Center for
Advanced
Decision
Support for
Water and
Environmental
Systems

Stochastic Optimization in RiverWare

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Based on J.D. Emmert's Masters Thesis

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& CADSWES

Outline

- Existing Objective Function
- Previous Stochastic Approaches
- Network Stochastic Programming

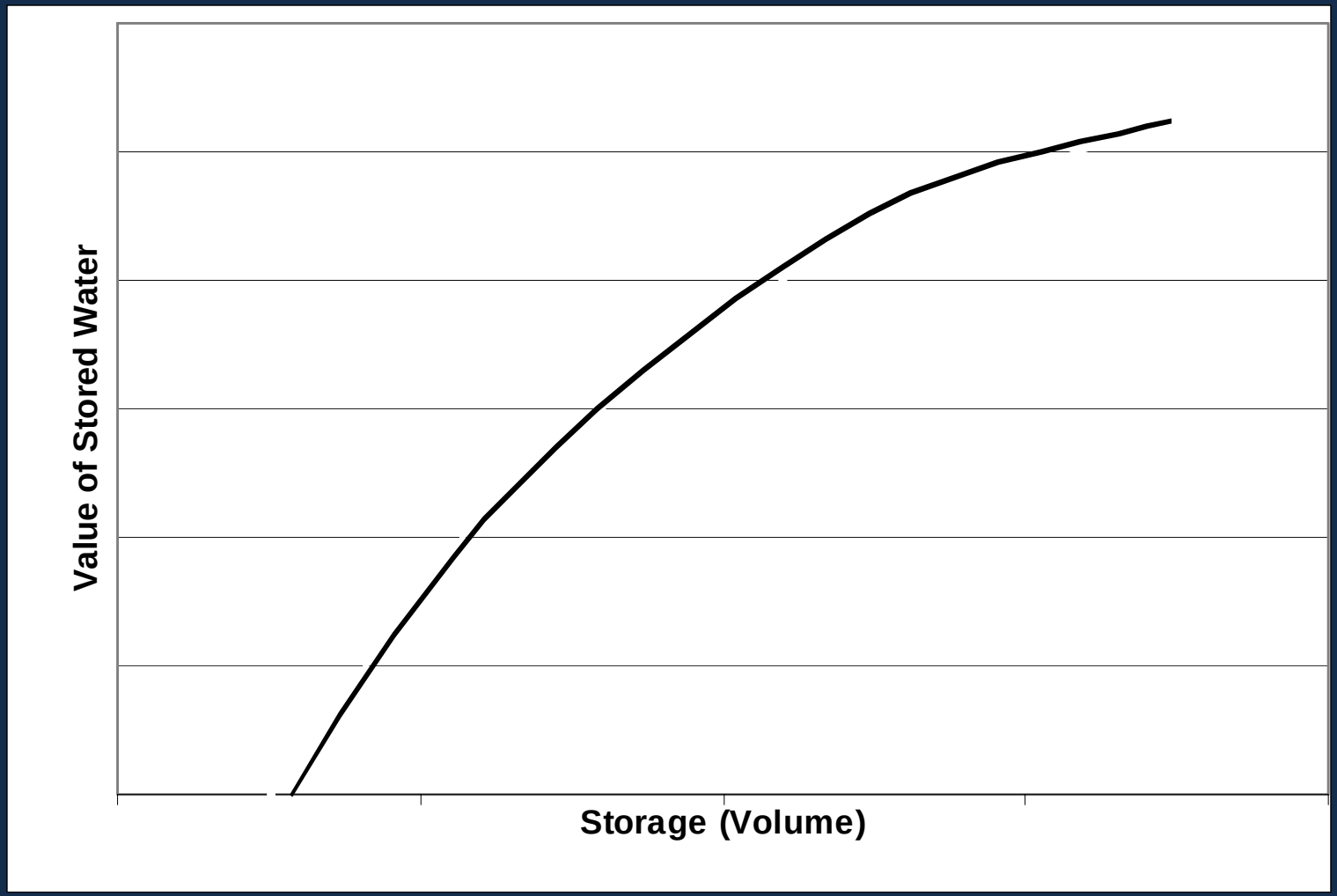
Basic Optimization Approach

Short Term Value + Long Term Value

- Optimization based on 1 week model: current value plus future value
- Maximize avoided cost + future value
- Existing Model: future value is input (from VPS)
- New Model: future value based on alternative hydrologic scenarios for future weeks
- TVA's objective function is hydropower, but the approach works for a consumptive value of water as well

Value of Water vs. Storage

Exaggerated curve, not to scale



Value of Project Storage

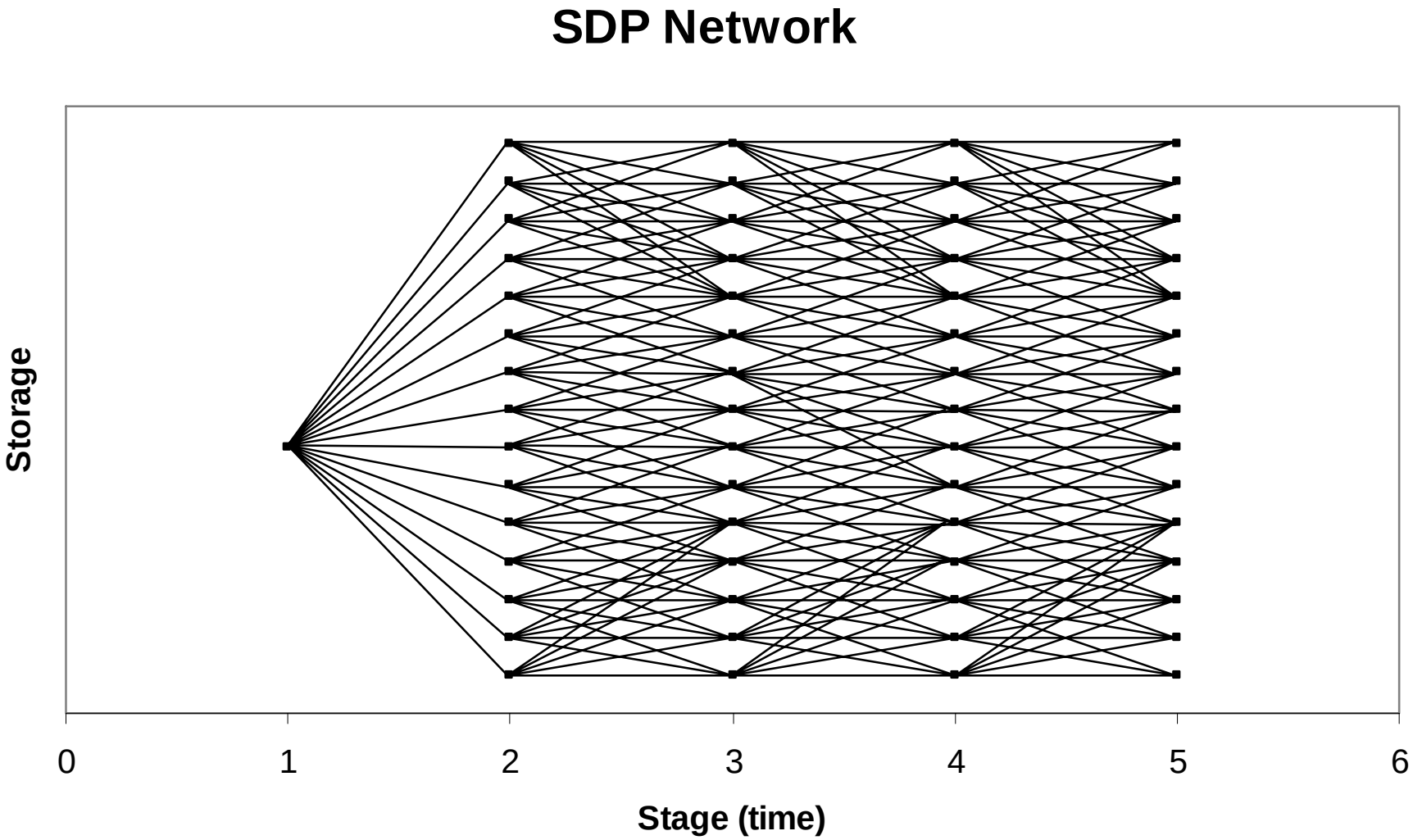
Lacks interaction of storage at other reservoirs

- One curve produced per reservoir
- No interaction between reservoirs is considered
- System wide operation so clearly there is reservoir interaction
- Example: One very high reservoir, rest very low
  - Operation decisions very different

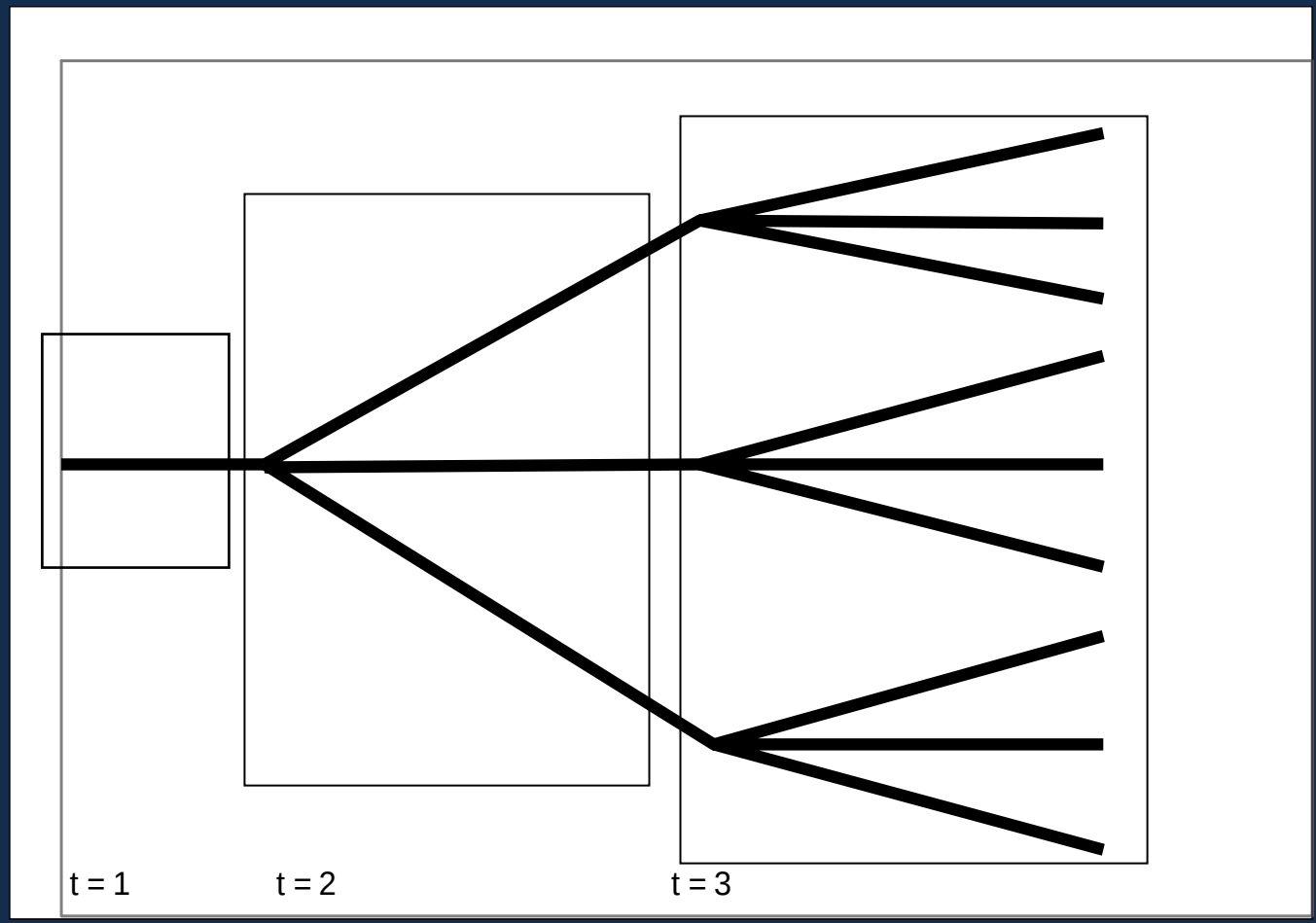
Two Exponential Approaches

1. Stochastic Dynamic Programming (SDP)
2. Stochastic Programming with Recourse (SPR)

Exponentially increases with reservoirs: Reservoirs Storage states

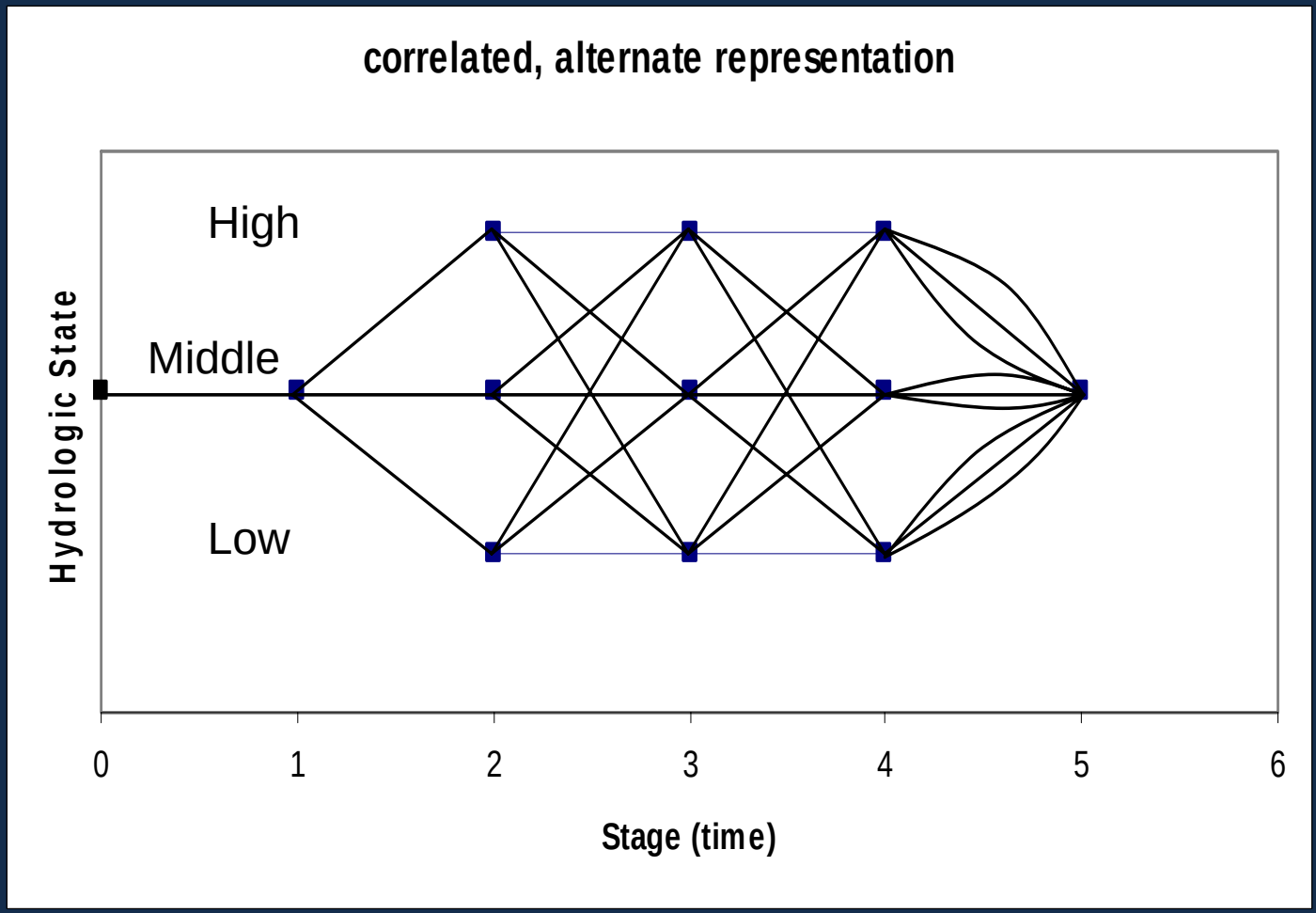


Exponential with number of time steps: $Timesteps^{Scenarios}$



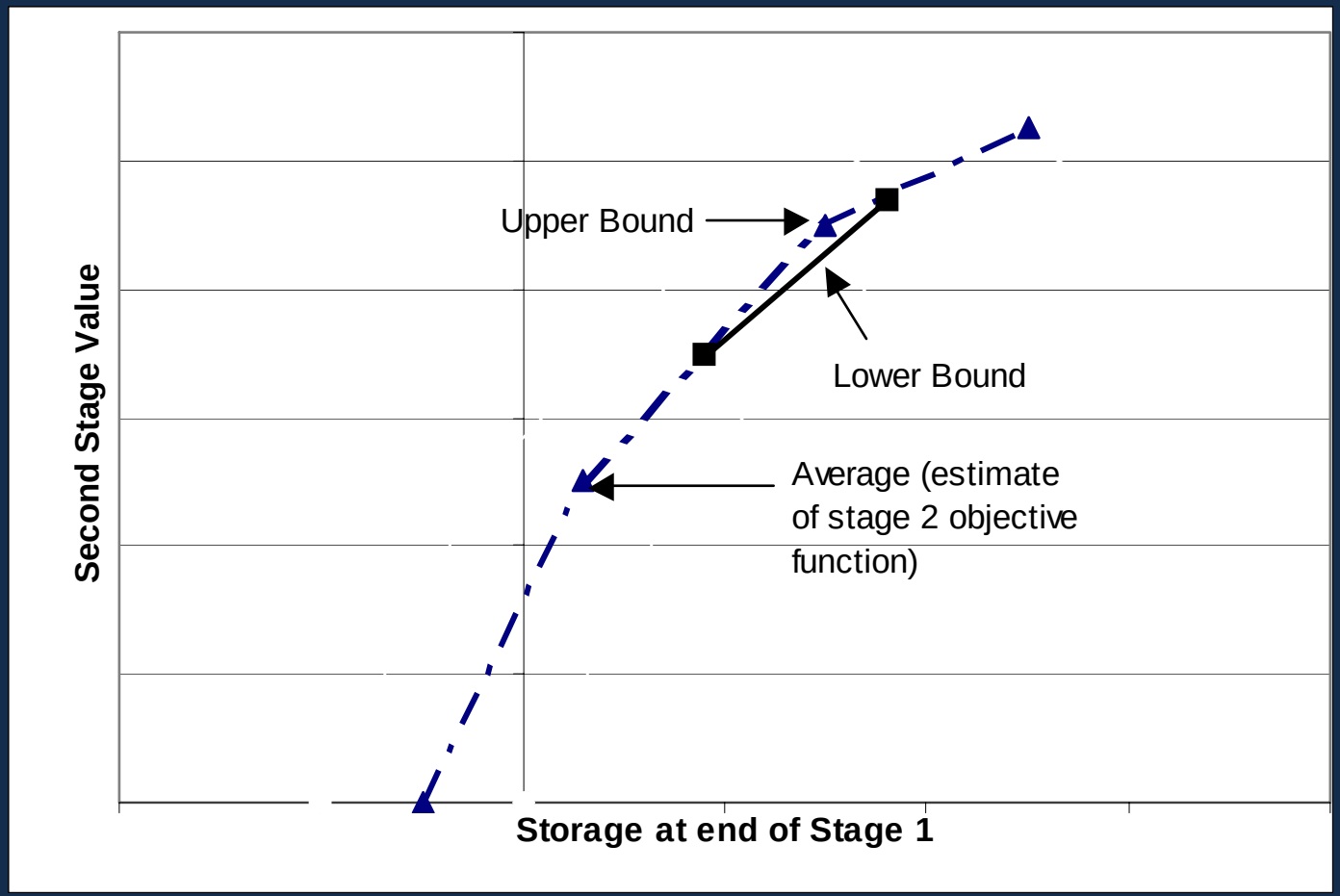
Network Stochastic Programming

Use hydrologic states to reduce trees to network of states



Visual Representation of bounds

Each solution improves the lower bound and the upper bound



Status

Available in the Next Release !

- Tested:
  - Beginning of Spring Runoff Season
  - 4, 6, and 8 week Models
  - Generate Cuts for multiple reservoirs
  - Single and Multiple Objectives
  - Approximately $50,000 improvement for 1 week
  - Updated code to include new MRM
- **To Do**:
  - Retest after changes for MRM
  - Test during other seasons
  - Improve Upper Bound computations
  - Improve Multi-objective case