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Practical Solutions in Advanced Financial Modeling

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BEST, WORST & EXPECTED CASE COSTING:
Applicability to Flight Services Planning

We have all seen them at one point in time. Those quasi-'income statement' financial reports that attempt to quantify the outcome of a projected service or activity - adding a new executive charter service to the operation, for example. Rather than just providing a one-dimensional view of what we expect to earn in Revenues and what the related Operational Expenses will be, these projections attempt to garner extra credibility by also including a "Worst-Case" and "Best-Case" scenario. What is the theory behind these predictions? More importantly, does the added information provided actually enhance or detract from the assessment of your project when viewed by outside investors or lenders?

The mechanics of the process is quite simple. It requires you to predict the plausible range of all unit Revenues, Expenses and Operational Factors for every variable associated with the service. If, for example, you expected that JetA Fuel many range from US $2.52 to $2.97/gallon and burn-rate will range from 625 lb./hr to 715 lb./hr, then the Worst Case prediction would be calculated using the $2.97 price @ a 715 lb./hr burn whereas the Best Case would assume $2.52/gallon @ a 625 lb./hr burn. In a similar fashion, all the variables (which may number in the hundreds) in your financial prediction would be calculated at the extremes of their ranges. At the end you would have derived the Best and Worst Cases. The Expected Case, of course, is simply the mathematical average of the extremes. With respect to fuel, for example, the Expected Case would be projected upon a price of US $2.745/gallon [($2.52 + $2.97)/2] and a burn-rate of 670 lb./hr [(625 + 715)/2].

The theory behind the Best/Worst Case scenario is elementary statistics and depends upon the assumption that every outcome between the two extremes is *normally distributed* (i.e. has a equal probability of occurring). The two extreme outcomes of a fairly-weighted die, for example, is 1 and 6.

The Expected Outcome (the average), of a sufficiently large number of die throws would be 3.5 [(1+2+3+4+5+6)/6 = 3.5][1]. So, in our example, the throw of a One may be the Worst Case (i.e. the highest fuel rates, highest burn-rates, highest insurance premiums, lowest charter miles sold, lowest revenue price per mile, etc.) And the Best Case would represent a throw of Six.

Consider the following ***grossly*** oversimplified case:

Charter Revenues are expected to range

- between CDN $6.50 and $8.00 per N. Mi.
- Expected Sales: 96,000 to 128,000 N. Mi./year
- Expected Ground Speed: 205 to 265 KTS
- Expected US$ Variable Operating Costs: US $310.00 to $390.00 hour
- Expected US$/CDN$ Exchange Rate: CDN $0.65 to $0.73
- Expected CDN$ Variable Operating Costs: CDN $275 to $317 hour
- Expected Fixed Incremental Costs: CDN $217,000 to $283,000

produces the following expected annual results seen in Table 1.

[1] Of course, anyone who has ever thrown the die once and achieved the Expected Outcome of 3.5 needs to have their prescription checked.

Table 1

(all CDN$ except USD Vari. Costs)	Expected	Best Case	Worst Case
EXPECTED CHARTER REVENUES	$ 812,000	$ 1,024,000	$ 624,000
CASH OPERATING EXPENSES			
USD Variable Expenses (in US$)	166,478	149,730	182,637
Foreign Exchange Effect	74,794	55,380	98,343
CDN$ Variable Expenses	140,792	132,825	148,451
Fixed Incremental Costs	250,000	217,000	283,000
TOTAL OPERATING EXPENSES	632,064	554,935	712,431
Net Expected Cash Profit / (Loss)	179,936	469,065	(88,431)

CREDIBILITY OF THE BEST/WORST CASE SCENARIOS

In theory, any process that promotes a more in-depth understanding of a potential business outcome should be looked upon favourably by potential investors and/or creditors. Each of the predicted ranges appears to be quite reasonable and demonstrates that the Estimator has a good understanding of all the potential sources of project volatility. However, the actual predictions generated by the model are not as useful as they should be. The outsider may begin to question whether the Estimator has a really good understanding of the elements involved. The Worst to Best potential cash payoff, for example, amounts to a huge $557K ($469K - - 88K)! Relative to the Expected Payoff of $180K, the upside could be $289K more or it could be $268K less. Hoping to attract a potential investor based upon such a range would be very similar to your stock broker attempting to convince you to purchase a given share certificate based on the estimate that the annual Earnings Per Share (EPS) was expected to come out at $0.18/share but could go as high as $0.47, or maybe they will wind up losing $0.09/share.

Faced with such volatility, the Estimator usually starts second-guessing his/her initial range estimates in order to manipulate the scenario outcomes. It is as this point, of course, that objectivity is lost. While the initial extreme ranges seemed entirely representative of reality when the Estimator started the projection - they wind up becoming a biassed input created to force a predetermined result.

THE PROBLEM WITH BEST/WORST CASE BUDGET SCENARIOS

Best/Worst Case predictions often produce results far more volatile than would ever happen in reality and the reason why is inherent in the process itself. Assuming, for example, that all the project variables involved (and there could be hundreds) are *all* going to turn out to be the *Worst Case* is precisely the same as expecting to roll a fairly-weighted die several hundred times and only achieving “Ones”. Conversely, the *Best Case* would require several hundred “Six’s” to be produced. Such a skewed result would defy the laws of probability.

ACTUAL OUTCOMES

In reality, the range of volatility predicted for individual variables, such as fuel price or sold miles or ground speed does occur, but the incurrence of one or two Worst Case extremes is almost always offset by other counter-balancing Best Case variables. As a result, the actual payoffs almost never attain the extremes predicted by the Best/Worst models. Moreover, many of the variables are not independent of one and another (e.g. lowering the charter price usually increases the number of charter miles sold).

THE SOLUTION

In order to preserve the objectivity of the BEST/WORST Case predictor, and yet establish a true *normal distribution* amongst all the Revenue, Cost and Operational variables, the simple solution is to develop a true multi variable random sampling model. The model works by randomly selecting each variable anywhere within the Best/Worst range and then calculating the resultant Net Income/(Loss) for that group of variables (any good spreadsheet or database that accepts Visual Basic code will handle this easily). The beauty of this methodology is that thousands of predictive instances can be generated in seconds and then each of these is compiled into one composite estimation, the Expected Outcome. From here, the standard deviation of the entire population of predictions is calculated such that a true Worst and Best Case Outcome can be determined with a known degree of confidence.[2]

For example, the data provided above was loaded in such a random sampling model and programmed to run 15,000 iterations (Which is enormous, if you think that each outcome simulates one year's potential earnings, then the end result of this model will represent the average of 15,000 years). The absolute extremes of all the outcomes was a Worst Case Net Loss of -$48K and a Best Case Net Income of $416K. More importantly, we found that the Expected Outcome was $177K and the standard deviation was $72K so, with 95% confidence we can predict the results will fall within the range seen in table 2.

Table 2

(all CDN$ except USD Vari. Costs)	Expected	Upper Expected	Lower Expected
EXPECTED CHARTER REVENUES	$ 812,742	$ 974,404	$ 693,151
CASH OPERATING EXPENSES			
USD Variable Expenses (in US$)	167,856	181,021	166,097
Foreign Exchange Effect	75,692	67,976	71,524
CDN$ Variable Expenses	142,017	160,267	148,267
Fixed Incremental Costs	250,143	243,502	274,855
TOTAL OPERATING EXPENSES	635,708	652,766	660,743
Net Expected Cash Profit	177,034	321,638	32,408

These results much more reliable than the extreme Best Case/Worst Case scenario. Objectivity is also preserved. The Estimator need only make an accurate assessment of the variable ranges, and the model does the rest. The other benefit of such a methodology is that sensitivity to key variables can be tested in seconds. For example, what the Outcome may be if our upper/lower bounds of Nautical Miles sold was only 82,000 to 112,000 instead of the current 96,000 to 128,000? It only takes a few key strokes to learn that the Expected Net Income would decrease to $119,690 (again, representing the average of 15,000 trials [or rolls of the die]). Equally important, we would learn that, with a standard deviation of $64,685 we would now expect the total range of possible outcomes to fall within -$9,680 to $249,060 with 95% confidence.

More than just an abstract mathematical exercise, the ability to generate objective Revenue/Cost projections using multi variate statistical random sampling provides a useful new tool in the business planning process. From the scenario above, we have learned that our planned outcome is not overtly sensitive to decreases in charter miles sold. Even with a 13.4% drop in average expected miles sold our predicted Net Income only fell from $177K to $120K. Further, we can see that, even if we only sell 82,000 NM we can be quite confident that our total loss from the operation would cap out at $10K. If we are confident that this minimum level of sales is a given, then we would go ahead with this service because the upside payoffs become increasingly favourable for any sales attained in excess of this minimum.

[2]You may remember the Empirical Rule from basic statistics that states, under the conditions of a normal distribution, 95% of all observations will fall within two standard deviations of the sample mean.