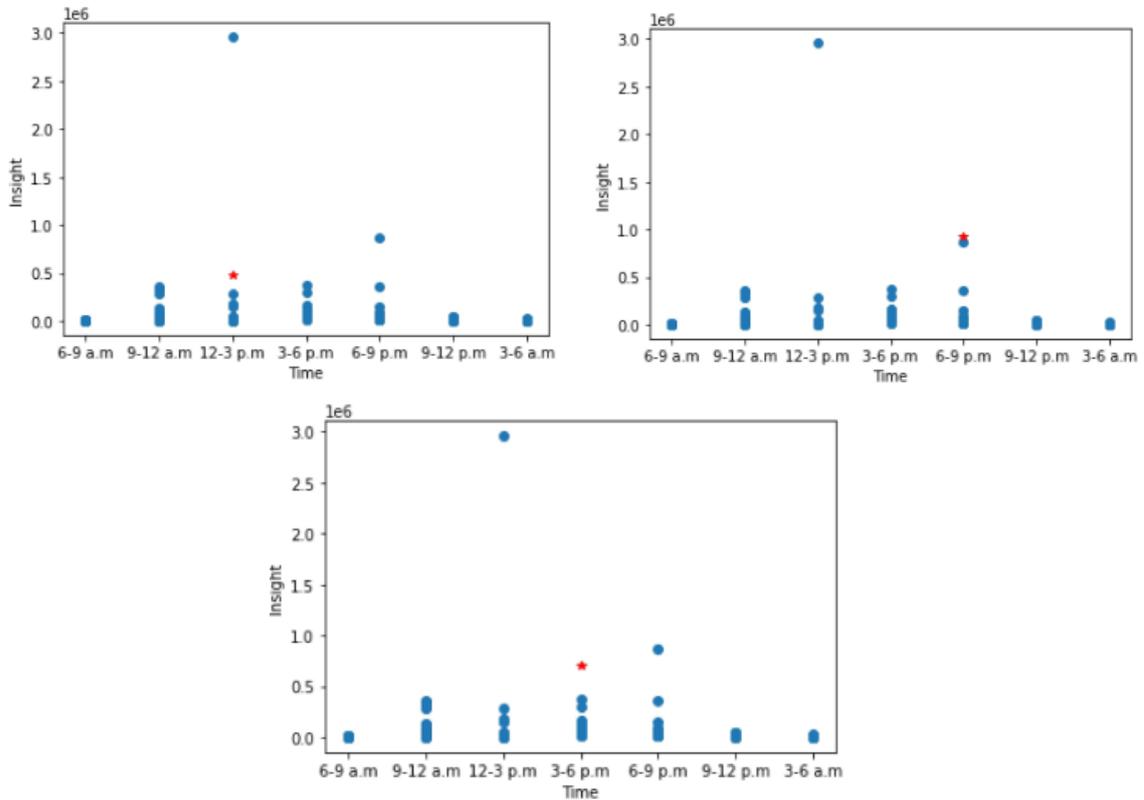
RQ4: Are the most effective day to post on Instagram the same for Western Countries and Iranian businesses?

Considering the answer to question 3, the best day to post differs in Iran and the West. Similar patterns, however, can also be observed. According to Figure 4, discussed in the exploratory analysis section, in Western Countries businesses, Sunday, Monday, and Tuesday were determined as the most favorable days for posting contents on Instagram. In Iranian businesses, in turn, Thursday, Wednesday, Tuesday, and Monday were identified as the most favorable days for posting on Instagram.

As well, it shows that in the West, Sunday is a more suitable day for posting as it is a weekend, but in Iran, Friday (weekend in Iran) was not identified as one of the most suitable days for posting. Instead,



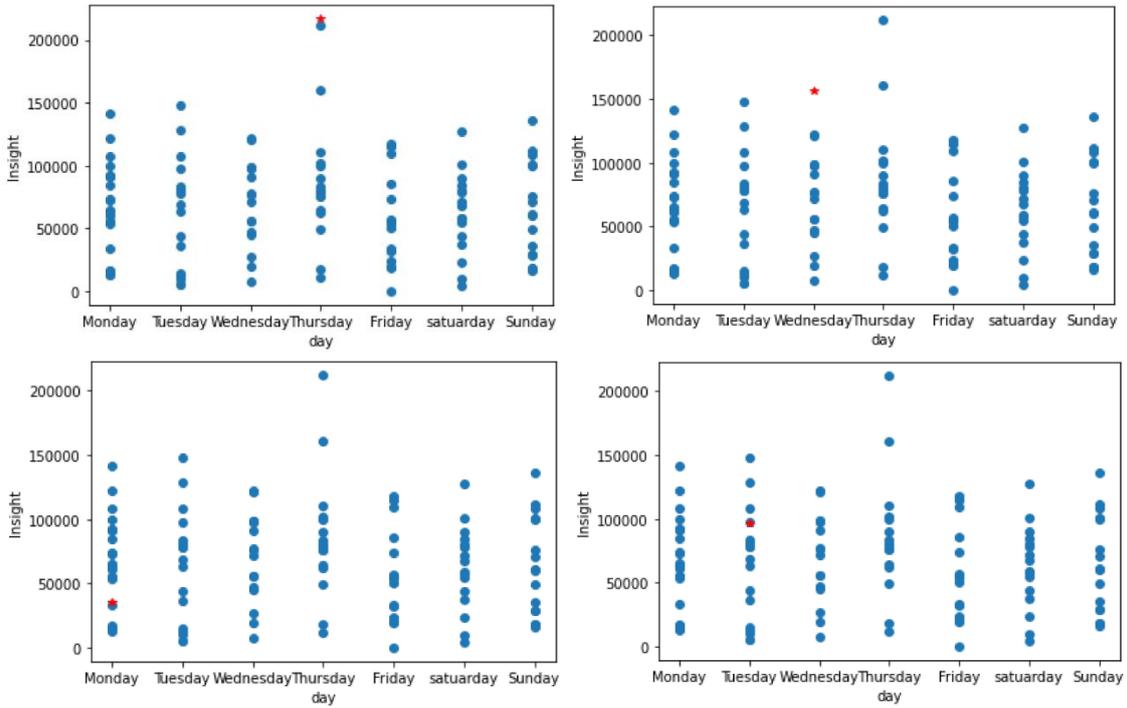
(a) Iranian Businesses



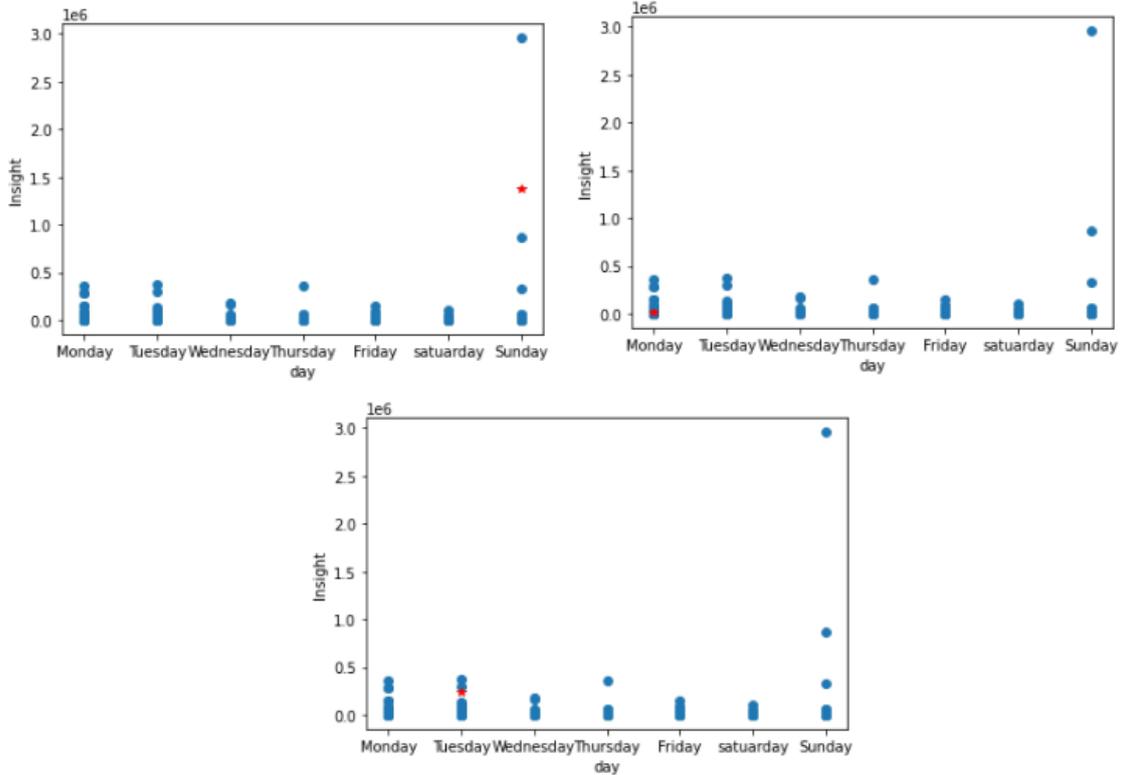
(b) Western Businesses

Figure. 6. Results of Linear Regression algorithm for forecasting based on time periods

When is the most Effective Time to Post on Instagram to Increase Engagement Rate?



(a) Iranian Businesses



(b) Western Businesses

Figure. 7. Results of Linear Regression algorithm for forecasting based on days

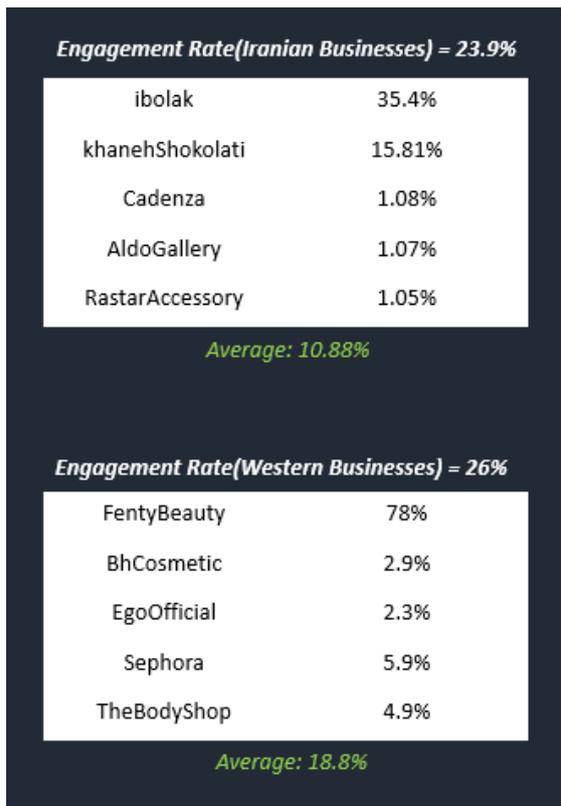


Figure 8. Results of evaluation of engagement rates of businesses

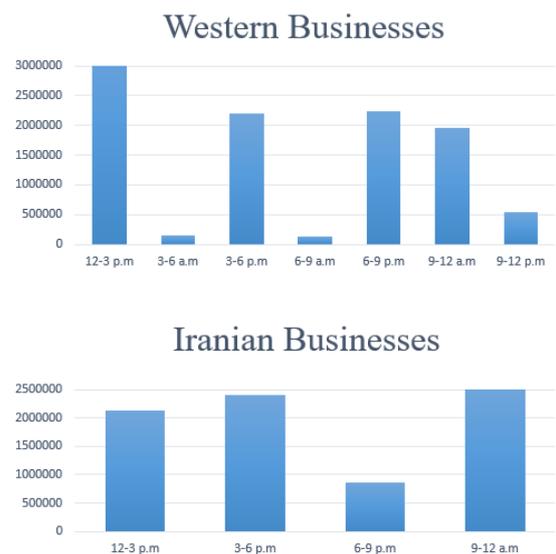


Figure 9. Optimal time periods for daily posts

in Iran, the day before the weekend, that is, Thursday, is a more suitable day for posting. It is interesting to note that Thursday is a half-holiday in Iran. Most government offices and companies operate on Thursday for fewer hours than during the week.

RQ5: Are regular Instagram postings associated with an increased engagement rate?

According to the number of followers before and after a certain period, the growth of followers can be observed. Within six months in this research, the growth rate of followers of each business was observed. It was found that among the Iranian businesses, Ibolak posts were done regularly every day between 9-12 am or 3-6 pm. This business has been most successful in attracting followers. During a period of six months, this business has gained 300,000 followers, and subsequently obtained the highest engagement rate among the selected businesses. Overall, this posting pattern has resulted in a greater number of followers and a higher rate of engagement. Thus, the answer to the above question is yes. The results of this study indicate that posting regularly and at the right time results in higher engagement.

In addition to addressing the research questions, two noteworthy findings emerged:

1. Divergence in Average Engagement Rates:

The data indicates a significant variance in average engagement rates between Western Countries and Iranian businesses. Western Countries businesses consistently exhibit higher engagement rates. This discrepancy could be attributed to several factors, including a more substantial follower base, ownership by well-known personalities, and the prestigious acquisition of the coveted blue tick verification on Instagram.

Exemplary Performance of FentyBeauty Brand: Notably, among Western Countries businesses, the FentyBeauty brand, owned by the renowned American singer Rihanna, stands out as an exemplar. This cosmetic brand showcased superior insight and engagement levels, amassing an impressive 1.5 million followers within a six-month period—from the initial data collection date until the conclusion of this study. This exceptional performance underscores the impact of celebrity ownership and strategic brand management on achieving heightened success in the dynamic realm of Instagram marketing.

7. Comparison of results with previous works

As mentioned earlier, the focus of most of the previous research studies has not been on identifying effective time periods on Instagram. In some previous studies, the investigated features were different from those of the present research. Further, in some previous works, such as [20], that have been similar to this research, Monday, Tuesday, Wednesday, Thursday, and Friday were suggested for publishing posts on Instagram (for Indonesian food products). This result is in line with that obtained in this study, especially for Iranian

businesses. Also, according to the results obtained in [21], the optimal time of advertising on Instagram related to Nagasaki Karwang area was identified to be from 7 to 10 pm, which is the same as one of the periods obtained in this research.

With respect to the accuracies obtained through the classification algorithms, due to the different datasets and parameters used in related research such as [23] and [24] an exact comparison cannot be made.

Analysis of the obtained results reveals a general convergence in posting times for Western countries, while highlighting a more nuanced pattern in the Iranian context. Across Western regions, optimal engagement appears to occur within the midday window of 12:00 to 15:00. Conversely, Iranian businesses exhibit diversified temporal preferences, with peak engagement concentrated between 09:00 and 12:00. These discrepancies can primarily be attributed to the interplay of geographical distance, time zone differentials, and cultural variations across the two regions.

These findings underscore the importance of region-specific tailoring in social media strategies, emphasizing the need to align posting timelines with local audience behavior and cultural nuances. This research direction holds significant promise for future investigations in optimizing social media engagement across diverse global markets.

8. Conclusion

In conclusion, this research aimed to determine the optimal time periods for posting content on Instagram to achieve the highest engagement rate. Given the absence of a standardized and optimal dataset aligned with this research objective, a pertinent dataset was meticulously extracted from Instagram accounts representing both Western Countries and Iranian businesses. The subsequent phase involved conducting exploratory analysis on the extracted data, identifying influential parameters. Following this, modeling was executed utilizing XGBOOST, K-NN, SVM, and Linear Regression classification algorithms, with the additional validation of results through the Linear Regression algorithm. The ultimate step encompassed a comparative analysis of business engagement levels.

In general, the results of the present research can be summarized as follows:

- The optimal posting time for Western Countries businesses is between 12 and 3 pm, while the best time for Iranian businesses is between 9 and 12 am.
- Western Countries and Iranian businesses have different optimal posting times on

Instagram. However, there are some similarities between the two.

- The best day to post in Iran is Thursday. Sunday, however, is the most effective day for posting in the West.
- The most effective day to post on Instagram differs for Iranian and Western Countries businesses. There are, however, some common patterns.
- The engagement rate can be increased by posting regularly at the appropriate time.

This study demonstrates the inherent challenge of precisely identifying a universally optimal time period for posting across all countries, despite the identification of noteworthy common patterns. The influence of cultural, social, and ethnic characteristics in diverse countries adds complexity to this determination. Consequently, investigations with a dedicated emphasis on regional and ethnic attributes hold promise for shedding light on additional dimensions of this issue. Moreover, if logistically viable, replicating this research on a broader scale with an expanded dataset and a more diverse array of businesses could offer deeper insights. It is important to acknowledge that ancillary factors, such as emotional advertisements, can impact visitors. These considerations are also pertinent in this research domain [26]. Additionally, for future research, the incorporation of alternative parameters in modeling and subsequent evaluation of results can contribute to a more comprehensive understanding of the subject.

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Authors' contributions

MJS: Study design, research supervision, interpretation of the results, edit manuscript, revision of the manuscript

FK: Study design, acquisition of data, interpretation of the results, statistical analysis, drafting the manuscript.

Conflict of interest

The authors declare that they have no conflict of interest.

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