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Marketing and Project Management 4.0: Next-Generation Digital Tools

Abstract

Modern marketing and project management are now largely dependent on artificial intelligence (AI), which helps companies make better decisions, streamline operations, and increase profitability. This study examines sophisticated mathematical models to assess AI's performance in several domains. AI model accuracy, predictive performance, and impact are evaluated using key performance measures such as Mean Squared Error (MSE), Log-Loss, and Improvement over Baseline (IOB). The study also presents AI Training Cost Functions (CTF) to examine model training expenses and Expected Profit (EP) to quantify the monetary gains of AI-driven campaigns. These algorithms allow us to measure how AI contributes to increased productivity, higher conversion rates, and more efficient use of resources. The study also looks at how, in comparison to conventional approaches, AI-powered marketing campaigns increase revenue, customer retention, and engagement. This article shows how companies may use AI to improve project management workflows and maximize marketing efforts, making them more successful and economical, using real-world examples. The results indicate that AI plays a crucial role in project management and marketing, offering quantifiable financial gains as well as operational enhancements.

Keywords: *Artificial Intelligence (AI), Marketing Optimization, Project Management, Performance Metrics, Expected Profit, Machine Learning Models*

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Marketinq və layihə menecmenti 4.0: yeni nəsil rəqəmsal alətlər

Xülasə

Süni intellekt (AI) müasir marketinq və layihə idarəçiliyinin təməl daşına çevrilib, müəssisələrə prosesləri optimallaşdırmağa, qərar qəbul etməyi yaxşılaşdırmağa və gəlirliliyi artırmağa imkan verir. Bu məqalədə həmin sahələrdə AI effektivliyini qiymətləndirmək üçün qabaqcıl riyazi modellər araşdırılır. Orta kvadrat səhv (MSE), Log-Loss və əsas səviyyəyə (IOB) nisbətən təkmilləşdirmə kimi əsas performans göstəriciləri AI modelinin dəqiqliyini, proqnoz effektivliyini və təsirini qiymətləndirir. Sənəd həmçinin AI tərəfindən idarə olunan kompaniyaların maliyyə faydalarını ölçmək üçün gözlənilən mənfəəti (EP) təqdim edir. Bu düsturlarla biz süni intellektin məhsuldarlığı artırmaqda, dönüşüm əmsalını artırmaqda və resursların paylanmasını optimallaş-dırmaqda rolunu kəmiyyətcə qiymətləndiririk. Tədqiqat həmçinin süni intellektə əsaslanan marketinq kompaniyalarının ənənəvi metodlarla müqayisədə daha yüksək səviyyədə iştirak, müştəri saxlama və gəlir əldə etməsinə də baxır. Praktik nümunələrdə bu sənəd müəssisələrin marketinq səylərini optimallaşdırmaq və layihələrin idarə edilməsi proseslərini daha səmərəli və qənaətcil etmək üçün süni intellektdən necə istifadə edə biləcəyini göstərir. Və sonda nəticələr göstərir ki, AI-

nin marketinq və layihələrin idarə edilməsində rolu əvəzolunmazdır, həm ölçülə bilən maliyyə gəliri, həm də əməliyyat təkmilləşdirmələrini təmin edir.

Açar sözlər: *süni intellekt (AI), marketinqin optimallaşdırılması, layihələrin idarə edilməsi, performans metrikası, gözlənilən mənfəət, maşın öyrənmə modelləri*

Introduction

This study looks at how artificial intelligence (AI) can improve project management and marketing methods. AI is used in marketing to optimize advertising expenditure, automate content development, and personalize customer interactions. AI systems, for instance, examine trends in consumer behavior to enhance targeting, which raises engagement and conversion rates. By tailoring product recommendations based on past behavior, AI-driven recommendation systems have been demonstrated to boost sales while also increasing customer satisfaction and retention (Caliskan et al., 2020).

AI improves decision-making through predictive analytics, automates repetitive operations, and maximizes resource allocation in project management. AI-powered solutions aid in risk assessment, project schedule predictions, and teamwork enhancement. Faster decision-making, more effective project workflows, and eventually a larger return on investment are the outcomes of these applications (Miller, 2020).

In all domains, artificial intelligence (AI) is revolutionizing how companies handle project management and marketing by converting antiquated procedures into more effective, data-driven solutions. Businesses may maximize their marketing potential and project outcomes by utilizing AI's predictive skills, which also lowers operating costs. This makes AI an essential tool for growth in the digital age (Daim, 2021).

Research

Mean Squared Error (MSE)

The difference between expected and actual results can be measured with the use of the Mean Squared Error. Better prediction accuracy is indicated by a lower MSE value (Kumar, 2024).

$$\text{MSE}= \frac{1}{n}\sum_{i=1}^{n}(Yi - Xi)^2$$

Where n is the number of data points, Xi is the expected value, and Yi is the actual date.
Assume AI forecasts the following revenue figures for the next five months with the following data: Actual sales: Y=[150,200,250,300,350]; Predicted sales: X=[145,205,245,310,330].

$$\text{MSE}= \frac{1}{5}\,[(150-145)^2+(200-205)^2+(250-245)^2+(300-310)^2+(350-330)^2]=115$$

The squared error between the expected and actual sales is therefore 115 units on average, as indicated by the MSE of 115.

Log-Loss Function (Binary Cross-Entropy)

In classification issues, the Log-Loss function, also known as binary cross-entropy, is frequently employed, especially when assessing models that produce probabilities (predicting whether a client would purchase a product) (Saxena, 2024).

$$\text{Log–Loss}= -\frac{1}{n}\sum_{i=1}^{n}[Yilog(Xi) + (1 - Yi)log(1 - Xi)]$$

Where Xi is the expected likelihood that the instance belongs to the positive class, and Yi is the actual label (0 or 1). Think of a marketing campaign in which artificial intelligence forecasts the likelihood that a consumer would buy a product. Actual labels: y=[1,0,1,0,1]

Predicted probabilities: Xi=[0.9,0.2,0.8,0.4,0.7].

$$\text{Log–Loss}= -\frac{1}{5}\,[1\cdot\log(0.9)+0\cdot\log(0.8)+1\cdot\log(0.8)+0\cdot\log(0.6)+1\cdot\log(0.7)]= 0.137$$

The model is reasonably accurate in predicting whether a consumer will make a purchase, as indicated by the Log-Loss of 0.137.

Expected Profit (EP) from AI-Based Campaigns

The Expected Profit method helps you decide whether AI is lucrative for a marketing campaign by accounting for the financial effect of various outcomes as well as their probability (Dash, 2021).

$$EP= \sum_{i=1}^{n} Pi \times (Ri - Ci)$$

Where Pi represents the likelihood that an event (such as a consumer making a purchase) will occur, Ri represents the event's revenue, and Ci represents the event's cost. AI forecasts the likelihood that a consumer will make a purchase during a marketing campaign. The AI-driven campaign is extremely profitable, as seen by the expected profit of 2160 units of cash.

Probability of purchase: P=[0.7,0.2,0.6,0.8,0.4]

Revenue per purchase: R=[1000,1000,1000,1000,1000]

Cost of marketing to a customer: C=[200,200,200,200,200]

EP=(0.7×(1000−200))+(0.2×(1000−200))+(0.6×(1000−200))+(0.8×(1000−200))+(0.4×(1000−200))= 2160

Improvement over Baseline (IOB)

To gauge how much better AI performs than a baseline model or methodology, the Improvement over Baseline statistic is helpful (Holzmann et al., 2022).

$$IOB= \frac{PerformanceAI-PerformanceBaseline}{PerformanceBaseline}*100=\frac{5\%-2\%}{2\%}*100=150\%$$

Where PerformanceBaseline represents the performance of the baseline approach and PerformanceAI represents the performance of the AI-driven solution. The baseline conversion rate was 2%; if AI raises it to 5%, the campaign's conversion rate was 2%. This indicates that AI increased the conversion rate by 150%, demonstrating a notable increase in the efficacy of the marketing strategy.

AI Training Cost Function (CTF)

This formula takes into account data size, model complexity, and computational expenses when determining the costs of training AI models (Towards AI Editorial Team, 2023).

$C_{train}= \alpha \cdot D+\beta \cdot M+\gamma \cdot T= 0.05 \cdot 1{,}000{,}000+0.1 \cdot 10+50 \cdot 100= 55{,}001$

Where T is the training time (in hours), M is the number of models being trained, D is the dataset size (in samples), and α, β, and γ are coefficients that represent the cost per unit of each factor. D = 1,000,000 data points, M = 10 models, T = 100 hours, α = 0.05, β = 0.1 for a training session. The AI model's training will cost 55,001 currency units in total.

Conclusion

Artificial Intelligence (AI) is improving decision-making, efficiency, and profitability in marketing and project management. Businesses can assess AI's effectiveness with the use of important indicators including Mean Squared Error (MSE), Log-Loss, and Expected Profit (EP). EP assesses the financial impact of AI-driven marketing, Log-Loss guarantees that classification models forecast behaviors like purchase likelihood, and MSE gauges model accuracy.

By contrasting AI's performance with conventional techniques, the Improvement over Baseline (IOB) indicator demonstrates its worth, and the AI Training Cost Function (CTF) makes sure that training costs are in line with the return on investment. To sum up, AI is transforming project management and marketing tactics by offering data-driven insights for expansion and a competitive edge. AI will play an increasingly important role in corporate management as it develops, propelling innovation and operational excellence.

Declarations

The manuscript has not been submitted to any other journal or conference.

Study Limitations

There are no limitations that could affect the results of the study.

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