UNDERSTANDING RISK ASSESSMENT AND INTERVENTIONS

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UNDERSTANDING RISK ASSESSMENT AND INTERVENTIONS

- Brendan A. Niemira – Risk calculation and assessment
- Alvin Lee – HPP and other interventions
- Eric Moorman – Case studies: bacteriophage and sanitation
- Q & A

RISK ASSESSMENT AND CALCULATION

RISK ASSESSMENT AND CALCULATION

- Every operation has hazards and risks
  - small vs. large, trivial vs. critical
- Analysis of hazards and risks guides decisions
  - Equipment, maintenance, processes, training, controls
  - Investments, insurance, strategic decisions
- Better decision-making leads to better outcomes

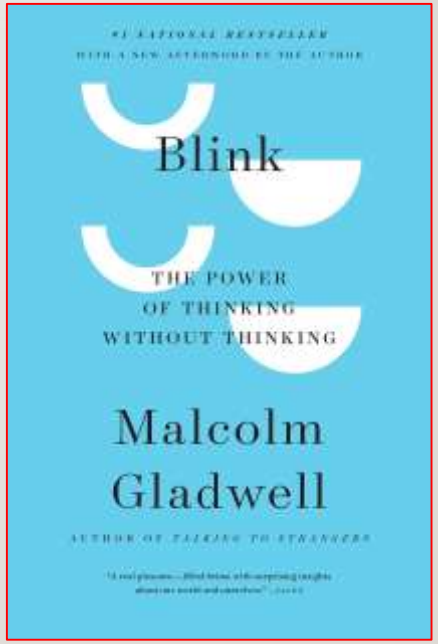
HAZARDS VS. RISKS, WITH A SIDE OF ANALYSIS

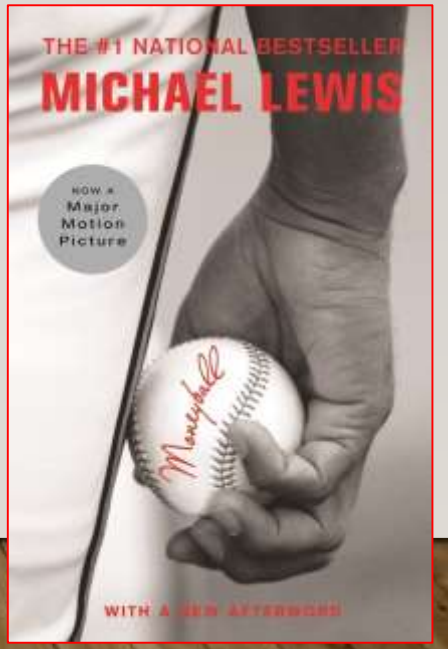
- Hazard: a bad thing that could happen
- Hazard analysis:
  - A list of all* the bad things that COULD happen
  - How bad* it would be if they DID happen
- Risk: the likelihood that a hazard WILL happen
- Risk analysis: $\sum$ (likelihood)*(how bad it would be)

"In most cases, decision makers rely primarily on common sense, intuition, ordinary knowledge, and nonscientific analyses in making decisions about risks. … It is easy for people, *especially scientists and professional analysts*, to form inflated hopes about the potential benefits from analytical or scientific contributions to decision making." **- Risk and Decision Making: Perspectives and Research.** National Research Council (US) Committee on Risk and Decision Making. Washington (DC): National Academies Press (US); 1982.

RISK ASSESSMENT AND CALCULATION

- Risk analysis always presents estimates, not certainty
- Qualitative: intuition, rules of thumb, "20 years experience", gut feelings, subjective
- Quantitative: data-driven, probabilistic, stochastic, model-based, objective(ish)
- Power in both methods
- Challenge: to be appropriately precise about the state of imprecision in prediction





RISK ASSESSMENT AND CALCULATION

- Example: Process operation goes out of spec ~3 times per 100,000 packages processed → (3/100,000) = 0.00003 failure rate
- Testing catches ~99.9% of failed packages. Testing has 0.001 failure rate.
- Risk of failed package going out the door is $(F_{process})*(F_{testing})$ = ~0.00003*0.001 = ~0.0000003
- Process 10,000,000 packages per week → ~3 failures in 10 weeks

RISK ASSESSMENT AND CALCULATION

- Model building, where A influences B
- Math can get complex, but ultimately is making a prediction
- What about when good data is not available?
  - Collect good data
  - Consult experts for reasoned opinions
  - Straw data: worst-case scenarios, blue sky predictions

RISK ASSESSMENT AND CALCULATION

- Models focus on primary risks, significant hazards
  - Can safely ignore risk of alien invasion
- Potential hazards: micro tests on raw ingredients out of spec; failure of process control; break in cold chain; glass fragments in finished product; etc., etc.
- Assign numerical probabilities to each risk based on statistics, experience, record-keeping, etc.
- Derive relationships among various risks, some of which you can control, some of which you can't.

RISK ASSESSMENT AND CALCULATION

- Example, again: Process operation goes out of spec more the longer the interval between maintenance overhaul. Fridays are always worse than Mondays.
  - How much worse is "worse"? What if it varies?
- Testing still catches ~99.9%, 0.001 failure rate.
- Risk: $([(F_{Monday})+(F_{Tuesday})+(F_{Wednesday})+(F_{Thursday})+(F_{Friday})]/5)*(F_{testing})$
- Simulations based on multiple, nested variables, each operating with ranges of outcomes.

Introduction to Monte Carlo simulation in Excel

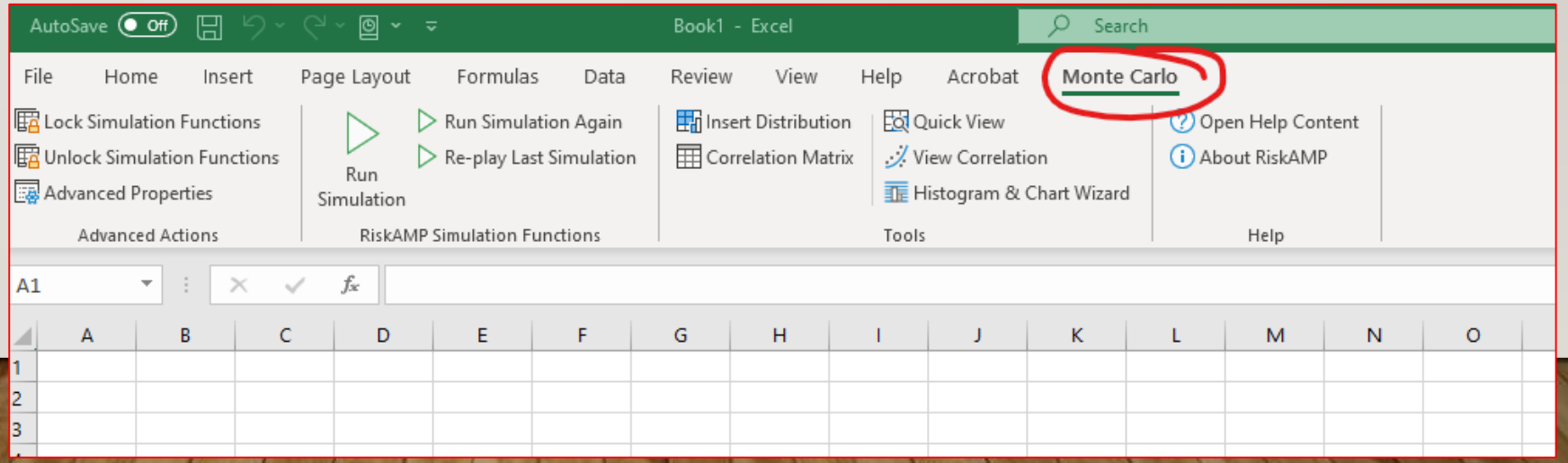
Excel for Microsoft 365, Excel 2021, Excel 2019, Excel 2016, Excel 2013, Excel 2010, More...

This article was adapted from *Microsoft Excel Data Analysis and Business Modeling* by Wayne L. Winston.

Overview

Who uses Monte Carlo simulation?

Risk analysis can run on specialty statistical software or with an Excel plug-in



USING RISK ASSESSMENTS TO MAKE DECISIONS

"Risk analysts gain confidence not by being right but by the act of making decisions." – Zach Wienersmith

- It's impossible, but don't let that stop you
- Risk analysis is iterative, drives continuous improvement
- Better data → better understanding → better analysis

DECISIONS MUST BE MADE

"Risk assessments deal with uncertainties: some are based on copious amounts of relatively uncontroversial statistics; others are based largely on reasoned speculation. We cannot ignore the problem of making assessments because decisions must be made, even if the decision is "no change". It is important for decision makers to know not only what is known but also what is not known." **- Risk and Decision Making: Perspectives and Research.**