The M-Score

Beneish (Financial Analysts Journal, Sept/Oct 1999) has developed a model for classifying firms into fraudulent reporters and non-fraudulent reporters. The model includes eight variables (and an intercept), one of which is a total accruals variable. The output of the model is an M-score (M stands for “manipulation of earnings”), which can be converted into a probability that the financial statements contain fraud. Beneish has set some cutoffs for M that minimize expected costs of classification errors. Depending on the cutoff, the model correctly identifies between 38% and 76% of the fraudulent reporting companies, while misclassifying as fraud companies 3.5% to 17.5% of the non-fraudulent companies. The model is easy to employ. You may find it useful in preparing case 9.

The model is as follows:

\[ M = -4.84 + 0.920 \times DSRI + 0.528 \times GMI + 0.404 \times AQI + 0.892 \times SGI + 0.115 \times DEPI - 0.172 \times SGAI + 4.679 \times ACCR - 0.327 \times LEVI, \]

where

- \( DSRI = \text{Days sales in receivables index} = \frac{(\text{netAR}_t / \text{Sales}_t)}{(\text{netAR}_{t-1} / \text{Sales}_{t-1})} \)
- \( GMI = \text{Gross margin index} = \frac{\left(\frac{\text{Sales}_{t-1} - \text{CostofGoodsSold}_{t-1}}{\text{Sales}_{t-1}}\right)}{\left(\frac{\text{Sales}_t - \text{CostofGoodsSold}_t}{\text{Sales}_t}\right)} \)
- \( AQI = \text{Asset quality index} = \left(1 - \frac{\text{CurrentAssets}_t + \text{netPPE}_t}{\text{TotalAssets}_t}\right) \times \left(1 - \frac{\text{CurrentAssets}_{t-1} + \text{netPPE}_{t-1}}{\text{TotalAssets}_{t-1}}\right) \)
- \( SGI = \text{Sales growth index} = \frac{\text{Sales}_t}{\text{Sales}_{t-1}} \)
- \( DEPI = \text{Depreciation index} = \left(\frac{\text{DepreciationExpense}_{t-1}}{\text{DepreciationExpense}_{t-1} + \text{netPPE}_{t-1}}\right) \times \left(\frac{\text{DepreciationExpense}_t}{\text{DepreciationExpense}_t + \text{netPPE}_t}\right) \)
- \( SGAI = \text{Sales, general, and administrative expense index} = \left(\frac{\text{SGA expense}_t}{\text{Sales}_t}\right) \times \left(\frac{\text{SGA expense}_{t-1}}{\text{Sales}_{t-1}}\right) \)
- \( ACCR = \text{Total accruals} = (\text{IBEI}_t - \text{CFO}_t) / \text{TotalAssets}_t \)
- \( LEVI = \text{Leverage index} = \left(\frac{\text{LTD}_t + \text{CurrentLiabilities}_t}{\text{TotalAssets}_t}\right) \times \left(\frac{\text{LTD}_{t-1} + \text{CurrentLiabilities}_{t-1}}{\text{TotalAssets}_{t-1}}\right) \)

Year \( t \) is the year under investigation. Note that unlike the discretionary accruals analysis, variables scaled by Total Assets are scaled by end-of-year values.
The higher the M-score (most M-scores are negative), the more likely it is that a company’s financial statements are fraudulent. Beneish’s misclassification cost analysis suggests that financial statements with M-scores greater than -1.8 or so should be investigated further for FFR.

M-scores can be converted into probabilities using the following formula:

\[
\text{Prob}(\text{FFR}|M) = \Phi(M),
\]

where \( M \) is the M-score from applying the model and \( \Phi \) is the cumulative distribution function of the standard normal distribution. For example, \( \Phi(-1.96) \) is .025 (that is, 2.5% of the area of the standard normal curve is to the left of -1.96; this can be inferred from tables such as the one in the “statistics for fraud” document), indicating a 2.5% probability that the company is fraudulently reporting. The NORMSDIST function in Excel can be used to retrieve \( \Phi \) values.