Applying Monte Carlo Simulation (MCS) to Microsoft Project Schedules

Meetup for Project Managers SIG

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Risk Analysis

- Projects are full of risks
  - Technical approach
  - Resource availability
  - Missed requirements
  - Too many defects
  - Late subcontract deliverable
- …
Risk Analysis and MS Project

• Major concern – Improving confidence in schedule and budget projections

• Key challenges
  • Uncertainty in time or cost estimates
  • Translating uncertainty into reserve or buffer
  • Applying models and simulation techniques

• One such modeling technique: Monte Carlo Simulation
Agenda

• Casino games and Monte Carlo theory.
• Multi-point or Stochastic estimating.
• PERT estimating technique.
• Monte Carlo Simulation in detail.
• Garbage in, garbage out…
• Demonstration of MS Project and Monte Carlo add-on.
• Summary and references.
Monte Carlo explained?

- How many ways to roll two dice?
- 36 unique combinations.
- What is the probability or rolling 4 or less? 6 or less?
The Three-point estimate...

- Stochastic (multi-point) vs. Deterministic (single point) estimating.
- Basis of PERT estimating and Monte Carlo Simulation techniques.
- Incorporates uncertainty into schedules and budgets.
- What do the Opt. and Pess. estimates represent?
Applying this model to estimates...

- Tasks with uncertain durations can lead to an uncertain finish.
- Single point estimates will lead to low probability projections.
- Multi point estimates can be modeled in order to project higher probability targets. More on this shortly…
- An iterative simulation can help apply statistical models to quantitative analysis, but let’s start with a simplified formula first…
PERT Estimates in MS Project...

\[ D_{est.} = \frac{(Opt. + 4(Most Likely) + Pess.)}{6} \]

- PERT formula – weighted average based on 3 pt estimate.
  - Historically driven by simplicity.
  - Essentially a ‘beta’ distribution.

- Determines the ‘mean’ finish date or budget but not necessarily a high probability one.
- Not a true simulation based on randomly distributed time or cost values.

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Applying a single point model...

- Deterministic estimates (single point) lead to the most likely finish date, but...
- ... the **probability** of finishing by this date is typically about 50%.
Applying a Stochastic model...

- Stochastic estimates (multi-point) can be modeled to generate a *properly modeled distribution curve* for the finish date or target budget that can be used to project a 90% confidence level.
Murphy’s Law of 3 pt estimates...

- Anecdotal evidence often suggests that ‘Most Likely’ estimates are usually the same as ‘Optimistic’.
- Why?
How Monte Carlo works in MSP...

- Apply a distribution model to ‘risky’ activities.
- Enter multi point estimates for time and/or cost.
- Run an ‘iteration’ where randomly generated estimates are selected for each activity based on the distribution model.
- Record projected finish date or budget and repeat many times (500-5000 iterations).
- Analyze the resulting finish date or budget distribution curves to determine high confidence schedules or budgets. (typically 90%)
Garbage in, ...

- This technique can be subjective and depends heavily on the quality of the estimates.
- What are our assumptions?
- How can be avoid ‘garbage in, garbage out’ data?
- Can pessimistic estimates be tied to quantifiable risk events?

- The PMBOK Guide would suggest that we:
  - Identify activities
  - Identify risk events for activity X (risk 1, risk 2, … risk n)
  - Plan risk response for activity X (contingency reserve)
  - Leverage contingency reserve to determine pessimistic estimates.

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Demonstration

- MS Project 2007.
- Built-in PERT Analysis toolbar & functionality in MSP.
- @Risk for Project add-on tool by Palisade Software.
  - ‘Outputs’ defined.
  - Three-point estimates set.
  - Simulation settings configured.
  - Run simulation.
  - Interpret results.

- Additional add-on vendor: Deltek Risk+
Moral of the story...

- PMs should challenge estimates. ‘Estimate QA’
- Incorporate uncertainty (time/cost) for riskiest activities.
- Tie specific risk contingencies to pessimistic estimates.
- Consider your risk tolerance and apply a model.
- MS Project PERT is ‘half’ of the story.
- Monte Carlo Simulation is feasible on desktop systems.
- Use MCS to determine higher confidence schedules/budgets and even uncover hidden critical paths.
Industry applications of MCS

- Transportation – Federal Transit Administration requires high probability schedules and budgets for municipal public transit proposals. MCS applied by transportation mgmt consultants.
- Medical – Large contact lens manufacturer applied MCS in Six Sigma program management rollout.
- Defense – Large contractor utilized MCS in program consolidation of missile and systems subdivision.
For more information...


- Thank you!
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Jim Park, PMP, has helped organizations improve their project management skills through public and corporate training courses since 1998. He is an instructor for UCSC Extension in Silicon Valley and specializes in courses such as Project Management Essentials, PMP Exam Prep, Microsoft Project, and Decision Making Tools and Techniques. Companies benefiting from Jim’s PMO training and consulting services include Oracle, Hitachi, PG&E, Lockheed Martin, Kaiser Permanente, ALZA Pharmaceuticals, Ingersoll-Rand, Symantec and the U.S. Air Force. Jim has over 15 years of experience in the software development, information technology, pharmaceutical, and medical device industries primarily focused on managing projects and developing better project management organizations, processes, and tools.

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