Project scheduling with alternative technologies: incorporating varying activity duration variability

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Introduction

• A project is a set of precedence-related activities that need to be completed in order to achieve a specific target
• Our objective is to schedule the activities of a project such that its value is maximized
• We examine how to incorporate the following characteristics:
  – Activity failure
  – Modular completion structure of the project
  – Different levels of variability in the durations of the activities
• Relevant especially for R&D and NPD but also in other sectors: pharmaceuticals, software development, ...
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• \( m \) modules \( N_i \)
Solution methodology

We build on earlier work of Creemers et al. (2010)*:

• At any moment in time, the state of each activity \( j \) can be:
  – Not Started
  – In progress
  – Past (successfully finished, failed or considered redundant because another activity of its module has completed successfully)

• The state of the system is defined by the state of the activities
• Use of Phase-Type distributions to model activity durations
• Use of a Continuous-Time Markov chain to model the statespace
• The optimal eNPV is found using a backward SDP-recursion

Research Question

• What is the impact of the variability of activity durations on the eNPV of a project?

• Experimental setup:
  – All activities in the project have the same level of variability
  – Variability is expressed using the Squared Coefficient of Variation (SCV)
  – We observe SCV’s ranging from 0 (deterministic) to ∞
  – We use Phase-Type distributions to model the activity durations*

Preliminary computational results indicate that networks with up to 60 activities can be solved to optimality.
Individual activity level
Summary

• We have extended the model of Creemers et al. (2010) to incorporate general activity durations (using Phase-Type distributions) & to allow for modular projects

• We have shown that variability in the duration of activities is not always bad with respect to the NPV of a project

• We have shown that even for a single activity, variability in the duration can be beneficial