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# Investigating the impact of catchment areas of airports on estimating air travel demand: A case study of regional Western Australia

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ABSTRACT

The aviation industry in Western Australia (WA) plays a vital role in the economic and social development of the state. However, accurate forecasts for passenger movements are not available to policy makers due to lack of relevant air travel demand information. The objective of this study is to estimate the domestic air passenger seat numbers between airport-pairs based on online flight information in regional WA based on a gravity model using Poisson pseudo-maximum likelihood estimation (PPML). Particularly, we aim to investigate the impact of distance, airfare, catchment areas, population, tourism and mining sector on forecasting air passenger seat numbers in order to inform and guide policy making.

This research collected appropriate data and produced valid models that represent air passenger seat numbers offered on regular public transport (RPT) air services in regional WA. The models consider both geographic and service-related variables, such as the catchment area of airports, population and number of tourists in the airport's catchment area. Two kinds of airport catchment areas are generated in this study, based on Thiessen polygon and two and half hours' driving distance. The Thiessen polygon catchment areas cover the whole WA regions, while the 2.5 h's driving catchment area covers only 32 percent of the WA region. The size of the catchment area can affect the magnitude of factors, and therefore influence the modelling results. When deciding the catchment area for the study, it is important to take the spatial distribution of factors into considerations. For both Thiessen polygon and two and half hours' driving distance catchment area, the model results illustrate that distance between airports, airfare of the flight, population of the origin airport's catchment area and the number of operating mine sites of the destination airport's catchment area are significantly correlated with domestic air travel seat capacity provided. Given the guidance from policy documents and policy makers, the results will improve the understanding of the key parameters of regional passenger aviation services and help to guide policy makers considering regional passenger aviation issues. The outcome of this study would be useful for and guide policy development.

## 1. Introduction

The aviation industry in Western Australia (WA) has experienced a noteworthy growth in recent years. It connects remote and regional areas and provides key services and resources to local communities, and tourism and mining industries. Demand is a key driving force for providing high quality and affordable air services. As shown in Fig. 1, the estimated growth rates of passenger movements at regional airports in WA between 2005 and 2010 is around 13%, which is the highest compared to other states in Australia (Department of Infrastructure and Regional Development, 2011). However, recent accurate passenger movement forecasts are currently not available to policy makers due to

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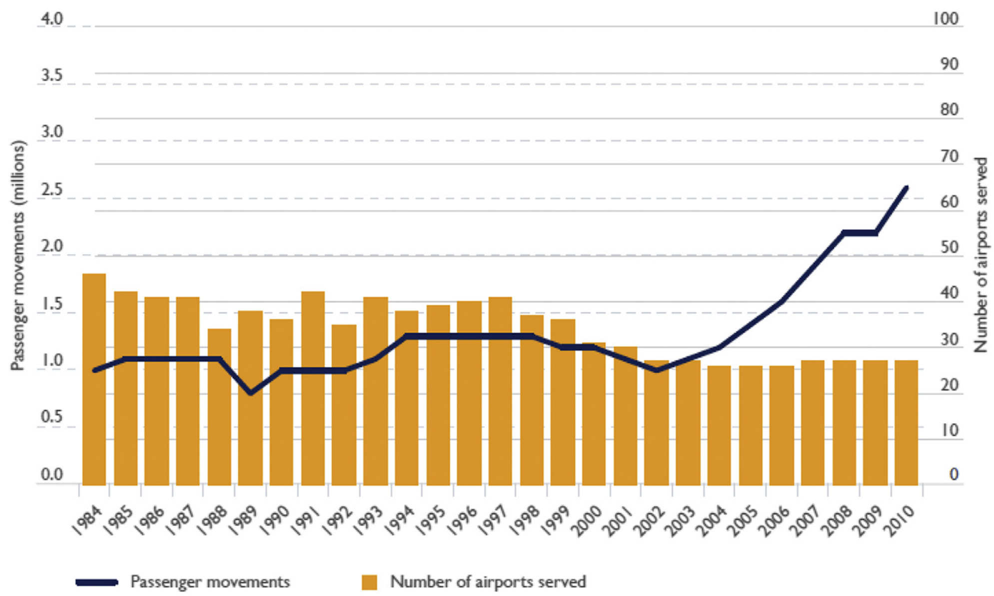


**Fig. 1.** Regional airports by passenger movement in WA (Source: BITRE time series estimates 2011 (Department of Infrastructure and Regional Development, 2011),).

lack of relevant air travel demand information (Regional Aviation Association of Australia, 2013). One of the objectives of this study is therefore to estimate air passenger seat numbers based on the flight information collected online.

Many different kinds of methods and techniques have been developed to forecast air passenger volumes, but gravity models are the most commonly employed method (Buraga and Rusu, 2014; Chang, 2012; Grosche et al., 2007; Zhang and Zhang, 2016). A modified gravity model was developed in this paper for forecasting bilateral air passenger seat numbers on domestic air routes in WA, as well as for exploring how determinant factors influence the air passenger seat numbers. The contribution of this study to existing modelling and aviation transport literature is that it considers the impact of different sizes of the airports' catchment area on air passenger seat modelling. We introduce two different methods to define airport catchment area; 1) Thiessen polygons and 2) 2.5 h' driving distance. The size and shape of these two catchment areas are indeed different. Therefore, the factors within the catchment area vary, such as population, tourist numbers and the number of operating mine sites. This will lead to differences in the air travel demand models. Furthermore, WA is currently experiencing decline from a previous mining 'boom' and the number of jobless people in the state has increased by one-third (Australian Bureau of Statistics, 2015; Deloitte Access Economics, 2014). At this critical moment, tourism has been considered as one of the major driving forces in boosting WA's economy (Hall, 2015; Tourism Western Australia, 2012). Consequently, we will test the direction and magnitude of influence of the mining industry and tourism sector on influencing air seat numbers.

In summary, the aim of this study is to forecast total available air passenger seat numbers on RPT air routes using a gravity model with Poisson pseudo-maximum likelihood estimation (PPML) based on online flight information. The models were developed based on the catchment area of Thiessen polygons and 2.5 h' driving distance separately. A case study of regional Western Australia was developed to implement the research methods. The reason we chose RPT air routes, is because the foci is on air aviation to service the general community, business and not just the mining industry, which is also serviced through closed charter flights, provided on a contract basis and not available for general travel. The outcome of this study would be useful for understanding the key parameters of aviation services and guiding policy development.[1]

## 2. Background: air passenger trips forecasting

### 2.1. Potential determinants

The results from most previous studies that applied gravity model for air passenger trips forecasting show that common factors, such as average per capita income, employment rate, distance, population and travel time were found to be correlated with air passenger volume (Binova, 2015; Chang, 2012; Dobruszkes et al., 2011; Grosche et al., 2007; Long, 1970). Generally, these driving factors can be divided into two classes; geo-economic and service-related factors (Binova, 2015; Grosche et al., 2007; Jorge-Calderón, 1997). For example, population and average per capita income of the airline serviced area are the two most widely used activity-related variables by many researchers (Binova, 2015; Chang, 2012; Grosche et al., 2007; Long, 1970). In addition, some studies also considered other activity-related factors, such as full time employment rate, employment composition and Gross Domestic Product (Buraga and Rusu, 2014; Grosche et al., 2007; Jorge-Calderón, 1997). The most commonly used geographic variable influencing the trip demand between two regions is distance. Grosche et al. (2007) noted that increasing distance can not only stimulate the competitiveness between air travel and other travel modes, but also reducing social interactions between the two regions. Apart from that, service-related variables are related to the airfare and service quality (Grosche et al., 2007; Jorge-Calderón, 1997). Travel time is an important factor, which can be related to airline service quality. This is because more frequent flights can increase the probability that air passengers can find the flights closer to their preferred departure time and reduce their waiting time. On the other hand, higher airfares can decrease the air passenger numbers, especially on those short-term air routes, since more passengers will choose other travel modes, such as bus and train instead (Grosche et al., 2007). The literature shows that some researchers ignored airfare as a factor when estimating air passenger trips because the airfare usually has a high correlation with

[1] In order for this study to be as relevant as possible, the research was conducted in close collaboration with the Department of Transport WA's Aviation Policy and Projects branch, which supports the objectives and approach.