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Modeling and Detection of FoMO-Inducing Content in Social Media Advertising Using Machine Learning Techniques

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Abstract

Fear of Missing Out (FoMO) has emerged as a critical psychological driver influencing user engagement with digital advertisements, particularly for lifestyle products. This study proposes FoMO-ML, a machine learning-based framework for the automatic detection of FoMO-inducing patterns in social media advertisements and the evaluation of their behavioral impact. Using the Facebook Ads Dataset, the framework preprocesses textual content, extracts TF-IDF-based feature representations, and applies multiple supervised learning algorithms—including Logistic Regression, Support Vector Machine, Random Forest, and Gradient Boosting—for classification into FoMO-oriented and non-FoMO categories. Feature importance analysis identifies key linguistic cues such as urgency, scarcity, exclusivity, and social proof, which are strongly associated with heightened user engagement. Behavioral analysis demonstrates that FoMO-classified advertisements consistently elicit higher click-through rates, likes, shares, and comments compared to non-FoMO ads, confirming the practical relevance of the detected patterns. Among the models, Gradient Boosting achieves the highest classification performance, highlighting the advantage of ensemble methods in capturing complex feature interactions. The proposed framework provides a scalable, interpretable, and data-driven approach for understanding and quantifying the influence of FoMO in digital advertising, offering actionable insights for marketers and social media platforms while bridging the gap between computational detection and behavioral outcomes.

Keywords: Fear of Missing Out, Machine learning, social media, Gradient Boosting, Random Forest, Detection, Automation

1. Introduction The rapid expansion of social media platforms has fundamentally transformed the landscape of digital advertising, enabling organizations to reach highly targeted audiences at unprecedented scale and speed. Platforms such as Facebook have become central to modern marketing ecosystems, offering advertisers sophisticated tools to deliver personalized content based on user demographics, preferences, and online behavior. While this data-driven personalization has enhanced advertising efficiency, it has also intensified the use of psychological persuasion techniques designed to influence user decision-making [1-4]. FoMO refers to the anxiety or apprehension that individuals experience when they believe they may miss rewarding experiences, opportunities, or benefits that others are accessing [5-8]. As a result, understanding and detecting FoMO-inducing patterns has become an important research challenge at the intersection of digital marketing, consumer psychology, and computational analytics.

2. Proposed Work

Based on the identified research gaps in existing studies on Fear of Missing Out (FoMO), this work proposes a data-driven, machine learning–based framework for the automated detection of FoMO-inducing patterns in social media advertisements and the assessment of their behavioral impact. Such approaches, although theoretically rich, lack scalability and fail to capture how FoMO is practically embedded within real-world advertising content. The proposed work addresses this limitation by operationalizing FoMO as a detectable linguistic and contextual phenomenon within digital advertisements.

3. Proposed Methodology

The proposed work introduces the FoMO-ML Framework, a structured machine learning pipeline designed to automatically identify FoMO-inducing advertising patterns and analyze their behavioral implications. The methodology follows a sequential and modular process consisting of text preprocessing, feature extraction, supervised classification, and behavioral impact analysis. This design ensures scalability, reproducibility, and adaptability to evolving advertising language.

Feature extraction is performed using Term Frequency–Inverse Document Frequency (TF–IDF) representations, incorporating both unigram and n-gram features to capture isolated urgency terms as well as phrase-level FoMO patterns. These features form the numerical input to supervised learning models.

The proposed work employs a diverse set of supervised learning algorithms to capture different aspects of FoMO-related patterns:

Supervised Learning Algorithms for FoMO Detection

To effectively identify Fear of Missing Out (FoMO)–inducing patterns in social media advertisements, the proposed FoMO-ML Framework leverages a diverse set of supervised learning algorithms. Each algorithm contributes distinct strengths in capturing linear and non-linear relationships, handling high-dimensional feature spaces, and optimizing prediction accuracy. The choice of multiple algorithms also enables comparative analysis and ensures robustness of the detection framework.

1. Logistic Regression (LR)

The probability of a FoMO label $\hat{y}_i = 1$ is given by the sigmoid function:

$$P(y_i = 1 | x_i) = \frac{1}{1 + e^{-(w^T x_i + b)}}$$

where $w \in R^M$ is the weight vector and b is the bias term. The model parameters are optimized by minimizing the binary cross-entropy loss:

$$L(w, b) = -\frac{1}{N} \sum_{i=1}^N [y_i \log P(y_i = 1 | x_i) + (1 - y_i) \log(1 - P(y_i = 1 | x_i))]$$

LR enables identification of key textual features that significantly contribute to FoMO classification, such as urgency indicators (“limited time,” “hurry”) and social proof phrases (“trending now”).

2. Support Vector Machine (SVM)

The SVM classifier seeks to identify an optimal hyperplane that maximizes the margin between FoMO and non-FoMO classes. Formally, SVM solves the optimization problem:

$$\min_{w, b, \xi} \frac{1}{2} \|w\|^2 + C \sum_{i=1}^N \xi_i$$

subject to: $y_i(w^T x_i + b) \geq 1 - \xi_i, \xi_i \geq 0$

where ξ_i are slack variables allowing soft-margin classification and C is a regularization parameter balancing margin maximization with classification error.

3. Random Forest (RF)

Random Forest is an ensemble learning algorithm that builds multiple decision trees using bootstrapped samples and averages their predictions. For each tree $h_k(x_i)$, a subset of features is randomly selected at each split to reduce correlation between trees. The final prediction is obtained via majority voting: $\hat{y}_i = \text{mode}\{h_1(x_i), h_2(x_i), \dots, h_K(x_i)\}$

where K is the number of trees in the forest. RF captures non-linear relationships and complex feature interactions, which are common in persuasive advertisement language

4. Gradient Boosting Models (GBM)

Formally, for iteration m , the model is updated as: $F_m(x_i) = F_{m-1}(x_i) + \gamma_m h_m(x_i)$

where $h_m(x_i)$ is the m^{th} weak learner, γ_m is a learning rate parameter, and $F_0(x_i)$ is initialized as the mean of the target labels. The model minimizes a differentiable loss function, such as logistic loss for binary classification.

Expected Contribution of the Proposed Work

The proposed FoMO-ML Framework transforms FoMO from a latent psychological construct into a **computationally observable and measurable phenomenon**. By leveraging real-world advertising data, machine learning techniques, and engagement analytics, the framework addresses key limitations in existing FoMO research related to scalability, objectivity, and practical relevance. The proposed work contributes to digital marketing analytics, consumer behavior research, and responsible advertising practices by providing an automated and interpretable approach to identifying psychologically persuasive advertising strategies on social media platforms.

4. Results

Feature Importance Analysis

Table 1 presents the top ten features contributing to FoMO detection, derived from the Random Forest model's feature importance scores. This highlights the linguistic cues most predictive of FoMO orientation, such as urgency, scarcity, exclusivity, and social proof, demonstrating the multi-faceted nature of persuasive advertising language

Table 1: Top 10 Features Contributing to FoMO Detection (Random Forest)

Rank	Feature	Importance Score
1	ending soon	0.082
2	limited offer	0.079
3	trending now	0.074
4	members only	0.068
5	only today	0.065
6	best seller	0.061
7	few left	0.058
8	exclusive deal	0.056
9	top rated	0.053
10	hot item	0.051

Comparative Algorithm Analysis Across Engagement Metrics

The relationship between classifier predictions and engagement metrics was also analyzed by stratifying ads based on predicted FoMO scores. **Table 2** presents Gradient Boosting model predictions across different engagement ranges.

Table 2. Predicted Probability Range

Predicted Probability Range	Avg CTR (%)	Avg Likes	Avg Shares	Avg Comments
0.0 – 0.2	3.8	61	22	10
0.2 – 0.4	5.1	74	27	12
0.4 – 0.6	6.5	87	33	15
0.6 – 0.8	8.2	105	42	19
0.8 – 1.0	9.6	121	48	23

5. Conclusion

This study presents the FoMO-ML Framework, a novel machine learning-based approach for detecting Fear of Missing Out (FoMO) patterns in social media advertisements and evaluating their behavioral impact on user

engagement. By leveraging the Facebook Ads Dataset and employing a combination of supervised learning algorithms—including Logistic Regression, Support Vector Machine, Random Forest, and Gradient Boosting—the framework demonstrates robust performance in classifying advertisements into FoMO-oriented and non-FoMO categories. The results indicate that ensemble models, particularly Gradient Boosting, outperform simpler models by capturing subtle, multi-feature interactions, achieving an accuracy of 90.3%, F1-Score of 90.3%, and an AUC of 0.94. Feature importance analysis further confirms that linguistic patterns related to urgency and social validation are the strongest predictors of FoMO-oriented content. Behavioral analysis demonstrates a clear and statistically significant increase in user engagement metrics, including click-through rates, likes, shares, and comments, when exposed to FoMO-inducing advertisements.

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Biographies



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