Val di Fassa Accommodation Tourism
Statistical Analysis

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1. Introduction

Tourism is a cornerstone of the Val di Fassa economy, attracting visitors from around the globe with its breathtaking landscapes and cultural heritage. However, understanding and optimizing tourism patterns require comprehensive analysis of visitors behaviors, regional comparisons, and forecasting trends.

The primary goal is to analyze tourism patterns in Val di Fassa, comparing local trends with other mountain regions to identify key drivers of tourist arrivals. By understanding these patterns, we want to provide actionable insights for stakeholders to enhance tourism strategies.

Preliminary Hypotheses

1. The influx of tourists to Val di Fassa is significantly influenced by seasonal variations compared to other mountain regions.
2. Trentino exhibits a more balanced ratio of foreign versus Italian tourists compared to Val di Fassa.
3. Economic factors such as accommodation costs and transportation availability play a critical role in shaping tourist preferences.

2. Data Presentation and Exploratory Data Analysis (EDA)

In this chapter, we provide a detailed presentation of the dataset and perform an exploratory data analysis (EDA) to uncover patterns, trends, and insights about tourist arrivals in Val di Fassa. This analysis will set the foundation for further modeling and comparisons.

2.1. Val di Fassa Data Preliminary Analysis

The focus of this section is to analyze the preliminary data specific to Val di Fassa, understanding patterns of tourist arrivals over time, and examining the distinctions between various categories such as Italians and foreigners, as well as the preferences for hotels versus non-hotel accommodations.

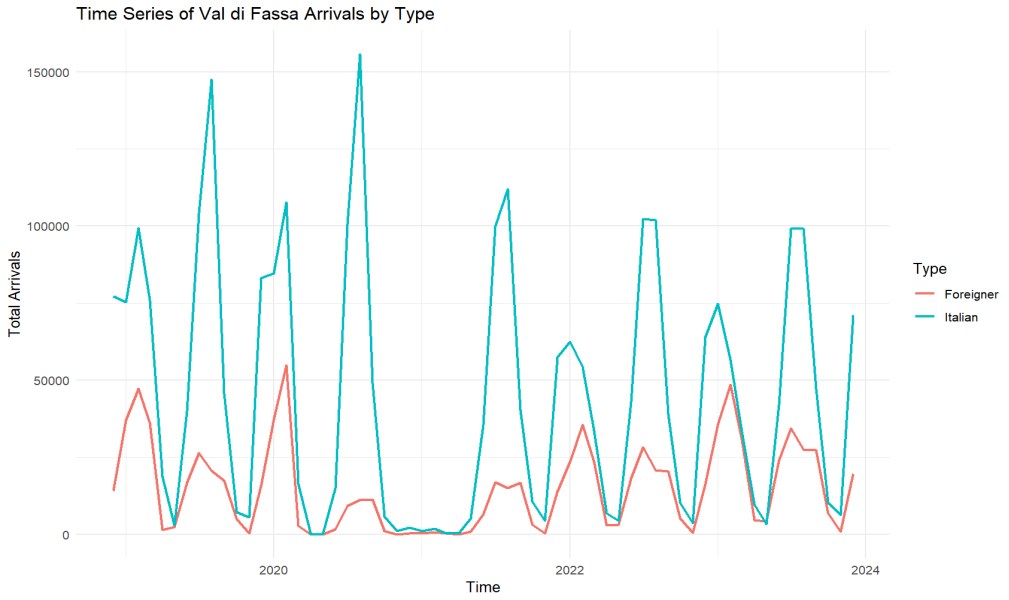

Figure 2.1.1: Time Series of Val di Fassa Arrivals

Figure 2.1.1 presents a time-series analysis of tourist arrivals, segmented into Italian and foreign arrivals. It highlights clear seasonal trends with significant peaks during winter and summer months, corresponding to ski and holiday seasons.
This seasonal behavior shows the strong impact of holiday periods and emphasizes the importance of international marketing strategies to increase foreigner influx.

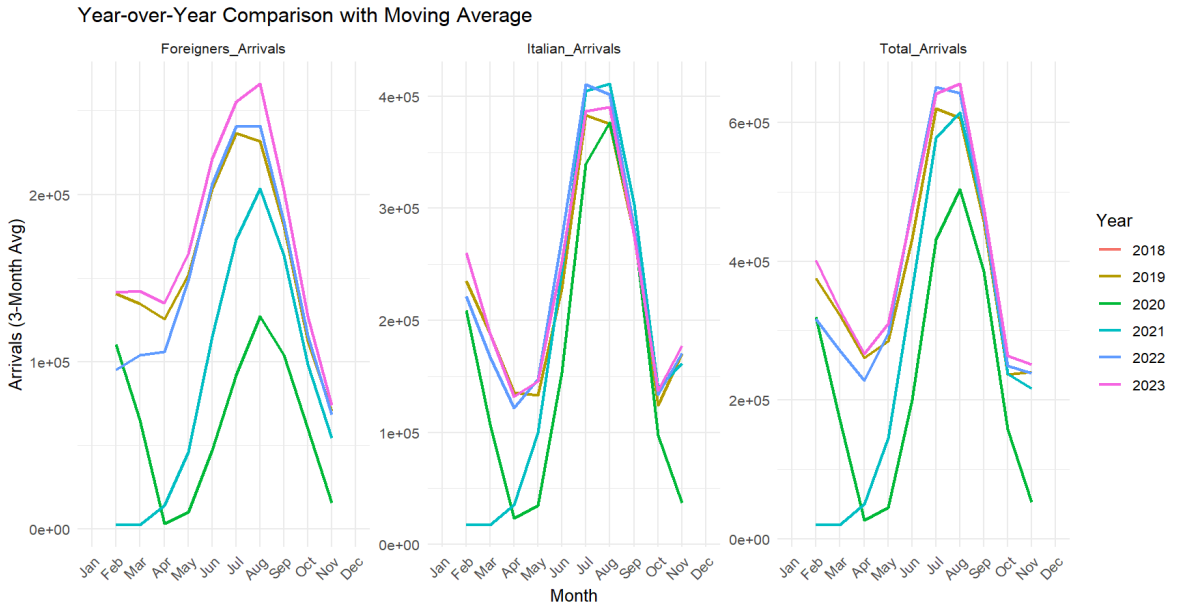

Figure 2.1.2: Year-over-Year Comparison of Arrivals (3-Months Moving Average)

Breaking down arrivals by year and month:

- We can observe gradual recovery post-2020, likely influenced by the COVID-19 pandemic.
- Italian arrivals have shown resilience and steady growth across the years.
- The total arrivals highlight a synchronized seasonal pattern with a growing trend in recovery since 2021.

However, if we take a look at the accommodation preference of the tourists we can have a deeper insight.

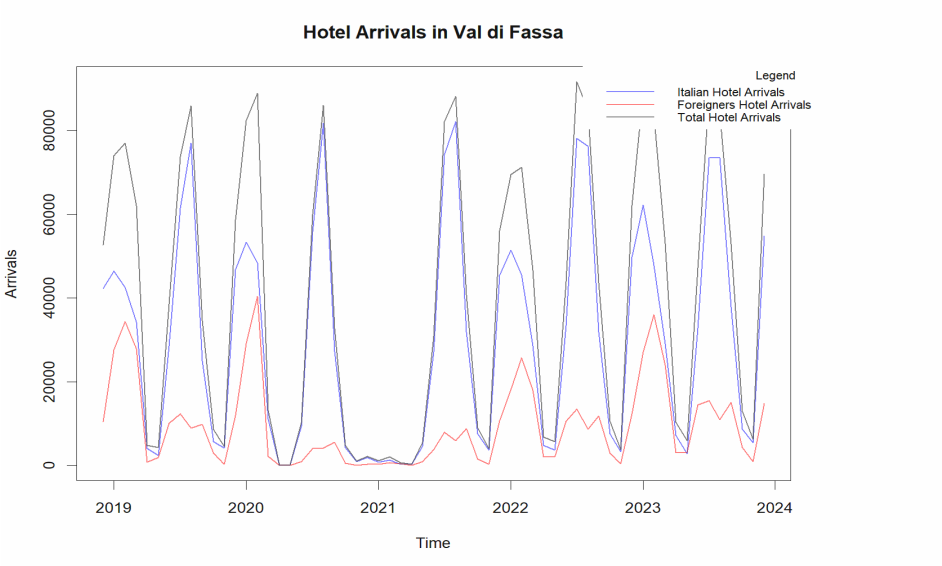

Figure 2.1.3: Val di Fassa Hotel Arrivals Time Series

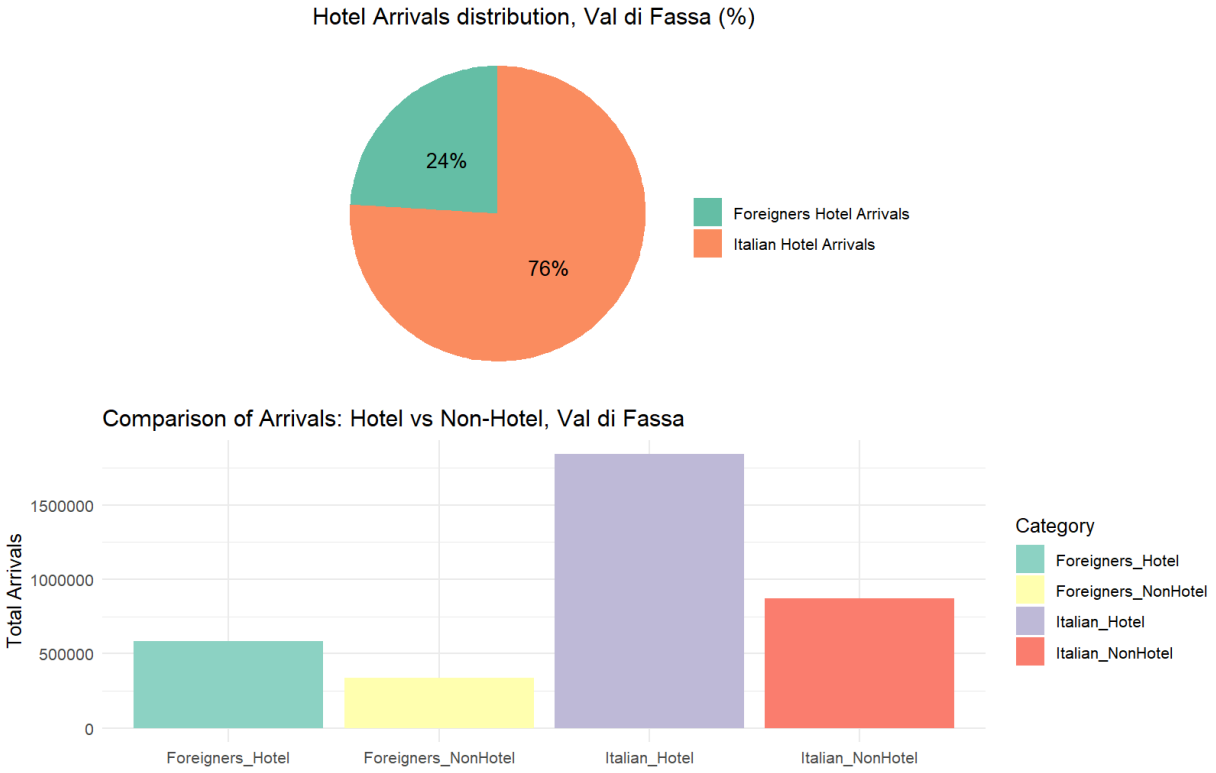

Figure 2.1.4: Hotel vs. Non-Hotel Arrivals

Figure 2.1.3 provides a breakdown of hotel arrivals for Italians, foreigners, and the total arrivals. This finding highlights:

- Italians' stronger inclination toward hotel accommodations.
- Foreigners have a slightly higher tendency to choose non-hotel options compared to Italians, which suggests potential growth areas for non-hotel facilities and services in Val di Fassa.

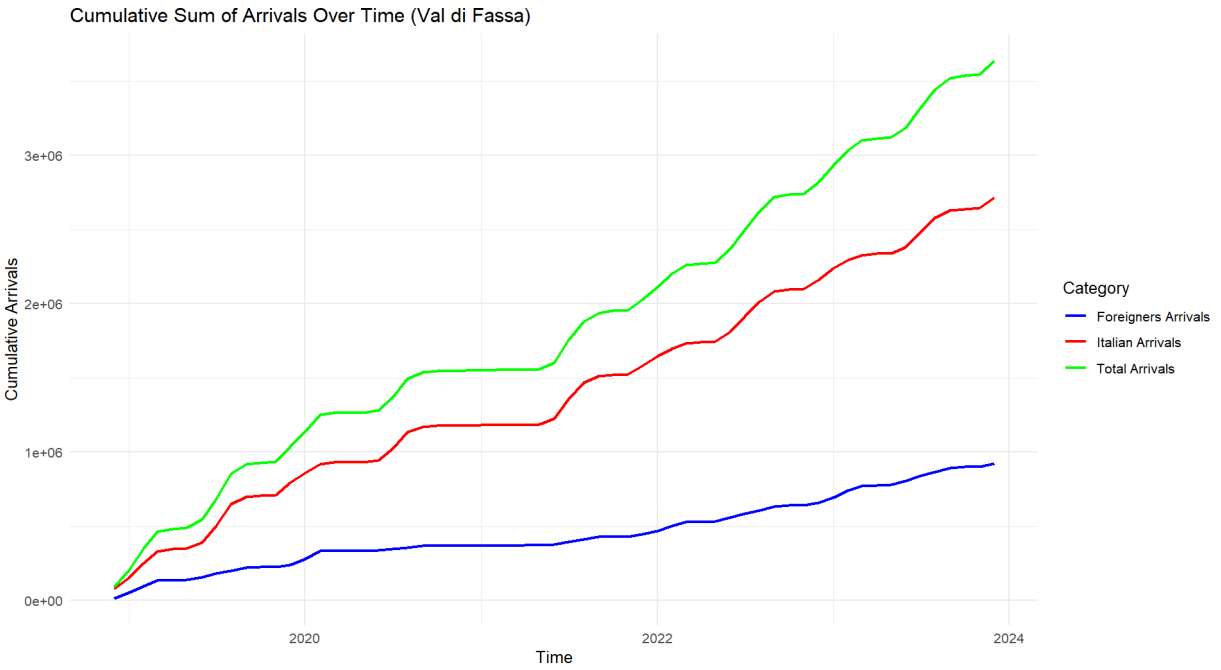

Figure 2.1.5: Cumulative Sum of Arrivals Over Time

Long-term trends in tourist visits demonstrates there has been a steady upward trend, with Italians making the largest contribution to the overall total. The consistent gap between Italian and foreign arrivals highlights the importance of enhancing strategies to attract more international tourists.

2.2. Trentino Data Preliminary Analysis (Comparison with Val di Fassa)

In this section, we expand our analysis to the entire Trentino province, comparing its trends to Val di Fassa to uncover similarities and distinctions in tourist arrivals.

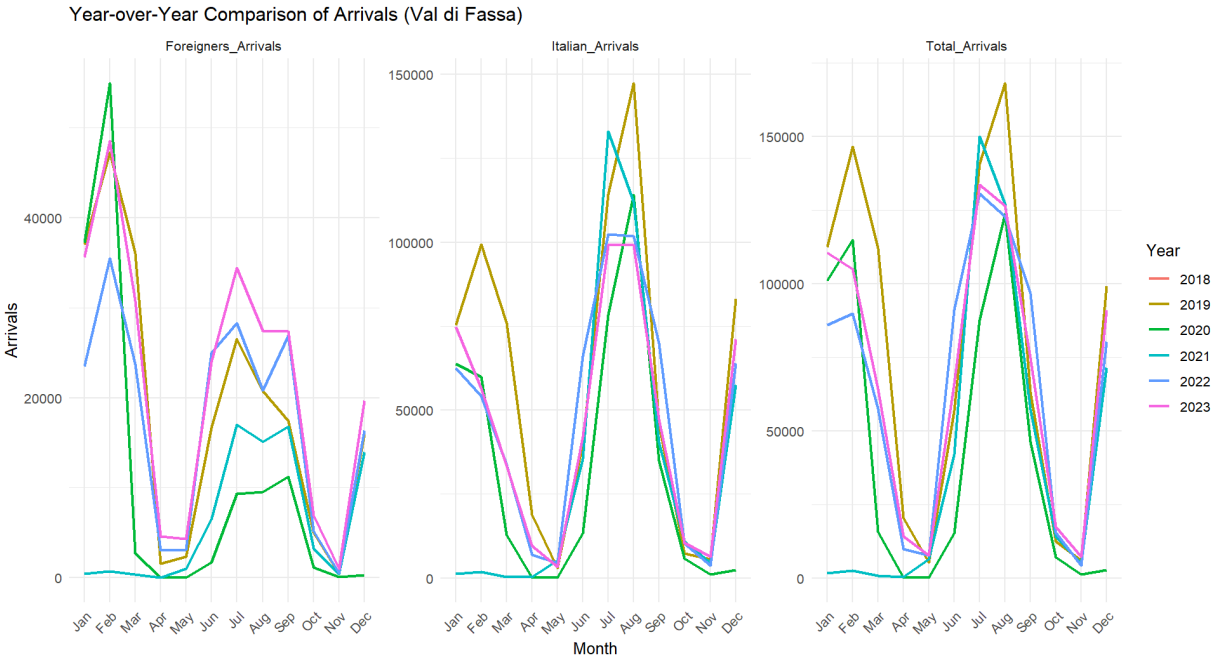

Figure 2.2.1: Year-over-Year Comparison of Arrivals in Trentino

While similar seasonal patterns exist, Trentino shows a broader distribution of total arrivals, possibly due to its more diverse offerings compared to Val di Fassa.

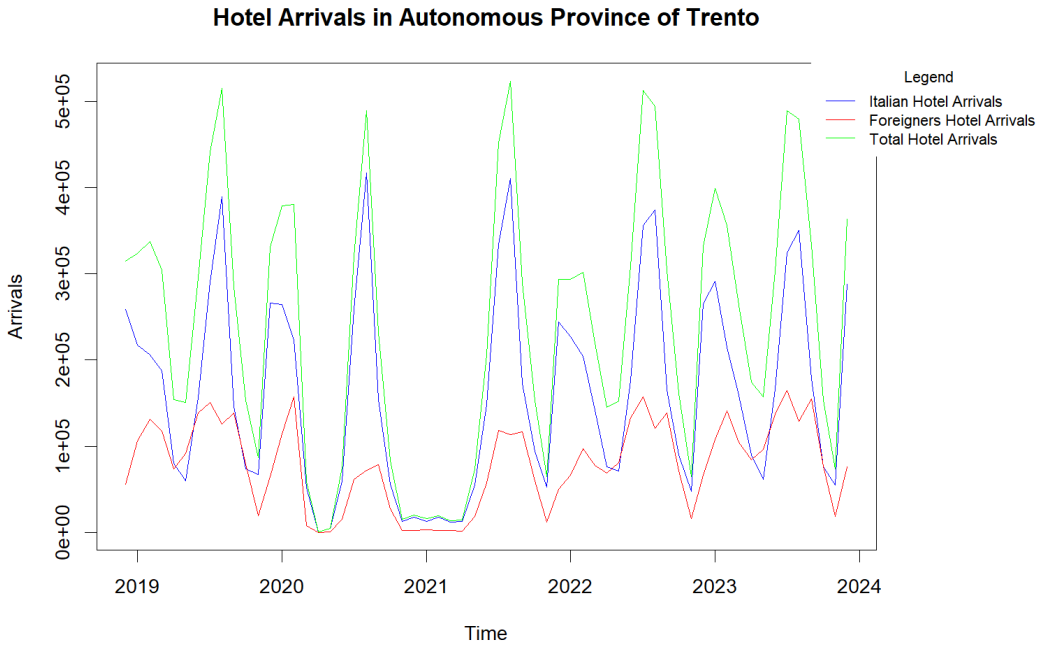

Figure 2.2.2: Hotel Arrivals in Autonomous Province of Trento

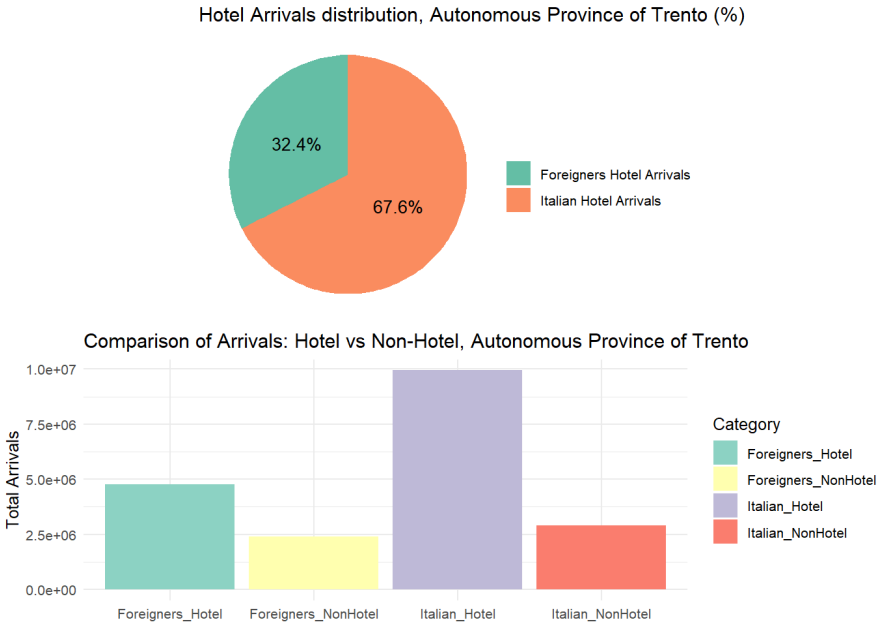

Figure 2.2.3: Hotel Arrivals in Autonomous Province of Trento

The pie charts and bar plots reveal the distribution of hotel versus non-hotel accommodations:

- Italians prefer hotel accommodations, comprising 67.6% of total hotel arrivals.
- Foreigners exhibit a slightly higher preference for non-hotel accommodations compared to Italians, with non-hotel options constituting 45.1% of their total arrivals.

These findings indicate that while Trentino's infrastructure supports a broad spectrum of tourists,

there is room for growth in non-hotel options, particularly for foreign tourists.

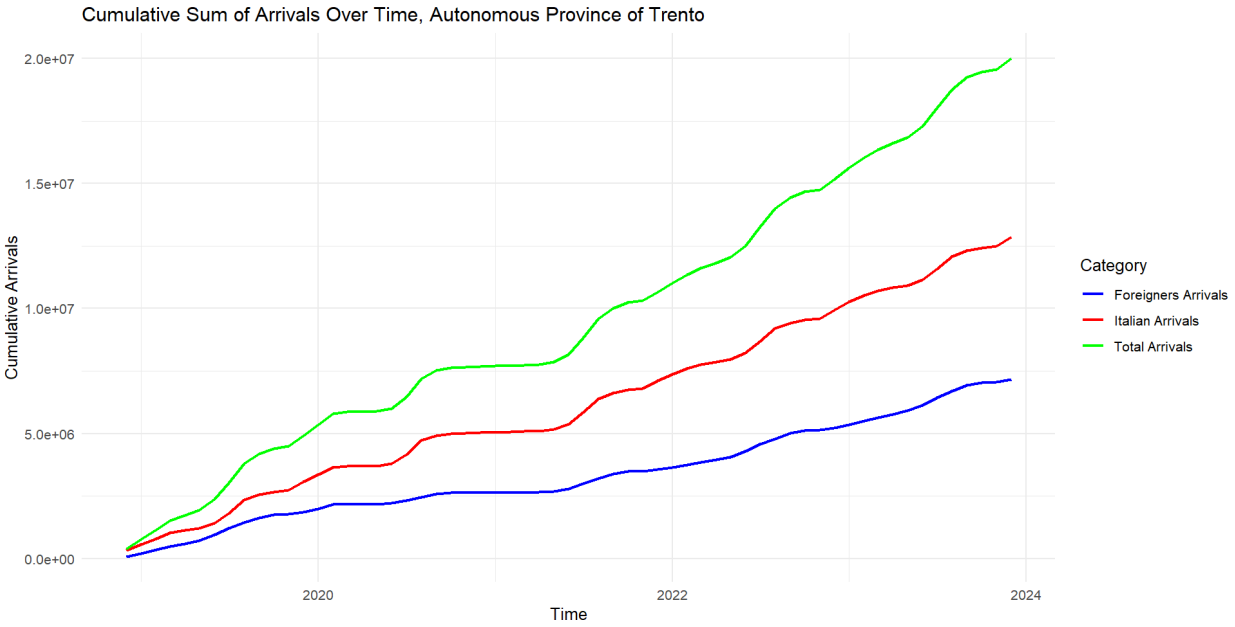

Figure 2.2.4: Cumulative Sum of Arrivals Over Time, Autonomous Province of Trento

This comparative analysis highlights Trentino's wider appeal and stronger infrastructure, while also identifying specific areas where Val di Fassa can focus on growth within the regional framework.

2.3. Trento Province vs Other Mountain Regions

To broaden our understanding, we compare Trento Province's tourism performance to other prominent mountain regions in northern Italy, including Bolzano, Aosta, Sondrio, and Belluno. This analysis highlights Trento's competitive position and areas for improvement.

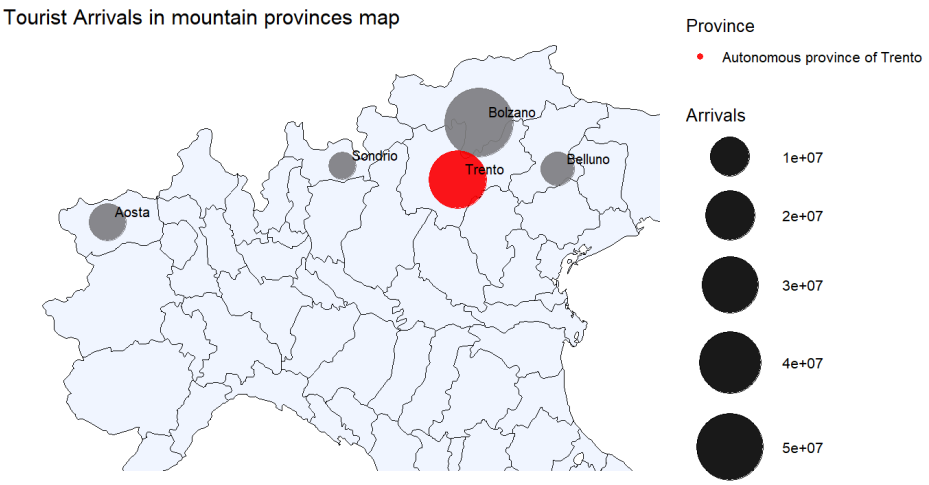

Figure 2.3.1: Tourist Arrivals in Mountain Provinces Map

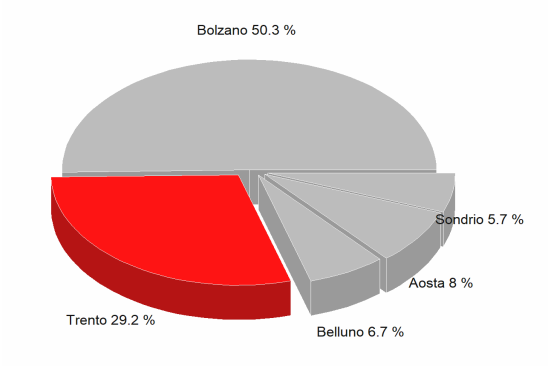

Figure 2.3.2: Mountain Provinces of Italy Arrivals (2016 - 2023)

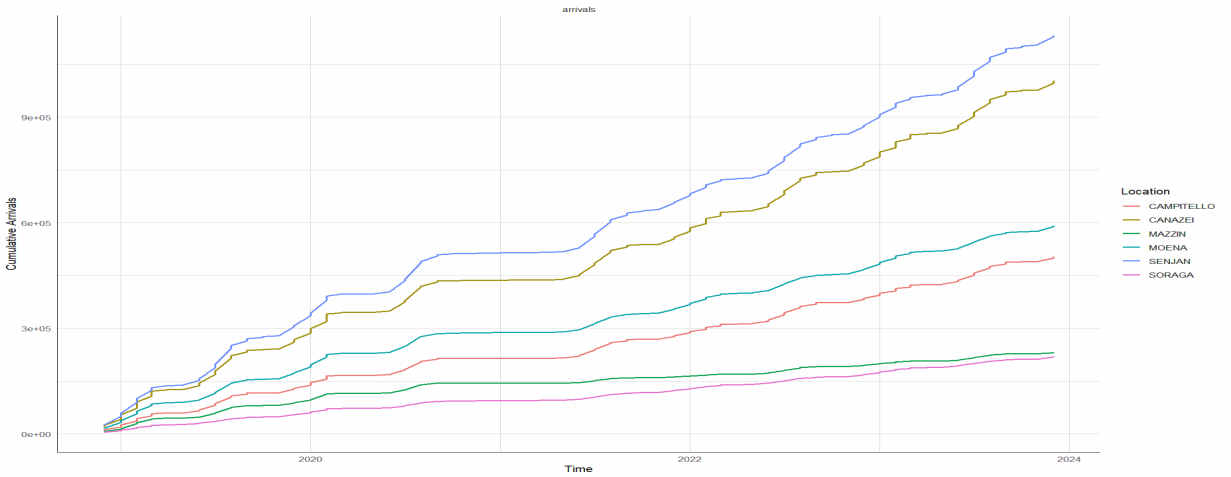

Figure 2.3.3: Cumulative Sum of Arrivals over Time

The analysis compares the performance of Trento's main cities over time, with Sen Jan and Canazei standing out as the top-performing cities. Together, these locations contribute significantly to the province's strong performance, reflecting broader trends observed across the region.

Figure 2.3.4: Seasonal Arrivals by Location

Figure 2.3.3 confirms that winter and summer are peak periods across cities. This aligns with seasonal appeals of skiing and summer outdoor activities.

This analysis highlighted the strengths and areas for improvement within Trento Province's strengths and areas of improvement. while it competes effectively with other mountain regions, targeted investments in infrastructure, diversification of offerings, and enhanced marketing could further elevate its position.

3. Models and comparisons

In this section we start by analyzing the historical data of arrivals in Val di Fassa using multiple statistical models. We applied the same for all the following analyses, in order to compare the results obtained in a more coherent way.
For Sections 3.1 and 3.2, we decided to consider and compare only data regarding hotel arrivals, because of some discrepancies between the data in our possession and those present on the statistical platform of the Autonomous Province of Trento [1] for non-hotel arrivals in Val di Fassa.

3.1 Overview Hotel Arrivals in Val di Fassa

We examined the residuals and patterns in the data to better understand the trends and variations in Val di Fassa's arrival statistics. The aim is to assess the accuracy and effectiveness of different models used for analysis.

The ARIMA (0,1,0)(0,1,1)[12] model reveal the following:

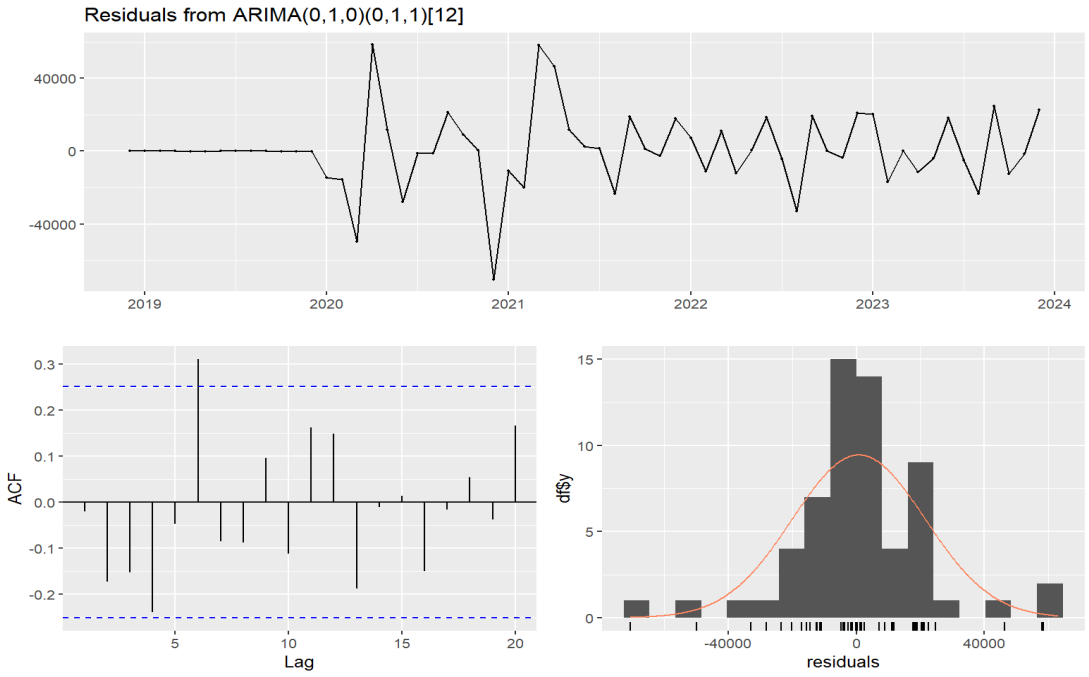

Figure 3.1.1: ARIMA (0,1,0)(0,1,1)[12]

The residual analysis for the ARIMA(0,1,0)(0,1,1)[12] model was conducted to evaluate its performance and accuracy. Residuals over time, indicating no significant trends or patterns,

suggesting a good fit of the model. The ACF plot highlights autocorrelation within the residuals, where most values lie within the confidence bands, confirming minimal correlation. The histogram illustrates the residuals' distribution, which approximates normality, validating the model's assumptions. These findings suggest that the ARIMA model effectively captures the data's seasonal and trend components, leaving no major unexplained variance.

The comparison of forecasting models for Val di Fassa hotel arrivals reveals notable differences in performance.

MODEL	AIC	MAE	RMSE
Linear (tslm)	1409.198	10035.02	16643.22
Exp smoothing (multiplicative)	1436.561	11643.25	16404.5
SARIMA(1,0,0)(1,1,0)[12]	1127.796	9795.014	15711.76
Prophet (multiplicative)	1385.326	10705.13	15619.37
Prophet+pandemic	1332.023	7101.604	10161.96
GAM	1385.626	9728.428	12936.28

Table 3.1.1: Comparison of Different Models

Based on table 3.1.1, The Prophet + pandemic model demonstrated the highest accuracy with the lowest MAE and RMSE, effectively capturing pandemic-related disruptions. Meanwhile, SARIMA(1,0,0)(1,1,0)[12] performed best, achieving the lowest AIC making it suitable for capturing seasonality and trends.

3.2 Trentino vs Val di Fassa Arrivals

We then decided to remove the Val di Fassa hotel arrivals from that of the entire Autonomous Province of Trento and try to perform on them the same kind of analyses as the for the previous section, in order to evaluate the arrivals in the other touristic areas of the province and to see if the tourism movement for the considered time span has a different behaviour from that of the Val di Fassa (almost stationary and heavy seasonal).

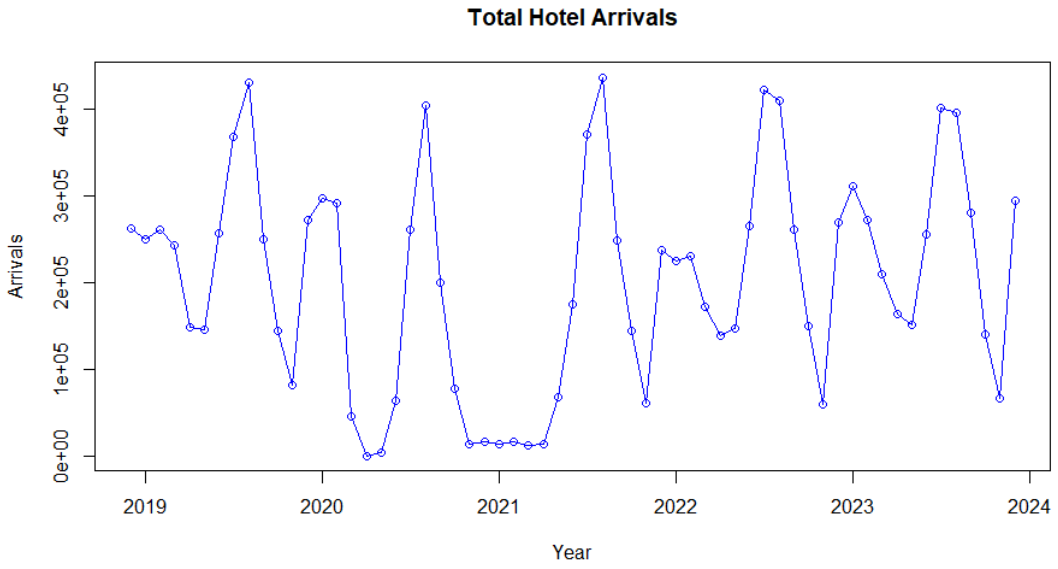

Figure 3.2.1: Total Hotel Arrivals Time Series for the Rest of Trentino

For the other areas of Trentino, the trend in overall tourist arrivals also seems to remain somewhat stationary, with a slightly positive trend for the post-pandemic period (from 2021 onwards). The presence of a strong seasonality in the winter-summer seasons is confirmed, with peaks greater for the latter and more pronounced compared to Val di Fassa.

To ensure consistency in the comparison, the same models were also fitted on this dataset and the results obtained were evaluated both in terms of modeling and forecasting.

Table 3.2.1 shows the values obtained for each model on the evaluation metrics considered.

MODEL	AIC	MAE	RMSE
Linear (tslm)	1560.33	50769.15	68950.34
Exp smoothing (multiplicative)	1585.413	30827.44	44083.86
SARIMA(0,1,0)(1,1,0)[12]	1198.66	33613.52	52173.11
Prophet (multiplicative)	1540.167	49167.8	66637.35
Prophet+pandemic	1496.477	33460.18	46579.06
GAM	1504.832	31152.29	40202.62

Table 3.2.1: Comparison of Different Models

For the rest of the Trento province data, the Generalized Additive Model (GAM) fitted on the data has the lowest RMSE value and one of the lowest MAE and shows a higher predictive accuracy, while the SARIMA model fitted (with different differencing parameters automatically estimated for the non-seasonal component) has the lowest AIC value and a better balance between model fit and complexity with respect to the others.

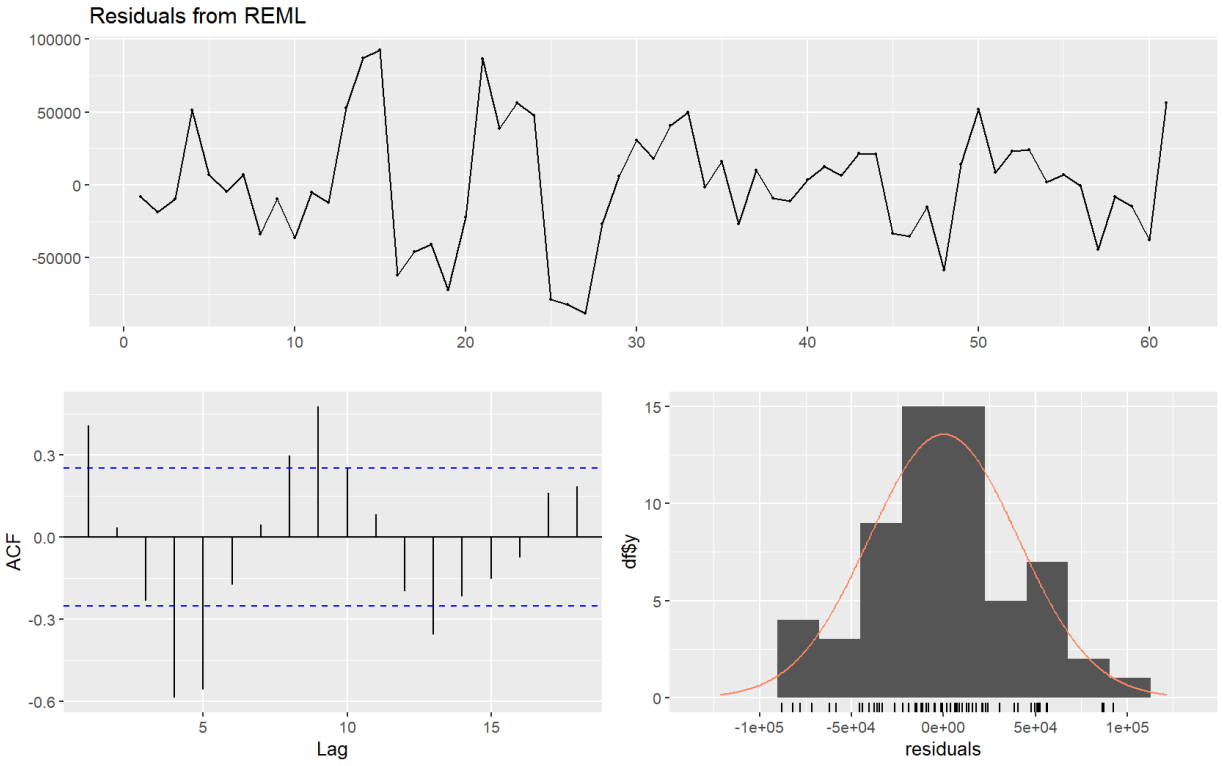

Figure 3.2.2: Residuals and ACF for the GAM Model (Gaussian)

This plot presents the pattern of residuals for the GAM model: the data appear to be captured reasonably well by the model even if some significant autocorrelations are present.

3.3 Foreigners vs Italians Arrivals

This part of the analysis examines the proportion of foreign arrivals relative to Italian arrivals in Val di Fassa from the 5-years time span. The normalized time series data reveals a growing trend in the proportion of foreign tourists over this period.

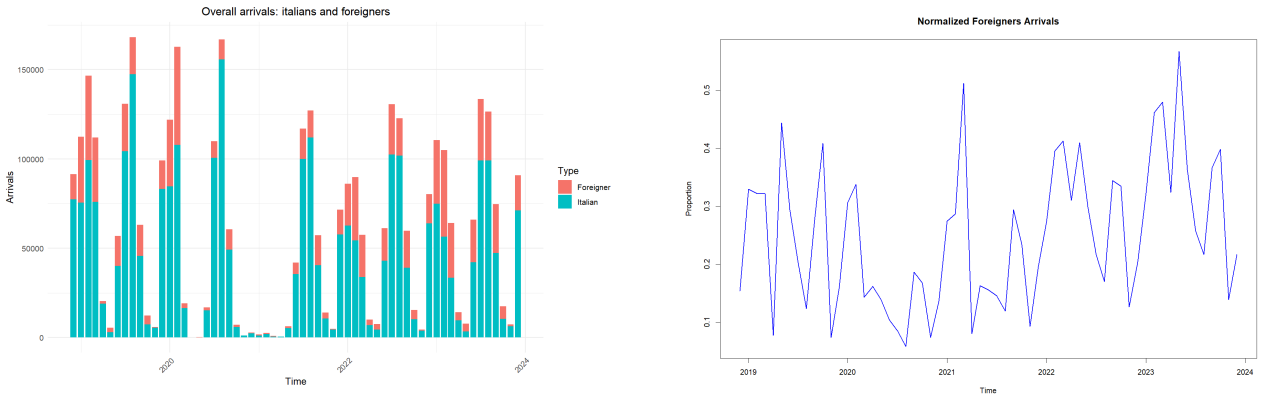

Figure 3.3.1: Overall Arrivals of Italian and Foreigners

However, this trend is accompanied by noticeable variability across months, influenced by seasonality and, reasonably, other external contributions. Furthermore, foreigners affluences between the main touristic cities of Val di Fassa exhibit high variability as shown in the time series in figure 3.3.2.

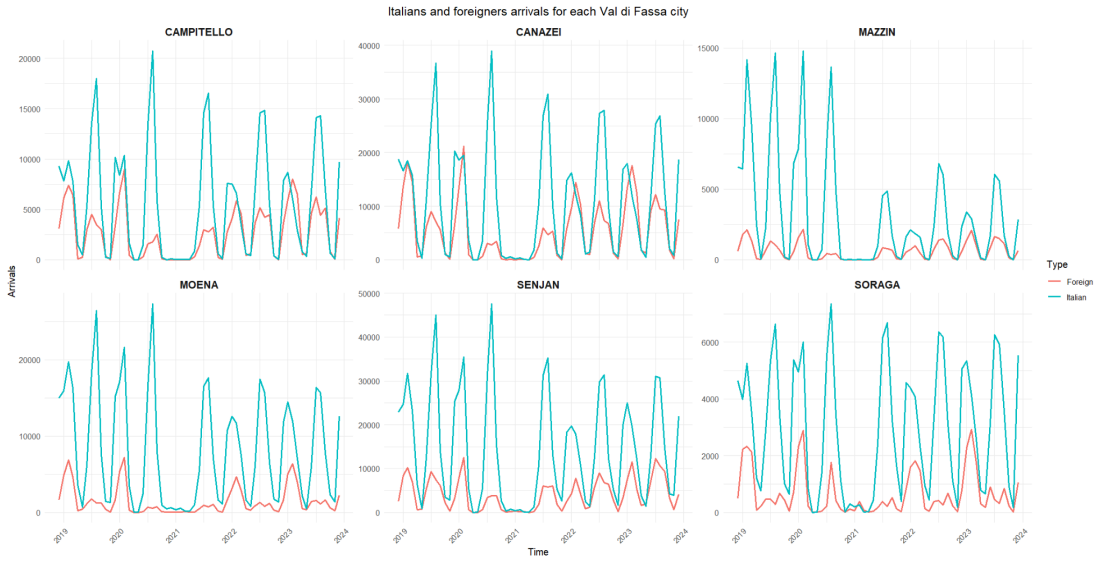

Figure 3.3.2: Comparison of Different Cities Arrivals

The collection of time series in figure 3.3.2 could provide some administrations with criteria to enhance foreign tourism promotion and strengthen city branding.

Our analysis specifically focused on the overall time series of the proportion of foreign visitors to Val di Fassa. Various statistical models were tested, and the evaluations based on relevant metrics are summarized in the table 3.3.1.

MODEL	AIC	MAE	RMSE
Linear (tslm)	-114.8418	0.05472915	0.0750371
Exp smoothing (multiplicative)	-65.51183	0.1975115	0.2663927
SARIMA(3,1,0)(1,1,0)[12]	-74.08	0.05807037	0.08717893
Prophet (multiplicative)	-143.4865	0.05280022	0.06764933
Prophet+pandemic	-143.6323	0.05096419	0.0675685
GAM	-118.7576	0.05185307	0.07102358

Table 3.3.1: Foreigners Proportion Models Comparison

From the produced evaluation of the models, the Prophet model seems to achieve the best results in terms of the error metrics (MAE and RMSE), and the parsimony of the model parameters (as demonstrated by AIC). The pandemic period inclusion confirms the slight improvement in fitting the data. The forecasts of this model are presented in the next chapter.

4. Forecasting

4.1 Val di Fassa Hotel Arrivals

Since Prophet model outperformed other models, we used the prediction of this model to rely on.

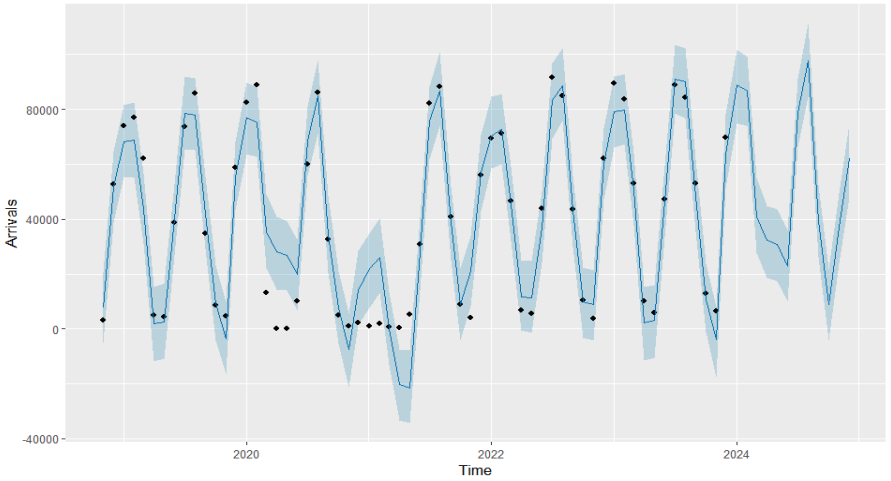

Figure 4.1.1: Forecast of Total Arrivals (12 Months) - Prophet with Pandemic

This forecast shows the expected number of tourist arrivals in Val di Fassa, taking into account seasonal trends and the effects of pandemic. The shaded blue area indicates the range of possible arrivals, helping to understand the level of uncertainty in predictions. This forecast provides a clear picture for planning ahead, such as deciding the best times to promote tourism or prepare for increased demand in the area.

4.2 Trentino vs Val di Fassa Arrivals

In order to provide a short-term forecast (horizon of 12 months) for the hotel arrivals in the rest of the Trento province, the GAM model with Gaussian distribution has been chosen as the best one.

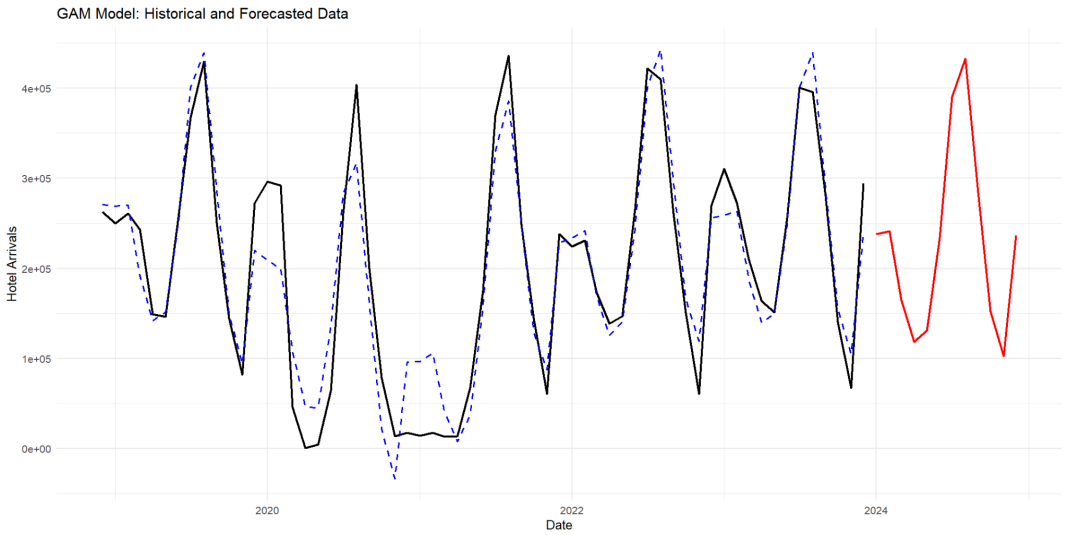

Figure 4.2.1: Rest of Trento Province Hotel Arrivals, with Forecasts

The figure 4.2.1 shows both the fitted values (dashed blue line) on the historical data and the forecasts (red line) of the hotel arrivals in the rest of the Autonomous Province of Trento for a 12-month future horizon: the model is able to capture both the underlying slightly positive trend, especially for the most recent periods with a high adaptive capacity, and the seasonal effects. Forecasts provided a reasonable pattern, following the seasonal fluctuations and an upward

trend as the historical data.

4.3 Foreigners vs Italians Arrivals

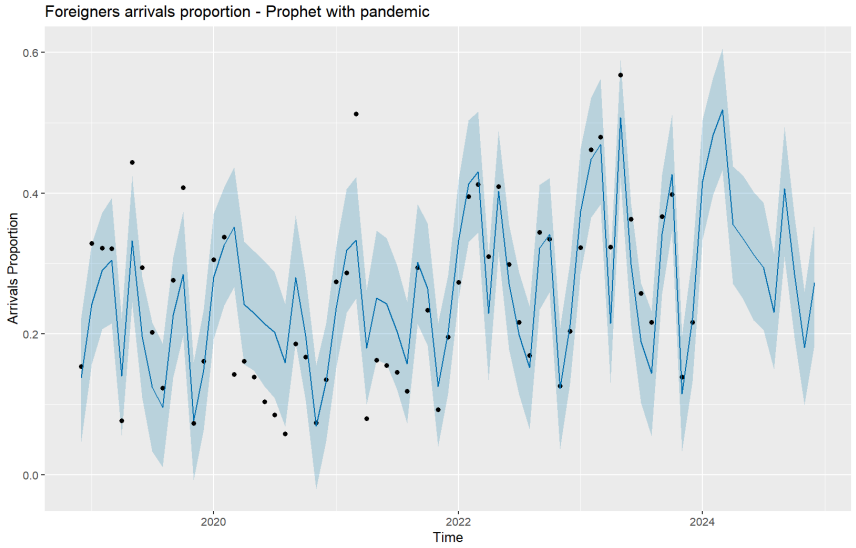

Figure 4.3.1: Foreigners Proportion Prophet Model Fit and Forecasts (Pandemic Included)

As shown in the figure 4.3.1, the proportion of foreign tourists shows a positive linear trend, indicating an increasing preference for Val di Fassa among international visitors. Despite this growth, the series exhibits high month-to-month fluctuations, likely attributable to differences in seasonal tourism behaviors and external disruptions (e.g., COVID-19 pandemic).
The seasonal decomposition highlights strong periodic variations, with peaks during winter, but is emphasized in summer months, probably corresponding hiking seasons. The share of foreigners dips during off-peak months, reasonably aligning with reduced international travel.

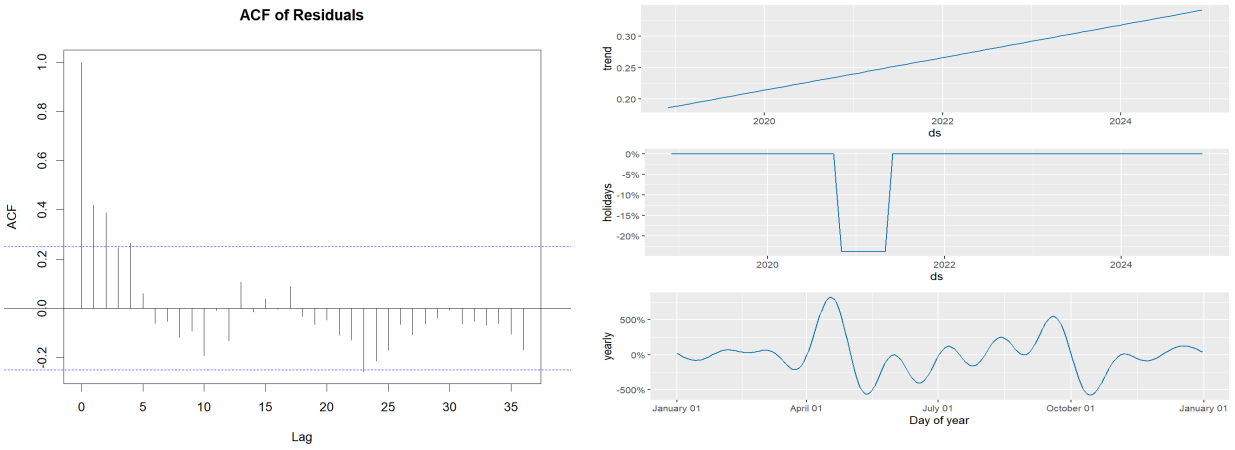

Figure 4.3.2: Autocorrelation Function of the Fitted Frophet Model Pandemic Included (left), Underlying Trend, Pandemic Shock and Seasonality Captured

Autocorrelation function of the residuals shows significant behaviour for lag 2 and 3, highlighting the limits of this model, as some of the time-wise correlations are left unexplained.

Nevertheless, in general the Prophet model was able to capture all the fluctuations of the proportion with reasonable confidence intervals for each data point. The forecasts of the next year (12 months) align with the increasing trend, reaching the 50% percentage of international

arrivals in 2024 with respect to italians. The model should be further evaluated as soon as new data is recorded.

5. Conclusions

5.1 Summary of Key Findings

In summary, the statistical analysis produced the following major findings:

- **Overall hotel arrivals in Val di Fassa:**
  Seasonal patterns are a key characteristic of hotel arrivals, with distinct peaks in winter and summer. The **Prophet + pandemic model** demonstrated superior performance in capturing the impact of the pandemic and forecasting trends. Predictions indicate an upward trend in arrivals, highlighting the need to capitalize on seasonal opportunities.
- **Trentino vs. Val di Fassa Tourist Arrivals:**
  Unlike Val di Fassa, which shows a near-stationary trend, the rest of Trentino has exhibited a modest positive growth in tourist arrivals after the pandemic, particularly during the summer. The **GAM model** effectively captured both the trend and seasonal variations, yielding reliable forecasts of continued recovery in Trentino's tourism activity.
- **Proportion of Foreign vs. Italian Tourists:**
  Foreign tourists have been steadily making up a larger share of visitors to Val di Fassa. According to the Prophet + pandemic model, the number of foreign and Italian tourists is expected to reach near-equal levels by 2024. However, foreign arrivals tend to fluctuate more because of seasonal trends and external factors, with many opting for non-hotel accommodations. This creates opportunities for businesses to expand their offerings and better meet the preferences of international visitors.

5.2 Recommendations for Businesses and Future Research Directions

1. **Leverage Seasonal Opportunities**
   Businesses in Val di Fassa should tailor marketing and promotional campaigns to maximize winter and summer peaks in tourist arrivals.
2. **Expand Non-Hotel Accommodation Options**
   Investing in non-hotel accommodations could attract a larger amount of international visitors, aligning with the growing trend of foreign arrivals and differentiating Val di Fassa from the broader Trentino region.
3. **Monitor Emerging Trends and External Factors**
   Continuous analysis of seasonality, visitor preferences, and external influences (e.g., global events) can enable data-driven strategies to remain competitive and adaptable.
4. **Future Research Opportunities**
   Further studies could explore the impact of new infrastructure, climate trends, and tourist behavior shifts to refine predictions and support long-term planning.

This analysis provides actionable insights for businesses and lays the groundwork for enhancing the tourism sector's resilience and growth in Val di Fassa.

6. References

1. ISPAT - Istituto di Statistica della Provincia di Trento (http://anteprime.provincia.tn.it/pat_statistica_new/dati_online/) for the data about the Autonomous Province of Trento, in particular:
    - Arrivals and stays for hotel accommodation by month and origin: https://statweb.provincia.tn.it/annuario/(S(tpu3c3e50shzwwi31sx2rp53))/tavola.aspx?idt=13.14&f=0&t=ss
    - Arrivals and stays for non-hotel accommodation by type, month and origin: https://statweb.provincia.tn.it/movturistico/data.asp?db=annuarioturismo&sp=spArrPresEsComplXTipoProvMese&var=0
2. ISTAT - Istituto Nazionale di Statistica (https://esploradati.istat.it/databrowser/#/it) for the data about tourism in other Italian mountain provinces.
3. We thank the municipal authorities of Val di Fassa for granting access to their city resolution data.