EDS 71: Application Portfolio

New Techniques for Drug Discovery

Application Summary

Daniel Harjes

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System Description

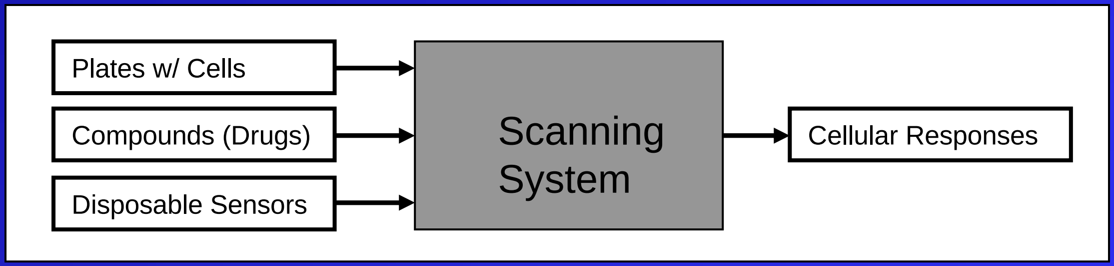
- Current high throughput drug screening techniques determine which compounds proceed to the clinical testing phase of development
- Current techniques can only test compounds for a one cell signaling marker
- False positives and negatives can cost pharmaceutical companies millions of dollars in the drug development process
- This new system offers a disposable sensor array than can screen a compound using several cellular activity markers
- The new system is high throughput while also adding higher information content
- These sensor modules are amenable to many current drug screening infrastructures, which will reduce integration costs for pharmaceutical companies

Application Portfolio Outline

- This application portfolio explores the various uncertain financial aspects to the manufacturing and marketing these sensor systems
- Parts 1-3 explore various system designs and uncertainties
- The system is described in detail and the primary sources of uncertainty are quantified
- Parts 4-6 of the portfolio investigate, using NPV, the various methods of uncertainty analysis and flexible design
- Such analysis techniques include decision trees and binomial lattices
- Overall simulation conclusions

Part 1: Defining the Topic

- The disposable sensor system consists of a disposable plastic injection molded "peg" array that fits into standard 96-well plates
- The end of each "peg" is coated with a patented optical ion sensor
- A flow through diagram of a standard screening system is shown below:



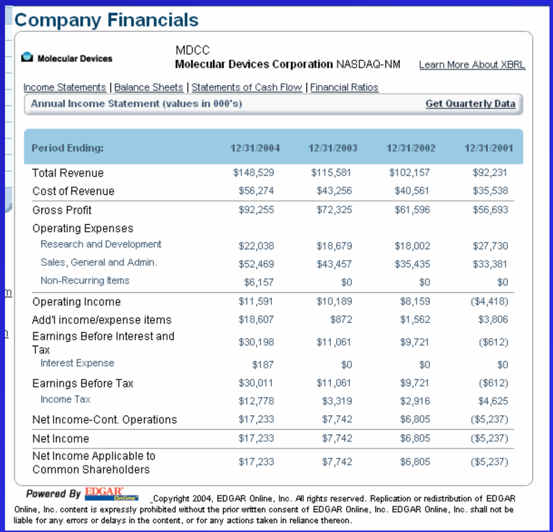
- There are several ways to present this sensor system for decision analysis
- The next sections simplify the sensor module into two possible disposable sensor packages for manufacturing

Part 2: Defining Salient Uncertainties

- This section outlines the major uncertainties in manufacturing a drug-screening sensor system
- It was decided that the primary two uncertainties in the system are:

1. Market demand
2. Manufacturing Costs

- For each of these two parameters, information was gathered that could be used to develop future parameter values and variances
- Example data sets that represent future parameters are shown below



Company Financials

Molecular Devices

MDCC
Molecular Devices Corporation NASDAQ-NM

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Income Statements | Balance Sheets | Statements of Cash Flow | Financial Ratios

Annual Income Statement (values in 000's) — **Get Quarterly Data**

Period Ending:	12/31/2004	12/31/2003	12/31/2002	12/31/2001
Total Revenue	$148,529	$115,581	$102,157	$92,231
Cost of Revenue	$56,274	$43,256	$40,561	$35,538
Gross Profit	$92,255	$72,325	$61,596	$56,693
Operating Expenses				
Research and Development	$22,038	$18,679	$18,002	$27,730
Sales, General and Admin.	$52,469	$43,457	$35,435	$33,381
Non-Recurring Items	$6,157	$0	$0	$0
Operating Income	$11,591	$10,189	$8,159	($4,418)
Add'l income/expense items	$18,607	$872	$1,562	$3,806
Earnings Before Interest and Tax	$30,198	$11,061	$9,721	($612)
Interest Expense	$187	$0	$0	$0
Earnings Before Tax	$30,011	$11,061	$9,721	($612)
Income Tax	$12,778	$3,319	$2,916	$4,625
Net Income-Cont. Operations	$17,233	$7,742	$6,805	($5,237)
Net Income	$17,233	$7,742	$6,805	($5,237)
Net Income Applicable to Common Shareholders	$17,233	$7,742	$6,805	($5,237)

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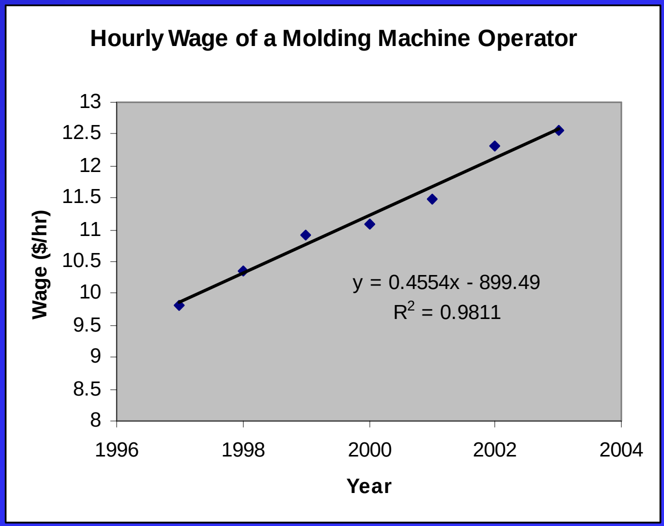


Part 3: Defining System Designs to be Analyzed

- To keep the decision analysis simple, the sensor array is split into two manufacturing approaches

System 1: Fixed – Sensor Plate

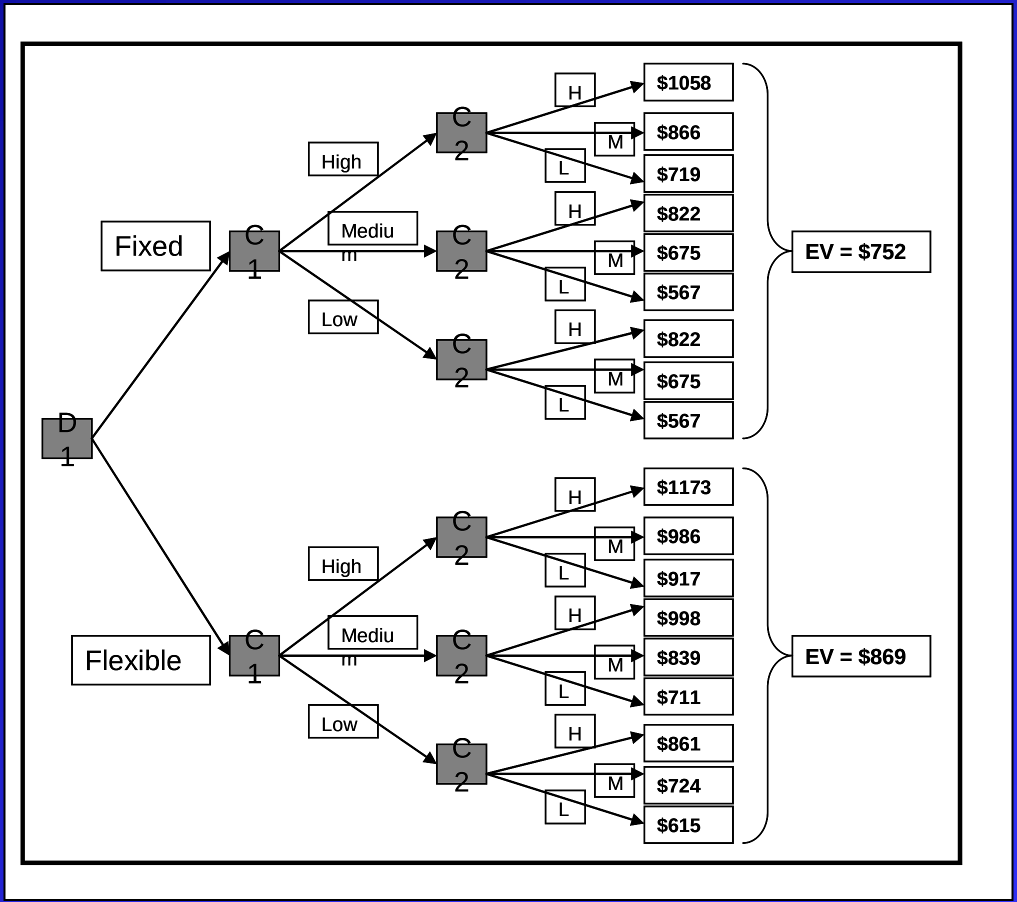
- Large single array (covers entire plate)
- Requires a single large manufacturing plant
- Large capital investment
- Could take advantage of economies of scale if production is high

System 2: Flexible – Sensor Strips

- Sensor pegs reside on a single strip (~ 12 strips / plate)
- Smaller manufacturing plants
- Equivalent economies of scale to the larger plant
- Allows plants to be built or shut down over time

Part 4: 2-Stage Decision Analysis of Alternative Designs

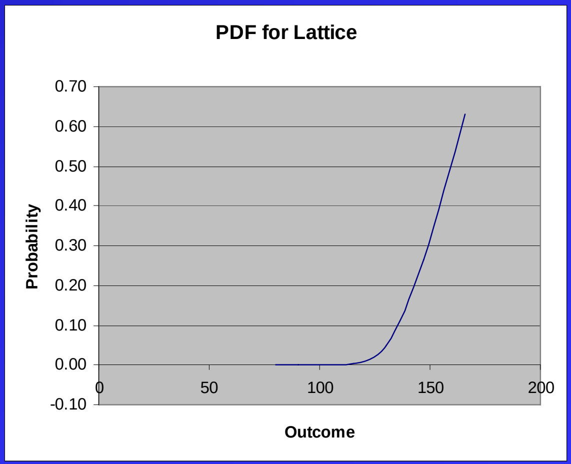
- Both fixed and flexible design approaches are evaluated using a 2-stage decision analysis with market demand as the uncertainly



- Both systems yield a positive NPV
- Flexible system offers and additional $120 million in NPV over the eight year time period
- Choose the flexible design approach with the given design parameters

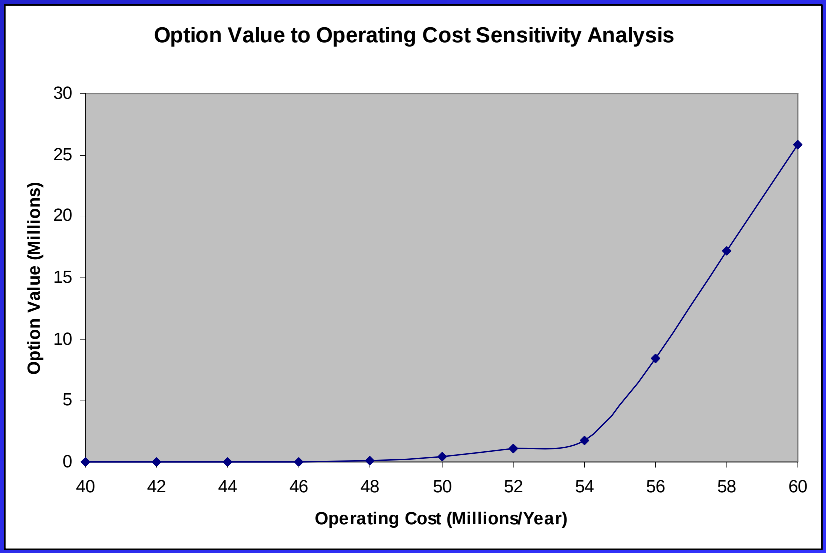
Part 5: Lattice Analysis of Evolution of a major uncertainty

- To model market demand uncertainty, a binomial lattice is employed
- Input parameters for the lattice (P,U,D) are chosen from Invitrogens revenue data over the last five years (company that produces a similar product)
- The PDF plots of the lattice are shown below
- It must be noted that since the growth rate is larger than the standard deviation, P is greater than 1
- P is set to 0.95 for this analysis; however, it should be noted that since the actual P is greater than 1, the lattice is a poor model for this system



Part 6: Decision Analysis Using Lattice

- The binomial lattice parameters developed in part 5 are used to develop a decision lattice
- At time zero, many plants are built to anticipate high demand. If demand is lower than expected, a plant can be closed down (Put option)
- Since the probability is high, the put option is only exercised when manufacturing costs are higher than expected
- The value of the option is plotted against yearly manufacturing costs below (sensitivity analysis)



Conclusions

- 2-stage decision analysis shows advantages in a flexible system design; however, the calculations would become highly intensive if the number of stages increases over two or three
- The binomial decision lattice is easily setup in a spreadsheet, but since the predicted growth exceeded the variance, this model is less appropriate
- The lattice did prove very useful in performing a sensitivity analysis on production parameters, such as manufacturing costs
- This portfolio dictates the use of a flexible design approach (sensor strips)
- The portfolio results also advocate being able to open and close plants over time (options ON the system)

Assumptions

- Used a fixed discount rate for all NPV calculations
- Manufacturing parameters were only estimates (actual parameters could be much different)
- Only investigated market demand as the uncertainty variable
- Market models did not include competition, marketing, and unknown demand markets
- Assumed path independence for all binomial lattice simulations