Objectives

• Overview of primary components of airplane performance analysis to provide:
  – How *airplane* characteristics affect airplane performance
  – How *airport* characteristics impact airplane performance
  – How *study flight rules* impact airplane performance
First steps: three main components of airplane analysis (also called a performance study)

In order for a performance study to be meaningful and useful to an airline, a set of performance ground rules must be developed that will be representative of the airline’s operational standards.
Advanced technology contributes to new airplane efficiencies

Numerous benefits and new design possibilities

- Lower fuel consumption
- Improved reliability
- Better passenger experience
- Weight reduction
- Simpler design—fewer parts
- Faster cruising speed
- Higher residual value
- Greater flexibility
- Easier assembly
- Lower maintenance cost
- Range

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Broad market coverage
The newest, most efficient, long range family

<table>
<thead>
<tr>
<th>SEATS</th>
<th>Current Boeing</th>
<th>Airbus</th>
<th>Future Boeing</th>
</tr>
</thead>
<tbody>
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<td>A380</td>
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<tr>
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<td>777-300ER</td>
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<td>777-9X*</td>
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* Product Development Study

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Family comparison chart example
This is a subhead, usage is optional

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<td>A330-200</td>
<td>300</td>
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Single aisle airplanes

### BOEING
- **737-900ER** 180 seats
- **737-800** 162 seats
- **737-700** 126 seats
- **737-600** 110 seats

### AIRBUS
- **A321-200** 183 seats
- **A320-200** 150 seats
- **A319-200** 126 seats
- **A318** 107 seats

#### Passenger Airplane Deliveries Forecast
- **2012-2031**: 23,240 seats
- **2010-2029**: 17,870 seats

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Airplane Performance

Airplane Characteristics

Airport Analysis

Study Flight Rules
### Mission Performance Summary

#### 737-700W Gross Weight Comparison

**Typical Intl Rules; 2% Fuel Markup**

**Mission Data**

- Enroute Wind Reliability: 85%
- Enroute Wind & Temps Season: Annual

**Airframe:** 737-700W  
**Engine:** CFM56-7B22E  
**Interior:** 126

**Max Taxi Wt:** 155,000 lb  
**Max TO Wt:** 154,500 lb  
**Max Land Wt:** 129,200 lb  
**Max Zero Fuel Wt:** 121,700 lb  
**Op Empty Wt:** 85,090 lb  
**Fuel Capacity:** 6,875 gal  
**Fuel Wt:** 46,063 lb @ 6.7 lb/gal

**Structural Payload:** 36,610 lb  
**Study Payload:** 36,610 lb  
**Passenger Seats:** 126 @ 210 lb ea  
**Pax Bags Payload:** 26,460 lb  
**Rev Cargo:** 10,150 lb

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#### Table: Mission Performance Summary

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<tr>
<th>Track</th>
<th>Rwy</th>
<th>Dist</th>
<th>ESAD</th>
<th>Cruise Altitude</th>
<th>Cruise Delta Temp</th>
<th>Mach</th>
<th>Block Time (h)</th>
<th>Takeoff Weight (lb)</th>
<th>Landing Weight (lb)</th>
<th>Block Fuel (lb)</th>
<th>Reserve Fuel (lb)</th>
<th>PAX</th>
<th>Cargo (lb)</th>
<th>Payload (lb)</th>
<th>Altn</th>
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<td>-70/-68</td>
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<td>3.759</td>
<td>142,453</td>
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<td>TUS 96</td>
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<td>10,149</td>
<td>36,610</td>
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Airplane characteristics

- Configuration
- Gross Weights
- Payload
  - Interior arrangement
  - Engine type and thrust
  - Design weight limit and empty weight
- Thrust Requirements
**Airplane characteristics: 777-200**

**Example for 305 passengers (24 first class, 54 business class, and 227 tourist class)**

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<thead>
<tr>
<th>Weight (lb)</th>
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<tr>
<td>Baseline Manufacturer’s Empty Weight (MEW)</td>
<td>273,500</td>
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<tr>
<td>Configuration specification, D019W005, Rev A (Date, TBD)</td>
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<tr>
<td>305 (24 F/54 B/227 Y) Interior</td>
<td></td>
</tr>
<tr>
<td>Rolls-Royce Trent 884 Engines</td>
<td></td>
</tr>
<tr>
<td>508,000 lb (230,424 kg) Maximum taxi weight</td>
<td></td>
</tr>
<tr>
<td>31,000 USG (117,347 L) Fuel capacity</td>
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</tr>
<tr>
<td><strong>Customer Changes:</strong></td>
<td>1,641</td>
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<tr>
<td>Interior change to 305 passengers (24 FC/54 BC/227 TC) (Ref: LOPS ICX-2776D)</td>
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<tr>
<td>Customer options allowance</td>
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<tr>
<td><strong>Manufacturer’s Empty Weight (MEW)</strong></td>
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<tr>
<td>Standard items allowance</td>
<td>5,765</td>
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<tr>
<td>Unusable fuel</td>
<td>475</td>
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<tr>
<td>Oil</td>
<td>175</td>
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<tr>
<td>Oxygen equipment</td>
<td>91</td>
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<tr>
<td>Miscellaneous equipment</td>
<td>71</td>
</tr>
<tr>
<td>Galley structure and fixed inserts</td>
<td>1,953</td>
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<tr>
<td>Operational items allowance</td>
<td>21,159</td>
</tr>
<tr>
<td>Crew and crew baggage</td>
<td>1,760</td>
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<tr>
<td>Flight crew (2)</td>
<td>340</td>
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<tr>
<td>Cabin crew (8)</td>
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<tr>
<td>Baggage (10)</td>
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<tr>
<td>Pilot briefcases (2)</td>
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<tr>
<td>Catering allowance</td>
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<tr>
<td>First class (24 at 110 lb each)</td>
<td>2,640</td>
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<tr>
<td>Business class (54 at 44 lb each)</td>
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<tr>
<td>Tourist class (227 at 22 lb each)</td>
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<tr>
<td>Passenger service equipment (305)</td>
<td>915</td>
</tr>
<tr>
<td>Potable water, U.S. gallons (218)</td>
<td>1,816</td>
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<tr>
<td>Waste tank disinfectant</td>
<td>150</td>
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<tr>
<td>Emergency equipment (including overwater equipment)</td>
<td>1,968</td>
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<tr>
<td>Cargo system</td>
<td>4,540</td>
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<tr>
<td>Forward 96- x 125-pallets (6)</td>
<td>1,740</td>
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<tr>
<td>Aft LD-3 containers (14)</td>
<td>2,800</td>
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<tr>
<td><strong>Standard and Operational Items</strong></td>
<td>26,924</td>
</tr>
<tr>
<td>Roundoff</td>
<td>35</td>
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<tr>
<td><strong>Operational Empty Weight (OEW)</strong></td>
<td>302,100</td>
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</tbody>
</table>
Airplane characteristics: relative relationships of design weights – typical 777-200 example

MEW: Maximum Empty Weight
OEW: Operational Empty Weight
MZFW: Maximum Zero Fuel Weight
MTOW: Maximum TakeOff Weight
MTW: Maximum Taxi Weight
MLW: Maximum Landing Weight

Weight, 1,000 lb

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Airplane characteristics: payload

What are some of the characteristics of your airplanes that impact their Payload?

• Aircraft Configuration
  – Interior arrangement
  – Engine type and thrust
  – Design weight limits and empty weight

• Payload Limit Definition
Airplane characteristics: volume limit payload - 777-200 example with 305 seats
Airplane characteristics: volume limit payload calculation - 777-200 example

<table>
<thead>
<tr>
<th>Description</th>
<th>Weight (lb)</th>
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</thead>
<tbody>
<tr>
<td>Weight of passengers and their baggage</td>
<td>64,050</td>
</tr>
<tr>
<td>(10 LD-3 containers required for baggage)</td>
<td></td>
</tr>
<tr>
<td>Cargo loaded in remaining LD-3 containers</td>
<td>6,320</td>
</tr>
<tr>
<td>Cargo loaded on pallets</td>
<td>24,900</td>
</tr>
<tr>
<td>Cargo loaded in bulk area</td>
<td>4,800</td>
</tr>
<tr>
<td><strong>Volume limit payload</strong></td>
<td><strong>100,070</strong></td>
</tr>
<tr>
<td><strong>Maximum structural limit payload</strong></td>
<td><strong>117,900</strong></td>
</tr>
</tbody>
</table>
Airplane characteristics: structural payload calculation - 777-200 example with 305 seats

Maximum Zero Fuel Weight = 420,000 lb
Minus
Operating Empty Weight = 302,100 lb
Equals
Maximum Structural Payload = 117,900 lb
Airplane characteristics: thrust example of available engine options supporting 777 family

<table>
<thead>
<tr>
<th>777-200</th>
<th>Pratt &amp; Whitney</th>
<th>General Electric</th>
<th>Rolls-Royce</th>
</tr>
</thead>
<tbody>
<tr>
<td>777-200</td>
<td>74,400 (PW4074)</td>
<td>77,000 (GE90-77B)</td>
<td>73,400 (Trent 875)</td>
</tr>
<tr>
<td></td>
<td>77,000 (PW4077)</td>
<td></td>
<td>76,000 (Trent 877)</td>
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<tr>
<td>777-200ER</td>
<td>84,400 (PW4084)</td>
<td>84,700 (GE90-85B)</td>
<td>83,600 (Trent 884)</td>
</tr>
<tr>
<td></td>
<td>90,000 (PW4090)</td>
<td>90,000 (GE90-90B)</td>
<td>90,000 (Trent 892)</td>
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<td></td>
<td>97,900 (PW4098)</td>
<td>93,700 (GE90-94B)</td>
<td>93,400 (Trent 895)</td>
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</tbody>
</table>

| 777-300  | 90,000 (PW4090) |                  | 83,600 (Trent 884) |
|          | 98,000 (PW4098) |                  | 90,000 (Trent 892) |

All thrusts are Boeing equivalent.
## Airport analysis

### 737-700W/CFM56-7B22E HGW Takeoff Weight Capability

### 737-700W Gross Weight Comparison

- **737-700W/CFM56-7B22E**
- **Certification:** FAA-SCAP
- **MTOW:** 154,500 lb
- **Surface Temperature Season:** Annual
- **Surface Temperature Reliability:** ADM

### Airports

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<th>Airport (CODE)</th>
<th>Runway</th>
<th>Pressure Altitude (ft)</th>
<th>Field Length (ft)</th>
<th>Slope (%)</th>
<th>Clearway (ft)</th>
<th>Stopway (ft)</th>
<th>Obstacle Height (ft)</th>
<th>Obstacle Distance (ft)</th>
<th>Temperature (°C)</th>
<th>Takeoff Weight (lb)</th>
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<td>501</td>
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<td><strong>Denver (DEN)</strong></td>
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<td>5,324</td>
<td>16,000</td>
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<td>0</td>
<td>0</td>
<td>16</td>
<td>908</td>
<td>17.9 †</td>
<td>154,500 (s)</td>
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<td>84</td>
<td>3,907</td>
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<td>12,091</td>
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<td>87</td>
<td>4,954</td>
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<td><strong>New York (JFK)</strong></td>
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<td></td>
<td></td>
<td>634</td>
<td>55,253</td>
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</tr>
</tbody>
</table>
Airport analysis: takeoff performance

Takeoff weights are set by the most restrictive of

- Maximum certified takeoff weight
- Field length limiting weight
- Second segment limiting weight
- Minimum control speed
- Tire speed limiting weight
- Brake energy limiting weight
- Obstacle clearance limiting weight
Airport analysis: takeoff field length at specified temperature

![Graph showing the relationship between runway length required and takeoff weight with sea level and above sea level marked.](image-url)
Airport analysis: takeoff field length at constant elevation

- Runway length required
- Above standard temperature
- Standard temperature
- Takeoff weight
Airport analysis: 777-200ER takeoff weight capability example

Dubai Runway 12L: Winter ADM Temp = 23.7° C

Takeoff weight, 1,000 lb

- Trent 877: 609.3
- Trent 877: 607.2
- Trent 877: 605.2
- Trent 877: 586.6
- Trent 877: 550.0
- Trent 877: 500
- Trent 877: 525
- Trent 877: 550
- Trent 877: 575
- Trent 877: 600
- Trent 877: 625
- Trent 884: 600.9

- Flaps 5
  - Impr. Climb
  - A/C Off
  - Alt. CG
- Flaps 5
  - Impr. Climb
  - A/C On
  - Alt. CG
- Flaps 5
  - Impr. Climb
  - A/C On
  - Fwd. CG
- Flaps 15
  - Impr. Climb
  - A/C On
  - Fwd. CG
- Flaps 15
  - No Impr. Climb
  - A/C On
  - Fwd. CG
- Flaps 15
  - No Impr. Climb
  - A/C On
  - Fwd. CG
Study flight rules

- Reserve Fuel Policy: En Route Deviation, Missed Approach; Flight to Alternate Airport; Hold-Over Alternate
- Route Distance
- En Route Winds
- En Route Temperature
- Flight Altitude
- Cruise Procedure
- Alternate Airports
Study flight rules: typical flight profile

Mission

Climb

Step cruise

Descent

Takeoff

Approach and land

Taxi out

Flight time and fuel

Distance

Block time and fuel

Taxi in
Study flight rules: typical reserve profile

- Reserve
- Cruise
- Contingency
- Flight to alternate
- Missed approach
- Hold at alternate
- Hold
- Approach and land
Study flight rules: great circle distance

• A plane that passes through the center of the Earth.

• Any arc on the perimeter of this plane will give the great circle distance between the two points that bound the arc.
Study flight rules: example routing LHR to SIN
Study flight rules: equivalent still air distance

The equivalent still air distance is the distance an airplane would fly in still air on a flight of the same duration as that required to fly the route with a given wind.

\[
\text{ESAD} = \text{distance} \times \left( \frac{\text{Airplane speed}}{\text{Airplane speed}} \pm \text{wind} \right)
\]

Where:

- **ESAD** = equivalent still air distance
- **Distance** = airway distance in nautical miles
- **Airplane speed** = true velocity in knots
- **Wind** = given wind in knots
Study flight rules: International Standard Atmosphere (ISA)

Temperature = $T_{SL} - \text{(lapse rate)} \times \text{altitude}$ (good to 36,089 ft)
Pressure = $r gRT$ (equation of state)
Density pressure = $r g D \text{ altitude}$ ("pascal")
Airplane Speed

**Definition of speeds:**

- Airplane speed is described in knots or Mach number
  - 1 knot = 1 nautical mile per hour
  - 1 nautical mile = 6,080 feet = 1,852 meters
  - Mach number is the airplane speed divided by the speed of sound

- Speed schedules
  - MRC (Maximum Range Cruise) speed schedule that maximizes airplane range
  - LRC (Long Range Cruise) speed schedule for 99% of MRC nams value
  - CI (Cost Index) speed schedule relating the cost of flight time to the cost of fuel
Study flight rules: cruise procedure for fuel mileage, example 777-200 at 35,000 feet, GE 90 engines, standard day
Study flight rules: cruise procedure for Long-Range Cruise (LRC) speed

- The speed where fuel mileage is 1% less than maximum
- Representative of an optimum cost index speed for most airlines
- Where did LRC originate?
  - Speed stability is difficult to achieve at maximum range cruise speed
  - Before the advent of FMCs, a variable cruise speed (like a cost index) was hard to fly
Study flight rules: ECON cruise

ECON Cruise Mach = f(Cost Index, CI)

\[
\text{CI} = \frac{\text{TimeCost}}{\text{FuelCost}} = \frac{\$/\text{hr}}{\text{cents/lb}}
\]

High CI ➔ high speed, high trip fuel, low trip time
Low CI ➔ low speed, low fuel burn, high trip time
Study flight rules: factors affecting fuel burn

- Range
  Increasing range increases fuel burn

- Weight
  Increasing weight increases fuel burn
  - Operating Empty Weight
  - Payload
  - Reserve fuel policy

- Cruise Speed
  Cruise speed above optimum increases fuel burn

- Altitude
  Higher cruise altitude decreases fuel burn

- Enroute Wind
  Headwind increases fuel burn; tailwind decreases fuel burn

- Enroute Temperature
  Higher en route temperature increases fuel burn
Study flight rules: usefulness of payload range curve

We can look at things to improve capability:
• Increased TOW
• Increased Fuel Capacity
• Lower OEW
• Lower Fuel Reserves

Increasing Range

Increasing Payload

Full passenger and baggage payload

Proposed region of operation

….Looks pretty good

Not so good out here..
Study flight rules: payload vs. range curve evolution

Increasing TOW (adding fuel) for increased range

Maximum payload limit (MZFW)

MTOW limit reached

TOW 1  TOW 2  MTOW

Increasing Payload

Increasing Range
Study flight rules: payload vs. range curve evolution

- Maximum payload limit (MZFW)
- Increasing Range
- Increasing Payload
- Trading payload for more fuel (at a constant TOW)
- Maximum takeoff weight limit
- Stop! The tanks are full
Study flight rules: payload vs. range curve evolution
Study flight rules: payload vs. range curve –
A complete performance envelope for the aircraft
Study flight rules: “circle chart” range capability from Denver

**Full Passenger Payload**

**737-700W/CFM56-7B22E Basic**
- Payload: 26,460 lb
- MTOW: 133,000 lb OEW: 85,090 lb
- Fuel Capacity: 6,875 gal
- Passengers: 126 (1,374 nm)

**737-700W/CFM56-7B22E HGW**
- Payload: 26,460 lb
- MTOW: 154,500 lb OEW: 85,090 lb
- Fuel Capacity: 6,875 gal
- Passengers: 126 (3,173 nm)

Boeing Typical Rules
- 85% Annual Winds
- 2% Airways Allowance
- 2% Fuel Burn Factor
- 210 lb per Pax and Bags
- 200 nm alternate
Payload range chart

737-700W Gross Weight Comparison
Payload - Range Capability

737-700W (CFM56-7B22E)
MTOW: 133,000 lb  OEW: 85,090 lb
Passengers: 126  (1,374 nm)

737-700W (CFM56-7B22E)
MTOW: 154,500 lb  OEW: 85,090 lb
Passengers: 126  (3,173 nm)

0  500  1,000  1,500  2,000  2,500  3,000  3,500  4,000  4,500

0  5  10  15  20  25  30  35  40

Range (nm)

Payload (1,000 lb)

0  5  10  15  20  25  30  35

Payload, Pax & Bags Wt: 210 lb
Alt Range: 200 nm
Enroute Temp (ISA): 0 DEG C.
Payload range data – high gross weight

Mission Performance Summary

<table>
<thead>
<tr>
<th>Track</th>
<th>Rwy</th>
<th>Dist (nm)</th>
<th>ESAD (nm)</th>
<th>Cruise Altitude (100ft)</th>
<th>Cruise Wind (kt)</th>
<th>Cruise Temp (°C)</th>
<th>Mach</th>
<th>Block Time (h)</th>
<th>Takeoff Weight (lb)</th>
<th>Landing Weight (lb)</th>
<th>Block Fuel (lb)</th>
<th>Reserve Fuel (lb)</th>
<th>PAX</th>
<th>Cargo (lb)</th>
<th>Payload (lb)</th>
<th>Altn</th>
<th>Altn Dist (nm)</th>
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<td>200</td>
<td>200</td>
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<td>0/0</td>
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<td>128,701</td>
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## Payload range data – basic gross weight

### Mission Performance Summary

#### 737-700W Gross Weight Comparison

<table>
<thead>
<tr>
<th>Airframe: 737-700W</th>
<th>Engine: CFM56-7B22E</th>
<th>Interior: 126</th>
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</thead>
<tbody>
<tr>
<td>Max Taxi Wt: 133,500 lb</td>
<td>Max TO Wt: 133,000 lb</td>
<td>Max Land Wt: 128,000 lb</td>
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<tr>
<td>Max Zero Fuel Wt: 120,500 lb</td>
<td>Op Empty Wt: 85,090 lb</td>
<td>Fuel Capacity: 6,875 gal</td>
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<tr>
<td>Fuel Wt: 46,063 lb @ 6.7 lb/gal</td>
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</tr>
<tr>
<td>Structural Payload: 35,410 lb</td>
<td>Study Payload: 35,410 lb</td>
<td>Pax Bags Payload: 26,460 lb</td>
</tr>
<tr>
<td>Passenger Seats: 126 @ 210 lb ea</td>
<td>Rev Cargo: 8,950 lb</td>
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</table>

#### Payload Range Data

<table>
<thead>
<tr>
<th>Track</th>
<th>Rwy</th>
<th>Dist (nm)</th>
<th>ESAD (nm)</th>
<th>Cruise Altitude (100ft)</th>
<th>Cruise Wind (kt)</th>
<th>Cruise Delta Temp (°C)</th>
<th>Mach</th>
<th>Block Time (h)</th>
<th>Takeoff Weight (lb)</th>
<th>Landing Weight (lb)</th>
<th>Block Fuel (lb)</th>
<th>Reserve Fuel (lb)</th>
<th>PAX</th>
<th>Cargo (lb)</th>
<th>Payload (lb)</th>
<th>Altn</th>
<th>Altn Dist (nm)</th>
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<td>LRC</td>
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<td>131,960</td>
<td>92,733</td>
<td>39,583</td>
<td>6,606</td>
<td>4</td>
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<td>1,037</td>
<td>FUEL 200</td>
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<tr>
<td>ORIG to DEST</td>
<td>-</td>
<td>4,106</td>
<td>4,106</td>
<td>0</td>
<td>0</td>
<td>LRC</td>
<td>9.786</td>
<td>131,446</td>
<td>92,206</td>
<td>39,598</td>
<td>6,593</td>
<td>2</td>
<td>0</td>
<td>523</td>
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<td>ORIG to DEST</td>
<td>-</td>
<td>4,121</td>
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<td>0</td>
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<td>9.828</td>
<td>130,923</td>
<td>91,670</td>
<td>39,610</td>
<td>6,580</td>
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Key takeaways

- Airplane Characteristics
- Airport Analysis
- Study Flight Rules
- Range
- Payload
- Takeoff Performance
- Block Time and Block Fuel
MonteCristoAir case study connection

- Aircraft performance capability can significantly impact the strategy MonteCristoAir chooses to respond to competition
Payload Range Questions:

1. What would be the effect of an OEW increase?
2. How would a passenger weight increase affect design range?
3. Where would an airport takeoff limit show up on a payload range curve?
4. How would a very long flight to alternate distance affect design range?
5. How would a hot enroute cruise temperature affect design range?
6. How does an auxiliary fuel tank affect the design range? (This has a two part answer)
7. How does reducing reserves contingency fuel affect a payload range?
8. How is a payload range curve impacted by flying at off optimum altitudes?
9. How does speed affect a design range?
MonteCristoAir
Payload - Range Capability

737-8 (LEAP-1B25)
MTOW: 82,191 kg  OEW: 44,711 kg
Passengers: 162  (6,534 km)

Pax & Bags Wt: 95 kg
Alt Range: 370 km
Enroute Temp (ISA): 0 DEG C.
MonteCristoAir
Payload - Range Capability - Effect of OEW Increase

- 737-8 (LEAP-1B25)
  MTOW: 82,191 kg OEW: 44,711 kg Passengers: 162 (6,534 km)
- 737-8 (LEAP-1B25)
  MTOW: 82,191 kg OEW: 45,711 kg Passengers: 162 (6,443 km)

Payload (1,000 kg) vs. Range (km)

- Pax & Bags Wt: 95 kg
- Alt Range: 370 km
- Enroute Temp (ISA): 0 DEG C.
MonteCristoAir

Payload - Range Capability - Effect of Pax Wt Increase

Alt Range: 370 km
Enroute Temp (ISA): 0 DEG C.

737-8 (LEAP-1B25)
MTOW: 82,191 kg  OEW: 44,711 kg
Passengers: 162  (6,534 km)

737-8 (LEAP-1B25)
MTOW: 82,191 kg  OEW: 44,711 kg
Passengers: 162  (5,970 km)

162 Passengers at 95kgs
162 Passengers at 110kgs
MonteCristoAir

Payload - Range Capability - Effect of Airport Takeoff Weight Limit

737-8 (LEAP-1B25)
MTOW: 82,191 kg OEW: 44,711 kg
Passengers: 162 (6,534 km)

737-8 (LEAP-1B25)
TOW: 78,000 kg OEW: 44,711 kg
Passengers: 162 (5,581 km)

Pax & Bags Wt: 95 kg
Alt Range: 370 km
Enroute Temp (ISA): 0 DEG C.

162 Passengers

Range (km)
Payload (1,000 kg)
MonteCristoAir
Payload - Range Capability - Effect of Long Alternate Distance
200nm vs 400nm

737-8 (LEAP-1B25)
MTOW: 82,191 kg  OEW: 44,711 kg
Passengers: 162  (6,534 km)

737-8 (LEAP-1B25)
MTOW: 82,191 kg  OEW: 44,711 kg
Passengers: 162  (6,176 km)

162 Passengers

Pax & Bags Wt: 95 kg
Enroute Temp (ISA): 0 DEG C.
MonteCristoAir

Payload - Range Capability - Effect of High Enroute Temperature
ISA vs ISA+15degC

Payload (1,000 kg) vs Range (km)

- 737-8 (LEAP-1B25)
  - MTO: 82,191 kg
  - OEW: 44,711 kg
  - Passengers: 162
  - Enroute Temp (ISA): 0 & 15 DEG C.

- 737-8 (LEAP-1B25)
  - MTO: 82,191 kg
  - OEW: 44,711 kg
  - Passengers: 162
  - Enroute Temp (ISA): 0 & 15 DEG C.

Pax & Bags Wt: 95 kg
Alt Range: 370 km
Enroute Temp (ISA): 0 & 15 DEG C.
MonteCristoAir
Payload - Range Capability - Effect of Auxiliary Fuel Tank

737-8 (LEAP-1B25)
MTOW: 82,191 kg OEW: 44,711 kg
Passengers: 162 (6,534 km)

737-8 (LEAP-1B25)
MTOW: 82,191 kg OEW: 44,938 kg
Passengers: 162 (6,867 km)

6,853 gal
7,600 gal

Pax & Bags Wt: 95 kg
Alt Range: 370 km
Enroute Temp (ISA): 0 DEG C.
MonteCristoAir

Payload - Range Capability - Effect of Reduced Contingency Fuel
3% vs 5% Contingency Fuel

737-8 (LEAP-1B25)
MTOW: 82,191 kg  OEW: 44,711 kg
Passengers: 162  (6,534 km)

737-8 (LEAP-1B25)
MTOW: 82,191 kg  OEW: 44,711 kg
Passengers: 162  (6,681 km)

Pax & Bags Wt: 95 kg
Alt Range: 370 km
Enroute Temp (ISA): 0 DEG C.
MonteCristoAir

Payload - Range Capability - Effect of Optimum vs Constant Altitude Cruise

737-8 (LEAP-1B25)
MTOW: 82,191 kg  OEW: 44,711 kg
Passengers: 162  (6,534 km)

737-8 (LEAP-1B25)
MTOW: 82,191 kg  OEW: 44,711 kg
Passengers: 162  (6,301 km)

- Pax & Bags Wt: 95 kg
- Alt Range: 370 km
- Enroute Temp (ISA): 0 DEG C.
MonteCristoAir

Payload - Range Capability - Effect of Speed on Range

LRC vs MRC

737-8 (LEAP-1B25)
MTOW: 82,191 kg  OEW: 44,711 kg  Passengers: 162  (6,534 km)

737-8 (LEAP-1B25)
MTOW: 82,191 kg  OEW: 44,711 kg  Passengers: 162  (6,585 km)

Pax & Bags Wt: 95 kg
Alt Range: 370 km
Enroute Temp (ISA): 0 DEG C.