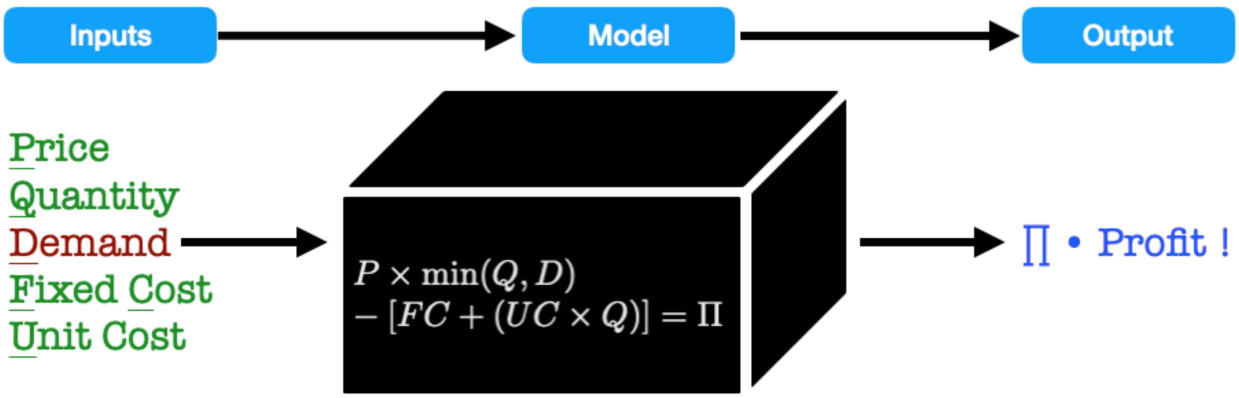
Ludic Pedagogy III • Roll The Bones

I had been using a Profit Model example (again, James Evans' *Business Analytics*, 3rd ed.) to begin to develop mathematical modelling techniques in students. I introduce new concepts as "black boxes" and then we dissect those boxes to reveal the inner workings. There are five inputs and one output:



We build this model in Excel. With an initial set of parameters (P = 40 \$/unit, Q = 40,000 units, D = 50,000 units, FC = \$400,000, and UC = 24 \$/unit), we get a profit value of ∏ = \$240,000. We use this model to learn about Excel's "What-if" analysis tools — Goal Seek to determine break even point quantity, Scenario Manager for looking at changes to various values, and Data Tables to look at even more ranges of changes than Scenario Manager can handle.

When it comes time to introduce Monte Carlo Simulation, we start with ranges of values (e.g., FC = \$400K or \$450K, UC = 22, 23, 24, or 25 \$/unit, and D = a range of values from 40K to 60K units; most likely 50K). We calculate best case (∏ = \$680,000), worst case (∏ = –\$350,000), and "average" case (∏ = \$400,000). Then the "boss" comes in an asks the "analyst" a number of **what-if questions** using probabilistic language:

- What is the probability of the best case scenario?
- What is the likelihood of breaking even?
- What are the chances of making more than \$400K?

You may have seen this done with flipping a coin – 50/50 chance for the two values of Fixed Cost. Then drawing cards from a deck; a 1 in 4 chance of getting a spade, which represents a Unit Cost of 25 \$/unit. Then rolling two dice — and using a look-up table like the one at right to translate the total number of pips into simulate Demand values

Demand We want a "triangular" shaped demand distribution. Hopefully you recall from BU255 that the distribution associated with rolling two fair 6-sided dice is roughly triangular shaped. Here's a wee histogram (if you look at it sideways):

2 • $P(2) = 1/36$ • represents $D = 40,000$ units
3 • $P(3) = 2/36$ • represents $D = 42,000$ units
4 • $P(4) = 3/36$ • represents $D = 44,000$ units
5 • $P(5) = 4/36$ • represents $D = 46,000$ units
6 • $P(6) = 5/36$ • represents $D = 48,000$ units
7 • $P(7) = 6/36$ • represents $D = 50,000$ units
8 • $P(8) = 5/36$ • represents $D = 52,000$ units
9 • $P(9) = 4/36$ • represents $D = 54,000$ units
10 • $P(10) = 3/36$ • represents $D = 56,000$ units
11 • $P(11) = 2/36$ • represents $D = 58,000$ units
12 • $P(12) = 1/36$ • represents $D = 60,000$ units

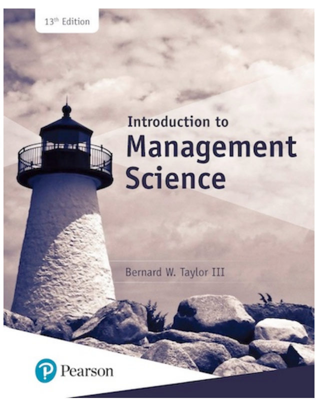
This lead to a lot of confusion for students! If only there was a better way. Enter big foam dice.

Big Foam Dice — I picked these up from Trainer's Warehouse. You can find 'em on Amazon and other places. They're foam so you can throw them around without injury. They have pockets on them so you can customize them to your class:

We "roll the bones" (throw the dice around the classroom) and when a student catches a die, which ever space the index finger of the catching hand reveals the simulated value.

I ask "yellow die?" and the student with the yellow dice shouts the value out to me and I enter it into a spreadsheet. We do this 10 times.

Dynamic Simulation



I like this problem (Q14.17) from Taylor III's *Introduction to Management Science* (13th ed.; Pearson) and wanted to bring it to life in the classroom…

A robbery has just been committed at the Corner Market in the downtown area of the city. The market owner was able to activate the alarm, and the robber fled on foot.

Police officers arrived a few minutes later and asked the owner, "How long ago did the robber leave?" "He left only a few minutes ago," the store owner responded. "He's probably 10 blocks away by now," one of the officers said to the other.

"Not likely," said the store owner. "He was so stoned on drugs that I bet even if he has run 10 blocks, he's still only within a few blocks of here! He's probably just running in circles!"

Let's test the store owner's hypothesis: Assume that at each corner of a city block there is an equal chance that the robber will go in any one of the four possible directions: north, south, east, or west.

I designed custom north-south-east-west tetrahedral dies and had them made by a gaming supply company. Now we can do a quick version of this problem in class with erasable boards & dry-erase pens!

I use Sli.do software to get the results from the many simulations running in class and debrief.

So many uses for dies and dice in the classroom!