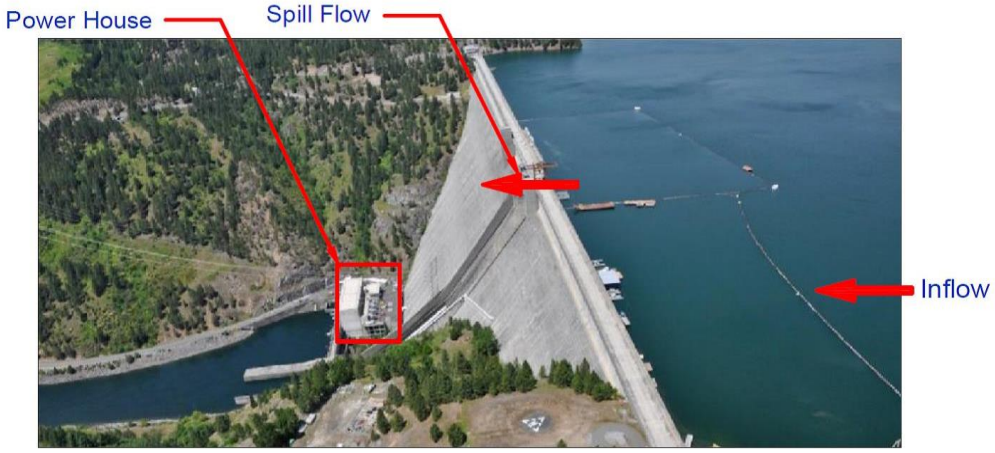
An approach to Robust Optimization of Large Scale Complex River System

Arpan Biswas

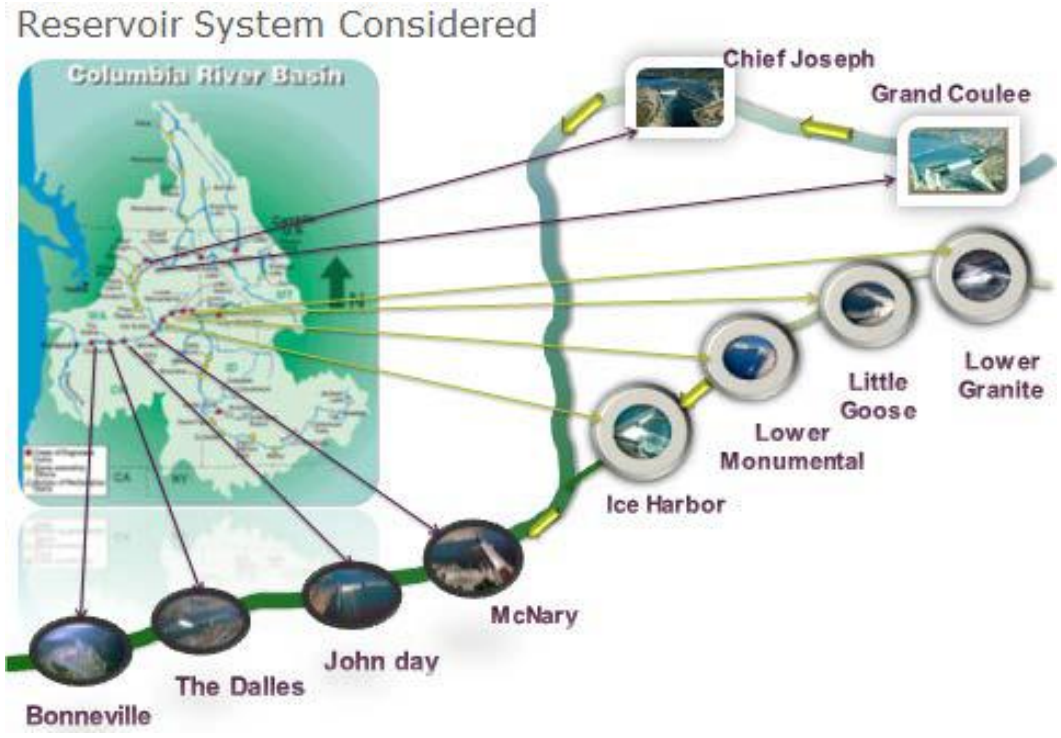
ST 541 Project

28th Nov, 2018

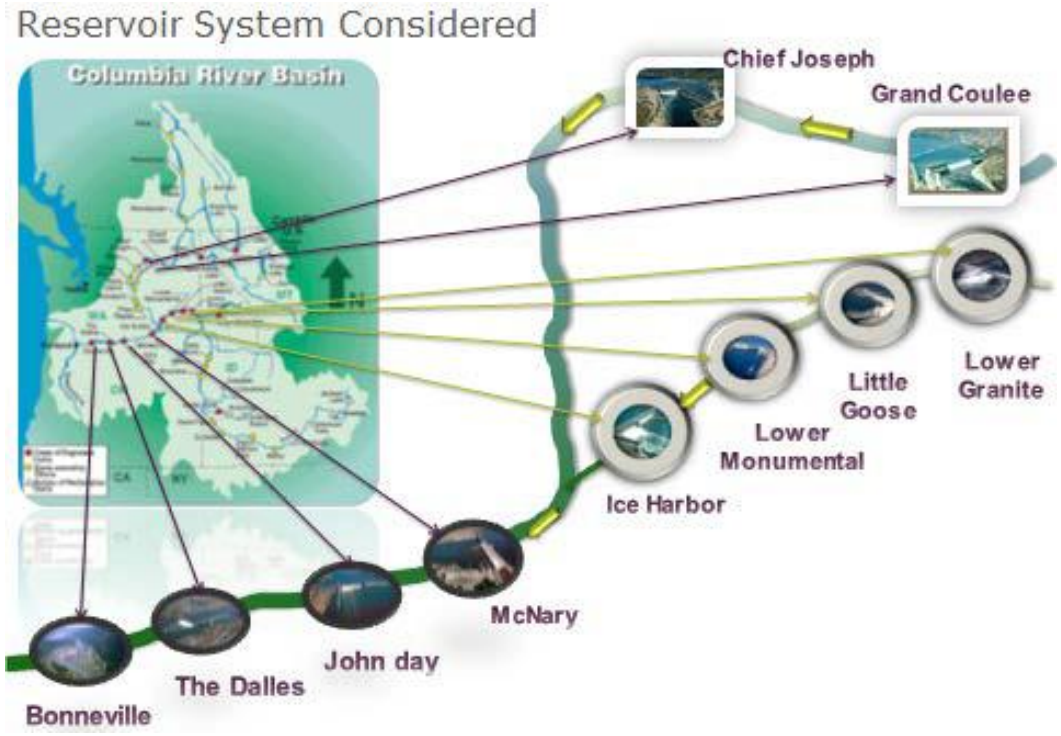
GitHub Link: https://github.com/ST541-Fall2018/arpanbiswas52-project-ComplexRiverSystem



Hydro energy generation problem



Hydro energy generation problem



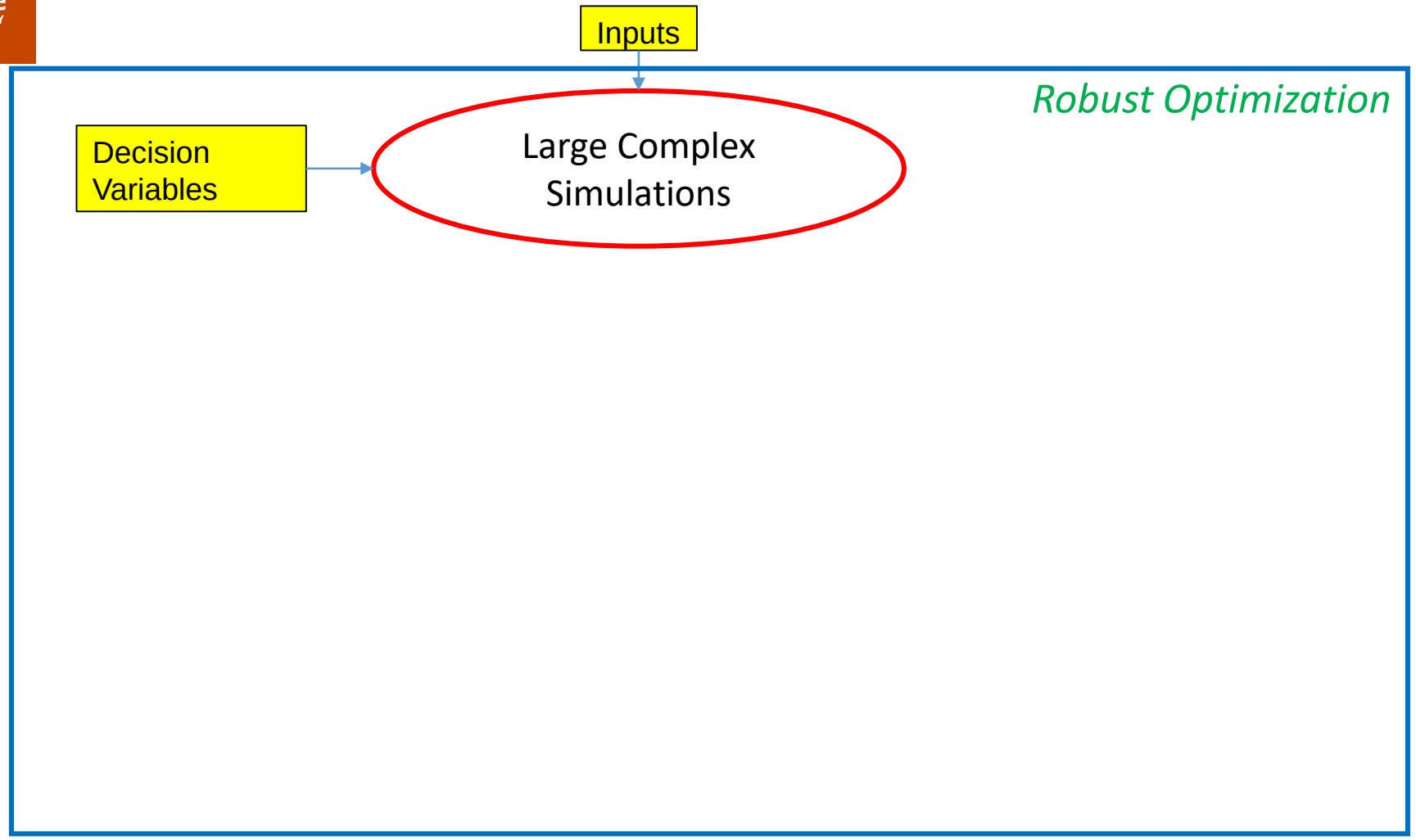
Goal:

- **Uncertainty Quantification** of Inflows, Prices etc.
- **Robust Decision** of Optimal Energy Allocation.

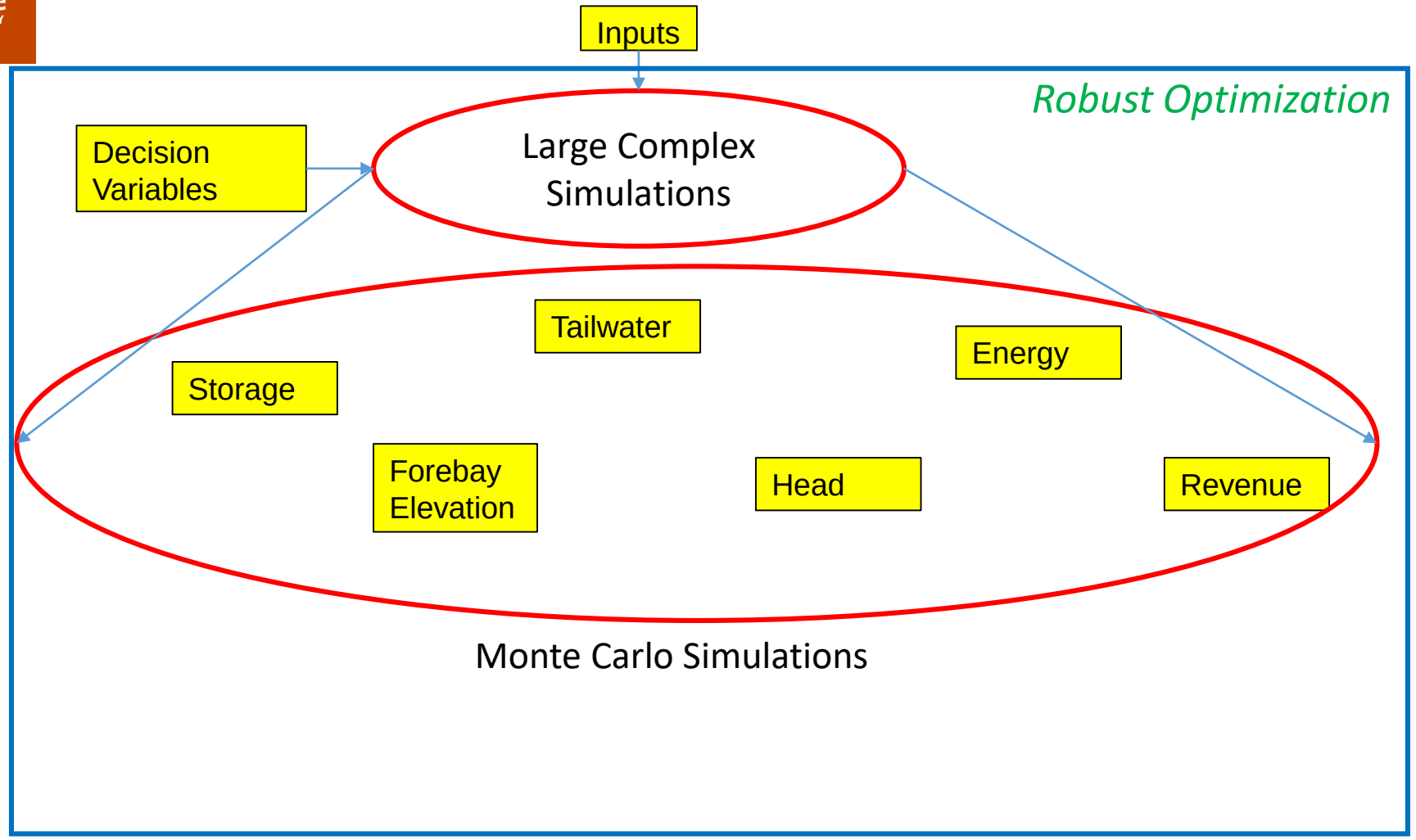
Optimization Model Framework

Inputs

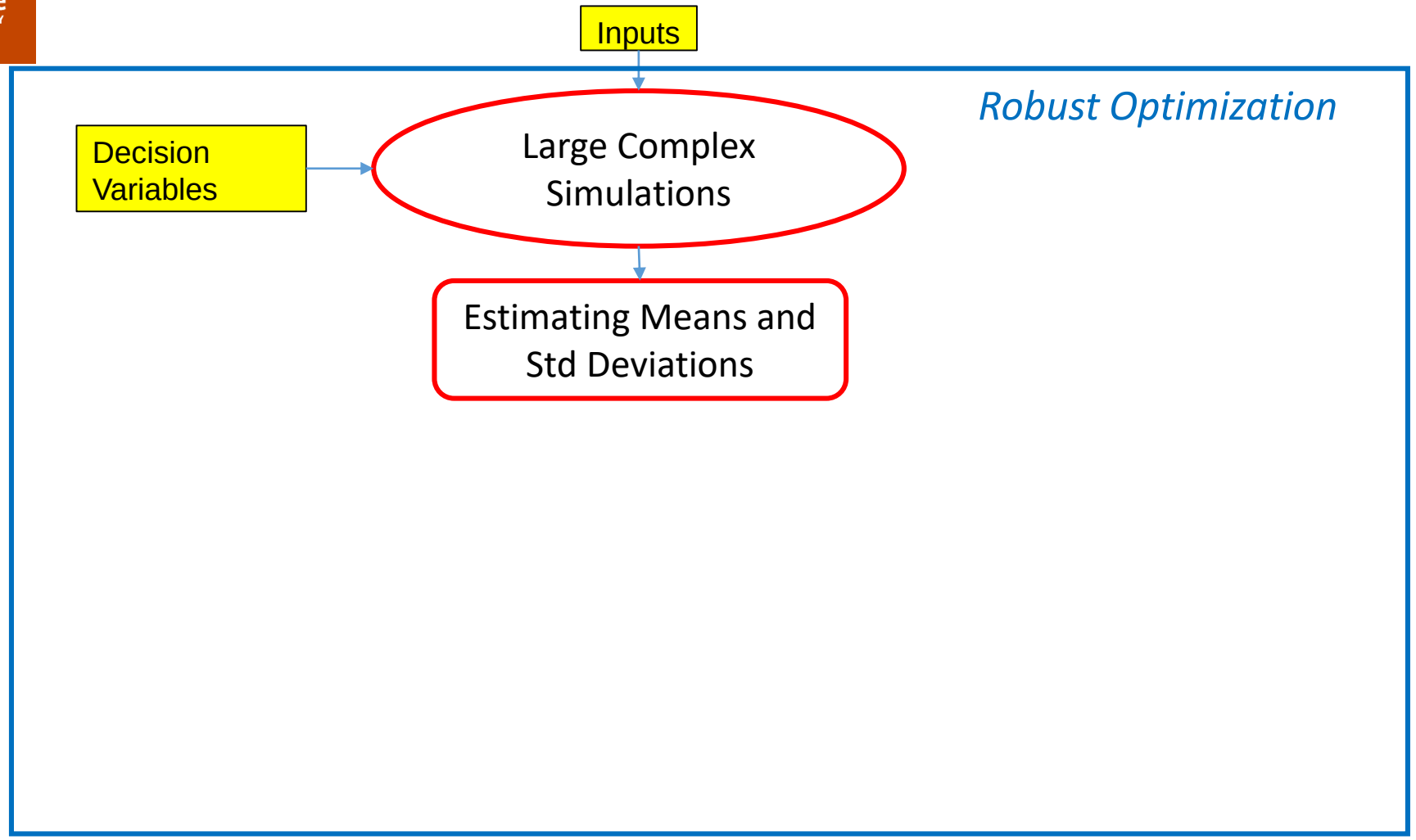
Optimization Model Framework



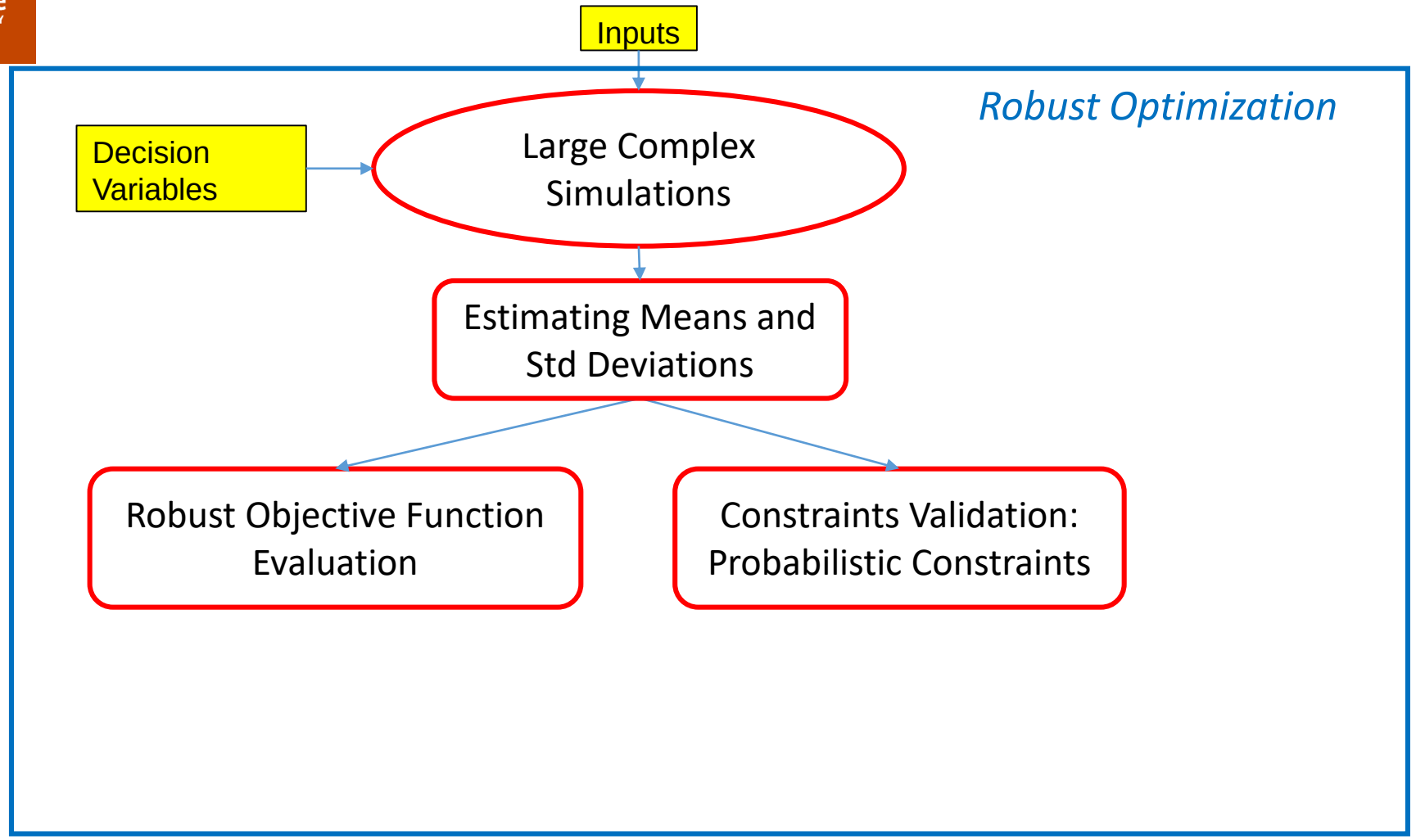
Optimization Model Framework



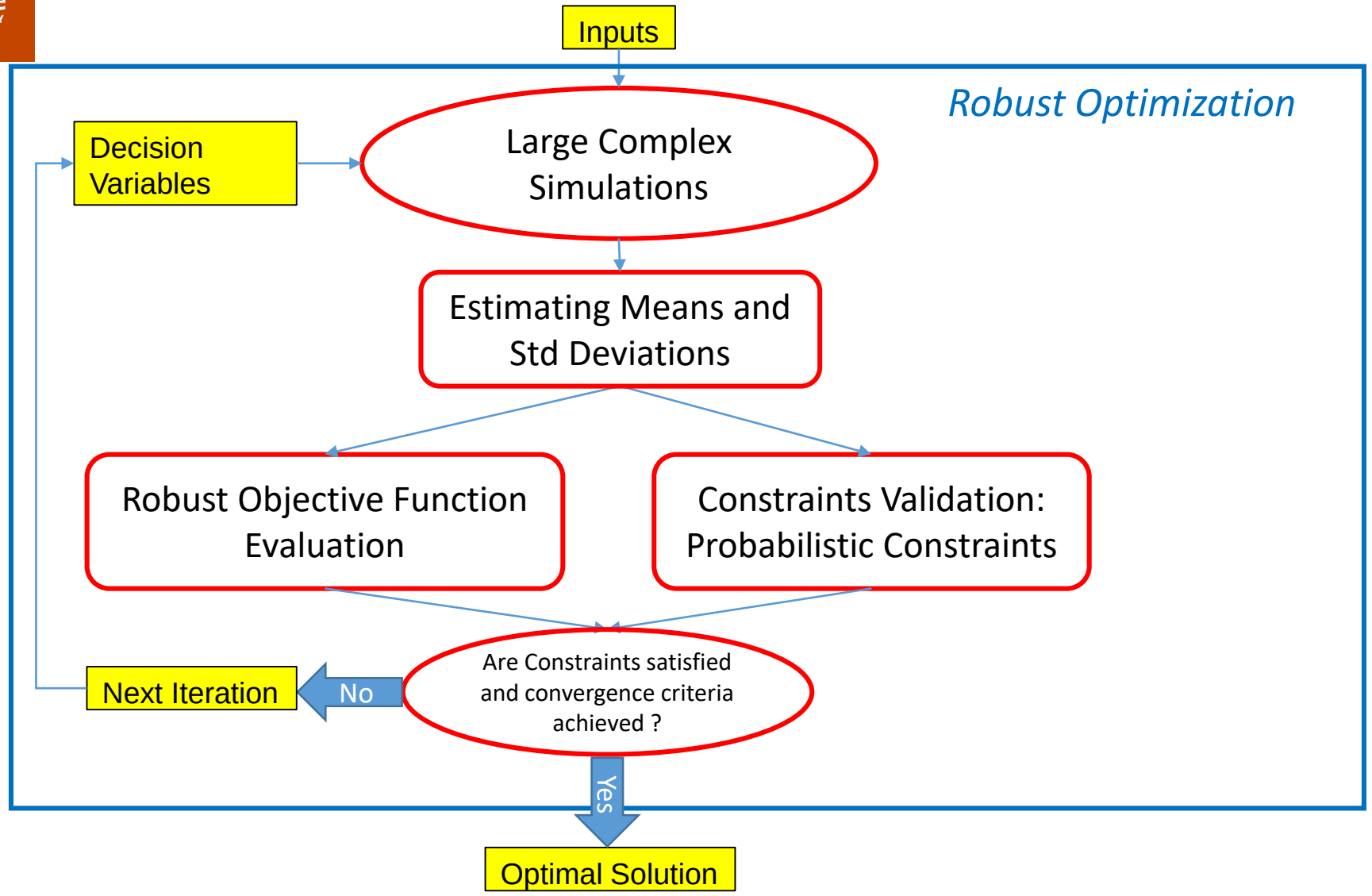
Optimization Model Framework



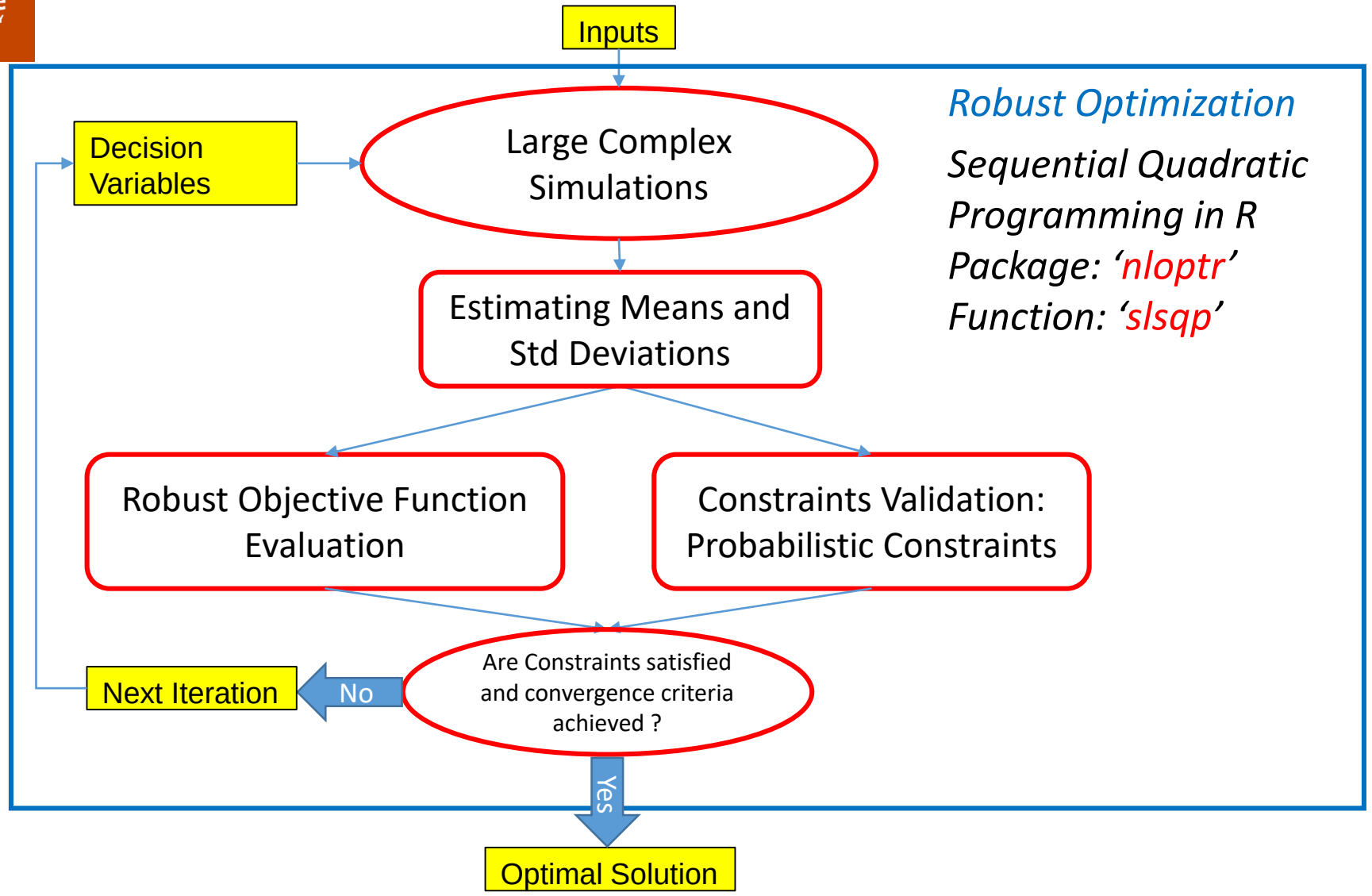
Optimization Model Framework



Optimization Model Framework



Optimization Model Framework



Robust Optimization

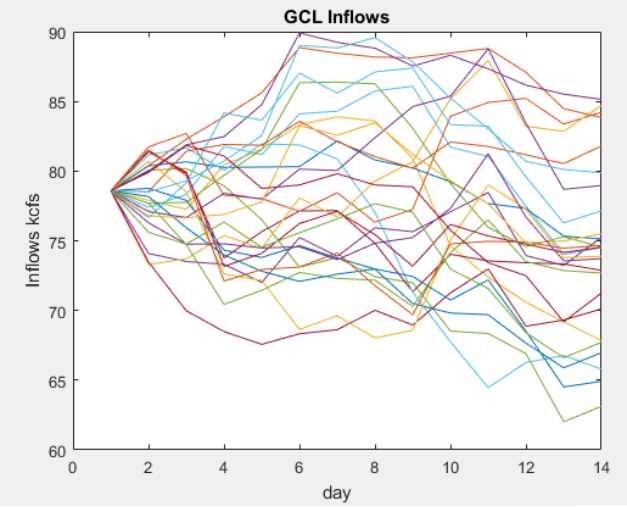
Sequential Quadratic Programming in R

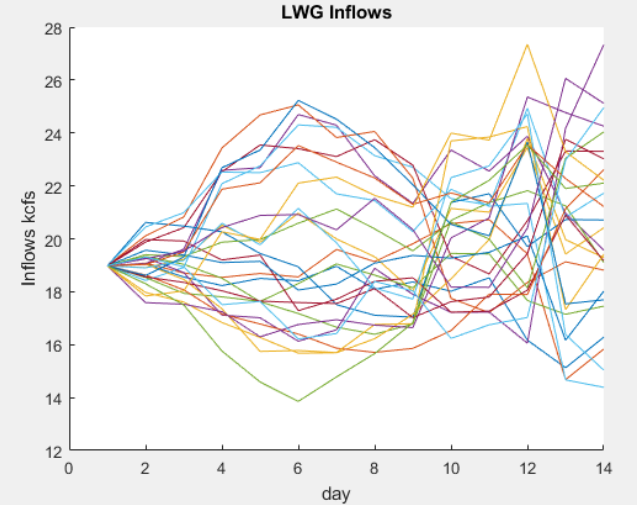
Package: 'nloptr'

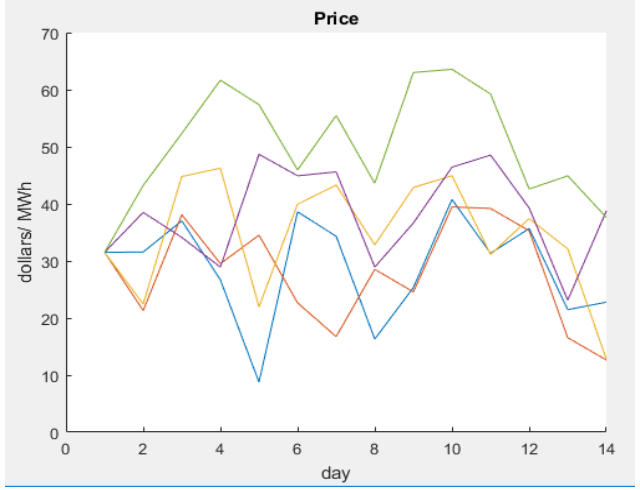
Function: 'slsqp'

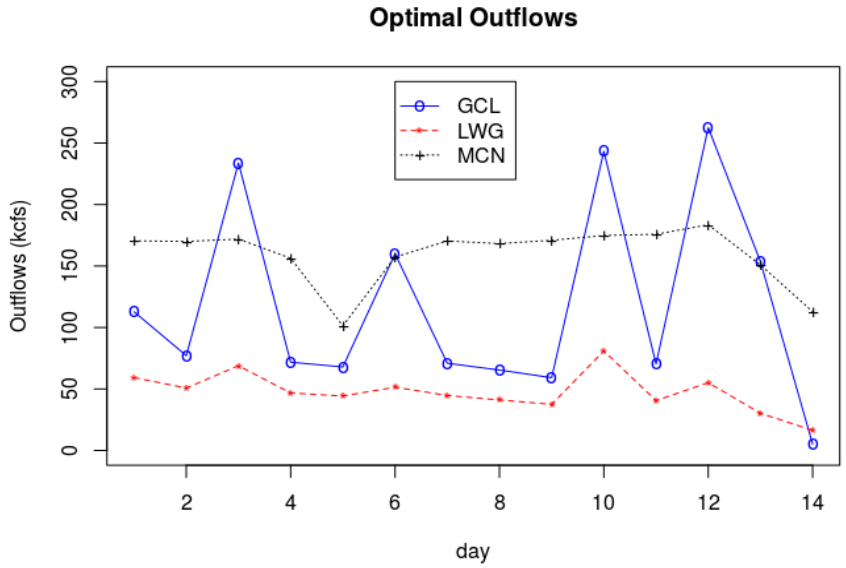
RESULTS

Reservoirs: Grand Coulee, Lower Granite and McNaire







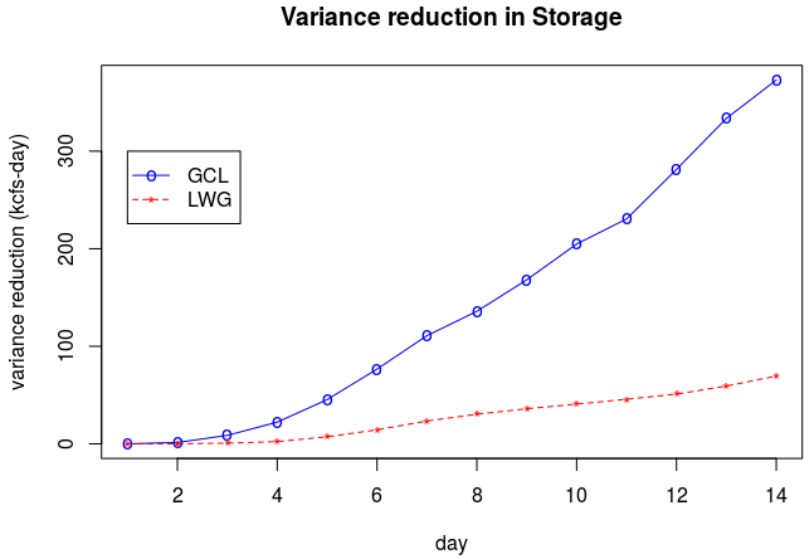


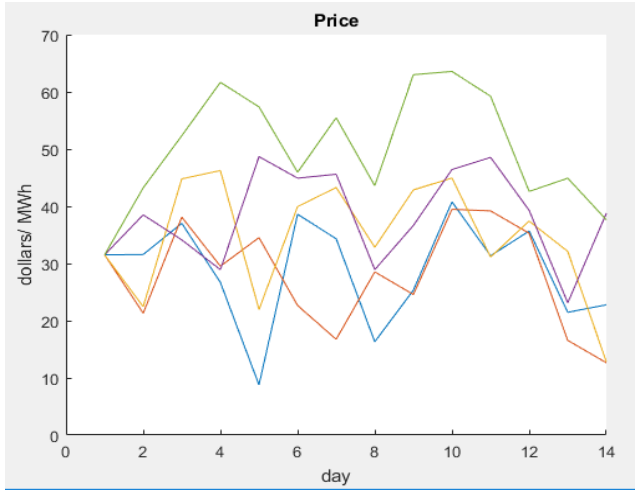
Challenges

Challenges

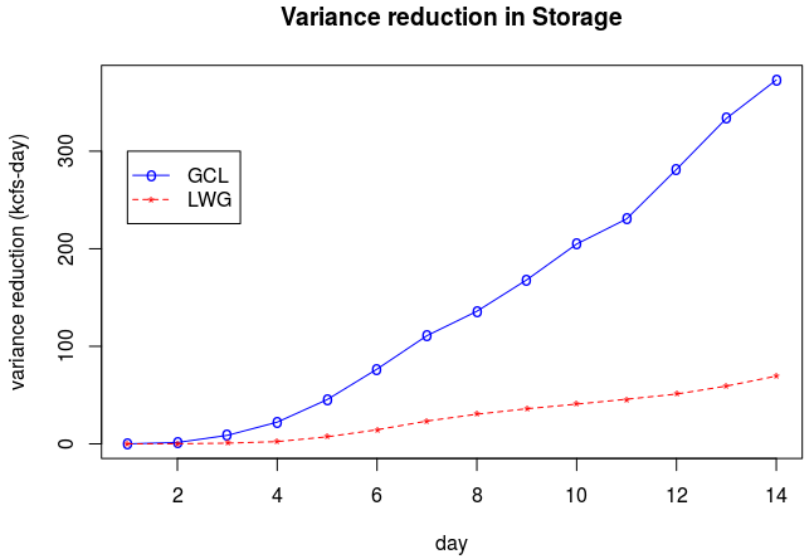
- **Antithetic Variable Approach** for efficient UQ and better decision

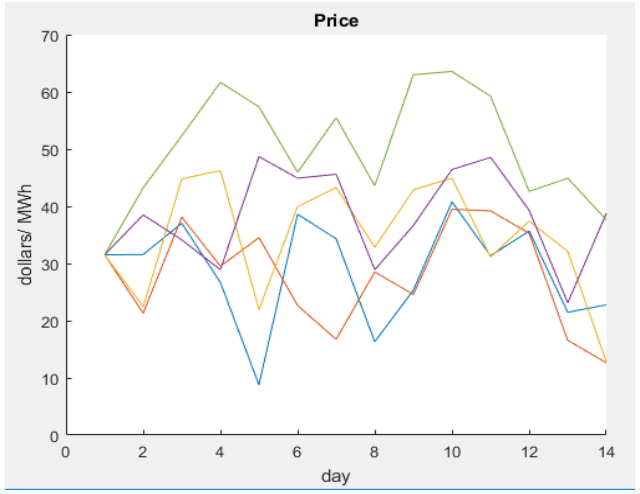
COMPARISON


Variance reduction in Storage
variance reduction (kcfs-day)
0
100
200
300
GCL
LWG
2
4
6
8
10
12
14
day

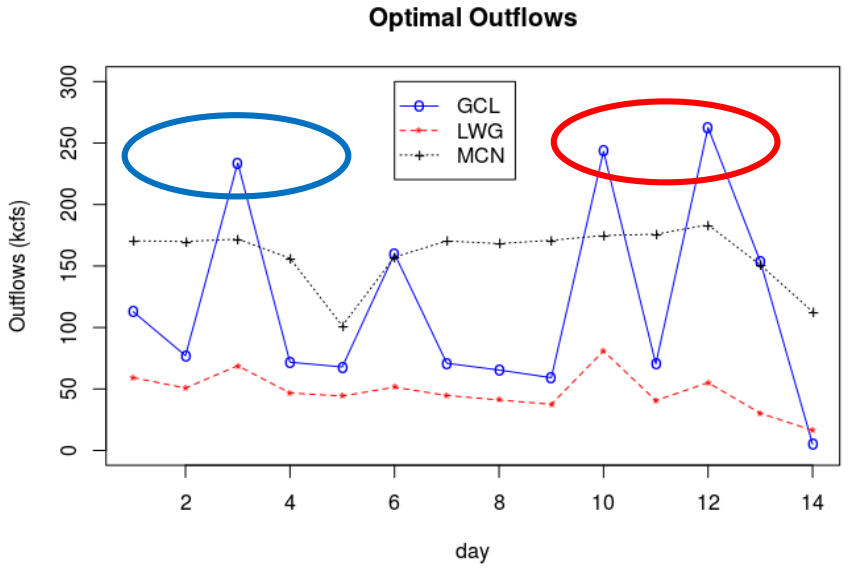

Price
dollars/ MWh
0
10
20
30
40
50
60
70
0
2
4
6
8
10
12
14
day

COMPARISON

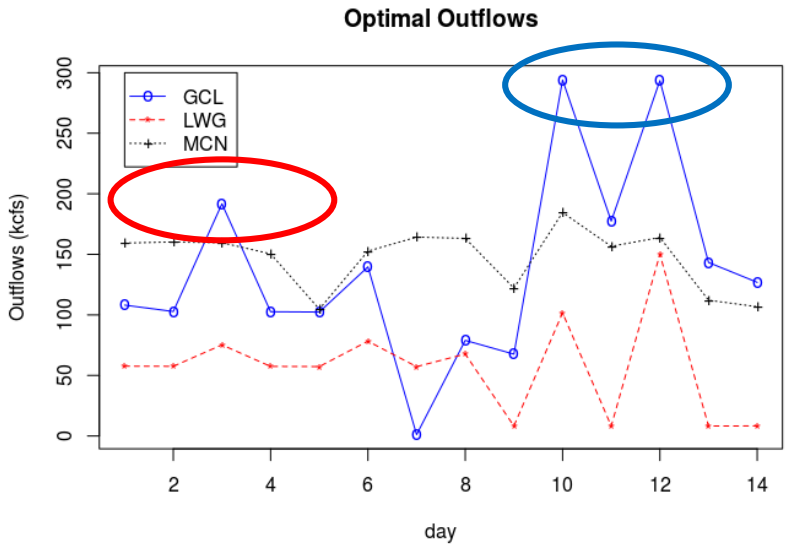




MC approach



Antithetic variables approach



lower

higher

COMPARISON

	MC approach	Antithetic variables approach
No. of simulations	500 / 62500 (for Revenue only)	100/ 10000 (for Revenue only)
Run-time per iterations (approx.)	128 s (Total time = 19 min approx.)	4.64 s (Total time = 8 min approx.)
Revenue (at optimal sol.)	$88 M	$88.9 M
Improvement in Revenue		$0.9 M (1%)

Thank You!!!

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