Problems in Air Traffic Flow Management

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Assignment #1
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Airlines and the FAA collectively manage the flow of aircraft around the US

• **Objective:**
  – Strategic and tactical routing of aircraft
  – Minimize the “cost”: fuel, labor, risk, lost goodwill of customers
  – Analyze the entire system as a whole

• **Tools:**
  – Mathematics
  – Optimal Algorithms
    • X “is the provably best way to” do something

• **Examples:**
  – Creating an airline schedule
  – Rerouting aircraft during periods of inclement weather
Some types of problems are difficult to solve

• Problems are too large and, therefore, cannot be solved by optimal algorithms
• Some aspects of the problem cannot be modeled mathematically
  – For example, how do you define equity?
  – Experience counts when it comes to modeling qualitative factors in a quantitative manner

• There is a tradeoff between how much of a problem is considered mathematically and how easy the math is to solve
Evaluating a model

• Analytical models always make some type of assumption
  – Data requirements
  – Practicality
  – Risk/Uncertainty
  – Static/Dynamics
  – Decision Makers

• A good model
  – Minimizes major assumptions
  – Is conceptually sound/similar to the system
  – Can be used to predict future behavior
  – Can be solved in hours/days
More “traditional” approaches often conflict with optimization

• In practice, the industry (FAA, airlines) approach the problem differently
  – Decisions are made based upon “feel”, intuition, or policy
  – Problems are often highly stochastic *and* qualitative
  – Decision are made on the fly by separate actors
  – “Optimization” work occurs only in isolated departments

• In making decisions
  – Experiential learning is key
  – Difficult problems are those for which there is no prior experience
The traditional approach values solutions differently, as well

• A good solution
  – Follows procedure, allowing separate actors to make cohesive decisions
  – Avoids crisis points and disasters
  – Is economically efficient

• The disparity between the academic and practical approaches poses an additional challenge to research!