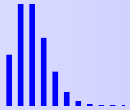


Tutorial

Lagrange multipliers

Given are a set of n values $x_1, x_2, \ldots, x_n$ with errors σ_i, $i = 1, \ldots, n$.
Determine the weights w_i, $i = 1, \ldots, n$ of the linear combination $S = \sum_i w_i x_i$ which minimizes $V = \sum_i w_i^2 \sigma_i^2$ under the constraint $\sum_i w_i = 1$.

a) For $n = 2$ determine the optimum by substituting $w_2 = 1 - w_1$.

b) For $n = 2$ determine the optimum using the Langrange multiplier method.

c) Generalize b) to arbitrary values of n.

Bayes' theorem

An accelerator produces a beam consisting to 90% of pions and 10% of muons. A muon-nucleon scattering experiment uses a trigger which can discriminate between the two particle types, with a probability to trigger on a muon $p(T|\mu) = 0.95$ and a probability to trigger on background $p(T|\pi) = 0.02$. How large is the fraction of true muons in the trigger.

Bayes' theorem

The host of a game show tell a candidate that there is a treasure behind one of three doors, while the room is empty behind the others. The door with the treasure is of course not known. Now the candidate is allowed to select one door - but not yet to open it. The candidate selects one of the doors. Then the host opens one of the other two doors, behind which there is nothing. The candidate now has the choice to either change his selection or to stick to the original choice. What should he do in order to maximize the chance to obtain the treasure?