Inbound Tourism to Ireland: Using Machine Learning to Predict Demand

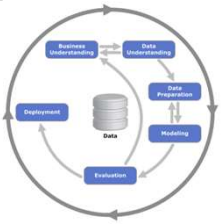
Parhad Keyim Idikut, CCT College Dublin, May 2025

INTRODUCTION

- **Project aim**: produce Irish inbound tourism demand forecasting models.
- **Research hypothesis**: Irish inbound tourism, as a part of international tourism, will continue to grow overall, but will experience temporary fluctuations.

STRATEGIC OVERVIEW OF THE BUSINESS PROBLEM: IRISH INBOUND TOURISM

- **General Goal**: The prediction could supplement the Irish tourism sustainable development strategy by equally considering the environmental and socio-economic impacts of the industry.
- **Ethical Considerations**: It is important to consider all potential forecasting biases which might be caused by inadequate data in terms of size and content.
- Project Plan and **Methodology**: Project is implemented by utilising the **CRISP-DM** methodology. It is a **cyclical** process that encourages continuous improvement. Thus, any problems that arose from the stage of this project are resolved by looping back to an earlier stage, until a desirable result is produced.



Source: Shearer, C., 2000. The CRISP-DM model: the new blueprint for data mining. Journal of Data Warehousing, 5(4), pp.13-22.

BUSINESS UNDERSTANDING: IRISH INBOUND TOURISM

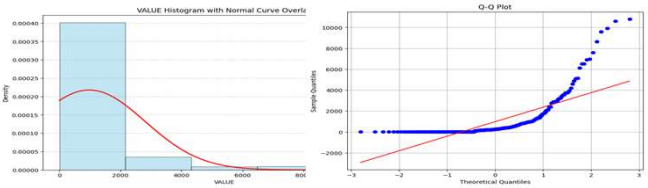
- Tourism is the country's largest indigenous industry and biggest regional employer.
- The Irish government aims to implement a sustainable development strategy.
- The inbound tourism demand prediction is relevant to the Irish government's strategy of prioritising the economic value per visitor over the volume of tourists visiting.

TECHNOLOGIES USED

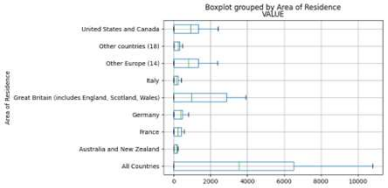
- **Libraries and Models:** Pandas, NumPy, Matplotlib, Seaborn, Scikit-learn, Sklearn, Sktime, Shapiro-Wilk Test, QQ-plot, ANOVA, Box plot, Adfuller, ACF, PACF, ARIMA, SARIMAX, and Theta Forecaster.
- **Model Selection and Appropriateness**: focused on **time series analysis** because forecasting tourism demand is a prediction problem.

DATA UNDERSTANDING

- **Data Sources/Acknowledgements**: Two datasets, covering the years 1983 – 2008 and 2009 – 2019, were obtained from the Central Statistics Office of Ireland. The datasets are open source for non-commercial use.
- **Descriptive Statistics and Findings:** It needs to perform a transformation, e.g., **differencing**, to **normalise the time series data to deal with non-stationarity**. Since stationary data **could improve the prediction accuracy**.

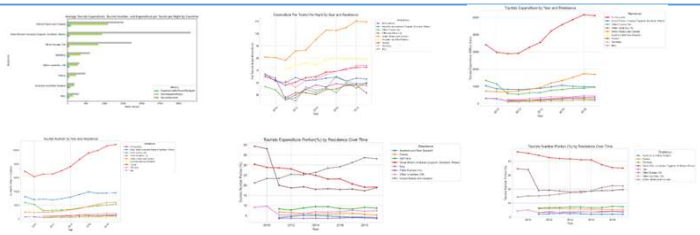


- **Boxplot** of nationality of the inbound tourists to Ireland: the most "VALUE" of inbound tourists to Ireland come from Great Britain, the United States and Canada (combined), Germany and France.



DATA PREPARATION

- **Data Cleansing, Formatting, EDA, and Identification of Relevant Variables and Features of Prediction:** Overall, the data preparation results, and visualization suggests, **the United States, Canada and Great Britain** are the main contributors to Irish inbound tourism.

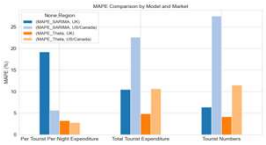


FORECASTING AND EVALUATING IRISH INBOUND TOURISM: ARIMA, SARIMA, AND THETA MODELS

- Data **stationarity** is checked by using the **ADF test**. Performed **ACF and PACF plots** to estimate the time-series model-building parameters such as **p, d, and q**.
- Key **forecasting indicators**: Total Tourist Expenditure, Per Tourist Per Night Expenditure, and Tourist Numbers.
- **Forecasting for the UK:**

- **Forecasting for the US/Canada:**

- **Model Evaluation and Comparison**: the Mean Absolute Percentage Error (**MAPE**); lower values reflect better model performance.
- The Theta model consistently outperforms the SARIMA model across all tourism indicators examined.



CHALLENGES ENCOUNTERED AND SOLUTIONS

- Main **challenges**: data size and its contents.
- **Solutions**: Combined data to produce a bigger dataset that covers the period from 1983 to 2019. Produced 10 years of future yearly dates from 2020 to 2029.

FINDINGS, RECOMMENDATIONS, AND CONCLUSION

- The UK remains the highest-volume source market, i.e. in terms of **tourists' number**.
- The US/Canada tourists represent a **higher per-visitor expenditure**, and the **forecasting** indicates that this trend is a **gradual growth**.
- **Recommendations**:
- The **Theta model** should be considered for use in the Irish inbound tourism forecasting.
- The Irish Tourism Authority should conduct dedicated **tourist behaviour surveys and statistical reporting on key markets** of Great Britain and the United States and Canada. These enriched datasets would help to conduct of more effective forecasting.
- Ireland's tourism **strategy should shift from mass tourism to value-driven tourism** products and services.
- In **summary**, there is a shift from British tourists' **dominance towards the United States & Canadian tourists**, in both spending and visitor numbers.
- The prediction models **should be continuously improved** in future projects.

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