

The Forecasting Challenge

Practical Uses and Limitations

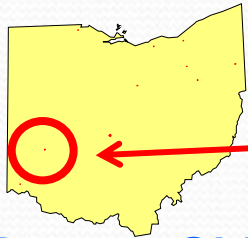
Lt Col Brad Anderson, Ph.D.
Air Force Institute of Technology
(AFIT)

Who am I?

- USAF 18 years
- Career supply officer (environmental compliance)
- Deployments...almost
- Professor 6 years
 - Faculty President
 - Division Chief
 - Energy Security research focus
 - Expert marksman M-4 rifle and M-5 pistol



Air Force Institute of Technology

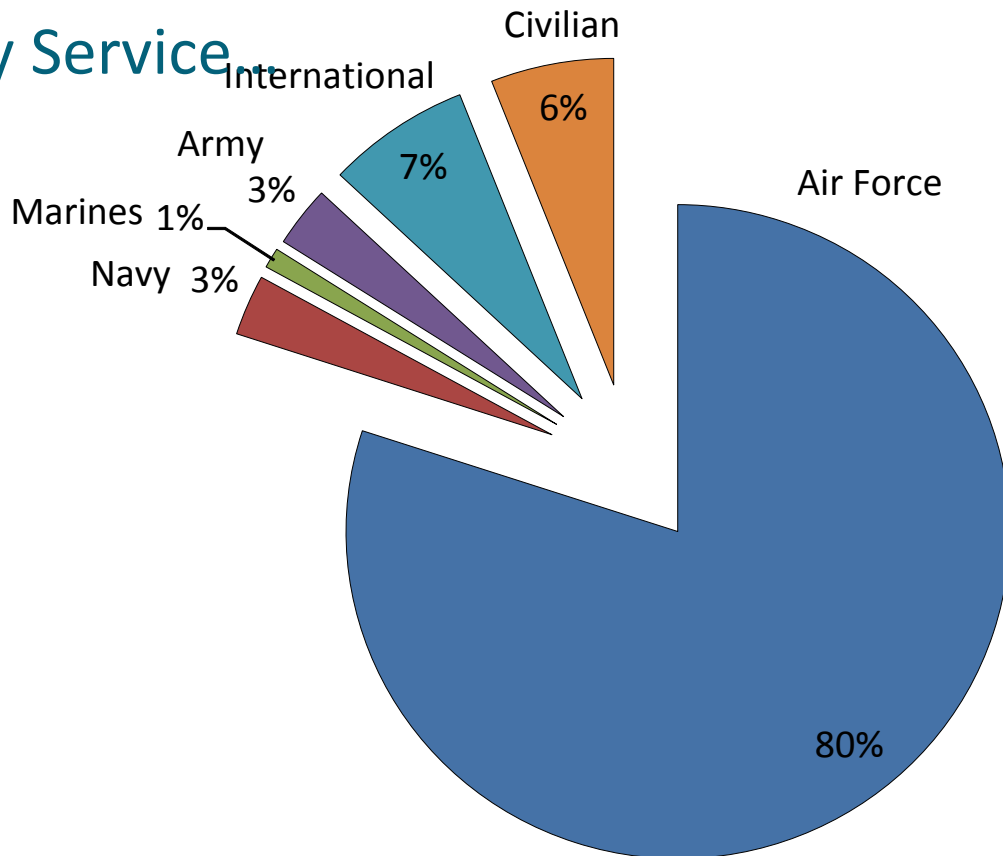


Dayton, Ohio



Our Vision: A *premier team* providing *universally respected* engineering and management graduate education to *sustain the technological supremacy* of America's Air and Space Forces

by Service



Fall 08
Enrollment:
MS: 566
PhD: 117
Total: 683

What We Do ...

- Mine Data for Patterns
- Improve Supply Chains
- Develop Decision Methods
- Design Experiments
- Schedule Resources
- Simulate System Behavior
- Exploit Social Networks
- Improve System Reliability
- Use Capacity Wisely
- Model War



Who We're Doing It For ...

- Deputy Secretary of Defense
- Joint IED Detection Organization
- US Transportation Command
- US Strategic Command
- US Central Command
- US Special Operations Command
- National Security Agency
- National Air and Space Intelligence Center
- National Reconnaissance Office
- Air Staff
- AF Materiel Command
- Air Mobility Command
- Air Combat Command
- Air Education and Training Command
- AF Operational Test & Evaluation Center
- AF Office of Scientific Research
- Air Force Personnel Center
- Air Force Research Laboratory

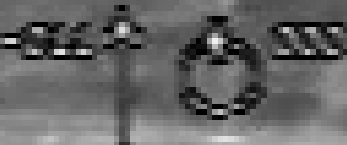
The USAF... A Unique Environment

- High Risk/Stress – life, family, results
- Strong need for innovation, adaptability, flexibility, and swift decisions
- However... achieving them is not so easy
 - Very bureaucratic – accountability to Congress
 - Mistakes not easily forgiven – risk averse
 - Public and professional appearances very important
 - High variability – politically and situationally driven
 - Military – internal promotion only
 - Heavy personnel churn and instability at all levels
 - Tradition
- Strong Family



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Quote

“Those who have knowledge, don’t predict. Those who predict, don’t have knowledge.”

Lao Tzu, 6th Century BC Poet

“Prediction is very difficult, especially if it’s about the future.”

Nils Bohr, Nobel laureate, Physics



When someone says
“Forecasting”, what’s the
first thing you think of?

SATURDAY'S WEATHER

Rain ■ Severe ■ Mix ■ Ice ■ Snow ■



The
Weather
Channel

weather.com

What is Forecasting?

- ...forecasts are required for scheduling, planning, and other future-oriented decisions that need predictions as inputs.
- Do you forecast/use forecasting?

What we mean by . . .

- Forecasting: Prediction, anticipation, expectation of future events or values
- Planning: Selection of alternative action(s) to influence future outcomes
- Judgmental methods: information memorized or used intuitively
- Quantitative methods: information recorded externally and/or analyzed systematically

Nostradamis

Quatrain - a poem with 4 lines.

- Beasts ferocious from hunger will swim across rivers:
The greater part of the region will be against the Hister,
The great one will cause it to be dragged in an iron cage,
When the German child will observe nothing.
- So does Hister actually refer to Hitler? An instance of Nostradamus changing letters around? Is this a reference to Germany during WWII?



Born in the early 16th century

Isaac Asimov

- Foundation Series
- The main character, Hari Seldon, a mathematician, has developed psychohistory which equates all possibilities in large societies to mathematics, allowing predictable long term outcomes.



1920-1992

Forecasting versus Prophecy

- Forecasting is not Prophecy
 - Forecasts are extrapolations or interpolations
 - For forecasts to be accurate:
 - No major changes must occur, or
 - Changes must cancel themselves out
- No method can accurately forecast the extent of future **uncertainty** when “history does not repeat itself”

Self-Fulfilling Prophecies

- Stocks
- Conflict
- Attitude/Outlook

Who Forecasts and What Can We Forecast?

- Weather?
- Energy Needs?
- Strategy/tactics?

- Short, Medium, Long-term?

- Who is “the forecaster” at your organization?

What About These?

- 911?
- Obama?
- Sunami?
- Market Crash?
- Conflicts?
- Global Warming?

Common Techniques – Which One?

- Decomposition
- Smoothing
 - Moving Averages
 - Linear extrapolation – regression
 - Trends – Holt/Holt-Winters
- Complex Models
 - Multiple Regression – (causal)
 - ARIMA
 - Neural Networks
- Expert Opinion(s)

How Do Companies Deal with Uncertainty?

- Many don't – many fail
- Identify and manage it!
 - Update strategy to meet current market
 - Supply chain resilience/Options (suppliers, distribution, demand, etc...)
 - Analysis – forecasting (one tool)

Example

- AEP – American Electric and Power
 - 24/7 Operations
 - Need precise forecasts! – complicated software
 - Hedge energy market
 - Training simulators
 - Contingency plans (epidemic)
 - Redundancies (backup office)
 - Alternative plants
- Fragile network – must comply with added oversight and security due to major blackout

How Does The U.S. Maintain National Security In Such An Uncertain World?

- Manage it! –Diplomacy, Economic Sanctions/Aid, Good Will/Humanitarian, Show of Force
- Strategic Alliances
- Scenario Building
- Contingency Plans
- Buffers
- Training
- Exercises
- Analysis (for much of the above) – Forecasting is one tool

DoD Examples

- Desert Storm - F-117 parts
- Afghanistan – Pakistan bottleneck/limitation
- People/manpower
- Weapon system development/obsolescence
- Energy Security

Weapon System Development/Obsolescence

- Planning for an uncertain mission/future
- Funding constraints
- Political agendas – senate arms committee
- R&D cycle
- Lack of adequate Forecasting
- Result – Outdated fleet
- Average aircraft age about 24 years
- Recent Forecasting and analysis – Gap Identification
- Identified need for phased update plan to match anticipated needs

The Energy/Fuel Problem

- International and domestic operations come at a price!
- USAF large consumer of fuel – \$5 billion annually
 - Flying very costly – highly variable price/cost
 - Dependent on foreign oil (U.S. imports 60%), so we are under their control
 - Predatory pricing – \$60-70 per barrel target, (what it would cost us to make synfuel)
 - Hubbard's Peak – reserves hidden?
- Energy security solution - reduce foreign reliance
 - Reduce consumption
 - Alternative fuels/energy
 - Technology – better alternatives

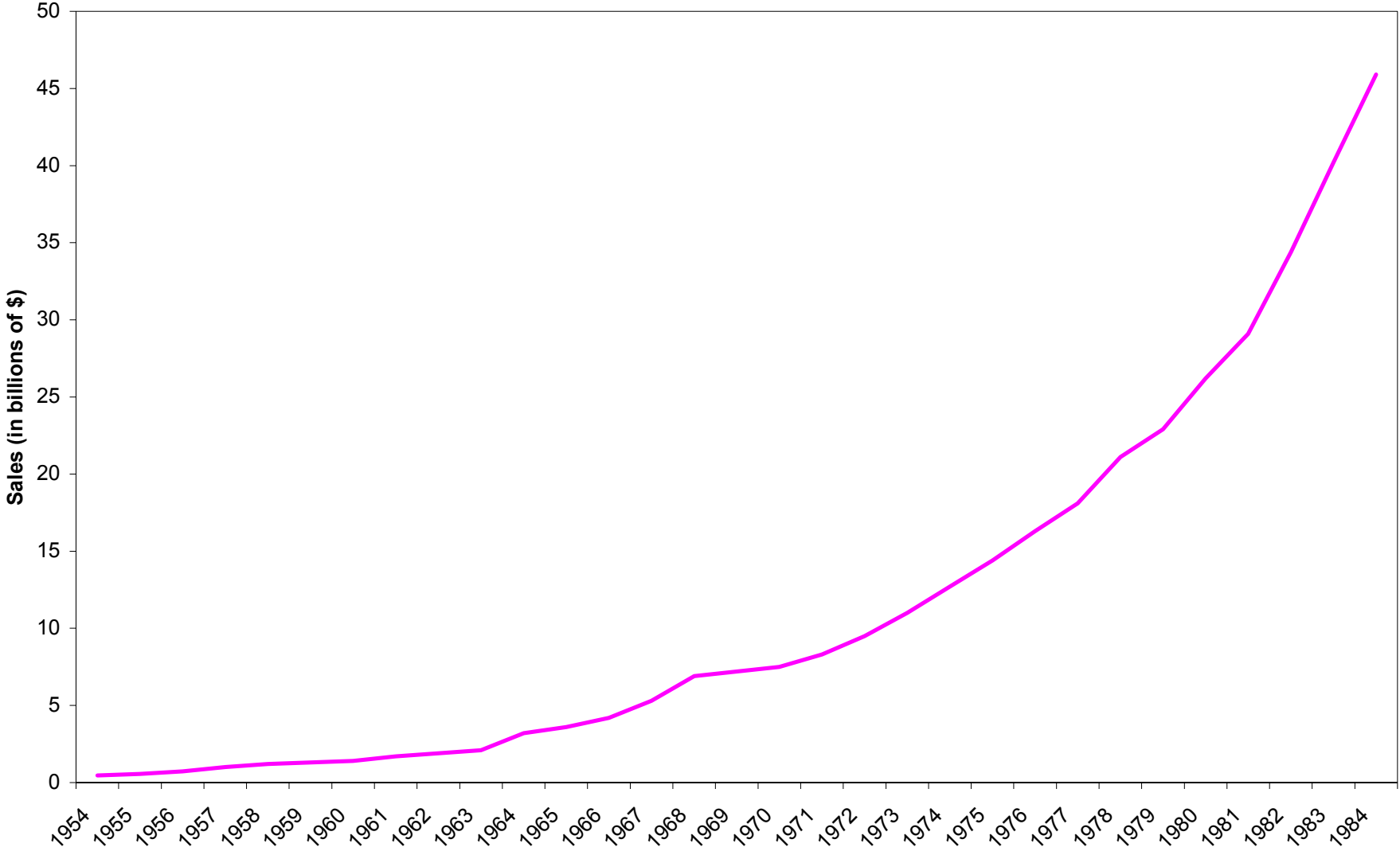
Forecasting Importance

- Good forecasting important to planning!
 - Helps manage/identify uncertainty
 - Can help identify strategic and tactical gaps
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- KISS (simple methods often work well)
 - Match method to need/audience

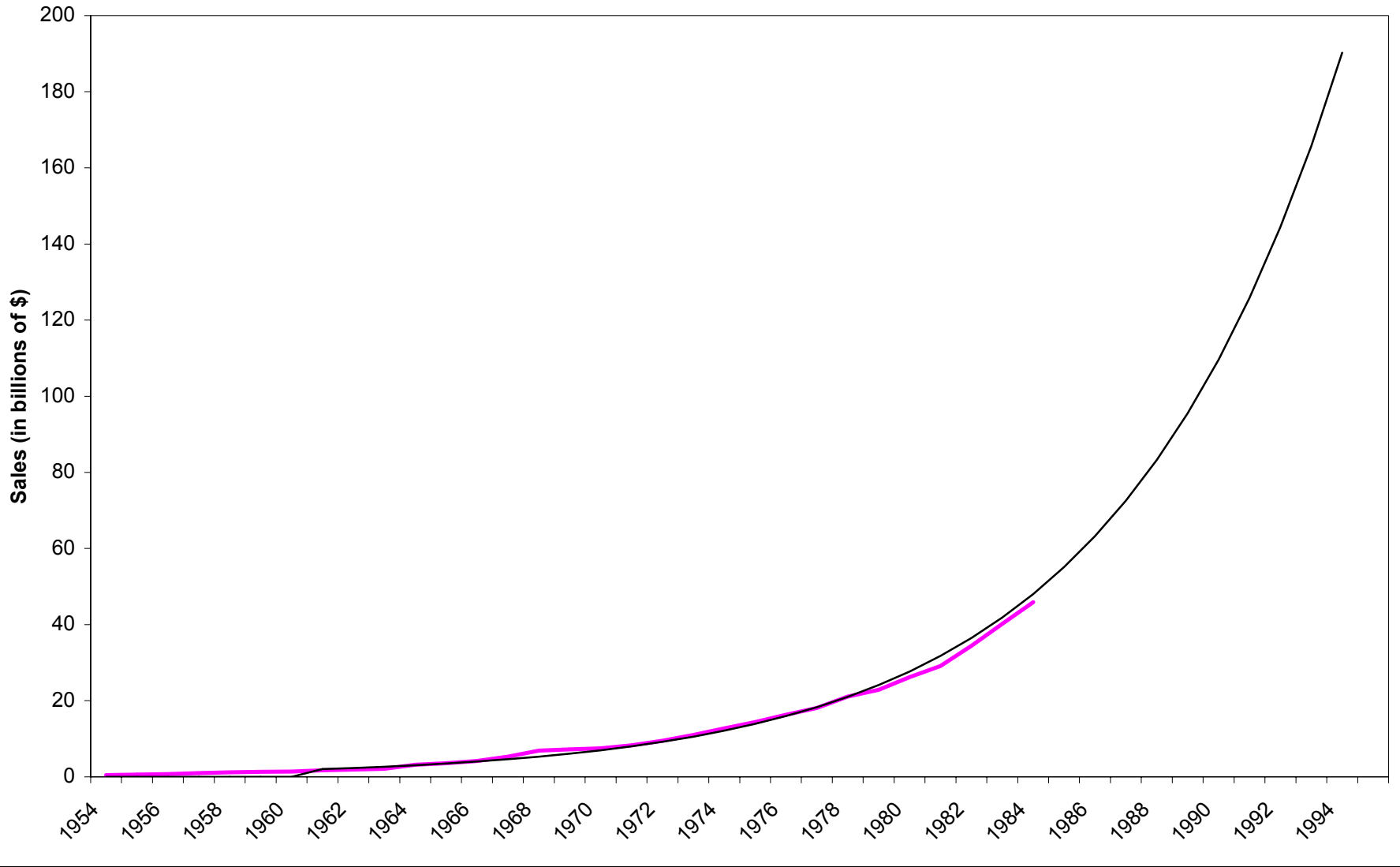
Forecasting Challenges

- Quantitative: Data
 - Subjective: Bias
 - Life - “Unexpected Events”
 - Uncertainty
 - Model overfitting
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- Experience and understanding of the situation is most important!!!

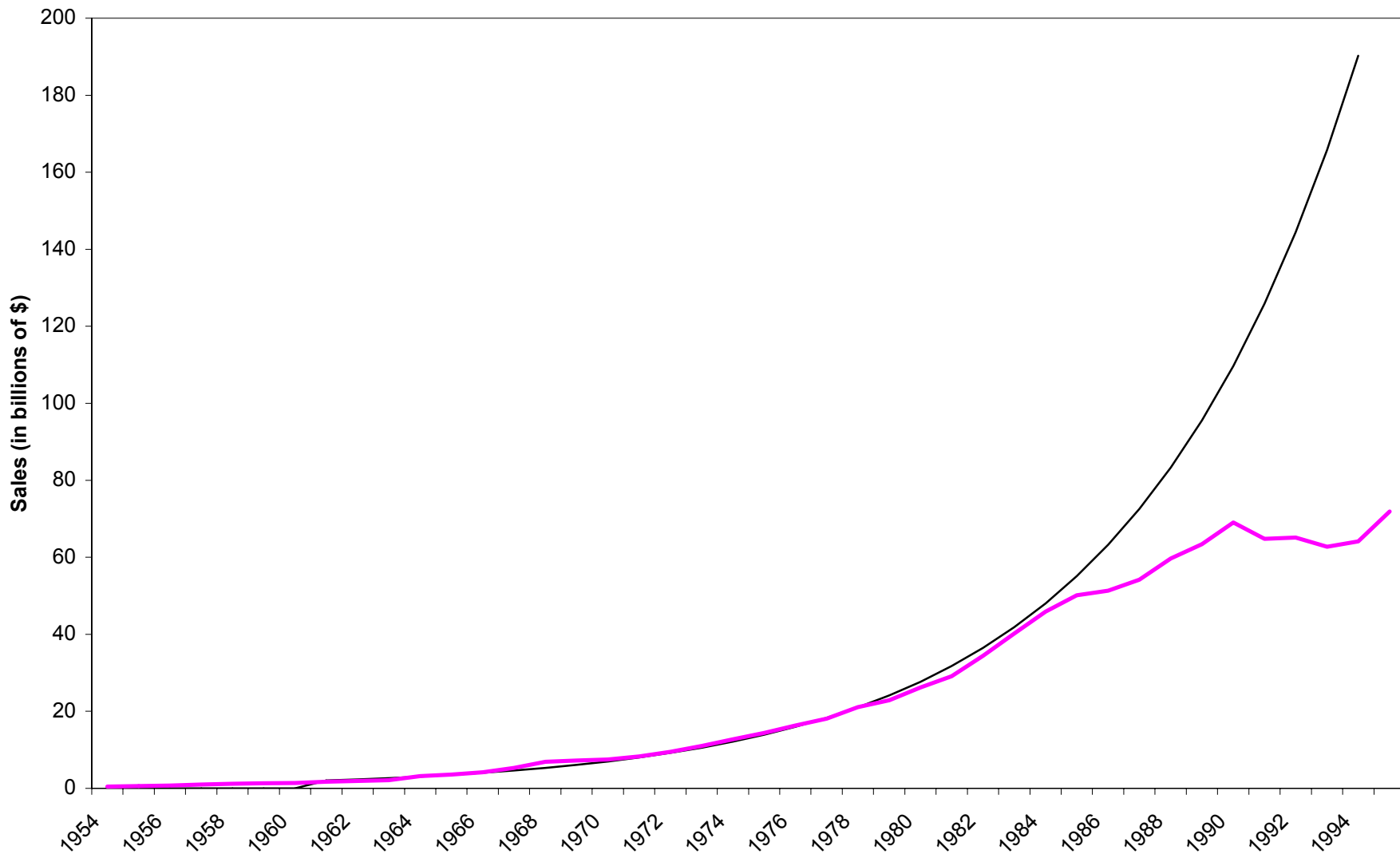
IBM Actual Sales: 1954-1984



IBM Sales and 1984 Forecast



IBM Actual Sales and 1984 Forecast



Quote

- “A good forecaster is not smarter than everyone else, he merely has his ignorance better organised.”
 - Anonymous
- “He who lives by the crystal ball soon learns to eat ground glass.”
 - Edgar R. Fiedler in *The Three R's of Economic Forecasting--Irrational, Irrelevant, and Irreverent*

