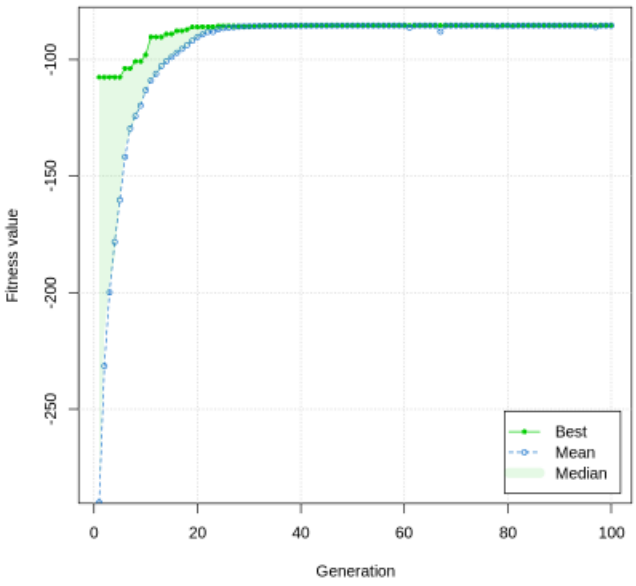
Report:

Optimization for minimizing cross-sectional area (func1).

```
── Genetic Algorithm ──────────────────

GA settings:
Type                  =  real-valued
Population size       =  50
Number of generations =  100
Elitism               =  2
Crossover probability =  0.75
Mutation probability  =  0.001
Search domain =
      x1 x2  x3  x4
lower 10 10 0.9 0.9
upper 80 50 5.0 5.0

GA results:
Iterations             = 100
Fitness function value = -85.39236
Solution =
          x1      x2       x3       x4
[1,] 22.10571 14.2004 1.016915 2.386044
```



Fitness Function Value: -85.39236

- This value indicates the fitness score achieved by the best solution found during the optimization. Since we're minimizing the cross-sectional area, a lower fitness value indicates a better solution.

Solution: x1: 22.10571 x2: 14.2004 x3: 1.016915 x4: 2.386044

- These are the values of the design variables (dimensions of the I-beam) that correspond to the best solution found. They represent the dimensions of the I-beam that result in the minimum cross-sectional area while meeting the constraints.

Optimization for Minimizing Static Deflection (func2)

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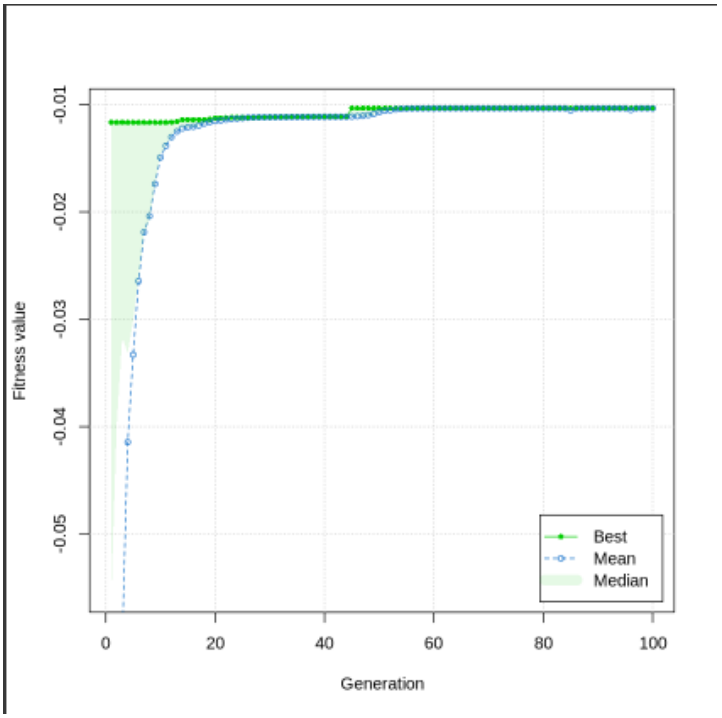
── Genetic Algorithm ──────────────────

GA settings:
Type                  =  real-valued
Population size       =  50
Number of generations =  100
Elitism               =  2
Crossover probability =  0.75
Mutation probability  =  0.001
Search domain =
      x1 x2  x3  x4
lower 10 10 0.9 0.9
upper 80 50 5.0 5.0

GA results:
Iterations             = 100
Fitness function value = -0.01033923
Solution =
          x1       x2       x3       x4
[1,] 70.21104 41.34311 4.854659 4.332985
```



Fitness Function Value: -0.01033923

- A lower fitness value indicates a better solution for this optimization as well. In this case, we're minimizing the static deflection of the I-beam.

Solution: x1: 70.21104 x2: 41.34311 x3: 4.854659 x4: 4.332985
These values represent the dimensions of the I-beam that result in the minimum static deflection while meeting the constraints once again.

Optimization 3: Minimizing Weighted Combination (func3)

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── Genetic Algorithm ──────────────────

GA settings:
Type                  =  real-valued
Population size       =  50
Number of generations =  100
Elitism               =  2
Crossover probability =  0.75
Mutation probability  =  0.001
Search domain =
      x1 x2  x3  x4 x5 x6
lower 10 10 0.9 0.9  0  0
upper 80 50 5.0 5.0  1  1

GA results:
Iterations             = 100
Fitness function value = -0.00936483
Solution =
          x1       x2       x3       x4        x5        x6
[1,] 77.42126 43.52288 3.572834 3.636106 0.6278896 0.7236997
```

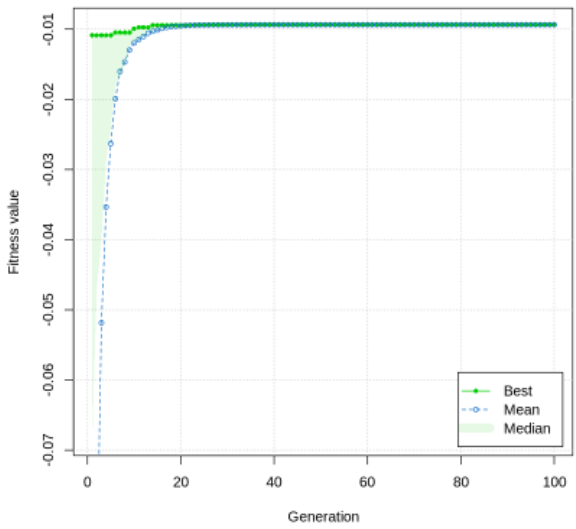

Fitness Function Value: -0.00936483

- This fitness value represents the result of optimizing the combined objective function (func3), which is a weighted combination of func1 and func2.

Solution: x1: 77.42126 x2: 43.52288 x3: 3.572834 x4: 3.636106 x5: 0.6278896 x6: 0.7236997

- These values represent the dimensions of the I-beam that provide a compromise solution, balancing the minimization of both the cross-sectional area and the static deflection. The addition of weights a and b allows for the adjustment of the relative importance of the two objective functions (func1 and func2) in the combined objective function func3. These weights enable the optimization process to balance the two functions.