Sydney Region Aviation Forecasts

Occasional Paper

The Paper presents methods used for forecasting future passenger and aircraft movements at Sydney Airport. Forecast movements at 5-year intervals to the year 2000 are also presented using these methods, on the basis of assumptions about the future course of many underlying determinants such as population, income, fares, aircraft types, load factors and so on. The forecasts were prepared in support of the Major Airports Needs of Sydney (MANS) Study, and embody assumptions adopted by a Forecasting Consultative Group consisting of members drawn from various Commonwealth and State Government bodies.

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BUREAU OF TRANSPORT ECONOMICS

SYDNEY REGION AVIATION FORECASTS

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FOREWORD

This Paper presents the results of work undertaken by the Bureau of Transport Economics (BTE) in support of a study of the Major Airport Needs of Sydney (MANS). The MANS study was directed by a committee of Commonwealth Government and New South Wales State Government representatives. This Committee set up a number of Consultative Groups, including one concerned with forecasting aviation activity at Sydney Airport. The BTE was a member of the Forecasting Consultative Group, and was asked to develop relationships and procedures suitable for producing forecasts of passenger and aircraft movements at Sydney. These relationships were used to produce forecasts in conjunction with assumptions made by the Consultative Group concerning forecasts of underlying factor values.

The study was carried out by a project team from the BTE's Economic Evaluation Branch. The project team was led at various stages by G.R. Carr, M.D. Fitzpatrick and A.B. Smith. Others involved in the project team were T.M. Hutton, R.O. McAndrew, S. Watt, J.N. Toms, T.M. Grant and B.R. Haddy. The interstate scheduling model was developed by A.J. Storry of the BTE's Operations Research Branch.

The BTE acknowledges the advice and information received from the Commonwealth Department of Transport, Qantas, Trans-Australia Airlines, Ansett Airlines of Australia, East-West Airlines, Masling Commuter Services and members of the Forecasting Consultative Group.

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October 1978

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SUMMARY

The Paper presents methods used for forecasting future passenger and aircraft movements at Sydney Airport. Forecast movements at 5-year intervals to the year 2000 are also presented using these methods, on the basis of assumptions about the future course of many underlying determinants such as population, income, fares, aircraft types, load factors and so on. The forecasts were prepared in support of the Major Airports Needs of Sydney (MANS) Study, and embody assumptions adopted by a Forecasting Consultative Group consisting of members drawn from various Commonwealth and State Government bodies.

A number of market categories were defined before commencing detailed analysis. The markets were defined on the basis of homogeneity with respect to the factors affecting demand, the nature of services supplied and the availability and consistency of data. The major market categories identified were international travel, interstate travel, NSW intrastate travel, NSW commuter travel and 'other aviation'. 'Other aviation' consists mainly of light aircraft engaged in a wide range of activities such as charter work and private flying.

An econometric analysis of the factors affecting passenger demand was undertaken. Variations in travel between origin-destination pairs and over time were explained in terms of variations in population, air fares measured in real terms, disposable income of individuals measured in real terms, and various other factors depending on which particular market was being analysed. The estimated relationships, together with assumptions about future growth for population, fares and so on were used as a basis for deriving origin-destination passenger forecasts.

Origin-destination passenger movements and assumptions about aircraft capacities (and in some cases their operating characteristics), load factors and network configurations were necessary for calculating passenger and aircraft movements at Sydney at a particular time in the forecast period. This process was more complex for the international and interstate markets because of the large numbers of passengers transiting through Sydney.

In addition to annual aircraft movements, within-day profiles of movements were produced for certain days of the week. These were based on current timetables but also take some account of expected changes in factors such as the business/non-business mix of passengers.

The forecasts of future passenger and aircraft movements in this study do not account for the impact congestion may have on these movements. Furthermore, the impact on demand of alternative locations for a possible new major airport for Sydney is not considered here.

Passenger movements at Sydney Airport are forecast to grow at an average annual rate of about 6 per cent between 1976 and 1985, and a little over 5 per cent between 1985 and 2000. These are lower rates than have been experienced over most of the period since the mid 1960's. The slower growth generally reflects a gradual process of saturation in the air travel market, a reduced rate of growth of population and real incomes and higher growth in real fares. Another contributing factor is the relatively low growth in the number of transit passengers at Sydney.

The commuter market is expected to experience the greatest decline in growth due, in large part, to an expectation that the market is becoming relatively mature after a phase of very rapid development. The very rapid growth of commuter travel since the late 1960's made it very difficult to establish the parameters for long-run growth in this market.

Expected growth in aircraft movements over the forecast period is significantly lower than the forecast growth in passenger movements. This is due mainly to the expected introduction of larger aircraft, and to a lesser extent to an expected increase in average load factors.

CHAPTER 1 - INTRODUCTION

This Paper presents the details and results of a study by the Bureau of Transport Economics (BTE) of the underlying relationships between the demand and supply for air travel at Sydney (Kingsford Smith) Airport and the factors which affect the various sectors of the market. The study forms part of a general review of the future Major Airport Needs of Sydney (MANS) being undertaken by a special committee including Commonwealth Government and New South Wales State Government representatives.

SCOPE OF THE STUDY

The Commonwealth/State Committee's terms of reference for the MANS study include 'identifying as far as possible, likely future trends in the demand for regular public air transport'. In pursuance of this requirement, a Forecasting Consultative Group was established to provide estimates of possible future levels of aviation activity in the Sydney region. This group consisted of representatives from the NSW Ministry of Transport and Highways, the NSW Planning and Environment Commission and the Commonwealth Departments of Transport, Finance, and Environment, Housing and Community Development, as well as the BTE. The BTE was asked to develop procedures for forecasting civil aviation activity in the Sydney region to the year 2000. These procedures were developed so that forecasts of the following variables could be obtained:

- Passenger movements at Sydney, at 5-year intervals for various market categories;

- Aircraft movements at Sydney, at 5-year intervals for various market categories, with consideration of hourly time-slots for arrivals and departures.

The BTE was directed to generate 'high', 'median' and 'low' forecasts of future levels of aviation activity at Sydney to the year 2000. This was done using BTE demand-modelling procedures. Forecasts for the underlying factors influencing demand and supply were provided by the MANS Forecasting Consultative Group. The methods used and the results of this process are presented in this Paper.

BTE INVOLVEMENT

It is emphasised that BTE involvement in this particular study differed somewhat from the usual form for BTE studies. In particular, the BTE was operating essentially as a member of a joint committee, and hence was required to use some assumptions determined on a committee basis. These would not necessarily align with those which the BTE might choose in its independent studies of the same topics.

CHAPTER 2 - APPROACH TO FORECASTING AVIATION ACTIVITY AT SYDNEY

DESCRIPTION OF AVIATION ACTIVITY AT SYDNEY AIRPORT

For a number of reasons Sydney is the most important centre of aviation in Australia. Not only is it the largest Australian city, but it also services a very large hinterland population. It therefore generates more air travel than any other Australian city. Furthermore, Sydney tends to attract a greater share of visitors from overseas countries than can be explained on the basis of its size alone. For example the number of overseas visitors to Sydney is approximately double the number to Melbourne.

In addition to its importance as an origin and destination, Sydney is a major transit port for both domestic and overseas air travel. Thus, very large numbers of Melbourne-Brisbane, Adelaide-Brisbane and Canberra-Brisbane travellers transit through Sydney Airport. Many international travellers bound for other Australian ports pass through Sydney.

Sydney is the focus of a significant network of air services within NSW. There are many relatively large country towns in NSW which are a sufficient distance from Sydney to make air travel very competitive with other modes. The increasing value which people are placing on their time is resulting in air travel increasing its share of the task even over relatively short distances.

The total number of passenger movements at Sydney Airport is currently in excess of 7.5 million per annum(1). About 120 thousand aircraft movements per annum cater for these passenger movements. It is estimated that about 30 per cent of the passenger movements are transit movements by passengers passing through Sydney. For many years, the number of passenger movements has been growing strongly, although there was a pause in this trend, for domestic travel movements, around 1976. The average long-term growth in aircraft movements has been much lower than the growth in passenger movements, mainly because of the introduction of new and larger aircraft.

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(1) A passenger movement is a passenger arrival or departure. Likewise an aircraft movement is an aircraft arrival or departure.

Sydney Airport not only handles regular air passenger services, but also caters for a wide range of other aviation activity. This includes large numbers of movements by small aircraft for private and commercial purposes (often described as 'general aviation'). Including all its components, 'other aviation' currently represents about 20 per cent of total aircraft movements at Sydney Airport.

The large volume of traffic and the upward trend in this traffic is putting pressure on the facilities at Sydney Airport. The resultant congestion is causing delays to regular passenger traffic. It is also tending to limit general aviation activity at Sydney Airport.

The forecasts of future passenger and aircraft movements in this study do not account for the impact congestion may have on those movements. The forecasts reflect expected demand for the use of facilities under normal conditions of operation. Even where congestion appears to have had some impact on demand already, such as in the case of certain categories of other aviation, it was seen as appropriate to forecast what demand would be in unconstrained conditions. These conditions could, of course, be achieved by expanding facilities.

The forecasts also are not responsive to future configurations of major airport facilities at Sydney. Thus, the impact on demand of alternative locations for a new major airport for Sydney is not considered here.

OUTLINE OF THE ANALYTICAL PROCEDURES

An earlier examination of future levels of aviation activity in the Sydney region was undertaken by R. Travers Morgan (RTM) and Partners in 1974 (RTM 1974a). The forecasts in the RTM study were reviewed in a further study by W.D. Scott and Company in 1976 (W.D. Scott 1976). The analysis by the BTE has benefited from both the studies themselves and from informed comments on them. Comments were sought from a wide range of people, including both those directly associated with the previous studies and the principal reviewers of those studies.

Broad Approach

The first stage of the study involved analysing the determinants of demand for passenger trips by air between origins and destinations. The analytical relationships developed were used to forecast future trips between origins and destinations. In some markets, forecasts of passenger movements at Sydney were obtained directly from these forecasts.

Many of the origin-destination pairs which were included in the analysis did not have Sydney as either an origin or a destination. This was necessary for two reasons. The first was to expand the information base and hence improve the confidence which could be placed in the analysis. The second reason relates to the fact that Sydney is one element in a complex network of air services. Origin-destination demands not directly involving Sydney can nevertheless have an impact on passenger and aircraft traffic at Sydney Airport.

The supply of services provided by airlines to meet future origin-destination passenger movements can be defined essentially in terms of aircraft type, load factors and network configurations. The procedures for determining future services generally allowed them to be influenced both by future origin-destination demands and various assumptions about the availability of aircraft and operating constraints. Aircraft movements at Sydney are an integral part of the overall services provided by the airlines and forecasts of these movements were therefore outputs of these procedures.

In some markets, passenger movements at Sydney Airport were also determined simultaneously from the above-mentioned procedures. Total passenger movements at Sydney include those with an origin or destination at Sydney and those with neither an origin nor a destination at Sydney but which involve calling at Sydney in transit. It was the presence of these transit movements which prevented forecasts of total passenger movements at Sydney being made independently of supply considerations. It was necessary to determine the routes taken by travellers in order to translate origin-destination movements into movements of passengers at particular airports. This was an important aspect of the overall approach to this study, given the significance of transits in relation to the total task handled at Sydney.

'Other aviation' was treated differently from the other markets, partly because it performs a variety of tasks apart from carrying passengers. As far as possible, these tasks or purposes were identified and demand was modelled in terms of aggregate hours flown for each purpose. Forecasts of hours flown were translated into forecasts of aircraft movements on the basis of a constant relationship between the two. Apart from this assumption, supply considerations did not enter the analysis.

Analysis of Demand

Chapters 3 and 4 contain a discussion of the principal passenger markets and an analysis of the factors affecting market demand. Separate markets have been defined and analysed on the basis of homogeneity with respect to the factors affecting demand and the nature of services supplied. Another criterion was the availability and consistency of data. These considerations led immediately to a distinction between international and domestic travel, and a further split of domestic travel into the interstate, NSW intrastate and NSW commuter markets(1). State boundaries have not been the determining factor in this disaggregation process, and the descriptions of interstate and intrastate, although broadly correct, are not precise. For example, the Sydney-Maroochydore route operated by East-West Airlines (most of whose services operate within NSW) has been included in the intrastate market.

Where the data were available, a further disaggregation of demand, based on trip purpose, was pursued. In the case of international travel, completely separate analyses of business and non-business travel were undertaken. In the case of the interstate and intrastate markets, the basic analysis was in terms of total demand and subsidiary analyses were carried out for various trip purposes.

The analysis of demand was based on hypotheses concerning the underlying determinants of demand in the various markets. Generally demand was expected to vary with income levels, fares and population. However, the relevant

(1) Both intrastate airlines and commuter services operate in NSW. Commuter services are a relatively recent innovation and use much smaller aircraft than the intrastate airlines.

explanatory variables differed between markets. For example, costs of travel by car influenced domestic air travel, and the volume of international trade affected demand for international business travel.

The hypotheses were tested and quantitative relationships estimated using econometric techniques. One of the features of this part of the analysis was the choice of functional forms for the demand relationships which allowed the demand elasticities(1) to vary. The result was that the elasticities tended to decline with the build-up of demand over time. This implies reductions in growth rates over the forecast period. The alternative approach of specifying constant elasticity models results in unrealistic long-term forecasts(2).

Another feature of the estimation procedures used in this study was the pooling of cross-section and time-series data. In earlier studies, a cross-sectional demand analysis(3) was performed on data relating to a particular time period(4), and was complemented by a separate time-series analysis(5) based on data aggregated over many origin-destination pairs. This procedure results in several estimates of elasticities. The pooled approach analyses cross-section and time-series data simultaneously, and estimates average elasticities. It requires a very large data base with a consequent wide range of variation in the variable values. This increases the confidence which can be placed in the analysis.

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(1) A demand elasticity is a measure of the degree of response of demand to a change in an underlying determinant of demand. In more precise terms, it is the percentage change in demand due to a 1 per cent change in the determinant.

(2) The earlier study by R. Travers Morgan (RTM 1974a) estimated constant-elasticity models, but recognised their problems for long-term forecasting. In that study, the elasticity values were reduced over the forecast period, although generally not to the extent indicated by the demand models in this study.

(3) Demand analysis using cross-sectional techniques involves relating differences in demand between different origin-destination pairs to differences in explanatory variables for those pairs.

(4) Sometimes several time periods were analysed separately.

(5) Time-series analysis involves observing variations in demand over time and comparing these with variations in explanatory variables.

The sources of air travel data for these analyses did not always provide the information in the required form. The air transport statistics published by the Department of Transport give data on passenger movements at airports and by stage length. This provided approximate origin-destination information for the intrastate and commuter markets. These statistics were inadequate as a source of origin-destination movements for the interstate market, but an alternative source provided origin-destination flows for a number of years and, when used in conjunction with the Department of Transport statistics (which extend back over a much longer time period), a satisfactory data set was obtained. A problem with these sources of domestic travel data was the absence of information on trip purpose. Separate analyses of different trip purposes had to rely on survey data for one year only.

For international travel, the Australian Bureau of Statistics (ABS) publications on overseas arrivals and departures (ABS 1976a and earlier issues) provided an excellent source in which trips could be identified by country of residence, country of destination and trip purpose.

Corresponding data for the explanatory variables (incomes, fares, populations, trade levels, etc.) came from a large number of sources, the major ones being:

- ABS publications on national income and expenditure (ABS 1976b and earlier issues), population and vital statistics (ABS 1976c and earlier issues), the consumer price index (ABS 1975a and earlier issues) and overseas trade (ABS 1976d and earlier issues);
- The Parliamentary paper on taxation statistics (Parliament of the Commonwealth of Australia 1976 and earlier issues);
- International Monetary Fund (IMF) details of international financial statistics (IMF 1976 and earlier issues);
- The United Nations (UN) monthly bulletin of statistics (UN 1976 and earlier issues).

Supply Considerations

Chapter 5 examines the current patterns and recent trends in the supply of air services, and discusses the assumptions about future services. There are several aspects of supply about which assumptions were needed in order to determine the number of future aircraft movements at Sydney for given expected patterns of passenger demand. Assumptions were made relating to the availability of aircraft, average load factors, minimum service frequencies, airport restrictions and network configurations. In some cases, assumptions relating to these factors are not sufficient to specify the supply conditions completely. These conditions are affected by demand levels and are determined as a result of analytical procedures used later in the study. This was the case for the route networks of the interstate and, to a lesser extent, the international airlines. As an important example, an assumption was made about the seating capacity of the wide-body jets expected to be introduced on the interstate market. However the numbers and deployment of these aircraft depends on the pattern of demand (among other things) and was determined with the aid of a scheduling model.

Forecasts

Chapters 6 and 7 present the forecasts of passenger movements and aircraft movements, respectively, at Sydney Airport. On the basis of the passenger demand relationships established for the various markets, forecasts of future demand for travel, on an origin-destination basis, were derived using growth assumptions for the demand-related variables decided upon by the MANS Forecasting Consultative Group. The growth rates assumed differ from those adopted in earlier studies and these differences generally contribute to a reduced growth-rate forecast in this study. It was necessary to define base levels of demand from which to derive forecasts of future demand levels. In order to remove the influence of short-run fluctuations about the long-run trends, base levels were obtained by taking a 5-year or 6-year average (depending on the market category under consideration) of demand levels about 1973. The base average for 1973 was then extrapolated forward to 1976 using the actual growth rates which occurred on the demand-related variables before applying the growth assumptions provided by the Forecasting Consultative Group.

In the case of intrastate and commuter travel, forecasts of passenger movements at Sydney were obtained directly from the origin-destination forecasts. Forecasts of aircraft movements for these markets were determined from passenger forecasts and assumptions about aircraft sizes and load factors.

Forecasts of international and interstate passenger movements at Sydney, which include transits, were determined simultaneously with route networks and aircraft movements. Origin-destination passenger demands influenced the route networks and aircraft movements at Sydney and all these factors affected the number of transits and hence total passenger movements at Sydney.

International travellers were allocated to Australian international airports of embarkation or disembarkation on the basis of various assumptions. The number of passenger and aircraft movements through Sydney also depends on the flight patterns of international airlines in Australia, and in particular whether flights to and from Melbourne also call at Sydney en route. It has been assumed that airlines will gradually reduce the proportion of their Melbourne-bound flights calling at Sydney.

For the interstate market, a linear programming model has been used to determine flight patterns by aircraft type and the allocation of passengers to the various flights and hence the passenger and aircraft movements at Sydney. The model minimizes the operating costs of airlines consistent with certain operating constraints and forecast origin-destination passenger demand levels.

Qualifications

The forecasts have been developed on the basis of many assumptions. In a number of cases the sensitivity of the forecasts to these assumptions has been tested and reported in this Paper. For example, the effect on passenger demand and aircraft movements of alternative growth rates for income and fares was examined, as was the effect on aircraft movements of the introduction of different aircraft types in several of the markets.

There are other qualifications or restrictions which are more difficult to quantify. The forecasts presume that the general socio-economic climate pertaining to aviation remains unchanged. If the status quo of the industry with regard to competition between airlines, or between aviation and other modes, is expected to be seriously disrupted, perhaps by legislation or extreme variations in industry economics, the forecasts obtained from the relationships established through the examination of historical trends would need modification. For example, widespread charter operations could have a profound effect on future developments in the industry. The international forecasts are based upon historical trends in some geographic regions in which there was considerable social upheaval and civil war. It has not been possible to identify the influence of these events on international travel demand, and the possible impacts of future social and political disturbances in those regions closely associated with travel to and from Australia are not examined in this Paper.

On the domestic side, two possible developments could influence the forecasts of long-run demand levels. These are the erosion of the aviation market through advances in telecommunications and the considerable improvement in the competitive position of other modes. Discussions were held with Telecom Australia on the extension of the Confravision market and the introduction of video-telephone facilities. Technical resource constraints and market development aspects make it unlikely that these innovations will have a major impact upon the level of aviation activity before the year 2000. Furthermore, it is uncertain that these facilities will be used as substitutes for travel. Some studies by Telecom indicate that face-to-face meetings will still be important, and innovative telecommunications technology may be supplementary to travel.

The second development of potential relevance to domestic aviation activity could be substantial improvements to major roads. The Hume Highway is gradually being converted to dual carriageways and significant portions of other intercapital highways are being upgraded. The distance between cities is such that these investments will not reduce the time of road travel sufficiently to cause a significant proportion of interstate business travellers to go by road. They may, however, have some impact on the leisure sector of the market. The influence of road developments on air travel is difficult to establish(1). The effects on the interstate markets during the study period would probably be limited to the Sydney, Canberra and Melbourne links. Some intrastate routes may also be affected. Revisions to government priorities have reduced the level of road investment and have tended to erode development plans. Given the cross-elasticity measurement difficulties and the uncertainty surrounding the timing of road investments, it has not been possible to include the impact of road development in the derivation of aviation forecasts.

(1) Estimates of the price and time cross-elasticities between road travel and demand for air travel were derived when modelling interstate and intrastate markets respectively. Some doubts remain, however, regarding the accuracy of these measurements.

CHAPTER 3 - MARKETS

As in the earlier study by RTM (RTM 1974a), demand for air services has been disaggregated according to types of services in this study. The types of services (or 'markets') used in the study are international, interstate, intrastate, commuter and 'other'[(1)]. The first four of these are treated on a passenger basis, while 'other aviation' is treated on an aircraft activity basis because of its special characteristics. While this study is centred on activity at Sydney Airport, information relating to areas outside the Sydney region had to be included for estimating demand relationships in some cases. Brief details of this are as follows:

- The international market was analysed using information on international passenger movements into and out of Australia as a whole;
- The interstate market was analysed using information on Australia-wide domestic air transport passenger movements;
- The intrastate and commuter markets were analysed using information on those passenger movements throughout NSW which involved Sydney Airport;
- The 'other aviation' market was analysed on the basis of hours flown on an Australia-wide basis.

Despite the wide geographic dispersion of information used in the study, the main thrust of the analysis is directed towards activity at Sydney Airport. In view of this, the relative impacts of the international, interstate, intrastate and commuter markets on passenger movements at Sydney Airport are shown in Table 3.1.

The total number of passenger movements through Sydney Airport has grown at an average of almost 11 per cent per annum over the last decade. There has been considerable variation in the growth rates of passenger movements at Sydney

(1) 'Other aviation' consists mainly of light aircraft engaged in a wide range of activities such as charter work and private flying. Only a small number of movements in this category involve heavy aircraft.

within the different markets. The growth in passenger movements at Sydney Airport for international services was 15 per cent per annum. For interstate services the growth was 10 per cent per annum, and for intrastate services the growth was 6.5 per cent per annum. For commuter services the corresponding growth rate was 30 per cent per annum. The rapid growth in this period is associated with substantial rises in real incomes, a growing migrant population, falling fares in the international market, and population growth in Sydney and in centres such as Canberra, the Gold Coast, Perth, Albury and Tamworth.

TABLE 3.1 - PASSENGER MOVEMENTS THROUGH SYDNEY AIRPORT[(a, b)]

Market	('000)	Per cent of total
International	2323.5	30.7
Interstate	4330.3	57.3
Intrastate	816.0	10.8
Commuter	91.3	1.2
Total	7561.1	100.0

(a) Excludes passengers on non-scheduled domestic flights (e.g. charters, private flights).

(b) Average movements for 3 years ending June 1976.

Sources: Department of Transport (1976a and earlier issues).

Department of Transport (1977a and earlier issues).

Unpublished information provided by the Department of Business and Consumer Affairs.

THE INTERNATIONAL MARKET

The international travel market is covered by a comprehensive set of official statistics which allow this market to be further disaggregated according to travellers' intended duration of stay and journey purpose. As indicated earlier this market was analysed on an Australia-wide basis. Table 3.2 shows the international passenger movements into and out of Australia segregated into various categories. Four basic types of travel movement are identified -

permanent, long-term, transit[1] and short-term. Short-term movements are those by travellers whose actual or intended period of stay or absence is less than 12 months. By far the most important of these categories is that involving short-term movements, which accounted for 83 per cent of the total Australian international market over the period examined.

TABLE 3.2 - INTERNATIONAL PASSENGER MOVEMENTS INTO AND OUT OF AUSTRALIA BY TRIP PURPOSE[a]

Type	('000)	Per cent of total
Permanent	124.9	4.9
Long-Term	184.1	7.2
Transit[b]	125.5	4.9
Short-Term:		
Business		
Overseas visitors to Australia	196.6	7.7
Australian residents going overseas	259.0	10.1
Leisure		
Overseas visitors to Australia	613.5	24.0
Australian residents going overseas	1053.4	41.2
Total	2557.0	100.0

(a) Average movements over the 3 year period ending June 1976. Note that these figures refer to total movements into and out of Australia, in contrast to the figures given in Table 3.1. The latter refer solely to Sydney Airport, and include transits through Sydney.

(b) Transit movements in this case refer to persons on international flights who stopover at Australia en route to other countries.

Source: Australian Bureau of Statistics (1976a and earlier issues).

Total international passenger movements into and out of Australia (through all airports) have grown in aggregate at approximately 19 per cent per annum over the past decade. Most of this growth has occurred in short-term movements which have increased at an average rate of 22 per cent per annum. In contrast, the number of long-term movements into and out of

(1) 'Transits' refer to passenger movements which do not involve any purpose other than changing aircraft, waiting while an aircraft is serviced and so on. This concept is treated in detail later.

Australia has grown at 4.5 per cent per annum, and the number of permanent movements has declined at 3 per cent per annum. Transits have grown at about 15 per cent per annum. These differences in growth patterns, together with the known differences in factors generating growth, suggest that the demand relationships for each segment within the international market should be modelled separately.

THE DOMESTIC MARKETS

It would be desirable to examine the domestic markets on a basis similar to that adopted above for the international market. However, the information available on trip purposes for domestic travel is sparse. Some in-flight surveys by the major airlines were available up to 1973, but the information provided was not in a suitable form for a complete analysis. The best data available on domestic trip purpose for interstate and intrastate travel are those from an RTM (RTM 1974a) survey at Sydney Airport for a three-month period in 1973. Despite some mild criticisms concerning seasonal influences, some undesirable features in drawing the sample and its outdatedness, the data were accepted as suitable for analysis by trip purpose.

In an attempt to overcome such problems it was decided, for domestic travel, to concentrate upon the relationships and forecasts of total traffic using a large data base extending over many routes and time periods. It would then be possible to undertake a supplementary analysis of the RTM survey data in order to establish the factors which influence the proportion of total travel for the various trip purposes. Table 3.3 shows a breakdown of domestic passenger movements at Sydney Airport by trip purpose, as determined using RTM survey data for 1973.

Although the interstate and intrastate airlines dominate the domestic passenger market, commuter services have recently become significant in terms of aircraft movements. NSW commuter operators use small aircraft and generally service small towns. The Sydney-Newcastle route is by far the busiest commuter link, with an average service frequency of around 35 minutes.

TABLE 3.3 - DOMESTIC PASSENGER MOVEMENTS BY TRIP PURPOSE AT SYDNEY AIRPORT, 1973[a]

(per cent)

Market	Business	Non-Business	Total
Interstate	62.7	37.3	100.0
Intrastate	42.0	58.0	100.0

(a) Excludes commuter travel, non-scheduled operations and 'other aviation'.

Source: RTM (1974b).

CHAPTER 4 - PASSENGER DEMAND RELATIONSHIPS

In general, the passenger demand relationships in this study are derived from an econometric analysis of pooled cross-section and time-series data for each of the markets examined. The method involved simultaneously relating changes in passenger flows across routes and over time to the corresponding changes in socio-economic factors affecting demand. Generalised least-squares regression techniques were used to determine the coefficients of demand. For the less significant elements of the international market, simple time-series analyses were undertaken. For the various elements of 'other aviation' demand was measured in terms of hours flown rather than passengers, and relationships were again modelled using a time-series approach.

In each of the more significant passenger markets examined, a wide variety of routes was selected and the changes were observed over an extensive number of time periods. For example, analysis of the international market for non-business travellers included fourteen different routes and twelve years of quarterly observations. This breadth of analysis draws in a vastly increased data base and permits a wider range of independent variables to be examined for their influence on demand than was the case in previous studies. For example, it allowed for the influence of seasonal factors and intrinsic route characteristics. A detailed description of the regression results is provided in Appendix I.

Results of the BTE's investigations show that three factors explain most of the variation in demand for air travel. These factors are population changes, income changes and fare changes. Other factors peculiar to specific markets (such as the competitive cost of car travel in the case of domestic services) were also found to have an important influence on demand. However, such influences were generally isolated to particular parts of the markets, and were of only minor consequence in explaining the growth in demand across all markets.

Historical trends in the major explanatory factors show considerable differences both between markets and between specific routes. Growth in population has been much higher in some overseas countries[(1)] than in Australia, and it has been lower in New South Wales than for the nation as a whole. International

(1) But not necessarily those involving significant travel links with Australia.

air fares have declined in real terms at a faster rate than domestic air fares. They have also changed at different relative rates between countries. Domestic fares across different routes have changed at much the same rate. The historical variations in income levels, whilst relatively similar between regions in Australia, differ greatly between international regions. For example, in Australian dollar terms, there has been a differential of up to eight per cent per annum in the growth rates of income levels per capita between countries over the historical period examined.

INTERNATIONAL DEMAND RELATIONSHIPS

The international travel market was disaggregated according to the intended duration of stay. The categories examined involved short-term, permanent, long-term and transit movements. By far the most important of these categories was that covering short-term movements, which accounted for 83 per cent of the total international market over the three-year period ending June 1976. Each category was examined separately.

Short-Term International Movements

To establish the influence of factors affecting growth in the short-term international travel market, four behavioural models were developed. These models were used to examine the demand for travel according to whether travel was for business or non-business purposes and whether persons travelling were Australians travelling overseas or overseas residents visiting Australia.

Variables were selected to explain short-term travel by purpose on fourteen major routes to and from Australia. The variables included real first class, economy and excursion fares, real income levels, exchange rates, Australian trade levels with each country, country populations and the numbers of migrants.

An important implication of the analysis was that the degree of responsiveness of demand to changes in the determinants (i.e. the elasticity of demand) varied both across routes and over time. The elasticities were generally higher on routes with low levels of demand per capita and this was consistent with a greater potential for growth on these routes. In general, the elasticities also declined over time, reflecting a reduction in the scope for further growth as markets gradually saturate.

Business travel by Australian residents going overseas expressed as a proportion of the Australian population was related to the level of business travel in the previous quarter, the level of real imports per capita, and real air fares. For some routes, demand was affected by other unidentified factors and the analysis was adjusted to account for these effects. As expected, the statistical estimation procedure revealed that demand for business travel responded positively to an increase in the level of imports and negatively to an increase in fares.

The wide variation in elasticities created difficulties in providing a precise quantitative summary of the total situation. However, the results indicated that business travel by Australian residents going overseas is relatively unresponsive to changes in real air fares and changes in the level of real imports per capita; that is, a proportional change in either air fares or imports would cause a lower proportional change in business travel. The fact that the level of business travel in the previous quarter was a significant explanatory variable implied that business travellers do not adjust immediately to changes in air fares and import levels.

The analysis of business travel by visitors to Australia was developed in a similar fashion. However, it was necessary to measure the trade and fare variables in the currency of the relevant overseas country, and to deflate these variables using overseas consumer price indices. This was done in order to capture changes in the perceived values of these variables by potential travellers resident in each of the overseas countries examined. It was then necessary to modify the variables by an exchange rate factor in order to express them in terms of a common unit. Again, demand was observed to respond in the expected direction to changes in the fares and trade variables, with the degree of responsiveness being fairly low. Perhaps the most noticeable outcome of the models developed for both categories of business travel was that trade levels rather than income levels proved to be significant in determining the amount of business travel between Australia and overseas countries.

Leisure travel by Australians going overseas expressed in per capita terms was explained in terms of the levels of real fares, real disposable income and the proportion of the Australian population born in the overseas country. The migrant variable was included in an attempt to capture the large amount of ethnic travel. Again, account had to be taken of unidentified factors affecting specific routes. The results of the estimation indicated that demand responded to changes in the underlying factors after a time lag.

Leisure travel by visitors to Australia was regressed on similar variables to the model for Australians visiting overseas. In this case the income variable related to the overseas country of origin. Both income and fares were deflated by the consumer price indices of the individual origin countries and brought to a common unit of measurement by use of an exchange rate factor. The exchange rate also played an independent role in the demand relationship, since it reflects the purchasing power of travel budgets in Australia in comparison with alternative destinations. This provides an indication of the extent to which changes in total trip cost, as opposed to changes in air fares alone, influence travel. As the relative worth of the Australian dollar changes in relation to the currencies of other countries the attractiveness of Australia to visitors also changes. One further factor affecting the number of visitors to Australia is the number of Australian-born migrants in the country of origin.

In both analyses of leisure travel, demand was found to respond positively to increases in income levels and migrant populations and negatively to increases in fares. The degree of responsiveness of the leisure markets to changes in fares and incomes varies widely over routes and over time. Overall, leisure travel by Australians overseas was observed to be highly responsive to income changes and much less so to fare changes. On the other hand, visitors from overseas were more responsive to fare changes than income changes. The relatively high responsiveness of visitors to fare changes may be due to the large range of alternative destinations with which Australia must compete.

Permanent International Movements

It was found impracticable to model the demand for permanent movements, as the number of permanent movements into and out of Australia is largely a function of Commonwealth Government policy towards migration. For the purposes of forecasting future levels the approach adopted was to examine the historical trends for permanent departures and arrivals in order to arrive at a likely net migration flow.

Long-Term International Movements

The historical trends in long-term movements were examined in terms of arrivals and departures and according to whether travellers in each category are Australian residents or overseas visitors.

Long-term arrivals and departures by Australian residents were separately regressed and satisfactorily explained simply by growth in the Australian population.

Long-term arrivals by overseas residents have been subject to large fluctuations over time and no satisfactory relationship explaining the historical growth pattern was found. Since no trend is evident, the average number of arrivals per annum for the nine years ending 1975 of 26,000 has been used as an indication of future demand in this market.

The number of overseas visitors departing Australia each year was satisfactorily related to variations in the migrant component of the Australian population. The analysis indicates that for every 1 per cent increase in the migrant component of the Australian population the number of long term departures by overseas visitors increases by approximately 1.8 per cent.

Transit Movements

International transit movements are classified into four categories and are a function of airline route structures, airline timetables, and air traffic regulations. 'Transit I' refers to persons who arrive on an international flight from overseas and leave the transit lounge but subsequently leave Australia on an international flight. 'Transit II' refers to persons who arrive on an international flight and who wait in the transit lounge for a connecting flight out of Australia. Both these categories apply only to overseas residents. A simple time series was fitted to the annual data for Transits I and II combined from 1969 to 1975. On average these transit movements have increased by 31,000 per annum.

'Transit III' refers to persons on international flights who stopover in Sydney before disembarking at other Australian ports of call. 'Transit IV' refers to persons arriving at (or leaving) Sydney on domestic interstate air services for the purpose of connecting with an international flight. There are no time-series data on these categories of travel. Historically, Sydney has been the main port of disembarkation as well as the major transit port for international airlines. Most international airlines have preferred to make Sydney their first port of call in Australia. The 1973 RTM survey results (RTM 1974a) and certain gateway assumptions were used to determine an allocation matrix for proportions of international passengers travelling on domestic interstate services by origin and destination. This information is necessary for determining Transit IV passengers at Sydney. To determine Transit III passengers, assumptions about the flight patterns of international airlines in Australia are required. These assumptions are discussed in Chapter 7.

INTERSTATE DEMAND RELATIONSHIPS

The demand for interstate passenger traffic through Sydney Airport accounted for approximately 57 per cent of all passenger movements at Sydney for the three years ending June 1976, and has grown at an average of 10 per cent per annum over the past decade.

A comprehensive model of the demand for air travel should consider the effects of modal characteristics such as speed, cost of travel, frequency of service and so on (including the characteristics of alternative transport modes) and socio-economic characteristics such as population, incomes, cultural and recreational attractiveness of destinations and the general state of the economy. In practice, constraints on the availability of data and the measurability of some characteristics restrict the comprehensiveness of the approach. In this analysis, the lack of data on travel by alternative modes, particularly car and bus, has limited the multi-modal nature of the model developed. The analysis in respect of the business and non-business sectors of the market was constrained to using data obtained in the 1973 RTM survey.

The model developed in this study to explain variations in the demand for interstate air travel excludes persons travelling on a domestic flight to connect with an international flight (that is, the international Transit IV category mentioned earlier) from the analysis since they are primarily affected by variables related to international travel rather than by those factors thought to influence typical interstate travel. The model shows that variations in the quarterly demand for interstate travel (excluding Transit IV) across twelve capital city pairs are almost totally explained by variations in population products[(1)], fare levels, costs of car travel, income levels, seasonal changes and intrinsic destination attractions. The analysis reveals that the variations in total demand for interstate travel are positively related to changes in real disposable incomes of individuals, the perceived cost of car travel[(2)], and in population products. However, they are negatively related to changes in perceived cost of air travel. These four factors, together, explain most of the increase in demand for interstate travel.

As with international travel, the income and fare elasticities of demand for interstate air travel tend to be greater in magnitude on routes with lower levels of demand per head, and gradually decline over time as demand builds up. Overall, demand is currently very responsive to changes in income and fares. It is much less responsive to changes in population and the perceived price of car travel.

A particular feature of interstate passenger movements is the strong seasonal pattern exhibited on most routes. The model formulated takes account of seasonal variation through inclusion of dummy variables at peak travelling periods. Inclusion of route dummy variables accounts for differences in the levels of demand across routes due to factors not covered by the other explanatory variables included in the model.

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(1) For a particular city pair, this is the product of the population for each member of the pair.

(2) Essentially the cost of petrol.

In order to allocate the forecasts of total interstate passenger traffic into business and non-business categories, a subsidiary analysis of the RTM survey data on interstate travel by trip purpose was undertaken. Two factors, population product[(1)] and the perceived cost of air travel, were found to explain more than 90 per cent of the differences in propensity to travel between origin-destination pairs for both business and non-business purposes. A number of other factors thought to affect the demand for travel were tested. These included differences in travel time by air, car and rail and differences in income. Regression analysis was not able, however, to establish these factors as significant explanators of demand. Perhaps the most surprising feature of the analysis was the non-significance of disposable income, particularly in respect of non-business travel.

INTRASTATE DEMAND RELATIONSHIPS

For the purposes of this study, intrastate travel was defined as travel within New South Wales[(2)] on either Ansett Airlines of New South Wales or East-West Airlines. The average number of intrastate passenger movements through Sydney Airport for the three years ending 1976 was 816,000 or approximately 10.8 per cent of total passenger movements at that airport. Over the past decade, intrastate passenger movements through Sydney Airport have grown at 6.4 per cent per annum.

Models explaining variations in intrastate passenger demand levels were developed in a similar manner to those for the interstate market. Variables were selected to first explain the variations in total (business and non-business) demand on services to 31 regional centres during the eight-year period ending June 1975. The demand for air travel by trip purpose was separately modelled using the 1973 RTM survey data and the relationships established used to allocate the forecasts for total intrastate passenger traffic into business and non-business categories.

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(1) As defined earlier.

(2) Certain services such as between Sydney (NSW) and Maroochydore (Qld), and Alice Springs (NT) are treated as intrastate services in keeping with the nature of general operations of the airline.

As intrastate travel is inherently short-haul, and hence particularly sensitive to competition from other modes, the analysis paid particular attention to the intermodal effects upon demand. The variables examined in the total demand model to measure intermodal effects were the perceived cost of travel by car and total travel times by air relative to road travel[1].

The analysis shows that nearly 70 per cent of the variation in total demand for intrastate air travel is explained by variations in population product, the perceived cost of air travel, real disposable income per capita and variations across routes of travel time by air relative to road. Some interim results suggested that relative costs may also be important, but this variable could not be confidently established in the final equation.

The analysis indicates that intrastate travel is more responsive than interstate travel to changes in population product, but less responsive to changes in fares.

Demand for air travel by purpose was examined using single-period (1973) cross-section survey data. The separate influences of road costs and road travel times could not be measured, because the driving time and the cost of car travel are both proportional to road distance. Also, the relative travel cost and relative travel time variables were highly correlated across routes.

The number of persons travelling intrastate by air on business was related to regional population, the perceived cost of air travel and a relative travel time variable for air versus car travel. Route dummy variables accounted for other differences in demand levels between regions.

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(1) Total travel time by air is defined as the scheduled flight time between Sydney and the appropriate regional airport plus the airline coach journey times between the airports and the city terminals. The fares were adjusted to include the cost of journeys to and from airports. Road was selected as the most likely alternative mode, in view of the contracting level of rail services and the limited number of intrastate bus services. Distance by road was used as a proxy for road travel time. This assumes that the average speed by road is similar in all travel corridors. As in the interstate model, the perceived cost by road reflects the cost of petrol.

Similar variables explained the variations in demand for air travel for non-business purposes, with the addition that variations in income were identified as having a positive influence on demand. In general, the elasticities for business travel were found to be less in magnitude than those for non-business travel.

COMMUTER DEMAND RELATIONSHIPS

Commuter operators are defined as those who operate under Regulation 203[1] of the Air Navigation Regulations. The commuter industry has experienced a rapid expansion in numbers of operators on immature routes, and has all the characteristics of an 'infant' industry passing through the rapid development phase. This rapid development phase is a particularly difficult one in which to establish the parameters likely to determine long-term growth in demand.

Six commuter routes from Sydney were selected as sufficiently mature (by 1971) to be modelled. Like the relationships for international, interstate and intrastate travel markets, the demand relationships for commuter travel were derived from an analysis of pooled cross-section time-series data. Between 1971-72 and 1975-76 passenger traffic on these routes grew from 29,000 to 99,000 (or 35.6 per cent per annum) and together accounted for about 90 per cent of total commuter passenger movements through Sydney in 1975.

The analysis indicated that demand for commuter travel is positively related to changes in population product and real disposable income per capita. No division into business and non-business categories was attempted. As expected, the elasticities on commuter travel are very much higher than those for either interstate or intrastate markets.

'OTHER AVIATION' DEMAND RELATIONSHIPS

This segment of air transport proved extremely difficult to model. The data available were of a macro nature, and were ill-suited for the purposes of this study. For the most part, the models presented in Appendix I should not be regarded therefore as representing behavioural relationships.

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(1) This is the regulation which permits holders of charter licences to operate regular services without obtaining an airline licence, subject to certain conditions.

The demand for 'other aviation' (in terms of hours flown) was examined after identifying various categories - charter (excluding commuter), flying training, business, private, aerial work, and test and ferry. Because of some concern over definitional problems, the private and business categories were combined and test and ferry operations were grouped with aerial work for analysis purposes. As statistics on a state basis were available only from 1970-71, the models developed were tested using annual Australia-wide data from 1963-64. Future levels of demand for Sydney Airport were subsequently determined after consideration of available State statistics on 'other aviation' between 1970-71 and 1975-76, and unpublished statistics for aircraft movements at Sydney.

Demand for charter services, after removal of the commuter component already examined, grew at 5.8 per cent per annum between 1963-64 and 1974-75. Typical economic variables offered little explanation of how the demand for charter services has changed, and a behavioural type analysis was abandoned. A simple trend curve was fitted to the historical growth pattern.

Flying training was found subject to enormous variation, and no clear trend was evident. A variety of models tested were unsuccessful in providing a satisfactory explanation of the data. For the purposes of forecasting, it was decided to use a five-year base average around 1973 and allow this base level to follow the trends in population levels.

Combined demand for business and private flying grew at an average of 14.5 per cent per annum between 1963-64 and 1974-75. The historical growth pattern was largely explained by changes in gross operating surplus levels of business as a whole(1) and changes in aircraft rent. The analysis suggests that demand for business and private flying is elastic to changes in both gross operating surplus and aircraft rent.

The demand for aerial work grew at an average 14.4 per cent per annum between 1963-64 and 1974-75. In view of the heterogeneous composition of aerial work, which includes aerial surveys, aerial spotting, advertising, ambulance operations, glider and towing, and search and rescue services, a simple time

(1) As reported in ABS (1976b and earlier issues).

trend was fitted to the historical growth pattern. To this category was added test and ferry operations, which grew at an average 1 per cent per annum between 1963-64 and 1974-75.

CHAPTER 5 - SUPPLY

Over the past fifteen years there has been a considerable change in the pattern of air services as markets have become more mature and larger aircraft have become available and more economic to operate. International air services have been the subject of most change, with constantly increasing traffic, changes in route patterns, changes in the numbers of competing airlines, increases in aircraft carrying capacity and the opening of new airports.

INTERNATIONAL AIR SERVICES

The number of international airlines operating to Australia increased from twelve in 1964 to twenty-three in 1976. The three major operators throughout this period were Qantas Airways, Air New Zealand and British Airways.

In 1964, most airlines operated early versions of jet aircraft with seating capacities of around 140 passengers. Since 1964 airlines have tended to replace and expand their fleets with larger aircraft. The most commonly operated aircraft at present is the Boeing 747 with typical seating capacity for about 400 passengers. This aircraft is particularly suited to routes with high-density traffic and is used on most international routes to and from Australia. A more recent development is operation by the Boeing 747SP model with 260 seats. This aircraft is operated by Pan American Airways and South African Airways, and is particularly suited to long-haul routes with low-density traffic.

Despite the increases in aircraft seating capacities and numbers of operators serving Australia, passenger load factors appear to have been at least maintained. In 1964, the proportion of available seats filled over all routes on services provided by Qantas was 56.7 per cent. In 1976, the corresponding load factor was 61.2 per cent.

Recently, there have been some changes in the domestic links of international flights. These changes have been aimed at increasing aircraft utilisation and operating efficiency and at the same time providing a better service to travellers. This has occurred with two developments. These are the opening of two new international airports and the introduction of a route 'triangulation' system. With the opening of Tullamarine Airport (1971) and the Brisbane International Terminal (1975) there has been a gradual shift in the supply of some services from Sydney Airport to these airports.

A significant proportion of international flights to and from Australia call at Sydney twice and Melbourne once. They arrive at Sydney from overseas, travel to Melbourne and return to Sydney before departing again. Such flights are generally under-utilised on the Sydney - Melbourne link. Recently, there has been a move by some airlines to overcome this problem by triangulating the route so that flights arrive in Australia at Melbourne and depart from Sydney, or vice versa. The extent to which triangulation is expected to occur in the future is discussed in Chapter 7.

DOMESTIC AIR SERVICES

The two-airline policy of the Commonwealth Government has tended to regulate changes in the supply of air services by the major domestic airlines. The introduction and deletion of services by the two major airlines have tended to occur simultaneously and in parallel fashion. New aircraft have also been introduced to the system in parallel, even though particular types of aircraft are not necessarily competing on the same routes.

The 1976 fleet size of Trans-Australia Airlines and Ansett Airlines of Australia, excluding aircraft on lease or charter to other operators, totalled 72 aircraft. The working life of most aircraft in the fleet is generally assessed at 12 years. There is a common belief by the airlines that the working life of future aircraft will be 15 to 20 years. Table 5.1 provides a summary of the age structure and type of aircraft in operation as at 30 June 1976.

The replacement of ageing aircraft by larger sized aircraft has tended to introduce discontinuities in the trends of the number of aircraft movements and the average number of passengers carried per aircraft movement. Thus, during the introduction of the Boeing 727-100 series aircraft on Brisbane routes, aircraft movements at Brisbane fell by nearly 4 per cent between 1966 and 1967, while passenger movements at Brisbane Airport went up by 5 per cent. The replacement of turbo-prop aircraft with DC9-30 aircraft had an even more dramatic effect at Canberra Airport. At Canberra, aircraft movements fell from 17,927 in 1970 to 17,023 in 1972 (a 5 per cent drop), despite an increase in passenger movements from 542,000 to 671,000 (an increase of 23 per cent).

TABLE 5.1 - AUSTRALIAN MAJOR DOMESTIC AIRLINE FLEET AT 30 JUNE 1976

Aircraft Type	Total Fleet	Age Structure		
		Up to 5 yrs	5-10 yrs	10-15 yrs
Boeing 727-100 (108 seats)	10	-	6	4
Boeing 727-200 (137 seats)	12	12	-	-
DC9-30 (97 seats)	24	4	20	-
F27 Series[(a)] (36-44 seats)	26	2	12	12
Total	72	18	38	16

(a) Most of these aircraft are used on intrastate links.

Sources: Department of Transport (1976b and earlier issues).
Airline Annual Reports.

Load factors on the interstate network have gradually increased as passenger traffic has became heavier. The growing proportion of non-business travellers has tended to smooth out morning and evening traffic peaks, whilst off-peak travel concessions have encouraged people to travel on previously half-empty planes. Over the last fifteen years, average passenger load factors have increased from around 60 per cent to 66 per cent. The growing trend towards higher load factors is expected to continue in the future.

Unlike the two major airlines, the two intrastate airlines operating through Sydney Airport (Ansett Airlines of New South Wales and East-West Airlines) operate on different networks and are not constrained to operating similar aircraft. The services of Ansett Airlines of NSW are predominantly to rural centres such as Wagga, Dubbo and Griffith. A notable exception is the service to the North Coast centres of Coffs Harbour and Casino. By way of contrast, the services of East-West Airlines are expanding and the route network includes growth centres such as Albury, Bathurst-Orange, Tamworth and popular tourist centres such as Maroochydore and Coolangatta. At present both airlines are operating F27 type aircraft with available seating capacity for 52 persons.

Average passenger load factors are currently around 67 per cent for Ansett Airlines of NSW and 62 per cent for East-West Airlines. For the three years ending June 1966 the average load factor on Ansett Airlines of NSW was 47 per cent and that of East-West Airlines 59 per cent. The increase in proportion of available seats filled is associated with an increase in the propensity to travel, a changing business/non-business travel mix and endeavours by both airlines, but particularly Ansett Airlines of NSW, to rationalise services and concentrate on large centres only.

Commuter services are in a stage of rapid growth and development. There are at present ten operators providing commuter services into and out of Sydney's Kingsford Smith Airport. In 1970 there was one operator and prior to 1967 there were none. Between Sydney and Newcastle, an at least hourly service is presently provided by both of the operators on this route (Masling Air Commuter Services and Aeropelican Commuter Air Services). The route is serviced by Twin Otter aircraft capable of seating up to nineteen passengers. On other commuter routes, operating frequencies are much lower, and smaller aircraft with 8 to 10 passenger seats are generally used.

Present passenger load factors on the Sydney-Newcastle route are around 67 per cent. On other routes load factors are typically lower, ranging from 50 per cent down to around 20 per cent on some newer routes.

FUTURE AIR SERVICES

The state of aircraft technology, curfews, technical operating constraints, market requirements and the cost of airline operations will largely determine the future supply of air services.

Competition, especially between international carriers, is likely to ensure that technology is up-to-date and the most modern aircraft are used in airline operations. The current international airline trend to wide-body aircraft with increased seating capacities and reduced operating costs per passenger seat is expected to continue and to spread to domestic air transport as markets grow.

During the analysis it was of some concern to know whether or not curfews, imposed on account of noise levels, were likely to be continued in the longer term. Since December 1972 there has been a curfew on jet movements between the hours of 11 p.m. and 6 a.m. at Adelaide, Brisbane and Sydney Airports. The present pattern of services could change (especially with regard to Perth) if the curfew was extended to Perth and Melbourne. This could reflect back into traffic at Sydney Airport. After discussion with various technical authorities, including the airlines, it would seem noise is not likely to be a long-term problem. Noise levels of some wide-body aircraft are presently below the Electra turbo-prop aircraft (for which the curfews do not apply) and are considered likely to be reduced even further on new aircraft types. On the strength of this information, no change in curfew hours to those presently imposed is contemplated, in spite of the possibility that the general public will become increasingly sensitive to noise pollution.

Market requirements necessitate minimum numbers of flights to be available on each route in order that airlines provide a satisfactory level of service. Where demand does not support such levels of flight frequencies, either the services operate at lower average passenger load factors or indirect flights are used.

As well as being an important terminus Sydney is a major transit port for travellers with other origins and destinations. In this study, it is presumed that the airlines plan their network so as to minimise the operating costs of the total network (consistent with achieving technical operating constraints and minimum service frequencies). In other words, whenever it is more economical for the airlines to route passengers through Sydney in preference to providing a direct flight the airlines are presumed to do so. This interaction between demand and supply is most important in the interstate market, where the pattern and size of origin-destination demands suggest that a wide range of route networks may be appropriate for future airline operations. The transit problem is also significant for the international sector. However, it is much less severe for intrastate and commuter services, as the majority of passenger trips terminate or originate in Sydney and 'transits' through Sydney are minimal.

Future International Services

Important factors affecting the forecasts of international services at Sydney concern the future role of Melbourne and Brisbane airports and the likely route pattern on international flights between Melbourne, Sydney and overseas destinations. The number of international aircraft movements at Sydney is presently almost twice the combined total at Melbourne and Brisbane, despite similarities between population bases and the importance of Melbourne and Brisbane as business and tourist centres. The situation partly reflects patronage requirements, and partly reflects the international flight patterns in Australia, with the airlines providing most of their direct services to Sydney. The forecasts developed in this study incorporate a gradual shift in the supply of services with Sydney playing a less dominant role in the future.

The present flight pattern of many international flights to Australia involves calling first at Sydney, then flying to Melbourne and back to Sydney before departure for overseas. This pattern has the effect of doubling the number of aircraft movements at Sydney compared to Melbourne for such flights. In this study, it is presumed that future international flight patterns between Sydney and Melbourne will be increasingly unidirectional, that is, from overseas airports to Sydney, then to Melbourne and directly to overseas airports or vice versa. This assumption is referred to in the study as the 'triangulation' assumption and is particularly relevant to understanding the reasons underlying the forecast growth in international aircraft movements. The effects of triangulation are discussed in Chapter 7.

Future Interstate Services

Future air services at Sydney on the interstate network will be strongly influenced by airport landing restrictions, the introduction of wide-body aircraft, changes in the expected working life of aircraft and changes to route flight patterns. It is assumed that no airports on the interstate network will have landing restrictions on Boeing 727's or wide-body aircraft. At present, there are restrictions on these aircraft at Mackay, Mount Isa, Coolangatta, Rockhampton, Hobart, Launceston, Alice Springs, Townsville and Cairns[(1)].

The aircraft most used on the present interstate network are DC9-30's (97 seats), B727-100's (108 seats) and B727-200's (137 seats). These aircraft are expected to be replaced progressively with wide-body aircraft from the early 1980's. The first wide-body aircraft are expected to have a seating capacity of 235-240 seats, which on average will be double the seating capacity of aircraft they are replacing. For any given number of passengers, the introduction of wide-body aircraft would lead to a marked reduction in the numbers of aircraft movements necessary to meet demand. The precise impact at Sydney airport will depend on the numbers of wide-body aircraft introduced, whether the minimum flight frequencies imposed are active constraints and the particular routes on which wide-body aircraft are used.

The working life (before retirement from interstate service) of aircraft currently used on the interstate network is around twelve years. As the life of aircraft increases, the replacement period for the introduction of larger aircraft is correspondingly extended (unless airlines choose to replace aircraft before they reach their full economic life). This has the effect of delaying the introduction of aircraft with larger seating capacities and consequently reducing the impact on aircraft movements. The situation is illustrated by comparing the effects of 12 and 15 year working lives for aircraft. With an age expectancy of up to 12 years, the forecasts of interstate aircraft movements at Sydney in 1990 are 63,560. The same forecast using a 15-year life expectancy is 73,460, an increase of nearly 10,000 aircraft movements or 16 per cent.

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(1) For the purposes of deriving aircraft movements using the aircraft scheduling model, to be discussed later, the interstate network has been defined to include all the major routes of Trans-Australia Airlines and Ansett Airlines of Australia. As a result some intrastate routes such as Brisbane-Cairns and Darwin-Alice Springs are included.

As was the case for international aircraft movements, the interstate forecasts of aircraft movements also reflect an important triangulation assumption. At present air travellers wishing to travel from Adelaide to Canberra or Brisbane do so almost entirely in stages involving a stopover at Melbourne or Sydney. Persons travelling between Canberra and Brisbane must stopover at Sydney. The forecasts in this study assume the introduction of a greater number of direct flights between Adelaide, Canberra and Brisbane. This reduces the necessity for passengers to transit through Sydney, and hence tends to reduce the number of aircraft movements there.

Future Intrastate Services

The forecasts developed in this study assume a minimum flight frequency of two flights per week to each regional airport. For this study, it is assumed that the existing regional airports will continue to be served. This view is consistent with forecasts of continually increasing demand. If there is a contraction in the number of airports served by intrastate airlines, it is assumed that there will be feeder services to nearby airports. The consequent reduction in aircraft movements at Sydney could be quite small. By 1985, it is assumed that Albury-Wodonga will have landing facilities for DC9-30 aircraft.

The most important factors influencing the forecasts of intrastate services at Sydney are the assumptions on passenger load factors and aircraft size. A load factor of 67 per cent has been used, which is slightly greater than the overall average at present. For major ports a 55-seat version of the F27 is expected to be used in the early part of the forecast period, with progressive but slow replacement by 80-100 seat aircraft from the mid 1980's (with the timing of introduction varying depending on the particular route).

Future Commuter Services

It is expected that aircraft capacities on the Sydney-Newcastle route will be increased throughout the forecast period. By the year 2000, thirty-seat aircraft are expected to be in use. On other routes, aircraft sizes are not expected to be increased above the present 8-10 seat capacities before the late 1980's. However, 16-seat aircraft are anticipated to be introduced in the latter part of the forecast period.

Average passenger load factors vary across routes. For 1985 a value of 70 per cent was assumed for Sydney-Newcastle, and an average of 67 per cent for other routes. These are significantly higher than the present levels but are consistent with increasing maturity of the various routes. The load factors are forecast to build up even more beyond 1985.

CHAPTER 6 - PASSENGER FORECASTS

In order to establish the likely levels of future demand for the various markets from the estimated relationships, it was necessary to forecast those factors which were found to influence demand. The values adopted in this report were established by the Forecasting Consultative Group, and are based upon the best information available to the Group. Where possible confirmation or assistance was sought from expert bodies outside the consultative group. Nevertheless, it is important to note that these values do not necessarily reflect BTE views.

Three sets of forecasts were generated - namely, high, median and low forecasts. The variations in these forecasts result from variations in the assumptions about the future growth in income, population and fare levels. Sensitivity tests had shown that the forecasts were particularly sensitive to small changes in the growth rates of both incomes and fares. The high forecasts were generated on the basis of high values for future income and population growth, and low values for future fares, in relation to the assumptions for the median forecasts. In the case of the low forecasts, low values for future incomes and populations only were used.

With respect to the future growth rate of the real disposable income of Australians, the Forecasting Consultative Group was unable to decide between the advice given by two expert bodies whose opinions varied from 1.5 per cent per annum to 3.0 per cent per annum. It was therefore decided to generate the median forecast based on a long-term growth rate of 2.25 per cent per annum. For the high and low forecasts, growth rates of 3.0 and 1.5 per cent per annum were used respectively. These growth rates relate to the entire forecast period.

The population levels assumed for Australia and for each State were derived from consideration of the 1971 and 1976 census data, the NSW Planning and Environment Commission's population projections for that State and recent studies completed by the Department of Environment, Housing and Community Development. From these considerations high, median and low population forecasts were developed. The median population forecasts were less than those developed for the Borrie Report (National Population Enquiry 1975) and adopted in the Role Study (W.D. Scott 1976).

The forecast growth rates assumed for most of the variables relating to overseas countries are based upon historical growth rates which were derived from United Nations statistical publications. The high and low growth rates on overseas incomes and populations bear the same sort of relativities to the median assumptions as assumed for the Australian variables.

Probably the greatest uncertainty amongst the independent variable forecasts concerns the likely growth trend in real air fares. In this Paper it is assumed that the current level of competition between international airlines will be maintained and that the major domestic airlines will need to justify fare increases to the Commonwealth Government. In these circumstances, fare increases are more likely to result from cost pressures than from a shift in market situations. After consideration of the airline cost structure, the nature of future aircraft types, and trends in such elements as labour costs and domestic and international fuel prices, the set of future air fare changes shown in Table 6.1 was assumed. As indicated earlier the growth rates assumed in the set of low forecasts are the same as for the median forecasts.

TABLE 6.1 - FUTURE GROWTH RATES FOR REAL AIR FARES

(per cent per annum)

	Median		High	
	1976 to 1985	1985 to 2000	1976 to 1985	1985 to 2000
International				
Business	-0.5	-0.6	-0.5	-0.6
Non-business	-2.5	-0.6	-2.5	-0.6
Interstate	2.0	-0.7	0.0	-0.7
Intrastate	1.5	-0.3	0.0	-0.3

Table 6.2 provides a summary of the forecasts obtained for each market. Details of procedures for forecasting origin-destination flows and of assumptions regarding various factors are given in Appendix II. Appendix III deals with conversion of passenger movements to aircraft movements, and also covers the question of transits. More detailed forecasts are provided in Appendix IV.

Basically future passenger demand is obtained by substituting for forecast future levels of the explanatory variables in the passenger demand relationships. The procedure is based upon the routes used to establish those relationships. These routes were taken as representative of all travel and the routes excluded from the demand analysis were assumed to have similar growth patterns to the routes studied. On some international routes, unrealistic forecasts resulted from the model projections and adjustments were necessary.

INTERNATIONAL PASSENGER FORECASTS

For the international market, it was necessary to forecast passenger movements for Australia as a prelude to determining the number of movements through Sydney. The Sydney component was derived after allocating total travel to and from Australia to the various States on the basis of historical data published by the ABS (ABS 1976a and earlier issues), and then assigning the state levels of demand through airports on the basis of likely service at each airport. The assumptions used for allocating travellers to the various international airports of embarkation of disembarkation are given in Appendix III.

The forecast volume of travel to and from each State through the international airports reflects an important change in the historical division of supply of international services between Sydney and Melbourne. The passenger forecasts reflect the view that there will be a growing supply of international services at Melbourne, thereby avoiding the necessity for many Victorian-based or destined travellers to transit through Sydney.

The forecast for international passengers through Sydney by 1985 is approximately 4.5 million, an increase of 1.9 million (or 75 per cent) on 1976. The forecast growth rate is approxiamtely 42 per cent of the historical growth

TABLE 6.2 - FORECAST PASSENGER MOVEMENTS AT SYDNEY AIRPORT

('000)

	1976 [(a)]	1980	1985	1990	1995	2000
High Forecast						
International	2529	3912	4732	5514	6924	8542
Interstate	3973	6096	8926	12878	18160	24584
Intrastate	826	1170	1605	1856	2146	2484
Commuters	112	146	213	298	400	521
Total	7440	11324	15476	20546	27630	36131
Median Forecast						
International	2529	3675	4549	5189	6416	7775
Interstate	3973	5419	6708	9722	13326	17575
Intrastate	826	1082	1401	1591	1807	2052
Commuters	112	134	183	245	314	396
Total	7440	10310	12841	16747	21863	27798
Low Forecast						
International	2529	3459	4239	4706	5666	6755
Interstate	3973	5102	6371	8966	12013	15879
Intrastate	826	972	1165	1291	1431	1587
Commuters	112	122	152	189	230	276
Total	7440	9655	11927	15152	19340	24497

(a) For the financial year ending 30 June 1976. The figures provided for 1975-76 are estimates only because of the problems of measuring the numbers of transit passengers. They are based on several sources of information, none of which measure exactly the categorisations of travel used for this study.

rate observed between 1968 and 1976. The slower growth rate is attributable to the expected gradual saturation of the markets, the expected reduction in population growth and real incomes, an expected reduction in net immigration movements, and the assumed shift in supply of services to Melbourne. After 1985, the forecast growth rate is expected to slow even further, largely as a result of the reduction in the rate of decrease of air fares for non-business travel.

INTERSTATE PASSENGER FORECASTS

The interstate forecasts are obtained after applying the demand model to each of the Sydney-oriented routes included in the analysis. The level of passenger demand for the Sydney-based routes not included was measured on the assumption that the demand relationships established for the twelve major routes included in the analysis were equally applicable to these other routes. The forecasts of total interstate passenger traffic obtained by this process were allocated into business and non-business categories according to the ratios obtained after extrapolating the demand relationships by trip purpose. The level of transit (domestic and international) passengers through Sydney was established from a consideration of future airline services and demand flows. The method used to establish transit forecasts is described in Chapter 7 and detailed in Appendix III.

An overall feature of the median interstate forecasts is the considerably reduced growth rate forecast (6 per cent per annum over the whole forecast period) compared with the historical growth rate (around 10 per cent per annum). The slower growth rate is attributable to a slowing down of the historical increase in propensity to travel, reduced population and income growth and the expected increase in the real price of air fares. Adoption of the assumptions of a 2.0 per cent per annum increase in real air fares and 2.25 per cent per annum increase in real incomes to 1985 are of particular significance. If the historical growth assumptions for personal incomes at 4 per cent per annum and real fares at 0.5 per cent per annum are adopted, then the forecast growth rate on passenger movements jumps to 8.1 per cent per annum.

The interstate forecasts include a growing proportion of non-business travellers, as might reasonably be expected with increases in real disposable incomes playing a major role in generating air travel for leisure purposes. A factor encouraging a fairly low growth for domestic passenger movements through Sydney Airport is the assumed introduction of new routes between Brisbane, Adelaide and Canberra. The forecasts also include comparatively low growth for international Transit IV category (that is, persons travelling on an interstate airline for the purpose of connecting with an international flight) reflecting the expectation of an increased supply of international services at Melbourne[1].

INTRASTATE PASSENGER FORECASTS

The forecast levels of intrastate travel are developed from an analysis of passenger flows through thirty-one regional airports. For this type of travel, Sydney is presumed to be the origin or destination, and the number of intrastate travellers through Sydney Airport is assumed to correspond with these forecast levels. The forecast growth rate of 1985 for intrastate travel is similar to that for interstate travel. However, the growth in intrastate travel drops off considerably over the latter part of the forecast period.

COMMUTER PASSENGER FORECASTS

As with the intrastate sector, commuter forecasts were based directly on the analysis of passenger demand with no identification of a separate transits category. It was not possible with the data available to provide any indication of the business/non-business split. The forecast growth rate of 5.3 per cent per annum to 1985 compares with the historical growth rate of 33.7 per cent per annum between 1969 and 1976. The slower growth rate is associated with lower growth rates on population and income, and declining market elasticities. The decline in market elasticities is a reflection of the rapid development phase through which the industry has progressed. On the Newcastle-Sydney link for example, patronage more than doubled from 1971 to 1973. However, from 1974 to 1975, the increase in patronage was only 3.3 per cent.

(1) Forecasts of Transit IV movements at Sydney are obtained from a model which determines international passenger and aircraft movements at Sydney from international origin-destination forecasts, and which is described in Appendix III.

Despite the effects of these influences some further qualification on the forecast growth for commuter travel is warranted. First, the rapid development phase of the commuter industry has made it particularly difficult to establish the parameters for long-run growth. The pooled cross-section and time-series approach tends to underestimate growth, particularly in the shorter term. Second, the forecasts ignore the possibility of a switch in patronage from the Sydney-Newcastle service operated by Trans-Australia Airlines (TAA) to commuter services, and vice versa. The forecasts on passenger movements between Sydney and Newcastle by TAA are included in the forecasts for interstate passenger movements. A switch in patronage from either TAA or commuter services, perhaps as a result of the airlines attempting to avoid duplication and to rationalise services, could have a large influence on the forecast growth rate for the commuter market.

The predicted levels of commuter passenger demand by route (through Sydney) are shown in Appendix IV.

CHAPTER 7 - AIRCRAFT FORECASTS

Separate forecasts of aircraft movements have been developed for each market category. Each forecast takes into account the expected origin-destination passenger demand levels, seating capacities of aircraft, landing restrictions and minimum flight frequencies desired by airlines for each route. These considerations presume a knowledge of the types of aircraft available and their average load factors in the forecast period. In this respect, the Forecasting Consultative Group has been largely guided by advice received from the Department of Transport and various airline fleet planning authorities.

With intrastate and commuter travel, the services mostly radiate from Sydney and no major scheduling problems are encountered with traffic growth. In the case of international traffic, a number of assumptions were made relating to the scheduling of aircraft through the international airports in order to derive the number of movements at Sydney.

The interstate routes form a more complex network of airline services, with Sydney a major transit point on domestic flights. Aircraft movements at Sydney are sensitive to shifts in demand which have nothing to do with Sydney origin-destination passengers. Therefore, it was necessary to undertake a more detailed study to determine likely aircraft movements.

Table 7.1 provides a summary of the forecast aircraft movements at Sydney Airport by each market category at five year intervals from 1980 to 2000. The high, median and low forecasts derive directly from the corresponding passenger forecasts.

INTERNATIONAL AIRCRAFT FORECASTS

The forecasts of international aircraft movements at Sydney Airport are derived from a consideration of the forecasts of origin-destination flows of passenger movements on an Australia-wide basis, with subsequent allocation to each Australian international airport. This was coupled with assumptions concerning direct and indirect service routes by airlines, average loading capacities (proportion of available passenger seats filled) on aircraft and

TABLE 7.1 - FORECAST AIRCRAFT MOVEMENTS AT SYDNEY AIRPORT

('000)

	1976[a]	1980	1985	1990	1995	2000
High Forecast						
International	19.5	22.5	21.7	22.6	24.1	26.6
Interstate	54.1	79.9	97.3	106.2	133.4	147.2
Intrastate	27.6	33.3	43.5	50.2	52.7	61.0
Commuters	19.5	21.2	24.5	27.8	30.9	34.3
Other Aviation	30.9	42.4	49.1	56.9	65.9	76.4
Total	151.6	199.3	236.1	263.7	307.0	345.5
Median Forecast						
International	19.5	20.2	20.9	21.3	22.6	24.5
Interstate	54.1	69.1	72.0	73.5	91.3	100.0
Intrastate	27.6	30.8	38.0	43.1	44.4	50.4
Commuters	19.5	19.5	21.0	22.9	24.3	26.1
Other Aviation	30.9	41.2	47.2	53.2	59.4	65.9
Total	151.6	180.8	199.1	214.0	242.0	266.9
Low Forecast						
International	19.5	19.0	19.5	19.4	20.1	21.5
Interstate	54.1	65.1	61.2	58.2	72.9	85.4
Intrastate	27.6	27.7	31.6	35.0	35.2	39.1
Commuters	19.5	17.6	17.4	17.5	17.7	18.3
Other Aviation	30.9	38.2	41.2	44.4	47.9	51.6
Total	151.6	167.6	170.9	174.5	193.8	215.9

(a) For the financial year ending 30 June 1976.

rules for establishing the extent of 'triangulation' between Melbourne and Sydney for each airline[1]. A full description of how the forecasts for international passenger movements were converted to aircraft movements is provided in Appendix III.

A feature of the international forecasts provided in Table 7.1 is the low growth, particularly to 1985. The low growth largely reflects the progressive introduction of larger aircraft, increasing load factors, shifts in the supply of services to Melbourne and 'triangulation' between Melbourne and Sydney.

The introduction of larger aircraft is of major significance in holding down expected future aircraft movements. Between 1976 and 1985 the average seating capacity is expected to increase from 164 seats to 376 seats or by 129 per cent, whilst patronage is expected to increase by 136 per cent over the corresponding period.

The average passenger load factor for overseas flights is assumed to increase from 60.8 per cent in 1975 to 63 per cent in 1985 and to 70 per cent in the year 2000. This increase in load factor also tends to reduce the number of forecast aircraft movements. If the forecasts were to assume the same average load factor as achieved in 1975, the median forecast in 1985 of international aircraft movements at Sydney Airport would increase by approximately 550 movements (or about 3 per cent).

The assumptions concerning the scheduling of services at Melbourne and Sydney are associated with an increase in the number of travellers using Melbourne as the port of embarkation/disembarkation on international flights, a reduction in the proportion of these travellers transiting through Sydney, and an increase in the average load factor on the Sydney-Melbourne links of international flights. In the absence of these changes, the forecast of passenger movements at Sydney would be higher by 273,000 movements (or 6 per cent) in 1985 and the forecast of aircraft movements would be higher by 2100 (or 10 per cent).

---

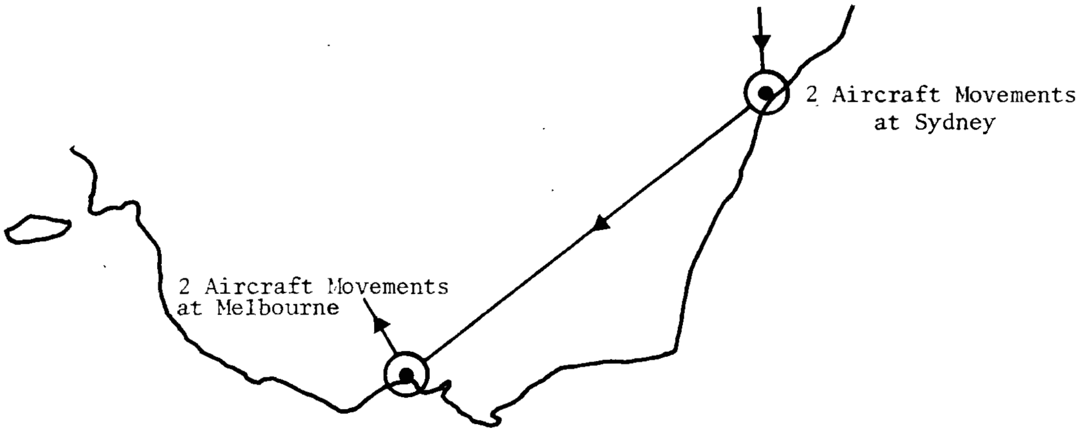
(1) 'Triangulation' refers to an overseas service calling once at Sydney and once at Melbourne. At present, many services call twice at Sydney and once at Melbourne.

The most important part of the scheduling assumptions relates to the routing of indirect flights through Melbourne and Sydney and has been referred to as the 'triangulation' assumption. The two alternatives for indirect routing are illustrated in Figure 7.1. In each case, both Sydney and Melbourne are serviced and the same number of travellers are taken to and from overseas destinations. From Figure 7.1 it can be readily seen that an international flight into and out of Australia involves two aircraft movements at Sydney with triangulation, compared with four movements without triangulation, which is currently the far more common pattern. The forecasts are based on a gradual trend towards the triangulated pattern. If the forecasts are re-generated using the low level of triangulation existing in 1976, the median forecast in 1985 for international aircraft movements at Sydney Airport increases by approximately 1,900 movements.

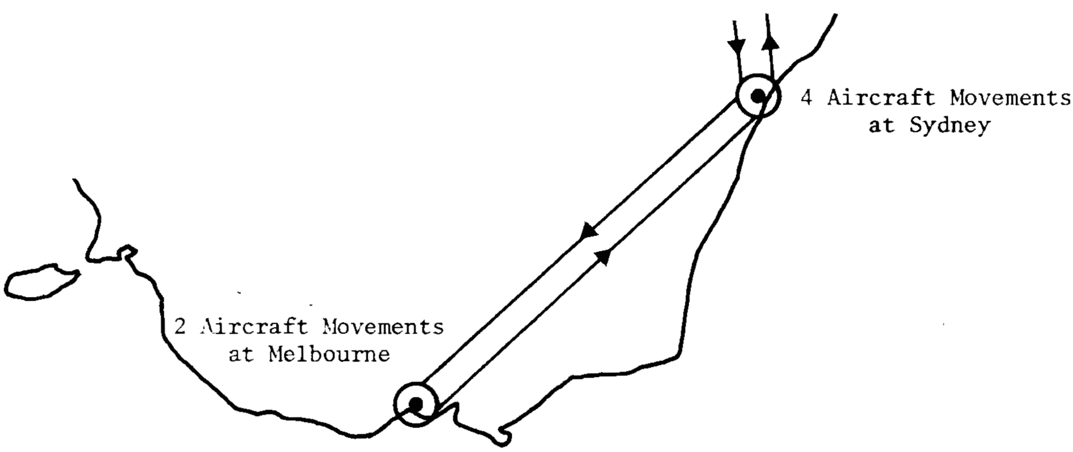
INTERSTATE AIRCRAFT FORECASTS

The special network problems associated with interstate air services were overcome with a scheduling model developed in the BTE. The model uses a linear programming technique to determine the optimum routing and number of aircraft movements for given demand levels. The model minimises the operating costs of airlines consistent with meeting constraints imposed by technical requirements and the forecast origin-destination passenger demand levels. The basic inputs to the model are:

- Passenger demand between city pairs;
- Maximum load factors (proportion of total available seats occupied) and minimum service frequencies for each possible service link;
- Technological data on each aircraft type, including seating capacity, flight times and turnaround times;
- Direct operating costs for each aircraft type, split into fixed and variable components;
- Restrictions on aircraft type and movements per week at each airport.



WITH TRIANGULATION



WITHOUT TRIANGULATION

FIGURE 7.1 - ALTERNATIVE INTERNATIONAL FLIGHT PATHS
INVOLVING SYDNEY AND MELBOURNE

The output of the model includes the number of flights on each route according to aircraft type as well as the allocation of passengers to direct and indirect services. The model is also used as a basis for determining domestic passenger transits at Sydney Airport. A full description of this model is given in Appendix III.

A feature of the interstate aircraft forecasts shown in Table 7.1 is the large increase in movements between 1990 and 1995. These intervals correspond to periods in which there is very little change in the airline fleet mix and very little consequent change in available seating capacities.

The forecasts proved particularly sensitive to assumptions concerning landing restrictions, seating capacities, expected working life of aircraft and dates for the introduction of new aircraft.

It has been assumed in this study that current landing restrictions on larger aircraft at Mackay, Coolangatta, Rockhampton, Hobart, Launceston, Alice Springs, Townsville and Cairns will be lifted by 1985. If landing facilities are not upgraded at these airports, then the airlines would be forced to operate some smaller aircraft with a possible resultant increase in aircraft movements at Sydney.

During the analysis, both interstate airlines expressed the view that in addition to wide-body aircraft they could forsee the possibility of a somewhat smaller 'intermediate' aircraft (having 180 to 200 seats) being introduced in the early 1980's. A sensitivity analysis on this possibility shows that the introduction of such an aircraft would not affect the forecasts of aircraft movements at Sydney by as much as one might first expect. The airlines would tend to use such aircraft on short distance flights and less dense routes. Probably only the Canberra-Sydney and Sydney-Coolangatta links would be affected. If such aircraft were to be introduced, a corresponding increase in forecast interstate aircraft movements of some 3,000 (or 4.4 per cent) in 1985 and some 6,800 (9.2 per cent) in 1990 could be expected.

The forecasts assume an average working life of 15 years on most aircraft. If the working life of an aircraft is extended, there is a delay in the introduction of new larger aircraft and a consequent increase in aircraft movements. If the expected life of new aircraft is extended to 20 years (a possibility suggested by some people in the airlines), there would be a very significant increase in the forecasts of aircraft movements. Table 7.2 summarises the effect.

TABLE 7.2 - SENSITIVITY OF MEDIAN FORECASTS OF INTERSTATE AIRCRAFT MOVEMENTS TO AIRCRAFT WORKING LIFE

Year	15-year working life	20-year working life	Per cent increase
1985	71,980	75,770	5.3
1990	73,460	82,470	12.3
1995	91,300	91,350	0.1
2000	100,030	103,430	3.4

INTRASTATE AIRCRAFT FORECASTS

Briefly, aircraft movements at Sydney are calculated directly from forecast passenger movements to the various airports and from the assumed passenger load factor and aircraft sizes operating to the airports. Over most of the period there is consistent and substantial growth in aircraft movements generated by the growth in passenger demand. By soon after the year 2000 aircraft movements are expected to have doubled. There is, however, a period of very slow growth in movements after 1990, when 80-seat aircraft are introduced on a number of routes.

The forecasts are sensitive to changes in the load factor and, much more so, to changes in assumptions about aircraft sizes. If the assumed passenger load factor of 67 per cent in 1985 was increased to 72 per cent, this would result in a reduction in the 1985 forecast of intrastate aircraft movements of 8 per cent. There is some possibility that larger aircraft (100-seat aircraft instead of 80-seat aircraft) will be introduced earlier and on more routes than has been assumed in the forecasts. If this were to eventuate, facilities at a substantial number of airports would need to be upgraded in order to take the larger-size aircraft. A detailed sensitivity analysis on the basis of assumptions broadly reflecting this view indicates that aircraft movements would fall after 1985 and would not regain their 1985 levels until after 2000.

A full description of the assumptions for converting intrastate passenger movements to aircraft movements is provided in Appendix III, and a more detailed breakdown of the aircraft movement forecasts by region is provided in Appendix IV.

COMMUTER AIRCRAFT FORECASTS

Calculation of future movements by commuter aircraft was similar to the approach used for intrastate services. Commuter aircraft movements at Sydney Airport are forecast to grow slowly in the early years of the forecast period, following the very rapid recent growth associated with the establishment of the industry. Passenger demand will continue to grow, but most of this growth will be absorbed in increasing load factors and, in the case of the Sydney-Newcastle route, increased use of the larger Twin-Otter aircraft. Later in the forecast period, the increase in load factors is certain to be very much less, but increasing average aircraft capacities will keep growth in aircraft movements down to a modest rate.

'OTHER AVIATION' AIRCRAFT FORECASTS

'Other Aviation' includes all aircraft movements which are not regular passenger flights scheduled by the intrastate, interstate and international airlines or commuter services. It consists of charter (both heavy and light aircraft), flying training, private and business flying, test and ferry operations, aerial work, military flights and freight-only flights. Helicopter movements and through flights are not included.

The forecasts are based on an analysis of hours flown using Australia-wide data for each of the major components (charter, flying training, private and business flying and aerial work). The relationships established are used to forecast hours flown in New South Wales for each major component. Future growth rates in the independent variables, gross operating surplus and aircraft rentals, were required. For the former the median growth rate for income was used; for the latter the median rate for intrastate fares was used. The forecast hours flown were totalled over the major components and the resultant growth pattern was assumed to be the same as the aggregate growth pattern of all components of 'other aviation' operating out of Sydney Airport. This growth pattern was then applied to the base for all 'other aviation' aircraft movements at Sydney Airport.

The median forecasts show aircraft movements for this market category growing at about 2.5 per cent per annum to the end of the century. The forecasts for this sector presume an absence of any constraints on operations by this sector at Sydney Airport. This assumption has been employed throughout this study, and applies equally to all the markets. However, it is particularly important to stress it in relation to 'other aviation', because constraints on parts of this sector have already been operating for several years. As a result, there has been a noticeable diversion of light 'other aviation' traffic from Sydney Airport, which was not reflected in the historical relationships established for the forecasts. Unlike the other markets, the high and low forecasts for 'other aviation' are not the result of specific variations of the assumptions on the independent variables, but simply represent an arbitrary bound straddling the median forecast.

DAY PROFILE FORECASTS

Table 7.3 shows the estimated daily pattern of aircraft movements for a Friday at Sydney Airport in 1985 and 2000, excluding movements for 'other aviation' and assuming unconstrained growth for each market.

More detailed profiles are shown in Appendix IV. The profiles shown in Table 7.3 correspond to the busiest day of a typical week for the median passenger forecasts, and take account of the effect of changes in business/non-business passenger mixes, changes in aircraft speed, changes in route structure and the influence of restrictions caused by curfews.

TABLE 7.3 - EXPECTED MEDIAN PROFILE OF AIRCRAFT MOVEMENTS AT SYDNEY AIRPORT[a]

Time Period	Arrivals		Departures	
	1985	2000	1985	2000
0600-0659	9	9	7	12
0700-0759	11	14	22	27
0800-0859	16	20	21	27
0900-0959	16	24	12	19
1000-1059	14	20	16	22
1100-1159	14	20	12	16
1200-1259	6	8	12	19
1300-1359	11	13	11	13
1400-1459	12	12	12	18
1500-1559	13	21	14	14
1600-1659	12	14	17	23
1700-1759	17	25	18	22
1800-1859	14	22	22	20
1900-1959	24	30	17	24
2000-2059	15	15	12	19
2100-2159	20	29	6	8
2200-2259	3	7	3	6
2300-2359	-	-	1	1
Total	227	303	235	310

(a) Excludes 'other aviation' aircraft movements. Figures relate to movements on a Friday (a 'busy day') of a typical week.

The demand profiles for international travel were determined from a consideration of current airline schedules, introduction of new flights, changes in flight patterns and restrictions caused by curfews at Sydney and other international airports.

The interstate scheduling model outlined earlier does not provide a 'within-day' profile of aircraft movements, and it was necessary to develop a supplementary model which assigned aggregate forecasts of aircraft movements into arrivals and departures by time slots. The assignment procedure was constrained by the number of available aircraft, the desired travel time of passengers and the necessity for route connections. The assignment method accommodated forecast changes in aircraft speed and type, shifts in the business/non-business mix, and changes in flight patterns. A description of the method of assignment is given in Appendix III.

A method similar to that adopted in the earlier RTM study (RTM 1974a), but based on current timetables, was used to determine the daily pattern of intrastate and commuter services.

The forecast profiles for a busy day, although reasonably representative of the total scene, are not necessarily so for each market category. In the case of interstate travel, for example, the busy days of a typical week are Friday and Sunday. Although the total movements on each of these days are approximately equal, the profile for a Sunday is very different to that for a Friday. There is little or no travel for business purposes on a Sunday. Aircraft movements spread further into the day and peak very much later in the evening. It should also be noted that arrivals are not equal to departures in Table 7.3. This is explained by the fact that the profiles are only for one day, and arrivals and departures would be equalised over a longer period. Day profiles were not produced for 'other aviation'. Available information indicates that aircraft movements for this sector varied erratically in the short-term.

CHAPTER 8 - CONCLUDING REMARKS

Assessment of future airport requirements for Sydney is clearly a complex process, involving many social, economic and technical issues. This Paper has presented comprehensive details of one aspect of the BTE's involvement in the assessment process. The end result of this involvement was to arrive at a set of models which would describe demand for passenger travel by air as it affects Sydney. These models were then used to forecast likely levels of passenger and aircraft movement at Sydney Airport to the year 2000. While the models themselves are of considerable value in a broad sense, primary interest at this stage is centred on the forecasting procedure for which they were used.

The results indicate that with unconstrained growth, passenger movements at Sydney Airport by the year 2000 could be almost five times the 1976 level in some circumstances. Over the same period, aircraft movements could more than double (again in the appropriate circumstances). The discrepancy between these figures is due to increasing aircraft size, changes in passenger load factors and variations in the balance between the various markets involved. The BTE's median forecasts, however, suggest that passenger movements at Sydney Airport in the year 2000 would be around 28 million, an increase of some 275 per cent over the 1976 level. The corresponding aircraft movement figure would be 267,000 (an increase of around 75 per cent).

Despite these dramatic increases, the forecast growth rates in passenger movements are lower than those recorded in all categories examined over the decade to 1976. The forecast growth in aircraft movements is also lower than general historic levels.

There is obviously a great deal of uncertainty associated with forecasting events over 20 years ahead. This is particularly the case in an industry as dynamic and complex as air travel. This uncertainty has been recognised to some extent by the provision of high and low forecasts.

A major contribution of this study has been the specification of a framework within which the various factors that bear upon the number of aircraft movements at Sydney can be integrated. Considerable analysis of individual factors has been undertaken but it would clearly be a worthwhile activity to carry out further research in a number of areas. For example, further research is needed on passenger demand relationships and on likely future trends in some explanatory factors such as income, fares and the quality of service. Advances in these areas would of course be useful in assessing the outlook for aviation activity throughout Australia, and not simply at Sydney.

Finally, the BTE repeats that choice of values for some of the underlying determinants of demand used in this study was not primarily a BTE responsibility. The values in question were laid down by the Forecasting Consultative Group set up in support of the MANS study.

APPENDIX I

SPECIFICATION OF PASSENGER DEMAND MODELS

This Appendix describes the approach used in this study to analyse air passenger transport demand. It also describes the statistical relationships upon which the forecasts included in this Paper were based. Brief descriptions of the variables are provided with the presentation of the equations. More detailed descriptions of variables and indications of data sources are provided in the last Section of this Appendix.

The models described below are essentially long-term models which seek to explain changes in passenger flows (numbers of trips), both across origin-destination pairs and over time, in terms of changes in socio-economic factors affecting demand. The models developed attempt to describe average behaviour patterns of travellers in various markets. To this end, total demand was disaggregated into international, interstate, intrastate, commuter and 'other aviation' markets, and each market was examined separately. The international, interstate and intrastate markets were further analysed by trip purpose.

The demand relationships are derived from an econometric analysis of pooled cross-section and time-series data for each of the markets examined (with the exception of 'other aviation' where time-series methods were generally used). The pooled approach involved relating, in a single equation, differences in passenger flows both across routes and across time to corresponding differences in explanatory factors affecting demand. Least squares regression techniques were used to determine the coefficients of demand. For some minor sub-markets of the international market it was not possible (due to a lack of suitable data) to model demand behaviour using this approach. In these instances, a simple time-series approach was used to explain the historical trend.

Most of the models used did not assume a lag in adjustment of demand to changes in explanatory variables. The models for international travel for both business and non-business purposes by Australian residents were exceptions, however. They included lagged dependent variables to allow for these effects.

Regression models were calibrated for various passenger market categories. The categories associated with each market for which regression models were calibrated are shown in Table I.1. For some market categories (e.g. long-term arrivals by overseas residents), satisfactory relationships explaining flow patterns could not be found.

The broad approach adopted involved estimation of functional relationships between demand and a range of explanatory variables including fares, income levels and population levels. The income measure used was disposable income per head of population, deflated by the consumer price index (CPI). The measure of fares was a weighted index of the various types of tickets, again deflated by the CPI. The way in which the income and fare variables were constructed varied between markets. The construction of these (and other) variables is discussed later.

In addition, special variables explaining growth in demand specific to particular markets were also incorporated into the model formulations. These included trade variables, migration effects and attributes of competing modes.

For many O-D pairs and time periods, demand was affected by intrinsic characteristics and seasonal factors. Appropriate allowance for these effects was made by the inclusion of dummy variables in the model formulations. These variables do not themselves enter the relationships used for forecasting (as explained in Appendix II) and they are not included in the mathematical descriptions of the models to follow.

In all cases the mathematical function relating the independent and dependent variables was chosen on the basis of both statistical and theoretical criteria.

INTERNATIONAL TRAVEL - SHORT-TERM MOVEMENTS

To establish the factors which influence short-term travel to and from Australia, four behavioural models were developed. These models examined the demand per capita for:

. Overseas business travel by Australians;
. Overseas non-business travel by Australians;

TABLE I.1 - CATEGORIES MODELLED WITHIN MARKETS

Market	Categories Modelled
International	Short-term passenger movements by Australian residents travelling for business purposes
	Short-term movements to Australia by overseas residents travelling for business purposes
	Short-term movements by Australian residents travelling for non-business purposes
	Short-term movements to Australia by overseas residents travelling for non-business purposes
	Long-term arrivals by Australian residents
	Long-term departures by Australian residents
	Long-term departures by overseas residents
	Transit I and Transit II passengers[(a)]
Interstate	Total passenger movements (excluding Transit IV passengers)
	Passenger movements (excluding Transit IV) for business purposes
	Passenger movements (excluding Transit IV) for non-business purposes
Intrastate	Total passenger movements
	Passenger movements for business purposes
	Passenger movements for holiday purposes
	Passenger movements for the purpose of visiting friends and relatives
Commuter	Total passenger movements
Other Aviation	Hours flown in the charter sector
	Hours flown in the business and private sector
	Hours flown in the aerial work sector

(a) For definitions of the various categories of 'transits', see Chapter 4.

- Business travel to Australia by overseas residents;
- Non-business travel to Australia by overseas residents.

The basic sources of demand data were the quarterly statistics on overseas arrivals and departures published by the Australian Bureau of Statistics (ABS 1976a and earlier issues). The ABS definition for short-term travel was adopted. Short-term travellers are those whose actual or intended period of stay or absence is less than 12 months.

The analyses used quarterly data over the period March 1964 to September 1975, and covered 14 major overseas origins/destinations. The overseas countries included as origins and destinations in the analyses were Canada, Fiji, France, Germany, Greece, Indonesia, Italy, Japan, Malaysia/Singapore, New Zealand, Papua-New Guinea, South Africa, United Kingdom and the United States.

During the analysis period, the ABS made some changes to its statistical series, which necessitated making some modifications to the original data in order to establish a consistent data set. The principal changes concerned modification of passenger movements for the period 1974-75 to exclude sea travel, and adjustment of travel data prior to 1974 to establish the ultimate or main destinations rather than the initial destinations or ports of disembarkation for Australians travelling overseas. The method developed in the R. Travers Morgan study (RTM 1974a) was used for this purpose. Further details are given later in this Appendix. The equations developed for these four categories of international air travel are presented below(1).

Business Travel By Australians

$$BAO = \underset{(59.1)}{0.956}\ BAO_{-1} + \underset{(2.7)}{0.061}\ RM - \underset{(-3.4)}{24.31}\ RF \qquad (I.1)$$

with $\bar{R}^2 = 0.91$

(1) The values in brackets are 't' values which indicate the confidence that can be placed in the coefficient estimates. They are equal to the coefficient estimates divided by the standard error of estimate. $\bar{R}^2$ provides a measure of the explanatory power of the equations in predicting the levels of demand per capita. The $\bar{R}^2$ measures have been adjusted for degrees of freedom.

where BAO is business travel by Australians going overseas divided by the population of Australia,

BAO_{-1} is BAO in the previous quarter,

RM is real imports per capita into Australia from the overseas country,

and RF is the real fare index.

Business Travel by Overseas Residents

$$\underset{}{BOA} = \underset{(2.9)}{35.02 \ln RM} + \underset{(2.3)}{15.80 \ln RX} - \underset{(-4.4)}{25.25 \ln RF} \qquad (I.2)$$

with $\bar{R}^2 = 0.85$

where RM and RF are as defined in Equation I.1,

BOA is business travel to Australia by overseas residents divided by the population of country of origin,

and RX is real exports from Australia to the overseas country.

Non-Business Travel by Australians

$$LAO = \underset{(2.4)}{583.6\, RI} + \underset{(4.2)}{0.002\, MI} - \underset{(-3.1)}{258.4\, RF} + \underset{(14.5)}{0.625\, LAO_{-1}} \qquad (I.3)$$

$$+ \underset{(4.9)}{0.222\, LAO_{-2}}$$

with $\bar{R}^2 = 0.79$

where RF is as defined in Equation I.1,

LAO is leisure travel by Australians going overseas divided by the population of Australia,

LAO_{-1} is LAO in the previous quarter,

LAO_{-2} is LAO two quarters ago,

RI is real income, measured in this case on a per capita basis in the country of residence,

and MI is the proportion of the Australian population born in the overseas country.

Non-Business Travel by Overseas Residents

$$LOA = \underset{(3.1)}{361.6\ RI} - \underset{(-16.1)}{287.8\ RF} - \underset{(-6.2)}{108.6\ EX} + \underset{(10.6)}{0.053\ MI} \qquad (I.4)$$

$$+\underset{(10.6)}{0.113\ MO}$$

with $\bar{R}^2 = 0.83$

where RF is as defined in Equation I.1,

RI and MI are as defined in Equation I.3,

LOA is leisure travel to Australia by overseas residents divided by the population of country of origin,

EX is the exchange rate,

and MO is the number of Australian-born permanent residents in the overseas country.

INTERNATIONAL TRAVEL - LONG-TERM MOVEMENTS

In this Paper, the ABS definition of long-term travel as journeys taking longer than twelve months has been used. The ABS breaks this travel into two groups - 'Australian residents' and 'overseas visitors'. For each group, arrivals and departures were examined separately. The analysis is based on annual data, and the results are given below.

Arrivals by Australian Residents

$$AA = \underset{(5.6)}{187844} + \underset{(7.6)}{2201\ PI} \qquad (I.5)$$

with $\bar{R}^2 = 0.86$

where AA is the number of arrivals by Australians,

and PI is an index of Australian population.

Departures by Australian Residents

$$AD = \underset{(-2.3)}{-59079} + \underset{(4.7)}{1126\ PI} \qquad (I.6)$$

with $\bar{R}^2 = 0.73$

where AD is the number of departures by Australians,

PI is as defined in Equation I.5.

Arrivals by Overseas Residents

Overseas long-term visitor arrivals have been subject to large fluctuations over time. Since no trend was evident and no satisfactory relationship for the flow pattern was found, the average figure over 9 years to 1975 of 26,000 a year was used as an indication of future demand in this travel market.

Departures by Overseas Residents

$$OD = \underset{(-4.3)}{-18845} + \underset{(8.9)}{3957\ MI} \qquad (I.7)$$

with $\bar{R}^2 = 0.91$

where OD is the number of departures from Australia by overseas residents,

and MI is an index of migrant population in Australia.

INTERNATIONAL TRAVEL - PERMANENT MOVEMENTS

The number of permanent movements into and out of Australia is largely a function of the Commonwealth Government's policy towards migration. Over the nine years to 1975, the average net immigration was 100,000 a year, but in 1975 this had dropped to 25,000. This Paper assumes an average net immigration figure of 50,000 a year which is the figure used by the Australian Bureau of Statistics (ABS 1977c) in projections of population, and by the National Population Inquiry (1975) to illustrate their populations projections.

ABS statistics on overseas arrivals and departures (ABS 1976a and earlier issues) partition the permanent arrivals into two categories 'assisted settlers' and 'other settlers'. The number of 'other settlers' remained relatively stable over the 9 years to 1975, at an average level of 52,500 per annum. However, there have been considerable fluctuations in the number of 'assisted settlers', due to changes in migration policy.

Permanent departures are also broken into two categories -'former settlers' and 'other residents'. Both of these categories remained reasonably stable over the 9 years to 1975, at average levels of 25,600 and 10,600 per annum, respectively. These average figures were used in this study to forecast permanent movements.

If the average numbers of permanent arrivals by 'other settlers' and permanent departures are maintained, and a net immigration flow of 50,000 a year is to be achieved, the total number of permanent passenger movements will be 122,400 per annum.

INTERNATIONAL TRAVEL - TRANSIT MOVEMENTS

From ABS statistics, two types of international transit passengers can be identified[1]. 'Transit I' refers to passengers who arrive on an international flight and leave the transit lounge but subsequently leave Australia on an international flight. 'Transit II' refers to those passengers who remain within the international transit lounge before leaving Australia on an international flight. A simple trend analysis using annual data was carried out to estimate combined Transit I and Transit II levels. The results are as follows:

$$TR = \underset{(16.4)}{43983} + \underset{(22.5)}{15511}\,t \qquad (I.8)$$

with $\bar{R}^2 = 0.99$

where TR is the sum of Transit I and Transit II passengers,

and t is time in years, with 1970 = 1.

(1) Note that two other type of transit movements ('Transit III' and 'Transit IV') are also considered later.

INTERSTATE TRAVEL

The interstate air passenger market was initially classified into three categories, namely business travel, non-business travel, and 'Transit IV' travel (passengers travelling on a domestic flight to connect with an international flight). Transit IV passengers were excluded from the analysis of interstate journeys, as they are primarily determined by factors affecting international travel and not by those factors thought to influence typical interstate travel.

Insufficient survey data were available to model the business and non-business sectors of the market separately, using pooled cross-section/time-series data. To overcome this problem, the main emphasis was placed on explaining the growth in demand for total (business and non-business aggregated) interstate travel. The analysis covered the 12 most important interstate routes (or, more correctly, origin-destination pairs) which together account for approximately 80 per cent of the total interstate passenger movements by air. The O-D pairs included in the model were Sydney-Melbourne, Sydney-Brisbane, Sydney-Adelaide, Sydney-Perth, Sydney-Canberra, Sydney-Coolangatta, Melbourne-Adelaide, Melbourne-Tasmania, Melbourne-Brisbane, Melbourne-Perth, Melbourne-Coolangatta, Adelaide-Perth. It should be noted that no distinction is made between travel originating at the two ends of a particular O-D pair. Thus, Sydney-Melbourne travellers include Sydney-based travellers with Melbourne as their destination and Melbourne-based travellers with Sydney as their destination. The analysis examines the variation between the numbers of persons travelling on these routes using quarterly data from September 1968 to June 1976. The basic sources for demand data were the stage-length(1) passenger levels available from the Commonwealth Department of Transport and origin-destination information made available by the airlines. A matrix of O-D flows over the period was developed from these sources.

To permit allocation of forecasts of total interstate traffic into business and non-business categories, separate subsidiary analyses of business travel and non-business travel were carried out using interstate trip purpose data obtained from the 1973 R. Travers Morgan survey (RTM 1974a).

(1) Stage-length statistics give the number of passengers who travelled between particular cities, and include through passengers. Travellers from Sydney to Hobart, for example, are included in both the Sydney-Melbourne and the Melbourne-Hobart stages.

Total Interstate Travel

$$\frac{D}{P} = \underset{(6.0)}{0.446} \ln RI - \underset{(-7.7)}{0.137} \ln P - \underset{(-9.2)}{0.284} \ln RF - \underset{(-1.4)}{0.144} \ln \left(\frac{RF}{CC}\right) \qquad (I.9)$$

with $\bar{R}^2 = 0.90$

where D is total passenger movements,

P is the population product for the origin/destination pair,

RI is real income, measured in this case as disposable income per person in the Australian labour force,

RF is real air fares plus access and egress costs,

and CC is the perceived cost of car travel in real terms.

Interstate Travel for Business Purposes

$$\ln BU = \underset{(9.6)}{0.948} \ln P - \underset{(-3.8)}{0.855} \ln RF \qquad (I.10)$$

with $\bar{R}^2 = 0.93$

where P and RF are as defined in Equation I.9,

and BU is the number of passengers travelling for business reasons.

Interstate Travel for Non-Business Purposes

$$\ln NB = \underset{(5.7)}{0.444} \ln P - \underset{(-7.0)}{1.264} \ln RF \qquad (I.11)$$

with $\bar{R}^2 = 0.91$

where P and RF are as defined in Equation I.9,

and NB is the number of passengers travelling for non-business reasons.

INTRASTATE TRAVEL

Intrastate travel is defined here as travel on the scheduled services of Ansett Airlines of New South Wales and East-West Airlines. The analysis is based upon annual demand for passenger services to 31 regional centres, during the eight-year period ending June 1975.

As these airports serve regional populations (and not just the nearby large towns), information derived from the 1973 R. Travers Morgan survey (RTM 1974a) was used as a guide to defining natural catchment areas for the airports. The local government areas (LGA's) comprising these catchment areas are shown in Table I.2, and information on these LGA's provided the basic socio-economic data for the regional centres. All LGA's were treated equally, and no attempt was made to weight the populations according to their location in the catchment area.

As for the interstate air transport market, emphasis was placed on explaining changes in the demand pattern for total intrastate travel (business and non-business) using pooled cross-section/time-series data. Subsidiary analyses of business and non-business travel were carried out using cross-section data provided by the 1973 R. Travers Morgan survey (RTM 1974a). The non-business market was further disaggregated into holiday travel and travel for the purpose of visiting friends and relatives.

Total Intrastate Travel

$$D = \underset{(4.0)}{28.0 \ln P} + \underset{(5.9)}{594.4 \ln RI} - \underset{(-4.4)}{172.5 \ln RF} - \underset{(-4.4)}{171.9 \ln \left(\frac{T}{K}\right)} \qquad (I.12)$$

with $\bar{R}^2 = 0.68$

where D,P and RI are as defined in Equation I.9,

RF is real air fares,

T is total travel time (including access and egress times),

and K is distance by road in kilometres.

TABLE I.2 - CATCHMENT AREAS FOR INTRASTATE AIRPORTS

Airport		Catchment Area[a]
ALBURY	NSW:	Albury(C), Hume Culcairn, Holbrook, Corowa, Berrigan
	Vic:	Wodonga, Chiltern, Rutherglen, Beechworth, Yackandandah, Towong, Wangaratta (C.of), Wangaratta (Shire)
ARMIDALE		Armidale(C), Dumaresq, Uralla, Guyra
BATHURST		Bathurst(C), Turon, Abercrombie
BOURKE		Darling
BROKEN HILL		Broken Hill(C), Central Darling, Unincorporated Area
CASINO		Casino(M), Woodburn, Terania, Byron, Tintenbar, Ballina(M), Tomki, Gundurimba, Lismore(C), Mullumbimby(M), Kyogle
COBAR		Cobar
COFF'S HARBOUR		Nambucca, Bellingen, Coff's Harbour
COOMA		Bibbenluke, Bombala(M), Snowy River, Cooma(M)
COONABARABRAN		Coonabarabran
COONAMBLE		Coonamble
COWRA		Cowra(M), Young(M), Grenfell(M), Boorowa, Waugoola, Weddin, Burrangong
DUBBO		Dubbo(C), Talbragar, Timbrebongie, Wellington, Warren, Gilgandra
GLEN INNES		Glen Innes(M), Severn, Tenterfield(M)
GRAFTON		Ulmarra, Nymboida, Grafton(C), Maclean
INVERELL		Inverell(M), Yallaroi, Ashford, MacIntyre (both parts)
KEMPSEY		Kempsey(M), Macleay
MERIMBULA		Bega(M), Imlay, Mumbulla
MOREE		Moree(M), Boomi, Boolooroo
MUDGEE		Mudgee(M), Cudgegong
NARRABRI		Narrabri(M), Namoi
NARRANDERA		Narrandera, Leeton
NYNGAN		Bogan
ORANGE		Orange(C), Canobolas, Lyndhurst, Boree
PARKES		Parkes, Forbes, Goobang, Jemalong, Condobolin(M)
PORT MACQUARIE		Port Macquarie(M), Hastings
TAMWORTH		Tamworth(C), Peel, Cockburn, Manilla, Gunnedah(M), Walcha, Barraba, Quirindi, Tamarang, Nundle, Liverpool Plains
TAREE		Taree(M), Manning, Wingham(M)
WAGGA		Wagga(C), Kyeamba, Lockhart, Mitchell, Junee(M), Illabo, Gundagai, Deniliquin, Coolamon, Urana
WALGETT		Walgett

(a) (C) stands for City; (M) stands for Municipality; all other names are shires.

Intrastate Travel for Business Purposes

$$BU = \underset{(9.4)}{114.5\ P} - \underset{(-4.6)}{51.7\ RF} - \underset{(-3.4)}{17.2}\left(\frac{T}{K}\right) \qquad (I.13)$$

with $\bar{R}^2 = 0.89$

where P is as defined in Equation I.9,
BU is as defined in Equation I.10,
and RF, T and K are as defined in Equation I.12.

Intrastate Travel for Holiday Purposes

$$HO = \underset{(4.8)}{22.3\ P} + \underset{(4.2)}{93.8\ RI} - \underset{(-3.4)}{28.6\ RF} - \underset{(-3.3)}{7.8}\left(\frac{T}{K}\right) \qquad (I.14)$$

with $\bar{R}^2 = 0.97$

where P and RI are as defined in Equation I.9,
RF, T and K are as defined in Equation I.12,
and HO is the number of holiday passengers.

Intrastate Travel for Visiting Friends and Relatives

$$VR = \underset{(6.4)}{1362.4\ \ln P} + \underset{(3.1)}{1136.7\ \ln RI} - \underset{(-2.8)}{994.6\ \ln RF} \qquad (I.15)$$

with $\bar{R}^2 = 0.81$

where P and RI are as defined in Equation I.9,
RF is as defined in Equation I.12,
and VR is the number of passengers visiting friends or relatives.

COMMUTER TRAVEL

Commuter operations are defined as those which operate under Regulation 203 of the Air Navigation Regulations. Annual statistics for this category of travel have been available from 1967. During this period, the commuter markets in NSW underwent very rapid development. This development phase is a particularly difficult one in which to establish the parameters likely to determine long-run growth. It was decided to make 1971 the initial year for the demand analysis. The analysis was based on data for 6 routes over the 6 years beginning with the year ending June 1971. The routes modelled were Sydney-Newcastle, Sydney-Nowra/Moruya, Sydney-Scone, Sydney-Young/Cootamundra, Sydney-Tumut and Sydney-Gunnedah. The catchment areas for the regional airports involved in these routes are shown in Table I.3. The routes modelled do not cover all commuter travel into Sydney. In June 1976, these six routes accounted for 88 per cent of the total commuter traffic.

The relationship established was:

$$\frac{D}{P} = \underset{(1.5)}{189.5 \ln RI} - \underset{(-3.2)}{23.6 \ln P} - \underset{(-1.2)}{30.2 \ln} \left(\frac{RF}{CC}\right) - \underset{(0.7)}{22.0 \ln RF} \qquad (I.16)$$

with $\overline{R}^2 = 0.61$

where D, P, RI and CC are as defined in Equation I.9,

and RF is as defined in Equation I.12.

OTHER AVIATION

'Other aviation' includes all aircraft movements which are not regular passenger flights scheduled by the international, interstate and intrastate airlines, or by commuter services. It includes charter (both heavy airline and light), flying training, private and business flying, test and ferry, aerial work, search and rescue services, military flights and freight-only flights. Helicopter flights and through flights are not included.

Demand for 'other aviation' was measured in terms of hours flown and the major categories were examined separately. Because of some concern over definitional problems, the private and business categories were combined, and test and ferry operations were grouped with aerial work for analysis purposes. As statistics on a State basis were available only from 1970-71, the models developed were tested using annual Australia-wide data, which was available from 1963-64. Future levels of demand for Sydney Airport were subsequently determined after

TABLE I.3 - CATCHMENT AREAS FOR COMMUTER AIRPORTS

Airport	Catchment Area[a]
NEWCASTLE[b]	Port Stephens, Maitland(C), Newcastle(C), Cessnock (Part)(C)
NOWRA/MORUYA	Shoalhaven, Eurobodalla
SCONE	Gloucester, Scone, Murrurundi
YOUNG/COOTAMUNDRA	Boorowa, Demondrille, Murrumburrah, Young(M), Burrangong, Narraburra, Temora(M), Cootamundra(M), Jindalee
TUMUT	Tumut, Tumbarumba
GUNNEDAH	Gunnedah(M), Liverpool Plains

(a) (C) stands for City; (M) stands for Municipality; all others are shires.

(b) Includes Newcastle and Belmont Airports.

consideration of available State statistics on this category of aviation between 1970-71 and 1975-76, and unpublished information on aircraft movements at Sydney.

Charter

The charter category was modelled after elimination of the commuter travel (already examined above). Typical economic variables offered little explanation of the demand for charter and the behavioural model was abandoned. A time-series study gave the following results:

$$H = \underset{(6.0)}{138.2\ t} + \underset{(15.0)}{1743.2} \qquad (I.17)$$

with $\bar{R}^2 = 0.83$

where H is the number of hours flown,
and t is time in years, with 1969 = 1.

Flying Training

Flying training was subject to enormous variation, and no clear trend was evident. A variety of models were unsuccessful in obtaining any explanation of the data. As a consequence, a five-year average around 1973 was taken as a base level. This base level was then assumed to follow the trends in population levels.

Business and Private Flying

Analysis of combined business and private flying yielded a relationship in terms of economic variables:

$$\frac{H}{N} = \underset{(4.2)}{457.7 \ln S} - \underset{(-1.2)}{180.7 \ln R} + \underset{(1.7)}{845.1} \qquad (I.18)$$

with $\bar{R}^2 = 0.75$

where H is as defined in Equation I.17,

N is the population of Australia,

S is gross operating surplus,

and R is aircraft rental.

Aerial Work

Aerial work is heterogenous in composition. It includes aerial surveys, aerial spotting, advertising, ambulance operations, glider and towing and search-and-rescue activities. To this grouping was added the test and ferry category. A time-series analysis was undertaken. The best result obtained was:

$$\ln H = \underset{(22.3)}{0.438} \ln t + \underset{(117.5)}{55.6}$$

$$\text{with} \quad \bar{R}^2 = 0.98 \qquad \text{(I.19)}$$

where H is as defined in Equation I.17,

and t is time in years, with 1964-65 = 1.

DATA SOURCES

This Section provides a description of the sources of data used in the passenger demand models. In some cases, the published or available sources did not present the data in a form suitable for the econometric analyses described earlier. Where necessary, construction of the variables used and adjustments to data series are described.

Demand Variables

Information on international travel movements, categorised by trip duration, purpose, country of origin and country of destination is published by the ABS in its series on overseas arrivals and departures (ABS 1976a and earlier issues).

In relation to data for the models of short-term international travel, a change in definition by ABS made it necessary to perform adjustments of the published data. Prior to 1974, the definition of destination referred to the intended country of disembarkation from the aircraft which took the passenger from Australia. This meant that if an Australian travelling to an overseas country stopped en route at an intermediate country, then this latter country would be reported as his destination. In March 1974, the definition was changed to reflect the main destination by identifying the country in which a passenger spent most time. Statistics prior to 1974 were adjusted using RTM survey data (RTM 1974a), which included tables which made it possible to match first and ultimate destinations for both business and leisure travellers.

Statistics on demand have been affected by changes in travel patterns which have resulted from the introduction of new fare structures. In 1968, a Group Affinity (GA) arrangement was introduced on the Australia-United Kingdom route to cater for the growing 'visiting friends and relatives' (VFR) market. Substantially reduced fares were offered under the GA arrangements, but these fares were not available to groups in categories involving other than VFR travellers. However, an increasing number of charters were operating between Europe and the Far East, attracting traffic from Australia to Singapore where travellers could join such charter flights. The old ABS definition of destination classified these people as travelling to or from Singapore.

In February 1972, the scheduled airlines introduced a low-cost Excursion fare to the general public. The fare attracted Australians back from the Far East charters. After the introduction of the Excursion fare, some travellers would have gone directly to London whereas before they would have travelled to Singapore first. Evidence from the RTM survey, conducted in 1973, suggests that 28 per cent of Australian leisure travellers stopping at Singapore had the UK as their ultimate destination. This was the factor used to adjust the ABS data prior to 1974. Between 1968 and 1972, this percentage would have been higher, and therefore the magnitude of travel to the UK has probably been underestimated during this period (and, conversely, travel to Singapore overestimated). The size of the error is not known. An inspection of the adjusted data disclosed no obvious discontinuities, and so the effect on demand was assumed to be small.

As mentioned earlier, measures of demand for the aggregate interstate model were derived from Department of Transport stage-length data and other origin-destination (O-D) data. The O-D data were available on a quarterly basis from the September quarter 1972 to the June quarter 1976. The stage-length data were available back to the June quarter 1968 on a quarterly basis.

A comparison of stage-length data and O-D data over time for a number of city pairs indicated that there was a stable relationship between the two sets of figures. Average ratios of O-D passenger flows to stage-length flows were calculated for the period 1972-73 to 1975-76 for the cities pairs used in the study. These ratios were applied to stage-length flows between June 1968 and September 1972 in order to derive O-D flows for that period(1).

For intrastate O-D demand, the Department of Transport statistics on the number of passenger movements at regional airports were generally assumed to be a fair indication of Sydney-oriented traffic. The figures were obtained from various issues of the Department of Transport publication covering domestic air transport statistics (Department of Transport 1976a and earlier issues). However, Albury-Wodonga was an exception. Passenger movements at Albury-Wodonga were split between Sydney-oriented and Melbourne-oriented travel in the ratio 75:25. Sydney-Albury travel had to be split further between the interstate and intrastate airlines.

Department of Transport publications (Department of Transport 1977a and earlier issues) were also the source of demand data on commuter travel. The number of passengers embarked were assumed to equal the numbers of O-D passengers travelling on commuter services into and out of Sydney.

Models of various components of 'other aviation' were based on Australia-wide data for hours flown. These were obtained from various issues of Department of Transport publications covering hours flown in the air transport industry (Department of Transport 1977b and earlier issues).

Population

In the international markets, separate models were developed for overseas-based and Australian-based travellers. Populations of the origin countries only are

(1) Data for Sydney-Canberra were less comprehensive than for the other city pairs, and the estimation of passenger flows for this pair is somewhat less reliable in consequence.

included in the models developed in this study. The population of Australia over the analysis period was obtained from ABS publications (ABS 1977c and earlier issues). Sources for the populations of overseas countries were:

. United Nations (UN 1976 and earlier issues);
. Organisation for Economic Cooperation and Development (OECD 1976 and earlier issues);
. Information supplied by the South African Embassy.

The models for domestic travel did not differentiate between the origin and destination for travel between a city pair. Travel demand between two regions includes trips by people living in each of the regions. The population variable used in the study of domestic travel was the product of the populations(1) of the two regions involved for each city pair.

The interstate demand model required populations of the ABS Statistical Divisions for the mainland state capitals, as well as the populations of Tasmania, the ACT and the city of Gold Coast. In some cases, it was necessary to extrapolate between annual ABS estimates to obtain population estimates at quarterly intervals. Estimates at quarterly intervals were available on a State-wide basis, and movements in these were used as a guide to movements in the city populations.

The sources for population data used in the interstate models were ABS publications on vital and population statistics (ABS 1977a and earlier issues), population estimates (ABS 1976e and earlier issues) and population of principal cities and towns (ABS 1976f).

For the intrastate and commuter demand models, the populations of the local government areas which make up the catchment areas for each airport were required. Tables I.2 and I.3 (mentioned earlier) define the catchment areas for intrastate and commuter airports respectively. The sources for the

(1) The simple average of the populations was also tested statistically, but was less satisfactory than the population product.

populations were publications of the ABS NSW Office on estimated population of municipalities and shires (ABS, NSW Office 1976a and earlier issues) and local government (ABS, NSW Office 1976b and earlier issues).

Income

The passenger demand relationships generally employed a measure of disposable income rather than gross income, because the former was believed to be a more relevant determinant of demand. The major difference between the two measures is direct taxation. The income measure used in specific cases was to some extent dictated by accessibility of data. In all cases, the effects of inflation were allowed for by deflating money incomes by appropriate consumer price index (CPI) values.

The income variable used in the model for Australians travelling overseas was total personal disposable income (PDI) divided by the CPI for Australia and by the Australian population. Measures of PDI and CPI were obtained from various issues of the relevant ABS publications (ABS 1976b and earlier issues and ABS 1975a and earlier issues).

The income variable for the models for overseas visitors to Australia was constructed by dividing each country's Gross Domestic Product (GDP) in its own currency by its CPI, population, and exchange rate with respect to Australian currency in a fixed period. Division by the exchange rate(1) was necessary to allow comparison of incomes between countries in a common unit of currency in the pooled cross-section and time-series models. The data sources for the GDP, CPI and exchange rate variables were:

- International Monetary Fund for GDP and exchange rates (IMF 1976 and earlier issues);
- United Nations, for CPI values (UN 1976 and earlier issues);
- Papua-New Guinea Bureau of Statistics for CPI values for PNG (Papua-New Guinea, Bureau of Statistics 1975 and earlier issues).

(1) Measured by the number of units of the foreign country's currency equivalent to one Australian dollar.

The income measure used for all domestic markets was average real disposable income[1] per person in the labour force. The measure was derived from the Parliamentary papers on taxation statistics (Parliament of the Commonwealth of Australia 1976 and earlier issues) and from various ABS publications.

For interstate travel, the incomes for cities included in the study were represented by measures or indices for the States in which the cities were situated. To get a measure for a particular O-D pair, a weighted average for the two cities was calculated, using the city populations as weights.

For intrastate and commuter travel, the income variable used was again real disposable income per person in the labour force, but only values for NSW were used. The same measure was used for all airport regions. This means that models developed for intrastate and commuter travel capture the influence of changes in income over time but not between airport regions.

Fares

In the international demand models, the average fare paid was calculated by applying weights to the various fare types, the weights being related to the number of passengers using each type of fare. The average fare (F_{ij}) for origin-destination i and purpose j is given by:

$$F_{ij} = FF_i\ FP_{ij} + EF_i\ EP_{ij} + LF_i\ LP_{ij} \qquad \text{(I.20)}$$

where FF_i is the First-Class fare for O-D i,
FP_{ij} is the proportion of passengers travelling First-Class for O-D i and purpose j,
EF_i is the Full Economy fare for O-D i,
EP_{ij} is the proportion of passengers travelling Full Economy for O-D i and purpose j,
LF_i is the equivalent low-cost fare for O-D i
and LP_{ij} is the proportion of people travelling on low-cost fares for O-D i and purpose j.

(1) It should be noted that this quantity is not identical to PDI. The main difference lies in the fact that disposable income in this case was derived from taxation statistics. Some categories of income are excluded.

For Australians travelling overseas, F_{ij} was simply deflated using the CPI for Australia. However, the situation was more complex for overseas visitors to Australia. The fare was expressed in the currency of the country of residence and was deflated by the CPI of that country. This measure was then divided by the exchange rate in a particular fixed period to allow comparisons between countries in a common unit (as was done for the income variable).

For interstate travel, economy fares were used, but were adjusted by adding the cost of travel between airports and city terminals. The nominal fares (including assumed access and egress costs) perceived by people at either end of a city pair are the same. However, because inflation rates can vary between cities (to some extent at least), the real perceived fares can differ, and a weighted average measure was calculated for each city pair (as with income).

The fare variable in the intrastate and commuter demand models was the nominal fare between Sydney and the relevant airport, deflated by the Sydney CPI.

Additional sources of information for the fare variables (beyond those mentioned earlier in relation to other variables) were timetables and unpublished information.

Trade Variables

Data on the value of exports and imports for Australia in current Australian dollars were obtained from ABS publications (1976d and earlier issues). These were deflated by the export and import price indices which were derived from ABS publications on the quarterly summary of Australian statistics (ABS 1976g and earlier issues) and export price index (ABS 1975b and earlier issues) and Reserve Bank of Australia publications on the import price index (Reserve Bank of Australia 1975 and earlier issues).

Migrant Variables

Two variables were used to describe the effects of migration. One of these variables was the number of overseas-born migrants permanently resident in Australia as a proportion of the Australian population. Information obtained from ABS Census publications (ABS 1972) was adjusted for permanent movements (ABS 1976a and earlier issues) and migrant deaths (ABS 1977b and earlier issues) for the intercensal years.

The other variable was the stock of Australian-born people resident in overseas countries. Information was obtained for permanent departures from ABS bulletins (ABS 1976a and earlier issues) and adjusted for deaths using mortality rates derived from ABS (ABS 1977b and earlier issues).

Modal Times and Costs

Travel times by air were obtained from timetables. Distances between cities by road were used as proxies for travel times by road in the intrastate models, and (together with an index of the price of petrol) were also used to represent costs of travel by road in the interstate model. Road distances were obtained from various sources, and the petrol price index values were obtained from the Industries Assistance Commission.

Gross Operating Surplus and Aircraft Rentals

In the business and private sector of other aviation, gross operating surplus and aircraft rental rates, measured in real terms, were used. Figures for gross operating surplus were obtained from ABS (ABS 1976b and earlier issues) and aircraft rentals were constructed in the Department of Transport.

APPENDIX II

PROCEDURES AND ASSUMPTIONS FOR FORECASTING PASSENGER DEMAND

FORECASTING PROCEDURES

The estimated demand relationships described in Appendix I formed the basis for forecasting passenger demand by origin-destination pairs. There are several possible ways of using the relationships for forecasting. One way involves direct substitution of assumed future levels of the independent variables in the relationships. Another way is to take as the starting point a measure of actual demand at the beginning of the forecast period, and to use the demand relationships to forecast future movements or changes from this initial demand level. An implication of this procedure is that those independent variables which remain constant from year to year (in particular the dummy variables) drop out of the calculation.

A modification of the second of the above approaches is to take an average of the passenger demands over a number of years or quarters just prior to the commencement of the forecast period, and to use the demand relationship to project demand forward from this base measure. This was the approach adopted in this study. In each case analysed, an average value centred on 1973 was calculated. Demand was then extrapolated forward to 1976 using the estimated relationships and the observed (i.e. actual) growth rates on the explanatory variables between 1973 and 1976. Forecasts beyond 1976 were then generated from this derived 1976 demand level, using forecast growth rates for the explanatory variables decided on by the MANS Forecasting Consultative Group.

The cross-sectional data used in the regression models did not cover all the origins and destinations of travellers. The methods used to generate forecasts for all the relevant origin-destination pairs varied between the markets.

In the case of international travel, the overseas sector was divided into eight regions. For a given region, forecasts for individual countries included in the model were aggregated. An expansion factor was then applied to derive the total forecasts for the region. For interstate travel, the forecasts for all origins and destinations not included in the model were derived using the estimated relationship and information on base level demands and growth rates of independent variables appropriate to the particular O-D's. In the case of intrastate travel, the origin-destination forecasts from the model were exhaustive. Forecasts for each region were obtained by aggregating the forecasts for individual towns within the region. Finally, in the commuter market, the forecast of the average growth rate for routes not included in the commuter model was assumed to be equal to the forecast growth on the modelled routes, excluding Sydney-Newcastle.

It is important to appreciate that passenger demand in any particular year can be influenced by short-run stochastic factors which cannot be adequately accounted for in a behavioural model. It can, of course, also be influenced by severe and atypical variations in one or more of the explanatory variables. The objectives of this study were to provide average long-run forecasts and to ignore short-run fluctuations about long-run trends.

ASSUMPTIONS FOR THE INDEPENDENT VARIABLES

Assumptions concerning future growth rates for real air fares and real disposable incomes of Australians were laid down in Chapter 6. The assumptions for population growth for Australia and the various states and territories are shown in Table II.1. The projections for Sydney have been assumed to be the same as for NSW.

Car costs, measured in real terms, were assumed to grow at 2.5 per cent per annum. Travel times by air and road, relevant only in the intrastate demand models, were assumed not to vary over the forecast period.

Future growth rates of other variables were obtained by extrapolating past trends. This applied to variables affecting overseas travel, such as real imports per capita and real exports, incomes of overseas residents and populations of overseas countries.

TABLE II.1 - POPULATION PROJECTIONS FOR AUSTRALIA

(average growth rates in per cent per annum)

		1976-80	1980-85	1985-90	1990-95	1995-2000
	Australia	1.48	1.45	1.42	1.38	1.35
	NSW	1.16	1.14	1.12	1.10	1.08
	Vic	1.29	1.26	1.23	1.21	1.19
	Qld	2.70	2.65	2.60	2.55	2.50
High	SA	1.46	1.42	1.38	1.35	1.32
	WA	2.55	2.48	2.41	2.33	2.26
	Tas	0.82	0.81	0.80	0.78	0.77
	NT	4.73	4.59	4.45	4.30	4.16
	ACT	7.36	6.76	6.16	5.55	4.95
	Australia	1.48	1.41	1.34	1.28	1.22
	NSW	1.03	0.99	0.95	0.92	0.90
	Vic	1.14	1.09	1.04	1.00	0.96
	Qld	2.59	2.44	2.29	2.14	2.00
Median	SA	1.25	1.19	1.13	1.06	1.00
	WA	2.28	2.15	2.02	1.88	1.80
	Tas	0.78	0.75	0.72	0.70	0.68
	NT	4.51	4.36	4.21	4.05	3.90
	ACT	6.51	5.44	4.37	3.31	2.30
	Australia	1.16	1.14	1.09	1.00	0.91
	NSW	0.75	0.75	0.71	0.67	0.63
	Vic	0.90	0.88	0.85	0.79	0.73
	Qld	1.96	1.90	1.77	1.62	1.47
Low	SA	0.97	0.96	0.89	0.82	0.75
	WA	1.93	1.85	1.73	1.59	1.54
	Tas	0.67	0.70	0.67	0.60	0.53
	NT	1.64	1.61	1.53	1.35	1.18
	ACT	5.09	3.99	3.19	2.59	2.00

APPENDIX III

PROCEDURES AND ASSUMPTIONS FOR CONVERTING PASSENGER MOVEMENTS TO AIRCRAFT MOVEMENTS

The techniques adopted for converting passenger movements to aircraft movements differed between market categories, largely on account of differences in network complexities. With intrastate and commuter travel, the services mostly radiate from Sydney, and simple algorithms are all that are necessary to convert the forecasts of origin-destination passenger demand to aircraft movements.

The international and interstate routes, however, form a more complex network of airline services, with Sydney being a major transit terminal for passengers whose origin or destination is not Sydney. Aircraft movements at Sydney are sensitive to shifts in demand which have nothing to do with Sydney origin-destination passengers, and more sophisticated algorithms were necessary to account for this complexity.

Forecasts of aircraft movements were made at five-year intervals commencing in 1980. Assumptions of aircraft types, load factors and so on, which were necessary for translating passenger movements into aircraft movements, were therefore specified for these particular years.

INTERNATIONAL AIRCRAFT MOVEMENTS

The forecasts of international aircraft movements were determined from a consideration of the forecasts of passenger movements to and from Australia, journey destinations and origins, future airline flight patterns, future aircraft types and expected passenger load factors. An algorithm, taking all the considered factors into account, was used to convert the forecasts of passenger movements for Australia into aircraft and passenger movements at Sydney.

The passenger forecasting procedures (described in Appendix II) led to future passenger movements to and from Australia, disaggregated by trip duration, purpose and country of residence (Australians or overseas residents) on the one hand and overseas region of origin or destination on the other. The first step in the algorithm was to allocate these forecasts to Australian states and territories of origin or destination. It should be noted that this does not include identification of Australian ports-of-call for travellers en route to their final destinations (or from their origins). The allocation percentages to Australian states and territories are shown in Table III.1. They vary with trip purpose, duration and country of residence, but not with overseas region of origin or destination. The percentages were based on historical figures derived from ABS statistics.

TABLE III.1 - PERCENTAGES OF INTERNATIONAL TRIPS TO OR FROM AUSTRALIAN STATES AND TERRITORIES

(per cent)

	Short-term Business		Short-term Leisure		Long-Term	Permanent Departures	Permanent Arrivals
	Australians	Overseas Residents	Australians	Overseas Residents			
NSW	47	56	42	51	36	35	37
Vic	26	24	26	21	26	24	26
Qld	11	8	11	13	15	13	9
SA	5	3	7	5	8	11	8
WA	6	4	9	7	9	12	15
Tas	1	1	2	1	3	2	2
NT	1	1	1	1	1	1	1
ACT	3	3	2	1	2	2	2
Total	100	100	100	100	100	100	100

It was assumed that supersonic transport (SST) services will be operating directly from Melbourne over the study period. These services will mainly carry short-term business travellers. It was necessary to generate a matrix for SST trips, similar to that for all international trips, describing them in terms of overseas origin or destination, Australian state of origin or destination and country of residence (Australian or overseas residents). Assumptions concerning the percentages of business travellers using SST by overseas region are given in Table III.2. The percentages are expected to increase over time. The allocation of these trips to Australian states is given in Table III.3.

TABLE III.2 - PERCENTAGE OF BUSINESS TRAVELLERS USING SUPERSONIC TRANSPORT

(per cent)

Year	Europe	America	Far East Asia
1980	10	-	-
1985	15	-	-
1990	20	10	-
1995	20	15	5
2000	25	20	10

TABLE III.3 - ALLOCATION OF BUSINESS TRIPS BY SUPERSONIC TRANSPORT TO AUSTRALIAN STATES

(per cent)

State	Australians	Overseas Residents
NSW	57	64
Vic	32	28
SA	6	3
Tas	1	1
ACT	4	4

Business trips involving SST flights were subtracted from the total of international business trips. This was accomplished in the algorithm by subtracting the matrix of SST trips from the matrix of all international trips. The remaining trips (which of course included the overwhelming majority of all trips to and from overseas) were then allocated to international ports of embarkation and disembarkation (called 'gateways').

The assumptions required for allocating trips to international gateways are given in Table III.4. The percentages of travellers to and from the States and Territories using particular international airports vary with overseas region. The assumptions reflect expectations about the supply of international services to the various gateways.

TABLE III.4 - GATEWAY ASSUMPTIONS FOR INTERNATIONAL PASSENGER TRAVEL THROUGH AUSTRALIAN AIRPORTS

Region (From/To)	Gateway (Airport)	Percentage of Travellers To/From Each State Using Gateway							
		NSW	Vic	Qld	SA	WA	Tas	NT	ACT
New Zealand	Sydney	100	-	-	50	50	-	100	100
	Melbourne	-	100	-	50	50	100	-	-
	Brisbane	-	-	100	-	-	-	-	-
Papua-New Guinea	Sydney	100	-	-	50	50	-	-	100
	Melbourne	-	100	-	50	50	100	-	-
	Brisbane	-	-	100	-	-	-	100	-
Oceania	Sydney	100	-	-	50	50	-	-	100
	Melbourne	-	100	-	50	50	100	-	-
	Brisbane	-	-	100	-	-	-	100	-
Far East Asia	Sydney	100	-	-	100	-	-	-	100
	Melbourne	-	100	-	-	-	100	-	-
	Brisbane	-	-	100	-	-	-	100	-
	Perth	-	-	-	-	100	-	-	-
South-East Asia	Sydney	100	-	50	50	-	-	-	100
	Melbourne	-	100	-	25	-	100	-	-
	Brisbane	-	-	50	-	-	-	100	-
	Perth	-	-	-	25	100	-	-	-
Africa	Sydney	100	-	100	-	-	-	-	100
	Melbourne	-	100	-	-	-	100	-	-
	Perth	-	-	-	100	100	-	100	-
Europe	Sydney	100	-	-	50	-	-	-	100
	Melbourne	-	100	-	25	-	100	-	-
	Brisbane	-	-	100	-	-	-	100	-
	Perth	-	-	-	25	100	-	-	-
America	Sydney	100	-	-	50	50	-	100	100
	Melbourne	-	100	-	50	50	100	-	-
	Brisbane	-	-	100	-	-	-	-	-

At this point, international trips could be categorised by Australian state or territory of origin or destination, and by international gateway. This allowed the numbers of trips on connecting domestic flights to be calculated. Part of these trips are movements into and out of Sydney Airport and these have been described as Transit IV movements in this study.

It was also possible to categorise international trips by overseas origin or destination and gateway. Forecasts of Transit I and Transit II trips through Sydney were added in. The aggregate forecasts from Equation (I.8) in Appendix I were allocated, on the basis of information from the ABS, to overseas regions as shown in Table III.5.

TABLE III.5 - ALLOCATION OF TRANSIT I AND II PASSENGERS TO OVERSEAS REGIONS[a]

From or To	Per Cent	To or From	Per Cent
New Zealand	40	Europe	22
Oceania	10	South-East Asia	13
		Far East Asia	10
		Papua-New Guinea	3
		Africa	2
Total	50		50

(a) The division into two columns reflects the flows between regions. Travellers between a region in one column may pass through Sydney en route to a region in the other column. Travellers between regions in the same column do not pass through Sydney.

The next step was to calculate the number of direct overseas flights by aircraft from Sydney and Melbourne which would be necessary to carry the forecast passengers to and from the various overseas origins and destinations on the basis of assumptions concerning available aircraft types and expected load factors. Table III.6 shows the aircraft types (with their corresponding seating capacities) which are expected to be available and in use over the forecast period. Taking into account the age structure of current fleets and their deployment on various routes, as well as the availability of new aircraft, average seating capacities were calculated by region and year (Table III.7). By applying the average load factors assumed for the regions

(Table III.8) to the seating capacities, the average numbers of passengers per aircraft were calculated. Dividing these into the numbers of passengers embarking or disembarking at Sydney and Melbourne airports (in turn) gave the number of international aircraft movements in these ports which would occur if there was only one Australian port of call.

TABLE III.6 - INTERNATIONAL AIRCRAFT TYPES CONSIDERED

Aircraft Type[(a)]	Seating Capacity	1980	1985	1990	1995	2000
707	140	*				
747/747B	400	*	*	*	*	*
747SP	260	*	*	*	*	
L1011/DC-10	280	*	*	*	*	
Stretched DC-10/ L1011	350		*	*	*	*
Stretched 747	500		*	*	*	*
Long-Range 747	400		*	*	*	*
Stretched-Twice 747	630				*	*
Double-Deck 747	800					*

(a) The later entries on this list describe generic types, rather than actual aircraft designations.

TABLE III.7 - AVERAGE SEATING CAPACITY ON INTERNATIONAL ROUTES

Route	1980	1985	1990	1995	2000
New Zealand	320	350	375	400	420
Papua-New Guinea	140	260	260	300	350
Oceania	400	400	400	430	470
Far East Asia	350	400	450	520	540
South-East Asia	350	400	400	500	500
Africa	335	335	335	400	400
Europe	400	420	460	500	540
America	335	335	400	400	500

TABLE III.8 - PASSENGER LOAD FACTORS FOR INTERNATIONAL AIRCRAFT

(per cent)

Route	1980	1985	1990	1995	2000
New Zealand	65	65	67	69	70
Papua-New Guinea	60	62.5	65	67.5	70
Oceania	65	65	67	69	70
Far East Asia	57.5	60	68	68	70
South-East Asia	61	62.5	65	67.5	70
Africa	54	57.5	62	67	70
Europe	61	62.5	65	67.5	70
America	65	65	67	69	70

The aircraft movements calculated according to the procedures of the above paragraph are hypothetical, because many international flights do not call at just one Australian port. They therefore needed to be adjusted to account for more complex flight patterns within Australia. Essentially, in order to determine total aircraft movements at Sydney, it was necessary to determine the numbers of flights calling or terminating at Melbourne which also called at Sydney.

The flight patterns of aircraft calling at Melbourne will vary between airlines and regions, mainly because of different demand levels. Historic market shares[(1)] of the airlines were examined and used as a basis for deducing the number of flights by each airline from Melbourne to various regions which would be required to meet expected demand. The airlines were assumed to prefer a daily service to and from Melbourne. Thus, if there was insufficient demand for an airline to justify a daily direct service to Melbourne, marketing considerations would lead the airline to operate some indirect services via Sydney. Table III.9 illustrates the relative numbers of direct and indirect services which (it was assumed) would be employed instead of all-direct services.

(1) Published in International Civil Aviation Organisation (1976 and earlier issues).

TABLE III.9 - NUMBERS OF DIRECT AND INDIRECT SERVICES AT MELBOURNE FOR VARIOUS LEVELS OF DEMAND

Number of services per week warranted by demand	Direct services per week	Indirect services (via Sydney) per week[a]
7	7	-
6	5	2
5	3	4
4	1	6
3	0	6
2	0	4
1	0	2

(a) Note that indirect services would only carry half the number of Melbourne passengers carried by direct services. Thus, two indirect services are equivalent to one direct service.

As discussed in Chapter 7, indirect services to Melbourne can be operated in two ways. Currently, most indirect services to Melbourne call at Sydney on both the inward and outward legs. The Sydney-Melbourne flight on these services operates at low load factors. Passengers embarking or disembarking at Sydney bring up the load factor for the overseas legs. On average, the effect of this flight pattern is to increase the number of aircraft movements at Sydney by 3 for every indirect service (to and from overseas)[1].

It is assumed in this study that in future years many of these indirect services will be 'triangulated'. In other words, Sydney will be a port of call on only one leg (either the outward or inward leg). In the latter case, the Sydney-Melbourne leg carries passengers embarking at Sydney or disembarking at Melbourne, and load factors are normal. The effect of this flight pattern is to increase the number of aircraft movements at Sydney by

(1) From the point of view of serving Sydney patronage, a direct service to Sydney, involving two aircraft movements (one take-off and one landing), can be replaced by 2 indirect services to Melbourne via Sydney, which involve 8 aircraft movements at Sydney. The assumption is that patronage on an indirect service is equally divided between Sydney and Melbourne passengers.

one for every indirect service. This result arises because one direct service to Sydney and one direct service to Melbourne can be replaced by two indirect triangulated services (with an increase of two movements at Sydney).

It is assumed that the percentage of indirect services which will be triangulated will increase to 20 per cent in 1980, 50 per cent in 1985 and 75 per cent in 1990, with no further changes thereafter. Table III.10 shows the percentages of different types of services operating through Sydney. Table III.11 shows the corresponding percentages for aircraft movements at Sydney.

TABLE III.10 - DISTRIBUTION OF TYPES OF SERVICES THROUGH SYDNEY AIRPORT[(a)]

(per cent)

Type of Service	1980	1985	1990	1995	2000
Direct services[(b)]	60.0	62.8	64.8	66.9	70.4
Indirect services					
- with triangulation[(c)]	8.1	18.6	26.4	24.8	22.2
- without triangulation[(d)]	31.9	18.6	8.8	8.3	7.4
Total	100.0	100.0	100.0	100.0	100.0

(a) One service is an aircraft movement to and from Australia.

(b) To Sydney.

(c) Calling at Sydney and Melbourne once.

(d) Calling at Sydney twice and Melbourne once.

TABLE III.11 - DISTRIBUTION OF AIRCRAFT MOVEMENTS AT SYDNEY BY TYPE OF SERVICE

(per cent)

Type of Service	1980	1985	1990	1995	2000
Direct services	45.5	53.2	59.5	61.8	65.5
Indirect services					
- with triangulation	6.1	15.6	24.3	22.9	20.7
- without triangulation	48.4	31.2	16.2	15.3	13.8
Total	100.0	100.0	100.0	100.0	100.0

From the point of view of aircraft movements at Sydney, replacing indirect services to Melbourne via Sydney with triangulated services has the same effect as replacing them with indirect services to Sydney via Melbourne (i.e. with aircraft calling once at Sydney and twice at Melbourne).

International Daily Profiles

The day profiles for international flights were determined from a consideration of the forecasts of future aircraft movements, journey times, landing curfews and existing timetables. Forecasts of annual aircraft movements, divided by 52, provided a monitoring constraint on the average number of weekly aircraft movements by international route to and from Sydney.

Existing curfews on jet operations at Kingsford Smith Airport and foreign airports, and expected journey times[(1)] on each international route were used to determine available time slots ('windows') when arrivals or departures for a particular route could occur. These windows are shown in Tables III.12 and III.13.

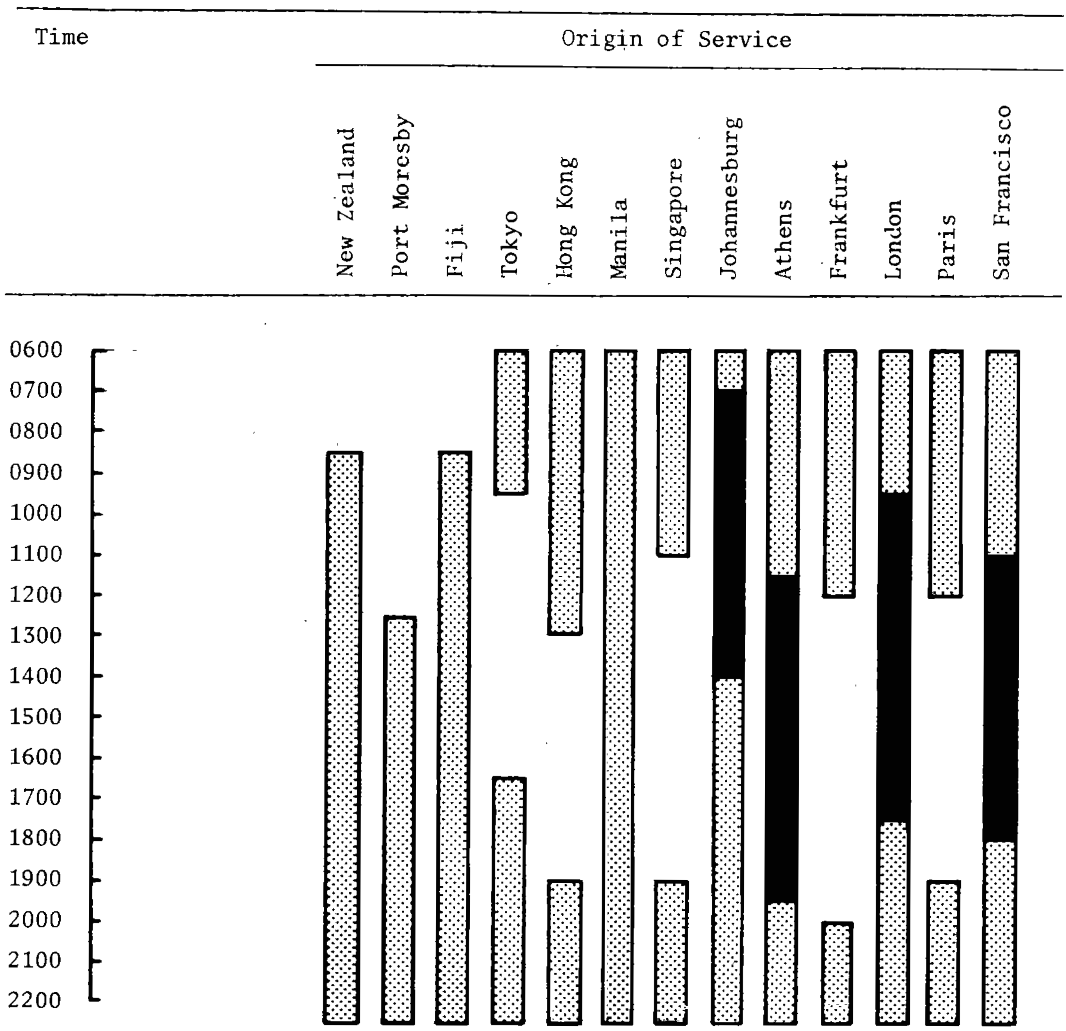
The current pattern of movements was used as a basis for determining the arrival and departure times of the major international airlines. As more flights per week were introduced over the forecast period, the additional flights were scheduled in the same time-slot on different days so as to spread flights as evenly as possible over days of the week. Further flights were then allocated to suitable adjacent time-slots, subject to the window constraints.

INTERSTATE AIRCRAFT MOVEMENTS

Determination of interstate aircraft movements in the context of the complex network of interstate services was accomplished on the basis of a linear programming model. In essence, the model was used to determine the number and type of aircraft in the interstate fleet and the allocation of these aircraft to routes, in order to cater for the forecast origin-destination passenger

(1) Taking into account the effect of international time zones.

TABLE III.12 - WINDOWS FOR INTERNATIONAL AIRCRAFT ARRIVALS AT SYDNEY



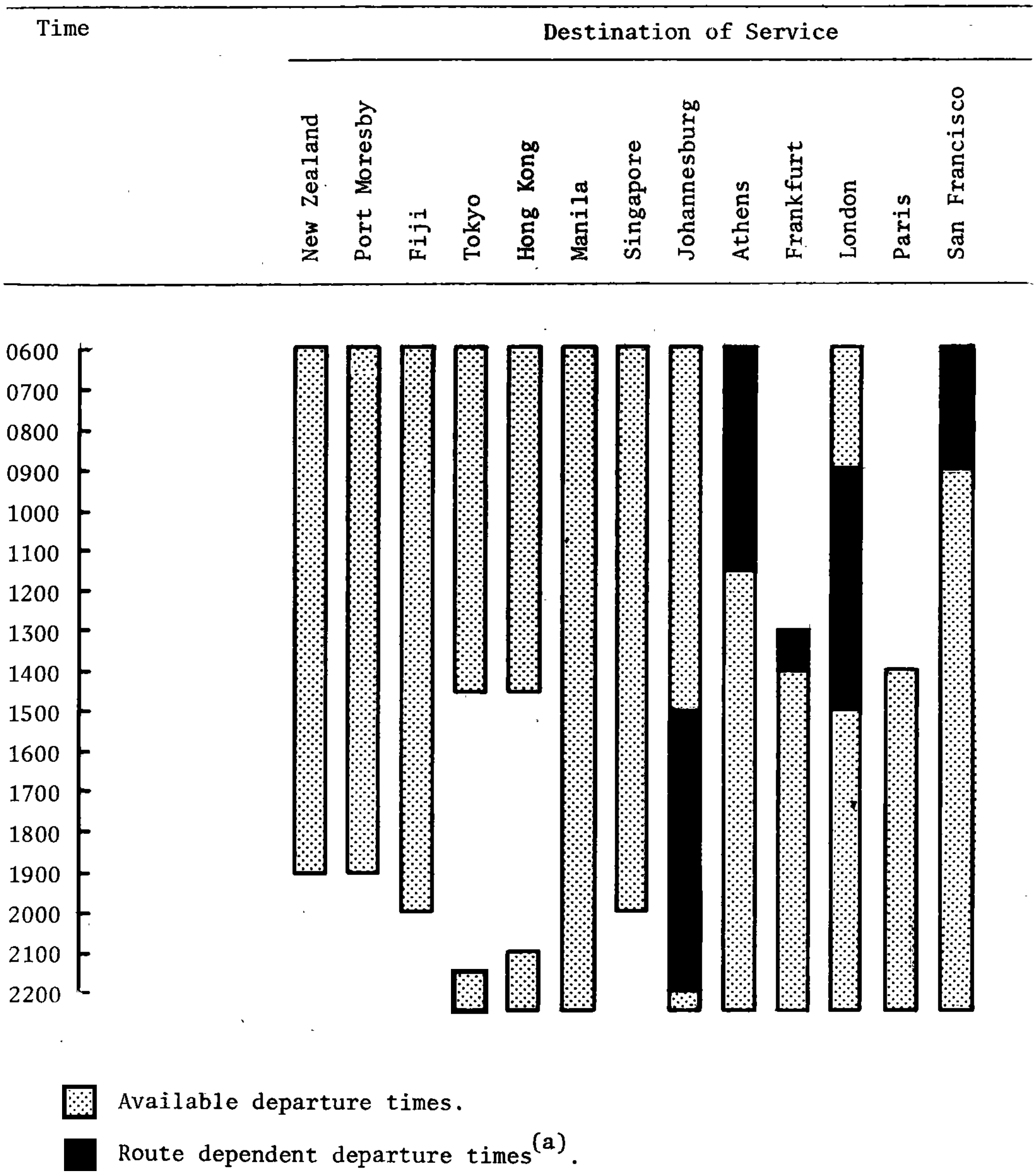
Available arrival times.

Route dependent arrival times [(a)].

NOTE: The curfew at Sydney applies between 2300 and 0600 hours.

(a) The existence of alternative routes allows a limited number of arrivals in these time periods.

TABLE III.13 - WINDOWS FOR INTERNATIONAL AIRCRAFT DEPARTURES AT SYDNEY



NOTE: The curfew at Sydney applies between 2300 and 0600 hours.

(a) The existence of alternative routes allows a limited number of departures in these time periods.

flows which had already been determined. At the same time, passengers were allocated to one or more paths available for any particular origin-destination. For example a proportion of the total O-D passenger flow between Melbourne and Brisbane would be allocated to direct Melbourne-Brisbane flights and a proportion to Melbourne-Sydney-Brisbane flights. This process provided the numbers of aircraft movements and domestic transit passengers at Sydney Airport.

In all, 6 different aircraft types were considered. These were selected for inclusion in the domestic fleets at various times up to the year 2000. The DC9-30, Boeing 727-100 (B727-100) and Boeing 727-200 (B727-200) series have seating capacities of 97, 108 and 137 respectively. These aircraft have been in service for a number of years. DC9-30 and B727-200 aircraft dominate the fleets in the early years of the forecast. Three versions of wide-body aircraft (referred to as WB1, WB2 and WB3) with seating capacities of 235, 280 and 350 were assumed to become available progressively over the forecast period (up to the year 2000). However, only WB1 and WB2 were selected for the median forecast. WB3 was selected for the high forecast for the year 2000.

The basic criterion for selecting a particular fleet mix and pattern of services was the minimisation of costs borne by the airlines. However, a number of constraints relating to operating procedures had to be satisfied by the fleet mix and service pattern selected.

Two sets of costs were identified, fixed costs and variable costs. The fixed costs associated with an aircraft were those costs incurred simply because of the presence of the aircraft in the fleet. They did not vary with the utilisation of the aircraft, but, of course, they differ for different aircraft types.

Fixed costs included insurance, allowances for depreciation and obsolescence, and some costs associated with the introduction of wide-body aircraft. These latter costs covered items such as enlarged hangars, new maintenance facilities, new airport handling facilities and pilot training.

Variable costs were those costs which depended on how an aircraft was used. They varied with the number of hours for which an aircraft was in use. They also depended on whether the aircraft was used on long-distance or short-distance routes. Variable costs included air navigation charges, maintenance and overhaul costs, fuel and oil costs, and crew costs (excluding cabin staff).

For a particular fleet and pattern of services, the procedure used arrived at a total cost, on the basis of unit costs applicable to particular aircraft.

As mentioned previously, the selection of aircraft in the fleet and of service patterns was subject to a number of constraints. Thus there were upper and/or lower bounds on the numbers of each type of aircraft in the fleet. In the case of the introduction of wide-body jets, it was necessary to acquire a minimum number for maintenance and schedule control reasons. The actual numbers of various types of aircraft in the forecast years were derived as part of the selection process involved in the linear program.

In relation to restrictions on the use of airports, curfews between the hours 2300 and 0600 at Adelaide, Sydney and Brisbane airports were assumed to continue to apply throughout the forecast period. Other landing restrictions (such as weight limitations) at airports in the interstate network were assumed not to be binding constraints beyond 1985.

Minimum frequencies on sectors[1] were specified (Table III.14), as were maximum sector load factors (Table III.15). The maximum load factors are constraints on the permissible upper limits on the average proportions of seats occupied on particular sectors over a year. They will be exceeded in various peak periods. They also do not allow for Transit IV movements, which mostly affect sectors involving Canberra, Adelaide and Tasmanian ports.

A system-wide load factor constraint was also specified. The system-wide load factor was defined as the total number of passenger-kilometres performed, divided by the total number of seat-kilometres provided. Sector distances were required to calculate values for this parameter, and these are given in

(1) A sector is a city pair connected by a direct flight.

TABLE III.14 - BASIC INTERSTATE SECTOR INFORMATION

Sector	Sector Distance (km)	Minimum Sector Frequency[a]
Sydney-Melbourne	743	232
Sydney-Brisbane	771	140
Melbourne-Brisbane	1402	28
Melbourne-Coolangatta	1378	8
Sydney-Coolangatta	682	26
Sydney-Adelaide	1196	52
Melbourne-Adelaide	655	66
Adelaide-Perth	2216	24
Melbourne-Perth	2721	20
Sydney-Perth	3341	4
Melbourne-Launceston	489	40
Melbourne-Hobart	634	40
Melbourne-Canberra	483	44
Sydney-Canberra	284	84
Brisbane-Rockhampton	571	28
Brisbane-Townsville	194	38
Rockhampton-Mackay	280	28
Mackay-Townsville	343	10
Townsville-Cairns	298	38
Brisbane-Mount Isa	1580	10
Mount Isa-Darwin	1307	6
Brisbane-Darwin	2887	4
Adelaide-Alice Springs	1413	12
Alice Springs-Darwin	1353	4
Adelaide-Darwin	2766	2
Canberra-Brisbane	943	-
Canberra-Adelaide	958	-
Brisbane-Adelaide	1599	-

(a) Round trips per week.

TABLE III.15 - MAXIMUM LOAD FACTORS ON INTERSTATE SECTORS[a]

(per cent)

Sector	1980	1985	1990	1995	2000
Sydney-Melbourne	70	70	72	73	75
Sydney-Brisbane	70	70	72	73	75
Melbourne-Brisbane	66	66	68	69	71
Melbourne-Coolangatta	65	65	67	67	70
Sydney-Coolangatta	69	69	71	72	69
Sydney-Adelaide	70	70	72	73	75
Melbourne-Adelaide	70	70	72	73	75
Adelaide-Perth	70	70	72	73	75
Melbourne-Perth	65	65	67	68	70
Sydney-Perth	65	67	68	70	70
Melbourne-Launceston	66	66	68	69	73
Melbourne-Hobart	66	66	68	69	73
Melbourne-Canberra	61	61	68	69	66
Sydney-Canberra	61	61	68	69	66
Brisbane-Rockhampton	67	67	67	69	71
Brisbane-Townsville	67	67	67	69	71
Rockhampton-Mackay	67	87	57	69	71
Mackay-Townsville	67	57	67	69	71
Townsville-Cairns	67	67	67	69	71
Brisbane-Mount Isa	63	63	65	66	70
Mount Isa-Darwin	65	65	67	68	68
Brisbane-Darwin	65	65	67	68	70
Adelaide-Alice Springs	65	65	67	58	70
Alice Springs-Darwin	63	63	65	66	68
Adelaide-Darwin	65	65	67	68	70
Canberra-Brisbane	65	65	67	68	70
Canberra-Adelaide	65	65	67	68	70
Brisbane-Adelaide	65	65	67	68	70

(a) These values are constraints applying on average load factors over a year, but may be exceeded during peak periods. See text.

Table III.14. The system-wide pattern of aircraft movements and the corresponding passenger flows were constrained by the model to give the specified system-wide load factor.

For a particular pattern of services, the total number of flying hours for each aircraft was calculated from information on route operating times, given in Table III.16. These were required to be less than the number of 'feasible' flying hours for each aircraft. The concept of feasible flying times takes account of transit and turnaround times for aircraft at various airports (Table III.17), the length of the airday for aircraft, and times required for overhaul and service operations.

For the purposes of operating the model, it was necessary to specify some additional identities which ensured a consistent pattern of flows within the overall system. The model selected the aircraft mix and pattern of services which met all the constraints, and minimised the total costs of operating the services. The aircraft mixes corresponding to the high, median and low forecasts are shown in Table III.18. The age structures of aircraft over the forecast period are shown in Table III.19 (for the median forecast only).

Interstate Daily Profiles

The daily profiles of interstate aircraft movements were derived from a consideration of current timetables, followed by an examination of the effect of changes in aircraft type or passenger loading capacities, introduction and deletion of services, and changes in the business/non-business mix of passengers.

Before determining the numbers of aircraft movements at Sydney by time of day, the total movements for a Friday and a Tuesday of a typical week in the forecast years were estimated(1). To do this, it was found necessary to repeat the entire forecasting procedure, including both the passenger and aircraft movement phases. The difference from the procedures used for generating the annual movements relates essentially to the use of a different

(1) Tuesday and Friday were selected because they are quiet and busy days, respectively, in a typical week.

TABLE III.16 - INTERSTATE ROUTE INFORMATION

Route	Cities En Route	Route Times by Aircraft Type[a] (hours)				
		B727-100	DC9-30	B727-200	WB1	WB2
Melbourne-Sydney	-	1.186	1.207	1.219	1.201	1.158
Sydney-Brisbane	-	1.214	1.259	1.247	1.229	1.184
Melbourne-Brisbane	-	1.892	2.024	1.925	1.903	1.837
Melbourne-Coolangatta	-	1.872	1.935	1.905	1.883	1.818
Sydney-Coolangatta	-	1.146	1.169	1.179	1.162	1.120
Sydney-Adelaide	-	1.742	1.818	1.775	1.754	1.695
Sydney-Perth	Adelaide	4.517	-	4.584	4.515	4.347
Sydney-Perth	-	4.169	-	4.202	4.167	4.034
Melbourne-Adelaide	-	1.090	1.118	1.123	1.106	1.065
Melbourne-Perth	Adelaide	3.865	-	3.932	3.872	3.729
Melbourne-Perth	-	3.417	-	3.504	3.473	3.361
Melbourne-Launceston	-	0.876	0.896	0.909	0.895	0.862
Melbourne-Hobart	-	1.056	1.075	1.089	1.073	1.033
Melbourne-Canberra	-	0.906	0.908	0.939	0.923	0.888
Sydney-Canberra	-	0.639	0.622	0.672	0.658	0.631
Melbourne-Brisbane	Sydney	2.400	2.464	2.467	2.430	2.340
Brisbane-Mackay	Rockhampton	1.491	1.500	1.558	1.534	1.478
Brisbane-Cairns	Rockhampton Mackay Townsville	2.793	2.814	2.926	2.882	2.775
Brisbane-Cairns	Townsville	2.235	2.285	2.302	2.267	2.183
Brisbane-Mount Isa	-	2.093	2.208	2.126	2.094	2.016
Brisbane-Darwin	Mount Isa	3.844	4.083	3.911	3.852	3.709
Brisbane-Darwin	-	3.557	-	3.590	3.536	3.405
Adelaide-Alice Springs	-	1.872	1.975	1.905	1.876	1.807
Adelaide-Darwin	Alice Springs	3.657	3.892	3.724	3.668	3.532
Adelaide-Darwin	-	3.374	-	3.407	3.355	3.231
Canberra-Brisbane	-	1.485	1.540	1.525	1.503	1.448
Canberra-Adelaide	-	1.509	1.564	1.549	1.527	1.471
Brisbane-Adelaide	-	2.118	2.235	2.156	2.145	2.066

(a) Route times for WB3 were assumed to be the same as for WB2.

TABLE III.17 - INTERSTATE AIRPORT INFORMATION

Airport	Adelaide	Alice Springs	Brisbane	Canberra	Mackay	Coolangatta	Perth	Rockhampton	Sydney	Townsville	Cairns	Darwin	Hobart	Mount Isa	Launceston	Melbourne
Airport Turnaround Time(a) (hours)																
B727-100	0.583	0.583	0.583	0.500	0.500	0.500	0.583	0.500	0.583	0.500	0.500	0.583	0.500	0.500	0.500	0.583
DC9-30	0.583	0.583	0.583	0.500	0.500	0.500	0.583	0.500	0.583	0.500	0.500	0.583	0.500	0.500	0.500	0.583
B727-200	0.583	0.583	0.583	0.500	0.500	0.500	0.583	0.500	0.583	0.500	0.500	0.583	0.500	0.500	0.500	0.583
WB1	0.750	0.750	0.750	0.750	0.750	0.750	1.000	0.750	0.750	0.750	0.750	1.000	0.750	0.750	0.750	0.750
WB2	0.750	0.750	0.750	0.750	0.750	0.750	1.000	0.750	0.750	0.750	0.750	1.000	0.750	0.750	0.750	0.750
WB3	0.750	0.750	0.750	0.750	0.750	0.750	1.000	0.750	0.750	0.750	0.750	1.000	0.750	0.750	0.750	0.750
Airport Transit Time(b) (hours)																
B727-100	0.583	0.500	0.583	0.417	0.417	0.417	0.583	0.417	0.583	0.417	0.417	0.583	0.417	0.417	0.417	0.583
DC9-30	0.583	0.500	0.583	0.417	0.417	0.417	0.583	0.417	0.583	0.417	0.417	0.583	0.417	0.417	0.417	0.583
B727-200	0.583	0.500	0.583	0.417	0.417	0.417	0.583	0.417	0.583	0.417	0.417	0.583	0.417	0.417	0.417	0.583
WB1	0.750	0.750	0.750	0.750	0.750	0.750	0.750	0.750	0.750	0.750	0.750	0.750	0.750	0.750	0.750	0.750
WB2	0.750	0.750	0.750	0.750	0.750	0.750	0.750	0.750	0.750	0.750	0.750	0.750	0.750	0.750	0.750	0.750
WB3	0.750	0.750	0.750	0.750	0.750	0.750	0.750	0.750	0.750	0.750	0.750	0.750	0.750	0.750	0.750	0.750

(a) Turnaround time applies when the aircraft terminates on a route.

(b) Transit time applies when the aircraft is at an intermediate port on a route.

TABLE III.18 - PROJECTED INTERSTATE FLEET MIX

	B727-100	DC9-30	B727-200	WB1	WB2	WB3	Total
For High Forecasts							
1980	2	24	34	-	-	-	60
1985	-	12	48	12	-	-	72
1990	-	-	36	52	-	-	88
1995	-	-	16	80	16	-	112
2000	-	-	4	66	44	16	130
For Median Forecasts							
1980	2	24	24	-	-	-	50
1985	-	12	30	8	-	-	50
1990	-	-	18	38	-	-	56
1995	-	-	16	58	4	-	78
2000	-	-	4	54	28	-	86
For Low Forecasts							
1980	2	24	22	-	-	-	48
1985	-	12	22	8	-	-	42
1990	-	-	20	26	-	-	46
1995	-	-	16	36	4	-	56
2000	-	-	4	38	10	-	62

TABLE III.19 - ASSUMED AGE STRUCTURE OF INTERSTATE FLEET - MEDIAN ASSUMPTIONS

Aircraft Type	Number of Aircraft				
	1980	1985	1990	1995	2000
B727-100					
Up to 5 years	-	-	-	-	-
5 to 10 years	-	-	-	-	-
10 to 15 years	2	-	-	-	-
DC9-30					
Up to 5 years	-	-	-	-	-
5 to 10 years	12	-	-	-	-
10 to 15 years	12	12	-	-	-
B727-200					
Up to 5 years	12	6	-	-	-
5 to 10 years	12	12	6	-	-
10 to 15 years	-	12	12	6	-
15 to 20 years	-	-	-	10	4
WB1					
Up to 5 years	-	8	30	20	4
5 to 10 years	-	-	8	30	20
10 to 15 years	-	-	-	8	30
WB2					
Up to 5 years	-	-	-	4	24
5 to 10 years	-	-	-	-	4
10 to 15 years	-	-	-	-	-
WB3 (a)					
Up to 5 years	-	-	-	-	-
5 to 10 years	-	-	-	-	-
10 to 15 years	-	-	-	-	-

(a) WB3 aircraft are not introduced by 2000 in the median case.

set of 1976 base origin-destination passenger flows from which to generate the forecasts. To obtain the movements for a typical Friday, the base passenger flows were increased to account for the increased traffic on a Friday. For a typical Tuesday the base flows were decreased.

The adjustments to the base flows were made on the basis of detailed information, made available to the BTE, on origin-destination flows by day of the week for 1976. For each O-D pair in turn, a ratio of movements on a typical Friday to movements on an average day (equal to annual movements divided by 365) was calculated. These were the factors by which the base figures were adjusted. The forecast passenger and aircraft movements for a typical Friday were then derived. A similar procedure was used to calculate movements for a typical Tuesday.

The next step was to determine the daily profiles (i.e. the numbers of movements in hourly intervals for a Friday and Tuesday). Timetables from 1976 were used to examine daily profiles disaggregated by sector and aircraft type. Initially, a daily profile for all movements at Sydney in a particular forecast year was constructed. This reflected the pattern observed in 1976, and was consistent with the total number of movements for the day in question (determined above). The effect of changes in aircraft types (and in particular their capacities) and flight patterns was considered by examining their impact on individual sectors, and hence on the overall profile.

It was necessary to take account of expected changes in the business/non-business mix of passenger travel. Non-business travel was expected to grow faster than business travel. Information was available on daily profiles of passenger movements at Sydney in 1973 for business and non-business travellers separately. This allowed the effect on the total passenger profile of predicted changes in the proportions of these travellers to be observed, on the assumption that the individual profiles of the two broad trip purposes would remain constant. Adjustments were then made to the aircraft movement profiles to reflect the expected changes in the passenger profiles.

INTRASTATE AND COMMUTER AIRCRAFT MOVEMENTS

Passenger movement forecasts were obtained for those services radiating from Sydney Airport (as described in Appendix II). Aircraft movement forecasts for particular routes were obtained by dividing passenger movement forecasts by expected numbers of passengers per aircraft. Assumptions about aircraft sizes and load factors were needed to determine passengers per aircraft.

For intrastate services, it was assumed that F27 type aircraft, with maximum seating capacity of 52 seats, would be operating on all routes except those to Albury-Wodonga, Casino, Dubbo, Tamworth and Wagga. An aircraft with a maximum of 100 seats was assumed to operate on the Albury-Wodonga route after 1980. A different version of the F27, with a maximum seating capacity of 55, was assumed to be used for the Casino, Dubbo, Tamworth and Wagga routes for the years 1985 and 1990. After 1990, an F28 type aircraft, with about 80 seats, was assumed to be operating on these routes. Finally, a single load factor of 67 per cent was used on all routes, together with the aircraft capacities, to calculate average numbers of passengers per aircraft.

For commuter services, the assumptions for the Sydney-Newcastle route and all other routes (taken together) are set out in Table III.20.

TABLE III.20 - ASSUMPTIONS FOR SEATING CAPACITIES AND LOAD FACTORS FOR COMMUTER SERVICES

Variable	1980	1985	1990	1995	2000
Average Seating Capacity					
Sydney-Newcastle					
33 per cent of the flights	19	9	19	30	19
67 per cent of the flights	9	19	19	19	30
Sydney-Other	8	10	12	14	16
Average Load Factor (per cent)					
Sydney-Newcastle	70	70	70	72	75
Sydney-Other	65	67	70	72	72

APPENDIX IV

PASSENGER AND AIRCRAFT MOVEMENT FORECASTS

This Appendix presents passenger and aircraft movement forecasts for specific years in more detail than was done in Chapters 6 and 7. Only the forecasts relating to the median assumptions are presented here. The passenger forecasts are presented in Tables IV.1 to IV.5, and the aircraft movement forecasts are presented in Tables IV.6 to IV.17.

PASSENGER MOVEMENT FORECASTS

The main purpose of Table IV.1 is to identify the transit movements among the total passenger movements at Sydney, and hence figures are only given for 1976, 1985 and 2000. Although the various types of transit movements have been discussed earlier in this Paper, they are defined in detail here in order to improve understanding of Table IV.1 and the following tables. In the domestic markets, a passenger departing from or arriving at Sydney is counted as a Sydney-oriented movement when Sydney is the airport of origin or destination for the trip. Domestic transits are movements at Sydney on domestic airlines by domestic passengers en route to and from other domestic airports. International Transit IV movements are passenger arrivals or departures at Sydney on interstate domestic airlines for the purpose of connecting with international flights.

Under the 'International Movements' heading in Table IV.1, Sydney-oriented movements are those for which Sydney is the international airport of embarkation or disembarkation. A resident of Sydney who takes an international flight from Sydney to Europe is obviously included in this category. However, it is also useful to consider an Adelaide resident who flies to Sydney on a domestic flight and takes a Europe-bound international flight at Sydney. The passenger's arrival on a domestic airline at Sydney is counted in international Transit IV movements (and appears under the 'Domestic Movements' heading), and his departure from Sydney on an international airline is counted as a Sydney-oriented international movement. An overseas resident who calls at

Sydney, leaves the transit lounge and declares his purpose as transit is not included in the Sydney-oriented category but in the Transit I category. An overseas resident who calls at Sydney en route between overseas countries, and who does not leave the transit lounge, is in the Transit II category. Visitors and Australian residents calling at Sydney on international airlines en route between overseas countries and another Australian international airport (usually Melbourne) are counted as Transit III movements at Sydney.

A traveller passing through Sydney Airport on both the outward and return legs of his journey will make 4 movements at Sydney. This compares with 2 movements at Sydney for the round trip by a traveller who resides in Sydney.

The Sydney-oriented international movements in Table IV.1 have been split up according to duration of stay. A movement involving period of stay or absence of less than 12 months is defined as a short-term movement.

Tables IV.2 to IV.6 allocate Sydney-oriented travellers to various origin and destination airports and regions. As explained in Appendix III, this was an important step in the process of generating aircraft movements. Table IV.4 gives the division of interstate passenger forecasts by purpose for Sydney-oriented trips. The split between business and non-business interstate travel had implications for the daily profiles of aircraft movements.

AIRCRAFT MOVEMENT FORECASTS

Generally speaking, the aircraft movement forecasts for Sydney have been disaggregated on a geographical basis, as well as by type of aircraft and time of day.

Table IV.7 shows international aircraft movements at Sydney for an average day, classified by the overseas region of origin or destination for the flights. These regions do not, of course, necessarily contain the first or last port of call. An arrival by an international aircraft from Melbourne is included in the region for which the aircraft is ultimately destined.

Table IV.8 breaks down international aircraft movements at Sydney by aircraft type. Again, the movements are shown for an average day. Tables IV.9 and IV.10 indicate international aircraft arrivals and departures within hourly time-slots throughout an average day and a busy day respectively. The figures for an average day are approximately equal to the annual figures divided by 365.

Tables IV.11 and IV.12 give details of interstate aircraft arrivals and departures at Sydney by sector[1] and aircraft type for a typical Tuesday and a typical Friday. Table IV.11 (for a Tuesday) can be taken to represent a quiet week-day for scheduled interstate services, and Table IV.12 (for a Friday) represents a busy week-day in a typical week. Interstate aircraft arrivals and departures by time of day are shown for the same two representative days in Tables IV.13 and IV.14. Tables IV.15 and IV.16 give information on aircraft movements at Sydney Airport by region and time of day for intrastate services. Table IV.17 gives time-of-day information for commuter services. The differences between average and busy days reflect the differences in scheduled services over a typical week.

(1) As defined in Appendix III, a sector is a city pair connected by a direct flight.

TABLE IV.1 - FORECAST BREAKDOWN OF PASSENGER MOVEMENTS AT SYDNEY AIRPORT

('000)

Category	1976 [(a)]	1985	2000
International Movements			
Sydney-oriented			
Permanent	62	56	56
Long-Term	86	108	164
Short-Term	1243	2636	5327
International Transits			
Transit I		234	420
Transit II	1138 [(b)]	351	630
Transit III		1164	1178
Total International Movements	2529	4549	7775
Interstate Movements			
Sydney-oriented	2822	5031	13325
Domestic Transits	830	1210	3201
International Transit IV	321	467	1049
Total Interstate Movements	3973	6708	17575
Intrastate Movements			
Sydney-oriented	826	1401	2052
Commuter Movements			
Sydney-oriented	112	183	396
Total	7440	12841	27798

NOTE: The precise interpretations of Sydney-oriented movements and the various categories of transit movements are discussed in the text.

(a) Refers to the financial year ended June 1976. The figures provided are estimates only.

(b) No separate estimates were available for the three classes of transit movements in 1976. This figure is a total for all categories except Transit IV.

TABLE IV.2 - FORECAST INTERNATIONAL PASSENGER MOVEMENTS AT SYDNEY AIRPORT BY ORIGIN OR DESTINATION

('000)

Origin or Destination	1980	1985	1990	1995	2000
Sydney-Oriented					
New Zealand	382	441	496	559	632
Papua-New Guinea	99	126	156	193	237
Oceania	10[illegible]	136	169	209	256
Far East Asia	19	327	502	721	1025
South-East Asia	281	401	542	714	930
Africa	57	98	137	199	266
Europe	632	812	984	1204	1473
America	344	460	538	628	730
Transits					
Transit 1 and Transit II	437	584	739	895	1050
Transit III	1147	1164	929	1093	1178
Total[a]	3675	4549	5191	6415	7775

(a) Figures may not add exactly due to rounding.

TABLE IV.3 - FORECAST INTERSTATE PASSENGER MOVEMENTS AT SYDNEY AIRPORT BY ORIGIN OR DESTINATION

('000)

Origin or Destination	1980	1985	1990	1995	2000
Sydney-Oriented					
Melbourne	1491	1739	2507	3410	4460
Canberra	1023	1383	1854	2368	2884
Brisbane	676	807	1171	1629	2193
Adelaide	239	294	525	802	1127
Coolangatta	199	237	297	367	450
Other	475	571	1004	1544	2211
Transits					
Domestic Transits	972	1210	1755	2414	3201
International Transit IV	344	467	609	792	1049
Total	5419	6708	9722	13326	17575

TABLE IV.4 - FORECAST INTERSTATE PASSENGER MOVEMENTS AT SYDNEY AIRPORT FOR BUSINESS AND NON-BUSINESS PURPOSES[a]

('000)

Origin or Destination	Business		Non-Business	
	1985	2000	1985	2000
Melbourne	956	2277	783	2183
Canberra	761	1473	622	1411
Brisbane	444	1120	363	1073
Adelaide	162	575	132	552
Coolangatta	130	230	107	220
Other	314	1129	257	1082
Total	2767	6804	2264	6521

(a) Excludes all transit movements at Sydney.

TABLE IV.5 - FORECAST INTRASTATE PASSENGER MOVEMENTS AT SYDNEY AIRPORT BY ORIGIN OR DESTINATION

('000)

Origin or Destination	1980	1985	1990	1995	2000
Northeast	216	274	308	345	387
Northwest	83	112	129	150	174
Central	365	472	536	609	692
Coast	245	232	371	425	488
Cooma	48	57	61	65	69
Albury-Wodonga	78	104	120	139	160
Other[(a)]	47	59	66	74	83
Total[(b)]	1082	1401	1591	1807	2052

(a) Includes passengers travelling on flights between Sydney and Norfolk Island and Maroochydore.

(b) Figures may not add exactly due to rounding.

TABLE IV.6 - FORECAST COMMUTER PASSENGER MOVEMENTS AT SYDNEY AIRPORT BY ORIGIN OR DESTINATION

('000)

Origin or Destination	1980	1985	1990	1995	2000
Newcastle	83	109	145	183	229
Nowra/Moruya	11	17	24	32	41
Scone	5	7	9	11	14
Young/Cootamundra	8	12	17	22	28
Tumut	4	5	7	9	11
Gunnedah	5	6	8	10	13
Other	18	26	36	47	60
Total[(a)]	134	183	245	314	396

(a) Figures may not add exactly due to rounding.

TABLE IV.7 - FORECAST INTERNATIONAL AIRCRAFT MOVEMENTS AT SYDNEY AIRPORT BY OVERSEAS REGION - AVERAGE DAY

Region	1980	1985	1990	1995	2000
New Zealand	8	8	8	10	10
Papua-New Guinea	6	4	4	4	4
Oceania	3	4	4	4	6
Far East Asia	6	8	10	10	12
South-East Asia	9	9	10	10	10
Africa	2	2	2	2	4
Europe	13	14	14	14	14
America	9	9	8	8	10
Total	56	58	60	62	70

TABLE IV.8 - FORECAST INTERNATIONAL AIRCRAFT MOVEMENTS AT SYDNEY AIRPORT BY AIRCRAFT TYPE - AVERAGE DAY

Aircraft Type[a]	1980	1985	1990	1995	2000
140 seats	10	-	-	-	-
260 seats	6	12	6	-	-
280 seats	4	2	2	-	-
400[b] seats	36	38	42	34	26
500 seats	-	6	10	22	30
650 seats	-	-	-	6	10
800 seats	-	-	-	-	4
Total	56	58	60	62	70

(a) Aircraft types are indicated in a generic fashion by the number of seats available.

(b) Includes stretched L1011/DC10 aircraft which are expected to have a capacity in the range 350-400 seats.

TABLE IV.9 - FORECAST INTERNATIONAL AIRCRAFT MOVEMENTS AT SYDNEY AIRPORT BY TIME-OF-DAY - AVERAGE DAY

Time	Arrivals					Departures				
	1980	1985	1990	1995	2000	1980	1985	1990	1995	2000
0600-0659	5	6	4	5	5	-	-	-	-	-
0700-0759	4	4	4	4	4	1	-	-	-	-
0800-0859	2	4	1	1	3	1	1	1	1	2
0900-0959	2	1	1	1	1	2	3	3	4	3
1000-1059	-	-	1	1	1	3	2	2	1	3
1100-1159	1	-	1	1	1	3	3	4	3	4
1200-1259	1	-	-	-	-	2	2	4	5	5
1300-1359	1	1	1	1	1	2	2	3	3	3
1400-1459	1	1	1	1	1	3	2	2	2	2
1500-1559	-	1	-	-	-	3	3	3	3	4
1600-1659	-	-	-	-	-	1	3	1	3	3
1700-1759	3	3	3	3	3	-	1	2	1	1
1800-1859	1	-	3	3	4	3	3	1	1	1
1900-1959	2	2	2	2	3	2	2	1	1	1
2000-2059	4	4	3	3	3	-	-	2	2	2
2100-2159	1	2	4	4	4	1	1	-	-	-
2200-2259	-	-	1	1	1	1	1	1	1	1
Total	28	29	30	31	35	28	29	30	31	35

TABLE IV.10 - FORECAST INTERNATIONAL AIRCRAFT MOVEMENTS AT SYDNEY AIRPORT BY TIME-OF-DAY - BUSY DAY[a]

Time	Arrivals					Departures				
	1980	1985	1990	1995	2000	1980	1985	1990	1995	2000
0600-0659	6	6	4	5	6	-	-	-	-	-
0700-0759	4	4	5	4	5	2	-	-	-	-
0800-0859	3	4	2	2	3	2	1	1	1	2
0900-0959	3	1	1	1	1	2	3	3	4	4
1000-1059	-	-	1	2	2	4	2	2	1	3
1100-1159	1	-	1	1	1	4	3	5	4	4
1200-1259	1	-	-	-	-	2	3	4	6	6
1300-1359	1	1	2	1	1	2	2	3	3	3
1400-1459	1	2	1	1	1	3	2	2	2	2
1500-1559	-	1	-	-	-	3	4	4	4	4
1600-1659	-	-	-	-	-	2	3	2	4	3
1700-1759	4	3	4	3	3	-	1	3	1	1
1800-1859	2	-	4	4	4	3	4	1	1	1
1900-1959	2	2	2	3	3	3	2	1	1	2
2000-2059	4	5	3	3	3	-	-	2	2	2
2100-2159	2	3	4	5	5	1	-	-	-	-
2200-2259	-	-	1	1	1	1	1	2	2	2
Total	34	32	35	36	39	34	32	35	36	39

(a) Typical of a Friday, Saturday or Sunday.

TABLE IV.11 - FORECAST INTERSTATE AIRCRAFT MOVEMENTS AT SYDNEY AIRPORT BY AIRCRAFT TYPE - TUESDAY

Movement Type	1980	1985	1990	1995	2000
Arrivals					
From Melbourne	14 DC9-30 16 B727-200	24 B727-200 4 WB1	12 B727-200 18 WB1	34 WB1	43 WB1
From Brisbane	16 DC9-30 3 B727-200	6 DC9-30 13 B727-200	11 B727-200 8 WB1	12 B727-200 13 WB1	26 WB1
From Adelaide	1 DC9-30 4 B727-100	1 WB1 3 B727-200	5 WB1	8 WB1	9 WB2
From Perth	4 B727-200	1 WB1 3 B727-200	6 WB1	8 WB1 1 WB2	10 WB2
From Canberra	20 DC9-30	21 DC9-30 4 B727-200	25 B727-200	32 B727-200	18 B727-200 12 WB1
From Coolangatta	5 DC9-30	4 B727-200	1 B727-200 2 WB1	4 WB1	5 WB1
Departures					
For Melbourne	15 DC9-30 19 B727-200	28 B727-200 4 WB1	14 B727-200 20 WB1	38 WB1	49 WB1
For Brisbane	16 DC9-30 3 B727-200	6 DC9-30 13 B727-200	11 B727-200 8 WB1	12 B727-200 13 WB1	26 WB1
For Adelaide	1 DC9-30 4 B727-100	1 WB1 3 B727-200	5 WB1	8 WB1	9 WB2
For Perth	4 B727-200	1 WB1 3 B727-200	6 WB1	8 WB1 1 WB2	10 WB2
For Canberra	24 DC9-30	24 DC9-30 5 B727-200	29 B727-200	34 B727-200	18 B727-200 12 WB1
For Coolangatta	5 DC9-30	4 B727-200	1 B727-200 2 WB1	4 WB1	5 WB1
Total Arrivals and Departures	174	176	184	230	252

TABLE IV.12 - FORECAST INTERSTATE AIRCRAFT MOVEMENTS AT SYDNEY AIRPORT BY AIRCRAFT TYPE - FRIDAY

Movement Type	1980	1985	1990	1995	2000
Arrivals					
From Melbourne	15 DC9-30 18 B727-200	24 B727-200 4 WB1	13 B727-200 29 WB1	37 WB1	47 WB1
From Brisbane	17 DC9-30 4 B727-200	7 DC9-30 14 B727-200	13 B727-200 8 WB1	13 B727-200 14 WB1	29 WB1
From Adelaide	1 DC9-30 5 B727-100	1 WB1 5 B727-200	6 WB1	9 WB1	10 WB1
From Perth	4 B727-200	1 WB1 5 B727-200	6 WB1	9 WB1 1 WB2	11 WB2
From Canberra	22 DC9-30	23 DC9-30 5 B727-200	28 B727-200	36 B727-200	20 B727-200 14 WB1
From Coolangatta	6 DC9-30	5 B727-200	1 B727-200 3 WB1	4 WB1	5 WB1
Departures					
For Melbourne	17 DC9-30 20 B727-200	28 B727-200 6 WB1	15 B727-200 22 WB1	41 WB1	53 WB1
For Brisbane	17 DC9-30 4 B727-200	7 DC9-30 14 B727-200	13 B727-200 8 WB1	13 B727-200 14 WB1	29 WB1
For Adelaide	1 DC9-30 5 B727-100	1 WB1 5 B727-200	6 WB1	9 WB1	10 WB2
For Perth	4 B727-200	1 WB1 5 B727-200	6 WB1	9 WB1 1 WB2	11 WB2
For Canberra	26 DC9-30	27 DC9-30 5 B727-200	30 B727-200	38 B727-200	20 B727-200 14 WB1
For Coolangatta	6 DC9-30	5 B727-200	1 B727-200 3 WB1	4 WB1	5 WB1
Total Arrivals and Departures	192	200	202	252	278

TABLE IV.13 - FORECAST INTERSTATE AIRCRAFT MOVEMENTS AT SYDNEY AIRPORT BY TIME-OF-DAY - TUESDAY

Time	Arrivals					Departures				
	1980	1985	1990	1995	2000	1980	1985	1990	1995	2000
0600-0659	2	2	2	2	2	-	-	-	1	3
0700-0759	4	4	4	4	5	10	8	10	10	10
0800-0859	5	8	7	9	10	13	13	13	14	16
0900-0959	8	5	8	12	12	6	6	6	6	8
1000-1059	5	5	4	6	6	6	8	8	12	12
1100-1159	6	7	7	10	11	2	2	2	4	4
1200-1259	4	4	6	6	6	4	4	4	6	6
1300-1359	6	6	6	6	6	4	4	4	4	4
1400-1459	3	4	4	6	6	4	4	6	8	6
1500-1559	2	2	2	4	7	5	4	4	4	5
1600-1659	5	5	5	5	5	6	6	6	8	8
1700-1759	8	6	7	8	10	9	8	9	12	14
1800-1859	5	5	5	8	8	8	9	9	10	8
1900-1959	13	14	14	14	14	6	8	7	9	10
2000-2059	3	3	3	6	6	6	6	6	7	8
2100-2159	4	4	4	6	7	2	2	2	3	5
2200-2259	-	-	-	-	2	-	-	-	-	2
Total	83	84	88	112	123	91	92	96	118	129

TABLE IV.14 - FORECAST INTERSTATE AIRCRAFT MOVEMENTS AT SYDNEY AIRPORT BY TIME-OF-DAY - FRIDAY

Time	Arrivals					Departures				
	1980	1985	1990	1995	2000	1980	1985	1990	1995	2000
0600-0659	2	2	2	2	2	1	1	1	3	4
0700-0759	4	4	4	4	6	9	9	9	9	10
0800-0859	6	8	7	11	11	14	14	13	16	18
0900-0959	6	6	7	12	12	5	5	6	7	9
1000-1059	4	4	4	7	5	8	8	8	12	12
1100-1159	6	8	8	10	11	3	5	5	6	6
1200-1259	4	4	6	6	6	4	4	4	6	7
1300-1359	6	6	6	6	6	4	4	4	4	4
1400-1459	6	6	6	6	6	4	4	6	8	8
1500-1559	2	2	2	6	8	6	5	4	4	4
1600-1659	4	4	4	4	4	6	6	6	8	9
1700-1759	10	10	10	10	16	8	8	8	6	10
1800-1859	6	6	6	8	8	10	12	10	12	11
1900-1959	14	14	14	14	16	6	8	8	9	12
2000-2059	6	6	6	6	6	8	7	8	11	10
2100-2159	6	6	6	9	10	2	2	2	5	4
2200-2259	-	-	-	2	3	2	2	2	3	4
Total	92	96	98	123	136	100	104	104	129	142

TABLE IV.15 - FORECAST INTRASTATE AIRCRAFT MOVEMENTS AT SYDNEY AIRPORT BY ORIGIN OR DESTINATION - AVERAGE DAY

Origin or Destination	1980	1985	1990	1995	2000
Northeast	17	21	24	23	26
Northwest	7	9	10	12	14
Central	29	36	41	40	46
Coast	19	25	28	30	34
Cooma[(a)]	4	4	5	5	5
Albury-Wodonga	6	4	5	6	7
Other	4	5	5	6	6
Total	86	104	118	122	138

(a) Cooma figures are subject to significant seasonal fluctuation.

TABLE IV.16 - INTRASTATE AIRCRAFT MOVEMENTS AT SYDNEY AIRPORT - PERCENTAGE OF MOVEMENTS BY TIME-OF-DAY[(a)]

(per cent)

Time	Average Day		Busy Day	
	Departures	Arrivals	Departures	Arrivals
0600-0659	11	-	8	-
0700-0759	17	-	17	-
0800-0859	6	4	5	3
0900-0959	-	11	3	9
1000-1059	7	11	4	12
1100-1159	4	6	3	6
1200-1259	6	-	4	-
1300-1359	2	4	5	3
1400-1459	6	-	6	3
1500-1559	4	13	5	12
1600-1659	11	4	9	8
1700-1759	8	4	9	3
1800-1859	6	6	6	8
1900-1959	8	10	8	9
2000-2059	4	6	4	5
2100-2159	-	15	4	15
2200-2259	-	6	-	4
Total	100	100	100	100

(a) The percentages are based on current timetables and are regarded as indicative of likely future patterns.

TABLE IV.17 - FORECAST COMMUTER AIRCRAFT MOVEMENTS AT SYDNEY AIRPORT BY TIME-OF-DAY

Time	Average Day					Busy Day				
	1980	1985	1990	1995	2000	1980	1985	1990	1995	2000
0600-0659	1	2	2	2	2	2	2	2	2	2
0700-0759	2	3	4	5	5	4	5	4	5	5
0800-0859	4	4	5	5	5	5	5	5	5	6
0900-0959	4	4	5	5	5	5	5	5	5	6
1000-1059	4	4	4	5	5	4	5	5	5	6
1100-1159	4	4	4	4	5	4	4	5	5	6
1200-1259	4	4	4	4	5	4	4	5	5	5
1300-1359	4	4	4	4	5	4	4	5	5	5
1400-1459	4	4	4	4	5	4	4	5	5	5
1500-1559	4	4	4	4	5	4	4	5	5	5
1600-1659	4	4	4	5	5	4	5	5	5	6
1700-1759	4	4	5	5	5	5	5	5	5	6
1800-1859	4	4	4	5	5	4	5	5	5	6
1900-1959	4	4	4	4	5	4	4	4	5	6
2000-2059	2	3	3	3	3	3	3	3	5	5
2100-2159	1	2	2	2	2	2	2	2	2	2
2200-2259	-	-	-	-	-	-	-	-	-	-
Total	54	58	62	66	72	62	66	70	74	82

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ABBREVIATIONS

ABS	Australian Bureau of Statistics
ACT	Australian Capital Territory
B	Boeing
BTE	Bureau of Transport Economics
C	City
CPI	Consumer Price Index
DC	McDonnell Douglas Corporation
F	Fokker
GA	Group Affinity
GDP	Gross Domestic Product
ICAO	International Civil Aviation Organisation
IMF	International Monetary Fund
LGA	Local Government Area
M	Municipality
MANS	Major Airport Needs of Sydney
NSW	New South Wales
NT	Northern Territory
O-D	Origin-Destination
OECD	Organisation for Economic Cooperation and Development
PDI	Personal Disposable Income
PNG	Papua-New Guinea
RTM	R. Travers Morgan
SA	South Australia
SST	Supersonic Transport
TAA	Trans-Australia Airlines
UK	United Kingdom
UN	United Nations
VFR	Visiting Friends and Relatives
WA	Western Australia
WB	Wide-Body
Qld	Queensland
Tas	Tasmania
Vic	Victoria
km	Kilometres
ln	Natural Logarithms

NOTATION

AA	Number of arrivals by Australians
AD	Number of departures by Australians
BAO	Business travel by Australians going overseas divided by the population of Australia
BAO_{-1}	BAO in the previous quarter
BOA	Business travel to Australia by overseas residents divided by the population of country of origin
BU	Number of passengers travelling for business reasons
CC	Perceived cost of car travel
D	Total passenger movements
EF_i	Full Economy fare for O-D i
EP_{ij}	Proportion of passengers travelling Full Economy for O-D i and purpose j
EX	Exchange rate
F_{ij}	Average fare for O-D i and purpose j
FF_i	First-Class fare for O-D i
FP_{ij}	Proportion of passengers travelling First-Class for O-D i and purpose j
H	Number of hours flown
HO	Number of holiday passengers
K	Distance by road in kilometres
LAO	Leisure travel by Australians going overseas divided by the population of Australia
LAO_{-1}	LAO in the previous quarter
LAO_{-2}	LAO two quarters ago
LF_i	Equivalent low-cost fare for O-D i
LOA	Leisure travel to Australia by overseas residents divided by the population of country of origin
LP_{ij}	Proportion of people travelling on low-cost fares for O-D i and purpose j
MI	Proportion of the Australian population born in the overseas country
MO	Number of Australian-born permanent residents in the overseas country
N	Population of Australia
NB	Number of passengers travelling for non-business purposes

OD	Number of departures from Australia by overseas residents
P	Population product for the origin/destination city pair
PI	Index of Australian population
R	Aircraft rental
RF	Real air fares
RI	Real income
RM	Real imports per capita into Australia from the overseas country
RX	Real exports from Australia to the overseas country
S	Gross operating surplus
T	Total travel time by air (including access and egress times)
TR	Sum of Transit I and Transit II passengers
VR	Number of passengers visiting friends or relatives
t	Time