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Interest and Issues in Simulation Optimization

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- Characterizing effects of estimation and problem size on solution quality
- Finding useful universal confidence regions
- Clarifying relationships among risk measures
- Obtaining useful results for QMC/sparse-grid/etc. methods

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Estimation, Problem Size, and Solution Quality

- Estimation errors:
  - Input parameter and model specification
  - Output performance criteria
  - Transience and non-stationarity
  - Exponential increases in dimension for large error chances (+increasing bias)
- Optimization effects:
  - Extremal properties driven by estimation errors
  - Batching and re-sampling can help reduce errors
- Question: how to determine the best level of granularity/aggregation for a simulation optimization model?

Useful Universal Confidence Regions

- Problem: Find x^* to minimize $\int_{\Xi} f(x,\xi)P(d\xi)$.

- Goal: find α_1, β_1, α_o, β_o with useful values s.t.

$$P\{|E_\xi[f(x^\nu,\xi) - f(x^*,\xi)]| \geq \epsilon\} \leq \alpha_1 e^{-\beta_1 \nu}.$$

and, if x^* is unique,

$$P\{\|x^\nu - x^*\| \geq \epsilon\} \leq \alpha_0 e^{-\beta_0 \nu}.$$

Risk-Measure Relationships

- Setup:

$$\int_{\Xi} f(x,\xi)P(d\xi) \rightarrow -\int_{\Xi} w(x,\xi)P(d\xi) + R(x,\Xi,P)$$

where $w(x,\xi)$=reward, $R(x,\Xi,P)$=risk.

- Overall: utility
- Properties: More risk is bad; other axioms.
- Questions:
  - When can/should the objective be an expected utility?
  - What objectives/properties best reflect preferences?
  - What are the relationships between solutions with "robust" risk measures and those with expected utility measures?

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Useful Results for QMC/Sparse-grid/etc. Methods

- Advantages of QMC/Sparse-grid
  - Deterministic bounds with good asymptotic properties (error reciprocals almost linear in sample size)
  - Can use with random sampling for error bounds
- Disadvantages
  - Theoretical bounds generally not useful and may not be available (depending on bounds/derivatives)
- Questions: what practically useful (small-sample) bounding properties are available?