

Forecasting

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Forecasting In Practice

- **Objective: To present procedure.**
- **Topics:**
 1. Premises
 2. Many Assumptions underlie forecast methods
 3. Basic mechanics of forecast methods
 4. Principles for Practice
 5. Recommended Procedure
 6. Mexico City Example
 7. Current International Considerations
 8. Summary

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Premises

- **Forecasting is an Art,
not a Science -- too many
assumptions
not a statistical exercise -- too
many solutions**
- **Forecasts are Inherently Risky**

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Assumptions behind any forecasting exercise

- **Span of data -- number of periods
or situations (10 years? 20? 30?)**
- **Variables -- which ones in formula
(price? income? employment? etc)**
- **Form of variables -- total price?
price relative to air? To ground?**
- **Form of equation -- linear? log-
linear? translog?**

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Common forms of forecasting equations

- **Linear**

→ $Pax = Population[a + b(Income) + c(Yield) \dots]$

- **Exponential**

→ $Pax = \{a [Yield]^b\} \{c [population]^d\} \{etc \dots\}$

- **Exponential in Time**

→ $Pax = a [e]^{rt}$

where r = rate per period

and t = number of periods

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Fundamental Mathematics of Regression Analysis

- **Linear equations**

→ Logarithm of exponential form => linear

- **Define “fit”**

→ = sum of squared differences of equation and data, $\sum (y_1 - y_2)^2$

→ => absolute terms, bell-shaped distribution

- **Optimize fit**

→ differentiate fit, solve for parameters

→ R-squared measures fit ($0 < R^2 < 1.0$)

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Ambiguity of Results -- Many 'good' results possible

- Common variables (employment, population, income, etc) usually grow exponentially $\sim a(e)^{rt}$
- They are thus direct functions of each other
 - $a(e)^{rt} = [(a/b)(e)^{(r/p)t}]b(e)^{pt}$
- Easy to get 'good' fit
 - See Miami example

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Forecasts of International Passengers (Millions per Year) for Miami Int'l Airport

Forecast		Forecast	Actual
Method	Case	2020	1990
Population	Dade Co.	16.00	10.01
	Dade/Broward	16.61	
	Dade/Broward (Non-Linear)	21.89	
Yield and Per Capita Personal Income	Dade Co.	19.25	
	Dade/Broward	22.25	
	Dade/Broward (Non-Linear)	20.31	
Time Series	Dade Co.	19.84	
	Dade/Broward	20.16	
	Dade/Broward (Non-Linear)	57.61	
Per Capita Personal Income	Dade Co.	28.38	
	Dade/Broward	25.57	
	Dade/Broward (Non-Linear)	53.79	
Share (US Int'l Pax)		37.76	
Share (US Reg'l Rev.)		25.45	
Source: Landrum and Brown (Feb. 5, 1992)	Maximum	57.61	
	Average	27.49	275 %
	Median	21.20	212 %
	Minimum	16.60	166 %
	Preferred	37.76	377 %

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Forecasts of Domestic Passengers (Millions per year) for Miami Int'l Airport

Forecast		Forecast 2020	Actual 1990	
Method	Case			
Population	Dade Co.	13.96	9.92	
	Dade/Broward	15.35		
	Dade/Broward (Non-Linear)	17.74		
Yield and Per Capita Personal Income	Dade Co.	19.87		
	Dade/Broward	19.69		
	Dade/Broward (Non-Linear)	19.13		
Time Series	Dade Co.	17.41		
	Dade/Broward	18.67		
	Dade/Broward (Non-Linear)	40.05		
Per Capita Personal Income	Dade Co.	26.58		
	Dade/Broward	24.34		
	Dade/Broward (Non-Linear)	42.40		
Share of US Traffic		23.48		
Source: Landrum and Brown (Feb. 5, 1992)	Maximum	42.40		427 %
	Average	22.97		232 %
	Median	19.69	198 %	
	Minimum	13.96	141 %	
	Preferred	15.35	155 %	

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Note Use of “preferred” forecast

- Forecasts obtained statistically often “don’t make sense”
- Forecasters thus typically disregard these results substituting intuition (cheap) for math (very expensive)
- E.g.: NE Systems Study (SH&E, 2005)
 “The long-term forecast growth... was inconsistent with...expectations...[and] were revised to... more reasonable levels”

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Domestic Pax for Miami update for 2008

Forecast Method and Variant		Forecast 2020	Actual	
Method	Data Used (form)		1990	2000
Population	Dade County	13.96	9.92	17.4
	Dade and Broward	15.35		
	Dade and Broward (non-linear)	17.74		
Yield and Per Capita Personal Income	Dade County	19.87		
	Dade and Broward	19.69		
	Dade and Broward (non-linear)	19.13		
Time Series	Dade County	17.41		
	Dade and Broward	18.67		
	Dade and Broward (non-linear)	40.05		
Per Capita Personal Income	Dade County	26.58		
	Dade and Broward	24.34		
	Dade and Broward (non-linear)	42.40		
Share of US		23.48		
	Maximum	42.40		
	Average	22.97		
	Medium	19.69		
	Minimum	13.96		
	Preferred		15.35	

**Actual
2008
= 16.4

Less
than in
2000**

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Principles for forecasting in practice

- **Detailed Examination of Data**
Statistics are often inconsistent, wrong, or otherwise inappropriate for extrapolation
- **Extrapolation for Short Term,**
About five years
- **Scenarios for Long Term,**
Allowing for basic changes
- **Ranges on Forecasts,**
As wide as experience indicates is appropriate

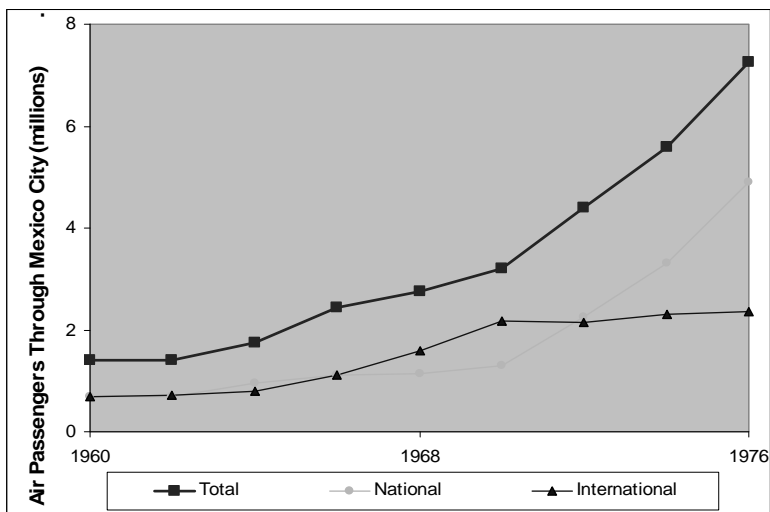
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Recommended Procedure

1. Examine Data
compare alternate sources, check internal consistency
2. Identify Possible Causal Factors
relevant to site, period, activity
3. Do regression, extrapolate for short term,
apply historical ranges on forecasts
4. Identify future scenarios
5. Project ranges of possible consequences
6. Validate Plausibility
compare with elsewhere, in similar circumstances

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Passengers, Mexico City International Airport (AICM)



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Mexico City -- Data Problems

- **Typographical Error**

Seen by examination of primary data
(Compare with Los Angeles)

- **Double Counting**

Introduced in series by a new category of data

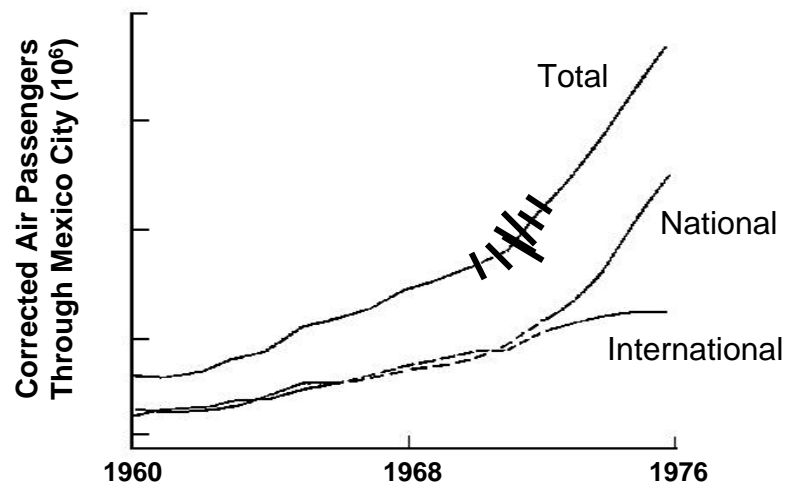
- **New Definitions of Categories**

Detected by anomalies in airline performance
(pax per aircraft) for national, internat'l traffic

These problems occur anywhere

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Passengers Through AICM (Corrected Version)



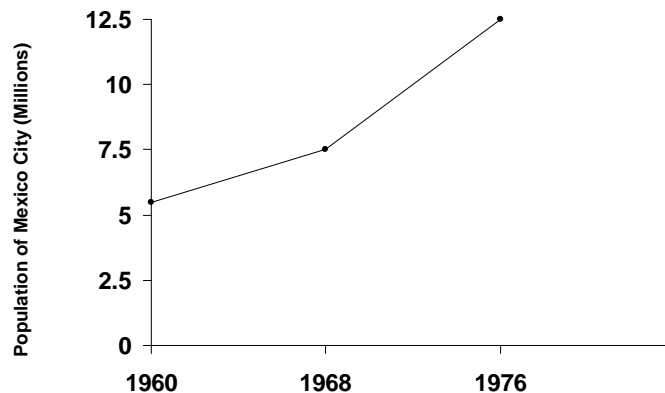
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Mexico City -- Causes of Trends

- **Economic Boom**
Post 1973 oil prosperity
- **Recessions Elsewhere**
Affecting international traffic
- **Population Growth**
- **Fare Cuts**
Relative to other commodities

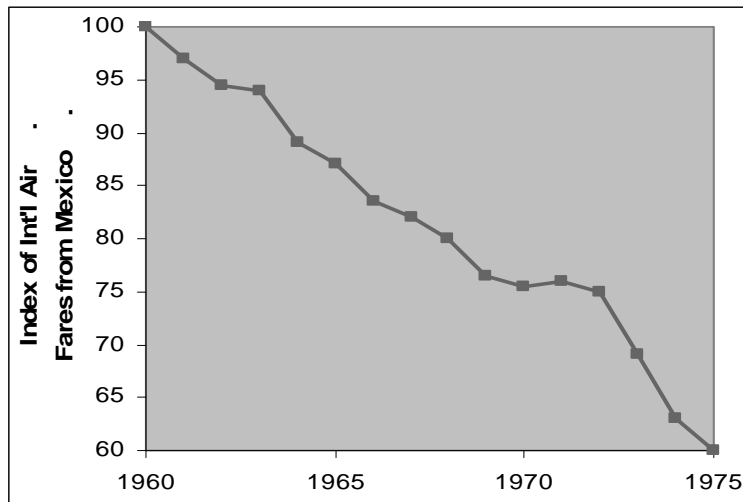
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Population Increase of Mexico City's Met. Area



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Trend of Int'l Air Fares at Constant Prices



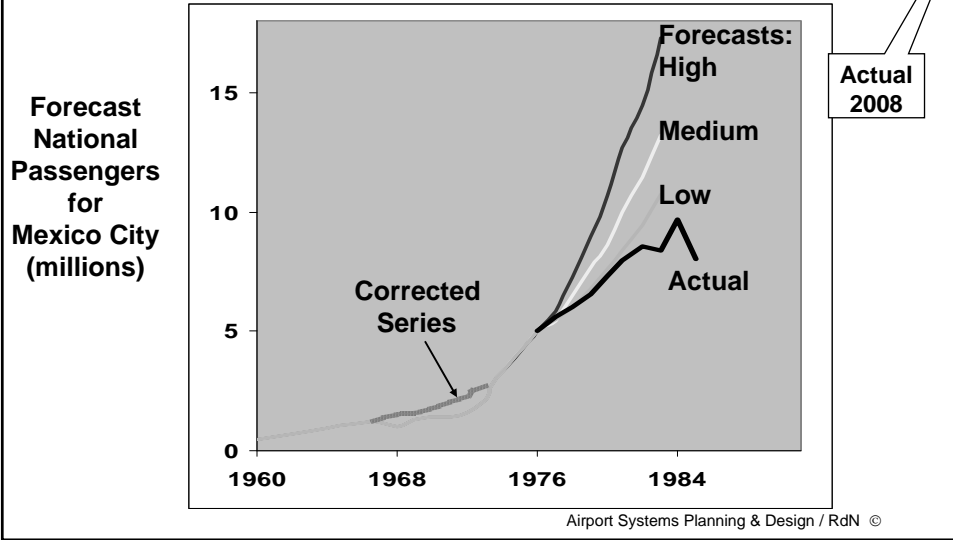
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Mexico City -- Note

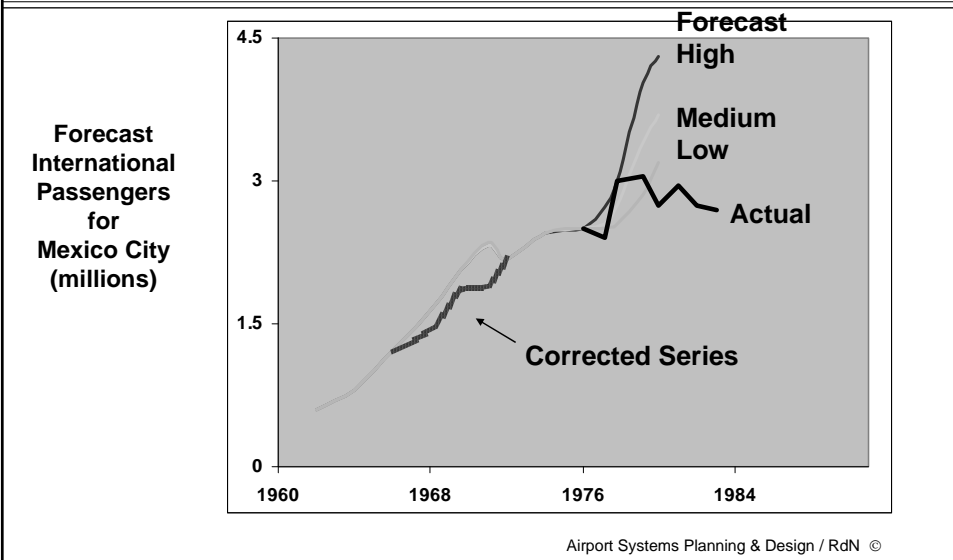
- Traffic formula based on these variables (or others) does not solve forecasting problem.
- Formula displaces problem, from traffic to other variables.
- How do we forecast values of other variables?

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Short-Range Forecasts, National Passengers, AICM



Short-Range Forecasts, International Pax. AICM



Mexico City -- Elements of Long-range Scenarios

- **Demographics**
 - Rate of Population Increase
 - Relative Size of Metropolis
- **Economic Future**
- **Fuel Prices and General Costs**
- **Technological, Operational Changes**
- **Timing of Saturation**

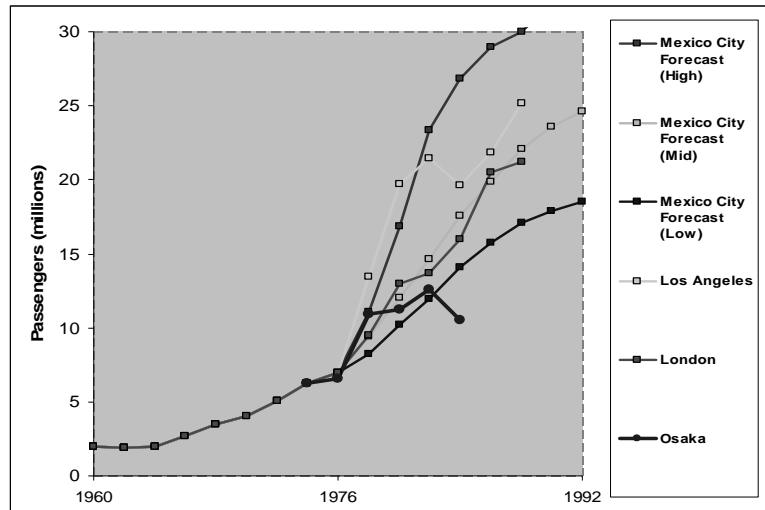
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Long-range Scenarios

- **New Markets**
 - Japan, Pacific Rim, United Europe
- **More Competition**
 - Deregulation, Privatization
 - Transnational Airlines
- **New Traffic Patterns**
 - Direct flights bypassing Mexico City
 - More Hubs (Bangkok, Seoul?)
 - New Routes, such as over Russia

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Long Term AICM Forecasts, validated by data elsewhere



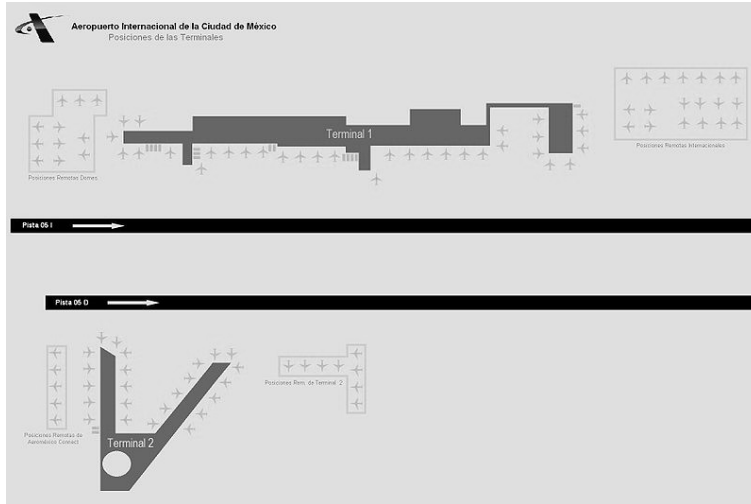
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Summary

- **Forecasting is not a Science**
 - too many assumptions
 - too much ambiguity
- **Regression analysis for short term**
 - Apply historical ranges on projections
- **Scenarios for Long range**
 - compare with experience elsewhere
- **STRESS UNCERTAINTY**

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Mexico City Airport 2009



Source: AICM via wikipedia

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