Airline Fleet Planning Models

16.75J/1.234J Airline Management

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Lecture Outline

- **Fleet Planning as part of Strategic Planning Process**
  - **Airline Evaluation Process**
- **Approaches to Fleet Planning**
  - **“Top-down” Capacity Gap Analysis**
  - **“Bottom-up” Detailed Analysis**
- **Airline selection criteria for aircraft acquisition**
  - **Technical/performance characteristics**
  - **Economic and financial impacts**
  - **Environmental regulations and constraints**
  - **Marketing considerations**
  - **Political realities**

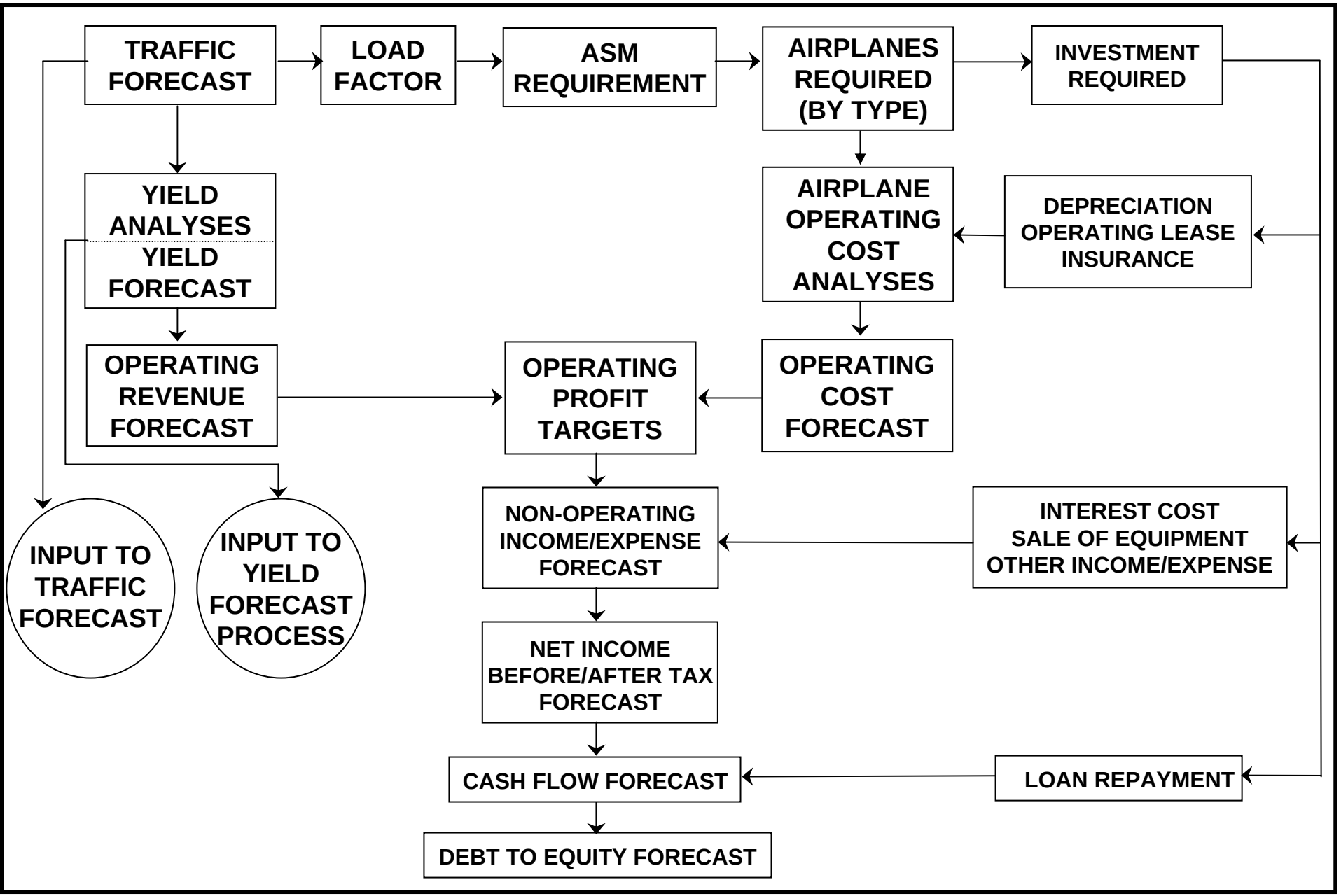
Airline Fleet Composition

- **Fleet composition is critical long-term strategic decision for an airline.**
  - **Fleet is the total number of aircraft that an airline operates, as well as the specific aircraft types that comprise the total fleet.**
  - **Each aircraft type has different technical performance characteristics e.g. capacity to carry payload over a maximum flight distance, or "range."**
  - **Affects financial position, operating costs, and especially the ability to serve specific routes.**
- **Huge capital investment with a long-term horizon:**
  - **US $40-60 million for narrow-body 150-seat airplane**
  - **$180+ million for wide-body long-range 747-400**
  - **Depreciation impacts on balance sheet last 10-15 years**
  - **Some aircraft have been operated economically for 30+ years**

Fleet Planning Process

- **Fleet planning requires an evaluation process for assessing the impacts of new aircraft (see next slide):**
  - **Traffic and yield forecasts used to estimate revenues**
  - **Planning ALF determines ASMs and number of aircraft required**
  - **Aircraft acquisition has financial impacts in terms of investment funding, depreciation, and interest expenses**
  - **Operating cost and revenue forecasts provide profit projections**
  - **Used to predict effects on balance sheet, cash flow, and debt load**
- **This planning process is ideally an ongoing effort that requires input from many sources within the airline:**
  - **A critical component of a long-term strategic planning process**

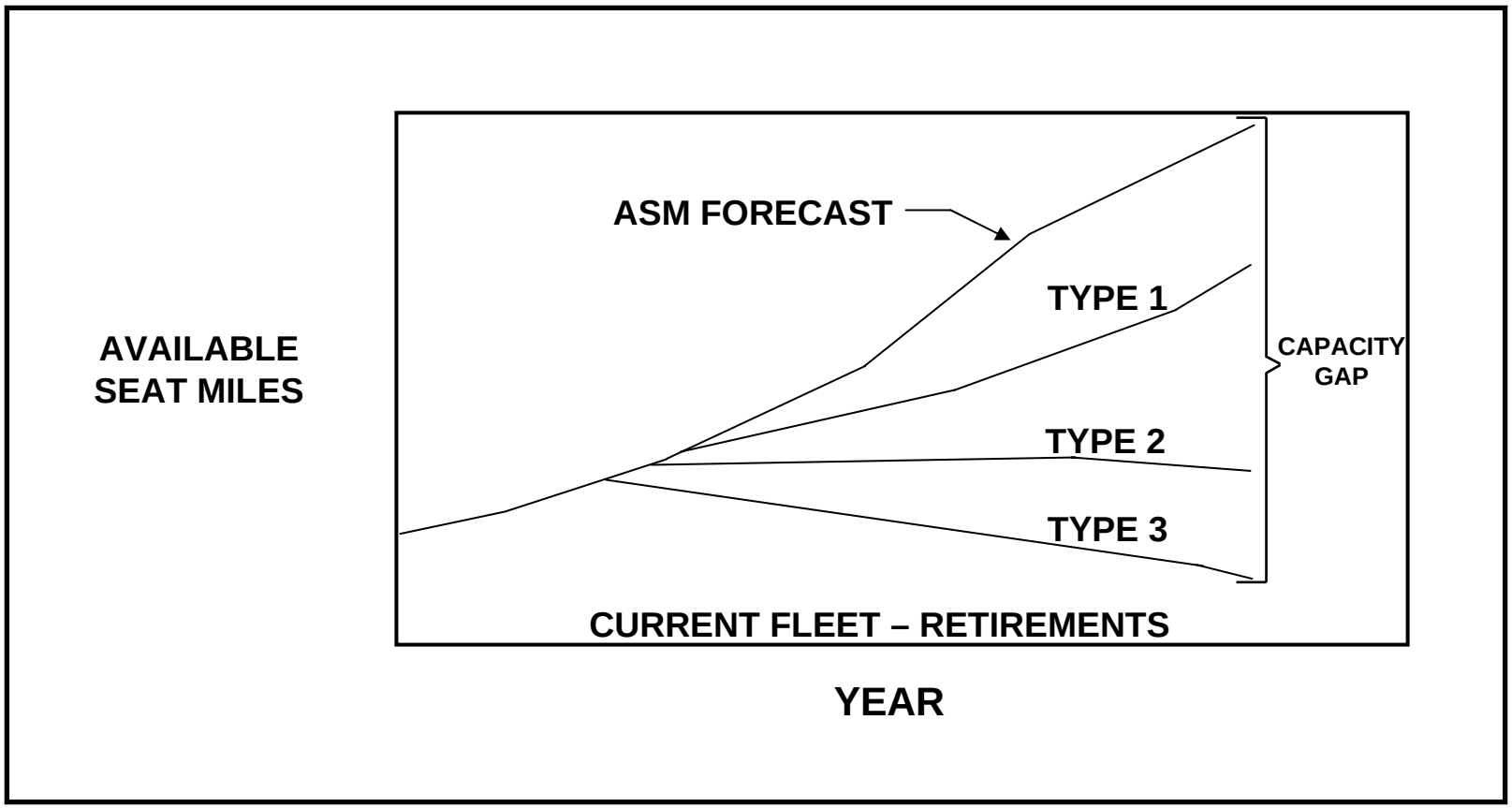
Airline Fleet Planning Evaluation Process



"Top-Down" (Macro) Approach

- **Aggregate demand and cost spreadsheets used to evaluate financial impacts of aircraft options for a defined sub-system, region, or route:**
  - **"Planning Load Factor" establishes ASMs needed to accommodate forecast RPM growth (e.g., 70% planned ALF)**
  - **"Capacity Gap" defined as required future ASMs minus existing ASMs and planned retirements**
  - **Assumptions about average aircraft stage length and daily utilization determine "aircraft productivity" in ASMs per day, used to calculate number of aircraft required**
  - **Estimates of aircraft operating costs can then be used to compare economic performance of different aircraft types**

Capacity Gap Analysis



"Bottom-Up" (Micro) Approach

- **Much more detailed evaluation of routes and aircraft requirements allows "what-if" analysis, but requires detailed future scenarios:**
  - **Future route networks and schedules must be generated, and airline's share of total market demand is assumed**
  - **Forecasts of demand and revenues by origin-destination market are then allocated to each future flight**
- **With more detailed inputs, bottom-up approach provides much more detailed outputs:**
  - **Aircraft assignments and operating statistics by route**
  - **Complete projection of financial results under different fleet plans**

Top-down vs. Bottom-up Fleet Planning

- **Top-down approach allows for rapid evaluation of new aircraft types, given high-level assumptions about:**
  - **Changes in traffic forecasts and/or operating costs (e.g., fuel price)**
  - **Airline structural changes (e.g., average stage length of flights)**
- **Bottom-up approach provides substantially more detail:**
  - **Changes to individual route characteristics can be evaluated**
  - **But, very difficult to incorporate future competitors' strategies**
- **Simpler top-down approach is commonly used, since detailed 10-15 year scenarios are highly speculative:**
  - **Likely to be inaccurate in face of changing market conditions**
  - **Political decisions can overrule "best" analysis of options**

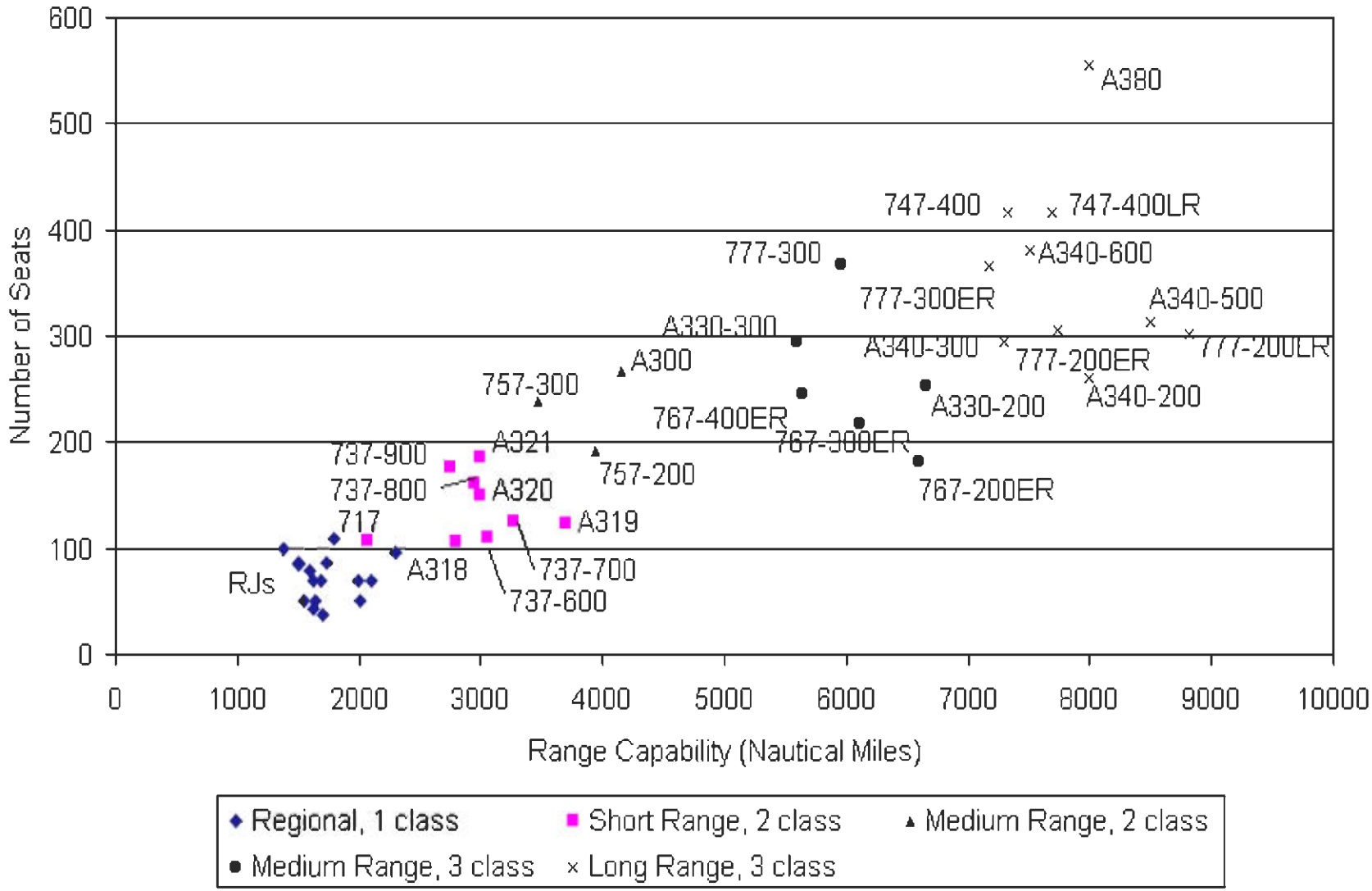
Financial Evaluation of Aircraft Alternatives

- **Comparisons of aircraft economic performance based heavily on DOC (cash flow) analysis**
  - **Profit/loss approach includes aircraft depreciation**
  - **Averages training, financing, maintenance costs over aircraft life**
- **Net Present Value (NPV) analysis can be used to incorporate time value of money**
  - **Depends on discount rate assumptions: Tendency is to assume too low for government-supported airlines; assume too high by private airlines trying to compensate for anticipated industry volatility**
- **Cash flow NPV models combined with Monte Carlo simulation of uncertain variables**
  - **Probability distributions of fuel prices, exchange rates, traffic growth and yield assumptions**
  - **Result is a range of possible outcomes and expected value NPV**

Aircraft Categories

- **Commercial aircraft are most commonly defined by their range and size:**
  - **The "range" is the maximum distance that it can fly without stopping for additional fuel, while still carrying a reasonable payload of passengers and/or cargo.**
  - **The "size" of an aircraft can be represented by measures such as its weight, its seating or cargo capacity, as indicators of the amount of payload that it can carry.**
- **Broad categories such as "small, short-haul" or "large, long-haul" aircraft can include several different aircraft types by different manufacturers.**
  - **Aircraft with similar capabilities are regarded as "competitors" in the airline's fleet planning decisions.**
  - **For example, the Airbus A320 and Boeing 737-800 are competing aircraft types, as they are both new generation aircraft with approximately 150 seats with similar range capabilities.**

Figure 2.3: Market Categories



Aircraft Categories - Trends

- **Historically, largest aircraft were designed for routes with the longest flight distances.**
  - **Relationship between aircraft size and range was almost linear.**
  - **Airlines wishing to serve a very long-haul non-stop route had to acquire the Boeing 747.**
- **Airlines now have a much wider choice of products by range and capacity in each category:**
  - **Range of new aircraft in the "small" category (100-150 seats) has increased dramatically.**
  - **US transcontinental routes are now being flown with Boeing 737 and Airbus 320 series aircraft.**
  - **Sizes of new "long-range" aircraft have decreased substantially.**
  - **Airlines even now serve certain low-demand long-haul non-stop international routes with Boeing 757 (180 seats) e.g., Newark to Lisbon, and Los Angeles to Maui.**

Aircraft Selection Criteria

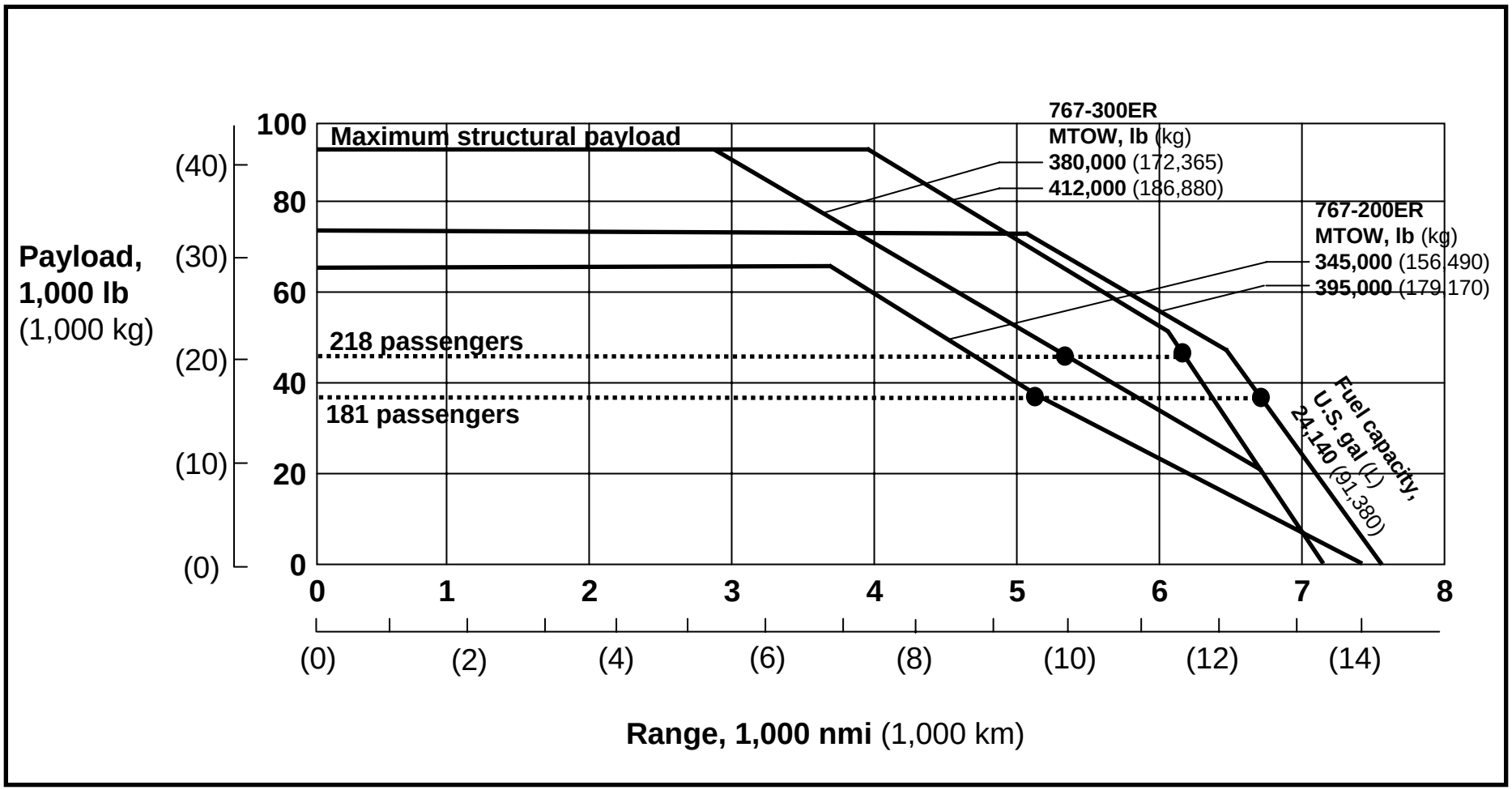
- **Fleet composition is an optimal staging problem:**
  - Number and type of aircraft required
  - Timing of deliveries and retirement of existing fleet
  - Tremendous uncertainty about future market conditions
  - Constrained by existing fleet, ability to dispose of older aircraft, and availability of future delivery slots
- **Aircraft evaluation criteria for airlines include:**
  - Technical and performance characteristics
  - Economics of operations and revenue generation
  - Marketing and environmental issues
  - Political and international trade concerns

Technical/Performance Characteristics

- **"Payload/range curve" is most important (next slide):**
  - **Defines capability of each aircraft type to carry passengers and cargo over a maximum flight distance.**
  - **Affected by aerodynamics, engine technology, fuel capacity and typical passenger/cargo configuration**
  - **Typical shape of curve allows trade-off of payload for extra fuel and flight range, before maximum operational range is reached**
- **Other important technical factors include:**
  - **Maximum take-off and landing weights determine runway length requirements and feasible airports**
  - **Fleet commonality with existing airline fleet reduces costs of training, new equipment and spare parts inventory for new types**

767-200ER/300ER Payload-Range Capability

General Electric Engines



- Three-class interiors
- Typical mission rules
- Passengers at 210 lb (95 kg) (passenger + baggage)

Financial/Economic Issues

- **Required financing from internal or external sources:**
  - **Cash on hand, retained earnings,debt (loans) or equity (stocks) for aircraft purchases**
  - **Leasing rate can be more expensive, but more flexible, allowing for more frequent fleet renewal and requiring less up-front capital**
  - **Typical operating leases 3-7 years long, with or without options to extend, can include sub-leasing rights**
  - **Leases provide flexibility for an airline introducing a new aircraft type, or help with exit strategy for a given type**
- **Financial evaluation to determine costs and revenues:**
  - **Up-front costs include purchase price, spare engines and parts, ground equipment, training**
  - **Newer aircraft offer lower operating costs at higher initial purchase price (vs. older aircraft that have been depreciated)**
  - **Increased revenue potential from larger and/or newer aircraft**

Other Aircraft Selection Criteria

- **Environmental factors:**
  - Noise performance has become a major concern (Stage 3 noise requirements and and airport curfews on louder aircraft)
  - Air pollution regulations likely to ground older aircraft
- **Marketing advantages of newer aircraft:**
  - Typically, most consumers have little aircraft preference
  - However, first airline with newest type or airline with youngest fleet can generate additional market share
- **Political and trade issues can dominate fleet decisions:**
  - Pressure to purchase from a particular manufacturer or country, especially at government-owned national airlines