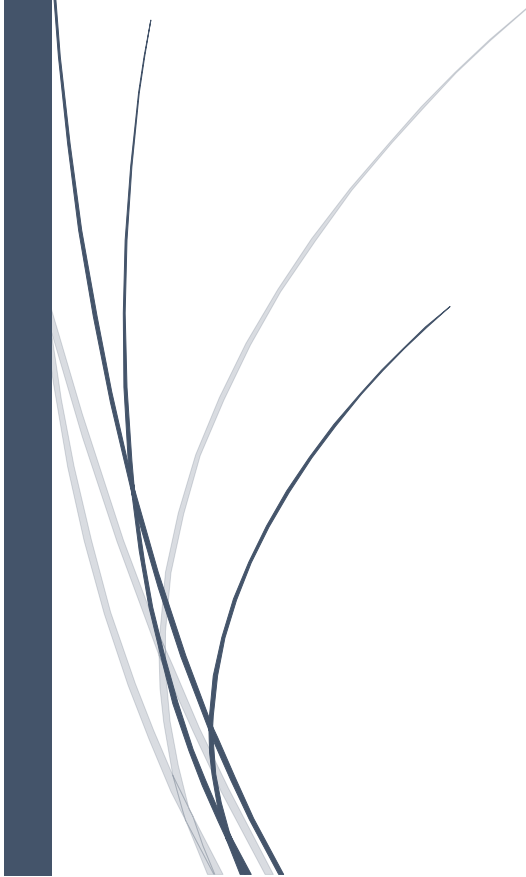


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RADemics

AI-Based Consumer Behaviour Prediction and Sales Forecasting in E-Commerce

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AI-Based Consumer Behaviour Prediction and Sales Forecasting in E-Commerce

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Abstract

The rapid expansion of e-commerce has generated vast volumes of consumer data, presenting both opportunities and challenges for businesses seeking to understand consumer behavior and optimize sales performance. Artificial intelligence (AI) and big data analytics provide robust frameworks for predicting consumer preferences, purchase intentions, and demand patterns with unprecedented accuracy. This chapter explores the integration of AI techniques, including machine learning, deep learning, and hybrid models, in consumer behavior prediction and sales forecasting. Multi-source data, encompassing transactional records, clickstream patterns, product reviews, and social media interactions, is leveraged to develop predictive models that enhance personalization, recommendation systems, and promotional strategies. Comparative analyses highlight the superior performance of AI-based forecasting methods over traditional approaches in capturing non-linear trends, temporal dependencies, and dynamic market shifts. Ethical considerations and privacy-preserving mechanisms are emphasized to ensure responsible use of consumer data while maintaining predictive accuracy. Case studies and practical implementations illustrate the application of AI-driven analytics in optimizing inventory management, dynamic pricing, targeted marketing, and customer engagement. The findings underscore the transformative potential of AI in enabling data-driven, adaptive, and strategic decision-making, offering e-commerce platforms a competitive advantage in increasingly complex digital markets.

Keywords: Artificial Intelligence, Consumer Behavior, Sales Forecasting, E-Commerce, Predictive Analytics, Big Data

Introduction

The evolution of e-commerce has fundamentally reshaped the global retail ecosystem, creating unprecedented opportunities for businesses to interact with consumers across diverse geographic and demographic segments [1]. The proliferation of digital platforms, mobile commerce, and internet-enabled services has resulted in the generation of massive volumes of data, encompassing transactional records, browsing histories, clickstream behavior, and product reviews [2]. These datasets contain valuable insights into consumer preferences, engagement patterns, and purchasing intent, which, when analyzed effectively, can enhance operational efficiency, marketing effectiveness, and revenue growth [3]. Traditional analytical techniques, which often rely on surveys, regression models, or heuristic approaches, are limited in their ability to manage the scale, complexity, and heterogeneity of these data sources. Advanced computational methods, including artificial intelligence (AI) and big data analytics, provide the capability to detect hidden patterns,

anticipate consumer behavior, and support decision-making processes in real time [4]. The integration of AI into e-commerce operations allows businesses to transition from reactive strategies to predictive and proactive frameworks, ensuring that product offerings, marketing interventions, and sales operations are aligned with evolving consumer demands [5].

Consumer behavior in online marketplaces is influenced by a complex set of factors, including individual preferences, socio-demographic attributes, browsing activity, social media interactions, and promotional stimuli [6]. Understanding these behavioral patterns is critical for designing targeted marketing campaigns, personalized recommendation systems, and dynamic pricing strategies [7]. Machine learning algorithms, including random forests, support vector machines, and gradient boosting methods, offer robust capabilities for modeling non-linear relationships between consumer actions and environmental variables [8]. Deep learning approaches, such as convolutional neural networks (CNNs) and recurrent neural networks (RNNs), further enhance predictive accuracy by processing sequential and unstructured data, including text reviews and visual product information. AI models can identify latent trends, segment consumers based on purchase likelihood, and forecast engagement patterns, providing actionable insights that enable businesses to optimize interactions across multiple touchpoints [9]. By leveraging these computational methods, e-commerce firms can enhance customer satisfaction, increase conversion rates, and improve retention through highly personalized experiences [10].