

## 4. BUSINESS MODELING

Understanding a business or proposed transaction requires, in large part, "working through the numbers." And the best way of doing that is by building and using a forecasting model.

The model is an abstraction of the real world entity or transaction. It is built from mathematical formulas, which represent the relationships between key parameters or variables. An example formula is:

$$\text{Total Revenue} = \text{Product Sales} + \text{Service Sales}$$

The model-building process involves abstracting the project's physical activities and accounting details into a set of equations. To provide structure and calculation expediency, we usually place the formulas into a computer spreadsheet or other calculation tool. Often, the understanding obtained from building the model is more important than the calculation results. This is because of the insights gained and improved communication.

Models can assist in answering questions about a project, company or particular transaction. Example questions could be about:

- long-term survivability
- expected performance results
- performance under a contractual obligation (e.g., a loan)
- adequacy of a partnership arrangement for sharing risks and rewards.

Here is a simple loan model written in Microsoft® QuickBasic:

```
PRINT "Amortization Schedule"
PRINT "Year   PrinPmt   IntPmt   TotPmt   End Bal"
a$ = "  ##   ####.###   ####.###   #####.###   #####.###"
Bal = 10000      ' loan balance
i = .1          ' annual interest rate
TotPmt = 2500 'total debt payment = principal + interest
year = 0
DO ' this loop until loan repaid
  year = year + 1
  IF TotPmt <= Bal * (1 + i) THEN 'won't repay this year
    IntPmt = (2 * Bal - TotPmt) * (i / (2 - i))
    PrinPmt = TotPmt - IntPmt
  ELSE ' payout year
    payout=(-1/LOG(1 + i)) * LOG(1 - Bal * LOG(1 + i) /
      TotPmt) ' yr fraction
    IntPmt = Bal * ((1 + i) ^ payout - 1)
    PrinPmt = Bal
  END IF
  Bal = Bal - PrinPmt
  PRINT USING a$;year;IntPmt;PrinPmt;IntPmt+PrinPmt;Bal
LOOP WHILE Bal > 0
END
```

Note that the BASIC statements are English-like, and variable names can (and should) be descriptive. Good modeling tools also provide capabilities for annotating and modularizing the program.

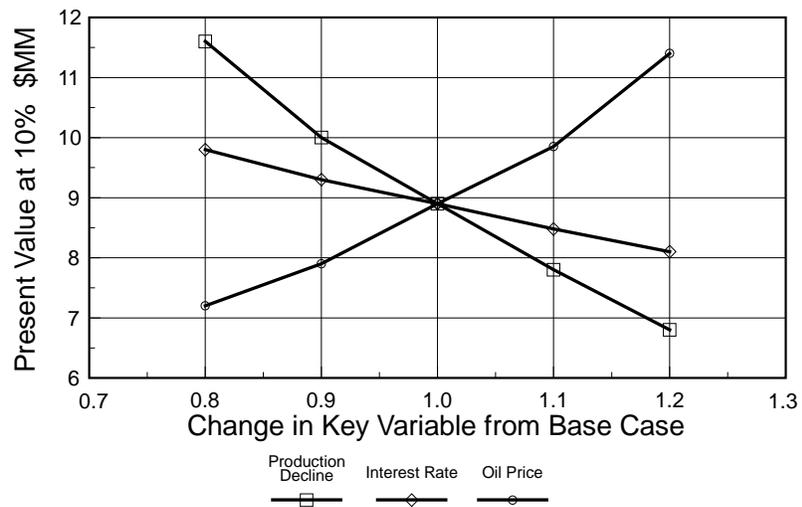
The variables in the model can be classified as independent or dependent. Dependent variables are those which are expressed as a formula function of other variables. A partially dependent formula relationship is one way to represent variable correlations.

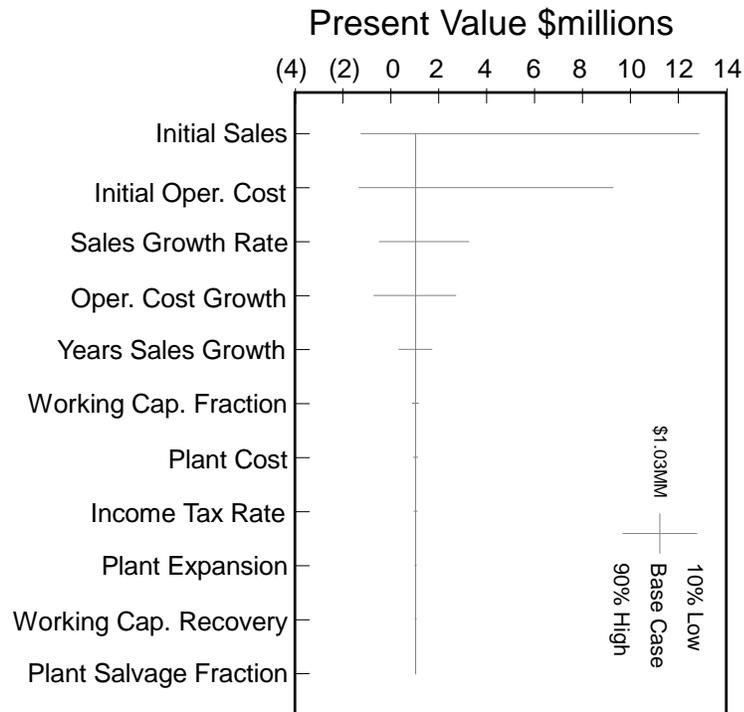
In most models, each independent variable is assigned a single value. Thus, each dependent variable also has only one value. Such a model and its variables are called deterministic because each input and output variable is singly determined (assumes only one value). The model, thus, represents only a single scenario of what might happen.

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## Sensitivity Analysis

Sensitivity analysis is the process where certain key variables are systematically modified to test the impact on the output function. Spider diagrams and tornado diagrams, examples below, show useful ways of presenting sensitivities:





My favorite is a tornado-like diagram of correlation coefficients. However, this requires running a Monte Carlo simulation

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## Benefits

Benefits from modeling include:

- Providing a logical and consistent basis for analysis and decisions
- Anticipating performance; reducing time to react
- Aid to planning for contingencies
- Calculating the potential impact of decision alternatives
- Developing longer and more-accurate projections than by extrapolating past performance
- Isolating key factors and components of variances for detailed analysis
- Providing a medium for communicating within the project team and to others involved with the decision.

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