Assignment 5: Maneuvering Performance, ETOPS and BADA

Solution Instructor: Trani

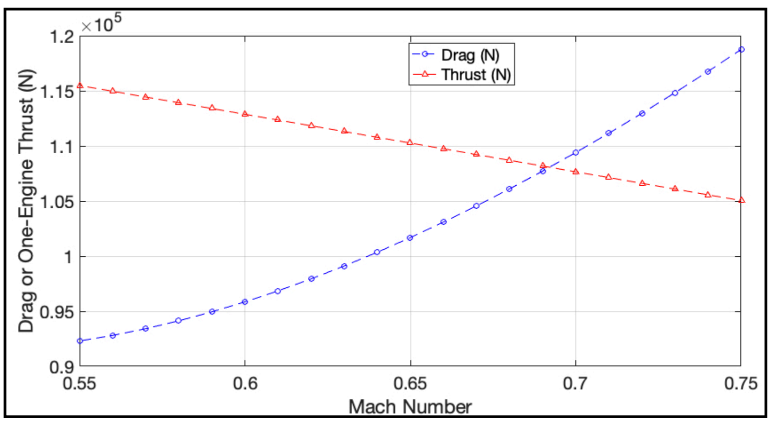
Problem 1

Use the data for the transport aircraft similar to the Boeing 787-8 (http://128.173.204.63/courses/cee5614/cee5614_pub/boeing787_class.m) to answer this problem.

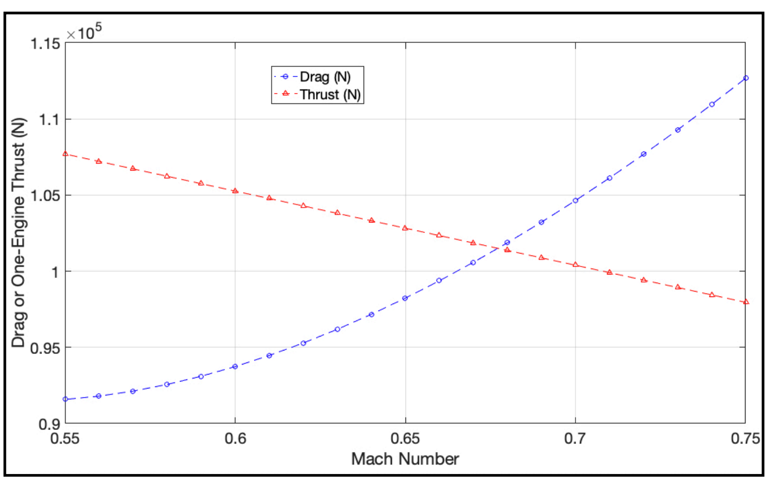
The aircraft is in cruise at FL 350 with a mass of 195,000 kgs and the fuel remaining at that point is 32,000 kilograms.

a) The aircraft has an engine failure over the ocean at the conditions stated above. Estimate the best altitude and Mach number to divert to an alternative airport. Explain your selection procedure. Avoid speeds that are on the back side of the drag curve.

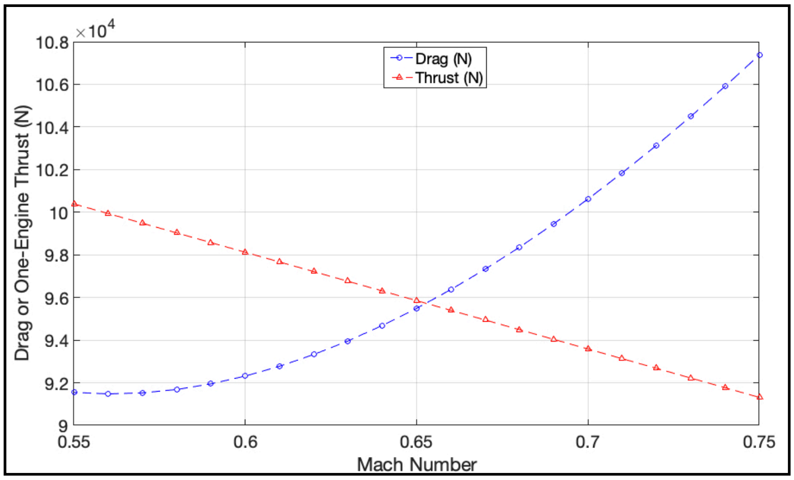
At 22,000 feet



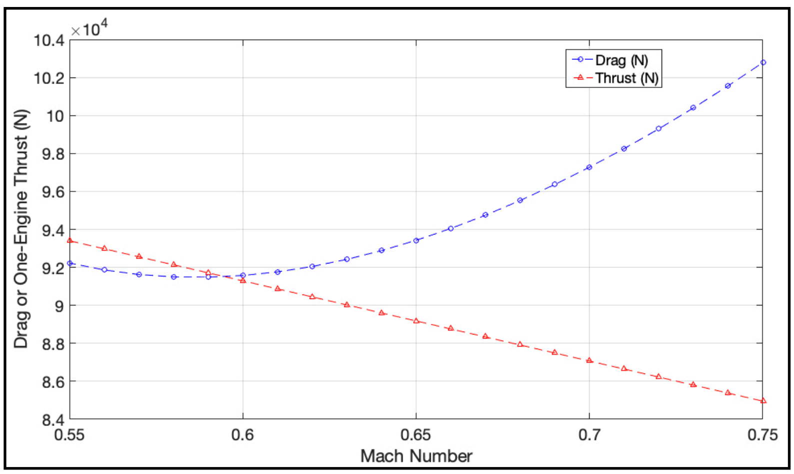
At 24,000 feet



At 26,000 feet



At 28,000 feet



Based on the plots above, feasible altitudes for a one-engine ETOPS operation are 22,000, 24,000 and 26,000 feet. 28,000 feet offers no margin for maneuvering. 22,000 feet offer the best Mach number range. For example, we could fly at Mach 0.65 at 22,000 feet.

b) The closest alternative airport selected in the flight plan is located 900 nm from the engine failure point. Assume no wind conditions and ISA atmospheric conditions in the calculation. Estimate the travel time to the alternate airport and state if the flight can be operated as an ETOPS 180 (minutes) flight. Assume the alternative airport is at sea level.

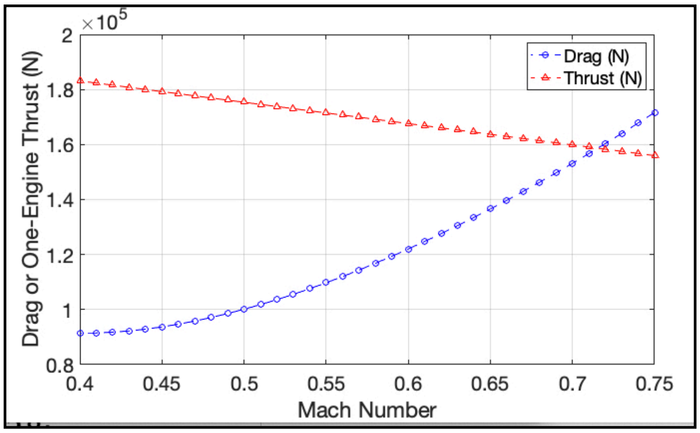
At 22,000 feet, the speed of sound is 313.5 m/s. Cruising at Mach 0,65 to the alternate, the aircraft true airspeed is then 396 knots (204 m/s). The alternative can be reached within the ETOPS 180 minute rule (3 hours time).

c) Do not perform computations. State what would be different if the aircraft has a failure of one engine and also a pressurization failure.

Pressurization fair means the aircraft descends to 10,000 feet instead. One engine speed is still restricted according to the figure below. Note that normally at 10,000 feet the aircraft will fly at a slower speed because of the potential of bird strikes. If we restrict the aircraft speed to 250 knots indicated at 10,000 feet the true airspeed is 279 knots. Such speed will not satisfy the ETOPS 180 criteria. The bottom line, the aircraft will have to either:

a) Fly another route closer to land

b) Speed up above 300 knots true airspeed to reach the alternative within the 180 minute limit.



c) If the aircraft flies over high terrain near the Dhaulagiri (see article in https://en.wikipedia.org/wiki/Dhaulagiri) as the engine fails, what actions would the pilot have to take to avoid an accident?

The pilot needs to aware of the terrain below. Flying at 24,000 feet or even 26,000 feet with one engine may offer advantages over flying at 22,000 feet over the ocean. Escape routes need to be available at any time flying at night over the Himalayas.