Temporal Dynamics of Posts and User Engagement of Influencers on Facebook and Instagram

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Framework and motivation

- **Online Social Networks** are a core component of modern communication
- Complex ecosystem arises around *influencers*
- **Billions of users**

Understanding and modeling content popularity evolution have an impact on opinion formation, advertisements, anomaly detection, information spreading and marketing
Quick overview of Instagram
Influencer
Followers

Cristiano Ronaldo
www.cristianoronaldo.com

2,819 posts
222m followers

449 following
Posts by Influencer

Instagram

cristiano
Follow

2,819 posts
222m followers
449 following

Cristiano Ronaldo
www.cristianoronaldo.com

Posts
Number of posts
Interactions on posts

[Image of an Instagram profile with comments and likes indicated]
Research Questions

Provide experimental analysis of the time evolution of interactions with user-generated content on social networks to understand:

- How much influencers publish over time and what is the activity level of their followers?
- How do followers interact with posts published by influencers? What is the temporal evolution of the reactions to these posts and the factors affecting it?
- What are the main aspects that an analytical model should capture, in order to accurately represent user interactions?
Previous work

Content popularity can be measured through the number of interactions

Vast literature on popularity prediction on social networks:

- Identification of internal and external factors that impact popularity (e.g., [1,2])

Limited literature on understanding temporal dynamics of interactions on user generated content:

- Popularity decay over time (negative exponential [3], power law [4,5])
- Preferential attachment systems [5]
- Constant rate [6]

A large-scale characterization of the temporal evolution of the popularity of posts in Online Social Networks is still missing
Data collection

- Facebook (FB) and Instagram (IG)
- Crowdtangle API
- Posts are monitored for 20 days after their publications
- 5 years (2016-2021)
- Top Italian influencers with more than 10,000 followers
- 110 GB of disk space, analyzed with PySpark on an Hadoop cluster

<table>
<thead>
<tr>
<th></th>
<th>Influencers</th>
<th>Posts</th>
<th>Interactions</th>
<th>Avg followers</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Instagram</strong></td>
<td>244</td>
<td>0.31 mil.</td>
<td>9.36 bil.</td>
<td>1.19 mil.</td>
</tr>
<tr>
<td><strong>Facebook</strong></td>
<td>407</td>
<td>3.57 mil.</td>
<td>4.02 bil.</td>
<td>1.55 mil.</td>
</tr>
</tbody>
</table>
Activity of influencers

Inter-arrival time of Influencers’ created posts – focus on the tail

- For a median influencer, average posts inter arrival time is 19 hours on FB, and 57 hours on IG
- Best fitting log-normal distribution, better than with an exponential distribution
- Long-tail distribution - influencers sometimes remain silent for a long time
Activity of influencers and followers

- Non-stationary pattern
- Similar patterns over FB and IG – FB contains aggregators, publishing even at night
- Followers tend to be more active later in the evening
Temporal dynamics of interactions

Fraction of received interactions on a post with respect to the ones after 20 days
Average over all posts

- Majority of the interactions occurs within the first few hours $\rightarrow$ freshness of the post has large impact on the attractiveness
- The growth of the number of user interactions is faster on IG than on FB
- Average interaction-time is 15 hours for FB, and 11 hours for IG
- Interaction rate exponentially decays in the first 24 hours
When interactions end?

**Lifetime of a post**

When post reaches 95-th percentile of its interactions

- Mean lifetime is 50 hours for FB and 55 for IG
- The difference between FB and IG is small, even though on average FB attracts a smaller fraction of interactions than IG in the first hours
Can total interactions be *forecast by observing just a first initial period* after publication?

- Pearson correlation coefficient is 0.85
- Even after 15 minutes – Pearson correlation coefficient 0.83
- High variance of the number of interactions received by a post, which can be attributed to the large diversity in the posts’ intrinsic attractiveness
Temporal dynamics – example posts

How a single post attract interactions?

- Non-monotonic behavior of the rate of interactions
- Due to the non-stationary behavior of users’ activity during the day
- After 12 hours the first post received 70% of its total interactions, the second one 91%
Impact of newly published content

Is popularity affected by new posts published by the same influencer?

Disentangle the impact of newly published content from variability of interaction rate

- The fraction of total interactions obtained within a given time interval is correlated with the number of newly published posts
- New posts reduce the ‘novelty’ of the post
Conclusions

Important lessons for developing a model for the interactions temporal evolution

- Posts are characterized by an initial attractiveness, highly heterogeneous even across the posts published by the same influencer.

- Growth rate of interactions naturally decays over time, but the decay rate is itself highly diverse from post to post.

- Interaction rate should be modulated by the daily pattern of user activity, which appears to be independent of the particular online platform.

- New posts published by the same influencer progressively reduce the attractiveness of the original post.
Questions?

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