EU-CHINA CIVIL AVIATION
CO-OPERATION
CONSOLIDATION PROJECT

A project supported by the European Commission, the European Industry, the MOFTEC, AVIC I, AVIC II and CAAC

AIR TRANSPORT DEMAND FORECAST

Christophe BONTEMPS

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Part I : The demand for air transport

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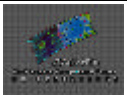
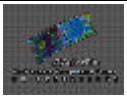


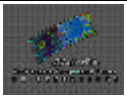
Why does demand matter ?

- Passenger matters ! : characteristics, travel needs, willingness to pay are important
- Need to forecast demand in order to adapt supply:
  - For the airlines : Network optimization, revenue management and marketing
  - For the airports : revenues optimization and infrastructures,
  - For the Authorities : infrastructure planning



The demand for air travel

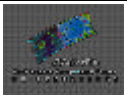
- Measuring demand
- Demand analysis
  - Global transportation demand
  - Modal split
  - Individual demand
- Stylized facts and outlook on demand
  - The case of USA and France (and China?)
  - New horizons



Quantitative measures of demand

- Several quantities may be collected on satisfied demand
  - Number of travelers,
  - Number of passengers-kilometer
  - Number of ton-kilometers for freight
- It is difficult to measure real demand

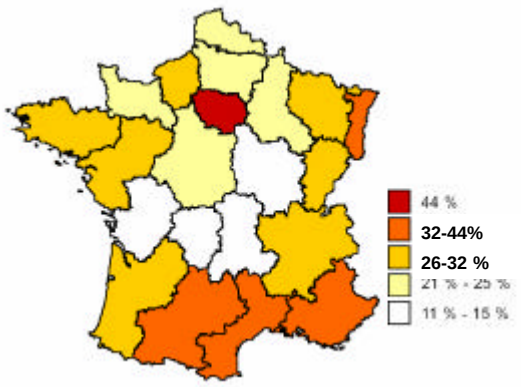
  (= satisfied + non-satisfied)



Qualitative measures of demand

- What proportion of a population has traveled by plane once ?
- Measure of rate of penetration:
  - % of the population who has traveled by plane during the last 12 month.
- Measure of the travel propensity:
  - Average number of travels per capita per year
- Equipment rate
  - % households owning a car…(not used in air statistics!)

Penetration rate in France in 2001



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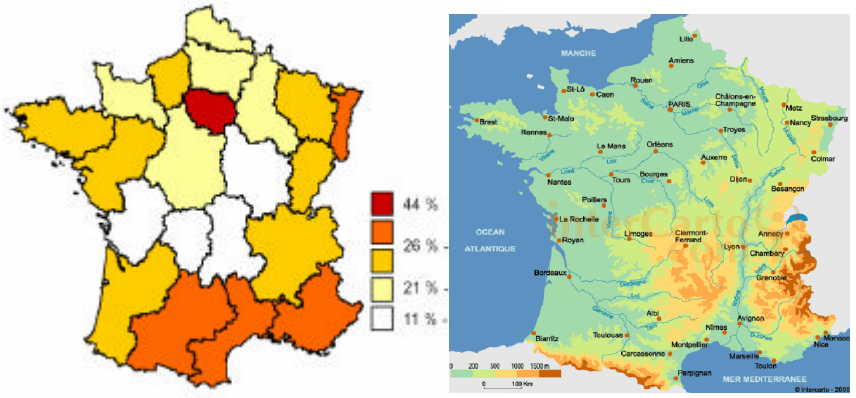

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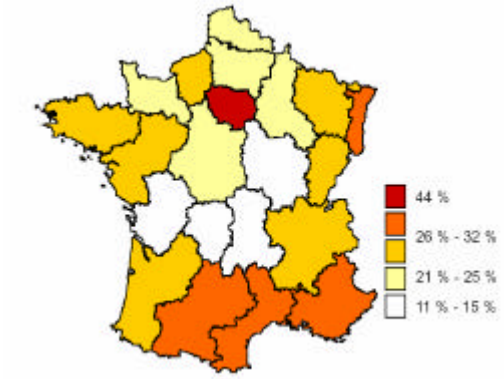

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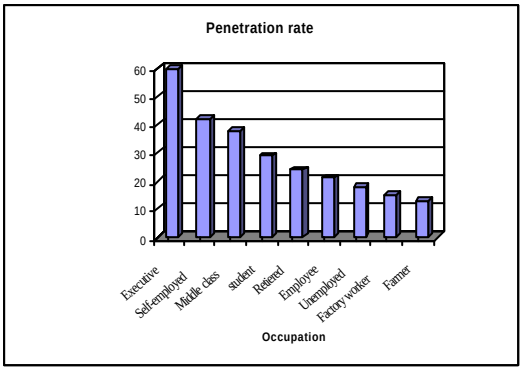

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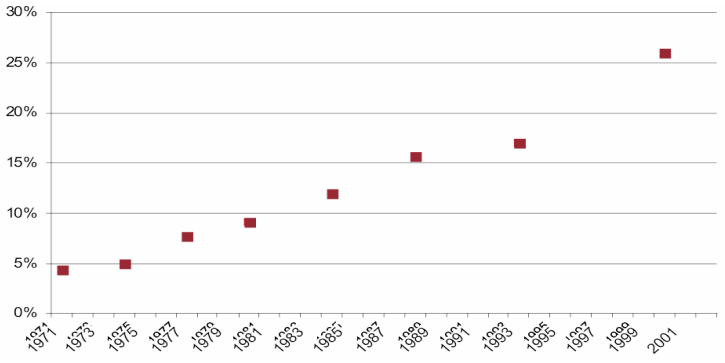
Penetration rate evolution in France



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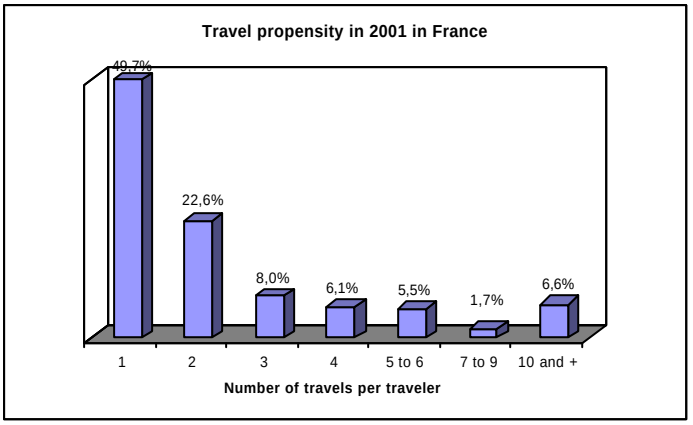
Propensity to travel in France in 2001



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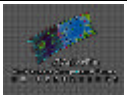

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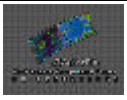
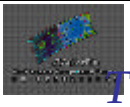


Transport and the Economy

Strong links exists between economic activities and transport

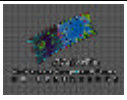
- All economies are based on exchanges and exchanges need (more or less) transport
- Double side link between economic growth and transport development



The economy as a factor of transport development

Transport demand evolution is well explained by the evolution of economic factor :

- *The economic activity (GDP or GNP for example)*
- *Transport Price*
- *Technological progress and infrastructures improvements*
  - Reduction of transport duration
  - Cost reduction and therefore price reduction



Transport as a factor of economic development

- Infrastructures : Effect on the economy of infrastructure development (not to be over-evaluated)
- Reduction of transport costs, and therefore production costs implying reduction of individuals transport costs
- External effects : Communication improvements, access to broader, further markets (fundamentals effects even if difficult to measure..)
- Long term effects on the economic and social organization (effects very difficult to measure)

Distance impact on modal split

- Traffic intensity and modal split between two cities are linked to distance :
  - *Ceteris paribus (all things being equal),* transport demand decreases when distance increases
  - Travelers are attracted by fastest transport solutions
  - Modal split is more linked to global travel duration than to distance.

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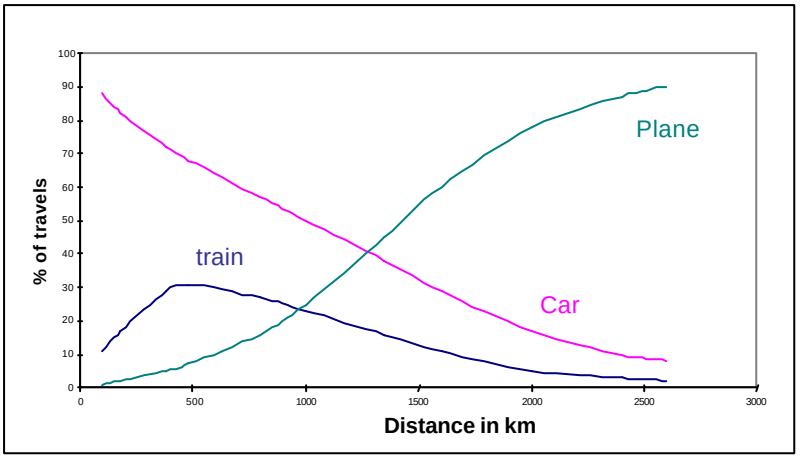
Impact of distance on modal split



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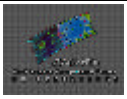
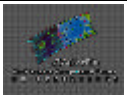


Individual demand

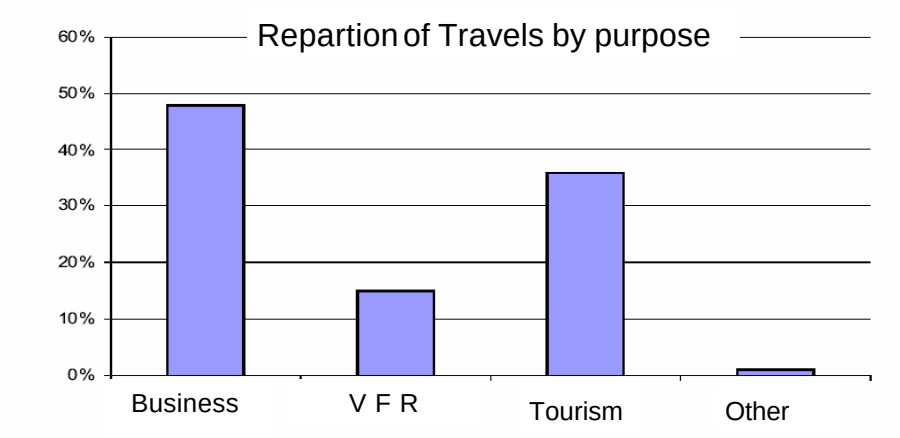
- Global demand (country global demand, world traffic, etc…) is the addition of all the individuals demands
- Two main kind of demands at the individual level
  - Travels for personal purpose : tourism, Visiting Friends and Relatives (VFR)...
  - Travels for business : meetings, …



Travel purpose

- A client traveling for personal reasons is making a choice :
  - He decides to travel and chooses his transport mode as a function of his personal characteristics (he maximizes his utility)
- A business traveler travels for the needs of his firm
  - The travel decision is made by the firm, with a profit maximization goal.

Travel purpose



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Business travelers

- At the origin of air travel
- Still an important part of domestic traffic
  - 48% of the French traffic in 2001
- One third of the regular international traffic
- Not very sensitive to prices, but choice criterions are : schedules, frequencies, flexibility, comfort...

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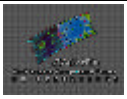
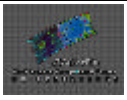


"Leisure" travelers

- Travel for personal reasons ("leisure" clients) have grown with the decrease of fares
- Represents 100% of the international non-scheduled regular flights, and 2/3 of scheduled international flights.
- Very sensitive to prices
- Divided into several types of clients
  - Airlines propose different fares as a response



Factors affecting individual demand

- Income
- Price
- Global transport duration
  - Quantitative factors
- Characteristics of supply : Quality, flexibility, availability, frequencies
  - Factors difficult to evaluate

Income and price elasticity of demand

One measures the reaction of a variable (*demand*) to a change in another variable (*income*, *price*) through an economic indicator : The elasticity

Income elasticity= % change in demand / % change in income

Price elasticity = % change in demand / % change in price

- If a 3% increase in personal income results in a 6% growth in demand, the income elasticity equals 2.

Income and price elasticity of demand: example

Country	Price elasticity	Income elasticity
High income countries		
Scandinavia	-0.27	+2.44
France	-0.66	+1.88
Switzerland	-0.52	+1.80
Germany	-0.62	+2.65
Low income Countries		
Portugal	-0.12	+3.02
Turkey	-0.56	+3.23
Ireland	-0.81	+1.17
Greece	-0.33	+2.65

Source Doganis 2002
Price = average yield per passenger on intra-European routes
Income = real Growth Domestic Product of each country

Income elasticity of demand: UK and non-UK residents example

Leisure segment		1989-93	1994-98	1995-2005
Short Haul				
	UK	2.0	1.8	1.7
	Non Uk	1.8	1.8	1.7
North Atlantic				
	UK	2.0	2.0	2.0
	Non Uk	1.6	1.8	1.5
Middle east				
	UK	2.0	2.0	2.0
	Non Uk	2.0	2.0	2.0
Other long Haul				
	UK	2.0	2.0	2.0
	Non Uk	2.2	2.2	2.2

Source Dogagnis 2002

Income elasticity of demand

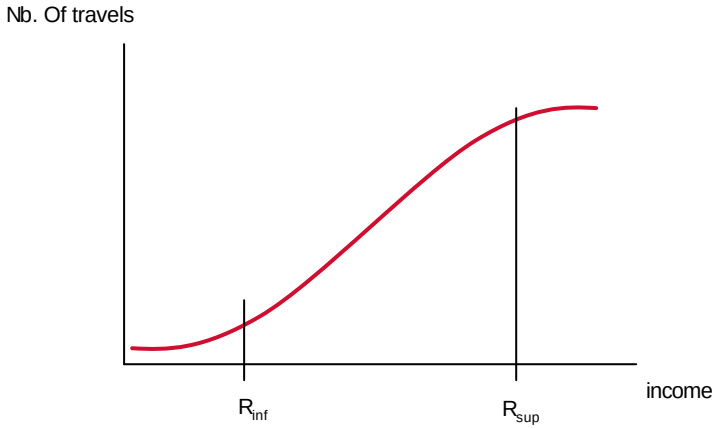
- Income elasticity of airline demand in China ranges between 1.5 to 1.8. (*Zhang 1997*)
- This means that a 10% growth in national income would increase demand travel by 15% to 18%.
  - The annual economic growth rate in China was 8.7 during the 1980-94 period, this would explain a 15% growth rate for airline demand
  - Growth during the period was 21% !!
  - There are other factors explaining that growth

Impact of income

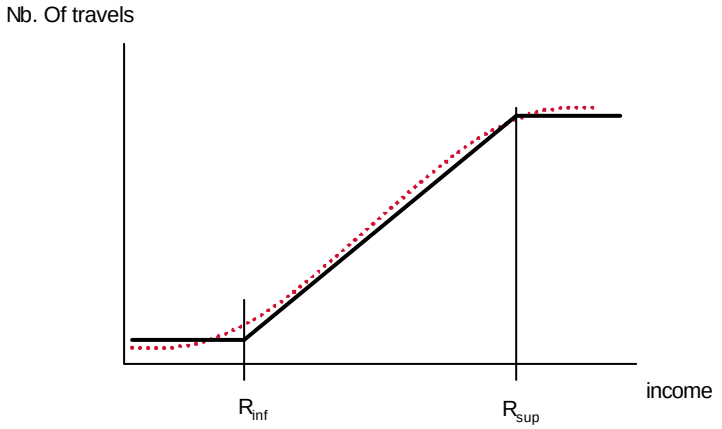
The income constraint influences more the "leisure" clients than the business travelers

- Still, there is a correlation between salary and number of business travels.
- Propensity to travel increases with the income, but within a non-linear relationship
- Less sensitive for high and low incomes
- Within a population, the air traveler has an average income higher than the average.

Propensity to travel and income

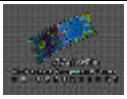


Propensity to travel and income: modeling



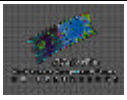
The trade –off between Price and Time : Modal choice

- Every traveler seeks the best best way to reach his destination, for the best price, and as fast as possible:
  - For an equal price, he always chooses the fastest transport mode
  - Very often, there is a trade-off between price and time
    - A fast but expensive mode
    - A slower but cheaper mode



Time (duration) : an essential factor

- The global journey duration is important :
  - Transport duration in vehicle (time spent in plane)
  - Access time (home to airport + boarding time)
  - Difference between preferred time and arrival time (importance of frequencies)
- Each stage has its own value of time and a different cost for the traveler.



The value of time : "time is money"

- Each traveler has its own valuation (cost) of the time spent in transport
- This cost is evaluated as the traveler's value of time : It is the cost of spending (wasting) one hour for the traveler
- *Ex: If my value of time is 50$, my willingness to pay for a "one hour shorter" journey is 50$*
- This value is usually estimated by surveys or statistical methods.

Examples of values of time

- Here are some values estimated by INRETS* in 1988, for France
  - Business travelers : 61.4 € (610 Rmb)
  - Leisure travelers : 28.7€ (280 Rmb)
  - All : 42.1 € (420 Rmb)
- More recent values exist, but not detailed by type of travelers (Quinet, 1998):
  - Air : 45.7 € (450 Rmb)
  - Train first class : 32.3 € (320 Rmb)
  - Train second class : 12.3 € (120 Rmb)

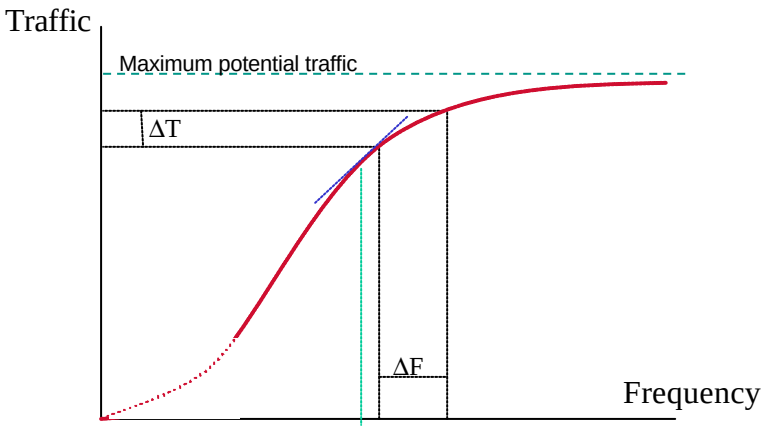
*Institut National de Recherche sur les Transports et leur Sécurité.

Frequency effect

There is a relation between traffic on a route and the number of flights (frequency) on this route

- Increasing the frequency of departures on a route results in traffic increases
- If flights are not frequent on a route, the time between the desired schedule and the available one is considered as an addition to the journey duration.
- The passenger may not travel or change his transport mode

Frequency effect



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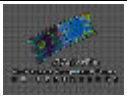
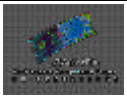


Facts on USA travelers

- Over 75% of adults have taken a plane at least once, (this rate was 50% at the beginning of the 1970's, and 25% in the 1950's).
- The rate of penetration was 33% in 1993, (while it was 21% in 1971 and 7% in 1955.
- This rate has increased slowly since the end of the 70's and is stable since the end of the 80's
  - Air transport is now « mature »



Another example : France

- About 70% of adults have taken a plane at least once in 2001 (60% in 1993).
- The rate of penetration is 25.7 in 2001, was 16.5% en 1993, and 5% in 1970
- This rate has increased more than in the USA, it has been multiplied by 3 in 20 years
  - only +50% for the USA in the same period
  - An important growth potential for air transport

China !

- Chinese civil air transport has grown by an average of 20% a year since 1980 (4.3 time the world average)

« *Air traffic in China is expected to maintain robust growth in the next decade* »

Gao Hongfeng, 2002.

Deputy director general of the General Administration of Civil Aviation of China (CAAC).

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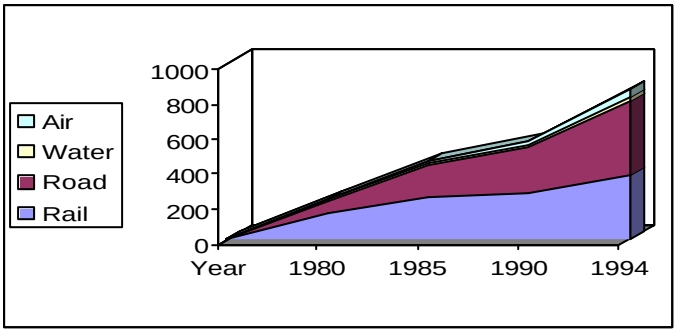
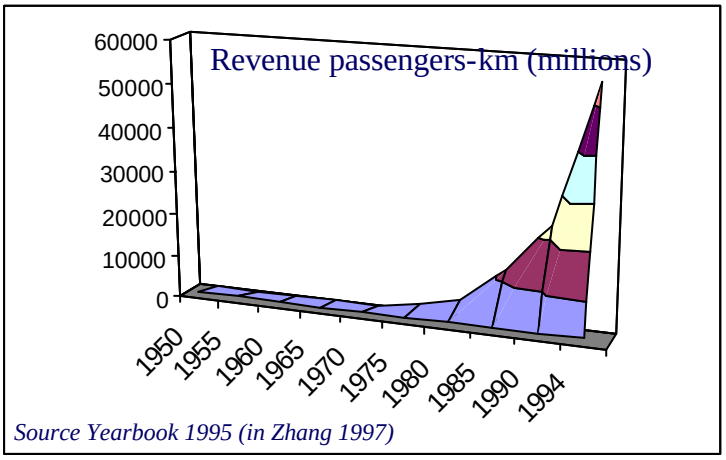
China !

Billion passenger-km



Source Yearbook 1995 in Zhang (1997)

China !



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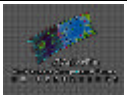
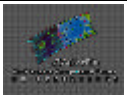
  - New horizons (What may happen in the future?)



The income effect

- The rate of penetration is highly correlated to the income, moreover air transport is more widely used for high incomes.
- Air transport consumption should evolve has a function of not only the mean purchasing power, but also of the income distribution
  - In France, 4% of the travelers make 30% of travels



Business travelers

- In the USA 48% of travels are business travels
- Almost half of the business travelers take the business class, 9% choose the first class.
- They are contributing to airlines revenues more than the other travelers
- This rate is however slowly decreasing

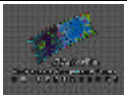
"Leisure" travelers

- The percentage of "leisure" travels is increasing. Within this group the "tourist" travels are increasing faster.
  - For the last 15 years, tourist traffic has increased at the rate of 10% per year in France.
- In the next future, this part may become a major part of the total number of travels

Is demand saturated ?

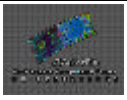
The progressive deceleration of traffic growth seems to indicate a saturation of the demand

- This idea of "saturation" is linked to the notion of "life cycle" of goods in marketing
- The current USA growth rates, which are quite low, may be a signal of saturation.
  - Rate of penetration almost stable (around 33%)
  - Stability of the average number of travels per travelers (3,6)



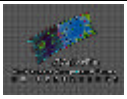
Demand key factors

- Economic, demographic and geopolitical world evolution
- International relationships and evolution of agreements.
- Evolution of air transport supply



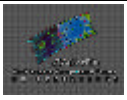
Economic outlook

- Economic growth (together with price decrease) has been the major factor of air transport growth, and will be even more important in the future
- A moderated positive growth is forecasted, this growth varies geographically
  - Between 2 and 3% in north America
  - Around 4 - 5 % in Europe
  - More than 5% in Asia-Pacific



Demography

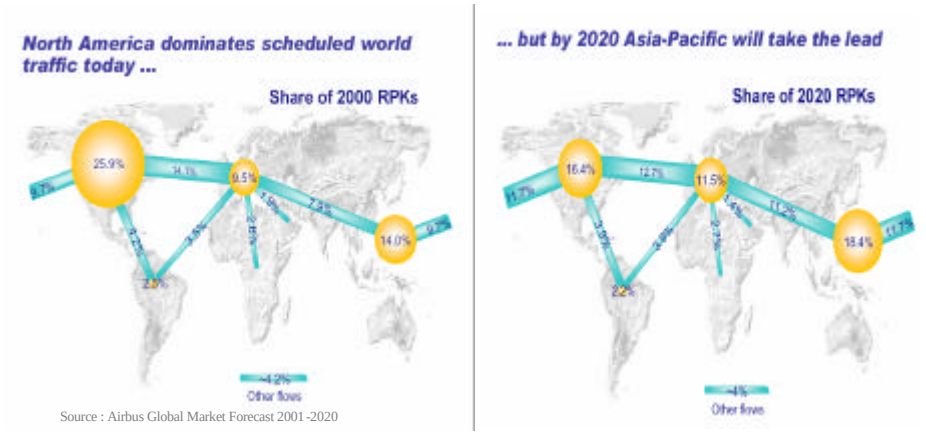
- The stagnation of the population in north America and in Europe has a negative impact on both economic growth and air transport
- On the contrary, the Asia-Pacific region (mostly Japan, South Korea, Taiwan, Singapore, Hong Kong) has a growing population (60% of the world population in 2015) and a strong economic growth
- Asia is the future big market for air transport



Geopolitics

- Blocs are emerging :
  - Europe
  - Alena (Canada, USA Mexico)
  - Asia-pacific
- Fast development of the world market
- Some regions are still uncertain
  - Eastern Europe and ex-soviet republics
  - South America
  - Middle east
  - Africa
- Regions with a high potential
  - India
  - China

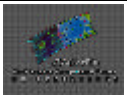
Geopolitics



Source : Airbus Global Market Forecast 2001 -2020

(de)regulation and international relationships

- Some blocs are deregulated (Europe, USA)
- There is a growing number of open-sky agreements between USA and other countries (including European countries), but bilateral agreements still hold
- Air transport rules and agreements will have a major impact on air transport growth



How does air transport supply evolves ?

The low-cost airlines in Europe and in the USA are influencing the market

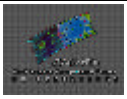
- Creation of new demands on new lines with very lower fares
- *Example : Nîmes-London* : traffic multiplied by 3 in 2 years
- *Example : Paris - Dublin* : traffic multiplied by 3 in 5 years after the arrival of *Ryanair* (low cost airline)
- *Example : Biarritz - London* : around 100 000 passengers the first year

EU-CHINA Civil Aviation Co-operation Project

EU-CHINA CIVIL AVIATION CO-OPERATION CONSOLIDATION PROJECT

A project supported by the European Commission, the European Industry, the MOFTEC, AVIC I, AVIC II and CAAC

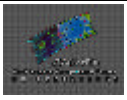
Part II : Introduction to traffic forecast models and methods



The need for forecasts

Examples are :

- What is the expected world traffic growth for the next ten years ?
- What impact will have the new fares of *Air France* on Toulouse-Paris traffic ?
- What will be the traffic on a specified route with a new low-cost airline entering the market?
- How many planes/crew should an airline prepare for the summer holidays ?
- What is the expected traffic on a new route ?
- Is the construction of a new airport justified by the expected traffic growth?



Forecast and forecast

Two notions of forecast are used and have to be clarified

- One may wish to know the **future** of a variable :

  « Time forecast »

Example : What will be the traffic next week on the Beijing-Paris route ?

- One may wish to know the **reaction** of a variable to some change in another variable influencing it :

  « Demand forecast »

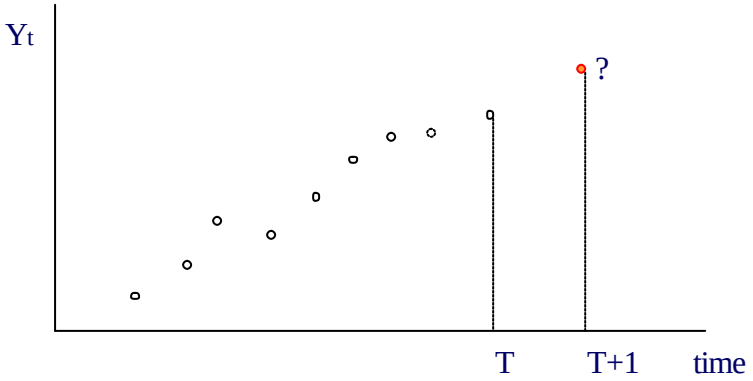
Example : What would be the traffic on the Beijing-Paris route if there was a change in fares ?

« Time series forecast »

Three forecast ranges

- Short-term forecasts
  - What will be the traffic on a specified route with a new low-cost Airline ?
  - How many planes/crew should an airline prepare for the summer holidays ?
- Medium-term forecasts
  - How many planes should Air-France order now for delivery in five years ?
- Long-term forecasts
  - What is the expected world traffic growth for the next ten years?

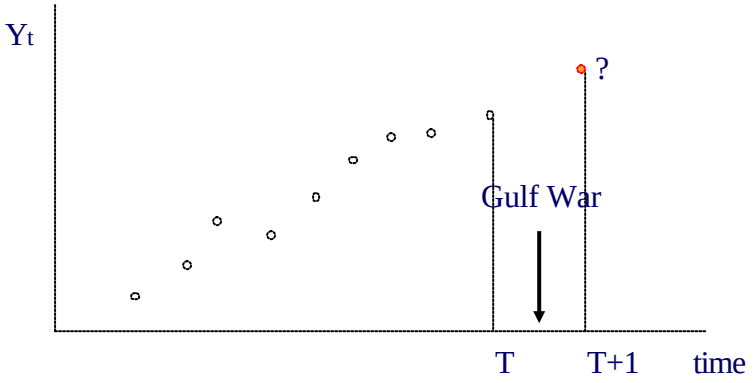
What's feasible ?



Everything else being equal,

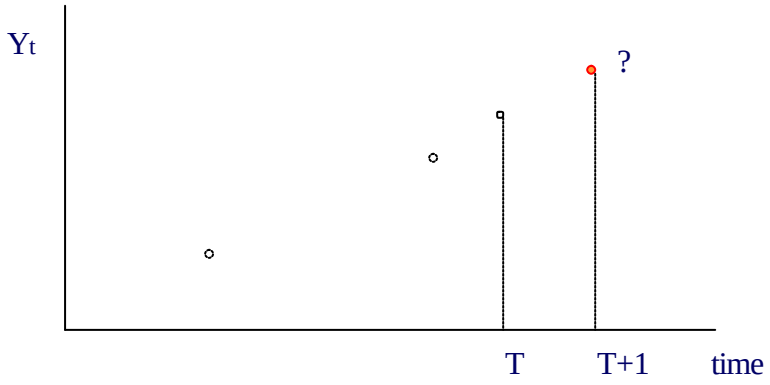
a model can forecast Y_{T+1} with accuracy

What's not feasible ?



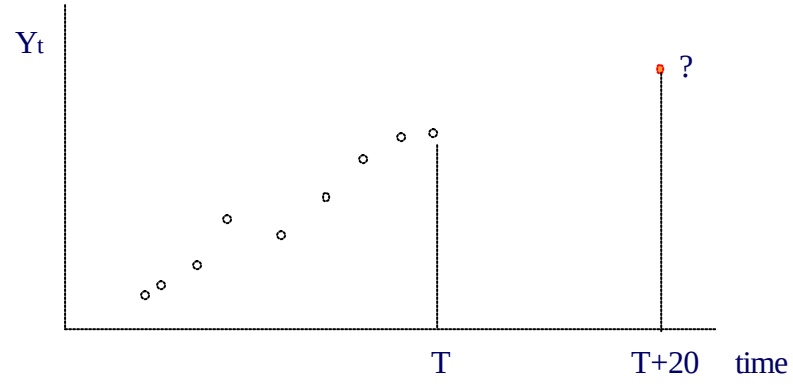
Unpredictable events may have a great impact on the forecast

What's very hard !



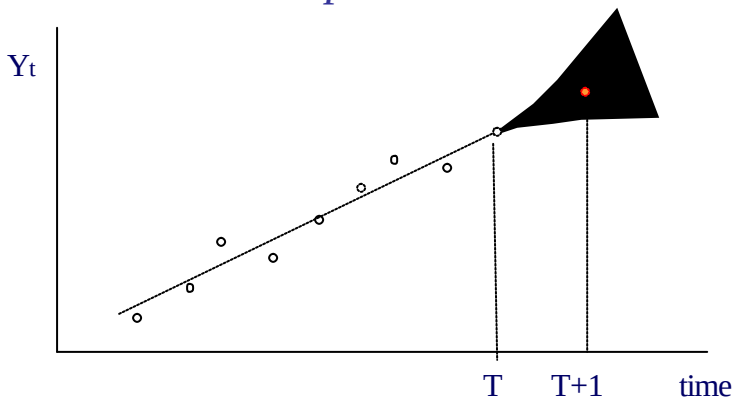
Quality of the forecast depends on the quality data

What's very hard !



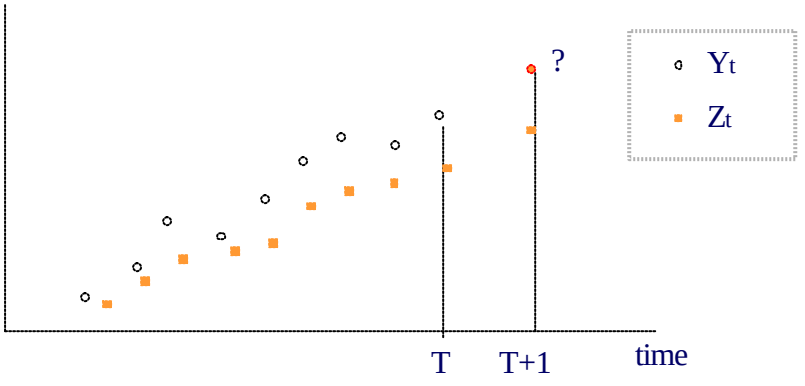
Forecasting in the long term needs additional information

Improvements

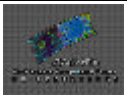


Confidence bounds are sometimes available and give the accuracy of the forecast

Models !



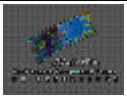
Relations observed between variables in the past may help the forecast



What's a model ?

It is an approximation of reality (or some part of it) using a set of mathematical expressions

- In the air transport field, one aim is to quantify and forecast demand
- A model needs data
  - Importance of past observations
  - Relation between the quantity to forecast and other variables (or other previsions) e.g. GDP.
  - Confidence bounds



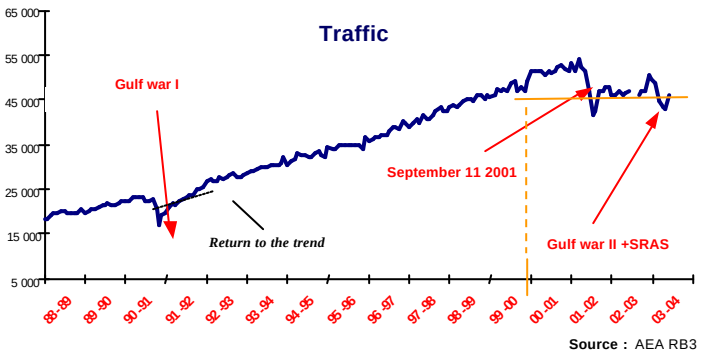
Three Aspects of forecasting

- Time-series Methods
  - One aims at evaluating the future value of a variable using its past features.
- Econometric Methods (Regression-based models)
  - A model is estimated linking the variable to be predicted to other variables of influence and/or to seasonal effects.
- Qualitative methods
  - « experts sayings »
  - Market research

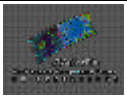
Definition of a Time Series

- One observes N realizations of a variable until date T, and one wishes to forecast its next realization(s) T+r
- The main idea is that the past realization of variable includes all the information about its features, all the relations with other variables linked to it and that the series is self-containing for the forecast.

Example of Time series I



Source : AEA RB3



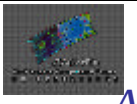
Time-series modeling

The belief that the series is self containing induces a natural modeling of the series. For example as a p-lag auto-regressive model

$$Y_t = a_0 + a_1 \cdot Y_{t-1} + a_2 \cdot Y_{t-2} + \cdots + a_p \cdot Y_{t-p} + e_t$$

Where the α_ι have to be estimated and where ε_τ is a zero mean random variable

The forecast is quite simple and is only based on the past of the series



Another type of time-series modeling

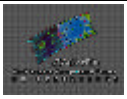
Usually one assumes that a time series was generated by a model of the type

$$Y_t = C_t + S_t + e_t$$

S_t : Seasonal component of the variable

C_t : Trend explained and caused by other entities (such as time or GNP)

e_t : Random *"idiosyncratic"* residual part of the phenomenon or irregular component

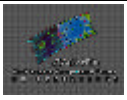


Short term forecast

- Only the seasonal component S_t is important. Other variables are assumed to be stable in the short term

$$Y_t = \text{Constant} + S_t + e_t$$

- This seasonal movement has often a periodicity of order 12 for monthly data and of order 7 for weekly data
- The model must be able to capture these features for the short term forecast



Medium term forecast

- The trend Ct has to be estimated. If one still assumes that the series is self-containing its features (time series), one uses a model with a deterministic trend

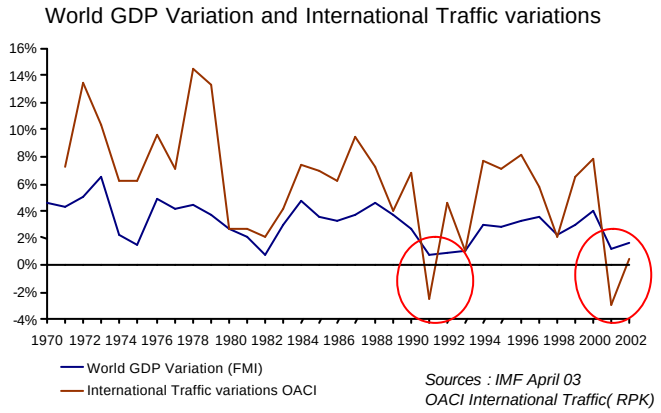
$$C_t = f(t)$$

- Example : a model with deterministic trend :

$$Y_t = a + b \cdot t + g \cdot t^2 + S_t + e_t$$

- But one may have the intuition that the series is linked to some external events (and variables).

Example of Time series II



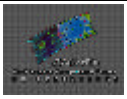
Sources : IMF April 03
OACI International Traffic(RPK)

Medium term forecast (cointegration)

- One may have the intuition that the series Y_t has a stable relationship with another variable Z_t and that :

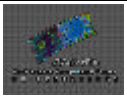
$$Y_t = f(Z_t) + e_t$$

- For example one often sees the global traffic (Y_t) linked to the GDP (Z_t). Forecasting Y_t is then done in two steps
  - Estimate the relation between Y_t and Z_t in the past (estimate the cointegration relationship f)
  - Use the forecast of Z_{t+p} for predicting Y_{t+p}



Remarks

- The forecast of the variable Y is entirely based on the forecast of the variable Z
- Very often in global traffic forecast, the estimation rest on some GDP forecast
- These GDP forecast are also based on some assumptions, and somehow linked to other variables
- This is a way to reduce (aggregate) the information into a single variable

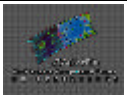


Medium term forecast : Regression

- One may also have the intuition that the series Y_t has some relationship with other " explicative" variables, or their past realization.
- One then may use some econometric model for estimating the relations in the past and predict the future.

$$Y_t = f(t, Y_{t-1}, Z_t, Z_{t-1}, W_t) + e_t$$

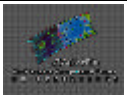
- The assumption that only the trend is important is relaxed and the whole series is considered.



Long term forecast

The previous methods are quite useless for long term forecasting, because:

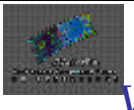
- The assumption that either the series is self containing or that the series is well correlated to another time-series cannot be maintained.
- The previous methods are based on assumptions (« *all things being equal »)* that are violated in the long term
- The confidence bounds explode in the long term and the accuracy of the forecast is poor…
- Unexpected events are more likely to append in the long term and cannot be included in long term expectations



Long term forecast

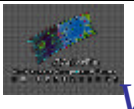
Other methods are used and are based on scenarios

- Experts list all the present and future economic variables that influence (or will influence) the considered variable (traffic)
- Their relative importance are evaluated
- Their probability of occurrence are estimated
- Scenarios (low and high) of probable situations are built



Variables that may affect long term forecast

- To forecast in the long term,
  - One does not care about « accidents » or events that affect only the short or medium term structure of the series
  - One has to anticipate events affecting travelers behavior (structural changes)
- New technologies for business (including high speed internet), home work, video-conferences, may have an impact on business travelers
- Environment considerations, terrorist fear, may also reduce the leisure travelers



Variables that may affect long term forecast

- Economic growth, new markets from emerging countries may have a positive impact on air transport
- Increasing life expectancy, reducing the working time (France) have also positive impacts

To forecast air transport on a long term basis one has to forecast the future of society and of the economy in the long term

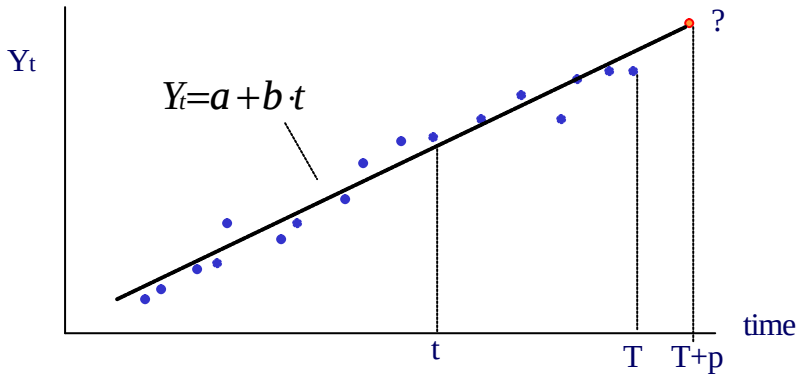
How to estimate ?
The least squares method

- A simple way to estimate parameters of a model is to use least square estimators.
- Let's assume that the series we observe is Yt and that the model we want to estimate is linear

$$Y_t = a + b \cdot t + e_t$$

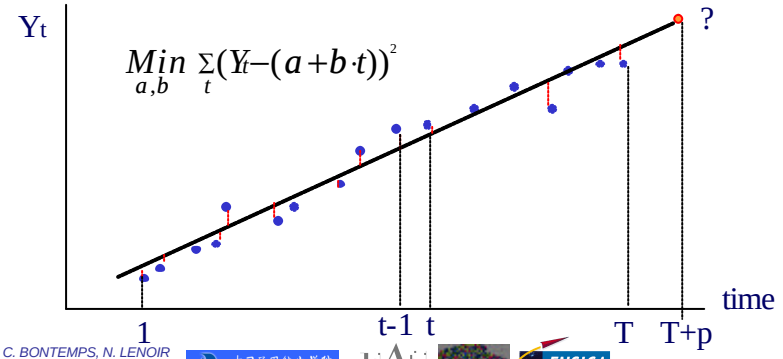
- Where a, b are unknown parameters to estimate

The least squares method



The least squares method

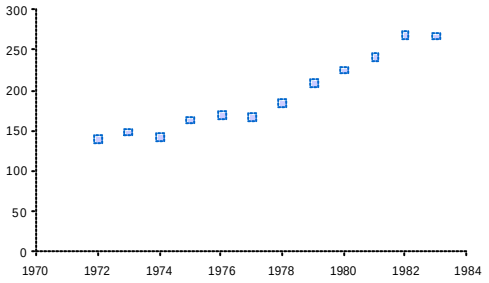
The parameters α and β are estimated such as minimizing the distance between the observed points and the estimation



Forecasting time series : examples

Total passenger traffic between London and Nice

1972	140,6
1973	148,5
1974	142,4
1975	163,8
1976	169,6
1977	167,4
1978	185
1979	209,9
1980	225,1
1981	241,2
1982	268,8
1983	268



Source Doganis 2002

Forecasting time series : example

How to forecast the traffic in 1988 : Y_{1988}?

First model Average rate of growth γ:

One computes

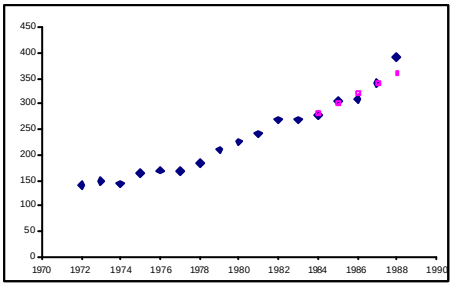
$$g_t = (Y_t - Y_{t-1}) / Y_{t-1} \qquad g = \sum_{t=2}^{11} g_t / 11$$

and one uses it to forecast

$Y_{1984} = Y_{1983}$ x $(1+\gamma)$ ... Gives $Y_{1988} = Y_{1983}$ x $(1+\gamma)^5$

Forecasting time series : Forecast versus observed

Year	Observed	Annual growth	Forecast
1984	278,1	0,037686567	284,63918
1985	305,6	0,098885293	302,311429
1986	308,7	0,010143979	321,080885
1987	341,4	0,105928086	341,015671
1988	392,8	0,150556532	362,188139



Forecasting time series

Second model Moving Average growth γ':
One computes the tree years moving average passengers Z_t

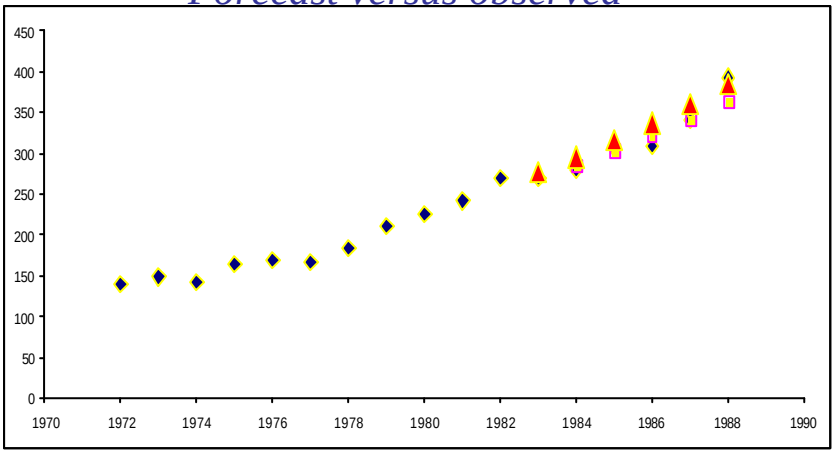
$$Z_t=(Y_t+Y_{t-1}+Y_{t+1})/3$$

$$g'_t=(Z_t-Z_{t-1})/Z_{t-1} \qquad g'=\sum_{t=2}^{11} g'_t/9$$

and one uses it to forecast

$Y_{1983}=Z_{1982}$ x $(\gamma+1)'$ ... Gives $Y_{1988}=Z_{1983}$ x $(1+\gamma')^6$

Forecasting time series :
Forecast versus observed



Forecasting time series

Third model Simple trend:

One computes the regression of the traffic on time

$$Y_t = a + bt + e_t$$

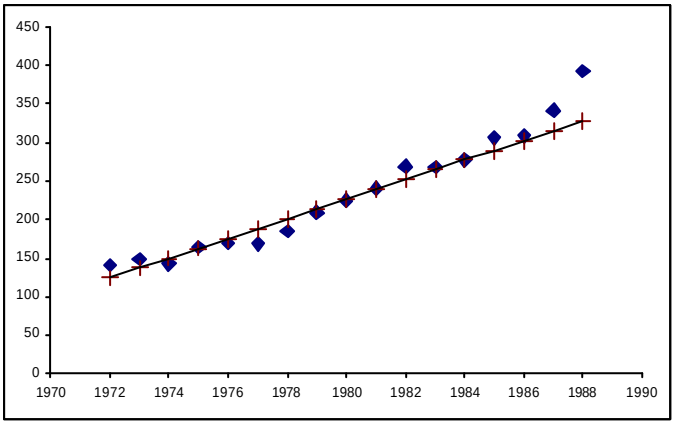
One computes the values of α and β using least squares.

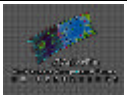
a = 119.9 and b=12.7

This means simply that the model forecasts

12 700 additional passengers each year.

Simple linear trend regression forecast





Forecasting a time series

Fourth model Exponential trend:

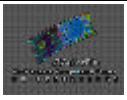
One computes the regression of traffic on the exponential of time to reflect the exponential shape of the trend

$$Y_t = a + \exp(bt) + e_t$$

One computes the values of α and β using least squares.

Fifth model Auto-regressive model:

$$Y_t = a + bY_{t-1} + e_t$$



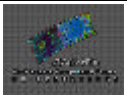
Forecasting time series : comments

- Very difficult to forecast time-series without additional elements
  - Regularity is needed
  - Several models may fit the observed data but produce bad forecast
- Usually one uses several forecasts on the same data set
- Use different routes forecast to do a global forecast

Choice of forecasting technique

		Qualitative methods		Time-series models	Econometric models (Regression)
		« Expert sayings »	Market research		
Accuracy	0-1 year	Good	Good	Good	Good
	1-5 years	Fair	Good/fair	fair	Good
	> 5 years	Poor	Fair/Poor	Poor	Fair/Poor
Ready and available Data		Good	Poor	Good	Fair/Poor
Confidence bounds		No	No	Yes	Yes
Costs		Very Low	**Very High**	Low	High

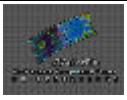
« Demand forecast »



Another type of forecast needs

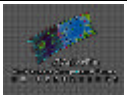
- What are the market shares of rail and air between Toulouse and Paris?
  - Impact of the relative prices and journey duration ?
  - Impact of a new pricing ?
- Will the new Toulouse-Florence direct route be profitable ?

⇧ Demand models



Forecasting demand

- At the individual level, on a specific route, it is possible to have models to forecast the behavior of the travelers.
- They are based on the idea that the probability of taking an airline can be estimated using observed characteristics of
  - Trip (distance, fare, duration)
  - The traveler (age, income, ..)
  - The alternative modes

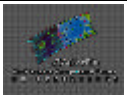


Forecasting demand

- The models can be used only with disaggregated data (very rare).
- These models are "logit" or "probit" models

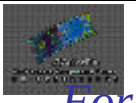
$$\Pr[X_i = plane] = f(R_i, D_{plane}, P_{plane}, D_{train}, P_{train}) + e_i$$

- One estimates the probability that individual X_i takes the "Plane" based on the information on its income R_i, the travel distance (or time) D_{plane}, the price of the plane ticket P_{plane}; and information on the alternative choices ("train ").



Forecasting demand

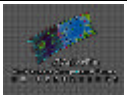
- Those models are very precise but data are needed
- They allow to predict or measure :
  - The reaction of demand to a new price
  - The reaction of demand to a new price of the other actors in the market
  - The reaction to changes of any significant variable in the demand model.



Forecasting demand with aggregate data : Example

Very often, the models are far from sophisticated statistical models, because of data.

- Real Example (see Doganis 2002):
- To forecast the traffic Tal between Algeria and France one has to use global (aggregate) variables
  - GNP = measure of the combined real GNP of Algeria and France in proportion to their share of Algerians in the total traffic
  - Fare = average yield per passenger on all Algeria-France Routes
  - S = average speed of all Algeria-France air services



Forecasting demand with aggregate data

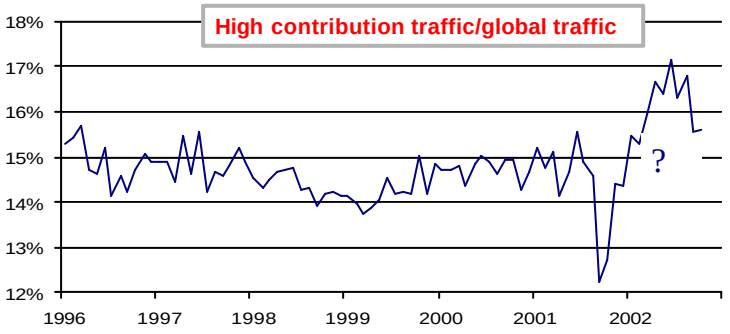
- Using the data available on the period 1968-1975 through the least square method one has the forecast as a log-linear relation :

  Log Total = 1.0963 + 1.447 Log GNP – 1.413 Log Fare +0.247 LogS

- Comments :
  - The coefficients have the expected signs
  - Using log variables is a trick to obtain directly the elasticities in the coefficients
  - A measure of the goodness of fit is R^2. Here R^2 =.9732
  - Another important feature is the significativity of the variables in the relation described by the *Student t* value (not reported here)

Concluding remarks

- People react differently

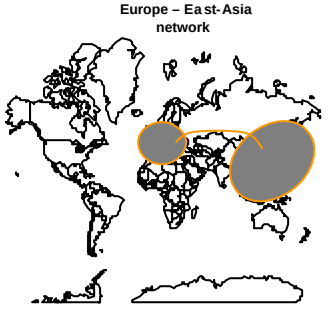


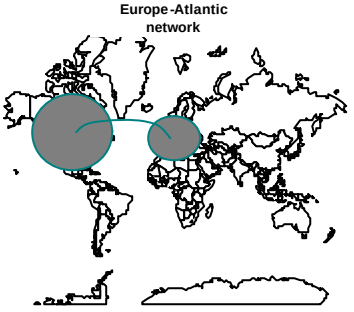
Source IATA

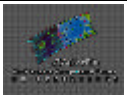
A project supported by the European Commission, the European Industry, the MOFTEC, AVIC I, AVIC II and CAAC

Concluding remarks

- Separate the forecast if the situations are different







Concluding remarks

- Compare what is comparable
- A forecast is always based on assumptions
- Give/ask confidence bounds or sensibility analysis
- Be conscious that a forecast is **always** false