Aircraft Design
Airliner Design Parameters
&
Flight Profile

Aircraft Design Process

New Airliner Design

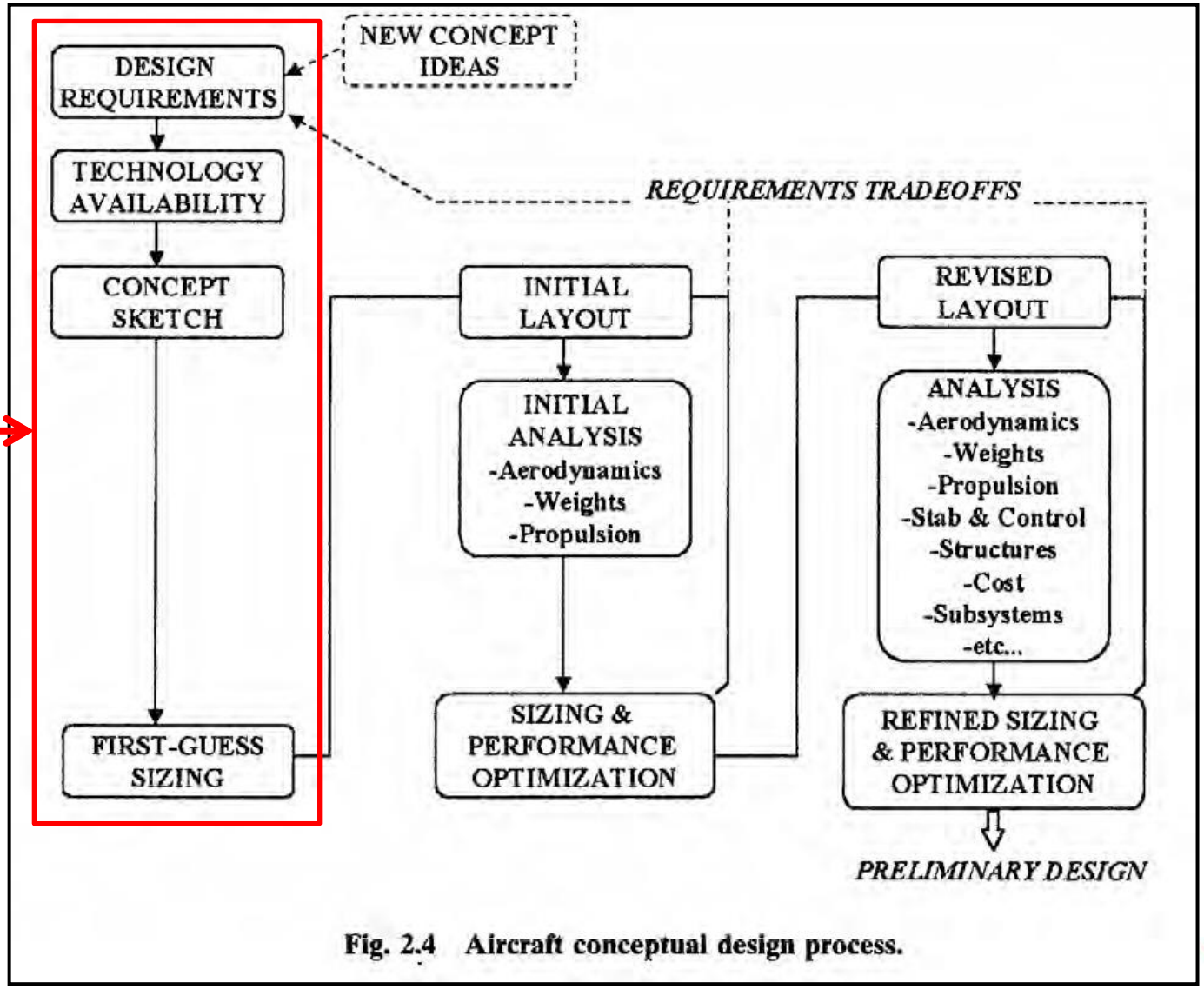

Fig. 2.4 Aircraft conceptual design process.

"Aircraft Design: A Conceptual Approach" by Daniel P. Raymer, page 9

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Airliner Design

What could the requirements for a new airliner be?

Cargo Capacity
Range
Fuel Efficiency
Speed
Takeoff Distance
Sound Abatement
Cost
Interior Furnishings
Safety
Maintainability
Reliability
Manufacturability
Turnaround Time
Handling Qualities

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Airliner Design

What kind of constraints are there for an airliner?

Wing Span / Aspect Ratio
Weight
Sound / Noise
Altitude
Range
Environmental Impact
Carrying Capacity
Maintenance Hangar
Maintenance Time
Engine Performance
Cockpit Visibility

Runway Length

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Airliner Design

What are the design drivers for an airliner?

Number of Passengers
Fuel Efficiency
Range
Endurance
Profit
Impact to Environment
Runway Length

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Airliner Design

What new technology is available for an airliner?

Avionics
Materials / Composites
New Engine Technology
Flight Controls
Interior Furnishings – Movie Screens, Satellite Internet, etc

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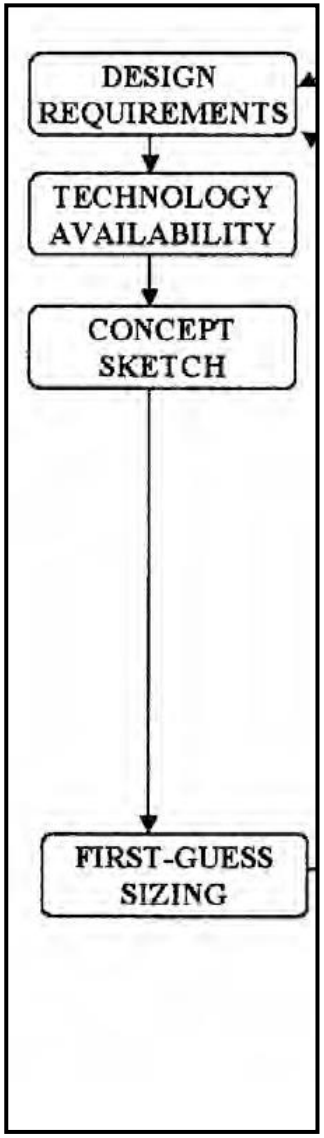
Airliner Design



Boeing aircraft (44)

- 707 (4)
- 717 (2)
- 727 (3)
- 737 Original (-100 thru -200) (3)
- 737 Classic (-300 thru -500) (3)
- 737 Next Gen (-600 thru -900) (4)
- 737 MAX (4)
- 747 (-100 thru -300) (3)
- 747 (-400, -400ER, -8I) (3)
- 757 (2)
- 767 (5)
- 777 (5)
- 787 (3)

Airbus aircraft (25)

- A220 (2)
- A300 (2)
- A310 (2)
- A320 (5)
- A320 NEO (4)
- A330 (2) & A380 (1) (3)
- A340 (4)
- A350 (3)

Bombardier aircraft (3)

Embraer aircraft (4)

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Airliner Design

Use the historical airliner information provided to prepare a short synopsis paper that includes:

- **Manufacturer**
- **Photo of the aircraft and three-view drawing**
- **First flight date**
- **Approximate # aircraft built to date and number of backlogged/ordered aircraft**
- **Approximate cost of each aircraft in the series**
- **Competitive aircraft**
- **Military variants, if any**
- **Other interesting facts or tidbits**
- **References**
- **Maximum range vs maximum takeoff gross weight plot**
- **Typical payload vs maximum takeoff gross weight plot**
- **Seat miles vs maximum takeoff gross weight plot**

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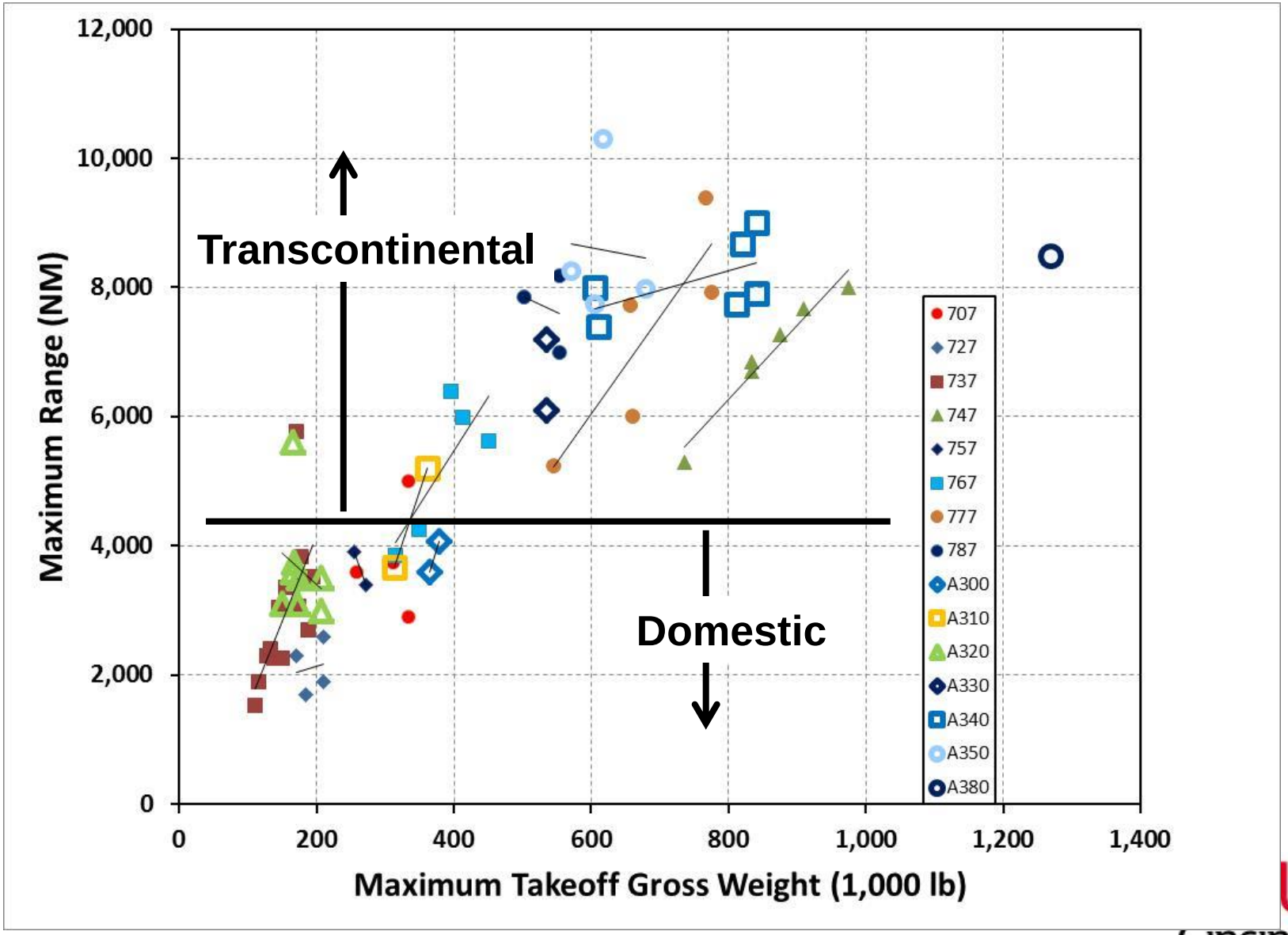
Airline Industry Homework



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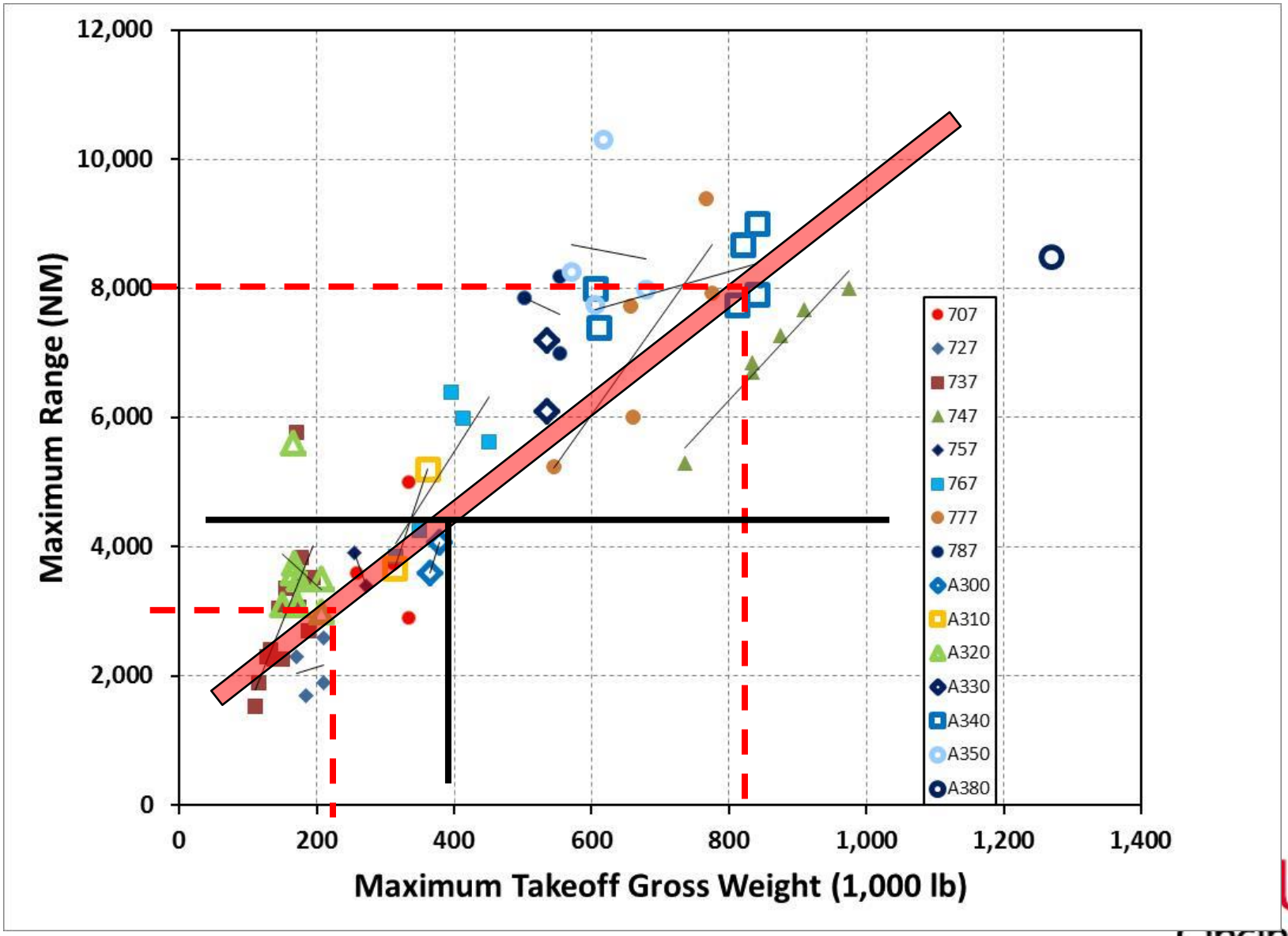
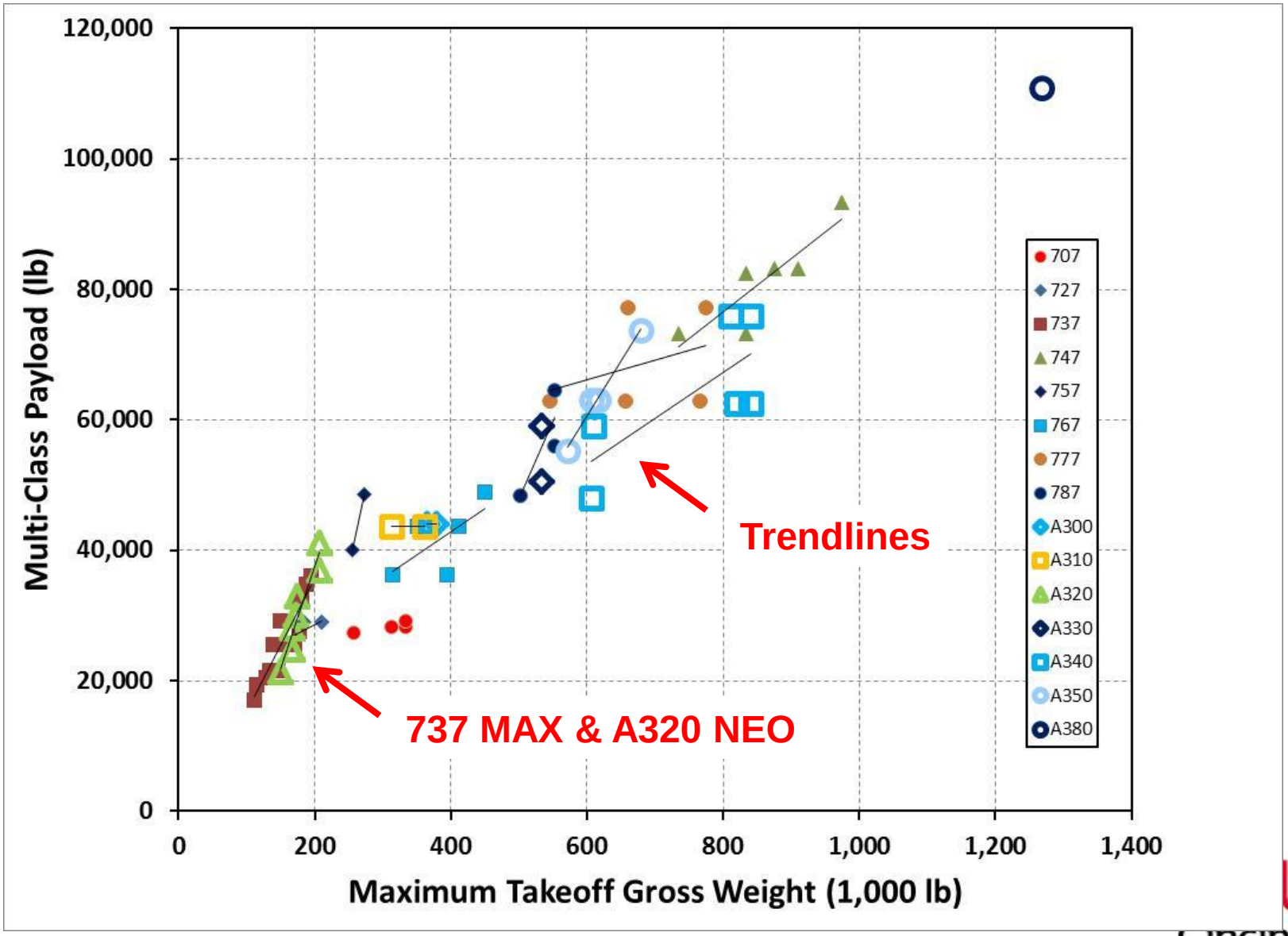
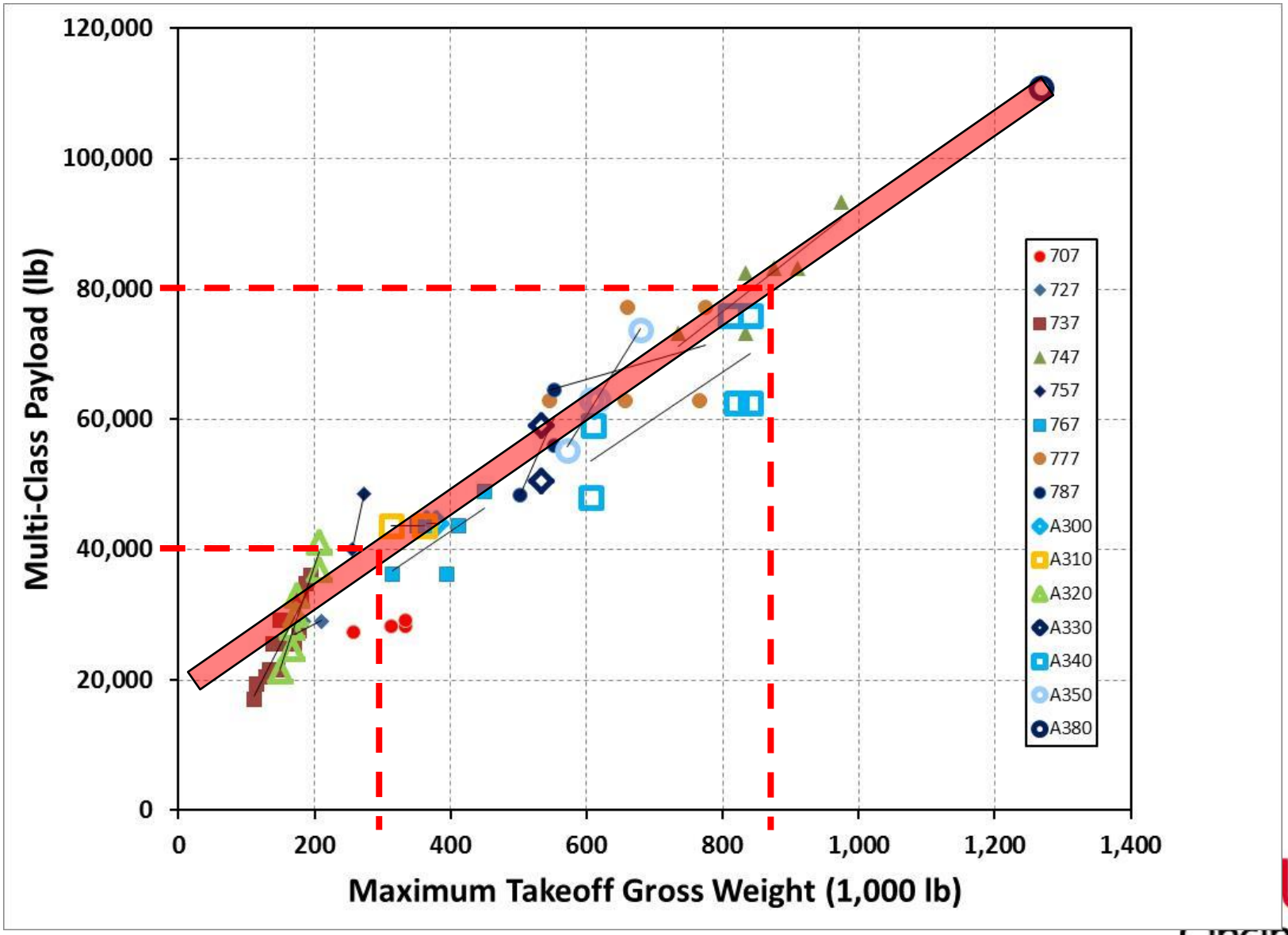
Airline Industry Homework



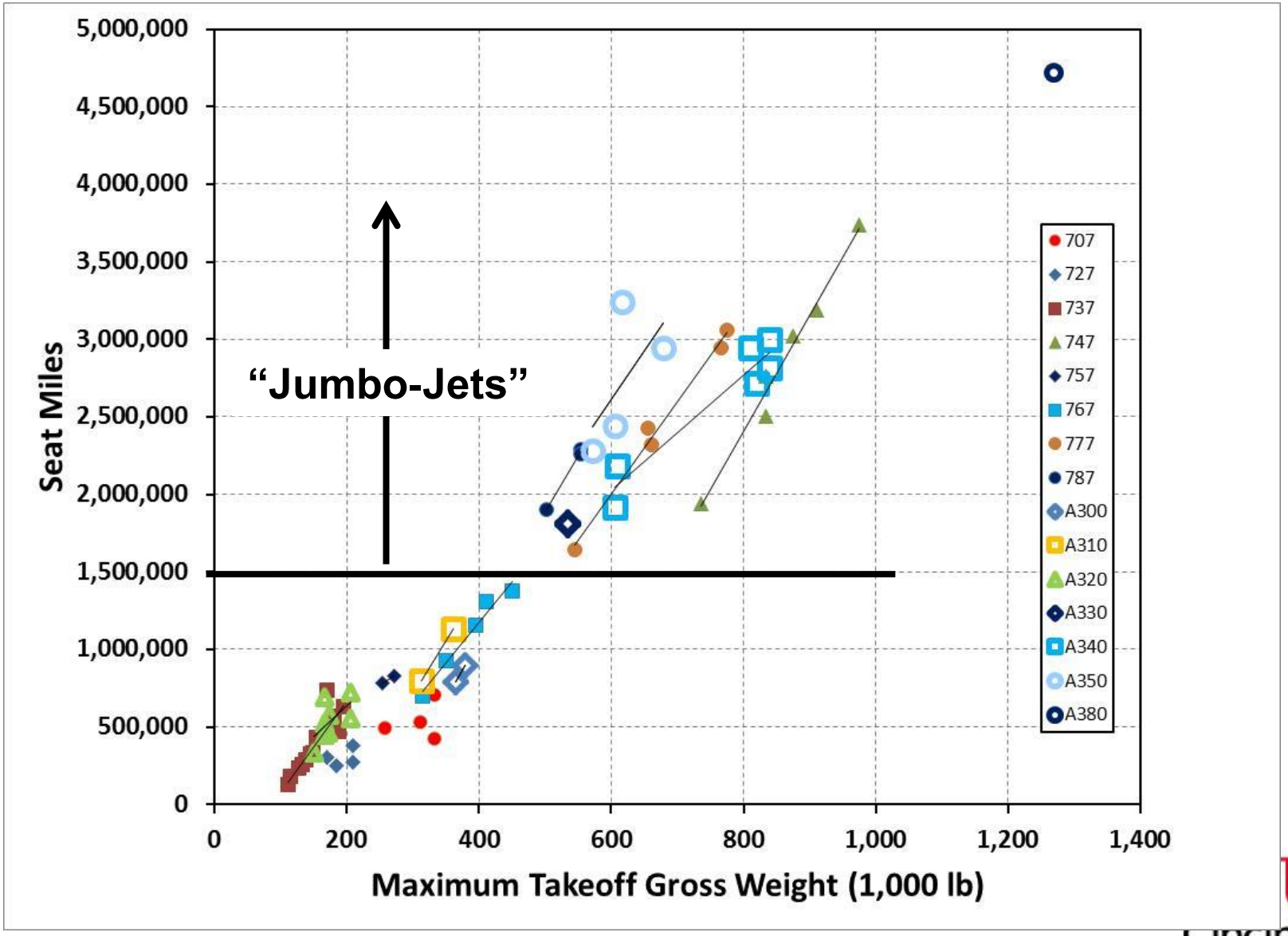
Airline Industry Homework



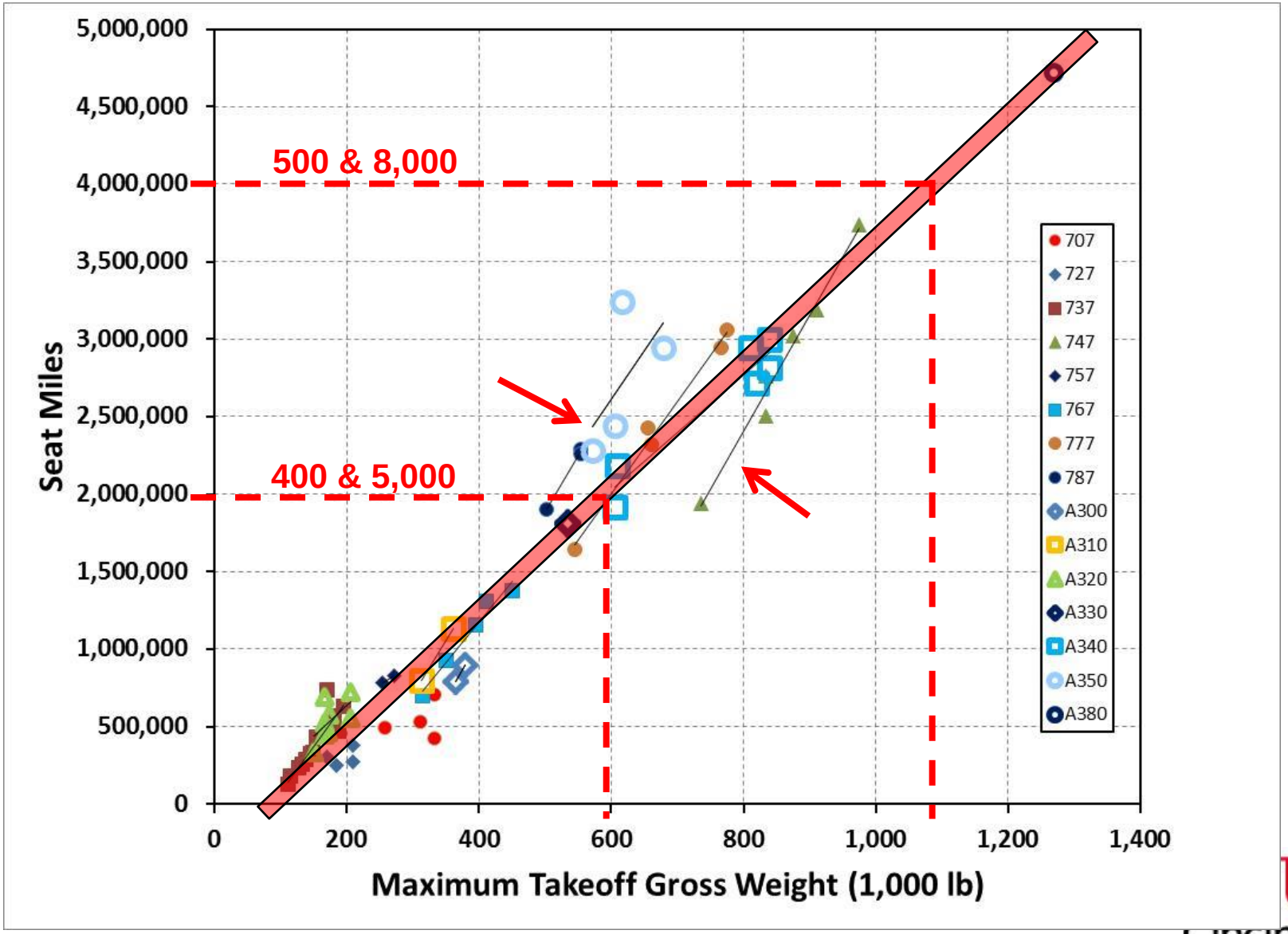
Airline Industry Homework



Airline Industry Homework



Airline Industry Homework



Airline Industry Homework

What did we learn from this exercise?

Even an extensive database will have holes in it
-- Use mathematical techniques to fill the holes

Sometimes trendlines won't fit the data very well
-- Maybe using the wrong parameters?

Sometimes the trendlines don't go the way they should
-- Other factors involved

The historical database provides a very good "first guess" sizing estimate
-- Learn from what others have already done!!

Investigate the outliers to the trendlines
-- Understand why they are outliers

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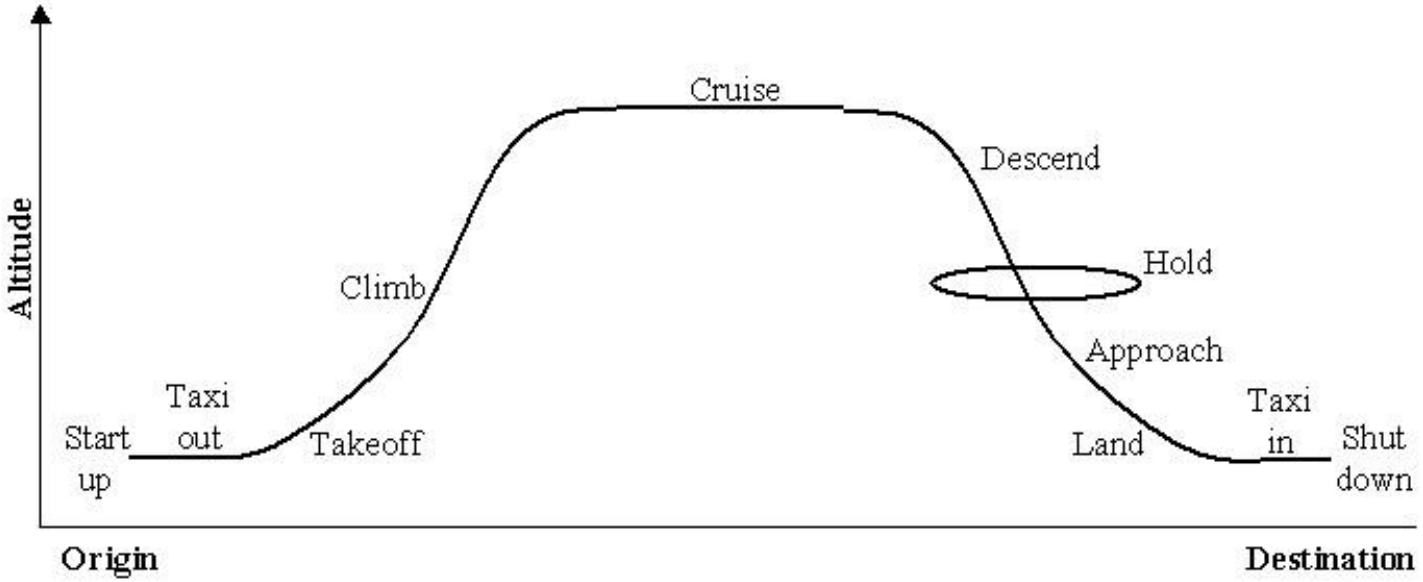
Airliner Flight Profile

What should an airliner's flight profile look like?

Start-up, Taxi, and Takeoff from the Origination Airport
Climb to Cruise Altitude
Cruise to Destination Area
Descend into Destination Airport
Land with Fuel Reserves, Taxi to Gate, and Shut-down



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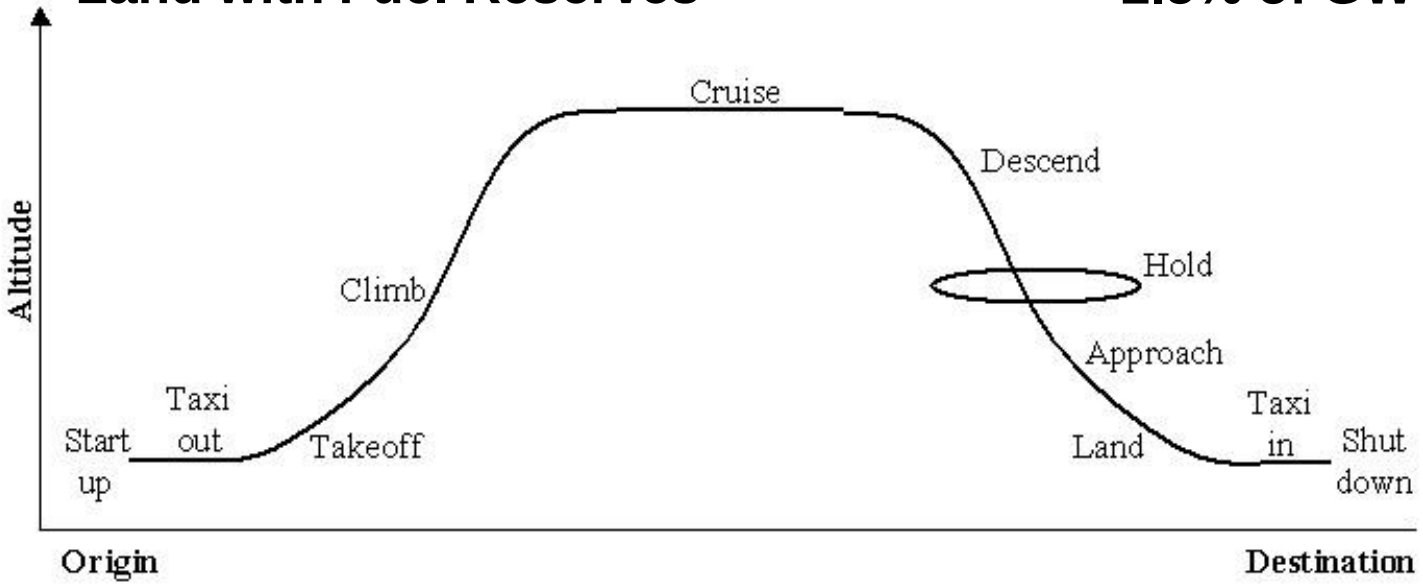
Airliner Flight Profile

How do we account for the fuel burned in each segment of the flight profile?

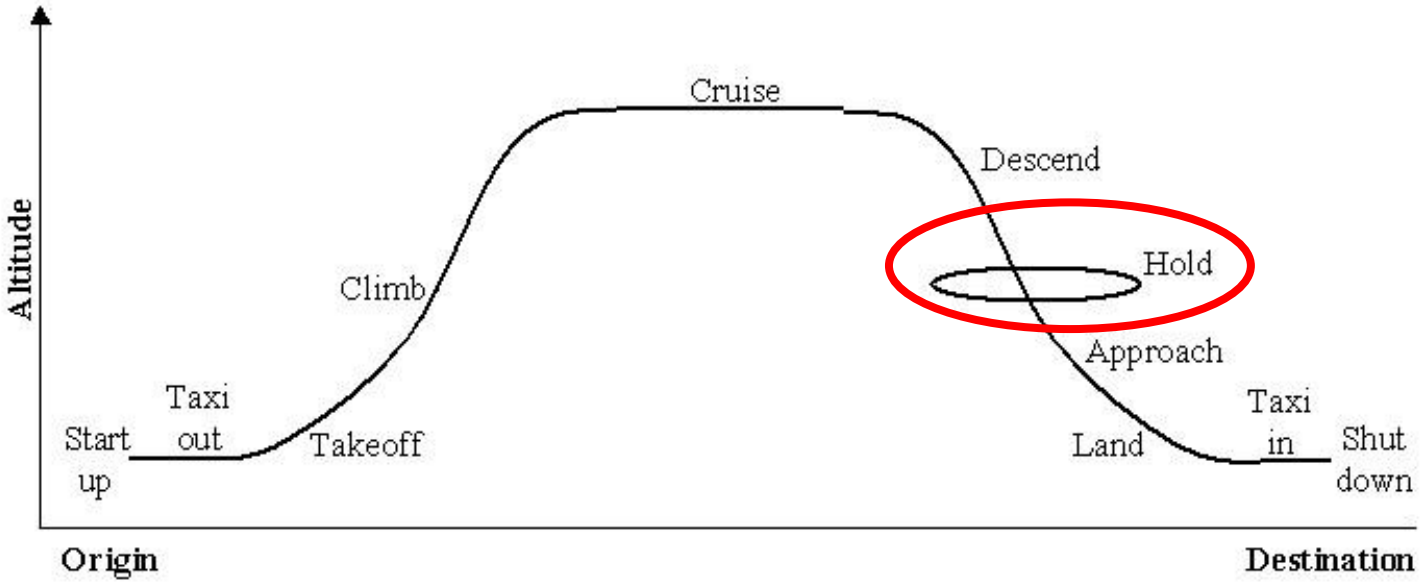
Takeoff from the Origination Airport	**2.5% of GW**
Climb to Cruise Altitude	**3.5% of GW**
Cruise to Destination Area	**X**
Descend into Destination Airport	**--**
Land with Fuel Reserves	**2.5% of GW + reserves**



Airliner Flight Profile

Landing Reserves – so we don't ever run out of fuel!

5% of fuel at takeoff
+ 45 minutes at 10,000 ft over Destination Airport
+ 1% Unusable Fuel – fuel trapped in the fuel lines and tanks



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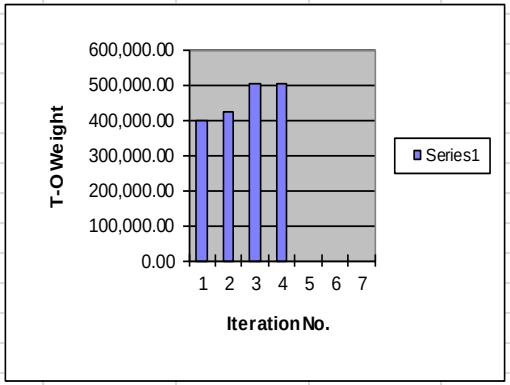
Airliner Flight Profile

	Mission Requirements						
Max. Mach	0.90						
Cruise Mach	0.85						
Cruise Alt. (ft)	36,000						
Range (nm)	7,850						
Payload: Non-exp. (lb)	114,300						
Engine: TSFC Min.	0.242637						
Engine: Thrust (lbs)	128,000						
Aspect Ratio	11.10						
Structure Factor	0.516418						
Loiter: Time (min)	45						
Loiter: Altitude (ft)	10,000						
Fuel Reserve (%)	5						
Trapped Fuel (%)	1						
		Iteration 1	Iteration 2	Iteration 3	Iteration 4	Iteration 5	Iteration 6
Weight: T-O (estimated)	400,000	400,000.00	423,315.11	502,501.02	502,501.02	#DIV/0!	#DIV/0!
Weight: T-O (final)		423,315.11	441,326.91	502,501.02	502,501.02	#DIV/0!	#DIV/0!
Surplus Empty Wt. (lbs)		-23,315.11	-18,011.80	0.00	0.00	#DIV/0!	#DIV/0!
1. Start-up & T-O		390,000.00	412,732.23	489,938.50	489,938.50	#DIV/0!	#DIV/0!
2. Climb & Accel. to Cruise		376,740.00	398,699.34	473,280.59	473,280.59	#DIV/0!	#DIV/0!
3a. L/D		21.10	21.10	21.10	21.10	21.10	21.10
3b. V (f/s)		834.36	834.36	834.36	834.36	834.36	834.36
3c. Cruise to destination		313,824.18	332,116.29	394,242.42	394,242.42	#DIV/0!	#DIV/0!
4. Loiter		311,129.22	329,264.26	390,856.88	390,856.88	#DIV/0!	#DIV/0!
5. Land		303,350.99	321,032.65	381,085.46	381,085.46	#DIV/0!	#DIV/0!
Total Fuel Wt. (lbs)		102,447.95	108,419.41	128,700.49	128,700.49	#DIV/0!	#DIV/0!
Available Empty Wt. (lbs)		183,252.05	200,595.70	259,500.53	259,500.53	#DIV/0!	#DIV/0!
Required Empty Wt. (lbs)		206,567.16	218,607.50	259,500.53	259,500.53	#DIV/0!	#DIV/0!



ITERTOW.XLS

Iteration on Takeoff Weight

“Design of Aircraft” - Thomas C. Corke

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Airliner Flight Profile

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Max. Mach	0.90
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Range (nm)	7,850
Payload: Non-exp. (lb)	114,300
Engine: TSFC Min.	0.242637
Engine: Thrust (lbs)	128,000
Aspect Ratio	11.10
Structure Factor	0.516418
Loiter: Time (min)	45
Loiter: Altitude (ft)	10,000
Fuel Reserve (%)	5
Trapped Fuel (%)	1

Input data from fact sheet

←

← **Max Range**

← **Max Payload**

← **# engines x thrust**

←

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Airliner Flight Profile

	Mission Requirements
Max. Mach	0.90
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Aspect Ratio	11.10
Structure Factor	0.516418
Loiter: Time (min)	45
Loiter: Altitude (ft)	10,000
Fuel Reserve (%)	5
Trapped Fuel (%)	1

Input other data

← **Cruise Mach + ΔM**

←

← **Optimum altitude**

← **Max Range**

← **Max Payload**

← **# engines x thrust**

←

←

←

← **Fuel Reserves**

←

←

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Airliner Flight Profile

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Aspect Ratio	11.10
Structure Factor	0.516418
Loiter: Time (min)	45
Loiter: Altitude (ft)	10,000
Fuel Reserve (%)	5
Trapped Fuel (%)	1

Calculate more data

← Cruise Mach + DM

←

← Optimum altitude

← Max Range

← Max Payload

← # engines x thrust

←

← **= Operating Weight Empty / Max TOGW**

←

←

← Fuel Reserves

←

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Airliner Flight Profile

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Aspect Ratio	11.10
Structure Factor	0.516418
Loiter: Time (min)	45
Loiter: Altitude (ft)	10,000
Fuel Reserve (%)	5
Trapped Fuel (%)	1

Iterate sfc to balance TOGW

← Cruise Mach + DM

←

← Optimum altitude

← Max Range

← Max Payload

←

← # engines x thrust

←

← = Operating Weight Empty / Max TOGW

←

←

← Fuel Reserves

←

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Airliner Flight Profile

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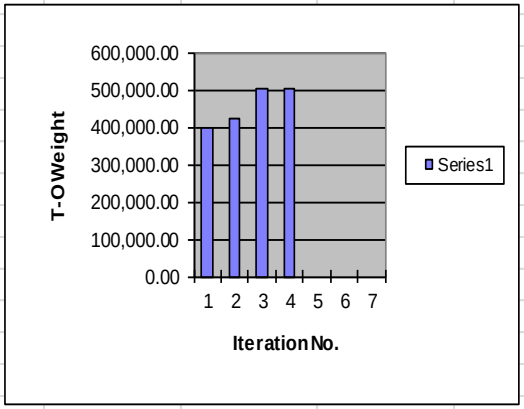
Loiter: Time (min)	45						
Loiter: Altitude (ft)	10,000						
Fuel Reserve (%)	5						
Trapped Fuel (%)	1						
		Iteration 1	Iteration 2	Iteration 3	Iteration 4	Iteration 5	Iteration 6
Weight: T-O (estimated)	400,000	400,000.00	423,315.11	502,501.02	502,501.02	#DIV/0!	#DIV/0!
Weight: T-O (final)		423,315.11	441,326.91	502,501.02	502,501.02	#DIV/0!	#DIV/0!
Surplus Empty Wt. (lbs)		-23,315.11	-18,011.80	0.00	0.00	#DIV/0!	#DIV/0!
1. Start-up & T-O		390,000.00	412,732.23	489,938.50	489,938.50	#DIV/0!	#DIV/0!
2. Climb & Accel. to Cruise		376,740.00	398,699.34	473,280.59	473,280.59	#DIV/0!	#DIV/0!
3a. L/D		21.10	21.10	21.10	21.10	21.10	21.10
3b. V (f/s)		834.36	834.36	834.36	834.36	834.36	834.36
3c. Cruise to destination		313,824.18	332,116.29	394,242.42	394,242.42	#DIV/0!	#DIV/0!
4. Loiter		311,129.22	329,264.26	390,856.88	390,856.88	#DIV/0!	#DIV/0!
5. Land		303,350.99	321,032.65	381,085.46	381,085.46	#DIV/0!	#DIV/0!
Total Fuel Wt. (lbs)		102,447.95	108,419.41	128,700.49	128,700.49	#DIV/0!	#DIV/0!
Available Empty Wt. (lbs)		183,252.05	200,595.70	259,500.53	259,500.53	#DIV/0!	#DIV/0!
Required Empty Wt. (lbs)		206,567.16	218,607.50	259,500.53	259,500.53	#DIV/0!	#DIV/0!



Iterate sfc

Get TOGW close to value on fact sheet

OWE should match closely

Max TOGW = 502,500 lb
OWE = 259,500 lb

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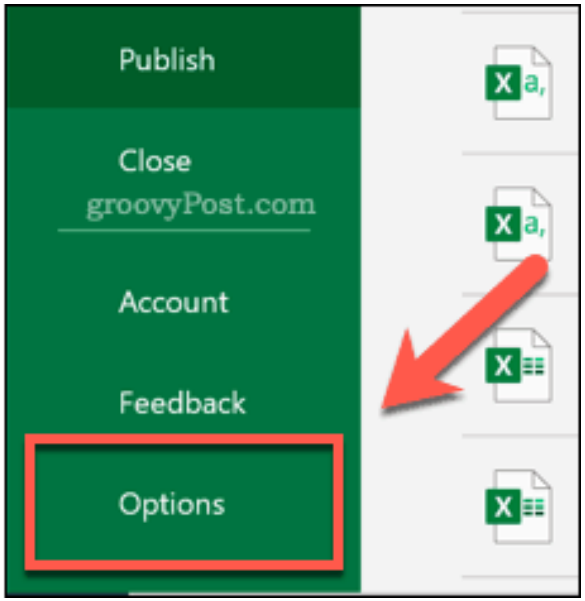
Excel Solver Function

Included in Excel, but disabled by default

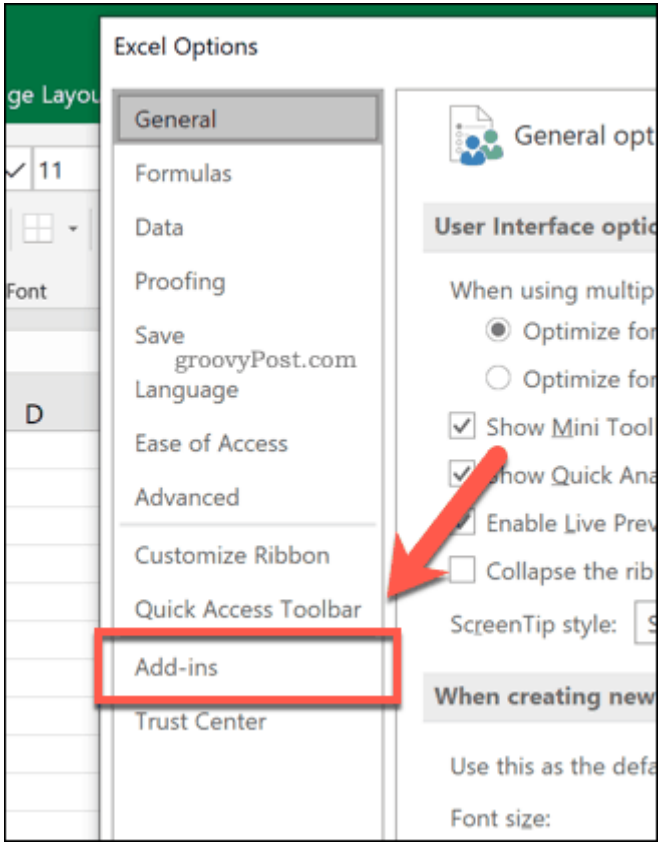
Installation Instructions

Open Excel and click on **File > Options** to open the Excel Options menu:



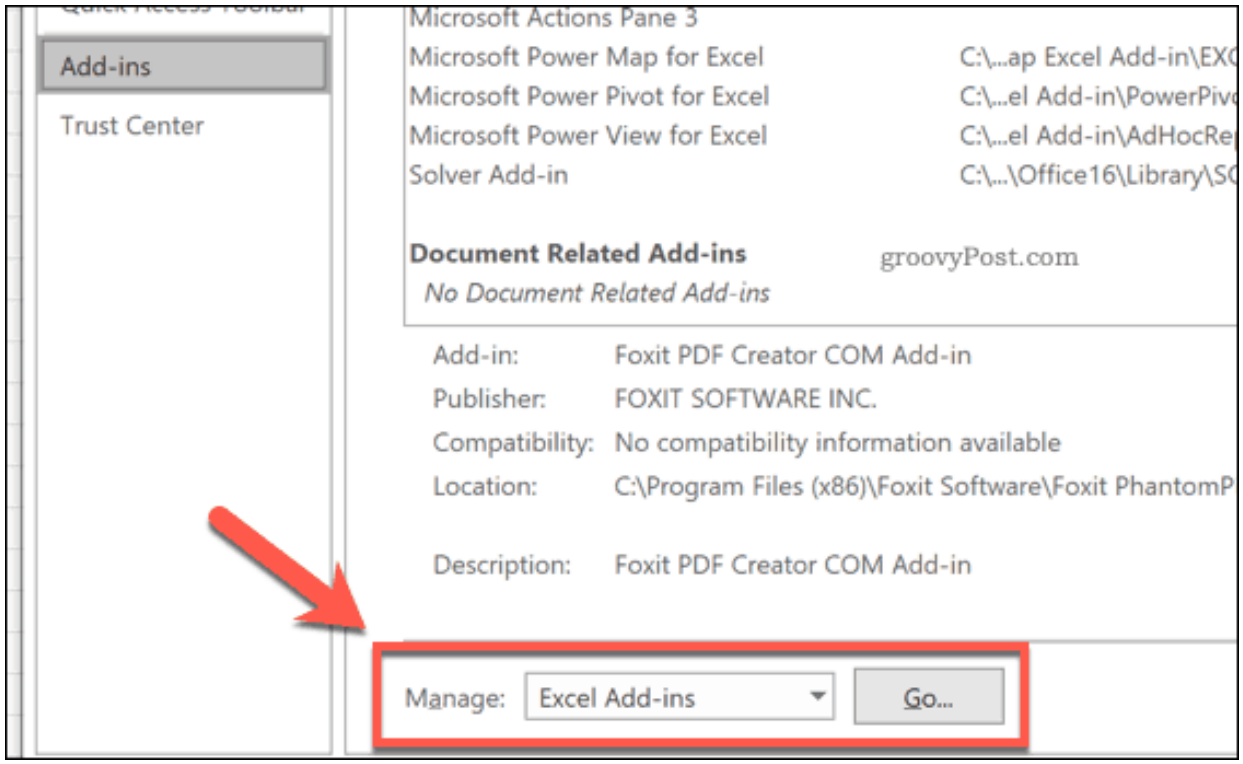
Excel Solver Function

In the **Excel Options** window, click on the **Add-ins** tab to view the settings for Excel add-ins:



Excel Solver Function

Select **Excel add-ins** from the **Manage** drop-down menu at the bottom of the window, then click on the **Go** button.



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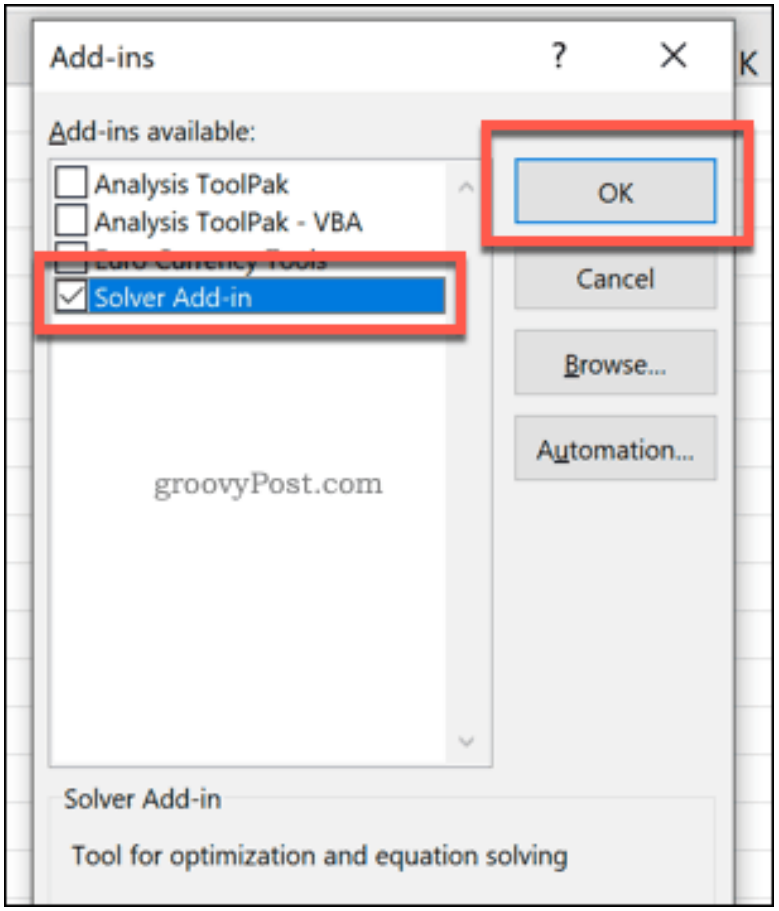
Excel Solver Function

In the **Add-ins** window, click on the checkbox next to the **Solver Add-in** option, then click on **OK** to confirm.



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	Mission Requirements
Max. Mach	0.85
Cruise Mach	0.8
Cruise Alt. (ft)	36,000
Range (nm)	5,200
Payload: Non-exp. (lb)	84,000
Engine: TSFC Min.	0.200000
Engine: Thrust (lbs)	128,000
Aspect Ratio	8.79
Structure Factor	0.5069
Loiter: Time (min)	45
Loiter: Altitude (ft)	10,000
Fuel Reserve (%)	5
Trapped Fuel (%)	1

ITERTOW.XLS

Find the TSFC that will result in

Takeoff Gross Weight = 361,600

Empty Weight = 183,300

		Iteration 1	Iteration 2	Iteration 3	Iteration 4	Iteration 5	Iteration 6	Iteration 7
Weight: T-O (estimated)	400,000	400,000.00	367,139.31	287,521.84	287,521.84	#DIV/0!	#DIV/0!	#DIV/0!
Weight: T-O (final)		367,139.31	343,878.93	287,521.84	287,521.84	#DIV/0!	#DIV/0!	#DIV/0!
Surplus Empty Wt. (lbs)		32,860.69	23,260.38	0.00	0.00	#DIV/0!	#DIV/0!	#DIV/0!
1. Start-up & T-O		390,000.00	357,960.83	280,333.79	280,333.79	#DIV/0!	#DIV/0!	#DIV/0!
2. Climb & Accel. to Cruise		377,520.00	346,506.08	271,363.11	271,363.11	#DIV/0!	#DIV/0!	#DIV/0!
3a. L/D		18.79	18.79	18.79	18.79	18.79	18.79	18.79
3b. V (f/s)		785.28	785.28	785.28	785.28	785.28	785.28	785.28
3c. Cruise to destination		335,152.70	307,619.32	240,909.30	240,909.30	#DIV/0!	#DIV/0!	#DIV/0!
4. Loiter		332,487.83	305,173.39	238,993.78	238,993.78	#DIV/0!	#DIV/0!	#DIV/0!
5. Land		324,175.64	297,544.05	233,018.94	233,018.94	#DIV/0!	#DIV/0!	#DIV/0!
Total Fuel Wt. (lbs)		80,373.82	73,770.98	57,773.07	57,773.07	#DIV/0!	#DIV/0!	#DIV/0!
Available Empty Wt. (lbs)		235,626.18	209,368.33	145,748.76	145,748.76	#DIV/0!	#DIV/0!	#DIV/0!
Required Empty Wt. (lbs)		202,765.49	186,107.95	145,748.76	145,748.76	#DIV/0!	#DIV/0!	#DIV/0!

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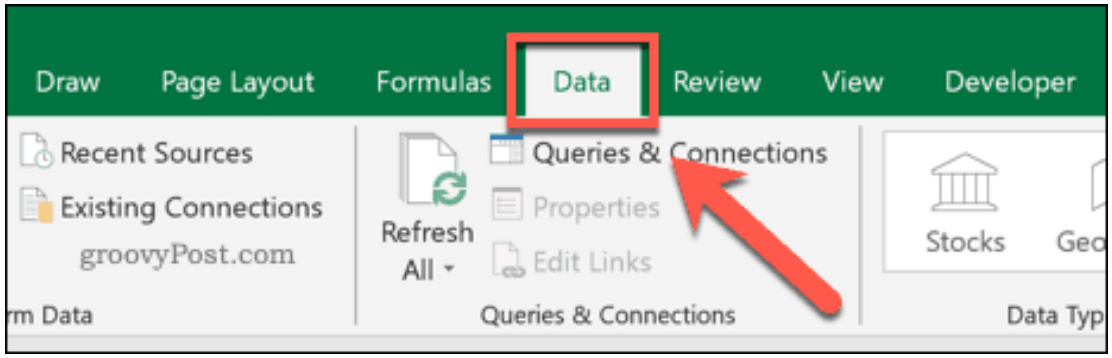
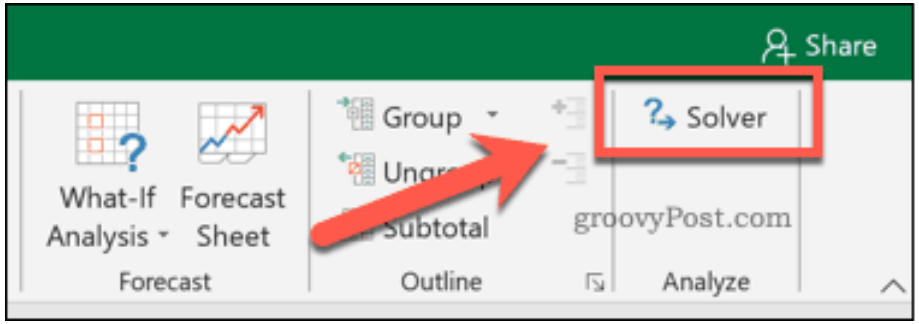
Excel Solver Function

To use Solver, click on the **Data** tab on the Excel ribbon bar.



In the **Analyze** section, click on the **Solver** option.



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AutoSave Off | 1 - ITERTOW with Solver.xlsx | Search

File Home Insert Page Layout Formulas Data Review View Developer Help

Get Data | From Text/CSV | From Web | From Table/ Range | Recent Sources | Existing Connections | Refresh All | Queries & Connections | Properties | Edit Links | Stocks | Geography | Sort | Filter | Clear | Reapply | Advanced | Text to Columns | Flash Fill | Remove Duplicates | Data Validation | Consolidate | Relationships | Manage Data Model | What-If Analysis | Forecast Sheet

Get & Transform Data | Queries & Connections | Data Types | Sort & Filter | Data Tools | Forecast

CMN | =E23-E25/((E25-D25)/(E23-D23))

	A	B	C	D	E	F	G	H	I
1		Mission Requirements							
2									
3	Max. Mach	0.85							
4	Cruise Mach	0.8							
5	Cruise Alt. (ft)	36,000							
6	Range (nm)	5,200							
7	Payload: Non-exp. (lb)	84,000							
8									
9	Engine: TSFC Min.	0.200000							
10	Engine: Thrust (lbs)	128,000							
11	Aspect Ratio	8.79							
12	Structure Factor	0.5069							
13									
14	Loiter: Time (min)	45							
15	Loiter: Altitude (ft)	10,000							
16	Fuel Reserve (%)	5							
17	Trapped Fuel (%)	1							
18									
19									
20									
21									
22			Iteration 1	Iteration 2	Iteration 3	Iteration 4	Iteration 5		
23	Weight: T-O (estimated)	400,000	400,000.00	367,139.31	287,521.84	287,521.84	#DIV/0!		
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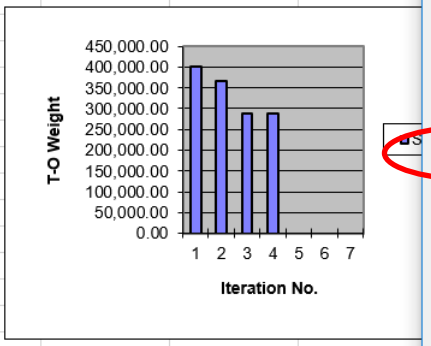
25	Surplus Empty Wt. (lbs)		32,860.69	23,260.38	0.00	0.00	#DIV/0!		
26									
27	1. Start-up & T-O		390,000.00	357,960.83	280,333.79	280,333.79	#DIV/0!		
28	2. Climb & Accel. to Cruise		377,520.00	346,506.08	271,363.11	271,363.11	#DIV/0!		
29	3a. L/D		18.79	18.79	18.79	18.79	18.79		
30	3b. V (f/s)		785.28	785.28	785.28	785.28	785.28		
31	3c. Cruise to destination		335,152.70	307,619.32	240,909.30	240,909.30	#DIV/0!	#DIV/0!	#DIV/0!
32	4. Loiter		332,487.83	305,173.39	238,993.78	238,993.78	#DIV/0!	#DIV/0!	#DIV/0!
33	5. Land		324,175.64	297,544.05	233,018.94	233,018.94	#DIV/0!	#DIV/0!	#DIV/0!
34									
35	Total Fuel Wt. (lbs)		80,373.82	73,770.98	57,773.07	57,773.07	#DIV/0!	#DIV/0!	#DIV/0!
36	Available Empty Wt. (lbs)		235,626.18	209,368.33	145,748.76	145,748.76	#DIV/0!	#DIV/0!	#DIV/0!
37	Required Empty Wt. (lbs)		202,765.49	186,107.95	145,748.76	145,748.76	#DIV/0!	#DIV/0!	#DIV/0!
38									



Solver Parameters

Set Objective: F23

To: Max Min Value Of: 361600

By Changing Variable Cells: B9

Subject to the Constraints:

Add | Change | Delete | Reset All | Load/Save

Make Unconstrained Variables Non-Negative

Select a Solving Method: GRG Nonlinear | Options

Solving Method

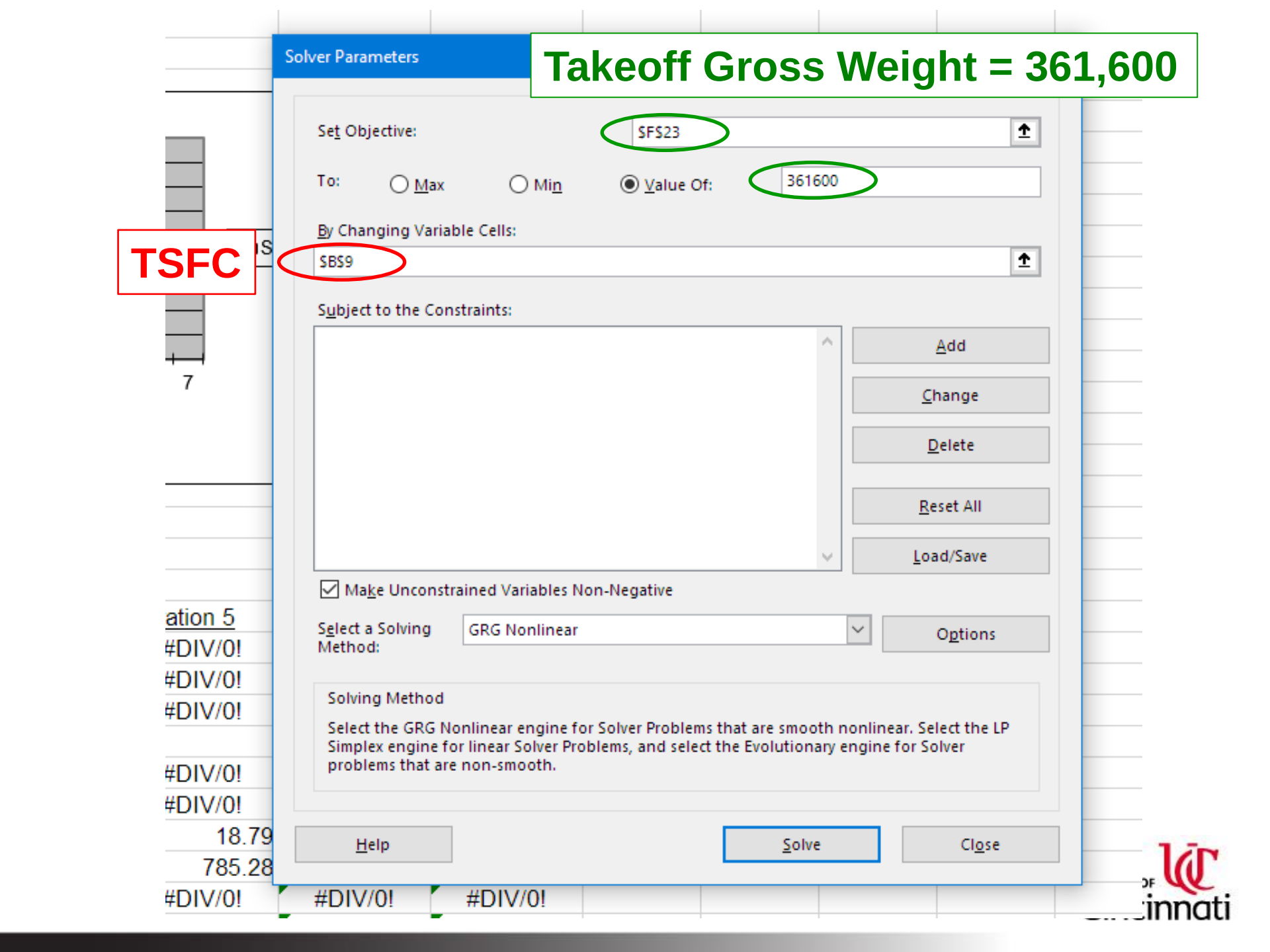
Select the GRG Nonlinear engine for Solver Problems that are smooth nonlinear. Select the LP Simplex engine for linear Solver Problems, and select the Evolutionary engine for Solver problems that are non-smooth.

Help | Solve | Close

ITERTOW

Point

Type here to search


Takeoff Gross Weight = 361,600
TSFC
Solver Parameters
Set Objective:
F23
To:
Max
Min
Value Of:
361600
By Changing Variable Cells:
B9
Subject to the Constraints:
Add
Change
Delete
Reset All
Load/Save
Make Unconstrained Variables Non-Negative
Select a Solving Method:
GRG Nonlinear
Options
Solving Method
Select the GRG Nonlinear engine for Solver Problems that are smooth nonlinear. Select the LP Simplex engine for linear Solver Problems, and select the Evolutionary engine for Solver problems that are non-smooth.
Help
Solve
Close
ation 5
#DIV/0!
#DIV/0!
#DIV/0!
#DIV/0!
#DIV/0!
18.79
785.28
#DIV/0!
#DIV/0!
#DIV/0!
7

AutoSave Off | 1 - ITERTOW with Solver.xlsx | Search

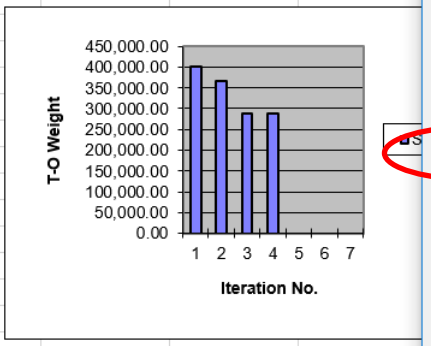
File Home Insert Page Layout Formulas Data Review View Developer Help

Get Data | From Text/CSV | From Web | From Table/ Range | Recent Sources | Existing Connections | Refresh All | Queries & Connections | Properties | Edit Links | Stocks | Geography | Sort | Filter | Clear | Reapply | Advanced | Text to Columns | Flash Fill | Remove Duplicates | Data Validation | Consolidate | Relationships | Manage Data Model | What-If Analysis | Forecast Sheet

Get & Transform Data | Queries & Connections | Data Types | Sort & Filter | Data Tools | Forecast

CMN | =E23-E25/((E25-D25)/(E23-D23))

	A	B	C	D	E	F	G	H	I
1		Mission Requirements							
2									
3	Max. Mach	0.85							
4	Cruise Mach	0.8							
5	Cruise Alt. (ft)	36,000							
6	Range (nm)	5,200							
7	Payload: Non-exp. (lb)	84,000							
8									
9	Engine: TSFC Min.	0.200000							
10	Engine: Thrust (lbs)	128,000							
11	Aspect Ratio	8.79							
12	Structure Factor	0.5069							
13									
14	Loiter: Time (min)	45							
15	Loiter: Altitude (ft)	10,000							
16	Fuel Reserve (%)	5							
17	Trapped Fuel (%)	1							
18									
19									
20									
21									
22			Iteration 1	Iteration 2	Iteration 3	Iteration 4	Iteration 5		
23	Weight: T-O (estimated)	400,000	400,000.00	367,139.31	287,521.84	287,521.84	#DIV/0!		
24	Weight: T-O (final)		367,139.31	343,878.93	287,521.84	287,521.84	#DIV/0!		
25	Surplus Empty Wt. (lbs)		32,860.69	23,260.38	0.00	0.00	#DIV/0!		
26									
27	1. Start-up & T-O		390,000.00	357,960.83	280,333.79	280,333.79	#DIV/0!		
28	2. Climb & Accel. to Cruise		377,520.00	346,506.08	271,363.11	271,363.11	#DIV/0!		
29	3a. L/D		18.79	18.79	18.79	18.79	18.79		
30	3b. V (f/s)		785.28	785.28	785.28	785.28	785.28		
31	3c. Cruise to destination		335,152.70	307,619.32	240,909.30	240,909.30	#DIV/0!	#DIV/0!	#DIV/0!
32	4. Loiter		332,487.83	305,173.39	238,993.78	238,993.78	#DIV/0!	#DIV/0!	#DIV/0!
33	5. Land		324,175.64	297,544.05	233,018.94	233,018.94	#DIV/0!	#DIV/0!	#DIV/0!
34									
35	Total Fuel Wt. (lbs)		80,373.82	73,770.98	57,773.07	57,773.07	#DIV/0!	#DIV/0!	#DIV/0!
36	Available Empty Wt. (lbs)		235,626.18	209,368.33	145,748.76	145,748.76	#DIV/0!	#DIV/0!	#DIV/0!
37	Required Empty Wt. (lbs)		202,765.49	186,107.95	145,748.76	145,748.76	#DIV/0!	#DIV/0!	#DIV/0!
38									



Solver Parameters

Set Objective: F23

To: Max Min Value Of: 361600

By Changing Variable Cells: B9

Subject to the Constraints:

Add | Change | Delete | Reset All | Load/Save

Make Unconstrained Variables Non-Negative

Select a Solving Method: GRG Nonlinear | Options

Solving Method

Select the GRG Nonlinear engine for Solver Problems that are smooth nonlinear. Select the LP Simplex engine for linear Solver Problems, and select the Evolutionary engine for Solver problems that are non-smooth.

Help | Solve | Close

ITERTOW

Point

Type here to search

	Mission Requirements
Max. Mach	0.85
Cruise Mach	0.8
Cruise Alt. (ft)	36,000
Range (nm)	5,200
Payload: Non-exp. (lb)	84,000
Engine: TSFC Min.	0.313707
Engine: Thrust (lbs)	128,000
Aspect Ratio	8.79
Structure Factor	0.5069
Loiter: Time (min)	45
Loiter: Altitude (ft)	10,000
Fuel Reserve (%)	5
Trapped Fuel (%)	1

ITERTOW.XLS

Find the TSFC that will result in

Takeoff Gross Weight = 361,600

Empty Weight = 183,300

		Iteration 1	Iteration 2	Iteration 3	Iteration 4	Iteration 5	Iteration 6	Iteration 7
Weight: T-O (estimated)	400,000	400,000.00	391,079.65	361,600.00	361,600.00	#DIV/0!	#DIV/0!	#DIV/0!
Weight: T-O (final)		391,079.65	384,231.50	361,600.00	361,600.00	#DIV/0!	#DIV/0!	#DIV/0!
Surplus Empty Wt. (lbs)		8,920.35	6,848.15	0.00	0.00	#DIV/0!	#DIV/0!	#DIV/0!
1. Start-up & T-O		390,000.00	381,302.66	352,560.00	352,560.00	#DIV/0!	#DIV/0!	#DIV/0!
2. Climb & Accel. to Cruise		377,520.00	369,100.97	341,278.08	341,278.08	#DIV/0!	#DIV/0!	#DIV/0!
3a. L/D		18.79	18.79	18.79	18.79	18.79	18.79	18.79
3b. V (f/s)		785.28	785.28	785.28	785.28	785.28	785.28	785.28
3c. Cruise to destination		313,221.07	306,235.96	283,151.85	283,151.85	#DIV/0!	#DIV/0!	#DIV/0!
4. Loiter		309,323.50	302,425.32	279,628.45	279,628.45	#DIV/0!	#DIV/0!	#DIV/0!
5. Land		301,590.42	294,864.68	272,637.74	272,637.74	#DIV/0!	#DIV/0!	#DIV/0!
Total Fuel Wt. (lbs)		104,314.16	101,987.86	94,300.00	94,300.00	#DIV/0!	#DIV/0!	#DIV/0!
Available Empty Wt. (lbs)		211,685.84	205,091.78	183,300.00	183,300.00	#DIV/0!	#DIV/0!	#DIV/0!
Required Empty Wt. (lbs)		202,765.49	198,243.64	183,300.00	183,300.00	#DIV/0!	#DIV/0!	#DIV/0!

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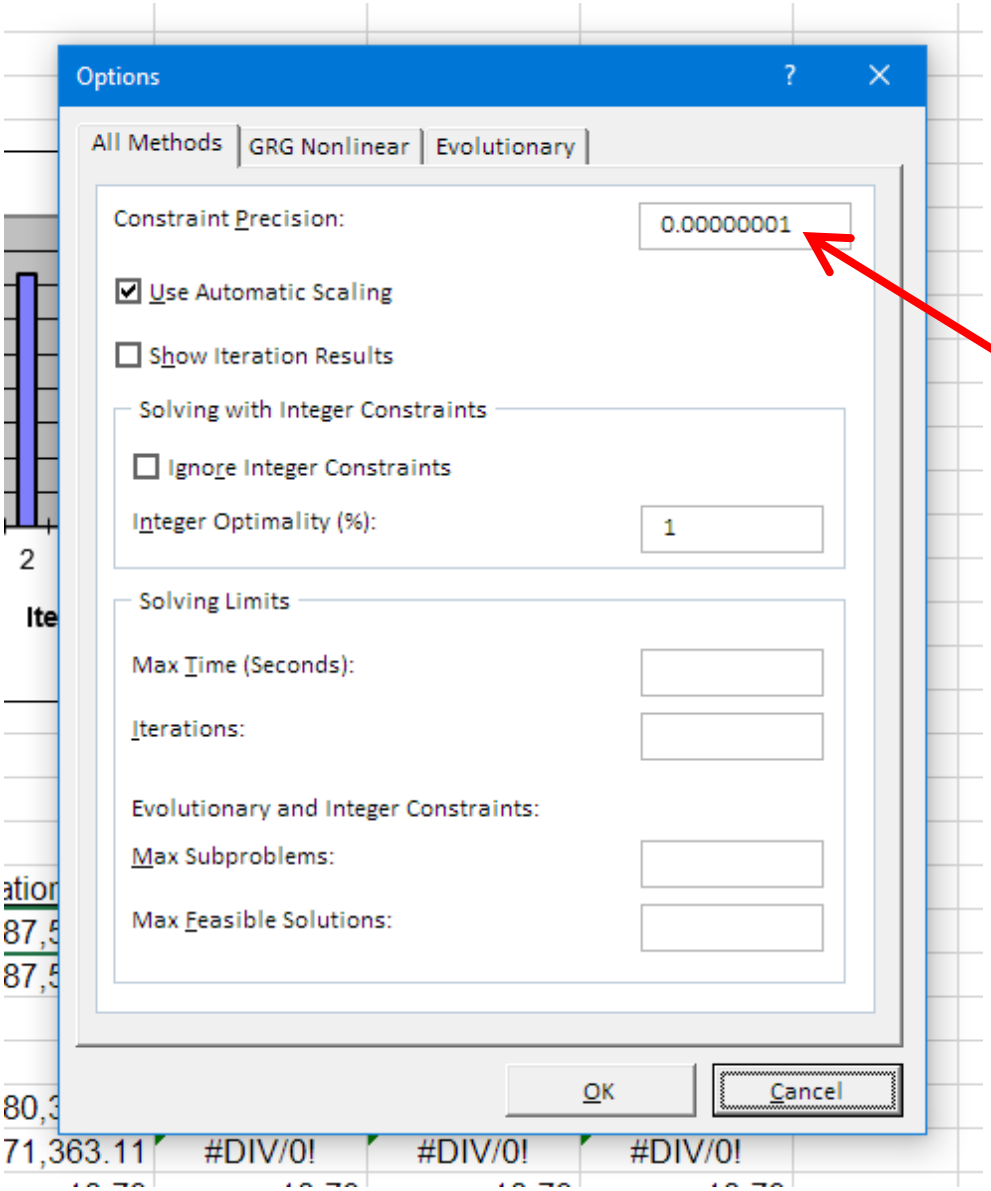

Use this precision value to get really close!

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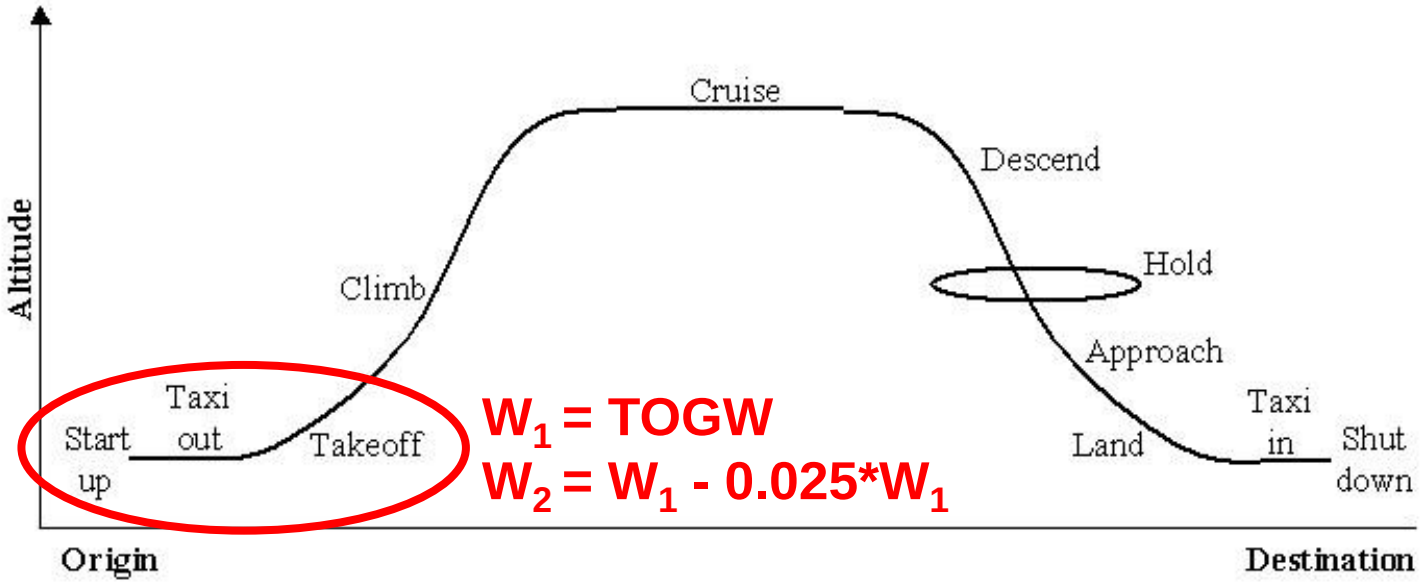
Airliner Flight Profile

How does the ITERTOW spreadsheet work?

Start-up, Taxi, and Takeoff from the Origination Airport
Climb to Cruise Altitude
Cruise to Destination Area
Descend into Destination Airport
Land with Fuel Reserves, Taxi to Gate, and Shut-down



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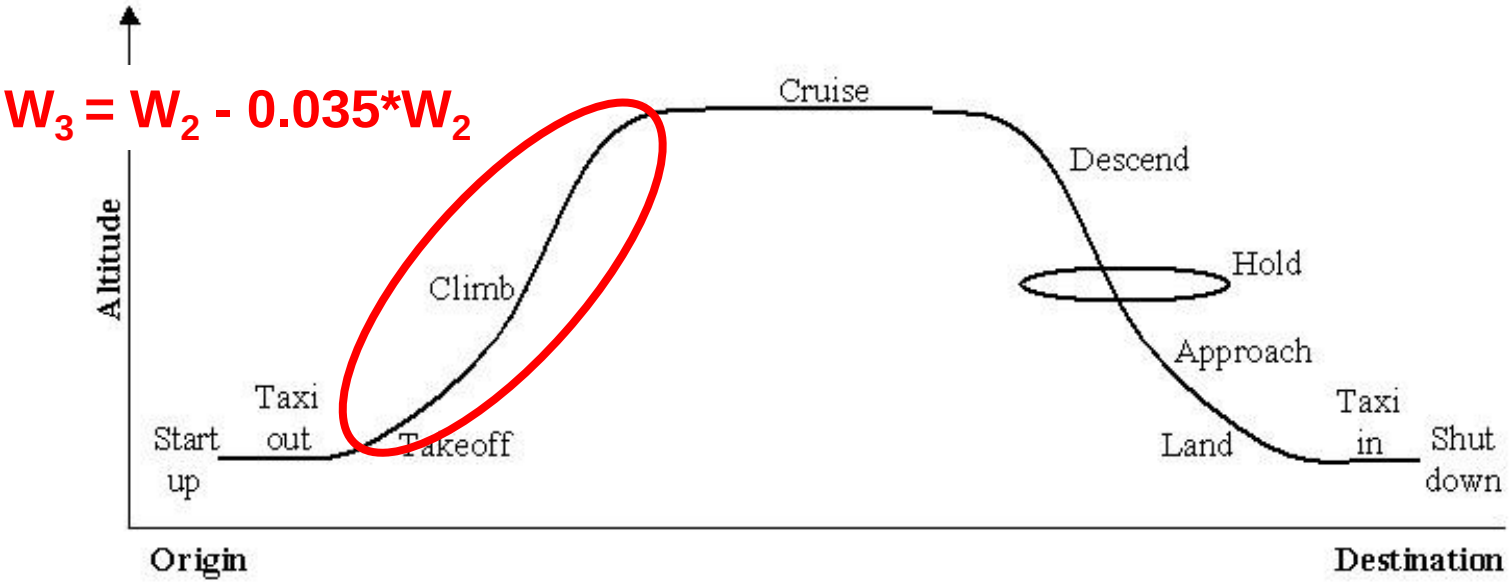
Cruise to Destination Area

Descend into Destination Airport

Land with Fuel Reserves, Taxi to Gate, and Shut-down



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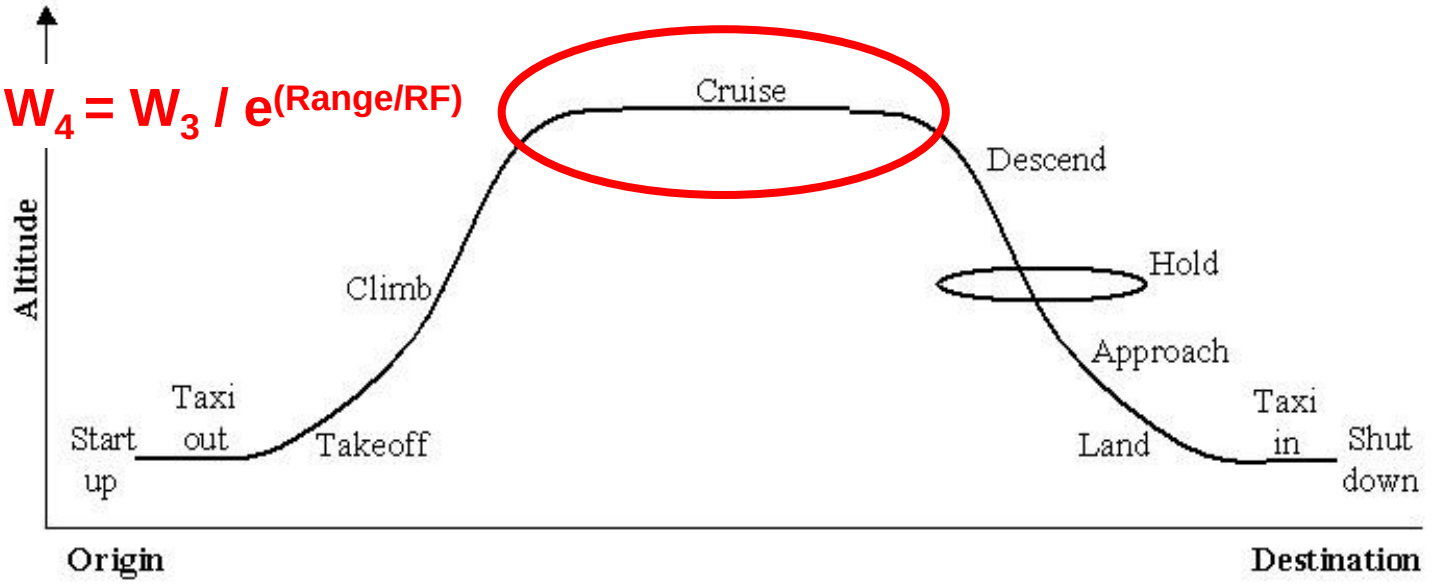

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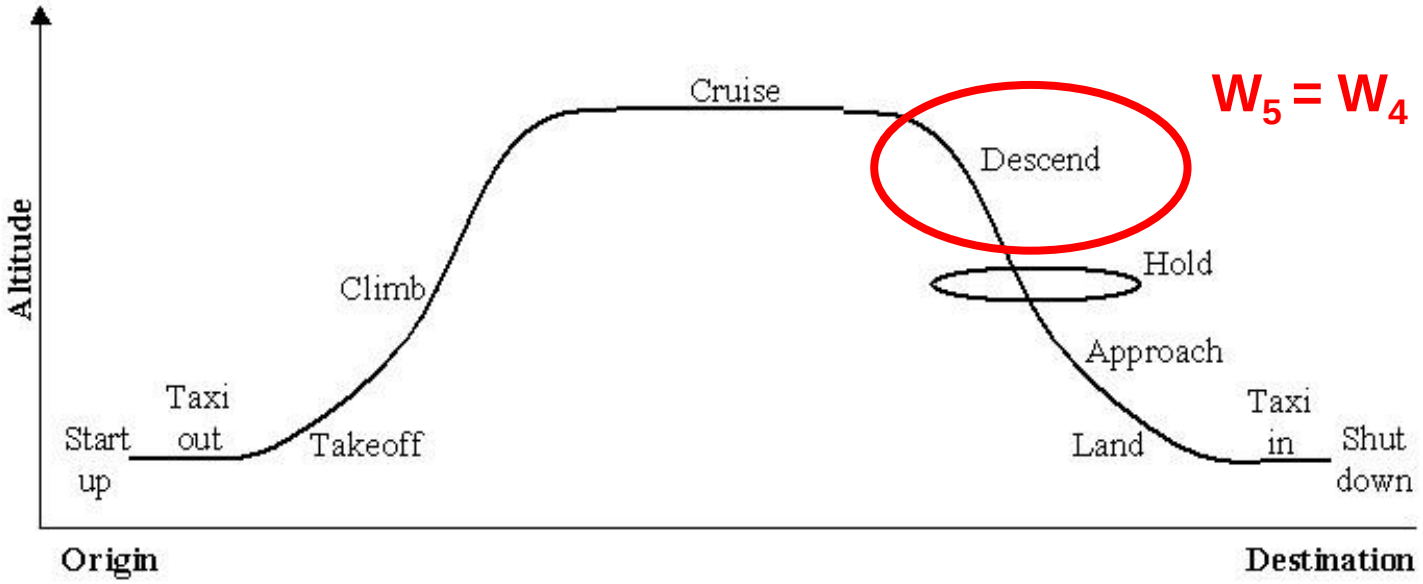

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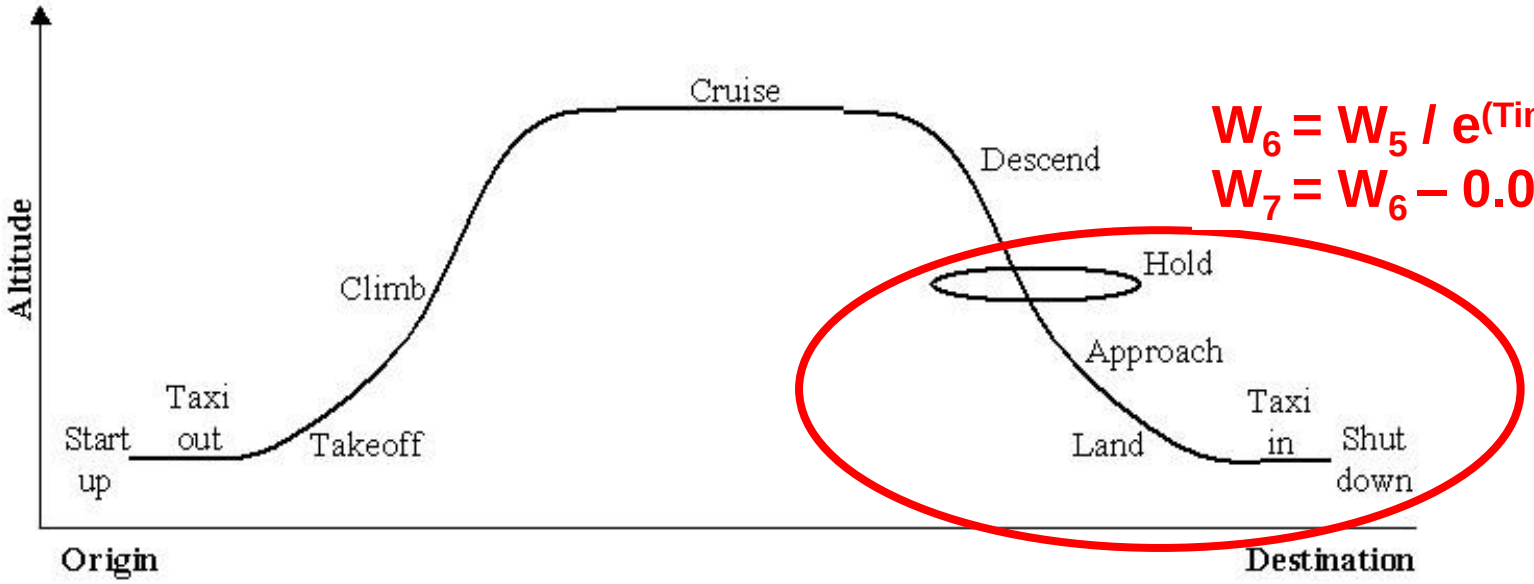

$W_6 = W_5 / e^{(Time/EF)}$

$W_7 = W_6 - 0.025*W_6$

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Homework Assignment

HW #19 – Aircraft Design - Weights
(due by 11:59 pm ET on Monday)

<u>HW Help Session</u>
Monday 4:00 – 5:00 pm ET

<u>Posted on Canvas</u>
HW #19 Assignment with instructions, tips, and checklist
ITERTOW.XLS Excel file

Teams must get confirmation from the TA that their TSFC value is correct before moving on to new HW assignments

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Questions?