Scenario Clarifications/ Errata

Updated 04.03.2024

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Scenario 1

For the landing distance equation, instead of Eq. 1 stated in the scenario, please use the following equations:

$S_L = S_A + S_B$	• S_L = landing distance [m] • S_A = prior to braking distance [m] • S_B = after braking distance [m]
$\mu_{rolling} = 0.02$ $\mu_b = 0.5$	• Coefficients of Friction (dimensionless) • Note when each coefficient is to be used • $\mu_{rolling}$: use in the calculations for prior to braking distance • μ_b: use in the calculations for after braking distance
Ground Drag Coefficient $$C_{D_g} = \frac{2T_{ac}}{\rho(1.3V_s)^2 S_{ref}}$$ **Note:** V_s is given with respect to certain atmospheric conditions (STP, where ρ=1.225). As such the drag coefficient for the Boeing 747 aircraft can be treated as a constant (**0.070138138**) for the calculation. The constant values for other aircraft would be different, and you can calculate it with the above equation under STP conditions.	• ρ = air density [kg/m^3] = 1.225 • S_{ref} = wing reference area [m^2]; use the value for Boeing 747-8F (511 m^2) • T_{ac} = aircraft thrust [N]. Since landing is being considered in this scenario, the aircraft thrust will be small in comparison to thrust needed for cruise speed at altitude. As a default, use the value for the Boeing 747-8F (13,000 lbf = 59,185 Newtons) • V_s = stall velocity [m/s]; as a default use the value for Boeing 747-8F (101 mph)
Ground Lift Coefficient $$C_{L_g} = \frac{2W_L}{\rho(1.3V_s)^2 S_{ref}}$$ **Note:** V_s is given with respect to certain atmospheric conditions (STP, where ρ=1.225). As such the lift coefficient for the Boeing 747 aircraft can be treated as a constant (**0.391071817**) for the calculation. The constant values for other aircraft would be different, and you can calculate it with the above equation under STP conditions.	• W_L = landing weight [kg]; as a default use the value for Boeing 747-8 (weight = 330,000 kg) • ρ = air density [kg/m^3] = 1.225 • S_{ref} = wing reference area [m^2]; use the value for Boeing 747-8F (511 m^2) • V_s = stall velocity [m/s]; as a default use the value for Boeing 747-8F (101 mph)

Variable **A** $$A = -g\mu$$	• g = gravitational acceleration = 9.80665 [m/sec^2] • *Note the correct coefficient to be used*
Variable **B** $$B = \frac{g}{W_L}\left[\frac{1}{2}\rho S_{ref}(C_{D_g} - \mu C_{L_g})\right]$$	• *Note the correct coefficient to be used* • ρ = air density [kg/m^3] • S_{ref} = wing reference area [m^2]; use the value for Boeing 747-8F (511 m^2) • g = gravitational acceleration = 9.80665 [m/sec^2] • W_L = landing weight [kg]; as a default use the value for Boeing 747-8 (weight = 330,000 kg)
Distance Before Braking: $$S_A = \frac{1}{2B}\ln\left[\frac{A - B(1.3V_s)^2}{A - B(1.04V_s)^2}\right]$$	• For the before braking distance, we need to calculate the variables A and B. Remember to use the correct friction coefficient ($\mu_{rolling}$) in the calculations for A and B. • V_s = stall velocity [m/s]; as a default use the value for Boeing 747-8F (101 mph)
Distance After Braking: $$S_B = \frac{1}{2B}\ln\left[\frac{A - B(1.04V_s)^2}{A}\right]$$	• For the after braking distance, we need to recalculate the variables A and B. Remember to use the correct friction coefficient (μ_b) in the calculations for A and B. • V_s = stall velocity [m/s]; as a default use the value for Boeing 747-8F (101 mph)

In addition, for Question 6, we are adding a second part, Q6b:

"In this scenario, we used various simplifications for the equations relating to landing distance as described in various textbooks (with simplified assumptions). Compare your plots against the plots in Zhu et al (2016) (https://www.worldscientific.com/doi/10.1142/S2010194516601745), where the equations for calculating landing distance are much more involved. How do your plots compare, and what are the implications of using the simplified equations for this scenario?"

i. In Barometric Law (Equation 8 in original scenario doc), let Hb = 0m
ii. For Q5b, ignore the bullet on "Assume ISA standard conditions…" Explanation was sent via Teams to Workbench and Baseline modelers, and by email on Friday, Mach 29th.
iii. For Table 2, C-5 Wing Area should be 576.1 m^2
iv. For Table 2, the 'Per Engine Thrust' should be changed to total thrust for the aircraft

Scenario 2

i. Use this data set for Greenland ice thickness: https://nsidc.org/data/idbmg4/versions/5. Smaller version can be found here: https://drive.google.com/file/d/1RVklSiWkG99iGFZA97piQxMNh-bpzpIF/view?usp=drive_link

ii. For anything in the scenario stating "2019", use data from "1993" instead (first year of above dataset)

Scenario 3

i. See https://github.com/fund-model/MimiFUND.jl/blob/master/examples/main.jl for boilerplate code for running model