Analyzing and Forecasting Online Tour Bookings using Google Analytics Metrics

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เจียรนัย อวิชนิโรจน์ : การวิเคราะห์และพยากรณ์การจองทัวร์ออนไลน์โดยใช้ตัวชี้วัดการวิเคราะห์กูเกิล. (Analyzing and Forecasting Online Tour Bookings using Google Analytics Metrics) อ.ที่ปรึกษาหลัก : อ. ดร.นันทชัย กานตานันทะ

ในโลกปัจจุบัน อินเทอร์เน็ตกำลังเติบโตอย่างรวดเร็วและได้ปฏิวัติการดำเนินธุรกิจมากมายในอุตสาหกรรมการท่องเที่ยว ซึ่งอุตสาหกรรมการท่องเที่ยวมีบทบาทสำคัญต่อ GDP ของประเทศไทยและเป็นการกระตุ้นเศรษฐกิจภายในประเทศได้เป็นอย่างมาก ผู้ประกอบการท่องเที่ยวส่วนใหญ่มีการจัดทำเว็บไซต์เพื่อใช้เป็นส่วนหนึ่งของการดำเนินธุรกิจ ซึ่งเป็นช่องทางหลักในการสร้างความสัมพันธ์กับลูกค้าและการขาย จึงทำให้การวัดประสิทธิภาพของเว็บไซต์เป็นปัจจัยเชิงกลยุทธ์ที่สำคัญสำหรับการตลาดออนไลน์ งานวิจัยนี้จึงมีวัตถุประสงค์เพื่อวิเคราะห์หาผลกระทบอย่างมีนัยสำคัญของตัวชี้วัดการวิเคราะห์กูเกิลซึ่งเป็นการวัดประสิทธิภาพเว็บไซต์ต่อการจองทัวร์ออนไลน์ซึ่งเป็นรายได้ของบริษัทในกรณีศึกษา การวิเคราะห์นี้ใช้วิธีการวิเคราะห์การถดถอยเชิงเส้นพหุคูณ เนื่องจากการวิเคราะห์ข้อมูลขึ้นอยู่กับหลายปัจจัย เช่น จำนวนการเข้าชมหน้าเว็บ จำนวนผู้เข้าชม ระยะเวลาในการเข้า ช่องทางการเข้าชม ประเภทผู้เข้าชม เป็นต้น จากนั้นตัวชี้วัดการวิเคราะห์กูเกิลที่ส่งผลต่อการจองออนไลน์อย่างมีนัยสำคัญจะถูกนำมาใช้เป็นตัวแปรอิสระในการพยากรณ์การจองทัวร์ออนไลน์ทั้งแบบรายวันและรายเดือน โดยเปรียบเทียบตัวแบบการพยากรณ์ 2 วิธี คือวิธีการวิเคราะห์การถดถอยเชิงเส้นพหุคูณและวิธีโครงข่ายประสาทเทียม ซึ่งเป็นวิธีหนึ่งของการเรียนรู้ของเครื่อง โดยใช้ค่าร้อยละความคลาดเคลื่อนสัมบูรณ์เฉลี่ยเป็นเกณฑ์ในการเปรียบเทียบ ผลวิจัยพบว่าในช่วงปี 2015 ถึง 2018 มี 5 ตัวชี้วัดการวิเคราะห์กูเกิลที่ส่งผลต่อการจองทัวร์รายวันอย่างมีนัยสำคัญ โดยมีค่าสัมประสิทธิ์แสดงการตัดสินใจที่ปรับแก้แล้วเท่ากับ 0.39 และมี 3 ตัวชี้วัดการวิเคราะห์กูเกิลที่ส่งผลต่อการจองทัวร์รายเดือน โดยมีค่าสัมประสิทธิ์แสดงการตัดสินใจที่ปรับแก้แล้วเท่ากับ 0.89 ในส่วนของการพยากรณ์ ตัวแบบพยากรณ์วิเคราะห์การถดถอยเชิงเส้นพหุคูณ, โครงข่ายประสาทเทียม, ตัวแบบการถดถอยซัพพอร์ตเวกเตอร์ และตัวแบบการสุ่มป่าไม้ มีความคลาดเคลื่อนไม่แตกต่างกันอย่างมีนัยสำคัญ ทางผู้เขียนจึงแนะนำให้บริษัทกรณีศึกษาใช้ตัวแบบการถดถอยเชิงเส้นพหุคูณสำหรับการพยากรณ์ โดยมีค่าร้อยละความคลาดเคลื่อนสัมบูรณ์เฉลี่ยเท่ากับ 31.47% สำหรับการจองทัวร์ออนไลน์แบบรายวัน และ 5.99% สำหรับการจองทัวร์ออนไลน์แบบรายเดือน เนื่องจากเป็นวิธีที่ง่ายที่สุดในการดำเนินการ, ใช้เวลาในการคำนวณน้อยกว่า และใช้ทักษะทางเทคนิคน้อยกว่า เมื่อเทียบกับตัวแบบการเรียนรู้ของเครื่อง ทั้งนี้ผลการวิจัยนี้สามารถเป็นอีกทางเลือกหนึ่งที่บริษัทกรณีศึกษาสามารถนำไปใช้พยากรณ์การจองออนไลน์และพัฒนาเว็ปไซต์ให้มีความน่าสนใจของผู้ที่มาเข้าเยี่ยมชมเว็บไซต์ซึ่งเป็นการเพิ่มกำไรและรายได้ให้กับองค์กรได้

สาขาวิชา	วิศวกรรมอุตสาหการ	ลายมือชื่อนิสิต	....
ปีการศึกษา	2562	ลายมือชื่อ อ.ที่ปรึกษาหลัก	....

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Jiaranai Awichanirost : Analyzing and Forecasting Online Tour Bookings using Google Analytics Metrics. Advisor: Nantachai Kantanantha, Ph.D.

In today's world, the internet is growing fast and has revolutionized many business operations in the tourism industry. The tourism industry plays an important role in Thailand's GDP and is a great boost to the domestic economy. Most tour operators have created websites to be used as part of their business operations which are the main way to build relationships with customers and sales and hence make the website performance measurement an important strategic factor for online marketing. The objective of this research is to analyze the significant impact of Google Analytics metrics that is a measurement of website performance on online tour bookings which is the case study company's revenue in this study. The analysis is conducted by means of multiple linear regression analysis, because data analysis depends on many factors such as the number of page views, the number of visitors, session duration and visitor types, etc. Then, the Google Analytics metrics that significantly affect online bookings will be used as independent variables in predicting for daily and monthly bookings. In comparing the forecasting models of 2 methods which are the multiple linear regression method and artificial neural network method, that is part of machine learning, by using the mean absolute percentage error as the criterion for comparison. The results show that from year 2015 to 2018, there are 5 metrics of Google Analytics that significantly affect daily bookings with an adjusted coefficient of determination about 0.39. And there are 5 metrics of Google Analytics that significantly affect monthly bookings with the adjusted coefficient of determination about 0.89. In the forecasting section, MLR, ANN, SVR and RF models were not insignificantly different. The author suggests the case study company use MLR model that have the mean absolute percentage error of 31.47% for daily online bookings and 5.99% for monthly online bookings for forecasting as it is the easiest method to be conducted, lesser time to compute and lesser technical skillset are required when compared to the machine learning models. The results of this research can be another option that the case-study company can use to forecast online bookings and develop its website to be attractive to those who visit the website, which will increase profits and revenue for the organization.

Field of Study:	Industrial Engineering	Student's Signature ....
Academic Year:	2019	Advisor's Signature ....

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Jiaranai Awichanirost

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Chapter 1 Introduction

1.1 Background

The internet is growing rapidly and has revolutionized many business operations of the entire travel and tourism industry. The majority of businesses now own websites that have integrated part of the business operations because they have become the main channel of customer relationship and sales (Cotter 2002). Hence, it makes website performance measurement a strategic factor that is critical for online marketing. Therefore, the usage of Web analytics is increasing among competitive tour operators.

Tour operators connect people from one corner to another, domestically or internationally. The exchanges that take place within or among nationals of different countries act as a great source of mutual advantage. The characteristic of the tourism industry lies in the fact that this industry brings customers to the product/services rather than delivering the products/services to the customers. Tourism by its nature is seasonal and fragile. There are frequent seasons of boom and slowdown that threatening the industry players.

Thus, discovering factors contributing to sales in the travel and tourism industry brings great economic value for both the public and private sectors. Information concerning the future evolution of tourism flows brings great importance to hoteliers, tour operators and other industries related to tourism.

Besides, with the data of factors contributing to sales, there can be a possible feasible forecasting method that can be implemented by using impactful factors that relate to the business's objective.

(Vimonmass 2014) Sales forecasting is an integral part of business planning. Because it is like another goal that the company must conduct business to achieve the sales target that is also planned. Every company must have cost and expenses all the time, especially the rising from operations or cost of sales. Therefore, it is very important for the sales team to make money for the company to offset the expenses and make a profit. A good sales forecast allows the company owner to calculate and manage their possibility risk. For example, if the sales forecast for next month is not good, the company can, therefore, reduce the cost of ordering products or stop hiring new employees.

1.1.1 Website analytics by using Google analytics tool

A corporate website enriches the image of a business to convert direct benefits in terms of electronic commerce (e-commerce) sales. Also, thousands of companies have a fear of left behind by their competitors, if online technologies are not used. Figure 1 shows the number of internet users worldwide from 2005 to 2018. It can be seen that the number has been continuously increasing for the past 14 years.

Furthermore, many companies engage technologies such as Web analytics to help with optimizing online marketing.

With sufficient web information, website optimization can be done by web developers and designers to improve the website user interface and navigation features, to have happier visitors/customers (Omidvar, Mirabi et al. 2011). One of the most popular methods to retrieve such information and data of a website is via Web Analytics.

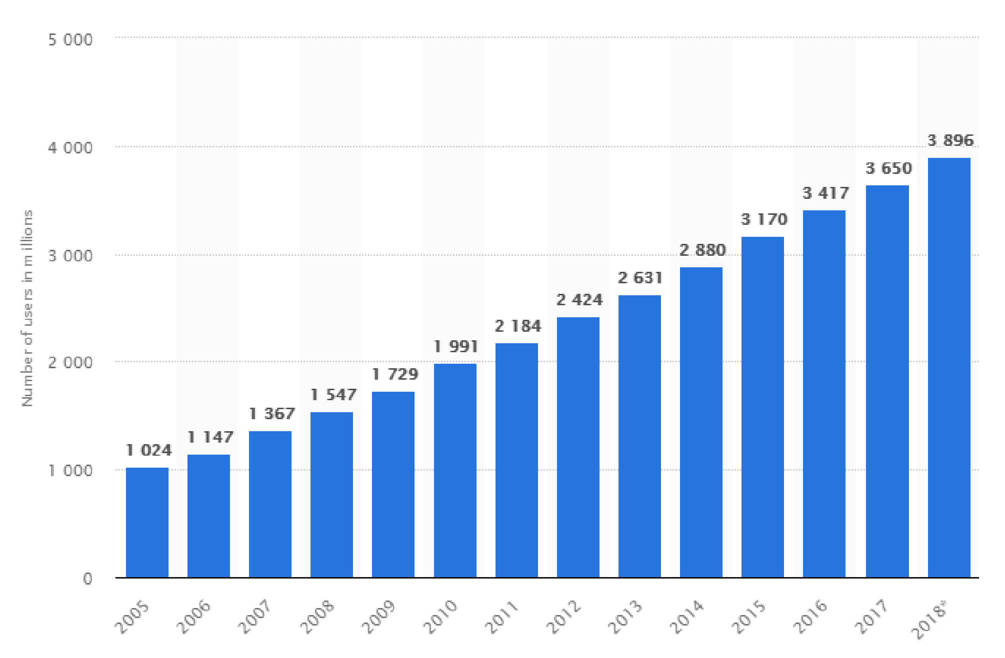


Figure 1 The number of internet users worldwide from 2005 to 2018 (in millions) (www.statista.com)

Web Analytics mainly involves data collections and analysis about website visitors' behaviors such as the number of visitors, unique users, page views and many more. One of the well-known Web Analytics, Google Analytics is used during the case study. Google Analytics, which is a free online service, developed by Google, is a powerful measuring tool for the success of websites, marketing efforts, and products and services (Plaza 2011). Google Analytics makes it easy to keep track of the customer's journey by connecting customer behavior, and channel performance and it also provides time series data that is important for this study.

In this thesis, insights from Google Analytics will be investigated to determine the effects of Google Analytics metrics on sales (bookings) of a leading the case-study website. Figure 2 shows one of the features in Google Analytics that will be used to determine the impacts of different factors on the interested dependent variables.

Figure 2 Example of Google Analytics dashboard of behavior report for the case study tourism website.

1.1.2 Tourism industry overview

(Pornphen 2018) Thailand is among the topmost visited countries because of the combination of its unique and culture-rich lifestyle. As one of the largest economic sectors, Thailand's GDP has increased steadily from 2010, with the tourism sector's direct contribution of 14% to 22.1%, to the GDP since 2018. Thailand's Ministry of Tourism and Sports found out that most of the tourism revenues are from foreign tourists with an average annual growth of 15% while 10.8% are coming from local tourists from 2012 to 2018. In addition, tourism helps to create jobs, drive exports and generate prosperity to the Kingdom. Besides, the industry also indirectly contributes to the economy such as investment spending and domestic purchases of goods and services for which the tourism industry able to benefit the domestic population at large.

Tour operators then have become an important part of the industry by bringing a memorable experience for the inbound tourist. Figure 3 shows the number of inbound tourists to Thailand in million which can be seen to steadily increase over the years.

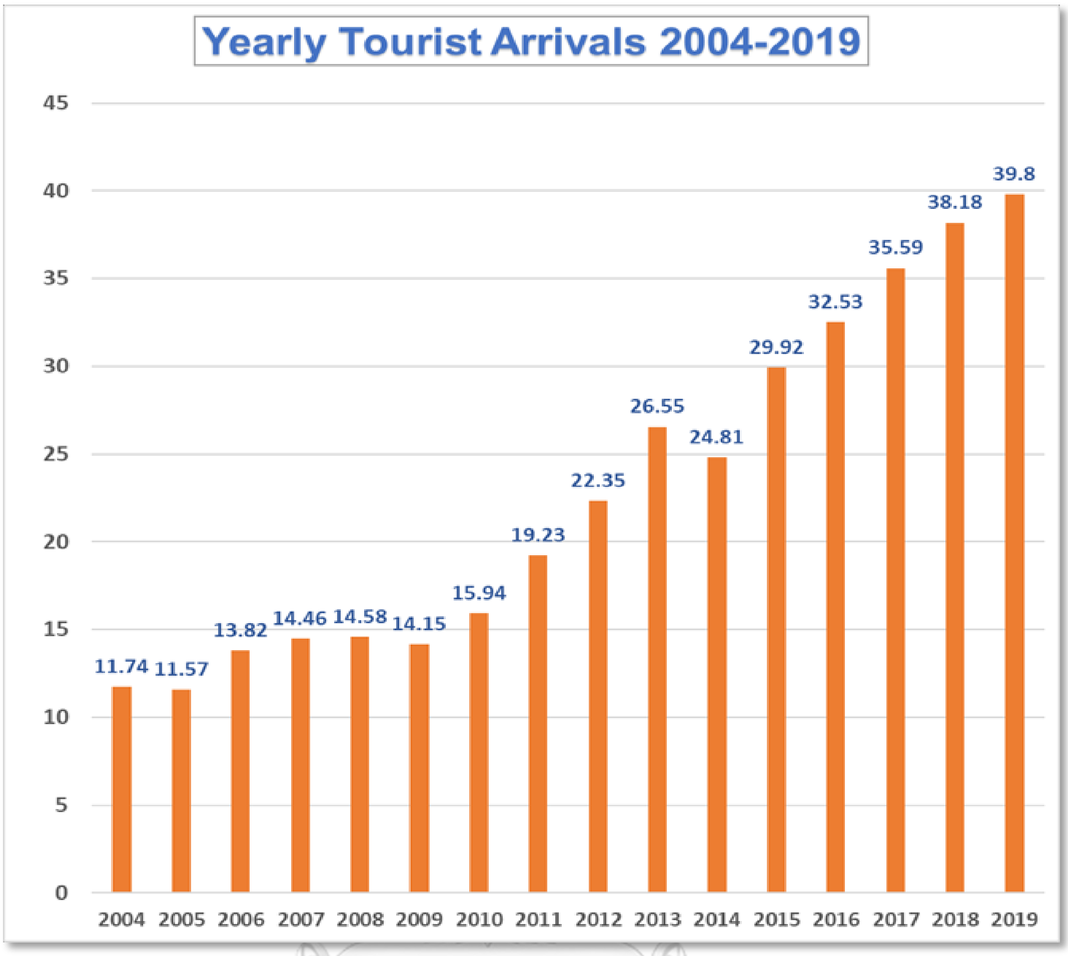


Figure 3 Yearly Tourist Arrivals 2004-2019 from www.thaiwebsites.com

1.1.3 Company overview

The case-study company is a leading tour operator in Thailand which was established in 2011. Most of the sales bookings are mainly from international customers, that purchased the tour online package, via the company website. The website is the main channel stream for the customer-sales relationships that consists of rich media and contents such as seasonal campaign advertisement, video presentation, photography presentation and many more.

In addition, it also contains product presentations that include detailed descriptions, high-quality images and customer’s review that attracts websites victors to convert as a sales booking. The website is one integrated tool for the business to generate revenues. Thus, online marketing performance and optimizations of the website are merely important.

1.1.4 Profile of the company website

A case study company website was launched in 2011. This website has many pages with images, videos, the content of products, etc. The Google Analytics traffic overview from 2015 - 2019 showed that the total visits were 818,204. The total page views during this period were 1,782,758.

1.2 Problem Statements

Currently, the case study company has a chunk of collected data from Google Analytics including the number of visitors on the website, page views, bounce rates, demographics, behavior reports, and many more. However, this gathered information remains untapped and no analysis of correlations between these data and sales was done. In contrast, all the data collected can be useful to the company by using those data for statistical analysis to maximize the benefit to the company. For example, the behavior of website visits may affect the company's revenue because the company uses a website as the main channel for customers to translate into sales bookings.

Also, it cannot be denied that the usage of technology and the internet are merely important and very popular in the present era. Therefore, it is very important for the analysis of various factors that affect sales in the business significantly to be used to improve and develop the company's website to be more interesting and easier to reach by visitors. Besides, online advertising can also be done to attract more visitors, hence increasing sales of the business.

Besides that, the analysis using the engineering statistical method allows achieving accurate and credible business insights that can be utilized in terms of marketing or management upon creating various campaigns or advertising through various websites. Since the factors are known to have an impact on sales, they can also be utilized as a forecasting mechanism which is an important part of business planning for the company to know its achievable sales target.

1.3 Research Objectives

The objectives of this thesis are as follows:

1) Analyze both booking transactions and Google Analytics data to understand further descriptive of the data.
2) Identify factors contributing from Google Analytics metrics to bookings.
3) Forecast bookings by using impactful factors from Google Analytics.

1.4 Research Scope

The scope of this study focuses on the following:

1) Data analysis uses a stepwise regression method to find impactful factors from Google Analytics on bookings in a period of 48 months (2015-2018).

2) Google Analytics will be utilized to study the factors contributing to bookings. The data will be examined thoroughly to produce such business insight to prediction.
3) A case study company for this thesis is a tour operator whose revenue stream comes from an online booking platform on their website which is the scope of this study, while others are offline and agency platform which are not included in study.
4) In this thesis, the data are derived from 1st January 2015 until 31st December 2019 which are a total of 5 years. In term of forecasting, these data are then divided into 3 intervals as per below:

➢ The data in January 2015 to December 2018 are used for the training set.

➢ The data in January 2019 to June 2019 are used for the cross validation set.

➢ The data in July 2019 to December 2019 are used for the testing set.

5) Multiple Linear Regression (MLR), Artificial Neural Network model (ANN), Support Vector Regression (SVR) and Random Forests (RF) models that are used to forecast bookings.

1.5 Expected Outcomes

1) Factors from Google Analytics that contributing to sales (bookings) with multiple linear regression method.
2) Forecasting sales (bookings) with Google Analytics metrics by using Multiple linear regression model (MLR) and machine learning models

1.6 Expected Benefits

The expected benefits of this thesis consist of;

1) Data analysis results from this thesis that able to give insights so the company can enhance the effectiveness of website performance.
2) The understanding of significant factors contributing from Google Analytics to sales can help the manager make better decisions in web optimization in order to increase sales in the future.
3) The result can provide accurate forecasting results, which is an important part of business planning for a company to achieve its goals.
4) The results from this study can be useful for online businesses in other industries by applying the analysis of their data for their own insights.

1.7 Timeline

No.	**Task**	**2019**																				**2020**																							
		Aug.				**Sep.**				**Oct.**				**Nov.**				**Dec.**				**Jan.**				**Feb.**				**Mar.**				**Apr.**				**May**				**Jun.**			
		1	**2**	**3**	**4**	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**
1	Study Tour Operator case study	■	■																																										
2	Understanding the data collected			■	■																																								
3	Identify problem and scope of thesis					■	■																																						
4	Literature review							■	■	■	■																																		
5	Data preparation											■	■	■																															
6	Data analysis														■	■	■	■																											
7	Multiple Linear Regression																		■	■	■																								
8	Proposal Preparation																					■	■	■	■	■	■																		
9	Proposal Exam																											■																	
10	Machine learning																												■	■	■														
11	Accuracy Measurement																															■													
12	Conclusion and Recommendation																																■												
13	Conference																																	■	■	■	■								
14	Defense Preparation																																					■	■	■	■				
15	Defense Exam																																									■	■	■	■

Chapter 2 Literature Reviews

2.1 Related Theory

2.1.1 Web Analytics

Web analytics is a method that involves collecting data, measurement, analysis and reporting of data from the websites for a website owner to study or optimize how websites are used. Web analytics allows web owners to precisely study various user's behavior of the website visitors which will help to increase website performance. Therefore, Web Analytics attracts entrepreneurs to aware of both existing problems and opportunities of using Web Analytics which can help to decide on how to improve or develop websites to achieve business goals or customer satisfaction (Burby, Brown et al. 2007).

Nowadays, many tools can help with web analysis. In this case study, it relates to Google Analytics which is a free Google tool that helps a website owner to collect site visitor data and provide summary and report results in a dashboard in a format of time series data. It also allows users to export data into Microsoft Excel, Portable Document Format (pdf.), etc. which making it easier for those who want to further use the data.

2.1.2 The Important Metrics of Google Analytics

Firstly, in the second half of 2006, the Web Analytics Association Standards Committee has established a consensus agreement to define the three most important indicators which consist of unique visitors, visits per session and page views (Burby, Brown et al. 2007).

Furthermore, the top main reason to measure search engine marketing (SEM) success relates to traffic measurement is traffic volume increasing about 76% of advantage respondents (Schonfeld 2010).

In addition, (Bekavac and Garbin Praničević 2015) the metrics are categorized into metrics for describing visits, metrics for describing visitors, metrics for describing the visitor engagement and conversion metrics as per below:

• **Metrics for describing visits** – it refers to the dimensions such as front page, target page, exit pages and metrics such as click-through rate, duration of the visit and source of traffic.

• **Metrics for describing visitors** – it presents different attributes that characterize website visitors and support the process of visitor segmentation. The metrics are new visitors, repeat visitors, visits per visitor, frequency and recency.

• **Metrics for describing visitor engagement** – it includes metrics that describe the degree of visitor interaction. based on the calculation of the proportion of those leaving a website with respect to exit ratio, bounce rate and the number of visited pages per visitor.

• **Conversion metrics** – the collection of website activities that provide business value, such as metrics that indicate the conversion rate.

2.1.3 Multiple Linear Regression Method (MLR; Stepwise Regression)

(Chanaboon 2017) Regression analysis is a statistical method that is to study the relationship between the independent and dependent variables. The study of two relationships between independent and dependent variables is called simple linear regression analysis. Also, it is called Multiple Linear Regression when there are multiple independent variables with one dependent variable.

(Ghani and Ahmad 2010) Multiple linear regression is a statistical technique that uses several explanatory variables to predict the outcome of the independent and dependent variables. For example, the time required for bread fermentation is depending on the quantity of liquid used, fermentation temperature, amount of yeast used, etc. These relationships cannot be analyzed using simple regression. Therefore, multiple linear regressions are one of linear regression analyzes that is used to analyze the relationship between the single response variable (dependent variable) with two or more controlled variables (independent variables). The accuracy of the analysis will increase just by using the independent variable.

(Gupta and Chaudhari 2016) Multiple linear regression attempts to model that has a relationship between two or more independent variables and a dependent variable by fitting a linear equation to observed data. The value of the independent variable "X" affects to a value of the dependent variable "Y". The forecasting model is in the form of a linear equation that shows the relationship between groups of independent variables and the variables as in the below equation.

$$Y = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3 + \cdots + \beta_i x_i + \varepsilon \quad (1)$$

(Natthaphon K. 2017) Where Y is the value of the dependent variable, x_i is the value of the independent variable where i, β_0 is the constant, β_i is the regression coefficient of independent variables x_i shows the rate of change of x_i connect the Y value as follows if the value x_i changing 1 unit will cause the Y value to change. β_i unit and ε is the tolerance value (error) between the true value (Y) and the forecast value (Ŷ). A Stepwise Regression is an appropriate method for selecting the best predictive variable. The procedure is similar to a forward method but the stepwise analysis will test the predictive variables in the equation one by one that can be eliminated from the equation when that predictive variable does not result in a statistically significant increase of R2 (There is no significant impact to increase in the prediction of the dependent variable) which the forward methods are not tested in this case. In this thesis, multiple linear regression with the stepwise method will be mainly focused because this method is a combination of forward selection and backward elimination methods.

2.1.4 Artificial neural networks (ANN)

(Anderson and McNeill 1992) Artificial neural networks (ANN) are fairly new computational tools that are utilized extensively in solving complex real-world problems (Basheer and Hajmeer 2000). ANN are relatively crude electronic models based on the neural structure of the brain that able to learn from experience. It has been natural proven that some problems solving are beyond the scope of current computers. However, computers do rote things well, like keeping entries or performing complex mathematical operations.

(Abraham 2005) Besides, ANN are also mathematical, algorithmic, software models inspired by biological artificial neural networks. The human brain is a collection of more than 10 billion interconnected neurons. Furthermore, each neuron is a cell that uses biochemical reactions to receive, process, and transmit information.

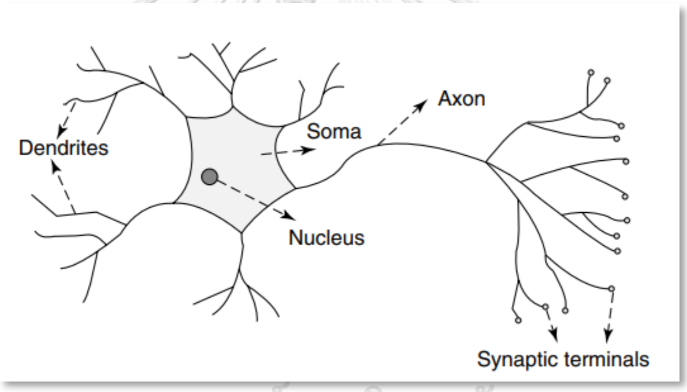


Figure 4 Mammalian Neuron (from Abraham. 2005)

(Pornpatcharapong 2012) The simulation of neural networks in the human brain has the objective to create tools that can learn pattern recognition and knowledge extraction, as well as the capabilities that exist in the human brain. The initial concept of this technique came from the study of the bio-electricity network in the brain. Which consists of neurons and "Synapses". Each neuron contains nerve ending called "Dendrite", which is the input while the end of the nerve impulses is called "Axons", which are similar to the output of cells. These cells work along with electrochemical reactions. When stimulated by external stimuli or stimulated by other cells together the nerve fibers pass through the dendrite into the nucleus, which determines whether or not other cells must be stimulated. The nucleus will continue to stimulate other cells through its axons show in Figure 4.

(Cannady 1998) An artificial neural network consists of a collection of processing elements that are highly interconnected and transformed into a set of inputs to a set of outputs desired. The transformation result is determined by the characteristics of the elements and the weights associated with the interconnections among them. Modifying the connections between the nodes and the network enables it to adapt to the desired outputs that Figure 5 shows the structure of the neural network.

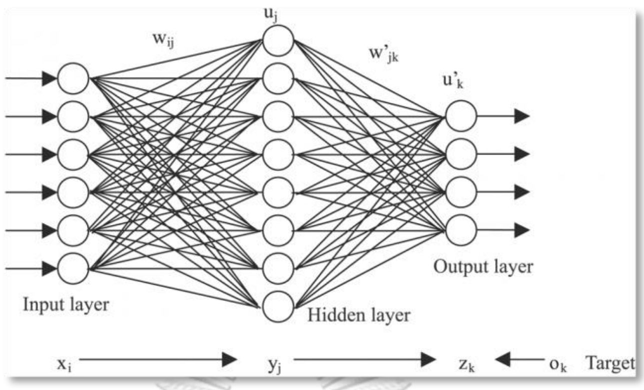


Figure 5 Example structure of neural network (Ungtrakul 2018)

(Pornpatcharapong 2012) The function of Neural Networks is happened when inputs are entering the network and been multiped by the weight of each leg. The results from every input of the neurons are combined and compared to the threshold set. If the combined sum is greater than the threshold then the neurons will send the output to the input of other neurons connected in the network. While, if the combined sum is lesser than the threshold then there will not be any output. It is important to know the weight and the criteria threshold to make the machine recognize and learning. Although it might be uncertain, we might adjust the values of the machine by teaching them what patterns we want them to remember which is called "Back Propagation" that process of reversal recognition. Feed-Forward Neural network uses "Back Propagation" algorithm to adjust network weight. After entering the data pattern to train the network each time, the output result will be used to compare with the actual value and compute the error value. This error value is sent back to the network to correct the additional weight score.

(Abraham 2005)A neural network must be configured such that the application of a set of inputs produces the desired set of outputs. There are various methods to be set the strengths of the connections that exist. One way is to set the weights explicitly, using a priori knowledge. Another way is to train the neural network by feeding it with teaching patterns and letting it change its weights according to some learning rules. The learning situations in neural networks may be classified into three distinct sorts namely supervised learning, unsupervised learning, and reinforcement learning. In supervised learning, an input vector is presented at the inputs together with a set of desired responses, one for each node, at the output layer. A forward pass is done, and the error discrepancies between the desired and actual responses for each node in the output layer are found. These are then used to determine weight changes in the net according to the prevailing learning rule. The term supervised originates from the fact that the desired signals on individual output nodes are provided by an external teacher.

Furthermore, the neural network able to gain experience initially by training the system to correctly identify preselected examples of a problem. The neural network response is reviewed, and the refined configuration of the system is carried out until the neural network's analysis of the training data reaches an adequate level. Besides the initial training period, the neural network able to gain experience over time as it performs analyses on data related to the problem.

2.1.5 Support Vector Regression (SVR)

(Ungtrakul. 2018) Support Vector Regression (SVR) is a technique that uses the Support Vector Machine (SVM) method to analyze regression problems between input and output variables, which can be applied to time series forecasts. By switching from SVM class classification to SVR prediction to find the relationship between vector input in n dimensions (X ⊆R) and output variable (Y ⊆ R) by modulating kernel function.

Assign a set of data points $(x_1,y_1),(x_2,y_2),\ldots,(x_l,y_l)$ $(x\text{i} \in X \subseteq Rn, y\text{i} \in Y \subseteq R)$, l is the total number of training samples randomly and generated independently of an unknown function. SVR approximates a function using the following format:

$$f(x) = w \cdot \phi(x) + b \qquad (2)$$

where $\phi(x)$ represents the high-dimensional feature spaces which is nonlinearly mapped from the input space x. The coefficient w and b are estimated by minimizing the regression risk as Figure 6.

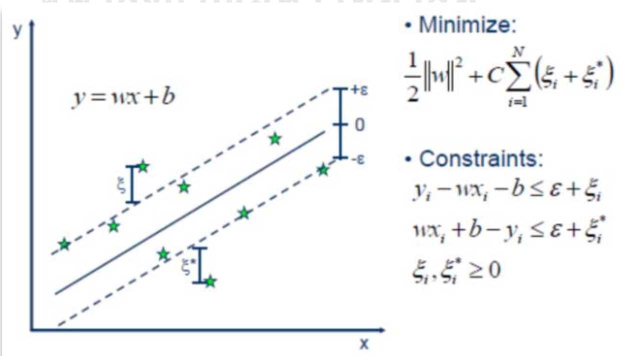


Figure 6 Linear SVR

When $C > 0$ and $\varepsilon > 0$ Where C is a constant that determines the tradeoff value between Equation $f(x)$ obtained from training data accuracy. Most x_i values are in the range of ε -tube values. ξ_i is the value of the error in low data training and ξ^*_i is the error in training elevated data to Lagrange Multipliers, a_i and a^*_i Instead of solving the

Quadratic Problem, the action contributes to the prediction that there is a Target Value (y_i) for the internal point ε -tube, Lagrange Multiplier equal to zero, cannot be supported in the regression function. Therefore, the approximate function of ε -SVR as below.

$$f(x)=\sum_{i=1}^{N}\left(a_i^*-a_i\right)\cdot K(x_i,x)+b \quad (3)$$

K (x_i, x_j) is defined as the kernel function. The value of the kernel is equal to the inner product of two vectors x_i and x_j in the feature space $\phi(x_i)$ and $\phi(x_j)$, that is $K(x_i,x_j) = \phi(x_i) \cdot \phi(x_j)$.

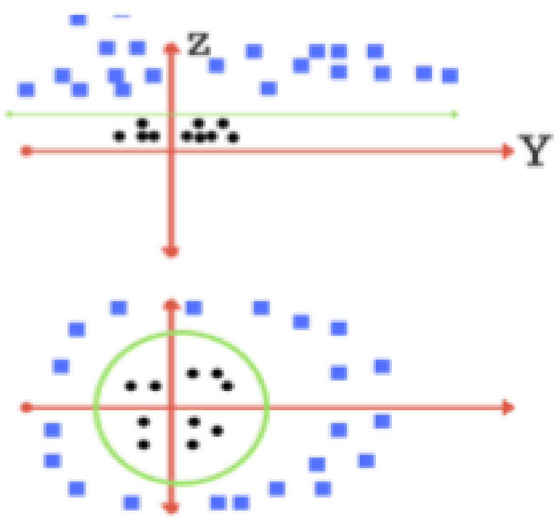


Figure 7 Graphical representation of kernel activation functions in Support Vector Regression (from Ungtrakul. 2018)

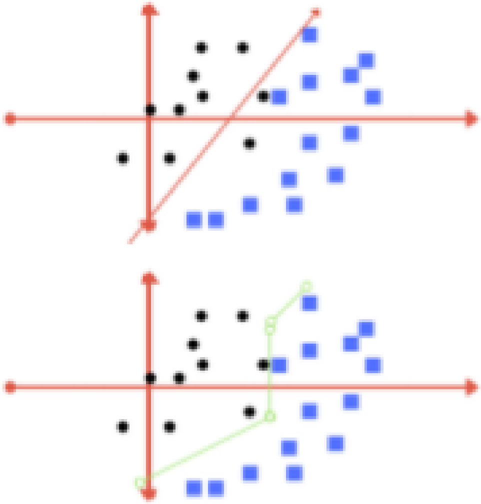


Figure 8 Graphical representation of regularization parameter in Support Vector Regression (from Ungtrakul. 2018)

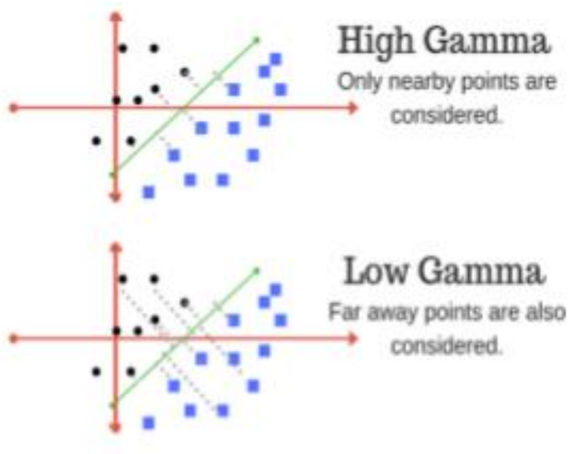


Figure 9 Graphical representation of gamma parameter in Support Vector Regression (from Ungtrakul. 2018)

Support Vector Regression can be handled in higher dimensional isolation planes with non-linear error function, three-parameter SVR configuration to achieve classification results. These three parameters are kernel functions, parameters, and parameters. First, the SVR model converts the data into a 2-D splitting plane. Once the extraction is complete, the model uses kernel functions to revert the extraction plane to its original dimensions. The available kernel activation functions are linear, polynomial, RBF and sigmoid in Figure 7, also the normalization parameters are adjusted to find the optimal extraction function. If the value of the value is large, optimization will select the smaller marginal hyperplain, and if the value of it is small, the additional data point may be classified incorrectly in Figure 8. How to determine the number of data points to create the separation hyperplain? If high values are considered only the data points close to the separation plane, but if the data points are too far beyond the separation plane to the extent of the data point Considered in Figure 9, the most important characteristic of Support Vector Regression is that the hyperplain separation is optimized to create a good distance between groups of data points and hyperplanes, which ensures classification. The types of data points will be optimized.

2.1.6 Random Forests (RF)

(Quadri and Kalyankar 2010) The Random Forest algorithm is a type of supervised learning algorithm that is considered to be extremely accurate, ranked in the world of machine learning by Random Forest, based on the idea of Decision Tree algorithm that focuses on modeling with multiple Decision Tree methods uniquely By using random variables. The results of each model were combined and counted the number of results that were the most repeated until the final result was obtained. The advantage of this method is that it provides accurate forecasts and less overfitting.

Basics of the Decision Tree algorithm can be summarized as follows: Decision Tree is one of the most widely used machine learning algorithms called the tree-based model that the original model called CART, stand for "Classification And Regression Trees." Or called "Decision Tree" for short, which is a model that is not difficult. But the accuracy is not very high compared to other models, DT is called the weak classifier.

The Decision Tree algorithm is the use of data to create forecasting model like a tree in which rules are created for making decisions. The decision tree was supervised learning, capable of automatically generating a classification model from the training set samples and predicting groups of items that had not yet been categorized

The tree structure pattern consists of a node, each of which has a characteristic condition, which is a test branch that represents the possible value of the feature being tested. And the leaf is the bottom of the tree, representing the group of information (class) is the forecast result. The characterization criteria for tree nodes were calculated from Information Gain calculations, considering characteristics with low information gain or entropy, meaning that the feature had a high classification (Lee and Lee 2006).

The principles for dividing data in each node for data with k feature and n observation are as follows:

1. Select 1 feature from k feature to sorting data by the value of selected feature.
2. Find all possible split points from the data. n observation can find possible dividing point n-1. For each possible separation, calculate the residual sum of squares (RSS) based on prediction of target variables with mean target

variables in each RSS group by selecting the split point that provide minimum RSS.

$$\sum_{j=1}^{J} \sum_{i \epsilon R_j} \left(y_i - \hat{y}_{R_j}\right)^2 \tag{4}$$

When,
R_j = Each group of observations divided into j groups.
y_i = Target variable
$\hat{y}_{Rj}$ = Prediction for each group, calculated from mean of target variable for that group.

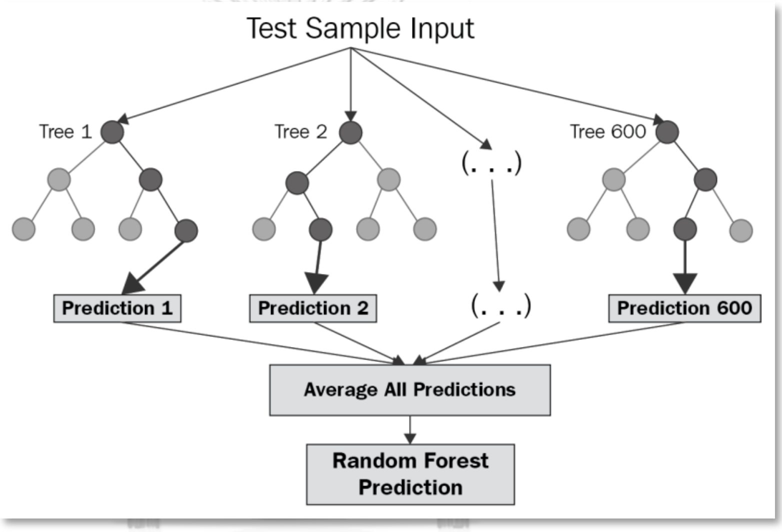


Figure 10 Random Forests structure (from www. towardsdatascience.com)

(KANSINEE 2018) Random Forest's working principle uses a technique that known as the ensemble technique, which is the use of multiple models to find results. Beginning with the training data set is used to create a model where these data are different data. After obtaining a set of models, it is used to predict the results of unknown results. The predictions use this ensemble technique that there are many models and each of which will produce a final result then combine these results to see which is the most appropriate by using a vote method to select the result that best matches as Figure 10.

Random Forest has randomized a sample data. It also increases model diversity by randomizing attributes (or statistical tree variables) through the technique used in model Decision Tree modeling, where when the data and attributes used in the modeling are different, the model have different characteristics as well.

2.2 Related Researches

2.2.1 Data Analysis by using Google Analytics Metrics

(Omidvar, Mirabi et al. 2011) Mohammad Amin Omidvar, Vahid Reza Mirabai and Narjes Shokry have researched to identify factors from Google Analytics that are impacted by visitors on page views with Google Analytics. In addition, Beatriz Plaza (2010) has also conducted a study on Google Analytics to measure website performance by determining the pageview per session is a dependent variable while the session in each traffic is independent variables by using multiple linear regression. Moreover, Roberta Milano, Rodolfo Baggio, and Robert Piattelli have researched to analyze the impact of visits from Facebook and Twitter on total visits by using the multiple regression analysis also (Milano, Baggio et al. 2011).

Unlike the previous research, this thesis focus on analyzing the effects of Google Analytics metrics on sales by using multiple regression method to find the impactful factors that have the effect on interested dependent variables and which the regression model to accurately predict sales.

2.2.2 Forecasting in Tourism Industry

(Gunter and Önder 2016) Studies conducted by Ulrich Gunter and Irem Onder on the ability of 10 Google Analytics website traffic indicators from the Viennese DMO website to predict actual tourist arrivals to Vienna are investigated within the Vector Autoregressive regression (VAR) model class is used to analyze the multivariate with time series data. Beside, Vector Autoregressive modeling (VAR) is used by Yuan-Yuan Liua, Fang-Mei Tsengc, and Yi-Heng Tsengc to examine the Granger causality between actual arrivals of the studied cultural tourism destination and its web search queries including to explore the correlation mentioned above. Then, it emphasizes the tourism destination arrivals' predictive power based on its web search queries (Liu, Tseng et al. 2018).

(Napagoda 2013) Furthermore, there is much research that uses machine learning methods in forecasting such as Chandana Napagoda on applying a suitable forecasting technique such as Gaussian Process, Multilayer Perceptron, Linear Regression and SMO Regression that are the multiple classifier functions in machine learning techniques used to predict web site visits. Thus, the results derived through forecasting will assist web site owners to predict the number of visitors on their website.

(Sun, Wei et al. 2019) Sun, Shaolong propose a forecasting framework that uses kernel extreme learning machine (KELM) models with different kernel functions and internet search indexes to forecast tourist arrivals on popular destinations in China.

(Claveria, Monte et al. 2015)Moreover, Claveria, Oscar, Enric Monte, and Salvador Torra compare the performance of three different artificial neural network techniques for tourist demand forecasting as a multi-layer perceptron (MLP), a radial basis function (RBF) and an Elman network (Elman ANN).

(Lin, Chen et al. 2011) Lin, Chang Jui, Hsueh Fang Chen, and Tian Shyug Lee tries to build the forecasting model of visitors to Taiwan using three commonly adopted ARIMA, artificial neural networks (ANN), and multivariate adaptive regression splines (MARS). In order to evaluate the appropriateness of the proposed modeling approaches, the dataset of monthly visitors to Taiwan was used as an illustrative example.

(Chen, Sun et al. 2017) Lastly, Chen and Wei have also conducted a study on an introduction to the theoretical principles of artificial neural networks (ANN) for designing a neural network for tourism time series forecasting that corresponding to tourism expenditure in the Balearic Islands (Spain).

Meanwhile, this thesis focuses on Google Analytics metrics that affect online bookings and which the statistical technique is multiple linear regression and machine learning techniques are artificial neural networks (ANN), Support Vector Regression (SVR) and Random Forests to accurately predict online bookings in a case-study company.

Chapter 3 Methodology

3.1 Research Structure

The research structure is referred based on 2 objectives that relate to this thesis. The first objective, analysis of factors contributing of Google Analytics to the number of bookings by extracting bookings volume from the booking transactions quantifying how many guests make purchase transactions no relation to its tour date. On the other hand, extracts the potential factors contributing to bookings volume are obtained from Google Analytics. The seasonal dummy variables are included in the model. Website traffic data were retrieved from the case study company's Google Analytics account. After that, the data then being executed in a statistical program call Minitab, in order to compile multiple linear regression. The second objective then relates to forecasting the number of bookings by using impactful factors from Google Analytics metrics and the seasonal dummy variables.

Figure 11 shows a diagram on the research structure that summarizes how the thesis is structured. It illustrates that the factors contributing to bookings which are the combination of data from both booking transactions and Google Analytics. After that, the impactful factors are used to forecast the number of bookings in monthly.

3.2 The Data

3.2.1 Data Preparation

The booking volume is used as the interest variable which is retrieved from the case study company's system while the metrics from the Google Analytics are used to be the factors of all the historical data obtained from Google Analytics website. The data consist of monthly data from 2015 to 2019 (60 months/1,826 days).

3.2.2 Independent Variables Selections

The factors that impact the number of bookings, they are studied in the website analytics term. The frequently used variables in the literature and the importance of website performance analysis are income to measure in terms of metrics such as the number of sessions, the number of unique users, the number of page views, etc., that are measured in daily. Moreover, the seasonal dummy variables of monthly effects are included in the model in Table 1.

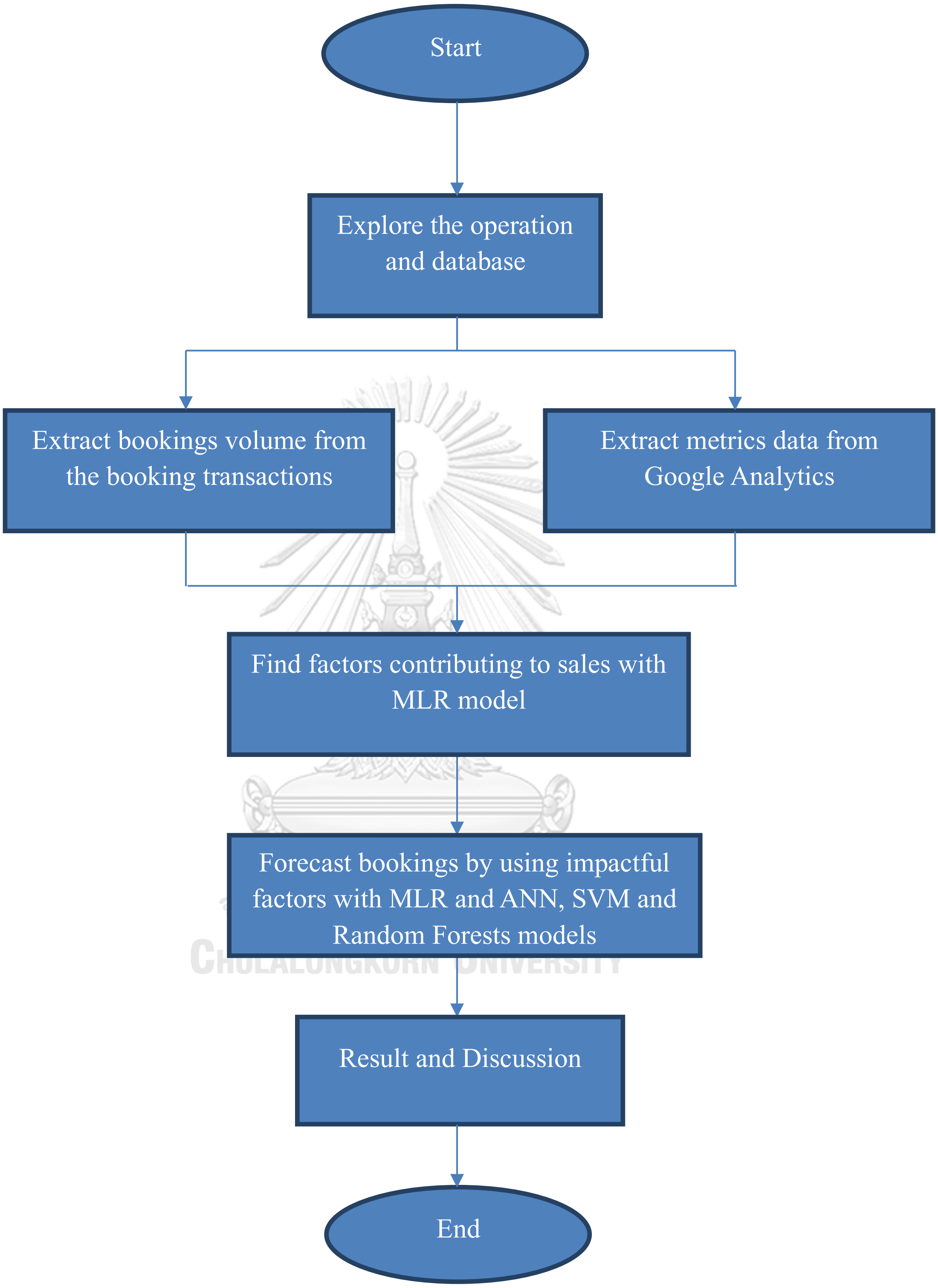


Figure 11 Research Structure

Table 1 Independent variables used in data analysis and forecasting

Category	Sub-category	Frequency	Remarks
The number of Sessions (Use 4 channels from Top 5 channels)	Top 1: Organic Search Top 2: Direct Top 3: Referral Top 5: Social Network	Daily/Monthly	- Exclude Top 4 is Paid Search - No Paid Search data in 2015 and 2016
The number of Unique Users	New Users Repeat Users Returning Users	Daily/Monthly	N/A
The number of Page Views	N/A	Daily/Monthly	N/A
The number of Unique Page Views	N/A	Daily/Monthly	N/A
The average of Page Views/Sessions	N/A	Daily/Monthly	N/A
The average Session Duration	N/A	Daily/Monthly	In minute
The average Time on Page	N/A	Daily/Monthly	In minute
Bounce Rate	N/A	Daily/Monthly	In %
Days of Week	Monday Tuesday Wednesday Thursday Friday Sunday	Daily Dummy	- Exclude Saturday that is chosen as a base value. - Saturday is the lowest day of the week
Month of the Year	January February March April May June July September October November December	Daily/Monthly Dummy	- Exclude August that is chosen as a base value. - August is the lowest month of the year

3.3 Descriptive Data

The company website is mainly used as a sales channel for a customer because it can deliver customers with tour information in the most convincing way and most importantly to direct customers to online payments conveniently.

Besides, the company uses a booking system that allows the customer to have instant confirmations upon purchasing the tour package from the website. Therefore, the transaction details which was provided by the company website are used.

1) Bookings in Transaction Data

This thesis, sales volume is measured in terms of the number of bookings (domestic and foreign) in transaction data that it will be used to a dependent variable. The daily booking data from 2015 until 2019 is collected from the case-study company's system and has been analyzed pre-processed into monthly data. As it can be seen in Table 2 showing transaction details provided by the case-study company, each row represents an individual transaction at different booking ID, customer name, product name, booking date, product type, personal details of the customer, etc. This huge shrunk of raw data was directly extracted from the company system. Therefore, it is required to be pre-processed before entering the Minitab program to perform regression.

Table 2 Raw data as transaction details

Booking ID	Customer	Product Name	Departure	Created	Payment Status	Booking Status	Departure Type	Product Type	Age	Nationality	Email
BK007152			1/22/2019	1/1/2019	Paid	Confirm	Repeat Everyweek	On Request Booking	41	United States	
BK007153			1/11/2019	1/1/2019	Paid	Confirm	Repeat Everyweek	Instant Booking	33	United States	
BK007154			1/2/2019	1/1/2019	Paid	Confirm	Repeat Everyweek	Instant Booking	35	United States	
BK007155			1/2/2019	1/1/2019	Paid	Confirm	Repeat Everyweek	On Request Booking	32	Germany	
BK007156			1/10/2019	1/1/2019	Paid	Confirm	Repeat Everyweek	Instant Booking	21	Korea"	
BK007157			1/3/2019	1/1/2019	Paid	Confirm	Repeat Everyweek	Instant Booking	43	Canada	
BK007158			1/2/2019	1/1/2019	Paid	Confirm	Repeat Everyweek	Instant Booking	30	United States	
BK007160			1/2/2019	1/1/2019	Paid	Confirm	Repeat Everyweek	Instant Booking	42	Canada	
BK007163			1/2/2019	1/1/2019	Paid	Confirm	Repeat Everyweek	Instant Booking	39	United States	
BK007167			1/2/2019	1/1/2019	Paid	Confirm	Repeat Everyweek	Instant Booking	18	Germany	
BK007168			1/3/2019	1/1/2019	Paid	Confirm	Repeat Everyweek	Instant Booking	44	Moldova"	
BK007172			1/3/2019	1/1/2019	Paid	Confirm	Repeat Everyweek	Instant Booking	33	Canada	
BK007173			1/12/2019	1/1/2019	Paid	Confirm	Repeat Everyweek	Instant Booking	29	Norway	
BK007174			2/6/2019	1/1/2019	Paid	Confirm	Repeat Everyweek	Instant Booking	58	United States	
BK007177			1/14/2019	1/2/2019	Paid	Confirm	Repeat Everyweek	Instant Booking	29	United States	
BK007178			1/17/2019	1/2/2019	Paid	Confirm	Repeat Everyweek	On Request Booking	29	United States	
BK007180			1/7/2019	1/2/2019	Paid	Confirm	Repeat Everyweek	Instant Booking	33	Brazil	
BK007181			2/8/2019	1/2/2019	Paid	Confirm	Repeat Everyweek	Instant Booking	28	United States	
BK007182			2/16/2019	1/2/2019	Paid	Confirm	Repeat Everyweek	Instant Booking	61	Canada	
BK007184			1/19/2019	1/2/2019	Paid	Confirm	Repeat Everyweek	Instant Booking	50	United States	
BK007187			2/7/2019	1/2/2019	Paid	Confirm	Repeat Everyweek	Instant Booking	26	United States	
BK007202			1/6/2019	1/2/2019	Paid	Confirm	Repeat Everyweek	Instant Booking	37	United States	

2) Insights from Google Analytics

Google Analytics is a powerful tool for measuring the success of websites, marketing efforts, and products and services. Google Analytics makes it easy to keep track of the customer's journeys by connecting customer behavior, and channel performance.

Google Analytics allows users to export raw data in Microsoft Excel format for statically analysis in time series data as Table 3. In this study, monthly data are derived from 1st January 2015 until 31st December 2019 which is a total of 60 months.

Table 3 Example of a raw data of each metrics from Google Analytics

Year	Months	Organic Search	Direct	Refferal	Social	Unique Users	New Users	Repeat Users	Returning Users	Page Views (100)	Unique Page Views	Avg. Session Duration (Sec.)	Pages/Session
	1	4387	2074	752	1682	6086	5697	1079	389	245.51	18233	6574.77	2.79
	2	3404	1697	550	1117	4728	4357	745	371	188.22	14064	5782.35	2.81
	3	4280	1657	668	1161	5528	5136	918	392	206.24	15750	6362.40	2.68
	4	3921	1450	565	1041	5073	4700	785	373	188.01	14212	5948.09	2.72
	5	3734	1646	779	1176	5212	4823	850	389	188.52	14497	5765.96	2.59
2015	6	3404	1782	1330	1117	5607	5257	837	350	203.5	15091	6178.35	2.69
	7	3837	1776	959	1239	5667	5315	976	352	220.88	16487	6884.11	2.86
	8	3426	1674	836	1083	5111	4730	836	381	192.87	14526	6352.52	2.73
	9	3018	1678	790	996	4645	4259	770	386	190.05	14399	6367.84	2.81
	10	3603	2028	634	1013	5194	4775	886	419	212.5	16095	6524.58	2.84
	11	4289	2356	881	1063	5919	5438	1010	481	247.43	18374	6440.71	2.89
	12	4630	2698	644	1084	6554	6159	1156	395	266.85	20078	6468.55	2.83
	13	5220	3079	1032	1136	7347	6810	1330	537	295.03	22380	6643.46	2.85
	14	4670	3195	731	1729	7252	6738	1262	514	273.22	20859	5992.71	2.67
	15	4914	2989	777	607	6521	5947	1129	574	256.43	19277	6476.09	2.79
	16	4479	2885	1776	323	6869	6383	1068	486	252.85	18837	6271.33	2.70
	17	5016	3028	2400	381	7839	7360	1246	479	287.26	21486	6199.05	2.68
2016	18	4526	2339	1863	341	6639	6188	992	451	233.74	17650	6145.32	2.60
	19	4539	2928	1992	375	7067	6634	1131	433	247.18	18749	6002.64	2.53
	20	4663	3189	1844	642	7508	7010	1162	498	267.99	19939	6150.91	2.62
	21	4981	2795	1710	612	7247	6693	1141	554	263.03	19821	6012.52	2.63
	22	5325	3684	1903	439	7992	7410	1373	582	303.79	22812	6434.20	2.70
	23	6050	3881	2450	464	8907	8257	1547	650	342.62	25272	6103.36	2.70
	24	5729	5405	2934	375	10085	9471	2107	614	388.25	28157	6119.12	2.69
	25	6585	6019	2705	366	11503	10783	2079	720	494.63	32789	6670.04	3.14
	26	5442	4686	1897	458	9347	8634	1559	713	419.88	26185	5841.80	2.89
	27	5827	4403	2028	359	9705	9050	1640	655	345.13	26551	6104.71	2.65
	28	5032	3946	1678	297	8511	7914	1325	597	289.74	22537	5394.36	2.56
	29	5012	3649	1772	353	8647	8121	1330	526	288.72	22573	5698.93	2.53
2017	30	4940	4333	903	235	8747	8269	1335	478	274.12	21418	5151.30	2.42
	31	4686	4352	224	492	9966	9432	1473	534	297.26	23418	4798.19	2.27
	32	4770	4254	210	428	10777	10126	1608	651	313.7	25086	4396.57	2.17
	33	4708	4282	307	617	9556	8966	1362	590	282.48	22559	4706.70	2.29
	34	5469	5412	274	492	10611	10029	1803	582	350.58	27233	5678.03	2.48
	35	5733	5362	283	478	10485	9725	1617	760	354.13	27526	5750.10	2.53
	36	6309	4685	454	393	10748	10153	1876	595	339.4	26282	4936.16	2.32
	37	7797	4475	560	776	12312	11649	1927	663	353.86	27740	4617.91	2.19
	38	8017	3683	539	662	12002	11317	1668	685	312.05	24849	3539.92	2.00
	39	8509	3473	600	514	12020	11397	1667	623	293.05	23696	3615.11	1.90
	40	7732	2750	464	336	10345	10022	1641	323	253.95	20601	3403.96	1.89
	41	9432	3042	279	288	11286	10793	1439	493	262.86	21608	3466.99	1.82
2018	42	9645	2680	206	277	11427	10924	1585	503	257.59	21450	3187.81	1.76
	43	9566	3011	242	330	12405	11888	1549	517	273.46	22830	3319.50	1.77
	44	10947	3527	448	439	14901	14369	1835	532	318.58	26621	3104.25	1.71
	45	7595	2257	284	273	9636	9136	1135	500	206.45	17204	2582.38	1.73
	46	11986	3757	2201	614	15992	15501	1920	491	342.42	28440	2851.93	1.71
	47	11320	3019	1302	649	14312	13593	1697	719	307.76	25395	2469.20	1.74
	48	15657	4632	2412	2226	22255	21628	2672	627	447.01	37035	2684.89	1.65
	49	18223	4655	1128	1369	21646	20729	2635	917	457.13	37584	3057.77	1.71
	50	22299	5053	1350	2078	25246	24374	3133	872	468.24	39321	2549.12	1.51
	51	17733	3508	345	761	18296	17467	2224	829	380.31	31256	3147.49	1.67
	52	11563	2568	207	653	12329	11717	1431	612	261.84	21179	3237.62	1.71
	53	13655	2875	304	671	14190	13689	1847	501	289.55	23929	3068.95	1.62
2019	54	12041	2763	186	604	12583	12020	1570	563	253.45	21188	2817.28	1.60
	55	12316	3236	233	592	13304	12893	1781	411	271.96	22641	2917.96	1.63
	56	12323	2983	168	636	12818	12301	1735	517	273.44	22591	3216.44	1.67
	57	11779	2495	196	377	12228	11758	1489	470	245.07	20543	3022.40	1.60
	58	15058	3704	270	544	15977	15433	1997	544	312.78	26425	2960.38	1.58
	59	11613	3623	316	666	14823	14263	2133	560	337.26	28035	3238.93	1.69
	60	11862	3893	310	1220	17681	17034	2380	647	360.47	30384	2785.44	1.61

In this study, insights from Google Analytics will be investigated to determine to what extent each factor from insights will contribute to the number of bookings. The followings are some of the features in Google Analytics that will be used to determine the most contributing factor to dependent variable Y. (Burby, Brown et al. 2007)

- **Sessions -** a single visit to your website, consisting of one or more-page views, along with events, eCommerce transactions and other interactions. By default, a session ends after 30 minutes of inactivity or when a user closes a browser. The session by channels is the number of sessions attributed to each channel group. Google Analytics channel grouping classify traffics to track the performance of an individual channel. The top 4 channels are used in this thesis are the following:

1) **Organic search** - Visitors who come to the website after searching Google.com and other search engines without clicking on a paid search ad.
2) **Direct** - Visitor who typed the website's URL into their browser or clicked a link in an email application (that didn't include campaign tags).
3) **Referral** - Visitor who clicks through to a website from another third-party website.
4) **Social Network** - Visitors who come to the website from social applications such as Facebook, Naver, YouTube, Instagram, etc.

• **Unique Users -** The number of distinct individuals within a designated reporting timeframe, with activity consisting of one or more visits to a site. Each individual is counted only once in the unique visitor measure of the reporting period.

1) **New Users** - The number of Unique Visitors which first-ever visit the site during a reporting period
2) **Repeat Users** - The number of Unique Visitors with activity consisting of two or more Visits to a site during a reporting period.
3) **Returning Users** - The number of Unique Visitors with activity consisting of a Visit to a site during a reporting period and where the Unique Visitor also Visited the site before the reporting period.

• **Page Views (in hundred)** - Reported when a page has been viewed by a user on your website.

• **Unique Page Views -** The number of sessions during which the specified page was viewed at least once. A unique pageview is counted for each page URL + page Title combination.

• **Pages Views/Session -** The number of page views in a reporting period divided by the number of visits in the same reporting period

• **The Average Session Duration (in minutes)** – Total of the number of time users that they are spending on website divided by the number of all sessions.

• **The Average Time on Page (in minutes)** – Total of the number of time users that they spend viewing a specific page divided by the number of page views on that page. A higher average time of page indicates to contents on the page are very interesting to visitors.

• **Bounce Rate (in %) -** The percentage of a single-page visit (is single-page sessions divided by all sessions). For the success of a case-study website depends on users viewing more than one page than a high bounce rate is bad.

3.4 Data Analysis and Forecasting

This thesis discusses the online bookings forecasting for a case-study company using daily and monthly metrics for the web site from the Google Analytics 1st January 2015 to 31st December 2019 time range. There is a comparison of prediction approaches has been applied between the statistical technique (MLR model) and machine learning models on time series analysis environment.

In a part of factors analysis and forecasting of this thesis, there is workflow follow as Figure 12 and this part uses the data of bookings and Google Analytics metrics are divided into 3 intervals as per below:

➢ The data on 1st January 2015 to 31st December 2018 (48 months/1,461 days) are used for the training set.

➢ The data on 1st January 2019 to 30th June 2019 (6 months/181 days) are used for the cross validation set.

➢ The data on 1st July 2019 to 31st December 2019 (6 months/184 days) are used for the testing set.

After analyzing data with stepwise regression, the impactful factors in the regression models with training dataset are used to forecast the bookings in cross validation dataset by using MLR model and ANN model and compare the forecasting performance by measurement error to select the best model to be used for the forecasting model to test dataset.

3.4.1 Multiple Linear Regression (Stepwise)

Based on the purpose is analyzing the effects of Google Analytics metrics on bookings in 2015 to 2018 by finding the relationship between independent variables (X) and dependent variables (Y). In this study, Google Analytics metrics are used as independent variables and the hypotheses that used:

H_0: $\beta_i = 0$ and H_a: At least one of the β_i does not equal to 0

Which says that

H_0: None of the Google Analytics metrics in X_i is significantly related to the number of online bookings.

H_a: At least one of the Google Analytics metrics in X_i is significantly related to the number of online bookings.

For this thesis, the model of multiple linear regression can be represented as:

$$Y_t = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \ldots + \beta_{30} X_{30} + \varepsilon \quad (5)$$

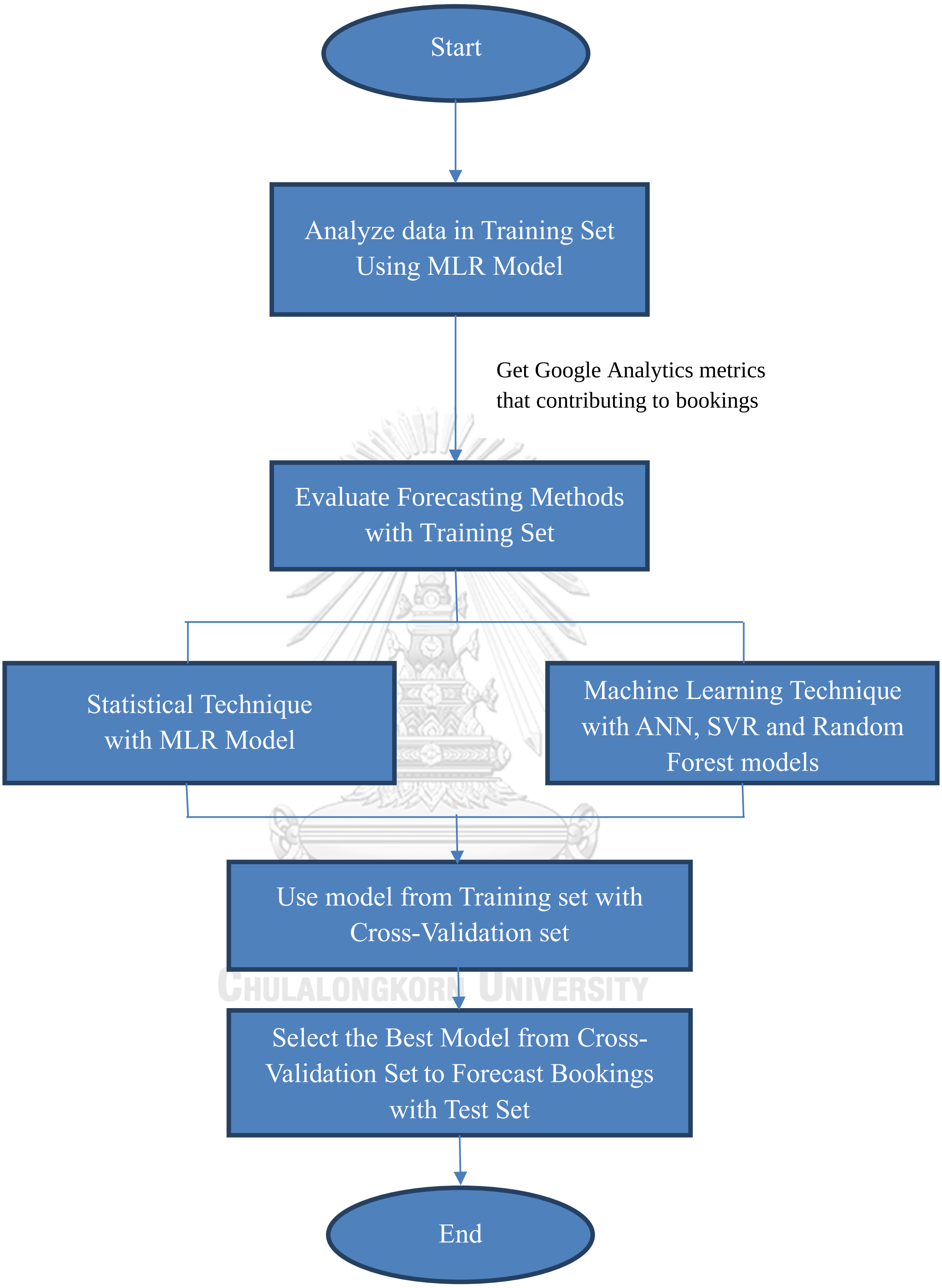


Figure 12 Workflow of booking forecasting

where,

Y is the number of Bookings.

β_0 is constant variable

β_i is coefficient of the control variables, X_i

β_t is coefficient of monthly variables, M_t

X_1 is the number of Sessions from Organic search

X_2 is the number of Sessions from Direct

X_3 is the number of Sessions from Referral

X_4 is the number of Sessions from Social

X_5 is the number of Unique New Users

X_6 is the number of Unique Repeat Users

X_7 is the number of Unique Returning Users

X_8 is the number of Page Views

X_9 is the number of Unique Page Views

X_{10} is the average of Page Views/Session

X_{11} is the average of Session Duration (in minutes)

X_{12} is the average of Time on Page (in minutes)

X_{13} is the average of Bounce rate (in %)

X_{14-19} is 6 days effect, set of k-1 weekdays seasonal dummy variables where k is an indicator of the weekdays (k = 7 days) to identify the seasonal pattern of bookings in that period. Saturday is chosen as a base value.

X_{20-30} is 11 Months effect, set of k-1 monthly seasonal dummy variables where k is an indicator of the month (k = 12 months) to identify the seasonal pattern of bookings in that period. August is chosen as a base value.

ε is error

This study applies stepwise regression is performed to test the hypothesis at alpha 0.1 to reduce the set of predictor variables to those that are necessary and significant to identify the most appropriate set of factors that have a significant impact on the number of bookings seen as "Y".

The main questions that relate to the objective of this research are "Are Google Analytics metrics and seasonal dummy variables well describe booking?" "Which factors are contributing to bookings and why?" The effects of Google Analytics metrics on bookings describe by the ANOVA table from the Minitab program in Figure 13 and 14.

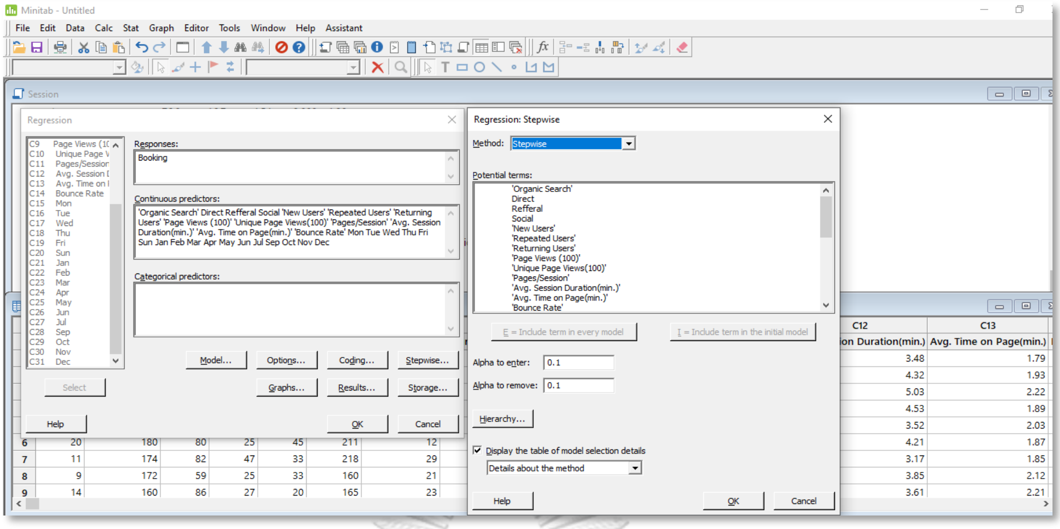


Figure 13 Parameter setting with daily data (2015-2018) in Minitab program

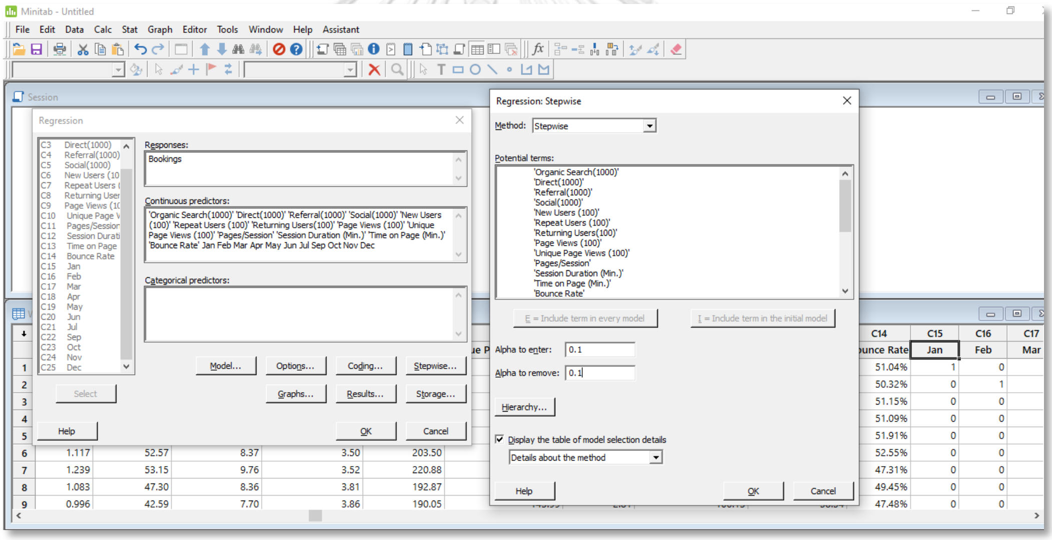


Figure 14 Parameter setting with monthly data (2015-2018) in Minitab program

3.4.2 Artificial Neural Network (ANN)

The input variables choice is generally based on a priori knowledge of causal variables, inspections of time series plots, and statistical analysis of potential inputs and outputs. The choice of input variables for the present neural network modeling is based on a statistical correlation analysis of the field data and the prediction accuracy of Google Analytics metrics variables. In this thesis, the input variables (Google Analytics metrics) have been chosen significantly which affect the output variable (Bookings) with the MLR model.

(Abraham. 2005) A typical artificial neuron and the modeling of a multilayered neural network are illustrated in Figure 15. The signal flow from inputs $x_1,\ldots,x_n$ is considered to be unidirectional, which is indicated by arrows, as is a neuron's output signal flow (O). The neuron output signal O is given by the following relationship:

$$O = f(net) = f\left(\sum_{j=1}^{n} w_j x_j\right) \tag{6}$$

where w_j is the weight vector, and the function f(net) is referred to as an activation (transfer) function. The variable net is defined as a scalar product of the weight and input vectors,

$$net = w^{\mathrm{T}}x = w_1x_1 + \cdots + w_nx_n \tag{7}$$

where T is the transpose of a matrix, and, in the simplest case, the output value O is computed as

$$O = f(net) = \begin{cases} 1 & if\ w^{\mathrm{T}}x \geqslant \theta \\ 0 & otherwise \end{cases} \tag{8}$$

where θ is called the threshold level; and this type of node is called a linear threshold unit.

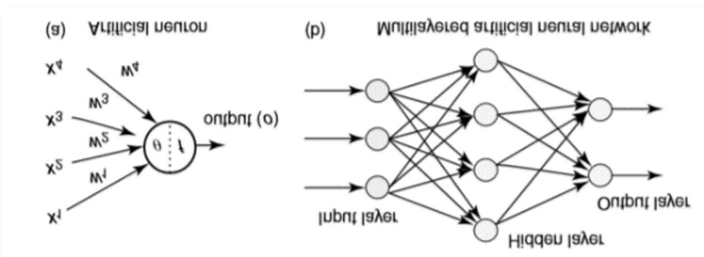


Figure 15 Architecture of an artificial neuron and a multilayered neural network (from Abraham. 2005).

For the generation of the ANN models, the parameter evaluated in this thesis as follows:

1. **The Number of Input Units:** The dimension of features as below detail.

- 13 input variables (5 Google Analytics metrics and 8 seasonal dummy variables) for the daily model. There are recoding about 1,461 days in training set, 181 days in cross validation set and 184 days in the test set.
- 7 input variables (5 Google Analytics metrics and 2 seasonal dummy variables) for the monthly model. There are recoding about 48 months in the training set and 6 months in the cross validation set and the test set.

2. **The Number of Hidden Layers:** 1 layer and 2 layers
3. **The Number of Hidden Units:** Vary from 5 to 100 units
4. **The Number of Epochs:**

- Define 4 epochs are 10, 40, 70 and 100 for daily data
- Define 4 epochs are 10, 100, 500 and 1000 for monthly data

The number of epochs is a hyperparameter of gradient descent that controls the number of complete passes through the training dataset. The number of epochs is traditionally large which is often hundreds or thousands, allowing the learning algorithm to run until the error from the model has been sufficiently reduced. The number of epochs in the literature and tutorials are set to 10, 100, 500, 1000, and larger (Jason Brownlee. 2018).

5. **Batch Size:** Define 4 sizes are 10, 32, 64 and 128

The batch size is a hyperparameter that defines the number of samples to work through before updating the internal model parameters or the total number of training examples present in a single batch. The learning algorithm is called batch gradient descent when all training samples are used to create in one batch. When the batch is the size of one sample, the learning algorithm is called stochastic gradient descent. When the batch size is more than one sample and less than the size of the training dataset, the learning algorithm is called mini-batch gradient descent. This thesis is in the case of mini-batch gradient descent, popular batch sizes include 32, 64 and 128. Figure 16 is the training comparison of each batch size that shows the high accuracy at batch size 32 and 64 and uses medium memory with a shorter time of training.

Batch Size	Time	Accuracy	Memory
512	08:35	24%	Large
2	34:00	2%	Small
64	07:09	54%	Medium
32	07:23	62%	Medium

Figure 16 The training comparison of each batch size.
(from www.bualabs.com)

6. The Number of Seeds: Vary from 1 to 100 seeds

When a random number is generated by a computer, it is not truly ‘random’ and is pseudorandom. We can think of the seed as a parameter that determines the sequence of generated pseudorandom numbers. A different sequence will be given when the start point is changed. The seed for any algorithms tells them where to start in the sequence. Keep the start point the same and get the same sequence.

7. Activation Function: Sigmoid and Rectified Linear Unit (ReLU)

The activation function is just a thing function that you use to get the output of the node. It is also known as “Transfer Function”. The activation function of the hidden node does not have fixed rules. The activation functions which are commonly used are Sigmoid function and ReLU function. But the preferred option is the ReLU function because it has many advantages. One of the advantages is that it can reduce the time for teaching large models.

- **Sigmoid Function** is a function on the S curve. The reason is popular because of its output (0–1), so it is very appropriate if we want to find the probability (probability) of the output, the probability ranges from 0 to 1.
- **ReLU Function** is the most popular function in the world currently used in the Convolutional Neural Network or Deep Learning. From the ReLU graph in Figure 17, there will be only half. Which, if the value is less than 0, will immediately output to 0. If the value is greater than or equal to 0, then the output will be greater than 0 (range is 0 to infinity). But the problem is that converting negative values to 0 will all reduce the ability of the model to train from the data. This means that regardless of what the value is, once negative and entering the ReLU function, it immediately becomes 0, causing the graph not to map any negative values at all.

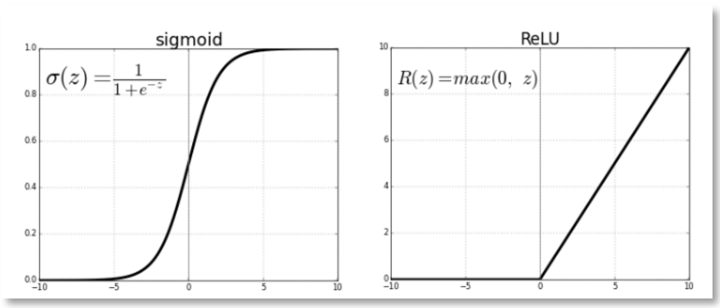


Figure 17 The graph of Sigmoid and ReLU functions
(from www.bualabs.com)

Generally, rules do not exist, nevertheless, it is important to start with the simplest configurations to see if they are acceptable or else more sophisticated configurations should be proposed.

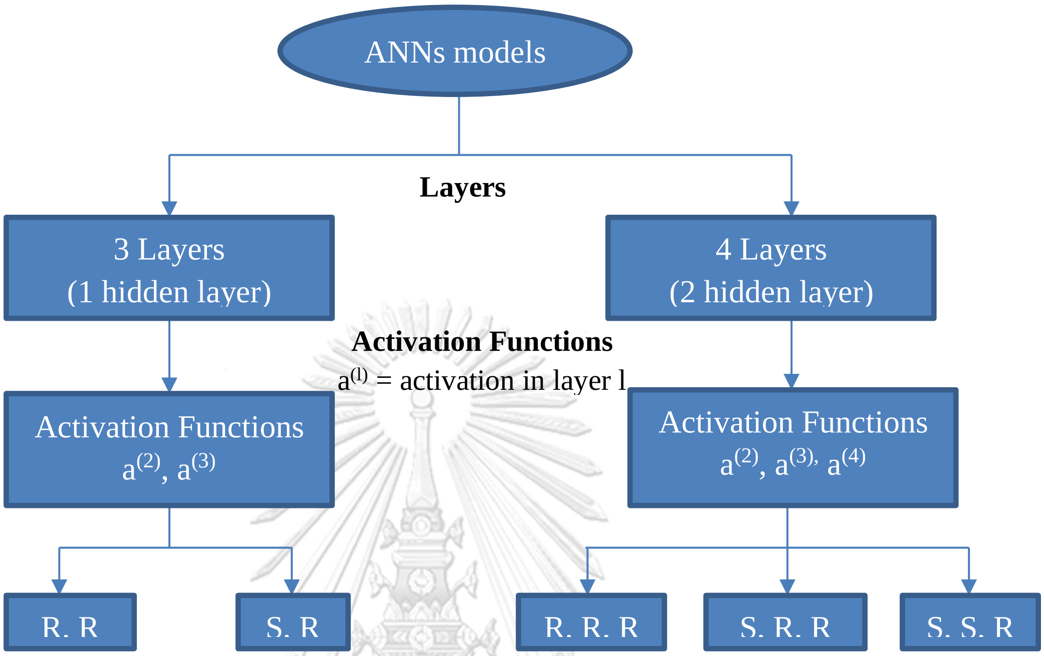


Figure 18 The combination of ANN models

As above Figure 18, the evaluation of ANN models is separated into 6 models by the number of layers and activation functions of the hidden layer and output layer as following.

Model 1: 1 Hidden layer

Where both a_1 and a_2 use ReLU functions.

Model 2: 1 Hidden layer

Where a_1 uses Sigmoid while a_2 uses ReLU functions.

Model 3: 2 Hidden layers

Where all a_1, a_2 and a_3 use ReLU functions.

Model 4: 2 Hidden layers

Where a_1 uses Sigmoid while both a_2 and a_3 use ReLU functions.

Model 5: 2 Hidden layers

Where a_2 uses Sigmoid while both a_1 and a_3 use ReLU functions.

Model 6: 2 Hidden layers

Where both a_1 and a_2 use Sigmoid while only a_3 uses ReLU functions

In this thesis, there is no use of Sigmoid function with the output layer since the output values computed by sigmoid is the probability ranges from 0 to 1. While the output value in this thesis is the number of bookings that it is continuous data.

Each of 6 models there is the determination of all parameters mainly depend on a hit-and-trial method based on the performance of the function So, this thesis has a workflow for parameter selection of ANN model in Figure 19.

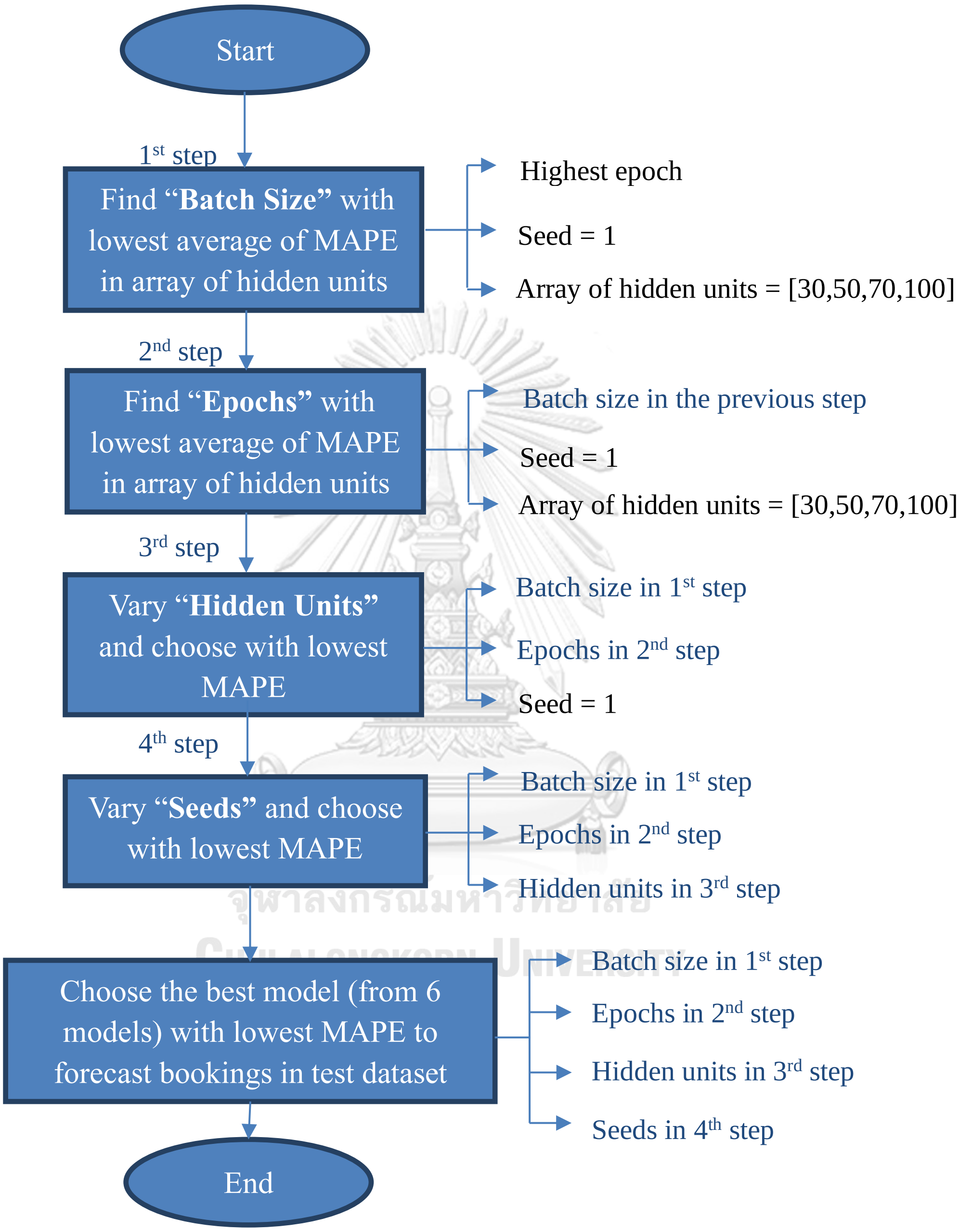


Figure 19 The workflow of ANN Parameter Selection

3.4.3 Support Vector Regression (SVR)

SVR is a technique used for prediction. This is a model showing the value of the bias (b) and the weight (w) in the case that the SVR is used in that forecast. This can only be achieved if the learning is adjusted to obtain the appropriate bias (b) and weight (w) values for the training data set. Therefore, SVR is used in research studies, additional variables have to be assigned depending on the kernel function are linear, polynomial, RBF and sigmoid that the gamma (γ), constant (C) and epsilon (ε) variables must appropriate to the dataset that will bring SVM to practice learning.

Where γ is the variable that determines the shape of the plane, whereas variable C is the constant used to determine the margin of the plane. The learning error and the ε variable is the ε - insensitive used to find the degree of accuracy of the estimate function. However, the effect of assigning gamma variables (γ), constant (C) and epsilon (ε) to each data set may be different.

Several values of C, γ and ε are tried to find which combinations of SVR parameters may be used for training SVR. By the combination of parameters, the SVR model undergoes both pieces of training using training data and cross validation data. From the result of computational time and MAPE, the best SVR parameters are selected.

For the generation of the SVR models, the parameter evaluated in this thesis as follows:

- **Gamma (γ):** Kernel coefficient that optimize to get best value of γ, which provides minimum % MAPE from the SVR model in training set.
- **Constant (C):** Regularization parameter. The strength of the regularization is inversely proportional to C that must be strictly positive. This thesis defines the constant values (C) are 0.001, 0.01, 0.1, 1, 10, 100 and 1,000.
- **Epsilon (ε):** Epsilon in the epsilon-SVR model. It specifies the epsilon-tube within which no penalty is associated in the training loss function with points predicted within a distance epsilon from the actual value. This thesis defines the epsilon values (ε) are 0.1, 0.2, 0.3, 0.4, 0.5, 0.6, 0.7, 0.8, 0.9 and 1.
- **Kernel function:** Specifies the kernel type to be used in the algorithm. It must be one of ‘Linear’, ‘Polynomial’, ‘Radial Basis Function (RBF)’, ‘Sigmoid’. If none is given, ‘RBF’ will be used. If a callable is given it is used to precompute the kernel matrix. SVR type and its kernel type are selected based on trial and error approach for various SVR parameters based on computational time and best MAPE in training set.

The following Figure 20 and Figure 21 show the example code in Python computing Support Vector Regression for daily and monthly booking models.

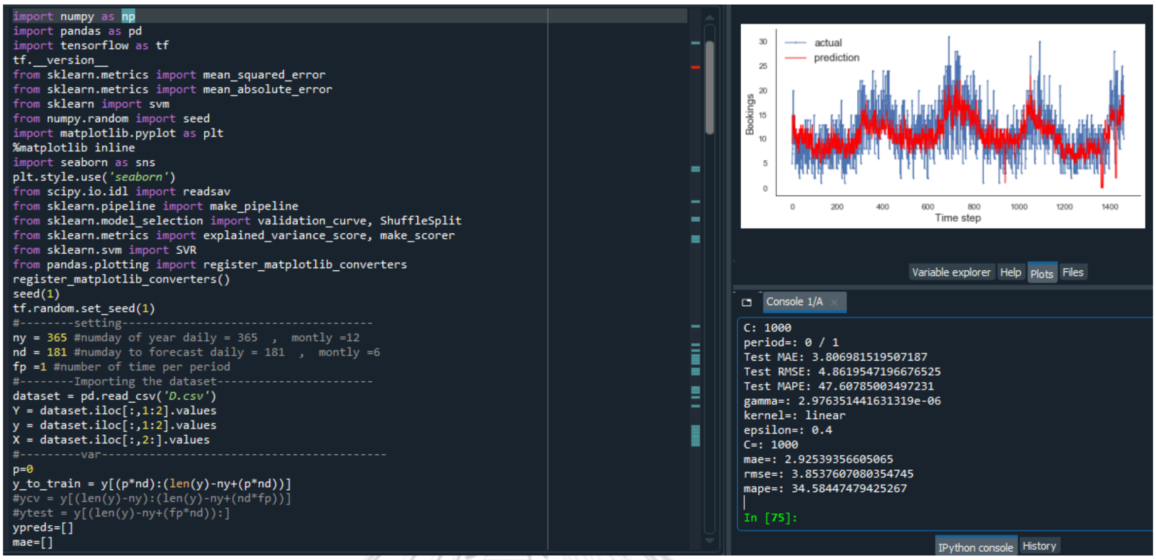


Figure 20 Code in Python computing Support Vector Regression for daily model

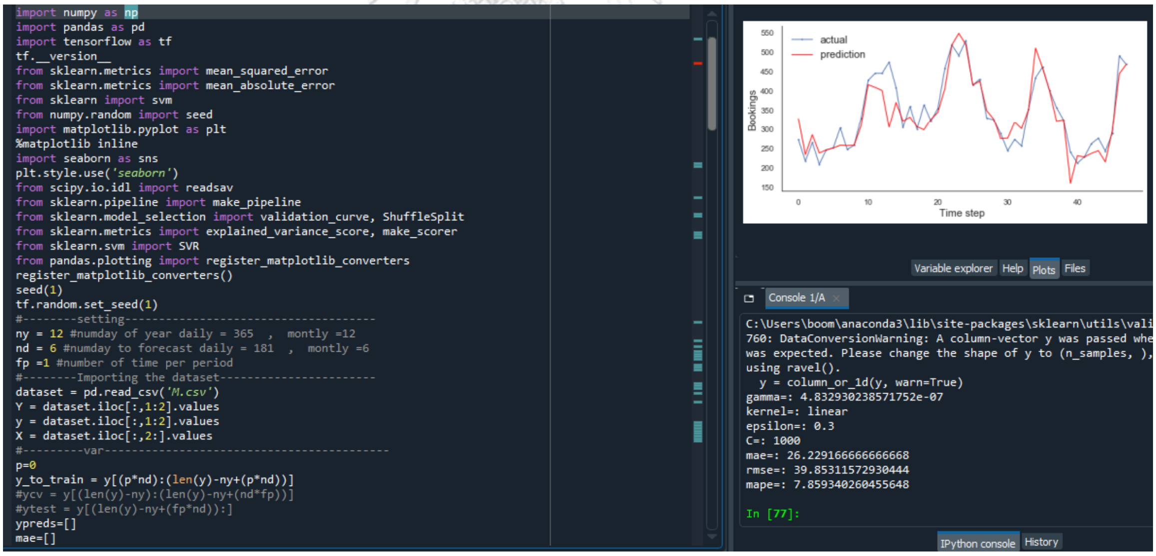


Figure 21 Code in Python computing Support Vector Regression for monthly model

3.4.4 Random Forests (RF)

The principle of Random Forest is to create a model from a Decision Tree of several smaller models (from 10 models to more than 1,000 models), each model receives a different data set, which is a subset of all data sets. In the case of regression, have each decision tree make a prediction of its own and calculate the prediction by finding the mean value from the output of each decision tree in Figure 22.

Decision Tree of each model in Random Forest is considered a weak learner - not a well model. But when using each Decision Tree to make prediction together, it will get a combined model that is more accurate than the Decision Tree that made a single prediction.

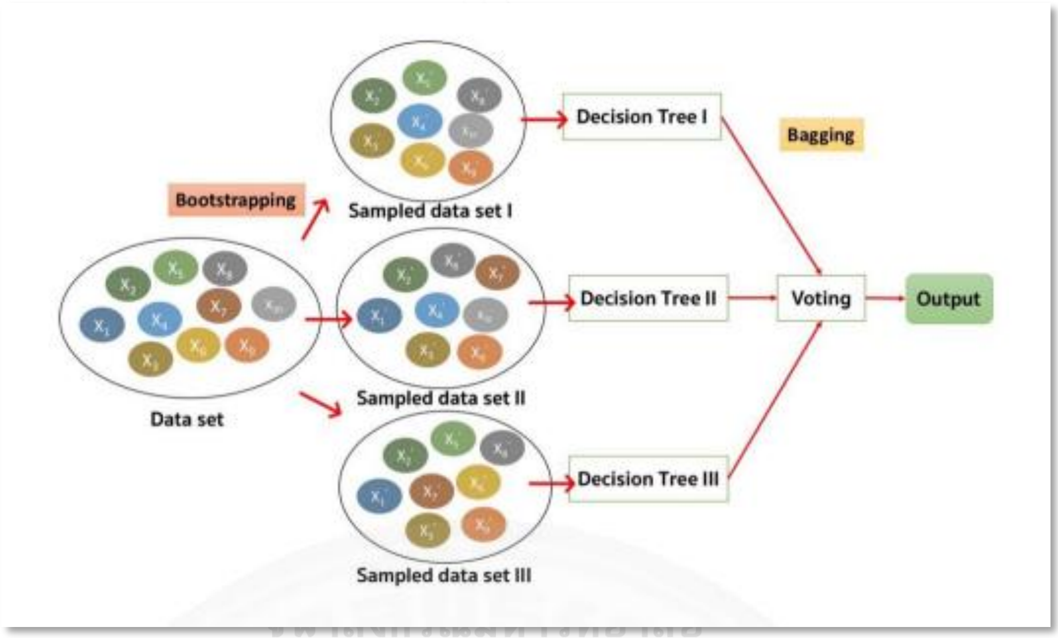


Figure 22 Random Forest's working principle from Data analysis using data mining techniques (from Kansinee J. 2019)

The Random Forest principle is

1. Sample the data (bootstrapping) from all data sets to get n different sets according to the number of Decision Trees in Random Forest. For example, the default data set has 10 features (X_1, X_2, ..., X_{10}), each Decision Tree will have a feature. Go not the same and will not get all data rows from all data sets (X_1 -> X_1 ', X_2-> X_2', ...)
2. Create a model Decision Tree for each data set.
3. Aggregation of results from each model (bagging) e.g. voting in classification or mean in regression case.

The main parameters of RF are the number of trees in the Random Forest (n_estimators), the higher the number of trees, the better the model performance, the more stagnant performance that the number of trees has no effect on the model performance. The recommended number of trees when the model test uses the value 50 – 1,000 trees. This thesis varies the number of trees from 10 to 1,000 trees in RF model.

The following Figure 23 and Figure 24 show the example code in Python computing Random Forests for daily and monthly booking models.

Figure 23 Code in Python computing Random Forests for daily model

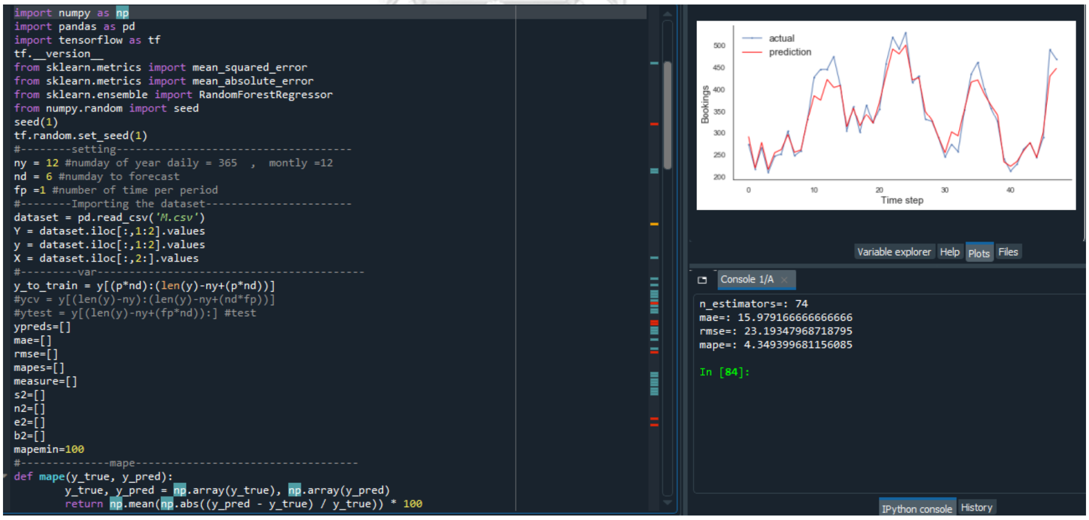


Figure 24 Code in Python computing Random Forests for monthly model

Chapter 4 Result and Discussion

4.1 Descriptive Data Results

4.1.1 The Result of Bookings in Transaction Data

The raw transaction data obtained from the case study company is analyzed with a pivot table in the Microsoft Excel program. Figure 25 shows weekdays summary of the bookings purchased by the customer from their website. It is recorded from the number of actual transactions.

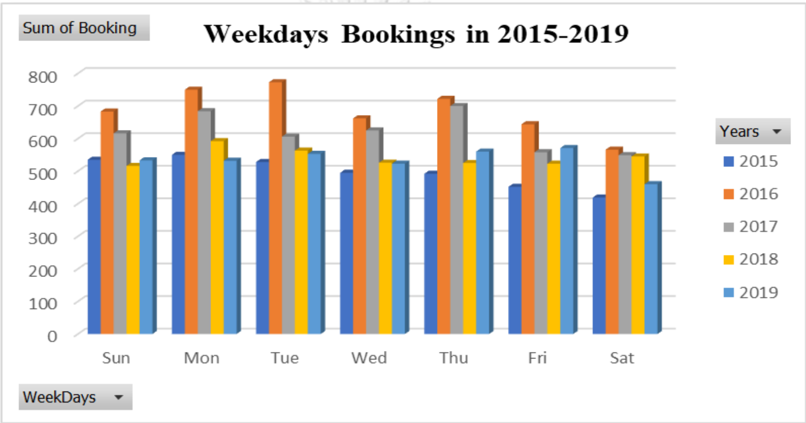


Figure 25 Weekdays summary of the number of bookings in 2015 – 2019

Moreover, Figure 26 shows monthly summary of the bookings that the customer prefers to book tour packages during the beginning and month-end of the year.

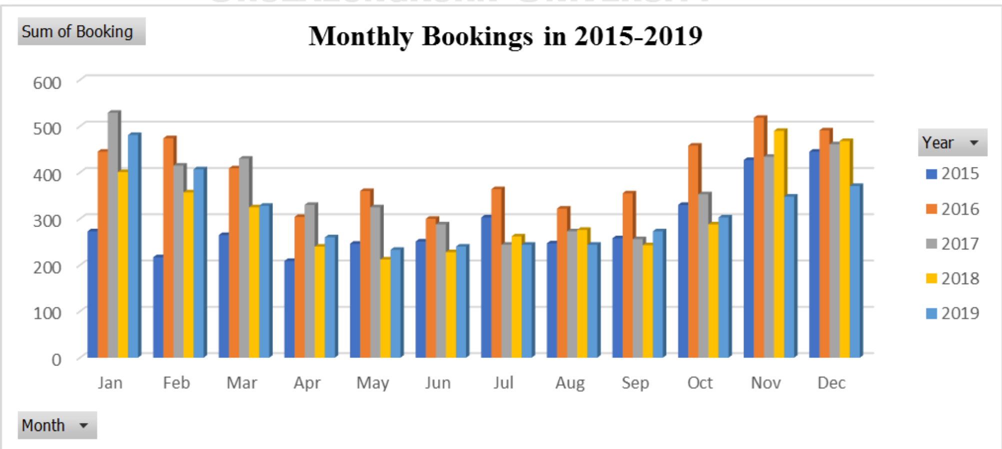


Figure 26 Monthly summary of the number of bookings in 2015 – 2019

In addition, the time series data shows that total booking from 2015 to 2019 has a seasonality pattern based on Figure 27. Therefore, the dummy variable is used to indicate the seasonal variables which are months that are one of the independent variables in this thesis.

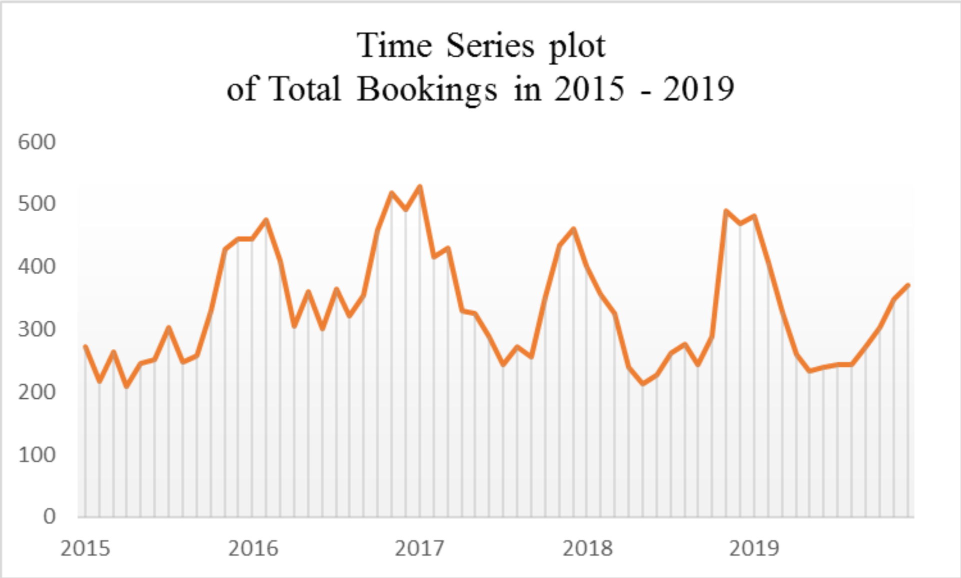


Figure 27 Time series plot of total bookings in 2015 – 2019

4.1.2 The Result of Insights from Google Analytics

The raw data has been used to construct a pivot table in the Microsoft Excel program and resulted into insight data, which summarized into yearly and monthly summary 13 Google Analytics metrics that are independent variables from the year 2015 to 2019 in order to perform better web analysis as in below Table 4 and Table 5.

Table 4 Yearly summary data of 13 metrics (2015-2019)

Year	Organic Search	Direct	Refferal	Social	New Users	Repeat Users	Returning Users	Page Views (100)	Unique Page Views	Pages per Session	Avg. Session Duration (Min.)	Avg. Time on Page (Min.)	Bounce Rate
2015	45933	22516	9388	13772	60646	10848	4678	2551	191806	3	105.07	59.50	49.59%
2016	60112	39397	21412	7424	84901	15488	6372	3411	255239	3	103.54	61.65	50.44%
2017	64513	55383	12735	4968	111202	19007	7401	4050	304157	3	90.45	61.16	53.25%
2018	118203	40306	9537	7384	152217	20735	6676	3629	297469	2	53.95	66.81	70.19%
2019	170465	41356	5013	10171	183678	24355	7443	3912	325076	2	50.03	78.19	73.57%
Total/Average	459226	198958	58085	43719	592644	90433	32570	17552	1373747	2	80.61	65.46	59.41%

Table 5 Monthly summary data of 13 metrics (January in 2015 - December in 2019)

Year	Organic Search	Direct	Refferal	Social	New Users	Repeat Users	Returning Users	Page Views (100)	Unique Page Views	Pages per Session	Avg. Session Duration (Min.)	Avg. Time on Page (Min.)	Bounce Rate
Jan	42212	20302	6177	5329	55668	9050	3226	1846.16	138726	3	91.88	62.89	54.65%
Feb	43832	18314	5067	6044	55420	8367	3155	1661.61	125278	2	79.02	61.38	58.08%
Mar	41263	16030	4418	3402	48997	7578	3073	1481.16	116530	2	85.69	65.91	57.99%
Apr	32727	13599	4690	2650	40736	6250	2391	1246.39	97366	2	80.85	62.75	58.58%
May	36849	14240	5534	2869	44786	6712	2388	1316.91	104093	2	80.67	67.34	60.11%
Jun	34556	13897	4488	2574	42658	6319	2345	1222.4	96797	2	78.27	66.77	60.92%
Jul	34944	15303	3650	3028	46162	6910	2247	1310.74	104125	2	79.74	68.02	60.82%
Aug	36129	15627	3506	3228	48536	7176	2579	1366.58	108763	2	77.40	68.27	61.37%
Sep	32081	13507	3287	2875	40812	5897	2500	1187.08	94526	2	75.64	66.31	60.60%
Oct	41441	18585	5282	3102	53148	7979	2618	1522.07	121005	2	81.50	67.93	59.81%
Nov	39005	18241	5232	3320	51276	8004	3170	1589.2	124602	2	80.01	62.48	58.71%
Dec	44187	21313	6754	5298	64445	10191	2878	1801.98	141936	2	76.65	65.49	61.25%
Total/Average	459226	198958	58085	43719	592644	90433	32570	17552.28	1373747	2	80.61	65.46	59.41%

Figure 28 is an example of Google Analytics dashboard in the audience report that shows a graph of the number of users visits the website (monthly data from 1st January 2015 to 31st December 2019). Beneath the graph are top-level user details showing total users who have visited website, total new users, total sessions, the average of sessions per user, total page view, the average of page views per session, the average of session duration (in seconds) and the average of bounce rate (in %) which is one of independent variables that are used in this study.

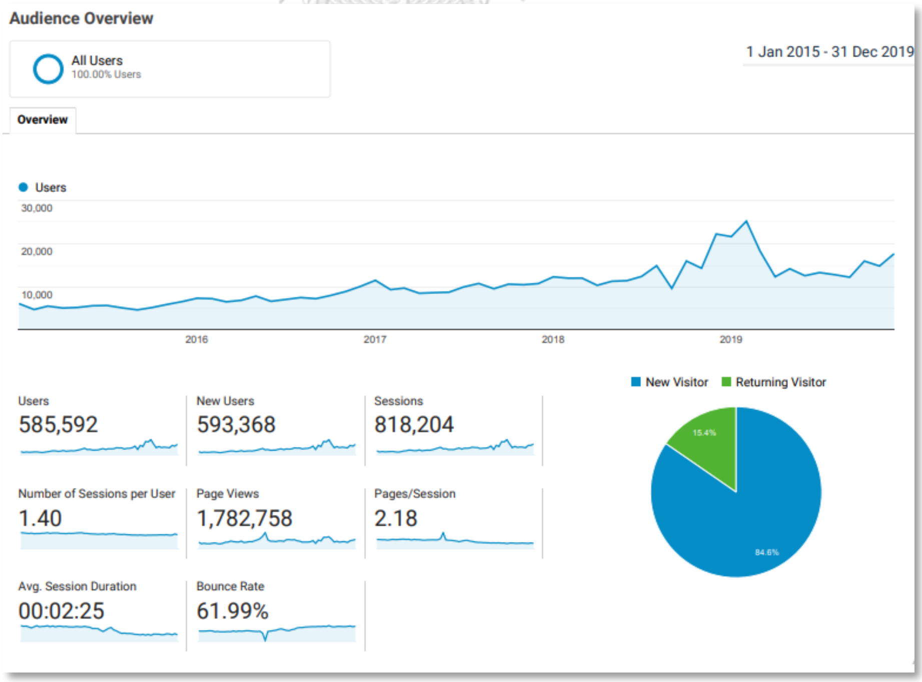


Figure 28 Example of Google Analytics dashboard in audience report for the case study company's website.

Due to the raw data from both booking transactions and Google Analytics metrics are monthly time series data from 2015 until 2019, therefore, these data are investigated for patterns and trends to provide insights by using the time series plot. In the following sections, monthly data from January 2015 until December 2019 with a total of 60 months are of my interest shows in Figure 31.

After the time series plots of all variables are performed, able to identify the relationship of patterns between booking and each metric from Google Analytics. Figure 29 is an example of data patterns between booking and unique returning users that the patterns are similar in a seasonal pattern.

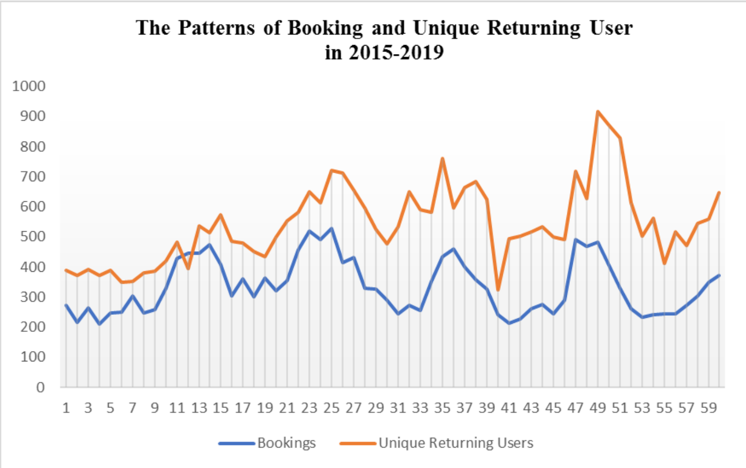


Figure 29 Data patterns of bookings and unique returning users in 2015-2019

However, both variables show positive correlations as they both tend to be the same in Figure 30. Nevertheless, it does not mean that both variables are the factors or reasons for each other. Therefore, further analyzing the regression is much needed.

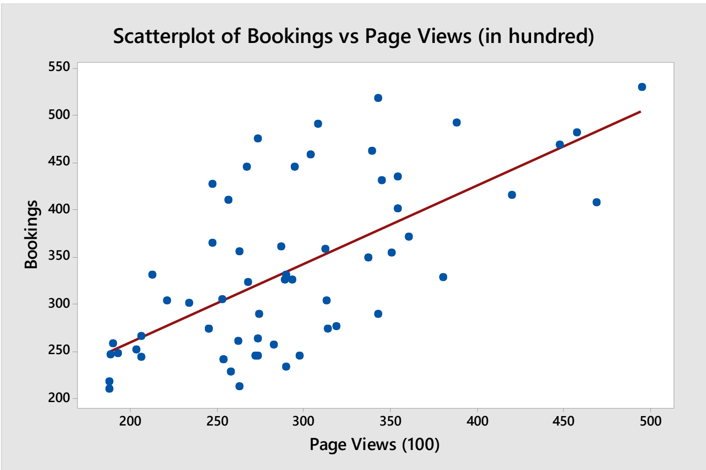


Figure 30 Positive relationship between bookings and page views with scatterplot

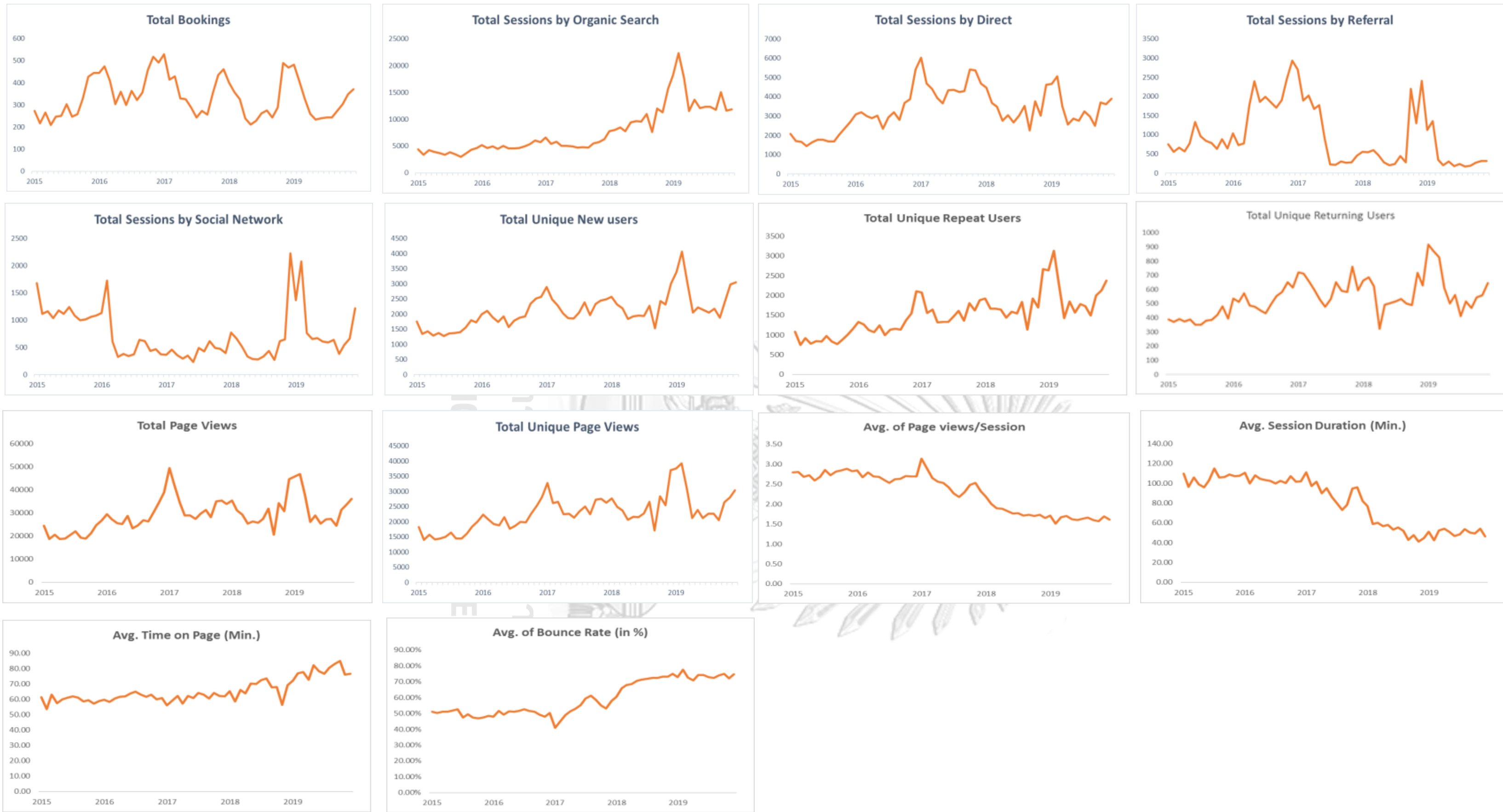


Figure 31 Time series plot of bookings and 13 Google Analytics metrics in 2015 - 2019

4.2 The Result of Multiple Linear Regression

After performed the stepwise regression with Minitab program, the result of daily training set (2015-2018) from Anova table shows statistical result indicates that Google Analytics metrics cannot well describe bookings with the adjusted R-squared is about to 38.56 %. Moreover, the present of multicollinearity by checking variance inflation factors (VIF) are less than 10, hence multicollinearity is not serious in this model (Freund, Wilson et al. 2006) in Figure 32.

Regression Analysis: Booking versus Organic Search (10), ... , Nov, Dec

Stepwise Selection of Terms

α to enter = 0.1, α to remove = 0.1

Analysis of Variance

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Regression	13	13476.1	1036.63	71.48	0.000
Organic Search (10)	1	236.1	236.11	16.28	0.000
Refferal(10)	1	277.9	277.92	19.16	0.000
Returning Users(10)	1	60.4	60.36	4.16	0.042
Unique Page Views(100)	1	683.7	683.73	47.14	0.000
Avg. Session Duration(min.)	1	462.7	462.71	31.90	0.000
Wed	1	46.8	46.78	3.23	0.073
Fri	1	73.4	73.42	5.06	0.025
Jan	1	372.3	372.26	25.67	0.000
Feb	1	502.8	502.80	34.67	0.000
Mar	1	342.3	342.27	23.60	0.000
Oct	1	154.3	154.32	10.64	0.001
Nov	1	2339.3	2339.29	161.29	0.000
Dec	1	1342.3	1342.25	92.55	0.000
Error	1447	20986.2	14.50		
Total	1460	34462.4			

Model Summary

S	R-sq	R-sq(adj)	R-sq(pred)
3.80832	39.10%	38.56%	37.62%

Coefficients

Term	Coef	SE Coef	T-Value	P-Value	VIF
Constant	1.325	0.616	2.15	0.032	
Organic Search (10)	-0.0759	0.0188	-4.03	0.000	3.41
Refferal(10)	0.1692	0.0387	4.38	0.000	1.26
Returning Users(10)	0.218	0.107	2.04	0.042	4.19
Unique Page Views(100)	0.788	0.115	6.87	0.000	5.84
Avg. Session Duration(min.)	0.875	0.155	5.65	0.000	1.83
Wed	-0.522	0.291	-1.80	0.073	1.04
Fri	-0.654	0.291	-2.25	0.025	1.04
Jan	1.982	0.391	5.07	0.000	1.20
Feb	2.359	0.401	5.89	0.000	1.15
Mar	1.810	0.373	4.86	0.000	1.09
Oct	1.229	0.377	3.26	0.001	1.11
Nov	4.946	0.389	12.70	0.000	1.15
Dec	3.793	0.394	9.62	0.000	1.22

Regression Equation

Booking = 1.325 - 0.0759 Organic Search (10) + 0.1692 Refferal(10)
+ 0.218 Returning Users(10) + 0.788 Unique Page Views(100)
+ 0.875 Avg. Session Duration(min.) - 0.522 Wed - 0.654 Fri + 1.982 Jan + 2.359 Feb
+ 1.810 Mar + 1.229 Oct + 4.946 Nov + 3.793 Dec

Residual Plots for Booking

Figure 32 Regression analysis output with daily training set by Anova table

The most appropriate multiple regression with interactions impact factors estimation is show in the equation below.

Bookings = 1.33 - 0.08 Sessions from Organic Search (10 sessions) + 0.17 Sessions from Referral (10 sessions) + 0.22 Unique Returning Users (10 users) + 0.79 Unique Page Views (100 pages) + 0.88 Avg. Session Duration (min.) - 0.52 Wednesday - 0.65 Friday + 1.98 January + 2.36 February + 1.81 March + 1.23 October + 4.95 November + 3.79 December (9)

As the daily regression model shows that there are 5 factors from Google Analytics metrics that have a significant impact on bookings are sessions from organic search traffic, sessions from referral traffic, unique returning users, unique page views and the average session duration. Likewise, there are 2 days and 6 months effect that have a significant impact on bookings are Wednesday, Friday, January, February, March, October, November, and December.

Based on the analysis of the tourist behavior, it is found that the most of them needed to find information from tourism operator's website to plan for their travel before deciding to book any travel package. Therefore, the date of each information such as sessions, page views, users etc. are not present as the booking date, which effect to the regression model with daily data is not well as above result.

In addition, the regression result of the monthly training set shows statistical results indicate that Google Analytics metrics can well describe bookings with the adjusted R-squared is about 86.88%. Moreover, the present of multicollinearity by checking variance inflation factors (VIF), the values of VIF are less than 10, hence multicollinearity is not serious in this model (Freund, Wilson et al. 2006).

From Figure 33, the above Anova table shows the most appropriate multiple regression with interactions impact factors estimation is show in the equation below.

Bookings = 8.1 + 31.58 Sessions from Referral (1,000 sessions) + 34.80 Unique Returning Users (100 users) + 88.4 Avg. Session Duration (100 min.) + 72.8 January + 38.6 March + 49.9 October + 116.8 November + 138.7 December (10)

As the monthly regression model, there are 3 factors from Google Analytics metrics that have a significant impact on bookings are sessions from referral traffic, unique returning users and the average of session duration. Likewise, there is 5 months effect that has a significant impact on bookings are January, March, October, November and December.

Finally, the residual of the MLR model has checked the normality assumption for the residual by using the residual plot in Figure 34 to Figure 36 as following (Osborne and Waters 2002).

- The residual should be a normal distribution.
- The variance of the residual should be constant meaning that homoscedasticity.
- The residuals are independent.

Regression Analysis: Bookings versus Direct(1000), ... ep, Oct, Nov, Dec

Stepwise Selection of Terms

α to enter = 0.1, α to remove = 0.1

Analysis of Variance

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Regression	8	342726	42841	39.09	0.000
Referral(1000)	1	21940	21940	20.02	0.000
Returning Users(100)	1	46542	46542	42.47	0.000
Session Duration (100Min.)	1	12852	12852	11.73	0.001
Jan	1	15939	15939	14.54	0.000
Mar	1	4789	4789	4.37	0.043
Oct	1	8549	8549	7.80	0.008
Nov	1	38527	38527	35.15	0.000
Dec	1	62465	62465	57.00	0.000
Error	38	41645	1096		
Total	46	384371			

Model Summary

S	R-sq	R-sq(adj)	R-sq(pred)
33.1047	89.17%	86.88%	79.74%

Coefficients

Term	Coef	SE Coef	T-Value	P-Value	VIF
Constant	8.1	38.7	0.21	0.835	
Referral(1000)	31.58	7.06	4.47	0.000	1.29
Returning Users(100)	34.80	5.34	6.52	0.000	1.58
Session Duration (100Min.)	88.4	25.8	3.42	0.001	1.40
Jan	72.8	19.1	3.81	0.000	1.22
Mar	38.6	18.5	2.09	0.043	1.14
Oct	49.9	17.9	2.79	0.008	1.07
Nov	116.8	19.7	5.93	0.000	1.29
Dec	138.7	18.4	7.55	0.000	1.13

Regression Equation

Bookings = 8.1 + 31.58 Referral(1000) + 34.80 Returning Users(100)
+ 88.4 Session Duration (100Min.) + 72.8 Jan + 38.6 Mar + 49.9 Oct + 116.8 Nov
+ 138.7 Dec

Figure 33 Regression analysis output for monthly data by Anova table

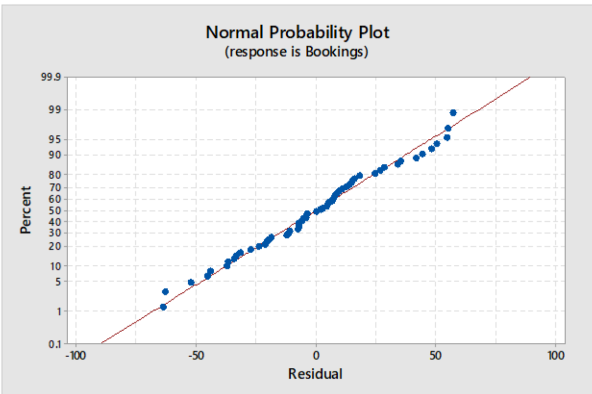


Figure 34 Normal Probability plot

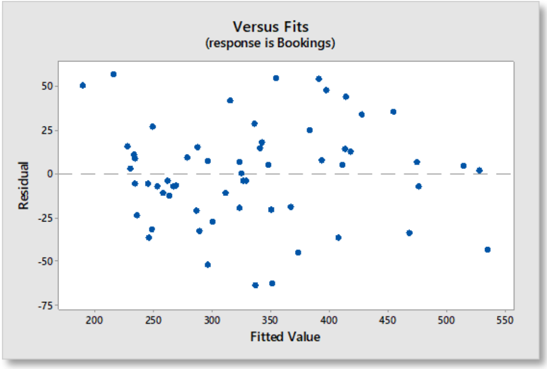


Figure 35 Versus Fits

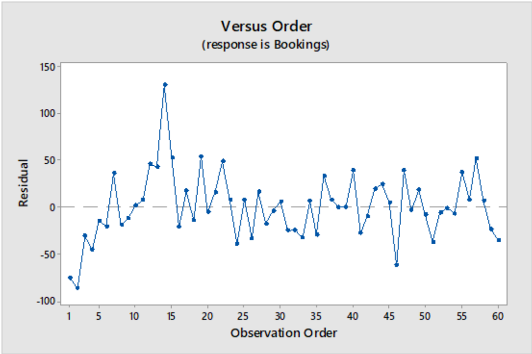


Figure 36 Versus order

Based on the daily and monthly regression models, the impactful factors of Google Analytics metrics are used to be independent variables to predict the bookings in the cross validation set. Figure 37 and Figure 38 show the graph representation of the forecast results with the actual booking of MLR models.

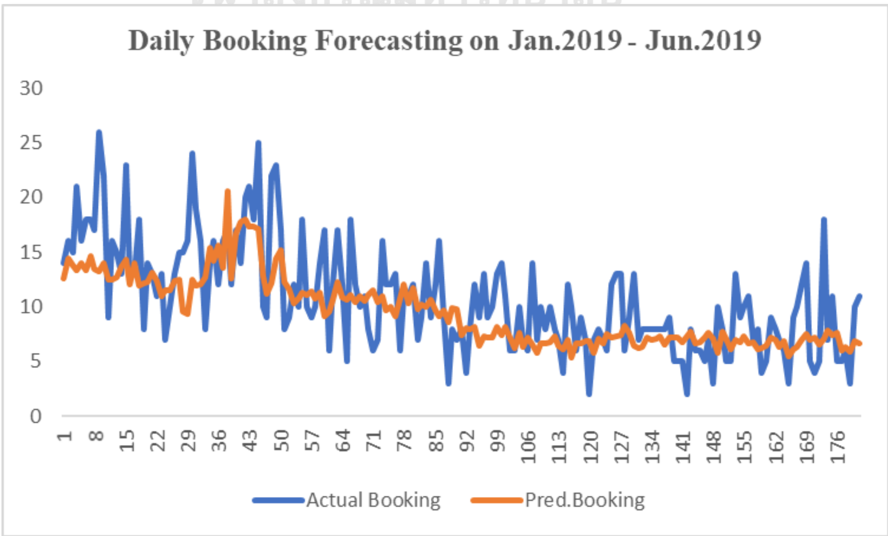


Figure 37 Daily booking forecasting by using MLR model for cross validation set

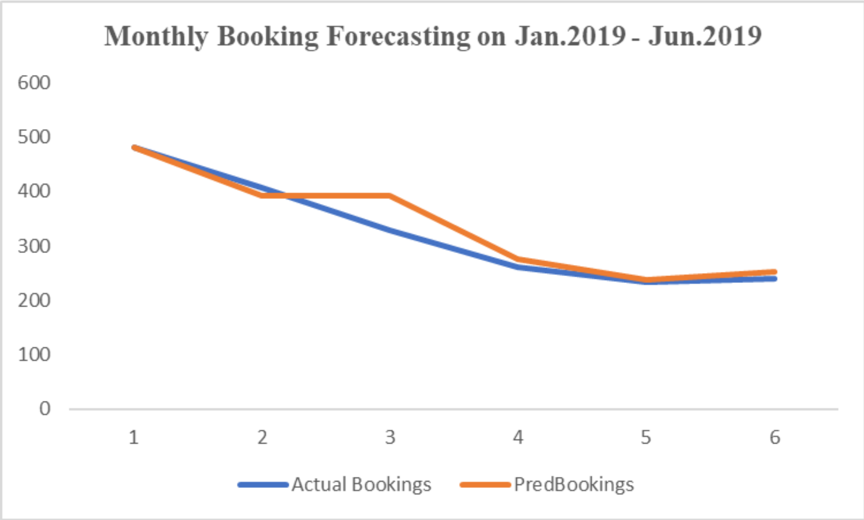


Figure 38 Monthly booking forecasting by using MLR model for cross validation set

The accuracy of the above forecast results has been analyzed and evaluated based on MAPE, MAE and RMSE Table 6 are show with results of accuracy for each of the forecasting data types.

Table 6 Daily and monthly forecasting performance of MLR for CV set

MLR Models	**Daily**	**Monthly**
Adjusted R^2	38.56%	86.88%
MAPE	31.47%	5.99%
MAE	2.96	18.50
RMSE	3.80	28.20

Results from the MLR model presents that the factors contributing from Google Analytics cannot well describe daily bookings with the R-squared is about 38.56% (Adjusted R-squared), while that the factors contributing from Google Analytics can well describe monthly bookings with the R-squared is about 86.88% (Adjusted R-squared).

Additionally, the most important aspect of forecasting is model accuracy. The daily MLR model has the accuracy at MAPE 31.47%, and the monthly MRL model has the accuracy at MAPE 5.99%.

4.3 The Result of Artificial Neural Network (ANN)

In this section, there are 6 different ANN models to select the main parameters such as the number of hidden units, the number of hidden layers, the number of epochs, batch sizes, the number of seed, etc. of each model with the lowest MAPE after that best ANN parameters in training set are used to predict booking in cross validation set. The 6 categories of ANN models are defined as follows.

Model 1: 1 Hidden layer
Where both a_1 and a_2 use ReLU functions.
Model 2: 1 Hidden layer
Where a_1 uses Sigmoid while a_2 uses ReLU functions.
Model 3: 2 Hidden layers
Where all a_1, a_2 and a_3 use ReLU functions.
Model 4: 2 Hidden layers
Where a_1 uses Sigmoid while both a_2 and a_3 use ReLU functions.
Model 5: 2 Hidden layers
Where a_2 uses Sigmoid while both a_1 and a_3 use ReLU functions.
Model 6: 2 Hidden layers
Where both a_1 and a_2 use Sigmoid while only a_3 uses ReLU functions

The evaluation result by following the workflow of ANN parameter selection, the model performance measured by MAPE of each step by step. For the performance result and the graph representation of forecasting results with the actual booking show in an appendix. Besides, the appropriate parameters of each 6 models show in Table 7 and Table 8.

Table 7 The parameters of 6 ANN models for daily data

Daily ANN Models	**Model 1**	**Model 2**	**Model 3**	**Model 4**	**Model 5**	**Model 6**
***Activation Functions of $a^{(2)}$, $a^{(3)}$ and $a^{(2)}$, $a^{(3)}$, $a^{(4)}$**	**R, R**	**S, R**	**R, R, R**	**S, R, R**	**R, S, R**	**S, S, R**
Batch Size	10	10	10	10	10	10
The number of Epochs	100	100	100	100	100	100
The number of Hidden Units	99	97	88	91	99	99
The number of Seeds	31	8	68	1	1	73
MAPE of Training Set	28.08%	33.31%	23.34%	31.91%	24.16%	31.76%
MAPE of CV Set	38.99%	34.59%	37.48%	35.17%	36.17%	**33.70%**

* **Activation Functions:** S = Sigmoid Function and R = ReLU Function/ $a^{(l)}$ = activation in layer l

Table 8 The parameters of 6 ANN models for monthly data

Monthly ANN Models	**Model 1**	**Model 2**	**Model 3**	**Model 4**	**Model 5**	**Model 6**
***Activation Functions of $a^{(2)}$, $a^{(3)}$ and $a^{(2)}$, $a^{(3)}$, $a^{(4)}$**	**R, R**	**S, R**	**R, R, R**	**S, R, R**	**R, S, R**	**S, S, R**
Batch Size	10	10	10	10	10	10
The number of Epochs	1000	1000	1000	1000	1000	1000
The number of Hidden Units	98	100	69	99	100	97
The number of Seeds	49	98	36	93	68	1
MAPE for Training Set	7.30%	16.60%	5.85%	6.93%	15.93%	21.81%
MAPE for CV Set	**6.03%**	18.08%	57.13%	7.61%	15.14%	23.60%

* **Activation Functions:** S = Sigmoid Function and R = ReLU Function/ $a^{(l)}$ = activation in layer l

Based on forecasting performance comparison of each ANN models for daily and monthly cross validation set, found that the best daily ANN model is Model 6 that has the lowest MAPE with the parameters as below.

- The number of hidden layers = 2 layer
- Activation functions in layer 2 ($a^{(2)}$) = Sigmoid function
- Activation functions in layer 3 ($a^{(3)}$) = Sigmoid function
- Activation functions in layer 4 ($a^{(4)}$) = ReLU function
- Batch size = 10 batch
- The number of epochs = 100 epochs
- The number of hidden units = 99 units
- The number of seeds = 73 seeds
- With MAPE for training set = 31.76%
- With MAPE for cross validation set = 33.70%

On the other hand, the best monthly ANN model that has the lowest MAPE is Model 1 with the parameters as below.

- The number of hidden layers = 1 layer
- Activation functions in layer 2 ($a^{(2)}$) = ReLU function
- Activation functions in layer 3 ($a^{(3)}$) = ReLU function
- Batch size = 10 batch
- The number of epochs = 1,000 epochs
- The number of hidden units = 98 units
- The number of seeds = 49 seeds
- With MAPE for training set = 7.30%
- With MAPE for cross validation set = 6.03%

Figure 39 and Figure 40 show the graph representation of the forecast results with the actual daily and monthly booking using ANN models for the cross validation set.

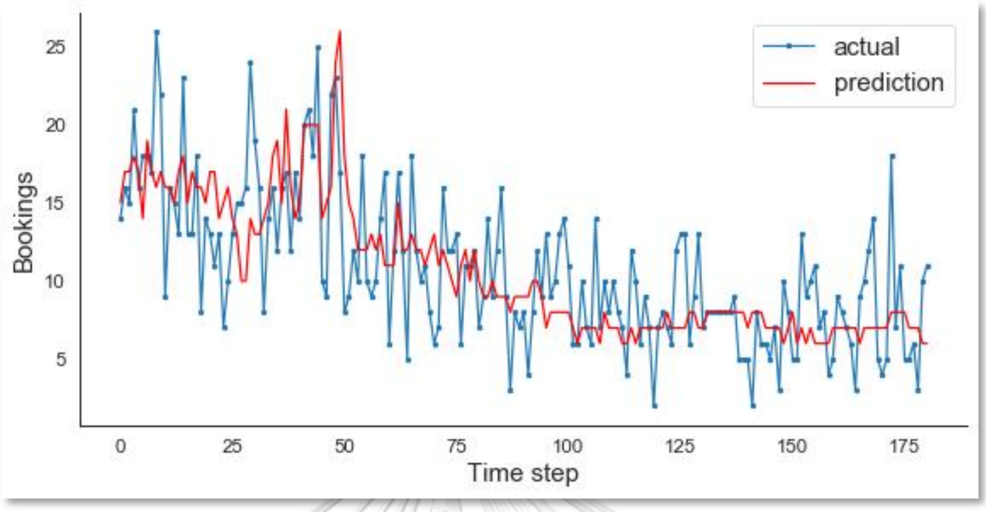


Figure 39 Daily booking forecasting by using ANN model 6 for CV set

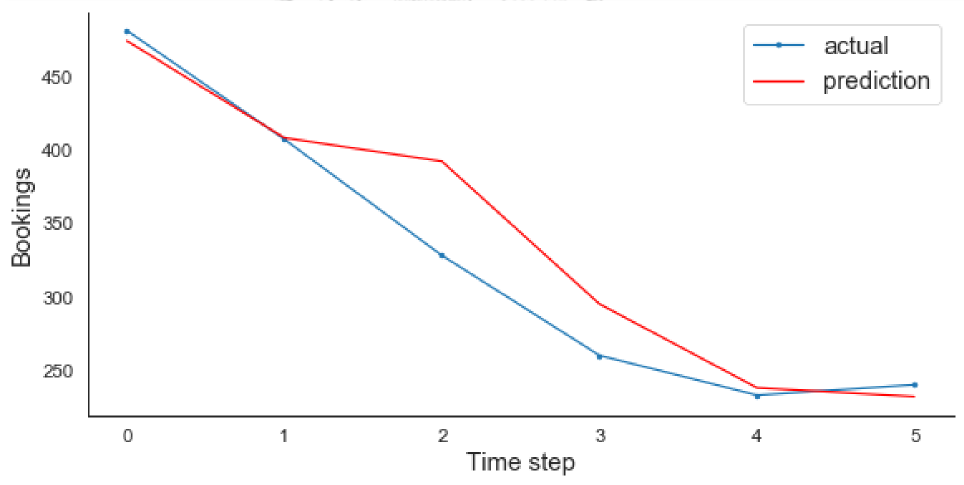


Figure 40 Monthly booking forecasting by using ANN model for CV set

4.4 The Result of Support Vector Regression (SVR)

In this part, SVR model selects best main parameters such as gamma (γ), constant (C), epsilon (ε) and kernel function with the lowest MAPE after that best SVR parameters in training set are used to predict booking in cross validation set.

As the forecasting result of SVR model for daily training set, found that best SVR parameter for daily forecasting model that has the lowest MAPE error as following.

- Gamma (γ) = 2.98e-06
- Constant (C) = 1,000
- Epsilon (ε) = 0.4
- Kernel function = Linear
- MAPE for training set = 34.58%
- MAPE for cross validation set = 31.67%

Figure 41 and Figure 42 show the graph representation of the forecast results with the actual daily booking using SVR model for the training set and cross validation set.

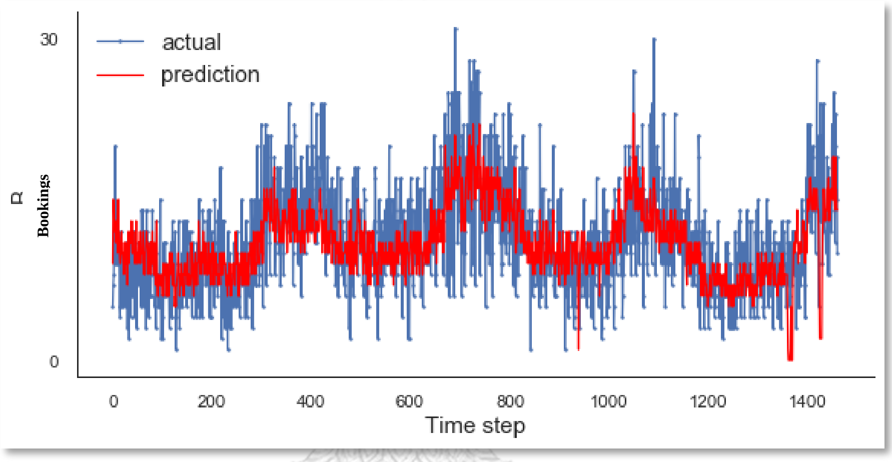


Figure 41 Daily booking forecasting by using SVR model for training set

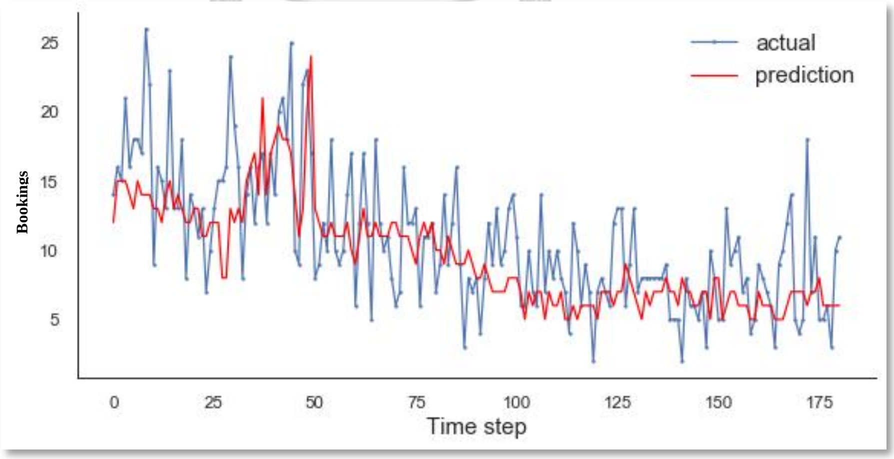


Figure 42 Daily booking forecasting by using SVR model for CV set

The forecasting result of SVR model for monthly training set showed the best SVR parameter for monthly forecasting model that has the lowest MAPE error as following.

- Gamma (γ) = 4.83e-07
- Constant (C) = 1,000
- Epsilon (ε) = 0.3
- Kernel function = Linear
- MAPE for training set = 7.85%
- MAPE for cross validation set = 6.07%

Figure 43 and Figure 44 show the graph representation of the forecast results with the actual monthly booking using SVR model for the training set and cross validation set.

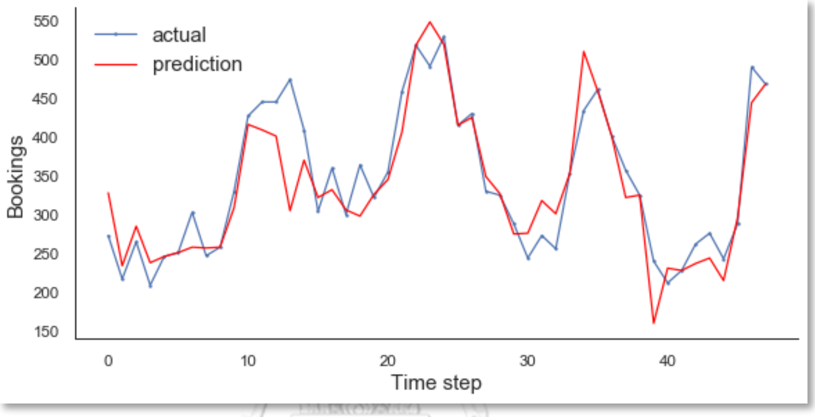


Figure 43 Monthly booking forecasting by using SVR model for training set

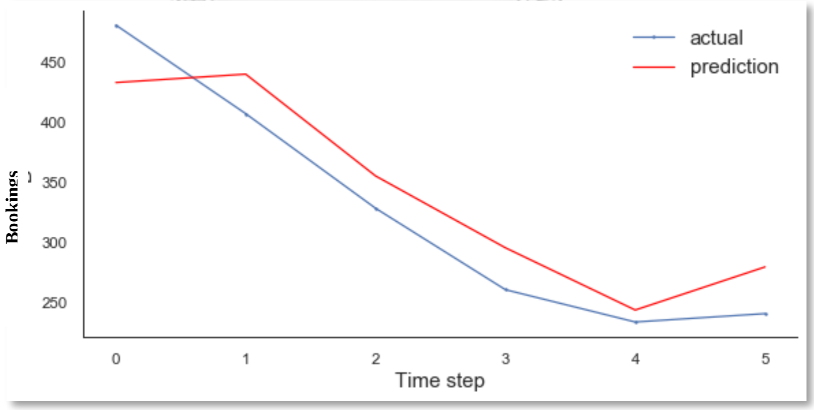


Figure 44 Monthly booking forecasting by using SVR model for CV set

4.5 The Result of Random Forests (RF)

Based on forecasting result of RF model for daily training set, found the best daily RF model has the lowest MAPE with the parameters as below.

- The number of trees = 91 trees
- MAPE for training set = 12.71%
- MAPE for cross validation set = 38.34%

Figure 45 and Figure 46 show the graph representation of the forecast results with the actual daily booking using RF model for the training set and cross validation set.

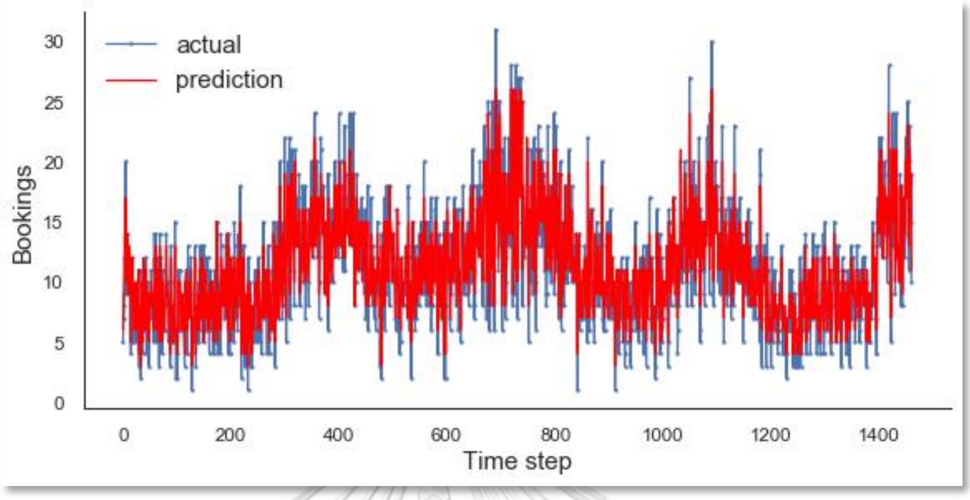


Figure 45 Daily booking forecasting by using RF model for training set

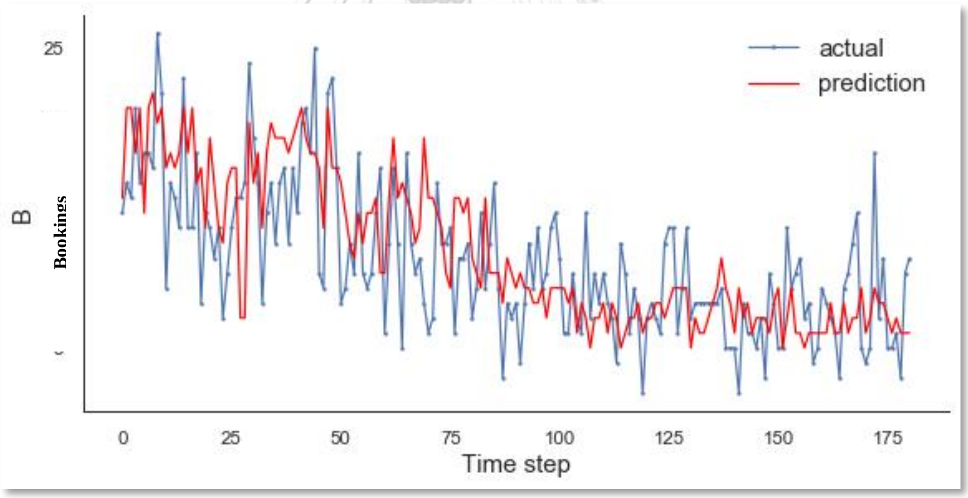


Figure 46 Daily booking forecasting by using RF model for CV set

Based on forecasting result of RF model for monthly training set found best daily RF model has the lowest MAPE with the parameters as below.

- The number of trees = 74 trees
- MAPE for training set = 4.35%
- MAPE for cross validation set = 10.05%

Figure 47 and Figure 48 show the graph representation of the forecast results with the actual monthly booking using RF model for the training set and cross validation set.

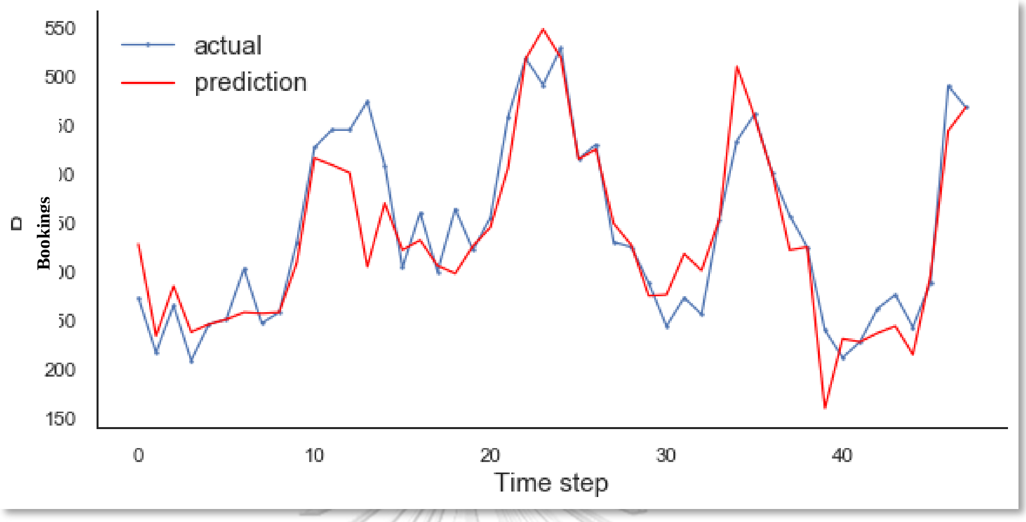


Figure 47 Monthly booking forecasting by using RF model for training set

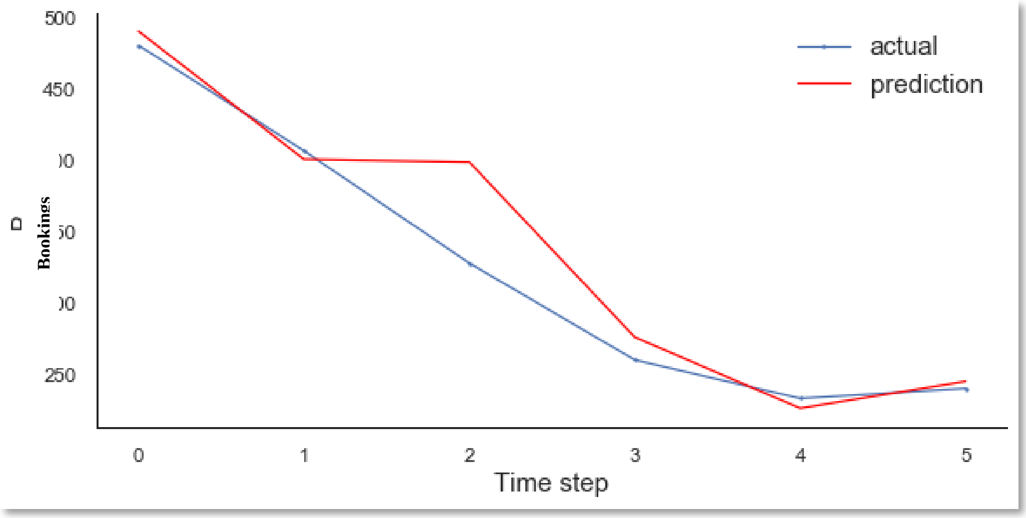


Figure 48 Monthly booking forecasting by using RF model for cross validation set

4.6 Forecasting Models Selections

Table 9 is the comparison result of forecasting performance of MLR, ANN, SVR and RF models in daily and monthly bookings for cross validation set.

Table 9 The bookings forecasting performance of all models for CV set.

Forecasting Models	Measures	Daily	Monthly
MLR	Adjusted R^2	38.56%	86.88%
	MAPE	31.47%	5.99%
ANN	MAPE	33.70% (ANN Model 6)	6.03% (ANN Model 1)
SVR	MAPE	31.67%	6.07%
RF	MAPE	38.34%	10.05%

Results from the MLR model presents that the factors contributing from Google Analytics cannot well describe daily bookings with the adjusted R-squared is about 38.56%, while that the factors contributing from Google Analytics can well describe monthly bookings with the adjusted R-squared is about 86.88%.

Additionally, the most important aspect of forecasting is model accuracy. The daily MLR model has the accuracy at MAPE 31.47%, and the monthly MRL model has the accuracy at MAPE 5.99%. Moreover, the ANN model for daily bookings has the accuracy at MAPE 31.47% but the ANN model for monthly bookings has the accuracy at MAPE 6.03%. Furthermore, the daily SVR model has the accuracy at MAPE 31.67%, and the monthly SVR model has the accuracy at MAPE 6.07%. Lastly, the RF model for daily bookings has the accuracy at MAPE 38.43% while the ANN model for monthly bookings is proven accuracy at MAPE 10.05%.

Since all model accuracy does not have much difference for both daily and monthly booking therefore, in order to compare the performance of each model to select best forecasting model for test set. Tukey pairwise comparisons and the randomized complete block designs (RCBD) are tested by absolute error that show in Table 10 and Table 11 at 95% confidence interval.

Table 10 Absolute error of daily bookings

Date	ABS ERROR for CV set			
	MLR	ANN	SVR	RF
1/1/2019	1	1	2	1
1/2/2019	2	1	1	5
1/3/2019	1	2	0	6
1/4/2019	8	3	6	3
1/5/2019	2	1	2	5
1/6/2019	5	4	5	4
1/7/2019	3	1	3	3
1/8/2019	4	0	3	5
1/9/2019	13	10	12	6
1/10/2019	8	5	8	1
…				
6/30/2019	4	5	5	5

Table 11 Absolute error of monthly bookings

Month	ABS ERROR for CV set			
	MLR	ANN	SVR	RF
Jan-19	0	7	10	48
Feb-19	15	1	6	33
Mar-19	64	64	71	27
Apr-19	15	35	16	35
May-19	4	5	7	10
Jun-19	11	8	5	39

One-way ANOVA: MLR, ANN, AVM, RF

Method

Null hypothesis	All means are equal
Alternative hypothesis	Not all means are equal
Significance level	α = 0.05

Equal variances were assumed for the analysis.

Factor Information

Factor	Levels	Values
Factor	4	MLR, ANN, AVM, RF

Analysis of Variance

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Factor	3	17.00	5.666	0.97	0.407
Error	720	4208.73	5.845		
Total	723	4225.73			

Model Summary

S	R-sq	R-sq(adj)	R-sq(pred)
2.41774	0.40%	0.00%	0.00%

Means

Factor	N	Mean	StDev	95% CI
MLR	181	2.955	2.399	(2.602, 3.308)
ANN	181	2.928	2.418	(2.575, 3.281)
AVM	181	2.972	2.455	(2.620, 3.325)
RF	181	3.304	2.399	(2.951, 3.657)

Pooled StDev = 2.41774

Tukey Pairwise Comparisons

Grouping Information Using the Tukey Method and 95% Confidence

Factor	N	Mean	Grouping
RF	181	3.304	A
AVM	181	2.972	A
MLR	181	2.955	A
ANN	181	2.928	A

Means that do not share a letter are significantly different.

Tukey Simultaneous 95% CIs

Interval Plot of MLR, ANN, ...

Figure 49 Randomized complete block designs (RCBD) in daily data

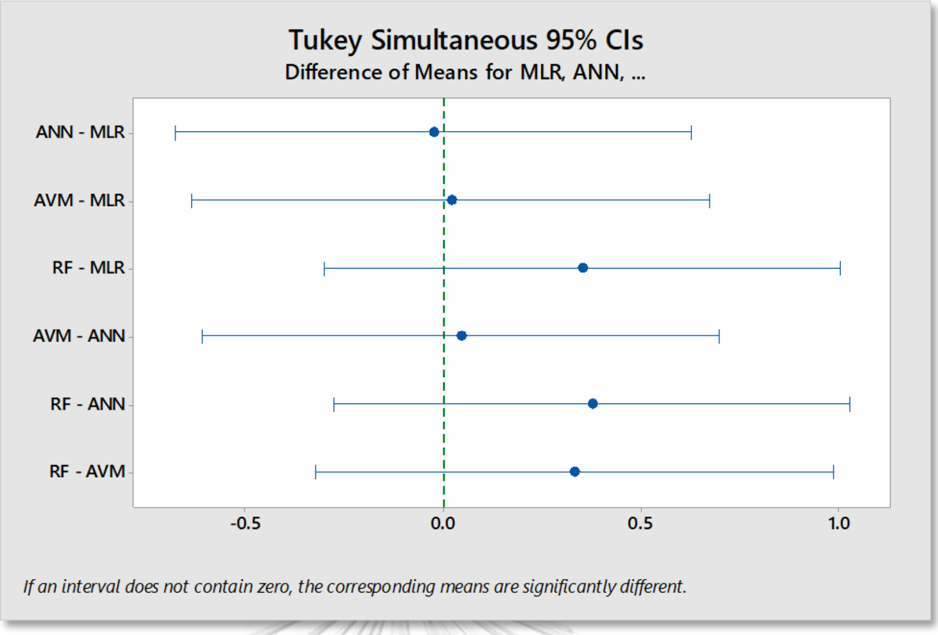


Figure 50 Tukey Simultaneous difference of mean in daily data

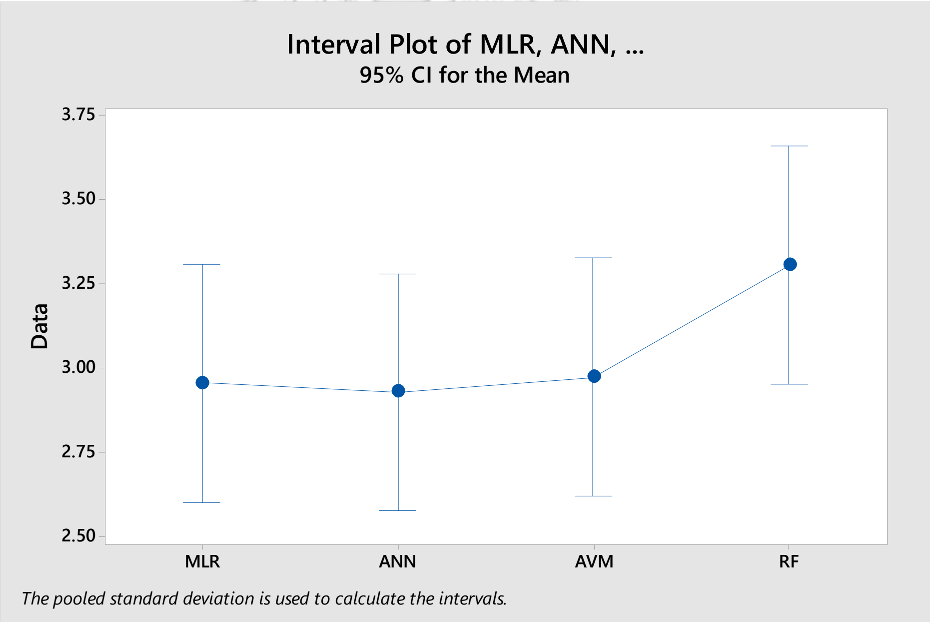


Figure 51 Interval Plot of forecasting model in daily data

One-way ANOVA: MLR, ANN, AVM, RF

Method

Null hypothesis	All means are equal
Alternative hypothesis	Not all means are equal
Significance level	α = 0.05

Equal variances were assumed for the analysis.

Factor Information

Factor	Levels	Values
Factor	4	MLR, ANN, AVM, RF

Analysis of Variance

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Factor	3	741.4	247.1	0.50	0.687
Error	20	9903.7	495.2		
Total	23	10645.1			

Model Summary

S	R-sq	R-sq(adj)	R-sq(pred)
22.2527	6.96%	0.00%	0.00%

Means

Factor	N	Mean	StDev	95% CI
MLR	6	18.50	23.31	(-0.45, 37.45)
ANN	6	20.0	24.7	(1.0, 39.0)
AVM	6	19.2	25.7	(0.2, 38.1)
RF	6	32.00	12.84	(13.05, 50.95)

Pooled StDev = 22.2527

Tukey Pairwise Comparisons

Grouping Information Using the Tukey Method and 95% Confidence

Factor	N	Mean	Grouping
RF	6	32.00	A
ANN	6	20.0	A
AVM	6	19.2	A
MLR	6	18.50	A

Means that do not share a letter are significantly different.

Tukey Simultaneous 95% CIs

Interval Plot of MLR, ANN, ...

Figure 52 Randomized complete block designs (RCBD) in monthly data

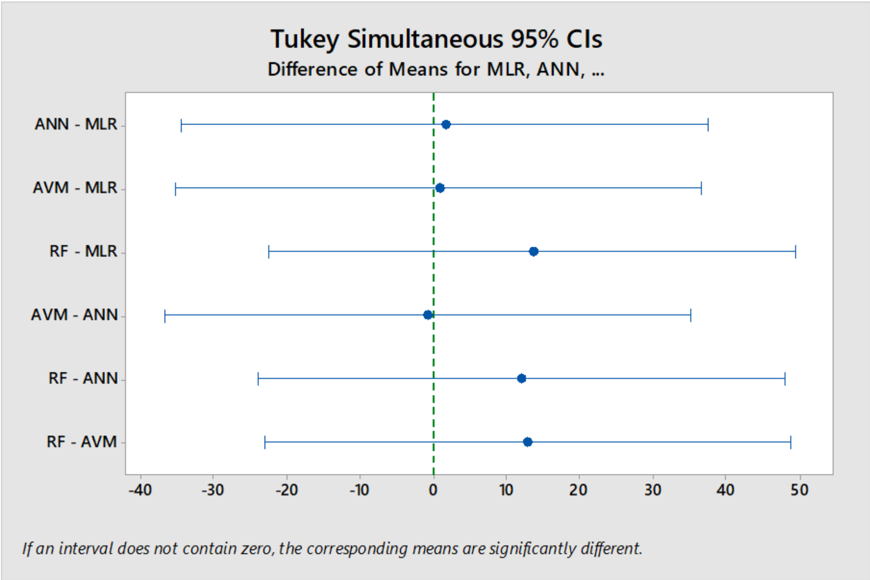


Figure 53 Tukey Simultaneous difference of mean in monthly data

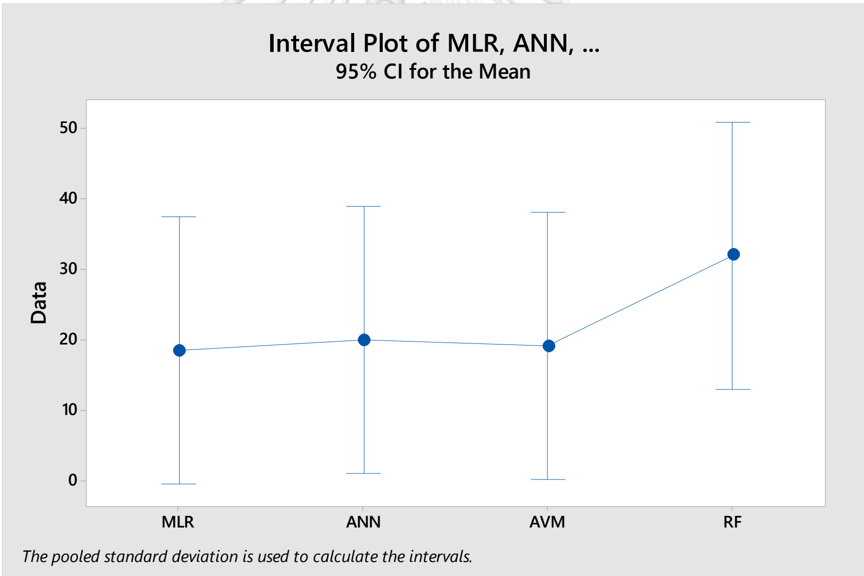


Figure 54 Interval Plot of forecasting model in monthly data

From the results of Tukey Simultaneous and randomized complete block designs (RCBD) in Figures 49 to Figures 54 show MLR model, ANN model, SVR model and RF model were not insignificantly different in cross validation set. Then, the author suggests the case study company to use MLR model for booking forecasting as it is the easiest method to be conducted, lesser time to compute and lesser technical skill set are required.

4.7 Forecasting Result for Test Set

The graph representation of forecast result with the actual booking of both MLR models showed in Figure 55 and Figure 56.

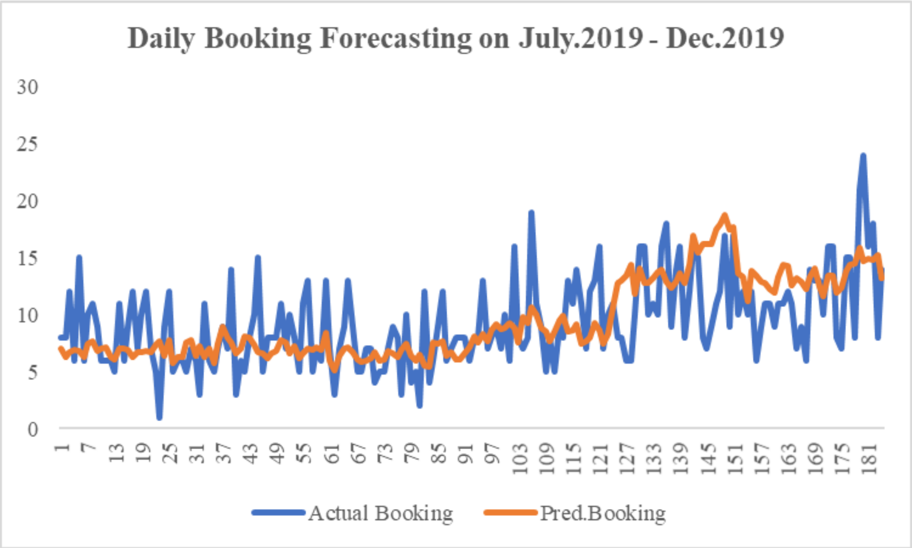


Figure 55 Daily booking forecasting by using MLR model for test set

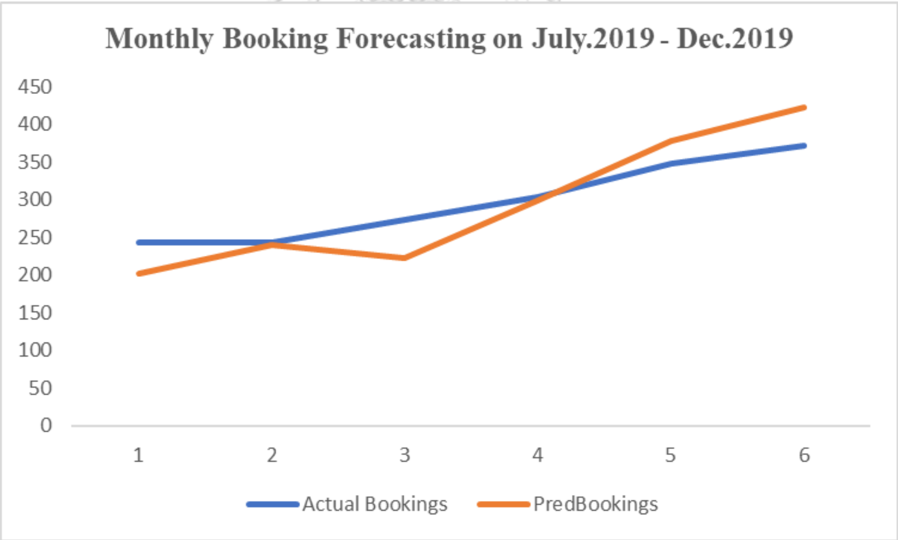


Figure 56 Monthly booking forecasting by using MLR model for test set

MLR models were used to forecast daily and monthly bookings for test set. The forecasting results showed that the daily MLR model had the accuracy at MAPE 36.13%, meanwhile, the monthly MLR model had the accuracy at MAPE 10.15% for the test set.

4.8 The Result of Applying MLR with Weekly and Bi-weekly Bookings

In this study, MLR is best model for online booking forecasting so it was used to analyze and forecast with other time length such as weekly data and bi-weekly data also that the daily data are transformed into weekly data and bi-weekly data instead by using Pivot table in Excel program to perform regression analysis. The results of these show as following.

Regression Analysis: Booking versus Organic Search (10), ... , Nov, Dec

Stepwise Selection of Terms

α to enter = 0.1, α to remove = 0.1

Analysis of Variance

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Regression	7	63813	9116.2	35.48	0.000
Refferal(10)	1	3284	3283.6	12.78	0.000
Social(10)	1	1002	1001.9	3.90	0.050
Returning Users(10)	1	30582	30582.4	119.03	0.000
Avg. Session Duration(min.)	1	4935	4935.4	19.21	0.000
Avg. Time on Page(min.)	1	1601	1601.2	6.23	0.013
May	1	1931	1930.5	7.51	0.007
Jul	1	1406	1405.9	5.47	0.020
Error	201	51644	256.9		
Total	208	115458			

Model Summary

S	R-sq	R-sq(adj)	R-sq(pred)
16.0293	55.27%	53.71%	46.94%

Coefficients

Term	Coef	SE Coef	T-Value	P-Value	VIF
Constant	14.7	13.5	1.09	0.277	
Refferal(10)	0.2460	0.0688	3.57	0.000	1.30
Social(10)	0.1825	0.0924	1.97	0.050	1.03
Returning Users(10)	1.204	0.110	10.91	0.000	1.25
Avg. Session Duration(min.)	7.44	1.70	4.38	0.000	1.34
Avg. Time on Page(min.)	-11.79	4.72	-2.50	0.013	1.13
May	10.46	3.82	2.74	0.007	1.03
Jul	8.95	3.83	2.34	0.020	1.03

Regression Equation

Booking = 14.7 + 0.2460 Refferal(10) + 0.1825 Social(10) + 1.204 Returning Users(10)
+ 7.44 Avg. Session Duration(min.) - 11.79 Avg. Time on Page(min.) + 10.46 May
+ 8.95 Jul

Figure 57 Regression analysis output for weekly data by Anova table

The regression result of the weekly training set shows statistical results indicate that Google Analytics metrics cannot well describe bookings with the adjusted R-squared is about 53.71%. Moreover, the present of multicollinearity by checking variance inflation factors (VIF), the values of VIF are less than 10, hence multicollinearity is not serious in this model. Lastly, the residual of the MLR model has checked the normality assumption for the residual by using the residual plot. From

Figure 57, the above Anova table shows the most appropriate multiple regression with interactions impact factors estimation is show in the equation below.

Bookings = 14.7 + 0.25 Sessions from Referral (10 sessions) + 0.18 Sessions from Social (10 sessions) + 1.24 Unique Returning Users (10 users) + 7.44 Avg. Session Duration (min.) + 11.79 Avg. Time on Page (min.) + 10.46 May + 8.95 July (11)

Regression Analysis: Booking versus Organic Search (10), ... , Nov, Dec

Stepwise Selection of Terms

α to enter = 0.1, α to remove = 0.1

Analysis of Variance

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Regression	7	157848	22549.7	43.28	0.000
Refferal(10)	1	8696	8696.4	16.69	0.000
New Users (10)	1	16855	16854.8	32.35	0.000
Returning Users(10)	1	31776	31776.3	60.99	0.000
Feb	1	2871	2871.3	5.51	0.021
May	1	1898	1897.8	3.64	0.059
Nov	1	18341	18341.2	35.20	0.000
Dec	1	19490	19490.1	37.41	0.000
Error	96	50018	521.0		
Total	103	207866			

Model Summary

S	R-sq	R-sq(adj)	R-sq(pred)
22.8259	75.94%	74.18%	71.17%

Coefficients

Term	Coef	SE Coef	T-Value	P-Value	VIF
Constant	52.5	11.0	4.78	0.000	
Refferal(10)	0.2801	0.0686	4.09	0.000	1.21
New Users (10)	-0.1281	0.0225	-5.69	0.000	2.38
Returning Users(10)	1.431	0.183	7.81	0.000	2.95
Feb	20.69	8.81	2.35	0.021	1.10
May	-15.66	8.20	-1.91	0.059	1.06
Nov	48.06	8.10	5.93	0.000	1.14
Dec	52.97	8.66	6.12	0.000	1.18

Regression Equation

Booking = 52.5 + 0.2801 Refferal(10) - 0.1281 New Users (10) + 1.431 Returning Users(10)
+ 20.69 Feb - 15.66 May + 48.06 Nov + 52.97 Dec

Figure 58 Regression analysis output for bi-weekly data by Anova table

The regression result of the bi-weekly training set shows statistical results indicate that Google Analytics metrics can well describe bookings with the adjusted R-squared is about 74.18%. Moreover, the present of multicollinearity by checking variance inflation factors (VIF), the values of VIF are less than 10, hence multicollinearity is not serious in this model. Lastly, the residual of the MLR model has checked the normality assumption for the residual by using the residual plot.

From Figure 58, the above Anova table shows the most appropriate multiple regression with interactions impact factors estimation is show in the equation below.

Bookings = 52.5 + 0.28 Sessions from Referral (10 sessions) – 0.13 Unique New Users (10 users) + 1.43 Unique Returning Users (10 users) + 20.69 February + 15.66 May + 48.06 November + 52.97 December (12)

Based on the weekly and bi-weekly regression models, the impactful factors of Google Analytics metrics are used to be independent variables to predict the bookings in the cross validation set. Figure 59 and Figure 60 show the graph representation of the forecast results with the actual booking of MLR models.

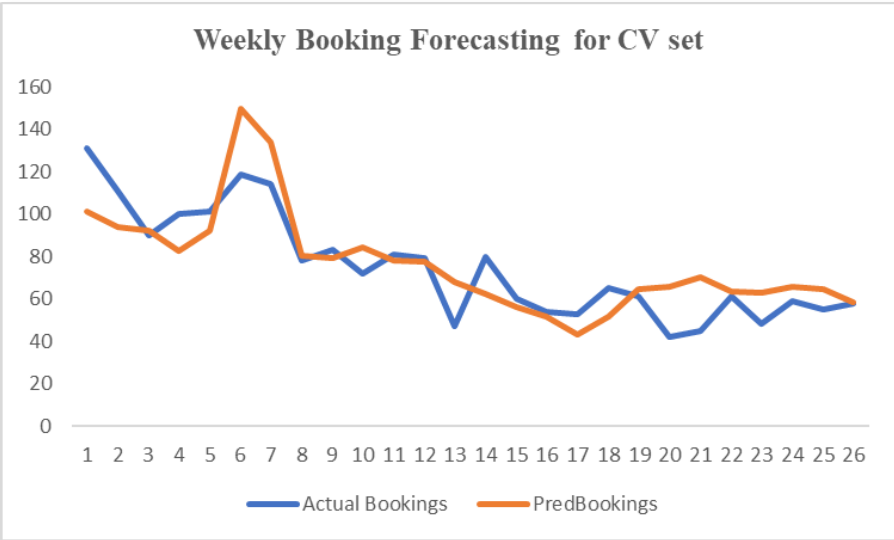


Figure 59 Weekly booking forecasting by using MLR model for CV set

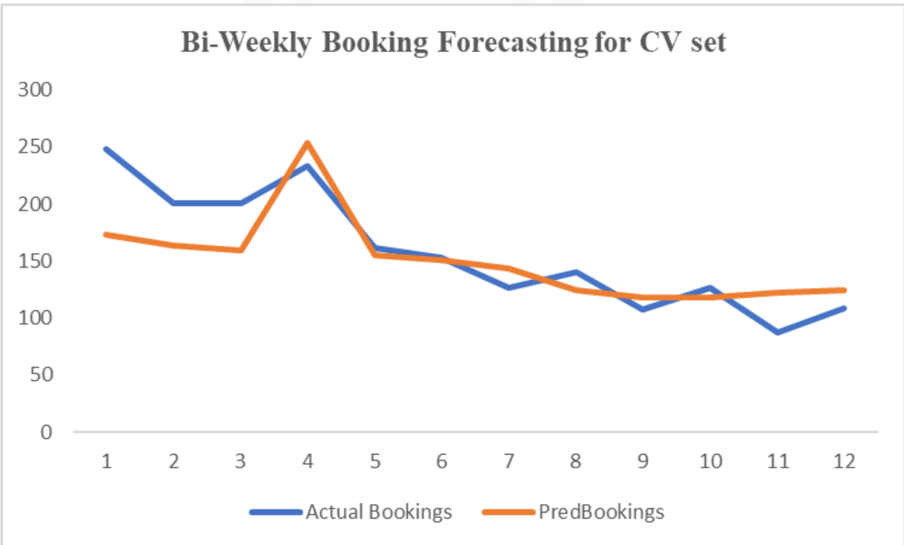


Figure 60 Bi-weekly booking forecasting by using MLR model for CV set

The accuracy of the above forecast results has been analyzed and evaluated based on MAPE, MAE and RMSE Table 12 are show with results of accuracy for each of the forecasting data types.

Table 12 Weekly and bi-weekly of MLR forecasting performance for CV set

MLR Models	**Weekly**	**Bi-Weekly**
Adjusted R^2	53.71%	74.18%
MAPE	16.95%	13.95%
MAE	11.68	30.48
RMSE	14.84	39.15

Results from the MLR model presents that the factors contributing from Google Analytics can describe weekly bookings with the adjusted R-squared is about 53.71%, while that the factors contributing from Google Analytics can describe bi-weekly bookings with the adjusted R-squared is about 74.18%. The weekly MLR model has the accuracy at MAPE 16.95%, and the bi-weekly MRL model has the accuracy at MAPE 13.95%.

Chapter 5 Conclusion and Recommendation

5.1 Conclusion

5.1.1 Data Analysis Google Analytics Metrics Contributing to the Bookings

A business website should use a Web Analytics tool to optimize website performance as it is important to know about their visitors and behaviors to keep them satisfied with the products or services displayed on the website. This research analyzed and compared the effects of Google Analysis metrics on bookings. By knowing the impactful factors, business owners can focus on those particular factors as they may convert traffic into potential customers effectively

Based on the data analysis result, it showed that the multiple linear regression model well describes monthly bookings with R-square 86.88%. Moreover, it showed that there are 3 metrics in Google Analytics that contributing to bookings, which are sessions from referral, unique returning users and the average session duration that the average session duration had the most effects on bookings.

The first of 3 metrics that contributing to bookings is the sessions from referral traffic. Referral traffics is another website referencing or writing to our website. Besides, advertising by placing a link to our website as well Interested people will click on the link to visit our website. Including clicking on links from Email and other Search Engines besides Google. In addition, we can create contents on other websites along with attaching links for people to follow. Considered as another way to increase traffic, which results in increasing the number of bookings as well.

Secondly it is on the unique returning users. The returning user on the website indicates the interest and engagement that we have created from entering the website for the first time and is a good sign of the eCommerce business. The approach such as introducing loyalty rewards programs potentially convert new user to a return user. The common loyalty program such as the point system allowing customer to earn points which then translate into some sort of reward or cash points to increase the number unique return visitor, thus resulting in increasing the number of bookings as well

Lastly, the session duration is one of the most important factors affecting the quality of the website. Having many people visiting our website or staying on our website for a long time that effects to the results in better quality of website as well. There are many steps to take when thinking about how to improve website’s average session duration metrics such as put up enough information for visitors to understand products or services, keep the fonts readable, use attractive colors, makes it easy to navigate, choose layouts that are user-friendly, interlink pages properly, add videos for interactive experience or improve the content.

These insights can help the case study company to enhance the effectiveness of website performance to increase the number of impactful metrics of Google Analytics in the MLR model hence, to increase the number of bookings or sales in the future. In additional, the use of the information provided by the 3 impactful metrics to predict booking that are based on the same period time data. These are the benefits of this research.

5.1.2 The Booking Forecasting

This thesis compares prediction approached that had been applied between the statistical technique and machine learning technique on time series analysis environment. The forecasting results in this study show that the Multiple Linear Regression (MLR) model with the effect factors of Google Analytics metrics as regressor variables outperforms the machine learning models of both daily and monthly bookings. This thesis was divided into two parts.

In the first part, the objective of this thesis was bookings forecasting by using impactful factors from Google Analytics. The MLR model was used to find the relationship effect between an interested variable was bookings and independent variables were Google Analytics metrics for the training set. The analysis results showed that 5 Google Analytics metrics from 13 metrics that had a significant impact on bookings were sessions from organic search traffic, sessions from referral traffic, unique returning users, unique page views and the average session duration and could not well-described bookings with the adjusted R-squared was about 38.56 % for daily bookings. While, 3 Google Analytics metrics from 13 metrics that had a significant impact on bookings were sessions from referral, unique returning users and the average session duration that could well describe bookings with the adjusted R-squared was about 86.88 % for monthly bookings.

In the second part, the most important aspect of forecasting was model accuracy. The daily MLR model had the accuracy at MAPE 31.47%, and the monthly MRL model had the accuracy at MAPE 5.99%. Moreover, the ANN model for daily bookings had the accuracy at MAPE 31.47% but the ANN model for monthly bookings was proven to accuracy at MAPE 6.03%. Furthermore, the daily SVR model had the accuracy at MAPE 31.67%, and the monthly SVR model had the accuracy at MAPE 6.07%. Lastly, the RF model for daily bookings had the accuracy at MAPE 38.43% while the ANN model for monthly bookings was proven accuracy at MAPE 10.05%.

Moreover, the results of Tukey Simultaneous and randomized complete block designs (RCBD) showed MLR model, ANN model, SVR model and RF model were not insignificantly different in cross validation set. Then, a case-study company could apply the MLR model in this thesis to forecast the monthly bookings therefore that the result will provide high accuracy, which is an important part of business planning for a company to achieve its goals and it is the easiest method to be conducted, lesser time to compute and lesser technical skill set are required. Thus, there were using MLR models to test general error with test set. the results showed the daily MLR model had the accuracy at MAPE 36.13%, meanwhile, the monthly MLR model had the accuracy at MAPE 10.15%.

Finally, due to MLR was best model for online booking forecasting, it was used to analyze and forecast with other time length such as weekly data and bi-weekly data also. The factors contributing from Google Analytics could describe weekly bookings with the adjusted R-squared was about 53.71%, while that the factors contributing from Google Analytics could describe bi-weekly bookings with the adjusted R-squared was about 74.18%. For the weekly forecasting results had the accuracy at MAPE 16.95%, and the bi-weekly model has the accuracy at MAPE 13.95%.

Based on comparison MLR performance for daily, weekly, bi-weekly and monthly bookings, the results in Table 13 showed that Google Analytics metrics could well-described bookings with high adjusted R-squared value affect well forecast bookings with low MAPE. Moreover, the longer period produced high adjusted R-squared and more prediction accuracy since time range could affect the accuracy prediction rate of model since booking does not occur immediately, but usually occur in a process of browsing, comparing price, planning then booking is last one, so there are time lag between browsing and booking which is more than one day. However, the monthly data provided the highest forecasting accuracy of online bookings when compared with daily, weekly and bi-weekly data at MAPE 5.99%. Nowadays, the case-study company does have a procedure or method for booking forecasting that the result of this thesis is good to be used to forecast booking for them.

Table 13 Overall MLR forecasting performance for CV set

MLR Models	**Daily**	**Weekly**	**Bi-Weekly**	**Monthly**
Adjusted R^2	38.56%	53.71%	74.18%	86.88%
MAPE	31.47%	16.95%	13.95%	5.99%
MAE	2.96	11.68	30.48	18.50
RMSE	3.80	14.84	39.15	28.20

5.2 Recommendation for Future Work

There are several areas that future studies can investigate in the following.

1) Future researchers could consider the analysis of data transformation upon the daily bookings such as Relative Difference in Percentage (RDP), and Moving Average (MA) that could be useful to improve the daily forecasting model with machine learning models (Ungtrakul. 2018), in order to have more accuracy for daily forecasting performance.
2) Future research may explore an extra hidden layer or try to optimize the other parameters in the Neural Network structure.
3) Future research may include forecasting other categories involving company development such as booking reservations, booking cancellations rate, potential customer sale conversion, etc. to have a wider insight forecast.
4) The results from this study can be useful for online businesses in other industries by applying the analysis of their data for their insights.
5) Since Google Analytics metrics cannot well-described bookings with the adjusted R-squared was about 38.56 % for daily bookings. So, the prediction model could be improved by adding more factors relating to online bookings from Google Analytics metrics. Moreover, the next study should focus on other factors that could be significant to daily forecasting.
6) Future research may try to use the time series models such as Holt-Winters' exponential smoothing, SARIMA, BATS, or TBATS models for the daily booking forecasting since the time series data of bookings showed that the bookings from 2015 to 2019 has a clear seasonality pattern, which might have better forecasting.

Appendix

The Forecasting Result and Parameter Evaluation of ANN Models for CV Set

Daily ANN Model 1:

1 Layer with Activation Functions $a^{(2)}$ = RelU and $a^{(3)}$ = ReLU

1st Step: Batch Size

MAE	RMSE	%MAPE	Seeds	Hidden Units	Epochs	Batch Size	Average %MAPE
2.73	3.53	32.63	1	30	100	10	
2.67	3.45	31.52	1	50	100	10	
2.59	3.35	31.06	1	70	100	10	
2.50	3.25	29.25	1	100	100	10	31.12
2.84	3.63	34.78	1	30	100	32	
2.78	3.57	33.77	1	50	100	32	
2.73	3.50	33.54	1	70	100	32	
2.68	3.45	32.54	1	100	100	32	33.66
2.90	3.71	36.34	1	30	100	64	
2.89	3.69	36.16	1	50	100	64	
2.86	3.65	36.05	1	70	100	64	
2.86	3.64	35.89	1	100	100	64	36.11
2.96	3.79	36.52	1	30	100	128	
2.96	3.78	36.51	1	50	100	128	
2.92	3.74	36.14	1	70	100	128	
2.93	3.73	36.19	1	100	100	128	36.34

2nd Step: Epochs

MAE	RMSE	%MAPE	Seeds	Hidden Units	Epochs	Batch Size	Average %MAPE
3.00	3.85	36.64	1	30	10	10	
2.97	3.82	35.73	1	50	10	10	
2.97	3.84	34.78	1	70	10	10	
2.96	3.82	34.47	1	100	10	10	35.41
2.91	3.70	36.59	1	30	40	10	
2.89	3.67	36.76	1	50	40	10	
2.90	3.65	37.37	1	70	40	10	
2.91	3.65	37.71	1	100	40	10	37.11
2.84	3.61	35.76	1	30	70	10	
2.76	3.52	34.50	1	50	70	10	
2.72	3.46	33.94	1	70	70	10	
2.64	3.39	32.31	1	100	70	10	34.13
2.73	3.53	32.63	1	30	100	10	
2.67	3.45	31.52	1	50	100	10	
2.59	3.35	31.06	1	70	100	10	

2.50	3.25	29.25	1	100	100	10	31.12

3rd Step: Hidden Units

MAE	RMSE	%MAPE	Seeds	Hidden Units	Epochs	Batch Size
2.88	3.68	35.24	1	5	100	10
2.88	3.68	35.22	1	6	100	10
2.87	3.67	35.10	1	7	100	10
2.88	3.68	35.14	1	8	100	10
2.86	3.66	34.92	1	9	100	10
2.88	3.68	35.09	1	10	100	10
2.82	3.60	34.35	1	11	100	10
2.78	3.57	33.73	1	12	100	10
2.78	3.58	33.63	1	13	100	10
2.85	3.65	34.63	1	14	100	10
2.85	3.65	34.33	1	15	100	10
2.83	3.63	34.09	1	16	100	10
2.78	3.57	33.54	1	17	100	10
2.82	3.63	33.98	1	18	100	10
2.73	3.52	33.01	1	19	100	10
2.85	3.65	34.55	1	20	100	10
2.75	3.55	33.15	1	21	100	10
2.70	3.49	32.28	1	22	100	10
2.72	3.50	32.90	1	23	100	10
2.73	3.53	32.85	1	24	100	10
2.72	3.53	32.72	1	25	100	10
2.77	3.57	33.28	1	26	100	10
2.76	3.55	33.15	1	27	100	10
2.73	3.52	32.45	1	28	100	10
2.65	3.42	31.64	1	29	100	10
2.73	3.53	32.63	1	30	100	10
2.70	3.49	32.22	1	31	100	10
2.80	3.60	33.51	1	32	100	10
2.66	3.43	31.82	1	33	100	10
2.66	3.44	31.78	1	34	100	10
2.69	3.47	31.97	1	35	100	10
2.71	3.49	32.37	1	36	100	10
2.70	3.50	32.01	1	37	100	10
2.64	3.43	31.84	1	38	100	10
2.60	3.38	31.32	1	39	100	10
2.56	3.32	30.45	1	40	100	10
2.61	3.36	31.17	1	41	100	10
2.64	3.40	31.88	1	42	100	10
2.61	3.38	31.32	1	43	100	10
2.53	3.28	30.49	1	44	100	10

2.61	3.37	31.35	1	45	100	10
2.63	3.41	31.16	1	46	100	10
2.57	3.31	30.41	1	47	100	10
2.59	3.33	30.84	1	48	100	10
2.62	3.39	31.45	1	49	100	10
2.67	3.45	31.52	1	50	100	10
2.61	3.37	30.92	1	51	100	10
2.63	3.38	31.32	1	52	100	10
2.60	3.36	30.81	1	53	100	10
2.57	3.32	30.98	1	54	100	10
2.61	3.35	31.64	1	55	100	10
2.56	3.31	30.43	1	56	100	10
2.60	3.38	30.96	1	57	100	10
2.64	3.40	31.25	1	58	100	10
2.57	3.31	30.59	1	59	100	10
2.57	3.34	30.64	1	60	100	10
2.54	3.26	30.36	1	61	100	10
2.61	3.37	31.29	1	62	100	10
2.57	3.32	30.71	1	63	100	10
2.52	3.27	29.77	1	64	100	10
2.57	3.33	30.56	1	65	100	10
2.58	3.35	30.76	1	66	100	10
2.56	3.31	30.65	1	67	100	10
2.51	3.25	29.86	1	68	100	10
2.57	3.33	30.60	1	69	100	10
2.59	3.35	31.06	1	70	100	10
2.57	3.34	30.24	1	71	100	10
2.53	3.27	29.89	1	72	100	10
2.51	3.24	29.52	1	73	100	10
2.50	3.22	29.55	1	74	100	10
2.55	3.32	30.26	1	75	100	10
2.53	3.26	29.84	1	76	100	10
2.52	3.27	29.67	1	77	100	10
2.51	3.26	29.67	1	78	100	10
2.59	3.34	30.60	1	79	100	10
2.51	3.25	29.74	1	80	100	10
2.51	3.24	29.62	1	81	100	10
2.49	3.23	29.33	1	82	100	10
2.54	3.29	29.71	1	83	100	10
2.58	3.32	30.45	1	84	100	10
2.50	3.25	29.63	1	85	100	10
2.56	3.30	30.16	1	86	100	10
2.57	3.34	30.37	1	87	100	10
2.57	3.33	30.20	1	88	100	10

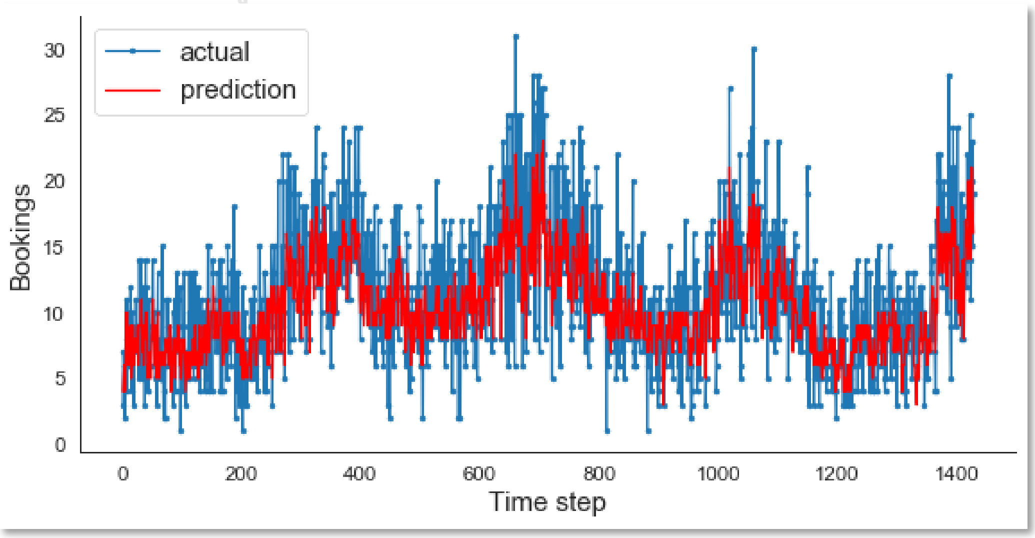
2.54	3.30	30.13	1	89	100	10
2.51	3.26	29.82	1	90	100	10
2.46	3.20	28.97	1	91	100	10
2.55	3.29	30.14	1	92	100	10
2.53	3.29	29.61	1	93	100	10
2.55	3.30	30.06	1	94	100	10
2.54	3.28	29.82	1	95	100	10
2.47	3.20	29.33	1	96	100	10
2.45	3.19	28.92	1	97	100	10
2.49	3.23	29.55	1	98	100	10
2.44	3.15	28.60	1	99	100	10
2.50	3.25	29.25	1	100	100	10

4th Step: Seeds

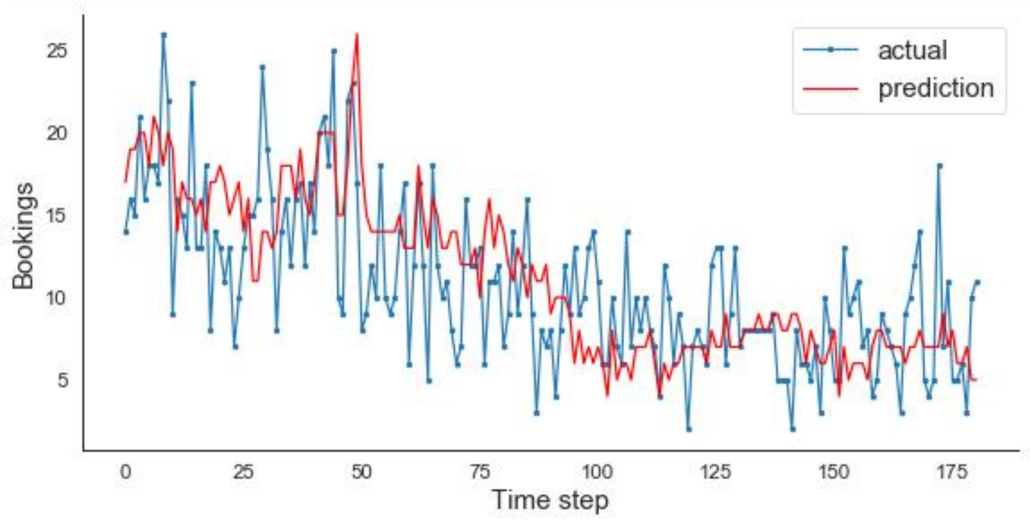
MAE	RMSE	%MAPE	Seeds	Hidden Units	Epochs	Batch Size
2.44	3.15	28.60	1	99	100	10
2.61	3.31	33.27	2	99	100	10
2.58	3.30	32.99	3	99	100	10
2.61	3.33	33.40	4	99	100	10
2.48	3.21	29.18	5	99	100	10
2.46	3.19	28.66	6	99	100	10
2.51	3.30	28.62	7	99	100	10
2.49	3.22	29.62	8	99	100	10
2.49	3.21	29.55	9	99	100	10
2.53	3.29	29.19	10	99	100	10
2.50	3.21	30.84	11	99	100	10
2.51	3.23	30.48	12	99	100	10
2.51	3.20	31.83	13	99	100	10
2.46	3.19	30.04	14	99	100	10
2.46	3.15	30.67	15	99	100	10
2.56	3.28	31.93	16	99	100	10
2.48	3.19	30.91	17	99	100	10
2.59	3.28	33.47	18	99	100	10
2.61	3.30	33.63	19	99	100	10
2.53	3.25	30.68	20	99	100	10
2.45	3.21	28.98	21	99	100	10
2.52	3.27	29.86	22	99	100	10
2.50	3.24	29.48	23	99	100	10
2.47	3.20	28.84	24	99	100	10
2.49	3.21	30.21	25	99	100	10
2.49	3.22	29.95	26	99	100	10
2.53	3.23	31.81	27	99	100	10
2.43	3.14	29.69	28	99	100	10
2.54	3.23	31.93	29	99	100	10

2.50	3.22	31.06	30	99	100	10
2.51	3.27	28.08	31	99	100	10
2.50	3.23	29.82	32	99	100	10
2.51	3.25	29.92	33	99	100	10
2.55	3.28	31.39	34	99	100	10
11.27	12.28	100.00	35	99	100	10
2.43	3.16	28.76	36	99	100	10
2.45	3.16	29.78	37	99	100	10
2.54	3.27	30.73	38	99	100	10
2.58	3.29	32.55	39	99	100	10
2.49	3.21	30.00	40	99	100	10
2.54	3.23	31.95	41	99	100	10
2.53	3.26	31.03	42	99	100	10
2.54	3.23	31.55	43	99	100	10
2.53	3.27	30.67	44	99	100	10
2.55	3.30	30.46	45	99	100	10
2.46	3.19	29.95	46	99	100	10
11.27	12.28	100.00	47	99	100	10
2.54	3.25	32.05	48	99	100	10
2.61	3.32	33.51	49	99	100	10
2.55	3.27	31.16	50	99	100	10
2.52	3.27	29.80	51	99	100	10
2.45	3.16	29.17	52	99	100	10
2.56	3.25	32.56	53	99	100	10
2.48	3.23	29.62	54	99	100	10
2.50	3.21	31.36	55	99	100	10
2.54	3.25	31.87	56	99	100	10
2.54	3.23	31.96	57	99	100	10
2.53	3.24	31.71	58	99	100	10
2.63	3.33	33.82	59	99	100	10
2.58	3.27	33.47	60	99	100	10
11.27	12.28	100.00	61	99	100	10
2.50	3.19	31.97	62	99	100	10
2.44	3.13	30.23	63	99	100	10
2.52	3.23	31.52	64	99	100	10
2.49	3.23	29.49	65	99	100	10
2.46	3.17	29.87	66	99	100	10
11.27	12.28	100.00	67	99	100	10
2.56	3.33	29.85	68	99	100	10
2.61	3.32	33.66	69	99	100	10
2.46	3.19	30.53	70	99	100	10
2.51	3.27	28.99	71	99	100	10
2.52	3.24	31.51	72	99	100	10
2.55	3.31	28.39	73	99	100	10

2.56	3.34	28.27	74	99	100	10
2.48	3.21	29.85	75	99	100	10
2.54	3.30	29.86	76	99	100	10
2.51	3.24	29.46	77	99	100	10
2.49	3.19	31.06	78	99	100	10
2.53	3.29	29.91	79	99	100	10
2.45	3.18	28.62	80	99	100	10
11.27	12.28	100.00	81	99	100	10
2.45	3.18	30.00	82	99	100	10
2.56	3.26	32.43	83	99	100	10
2.51	3.22	30.85	84	99	100	10
2.50	3.23	30.30	85	99	100	10
11.27	12.28	100.00	86	99	100	10
2.56	3.25	31.62	87	99	100	10
11.27	12.28	100.00	88	99	100	10
2.51	3.23	30.16	89	99	100	10
2.49	3.23	29.31	90	99	100	10
2.47	3.19	30.67	91	99	100	10
2.54	3.23	31.99	92	99	100	10
2.48	3.22	30.42	93	99	100	10
2.47	3.22	28.58	94	99	100	10
2.52	3.23	31.29	95	99	100	10
2.48	3.19	30.57	96	99	100	10
2.66	3.37	34.81	97	99	100	10
2.45	3.15	29.05	98	99	100	10
2.48	3.19	29.52	99	99	100	10
11.27	12.28	100.00	100	99	100	10



The daily booking forecasting with training set using ANN model 1



The daily booking forecasting with cross validation set using ANN model 1

Daily ANN Model 2:

1 Layer with Activation Functions $a^{(2)}$ = Sigmiod and $a^{(3)}$ = ReLU

1st Step: Batch Size

MAE	RMSE	%MAPE	Seeds	Hidden Units	Epochs	Batch Size	Average %MAPE
2.89	3.72	34.85	1	30	100	10	
2.86	3.69	34.23	1	50	100	10	
2.86	3.68	34.11	1	70	100	10	
2.85	3.68	33.82	1	100	100	10	34.25
3.01	3.83	37.42	1	30	100	32	
2.97	3.79	36.87	1	50	100	32	
2.94	3.75	36.19	1	70	100	32	
2.93	3.74	35.59	1	100	100	32	36.52
3.11	3.97	38.92	1	30	100	64	
3.07	3.91	38.37	1	50	100	64	
3.05	3.88	38.01	1	70	100	64	
3.02	3.84	37.44	1	100	100	64	38.19
3.36	4.31	42.09	1	30	100	128	
3.22	4.15	40.97	1	50	100	128	
3.17	4.07	40.33	1	70	100	128	
3.12	4.00	39.49	1	100	100	128	40.72

2nd Step: Epochs

MAE	RMSE	%MAPE	Seeds	Hidden Units	Epochs	Batch Size	Average %MAPE
3.33	4.27	42.09	1	30	10	10	
3.23	4.15	41.31	1	50	10	10	

3.18	4.09	40.55	1	70	10	10	
3.13	4.01	39.30	1	100	10	10	40.81
3.01	3.84	37.33	1	30	40	10	
2.98	3.79	37.03	1	50	40	10	
2.96	3.77	37.11	1	70	40	10	
2.95	3.76	37.22	1	100	40	10	37.17
2.97	3.78	37.47	1	30	70	10	
2.95	3.75	37.22	1	50	70	10	
2.94	3.73	37.03	1	70	70	10	
2.93	3.72	36.88	1	100	70	10	37.15
2.89	3.72	34.85	1	30	100	10	
2.86	3.69	34.23	1	50	100	10	
2.86	3.68	34.11	1	70	100	10	
2.85	3.68	33.82	1	100	100	10	34.25

3rd Step: Hidden Units

MAE	RMSE	%MAPE	Seeds	Hidden Units	Epochs	Batch Size
2.99	3.81	36.72	1	5	100	10
2.99	3.82	36.82	1	6	100	10
2.98	3.80	36.47	1	7	100	10
2.98	3.80	36.58	1	8	100	10
2.98	3.79	36.56	1	9	100	10
2.97	3.78	36.35	1	10	100	10
2.94	3.76	35.96	1	11	100	10
2.94	3.76	35.89	1	12	100	10
2.94	3.76	35.86	1	13	100	10
2.93	3.75	35.79	1	14	100	10
2.92	3.74	35.47	1	15	100	10
2.91	3.73	35.38	1	16	100	10
2.91	3.73	35.37	1	17	100	10
2.91	3.73	35.36	1	18	100	10
2.91	3.73	35.38	1	19	100	10
2.91	3.73	35.37	1	20	100	10
2.91	3.73	35.23	1	21	100	10
2.91	3.73	35.30	1	22	100	10
2.90	3.72	35.13	1	23	100	10
2.90	3.73	35.11	1	24	100	10
2.90	3.72	35.03	1	25	100	10
2.89	3.71	34.85	1	26	100	10
2.89	3.72	34.93	1	27	100	10
2.89	3.71	34.73	1	28	100	10
2.89	3.71	34.83	1	29	100	10
2.89	3.72	34.85	1	30	100	10
2.89	3.71	34.71	1	31	100	10

2.89	3.72	34.81	1	32	100	10
2.89	3.71	34.71	1	33	100	10
2.88	3.71	34.55	1	34	100	10
2.89	3.71	34.63	1	35	100	10
2.88	3.71	34.65	1	36	100	10
2.90	3.72	34.75	1	37	100	10
2.88	3.70	34.48	1	38	100	10
2.88	3.70	34.47	1	39	100	10
2.88	3.70	34.44	1	40	100	10
2.88	3.70	34.59	1	41	100	10
2.88	3.70	34.43	1	42	100	10
2.88	3.69	34.35	1	43	100	10
2.87	3.70	34.42	1	44	100	10
2.87	3.69	34.36	1	45	100	10
2.87	3.69	34.35	1	46	100	10
2.87	3.69	34.29	1	47	100	10
2.87	3.69	34.26	1	48	100	10
2.87	3.69	34.29	1	49	100	10
2.86	3.69	34.23	1	50	100	10
2.87	3.69	34.26	1	51	100	10
2.86	3.68	34.14	1	52	100	10
2.86	3.68	34.16	1	53	100	10
2.87	3.69	34.31	1	54	100	10
2.86	3.68	34.22	1	55	100	10
2.86	3.68	34.14	1	56	100	10
2.86	3.68	34.17	1	57	100	10
2.86	3.68	34.15	1	58	100	10
2.86	3.68	34.13	1	59	100	10
2.85	3.68	34.06	1	60	100	10
2.86	3.68	34.14	1	61	100	10
2.85	3.68	34.04	1	62	100	10
2.86	3.68	34.14	1	63	100	10
2.84	3.67	33.96	1	64	100	10
2.85	3.67	34.08	1	65	100	10
2.85	3.67	34.09	1	66	100	10
2.85	3.67	34.00	1	67	100	10
2.86	3.68	34.10	1	68	100	10
2.85	3.68	34.04	1	69	100	10
2.86	3.68	34.11	1	70	100	10
2.85	3.67	33.99	1	71	100	10
2.85	3.69	34.06	1	72	100	10
2.85	3.68	33.99	1	73	100	10
2.85	3.68	33.96	1	74	100	10
2.85	3.68	34.00	1	75	100	10

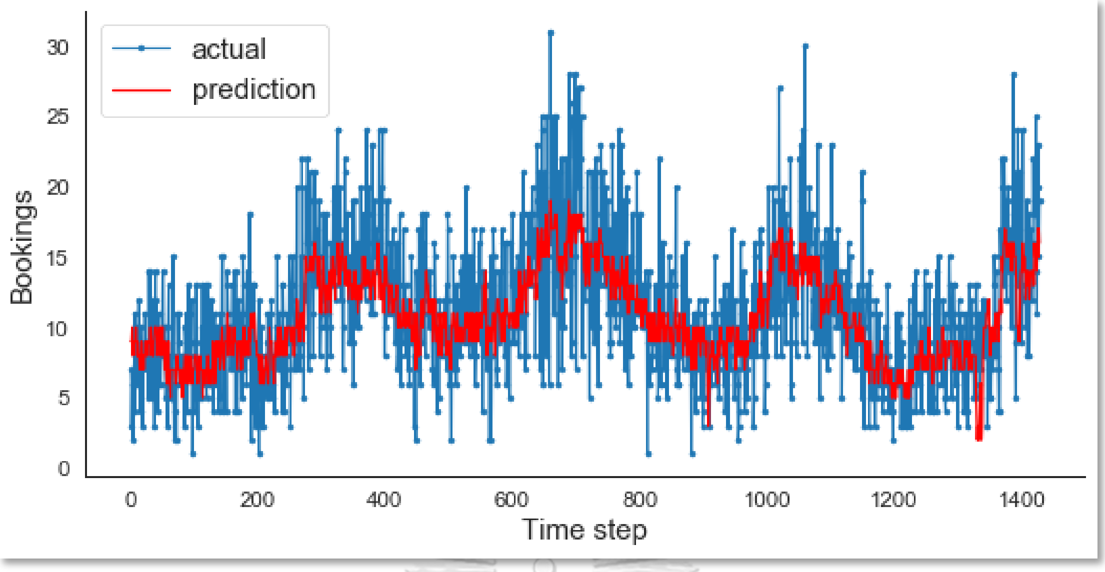
2.85	3.68	33.95	1	76	100	10
2.85	3.68	33.94	1	77	100	10
2.86	3.69	34.05	1	78	100	10
2.85	3.68	33.96	1	79	100	10
2.85	3.69	34.01	1	80	100	10
2.85	3.68	33.89	1	81	100	10
2.85	3.68	33.95	1	82	100	10
2.85	3.68	34.00	1	83	100	10
2.85	3.68	33.88	1	84	100	10
2.85	3.68	33.86	1	85	100	10
2.85	3.68	33.88	1	86	100	10
2.85	3.68	33.91	1	87	100	10
2.85	3.68	33.94	1	88	100	10
2.84	3.67	33.83	1	89	100	10
2.85	3.68	33.87	1	90	100	10
2.85	3.68	33.82	1	91	100	10
2.85	3.68	33.87	1	92	100	10
2.84	3.68	33.79	1	93	100	10
2.85	3.68	33.85	1	94	100	10
2.85	3.68	33.82	1	95	100	10
2.84	3.68	33.83	1	96	100	10
2.84	3.67	33.77	1	97	100	10
2.84	3.68	33.82	1	98	100	10
2.84	3.68	33.82	1	99	100	10
2.85	3.68	33.82	1	100	100	10

4th Step: Seeds

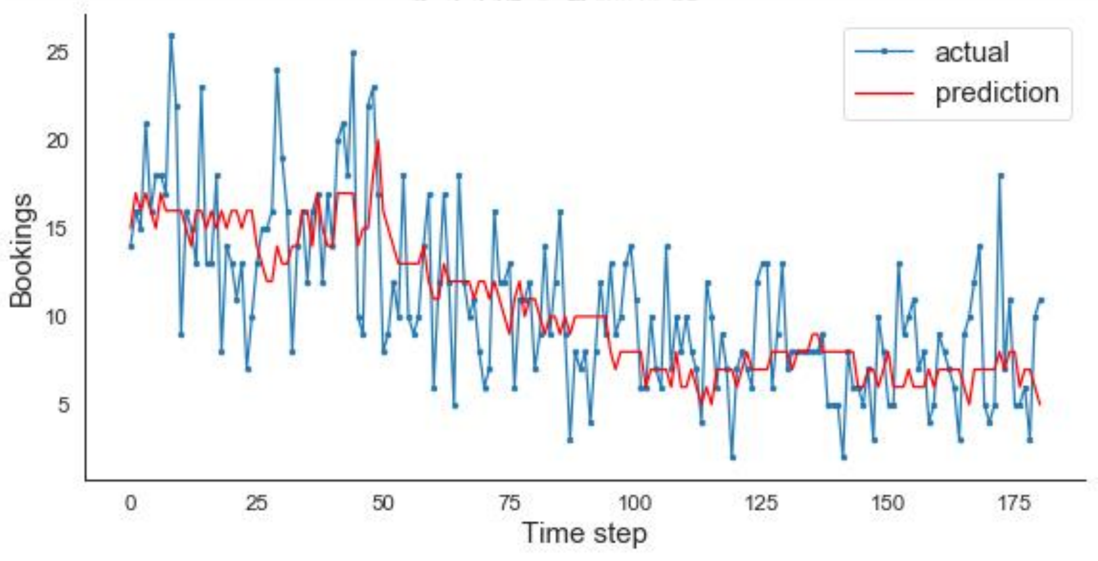
MAE	**RMSE**	**%MAPE**	**Seeds**	**Hidden Units**	**Epochs**	**Batch Size**
2.84	3.67	33.77	1	97	100	10
11.27	12.28	100.00	2	97	100	10
2.97	3.75	38.47	3	97	100	10
11.27	12.28	100.00	4	97	100	10
2.88	3.68	35.52	5	97	100	10
2.87	3.67	34.83	6	97	100	10
11.27	12.28	100.00	7	97	100	10
2.87	3.73	33.31	8	97	100	10
11.27	12.28	100.00	9	97	100	10
11.27	12.28	100.00	10	97	100	10
2.88	3.68	35.71	11	97	100	10
2.85	3.68	33.89	12	97	100	10
2.95	3.72	37.86	13	97	100	10
11.27	12.28	100.00	14	97	100	10
11.27	12.28	100.00	15	97	100	10
2.88	3.68	35.72	16	97	100	10

2.85	3.68	33.82	17	97	100	10
2.96	3.74	38.30	18	97	100	10
11.27	12.28	100.00	19	97	100	10
11.27	12.28	100.00	20	97	100	10
11.27	12.28	100.00	21	97	100	10
11.27	12.28	100.00	22	97	100	10
2.86	3.68	34.42	23	97	100	10
2.86	3.68	34.50	24	97	100	10
2.91	3.69	36.62	25	97	100	10
2.86	3.70	33.58	26	97	100	10
11.27	12.28	100.00	27	97	100	10
2.88	3.68	35.64	28	97	100	10
11.27	12.28	100.00	29	97	100	10
11.27	12.28	100.00	30	97	100	10
2.87	3.68	34.83	31	97	100	10
11.27	12.28	100.00	32	97	100	10
2.86	3.70	33.56	33	97	100	10
2.91	3.70	36.63	34	97	100	10
11.27	12.28	100.00	35	97	100	10
2.86	3.68	34.36	36	97	100	10
11.27	12.28	100.00	37	97	100	10
11.27	12.28	100.00	38	97	100	10
11.27	12.28	100.00	39	97	100	10
11.27	12.28	100.00	40	97	100	10
11.27	12.28	100.00	41	97	100	10
2.86	3.68	34.58	42	97	100	10
11.27	12.28	100.00	43	97	100	10
11.27	12.28	100.00	44	97	100	10
11.27	12.28	100.00	45	97	100	10
11.27	12.28	100.00	46	97	100	10
11.27	12.28	100.00	47	97	100	10
2.91	3.70	36.67	48	97	100	10
11.27	12.28	100.00	49	97	100	10
2.85	3.68	33.71	50	97	100	10
2.86	3.67	34.72	51	97	100	10
2.86	3.68	34.34	52	97	100	10
11.27	12.28	100.00	53	97	100	10
11.27	12.28	100.00	54	97	100	10
2.95	3.73	38.04	55	97	100	10
2.90	3.69	36.50	56	97	100	10
2.85	3.68	34.17	57	97	100	10
11.27	12.28	100.00	58	97	100	10
11.27	12.28	100.00	59	97	100	10
2.90	3.69	36.22	60	97	100	10

11.27	12.28	100.00	61	97	100	10
2.87	3.68	35.49	62	97	100	10
2.94	3.71	37.55	63	97	100	10
11.27	12.28	100.00	64	97	100	10
2.87	3.68	34.71	65	97	100	10
11.27	12.28	100.00	66	97	100	10
11.27	12.28	100.00	67	97	100	10
2.84	3.69	33.45	68	97	100	10
2.88	3.68	35.43	69	97	100	10
11.27	12.28	100.00	70	97	100	10
2.85	3.69	33.50	71	97	100	10
2.86	3.68	34.32	72	97	100	10
11.27	12.28	100.00	73	97	100	10
11.27	12.28	100.00	74	97	100	10
2.91	3.70	36.51	75	97	100	10
2.86	3.68	35.10	76	97	100	10
2.85	3.68	34.10	77	97	100	10
2.86	3.66	34.87	78	97	100	10
2.84	3.68	33.71	79	97	100	10
2.93	3.71	37.41	80	97	100	10
11.27	12.28	100.00	81	97	100	10
11.27	12.28	100.00	82	97	100	10
2.86	3.68	34.48	83	97	100	10
2.84	3.68	33.61	84	97	100	10
11.27	12.28	100.00	85	97	100	10
11.27	12.28	100.00	86	97	100	10
11.27	12.28	100.00	87	97	100	10
11.27	12.28	100.00	88	97	100	10
2.88	3.68	35.69	89	97	100	10
2.89	3.68	35.84	90	97	100	10
11.27	12.28	100.00	91	97	100	10
2.99	3.76	39.05	92	97	100	10
2.85	3.68	34.07	93	97	100	10
11.27	12.28	100.00	94	97	100	10
2.89	3.68	35.92	95	97	100	10
2.93	3.71	37.44	96	97	100	10
2.96	3.74	38.34	97	97	100	10
2.86	3.69	34.39	98	97	100	10
11.27	12.28	100.00	99	97	100	10
11.27	12.28	100.00	100	97	100	10



The daily booking forecasting with training set using ANN model 2



The daily booking forecasting with cross validation set using ANN model 2

Daily ANN Model 3:

2 Layers with Activation Functions $a^{(2)}$ = ReLU, $a^{(3)}$ = ReLU, $a^{(4)}$ = ReLU

1st Step: Batch Size

MAE	RMSE	%MAPE	Seeds	Hidden Units	Epochs	Batch Size	Average %MAPE
2.51	3.25	30.02	1	30	100	10	
2.33	3.00	27.79	1	50	100	10	
2.24	2.88	26.01	1	70	100	10	
2.09	2.76	23.91	1	100	100	10	26.93
2.70	3.50	32.43	1	30	100	32	
2.48	3.21	28.53	1	50	100	32	
2.37	3.05	27.97	1	70	100	32	
2.31	2.98	28.76	1	100	100	32	29.42
2.73	3.52	32.58	1	30	100	64	
2.55	3.28	31.15	1	50	100	64	
2.51	3.21	30.62	1	70	100	64	
2.39	3.10	28.73	1	100	100	64	30.77
2.85	3.65	35.64	1	30	100	128	
2.75	3.51	34.97	1	50	100	128	
2.75	3.47	35.05	1	70	100	128	
2.69	3.42	34.04	1	100	100	128	34.92

2nd Step: Epochs

MAE	RMSE	%MAPE	Seeds	Hidden Units	Epochs	Batch Size	Average %MAPE
2.99	3.87	34.36	1	30	10	10	
2.94	3.81	33.63	1	50	10	10	
2.90	3.75	33.46	1	70	10	10	
2.88	3.73	33.30	1	100	10	10	33.69
2.92	3.67	38.38	1	30	40	10	
2.74	3.45	35.83	1	50	40	10	
2.66	3.35	34.15	1	70	40	10	
2.61	3.30	33.64	1	100	40	10	35.50
2.66	3.41	33.77	1	30	70	10	
2.45	3.14	30.38	1	50	70	10	
2.38	3.05	28.41	1	70	70	10	
2.32	2.98	28.46	1	100	70	10	30.25
2.51	3.25	30.02	1	30	100	10	
2.33	3.00	27.79	1	50	100	10	
2.24	2.88	26.01	1	70	100	10	
2.09	2.76	23.91	1	100	100	10	26.93

3rd Step: Hidden Units

MAE	RMSE	%MAPE	Seeds	Hidden Units	Epochs	Batch Size
2.80	3.59	33.62	1	5	100	10

2.80	3.61	33.59	1	6	100	10
2.87	3.67	34.58	1	7	100	10
2.82	3.63	34.09	1	8	100	10
2.78	3.57	33.26	1	9	100	10
2.80	3.60	33.85	1	10	100	10
2.80	3.59	33.68	1	11	100	10
2.71	3.49	32.58	1	12	100	10
2.66	3.43	31.60	1	13	100	10
2.74	3.53	33.12	1	14	100	10
2.59	3.33	30.61	1	15	100	10
2.65	3.43	31.44	1	16	100	10
2.70	3.49	31.89	1	17	100	10
2.58	3.31	30.74	1	18	100	10
2.54	3.28	29.57	1	19	100	10
2.61	3.34	30.62	1	20	100	10
2.66	3.43	31.38	1	21	100	10
2.61	3.38	30.57	1	22	100	10
2.44	3.13	28.97	1	23	100	10
2.52	3.29	29.28	1	24	100	10
2.52	3.27	28.82	1	25	100	10
2.53	3.25	29.76	1	26	100	10
11.27	12.28	100.00	1	27	100	10
2.44	3.16	28.50	1	28	100	10
2.43	3.10	28.78	1	29	100	10
2.51	3.25	30.02	1	30	100	10
2.51	3.24	28.41	1	31	100	10
2.53	3.27	29.76	1	32	100	10
2.42	3.13	28.72	1	33	100	10
2.49	3.22	28.81	1	34	100	10
2.51	3.27	28.91	1	35	100	10
2.37	3.08	28.40	1	36	100	10
2.39	3.10	28.74	1	37	100	10
2.44	3.16	28.44	1	38	100	10
2.41	3.12	28.05	1	39	100	10
2.42	3.12	28.36	1	40	100	10
2.42	3.11	28.47	1	41	100	10
2.43	3.14	28.23	1	42	100	10
2.35	3.03	27.67	1	43	100	10
2.39	3.08	28.00	1	44	100	10
2.34	3.00	27.73	1	45	100	10
2.32	3.01	26.62	1	46	100	10
2.36	3.05	27.52	1	47	100	10
2.33	3.03	27.73	1	48	100	10
2.37	3.04	27.58	1	49	100	10

2.33	3.00	27.79	1	50	100	10
2.34	3.02	27.40	1	51	100	10
2.26	2.93	26.75	1	52	100	10
2.32	3.01	27.84	1	53	100	10
2.30	2.95	27.46	1	54	100	10
2.32	2.99	28.09	1	55	100	10
2.38	3.07	27.39	1	56	100	10
2.28	2.97	27.09	1	57	100	10
2.30	2.97	26.88	1	58	100	10
2.27	2.97	26.60	1	59	100	10
2.32	3.00	27.37	1	60	100	10
2.26	2.92	27.08	1	61	100	10
2.30	2.99	27.24	1	62	100	10
2.28	2.95	26.31	1	63	100	10
2.21	2.87	26.44	1	64	100	10
2.30	2.96	27.05	1	65	100	10
2.25	2.92	26.58	1	66	100	10
2.28	2.93	26.77	1	67	100	10
2.18	2.81	25.23	1	68	100	10
2.26	2.90	27.00	1	69	100	10
2.24	2.88	26.01	1	70	100	10
2.24	2.91	26.13	1	71	100	10
2.24	2.91	26.48	1	72	100	10
2.25	2.93	25.84	1	73	100	10
2.23	2.90	26.63	1	74	100	10
2.17	2.84	24.85	1	75	100	10
2.13	2.80	25.09	1	76	100	10
2.25	2.92	26.33	1	77	100	10
2.25	2.92	25.82	1	78	100	10
2.12	2.79	25.33	1	79	100	10
2.13	2.79	24.39	1	80	100	10
2.17	2.83	25.10	1	81	100	10
2.22	2.89	25.30	1	82	100	10
2.20	2.85	26.37	1	83	100	10
2.17	2.84	24.70	1	84	100	10
2.17	2.85	25.17	1	85	100	10
11.27	12.28	100.00	1	86	100	10
2.15	2.80	24.42	1	87	100	10
2.14	2.81	23.64	1	88	100	10
11.27	12.28	100.00	1	89	100	10
2.11	2.77	24.58	1	90	100	10
2.15	2.79	24.86	1	91	100	10
2.22	2.88	25.29	1	92	100	10
2.15	2.81	25.09	1	93	100	10

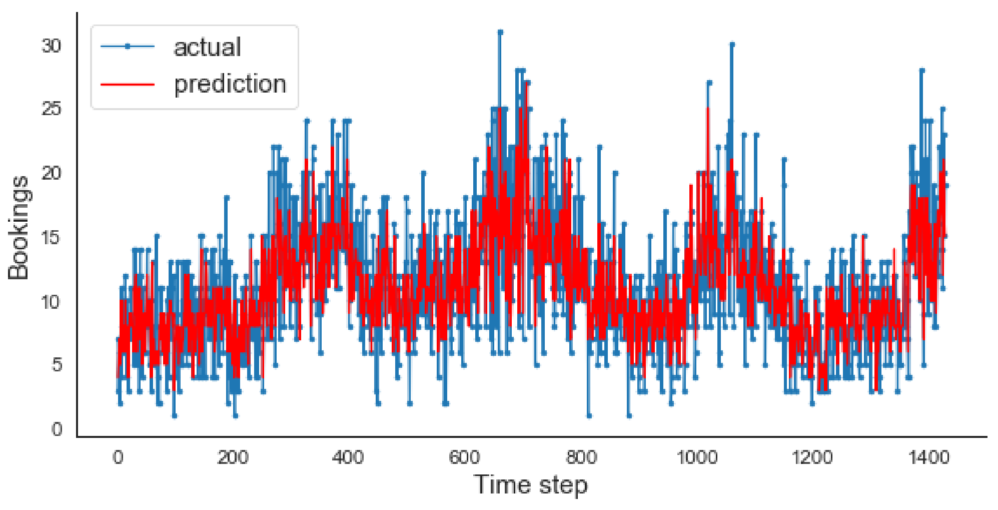
2.15	2.81	24.19	1	94	100	10
2.09	2.73	24.17	1	95	100	10
2.08	2.75	24.16	1	96	100	10
2.08	2.74	24.56	1	97	100	10
2.11	2.78	24.77	1	98	100	10
2.02	2.70	24.00	1	99	100	10
2.09	2.76	23.91	1	100	100	10

4th Step: Seeds

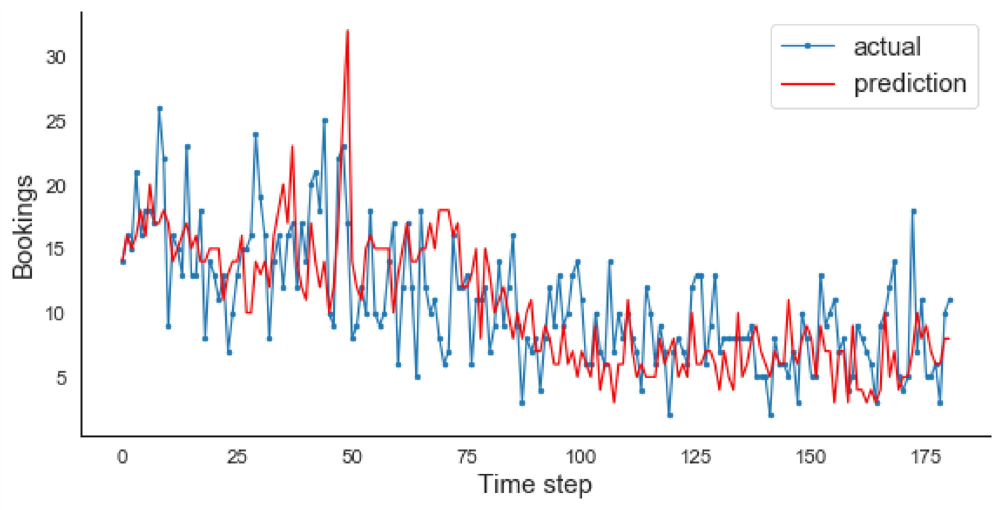
MAE	RMSE	%MAPE	Seeds	Hidden Units	Epochs	Batch Size
2.14	2.81	23.64	1	88	100	10
2.15	2.82	24.88	2	88	100	10
2.12	2.76	25.70	3	88	100	10
2.16	2.80	26.97	4	88	100	10
2.17	2.85	23.97	5	88	100	10
2.35	3.08	25.08	6	88	100	10
2.33	3.03	24.78	7	88	100	10
2.15	2.82	25.85	8	88	100	10
2.16	2.84	25.91	9	88	100	10
2.40	3.13	24.61	10	88	100	10
2.37	3.05	30.46	11	88	100	10
2.15	2.80	25.66	12	88	100	10
2.21	2.88	27.38	13	88	100	10
2.30	3.02	24.36	14	88	100	10
2.14	2.78	27.09	15	88	100	10
2.23	2.90	27.35	16	88	100	10
2.20	2.84	26.73	17	88	100	10
2.17	2.85	25.34	18	88	100	10
2.16	2.81	26.44	19	88	100	10
2.14	2.79	26.78	20	88	100	10
2.14	2.82	23.84	21	88	100	10
2.17	2.82	25.96	22	88	100	10
2.24	2.90	24.24	23	88	100	10
2.19	2.87	24.38	24	88	100	10
2.25	2.93	25.06	25	88	100	10
11.27	12.28	100.00	26	88	100	10
2.31	2.98	29.32	27	88	100	10
2.09	2.75	24.32	28	88	100	10
2.19	2.86	25.70	29	88	100	10
2.34	3.03	29.86	30	88	100	10
2.41	3.14	24.88	31	88	100	10
2.09	2.73	25.10	32	88	100	10
11.27	12.28	100.00	33	88	100	10
2.17	2.83	25.33	34	88	100	10

2.24	2.95	24.69	35	88	100	10
2.14	2.79	25.61	36	88	100	10
2.12	2.77	25.04	37	88	100	10
2.19	2.86	23.78	38	88	100	10
2.11	2.79	25.95	39	88	100	10
11.27	12.28	100.00	40	88	100	10
2.36	3.01	29.83	41	88	100	10
2.18	2.85	24.91	42	88	100	10
2.28	2.94	28.12	43	88	100	10
2.11	2.77	25.14	44	88	100	10
2.14	2.81	25.21	45	88	100	10
2.19	2.86	26.62	46	88	100	10
2.15	2.80	26.31	47	88	100	10
2.19	2.86	25.73	48	88	100	10
2.24	2.90	27.50	49	88	100	10
2.22	2.90	26.44	50	88	100	10
2.14	2.81	25.41	51	88	100	10
2.15	2.83	25.11	52	88	100	10
2.31	2.96	28.96	53	88	100	10
2.15	2.81	25.06	54	88	100	10
2.26	2.92	27.75	55	88	100	10
2.22	2.90	28.25	56	88	100	10
2.16	2.83	25.56	57	88	100	10
11.27	12.28	100.00	58	88	100	10
2.40	3.07	31.33	59	88	100	10
2.16	2.80	26.12	60	88	100	10
2.31	2.97	29.13	61	88	100	10
11.27	12.28	100.00	62	88	100	10
2.16	2.84	24.39	63	88	100	10
2.17	2.83	25.16	64	88	100	10
2.28	2.97	25.38	65	88	100	10
11.27	12.28	100.00	66	88	100	10
2.29	2.96	24.97	67	88	100	10
2.03	2.72	23.35	68	88	100	10
2.28	2.94	28.84	69	88	100	10
2.22	2.87	27.96	70	88	100	10
2.18	2.83	26.32	71	88	100	10
2.15	2.82	25.51	72	88	100	10
2.14	2.82	24.17	73	88	100	10
2.42	3.15	23.97	74	88	100	10
2.18	2.86	24.18	75	88	100	10
2.19	2.86	26.71	76	88	100	10
2.24	2.88	26.60	77	88	100	10
2.06	2.75	24.40	78	88	100	10

2.16	2.81	25.34	79	88	100	10
2.16	2.83	24.51	80	88	100	10
2.10	2.75	24.54	81	88	100	10
2.17	2.85	25.57	82	88	100	10
2.15	2.79	26.23	83	88	100	10
2.19	2.87	27.18	84	88	100	10
2.17	2.85	25.30	85	88	100	10
2.39	3.10	25.47	86	88	100	10
2.27	2.93	28.58	87	88	100	10
2.32	2.96	29.26	88	88	100	10
2.19	2.84	26.99	89	88	100	10
2.30	3.03	24.79	90	88	100	10
2.19	2.84	26.61	91	88	100	10
2.16	2.84	26.54	92	88	100	10
2.08	2.75	24.47	93	88	100	10
2.20	2.86	26.10	94	88	100	10
2.22	2.88	24.81	95	88	100	10
2.30	2.97	25.90	96	88	100	10
2.17	2.83	25.88	97	88	100	10
2.31	2.95	28.99	98	88	100	10
2.22	2.88	24.15	99	88	100	10
11.27	12.28	100.00	100	88	100	10



The daily booking forecasting with training set using ANN model 3



The daily booking forecasting with cross validation set using ANN model 3

Daily ANN Model 4:

2 Layers with Activation Functions $a^{(2)}$ = Sigmoid, $a^{(3)}$ = ReLU, $a^{(4)}$ = ReLU

1st Step: Batch Size

MAE	RMSE	%MAPE	Seeds	Hidden Units	Epochs	Batch Size	Average %MAPE
11.27	12.28	100.00	1	30	100	10	
2.80	3.62	32.97	1	50	100	10	
2.77	3.59	32.50	1	70	100	10	
2.74	3.57	32.01	1	100	100	10	49.37
11.27	12.28	100.00	1	30	100	32	
2.87	3.68	34.94	1	50	100	32	
2.88	3.70	34.40	1	70	100	32	
2.85	3.68	33.09	1	100	100	32	50.61
11.27	12.28	100.00	1	30	100	64	
2.95	3.75	36.40	1	50	100	64	
2.93	3.77	35.00	1	70	100	64	
2.90	3.72	34.38	1	100	100	64	51.45
11.27	12.28	100.00	1	30	100	128	
3.04	3.86	37.74	1	50	100	128	
3.05	3.88	38.24	1	70	100	128	
3.00	3.80	37.92	1	100	100	128	53.48

2nd Step: Epochs

MAE	RMSE	%MAPE	Seeds	Hidden Units	Epochs	Batch Size	Average %MAPE
11.27	12.28	100.00	1	30	10	10	
3.11	4.01	36.41	1	50	10	10	

3.08	4.00	36.19	1	70	10	10	
3.04	3.92	35.13	1	100	10	10	51.93
11.27	12.28	100.00	1	30	40	10	
3.07	3.84	40.61	1	50	40	10	
3.11	3.89	41.52	1	70	40	10	
3.06	3.83	40.73	1	100	40	10	55.72
11.27	12.28	100.00	1	30	70	10	
2.87	3.66	35.32	1	50	70	10	
2.84	3.64	35.09	1	70	70	10	
2.83	3.62	35.33	1	100	70	10	51.44
11.27	12.28	100.00	1	30	100	10	
2.80	3.62	32.97	1	50	100	10	
2.77	3.59	32.50	1	70	100	10	
2.74	3.57	32.01	1	100	100	10	49.37

3rd Step: Hidden Units

MAE	RMSE	%MAPE	Seeds	Hidden Units	Epochs	Batch Size
2.93	3.75	35.79	1	5	100	10
11.27	12.28	100.00	1	6	100	10
2.89	3.71	34.62	1	7	100	10
2.92	3.74	35.47	1	8	100	10
11.27	12.28	100.00	1	9	100	10
11.27	12.28	100.00	1	10	100	10
11.27	12.28	100.00	1	11	100	10
11.27	12.28	100.00	1	12	100	10
2.89	3.71	34.60	1	13	100	10
11.27	12.28	100.00	1	14	100	10
2.84	3.67	33.94	1	15	100	10
2.92	3.75	35.32	1	16	100	10
11.27	12.28	100.00	1	17	100	10
11.27	12.28	100.00	1	18	100	10
2.87	3.69	34.11	1	19	100	10
2.85	3.67	33.86	1	20	100	10
2.84	3.68	33.90	1	21	100	10
2.83	3.66	33.49	1	22	100	10
2.83	3.66	33.52	1	23	100	10
2.85	3.67	33.87	1	24	100	10
11.27	12.28	100.00	1	25	100	10
2.89	3.71	34.38	1	26	100	10
11.27	12.28	100.00	1	27	100	10
2.85	3.68	33.95	1	28	100	10
11.27	12.28	100.00	1	29	100	10
11.27	12.28	100.00	1	30	100	10
11.27	12.28	100.00	1	31	100	10

2.85	3.68	33.82	1	32	100	10
2.84	3.67	33.58	1	33	100	10
2.83	3.65	33.42	1	34	100	10
2.83	3.67	33.61	1	35	100	10
11.27	12.28	100.00	1	36	100	10
11.27	12.28	100.00	1	37	100	10
11.27	12.28	100.00	1	38	100	10
2.86	3.69	33.90	1	39	100	10
2.82	3.64	33.58	1	40	100	10
2.83	3.66	33.47	1	41	100	10
2.83	3.64	33.61	1	42	100	10
2.83	3.66	33.43	1	43	100	10
2.83	3.65	33.46	1	44	100	10
2.84	3.67	33.73	1	45	100	10
2.81	3.63	33.26	1	46	100	10
2.84	3.67	33.51	1	47	100	10
2.83	3.65	33.36	1	48	100	10
2.81	3.63	33.25	1	49	100	10
2.80	3.62	32.97	1	50	100	10
2.82	3.64	33.31	1	51	100	10
2.82	3.64	33.30	1	52	100	10
2.78	3.61	32.92	1	53	100	10
2.79	3.61	33.02	1	54	100	10
2.81	3.64	33.19	1	55	100	10
11.27	12.28	100.00	1	56	100	10
11.27	12.28	100.00	1	57	100	10
2.80	3.63	32.93	1	58	100	10
11.27	12.28	100.00	1	59	100	10
2.80	3.62	33.00	1	60	100	10
2.75	3.56	32.38	1	61	100	10
2.77	3.58	32.42	1	62	100	10
11.27	12.28	100.00	1	63	100	10
2.80	3.62	32.81	1	64	100	10
2.79	3.62	32.76	1	65	100	10
2.80	3.63	32.87	1	66	100	10
2.76	3.59	32.38	1	67	100	10
2.78	3.60	32.67	1	68	100	10
11.27	12.28	100.00	1	69	100	10
2.77	3.59	32.50	1	70	100	10
2.76	3.58	32.58	1	71	100	10
2.76	3.57	32.49	1	72	100	10
2.75	3.57	32.31	1	73	100	10
2.78	3.61	32.67	1	74	100	10
2.78	3.60	32.51	1	75	100	10

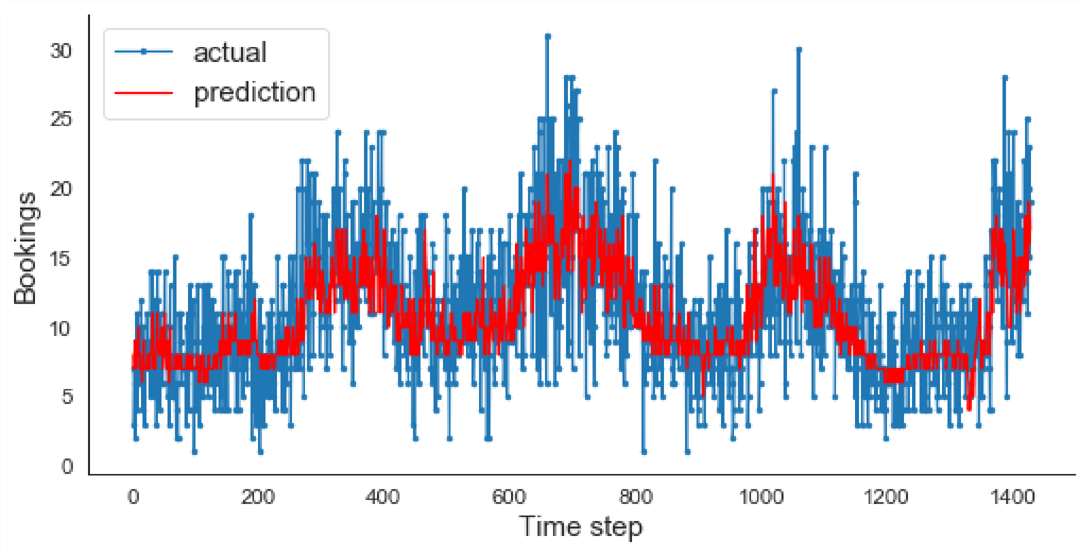
11.27	12.28	100.00	1	76	100	10
2.74	3.55	31.95	1	77	100	10
2.79	3.62	32.74	1	78	100	10
11.27	12.28	100.00	1	79	100	10
11.27	12.28	100.00	1	80	100	10
11.27	12.28	100.00	1	81	100	10
2.74	3.54	32.22	1	82	100	10
11.27	12.28	100.00	1	83	100	10
2.75	3.57	32.05	1	84	100	10
2.75	3.57	32.41	1	85	100	10
11.27	12.28	100.00	1	86	100	10
11.27	12.28	100.00	1	87	100	10
2.76	3.59	32.19	1	88	100	10
11.27	12.28	100.00	1	89	100	10
2.74	3.56	32.11	1	90	100	10
2.73	3.54	31.91	1	91	100	10
2.74	3.56	32.16	1	92	100	10
2.75	3.56	32.23	1	93	100	10
2.74	3.55	32.13	1	94	100	10
2.75	3.56	32.16	1	95	100	10
2.73	3.55	31.99	1	96	100	10
2.74	3.54	32.03	1	97	100	10
11.27	12.28	100.00	1	98	100	10
2.75	3.57	32.26	1	99	100	10
2.74	3.57	32.01	1	100	100	10

4th Step: Seeds

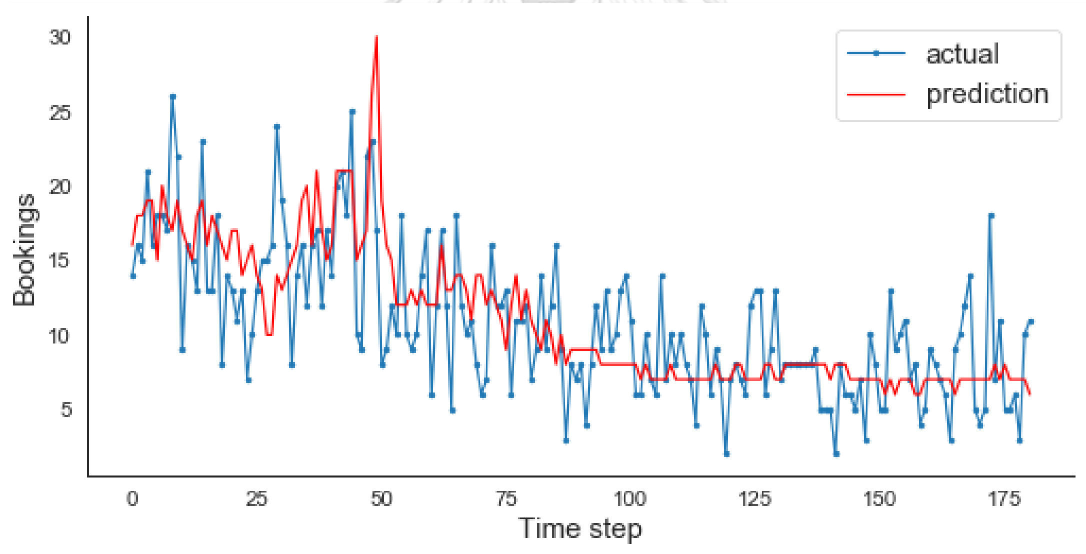
MAE	**RMSE**	**%MAPE**	**Seeds**	**Hidden Units**	**Epochs**	**Batch Size**
2.73	3.54	31.91	1	91	100	10
2.95	3.71	38.98	2	91	100	10
2.78	3.55	35.44	3	91	100	10
11.27	12.28	100.00	4	91	100	10
11.27	12.28	100.00	5	91	100	10
2.83	3.68	32.17	6	91	100	10
11.27	12.28	100.00	7	91	100	10
11.27	12.28	100.00	8	91	100	10
2.75	3.54	33.15	9	91	100	10
2.76	3.59	32.18	10	91	100	10
11.27	12.28	100.00	11	91	100	10
2.75	3.55	33.01	12	91	100	10
2.82	3.59	36.00	13	91	100	10
2.81	3.65	32.30	14	91	100	10
2.77	3.55	34.67	15	91	100	10
2.88	3.66	36.86	16	91	100	10

11.27	12.28	100.00	17	91	100	10
11.27	12.28	100.00	18	91	100	10
2.91	3.67	38.59	19	91	100	10
11.27	12.28	100.00	20	91	100	10
11.27	12.28	100.00	21	91	100	10
2.77	3.59	33.52	22	91	100	10
11.27	12.28	100.00	23	91	100	10
2.77	3.58	33.12	24	91	100	10
11.27	12.28	100.00	25	91	100	10
2.75	3.56	32.31	26	91	100	10
2.81	3.56	35.88	27	91	100	10
11.27	12.28	100.00	28	91	100	10
11.27	12.28	100.00	29	91	100	10
11.27	12.28	100.00	30	91	100	10
2.80	3.63	32.53	31	91	100	10
2.76	3.54	33.50	32	91	100	10
11.27	12.28	100.00	33	91	100	10
2.74	3.51	33.93	34	91	100	10
2.80	3.61	34.22	35	91	100	10
2.73	3.50	33.30	36	91	100	10
2.75	3.53	34.60	37	91	100	10
2.82	3.67	31.92	38	91	100	10
2.74	3.52	33.97	39	91	100	10
11.27	12.28	100.00	40	91	100	10
2.79	3.56	35.62	41	91	100	10
2.74	3.53	33.09	42	91	100	10
2.82	3.59	36.52	43	91	100	10
2.76	3.54	33.99	44	91	100	10
11.27	12.28	100.00	45	91	100	10
2.77	3.60	32.79	46	91	100	10
2.77	3.53	35.59	47	91	100	10
2.84	3.61	37.01	48	91	100	10
11.27	12.28	100.00	49	91	100	10
2.78	3.55	34.80	50	91	100	10
2.76	3.57	33.57	51	91	100	10
2.73	3.52	33.01	52	91	100	10
11.27	12.28	100.00	53	91	100	10
11.27	12.28	100.00	54	91	100	10
11.27	12.28	100.00	55	91	100	10
11.27	12.28	100.00	56	91	100	10
2.80	3.57	35.17	57	91	100	10
11.27	12.28	100.00	58	91	100	10
11.27	12.28	100.00	59	91	100	10
2.88	3.65	37.27	60	91	100	10

11.27	12.28	100.00	61	91	100	10
2.84	3.60	36.95	62	91	100	10
11.27	12.28	100.00	63	91	100	10
2.78	3.54	34.70	64	91	100	10
11.27	12.28	100.00	65	91	100	10
2.75	3.51	34.72	66	91	100	10
2.78	3.59	33.13	67	91	100	10
2.76	3.57	32.64	68	91	100	10
11.27	12.28	100.00	69	91	100	10
2.74	3.50	34.33	70	91	100	10
11.27	12.28	100.00	71	91	100	10
2.78	3.53	35.68	72	91	100	10
2.81	3.66	32.08	73	91	100	10
2.93	3.82	32.29	74	91	100	10
11.27	12.28	100.00	75	91	100	10
2.78	3.58	33.76	76	91	100	10
2.77	3.57	33.05	77	91	100	10
2.78	3.56	34.70	78	91	100	10
2.77	3.57	33.76	79	91	100	10
2.85	3.70	32.24	80	91	100	10
11.27	12.28	100.00	81	91	100	10
2.78	3.56	35.05	82	91	100	10
2.78	3.55	34.99	83	91	100	10
2.79	3.56	35.57	84	91	100	10
2.81	3.59	35.03	85	91	100	10
11.27	12.28	100.00	86	91	100	10
11.27	12.28	100.00	87	91	100	10
11.27	12.28	100.00	88	91	100	10
2.76	3.59	32.49	89	91	100	10
2.77	3.59	33.20	90	91	100	10
2.76	3.53	34.15	91	91	100	10
2.75	3.53	34.36	92	91	100	10
2.73	3.50	34.04	93	91	100	10
11.27	12.28	100.00	94	91	100	10
11.27	12.28	100.00	95	91	100	10
2.76	3.55	33.96	96	91	100	10
2.94	3.70	38.85	97	91	100	10
11.27	12.28	100.00	98	91	100	10
11.27	12.28	100.00	99	91	100	10
11.27	12.28	100.00	100	91	100	10



The daily booking forecasting with training set using ANN model 4



The daily booking forecasting with cross validation set using ANN model 4

Daily ANN Model 5:

2 Layers with Activation Functions $a^{(2)}$ = ReLU, $a^{(3)}$ = Sigmoid, $a^{(4)}$ = ReLU

1st Step: Batch Size

MAE	RMSE	%MAPE	Seeds	Hidden Units	Epochs	Batch Size	Average %MAPE
11.27	12.28	100.00	1	30	100	10	
2.37	3.06	27.54	1	50	100	10	
2.29	2.97	26.49	1	70	100	10	
2.20	2.85	25.40	1	100	100	10	44.86
11.27	12.28	100.00	1	30	100	32	
2.55	3.33	29.16	1	50	100	32	
2.47	3.21	28.45	1	70	100	32	
2.40	3.11	29.25	1	100	100	32	46.72
11.27	12.28	100.00	1	30	100	64	
2.74	3.59	31.53	1	50	100	64	
2.64	3.41	31.47	1	70	100	64	
2.56	3.32	31.15	1	100	100	64	48.54
11.27	12.28	100.00	1	30	100	128	
2.97	3.80	37.18	1	50	100	128	
2.93	3.76	36.79	1	70	100	128	
2.87	3.67	35.93	1	100	100	128	52.48

2nd Step: Epochs

MAE	RMSE	%MAPE	Seeds	Hidden Units	Epochs	Batch Size	Average %MAPE
11.27	12.28	100.00	1	30	10	10	
3.05	3.95	34.68	1	50	10	10	
3.00	3.90	33.78	1	70	10	10	
3.00	3.91	33.51	1	100	10	10	50.49
11.27	12.28	100.00	1	30	40	10	
2.79	3.54	36.02	1	50	40	10	
2.67	3.41	34.21	1	70	40	10	
2.61	3.32	33.05	1	100	40	10	50.82
11.27	12.28	100.00	1	30	70	10	
2.46	3.18	30.31	1	50	70	10	
2.39	3.07	29.00	1	70	70	10	
2.37	3.03	29.05	1	100	70	10	47.09
11.27	12.28	100.00	1	30	100	10	
2.37	3.06	27.54	1	50	100	10	
2.29	2.97	26.49	1	70	100	10	
2.20	2.85	25.40	1	100	100	10	44.86

3rd Step: Hidden Units

MAE	RMSE	%MAPE	Seeds	Hidden Units	Epochs	Batch Size
2.87	3.71	34.17	1	5	100	10

2.83	3.68	33.70	1	6	100	10
11.27	12.28	100.00	1	7	100	10
11.27	12.28	100.00	1	8	100	10
11.27	12.28	100.00	1	9	100	10
11.27	12.28	100.00	1	10	100	10
11.27	12.28	100.00	1	11	100	10
11.27	12.28	100.00	1	12	100	10
2.68	3.48	31.31	1	13	100	10
2.69	3.50	31.52	1	14	100	10
2.74	3.56	32.27	1	15	100	10
2.65	3.45	30.54	1	16	100	10
2.66	3.48	31.03	1	17	100	10
11.27	12.28	100.00	1	18	100	10
11.27	12.28	100.00	1	19	100	10
11.27	12.28	100.00	1	20	100	10
11.27	12.28	100.00	1	21	100	10
2.55	3.31	29.82	1	22	100	10
2.56	3.32	30.37	1	23	100	10
2.54	3.32	28.92	1	24	100	10
2.50	3.26	28.78	1	25	100	10
11.27	12.28	100.00	1	26	100	10
11.27	12.28	100.00	1	27	100	10
11.27	12.28	100.00	1	28	100	10
11.27	12.28	100.00	1	29	100	10
11.27	12.28	100.00	1	30	100	10
2.49	3.21	29.70	1	31	100	10
2.43	3.16	27.74	1	32	100	10
2.48	3.22	29.02	1	33	100	10
2.48	3.23	28.74	1	34	100	10
2.51	3.24	28.79	1	35	100	10
2.40	3.11	28.07	1	36	100	10
2.52	3.27	29.43	1	37	100	10
2.38	3.11	27.47	1	38	100	10
2.47	3.22	28.59	1	39	100	10
2.49	3.21	28.57	1	40	100	10
2.38	3.10	27.67	1	41	100	10
2.37	3.07	27.74	1	42	100	10
2.44	3.14	29.00	1	43	100	10
2.41	3.10	28.27	1	44	100	10
2.33	3.01	27.53	1	45	100	10
2.39	3.10	27.63	1	46	100	10
2.38	3.09	27.63	1	47	100	10
2.35	3.05	27.54	1	48	100	10
2.37	3.09	27.38	1	49	100	10

2.37	3.06	27.54	1	50	100	10
2.37	3.08	27.15	1	51	100	10
2.36	3.05	27.25	1	52	100	10
2.39	3.09	27.35	1	53	100	10
2.37	3.08	27.45	1	54	100	10
2.36	3.04	27.79	1	55	100	10
2.32	3.00	26.73	1	56	100	10
2.37	3.08	27.71	1	57	100	10
2.29	2.96	27.20	1	58	100	10
2.33	3.02	27.09	1	59	100	10
2.33	3.04	27.09	1	60	100	10
2.27	2.98	27.25	1	61	100	10
2.31	2.99	26.53	1	62	100	10
2.34	3.03	26.89	1	63	100	10
2.27	2.94	26.40	1	64	100	10
2.29	2.99	26.04	1	65	100	10
2.31	3.00	27.12	1	66	100	10
2.29	2.96	26.29	1	67	100	10
2.29	2.96	26.59	1	68	100	10
2.33	3.02	26.71	1	69	100	10
2.29	2.97	26.49	1	70	100	10
2.35	3.04	26.83	1	71	100	10
2.30	2.98	26.78	1	72	100	10
2.28	2.95	26.44	1	73	100	10
2.33	3.03	26.99	1	74	100	10
2.26	2.95	25.90	1	75	100	10
2.35	3.02	27.07	1	76	100	10
2.34	3.03	26.58	1	77	100	10
2.29	2.96	26.11	1	78	100	10
2.28	2.97	26.28	1	79	100	10
2.28	2.95	26.08	1	80	100	10
2.26	2.92	25.84	1	81	100	10
2.30	3.00	26.37	1	82	100	10
2.33	3.01	27.23	1	83	100	10
2.25	2.92	25.66	1	84	100	10
2.30	2.95	26.70	1	85	100	10
2.20	2.86	25.51	1	86	100	10
2.24	2.92	26.10	1	87	100	10
2.26	2.92	26.66	1	88	100	10
2.17	2.83	25.78	1	89	100	10
2.24	2.91	25.60	1	90	100	10
2.25	2.92	25.81	1	91	100	10
2.22	2.87	25.81	1	92	100	10
2.22	2.86	26.00	1	93	100	10

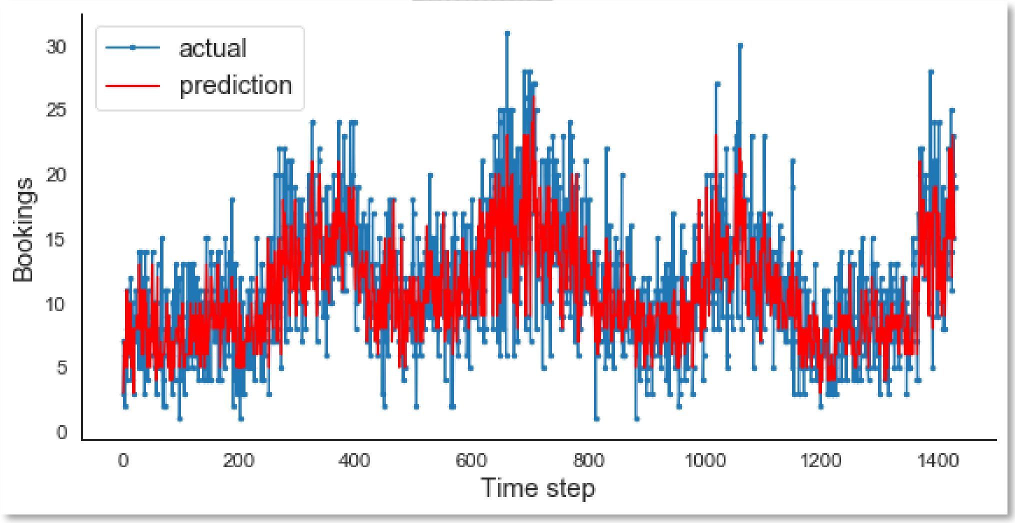
2.24	2.90	25.75	1	94	100	10
2.24	2.91	25.16	1	95	100	10
2.22	2.91	25.02	1	96	100	10
2.22	2.89	25.26	1	97	100	10
2.20	2.86	25.77	1	98	100	10
2.14	2.81	24.16	1	99	100	10
2.20	2.85	25.40	1	100	100	10

4th Step: Seeds

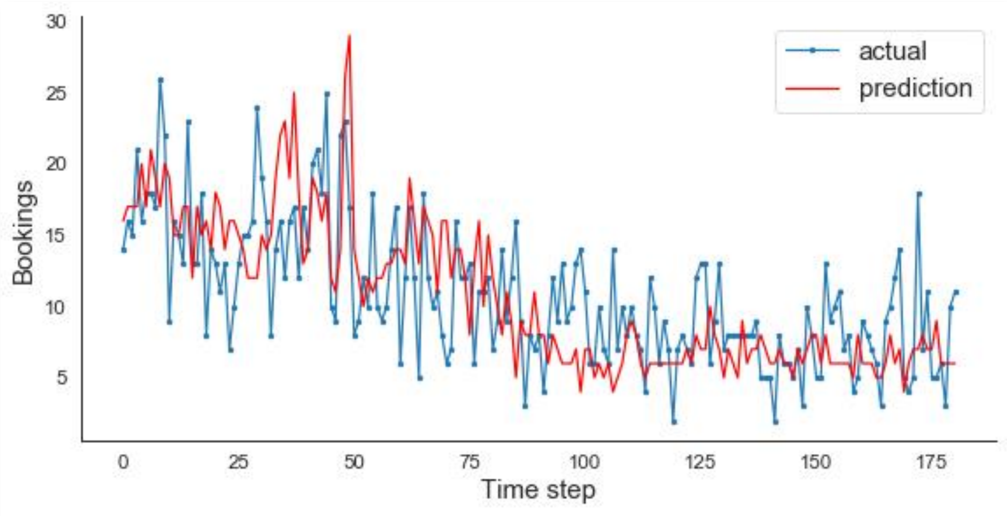
MAE	RMSE	%MAPE	Seeds	Hidden Units	Epochs	Batch Size
2.14	2.81	24.16	1	99	100	10
11.27	12.28	100.00	2	99	100	10
2.26	2.93	27.42	3	99	100	10
2.18	2.84	26.59	4	99	100	10
2.27	2.93	25.72	5	99	100	10
2.46	3.19	25.67	6	99	100	10
2.22	2.90	24.92	7	99	100	10
11.27	12.28	100.00	8	99	100	10
2.26	2.92	26.39	9	99	100	10
2.36	3.10	25.06	10	99	100	10
11.27	12.28	100.00	11	99	100	10
2.23	2.89	27.24	12	99	100	10
2.30	2.99	28.64	13	99	100	10
2.38	3.10	25.42	14	99	100	10
11.27	12.28	100.00	15	99	100	10
11.27	12.28	100.00	16	99	100	10
11.27	12.28	100.00	17	99	100	10
11.27	12.28	100.00	18	99	100	10
2.22	2.89	27.32	19	99	100	10
11.27	12.28	100.00	20	99	100	10
2.35	3.00	25.75	21	99	100	10
2.21	2.87	25.89	22	99	100	10
2.28	2.96	25.55	23	99	100	10
11.27	12.28	100.00	24	99	100	10
11.27	12.28	100.00	25	99	100	10
11.27	12.28	100.00	26	99	100	10
2.21	2.85	27.71	27	99	100	10
11.27	12.28	100.00	28	99	100	10
2.23	2.90	25.70	29	99	100	10
11.27	12.28	100.00	30	99	100	10
2.31	3.03	25.66	31	99	100	10
2.22	2.87	25.35	32	99	100	10
11.27	12.28	100.00	33	99	100	10
2.15	2.80	25.33	34	99	100	10

2.30	3.00	25.97	35	99	100	10
2.22	2.88	27.24	36	99	100	10
2.24	2.93	25.50	37	99	100	10
2.33	3.04	25.36	38	99	100	10
2.22	2.88	26.95	39	99	100	10
11.27	12.28	100.00	40	99	100	10
2.31	2.96	28.23	41	99	100	10
2.27	2.93	25.72	42	99	100	10
2.18	2.85	25.61	43	99	100	10
2.23	2.87	26.96	44	99	100	10
11.27	12.28	100.00	45	99	100	10
11.27	12.28	100.00	46	99	100	10
2.21	2.85	27.24	47	99	100	10
2.20	2.85	25.61	48	99	100	10
11.27	12.28	100.00	49	99	100	10
2.23	2.91	26.32	50	99	100	10
11.27	12.28	100.00	51	99	100	10
11.27	12.28	100.00	52	99	100	10
11.27	12.28	100.00	53	99	100	10
11.27	12.28	100.00	54	99	100	10
2.23	2.88	27.49	55	99	100	10
2.34	2.99	30.03	56	99	100	10
2.20	2.85	25.70	57	99	100	10
11.27	12.28	100.00	58	99	100	10
11.27	12.28	100.00	59	99	100	10
2.22	2.89	27.39	60	99	100	10
11.27	12.28	100.00	61	99	100	10
11.27	12.28	100.00	62	99	100	10
11.27	12.28	100.00	63	99	100	10
2.27	2.92	26.62	64	99	100	10
2.25	2.94	24.83	65	99	100	10
11.27	12.28	100.00	66	99	100	10
2.25	2.91	25.98	67	99	100	10
2.28	2.97	26.25	68	99	100	10
11.27	12.28	100.00	69	99	100	10
2.23	2.90	28.39	70	99	100	10
2.21	2.85	26.99	71	99	100	10
2.30	2.98	26.83	72	99	100	10
2.19	2.87	24.16	73	99	100	10
2.55	3.32	25.46	74	99	100	10
11.27	12.28	100.00	75	99	100	10
11.27	12.28	100.00	76	99	100	10
2.17	2.83	25.82	77	99	100	10
2.26	2.92	27.62	78	99	100	10

2.21	2.88	26.74	79	99	100	10
2.26	2.95	25.48	80	99	100	10
2.30	3.01	25.44	81	99	100	10
2.26	2.91	27.73	82	99	100	10
2.31	2.96	29.11	83	99	100	10
2.21	2.87	28.07	84	99	100	10
2.19	2.84	25.99	85	99	100	10
11.27	12.28	100.00	86	99	100	10
11.27	12.28	100.00	87	99	100	10
11.27	12.28	100.00	88	99	100	10
2.23	2.87	27.14	89	99	100	10
2.40	3.13	25.29	90	99	100	10
11.27	12.28	100.00	91	99	100	10
2.16	2.82	26.15	92	99	100	10
2.22	2.87	27.12	93	99	100	10
11.27	12.28	100.00	94	99	100	10
11.27	12.28	100.00	95	99	100	10
2.23	2.90	25.96	96	99	100	10
11.27	12.28	100.00	97	99	100	10
11.27	12.28	100.00	98	99	100	10
2.31	2.99	25.13	99	99	100	10
11.27	12.28	100.00	100	99	100	10



The daily booking forecasting with training set using ANN model 5



The daily booking forecasting with cross validation set using ANN model 5

Daily ANN Model 6:

2 Layers with Activation Functions $a^{(2)}$ = Sigmoid, $a^{(3)}$ = Sigmoid, $a^{(4)}$ = ReLU

1st Step: Batch Size

MAE	**RMSE**	**%MAPE**	**Seeds**	**Hidden Units**	**Epochs**	**Batch Size**	**Average %MAPE**
11.27	12.28	100.00	1	30	100	10	
2.80	3.62	33.16	1	50	100	10	
2.76	3.57	32.97	1	70	100	10	
2.76	3.57	32.78	1	100	100	10	49.73
11.27	12.28	100.00	1	30	100	32	
2.92	3.74	35.39	1	50	100	32	
2.88	3.69	35.06	1	70	100	32	
2.87	3.68	34.34	1	100	100	32	51.20
11.27	12.28	100.00	1	30	100	64	
3.08	3.91	38.61	1	50	100	64	
3.00	3.81	37.29	1	70	100	64	
2.94	3.80	34.68	1	100	100	64	52.65
11.27	12.28	100.00	1	30	100	128	
3.50	4.51	43.52	1	50	100	128	
3.14	4.01	39.11	1	70	100	128	
3.09	3.91	38.60	1	100	100	128	55.31

2nd Step: Epochs

MAE	**RMSE**	**%MAPE**	**Seeds**	**Hidden Units**	**Epochs**	**Batch Size**	**Average %MAPE**
11.27	12.28	100.00	1	30	10	10	

3.49	4.51	43.22	1	50	10	10	
3.23	4.17	38.61	1	70	10	10	
3.14	4.06	36.86	1	100	10	10	54.67
11.27	12.28	100.00	1	30	40	10	
3.02	3.82	38.81	1	50	40	10	
3.06	3.85	40.00	1	70	40	10	
3.09	3.86	40.92	1	100	40	10	54.93
11.27	12.28	100.00	1	30	70	10	
2.88	3.68	35.57	1	50	70	10	
2.84	3.63	34.95	1	70	70	10	
2.82	3.61	34.69	1	100	70	10	51.30
11.27	12.28	100.00	1	30	100	10	
2.80	3.62	33.16	1	50	100	10	
2.76	3.57	32.97	1	70	100	10	
2.76	3.57	32.78	1	100	100	10	49.73

3rd Step: Hidden Units

MAE	**RMSE**	**%MAPE**	**Seeds**	**Hidden Units**	**Epochs**	**Batch Size**
2.98	3.82	35.82	1	5	100	10
11.27	12.28	100.00	1	6	100	10
11.27	12.28	100.00	1	7	100	10
11.27	12.28	100.00	1	8	100	10
11.27	12.28	100.00	1	9	100	10
11.27	12.28	100.00	1	10	100	10
11.27	12.28	100.00	1	11	100	10
11.27	12.28	100.00	1	12	100	10
2.91	3.75	34.95	1	13	100	10
11.27	12.28	100.00	1	14	100	10
2.89	3.72	34.42	1	15	100	10
2.92	3.76	34.93	1	16	100	10
2.85	3.68	33.95	1	17	100	10
11.27	12.28	100.00	1	18	100	10
11.27	12.28	100.00	1	19	100	10
11.27	12.28	100.00	1	20	100	10
11.27	12.28	100.00	1	21	100	10
2.90	3.74	34.50	1	22	100	10
11.27	12.28	100.00	1	23	100	10
2.87	3.70	34.05	1	24	100	10
11.27	12.28	100.00	1	25	100	10
11.27	12.28	100.00	1	26	100	10
11.27	12.28	100.00	1	27	100	10
11.27	12.28	100.00	1	28	100	10
11.27	12.28	100.00	1	29	100	10
11.27	12.28	100.00	1	30	100	10

2.84	3.67	33.76	1	31	100	10
2.83	3.65	33.56	1	32	100	10
2.83	3.65	33.62	1	33	100	10
2.82	3.64	33.47	1	34	100	10
2.83	3.65	33.55	1	35	100	10
2.83	3.64	33.47	1	36	100	10
2.82	3.64	33.44	1	37	100	10
2.81	3.63	33.37	1	38	100	10
2.82	3.63	33.27	1	39	100	10
2.81	3.64	33.22	1	40	100	10
2.80	3.62	33.17	1	41	100	10
2.82	3.64	33.36	1	42	100	10
2.82	3.65	33.41	1	43	100	10
2.81	3.63	33.26	1	44	100	10
2.81	3.63	33.22	1	45	100	10
2.80	3.62	33.23	1	46	100	10
2.81	3.62	33.26	1	47	100	10
2.82	3.63	33.33	1	48	100	10
2.79	3.61	32.93	1	49	100	10
2.80	3.62	33.16	1	50	100	10
2.80	3.62	33.14	1	51	100	10
2.80	3.62	33.21	1	52	100	10
2.80	3.61	33.23	1	53	100	10
2.79	3.60	33.06	1	54	100	10
2.79	3.61	32.98	1	55	100	10
11.27	12.28	100.00	1	56	100	10
11.27	12.28	100.00	1	57	100	10
2.79	3.60	32.96	1	58	100	10
2.79	3.61	33.16	1	59	100	10
2.78	3.58	33.00	1	60	100	10
2.78	3.59	32.88	1	61	100	10
2.80	3.62	33.06	1	62	100	10
2.78	3.59	33.00	1	63	100	10
2.79	3.62	33.05	1	64	100	10
2.79	3.60	33.08	1	65	100	10
2.78	3.59	32.98	1	66	100	10
2.79	3.61	32.91	1	67	100	10
2.80	3.61	33.18	1	68	100	10
2.79	3.59	33.09	1	69	100	10
2.76	3.57	32.97	1	70	100	10
2.77	3.59	32.83	1	71	100	10
2.79	3.61	33.08	1	72	100	10
2.78	3.59	33.02	1	73	100	10
2.78	3.60	32.90	1	74	100	10

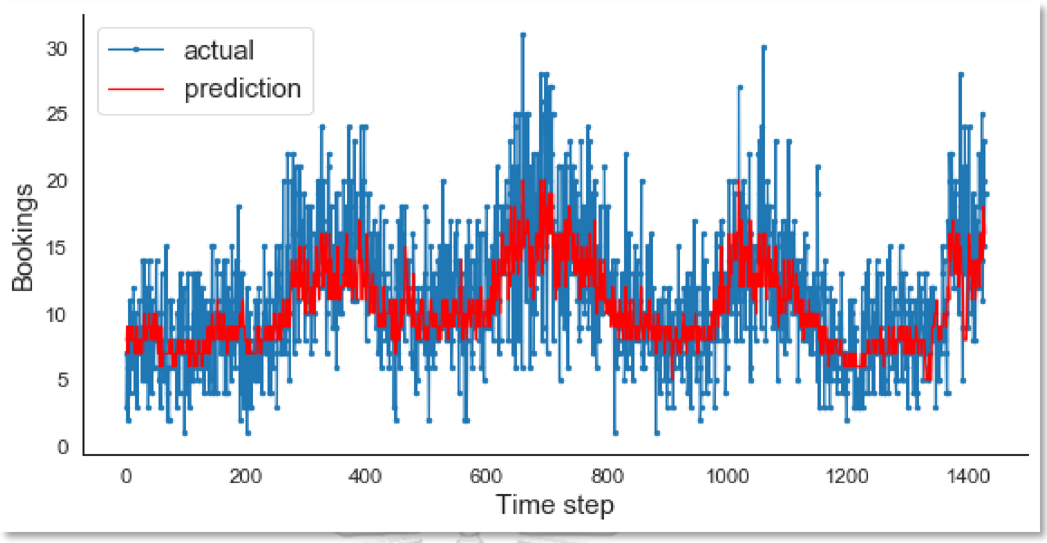
2.77	3.57	32.97	1	75	100	10
11.27	12.28	100.00	1	76	100	10
2.78	3.60	33.00	1	77	100	10
2.77	3.58	32.92	1	78	100	10
11.27	12.28	100.00	1	79	100	10
2.77	3.58	32.93	1	80	100	10
2.77	3.57	32.89	1	81	100	10
2.75	3.57	32.68	1	82	100	10
2.78	3.58	32.92	1	83	100	10
2.77	3.59	32.91	1	84	100	10
2.78	3.59	32.82	1	85	100	10
2.75	3.56	32.75	1	86	100	10
11.27	12.28	100.00	1	87	100	10
2.76	3.56	32.81	1	88	100	10
2.77	3.59	32.84	1	89	100	10
2.76	3.57	32.69	1	90	100	10
2.76	3.58	32.73	1	91	100	10
2.77	3.58	32.76	1	92	100	10
2.75	3.55	32.67	1	93	100	10
2.77	3.58	32.86	1	94	100	10
2.75	3.56	32.71	1	95	100	10
2.75	3.55	32.73	1	96	100	10
2.76	3.57	32.73	1	97	100	10
2.75	3.56	32.78	1	98	100	10
2.75	3.55	32.62	1	99	100	10
2.76	3.57	32.78	1	100	100	10

4th Step: Seeds

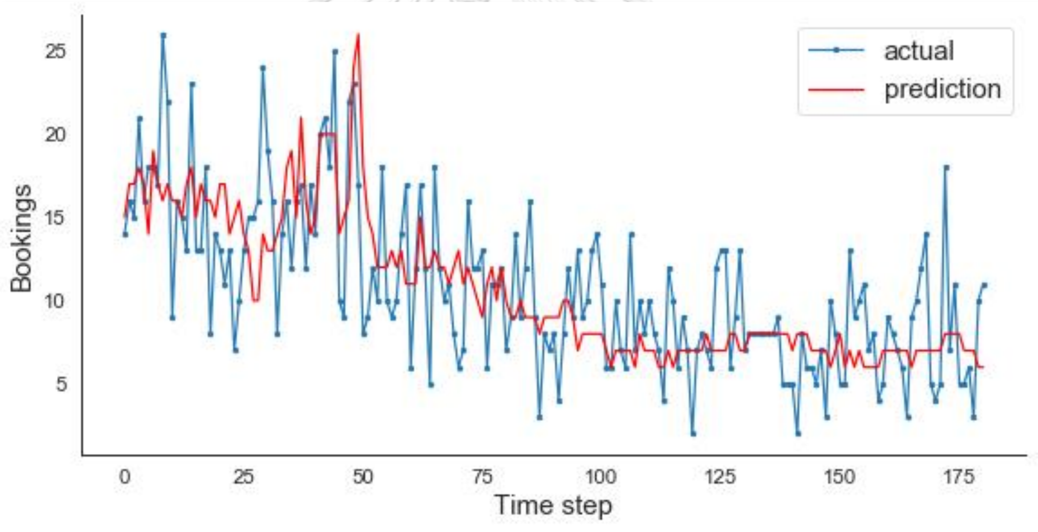
MAE	**RMSE**	**%MAPE**	**Seeds**	**Hidden Units**	**Epochs**	**Batch Size**
2.75	3.55	32.62	1	99	100	10
11.27	12.28	100.00	2	99	100	10
2.85	3.61	36.85	3	99	100	10
11.27	12.28	100.00	4	99	100	10
11.27	12.28	100.00	5	99	100	10
2.76	3.58	32.30	6	99	100	10
2.77	3.58	32.65	7	99	100	10
11.27	12.28	100.00	8	99	100	10
2.75	3.54	33.64	9	99	100	10
2.76	3.57	32.67	10	99	100	10
11.27	12.28	100.00	11	99	100	10
11.27	12.28	100.00	12	99	100	10
2.85	3.61	36.65	13	99	100	10
2.77	3.58	33.18	14	99	100	10
11.27	12.28	100.00	15	99	100	10

11.27	12.28	100.00	16	99	100	10
11.27	12.28	100.00	17	99	100	10
11.27	12.28	100.00	18	99	100	10
2.86	3.63	36.99	19	99	100	10
11.27	12.28	100.00	20	99	100	10
2.75	3.57	32.43	21	99	100	10
2.77	3.58	32.97	22	99	100	10
2.77	3.57	33.22	23	99	100	10
11.27	12.28	100.00	24	99	100	10
11.27	12.28	100.00	25	99	100	10
11.27	12.28	100.00	26	99	100	10
2.81	3.58	35.92	27	99	100	10
11.27	12.28	100.00	28	99	100	10
11.27	12.28	100.00	29	99	100	10
11.27	12.28	100.00	30	99	100	10
2.81	3.66	32.37	31	99	100	10
2.76	3.55	33.64	32	99	100	10
11.27	12.28	100.00	33	99	100	10
2.79	3.56	34.77	34	99	100	10
11.27	12.28	100.00	35	99	100	10
2.77	3.56	33.65	36	99	100	10
2.77	3.54	34.38	37	99	100	10
2.76	3.57	33.13	38	99	100	10
2.78	3.55	34.73	39	99	100	10
11.27	12.28	100.00	40	99	100	10
2.79	3.56	34.81	41	99	100	10
2.77	3.55	33.91	42	99	100	10
2.80	3.58	35.53	43	99	100	10
2.79	3.57	34.45	44	99	100	10
11.27	12.28	100.00	45	99	100	10
11.27	12.28	100.00	46	99	100	10
2.80	3.57	35.67	47	99	100	10
11.27	12.28	100.00	48	99	100	10
11.27	12.28	100.00	49	99	100	10
2.79	3.56	34.91	50	99	100	10
11.27	12.28	100.00	51	99	100	10
11.27	12.28	100.00	52	99	100	10
11.27	12.28	100.00	53	99	100	10
11.27	12.28	100.00	54	99	100	10
11.27	12.28	100.00	55	99	100	10
2.80	3.57	35.81	56	99	100	10
2.77	3.54	35.08	57	99	100	10
11.27	12.28	100.00	58	99	100	10
11.27	12.28	100.00	59	99	100	10

2.88	3.65	37.46	60	99	100	10
11.27	12.28	100.00	61	99	100	10
11.27	12.28	100.00	62	99	100	10
11.27	12.28	100.00	63	99	100	10
11.27	12.28	100.00	64	99	100	10
11.27	12.28	100.00	65	99	100	10
11.27	12.28	100.00	66	99	100	10
2.75	3.56	33.23	67	99	100	10
2.75	3.57	32.62	68	99	100	10
11.27	12.28	100.00	69	99	100	10
2.78	3.56	34.17	70	99	100	10
2.80	3.65	32.08	71	99	100	10
2.81	3.58	35.73	72	99	100	10
2.82	3.69	31.76	73	99	100	10
2.83	3.69	31.77	74	99	100	10
11.27	12.28	100.00	75	99	100	10
11.27	12.28	100.00	76	99	100	10
2.77	3.57	33.32	77	99	100	10
2.79	3.56	35.08	78	99	100	10
2.76	3.58	32.69	79	99	100	10
2.76	3.58	32.56	80	99	100	10
11.27	12.28	100.00	81	99	100	10
2.77	3.56	33.85	82	99	100	10
2.79	3.56	34.81	83	99	100	10
2.77	3.56	34.14	84	99	100	10
2.78	3.55	34.91	85	99	100	10
11.27	12.28	100.00	86	99	100	10
11.27	12.28	100.00	87	99	100	10
11.27	12.28	100.00	88	99	100	10
2.76	3.59	32.27	89	99	100	10
2.76	3.56	33.09	90	99	100	10
11.27	12.28	100.00	91	99	100	10
11.27	12.28	100.00	92	99	100	10
2.78	3.56	34.59	93	99	100	10
11.27	12.28	100.00	94	99	100	10
11.27	12.28	100.00	95	99	100	10
2.80	3.56	35.19	96	99	100	10
11.27	12.28	100.00	97	99	100	10
11.27	12.28	100.00	98	99	100	10
2.77	3.58	32.78	99	99	100	10
11.27	12.28	100.00	100	99	100	10



The daily booking forecasting with training set using ANN model 6



The daily booking forecasting with cross validation set using ANN model 6

Monthly ANN Model 1:

1 Layer with Activation Functions $a^{(2)}$ = RelU and $a^{(3)}$ = ReLU

1st Step: Batch Size

MAE	RMSE	MAPE	Seeds	Hidden Units	Epochs	Batch Size	Average MAPE
28.00	38.02	8.25	1	30	1000	10	
26.54	35.74	7.87	1	50	1000	10	
25.59	34.14	7.58	1	70	1000	10	
25.00	33.47	7.40	1	100	1000	10	7.77
44.43	56.00	13.17	1	30	1000	32	
38.35	49.90	11.25	1	50	1000	32	
35.13	46.54	10.35	1	70	1000	32	
33.00	44.20	9.73	1	100	1000	32	11.13
185.33	192.28	54.05	1	30	1000	64	
134.98	142.43	39.59	1	50	1000	64	
78.72	90.36	23.51	1	70	1000	64	
51.22	64.15	15.47	1	100	1000	64	33.16
185.33	192.28	54.05	1	30	1000	128	
134.98	142.43	39.59	1	50	1000	128	
78.72	90.36	23.51	1	70	1000	128	
51.22	64.15	15.47	1	100	1000	128	33.16

2nd Step: Epochs

MAE	RMSE	MAPE	Seeds	Hidden Units	Epochs	Batch Size	Average MAPE
345.37	357.07	99.88	1	30	10	10	
344.63	356.40	99.64	1	50	10	10	
344.59	356.34	99.63	1	70	10	10	
344.11	355.82	99.50	1	100	10	10	99.66
303.17	313.45	87.73	1	30	100	10	
283.07	292.80	81.91	1	50	100	10	
263.72	272.80	76.37	1	70	100	10	
230.02	238.38	66.65	1	100	100	10	78.16
38.78	50.52	11.27	1	30	500	10	
35.33	47.03	10.29	1	50	500	10	
32.15	43.63	9.39	1	70	500	10	
30.33	41.45	8.87	1	100	500	10	9.95
28.00	38.02	8.25	1	30	1000	10	
26.54	35.74	7.87	1	50	1000	10	
25.59	34.14	7.58	1	70	1000	10	
25.00	33.47	7.40	1	100	1000	10	7.77

3rd Step: Hidden Units

MAE	RMSE	MAPE	Seeds	Hidden Units	Epochs	Batch Size
41.26	53.12	11.90	1	5	1000	10
38.35	49.96	11.10	1	6	1000	10
36.67	48.52	10.67	1	7	1000	10
35.04	46.84	10.20	1	8	1000	10
36.59	48.05	10.63	1	9	1000	10
32.52	44.00	9.45	1	10	1000	10
32.80	44.59	9.55	1	11	1000	10

32.04	43.71	9.34	1	12	1000	10
32.37	43.97	9.43	1	13	1000	10
30.54	42.02	8.93	1	14	1000	10
31.74	43.41	9.26	1	15	1000	10
30.33	41.53	8.87	1	16	1000	10
30.30	41.63	8.87	1	17	1000	10
29.35	40.16	8.62	1	18	1000	10
29.00	39.52	8.51	1	19	1000	10
29.20	39.83	8.56	1	20	1000	10
29.57	40.61	8.67	1	21	1000	10
28.98	39.59	8.50	1	22	1000	10
29.00	39.68	8.50	1	23	1000	10
28.80	39.34	8.45	1	24	1000	10
29.11	39.71	8.53	1	25	1000	10
28.09	38.06	8.25	1	26	1000	10
28.07	38.07	8.27	1	27	1000	10
28.76	39.25	8.45	1	28	1000	10
28.07	38.11	8.27	1	29	1000	10
28.00	38.02	8.25	1	30	1000	10
27.91	37.79	8.24	1	31	1000	10
27.63	37.53	8.16	1	32	1000	10
26.93	36.47	7.96	1	33	1000	10
27.37	37.26	8.09	1	34	1000	10
27.17	36.73	8.04	1	35	1000	10
27.00	36.45	8.00	1	36	1000	10
26.74	36.03	7.93	1	37	1000	10
26.83	36.15	7.95	1	38	1000	10
26.65	35.92	7.90	1	39	1000	10
26.57	35.77	7.88	1	40	1000	10
26.85	36.20	7.95	1	41	1000	10
26.63	35.74	7.89	1	42	1000	10
26.41	35.46	7.84	1	43	1000	10
26.50	35.61	7.87	1	44	1000	10
26.00	34.91	7.72	1	45	1000	10
26.15	35.12	7.76	1	46	1000	10
26.50	35.60	7.86	1	47	1000	10
26.30	35.33	7.81	1	48	1000	10
26.37	35.38	7.84	1	49	1000	10
26.54	35.74	7.87	1	50	1000	10
26.15	35.02	7.76	1	51	1000	10
26.11	34.96	7.75	1	52	1000	10
26.00	34.79	7.71	1	53	1000	10
26.09	34.93	7.74	1	54	1000	10
26.11	34.83	7.75	1	55	1000	10
25.87	34.58	7.67	1	56	1000	10
25.89	34.64	7.68	1	57	1000	10
25.91	34.60	7.68	1	58	1000	10
25.74	34.39	7.64	1	59	1000	10
26.17	35.05	7.77	1	60	1000	10
26.04	34.84	7.73	1	61	1000	10
25.76	34.41	7.64	1	62	1000	10

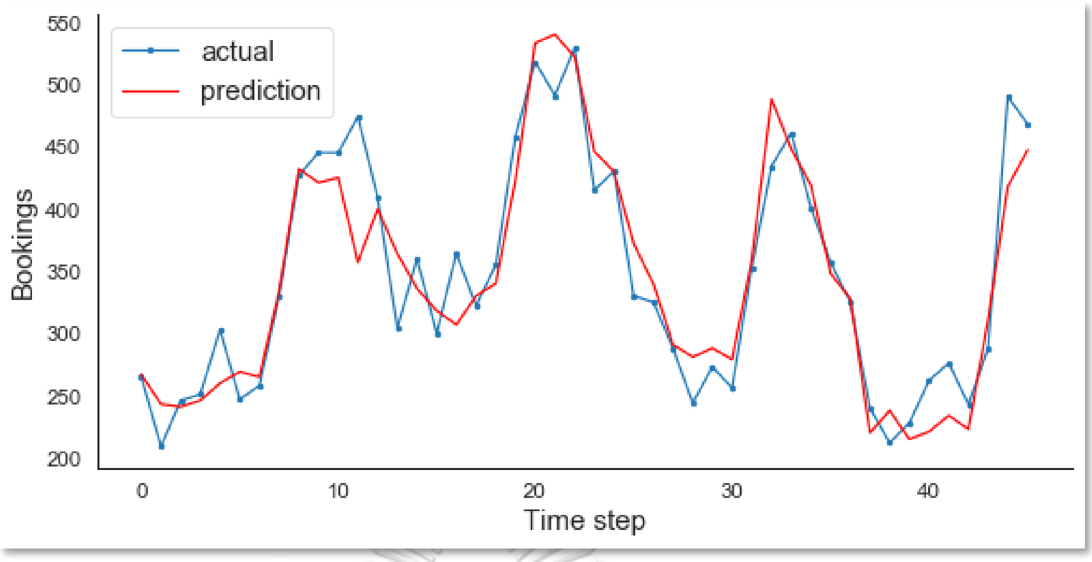
25.91	34.74	7.68	1	63	1000	10
25.85	34.63	7.66	1	64	1000	10
25.67	34.25	7.61	1	65	1000	10
25.20	33.62	7.46	1	66	1000	10
25.80	34.33	7.65	1	67	1000	10
25.93	34.59	7.69	1	68	1000	10
25.57	34.12	7.58	1	69	1000	10
25.59	34.14	7.58	1	70	1000	10
25.63	34.14	7.60	1	71	1000	10
25.30	33.86	7.50	1	72	1000	10
25.63	34.19	7.60	1	73	1000	10
25.37	33.93	7.51	1	74	1000	10
25.26	33.75	7.48	1	75	1000	10
25.35	33.90	7.51	1	76	1000	10
25.35	33.84	7.51	1	77	1000	10
25.26	33.75	7.48	1	78	1000	10
25.24	33.72	7.47	1	79	1000	10
25.17	33.66	7.46	1	80	1000	10
25.15	33.59	7.45	1	81	1000	10
25.30	33.78	7.49	1	82	1000	10
25.20	33.61	7.46	1	83	1000	10
25.07	33.51	7.43	1	84	1000	10
25.22	33.70	7.47	1	85	1000	10
25.28	33.76	7.49	1	86	1000	10
25.17	33.65	7.45	1	87	1000	10
25.13	33.58	7.44	1	88	1000	10
25.15	33.53	7.45	1	89	1000	10
25.11	33.59	7.44	1	90	1000	10
25.20	33.63	7.47	1	91	1000	10
25.00	33.40	7.41	1	92	1000	10
25.13	33.57	7.45	1	93	1000	10
25.22	33.65	7.48	1	94	1000	10
25.02	33.37	7.41	1	95	1000	10
25.09	33.47	7.44	1	96	1000	10
25.20	33.65	7.46	1	97	1000	10
24.83	33.17	7.35	1	98	1000	10
25.09	33.47	7.43	1	99	1000	10
25.00	33.47	7.40	1	100	1000	10

4th Step: Seeds

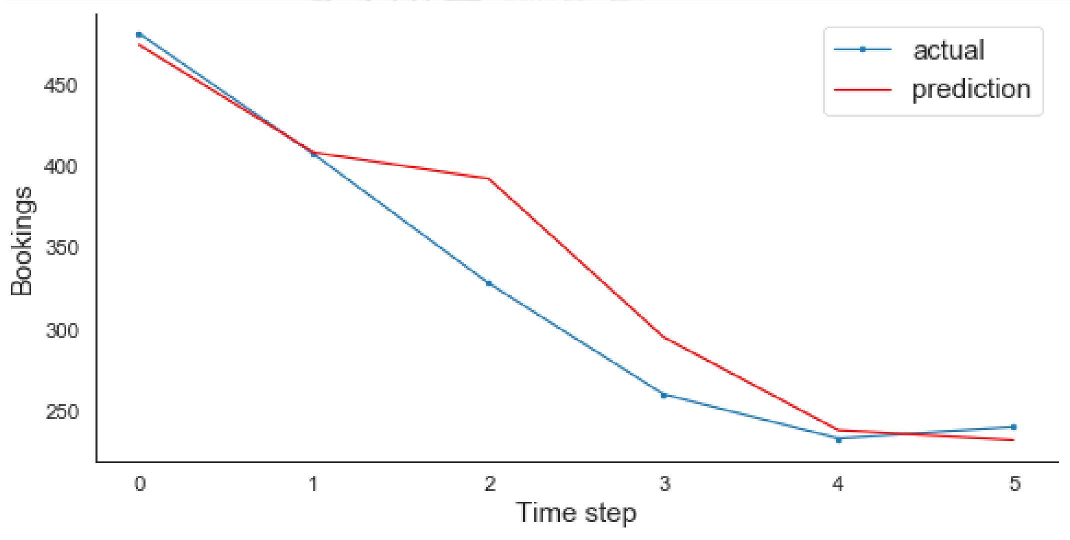
MAE	RMSE	MAPE	Seeds	Hidden Units	Epochs	Batch Size
24.83	33.17	7.35	1	98	1000	10
25.17	33.63	7.46	2	98	1000	10
25.13	33.48	7.45	3	98	1000	10
25.22	33.71	7.47	4	98	1000	10
25.07	33.36	7.43	5	98	1000	10
24.96	33.24	7.41	6	98	1000	10
25.00	33.49	7.39	7	98	1000	10
25.24	33.65	7.47	8	98	1000	10
25.11	33.52	7.45	9	98	1000	10
25.20	33.58	7.47	10	98	1000	10
25.04	33.42	7.43	11	98	1000	10

25.35	33.82	7.52	12	98	1000	10
25.24	33.61	7.48	13	98	1000	10
24.80	33.20	7.35	14	98	1000	10
25.24	33.65	7.48	15	98	1000	10
345.85	357.63	100.00	16	98	1000	10
24.89	33.26	7.39	17	98	1000	10
25.09	33.44	7.44	18	98	1000	10
25.22	33.70	7.47	19	98	1000	10
25.20	33.63	7.47	20	98	1000	10
25.28	33.76	7.49	21	98	1000	10
345.85	357.63	100.00	22	98	1000	10
24.96	33.24	7.40	23	98	1000	10
24.76	33.06	7.35	24	98	1000	10
25.02	33.45	7.42	25	98	1000	10
25.09	33.55	7.44	26	98	1000	10
25.28	33.77	7.49	27	98	1000	10
24.83	33.27	7.36	28	98	1000	10
345.85	357.63	100.00	29	98	1000	10
24.96	33.27	7.39	30	98	1000	10
25.02	33.43	7.42	31	98	1000	10
25.20	33.67	7.46	32	98	1000	10
25.02	33.39	7.41	33	98	1000	10
25.17	33.64	7.46	34	98	1000	10
25.33	33.72	7.51	35	98	1000	10
24.87	33.25	7.36	36	98	1000	10
345.85	357.63	100.00	37	98	1000	10
25.11	33.46	7.44	38	98	1000	10
25.28	33.70	7.49	39	98	1000	10
25.30	33.76	7.50	40	98	1000	10
25.11	33.59	7.43	41	98	1000	10
24.78	33.16	7.35	42	98	1000	10
345.85	357.63	100.00	43	98	1000	10
25.07	33.50	7.43	44	98	1000	10
24.96	33.38	7.40	45	98	1000	10
25.26	33.66	7.49	46	98	1000	10
25.39	33.88	7.53	47	98	1000	10
25.09	33.49	7.42	48	98	1000	10
24.61	33.03	7.30	49	98	1000	10
24.98	33.33	7.42	50	98	1000	10
24.85	33.22	7.36	51	98	1000	10
25.04	33.37	7.42	52	98	1000	10
24.91	33.20	7.39	53	98	1000	10
345.85	357.63	100.00	54	98	1000	10
24.85	33.22	7.36	55	98	1000	10
25.15	33.51	7.46	56	98	1000	10
25.09	33.40	7.43	57	98	1000	10
25.00	33.50	7.39	58	98	1000	10
25.17	33.61	7.46	59	98	1000	10
25.15	33.55	7.46	60	98	1000	10
345.85	357.63	100.00	61	98	1000	10
25.04	33.49	7.42	62	98	1000	10

25.04	33.42	7.42	63	98	1000	10
25.04	33.56	7.42	64	98	1000	10
25.07	33.39	7.43	65	98	1000	10
25.02	33.36	7.41	66	98	1000	10
345.85	357.63	100.00	67	98	1000	10
25.13	33.56	7.45	68	98	1000	10
25.04	33.36	7.43	69	98	1000	10
25.43	33.85	7.55	70	98	1000	10
25.07	33.44	7.43	71	98	1000	10
24.96	33.17	7.41	72	98	1000	10
345.85	357.63	100.00	73	98	1000	10
25.04	33.37	7.44	74	98	1000	10
24.89	33.28	7.37	75	98	1000	10
25.09	33.55	7.42	76	98	1000	10
24.96	33.28	7.40	77	98	1000	10
24.89	33.25	7.38	78	98	1000	10
24.98	33.43	7.40	79	98	1000	10
345.85	357.63	100.00	80	98	1000	10
25.33	33.76	7.52	81	98	1000	10
25.33	33.82	7.50	82	98	1000	10
25.13	33.57	7.45	83	98	1000	10
25.09	33.46	7.44	84	98	1000	10
24.98	33.36	7.40	85	98	1000	10
25.04	33.39	7.43	86	98	1000	10
345.85	357.63	100.00	87	98	1000	10
345.85	357.63	100.00	88	98	1000	10
25.22	33.58	7.47	89	98	1000	10
24.96	33.30	7.40	90	98	1000	10
25.04	33.50	7.42	91	98	1000	10
25.11	33.58	7.44	92	98	1000	10
25.22	33.60	7.48	93	98	1000	10
25.09	33.50	7.44	94	98	1000	10
25.02	33.53	7.42	95	98	1000	10
24.89	33.30	7.38	96	98	1000	10
25.09	33.42	7.45	97	98	1000	10
24.80	33.17	7.35	98	98	1000	10
25.07	33.54	7.42	99	98	1000	10
345.85	357.63	100.00	100	98	1000	10



The monthly booking forecasting with training set using ANN model 1



The monthly booking forecasting with cross validation set using ANN model 1

Monthly ANN Model 2:

1 Layer with Activation Functions $a^{(2)}$ = Sigmiod and $a^{(3)}$ = ReLU

1st Step: Batch Size

MAE	RMSE	MAPE	Seeds	Hidden Units	Epochs	Batch Size	Average MAPE
193.04	213.34	52.68	1	30	1000	10	
115.28	145.05	28.94	1	50	1000	10	
81.41	104.61	21.21	1	70	1000	10	
61.33	77.63	16.84	1	100	1000	10	29.92
278.65	292.88	79.26	1	30	1000	32	
239.04	255.23	67.06	1	50	1000	32	
202.07	220.76	55.65	1	70	1000	32	
153.09	176.50	40.57	1	100	1000	32	60.64
311.87	324.50	89.59	1	30	1000	64	
291.11	304.37	83.23	1	50	1000	64	
270.63	284.62	76.95	1	70	1000	64	
242.17	257.35	68.23	1	100	1000	64	79.50
311.87	324.50	89.59	1	30	1000	128	
291.11	304.37	83.23	1	50	1000	128	
270.63	284.62	76.95	1	70	1000	128	
242.17	257.35	68.23	1	100	1000	128	79.50

2nd Step: Epochs

MAE	RMSE	MAPE	Seeds	Hidden Units	Epochs	Batch Size	Average MAPE
343.94	355.76	99.41	1	30	10	10	
343.83	355.66	99.38	1	50	10	10	
342.85	354.73	99.07	1	70	10	10	
342.65	354.48	99.03	1	100	10	10	99.22
330.87	342.93	95.43	1	30	100	10	
322.07	334.29	92.75	1	50	100	10	
312.80	325.23	89.93	1	70	100	10	
299.67	312.39	85.93	1	100	100	10	91.01
263.50	278.55	74.55	1	30	500	10	
216.07	233.96	59.91	1	50	500	10	
172.46	194.12	46.46	1	70	500	10	
118.50	146.75	30.02	1	100	500	10	52.74
193.04	213.34	52.68	1	30	1000	10	
115.28	145.05	28.94	1	50	1000	10	
81.41	104.61	21.21	1	70	1000	10	
61.33	77.63	16.84	1	100	1000	10	29.92

3rd Step: Hidden Units

MAE	RMSE	MAPE	Seeds	Hidden Units	Epochs	Batch Size
313.85	326.78	90.09	1	5	1000	10
308.85	321.98	88.54	1	6	1000	10
303.91	317.23	87.02	1	7	1000	10
298.89	312.43	85.46	1	8	1000	10
293.85	307.63	83.89	1	9	1000	10
288.85	302.85	82.34	1	10	1000	10
283.85	298.09	80.79	1	11	1000	10

278.87	293.34	79.25	1	12	1000	10
273.89	288.61	77.71	1	13	1000	10
268.94	283.90	76.18	1	14	1000	10
264.02	279.21	74.67	1	15	1000	10
259.24	274.63	73.20	1	16	1000	10
254.89	270.64	71.83	1	17	1000	10
249.89	265.94	70.28	1	18	1000	10
244.91	261.26	68.74	1	19	1000	10
239.96	256.60	67.21	1	20	1000	10
235.07	251.99	65.71	1	21	1000	10
230.00	247.29	64.13	1	22	1000	10
225.91	243.54	62.85	1	23	1000	10
220.78	238.72	61.28	1	24	1000	10
215.96	234.32	59.77	1	25	1000	10
211.13	229.79	58.30	1	26	1000	10
206.98	226.06	56.99	1	27	1000	10
202.13	221.55	55.51	1	28	1000	10
197.30	217.09	54.03	1	29	1000	10
193.04	213.34	52.68	1	30	1000	10
188.17	208.88	51.19	1	31	1000	10
184.09	205.24	49.92	1	32	1000	10
180.04	201.65	48.66	1	33	1000	10
175.20	197.26	47.17	1	34	1000	10
171.13	193.69	45.91	1	35	1000	10
166.37	189.38	44.45	1	36	1000	10
162.17	185.80	43.13	1	37	1000	10
158.17	182.32	41.90	1	38	1000	10
154.17	178.86	40.66	1	39	1000	10
150.24	175.44	39.44	1	40	1000	10
146.39	172.08	38.27	1	41	1000	10
142.39	168.69	37.03	1	42	1000	10
138.54	165.38	35.85	1	43	1000	10
135.28	162.78	34.82	1	44	1000	10
131.61	159.50	33.73	1	45	1000	10
128.02	156.25	32.68	1	46	1000	10
125.04	153.59	31.80	1	47	1000	10
121.59	150.58	30.78	1	48	1000	10
118.20	147.50	29.80	1	49	1000	10
115.28	145.05	28.94	1	50	1000	10
112.00	142.03	28.00	1	51	1000	10
109.26	139.65	27.22	1	52	1000	10
106.11	136.78	26.33	1	53	1000	10
103.50	134.39	25.60	1	54	1000	10
101.41	132.18	25.07	1	55	1000	10
99.46	130.00	24.59	1	56	1000	10
97.46	127.57	24.12	1	57	1000	10
95.61	125.35	23.69	1	58	1000	10
93.93	123.15	23.34	1	59	1000	10
92.28	121.05	22.99	1	60	1000	10
90.80	119.03	22.69	1	61	1000	10
89.59	117.23	22.47	1	62	1000	10

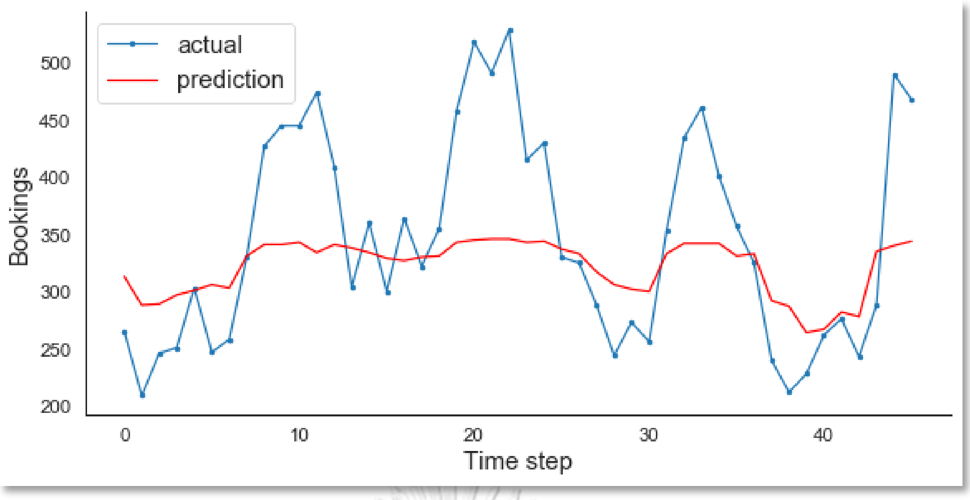
88.50	115.73	22.28	1	63	1000	10
87.26	113.84	22.07	1	64	1000	10
85.98	111.98	21.84	1	65	1000	10
85.00	110.41	21.70	1	66	1000	10
84.09	109.03	21.56	1	67	1000	10
83.00	107.36	21.39	1	68	1000	10
82.33	106.20	21.32	1	69	1000	10
81.41	104.61	21.21	1	70	1000	10
80.78	103.48	21.15	1	71	1000	10
80.17	102.44	21.09	1	72	1000	10
79.46	101.17	21.01	1	73	1000	10
78.78	100.07	20.93	1	74	1000	10
78.11	98.98	20.85	1	75	1000	10
77.63	98.01	20.83	1	76	1000	10
77.15	97.06	20.80	1	77	1000	10
76.70	96.16	20.78	1	78	1000	10
76.20	95.23	20.74	1	79	1000	10
75.72	94.37	20.69	1	80	1000	10
75.17	93.49	20.63	1	81	1000	10
74.65	92.72	20.55	1	82	1000	10
74.11	91.99	20.45	1	83	1000	10
73.59	91.20	20.37	1	84	1000	10
72.89	90.32	20.22	1	85	1000	10
72.33	89.69	20.10	1	86	1000	10
71.67	88.82	19.95	1	87	1000	10
71.09	88.14	19.82	1	88	1000	10
70.46	87.31	19.67	1	89	1000	10
69.87	86.61	19.51	1	90	1000	10
69.15	85.66	19.32	1	91	1000	10
68.43	84.89	19.11	1	92	1000	10
67.57	83.94	18.85	1	93	1000	10
66.80	83.09	18.61	1	94	1000	10
65.91	82.15	18.32	1	95	1000	10
64.85	81.12	17.99	1	96	1000	10
64.02	80.31	17.72	1	97	1000	10
63.09	79.34	17.41	1	98	1000	10
62.17	78.45	17.11	1	99	1000	10
61.33	77.63	16.84	1	100	1000	10

4th Step: Seeds

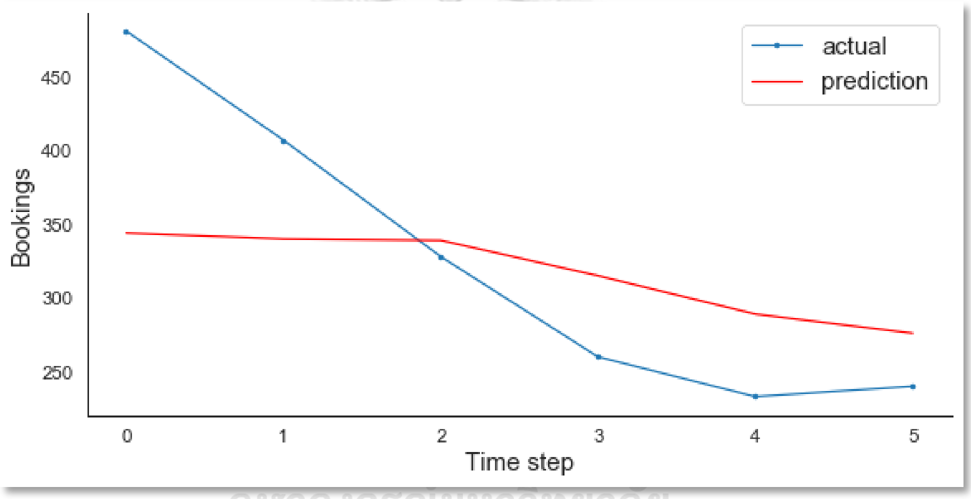
MAE	RMSE	MAPE	Seeds	Hidden Units	Epochs	Batch Size
61.33	77.63	16.84	1	100	1000	10
60.98	77.15	16.74	2	100	1000	10
61.04	77.18	16.77	3	100	1000	10
345.85	357.63	100.00	4	100	1000	10
345.85	357.63	100.00	5	100	1000	10
61.17	77.45	16.78	6	100	1000	10
345.85	357.63	100.00	7	100	1000	10
61.13	77.31	16.79	8	100	1000	10
345.85	357.63	100.00	9	100	1000	10
345.85	357.63	100.00	10	100	1000	10
61.07	77.29	16.75	11	100	1000	10

345.85	357.63	100.00	12	100	1000	10
61.22	77.31	16.83	13	100	1000	10
345.85	357.63	100.00	14	100	1000	10
345.85	357.63	100.00	15	100	1000	10
60.93	77.26	16.69	16	100	1000	10
60.74	77.09	16.62	17	100	1000	10
61.11	77.31	16.77	18	100	1000	10
345.85	357.63	100.00	19	100	1000	10
345.85	357.63	100.00	20	100	1000	10
345.85	357.63	100.00	21	100	1000	10
345.85	357.63	100.00	22	100	1000	10
60.70	76.89	16.64	23	100	1000	10
60.80	77.05	16.67	24	100	1000	10
61.28	77.38	16.85	25	100	1000	10
60.91	77.20	16.69	26	100	1000	10
345.85	357.63	100.00	27	100	1000	10
60.80	77.04	16.67	28	100	1000	10
345.85	357.63	100.00	29	100	1000	10
345.85	357.63	100.00	30	100	1000	10
60.74	76.94	16.65	31	100	1000	10
345.85	357.63	100.00	32	100	1000	10
60.83	76.97	16.70	33	100	1000	10
61.13	77.30	16.79	34	100	1000	10
345.85	357.63	100.00	35	100	1000	10
60.80	77.07	16.67	36	100	1000	10
345.85	357.63	100.00	37	100	1000	10
345.85	357.63	100.00	38	100	1000	10
345.85	357.63	100.00	39	100	1000	10
345.85	357.63	100.00	40	100	1000	10
345.85	357.63	100.00	41	100	1000	10
60.72	76.83	16.66	42	100	1000	10
345.85	357.63	100.00	43	100	1000	10
345.85	357.63	100.00	44	100	1000	10
345.85	357.63	100.00	45	100	1000	10
345.85	357.63	100.00	46	100	1000	10
345.85	357.63	100.00	47	100	1000	10
60.91	77.19	16.69	48	100	1000	10
345.85	357.63	100.00	49	100	1000	10
61.15	77.36	16.79	50	100	1000	10
60.83	77.17	16.65	51	100	1000	10
60.93	77.14	16.73	52	100	1000	10
345.85	357.63	100.00	53	100	1000	10
345.85	357.63	100.00	54	100	1000	10
60.89	77.10	16.71	55	100	1000	10
345.85	357.63	100.00	56	100	1000	10
61.15	77.46	16.77	57	100	1000	10
345.85	357.63	100.00	58	100	1000	10
345.85	357.63	100.00	59	100	1000	10
61.02	77.22	16.74	60	100	1000	10
345.85	357.63	100.00	61	100	1000	10
61.22	77.49	16.79	62	100	1000	10

60.85	76.88	16.71	63	100	1000	10
345.85	357.63	100.00	64	100	1000	10
61.22	77.42	16.81	65	100	1000	10
345.85	357.63	100.00	66	100	1000	10
345.85	357.63	100.00	67	100	1000	10
61.09	77.26	16.77	68	100	1000	10
60.93	77.18	16.71	69	100	1000	10
345.85	357.63	100.00	70	100	1000	10
345.85	357.63	100.00	71	100	1000	10
60.93	77.18	16.72	72	100	1000	10
345.85	357.63	100.00	73	100	1000	10
345.85	357.63	100.00	74	100	1000	10
60.96	77.17	16.71	75	100	1000	10
61.02	77.22	16.75	76	100	1000	10
60.89	77.20	16.68	77	100	1000	10
61.13	77.43	16.76	78	100	1000	10
60.70	76.97	16.63	79	100	1000	10
61.33	77.52	16.85	80	100	1000	10
345.85	357.63	100.00	81	100	1000	10
345.85	357.63	100.00	82	100	1000	10
61.15	77.41	16.78	83	100	1000	10
345.85	357.63	100.00	84	100	1000	10
345.85	357.63	100.00	85	100	1000	10
345.85	357.63	100.00	86	100	1000	10
345.85	357.63	100.00	87	100	1000	10
345.85	357.63	100.00	88	100	1000	10
345.85	357.63	100.00	89	100	1000	10
60.87	77.11	16.69	90	100	1000	10
345.85	357.63	100.00	91	100	1000	10
61.20	77.36	16.81	92	100	1000	10
60.80	77.12	16.66	93	100	1000	10
345.85	357.63	100.00	94	100	1000	10
61.15	77.44	16.77	95	100	1000	10
60.72	76.94	16.64	96	100	1000	10
60.59	76.70	16.61	97	100	1000	10
60.61	76.84	16.60	98	100	1000	10
345.85	357.63	100.00	99	100	1000	10
345.85	357.63	100.00	100	100	1000	10



The monthly booking forecasting with training set using ANN model 2



The monthly booking forecasting with cross validation set using ANN model 2

Monthly ANN Model 3:

2 Layers with Activation Functions $a^{(2)}$ = ReLU, $a^{(3)}$ = ReLU, $a^{(4)}$ = ReLU

1st Step: Batch Size

MAE	RMSE	MAPE	Seeds	Hidden Units	Epochs	Batch Size	Average MAPE
23.35	32.05	6.88	1	30	1000	10	
23.20	31.96	6.84	1	50	1000	10	
23.37	31.98	6.89	1	70	1000	10	
23.30	31.94	6.87	1	100	1000	10	6.87
24.72	33.24	7.29	1	30	1000	32	
24.02	32.61	7.12	1	50	1000	32	
23.89	32.45	7.08	1	70	1000	32	
23.59	32.21	6.97	1	100	1000	32	7.11

29.43	39.89	8.70	1	30	1000	64	
26.54	35.72	7.85	1	50	1000	64	
25.91	34.88	7.66	1	70	1000	64	
24.89	33.41	7.38	1	100	1000	64	7.90
29.43	39.89	8.70	1	30	1000	128	
26.54	35.72	7.85	1	50	1000	128	
25.91	34.88	7.66	1	70	1000	128	
24.89	33.41	7.38	1	100	1000	128	7.90

2nd Step: Epochs

MAE	RMSE	MAPE	Seeds	Hidden Units	Epochs	Batch Size	Average MAPE
344.61	356.37	99.63	1	30	10	10	
342.91	354.62	99.15	1	50	10	10	
341.65	353.28	98.79	1	70	10	10	
337.41	348.97	97.55	1	100	10	10	98.78
39.20	51.09	11.30	1	30	100	10	
32.00	43.41	9.35	1	50	100	10	
31.74	42.29	9.22	1	70	100	10	
28.65	38.99	8.45	1	100	100	10	9.58
24.17	32.54	7.14	1	30	500	10	
23.76	32.36	7.03	1	50	500	10	
23.65	32.25	6.98	1	70	500	10	
23.20	31.95	6.82	1	100	500	10	6.99
23.35	32.05	6.88	1	30	1000	10	
23.20	31.96	6.84	1	50	1000	10	
23.37	31.98	6.89	1	70	1000	10	
23.30	31.94	6.87	1	100	1000	10	6.87

3rd Step: Hidden Units

MAE	RMSE	MAPE	Seeds	Hidden Units	Epochs	Batch Size
24.87	33.39	7.36	1	5	1000	10
345.85	357.63	100.00	1	6	1000	10
24.70	32.98	7.30	1	7	1000	10
24.78	33.14	7.35	1	8	1000	10
24.39	32.72	7.22	1	9	1000	10
24.50	32.83	7.25	1	10	1000	10
24.11	32.53	7.14	1	11	1000	10
345.85	357.63	100.00	1	12	1000	10
23.89	32.33	7.06	1	13	1000	10
345.85	357.63	100.00	1	14	1000	10
23.91	32.34	7.07	1	15	1000	10
23.67	32.18	7.00	1	16	1000	10
23.78	32.33	7.02	1	17	1000	10
23.85	32.28	7.05	1	18	1000	10
345.85	357.63	100.00	1	19	1000	10
23.61	32.18	6.97	1	20	1000	10

23.80	32.31	7.03	1	21	1000	10
23.59	32.19	6.96	1	22	1000	10
23.39	32.02	6.89	1	23	1000	10
23.50	32.11	6.93	1	24	1000	10
23.43	32.11	6.91	1	25	1000	10
23.35	31.99	6.88	1	26	1000	10
23.57	32.16	6.95	1	27	1000	10
23.37	31.99	6.88	1	28	1000	10
23.41	32.06	6.90	1	29	1000	10
23.35	32.05	6.88	1	30	1000	10
23.37	32.05	6.88	1	31	1000	10
23.15	31.92	6.82	1	32	1000	10
22.59	31.67	6.68	1	33	1000	10
23.28	31.99	6.86	1	34	1000	10
23.33	32.02	6.87	1	35	1000	10
21.74	30.77	6.48	1	36	1000	10
23.28	32.02	6.85	1	37	1000	10
22.93	31.78	6.78	1	38	1000	10
23.26	31.90	6.85	1	39	1000	10
23.37	32.02	6.89	1	40	1000	10
23.30	32.01	6.86	1	41	1000	10
23.28	31.99	6.86	1	42	1000	10
22.78	31.16	6.79	1	43	1000	10
23.33	31.93	6.87	1	44	1000	10
23.11	31.91	6.82	1	45	1000	10
23.30	31.90	6.86	1	46	1000	10
23.00	31.84	6.79	1	47	1000	10
23.33	31.94	6.87	1	48	1000	10
23.33	31.96	6.87	1	49	1000	10
23.20	31.96	6.84	1	50	1000	10
23.00	31.78	6.81	1	51	1000	10
22.83	31.58	6.73	1	52	1000	10
23.37	31.95	6.88	1	53	1000	10
23.30	31.92	6.86	1	54	1000	10
23.30	31.92	6.86	1	55	1000	10
23.28	31.89	6.86	1	56	1000	10
23.39	31.96	6.89	1	57	1000	10
22.83	31.62	6.76	1	58	1000	10
23.30	31.93	6.86	1	59	1000	10
22.26	31.15	6.60	1	60	1000	10
22.67	31.57	6.72	1	61	1000	10
23.35	31.96	6.88	1	62	1000	10
23.39	31.97	6.89	1	63	1000	10
23.41	32.02	6.90	1	64	1000	10

22.76	31.53	6.75	1	65	1000	10
22.89	31.56	6.77	1	66	1000	10
23.11	31.85	6.83	1	67	1000	10
23.11	31.88	6.82	1	68	1000	10
21.65	30.43	6.43	1	69	1000	10
23.37	31.98	6.89	1	70	1000	10
23.30	31.96	6.87	1	71	1000	10
22.87	31.78	6.75	1	72	1000	10
23.13	31.61	6.82	1	73	1000	10
23.39	32.01	6.89	1	74	1000	10
23.39	32.01	6.89	1	75	1000	10
23.37	31.99	6.89	1	76	1000	10
23.11	31.86	6.81	1	77	1000	10
23.22	31.91	6.84	1	78	1000	10
23.07	31.82	6.81	1	79	1000	10
22.43	31.31	6.65	1	80	1000	10
23.41	31.99	6.90	1	81	1000	10
22.89	31.81	6.77	1	82	1000	10
22.93	31.72	6.79	1	83	1000	10
23.41	31.99	6.90	1	84	1000	10
23.11	31.67	6.84	1	85	1000	10
23.15	31.87	6.82	1	86	1000	10
23.09	31.73	6.83	1	87	1000	10
21.93	30.65	6.52	1	88	1000	10
23.28	31.94	6.86	1	89	1000	10
23.41	31.98	6.90	1	90	1000	10
21.70	30.33	6.48	1	91	1000	10
23.43	31.98	6.91	1	92	1000	10
23.43	31.98	6.90	1	93	1000	10
22.80	31.46	6.74	1	94	1000	10
23.39	31.70	6.95	1	95	1000	10
23.37	31.97	6.89	1	96	1000	10
22.67	31.51	6.72	1	97	1000	10
23.35	31.74	6.89	1	98	1000	10
23.41	31.98	6.90	1	99	1000	10
23.30	31.94	6.87	1	100	1000	10

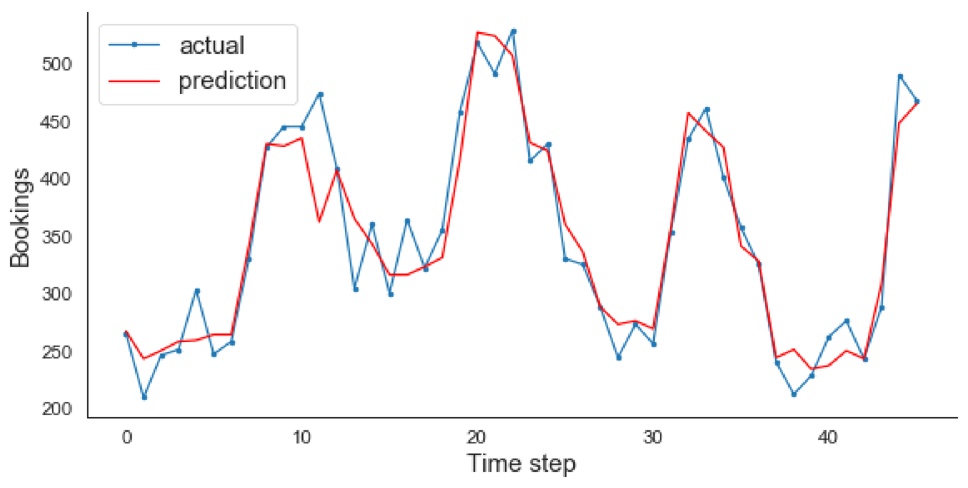
4th Step: Seeds

MAE	RMSE	MAPE	Seeds	Hidden Units	Epochs	Batch Size
21.65	30.43	6.43	1	69	1000	10
22.85	31.78	6.71	2	69	1000	10
23.41	31.84	7.01	3	69	1000	10
345.85	357.63	100.00	4	69	1000	10
22.87	31.63	6.84	5	69	1000	10
22.98	31.75	6.82	6	69	1000	10

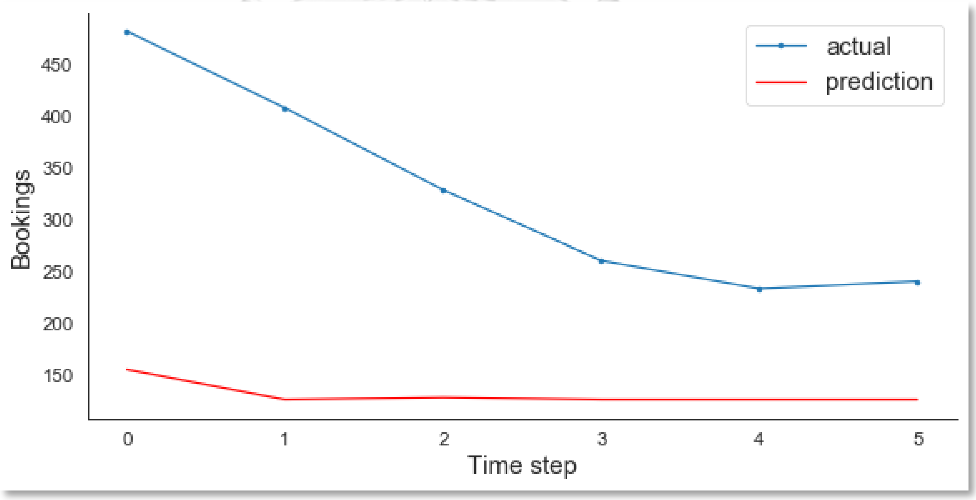
23.67	32.06	7.05	7	69	1000	10
23.50	32.03	6.92	8	69	1000	10
23.46	31.96	6.94	9	69	1000	10
23.02	31.78	6.76	10	69	1000	10
23.09	31.76	6.86	11	69	1000	10
22.04	30.84	6.56	12	69	1000	10
23.63	32.02	6.99	13	69	1000	10
23.43	31.99	6.88	14	69	1000	10
21.98	31.10	6.55	15	69	1000	10
23.48	31.97	6.94	16	69	1000	10
345.85	357.63	100.00	17	69	1000	10
23.15	31.82	6.85	18	69	1000	10
21.41	30.59	6.34	19	69	1000	10
345.85	357.63	100.00	20	69	1000	10
23.46	31.91	6.97	21	69	1000	10
23.46	31.90	6.93	22	69	1000	10
23.54	31.95	6.96	23	69	1000	10
23.00	31.74	6.78	24	69	1000	10
22.80	31.76	6.72	25	69	1000	10
23.13	31.88	6.82	26	69	1000	10
23.52	32.04	6.92	27	69	1000	10
345.85	357.63	100.00	28	69	1000	10
23.15	31.90	6.82	29	69	1000	10
22.22	30.60	6.63	30	69	1000	10
23.28	31.88	6.94	31	69	1000	10
23.28	31.95	6.85	32	69	1000	10
23.35	32.02	6.84	33	69	1000	10
22.17	31.18	6.57	34	69	1000	10
22.98	31.73	6.80	35	69	1000	10
19.70	28.12	5.82	36	69	1000	10
22.63	30.87	6.75	37	69	1000	10
23.37	31.96	6.91	38	69	1000	10
23.15	31.90	6.81	39	69	1000	10
23.02	31.65	6.86	40	69	1000	10
23.35	31.85	6.88	41	69	1000	10
22.00	30.73	6.52	42	69	1000	10
23.22	31.85	6.87	43	69	1000	10
345.85	357.63	100.00	44	69	1000	10
22.63	31.64	6.71	45	69	1000	10
345.85	357.63	100.00	46	69	1000	10
23.11	31.73	6.82	47	69	1000	10
21.39	30.32	6.37	48	69	1000	10
23.07	31.66	6.82	49	69	1000	10
23.54	32.01	6.99	50	69	1000	10

345.85	357.63	100.00	51	69	1000	10
345.85	357.63	100.00	52	69	1000	10
23.41	31.89	6.93	53	69	1000	10
23.07	31.80	6.81	54	69	1000	10
23.37	31.88	6.89	55	69	1000	10
23.15	31.79	6.90	56	69	1000	10
23.41	32.04	6.88	57	69	1000	10
345.85	357.63	100.00	58	69	1000	10
23.46	31.97	6.93	59	69	1000	10
22.04	30.81	6.59	60	69	1000	10
23.67	31.98	7.01	61	69	1000	10
22.85	31.08	6.80	62	69	1000	10
345.85	357.63	100.00	63	69	1000	10
21.39	30.89	6.28	64	69	1000	10
23.50	31.89	6.95	65	69	1000	10
23.41	31.93	6.88	66	69	1000	10
23.83	32.00	7.08	67	69	1000	10
20.02	29.36	6.02	68	69	1000	10
345.85	357.63	100.00	69	69	1000	10
23.87	32.05	7.11	70	69	1000	10
345.85	357.63	100.00	71	69	1000	10
23.46	31.95	6.90	72	69	1000	10
23.28	31.87	6.85	73	69	1000	10
23.57	31.97	6.97	74	69	1000	10
23.33	31.90	6.87	75	69	1000	10
23.70	32.08	7.04	76	69	1000	10
22.89	31.49	6.72	77	69	1000	10
23.46	31.88	6.96	78	69	1000	10
22.91	31.72	6.78	79	69	1000	10
23.20	31.84	6.85	80	69	1000	10
23.33	31.78	6.87	81	69	1000	10
19.96	28.30	6.02	82	69	1000	10
22.52	31.22	6.68	83	69	1000	10
23.04	31.54	6.83	84	69	1000	10
23.17	31.88	6.86	85	69	1000	10
345.85	357.63	100.00	86	69	1000	10
345.85	357.63	100.00	87	69	1000	10
345.85	357.63	100.00	88	69	1000	10
23.28	31.95	6.84	89	69	1000	10
23.41	32.01	6.89	90	69	1000	10
345.85	357.63	100.00	91	69	1000	10
23.43	32.03	6.91	92	69	1000	10
23.41	32.05	6.86	93	69	1000	10
22.65	31.47	6.70	94	69	1000	10

21.96	30.41	6.60	95	69	1000	10
22.72	31.68	6.72	96	69	1000	10
22.78	31.83	6.73	97	69	1000	10
23.48	31.99	6.94	98	69	1000	10
21.41	30.57	6.32	99	69	1000	10
345.85	357.63	100.00	100	69	1000	10



The monthly booking forecasting with training set using ANN model 3



The monthly booking forecasting with cross validation set using ANN model 3

Monthly ANN Model 4:

2 Layers with Activation Functions $a^{(2)}$ = Sigmoid, $a^{(3)}$ = ReLU, $a^{(4)}$ = ReLU

1st Step: Batch Size

MAE	RMSE	MAPE	Seeds	Hidden Units	Epochs	Batch Size	Average MAPE
345.85	357.63	100.00	1	30	1000	10	
23.41	31.68	7.04	1	50	1000	10	
23.35	31.59	7.01	1	70	1000	10	
23.30	31.52	6.99	1	100	1000	10	30.26
345.85	357.63	100.00	1	30	1000	32	
30.22	38.21	9.30	1	50	1000	32	
28.61	36.82	8.83	1	70	1000	32	
27.76	36.01	8.58	1	100	1000	32	31.68
345.85	357.63	100.00	1	30	1000	64	
50.28	59.01	15.36	1	50	1000	64	
45.39	53.44	14.01	1	70	1000	64	
42.70	50.18	13.28	1	100	1000	64	35.66
345.85	357.63	100.00	1	30	1000	128	
50.28	59.01	15.36	1	50	1000	128	
45.39	53.44	14.01	1	70	1000	128	
42.70	50.18	13.28	1	100	1000	128	35.66

2nd Step: Epochs

MAE	RMSE	MAPE	Seeds	Hidden Units	Epochs	Batch Size	Average MAPE
345.85	357.63	100.00	1	30	10	10	
338.59	350.54	97.77	1	50	10	10	
335.78	347.88	96.89	1	70	10	10	
326.74	339.10	94.10	1	100	10	10	97.19
345.85	357.63	100.00	1	30	100	10	
58.65	71.68	16.63	1	50	100	10	
56.46	65.68	17.22	1	70	100	10	
54.96	63.77	16.87	1	100	100	10	37.68
345.85	357.63	100.00	1	30	500	10	
26.96	35.37	8.28	1	50	500	10	
26.48	34.89	8.14	1	70	500	10	
26.15	34.39	8.03	1	100	500	10	31.11
345.85	357.63	100.00	1	30	1000	10	
23.41	31.68	7.04	1	50	1000	10	
23.35	31.59	7.01	1	70	1000	10	
23.30	31.52	6.99	1	100	1000	10	30.26

3rd Step: Hidden Units

MAE	RMSE	MAPE	Seeds	Hidden Units	Epochs	Batch Size
35.65	45.81	10.04	1	5	1000	10

345.85	357.63	100.00	1	6	1000	10
34.52	44.10	9.76	1	7	1000	10
27.30	36.18	8.01	1	8	1000	10
345.85	357.63	100.00	1	9	1000	10
345.85	357.63	100.00	1	10	1000	10
345.85	357.63	100.00	1	11	1000	10
345.85	357.63	100.00	1	12	1000	10
25.20	33.53	7.48	1	13	1000	10
345.85	357.63	100.00	1	14	1000	10
25.70	34.10	7.61	1	15	1000	10
24.76	32.99	7.37	1	16	1000	10
345.85	357.63	100.00	1	17	1000	10
345.85	357.63	100.00	1	18	1000	10
25.00	33.25	7.44	1	19	1000	10
24.46	32.76	7.31	1	20	1000	10
25.22	33.46	7.50	1	21	1000	10
24.22	32.62	7.25	1	22	1000	10
24.11	32.55	7.22	1	23	1000	10
24.11	32.49	7.22	1	24	1000	10
345.85	357.63	100.00	1	25	1000	10
24.04	32.46	7.20	1	26	1000	10
345.85	357.63	100.00	1	27	1000	10
23.87	32.28	7.16	1	28	1000	10
345.85	357.63	100.00	1	29	1000	10
345.85	357.63	100.00	1	30	1000	10
345.85	357.63	100.00	1	31	1000	10
23.78	32.09	7.15	1	32	1000	10
23.72	31.96	7.12	1	33	1000	10
23.76	32.11	7.13	1	34	1000	10
23.67	31.96	7.10	1	35	1000	10
345.85	357.63	100.00	1	36	1000	10
345.85	357.63	100.00	1	37	1000	10
23.61	31.89	7.08	1	38	1000	10
23.54	31.84	7.06	1	39	1000	10
23.52	31.88	7.06	1	40	1000	10
23.61	31.96	7.08	1	41	1000	10
23.61	31.92	7.09	1	42	1000	10
23.52	31.84	7.06	1	43	1000	10
23.52	31.74	7.06	1	44	1000	10
23.57	31.82	7.08	1	45	1000	10
23.54	31.82	7.07	1	46	1000	10
23.54	31.83	7.07	1	47	1000	10
23.48	31.74	7.05	1	48	1000	10
23.52	31.76	7.06	1	49	1000	10

23.41	31.68	7.04	1	50	1000	10
23.39	31.64	7.03	1	51	1000	10
23.41	31.65	7.04	1	52	1000	10
23.35	31.60	7.02	1	53	1000	10
23.43	31.67	7.04	1	54	1000	10
23.41	31.66	7.04	1	55	1000	10
345.85	357.63	100.00	1	56	1000	10
345.85	357.63	100.00	1	57	1000	10
23.43	31.72	7.04	1	58	1000	10
345.85	357.63	100.00	1	59	1000	10
23.46	31.71	7.05	1	60	1000	10
23.46	31.70	7.04	1	61	1000	10
23.37	31.61	7.02	1	62	1000	10
345.85	357.63	100.00	1	63	1000	10
23.43	31.69	7.04	1	64	1000	10
23.41	31.68	7.03	1	65	1000	10
23.43	31.69	7.04	1	66	1000	10
23.33	31.59	7.01	1	67	1000	10
23.37	31.62	7.02	1	68	1000	10
345.85	357.63	100.00	1	69	1000	10
23.35	31.59	7.01	1	70	1000	10
23.46	31.68	7.04	1	71	1000	10
23.41	31.66	7.03	1	72	1000	10
345.85	357.63	100.00	1	73	1000	10
23.37	31.60	7.02	1	74	1000	10
23.33	31.59	7.00	1	75	1000	10
345.85	357.63	100.00	1	76	1000	10
23.30	31.59	7.00	1	77	1000	10
23.37	31.61	7.01	1	78	1000	10
345.85	357.63	100.00	1	79	1000	10
345.85	357.63	100.00	1	80	1000	10
345.85	357.63	100.00	1	81	1000	10
23.35	31.58	7.01	1	82	1000	10
345.85	357.63	100.00	1	83	1000	10
23.37	31.60	7.01	1	84	1000	10
23.33	31.60	7.00	1	85	1000	10
345.85	357.63	100.00	1	86	1000	10
345.85	357.63	100.00	1	87	1000	10
23.30	31.58	6.99	1	88	1000	10
23.33	31.59	7.00	1	89	1000	10
23.30	31.58	6.99	1	90	1000	10
23.33	31.58	7.00	1	91	1000	10
23.28	31.52	6.98	1	92	1000	10
23.30	31.55	7.00	1	93	1000	10

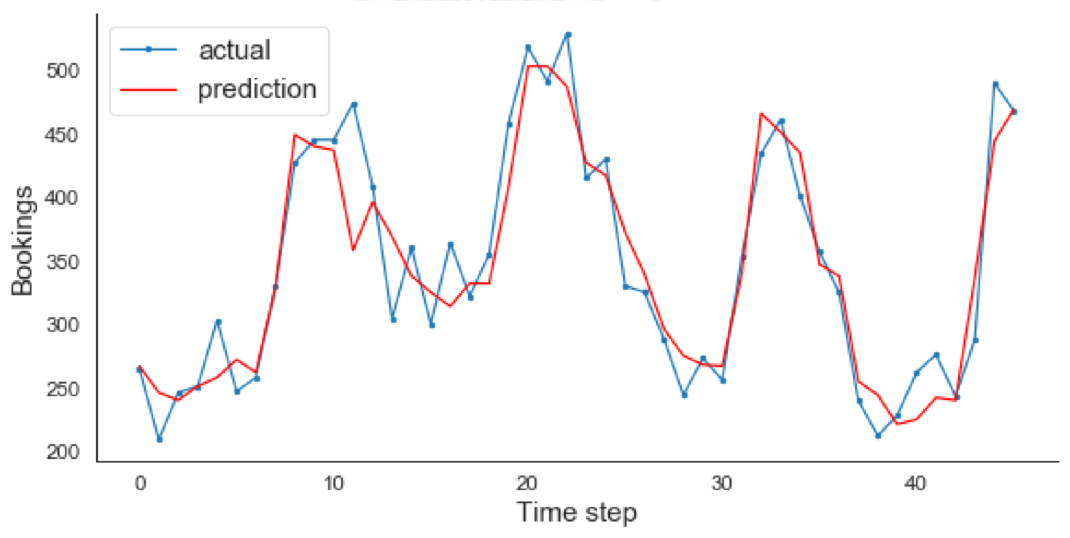
23.33	31.56	7.00	1	94	1000	10
23.33	31.60	7.00	1	95	1000	10
23.33	31.56	7.00	1	96	1000	10
23.30	31.53	6.99	1	97	1000	10
345.85	357.63	100.00	1	98	1000	10
23.26	31.50	6.98	1	99	1000	10
23.30	31.52	6.99	1	100	1000	10

4th Step: Seeds

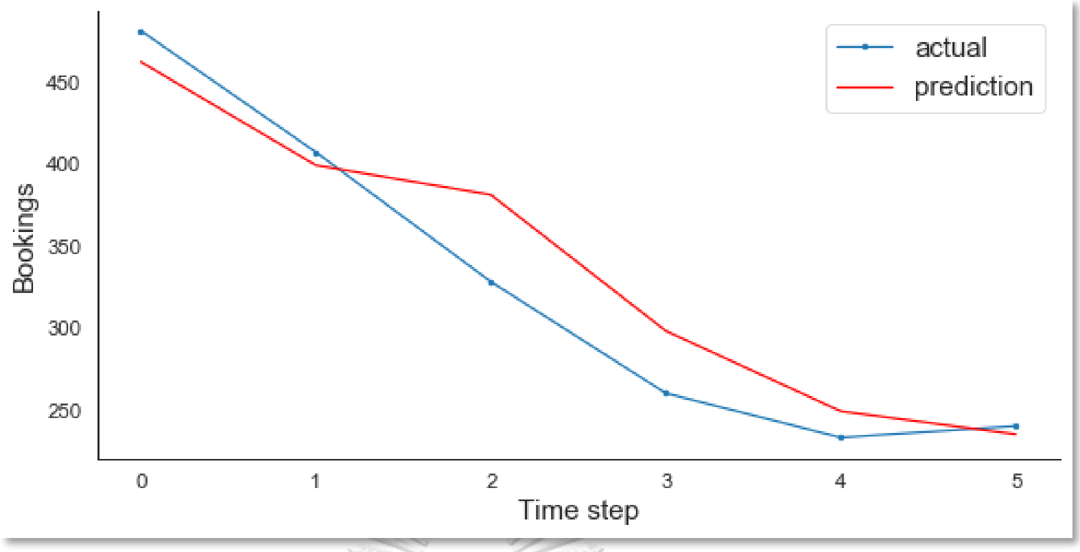
MAE	RMSE	MAPE	Seeds	Hidden Units	Epochs	Batch Size
28.67	38.78	8.60	1	93	1000	32
29.33	39.54	8.90	2	93	1000	32
324.83	337.66	100.00	3	93	1000	32
29.00	38.82	8.74	4	93	1000	32
29.17	39.52	8.83	5	93	1000	32
29.67	39.81	8.98	6	93	1000	32
324.83	337.66	100.00	7	93	1000	32
28.83	39.12	8.72	8	93	1000	32
324.83	337.66	100.00	9	93	1000	32
29.33	39.45	8.92	10	93	1000	32
324.83	337.66	100.00	11	93	1000	32
324.83	337.66	100.00	12	93	1000	32
324.83	337.66	100.00	13	93	1000	32
324.83	337.66	100.00	14	93	1000	32
29.83	40.04	9.05	15	93	1000	32
324.83	337.66	100.00	16	93	1000	32
29.67	39.97	9.02	17	93	1000	32
324.83	337.66	100.00	18	93	1000	32
324.83	337.66	100.00	19	93	1000	32
324.83	337.66	100.00	20	93	1000	32
28.83	38.96	8.65	21	93	1000	32
28.67	38.73	8.64	22	93	1000	32
28.83	39.12	8.69	23	93	1000	32
29.00	39.17	8.74	24	93	1000	32
29.00	39.06	8.67	25	93	1000	32
324.83	337.66	100.00	26	93	1000	32
28.67	38.53	8.68	27	93	1000	32
324.83	337.66	100.00	28	93	1000	32
324.83	337.66	100.00	29	93	1000	32
324.83	337.66	100.00	30	93	1000	32
29.00	39.34	8.78	31	93	1000	32
29.17	39.24	8.75	32	93	1000	32
324.83	337.66	100.00	33	93	1000	32
28.50	38.83	8.61	34	93	1000	32

29.00	39.32	8.78	35	93	1000	32
324.83	337.66	100.00	36	93	1000	32
29.17	39.33	8.83	37	93	1000	32
28.83	38.93	8.71	38	93	1000	32
29.00	39.17	8.71	39	93	1000	32
324.83	337.66	100.00	40	93	1000	32
29.00	38.82	8.74	41	93	1000	32
29.00	39.10	8.76	42	93	1000	32
324.83	337.66	100.00	43	93	1000	32
324.83	337.66	100.00	44	93	1000	32
324.83	337.66	100.00	45	93	1000	32
29.00	38.94	8.72	46	93	1000	32
29.33	39.71	8.89	47	93	1000	32
324.83	337.66	100.00	48	93	1000	32
324.83	337.66	100.00	49	93	1000	32
29.00	39.17	8.74	50	93	1000	32
324.83	337.66	100.00	51	93	1000	32
28.83	39.08	8.75	52	93	1000	32
324.83	337.66	100.00	53	93	1000	32
29.33	39.37	8.83	54	93	1000	32
324.83	337.66	100.00	55	93	1000	32
324.83	337.66	100.00	56	93	1000	32
324.83	337.66	100.00	57	93	1000	32
324.83	337.66	100.00	58	93	1000	32
324.83	337.66	100.00	59	93	1000	32
324.83	337.66	100.00	60	93	1000	32
324.83	337.66	100.00	61	93	1000	32
324.83	337.66	100.00	62	93	1000	32
28.33	38.64	8.56	63	93	1000	32
28.83	39.09	8.69	64	93	1000	32
29.00	39.00	8.75	65	93	1000	32
324.83	337.66	100.00	66	93	1000	32
29.33	39.27	8.91	67	93	1000	32
28.50	38.72	8.60	68	93	1000	32
324.83	337.66	100.00	69	93	1000	32
29.33	39.76	8.90	70	93	1000	32
324.83	337.66	100.00	71	93	1000	32
28.83	39.03	8.73	72	93	1000	32
28.50	38.69	8.57	73	93	1000	32
324.83	337.66	100.00	74	93	1000	32
324.83	337.66	100.00	75	93	1000	32
30.00	39.78	9.00	76	93	1000	32
324.83	337.66	100.00	77	93	1000	32
29.33	39.48	8.82	78	93	1000	32

324.83	337.66	100.00	79	93	1000	32
29.00	39.10	8.76	80	93	1000	32
324.83	337.66	100.00	81	93	1000	32
28.83	38.81	8.66	82	93	1000	32
29.00	39.06	8.77	83	93	1000	32
28.83	39.03	8.73	84	93	1000	32
324.83	337.66	100.00	85	93	1000	32
324.83	337.66	100.00	86	93	1000	32
324.83	337.66	100.00	87	93	1000	32
29.00	38.97	8.72	88	93	1000	32
324.83	337.66	100.00	89	93	1000	32
29.33	39.45	8.79	90	93	1000	32
324.83	337.66	100.00	91	93	1000	32
324.83	337.66	100.00	92	93	1000	32
28.17	38.42	8.49	93	93	1000	32
324.83	337.66	100.00	94	93	1000	32
324.83	337.66	100.00	95	93	1000	32
29.00	38.97	8.72	96	93	1000	32
29.00	39.32	8.78	97	93	1000	32
324.83	337.66	100.00	98	93	1000	32
29.00	38.82	8.68	99	93	1000	32
324.83	337.66	100.00	100	93	1000	32



The monthly booking forecasting with training set using ANN model 4



The monthly booking forecasting with cross validation set using ANN model 4

Monthly ANN Model 5:

2 Layers with Activation Functions $a^{(2)}$ = ReLU, $a^{(3)}$ = Sigmoid, $a^{(4)}$ = ReLU

1st Step: Batch Size

MAE	RMSE	MAPE	Seeds	Hidden Units	Epochs	Batch Size	Average MAPE
345.85	357.63	100.00	1	30	1000	10	
158.85	183.08	42.07	1	50	1000	10	
104.20	135.12	25.80	1	70	1000	10	
71.00	97.50	17.48	1	100	1000	10	46.34
345.85	357.63	100.00	1	30	1000	32	
262.85	278.17	74.29	1	50	1000	32	
232.85	250.01	64.99	1	70	1000	32	
195.85	215.97	53.53	1	100	1000	32	73.20
345.85	357.63	100.00	1	30	1000	64	
299.85	313.36	85.75	1	50	1000	64	
284.85	299.04	81.10	1	70	1000	64	
263.85	279.11	74.60	1	100	1000	64	85.36
345.85	357.63	100.00	1	30	1000	128	
299.85	313.36	85.75	1	50	1000	128	
284.85	299.04	81.10	1	70	1000	128	
263.85	279.11	74.60	1	100	1000	128	85.36

2nd Step: Epochs

MAE	RMSE	MAPE	Seeds	Hidden Units	Epochs	Batch Size	Average MAPE
345.85	357.63	100.00	1	30	10	10	
343.30	355.07	99.24	1	50	10	10	

342.52	354.34	98.99	1	70	10	10	
340.44	352.28	98.36	1	100	10	10	99.15
345.85	357.63	100.00	1	30	100	10	
320.85	333.51	92.26	1	50	100	10	
311.85	324.86	89.47	1	70	100	10	
299.85	313.36	85.75	1	100	100	10	91.87
345.85	357.63	100.00	1	30	500	10	
244.85	261.22	68.71	1	50	500	10	
208.85	227.83	57.56	1	70	500	10	
164.85	188.31	43.93	1	100	500	10	67.55
345.85	357.63	100.00	1	30	1000	10	
158.85	183.08	42.07	1	50	1000	10	
104.20	135.12	25.80	1	70	1000	10	
71.00	97.50	17.48	1	100	1000	10	46.34

3rd Step: Hidden Units

MAE	RMSE	MAPE	Seeds	Hidden Units	Epochs	Batch Size
313.85	326.78	90.09	1	5	1000	10
345.85	357.63	100.00	1	6	1000	10
345.85	357.63	100.00	1	7	1000	10
345.85	357.63	100.00	1	8	1000	10
345.85	357.63	100.00	1	9	1000	10
345.85	357.63	100.00	1	10	1000	10
345.85	357.63	100.00	1	11	1000	10
345.85	357.63	100.00	1	12	1000	10
345.85	357.63	100.00	1	13	1000	10
283.85	298.09	80.79	1	14	1000	10
279.85	294.28	79.55	1	15	1000	10
275.85	290.48	78.32	1	16	1000	10
271.85	286.69	77.08	1	17	1000	10
345.85	357.63	100.00	1	18	1000	10
345.85	357.63	100.00	1	19	1000	10
345.85	357.63	100.00	1	20	1000	10
345.85	357.63	100.00	1	21	1000	10
345.85	357.63	100.00	1	22	1000	10
345.85	357.63	100.00	1	23	1000	10
250.85	266.86	70.57	1	24	1000	10
245.85	262.16	69.02	1	25	1000	10
345.85	357.63	100.00	1	26	1000	10
345.85	357.63	100.00	1	27	1000	10
345.85	357.63	100.00	1	28	1000	10
345.85	357.63	100.00	1	29	1000	10
345.85	357.63	100.00	1	30	1000	10
345.85	357.63	100.00	1	31	1000	10

218.85	237.03	60.66	1	32	1000	10
222.85	240.72	61.90	1	33	1000	10
213.85	232.42	59.11	1	34	1000	10
205.85	225.08	56.63	1	35	1000	10
203.85	223.25	56.01	1	36	1000	10
200.85	220.52	55.08	1	37	1000	10
195.85	215.97	53.53	1	38	1000	10
196.85	216.88	53.84	1	39	1000	10
192.85	213.25	52.60	1	40	1000	10
187.85	208.74	51.05	1	41	1000	10
183.85	205.15	49.82	1	42	1000	10
179.85	201.57	48.58	1	43	1000	10
177.85	199.79	47.96	1	44	1000	10
170.85	193.59	45.79	1	45	1000	10
166.85	190.07	44.55	1	46	1000	10
162.85	186.57	43.31	1	47	1000	10
162.85	186.57	43.31	1	48	1000	10
158.85	183.08	42.07	1	49	1000	10
158.85	183.08	42.07	1	50	1000	10
155.85	180.49	41.14	1	51	1000	10
151.85	177.04	39.90	1	52	1000	10
147.85	173.63	38.66	1	53	1000	10
143.85	170.23	37.42	1	54	1000	10
143.85	170.23	37.42	1	55	1000	10
345.85	357.63	100.00	1	56	1000	10
139.85	166.87	36.18	1	57	1000	10
135.89	163.53	34.97	1	58	1000	10
130.33	158.58	33.31	1	59	1000	10
129.41	157.76	33.05	1	60	1000	10
126.67	155.32	32.24	1	61	1000	10
122.11	151.30	30.90	1	62	1000	10
119.37	148.91	30.09	1	63	1000	10
114.15	144.21	28.60	1	64	1000	10
114.15	144.21	28.60	1	65	1000	10
111.54	141.90	27.85	1	66	1000	10
111.54	141.90	27.85	1	67	1000	10
104.94	135.86	26.00	1	68	1000	10
105.67	136.60	26.19	1	69	1000	10
104.20	135.12	25.80	1	70	1000	10
103.50	134.38	25.62	1	71	1000	10
101.54	132.19	25.14	1	72	1000	10
99.67	130.03	24.70	1	73	1000	10
97.85	127.91	24.27	1	74	1000	10
99.67	130.03	24.70	1	75	1000	10

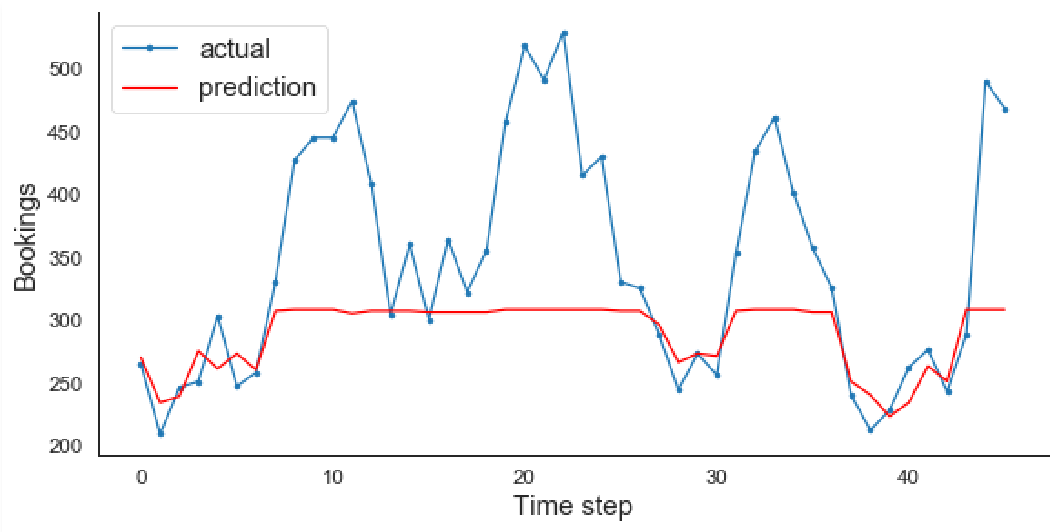
96.20	125.82	23.91	1	76	1000	10
96.72	126.51	24.02	1	77	1000	10
94.63	123.76	23.58	1	78	1000	10
94.63	123.76	23.58	1	79	1000	10
92.33	120.43	23.15	1	80	1000	10
91.46	119.13	23.00	1	81	1000	10
91.89	119.78	23.07	1	82	1000	10
89.72	116.59	22.69	1	83	1000	10
89.72	116.59	22.69	1	84	1000	10
89.72	116.59	22.69	1	85	1000	10
88.54	114.74	22.51	1	86	1000	10
86.80	111.77	22.29	1	87	1000	10
86.11	110.62	22.20	1	88	1000	10
86.11	110.62	22.20	1	89	1000	10
85.41	109.50	22.11	1	90	1000	10
84.37	107.86	21.98	1	91	1000	10
84.37	107.86	21.98	1	92	1000	10
83.85	106.80	21.95	1	93	1000	10
82.57	105.45	21.61	1	94	1000	10
83.33	105.77	21.92	1	95	1000	10
80.65	103.03	21.18	1	96	1000	10
78.54	101.37	20.51	1	97	1000	10
82.48	104.24	21.85	1	98	1000	10
81.96	103.28	21.82	1	99	1000	10
71.00	97.50	17.48	1	100	1000	10

4th Step: Seeds

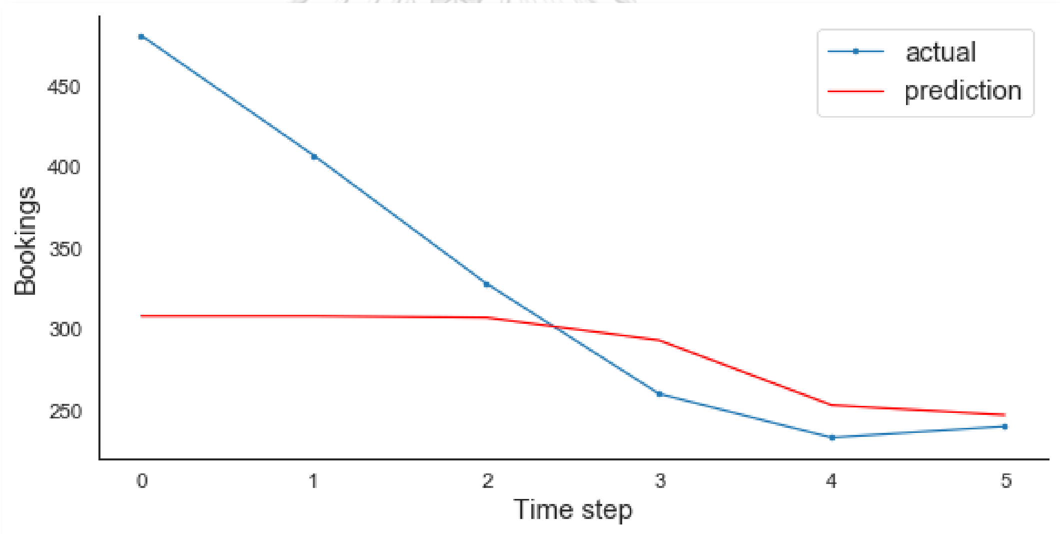
MAE	**RMSE**	**MAPE**	**Seeds**	**Hidden Units**	**Epochs**	**Batch Size**
71.00	97.50	17.48	1	100	1000	10
345.85	357.63	100.00	2	100	1000	10
83.07	105.26	21.91	3	100	1000	10
345.85	357.63	100.00	4	100	1000	10
345.85	357.63	100.00	5	100	1000	10
70.61	97.41	17.33	6	100	1000	10
79.33	102.10	20.70	7	100	1000	10
85.76	110.06	22.16	8	100	1000	10
83.07	105.26	21.91	9	100	1000	10
68.11	95.31	16.56	10	100	1000	10
345.85	357.63	100.00	11	100	1000	10
86.46	111.19	22.25	12	100	1000	10
86.46	111.19	22.25	13	100	1000	10
85.41	109.50	22.11	14	100	1000	10
345.85	357.63	100.00	15	100	1000	10
345.85	357.63	100.00	16	100	1000	10

345.85	357.63	100.00	17	100	1000	10
345.85	357.63	100.00	18	100	1000	10
75.22	101.15	18.92	19	100	1000	10
345.85	357.63	100.00	20	100	1000	10
85.76	110.06	22.16	21	100	1000	10
82.13	103.70	21.80	22	100	1000	10
84.74	108.87	21.90	23	100	1000	10
345.85	357.63	100.00	24	100	1000	10
345.85	357.63	100.00	25	100	1000	10
345.85	357.63	100.00	26	100	1000	10
78.61	101.80	20.44	27	100	1000	10
345.85	357.63	100.00	28	100	1000	10
345.85	357.63	100.00	29	100	1000	10
345.85	357.63	100.00	30	100	1000	10
82.89	105.17	21.83	31	100	1000	10
84.11	107.33	21.96	32	100	1000	10
345.85	357.63	100.00	33	100	1000	10
82.24	103.77	21.85	34	100	1000	10
345.85	357.63	100.00	35	100	1000	10
84.11	107.33	21.96	36	100	1000	10
82.43	105.39	21.55	37	100	1000	10
78.63	101.43	20.50	38	100	1000	10
85.76	110.06	22.16	39	100	1000	10
345.85	357.63	100.00	40	100	1000	10
85.07	108.94	22.07	41	100	1000	10
81.76	105.13	21.28	42	100	1000	10
83.59	106.28	21.94	43	100	1000	10
83.85	106.80	21.95	44	100	1000	10
345.85	357.63	100.00	45	100	1000	10
345.85	357.63	100.00	46	100	1000	10
74.28	99.53	18.67	47	100	1000	10
345.85	357.63	100.00	48	100	1000	10
345.85	357.63	100.00	49	100	1000	10
68.87	96.45	16.73	50	100	1000	10
345.85	357.63	100.00	51	100	1000	10
345.85	357.63	100.00	52	100	1000	10
345.85	357.63	100.00	53	100	1000	10
345.85	357.63	100.00	54	100	1000	10
84.37	107.86	21.98	55	100	1000	10
84.11	107.33	21.96	56	100	1000	10
80.39	102.55	21.18	57	100	1000	10
345.85	357.63	100.00	58	100	1000	10
345.85	357.63	100.00	59	100	1000	10
83.07	105.26	21.91	60	100	1000	10

345.85	357.63	100.00	61	100	1000	10
345.85	357.63	100.00	62	100	1000	10
345.85	357.63	100.00	63	100	1000	10
86.11	110.62	22.20	64	100	1000	10
66.83	93.87	16.22	65	100	1000	10
345.85	357.63	100.00	66	100	1000	10
79.87	102.33	20.93	67	100	1000	10
65.76	92.64	15.94	68	100	1000	10
345.85	357.63	100.00	69	100	1000	10
83.59	106.28	21.94	70	100	1000	10
83.07	105.26	21.91	71	100	1000	10
81.70	102.81	21.81	72	100	1000	10
70.28	97.08	17.22	73	100	1000	10
82.02	103.31	21.85	74	100	1000	10
345.85	357.63	100.00	75	100	1000	10
345.85	357.63	100.00	76	100	1000	10
83.96	107.71	21.79	77	100	1000	10
79.96	102.76	20.91	78	100	1000	10
83.57	106.68	21.83	79	100	1000	10
82.50	104.25	21.86	80	100	1000	10
86.46	111.19	22.25	81	100	1000	10
82.54	104.27	21.88	82	100	1000	10
82.50	105.01	21.67	83	100	1000	10
72.41	98.83	17.91	84	100	1000	10
83.59	106.28	21.94	85	100	1000	10
345.85	357.63	100.00	86	100	1000	10
345.85	357.63	100.00	87	100	1000	10
345.85	357.63	100.00	88	100	1000	10
80.17	104.00	20.72	89	100	1000	10
83.59	106.28	21.94	90	100	1000	10
345.85	357.63	100.00	91	100	1000	10
87.85	113.54	22.42	92	100	1000	10
67.24	94.60	16.30	93	100	1000	10
345.85	357.63	100.00	94	100	1000	10
345.85	357.63	100.00	95	100	1000	10
69.72	96.64	17.05	96	100	1000	10
345.85	357.63	100.00	97	100	1000	10
345.85	357.63	100.00	98	100	1000	10
85.07	108.94	22.07	99	100	1000	10
345.85	357.63	100.00	100	100	1000	10



The monthly booking forecasting with training set using ANN model 5



The monthly booking forecasting with cross validation set using ANN model 5

Monthly ANN Model 6:

2 Layers with Activation Functions $a^{(2)}$ = Sigmoid, $a^{(3)}$ = Sigmoid, $a^{(4)}$ = ReLU

1st Step: Batch Size

MAE	RMSE	MAPE	Seeds	Hidden Units	Epochs	Batch Size	Average MAPE
345.85	357.63	100.00	1	30	1000	10	

153.85	178.76	40.52	1	50	1000	10	
101.54	132.19	25.14	1	70	1000	10	
80.59	100.61	21.81	1	100	1000	10	46.87
345.85	357.63	100.00	1	30	1000	32	
260.85	276.28	73.67	1	50	1000	32	
229.85	247.22	64.07	1	70	1000	32	
195.85	215.97	53.53	1	100	1000	32	72.82
345.85	357.63	100.00	1	30	1000	64	
299.85	313.36	85.75	1	50	1000	64	
283.85	298.09	80.79	1	70	1000	64	
263.85	279.11	74.60	1	100	1000	64	85.29
345.85	357.63	100.00	1	30	1000	128	
299.85	313.36	85.75	1	50	1000	128	
283.85	298.09	80.79	1	70	1000	128	
263.85	279.11	74.60	1	100	1000	128	85.29

2nd Step: Epochs

MAE	RMSE	MAPE	Seeds	Hidden Units	Epochs	Batch Size	Average MAPE
345.85	357.63	100.00	1	30	10	10	
341.85	353.76	98.76	1	50	10	10	
340.85	352.80	98.45	1	70	10	10	
337.85	349.90	97.52	1	100	10	10	98.68
345.85	357.63	100.00	1	30	100	10	
320.85	333.51	92.26	1	50	100	10	
312.85	325.82	89.78	1	70	100	10	
301.85	315.28	86.37	1	100	100	10	92.10
345.85	357.63	100.00	1	30	500	10	
242.85	259.35	68.09	1	50	500	10	
205.85	225.08	56.63	1	70	500	10	
163.85	187.44	43.62	1	100	500	10	67.09
345.85	357.63	100.00	1	30	1000	10	
153.85	178.76	40.52	1	50	1000	10	
101.54	132.19	25.14	1	70	1000	10	
80.59	100.61	21.81	1	100	1000	10	46.87

3rd Step: Hidden Units

MAE	RMSE	MAPE	Seeds	Hidden Units	Epochs	Batch Size
313.85	326.78	90.09	1	5	1000	10
345.85	357.63	100.00	1	6	1000	10
345.85	357.63	100.00	1	7	1000	10
345.85	357.63	100.00	1	8	1000	10
345.85	357.63	100.00	1	9	1000	10
345.85	357.63	100.00	1	10	1000	10
345.85	357.63	100.00	1	11	1000	10
345.85	357.63	100.00	1	12	1000	10

281.85	296.18	80.17	1	13	1000	10
345.85	357.63	100.00	1	14	1000	10
271.85	286.69	77.08	1	15	1000	10
267.85	282.90	75.84	1	16	1000	10
261.85	277.22	73.98	1	17	1000	10
345.85	357.63	100.00	1	18	1000	10
345.85	357.63	100.00	1	19	1000	10
345.85	357.63	100.00	1	20	1000	10
345.85	357.63	100.00	1	21	1000	10
345.85	357.63	100.00	1	22	1000	10
345.85	357.63	100.00	1	23	1000	10
239.85	256.54	67.16	1	24	1000	10
345.85	357.63	100.00	1	25	1000	10
345.85	357.63	100.00	1	26	1000	10
345.85	357.63	100.00	1	27	1000	10
345.85	357.63	100.00	1	28	1000	10
345.85	357.63	100.00	1	29	1000	10
345.85	357.63	100.00	1	30	1000	10
345.85	357.63	100.00	1	31	1000	10
210.85	229.66	58.18	1	32	1000	10
207.85	226.91	57.25	1	33	1000	10
202.85	222.34	55.70	1	34	1000	10
199.85	219.60	54.77	1	35	1000	10
194.85	215.06	53.22	1	36	1000	10
191.85	212.35	52.29	1	37	1000	10
187.85	208.74	51.05	1	38	1000	10
187.85	208.74	51.05	1	39	1000	10
184.85	206.05	50.13	1	40	1000	10
179.85	201.57	48.58	1	41	1000	10
175.85	198.01	47.34	1	42	1000	10
172.85	195.35	46.41	1	43	1000	10
167.85	190.95	44.86	1	44	1000	10
164.85	188.31	43.93	1	45	1000	10
160.85	184.82	42.69	1	46	1000	10
156.85	181.35	41.45	1	47	1000	10
156.85	181.35	41.45	1	48	1000	10
152.85	177.90	40.21	1	49	1000	10
153.85	178.76	40.52	1	50	1000	10
149.85	175.33	39.28	1	51	1000	10
145.85	171.93	38.04	1	52	1000	10
141.85	168.55	36.80	1	53	1000	10
140.85	167.71	36.49	1	54	1000	10
139.85	166.87	36.18	1	55	1000	10
345.85	357.63	100.00	1	56	1000	10

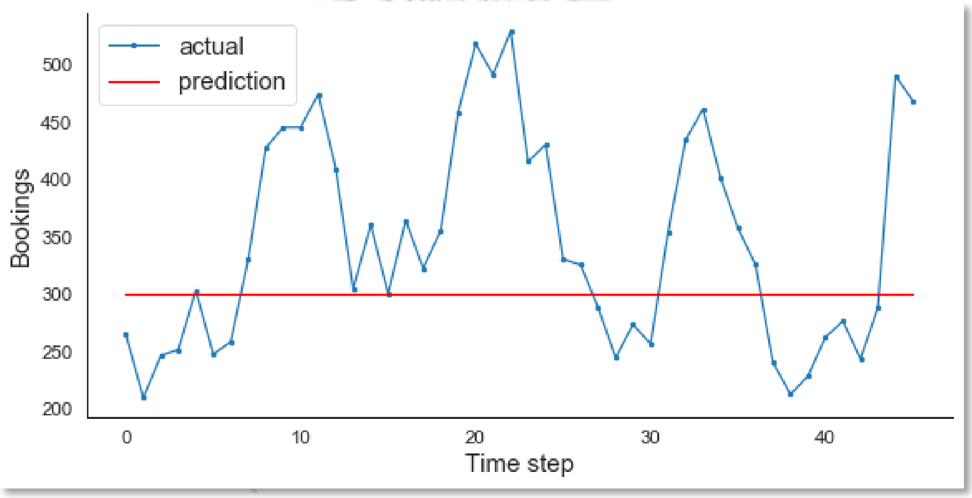
345.85	357.63	100.00	1	57	1000	10
131.24	159.40	33.58	1	58	1000	10
128.50	156.95	32.78	1	59	1000	10
125.76	154.51	31.97	1	60	1000	10
122.11	151.30	30.90	1	61	1000	10
118.50	148.12	29.84	1	62	1000	10
116.76	146.55	29.34	1	63	1000	10
114.15	144.21	28.60	1	64	1000	10
110.67	141.13	27.60	1	65	1000	10
108.94	139.61	27.10	1	66	1000	10
106.46	137.35	26.41	1	67	1000	10
103.50	134.38	25.62	1	68	1000	10
101.54	132.19	25.14	1	69	1000	10
101.54	132.19	25.14	1	70	1000	10
99.67	130.03	24.70	1	71	1000	10
99.67	130.03	24.70	1	72	1000	10
97.85	127.91	24.27	1	73	1000	10
96.20	125.82	23.91	1	74	1000	10
96.20	125.82	23.91	1	75	1000	10
345.85	357.63	100.00	1	76	1000	10
95.15	124.44	23.69	1	77	1000	10
93.67	122.42	23.39	1	78	1000	10
345.85	357.63	100.00	1	79	1000	10
91.02	118.49	22.92	1	80	1000	10
90.15	117.22	22.77	1	81	1000	10
90.15	117.22	22.77	1	82	1000	10
88.93	115.35	22.57	1	83	1000	10
87.85	113.54	22.42	1	84	1000	10
87.85	113.54	22.42	1	85	1000	10
87.15	112.35	22.33	1	86	1000	10
345.85	357.63	100.00	1	87	1000	10
85.41	109.50	22.11	1	88	1000	10
85.41	109.50	22.11	1	89	1000	10
84.72	108.40	22.02	1	90	1000	10
83.85	106.80	21.95	1	91	1000	10
83.33	105.77	21.92	1	92	1000	10
83.33	105.77	21.92	1	93	1000	10
82.80	104.76	21.89	1	94	1000	10
82.28	103.79	21.86	1	95	1000	10
81.76	102.84	21.84	1	96	1000	10
81.24	101.93	21.81	1	97	1000	10
81.24	101.93	21.81	1	98	1000	10
81.02	101.48	21.81	1	99	1000	10
80.59	100.61	21.81	1	100	1000	10

4th Step: Seeds

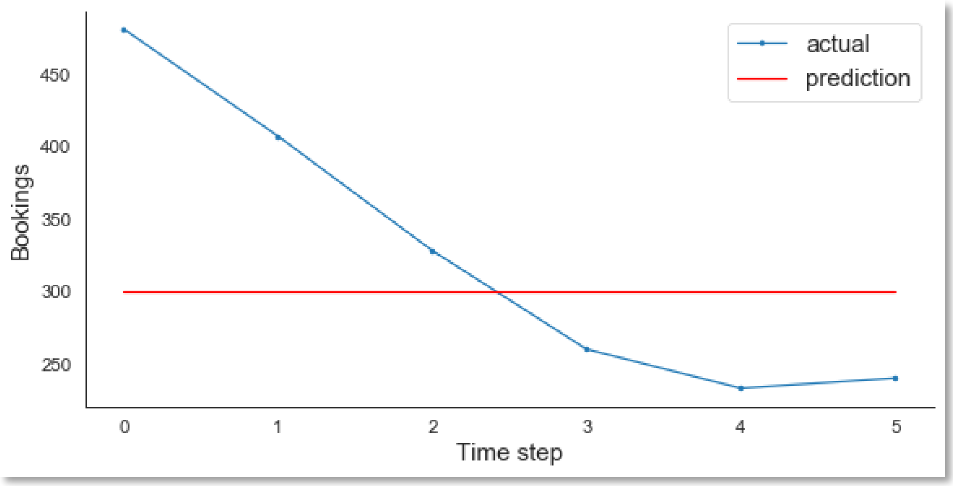
MAE	RMSE	MAPE	Seeds	Hidden Units	Epochs	Batch Size
81.24	101.93	21.81	1	97	1000	10
345.85	357.63	100.00	2	97	1000	10
83.85	106.80	21.95	3	97	1000	10
345.85	357.63	100.00	4	97	1000	10
85.41	109.50	22.11	5	97	1000	10
81.24	101.93	21.81	6	97	1000	10
80.59	100.61	21.81	7	97	1000	10
84.72	108.40	22.02	8	97	1000	10
81.50	102.38	21.82	9	97	1000	10
80.41	100.19	21.82	10	97	1000	10
345.85	357.63	100.00	11	97	1000	10
86.11	110.62	22.20	12	97	1000	10
84.11	107.33	21.96	13	97	1000	10
85.07	108.94	22.07	14	97	1000	10
345.85	357.63	100.00	15	97	1000	10
345.85	357.63	100.00	16	97	1000	10
345.85	357.63	100.00	17	97	1000	10
345.85	357.63	100.00	18	97	1000	10
81.76	102.84	21.84	19	97	1000	10
345.85	357.63	100.00	20	97	1000	10
85.76	110.06	22.16	21	97	1000	10
82.28	103.79	21.86	22	97	1000	10
345.85	357.63	100.00	23	97	1000	10
345.85	357.63	100.00	24	97	1000	10
345.85	357.63	100.00	25	97	1000	10
345.85	357.63	100.00	26	97	1000	10
82.28	103.79	21.86	27	97	1000	10
345.85	357.63	100.00	28	97	1000	10
345.85	357.63	100.00	29	97	1000	10
345.85	357.63	100.00	30	97	1000	10
82.28	103.79	21.86	31	97	1000	10
83.85	106.80	21.95	32	97	1000	10
345.85	357.63	100.00	33	97	1000	10
82.02	103.31	21.85	34	97	1000	10
345.85	357.63	100.00	35	97	1000	10
82.54	104.27	21.88	36	97	1000	10
84.37	107.86	21.98	37	97	1000	10
82.02	103.31	21.85	38	97	1000	10
84.37	107.86	21.98	39	97	1000	10
345.85	357.63	100.00	40	97	1000	10
85.41	109.50	22.11	41	97	1000	10

81.50	102.38	21.82	42	97	1000	10
83.07	105.26	21.91	43	97	1000	10
84.37	107.86	21.98	44	97	1000	10
345.85	357.63	100.00	45	97	1000	10
345.85	357.63	100.00	46	97	1000	10
80.28	99.78	21.85	47	97	1000	10
345.85	357.63	100.00	48	97	1000	10
345.85	357.63	100.00	49	97	1000	10
79.89	98.59	21.94	50	97	1000	10
345.85	357.63	100.00	51	97	1000	10
345.85	357.63	100.00	52	97	1000	10
82.54	104.27	21.88	53	97	1000	10
345.85	357.63	100.00	54	97	1000	10
345.85	357.63	100.00	55	97	1000	10
86.46	111.19	22.25	56	97	1000	10
82.54	104.27	21.88	57	97	1000	10
345.85	357.63	100.00	58	97	1000	10
345.85	357.63	100.00	59	97	1000	10
81.02	101.48	21.81	60	97	1000	10
345.85	357.63	100.00	61	97	1000	10
85.07	108.94	22.07	62	97	1000	10
345.85	357.63	100.00	63	97	1000	10
84.37	107.86	21.98	64	97	1000	10
345.85	357.63	100.00	65	97	1000	10
345.85	357.63	100.00	66	97	1000	10
345.85	357.63	100.00	67	97	1000	10
79.76	98.21	21.97	68	97	1000	10
345.85	357.63	100.00	69	97	1000	10
84.11	107.33	21.96	70	97	1000	10
83.07	105.26	21.91	71	97	1000	10
80.80	101.04	21.81	72	97	1000	10
81.50	102.38	21.82	73	97	1000	10
80.28	99.78	21.85	74	97	1000	10
345.85	357.63	100.00	75	97	1000	10
345.85	357.63	100.00	76	97	1000	10
82.02	103.31	21.85	77	97	1000	10
83.85	106.80	21.95	78	97	1000	10
81.76	102.84	21.84	79	97	1000	10
82.28	103.79	21.86	80	97	1000	10
85.41	109.50	22.11	81	97	1000	10
82.28	103.79	21.86	82	97	1000	10
81.24	101.93	21.81	83	97	1000	10
80.15	99.37	21.88	84	97	1000	10
83.07	105.26	21.91	85	97	1000	10

345.85	357.63	100.00	86	97	1000	10
345.85	357.63	100.00	87	97	1000	10
345.85	357.63	100.00	88	97	1000	10
345.85	357.63	100.00	89	97	1000	10
81.76	102.84	21.84	90	97	1000	10
345.85	357.63	100.00	91	97	1000	10
85.76	110.06	22.16	92	97	1000	10
80.41	100.19	21.82	93	97	1000	10
345.85	357.63	100.00	94	97	1000	10
345.85	357.63	100.00	95	97	1000	10
80.80	101.04	21.81	96	97	1000	10
345.85	357.63	100.00	97	97	1000	10
345.85	357.63	100.00	98	97	1000	10
85.76	110.06	22.16	99	97	1000	10
345.85	357.63	100.00	100	97	1000	10



The monthly booking forecasting with training set using ANN model 6



The monthly booking forecasting with cross validation set using ANN model 6

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