Intelligent Financial Planning Models
Using PROC LP

W. R. Gjersten, M. Cohen, and A. Eaton
SAS Institute

Introduction:
Financial management requires planning based on the simultaneous consideration of the investments, financing and divestiture options facing the firm. The FDCA model (Opalski and Pogue 1984) is a linear programming model that initiates this asset.
In this report we introduce the concepts behind financial models based on linear programming, we show how to use PROC LP and PROC CONVERGE to define an LP model for answering financial questions and how to report the solutions.

Examples:
Consider a firm which has to decide how much to invest or borrow in the coming year.
Let:
\( x \) = net investment in millions of dollars
\( y \) = net borrowing in millions of dollars.

Assume:
1. Available investment opportunities can absorb $1 million at most.
2. The investment opportunity generates a net present value of $0.10 per invested dollar.
3. Net debt is limited to 40 percent of new investment.
4. The firm has $800,000 in cash.
5. Marginal corporate tax rate is 0.4.
6. The firm makes decisions on maximizing the value of the firm (which includes the present value of the tax shield).

The question of interest is: What levels of net investment and borrowing maximize the value of the firm?
If the current value of the firm is \( V \) then the the values of \( x \) and \( y \) that maximize
\[
V = 0.1x + 0.3y
\]
and satisfy the constraints imposed by the assumptions maximize the value of the firm.

This can be solved with PROC LP.

The Linear Programming Formulation is:
Maximize: \(-0.1x + 0.3y\)
Subject to the constraints:
assumption 1: \( x \leq 1 \)
assumption 2: \( x \leq 0.4x \)
assumption 3: \( x \leq -y \cdot 0.8\)
These constraints are geometrically represented as:

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GEOMETRIC REPRESENTATION OF PROBLEM
To solve this problem with PROC LP you will need the model
in a SAS data set and then call the LP procedure.

The objective activity of 1 shown that following this level of investment and borrowing increases the
value of the firm by $1 million.  

The model can be extended to include other aspects of corporate finance:  
1. dividend policy  
2. debt policy  
3. liquidity  
4. project interactions 

For example consider the following pro-forma financial statements for 1984 for the Executive Fruit Company.  
This is merely an accounting model.

Since the variable Z, investment, has an activity of 1 and 
the variable P, borrowing, has an activity of 0 the firm can maintain the $1 value in this scenario by investing 
$1 million of which a $1 million is borrowed.
To help you interpret the model consider the observation where the variable ID equals RENV.

RENV = 0 IF RENV = 1 RENV = 1 INVEST = 1 INVEST = 1

This constraint defines the revenue in the second period. The constraint is interpreted as the equation:

- RENV = 1.5 RENV = 1 INVEST = 1 INVEST = 1

or rewriting it as

RENV = 1.5 RENV = 1 INVEST = 1 INVEST = 1

As the assumptions state, the revenue in the second period is greater than the revenue in the first period plus set of investment A and 1 of investment B.
There is no visible text in the provided image.
This program produces the report:

**Balance Sheet**

<table>
<thead>
<tr>
<th>ASSETS</th>
<th></th>
<th>Liabilities</th>
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<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>SHAREHOLDERS' EQUITY</td>
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<td></td>
<td>1,288.1</td>
</tr>
<tr>
<td>TOTAL ASSETS</td>
<td></td>
<td>1,288.1</td>
<td></td>
<td>1,288.1</td>
</tr>
<tr>
<td>TOTAL LIABILITIES</td>
<td></td>
<td>1,288.1</td>
<td></td>
<td>1,288.1</td>
</tr>
</tbody>
</table>

**Profit Statement**

<table>
<thead>
<tr>
<th>PERIOD</th>
<th></th>
<th>PERIOD</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>NET INCOME</td>
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<td>149.9</td>
<td></td>
<td>270.0</td>
</tr>
<tr>
<td>OPERATING INCOME</td>
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<td>149.9</td>
<td></td>
<td>270.0</td>
</tr>
<tr>
<td>NET REALIZED GAINS</td>
<td></td>
<td>0.0</td>
<td></td>
<td>0.0</td>
</tr>
<tr>
<td>NET INCOME</td>
<td></td>
<td>149.9</td>
<td></td>
<td>270.0</td>
</tr>
</tbody>
</table>

**Summary:**

We have shown with two examples how linear programming can help the financial planner. The examples indicate how procedures in the GROVITAS can be used together to implement the LINDER model proposed by Brealey and Myers.

Furthermore, Brealey and Myers claim that you need adjusted present values (APV) because it is the only generally reliable approach to capital budgeting when investment decisions have important financing side effects. They also claim that most financial managers use ad-hoc simulations so that it not only optimizes the value of the firm but also provides APV for the capital budgeting of investment as well as the shadow prices (goal activities) of the investment constraints.

This is only a start. No model accommodates entirely the decisions required by the financial planner, or captures all of the issues. The linear programming model we have shown does however give an efficient, intuitive tool for financial planning.

**References:**
