When your company's bills come due, will you have enough cash to pay them? No matter what the general health of a business, insufficient liquidity can have disastrous consequences, including increased financing costs, strained credit relations, and even bankruptcy.

Managing liquidity has always been tricky. It's important to have a liquid reserve that will cover expenses and leave a significant margin of error. However, carrying too much cash can represent a lost opportunity for longer-term investments.

Because standard cash forecasts rely on traditional balance sheet relationships, few really predict liquidity. The two most common proxies for liquidity are net working capital, which is current assets minus current liabilities, and the current ratio, which is current assets divided by current liabilities. Unfortunately, both measures fail to differentiate between cash and noncash items. They also ignore cash flows and available unused credit—the key components of liquidity.

Another popular measure, the quick ratio, is calculated by subtracting inventory from current assets and dividing the result by current liabilities. The quick ratio, though, still ignores lines of credit.

To get a more accurate measure of liquidity, finance professor Gary Emery of the University of Oklahoma designed the Lambda index, a dynamic ratio that pinpoints relevant components of liquidity: short-term cash balances and available credit. Emery's work builds on an earlier liquidity model developed by 1990 Nobel Laureate Merton Miller. Emery extended Miller's cash-based model to cover all of a company's liquid investments, then modified it to get a measure of the likelihood that the company would become insolvent.

Both Miller's and Emery's models add a second, essential dimension to cash-flow measurement: uncertainty. Lambda incorporates uncertainty about cash flows in the form of a sample standard deviation from those cash flows. Consequently, Lambda can be used like a z value from the standard normal distribution table. A Lambda of 3 means that there is only about one chance in a thousand that cash requirements will exceed cash on hand. When Lambda is 3.29, the odds are one in two
Lambda isn't just for cash managers trying to forecast the probability of meeting next November's payroll. Ron Lyons, a supervisor of credit administration at Amoco, uses Lambda to help evaluate the wholesalers and large institutional customers that buy Amoco's natural gas on credit. The only problem in using Lambda as a credit check, Lyons reports, is getting cash flow numbers from private companies. But "once we've gotten that information," he says, "the model has accurately portrayed [the company's liquidity status]."

Lyons recounts the credit history of a large institutional customer that nearly went bankrupt. After learning about Lambda, Lyons conducted an analysis of the customer's cash flow. Early in the relationship, the customer's Lambda was healthy—9 or better—but it deteriorated steadily as the customer's financial hardships piled up. At the time of a publicly threatened bankruptcy filing, the customer's Lambda was a sickly 1.4.

The Lambda Index

For a given period, Lambda is the sum of a company's initial liquid reserve and net flow of funds divided by the uncertainty associated with the flows:

\[
\text{Initial liquid reserve + Total anticipated net cash flow during the analysis horizon} / \text{Uncertainty about net cash flow during the analysis horizon}
\]
The initial liquid reserve consists of cash balances, short-term investments, and unused lines of credit. Net cash flow is the difference between cash receipts and disbursements. Uncertainty, as quantified in the denominator, is a function of the standard deviation of net cash flow. The uncertainty factor is important because a cash reserve is only as safe as its ability to withstand swings in cash flow with each new period.

The Lambda index produced by this equation is equivalent to the z value in one tail of a normal distribution. The second tail isn’t relevant because a liquidity crisis results only from a negative deviation from the mean, not a positive deviation. To figure out the odds that pertain to any given Lambda, look up the value in the standard normal distribution table and add 0.5. This sum represents the chance that cash requirements won’t exceed the initial liquid reserve plus net cash flow. A Lambda of 2.33, for example, corresponds to a value of .4901 in the standard normal distribution table. Adding 0.5 results in a value of .9901, a 99% chance that problems won’t occur—or a 1% chance that they will.

A Chilling Example

The worksheet at the bottom of the page, which runs in 1-2-3 Releases 2.x and 3.x and in Symphony Release 2.x, uses the Lambda index to forecast liquidity for the Chalet Iguana, a new ski resort. To build the model, see the instructions in the setup box at the end of this article.

Because the resort expects a dip in revenues during the summer months, management has decided to submit its 1991 cash forecast to the Lambda test. For simplicity, this example uses only a summary of the resort’s forecast (the inputs in rows 11 and 12). A real company would derive these inputs from several worksheets of supporting data, covering items such as debt and equity financings, payroll, taxes, insurance, interest, dividends, and other sources and uses of funds.

The shaded areas of the figure show the inputs

In this 12-month cash forecast, the Lambda index in row 24 points out a potential for trouble in August. Where possible, it’s better to calculate the standard deviation of net cash change (row 22) from actual past data rather than from forecasts. The shaded numbers are inputs that can be entered manually or imported from other worksheets.
that the Chalet Iguana's management must make. Row 6 contains the company's short-term line of credit, which management expects to remain at $25,000 throughout the year.

The value $12,500 in cell B7 represents the Chalet Iguana's short-term liquid assets, including cash and marketable securities, at the beginning of the analysis. In the following months, this number fluctuates with the resort's net cash flow.

The adjustment cells in row 8 allow the cash manager to gauge the effect of adding or subtracting cash from the worksheet after the cash forecast has been entered. These cells initially contain zeros.

Rows 11 and 12 contain management's revenue and expense forecasts for each month of the calendar year. Once management has entered these figures, the model's formulas do the rest. The formulas in row 14 calculate net cash flow from the forecasted sources and uses of funds in rows 11 and 12. As long as net cash flow is positive and the short-term line of credit in row 6 remains stable, Lambda should increase, indicating improving liquidity.

The formulas in row 16 add the beginning liquid assets in row 7, the adjustments in row 8, and the net cash flows in row 14 to obtain the ending net short-term assets for the period. The formulas in row 20 calculate the liquid reserve at the end of the period by combining the short-term line of credit in row 6 with the ending liquid assets in row 16.

The formulas in row 22 calculate the standard deviation of the net cash flows in row 14, the denominator for the Lambda index in row 24.

The formulas in row 26 calculate liquidity imbalance using a target Lambda of 3. A negative figure means that there may be extra cash on hand that should be invested elsewhere—depending on how comfortable management is with the accuracy of the cash forecast. A positive value indicates that more money or additional credit is required to keep liquidity at a comfortable level.

Interpreting the Model

A worksheet that keeps a running monthly tally of Lambda shows how changes in the financial picture affect future cash balances.

For example, the figure shows that in February, the Chalet Iguana will have $37,167 more cash on hand than it needs to cover February's cash outlays and maintain a Lambda of 3 (cell C26). If management put this cash to other use and entered an adjustment of -37,167 in cell C8, then February's Lambda would equal 3.

However, the worksheet clearly shows that unless the money is replaced later in the year, the long-term effects of such a move would be disastrous. The initial forecast for later months indicates that cash balances will already be on shaky ground in August, before recovering in the fall season. Therefore, subtracting $37,167 in February would exacerbate the situation.

Lambda is designed to penalize erratic cash flows, such as the one in this example, by including the standard deviation of cash flows in its denominator. The greater the fluctuation in cash flows, the smaller the Lambda for any given liquid reserve. Even though the Chalet Iguana's liquid assets have more than doubled by the end of the year, December's Lambda is much smaller than February's. Thus, with a 12-month track record, Lambda becomes more reliable—that is, it reflects the kind of fluctuations that can be expected from the Chalet Iguana's cash flow.

As 1991 progresses, management should substitute actual cash flow numbers for the monthly forecasts to fine-tune the resort's Lambda index. Lambda's denominator hinges upon standard deviations in net cash flow, and actual numbers will produce a more accurate picture than forecast numbers. If, at the end of 1991, the Chalet Iguana decides to apply Lambda to its cash forecast for 1992, it should extend the current model (in columns N through Y), using the actual cash flows.
reported in 1991 as the basis for calculating standard deviations in 1992.

The Lambda Lambda

Lambda is extremely sensitive to forecast accuracy, as a little experimentation with the Chalet Iguana's revenue projections will show. An especially bad June, for example, with revenues of $20,000 rather than the projected $30,700, would dramatically affect the resort's Lambda index in the following months.

For this reason, Emery counsels caution when interpreting Lambda. Favorable odds mean nothing if the forecast is off. "If you are certain that you estimated the cash flows correctly, you can have confidence in a smaller Lambda," says Emery, "but you may need to allow a little extra safety in case you've made an error. Really safe companies have a Lambda of 15 or higher." Emery recommends using a risk-analysis program such as @Risk, a 1-2-3 and Symphony add-in from Palisade Corp., Newfield, N.Y., to conduct sensitivity testing on variables used in the forecast.

Credit experts like Amoco's Lyons don't rely on any single measurement. Lyons hopes to add Lambda to Amoco's existing credit-evaluation package, which includes such traditional variables as debt, working capital, and profitability ratios. "Lambda is a sound, logical way to [measure liquidity], but you don't throw out your logic or your experience," Emery confirms. "This is another tool. It isn't a magic number." (Linda Stanley, coauthor of Lotus for Treasury Managers (NCCMA Publications, Fairfield, N.J., 1989), contributed to this article.

The model described in this article is available on disk. See page 65 for details.

### HOW TO SET UP THE LIQUIDITY-ANALYSIS WORKSHEET

| 1. Releases | This model runs in 1-2-3 Releases 2.x and 3.x and in Symphony Release 2.x.
| 2. Global settings | Select /Worksheet Global Format Currency, enter 0. (Symph: MENU Settings Format Currency, enter 0, and select Quit.)
| 3. Column widths | Place the cell pointer in column A, select /Worksheet Column Set-Width (Symph: MENU Set Width), and enter 27.
| 5. Labels | Enter all labels in the figure. Begin the labels in cells A17, A18, and A27 with two spaces. To right-align the month names in row 3, select /Range Label Right (Symph: MENU Range Label Alignment Right) and indicate range B3..M3.
| 6. Values | Enter the values in ranges B6..M6, B7..B8, M8, and B11..M12.
| 7. Formulas | Copy range C22..C26 to range D22..M22.
| 8. Global protection | Select /Worksheet Global Protection Enable. (Symph: SERVICES Settings Global-Protection Yes Quit.)
| 9. Range unprotect | Select /Range Unprotect (Symph: MENU Range Protect Allow-Changes) and specify the following ranges: B6..M6, B7..B8, C8..M8, B11..M12.
| 10. Worksheet titles | Place the cell pointer in cell B6 and select /Worksheet Titles Both. (Symph: MENU Settings Titles Both Quit.)

C22 @STD($B14..C14)+@SORT(@COUNT ($B14..C14),@COUNT ($B14..C14)+1))

(Release 3.x users can replace the formula in cell C22 with the formula @STDS($B14..C14), which also calculates a sample standard deviation.)

C24 =C20/C22
C26 =C22-3-(C9+C14)