

AVIATION FORECASTING IN ICAO

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Introduction to ICAO

ICAO, the International Civil Aviation Organization, is a specialized agency of the United Nations which came into existence as a result of the 1944 "Chicago Convention". The aims and objectives of ICAO as outlined in the Convention are "to develop the principles and techniques of international air navigation and to foster the planning and development of international air transport..."

ICAO has a sovereign body, the Assembly, and a governing body, the Council. The Assembly normally meets every three years to review the entire work of the Organization in the technical, economic, legal and technical assistance fields and to plan the work programme for the ensuing three year period. There are presently 124 Contracting States and each State has one vote in the Assembly.

The Council is a permanent body responsible to the Assembly and is currently made up of twenty-seven Contracting States elected for a three-year term. The Council provides the continuing direction for the Organization and is aided in its work by various Committees it has established and by the Air Navigation Commission.

A number of international organizations participate in the work of the Organization through their role as observers at many of the meetings of the ICAO bodies. These organizations include the International Air Transport Association (IATA) which is an organization of international airlines, and the International Federation of Airline Pilots Associations (IFALPA) among others.

The work programme of the Organization is carried out by a Secretariat of some 500 headquartered in Montreal and some 125 secretariat in the six Regional Offices in Bangkok, Cairo, Dakar, Lima, Mexico and Paris.

#### Air Navigation

I think it is fair to say that the main thrust of the work of ICAO has been in the field which we term "air navigation". In this field ICAO deals with the technical standards and practices for all aspects of international civil aviation operations - in the operation of aircraft, aircraft airworthiness and the numerous facilities and services required in their support such as airports, telecommunications, navigational aids, meteorology, air traffic services, search and rescue, aeronautical information services and aeronautical charts.

Recommendations for Standards and Recommended Practices of international air navigation are made by the Air Navigation Commission and are adopted by the ICAO Council as annexes to the Convention on International Civil Aviation.

The work of ICAO in air navigation also involves the detailed planning of facilities and services and the formulation of procedures to support increases in traffic density, new air routes and the introduction of new types of aircraft. This planning function is facilitated by regional air navigation meetings which are held periodically in each of the nine regions of ICAO. The Air Navigation Plans which result from these meetings are reviewed by the Air Navigation Commission and presented to the Council for approval.

#### Technical Assistance

ICAO has participated in the multinational effort to assist technologically developing nations of the world primarily through its role as the Executing Agency for aviation projects of the United Nations Development Programme (UNDP). The degree of ICAO's participation is determined by the individual requests

submitted by the Governments of developing countries, which are responsible for deciding what portion of the total assistance made available to them by the UNDP should be used for civil aviation.

ICAO's work in the field of technical assistance covers a number of different activities. One of the most important activities is to supply aviation experts to developing countries to carry out the aviation component of their country programme. Our work in technical assistance also includes operating training courses for civil aviation personnel, such as the Civil Aviation Safety Centre in Beirut which provides training in air navigation and in air transport economics. ICAO currently has a roster of some 165 experts engaged in technical assistance around the world. While much of the aid provided by ICAO has been of an advisory nature, some projects have called for assistance of an operational nature, involving the actual discharge of executive functions within the departments of civil aviation. To give you an idea of the scope of our activities in this field, current ICAO projects include among others: development of STOL operations for a domestic airline, initial operation of air navigation and aeronautical meteorological services at a new airport, design of an air terminal complex, and establishment of remote communications switching centres.

#### Legal

The Legal Committee of ICAO advises the Assembly and Council on the interpretation of the Chicago Convention; it studies and makes recommendations on other questions of public international law brought to it by the Assembly or the Council; and it also considers problems of private law affecting international civil aviation.

Although the Legal Committee has a number of items on its general work programme, an item of major concern currently is the problem of unlawful interference with civil aviation - including the subject of hijacking. As early as 1963 the Aviation Community adopted the Tokyo Convention on offenses and certain other acts committed on board aircraft. This Convention contains some limited but nevertheless useful provisions on unlawful seizure of aircraft. However, due to the sharp increase in the number of incidents of unlawful seizure of aircraft in later years,

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a detailed convention concerning unlawful seizure was developed at the Hague Conference of 1970. This Convention is concerned with acts performed by a person on board an aircraft and while it does not contain specific penalties, it does contain an undertaking by each Contracting State to make the offence of unlawful seizure of aircraft punishable by severe penalties. The States however, were unwilling to make provision for automatic extradition of the suspected hijacker.

In Montreal in September 1971 States adopted the Convention for the Suppression of Unlawful Acts Against the Safety of Civil Aviation. The Montreal Convention is intended to supplement the Tokyo and Hague Conventions and is aimed at suppressing such acts as sabotage, armed attacks, or any act which could endanger the safety of an aircraft or damage or destroy an aircraft.

Work in ICAO on these problems is continuing. For example, on the 19th of June the Council directed that a special sub-committee be established to look into the question of multilateral action to eliminate havens for hijackers.

#### Air Transport

ICAO's work in air transport covers a wide range of subjects including: facilitation, the joint financing of air navigation services, airport economics and the economics of en route navigational facilities, air transport statistics and air transport studies.

Our work in facilitation is aimed at simplifying the entry and departure of international civil aviation traffic. Broadly speaking, the facilitation programme aims at 1) eliminating all unessential documentary requirements, 2) simplifying and standardizing the remaining forms, 3) providing certain minimum facilities at international airports and 4) simplifying handling and clearance procedures at airports.

Although each State normally provides air navigation facilities and services in its own territory there are cases where States cannot afford to provide these services (which are frequently very costly) or where these services must be

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provided in regions of undetermined sovereignty and on the high seas. These are cases where the joint financing of facilities becomes necessary and there are currently several agreements in effect, administered by ICAO, which provide for this.

ICAO periodically reviews the financial situation of airports and has issued studies on significant individual items of airport finance - such as landing charges and non-aeronautical revenues. ICAO also publishes annually a manual of airport and route facilities charges levied by States. The organization has also become involved with on route facility costing and charging and has attempted to establish guidelines in this area.

Our work in statistics is probably best known to those outside the organization through those blue and grey Digests of Statistics we publish. These digests cover data on traffic, traffic flows, finances and fleet and personnel of the airlines, and also airport traffic and the civil aircraft on register in different countries. Recently, we have expanded our programme to begin collecting statistics on non-scheduled operations.

Over the years our air transport studies have covered a wide variety of subjects. This range includes studies on international air mail and those on the development of passenger and freight transport in various regions such as Africa, Latin America, the Middle East, Europe and, most recently, South and East Asia and the Pacific. We have also published studies on cooperative efforts in air transport and periodic reviews of the economic situation of air transport. Recent work in this area includes the publishing of a manual on air traffic forecasting which I will describe in some detail a little later on, and an examination of the feasibility of undertaking studies on fares and rates in international air transport. Our future programme of air transport studies includes the continuation of the series of regional studies on the development of international air passenger and air freight transport, and the preparation every three years of a new Review of the Economic Situation of Air Transport.

Most of the substantive work described above is carried out by the Secretariat of the Air Transport Bureau at Headquarters. However, by the end of the year we will have an Air Transport Officer stationed in each of the six Regional Offices I listed earlier. The main functions of these officers is to lend general air transport assistance to States in each region and to serve as a liaison between civil aviation administrations and ICAO Headquarters in Montreal.

In a further effort to give assistance to Member States in air transport we have arranged a number of small, informal workshop meetings on such subjects as statistics and airport economics in an effort to bring civil aviation personnel into direct contact with the specialized staff at Headquarters.

ICAO has also lent assistance in the creation of regional civil aviation bodies - notably the European Civil Aviation Conference (ECAC) and the African Civil Aviation Commission (AFCAC). These organizations, which are independent of ICAO but work closely with it, consider the problems of international air transport from the point of view of their respective regions.

#### Brief Description of ICAO Forecasting Activities

Now that you have a general idea of the work we do, I would like to give you a brief description of our forecasting activities to date in the fields of air navigation, technical assistance and air transport.

In preparing for the regional air navigation meetings which I mentioned earlier, the Secretariat normally prepares a five year forecast showing the frequency of service over each of the routes in the given region. These short term forecasts are derived from information provided both by States and by the carriers on their anticipated future operations. Two forecasting groups - the EUM Traffic Forecasting Group and the NAT Systems Planning Group - have been created by some of the States in the European and North Atlantic regions, respectively, to prepare long-term forecasts of the peak traffic demands. These forecasts are then used in establishing the long-term systems requirements for air navigation facilities and services in the region.

In the technical assistance area the forecasting work being done is really an integral part of the work of the technical assistance experts. What frequently happens is the developing country requests a technical assistance expert, usually an aerodrome engineer, to give them some guidance on planning for their future airport facilities. Of course, one of the necessary prerequisites for this type of planning is the preparation of a traffic forecast for the airport in question so that the requirements for such items

as passenger and cargo handling facilities, runway length etc., can be developed. Although we do have air transport economists among our technical assistance staff, there is such a great demand for their services relative to the number we do have, that it is frequently the aerodrome engineer who must prepare the forecast. This coupled with the factor that the data are frequently faulty, incomplete or even non-existent and that the time in which the work must be completed is frequently very short, makes this work extremely difficult. There does not seem to be any simple solution to these problems in the short-run, at least.

Prior to producing our Manual on Air Traffic Forecasting (which I will describe in a moment) the bulk of the forecasting work of the Air Transport Bureau was done in conjunction with our other studies, some of which I mentioned earlier. An exception to this was the circular we prepared in 1966 on traffic forecasts for the North Atlantic covering the period to 1975. This study, which included forecasts for passengers, cargo and mail, was based on trend analysis modified by some explicit assumptions we made regarding relevant economic parameters such as price elasticity, fare changes and the timing of the introduction of new aircraft types.

Our studies of passenger, cargo and mail development in the different regions normally contain a discussion of the forecasts made by others for the given region. For example, in our latest study of the East and South Asia and Pacific region, we discuss four recent forecasts made for the area by Boeing, McDonnell Douglas, the Economist Intelligence Unit and by Curtis Greensted Associates. In addition, we present some information supplied by the States in the region estimating the probable growth of airport and airline traffic through 1980.

Our triennial reviews of the economic situation of air transport have presented our own work in forecasting the future volume of passenger, freight and mail traffic. These forecasts are based on trend projections coupled with explicit assumptions regarding the development of key economic variables; a procedure we used in our North Atlantic forecasts.

From this you can see that we are certainly not newcomers to the field of air transport forecasting. On the other hand, I think we would be the first to admit that, in the past, we have concentrated on extremely simple forecasting techniques.

Currently, as a result of a recent Assembly resolution, we are beginning to strengthen our forecasting capabilities. An initial step in this direction is the recent publication of our Manual on Air Traffic Forecasting which I would now like to describe for you in some detail.

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The ICAO Manual on Air Traffic Forecasting

The Assembly of ICAO, at its sixteenth session held in Buenos Aires in 1968, set up two requirements for the Organization's work in forecasting - one was the preparation of medium-and long-term forecasts of future trends and developments in civil aviation, both on a global and on a regional basis, and the second was the development of material on current forecasting methods to be used in the Organization's own forecasting work and to be disseminated to member States for guidance in their own forecasting.

As a partial fulfilment of the second requirement the Secretariat developed a Manual on Air Traffic Forecasting, which was published and distributed to member States in the spring of this year.

The manual is primarily addressed to directors of civil aviation as well as to others in civil aviation administrations and to planners of airports and route facilities. The purpose of the manual is to provide a survey of the techniques currently in use in medium-and long-term forecasting and to give practical guidance on the application of these techniques. Discussion of theoretical problems or of methods which are not readily and quantitatively applicable has been avoided to the greatest possible extent.

Our objective at this stage is certainly not to advance the state of the art but rather to make more effective use of what has already been developed and our manual is the initial step in this process.

The manual is divided into two basic parts - the first part deals with forecasting by trend projection, the second part with methods of traffic forecasting based on studies of the factors governing traffic development. The second part includes a chapter on the technique of formulating mathematical relationships between the traffic variable and the underlying factors which we have called "Econometric Forecasting". Other techniques included in the second part of the document are based on specific studies of individual sectors of the air transport market or on studies of plans and expectations of the parties engaged in the air traffic activity.

## Trend Projection

In the material dealing with forecasting by trend projection the various types of trend curves such as the linear, exponential, modified exponential, Gompertz and Logistic are described both mathematically and geometrically and the methods of fitting trend curves to observed data are described. One appendix describes and illustrates a simple method of fitting a Gompertz and a modified exponential curve to observed data. The least squares method for curve fitting is demonstrated in another appendix using, as an example, the passenger traffic development at Geneva airport. While the method and rationale for calculating both regression coefficients and the coefficient of determination are described in the appendix, readers are referred to standard statistics textbooks for a more complete discussion of significance tests and confidence intervals. It was felt that a discussion of probability theory which, of course, is necessary for an understanding of these two topics, went beyond the scope of the manual.

## Econometric forecasting

The bulk of the material in the manual deals with what we call the econometric technique in forecasting. In addition to describing the different models which have been developed in this area, practical guidance is given regarding the problems of applying this technique.

Whether applied to passenger air transport, freight transport, general aviation or other aspects of civil aviation, the conduct of an econometric forecast comprises, in principle, four phases: first, there is the identification of the underlying factors (independent variables) to be taken into account in forecasting the air traffic activity (dependent variable); second, the determination of the type of functional relationship existing between the dependent and independent variable; third, there is the empirical testing of the relationship between the dependent and independent variables, including the evaluation of coefficients and exponents; and fourth, the forecasting of the values for the independent variables and the subsequent derivation of the traffic forecast.

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In an attempt to provide a summary of the independent variables most frequently used in econometric forecasts, we developed a table which showed, for each type of influence on traffic (eg. size and spending ability of the market), the different variables used to represent that influence (eg. population, disposable personal income). The list was not intended to be exhaustive but rather to indicate the range of variables that can be used.

In determining the type of functional relationship between the dependent traffic variable and the independent variables, emphasis is placed on judgment and experimentation, taking into account the experience gained from earlier forecasting work. In order to give the reader an idea of the range of models already in use in forecasting, we present a dozen different models under four headings: non-directional passenger forecasts (i.e. those dealing with the overall volume of traffic generated at a certain place or in a certain region), directional passenger forecasts (i.e. those concerned with traffic on specified routes or between specified regions), a model for non-directional air freight forecasts, and a model for forecasting general aviation activity. While we have nearly 400 documents on forecasting in our files, it should be stressed that the list of models included in the study is far from exhaustive - some of the comments we have already received on this study amply demonstrate this point.

Six different models for forecasting non-directional passenger traffic are presented. The first model, developed by the Air Transport Association in 1969, was used to forecast domestic passenger traffic in the United States. It is a very simple model - it makes passenger revenue a multiplicative function of Personal Consumption Expenditure in the United States. Testing the model on U.S. data gave an elasticity of passenger revenue to Personal Consumption Expenditure of about 2.0.

The second model was developed by the Institut du Transport Aérien (ITA) in 1971 for predicting future growth rates for a country or a region or between countries or regions. The model was intended to be used for three to five year forecasts. This model relates the traffic in a given year to the traffic in the initial year in a multiplicative fashion through a series of three coefficients. The first coefficient reflects the changing propensity of the market to travel due to exogenous factors; the

second reflects changes in the air transport services available; and the third reflects the changing penetration of air transport into the overall travel market. Although the future values of these coefficients are left more or less to a subjective judgment, ITA gives some guidance as to how they might be calculated. The first coefficient - representing the influence of exogenous factors - is presented as a function of the growth rate of a general economic indicator (such as Gross Domestic Product) and of the growth in the proportion of consumption devoted to travel. The second coefficient - representing the availability of air services - is presented as a function of the change in air fares during the forecast period and the relevant price elasticity which, for the domestic traffic cases studied, was found to be between -0.6 to -1.7. The third coefficient - representing the penetration of air transport - could be estimated by estimating the total potential travel market and through a subjective evaluation both of the development of surface/air competition and of political factors.

The third model for forecasting passenger traffic volume was prepared by Bo Bjorkman for the European Civil Aviation Conference (ECAC) in 1970. This model makes the dependent variable, passenger-kilometres a multiplicative function of disposable income, disposable income per capita, and yield (average revenue per passenger kilometre). Using data on European air travel Bjorkman obtains a price elasticity of -1.5 and an income elasticity of 0.6. This model was also tested against U.S. domestic and international air travel from 1962 to 1968 and gave elasticities of similar magnitude to those for European travel.

The fourth model, intended for forecasts of long-term developments of long-distance international air travel demand in the United States, Europe and elsewhere was presented by the National Planning Association (NPA) in 1971. This model makes the dependent variable, total air passenger miles, a multiplicative function of discretionary income and an index of the cost of air travel which is defined by the level of fares plus the value of elapsed air travel time. The NPA tried alternative models, which included time and a variable reflecting the business cycle, but these models were found no better than the simpler model they adopted.

The values for income elasticity were developed from cross-sectional data (i.e., studies of the frequency of air travel in different income groups at a certain time). The income elasticities were found to be between 1.2 and 1.6.

To determine the price (cost) elasticities, the value of time was equated to a typical hourly wage rate for air passenger. The resulting price (cost) elasticities were between -0.8 and -1.8.

The fifth model was developed by Sam Brown and Wayne Wathins of the CAB in 1968. In this model the dependent variable, the change in annual passenger miles per capita, is a multiplicative function of the change in the average fare per mile, the change in disposable personal income per capita and a residual term representing time. This model differs from the others in that it relates the change in traffic to the changes in the independent variables while the other models related traffic levels to the levels of the independent variable. One result of this difference is the fact that the intercept value in this model represents a time influence on travel while this is not so for the other models.

The coefficients developed by applying the model to U.S. data for the 1946-1966 period imply that if fares and income had been constant in constant money value, the traffic would have increased by something less than 5 per cent per year. The coefficient on the time variable was negative, implying that this "automatic" growth rate tends to decrease over time.

The final non-directional passenger forecast model was developed in 1968 by Wallace and Moore of the Boeing Company. The dependent variable in this model is an unusual one - revenue passenger miles per unit of Gross National Product - and its percentage change is given as a function of the percentage change in the quality of service plus the percentage change in fare multiplied by the fare elasticity. A notable feature of this model is, of course, the use of a quality of service variable in the formulation. The quality of service is defined as a weighted index of a number of items - among them are the number of seat departures, schedule reliability ("on time"), flight time, cabin noise and ride comfort. In total there are nine quality items.

There is a peculiarity regarding the price elasticity in this model since it is given a different value for price increases than for price decreases. For price increases the elasticity was given as -1.0 while for price decreases the value was -2.0. The measure of "quality" in this model was developed through judgment and specifically

related to U.S. traffic. For this reason, and because data on a number of quality elements might be difficult to obtain, we felt the application of the model precisely as it was presented might prove difficult.

The section on directional models of passenger traffic starts off with a somewhat detailed description of the classic gravity model where the number of travellers between two points is positively related to the product of the populations in the two cities and inversely related to the distance between the cities. It is pointed out that while the basic gravity model is not really applicable to medium-or long-term forecasting, modified versions of this model have found rather widespread use. Since the variety of modifications to this model have been so great it was only possible to give a general indication of the range of these modifications.

A model for forecasting air travel between pairs of countries which is based on the gravity model, as well as on the non-directional model developed by Bjorkman previously described, was presented by the European Civil Aviation Conference in 1970. This model includes as independent variables: the populations of the two countries, the Gross National Products, a typical fare for air travel between the two countries and the price elasticity of demand. Coefficients for this model were developed using data on intra-European traffic. It was found that the value for price elasticity which best explained the distribution of traffic at a certain point in time among different European States was 2.0, whereas a representative value for predicting the development of traffic over time for one pair of States was 1.6. Regarding the applicability of the model, it was found that this model, which does not take into account competition from surface transport, tends to over-estimate the traffic on short distance routes.

A method for forecasting the total travel by public transport between two cities, as well as the air transport share, was developed by Eric Culley and presented by the Canadian Transport Commission in 1970. This method was intended for application in Canada but it can be applied wherever there is significant competition between surface and air transport. The method takes into account the time and cost involved in using the various modes as well as their frequency of service. It also includes the populations of the cities involved and the different income levels of the cities. Finally the model takes account of the linguistic similarities of the two cities.

Use of this model involves two separate estimating procedures. One is to estimate the total traffic between the two cities regardless of the mode used and the other to estimate how the total traffic is to be split among the various modes (bus, rail and air in this model).

The modal split model estimates the share of each mode on the basis of what the author calls their "level of service". For a given mode, the level of service is a multiplicative function of a constant (which differs for each mode with the lowest value for bus and the highest for air), the average trip time, the average trip cost, and the daily frequency.

The model for estimating the total traffic between two cities regardless of mode includes seven independent variables: the product of the populations of the two cities, an index of linguistic community of the cities, the percentage of families above \$12,000 income, highway driving time between the cities; both average trip time and average trip cost by public transport (weighted according to the modal split), the perceived total trip cost by automobile (approximately 1.5 cents per mile per person) and finally, the level of service (as defined in the modal split) for the entire public transport system. Since the exponents were developed for transport in eastern Canada it is likely they would have to be adjusted for application elsewhere.

Another model, intended for use on routes with effective surface competition, was presented by Abraham, Baumgart and Blanchet in 1969. This model, which originally was applied to French domestic traffic, is more micro-economic in character than the other models presented in the sense that it deals with the market on a route as a spectrum of users, each of whom behaves in accordance with his economic status.

The basic assumption is that the traveller's time can be assigned a value which is directly related to his income and that the traveller will choose that mode which minimizes the "generalized" cost of the trip where cost is defined as the fare plus this value of time in transit. The model further assumes that the frequency of travel is directly proportional to the individual's income (raised to a certain power) and inversely proportional to this "generalized cost" to the 2nd power.

A further factor determining the number of travellers on a route is the product of the populations raised to a certain power. Finally the model assumes that the income distribution, and therefore the value of time distribution, in a developed country like France can be approximated by Praeto's law.

As I stated earlier, we presented only one model for forecasting freight traffic. This is due to the fact that there have been relatively few econometric models developed for forecasting freight perhaps because the factors governing both the demand and supply for air freight capacity are so complex. However a model for predicting the development of domestic air freight in the United States was developed by Irving Saginor and David Richards of the CAB which is similar to the other CAB model we presented in that it relates changes in traffic to changes in the independent variables. This model makes the change in annual freight-ton-miles a multiplicative function of the change in the rate per ton-mile and the change in the gross national product. The results of the application of this model to the 1946-1969 air freight experience in the United States imply that if freight rates and GNP had remained constant over the period the volume of air freight would still have grown by about 6.7 per cent per year under the influence of factors not accounted for in the model.

We presented one example of the use of the econometric approach to the problem of forecasting the number of general aviation operations in a district. This approach was developed by Baxter and Howrey in 1967 and consisted in testing different combinations of five independent variables against the dependent variable-the number of general aviation operations. The independent variables tested were: the population of the district, the per capita income of this population, the number of airports in the district, an index of the quality of those airports and the proportion of the employment in the district being in agriculture.

Different models were tested by cross sectional analysis of the general aviation activities in 485 countries in Eastern United States. In general, the multiplicative rather than additive function proved superior. Generally, models including all the independent variables mentioned except agricultural employment were found to explain the differences between general aviation operations in the countries reasonably well.



We point out in the manual that this model could also be used for forecasting the effect of building a new airport in a district or for medium-or long-term forecasts of general aviation at existing airports if time series data is used.

After presenting these forecasting models we discuss the application and testing of econometric models and the forecasting of independent variables. It is pointed out that every forecasting problem is to a certain extent, unique, and that a good deal of care and judgment should be exercised before attempting to apply these results to a different set of circumstances.

Once the model has been selected and the independent variables are defined, it is necessary of course to evaluate the constants and coefficients in the model. Although the forecaster is not entirely in the dark since he can develop some expectations regarding the range of values of these coefficients based on the examples given, the uniqueness of each forecasting situation requires a new estimation of these values. We point out that since the relationship between the dependent and independent variables can frequently be expressed by a linear equation (eg. a multiplicative relationship which is linear in its logarithms) the coefficient can be developed through multiple regression. An appendix explains the concepts behind multiple regression and gives a step-by-step demonstration of the calculations involved. Because of its complexity, tests of significance are described in very brief terms and the reader is referred to standard statistics textbooks for further elaboration.

In discussing the testing of models we covered a number of problem areas including the importance of sample size, time series vs. cross-sectional analysis and the problems created by omitted variables and misspecification. We try to caution the reader against placing too great a faith in the accuracy of any model and point out that, in fact, there is just no adequate substitute for good judgment.

The final section of our manual describes two approaches to forecasting which do not involve the formulation and testing of mathematical models.

The Port of New York Authority in 1957 carried out an air traffic forecast of U.S. domestic traffic which was based on a detailed market study. This approach was chosen because of the availability of abundant information on the characteristics of air travellers. For the purpose of the forecast, all air travel was divided into personal and business travel. To analyse personal travel, the entire population was divided into 160 different groups, each characterized by a certain combination of age, occupation, income and education. To analyse business travel the total labor force was similarly divided into 130 groups, each characterized by a certain combination of occupation, income and type of industry.

All the 290 groups were so chosen that the travel habits with respect to personal travel or business travel according to travel surveys were uniform within each group. Travel surveys had further shown how the travel habits tended to develop within each group and on this basis, as well as on the basis of forecasts of future numbers of people in each group, the forecast for the total volume of air travel could be derived for the period 1957 to 1975. The actual traffic development up to 1970 confirmed that the forecast was fairly accurate.

An example of a market analysis approach to air freight forecasting was outlined in an ICAO study of air freight in the Europe-Mediterranean region issued in 1970. It was shown there that in North Atlantic trade, the share of a commodity group carried by air was fairly closely related to the average value per unit weight. Above a certain average value per unit weight, the use of air transportation increased rapidly. Using available information on the distribution of all trade with respect to value per unit weight, and assuming that the values above which air transportation tends to be competitive will decrease if the air transport rates also decrease, it was possible to estimate the potential future demand for air freight capacity. In the ICAO study, the analysis was not aimed at actually preparing a forecast but rather at verifying that other forecasts were plausible. However, the approach may serve as an example of a possible avenue for air freight forecasting through market studies.

A second approach to forecasting discussed in the manual is that based on the opinions or plans of qualified experts in the field.

ICAO uses this approach for forecasting the future requirements for the air navigational facilities and services of international civil aviation. ICAO periodically collects information from States and operators on their anticipated future operations, consolidates this information, and forecasts the future level of activity at different airports.

The International Air Transport Association also uses a similar approach in providing a forecast service for airport authorities to assist them, at their request, in developing master plans for their airport development. In preparing these forecasts, IATA circulates a number of questionnaires to member airlines serving the airport requesting information on their future services and their requirements for airport facilities and services.

This information is consolidated by IATA and used to establish forecasts of essential aspects of airport activity required for airport master planning.

#### Future Forecasting Work in ICAO

As the forecasting work of the Organization in the past has been fragmentary and limited, it is the firm intention of the Organization to make a much more solid and consistent contribution in this field in the years to come.

In accordance with the directives given to us by the Assembly, the future activities in civil aviation forecasting will serve three objectives:

- 1) a more extensive and improved treatment of forecasting aspects in studies carried out by the Organization;
- 2) as a service to our Member States, a systematic collection and dissemination of material on aviation forecasting;
- 3) a contribution to the science of forecasting by organizing meetings where forecasting experts can exchange views on methods and techniques.

The first of these objectives will be met primarily by involving our forecasting officer in most of the economic and other studies being carried out as part of the regular ICAO work programme and particularly in our studies of the development of international air transport in various regions of the world. A special effort will also be made to take a close look at the overall prospects for international air transport in connection with the general Reviews prepared every three years for the Assembly.

The second objective will be met partly by periodically updating and improving the Manual I already described to you. In addition to this, we are also envisaging a great increase in ad hoc requests for guidance material which can be used for forecasting work by national administrations in our Member Countries.

The third objective we will try to meet by organizing about once every year informal meetings where a limited number of people active in aviation forecasting will get an opportunity to discuss matters of principle and techniques in forecasting work. The Organization has had experience with such informal international meetings in other fields and we hope that this type of meeting will also prove fruitful in fostering a better and wider application of good and sensible forecasting techniques.

You will see from this that our ambitions for the future are quite high compared with what we have accomplished in the past. We do, however, realize that our resources are very modest and that our muscle may not be quite compatible with our ambition, but we will do our best.

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