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Rethinking PERT-Beta Distribution: A Systematic Evaluation of PERT RNG Models in Project Risk Simulation

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Abstract

This study investigates the functional equivalency of various random number generation (RNG) models for the PERT (Program Evaluation and Review Technique)-beta distribution in Monte Carlo project risk simulations. The existing project management literature contains multiple PERT-beta RNG models, which are often used interchangeably under the assumption that they possess a level of functional equivalency. Our study highlights that this assumption may be inaccurate, leading to potential model selection errors when analysts apply a PERT-beta model without a thorough understanding of its unique statistical properties. Our study makes three contributions to the field of project risk simulation. First, we identify seven widely used PERT-beta RNG models prevalent in the project management literature and specialized simulation software (e.g., @Risk and Crystal Ball). Second, we conduct a comparative experiment to characterize the stochastic behaviors of each model. Finally, we propose and test a hypothesis on the functional equivalency of these alternative PERT-beta RNG models, employing both parametric and empirical approaches. Both researchers and practitioners stand to gain from these insights, as they facilitate the prevention of model selection errors and mitigate confusion stemming from latent algorithmic discrepancies among the alternative PERT-beta models.

Keywords
PERT, Monte Carl simulation, ambiguity errors, random number generation (RNG), and project management.

Biography
Dr. Byung-Cheol "BC" Kim is an Associate Professor of Project and Supply Chain Management at the Black School of Business, Penn State Behrend. He completed his Ph.D. at Texas A&M University in Texas and boasts seven years of industry experience in the field of heavy highway construction. As a prolific scholar, Dr. Kim has authored a book on project management and numerous research articles in leading management journals such as the European Journal of Operations Research, IEEE Transactions on Engineering Management, Production Planning and Control, Journal of Construction Engineering and Management, Journal of Management in Engineering, and the Engineering Economist. His current research interests encompass a range of topics, including project analytics, stochastic project control, risk visualization, forecasting, simulation modeling, Kalman filter forecasting, Bayesian decision-making, and risk-based EVM systems. In addition to his academic accomplishments, Dr. Kim is a registered Professional Engineer in Ohio, a registered Structural Engineer in South Korea, and holds the designation of a Project Management Professional.