Forecasting Edinburgh's Tourism Demand

Introduction

Over tourism and unpredictable visitor fluctuations have become pressing issues for Edinburgh's tourism industry. Managing resources amidst volatility in demand hampers sustainability efforts and strains local small and medium enterprises (SMEs). Forecasting models, leveraging tourism data, economic trends, and environmental impact projections, could enable data-driven planning and resilient, sustainable growth. We would like to develop an accessible mathematical model that provides key insights to support tourism SMEs and policymakers.

Problem Definition

The core problem this modelling challenge aims to address is unpredictable tourism demand and its cascading effects on sustainability and local businesses. Current resource allocation and planning practices lack robust quantitative methods to forecast visitor volume and associated environmental impacts. This results in reactive responses, waste from under- or over-preparation, missed opportunities, and uncoordinated policies. SMEs in particular need targeted decision support to optimise operations based on demand signals.

Objectives

The objectives are to develop a practical forecasting tool providing visitor volume and visitor segmentation projections. These could look at any or all of the following time horizons:

- **1 week in advance**: Enables SMEs to fine-tune staffing levels, inventory orders, and operational capacity for the upcoming week.
- **3 months in advance**: Supports SME and destination organisations marketing plans, seasonal capacity adjustments, and resource allocation for the quarter ahead.
- **1 year in advance**: Allows destination organisations and SMEs to strategically budget, manage capital projects, and coordinate with policymakers for major events/seasons.

The model should leverage historical tourism data, economic indicators, and environmental impact projections to provide actionable insights. The primary aim is equipping SMEs across the tourism industry with accurate short, medium and long-term demand forecasts to improve financial planning, and staffing, marketing and sustainable practices. Secondarily, the model should inform infrastructure development and policies supporting sustainable tourism growth.

Data Sources

The following datasets from around 2018-2022 have been provided:

- Airdna data - listings and occupancy rates
- Edinburgh Castle, Craigmillar Castle and National Museum visitor numbers
- Hotel revenue and occupancy data
- Google Trends and Skyscanner search data
- Event listings from Data Thistle
- ScotRail passenger journey data
- Tamoco footfall data (excluding EU visitors) and Edinburgh New Town footfall (Essential Edinburgh)
- Edinburgh International Festival ticket sales
- East Lothian beach car park sensors
- Links to publically available tourism data from surveys and other sources

Potential data gaps:

- Granular data on non-hotel/Airbnb visitors
- Geographic visitor flow and location data
- Visitor demographics and trip purpose
- Tourism environmental impact data
- Future economic/geopolitical events
- More real-time data sources

Helpful References

https://thedatalab.com/tech-blog/using-generalised-additive-mixed-models-gamms-to-predict-visitors-to-edinburgh-and-craigmillar-castles/

Traveltech for Scotland