RADemics

Machine Learning Models for Climate Change Effects on Economic Growth

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Abstract

Climate change presents an unprecedented challenge to global economies, with profound and far-reaching impacts on various sectors. The tourism industry, a major contributor to the global economy, is particularly vulnerable to climate-induced disruptions, including rising temperatures, shifting precipitation patterns, and extreme weather events. This chapter explores the application of machine learning (ML) models for forecasting the economic consequences of climate change on the tourism sector. By integrating climate projections with economic data, ML techniques provide powerful tools for understanding how changes in the environment will affect tourism demand, regional economic stability, and sectoral performance. The chapter discusses the use of supervised and unsupervised learning methods, as well as advanced deep learning techniques, to predict shifts in tourism patterns and revenue generation under different climate scenarios. Emphasis is placed on the importance of granular, high-resolution data and the challenges of incorporating regional disparities and model uncertainty. The chapter also highlights how ML can support adaptive strategies for policy-makers and industry stakeholders, helping to mitigate the economic risks posed by climate change. By leveraging the capabilities of machine learning, the tourism sector can better prepare for future disruptions, ensuring resilience and sustainability in the face of a rapidly changing climate.

Keywords: Climate Change, Economic Impact, Tourism Industry, Machine Learning, Forecasting, Adaptive Strategies.

Introduction

Climate change represents one of the most profound challenges faced by economies around the world today, with its multifaceted impacts being felt across sectors and regions [1]. Among these, the tourism industry is particularly vulnerable, as it depends heavily on stable climatic conditions and environmental resources [2]. Increased temperatures, changing weather patterns, rising sea levels, and the intensification of extreme weather events are altering the landscape of tourism destinations, threatening their viability and attractiveness [3]. These shifts not only disrupt the natural environment but also affect the socio-economic fabric of regions that depend on tourism for income, employment, and growth [4]. Consequently, assessing the economic impacts of climate change on the tourism sector is essential for enabling decision-makers to implement effective strategies to mitigate risks and adapt to new realities [5].

Tourism, a key driver of global economic growth, is expected to face disruptions due to the adverse effects of climate change [6]. It contributes significantly to GDP, generates employment opportunities, and acts as a source of foreign exchange for many countries [7]. Coastal destinations, for example, are already experiencing the repercussions of sea-level rise and more frequent storms [8]. Similarly, regions dependent on winter sports are witnessing shorter ski seasons due to warmer temperatures. These disruptions not only affect the destinations themselves but also the global tourism value chain, including airlines, hospitality, and local services [9]. Forecasting the future economic disruptions in tourism due to climate change is critical, as it provides actionable insights for adapting policies, diversifying tourism offerings, and investing in climate-resilient infrastructure [10].

Machine learning (ML) has emerged as a powerful tool for understanding the complex dynamics between climate change and economic systems [11]. ML algorithms can process large volumes of data, identify patterns, and make predictions that are far more accurate than traditional models [12]. In the context of tourism, ML can be used to integrate climate data, historical visitor trends, and economic indicators to forecast how changes in climate conditions will impact tourism demand and revenue [13]. Through supervised learning methods, such as regression analysis and decision trees, ML models can estimate the potential economic losses or gains in tourism under various climate scenarios [14]. These models can incorporate a wide range of climate variables, such as temperature, precipitation, and extreme weather events, to provide more precise forecasts that account for regional differences and sectoral impacts [15].