Math Notes

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Many people have an aversion to mathematics. Typically that aversion is because someone once told them that mathematics was hard or they had no head for mathematics or because mathematics was initially presented to them in an inappropriate manner.

Fundamentally, you can consider mathematics as a language. It has a syntax, construction rules, spelling rules, etc. In fact, mathematics is a shorthand language in which simple symbols stand for complex concepts in order to simplify communication. Is that not the purpose of language? Every discipline, be it mathematics, aeronautical engineering, flying, accountancy, business or carpentry, has its own language. If you do not understand the language, then you have difficulty communicating in that discipline.

To understand most of the mathematics in my technical flying articles you need only to understand what an equation is and fractions. Fractions you learned in school, but we'll review them. If you took algebra (sorry I know that is a dirty word), then you ran into equations. Again, we'll review them in a simple way.

An equation has two parts – the left hand part which we call the Result and the right hand part which we call the Input – separated by an equal sign (=). Here is an example

$$\text{Result} \;=\; \text{Input} \qquad \text{or} \qquad R = I$$

Let's read this mathematical sentence: The Result (R) is equal to the Input (I). Alternatively, we can read the sentence somewhat differently: If we know all the Input, the Result can be determined. Now let's add some detail to the equation

$$\text{Result} \;=\; \frac{\text{Numerator}}{\text{Denominator}} \qquad \text{or} \qquad R = \frac{N}{D}$$

Now let's look at the fraction, N/D, to see what happens when we change the values of the numerator, N, while keeping the value of the denominator, D, the same, i.e., constant.

If the numerator, N, increases, the Result, R, increases.

If N decreases, then R decreases.

Now let's keep the value of the numerator, N, constant while changing the denominator, D

If D increases, then R decreases.

If D decreases, then R increases.

We are almost done. Suppose that the equation has two terms on the righthand side, e.g.

$$R = \frac{(a)(N_1)}{D_1} + \frac{N_2}{(a)(D_2)}$$

where a is a parameter that appears in the numerator of the first term and also in the denomenator of the second term as shown. If a increases, then the first term increases while the second term decreases. However, if a decreases, then the first term decreases while the second term increases. In this case, you really can't say exactly what will happen to the result R. What you can say is that as you change the value of a at some point R will have either a maximum or a minimum value. Why is this important? Because this phenomena occurs frequently in aircraft performance. For example, remember from ground school that total drag is composed of two types of drag – induced drag and parasite drag, i.e., the drag equation has two terms on the right hand side. As the velocity increases the induced drag term decreases because the velocity is in the denominator of the induced drag term. On the other hand the parasite drag increases as the velocity increases

because the velocity is in the numerator of the parasite drag term. Hence, the Result, i.e., the drag, passes through a minimum as the velocity increases from the stall velocity to the maximum aircraft velocity.

Hopefully, you have stuck with me. So, let me ask you some questions: Is flying hard? Are the basic stick and rudder skills hard? Well no, it just takes work, desire and practice to master them. Was ground school hard? Well perhaps, but work and desire allowed you to master them. Is aeronautical decision making hard? Well, yes, but work, desire and *experience* make it easier. And, so it is with mathematics. I hope this helps.