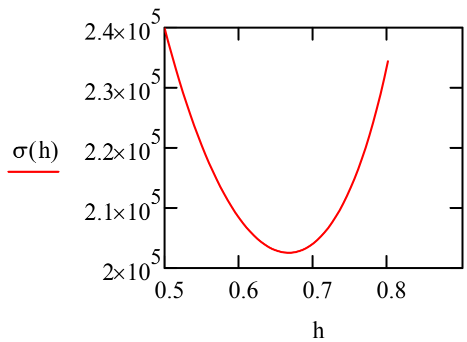
Exhaustive Search Optimization Example

Beam example:

$F := 500$ $L := 10$ $P := 2$

$$\sigma(h) := \frac{6 \cdot F \cdot L}{\left(\frac{P}{2} - h\right) \cdot h^2}$$

$h := 0.5, 0.505 .. 0.8$



Using range variables:

$N_h := 1000$ $i := 0 .. N_h$

$h_{max} := \frac{P}{2} - 0.001$ $h_{min} := 0.001$

$$\Delta h := \frac{\left(h_{max} - h_{min}\right)}{N_h}$$

$h_i := h_{min} + i \cdot \Delta h$

$\sigma h_i := \sigma\left(h_i\right)$

$\sigma h_{opt} := \min(\sigma h)$

$h =$

	0
0	$1 \cdot 10^{-3}$
1	$1.998 \cdot 10^{-3}$
2	$2.996 \cdot 10^{-3}$
3	$3.994 \cdot 10^{-3}$
4	$4.992 \cdot 10^{-3}$
5	$5.99 \cdot 10^{-3}$
6	...

$\sigma h_{opt} = 2.025 \times 10^{5}$

$h_{opt} := \text{lookup}(\sigma h_{opt}, \sigma h, h)$

$h_{opt} = (0.667)$

$\sigma h =$

	0
655	$2.027 \cdot 10^{5}$
656	$2.027 \cdot 10^{5}$
657	$2.026 \cdot 10^{5}$
658	$2.026 \cdot 10^{5}$
659	$2.026 \cdot 10^{5}$
660	$2.026 \cdot 10^{5}$
661	$2.025 \cdot 10^{5}$
662	$2.025 \cdot 10^{5}$
663	$2.025 \cdot 10^{5}$
664	$2.025 \cdot 10^{5}$
665	...

Using MathCAD program:

```
(h_opt  σ_opt) := | h_opt ← 0
                  | σ_opt ← 10^100
                  | pause("about to start loop")
                  | for  h ∈ h_min, (h_min + Δh) .. h_max
                  |     | σh ← σ(h)
                  |     | trace("h={0} sopt={1} sh={2}" , h, σ_opt, σh)
                  |     | if  σh < σ_opt
                  |     |     | h_opt ← h
                  |     |     | σ_opt ← σh
                  |     |     | trace("  new optimum found: h={0}" , h)
                  | (h_opt  σ_opt)
```

large positive number necessary to initialize the minimization process (A large negative number would be used for a maximum problem)

$h_{opt} = 0.667 \qquad \sigma_{opt} = 2.025 \times 10^{5}$

$w_{opt} := \frac{1}{2}(P - 2 \cdot h_{opt}) \qquad \frac{h_{opt}}{w_{opt}} = 2$

MathCAD Solve Block Solution with perimeter constraint equation:

$$\sigma(w,h) := \frac{6 \cdot F \cdot L}{w \cdot h^2}$$

$w := \frac{P}{2}$ $\quad$ $h := \frac{P}{2}$ $\quad$ initial guesses $\quad$ $h = 1$

Given

$$P = 2 \cdot w + 2 \cdot h$$

$$w > 0$$

$$h > 0$$

$$\begin{pmatrix} w_{opt} \\ h_{opt} \end{pmatrix} := \text{Minimize}(\sigma, w, h) \qquad \begin{pmatrix} w_{opt} \\ h_{opt} \end{pmatrix} = \begin{pmatrix} 0.333 \\ 0.667 \end{pmatrix}$$

$$\frac{h_{opt}}{w_{opt}} = 2$$