Developments in Business Simulation & Experiential Exercises, Volume 15, 1988
SIMULATION WITH INTEGRATED SPREADSHEETS: THE DESIGN AND DEVELOPMENT OF A CONVERSATIONAL MARKETING CONCEPTS DECISION GAME
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ABSTRACT
Integrated spreadsheets aren’t just for financial models. In fact, they can simulate many different types of dynamic processes. This paper attempts to outline some of the basic principles that could be applied in designing and developing a spreadsheet simulation. MARKETING CONCEPTS, a spreadsheet simulation developed by the author is used to illustrate program development and system utilization.

INTRODUCTION
Many marketing faculty find computer simulations lively and effective. In fact, many book publishers are now offering as part of their principles of marketing textbook packages companion microcomputer software, including various simulation packages. Marketing decision games offer a unique means of teaching marketing concepts and developing strategic abilities. With hands-on decision-making through simulation, students were fully appreciate the complexity of the interaction among marketing mix components. Opportunities emerge for employing previously studied marketing decision-making tools. Also, through computer feedback, students note applications and limitations of various concepts such as price elasticity, break even analysis, ratio analysis, price markups, and a myriad of other concepts applicable to marketing opportunities and problems. This paper reports an alternative form of decision game which the author believes has a number of unique advantages over the traditionally used programming language batch mode games - a conversational spreadsheet simulation involving competition between one player and a programmed, synthetic environment.

There is little doubt in the question that the first, and still the primary, use of an integrated spreadsheet is for financial applications such as budgeting, cash planning, and forecasting. In fact, advanced generations of spreadsheet software have concentrated on improving such features as formatting, word-processing, and integration with data bases; that is, features whose primary beneficiaries are the financial modelers. However, less obvious to the casual observer is the fact that most spreadsheet software can be used to perform a series of analysis modules which enable a student to explore several marketing concepts (e.g. price elasticity of demand, break even analysis, ratio analysis, price markups, and selected component interactions). Probably the biggest problem with using a general-purpose computer language for simulations is the complexity of the simulation results [6]. Like all programming tasks, writing a simulation is usually far more complex than it first appears and, sooner or later, most programmers feel the need for something easier. Spreadsheets, the other hand, provide the writer with a systematic approach in developing the simulation. Good worksheet structure conveys a sense of flow or progression. With a modular approach used in spreadsheet design, the writer can easily add functions and modify existing model assumptions.

Finally, spreadsheets are becoming standard tools on the desks of many executives in the business community. Therefore, the spreadsheet environment watches the reeds of a manager or decision maker. Data is placed in tables, very much like the tables a manager might write on a sheet of paper. The results of the analysis can be readily printed, and can appear in the form of a table suitable for insertion in a report. That is, the spreadsheet conforms to the way managers handle data and information. Thereby, using the spreadsheet for simulations, students may be provided positive experience with the same type of software they are likely to find in the workplace.

Simulation Worksheets by Design
To indicate the potential of a spreadsheet simulation methodology, a conversational marketing simulation entitled MARKETING CONCEPTS, has been developed by the author. It appears to be a workable, pedagogical tool. The specific model from which this simulation evolved is based on a commercially available computer game called Painco [21]. The Paintco computer program permits a set of marketing decisions for the paint market (e.g. price, distribution, promotion, product quality, seasonality, for both the company and the market to be entered for a period of play and the computer then calculate their results and shows a series of reports. Several features of Paintco have been retained in the development of MARKETING CONCEPTS. The use of numerical levels (i.e., 1 through 9) for data entry have been retained as an easily understood way of choosing a decision variable for data input and the formulas have been modified to reflect the layout of the computer. Added to the spreadsheet simulation, however, have been a series of analysis modules which enable a student to explore several marketing concepts (e.g. price elasticity of demand, break even analysis, price markups, and selected component interactions).

The design and development of this spreadsheet decision game was primarily the result of finding simulation design fundamentals on a trial-and-error basis. Upon reflection on this simulation writing
Developments in Business Simulation & Experiential Exercises, Volume 15, 1988

experience, the author has been able to develop a
generalized model for writing conversational spreadsheet
simulations. There are a number of specific design principles
which a simulation writer should address when specifically
designing a spreadsheet simulation. While probably not
exhaustive, they include the following:

Design Principle #1
Build a Simulation Worksheet Block by Block

After determining what your simulation will accomplish,
follow the pattern laid out in Figure 1 and block out the
worksheet’s main sections in a vertical structure, from top to
bottom: Data Input, Reference, Formulas, Results, Analysis,
Menu Selection, and Macros. Figure 1 provides the blueprint
for the MARKETING CONCEPTS simulation worksheet.

The data input block is where the player enters the data that
the worksheet will digest and use for the simulations
calculations. This block contains the marketing mix decision
variables of price, promotion, product features, and
distribution. An example of this input is shown in Figure 2.
Think of the data input block as a control panel. The player
can change the decision variables to test “what if” conditions
such as a decrease in price or an increase in advertising. A
changed variable in this block, and the whole worksheet
changes.

Related to the data input block is a reference block which
provides the user with a quick reference of the data input
variables without having to go back to the instructions
section of the simulation (See Figure 3). The formula block
is entirely mechanical; the simulations formulas gather data
from the input block and crunch away. The complexities of
the equations and the interrelationships are illustrated in
Figure 4. The results block is an abbreviated income
statement which reports the bottom line of the students
decisions. A complete illustration of the results is presented
in Figure 5. It includes for the decision period in question,
the units sold, the expenses incurred, the profit or loss, the
total units sold in the market and the company’s market
share.

The analysis blocks permit the student to analyze in more
detail their decisions. This block contains price elasticity of
demand (See Figure 6 as an example), breakeven analysis,
price markups, and selected ratio analysis techniques.

Figure 7 illustrates the menu selection block which offers a
variety of commands for use in moving around the simulation
worksheet easily. Commands for moving to
another section of the spreadsheet can be selected by using
the computer’s right or left arrow keys which will move the
cursor and highlight the desired command. Pressing the enter
key at this time will move you to the desired section
selected.

Figure 8 illustrates the Macros used in the worksheet. The
macro blocks should always be below and off to the side of
the worksheet’s main activities. In Figure 1, for example, the
macros for this simulation are fastened at row AA321 and
8B381.

By setting up a worksheet with the vertical block model
approach, each step in the worksheet will be visible and will
support the one that follows it. In the MARKETING
CONCEPTS simulation, the seven major blocks are made up
of smaller, structurally similar blocks, which make it easier
to root out errors in procedures or logic.

This modular structure even makes it easier to print selected
sections of the worksheet. Want a printout of the results
section so that it can be compared with previous results, or
you want a printout of one of the analysis sections? No

problem; mark it and print it out.

Good vertical block structure also really pays off when you
have to modify the simulation worksheet, because it’s easier
to recognize logically discrete elements, add new blocks, or
reorder blocks. The
### Figure 2. Data Input Table

<table>
<thead>
<tr>
<th></th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>G</th>
<th>H</th>
</tr>
</thead>
<tbody>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>PRODUCT QUALITY &amp; FEATURES</td>
<td>1</td>
<td>5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>DISTRIBUTION</td>
<td>1</td>
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<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>7</td>
<td>PROMOTION</td>
<td>1</td>
<td>5</td>
<td></td>
<td></td>
<td></td>
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</tr>
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<td>8</td>
<td>PRICE</td>
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### Figure 4. Formulas

<table>
<thead>
<tr>
<th></th>
<th>A41*Formulas</th>
<th>B4</th>
<th>C4</th>
<th>D4</th>
<th>E4</th>
<th>F4</th>
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<td>A44</td>
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<td>B4</td>
<td></td>
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</tr>
</tbody>
</table>

After entering data, return cursor to Cell A1 by pressing the Home key, then press [Alt] R keys for the results of the simulation run.

To review the input options available for your company or market variable press the [Alt] A keys when the cursor is in Cell A1.

For other options, press Alt M keys to go to the Menu Selection Table.

A1

1 help 2 edit 3 name 5 go to 6 window 7 data 8 table 9 recalculate ograph

### Figure 3. Reference Table

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<td></td>
</tr>
<tr>
<td>5</td>
<td>Product Quality &amp; Features</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Ranges from a low quality and very few features representing a level of '1', to a very high quality and many advanced features representing a level of '9'.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Distribution:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Ranges from a level of '1', representing exclusive distribution, to '5', representing intensive distribution.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Promotion:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Ranges from a level of '1', representing all personal selling, to a '5', representing 1/2 personal selling and 1/2 advertising, to a level of '9', representing all advertising.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>Pricing:</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>Varies from a level of '1' = $500, to a '5' = $1200, to a level of '9' = $1680.</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>13</td>
<td>Press [Alt] keys to return to the Data Input Table.</td>
<td></td>
<td></td>
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</table>

### Figure 5. Results

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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>RESULTS OF SIMULATION RUN</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>PROFIT &amp; LOSS SUMMARY</td>
<td></td>
<td></td>
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</tr>
<tr>
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</tr>
<tr>
<td>8</td>
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<td></td>
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</tr>
<tr>
<td>9</td>
<td>UNITS SOLD</td>
<td>628</td>
<td>8962</td>
<td></td>
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<tr>
<td>10</td>
<td>@ PRICE</td>
<td>1120</td>
<td>560</td>
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</tr>
<tr>
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<td>SALES REVENUE</td>
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<td>COST OF GOODS</td>
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</tr>
<tr>
<td>14</td>
<td>LESS OPERATING EXPENSES:</td>
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</tr>
<tr>
<td>15</td>
<td>DISTRIBUTION</td>
<td>$92560</td>
<td>$179300</td>
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<td>SALES COMMISSION</td>
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</tr>
<tr>
<td>17</td>
<td>ADVERTISING</td>
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<td>$200000</td>
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</tr>
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<td>$76000</td>
<td>$38000</td>
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<td>21</td>
<td>TOTAL OPERATING EXPENSES</td>
<td>$331154</td>
<td>$3061340</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>22</td>
<td>NET BEFORE TAX</td>
<td>$250414</td>
<td>$614310</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>23</td>
<td>ANNUAL MARKET SALE: Estimate WAS</td>
<td>100000</td>
<td>104337 UNITS</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>24</td>
<td>MARKET SHARE WAS ESTIMATED</td>
<td>18.5, now 24.3%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Press the [Alt] M keys to go to Menu Selection Table A61

1 help 2 edit 3 name 4 abs 5 goto 6 window 7 data 8 table 9 recalculate ograph

270K 2:56 READY
A computer simulation worksheet will also make more sense from the start - both to you the author and to any one look over your shoulder - leaving you free to concentrate on the simulation objectives itself.

Design Principle #2 Developing Block Structure

Cast the worksheet’s general shape by entering labels for each block (such as Data Input, Formulas, Results, etc.). This will permit the user to know which section they are viewing.

Also, for convenience’ sake, anchor the different blocks in the worksheet to easy-to-remember rows as A21, A41, and A81.

Don’t put blocks side by side, because if you later insert rows in one block, you’ll encroach on its neighbor.

Design Principle #3: Use Range Names to Minimize Reference Errors

Although the worksheet’s formulas and macros can reference specific cells or labels, using range names simplifies matters. Range names should be applied to a cell, row, or entire block in a worksheet if it will minimize typing errors when creating formulas and macros. Most spreadsheet programs include a show function that lists all range names with their beginning and ending cells. Ranges should always be assigned to cells or rows that are used in calculations. Range names have been assigned to the equations in the formulas block.

Design Principle #4: Protect Key Cells of the Worksheet

When you create a worksheet simulation, all of the cells are unprotected; you can enter data in any of them. It’s a good idea to protect the final version when you have unfinished building and modifying the simulation. This will prevent anyone from inadvertently modifying or erasing important cell contents. Most worksheet protection is global: it protects all the cells in the worksheet. Once global protection is enabled, you can then unprotect specific ranges or cells that you want to be able to access and change.

Design Principle #5: Use Macro’s to Simplify Interaction with systems

Any task that a spreadsheet can perform, from the simplest to the most complex, can be automated with a macro facility. A macro is made up of a series of steps, each of which represents an instruction to the spreadsheet. Regardless of how many steps a macro includes, it can be invoked with only two activating keystrokes. In MARKETING CONCEPTS, macros are used to move the user to certain locations within the spreadsheet, in developing the menu selection table, and to create a message screen to hide a macro activity (See Figure 8).


Documentation takes two forms: one for the simulation participant and the other for faculty members who would like to see the model and the various elements making up the simulation itself.

You can display a description of the simulation scenario and the participant’s instructions on how to run the simulation in a number of ways so that they are easy to find. One of the simplest techniques is to assign them to a “satellite” worksheet - a separate worksheet that passes to the main worksheet after it is used. In MARKETING CONCEPTS, the satellite worksheet is automatically loaded without operator intervention. Every time the spreadsheet (Lotus 1-2-3 or VP Planner) starts up, it searches the default disk drive for a file named AUTO123.WKS.
When the file is found, it is automatically retrieved and the simulation scenario and instructions are displayed on the screen. To make the reading of this material as easy as possible, you should assign material to a full-sized-screen area only and tell the viewer to leave the cursor in the Al cell and use the PgDn key to move to another window.

After reviewing the scenario and instructions the user can either recycle the scenario and instructions or pass to the data input section of the main worksheet to begin the simulation. In the satellite worksheet the user manual is completely written down as to all the fine points and details. An accurate and clear description must be made for all simulation data necessary to make appropriate decisions. Therefore, charts, tables, graphs, etc., would be helpful in presenting and understanding simulation data. An illustration of a typical table used throughout the introduction is shown in Figure 9. After the detailed explanation has been digested, the user can often refer to a summary table in the reference block. Also, make some room for documentation throughout the worksheet. Just as an article summary helps to guide readers, worksheet documentation helps subsequent users find the information they need to add or modify the simulation model. For example, a “table of contents” that lists the function of each of the models formulas is a handy guide. It also makes sense to note macro key combinations and describe what each macro does.

**Summary**

MARKETING CONCEPTS is an integrated spreadsheet based simulation designed for the introductory marketing course. Its intended role is as a complement to the typical course format of text assignments, lectures, discussions, cases, and so forth. As such, it embodies the major marketing concepts to familiarize students with basic decision alternatives, and the interaction among marketing mix variables vis-à-vis the marketing environment. The simulation is still under development, and it is difficult to judge its effectiveness at this time. It is expected to require at least 6 months to test the game in the classroom and make appropriate modifications on it.

Design and development of a marketing simulation at best is a challenging and time-consuming task. However, an integrated spreadsheet provides some unique opportunities for simulations. The availability of
such simulations opens the door for many instructors to
develop and use simulations as a pedagogical technique. One
no longer needs to be an expert in computer programming to
develop simulations. As an instructor becomes familiar with
the principles presented in the paper, the time involved in
creating models for conversational simulations can be
greatly reduced.

There are many other dynamic systems, discrete and
continuous, that one can simulate with a spreadsheet. I have
tried to show how a spreadsheet can be used to model a
marketing system, which demonstrates that a spreadsheet
can be used for much more than financial analysis.

Overall, the implementation of a spreadsheet simulation is
technically impressive and has the potential to be a valuable
pedagogical tool when applied in the right situations.

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