MU-2 Direct Costs of Operation
By Rick Wheldon

Every operator is concerned with the costs of flying his airplane, and MU-2 operators are no different. What altitude gives the best cost numbers, or lowest fuel consumption, or shortest flight time? In order to evaluate what effects differing operating techniques play in the equation, I pulled out our flight planning software and refined the program with about three years of operating data for our Marquise, N794MA. After plugging the numbers, I found that I could predict the actual fuel burn and speed for any given trip to within 60 or 70 pounds and 3 minutes. Once the computer model was close, then it became possible to analyze any given hypothetical trip, varying one condition at a time, and clearly see what effects that factor had on the cost, fuel or time parameters.

First, we had to establish the methodology. Numbers for the cost of fuel, maintenance and engine reserve needed to be established. I selected data from one of the sales organizations that publish fleet averages for these numbers. While the data may not accurately reflect your operation, it does establish a reasonable standard for purposes of this study. I used fuel at $2.51 a gallon, maintenance at $253.08 per hour, and engine reserve at $100.06 per hour.

One parameter that the pilot has control over is altitude selection. It is commonly understood that higher altitudes reduce fuel burn, but true airspeeds are lower at those higher altitudes. If we assume that maintenance costs and engine reserve costs are a function of flight hours only, then maintenance costs increase with altitude.

Let’s look at a trip of about 1 hour – Lafayette LA to Addison, TX (Table 1). We’ll analyze this trip at three different cruise altitudes, 16,000 feet, 20,000 feet, and 24,000 feet, and use minimum fuel reserve and no wind for all legs. Plug this data into the computer and we find the following:

Altitude	16000	20000	24000
Wind	0	0	0
Flight time	1+06	1+08	1+09
Maintenance	$276.94	$286.48	$289.16
Eng reserve	$109.49	$113.26	$114.33
Fuel cost	$304.36	$296.67	$287.23
Total cost	$690.79	$696.41	$690.72

Table 1

This table demonstrates that, in a no wind condition on a relatively short trip, the cost of operation is substantially the same at most operational altitudes. The fuel cost savings are offset by higher maintenance costs due to longer trip times. No cost argument can be made for selecting one altitude over another.

What if the trip is a little longer? Do the same rules hold up, and do all altitudes reflect identical costs? To find out, we can look at a trip from Atlanta, GA (PDK) to Addison, TX (Table 2), using the same parameters.

Altitude	16000	20000	24000
Wind	0	0	0
Flight time	2+10	2+13	2+14
Maintenance	$550.31	$559.67	$566.26
Eng reserve	$217.58	$221.28	$223.88
Fuel cost	$589.16	$550.27	$515.63
Total cost	$1,357.05	$1,331.22	$1,305.77
Cost per NM	$2.19	$2.15	$2.11

Table 2

As can be seen, for the longer trips, it is clearly less expensive to operate at higher altitudes. For this 2 hour plus trip, the savings are approximately 4% by cruising at 24,000 feet rather than 16,000 feet. Some may find it odd that there was no cost advantage for cruising at higher altitudes on the shorter trip while on and the longer trip, there was a definite advantage at higher altitudes. This might be easily understood by remembering that a greater portion of the shorter trip was flown in the less efficient climb and descent phases, negating any advantages during cruise.

Next, let’s look at how wind gradients affect trip costs. In general terms, winds travel from west to east, and winds at higher altitudes are generally stronger than those down low. Therefore, a pilot can expect to see stronger tailwinds heading eastbound as he climbs. The central issue here is wind gradient – if there is no variation in winds as altitude increases, the analysis is similar to the no wind case and small cost advantages are experienced on longer trips.

Table 3 is data for an increasing tailwind with altitude for the PDK to ADS trip. We will assume a 2 ½ knot tailwind gradient per 1000 feet of altitude change, with tailwinds at the three altitudes of 40, 50 and 60 knots. Let’s look at the data.

Altitude	16000	20000	24000
Tailwind	40 knots	50 knots	60 knots
Flight time	1+57	1+56	1+55
Maintenance	$491.49	$489.42	$485.71
Eng reserve	$194.32	$193.50	$192.03
Fuel cost	$527.82	$484.89	$448.98
Total cost	$1,213.63	$1,167.81	$1,126.72
Cost per NM	$1.96	$1.89	$1.82

Table 3

As can be seen clearly from Table 3, if there is a positive wind gradient, there are clear cost benefits to flying at the higher altitudes. With a 2 ½ knot gradient, the cost savings approach 8 % by flying at the higher altitudes. Also, note that the flight time is actually shorter with the positive wind gradient.

What about the headwind gradient scenario? Table 4 presents this data.

Altitude	16000	20000	24000
Headwind	40 knots	50 knots	60 knots
Flight time	2+29	2+36	2+43
Maintenance	$627.87	$659.01	$689.15
Eng reserve	$248.24	$260.55	$272.47
Fuel cost	$670.05	$642.72	$617.29
Total cost	$1,546.16	$1,562.28	$1,578.91
Cost per NM	$2.50	$2.53	$2.55

Table 4

The conclusions are obvious for this headwind gradient – select lower cruise altitudes. This 2 ½ knot gradient illustrated in Table 4 results in a 2% cost savings by cruising at 16000 feet rather than 24000 feet. Since, in Table 2 we saw that there was a 4% cost advantage by flying higher in a no wind situation, it appears that the break even wind gradient is somewhere in the order of 1 ½ knots per 1000 feet. In other words, if cost is your main concern, then select higher altitudes unless the headwind gradient exceeds 1 ½ knots.

One other point I would like to make here. – this analysis is dependent on cost assumptions. If fuel is bought at a lower price than $2.51, fuel becomes less important to the overall cost. Proportionately greater savings are generated by reducing flight time and maintenance costs. However, if maintenance and engine reserve are lower than the numbers we used, then fuel cost becomes relatively more important. For most operations, however, the effects on this analysis would be minimal.

Let’s review. For our airplane on short trips, altitude selection will not have much of an effect on trip cost. Savings due to shorter trip times at low altitudes will be offset by slightly higher fuel costs. We can still use wind gradients as an aid in selecting cruise altitude, but trip savings will be minimal. However, longer trips present us with an opportunity to control our costs substantially. Savings can be achieved by flying higher whenever there is a tailwind gradient or a headwind gradient of less than 1 ½ knots. For a pilot flying 300 hours per year, a 2% savings equates to over $4,000 in the pocket at the end of the year that would not have been there otherwise. Therefore, it might be worth the effort to closely check the winds aloft forecasts along your route of flight as part of your preflight routine.