MGB 206: Decision Making and Management Science

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Lesson Plan: Session 2

1. Recalling Session 1
2. Example: Boat production
3. About Excel
4. Exercise: Banjul
5. Monte Carlo simulation
6. Central limit theorem

What We Discussed Last Time

Formal Decision-Making

- Choosing
  between possible alternatives
  based on preferences

But, but, but

- Do you {always, sometimes, ever} know
  - Your alternatives?
  - Your preferences?
- Can you choose meaningfully?

Example: Boat Production

- Production planning in a boat yard
  - Two types – sailboats and motorboats
  - Different raw materials, different profits
  - Raw materials are limited
  - Otherwise, production can be unlimited
- We'll explore this "what if" problem in Excel

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‘What-if’ Modeling In Excel

- Easy to set up and explore
- May provide “best possible” answer
- Best practices
  - Separate data & formulas (e.g., via sumproduct)
  - Test for correctness (=if(), auditing tools)
  - Maintain ability to scale (range names)
- Size and complexity are fatal limitations

Excel As Analytic Workbench?

- Many disadvantages
  - Easy to mix data and formulas/logic
  - Documentation, validation and error checking are tedious
  - Dimensionally limited
    - Can't easily go beyond row and column
  - Performance slow for large models
- Killer advantage: It's everywhere!

Exercise: Medical Supplies

- Using micro-case description in handout, create spreadsheet for ops
  - Communicate financial requirements
  - Order supplies (in #packages)
  - Ensure distribution
- Let's see

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About Uncertainty

- The past is not entirely known
  - Information is incomplete and/or dirty
- The future is essentially unknowable
  - Every forecast is wrong
- Yet, everyone operates under uncertainty
  - Some even prosper

Example: Estimating Profits

- New product to be introduced
- Profit forecast depends on
  - Quantity sold (uncertain)
  - Price per unit (uncertain)
  - Cost per unit (uncertain)
  - Fixed costs (estimated at $30,000)
- Look at a simple P&L forecast

Monte Carlo Simulation

- Technique to analyze systems where precise relationships are unknown or contain uncertainty
- Origins in Manhattan Project (‘40s)
- Management use relatively recent (‘70s)

Monte Carlo Software

- Many simulation packages in the market
  - Analytica, Arena, @Risk, Crystal Ball, Modsim, Vanguard Systems, …
- Risk Solver Platform fast & full-featured
  - Educational version is size limited, but enough for our purposes
  - The professional version is sufficient for most end-user applications

Learnings

- Different from average case analysis
- Simple steps for Monte Carlo
  1. Model the uncertain variables
  2. Select outputs
  3. Change simulation options if necessary
- We get not just "expected" outcomes, but a range of possible outcomes
- Results may vary from run to run

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Randomness

- An uncertain number (or random variable) is a number whose exact quantity is uncertain
  - Continuous or discrete

Exercise: Test Your Intuition

- Multiply spinner result by $1,000,000 to get company profit forecast. If profit is less than $200,000, you are fired!
- Write down on paper
  a) What's the average company profit?
  b) What's the chance you'll be laid off?
  c) Create a bar graph showing percentage of time the profit (in millions) will fall between 0 and 0.2, 0.2 and 0.4, etc.

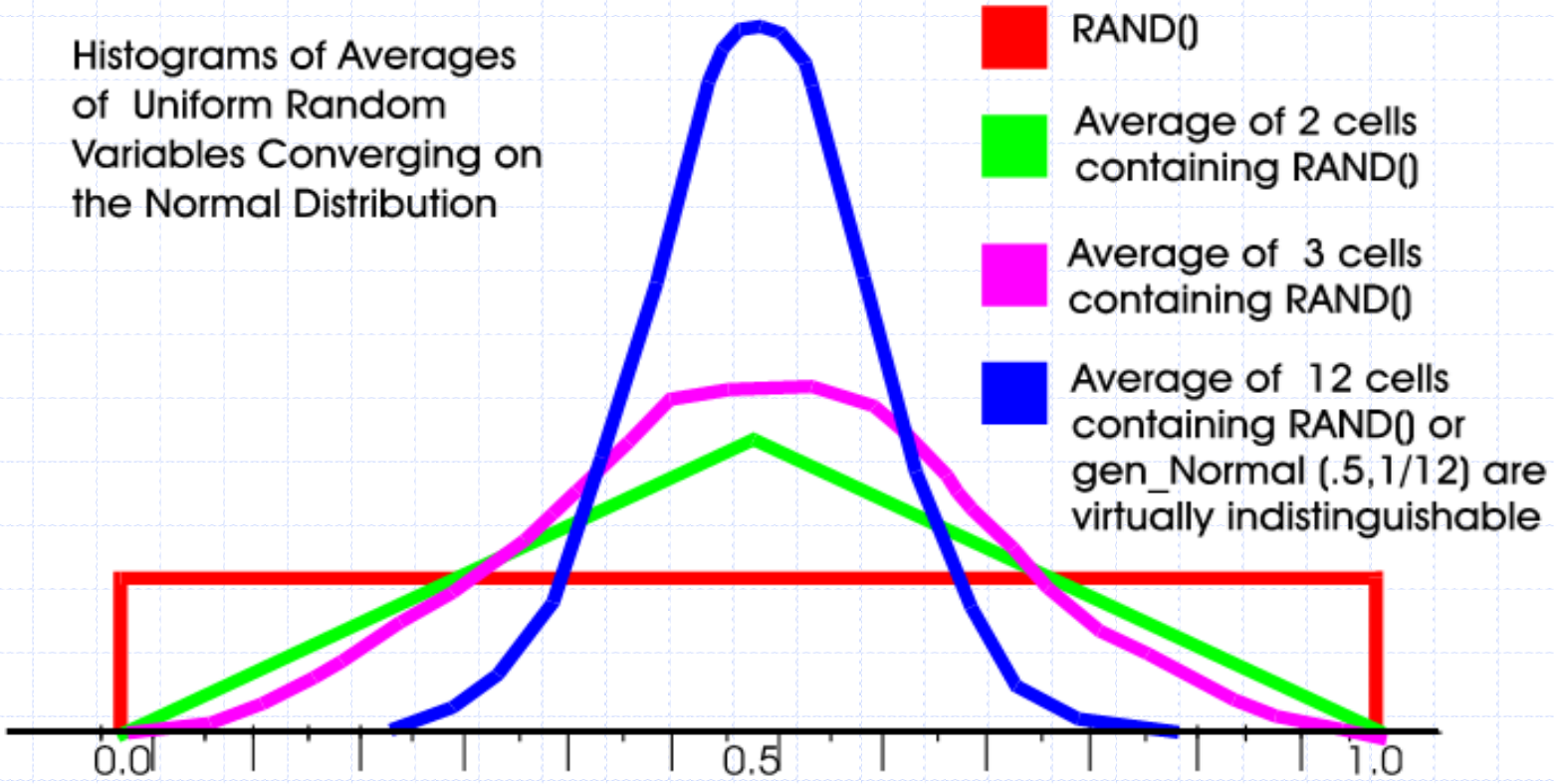
Exercise: Simulate To Check

- Simulate the company profit in Excel
  - Model uncertainty
  - Tie uncertainty to a result (output)
  - Analyze the result
- Compare against your previous answer on paper

Exercise: Double Down!

- Company's profit is now the average of *two* spins multiplied by one million
- First on paper, then in Excel, describe:
  a) Average company profit
  b) Chance you'll be laid off
  c) Histogram showing percentage of time the profit (in millions) will fall between 0 and 0.2, 0.2 and 0.4, etc.

Central Limit Theorem



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