Secure Flights?
Models and Observations

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Four Years After 9/11, Airline Security Is Still Debated

- Many new aviation security policies implemented since September 11
  - Aviation and Transportation Security Act (ATSA), 2001
  - Homeland Security Act, 2002
- Some worry efforts are haphazard and “reactive”
- Airlines find efforts costly

Analytical Methods Can Contribute to the Debate

- We examine a few prominent issues
  - Priority placed on aviation security
  - Performance of passenger pre-screening systems
  - Efficient allocation of security employees to airport checkpoints

Are We Fighting The "Last War"?

- "With the amount of security that we have... the likelihood of a terrorist choosing aviation as the venue for future attack is very low." – Donald Carty
- Yet, terrorists seem fascinated by aviation:
  - "A promising means to inflict massive casualties"

    Mohammed Atef, mid-1990's
  - "[A] single lapse in aviation security can result in hundreds of deaths, destroy equipment worth hundreds of millions of dollars, and have immeasurable negative impacts on the economy and the public's confidence in air travel."

    Gerald Dillingham, 2000

Perhaps 9/11 Was a Continuation of a Pattern of Aviation Terrorism?

- 1968-2001 (pre-9/11), worldwide:
  - 179 fatal terrorist attacks killed 740 American civilians
  - Aviation attacks accounted for 39.7% of the deaths
  - People spend only 0.1% of their time in aviation activities

Over 600 times more likely to be a victim of aviation terrorism per hour than of *all* other forms of terrorism

Aviation terrorism has been a concern both **before and after 9/11**.

But we need to examine how aviation security resources are allocated.

How Effective Might Passenger Profiling Systems Be?

Strongly Opposing Viewpoints Exist About Pre-Screening Systems

- *Supporters*: "Right Answer" to security (Carty)
  - Focus security resources only on dangerous passengers
  - Deter terrorists from attempting an attack
  - Profiling: "foundation" of aviation security (Sec. Mineta)
- *Critics*: Induce loopholes that can help terrorists
  - Chakrabarti & Strauss, *Carnival Booth: An Algorithm for Defeating the Computer-Assisted Passenger Screening System*
  - Terrorists can always find "low-risk" member to use

Both Arguments May Be Shortsighted: Optimists

- Optimists focus on identifying terrorists
  - The profiling system will identify most terrorists
  - Once flagged, additional screening will stop them
  - Knowing this, the terrorists will be deterred
- BUT they ignore screening effectiveness:
  - How good is additional screening?
    - 9/11: Plot not detectable by secondary screening
    - 2004 DHS inspection: Screening is "poor" in general. Explosives screening is "absolutely horrendous"
  - If profiling imperfect, can't ignore primary screening
  - Profiling irrelevant if secondary no better than primary

Both Arguments May Be Shortsighted: Pessimists

- Critics focus on loopholes and assume *C* is low:
  - Can *always* find "low-risk" member by duping or probing
    - Profiling adds ***no*** benefit over random selection
- BUT ignore possible deterrence effects of probing
  - If the information gained through probing is *discouraging*, the terrorist's chance of success might *decrease*.

Decisions on Passenger Screening Must Be Multi-Dimensional

- Judgments on profiling must consider:
  - The profiling algorithm itself
  - The quality of the screening
  - Terrorist behavior (loopholes, deterrence, ...)

Dynamic Server Allocation

At SFO Officials Manage Queues by Video

- Cameras focus on queues at security checkpoints
- TSA employees check for breaches, but also examine queue operations
- If the line at Checkpoint B gets “too long”, can switch screeners from Checkpoint A to Checkpoint B
- What is “too long”? Depends on:
  - Current queue lengths
  - Expected passenger arrival rates based on flight schedules
  - Experience

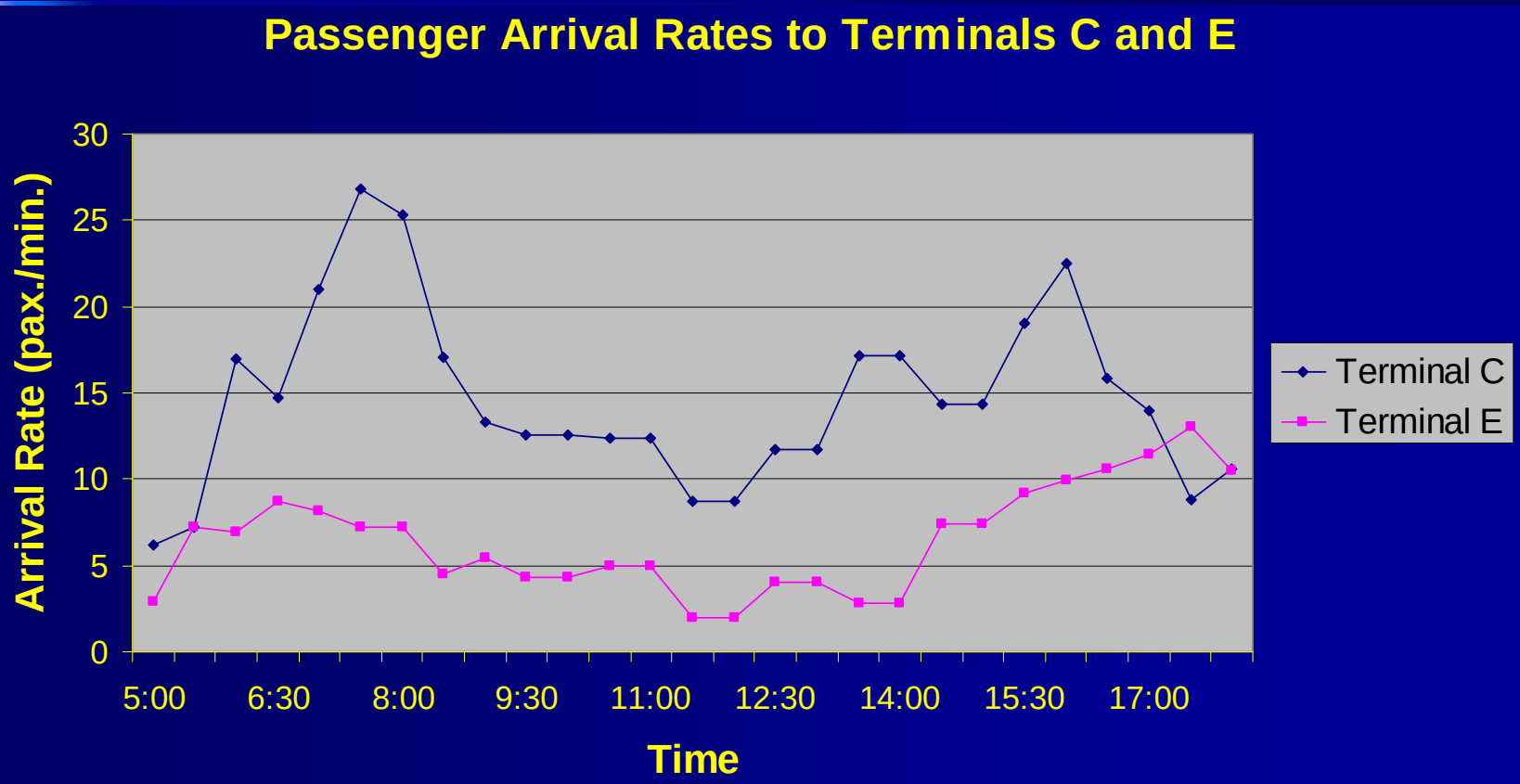
Could An Optimization Heuristic Help?

- Consider a fixed pool of *N* servers, divided between two parallel checkpoints
- Every few minutes, a decision is made to switch servers from Checkpoint A to Checkpoint B, from B to A, or not to switch
  - If a switch occurs, servers are unavailable for some time
- What should the decision be, as a function of system state, to minimize average wait?

Data Provided by Logan Airport

- Hourly/Half-hourly, by security checkpoint
  - Throughput, estimated wait and number of lanes open
- We examine Terminals C and E
- On January 18, 2005, 10 lanes were open between the two terminals, on average (N=10)

The Ratio of Arrival Rates Varies, Indicating Switching Might Be Helpful



We tested this hypothesis using several methods

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  - Anticipation of arrival rate changes

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- Sometimes optimal to switch servers from a non-empty queue to an empty queue
- Even under large imbalances with one queue empty, might not switch
- Number of servers switched might *increase* if switching times are large
  - Longer queues might form during extra lag time

In an Airport Setting, Dynamic Allocation May Not Be Necessary

- Using a pre-determined (time-varying) schedule is often sufficient
- Under high variability, dynamic staffing flexibility could be beneficial
  - Simple rules of thumb not helpful
  - More elaborate methods are needed

Concluding Remarks

Despite Limitations, Quantitative Analysis Can Guide Aviation Security Policy

- Key obstacle: lack of information
- Yet these models are useful tools:
  - Guide decisions assuming ranges of parameters
  - Explore sensitivity of decisions to changes in these values
  - Identify which components are most crucial to a policy's success
  - Help clarify qualitative reasoning and point out weak assumptions