

Method of Morris Algo

9/26/21

Concept

Problem

$$X_1 = [0,5]$$

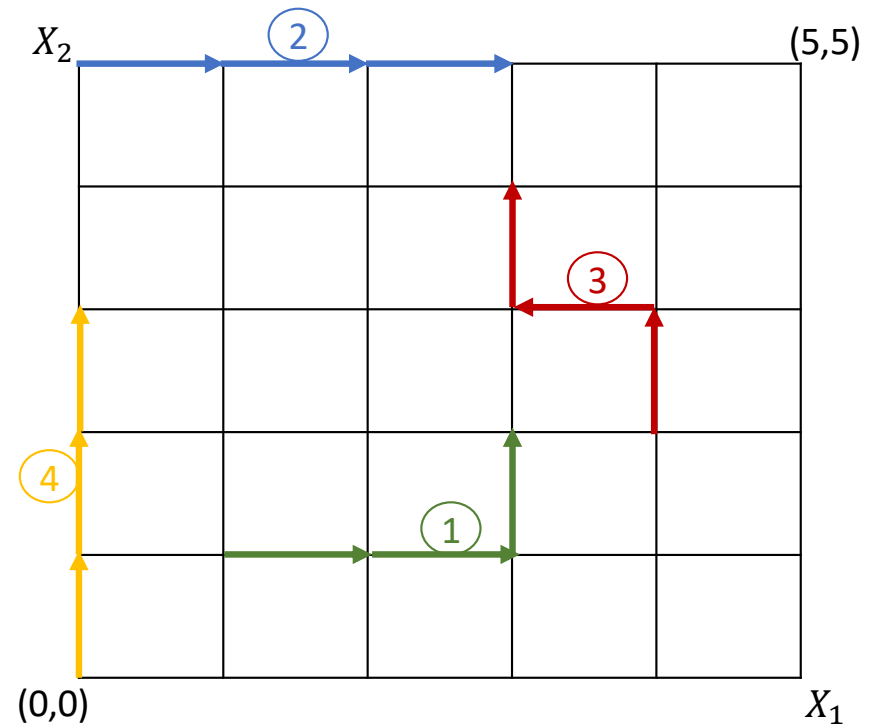
$$X_2 = [0,5]$$

$$P_steps = 5$$

$$Len_design_mat = 4$$

$$Total_num_trajectory = 4$$

$$Num_trajectory = 2$$



	T1				T2				T3				T4			
X_1	1	2	3	3	0	1	2	3	4	4	3	3	0	0	0	0
X_2	1	1	1	2	5	5	5	5	2	3	3	4	0	1	2	3



Calculate spread of each trajectory

$$spread_j = \sum_{i=2}^{len_design_mat} \sqrt{(T_j[i, 1] - T_j[i - 1, 1])^2 + (T_j[i, 2] - T_j[i - 1, 2])^2}$$

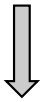


Select Num_trajectory matrices with highest spread

	T1				T2				T3				T4			
X_1	1	2	3	3	0	1	2	3	4	4	3	3	0	0	0	0
X_2	1	1	1	2	5	5	5	5	2	3	3	4	0	1	2	3



$$ElemEffect_j = \frac{Obj_{i+1} - Obj_i}{p_{j,i+1} - p_{j,i}} \quad \forall i < NewLenDesignMat$$



Calculate mean, variance from elementary effect and allocate ranking

Parameter specification

Method_of_morris_range.csv									
Open with Microsoft Excel									
Resource	Zone	Lower_bound	Upper_bound	Parameter	Group	p_steps	total_num_trajectory	num_trajectory	len_design_mat
natural_gas_combined_cycle	1	-5	5	Inv_Cost_per_MWyr	ng	10	2	2	15
solar_pv	1	-10	10	Inv_Cost_per_MWyr	solar	20			
onshore_wind	1	-7	7	Inv_Cost_per_MWyr	wind	14			
battery	1	-20	20	Inv_Cost_per_MWyr	battery	40			
natural_gas_combined_cycle	1	-5	5	Fixed_OM_Cost_per_MWyr	ng	10			
solar_pv	1	-10	10	Fixed_OM_Cost_per_MWyr	solar	20			
onshore_wind	1	-7	7	Fixed_OM_Cost_per_MWyr	wind	14			
battery	1	-20	20	Fixed_OM_Cost_per_MWyr	battery	40			

Notes

- Upper and lower bounds are specified in terms of percentage deviation from the nominal value
- Percentage variation for uncertain parameters in a given group is identical. For example, if solar cluster 1 and solar cluster 2 both belong to the 'solar' group, their Lower_bound and Upper_bound must be identical
- P_steps should at least be = 1%, i.e., $\text{Upper_bound} - \text{Lower_bound} < p_steps$
- P_steps for parameters in one group must be identical
- Total_num_trajectory should be around 3 to 4 times the total number of uncertain parameters
- Num_trajectory should be approximately equal to the total number of uncertain parameters
- Len_design_mat should be 1.5 to 2 times the total number of uncertain parameters
- Higher number of Num_trajectory and len_design_mat would lead to higher accuracy

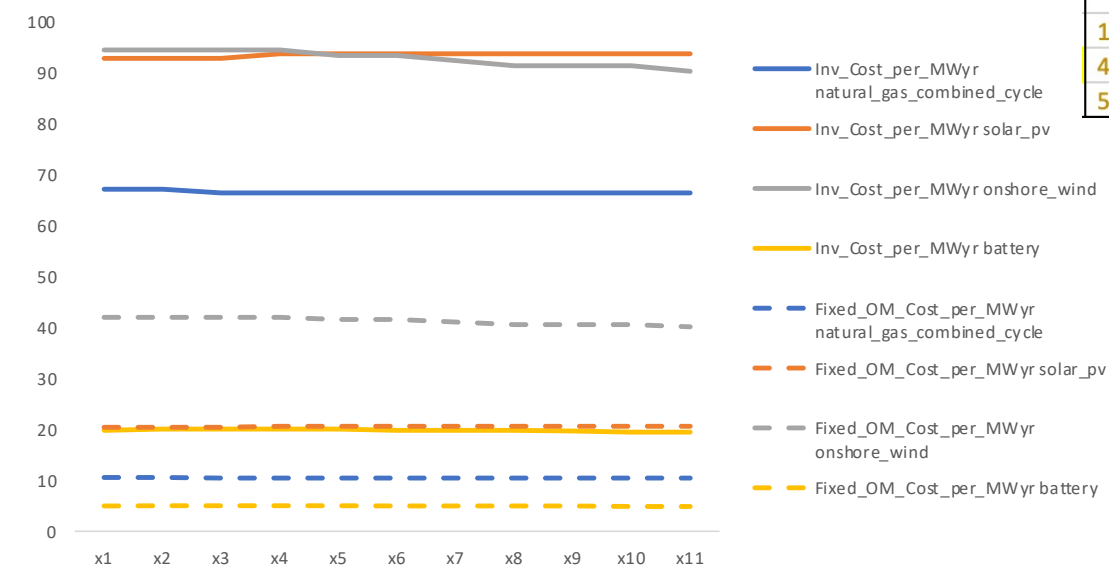
Sample results

With CO₂ Cap

2 sample trajectories

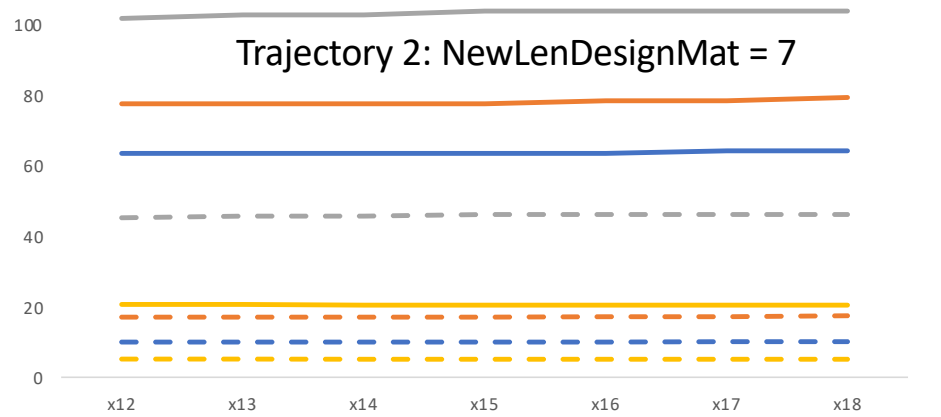
Parameters		x1	x2	x3	x4	x5	x6	x7	x8	x9	x10	x11
Inv_Cost_per_MWyr	natural_gas_combined_cycle	67.2166667	67.2166667	66.49	66.49	66.49	66.49	66.49	66.49	66.49	66.49	66.49
Inv_Cost_per_MWyr	solar_pv	92.9321053	92.9321053	92.9321053	93.83	93.83	93.83	93.83	93.83	93.83	93.83	93.83
Inv_Cost_per_MWyr	onshore_wind	94.5830769	94.5830769	94.5830769	94.5830769	93.5363077	93.5363077	92.4895385	91.4427692	91.4427692	91.4427692	90.396
Inv_Cost_per_MWyr	battery	19.8852923	20.0861538	20.0861538	20.0861538	20.0861538	19.8852923	19.8852923	19.8852923	19.6844308	19.4835692	19.4835692
Fixed_OM_Cost_per_MWyr	natural_gas_combined_cycle	10.57275	10.57275	10.45845	10.45845	10.45845	10.45845	10.45845	10.45845	10.45845	10.45845	10.45845
Fixed_OM_Cost_per_MWyr	solar_pv	20.4385263	20.4385263	20.4385263	20.636	20.636	20.636	20.636	20.636	20.636	20.636	20.636
Fixed_OM_Cost_per_MWyr	onshore_wind	42.0417885	42.0417885	42.0417885	42.0417885	41.5765038	41.5765038	41.1112192	40.6459346	40.6459346	40.6459346	40.18065
Fixed_OM_Cost_per_MWyr	battery	4.97030769	5.02051282	5.02051282	5.02051282	5.02051282	4.97030769	4.97030769	4.97030769	4.92010256	4.86989744	4.86989744

Trajectory 1: NewLenDesignMat = 11



x12	x13	x14	x15	x16	x17	x18
63.5833333	63.5833333	63.5833333	63.5833333	63.5833333	64.31	64.31
77.6678947	77.6678947	77.6678947	77.6678947	78.5657895	78.5657895	79.4636842
101.910462	102.957231	102.957231	104.004	104.004	104.004	104.004
20.6887385	20.6887385	20.4878769	20.4878769	20.4878769	20.4878769	20.4878769
10.00125	10.00125	10.00125	10.00125	10.00125	10.11555	10.11555
17.0814737	17.0814737	17.0814737	17.0814737	17.2789474	17.2789474	17.4764211
45.2987808	45.7640654	45.7640654	46.22935	46.22935	46.22935	46.22935
5.17112821	5.17112821	5.12092308	5.12092308	5.12092308	5.12092308	5.12092308

Trajectory 2: NewLenDesignMat = 7



$$ElemEffect_j = \frac{Obj_{i+1} - Obj_i}{p_{j,i+1} - p_{j,i}} \quad \forall i < NewLenDesignMat$$

Trajectory 1

Elementary Effect			1	2	3	4	5	6	7	8	9	10
Inv_Cost_per_MWyr	natural_gas_combined_cycle			0.01057028								
Inv_Cost_per_MWyr	solar_pv				115.14183							
Inv_Cost_per_MWyr	onshore_wind					10.7785391		10.7785391	10.7785391			10.7785391
Inv_Cost_per_MWyr	battery		47.1811944				47.1811944			47.1811944	47.1811944	
Fixed_OM_Cost_per_MWyr	natural_gas_combined_cycle			0.01057028								
Fixed_OM_Cost_per_MWyr	solar_pv				115.14183							
Fixed_OM_Cost_per_MWyr	onshore_wind					10.7785391		10.7785391	10.7785391			10.7785391
Fixed_OM_Cost_per_MWyr	battery		47.1811944				47.1811944			47.1811944	47.1811944	

Trajectory 2

	13	14	15	16	17	18
					0.01057028	
				115.14183		115.14183
	10.7785391		10.7785391			
		47.1811944				
					0.01057028	
				115.14183		115.14183
	10.7785391		10.7785391			
		47.1811944				

Mean, Variance and Ranking of each uncertain parameter group

		Mean	Variance	Ranking
Inv_Cost_per_MWyr	natural_gas_combined_cycle	0.01057028	7.33567E-21	4
Inv_Cost_per_MWyr	solar_pv	115.14183	4.24094E-23	1
Inv_Cost_per_MWyr	onshore_wind	10.7785391	7.3632E-22	3
Inv_Cost_per_MWyr	battery	47.1811944	4.67846E-20	2
Fixed_OM_Cost_per_MWyr	natural_gas_combined_cycle	0.01057028	7.33567E-21	
Fixed_OM_Cost_per_MWyr	solar_pv	115.14183	4.24094E-23	
Fixed_OM_Cost_per_MWyr	onshore_wind	10.7785391	7.3632E-22	
Fixed_OM_Cost_per_MWyr	battery	47.1811944	4.67846E-20	

Sample results

Without CO2 Cap

Mean, Variance and Ranking of each uncertain parameter group

		Mean	Variance	Ranking
Inv_Cost_per_MWyr	natural_gas_combined_cycle	22.0263749	6.57E-26	1
Inv_Cost_per_MWyr	solar_pv	0	0	-
Inv_Cost_per_MWyr	onshore_wind	0	0	-
Inv_Cost_per_MWyr	battery	1.83641691	NaN	2
Fixed_OM_Cost_per_MWyr	natural_gas_combined_cycle	22.0263749	6.57E-26	
Fixed_OM_Cost_per_MWyr	solar_pv	0	0	
Fixed_OM_Cost_per_MWyr	onshore_wind	0	0	
Fixed_OM_Cost_per_MWyr	battery	1.83641691	NaN	