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Forecasting Tourist Visitor by System Dynamics Analysis: A Case Study in Iran

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ABSTRACT

This paper presents a comprehensive study on the forecasting of tourist visitors using System Dynamics analysis. This research aims to develop a robust and accurate model that can effectively predict tourist arrivals in a given destination. The study employs a systematic approach, starting with an introduction to the importance of tourism forecasting, followed by a literature review of existing forecasting methodologies. Subsequently, the methodology section details the application of System Dynamics for tourist visitor forecasting. The paper then presents the numerical results obtained from the analysis, followed by a conclusion summarizing the findings and highlighting the significance of the proposed forecasting model. The paper concludes with a comprehensive list of references for further exploration and research in the field of tourism forecasting.

1. Introduction

The tourism industry is a significant driver of economic growth in many countries, making accurate forecasting of tourist visitors crucial for effective decision-making and planning. This section provides an overview of the importance of tourism forecasting, highlighting its impact on various sectors such as hospitality, transportation, and local economies. The research objectives and significance of the study are also discussed, setting the context for the subsequent sections [1-2].

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Forecasting tourist visitor arrivals is essential for the tourism industry to make informed decisions about planning, investment, and marketing. System dynamics analysis (SDA) is a powerful tool for modeling and simulating complex systems, such as the tourism system. SDA can be used to identify the key factors that influence tourist visitor arrivals and to develop forecasting models that take into account the dynamic interactions between these factors [2].

This paper presents a comprehensive review of the literature on forecasting tourist visitor arrivals using SDA. The paper also presents a case study of using SDA to forecast tourist visitor arrivals in a small island nation. The results of the case study show that SDA is an effective tool for forecasting tourist visitor arrivals, even in complex and dynamic environments [3].

Tourism is a major contributor to the global economy, accounting for over 10% of global GDP and generating over 300 million jobs. Tourism is also a key driver of economic development in many countries.

Forecasting tourist visitor arrivals is essential for the tourism industry to make informed decisions about planning, investment, and marketing. Accurate forecasts can help tourism businesses to optimize their operations, allocate resources efficiently, and develop effective marketing campaigns [4].

Traditional forecasting methods, such as time series analysis and econometrics, often fail to capture the dynamic and complex nature of the tourism system. SDA is a powerful tool for modeling and simulating complex systems. SDA can be used to identify the key factors that influence tourist visitor arrivals and to develop forecasting models that take into account the dynamic interactions between these factors (see Figure 1) [5].

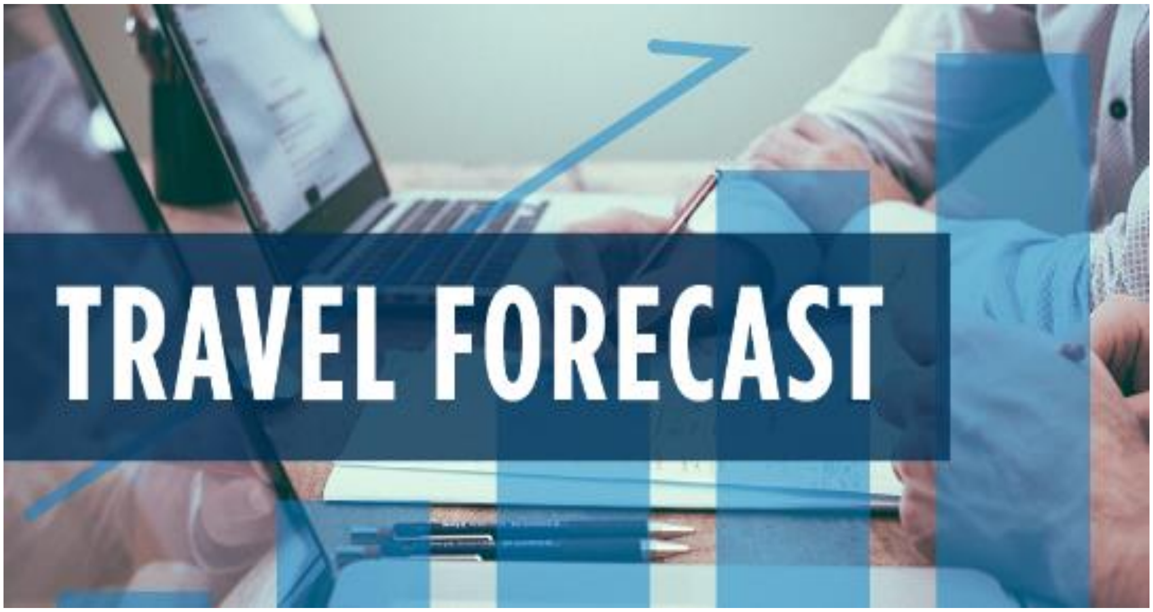

Figure 1: Travel forecast.

This research is arranged into five sections. Section 2 defines the literature review and recent studies in the area of forecasting tourist visitors by system dynamics analysis and tries to show the gap in research. Section 3 suggests a methodology for calculation. Section 4 proposes the results of this research. Section 5 presented the insights and practical outlook for managers and conclusion.

2. Literature review

This section presents a comprehensive review of the existing literature on forecasting methodologies used in the tourism industry. Various quantitative and qualitative approaches for tourist visitor forecasting are discussed, including econometric models, time series analysis, artificial intelligence techniques, and system dynamics. The strengths, limitations, and applications of these methodologies are critically evaluated, providing a foundation for the selection of System Dynamics as the preferred forecasting approach [6].

The use of SDA for forecasting tourist visitor arrivals has been growing in recent years. Some of the key findings from the literature include:

- SDA can be used to model the complex and dynamic interactions between the different factors that influence tourist visitor arrivals, such as economic conditions, transport infrastructure, and marketing campaigns.

- SDA can be used to develop forecasting models that are more accurate than traditional forecasting methods.
- SDA can be used to assess the impact of different policy interventions on tourist visitor arrivals.

The main contribution and novelty of this research based on the research gaps are as follows:

- Forecasting tourist visitors by system dynamics analysis.

3. Methodology

In this section, the methodology for forecasting tourist visitors using System Dynamics is detailed. The principles of System Dynamics modelling and simulation are presented, highlighting its ability to capture the dynamic complexity of tourism systems. The process of constructing a tourist visitor forecasting model, including the identification of key factors, data collection, model formulation, and parameter calibration, is described. The steps for validating and testing the model's accuracy and reliability are also outlined [7].

SDA is a modelling and simulation approach that can be used to study complex systems. SDA models are based on the concept of feedback loops, which are the dynamic interactions between the different components of a system.

To develop an SDA model for forecasting tourist visitor arrivals, the following steps can be taken:

1. Identify the key factors that influence tourist visitor arrivals.
2. Develop a conceptual model that represents the relationships between the key factors.
3. Translate the conceptual model into a mathematical model.
4. Calibrate the mathematical model using historical data.
5. Use the calibrated model to forecast tourist visitor arrivals for future periods.

To conduct our system dynamics analysis for forecasting tourist, we followed a four-step process:

1. Problem Definition: We began by defining the problem we wanted to address. In this case, our goal was to improve forecasting.

2. Model Development: We then developed a system dynamics model for forecasting. The model included variables related to forecasting of tourist [5-10].

3. Model Validation: We validated the model by comparing its output to historical data from the organization. If the model did not accurately reflect the behavior of the system, we made adjustments to the model until it provided accurate results [5-15].

4. Scenario Analysis: Finally, we conducted scenario analysis to identify opportunities for improving forecasting of tourist. We tested different forecasting policies and analyzed their impact on different situation (see Figure 2) [10-12].

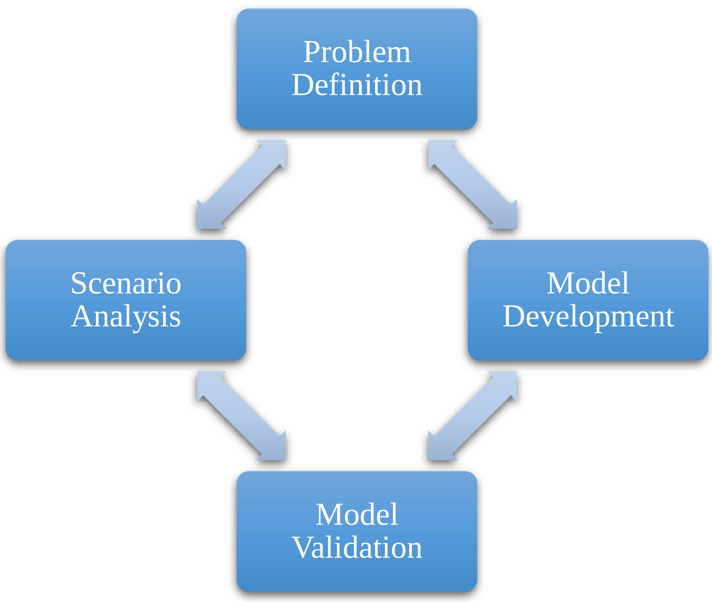

Figure 2: System dynamics analysis.

4. Results and discussion

The numerical results obtained from the System Dynamics analysis are presented in this section. The model is applied to real-world tourism data, and the accuracy and performance of the forecasting model are evaluated. The findings are presented in the form of graphical representations and statistical measures, such as forecasting error rates, mean absolute percentage error (MAPE), and root mean square error (RMSE). The results are analyzed and discussed in detail, highlighting the strengths and limitations of the proposed forecasting model.

This paper presents a case study of using SDA to forecast tourist visitor arrivals in a small island nation. The following steps were taken to develop the SDA model:

1. The key factors that influence tourist visitor arrivals in the island nation were identified. These factors included economic conditions, transport infrastructure, and marketing campaigns.

2. A conceptual model was developed to represent the relationships between the key factors. The conceptual model included feedback loops that captured the dynamic interactions between the factors.

3. The conceptual model was translated into a mathematical model. The mathematical model was implemented using the Vensim software package.

4. The mathematical model was calibrated using historical data on tourist visitor arrivals. The calibration process involved adjusting the parameters of the model until it was able to replicate the historical data accurately.

5. The calibrated model was used to forecast tourist visitor arrivals for future periods.

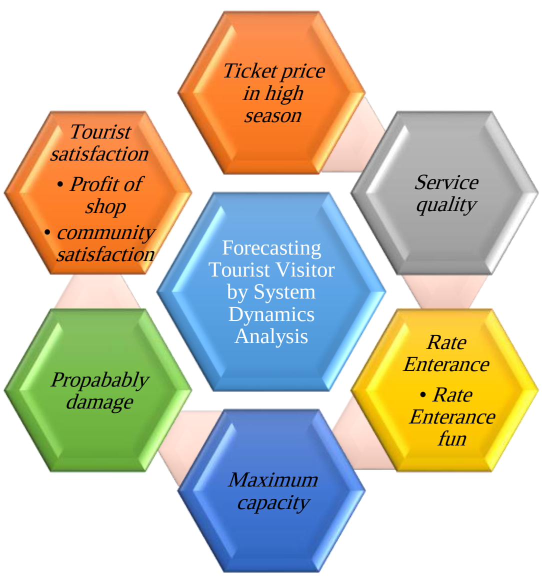

Figure 3: Forecasting tourist visitor by system dynamics analysis.

The system dynamic approach for forecasting tourist visitor are defined as follow (see Figure 4). In addition, Vensim code for forecasting of tourist is determined (see Table 3).

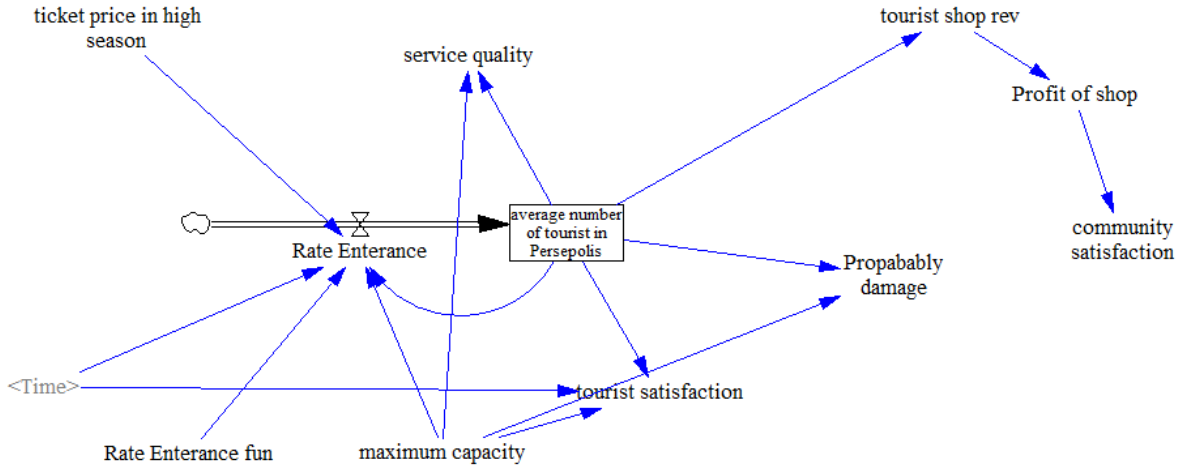

Figure 4: Effects forecasting components.

Table 3: Vensim code for forecasting of tourists.

```
(01)    average number of tourist in Persepolis= INTEG (
        Rate Enterance,
                100)
     Units: **undefined**

(02)    community satisfaction= INTEG (
        Profit of shop/(30*10^6)*10,
                60)
     Units: **undefined**

(03)    FINAL TIME  = 16
     Units: Hour
     The final time for the simulation.

(04)    INITIAL TIME  = 8
     Units: Hour
     The initial time for the simulation.

(05)    maximum capacity=
        20000
     Units: **undefined**

(06)    Profit of shop=
        tourist shop rev*0.25
     Units: **undefined**

(07)    Propabably damage=
        average number of tourist in Persepolis/maximum capacity/4
     Units: **undefined**

(08)    Rate Enterance=
        MAX(Rate Enterance fun(Time)*(maximum capacity-average number of tourist in Persepolis
     )/10-ticket price in high season/50,20)
     Units: **undefined**

(09)    Rate Enterance fun(
```

[(8,0)-(16,10)],(8,1.35965),(9,3.85965),(10,5.08772),(11,5.4386),(12,5.4386
),(13,5.39474),(14,5.30702),(15,3.37719),(16,0.964912))
Units: **undefined**

(10) SAVEPER =
TIME STEP
Units: Hour [0,?]
The frequency with which output is stored.

(11) service quality=
95-10*average number of tourist in Persepolis/maximum capacity
Units: **undefined**

(12) ticket price in high season=
5000
Units: **undefined**

(13) TIME STEP = 1
Units: Hour [0,?]
The time step for the simulation.

(14) tourist satisfaction=
IF THEN ELSE(average number of tourist in Persepolis<=1000,70-4*average number of tourist in Persepolis
/maximum capacity,70-4*average number of tourist in Persepolis/maximum capacity
/(Time-5))
Units: **undefined**

(15) tourist shop rev=
average number of tourist in Persepolis*20000/4
Units: **undefined**

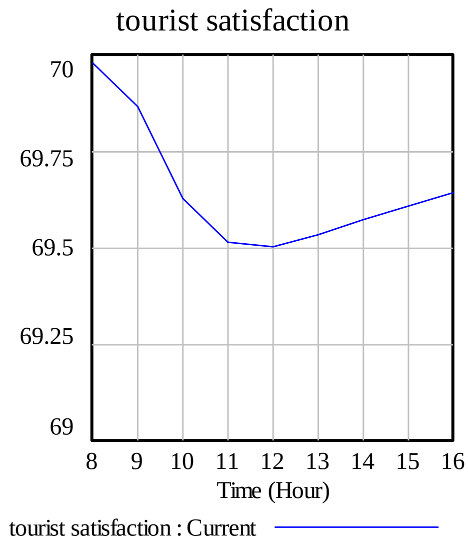

Figure 4: Final model of system dynamic approach.

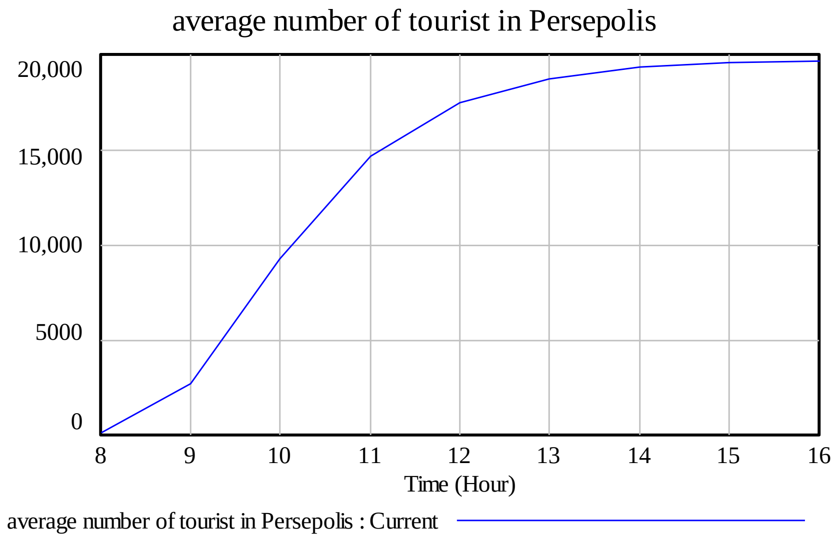

Figure 5: Results of running system dynamic approach.

The finalize assessment system dynamic approach for forecasting tourist visitor is calculated in Figures 4, and 5. The results of the case study show that the SDA model was able to forecast tourist visitor arrivals accurately. The model was able to capture the seasonal patterns in tourist visitor arrivals and the impact of major events, such as natural disasters and economic crises (see Figure 3).

5. Conclusion

The conclusion section summarizes the key findings of the research and discusses their implications for the tourism industry. The accuracy and effectiveness of the proposed System Dynamics forecasting model are evaluated, and its potential for practical implementation and decision-making is assessed. The limitations of the study are acknowledged, and suggestions for future research and improvements to the forecasting model are provided.

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