

■ RICK HESSE, Feature Editor, Pepperdine University

# Reverse Engineering Cash Flow Revenues for Forecasting

by Rick Hesse, Feature Editor, Pepperdine University

Two MBA graduates of our Pepperdine full-employed program approached me last year with the following problem. It is common for chip manufacturers to win many million dollar contract awards from several companies that go into several different products (cell phones, computers, printers). The cash flow of revenues takes place over the next several quarters for each award after a delay of a quarter or so, as shown in Figure 1. Because each customer simply lumps all their quarterly payments for each particular chip (which may go into several products of theirs), it is difficult to break down which award is responsible for certain dollar amounts. The total quarterly cash flow is known for each chip number, and from that the company assumed the future cash flow from each contract is approximately the same, such as (0%, 15%, 20%, 40%, 25%) for a particular chip design. The company did know that chips used for PCs had a different life cycle (shorter) than

for cell phones, but assumed that each product had its own distinct life cycle. What was needed was the ability to determine estimates of these percentages to accurately forecast cash flow in the future, given the design awards.

## Simplified Example

Let's use a hypothetical, simplified example, where the Award is distributed over the next four quarters, as shown in Figure 2, along with the Solver setup and Options. The data represents contract awards and the revenue from a single chip from several manufacturers. **B2:B9** is the first eight quarters of known contracts, while **B10:B13** represents future contracts. **F2:F5** are the percentage of the contract for quarters 2, 3, 4, and 5 from the contract quarter. They help build the Revenues in column C. The Forecast in column D uses the estimated percentages in **G2:G5** (which must add up to 100% in **G1**), and column E computes the error and **H2** is the



**Rick Hesse**

is professor of quantitative methods at Pepperdine University in the Graziadio Graduate School of Business and Management. He received his BS, MS, and DSc at Washington University School of Engineering in

applied math and computer science. Dr. Hesse is the author of *Managerial Spreadsheet Modeling & Analysis* and *Applied Management Science: A Quick & Dirty Approach* (with Gene Woolsey), articles in numerous journals, and software for personal computers. Rick was the first professor to be awarded the Outstanding Civilian Service Medal by the Department of the Army at West Point in 1982, and was the winner of the Decision Sciences Institute's Innovative Instructional Award in 1981.

**Rick Hesse**

Pepperdine University  
 Graziadio Graduate School of Business  
 and Management  
 Malibu, CA 90265  
 rickhesse@aol.com

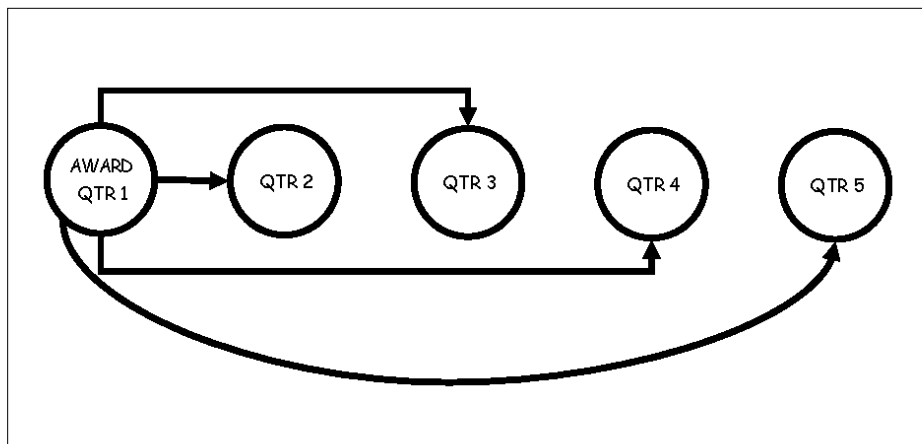


Figure 1. Cash flow from award to successive quarters.

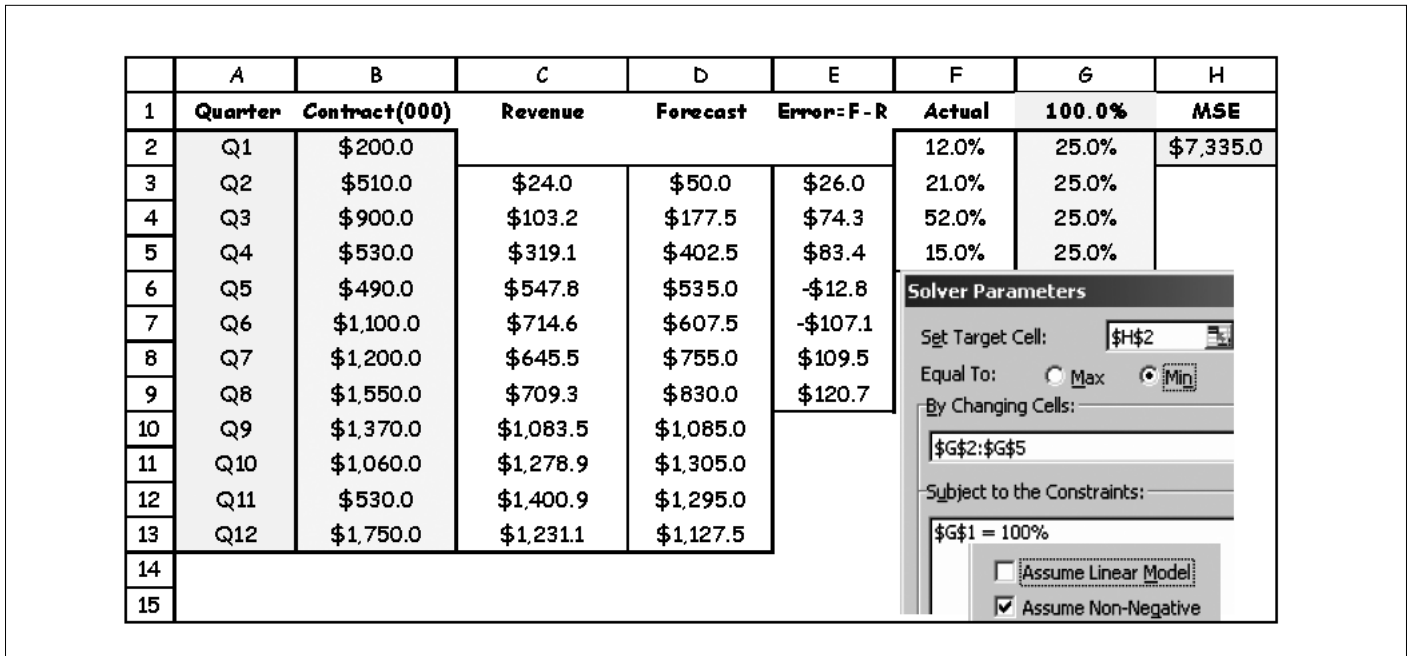


Figure 2. Setup for forecasting.

average mean squared error (Revenue-Forecast).

The Revenue is derived using the percentages given in F2:F5 and the initial values to guess the distribution are 25% each (LaPlace conditions). The Revenue for Q2 is 12%\*Contract(Q1) and the Forecast for Q2 is 25%\*Contract(Q1). Q3 Revenue and Forecast use the first two percentages, and so forth. From Q5 on, the formulae are:

C6:  
 $=B5 * F52 + B4 * F53 + B3 * F54 + B2 * F55$   
 copied over to C6:D13.

When the Solver is run, it immediately finds the correct percentages with no problem, as shown in Figure 3, even though it is a nonlinear problem.

Actual	100.0%	MSE
12.0%	12.0%	\$0.0
21.0%	21.0%	
52.0%	52.0%	
15.0%	15.0%	

Figure 3. Correct solver solution.

### Using Realistic Data

When the revenues are generated using the RAND() function to allow a +/- 2% change in the actual percentages, the formulas in column C must be altered.

**Solver Results**  
 Solver cannot improve the current solution. All constraints are satisfied.

$C3: =B2 * (F52 + (2 - 4 * RAND()) / 100)$  and copied to C4:C13. A Move/Copy of this worksheet is done and then the values in C4:C13 are copied and Paste Valued in the same place, to “freeze” the values. Otherwise, the Solver won’t budge from its initial values. When the Revenues are “frozen,” then the Solver finds the weights that minimize the error from forecasting Quarters 2→8. These are then used to forecast Quarters 9→12. The average MSE is reduced from \$7,325.4 (using 25% initial weights) down to \$99.2, as shown in Figure 4 (see next page).

### Using Real Data

But the real surprise came when I used some real data, and the results were not encouraging at all. Even though this model had the lowest MSE of any others that were tried by the company, it still did not do a good job of forecasting the future revenue stream. It became obvious that better data tracking and accounting needed to be employed by the company to break down actual cash flows per contract, and also to detect if the suppositions about these disbursements were correct. What worked well in theory was not bearing out with actual data. What had been a company-wide assumption about the cash flow from contracts was not necessarily correct—a valuable lesson “in the classroom.” ■

Quarter	Contract(000)	Revenue	Forecast	Error=F-R	Actual	100.0%	MSE
Q1	\$200.0				12.0%	14.1%	\$99.2
Q2	\$510.0	\$23.1	\$28.3	\$5.2	21.0%	20.7%	
Q3	\$900.0	\$96.3	\$113.4	\$17.1	52.0%	56.3%	
Q4	\$530.0	\$344.4	\$345.2	\$0.9	15.0%	8.9%	
Q5	\$490.0	\$566.7	\$566.0	-\$0.8			
Q6	\$1,100.0	\$741.7	\$731.0	-\$10.6			
Q7	\$1,200.0	\$645.1	\$635.1	-\$10.0			
Q8	\$1,550.0	\$732.6	\$719.9	-\$12.7			
Q9	\$1,370.0	\$1,056.0	\$1,130.2				
Q10	\$1,060.0	\$1,309.9	\$1,287.5				
Q11	\$530.0	\$1,424.7	\$1,412.5				
Q12	\$1,750.0	\$1,218.3	\$1,203.2				

Figure 4. Random generated revenues and solution.

## BOARD OF DIRECTORS REPORT

President Thomas E. Callarman (CEIBS and Arizona State University) chaired the Board of Directors meeting that was held on Saturday, January 14, 2006, in Sarasota, Florida. The following is a report of the actions taken by the Board and matters brought to its attention. The Executive committee also met on Friday, January 13, 2006. Its recommendations to the Board are included in the items reported below.

1. The minutes of the November 2005 Board of Directors meeting were approved.
2. The President-Elect was granted permission to speak with the Institute's auditor about reporting allocated costs on the Institute's financial statements.
3. The financial statement for the period ended December 31, 2005 was reviewed and accepted.
4. Reports from the following 2005-06 committees and elected or appointed officials were accepted for review:
  - Case Studies Committee/Award Competition

- Development Committee for Excellence in the Decision Sciences
- Doctoral Student Affairs Committee
- Fellows Committee
- Information Technology Committee
- Investment Advisory Committee
- Member Services Committee
- Programs and Meetings Committee
- *Decision Sciences* Journal
- *Decision Sciences Journal of Innovative Education*
- *Decision Line*
- Regional Activities Committee
- Strategic Planning for International Affairs
- Ad hoc Committee to Investigate the Development of an India Region
- Marketing Director
- 2005 Program Chair
  - a) Doctoral Dissertation Award Competition
  - b) Doctoral Student Consortium
  - c) Instructional Innovation Award Competition
  - d) Professional and Faculty Development Program
  - e) New Faculty Development Consortium

- f) Research Methods Miniconference
  - g) Technology in the Classroom Miniconference
  - h) Curricular Issues Program
  - i) Analysis of CIS User Requests
- IT Systems Report
  - Director of Professional Development Programs
  - Coordinator of Job Placement Services
  - Ad hoc Committee on Job Placement
  - 2006 Annual Meeting Program Chair
  - 2007 Annual Meeting Program Chair "Visionary" Meeting
  - Treasurer
  - Regional Reports: Northeast, Western
5. The Fellows Committee's Recommendations 1 and 2 that (1) "all documents related to the nomination of a Fellow candidate must be submitted in electronic form and must be received by the Chair of the Fellows Committee by or before October 1 to be considered in that year. Documents arriving after October 1 will be forwarded to the next Chair of the Fellows Com-

See **BOD REPORT**, page 45