Adapting to Change:
The Effects of Climate Change on Athens' Tourism Sector

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Extended Abstract: The tourism sector is one of the most vital industries, playing a crucial role in job creation, revenue generation, and cultural exchange. However, climate change presents a significant challenge to this industry, posing substantial risks to its future growth and stability. Rising temperatures, shifting precipitation patterns, and sea-level rise impact not only natural and man-made tourist attractions but also tourism-related resources and assets. With climate change intensifying over the years, its consequences are becoming more evident across various destinations, forcing tourism-dependent economies to reconsider long-term strategies. As extreme weather events become more frequent and unpredictable, traditional tourism seasons may be disrupted, resulting in economic instability. Furthermore, shifts in tourist preferences due to climatic changes necessitate new approaches to sustainable tourism planning. Addressing these challenges requires urgent interventions that integrate climate adaptation measures with tourism development policies to ensure industry resilience.

This paper adds to the existing body of literature by using Athens as a case study. As one of the world's oldest cities, located in Greece and characterized by a Mediterranean climate, Athens faces both challenges and opportunities due to climate change. Employing a quantitative approach, this study investigates the extent to which climate factors influence the resilience of Athens' tourism industry. More specifically, it contributes to the literature by providing a thorough econometric analysis of the effects of climate variability on tourism in Athens. Firstly, the study utilizes a comprehensive dataset spanning nearly three decades (1995–2023), incorporating climatic variables such as precipitation and temperature, as well as macroeconomic indicators and tourism-specific metrics, to examine the relationship between climate conditions and tourism expenditures. Secondly, it highlights the seasonal variations in climate impacts, demonstrating that temperature and precipitation significantly affect tourism activity during different periods of the year. Thirdly, the findings stress the necessity of adaptive policy measures, particularly in urban infrastructure and sustainable tourism strategies, to enhance Athens' resilience against climate-related disruptions. By presenting data-driven

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insights, this study contributes to formulating targeted strategies that mitigate the negative impacts of climate change, ensuring the long-term viability and competitiveness of Athens' tourism sector amid an evolving global climate crisis. Additionally, this study seeks to foster discussions on how Athens can leverage its historical and cultural heritage to counteract the adverse effects of climate change. By integrating climate adaptation measures into urban planning and tourism management, policymakers can enhance the city's resilience while ensuring sustained economic benefits from tourism.

In this study, we utilize data reflecting tourist traffic in Athens alongside climatic conditions and key macroeconomic indicators that capture the broader economic landscape. Specifically, tourist traffic is measured using total tourist arrivals and tourism expenditures. Climatic conditions are represented by average temperature and cumulative precipitation levels, while broader economic conditions are assessed through the inclusion of variables such as inflation rates and the Consumer Confidence Index. The dataset comprises monthly data spanning the period from 1995 to 2023. The analysis is conducted in two stages: first, by applying robust standard errors, and second, by clustering standard errors according to seasonal patterns. This methodological approach allows us to systematically introduce variables to evaluate their individual and combined effects on tourism expenditures. Additionally, the use of robust and clustered standard errors helps address potential heteroskedasticity and intra-seasonal correlations within the data, thereby strengthening the validity of our findings. By employing a rigorous methodological framework, this study ensures a more accurate representation of the long-term relationship between climate factors and tourism. Understanding these dynamics is essential for developing proactive policies that mitigate risks and capitalize on emerging opportunities in a changing climate landscape.

Our results reveal that, on average, approximately 274,000 tourists visit Athens each month, with the mean monthly temperature recorded at 18.7°C. However, over the past 30 years, climate change has led to a nearly 2°C increase in Athens' annual average temperature. Specifically, seasonal temperature increases have been recorded at 1.3°C in winter, 1.4°C in spring, 1.8°C in summer, and 2.7°C in fall over the last three decades, illustrating the significant impact of climate change on Athens' climate. As extreme temperatures become more frequent, visitor comfort and overall travel experiences are significantly affected, potentially altering tourism demand. For instance, prolonged heat waves could discourage tourists from engaging in outdoor sightseeing activities, such as visiting archaeological sites and open-air museums, which form the core of Athens' cultural tourism appeal. Moreover, increased energy demands for cooling systems in hotels and transportation services could drive up operational costs, affecting both businesses and tourists. Thus, climate change is reshaping not just visitor numbers but also the broader economic dynamics of the city's tourism sector.

Tourist arrivals peak in the summer months, averaging 360,000 per month, with corresponding increases in tourism expenditures. Conversely, winter experiences the lowest tourist traffic, reaffirming that Athens is not a favored winter travel destination. A similar trend is observed in tourism spending, which is highest in the summer and lowest during the winter months. The seasonality of Athens' tourism sector highlights its vulnerability to climate variations, making it imperative to diversify offerings beyond peak summer months. Expanding year-round tourism, such as through cultural festivals, gastronomy tourism, and wellness tourism, can provide alternatives that are less climate-dependent. Furthermore, addressing seasonality through strategic marketing and infrastructure development could help sustain tourism revenue even in off-peak months. A concerted effort to adapt tourism strategies to climate realities is necessary to maintain Athens' appeal and competitiveness in the long term.

The relationship between temperature and tourism expenditures yields particularly noteworthy findings. Across both econometric approaches employed, our results indicate that higher temperatures exert a statistically significant negative impact on tourism spending. This suggests that rising temperatures deter visitors from traveling to urban destinations and large cities, underscoring the long-term risks posed by climate change and rising temperatures to the sustainability of Athens' tourism industry. Additionally, while precipitation levels also demonstrate a statistically significant impact on tourism expenditures, the magnitude of this effect is relatively modest. This finding suggests that temperature-related factors are more influential in shaping tourist behavior compared to rainfall patterns. However, extreme precipitation events, such as sudden storms or flooding, could still disrupt tourism-related activities and infrastructure, emphasizing the need for resilience planning. Given that climate change is expected to intensify both heat waves and extreme precipitation, cities like Athens must proactively invest in adaptive strategies that ensure the tourism sector remains viable despite changing environmental conditions.

Given the considerable seasonal variations in climate conditions, we extended our analysis by conducting separate regressions for each season. Our findings indicate that temperature significantly affects tourism spending in the spring and fall, but not during the summer or winter. Specifically, increases in average temperature during spring and fall negatively influence tourist expenditures. This suggests that during these periods—when weather conditions are typically favorable for visiting historical sites such as the Acropolis and the Ancient Agora—further increases in temperature discourage tourists from engaging in such activities. In contrast, temperature does not exhibit a statistically significant effect on tourism expenditures during the winter and summer seasons.

This study demonstrates that it is high time to implement complex measures regulating climate change to minimize its effects on the tourism business. Due to these conditions, it can be stated that regional and organizational stakeholders must focus on the elements of innovation and collaboration together with the construction of resilience. It is only when the global tourism industry and the broader economy collectively embrace sustainability that the sector and the economy can grow and prosper in an unpredictable climate environment. In the case of Athens, climate change is a threat to one of the most important sources of income, i.e. tourism. High temperatures, protecting against heat stress, and shortages of water are also factors affecting the tourist preferences and may negatively affect the city attractive-ness in summer. However, Athens has the chance to do so by using its cultural and historical background as a tool for developing sustainable and all-seasons tourism. Policy actions including upgrading urban facilities to withstand climate change effects, increasing better green space and energy from renewable sources could not only help to counter climate change but also promote tourism to eco tourists. Thus, incorporating climate resilience into the Tourism Master Plan is a way for Athens to become a world pioneer in sustainable tourism that will serve as a model of long-term sustainable economic development in response to the climate change.

Keywords: Athens, Climate, Weather, Precipitation, Temperature, Tourism.