NEW ZEALAND TOURISM FORECASTING METHODOLOGY 2007

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MINISTRY OF TOURISM
TE MANATŪ TĀPOI

New Zealand Tourism Forecasting Methodology 2007

This report has been prepared for the Ministry of Tourism by the forecasting team at Covec Limited.

Ministry of Tourism
PO Box 5640
Wellington
New Zealand
Ph: +64 4 498 7440
Fax: +64 4 498 7445
Email: info@tourism.govt.nz
Web: www.tourism.govt.nz; www.touismresearch.govt.nz

Covec Limited
PO Box 3224
Shortland St
Auckland
New Zealand
Ph: +64 9 916 1970
Fax: +64 9 916 1971
Email: info@covec.co.nz
Web: www.covec.co.nz

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Fern – Rebecca Davis, www.moxie.co.nz
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1 Introduction and Overview

This document summarises the methods that have been used to produce the 2006-base tourism forecasts, and is intended to provide a relatively high-level overview of the forecasting process. If you require more detailed information please feel free to contact us.

1.1 Outputs from the National Forecasting Process

1.1.1 Inbound Outputs

All of the annual inbound forecasts are produced for the seven year period 2007-2013 inclusive. Forecasts are generated for each of the following 28 origin markets (including residual areas) in the forecasting programme ('A' indicates arrivals forecast, 'L' indicates length of stay forecast, and 'E' indicates expenditure forecast):

Table 1 International Visitor Forecast Outputs.

Frequency	Annual		Monthly
Disaggregation	Origin	Purpose	Port
Australia	A, L, E	A, L	A
United States	A, L, E	A, L	A
Canada	A, L, E	A, L	
South America	A, L, E	A, L	
Americas nec	A, L, E	A, L	
Japan	A, L, E	A, L	A
Taiwan	A, L, E	A, L	
Hong Kong	A, L, E	A, L	
South Korea	A, L, E	A, L	A
China	A, L, E	A, L	A
North East Asia nec	A, L, E	A, L	
Singapore	A, L, E	A, L	
Malaysia	A, L, E	A, L	
Indonesia	A, L, E	A, L	
Thailand	A, L, E	A, L	
India	A, L, E	A, L	
Rest of Asia nec	A, L, E	A, L	
United Kingdom	A, L, E	A, L	A
Northern Europe	A, L, E	A, L	
Ireland	A, L, E	A, L	
Germany	A, L, E	A, L	A
Netherlands	A, L, E	A, L	
Switzerland	A, L, E	A, L	
Euro 7	A, L, E	A, L	
Europe nec	A, L, E	A, L	
South Africa	A, L, E	A, L	
Pacific Islands	A, L, E	A, L	
Rest of World nec	A, L, E	A, L	
TOTAL WORLD	A, L, E	A, L	A

1.1.2 Outbound Outputs

Forecasts of short-term departures by New Zealand residents are produced at an annual frequency for the following countries: Australia, United States, Hong Kong, China, Thailand, India, United Kingdom, Fiji, Cook Islands, Samoa, and the Rest of the World. The forecasts by each market are segmented by purpose: holiday, VFR, business and other.

1.1.3 Domestic Outputs

Forecasts of domestic visitor activity by New Zealanders are produced at an annual frequency for day trips and overnight trips, segmented by purpose of travel: holiday, business, VFR, education and other. Forecasts of visitor nights and expenditure are also presented at the national level, but these are produced as part of the regional forecasting programme (see below).

1.2 Overview of the Forecasting Process

The forecasting process consists of a number of stages that culminate in the forecasts presented in the various documents.

1.2.1 Data Collection and Preliminary Analysis

The first stage in the process is a large data collection exercise which involves assembling the latest tourism data. All data is examined visually and statistical tools are used to identify basic trends and detect any anomalies or identify volatile series that may be difficult to forecast. Data collection and preliminary analysis is described in more detail in Section 2 of this document.

1.2.2 International Visitor Forecasts

Forecasts of visitor arrivals, average length of stay, and average daily spend are prepared independently. Average length of stay and arrivals are then combined to produce forecasts of total visitor nights. Visitor nights are then combined with average daily spend to produce forecasts of total expenditure.

Each of these forecasts is produced for a number of different market segmentations, as described in section 1.1 above. The process used to generate these forecasts is described in Sections 3, 4, and 5 of this report.

1.2.3 Outbound and Domestic Forecasts

The procedure used to generate outbound and domestic forecasts is less complex than that for international visitors due to data constraints. The process used to generate these forecasts is described in detail in sections 6 and 7 of this report.

1.2.4 Manual Adjustment and the Delphi Process

Even the best models sometimes produce forecasts that are obviously implausible and/or which could be improved by the use of information that cannot be captured by numerical data. Some forecasts are therefore manually adjusted to improve accuracy and plausibility.

The forecasts are also moderated by a panel of industry experts in what is known as the *Delphi Process*. The Delphi Process is described in more detail in Section 3.2 of this report.

1.3 Software Employed

The forecasts were produced using a combination of Excel and EViews 5.1 software. The econometrics, data analysis, and forecasting was performed in EViews. Excel was used to store data and generate reports and tables.

1.4 General Forecasting Issues

In this section we discuss various candidate forecasting methods, followed by a discussion of techniques for selecting appropriate models among these candidates. We also briefly discuss diagnostic tests that were used to reduce the possibility of error.

1.4.1 Candidate Forecasting Methods

In any forecasting exercise there are essentially two basic types of econometric models that can be used:

Pure time series models, which attempt to forecast a series from historical values of the series itself. For example, historical patterns in the series of Australian VFR arrivals could be used to predict future values of this series.

Structural models, which attempt to identify relationships between a series and other related variables and possibly deterministic time trends. These relationships together with forecasts of the explanatory variables are then used to forecast the series of interest. For example, the relationship between Australian VFR arrivals and variables such as Australian and New Zealand real GDP and exchange rates could be identified from past values of these series, and then forecasts of the GDP and exchange rate series could be used to forecast future Australian VFR arrivals.

Lying between these two extremes are mixed models which include both time series and structural elements.

Within the class of time series models, there are again many different forms that such models can take. The typical and most generally accepted methodology for forecasting with time series models is for the forecaster to choose a particular class of model and then use a set of objective criteria to choose the most suitable model within this class as indicated by the data.

To develop the base forecasts for this year's forecasting exercise, we have used a pure time series approach aimed at identifying the long-term trends and predictable deviations from these trends. We believe that such an approach is the best and most practical way to identify long term tourism trends. The alternative structural approach relies on (i) being able to identify meaningful relationships between tourism variables and other explanatory variables, and (ii) the accuracy of the forecasts of the explanatory variables. In our experience, the pure time series approach produces better base forecasts, and is subject to fewer arbitrary modelling decisions compared to the structural approach.

While there is some evidence of relationships between tourism variables and other explanatory variables such as economic growth in other countries and exchange rates, such variables (particularly exchange rates) can be difficult to forecast, and such models would carry these errors through into the tourism forecasts. Having tested both approaches, we believe that the time series approach is the best way of identifying the future changes in tourism variables that can be predicted by numerical models.

One common class of time series model that is often used as a forecasting tool is the autoregressive plus trend model. This is a flexible model form with various parameters that can be adjusted to best fit a particular time series. Given its popularity with practitioners and relative ease of application, the autoregressive plus trend class of time series models was used in this forecasting exercise.

In general, the form of model that we have used is given by:

$$Y_t = \sum_{j=0}^{q} \alpha_j t^j + \sum_{i=1}^{p} \beta_i Y_{t-i} + \varepsilon_t$$

where Y_t is the variable of interest (differenced if necessary, to obtain stationarity), p and q are parameters to be chosen, and ε_t is a random error. We allowed for values of p between 0 and 4, and values of q between 0 and 1, with 0 corresponding to a constant and 1 a linear trend. We also allowed a logarithmic trend of the form log(t) in some cases where linear trends produced implausible forecasts. The selection of the lag length parameters p and q is discussed in section 1.4.2 below.

1.4.2 Model Selection and Evaluation Criteria

In the forecasting exercise there were a large number of potential models that needed to be evaluated and compared. We used a set of objective statistical criteria to choose the best model for each type of output.

In particular, the model selection criteria and tools that were used included:

- Measures of goodness of fit, including adjusted R-squared, directional change accuracy (DCA) and mean absolute prediction error (MAPE).
- Bayesian model selection criteria including the Akiake information criterion (AIC) and the Bayesian information criterion (BIC, also known as the Schwarz criterion).[1]
- Within-sample forecasting accuracy. This involves truncating the sample and then comparing the model's forecasts with actual observations at the end of the sample.
- Plots of actual and fitted values and out of sample forecasts.

[1] These are similar to the measures of goodness of fit, except they include a penalty that depends on the number and the type of variables included in the model.

The procedure for selecting the most appropriate model for each time series was as follows: Perform Augmented Dickey Fuller (ADF) tests to determine whether the time series is stationary around a constant, stationary around a linear trend, or difference stationary (i.e. select the appropriate value of the parameter q).

Using the stationary series (including trend variables or differencing if necessary), estimate all models with autoregressive lag lengths between 0 and 4, and select the best model as suggested by the BIC criteria (i.e. select the appropriate value of the parameter p).

Selection of the most appropriate model within the class of pure time series ARIMA models is amenable to automation since the set of potential models is well defined by the ARIMA parameters. Accordingly, Covec developed an automated process in EViews that utilised the BIC criterion to select the best autoregressive model for each data series. This automated model selection program allowed us to test a large number of models for each series and select the best model based on the historical patterns in the data.

The best models selected according to the above procedure were then used to generate annual forecasts of average length of stay out to 2013. In some cases a model that fitted the historical data quite well produced implausible forecasts that exhibited exponential growth or decay. In such cases we tested whether a logarithmic trend was more appropriate than a linear trend if a linear trend had been included in the model. If this was also unsuccessful, we resorted to using the second- or even third-best models that, although they did not fit the data quite as well as the best model, produced more plausible forecasts.

Furthermore, some data series (particularly the Asian countries) have exhibited extreme instability. In such cases there appear to be obvious breaks in the trends of the series, which we have modelled by using piecewise linear trends with breaks at appropriate points.

1.4.3 Diagnostic Tests

There are various statistical problems that forecasting models can suffer from. Such problems can stem from using an inappropriate model, and/or issues with the data itself. Standard regression analysis assumes that the data and model conform to a number of underlying assumptions. If these assumptions are violated, the forecasts generated by the analysis can be inaccurate at best and completely erroneous at worst. To reduce the possibility of such problems affecting the forecasts, we employed a variety of diagnostic tests. If these tests indicated the presence of a serious problem for a particular model, we adjusted the model and/or applied mathematical transformations to the data in order to generate statistically acceptable results.

The following diagnostic tests and techniques were employed:

- Augmented Dickey Fuller (ADF) tests: Test for the presence of non-stationarity (non-constant mean and/or variance) in the data.
- Breusch-Godfrey serial correlation LM tests: Test for the presence of serial correlation in the residuals of an estimated model.
- F- and t-tests: Test for the statistical significance of explanatory variables in an estimated model.
- Plots of residuals and fitted values.

2 Data Collection and Preliminary Analysis

Having defined the forecasting process and the outputs required, the next task was to collate all of the necessary data and perform preliminary analysis. Table 2 lists the different data series that were used and where they were sourced from.

Table 2 **Data and Data Sources.**

Data	Coverage		Source
	Countries	*Years*	
Annual expenditure	All	1997-2006	International Visitor Survey, The Ministry of Tourism
Annual outbound travel	All	1979-2006	Statistics NZ
Annual visitor arrivals	All	1979-2006	Statistics NZ
Monthly visitor arrivals	Major Markets	1979-2006	Statistics NZ
Annual visitor nights	All	1979-2006	Statistics NZ
Domestic travel	All	1999-2006	Domestic Travel Survey, The Ministry of Tourism

Having collated all the necessary data, a preliminary statistical analysis was conducted to identify any obvious trends, patterns, or anomalies in the data. This included generating descriptive statistics for each data series on mean, variation, and distribution, as well as correlations between the series. Data plots were generated and used to help identify any anomalous data points (outliers) and trends.

In many time series models, the variance of the series increases over time. This can hamper attempts to forecast the underlying data generating process. To stabilize the variance and improve the accuracy of forecasts, we transformed the data using the natural logarithm, where appropriate.

3 International Visitor Arrivals Forecasts

Annual and monthly forecasts were generated of international visitor arrivals for each of the 28 origin markets and five purposes of travel. The first step in this process was to generate annual visitor arrivals forecasts. These forecasts were then moderated by the Delphi process, which is described below in section 3.2. The moderated annual forecasts were then used together with historical seasonal patterns to produce monthly forecasts of arrivals from the eight major origin regions.

3.1 Annual Forecasts

The annual forecasts of international visitor arrivals are presented in their own right, and are also used to generate monthly visitor arrivals forecasts, annual visitor nights forecasts, and annual expenditure forecasts. We have chosen this structure because the international visitor arrivals data is of the highest quality among all the data that is available on international visitors.

For producing the annual arrivals forecasts, we used the model selection techniques discussed above to select the optimal time series model for each arrival series. Due to the length of the data series, it was not practical to attempt to use multivariate models such as vector autoregressions or systems models. We therefore estimated separate models, one for each origin market.

All models were tested to ensure that they were as free as possible from statistical problems, as described in section 1.4.3 above. Details of the selected model in each case are presented in Appendix 2.

In most cases, the econometric models produced plausible forecasts of international visitor arrivals. In some cases, forecasts had to be manually adjusted to reduce the effects of implausible exponential growth or decline generated by the model. Some forecasts were also manually adjusted to take account of recent events such as ongoing tensions in the Middle East, which could not be validly incorporated into a statistical model.

3.2 The Delphi Process

The Delphi process is an integral part of the forecasting process. The purpose of the Delphi process is to moderate the annual international visitor arrival forecasts, which have been constructed using the econometric techniques described above. The Delphi process draws on a wide range of key tourism stakeholders, and helps to achieve an important balance between statistical forecasting methods and industry experience.

This year's Delphi process had three important parts: (1) an initial phone interview prior to generating the statistical forecasts; (2) a phone conversation with each Delphi member to discuss the statistical forecasts; and (3) a group meeting. The purpose of the two phone interviews is to receive feedback that, for commercial reasons, might not otherwise be contributed at a group meeting. They are also intended to prepare Delphi members for the group meeting. The purpose of the group meeting is to achieve consensus on the forecasts by requesting input from the Delphi members on a market-by-market basis, focussing on the top 8 markets. The group meeting is designed to be highly interactive to ensure that the final forecasts reflect the collective views of the wider tourism industry.

At the Delphi meeting, the annual international visitor arrivals forecasts generated by Covec were presented to representatives from the tourism industry who were asked for their views for each origin market. If they did not agree with Covec's forecast, their own forecast was entered into a spreadsheet and a weighted average of all forecasts (including Covec's original forecast) was calculated to determine a consensus forecast. This consensus forecast was then used in the remainder of the forecasting process.

3.3 Monthly Forecasts

Monthly international visitor arrivals forecasts are generated for the eight major origin regions for the 24 months from June 2007 to May 2009 inclusive. The monthly forecasts are based on the observation that there is a regular seasonal pattern to international visitor arrivals.

For each origin region, the monthly pattern in arrivals was modelled by computing the historic shares of annual arrivals that fell in each of the 12 months of the year. These annual shares were found to be quite stable over time and are not expected to change significantly within the two year forecast period for the monthly forecasts. Accordingly, historical estimates of monthly shares were used to generate monthly forecasts from the annual arrivals forecasts.

4 International Visitor Length of Stay Forecasts

Annual forecasts of length of stay by international visitors were generated for all origin regions and all purposes of visit. The average length of stay forecasts estimate the average length of time that a particular type of international visitor spent in New Zealand. The total length of stay forecasts estimate the total number of nights that a particular type of visitor spent in New Zealand.

4.1 Average Length of Stay

The historic data on average length of stay contains fluctuations that are not easily explained by other variables such as exchange rates and GDP. For this reason, we have also chosen to use a pure time-series approach to forecast average length of stay. That is, for a given origin and purpose, we forecast average length of stay by that type of visitor only as a function of historic values of itself.

In particular, as with visitor arrivals, we have used autoregressive plus trend time series models to generate the average length of stay forecasts. We employed the same model selection procedure and diagnostic tests discussed above.

4.2 Total Length of Stay

Total length of stay was estimated by multiplying the estimates of average length of stay by the appropriate estimate of international visitor arrivals to give a total visitor nights figure for each origin region and purpose of visit.

5 International Visitor Expenditure Forecasts

To generate forecasts of international visitor expenditure, the average expenditure per night for each market was forecast. This was then combined with the visitor nights forecasts to generate forecasts of total expenditure. This section describes the relevant procedures for generating these forecasts.

5.1 Average Expenditure per Night

Nominal estimates of expenditure per night are heavily influenced by exchange rates; hence it was necessary to examine the relationships (if any) between exchange rates and *real* expenditure levels. These relationships were very obvious for some origin regions e.g. the united States and Japan, and less obvious for others e.g. Australia.

Real expenditure levels per night were then projected forward based on historical growth (controlling for exchange rates) and expected changes in exchange rates.

The final step was to convert the real estimates back to nominal estimates using an estimated CPI inflator of 1.8% per annum, based on long-term average inflation rates.

5.2 Total Expenditure

The total expenditure forecasts are estimated by combining the visitor nights forecasts with the nominal expenditure per night forecasts for each origin region and each purpose of travel.

6 Outbound Forecasts

The outbound forecasts cover New Zealand residents travelling overseas. Forecasts are constructed for the 10 largest outbound markets and a "Rest of World" residual.

Annual forecasts of outbound tourism by New Zealanders are produced for these eleven destinations and four purposes of travel (holiday, business, VFR, other). These forecasts were again generated using time series autoregressive plus trend models.

The best estimated models were then used to generate annual forecasts of outbound tourism for 2007 to 2013. Some of the forecasts were manually adjusted to factor in effects that could not be modelled statistically e.g. the coup in Fiji.

7 Domestic Forecasts

The domestic tourism forecasts are developed in two stages. The first stage involves forecasting the number of day and overnight trips that will be initiated by New Zealand residents. This is done by observing historical data on the number of domestic trips per capita at a regional council level. The number of trips per capita is then trended forward for each region, incorporating the impact of future outbound travel patterns (outbound travel is a strong substitute for domestic travel). The projected trips per capita figures are then combined with Statistics New Zealand population projections for each region to produce estimates of day and overnight trips initiated in each year over the forecast period.

The second stage involves translating the projected trips into estimates of actual tourism activity i.e. visits, nights and expenditure. This is done by examining the historical relationships between trips taken and tourism activity in each of New Zealand's Regional Tourism Organisations (RTOs).

The first step is to establish historical *conversion rates* between trips originating from each regional council area and visits to each RTO. The conversion rate is simply the ratio of visits to a destination divided by trips from an origin. There is a different conversion rate for every origin/destination combination – around 500 in total (15 origins and 32 RTO destinations). The conversion rates are then projected forward and combined with the trip estimates to produce forecasts of day and overnight visits to each RTO. The individual RTO forecasts are summed together to derive a national level forecast.

The second step is to estimate the number of domestic nights spent in each RTO. This is done by observing historical data on the average number of nights per visit to each RTO by travellers from each origin region. The average nights per visit data is then trended forward and combined with the visits forecasts to generate estimates of total nights in each RTO. The individual RTO forecasts are then summed together to derive a national level forecast.

And finally, historical data on average spend per day visit and visitor night is used to determine the historical trend, which is used to project these values forward. The average spend figures are then combined with the day visit and visitor night forecasts to generate forecasts of total expenditure in each RTO. The individual RTO forecasts are once again summed together to derive a national level forecast. A general inflation multiplier of 1.8% per annum is factored into the forecasts i.e. the forecasts are *nominal* not *real*..

8 Regional Forecasts

This year's regional forecasts have again been constructed using the *bottom up* technique developed and applied in 2005. The bottom up methodology is based on the premise that travel preferences are strongly influenced by the origin of the traveller. For example, on average an Auckland resident will have a higher propensity to visit a destination in Northland than she will to visit a destination in Southland, simply because it is cheaper and easier to visit Northland from Auckland than it is to visit Southland. Similarly, a visitor from the United Kingdom will have a higher propensity to visit some locations in New Zealand than others. This will be driven partly by cost and convenience and partly by travel preferences which are driven by things like cultural factors, personal preferences, style of travel, previous experiences and the amount of time they have in New Zealand.

The regional forecasts were prepared for the 32 Regional Tourism Organisation (RTO) areas in New Zealand that existed at the time the analysis was conducted (see Appendix 1 for a map of the RTO boundaries).

In total we defined 23 separate traveller origins, comprising 15 domestic origins and 8 international origins. The domestic origins are regional council areas, and the international origins are New Zealand's 7 largest inbound markets plus the rest of the world.

Domestic Origins
Northland Region
Auckland Region
Waikato Region
Bay of Plenty Region
Gisborne Region
Hawke's Bay Region
Taranaki Region
Manawatu-Wanganui Region
Wellington Region
Nelson-Tasman Region
Marlborough Region
West Coast Region
Canterbury Region
Otago Region
Southland Region

International Origins
Australia
United States
Japan
South Korea
China
United Kingdom
Germany
Rest of the World

All tourism activity is generated by *trips*. In the case of domestic tourism there are two types of trip – day trips and overnight trips. A day trip is a trip by a New Zealand resident of at least 40km one way from home within New Zealand but outside their usual environment that is completed within the same day, and an overnight trip is a trip by a New Zealand resident resulting in one or more nights being spent away from home within New Zealand. In the case of international tourism, a trip is the same as a visitor arrival.

A trip results in one or more visits to one or more locations, and may generate visitor nights and expenditure in some or all of these locations.

The following steps have been used to produce the regional tourism forecasts:

1. We have expressed the propensity of travellers from each origin to visit certain locations as the ratio of visits to that location divided by the number of trips initiated. For a given year this tells us how many visits we can expect to each location based on the number of trips initiated from each origin. We have called this ratio the *conversion rate* because it describes the rate at which trips originating in certain regions convert to visitations to locations in New Zealand.

2. Forecasts of trips by origin were developed for domestic travel (these already existed as part of the Ministry of Tourism's Forecasting Programme for international travel (visitor arrivals)). We started with historical estimates of domestic trips per capita for each region, and looked for relationships between domestic trips per capita and international trips per capita. There was quite a strong negative relationship between domestic and international travel (i.e. increases in outbound travel tended to decrease domestic travel, as expected), so we projected trips per capita based on future estimates of outbound travel (taken from the Ministry of Tourism's Forecasting Programme). The resulting figures were then combined with regional council population projections provided by Statistics New Zealand to produce forecasts of the total number of trips originating from each regional council area.

3. Ideally the conversion rates would be observed over time and trended forward to reflect changing travel preferences. However, the data is too volatile to produce reliable trends, so we adopted the conservative assumption that the 2006 conversion rates for each origin market will remain unchanged across the forecasting period. We did further analysis on markets that had large sample sizes and found very stable conversion rate patterns over time (i.e. the ratio of location visits to trips showed good stability over time), indicating that holding the 2006 conversion rates constant over time is a reasonable approach.

4. We then cross-multiplied the future trip estimates and the conversion rates to forecast the number of visits to each location. The resulting forecasts were segmented by origin of traveller, type of travel (day vs. overnight) and purpose of travel. This methodology ensures that locations that are popular among travellers in high growing origin markets such as China (international) and Auckland (domestic) will experience the highest projected growth rates.

5. Once forecasts of visits had been developed the next step was to forecast visitor nights in each location. An additional constraint on the visitor night forecasts was the fact that we already had national level forecasts that the regional forecasts had to sum to. We used the historical data to estimate the average number of nights spent in each location for each market segment, and assumed that the average length of stay patterns would remain unchanged at 2006 levels across the

forecasting period. We then calculated the total number of visitor nights that this produced and used the resulting distribution to distribute the national level nights across locations. This method ensured that the underlying visitor nights patterns were reflected in the forecasts while also adhering to the constraint imposed by the national visitor night forecasts.

6. The final step was to translate day visit and visitor night activity into estimates of expenditure. This was done by:

   (a) Observing historical spending behaviour (average spend per day visit and average spend per visitor night) for travellers from each origin. This information is collected and initially observed at the national level; and
   (b) Introducing regional variation into the national spend figures by adjusting them to reflect the types of activities that visitors consume in each RTO. This resulted in average spend figures being scaled up in areas offering high-value activities (e.g. adventure tourism, retail shopping), and down in areas offering low-value activities (e.g. bush walks and beaches). The activities data was sourced from the IVS and DTS.

The future average spend estimates were adjusted for real growth and inflation based on historical growth patterns. The average spend estimates were then combined with the forecasts of day visits and visitor nights to produce forecasts of total expenditure in each location.

9 Dissemination of Forecasts

The forecasts are disseminated by the Ministry of Tourism in two main ways. The first is through the publication and distribution of a glossy summary document which brings together the major national and regional-level forecasting outputs. The majority of these documents are distributed at the National Tourism Conference, with the remainder being sent to tourism stakeholders as required. The second major dissemination channel is through the Ministry of Tourism's website - www.tourismresearch.govt.nz. There are several levels of information available on the website, from executive summaries to detailed data tables. The data is housed and deployed in a program called Harmoni, which allows users to view a wide range of data tables and graphs online. The website is also the distribution point for the main written reports, which are downloadable in PDF format. The main information from the written reports is also available in HTML format on the website.

Appendix 1: Map of RTO Boundaries

Figure 1 Map of North Island RTOs as at May 2006

*Not a formal RTO; **Not currently a funded RTO

Figure 2 Map of South island RTOs as at May 2006

*Not a formal RTO; **Not currently a funded RTO

Appendix 2: International Visitor Arrivals Models

In this Appendix we report the estimated models that were used to generate the base annual international visitor arrivals forecasts by origin and purpose. Models are constructed for all 28 origin markets. 'Residual' origins (i.e. those not modelled as separate markets) are modelled as proportions of arrivals from modelled origins in the same area e.g. the forecast for the "Rest of the Americas" is based on the combined United States, Canada and South America forecasts. In addition, due to instability in the 'Other' purpose of visit, as well as problems arising from the disaggregation of this category into 'Unspecified' and 'Education' categories, only the 'Business', 'Holiday', and 'VFR' purposes of travel are explicitly modelled for each of these 28 markets. The 'Other' category is modelled as a proportion of the other three categories, and the breakdown into 'Unspecified' and 'Education' is based on historic trends. The models were estimated using *EViews* 5.1.

Selected Visitor Arrivals Models

The following tables give the relevant parameters of the models that were selected for annual visitor arrivals, using the process described in section 1.4 above.

Table 3 **Holiday Arrivals Models.**

Origin	Log Trans.?	Unit Root?	AR Lag(s)	Trend
Australia	No	Yes	0	Constant
United States	No	Yes	1	None
Canada	No	Yes	1	None
South America	No	Yes	1	None
Japan	No	No	3	Broken/Linear
Taiwan	No	Yes	3	Broken/Linear
Hong Kong	No	Yes	0	Broken/Log
South Korea	Yes	Yes	0	Linear
China	Yes	Yes	0	Constant
Singapore	No	Yes	0	Linear
Malaysia	No	Yes	1,2	Constant
Thailand	Yes	Yes	0	Broken/Constant
Indonesia	Yes	Yes	0	Linear
India	No	Yes	0	Constant
United Kingdom	Yes	Yes	0	Constant
Northern Europe	No	Yes	1	Constant
Ireland	Yes	Yes	1,4	Constant
Germany	No	Yes	1	None
Netherlands	No	Yes	1	None
Switzerland	No	Yes	1	None
Euro 7	No	Yes	0	Constant
South Africa	No	No	0	Broken/Linear
Pacific Islands	No	Yes	0	Constant

Table 4 VFR Arrivals Models.

Origin	Log Trans.?	Unit Root?	AR Lag(s)	Trend
Australia	No	Yes	0	Linear
United States	Yes	Yes	1	Constant
Canada	No	Yes	0	Constant
South America	No	Yes	2	Constant
Japan	Yes	No	1,3	Linear
Taiwan	No	Yes	1,3,4	Broken/Constant
Hong Kong	No	Yes	1	None
South Korea	No	Yes	1,3	Broken/Constant
China	Yes	Yes	4	Constant
Singapore	No	Yes	0	Constant
Malaysia	No	Yes	0	Constant
Thailand	No	Yes	1	None
Indonesia	No	Yes	0	Constant
India	No	Yes	0	Linear
United Kingdom	No	Yes	1	Linear
Northern Europe	No	Yes	1,2	Constant
Ireland	Yes	No	0	Linear
Germany	No	Yes	0	Constant
Netherlands	No	No	3	Linear
Switzerland	No	No	0	Linear
Euro 7	No	Yes	1	Linear
South Africa	No	Yes	1,2,3,4	Broken/Constant
Pacific Islands	No	Yes	1	Constant

Table 5 Business Arrivals Models.

Origin	Log Trans.?	Unit Root?	AR Lag(s)	Trend
Australia	No	Yes	2	Linear
United States	No	Yes	0	Constant
Canada	No	No	0	Linear
South America	No	Yes	1	Constant
Japan	No	Yes	0	Constant
Taiwan	No	Yes	4	Constant
Hong Kong	No	Yes	0	Constant
South Korea	No	Yes	4	Constant
China	Yes	Yes	1,4	Constant
Singapore	No	Yes	0	Constant
Malaysia	No	Yes	1	Constant
Thailand	No	No	2	Linear
Indonesia	No	No	0	Linear
India	No	Yes	1,4	Constant
United Kingdom	No	No	3	Linear
Northern Europe	No	Yes	1,2	Linear
Ireland	No	Yes	1	Constant
Germany	No	Yes	1	Constant
Netherlands	No	No	2,4	Linear
Switzerland	No	No	4	Linear
Euro 7	No	Yes	1	Constant
South Africa	No	Yes	1	Broken/Linear
Pacific Islands	No	Yes	0	Constant