Replication of Optimal Computing Budget Allocation (OCBA) by Dr. Chun-Hung Chen (2000)

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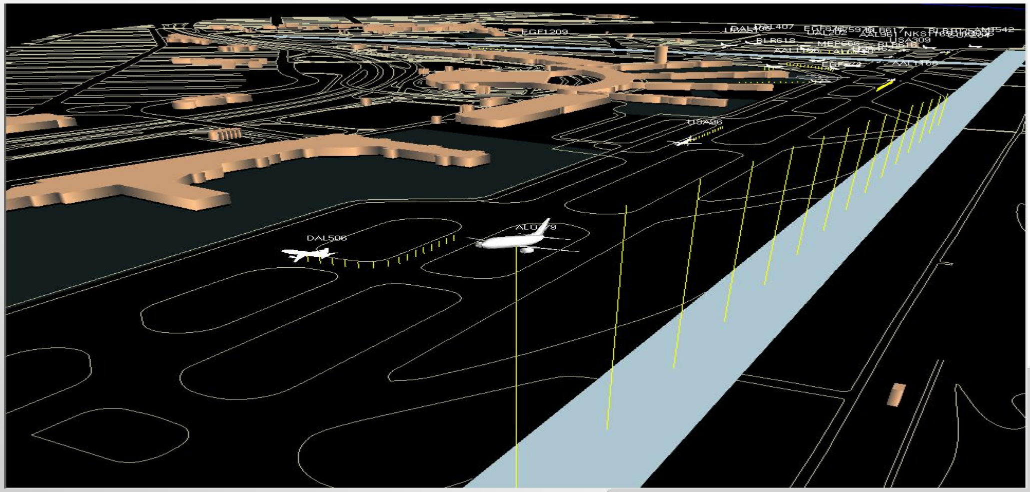
November 14, 2005



CENTER FOR AIR TRANSPORTATION SYSTEMS RESEARCH

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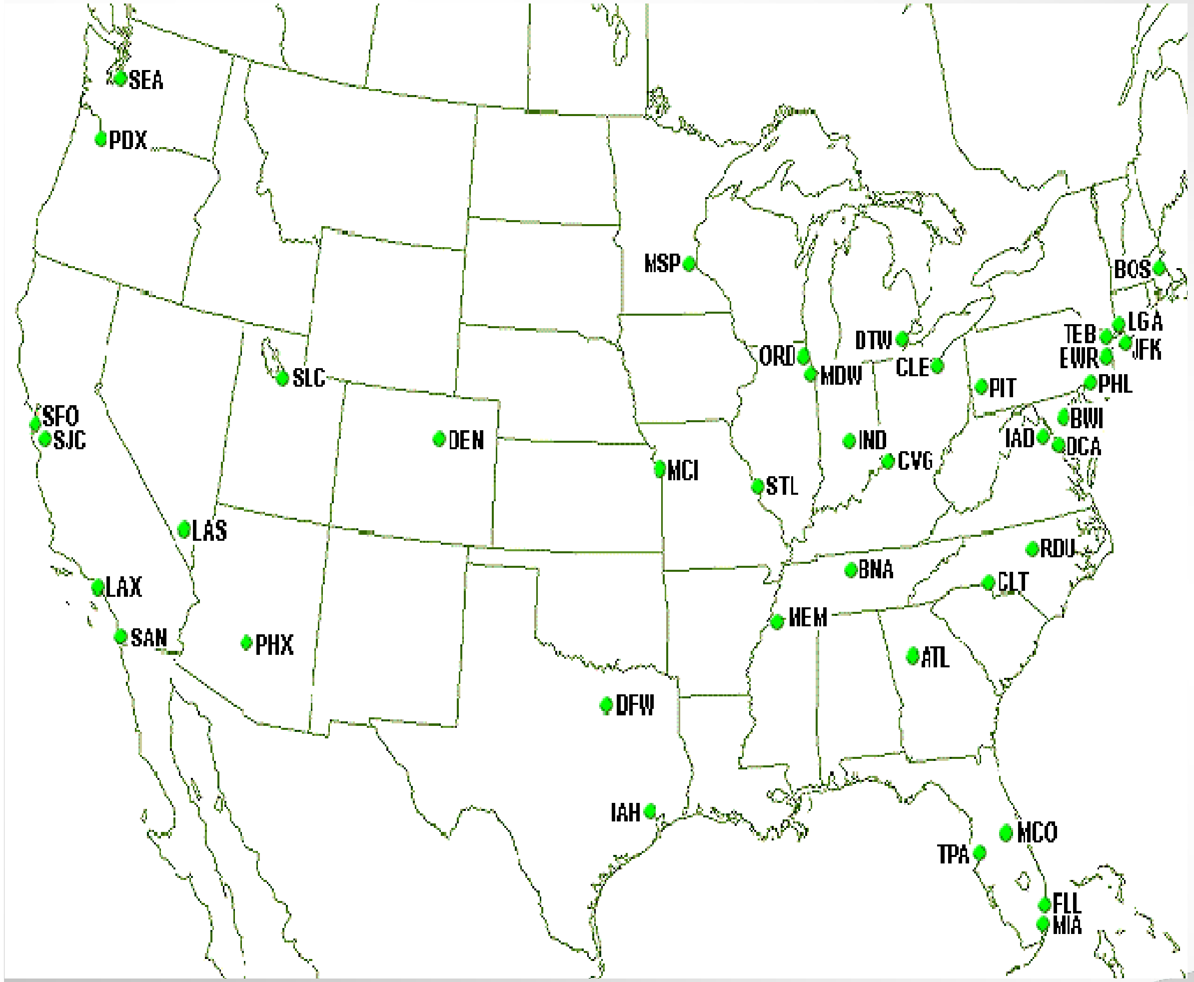
An example: US Air Transportation Network



Consider to add runway to one of the following five congested airports:

- Atlanta (ATL)
- Chicago O'Hare (ORD)
- Dallas/Fort worth (DFW)
- Denver (DEN)
- Washington Dulles (IAD) airports.

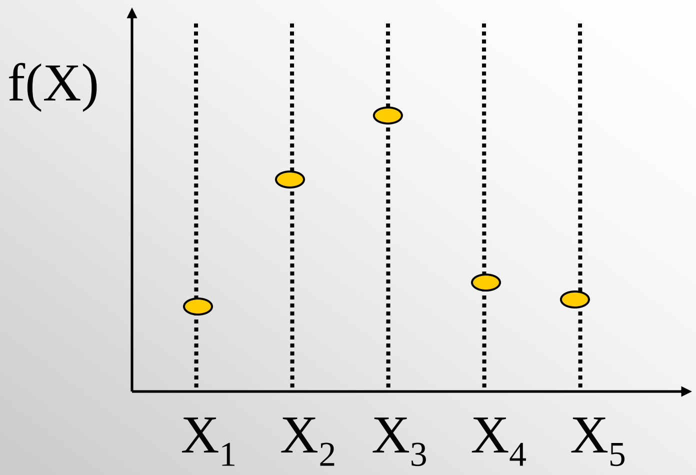
Suppose there is a budget to add one runway.

Which airport? Goal is to minimize expected system daily flight delay

Deterministic vs. Stochastic

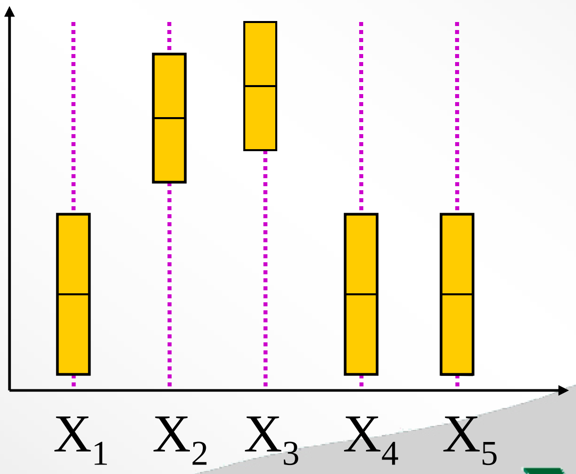
Deterministic:

an exact value f(X)



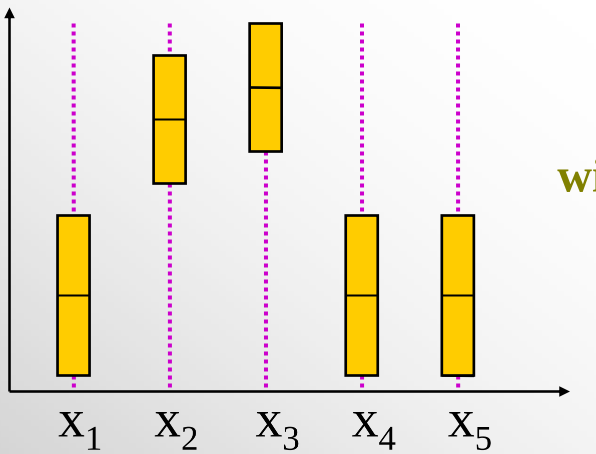
Stochastic:

a confidence interval (say 99%) obtained from multiple runs/samples/ replications/evaluations

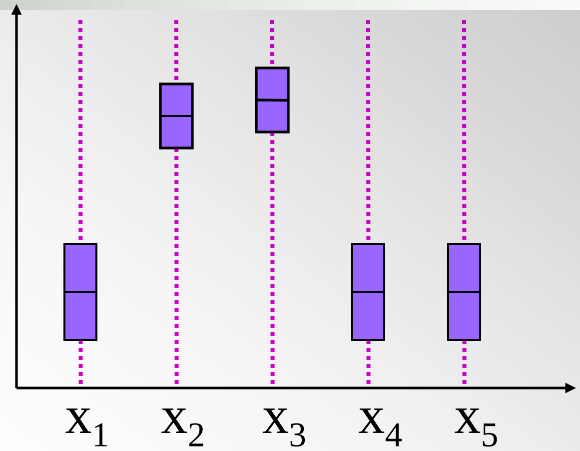


An Intuitive Example - Maximization

99% Confidence Intervals

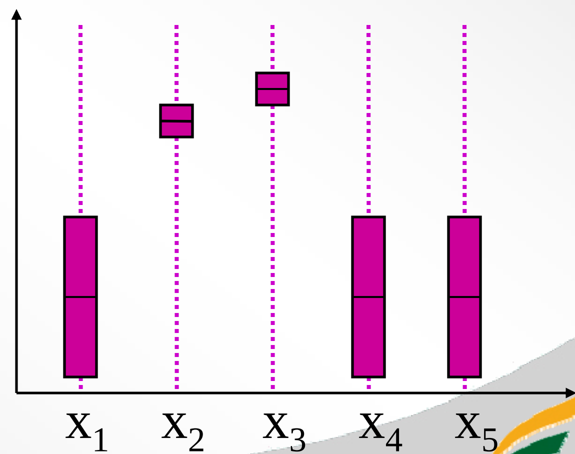


Equal Simulation



with the same number of total runs

Intelligent



⇒ Option 3 is better isolated

Optimal Computing Budget Allocation (OCBA)

(P1) ***Minimize the total number of simulation runs in order to achieve a desired simulation quality:***

$$\min_{N_1,..,N_k} \; [\, N_1 + N_2 + .. + N_k \,]$$

$$\text{s.t. } P\{\text{CS}\} > \text{P}_{\text{sat}} \;\; \text{(a satisfactory level)}$$

(P2) ***Maximize the simulation quality with a given simulation budget:***

$$\max_{N_1,..,N_k} \; P\{\text{CS}\}$$

$$\text{s.t. } N_1 + N_2 + .. + N_k = T \;\; \text{(total comp. budget)}$$

Asymptotic Solution of OCBA

Given a total number of simulation runs T to be allocated to k competing designs, as $T \to \infty$, the $P\{\text{CS}\}$ can be asymptotically maximized when

★ $$\frac{N_i}{N_j} = \frac{(\sigma_i / \delta_{b,i})^2}{(\sigma_j / \delta_{b,j})^2} \quad \text{for } i \neq j \neq b$$

★ $$N_b = \sigma_b \sqrt{\sum_{i \neq b} (N_i^2 / \sigma_i^2)}$$

Numerical results

design	mean	std
0	0	6
1	1	6
2	2	6
3	3	6
4	4	6
5	5	6
6	6	6
7	7	6
8	8	6
9	9	6
10	10	6