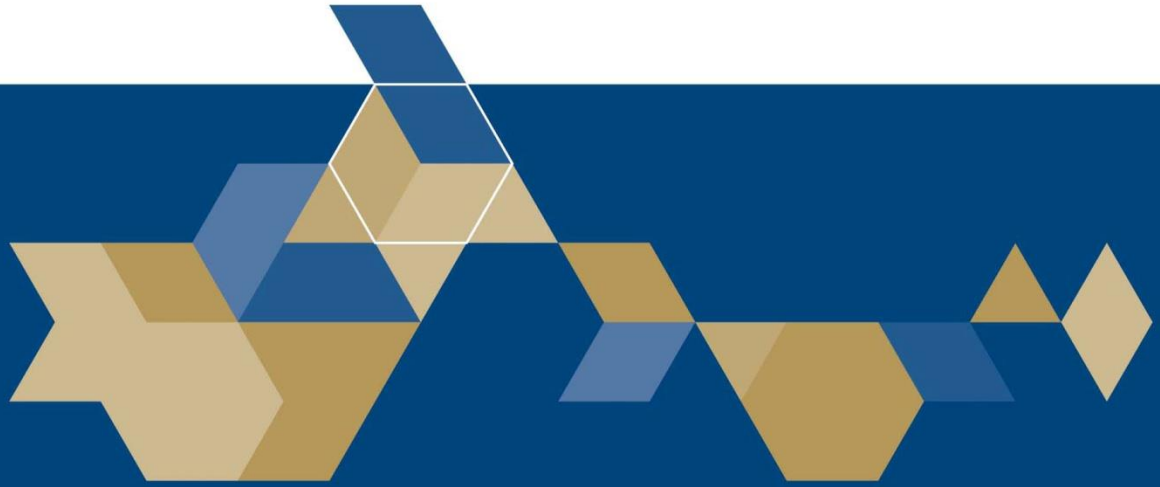

Airport Forecasting

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Module 07

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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**

Premises

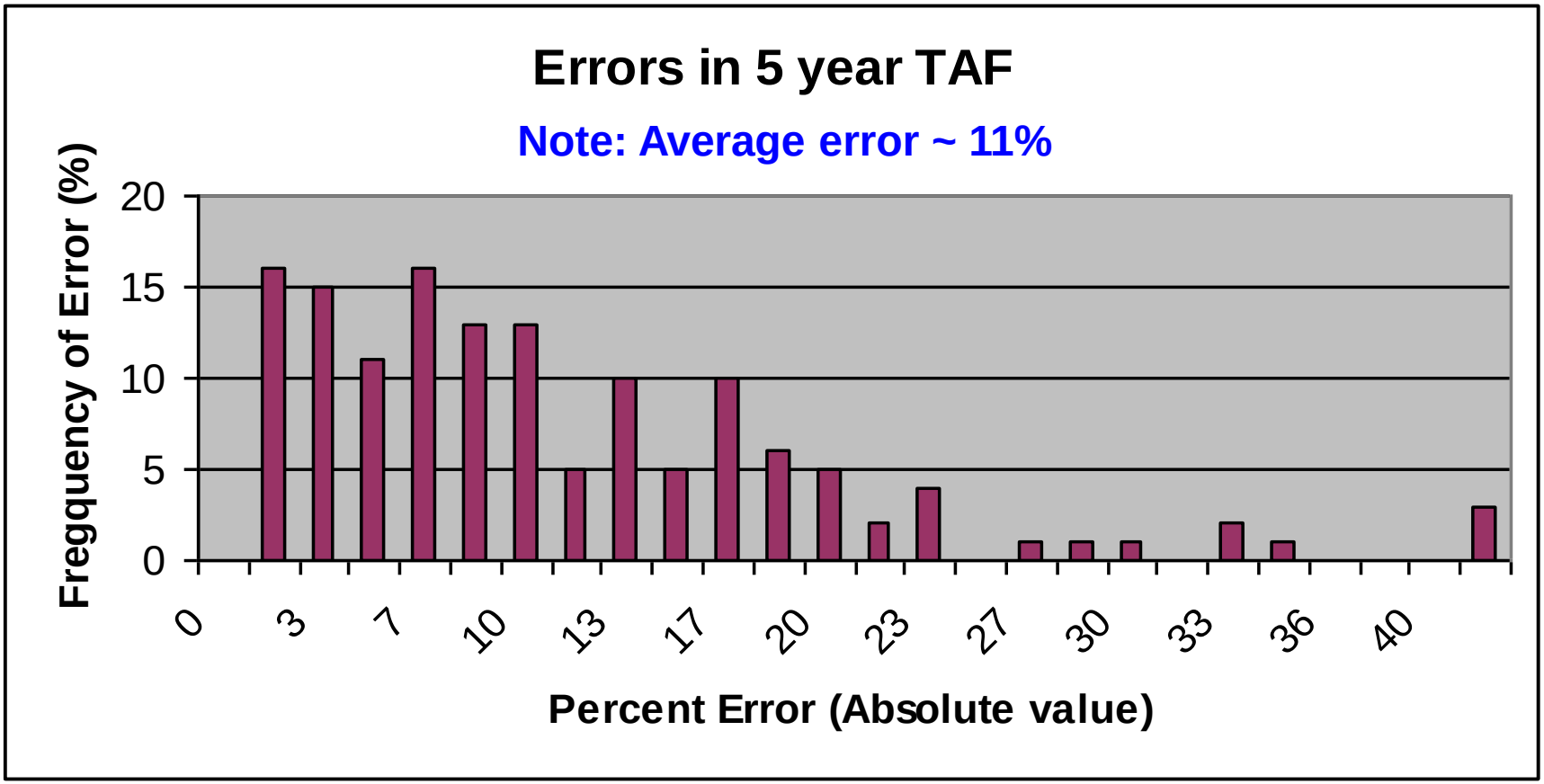
- **Forecasting is an Art,**

  not a Science -- too many assumptions

  not a statistical exercise -- too many solutions

- **Forecasts are Inherently Risky**

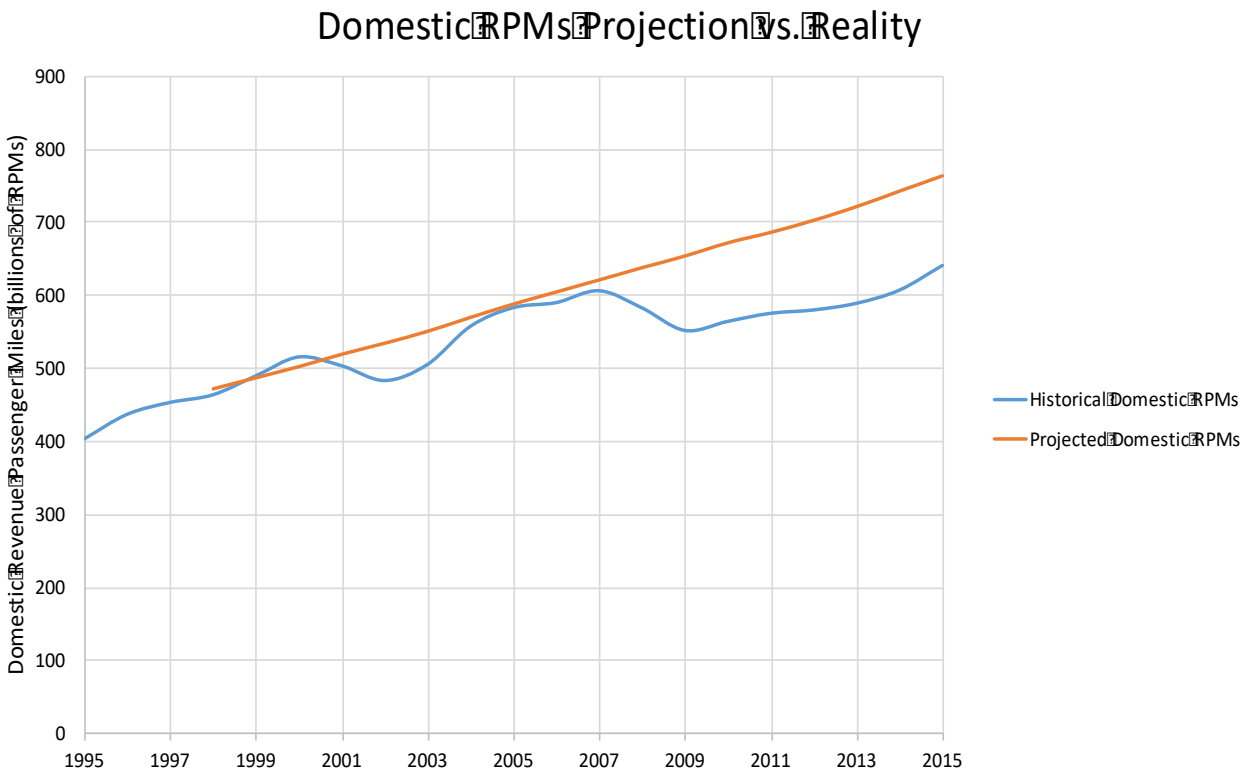
Results of a study of TAF



Adapted from: Terminal Area Forecast (TAF) Accuracy Assessment Results Jerome Friedman, MITRE CAASD. Study dated Sept. 30, 2004, but data until 2000. Deliberate omission of 2001, 2002 – when traffic dropped enormously

Assumptions behind any forecasting exercise

- **Span of data -- number of periods or situations (10 years? 20? 30?)**



Past 10 years: almost level…

Past 20 years: Strong rise…

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? Logit?

Logical House of Cards

Choice of variables

- **Note first: The more variables you include, the better the statistics in model, the better the fit!**
- **Why is that?**
- **Because procedures for creating statistical model only include variables to extent they improve R^2**

Common forms of forecasting equations

- **Linear**
  - Pax = Population [a +b(Income)+c(Yield)…]
- **Exponential**
  - Pax = {a [Yield]^{b}}{c [population] ^{d}} {etc…}
- **Exponential in Time**
  - Pax = a [e]^{rt}
    where r =rate per period
    and t = number of periods
- **Benefits of each?**

Fundamental Mathematics of Regression Analysis

- **Linear equations**
  - Logarithm of exponential form => linear
- **Define "fit"**
  - = sum of squared differences of equation and data, $\Sigma (y_1-y_2)^2$
  - => absolute terms, bell-shaped distribution
- **Optimize fit**
  - differentiate fit, solve for parameters
  - R-squared measures fit ($0 < R^2 < 1.0$)

Let's discuss meaning of correlation for a moment

- **There is well-established good correlation between:**
  (Damage at Fire) and (Number of Firemen)
- **What do I conclude about how Firemen cause damage?**
  → Should I send less firemen to fire?
- **The correlation is "spurious":**
  Big fires => damage, firemen sent

Ambiguity of Results: Many 'good' results possible

- **Common variables (employment, population, income, etc) usually grow exponentially ~ $a(e)^{rt}$**
- **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

Forecasts of International Passengers (Millions/Year) for Miami/International

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	
	Maximum	57.61	576 %
	Average	27.49	275 %
	Median	21.20	212 %
	Minimum	16.60	166 %
	Preferred	37.76	377 %

Source: Landrum and Brown (Feb. 5, 1992)

Forecasts of Domestic Passengers (Millions per year) for Miami/International

Forecast		Forecast	Actual
Method	Case	2020	1990
Population	Dade Co.	13.96	
	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	9.92
	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	
	Maximum	42.40	427 %
	Average	22.97	232 %
	Median	19.69	198 %
	Minimum	13.96	141 %
	Preferred	15.35	155 %

Source: Landrum and Brown (Feb. 5, 1992)

Note Use of "preferred" forecast

- Forecasts obtained statistically often "don't make sense"
- Forecasters often disregard statistical results (expensive, misleading), substituting intuition (cheap)
- E.g.: NE Systems Study (SH&E, 2005)

  "The long-term forecast growth… was inconsistent with…expectations…[and] were revised to… more reasonable levels"

Domestic Pax for Miami update for 2010, 2012

Forecast Method and Variant		Forecast	Actual	
Method	Data Used (form)	2020	1990	2000
Population	Dade Country	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		
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Share of US		23.48		
	Maximum	42.40		
	Average	22.97		
	Medium	19.69		
	Minimum	13.96		
	Preferred	**15.35**		

Actual 2010 =18.8

Actual 2015 =20.8

Miami press release, Jan 2011

- **“Miami set a new all-time record for annual passenger traffic in 2011 with 35.7 million passengers”**
- **BUT:**
- **“The previous record was set in 1997 when the airport welcomed 34.5 million passengers.”**
- **Source: http://blogs.sun-sentinel.com/south-florida-travel/2011**

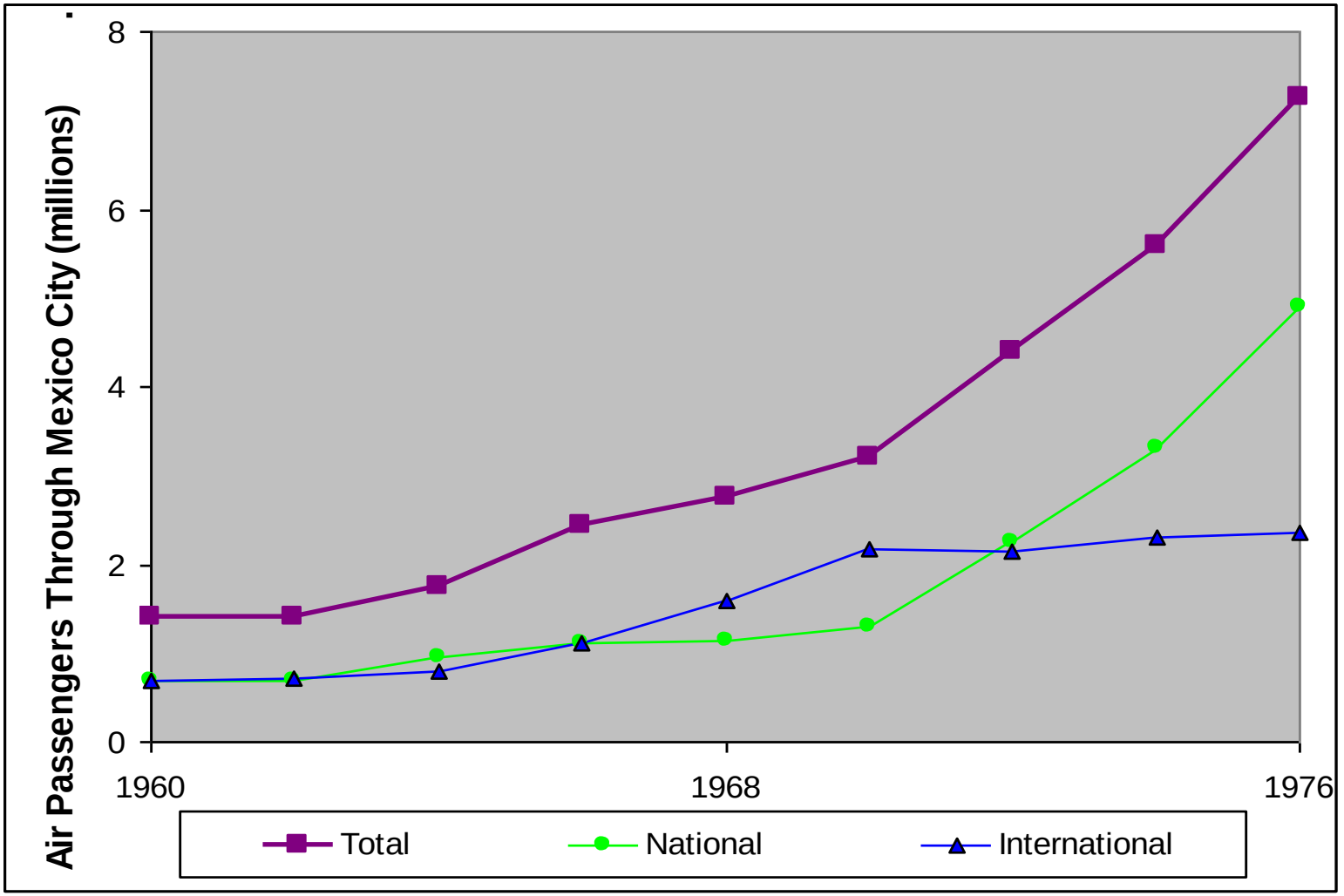
Principles for forecasting in practice

- **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 demonstrates

Recommended Procedure

1. **Examine Data**
   compare sources, check 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

Passengers, Mexico City International Airport (AICM)

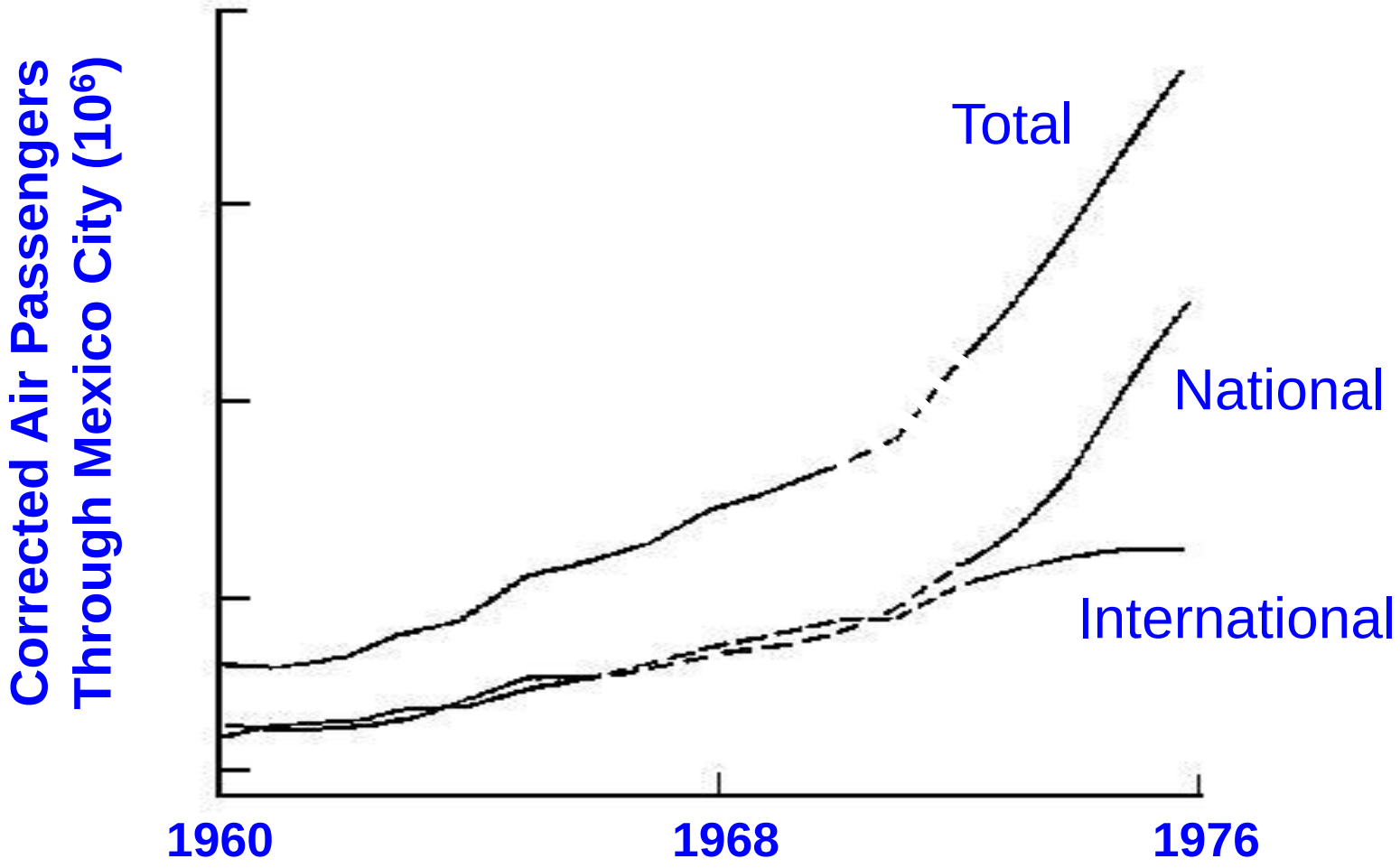


Mexico City -- Data Problems

- **Typographical Error**
  - Seen by examination of primary data
- **Double Counting**
  - Introduced 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

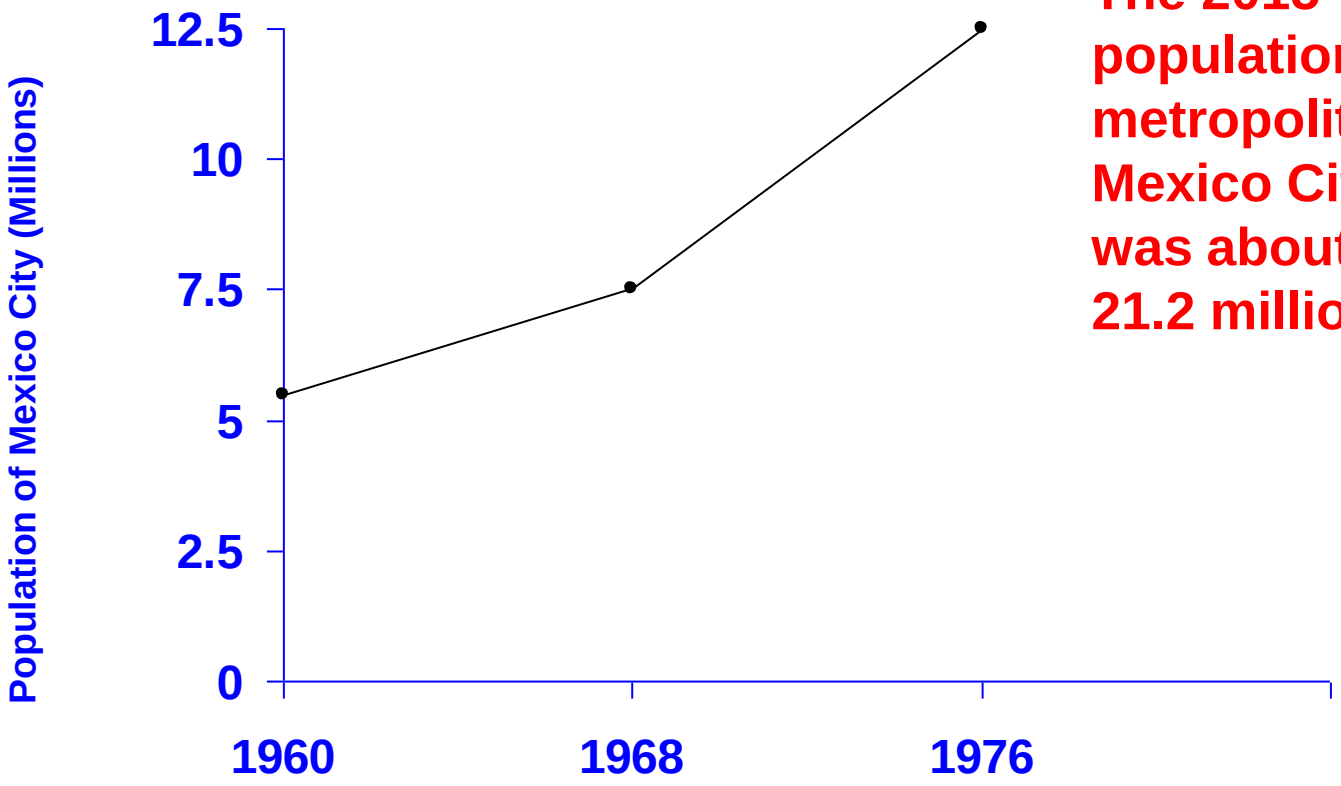
Passengers Through AICM (Corrected Version)



Mexico City
Causes of Trends

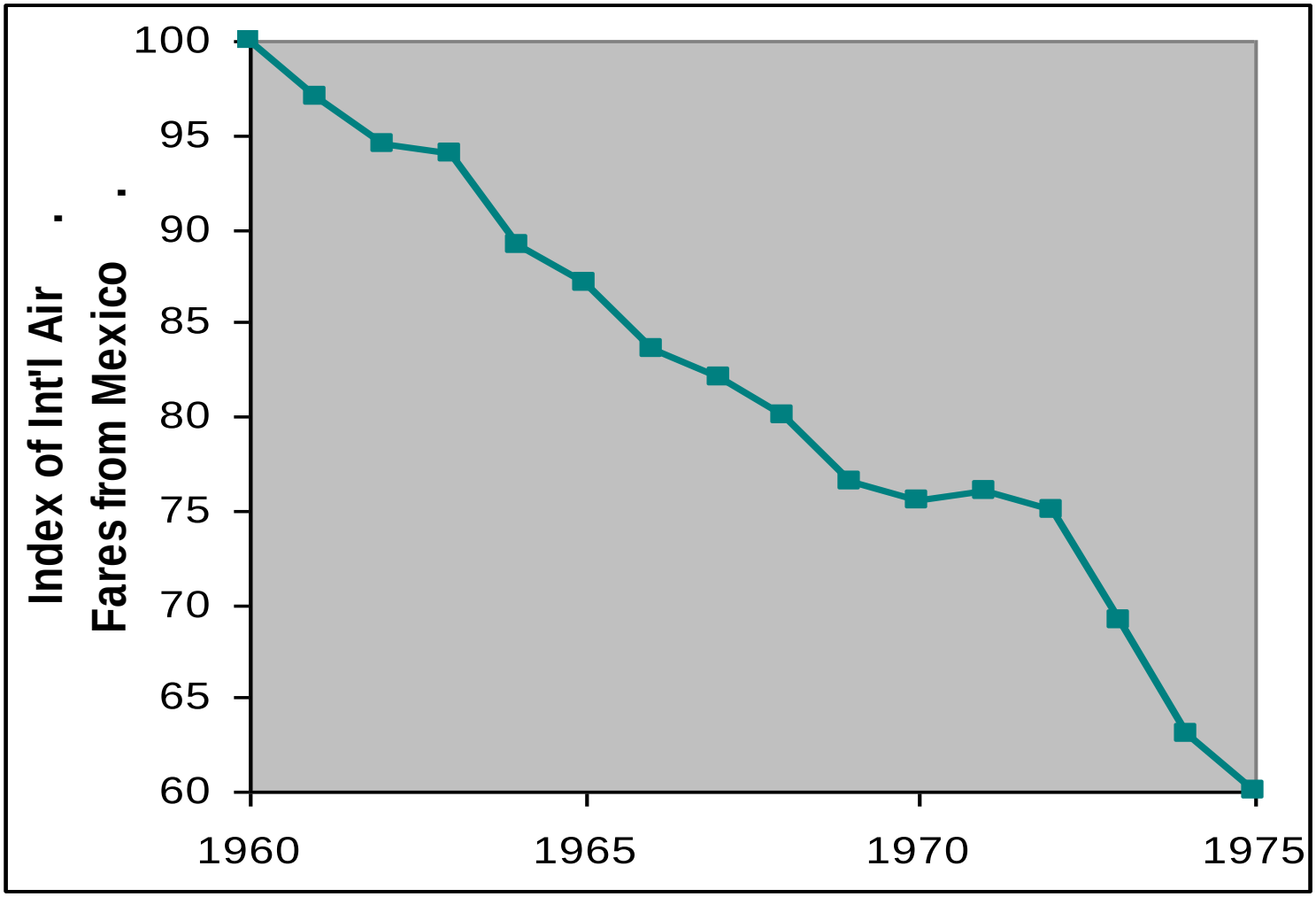
- **Economic Boom**
  Post 1973 oil prosperity
- **Recessions Elsewhere**
  Affecting international traffic
- **Population Growth**
- **Fare Cuts**
  Relative to other commodities

Population Increase of Mexico City's Metro Area



The 2015 population of metropolitan Mexico City was about 21.2 million!

Trend of International Air Fares (at Constant Prices)

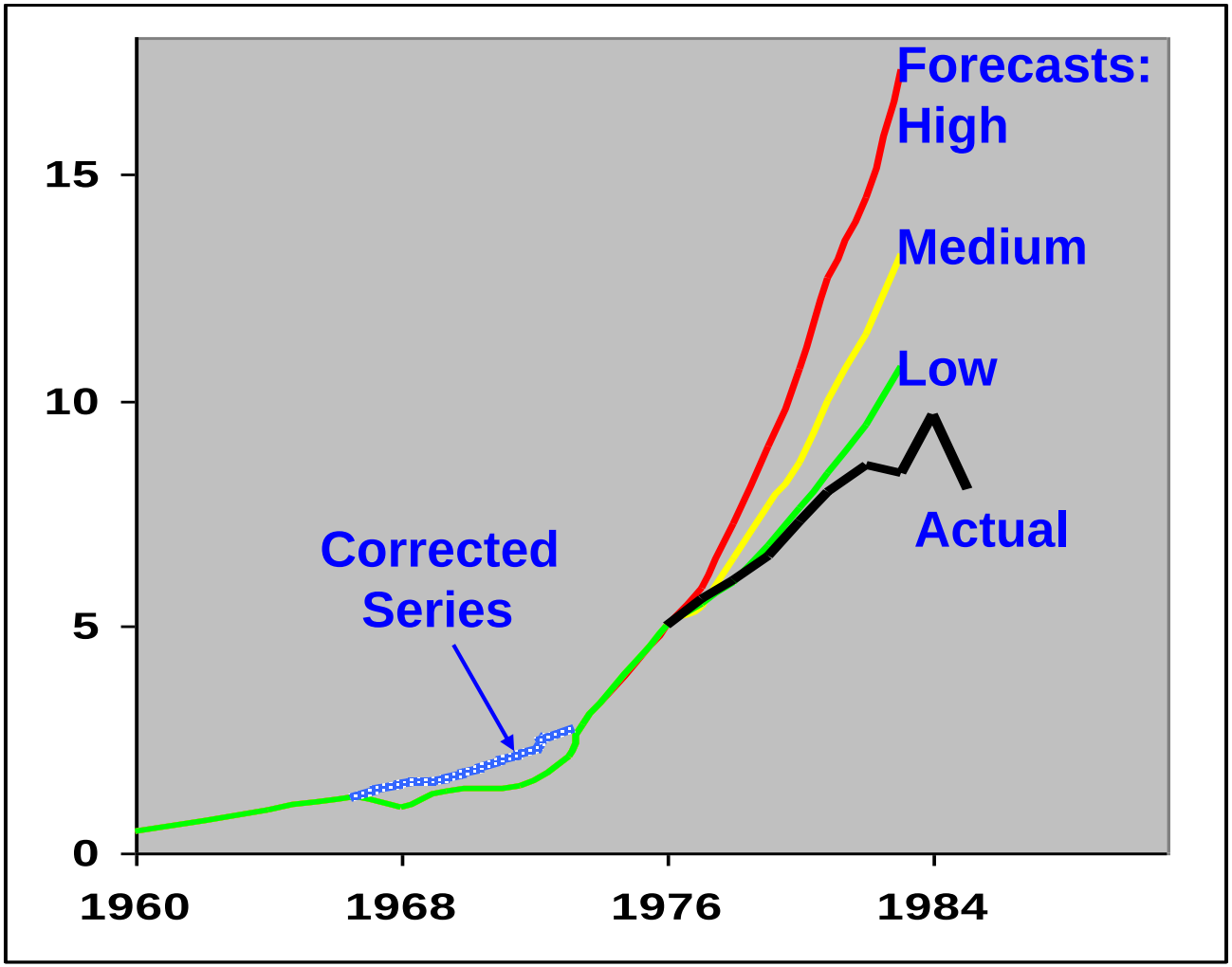


Mexico City -- Note

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

Short-Range Forecasts, National Passengers, AICM

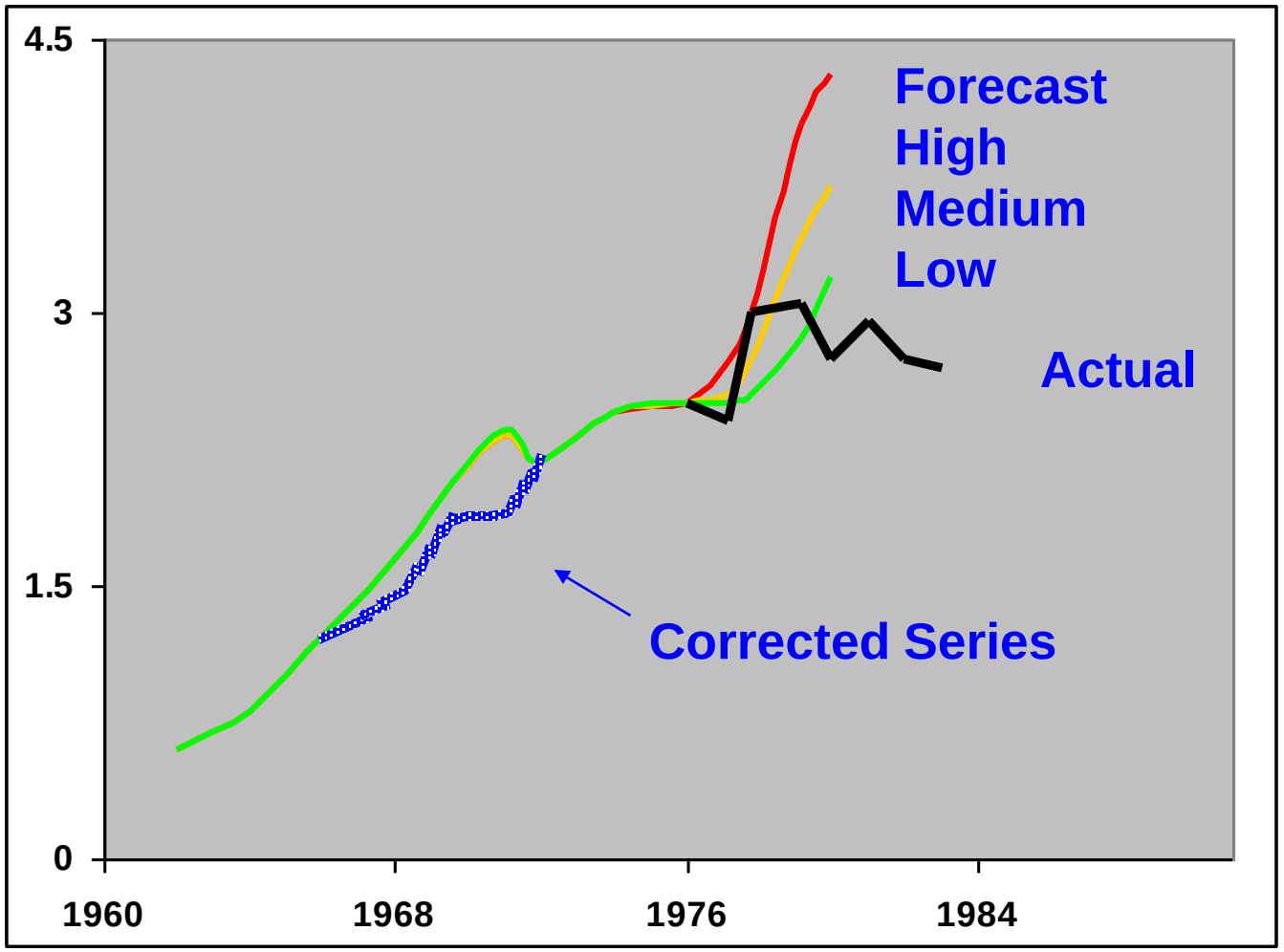
Forecast National Passengers for Mexico City (millions)



Actual 2010 Was 15.6

Short-Range Forecasts, International Pax. AICM

Forecast International Passengers for Mexico City (millions)



Actual 2010 was 8.5

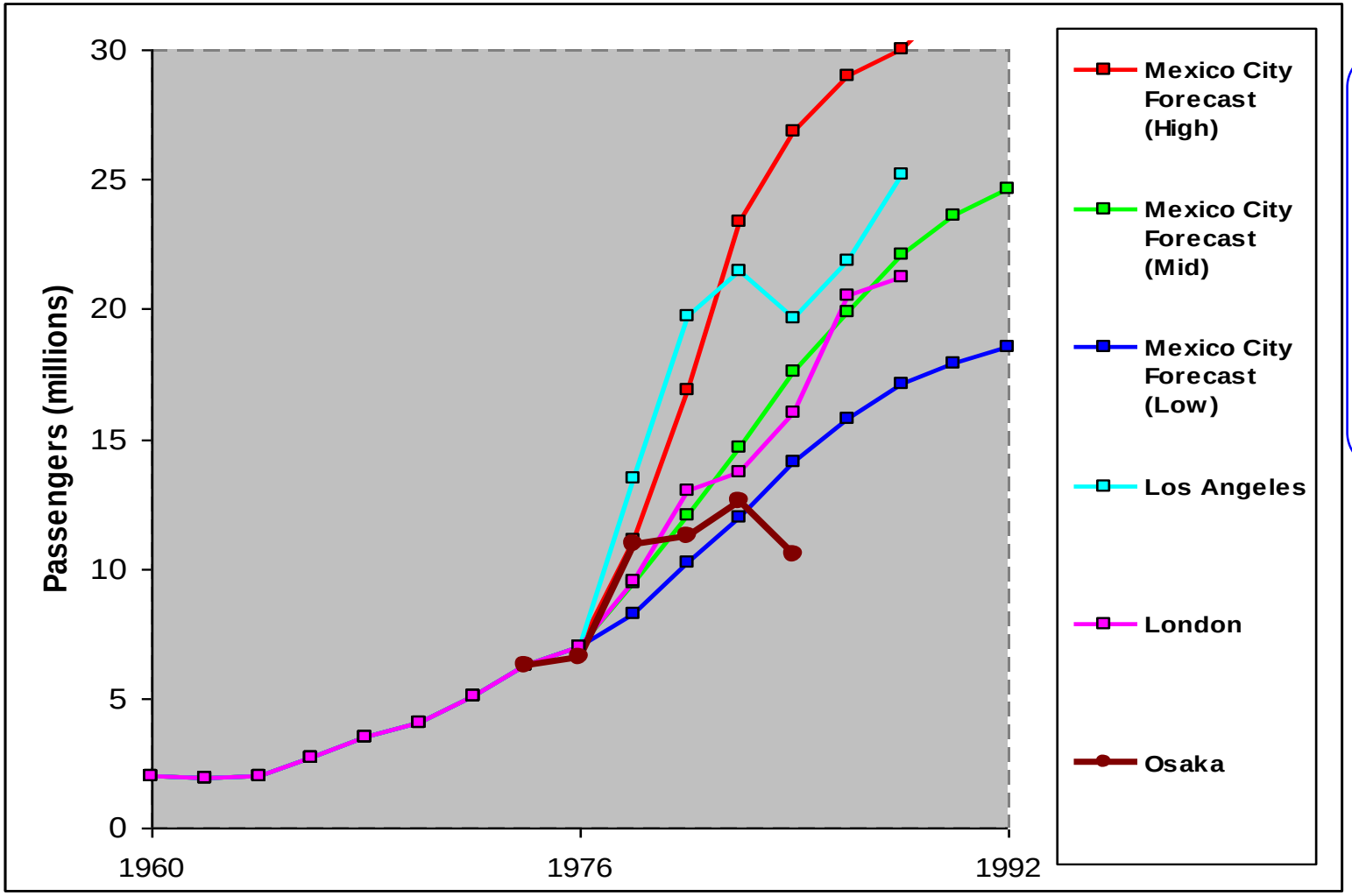
Mexico City -- Elements of Long-range Scenarios

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

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**

Long Term AICM Forecasts, validated by data elsewhere



Actual 2010 24.1 M

and 38.4 M in 2015

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**