DoptFractPoly Demonstration

This document demonstrates the use of the DoptFracPoly function to find locally D-optimal designs for fractional polynomials for logistic regression.

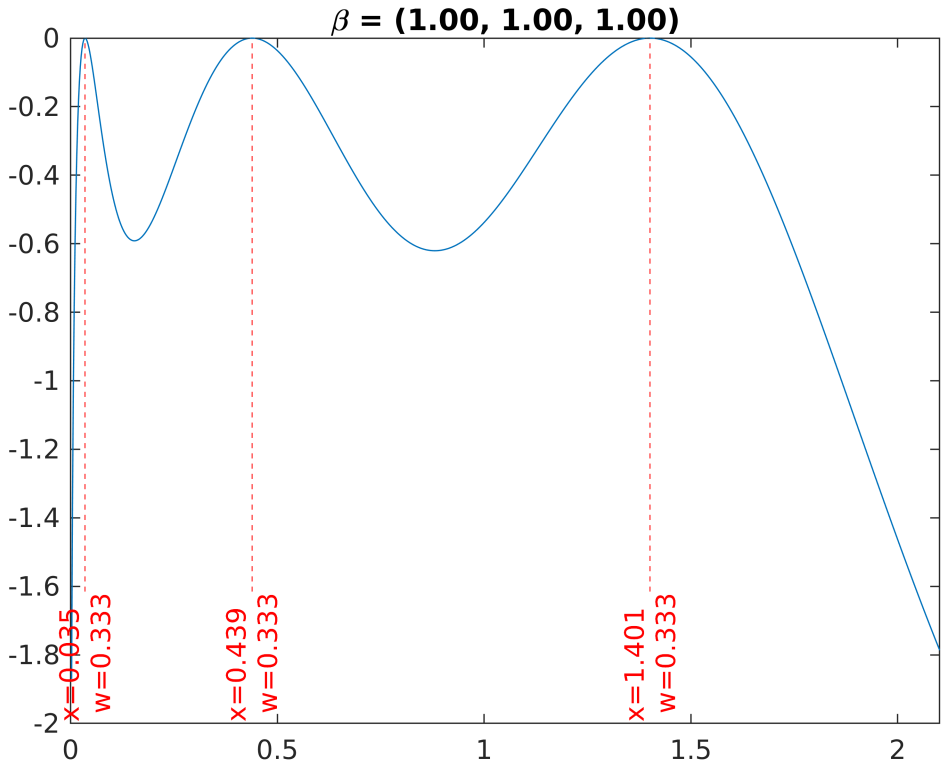
Start with a standard polynomial $1 + x + x^2$. We need to give the nominal coefficient values, the powers on x, the number of design points, and the design interval. We also need to specify which algorithm from PlatEMO to use.

```
beta = [1, 1, 1];
powers = [1, 2];
pts = 3;
int = [0, Inf];
sens = true; % compute and plot sensitivity function
algo = {@GA, 100000, 1000, 1, 20, 1, 20};

[obj, xi] = DoptFracPoly(beta, powers, pts, sens, algo, int);
```

```
GA on 1-objective 6-variable UserProblem (  1.00%), 0.04s passed...
GA on 1-objective 6-variable UserProblem (  2.00%), 0.08s passed...
GA on 1-objective 6-variable UserProblem (  3.00%), 0.13s passed...
GA on 1-objective 6-variable UserProblem (  4.00%), 0.17s passed...
GA on 1-objective 6-variable UserProblem (  5.00%), 0.20s passed...
GA on 1-objective 6-variable UserProblem (  6.00%), 0.23s passed...
GA on 1-objective 6-variable UserProblem (  7.00%), 0.26s passed...
GA on 1-objective 6-variable UserProblem (  8.00%), 0.29s passed...
GA on 1-objective 6-variable UserProblem (  9.00%), 0.32s passed...
GA on 1-objective 6-variable UserProblem ( 10.00%), 0.35s passed...
GA on 1-objective 6-variable UserProblem ( 11.00%), 0.37s passed...
GA on 1-objective 6-variable UserProblem ( 12.00%), 0.40s passed...
GA on 1-objective 6-variable UserProblem ( 13.00%), 0.43s passed...
GA on 1-objective 6-variable UserProblem ( 14.00%), 0.46s passed...
GA on 1-objective 6-variable UserProblem ( 15.00%), 0.49s passed...
GA on 1-objective 6-variable UserProblem ( 16.00%), 0.52s passed...
GA on 1-objective 6-variable UserProblem ( 17.00%), 0.55s passed...
GA on 1-objective 6-variable UserProblem ( 18.00%), 0.57s passed...
GA on 1-objective 6-variable UserProblem ( 19.00%), 0.60s passed...
GA on 1-objective 6-variable UserProblem ( 20.00%), 0.63s passed...
GA on 1-objective 6-variable UserProblem ( 21.00%), 0.66s passed...
GA on 1-objective 6-variable UserProblem ( 22.00%), 0.69s passed...
GA on 1-objective 6-variable UserProblem ( 23.00%), 0.72s passed...
GA on 1-objective 6-variable UserProblem ( 24.00%), 0.75s passed...
GA on 1-objective 6-variable UserProblem ( 25.00%), 0.77s passed...
GA on 1-objective 6-variable UserProblem ( 26.00%), 0.80s passed...
GA on 1-objective 6-variable UserProblem ( 27.00%), 0.83s passed...
GA on 1-objective 6-variable UserProblem ( 28.00%), 0.86s passed...
GA on 1-objective 6-variable UserProblem ( 29.00%), 0.89s passed...
GA on 1-objective 6-variable UserProblem ( 30.00%), 0.92s passed...
GA on 1-objective 6-variable UserProblem ( 31.00%), 0.95s passed...
GA on 1-objective 6-variable UserProblem ( 32.00%), 0.97s passed...
GA on 1-objective 6-variable UserProblem ( 33.00%), 1.00s passed...
GA on 1-objective 6-variable UserProblem ( 34.00%), 1.03s passed...
GA on 1-objective 6-variable UserProblem ( 35.00%), 1.06s passed...
GA on 1-objective 6-variable UserProblem ( 36.00%), 1.09s passed...
GA on 1-objective 6-variable UserProblem ( 37.00%), 1.11s passed...
GA on 1-objective 6-variable UserProblem ( 38.00%), 1.14s passed...
GA on 1-objective 6-variable UserProblem ( 39.00%), 1.17s passed...
GA on 1-objective 6-variable UserProblem ( 40.00%), 1.20s passed...
GA on 1-objective 6-variable UserProblem ( 41.00%), 1.23s passed...
GA on 1-objective 6-variable UserProblem ( 42.00%), 1.25s passed...
GA on 1-objective 6-variable UserProblem ( 43.00%), 1.28s passed...
```

```
GA on 1-objective 6-variable UserProblem ( 44.00%), 1.31s passed...
GA on 1-objective 6-variable UserProblem ( 45.00%), 1.34s passed...
GA on 1-objective 6-variable UserProblem ( 46.00%), 1.37s passed...
GA on 1-objective 6-variable UserProblem ( 47.00%), 1.40s passed...
GA on 1-objective 6-variable UserProblem ( 48.00%), 1.42s passed...
GA on 1-objective 6-variable UserProblem ( 49.00%), 1.45s passed...
GA on 1-objective 6-variable UserProblem ( 50.00%), 1.48s passed...
GA on 1-objective 6-variable UserProblem ( 51.00%), 1.51s passed...
GA on 1-objective 6-variable UserProblem ( 52.00%), 1.54s passed...
GA on 1-objective 6-variable UserProblem ( 53.00%), 1.56s passed...
GA on 1-objective 6-variable UserProblem ( 54.00%), 1.59s passed...
GA on 1-objective 6-variable UserProblem ( 55.00%), 1.63s passed...
GA on 1-objective 6-variable UserProblem ( 56.00%), 1.66s passed...
GA on 1-objective 6-variable UserProblem ( 57.00%), 1.68s passed...
GA on 1-objective 6-variable UserProblem ( 58.00%), 1.71s passed...
GA on 1-objective 6-variable UserProblem ( 59.00%), 1.74s passed...
GA on 1-objective 6-variable UserProblem ( 60.00%), 1.77s passed...
GA on 1-objective 6-variable UserProblem ( 61.00%), 1.80s passed...
GA on 1-objective 6-variable UserProblem ( 62.00%), 1.83s passed...
GA on 1-objective 6-variable UserProblem ( 63.00%), 1.85s passed...
GA on 1-objective 6-variable UserProblem ( 64.00%), 1.88s passed...
GA on 1-objective 6-variable UserProblem ( 65.00%), 1.91s passed...
GA on 1-objective 6-variable UserProblem ( 66.00%), 1.94s passed...
GA on 1-objective 6-variable UserProblem ( 67.00%), 1.96s passed...
GA on 1-objective 6-variable UserProblem ( 68.00%), 1.99s passed...
GA on 1-objective 6-variable UserProblem ( 69.00%), 2.02s passed...
GA on 1-objective 6-variable UserProblem ( 70.00%), 2.04s passed...
GA on 1-objective 6-variable UserProblem ( 71.00%), 2.07s passed...
GA on 1-objective 6-variable UserProblem ( 72.00%), 2.10s passed...
GA on 1-objective 6-variable UserProblem ( 73.00%), 2.13s passed...
GA on 1-objective 6-variable UserProblem ( 74.00%), 2.15s passed...
GA on 1-objective 6-variable UserProblem ( 75.00%), 2.18s passed...
GA on 1-objective 6-variable UserProblem ( 76.00%), 2.21s passed...
GA on 1-objective 6-variable UserProblem ( 77.00%), 2.24s passed...
GA on 1-objective 6-variable UserProblem ( 78.00%), 2.27s passed...
GA on 1-objective 6-variable UserProblem ( 79.00%), 2.29s passed...
GA on 1-objective 6-variable UserProblem ( 80.00%), 2.32s passed...
GA on 1-objective 6-variable UserProblem ( 81.00%), 2.35s passed...
GA on 1-objective 6-variable UserProblem ( 82.00%), 2.38s passed...
GA on 1-objective 6-variable UserProblem ( 83.00%), 2.41s passed...
GA on 1-objective 6-variable UserProblem ( 84.00%), 2.43s passed...
GA on 1-objective 6-variable UserProblem ( 85.00%), 2.46s passed...
GA on 1-objective 6-variable UserProblem ( 86.00%), 2.49s passed...
GA on 1-objective 6-variable UserProblem ( 87.00%), 2.52s passed...
GA on 1-objective 6-variable UserProblem ( 88.00%), 2.55s passed...
GA on 1-objective 6-variable UserProblem ( 89.00%), 2.58s passed...
GA on 1-objective 6-variable UserProblem ( 90.00%), 2.60s passed...
GA on 1-objective 6-variable UserProblem ( 91.00%), 2.63s passed...
GA on 1-objective 6-variable UserProblem ( 92.00%), 2.66s passed...
GA on 1-objective 6-variable UserProblem ( 93.00%), 2.69s passed...
GA on 1-objective 6-variable UserProblem ( 94.00%), 2.72s passed...
GA on 1-objective 6-variable UserProblem ( 95.00%), 2.74s passed...
GA on 1-objective 6-variable UserProblem ( 96.00%), 2.77s passed...
GA on 1-objective 6-variable UserProblem ( 97.00%), 2.80s passed...
GA on 1-objective 6-variable UserProblem ( 98.00%), 2.83s passed...
GA on 1-objective 6-variable UserProblem ( 99.00%), 2.86s passed...
GA on 1-objective 6-variable UserProblem (100.00%), 2.89s passed...
Design found:
    0.4388    0.0348    1.4012

    0.3333    0.3333    0.3333

Objective value: 7.725651
```

```
Sensitivity function values:
-0.000002 0.000003 -0.000001
```



The function returns the objective value obtained and the optimal design points with the corresponding weights. The sensitivity function will also be plotted.

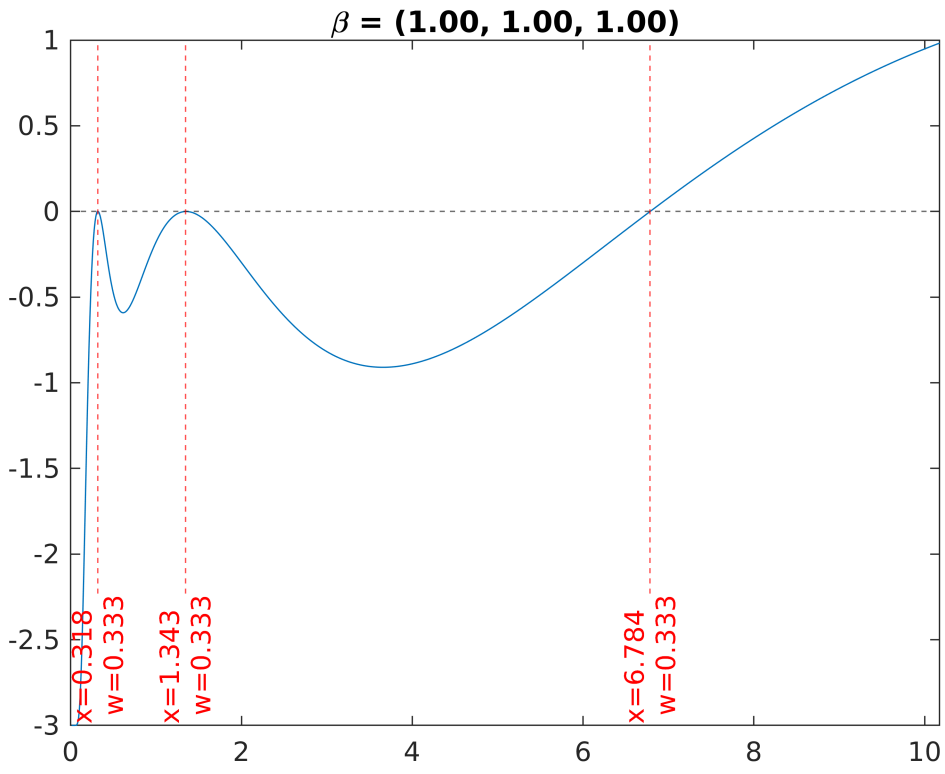
Now suppose we want to find the optimal design for $1 + x^{-1} + \sqrt{x}$. We can do this by changing the powers vector.

```
powers = [-1, 0.5];
[obj, xi] = DoptFracPoly(beta, powers, pts, sens, algo, int);
```

```
GA on 1-objective 6-variable UserProblem (  1.00%), 0.04s passed...
GA on 1-objective 6-variable UserProblem (  2.00%), 0.07s passed...
GA on 1-objective 6-variable UserProblem (  3.00%), 0.10s passed...
GA on 1-objective 6-variable UserProblem (  4.00%), 0.13s passed...
GA on 1-objective 6-variable UserProblem (  5.00%), 0.16s passed...
GA on 1-objective 6-variable UserProblem (  6.00%), 0.19s passed...
GA on 1-objective 6-variable UserProblem (  7.00%), 0.21s passed...
GA on 1-objective 6-variable UserProblem (  8.00%), 0.24s passed...
GA on 1-objective 6-variable UserProblem (  9.00%), 0.27s passed...
GA on 1-objective 6-variable UserProblem ( 10.00%), 0.30s passed...
GA on 1-objective 6-variable UserProblem ( 11.00%), 0.33s passed...
GA on 1-objective 6-variable UserProblem ( 12.00%), 0.36s passed...
GA on 1-objective 6-variable UserProblem ( 13.00%), 0.39s passed...
GA on 1-objective 6-variable UserProblem ( 14.00%), 0.43s passed...
GA on 1-objective 6-variable UserProblem ( 15.00%), 0.46s passed...
GA on 1-objective 6-variable UserProblem ( 16.00%), 0.49s passed...
GA on 1-objective 6-variable UserProblem ( 17.00%), 0.52s passed...
```

```
GA on 1-objective 6-variable UserProblem ( 18.00%), 0.55s passed...
GA on 1-objective 6-variable UserProblem ( 19.00%), 0.57s passed...
GA on 1-objective 6-variable UserProblem ( 20.00%), 0.60s passed...
GA on 1-objective 6-variable UserProblem ( 21.00%), 0.63s passed...
GA on 1-objective 6-variable UserProblem ( 22.00%), 0.66s passed...
GA on 1-objective 6-variable UserProblem ( 23.00%), 0.69s passed...
GA on 1-objective 6-variable UserProblem ( 24.00%), 0.72s passed...
GA on 1-objective 6-variable UserProblem ( 25.00%), 0.74s passed...
GA on 1-objective 6-variable UserProblem ( 26.00%), 0.77s passed...
GA on 1-objective 6-variable UserProblem ( 27.00%), 0.80s passed...
GA on 1-objective 6-variable UserProblem ( 28.00%), 0.83s passed...
GA on 1-objective 6-variable UserProblem ( 29.00%), 0.86s passed...
GA on 1-objective 6-variable UserProblem ( 30.00%), 0.88s passed...
GA on 1-objective 6-variable UserProblem ( 31.00%), 0.91s passed...
GA on 1-objective 6-variable UserProblem ( 32.00%), 0.94s passed...
GA on 1-objective 6-variable UserProblem ( 33.00%), 0.97s passed...
GA on 1-objective 6-variable UserProblem ( 34.00%), 1.00s passed...
GA on 1-objective 6-variable UserProblem ( 35.00%), 1.03s passed...
GA on 1-objective 6-variable UserProblem ( 36.00%), 1.05s passed...
GA on 1-objective 6-variable UserProblem ( 37.00%), 1.08s passed...
GA on 1-objective 6-variable UserProblem ( 38.00%), 1.11s passed...
GA on 1-objective 6-variable UserProblem ( 39.00%), 1.14s passed...
GA on 1-objective 6-variable UserProblem ( 40.00%), 1.18s passed...
GA on 1-objective 6-variable UserProblem ( 41.00%), 1.22s passed...
GA on 1-objective 6-variable UserProblem ( 42.00%), 1.26s passed...
GA on 1-objective 6-variable UserProblem ( 43.00%), 1.29s passed...
GA on 1-objective 6-variable UserProblem ( 44.00%), 1.32s passed...
GA on 1-objective 6-variable UserProblem ( 45.00%), 1.35s passed...
GA on 1-objective 6-variable UserProblem ( 46.00%), 1.38s passed...
GA on 1-objective 6-variable UserProblem ( 47.00%), 1.40s passed...
GA on 1-objective 6-variable UserProblem ( 48.00%), 1.43s passed...
GA on 1-objective 6-variable UserProblem ( 49.00%), 1.46s passed...
GA on 1-objective 6-variable UserProblem ( 50.00%), 1.49s passed...
GA on 1-objective 6-variable UserProblem ( 51.00%), 1.52s passed...
GA on 1-objective 6-variable UserProblem ( 52.00%), 1.54s passed...
GA on 1-objective 6-variable UserProblem ( 53.00%), 1.57s passed...
GA on 1-objective 6-variable UserProblem ( 54.00%), 1.60s passed...
GA on 1-objective 6-variable UserProblem ( 55.00%), 1.63s passed...
GA on 1-objective 6-variable UserProblem ( 56.00%), 1.66s passed...
GA on 1-objective 6-variable UserProblem ( 57.00%), 1.69s passed...
GA on 1-objective 6-variable UserProblem ( 58.00%), 1.71s passed...
GA on 1-objective 6-variable UserProblem ( 59.00%), 1.74s passed...
GA on 1-objective 6-variable UserProblem ( 60.00%), 1.77s passed...
GA on 1-objective 6-variable UserProblem ( 61.00%), 1.80s passed...
GA on 1-objective 6-variable UserProblem ( 62.00%), 1.83s passed...
GA on 1-objective 6-variable UserProblem ( 63.00%), 1.86s passed...
GA on 1-objective 6-variable UserProblem ( 64.00%), 1.88s passed...
GA on 1-objective 6-variable UserProblem ( 65.00%), 1.91s passed...
GA on 1-objective 6-variable UserProblem ( 66.00%), 1.94s passed...
GA on 1-objective 6-variable UserProblem ( 67.00%), 1.97s passed...
GA on 1-objective 6-variable UserProblem ( 68.00%), 2.00s passed...
GA on 1-objective 6-variable UserProblem ( 69.00%), 2.02s passed...
GA on 1-objective 6-variable UserProblem ( 70.00%), 2.05s passed...
GA on 1-objective 6-variable UserProblem ( 71.00%), 2.08s passed...
GA on 1-objective 6-variable UserProblem ( 72.00%), 2.11s passed...
GA on 1-objective 6-variable UserProblem ( 73.00%), 2.14s passed...
GA on 1-objective 6-variable UserProblem ( 74.00%), 2.16s passed...
GA on 1-objective 6-variable UserProblem ( 75.00%), 2.19s passed...
GA on 1-objective 6-variable UserProblem ( 76.00%), 2.22s passed...
GA on 1-objective 6-variable UserProblem ( 77.00%), 2.25s passed...
GA on 1-objective 6-variable UserProblem ( 78.00%), 2.28s passed...
GA on 1-objective 6-variable UserProblem ( 79.00%), 2.30s passed...
GA on 1-objective 6-variable UserProblem ( 80.00%), 2.33s passed...
GA on 1-objective 6-variable UserProblem ( 81.00%), 2.36s passed...
```

```
GA on 1-objective 6-variable UserProblem ( 82.00%), 2.39s passed...
GA on 1-objective 6-variable UserProblem ( 83.00%), 2.42s passed...
GA on 1-objective 6-variable UserProblem ( 84.00%), 2.44s passed...
GA on 1-objective 6-variable UserProblem ( 85.00%), 2.47s passed...
GA on 1-objective 6-variable UserProblem ( 86.00%), 2.50s passed...
GA on 1-objective 6-variable UserProblem ( 87.00%), 2.53s passed...
GA on 1-objective 6-variable UserProblem ( 88.00%), 2.56s passed...
GA on 1-objective 6-variable UserProblem ( 89.00%), 2.59s passed...
GA on 1-objective 6-variable UserProblem ( 90.00%), 2.61s passed...
GA on 1-objective 6-variable UserProblem ( 91.00%), 2.64s passed...
GA on 1-objective 6-variable UserProblem ( 92.00%), 2.67s passed...
GA on 1-objective 6-variable UserProblem ( 93.00%), 2.70s passed...
GA on 1-objective 6-variable UserProblem ( 94.00%), 2.72s passed...
GA on 1-objective 6-variable UserProblem ( 95.00%), 2.75s passed...
GA on 1-objective 6-variable UserProblem ( 96.00%), 2.78s passed...
GA on 1-objective 6-variable UserProblem ( 97.00%), 2.81s passed...
GA on 1-objective 6-variable UserProblem ( 98.00%), 2.84s passed...
GA on 1-objective 6-variable UserProblem ( 99.00%), 2.87s passed...
GA on 1-objective 6-variable UserProblem (100.00%), 2.90s passed...
Design found:
    6.7837    0.3180    1.3429

    0.3334    0.3332    0.3334

Objective value: 12.558908
Sensitivity function values:
-0.000631 0.000987 -0.000355
```

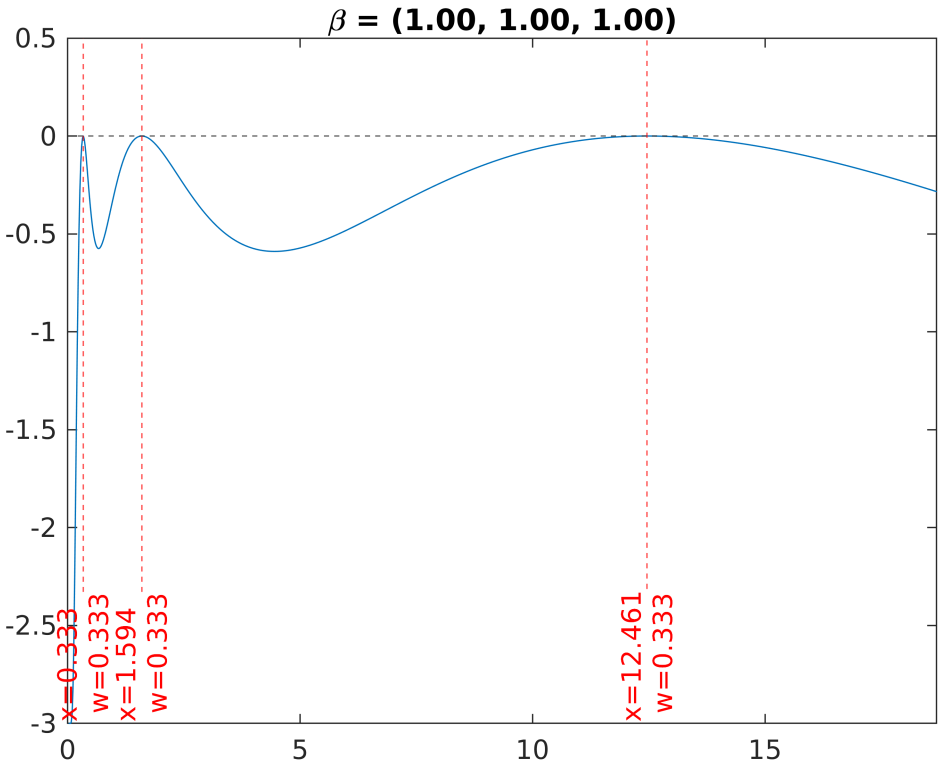


Note that the algorithm does not find the optimal design as indicated by the sensitivity plot. It seems that some designs have an unbounded 3rd point that causes some issues in finding the optimal design. This problem may be solved by specifying an upper bound for x. This approach should be applicable in most situations.

```
int = [0, 20];
[obj, xi] = DoptFracPoly(beta, powers, pts, sens, algo, int);
```

```
GA on 1-objective 6-variable UserProblem (  1.00%), 0.04s passed...
GA on 1-objective 6-variable UserProblem (  2.00%), 0.07s passed...
GA on 1-objective 6-variable UserProblem (  3.00%), 0.10s passed...
GA on 1-objective 6-variable UserProblem (  4.00%), 0.13s passed...
GA on 1-objective 6-variable UserProblem (  5.00%), 0.16s passed...
GA on 1-objective 6-variable UserProblem (  6.00%), 0.19s passed...
GA on 1-objective 6-variable UserProblem (  7.00%), 0.22s passed...
GA on 1-objective 6-variable UserProblem (  8.00%), 0.24s passed...
GA on 1-objective 6-variable UserProblem (  9.00%), 0.27s passed...
GA on 1-objective 6-variable UserProblem ( 10.00%), 0.30s passed...
GA on 1-objective 6-variable UserProblem ( 11.00%), 0.33s passed...
GA on 1-objective 6-variable UserProblem ( 12.00%), 0.36s passed...
GA on 1-objective 6-variable UserProblem ( 13.00%), 0.39s passed...
GA on 1-objective 6-variable UserProblem ( 14.00%), 0.41s passed...
GA on 1-objective 6-variable UserProblem ( 15.00%), 0.44s passed...
GA on 1-objective 6-variable UserProblem ( 16.00%), 0.47s passed...
GA on 1-objective 6-variable UserProblem ( 17.00%), 0.50s passed...
GA on 1-objective 6-variable UserProblem ( 18.00%), 0.53s passed...
GA on 1-objective 6-variable UserProblem ( 19.00%), 0.55s passed...
GA on 1-objective 6-variable UserProblem ( 20.00%), 0.58s passed...
GA on 1-objective 6-variable UserProblem ( 21.00%), 0.61s passed...
GA on 1-objective 6-variable UserProblem ( 22.00%), 0.65s passed...
GA on 1-objective 6-variable UserProblem ( 23.00%), 0.68s passed...
GA on 1-objective 6-variable UserProblem ( 24.00%), 0.70s passed...
GA on 1-objective 6-variable UserProblem ( 25.00%), 0.73s passed...
GA on 1-objective 6-variable UserProblem ( 26.00%), 0.76s passed...
GA on 1-objective 6-variable UserProblem ( 27.00%), 0.79s passed...
GA on 1-objective 6-variable UserProblem ( 28.00%), 0.82s passed...
GA on 1-objective 6-variable UserProblem ( 29.00%), 0.85s passed...
GA on 1-objective 6-variable UserProblem ( 30.00%), 0.87s passed...
GA on 1-objective 6-variable UserProblem ( 31.00%), 0.90s passed...
GA on 1-objective 6-variable UserProblem ( 32.00%), 0.93s passed...
GA on 1-objective 6-variable UserProblem ( 33.00%), 0.96s passed...
GA on 1-objective 6-variable UserProblem ( 34.00%), 0.98s passed...
GA on 1-objective 6-variable UserProblem ( 35.00%), 1.01s passed...
GA on 1-objective 6-variable UserProblem ( 36.00%), 1.04s passed...
GA on 1-objective 6-variable UserProblem ( 37.00%), 1.07s passed...
GA on 1-objective 6-variable UserProblem ( 38.00%), 1.10s passed...
GA on 1-objective 6-variable UserProblem ( 39.00%), 1.13s passed...
GA on 1-objective 6-variable UserProblem ( 40.00%), 1.16s passed...
GA on 1-objective 6-variable UserProblem ( 41.00%), 1.19s passed...
GA on 1-objective 6-variable UserProblem ( 42.00%), 1.22s passed...
GA on 1-objective 6-variable UserProblem ( 43.00%), 1.25s passed...
GA on 1-objective 6-variable UserProblem ( 44.00%), 1.28s passed...
GA on 1-objective 6-variable UserProblem ( 45.00%), 1.31s passed...
GA on 1-objective 6-variable UserProblem ( 46.00%), 1.33s passed...
GA on 1-objective 6-variable UserProblem ( 47.00%), 1.36s passed...
GA on 1-objective 6-variable UserProblem ( 48.00%), 1.39s passed...
GA on 1-objective 6-variable UserProblem ( 49.00%), 1.42s passed...
GA on 1-objective 6-variable UserProblem ( 50.00%), 1.45s passed...
GA on 1-objective 6-variable UserProblem ( 51.00%), 1.48s passed...
GA on 1-objective 6-variable UserProblem ( 52.00%), 1.50s passed...
GA on 1-objective 6-variable UserProblem ( 53.00%), 1.53s passed...
GA on 1-objective 6-variable UserProblem ( 54.00%), 1.56s passed...
GA on 1-objective 6-variable UserProblem ( 55.00%), 1.59s passed...
GA on 1-objective 6-variable UserProblem ( 56.00%), 1.62s passed...
GA on 1-objective 6-variable UserProblem ( 57.00%), 1.65s passed...
GA on 1-objective 6-variable UserProblem ( 58.00%), 1.67s passed...
GA on 1-objective 6-variable UserProblem ( 59.00%), 1.70s passed...
```

```
GA on 1-objective 6-variable UserProblem ( 60.00%), 1.73s passed...
GA on 1-objective 6-variable UserProblem ( 61.00%), 1.76s passed...
GA on 1-objective 6-variable UserProblem ( 62.00%), 1.79s passed...
GA on 1-objective 6-variable UserProblem ( 63.00%), 1.81s passed...
GA on 1-objective 6-variable UserProblem ( 64.00%), 1.84s passed...
GA on 1-objective 6-variable UserProblem ( 65.00%), 1.87s passed...
GA on 1-objective 6-variable UserProblem ( 66.00%), 1.90s passed...
GA on 1-objective 6-variable UserProblem ( 67.00%), 1.93s passed...
GA on 1-objective 6-variable UserProblem ( 68.00%), 1.95s passed...
GA on 1-objective 6-variable UserProblem ( 69.00%), 1.99s passed...
GA on 1-objective 6-variable UserProblem ( 70.00%), 2.01s passed...
GA on 1-objective 6-variable UserProblem ( 71.00%), 2.04s passed...
GA on 1-objective 6-variable UserProblem ( 72.00%), 2.07s passed...
GA on 1-objective 6-variable UserProblem ( 73.00%), 2.10s passed...
GA on 1-objective 6-variable UserProblem ( 74.00%), 2.13s passed...
GA on 1-objective 6-variable UserProblem ( 75.00%), 2.16s passed...
GA on 1-objective 6-variable UserProblem ( 76.00%), 2.19s passed...
GA on 1-objective 6-variable UserProblem ( 77.00%), 2.22s passed...
GA on 1-objective 6-variable UserProblem ( 78.00%), 2.24s passed...
GA on 1-objective 6-variable UserProblem ( 79.00%), 2.27s passed...
GA on 1-objective 6-variable UserProblem ( 80.00%), 2.30s passed...
GA on 1-objective 6-variable UserProblem ( 81.00%), 2.33s passed...
GA on 1-objective 6-variable UserProblem ( 82.00%), 2.36s passed...
GA on 1-objective 6-variable UserProblem ( 83.00%), 2.39s passed...
GA on 1-objective 6-variable UserProblem ( 84.00%), 2.41s passed...
GA on 1-objective 6-variable UserProblem ( 85.00%), 2.44s passed...
GA on 1-objective 6-variable UserProblem ( 86.00%), 2.47s passed...
GA on 1-objective 6-variable UserProblem ( 87.00%), 2.50s passed...
GA on 1-objective 6-variable UserProblem ( 88.00%), 2.53s passed...
GA on 1-objective 6-variable UserProblem ( 89.00%), 2.56s passed...
GA on 1-objective 6-variable UserProblem ( 90.00%), 2.59s passed...
GA on 1-objective 6-variable UserProblem ( 91.00%), 2.61s passed...
GA on 1-objective 6-variable UserProblem ( 92.00%), 2.64s passed...
GA on 1-objective 6-variable UserProblem ( 93.00%), 2.67s passed...
GA on 1-objective 6-variable UserProblem ( 94.00%), 2.70s passed...
GA on 1-objective 6-variable UserProblem ( 95.00%), 2.73s passed...
GA on 1-objective 6-variable UserProblem ( 96.00%), 2.75s passed...
GA on 1-objective 6-variable UserProblem ( 97.00%), 2.78s passed...
GA on 1-objective 6-variable UserProblem ( 98.00%), 2.81s passed...
GA on 1-objective 6-variable UserProblem ( 99.00%), 2.84s passed...
GA on 1-objective 6-variable UserProblem (100.00%), 2.87s passed...
Design found:
    0.3334   12.4608    1.5943

    0.3333    0.3333    0.3333

Objective value: 12.300888
Sensitivity function values:
-0.000037 0.000001 0.000035
```



Examples of Designs

In their original paper, Royston and Altman give two applied examples of logistic regression using fractional polynomials. In both cases, they find the best values of the powers so that the model fits the data optimally. The authors do not share the final regression coefficients. Therefore, we will find optimal designs for the two sets of powers and experiement with different values for the regression coeffficients.

In Vitro Fertilization example, p = (-1, 1)

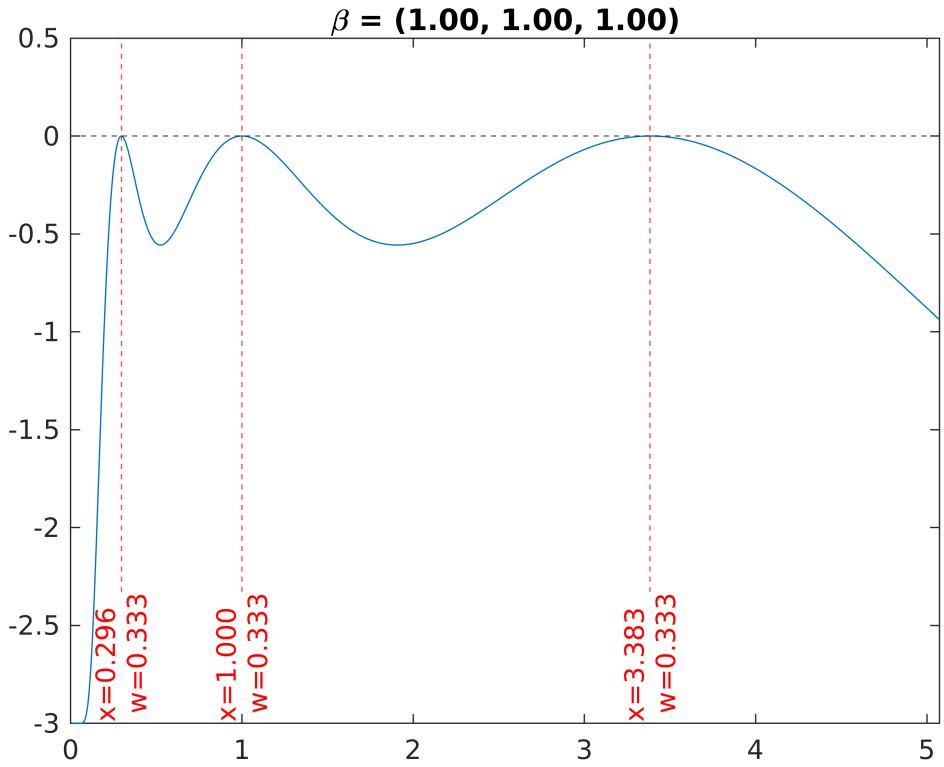
```
powers = [-1, 1];
```

```
% simple coef
beta = [1,1,1];
pts = 3;
sens = true;
int = [0, 100];
[obj, xi] = DoptFracPoly(beta, powers, pts, sens, algo, int);
```

```
GA on 1-objective 6-variable UserProblem (  1.00%), 0.04s passed...
GA on 1-objective 6-variable UserProblem (  2.00%), 0.07s passed...
GA on 1-objective 6-variable UserProblem (  3.00%), 0.10s passed...
GA on 1-objective 6-variable UserProblem (  4.00%), 0.13s passed...
GA on 1-objective 6-variable UserProblem (  5.00%), 0.16s passed...
GA on 1-objective 6-variable UserProblem (  6.00%), 0.19s passed...
GA on 1-objective 6-variable UserProblem (  7.00%), 0.22s passed...
```

```
GA on 1-objective 6-variable UserProblem (  8.00%), 0.25s passed...
GA on 1-objective 6-variable UserProblem (  9.00%), 0.28s passed...
GA on 1-objective 6-variable UserProblem ( 10.00%), 0.31s passed...
GA on 1-objective 6-variable UserProblem ( 11.00%), 0.34s passed...
GA on 1-objective 6-variable UserProblem ( 12.00%), 0.37s passed...
GA on 1-objective 6-variable UserProblem ( 13.00%), 0.39s passed...
GA on 1-objective 6-variable UserProblem ( 14.00%), 0.42s passed...
GA on 1-objective 6-variable UserProblem ( 15.00%), 0.45s passed...
GA on 1-objective 6-variable UserProblem ( 16.00%), 0.48s passed...
GA on 1-objective 6-variable UserProblem ( 17.00%), 0.51s passed...
GA on 1-objective 6-variable UserProblem ( 18.00%), 0.55s passed...
GA on 1-objective 6-variable UserProblem ( 19.00%), 0.58s passed...
GA on 1-objective 6-variable UserProblem ( 20.00%), 0.61s passed...
GA on 1-objective 6-variable UserProblem ( 21.00%), 0.64s passed...
GA on 1-objective 6-variable UserProblem ( 22.00%), 0.67s passed...
GA on 1-objective 6-variable UserProblem ( 23.00%), 0.70s passed...
GA on 1-objective 6-variable UserProblem ( 24.00%), 0.73s passed...
GA on 1-objective 6-variable UserProblem ( 25.00%), 0.75s passed...
GA on 1-objective 6-variable UserProblem ( 26.00%), 0.78s passed...
GA on 1-objective 6-variable UserProblem ( 27.00%), 0.81s passed...
GA on 1-objective 6-variable UserProblem ( 28.00%), 0.84s passed...
GA on 1-objective 6-variable UserProblem ( 29.00%), 0.87s passed...
GA on 1-objective 6-variable UserProblem ( 30.00%), 0.90s passed...
GA on 1-objective 6-variable UserProblem ( 31.00%), 0.93s passed...
GA on 1-objective 6-variable UserProblem ( 32.00%), 0.96s passed...
GA on 1-objective 6-variable UserProblem ( 33.00%), 0.99s passed...
GA on 1-objective 6-variable UserProblem ( 34.00%), 1.02s passed...
GA on 1-objective 6-variable UserProblem ( 35.00%), 1.04s passed...
GA on 1-objective 6-variable UserProblem ( 36.00%), 1.07s passed...
GA on 1-objective 6-variable UserProblem ( 37.00%), 1.10s passed...
GA on 1-objective 6-variable UserProblem ( 38.00%), 1.13s passed...
GA on 1-objective 6-variable UserProblem ( 39.00%), 1.16s passed...
GA on 1-objective 6-variable UserProblem ( 40.00%), 1.19s passed...
GA on 1-objective 6-variable UserProblem ( 41.00%), 1.22s passed...
GA on 1-objective 6-variable UserProblem ( 42.00%), 1.25s passed...
GA on 1-objective 6-variable UserProblem ( 43.00%), 1.28s passed...
GA on 1-objective 6-variable UserProblem ( 44.00%), 1.31s passed...
GA on 1-objective 6-variable UserProblem ( 45.00%), 1.33s passed...
GA on 1-objective 6-variable UserProblem ( 46.00%), 1.36s passed...
GA on 1-objective 6-variable UserProblem ( 47.00%), 1.39s passed...
GA on 1-objective 6-variable UserProblem ( 48.00%), 1.42s passed...
GA on 1-objective 6-variable UserProblem ( 49.00%), 1.45s passed...
GA on 1-objective 6-variable UserProblem ( 50.00%), 1.48s passed...
GA on 1-objective 6-variable UserProblem ( 51.00%), 1.51s passed...
GA on 1-objective 6-variable UserProblem ( 52.00%), 1.54s passed...
GA on 1-objective 6-variable UserProblem ( 53.00%), 1.57s passed...
GA on 1-objective 6-variable UserProblem ( 54.00%), 1.59s passed...
GA on 1-objective 6-variable UserProblem ( 55.00%), 1.62s passed...
GA on 1-objective 6-variable UserProblem ( 56.00%), 1.65s passed...
GA on 1-objective 6-variable UserProblem ( 57.00%), 1.68s passed...
GA on 1-objective 6-variable UserProblem ( 58.00%), 1.71s passed...
GA on 1-objective 6-variable UserProblem ( 59.00%), 1.74s passed...
GA on 1-objective 6-variable UserProblem ( 60.00%), 1.77s passed...
GA on 1-objective 6-variable UserProblem ( 61.00%), 1.80s passed...
GA on 1-objective 6-variable UserProblem ( 62.00%), 1.83s passed...
GA on 1-objective 6-variable UserProblem ( 63.00%), 1.85s passed...
GA on 1-objective 6-variable UserProblem ( 64.00%), 1.88s passed...
GA on 1-objective 6-variable UserProblem ( 65.00%), 1.91s passed...
GA on 1-objective 6-variable UserProblem ( 66.00%), 1.94s passed...
GA on 1-objective 6-variable UserProblem ( 67.00%), 1.97s passed...
GA on 1-objective 6-variable UserProblem ( 68.00%), 2.00s passed...
GA on 1-objective 6-variable UserProblem ( 69.00%), 2.03s passed...
GA on 1-objective 6-variable UserProblem ( 70.00%), 2.06s passed...
GA on 1-objective 6-variable UserProblem ( 71.00%), 2.09s passed...
```

```
GA on 1-objective 6-variable UserProblem ( 72.00%), 2.12s passed...
GA on 1-objective 6-variable UserProblem ( 73.00%), 2.15s passed...
GA on 1-objective 6-variable UserProblem ( 74.00%), 2.18s passed...
GA on 1-objective 6-variable UserProblem ( 75.00%), 2.20s passed...
GA on 1-objective 6-variable UserProblem ( 76.00%), 2.23s passed...
GA on 1-objective 6-variable UserProblem ( 77.00%), 2.26s passed...
GA on 1-objective 6-variable UserProblem ( 78.00%), 2.29s passed...
GA on 1-objective 6-variable UserProblem ( 79.00%), 2.32s passed...
GA on 1-objective 6-variable UserProblem ( 80.00%), 2.35s passed...
GA on 1-objective 6-variable UserProblem ( 81.00%), 2.38s passed...
GA on 1-objective 6-variable UserProblem ( 82.00%), 2.41s passed...
GA on 1-objective 6-variable UserProblem ( 83.00%), 2.43s passed...
GA on 1-objective 6-variable UserProblem ( 84.00%), 2.46s passed...
GA on 1-objective 6-variable UserProblem ( 85.00%), 2.49s passed...
GA on 1-objective 6-variable UserProblem ( 86.00%), 2.52s passed...
GA on 1-objective 6-variable UserProblem ( 87.00%), 2.55s passed...
GA on 1-objective 6-variable UserProblem ( 88.00%), 2.58s passed...
GA on 1-objective 6-variable UserProblem ( 89.00%), 2.60s passed...
GA on 1-objective 6-variable UserProblem ( 90.00%), 2.63s passed...
GA on 1-objective 6-variable UserProblem ( 91.00%), 2.67s passed...
GA on 1-objective 6-variable UserProblem ( 92.00%), 2.70s passed...
GA on 1-objective 6-variable UserProblem ( 93.00%), 2.73s passed...
GA on 1-objective 6-variable UserProblem ( 94.00%), 2.76s passed...
GA on 1-objective 6-variable UserProblem ( 95.00%), 2.78s passed...
GA on 1-objective 6-variable UserProblem ( 96.00%), 2.82s passed...
GA on 1-objective 6-variable UserProblem ( 97.00%), 2.85s passed...
GA on 1-objective 6-variable UserProblem ( 98.00%), 2.88s passed...
GA on 1-objective 6-variable UserProblem ( 99.00%), 2.91s passed...
GA on 1-objective 6-variable UserProblem (100.00%), 2.94s passed...
Design found:
    0.2956    0.9999    3.3831

    0.3333    0.3333    0.3333

Objective value: 12.496623
Sensitivity function values:
0.000002 0.000005 -0.000007
```

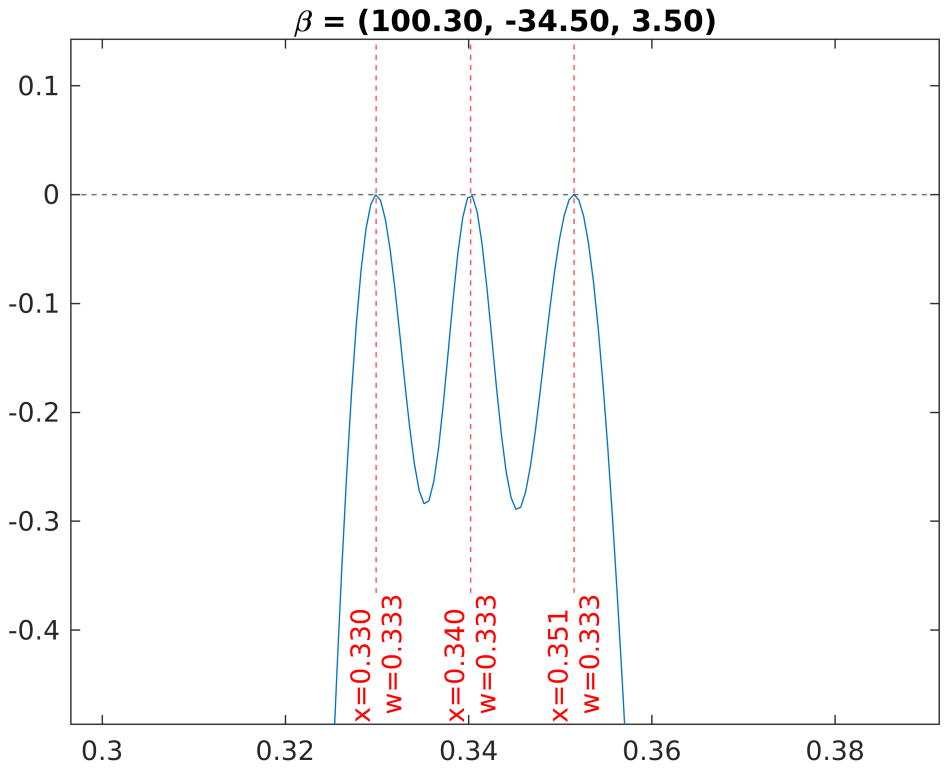



```
% more complicated case
beta = [100.3, -34.5, 3.5];
[obj, xi] = DoptFracPoly(beta, powers, pts, sens, algo, int);
```

```
GA on 1-objective 6-variable UserProblem (  1.00%), 0.04s passed...
GA on 1-objective 6-variable UserProblem (  2.00%), 0.07s passed...
GA on 1-objective 6-variable UserProblem (  3.00%), 0.11s passed...
GA on 1-objective 6-variable UserProblem (  4.00%), 0.14s passed...
GA on 1-objective 6-variable UserProblem (  5.00%), 0.17s passed...
GA on 1-objective 6-variable UserProblem (  6.00%), 0.20s passed...
GA on 1-objective 6-variable UserProblem (  7.00%), 0.23s passed...
GA on 1-objective 6-variable UserProblem (  8.00%), 0.25s passed...
GA on 1-objective 6-variable UserProblem (  9.00%), 0.28s passed...
GA on 1-objective 6-variable UserProblem ( 10.00%), 0.31s passed...
GA on 1-objective 6-variable UserProblem ( 11.00%), 0.34s passed...
GA on 1-objective 6-variable UserProblem ( 12.00%), 0.37s passed...
GA on 1-objective 6-variable UserProblem ( 13.00%), 0.40s passed...
GA on 1-objective 6-variable UserProblem ( 14.00%), 0.43s passed...
GA on 1-objective 6-variable UserProblem ( 15.00%), 0.46s passed...
GA on 1-objective 6-variable UserProblem ( 16.00%), 0.49s passed...
GA on 1-objective 6-variable UserProblem ( 17.00%), 0.52s passed...
GA on 1-objective 6-variable UserProblem ( 18.00%), 0.54s passed...
GA on 1-objective 6-variable UserProblem ( 19.00%), 0.57s passed...
GA on 1-objective 6-variable UserProblem ( 20.00%), 0.60s passed...
GA on 1-objective 6-variable UserProblem ( 21.00%), 0.63s passed...
GA on 1-objective 6-variable UserProblem ( 22.00%), 0.66s passed...
GA on 1-objective 6-variable UserProblem ( 23.00%), 0.69s passed...
GA on 1-objective 6-variable UserProblem ( 24.00%), 0.72s passed...
GA on 1-objective 6-variable UserProblem ( 25.00%), 0.75s passed...
GA on 1-objective 6-variable UserProblem ( 26.00%), 0.77s passed...
GA on 1-objective 6-variable UserProblem ( 27.00%), 0.80s passed...
```

```
GA on 1-objective 6-variable UserProblem ( 28.00%), 0.83s passed...
GA on 1-objective 6-variable UserProblem ( 29.00%), 0.86s passed...
GA on 1-objective 6-variable UserProblem ( 30.00%), 0.89s passed...
GA on 1-objective 6-variable UserProblem ( 31.00%), 0.92s passed...
GA on 1-objective 6-variable UserProblem ( 32.00%), 0.95s passed...
GA on 1-objective 6-variable UserProblem ( 33.00%), 0.98s passed...
GA on 1-objective 6-variable UserProblem ( 34.00%), 1.00s passed...
GA on 1-objective 6-variable UserProblem ( 35.00%), 1.03s passed...
GA on 1-objective 6-variable UserProblem ( 36.00%), 1.06s passed...
GA on 1-objective 6-variable UserProblem ( 37.00%), 1.09s passed...
GA on 1-objective 6-variable UserProblem ( 38.00%), 1.12s passed...
GA on 1-objective 6-variable UserProblem ( 39.00%), 1.15s passed...
GA on 1-objective 6-variable UserProblem ( 40.00%), 1.18s passed...
GA on 1-objective 6-variable UserProblem ( 41.00%), 1.21s passed...
GA on 1-objective 6-variable UserProblem ( 42.00%), 1.24s passed...
GA on 1-objective 6-variable UserProblem ( 43.00%), 1.27s passed...
GA on 1-objective 6-variable UserProblem ( 44.00%), 1.29s passed...
GA on 1-objective 6-variable UserProblem ( 45.00%), 1.32s passed...
GA on 1-objective 6-variable UserProblem ( 46.00%), 1.35s passed...
GA on 1-objective 6-variable UserProblem ( 47.00%), 1.38s passed...
GA on 1-objective 6-variable UserProblem ( 48.00%), 1.41s passed...
GA on 1-objective 6-variable UserProblem ( 49.00%), 1.44s passed...
GA on 1-objective 6-variable UserProblem ( 50.00%), 1.47s passed...
GA on 1-objective 6-variable UserProblem ( 51.00%), 1.50s passed...
GA on 1-objective 6-variable UserProblem ( 52.00%), 1.53s passed...
GA on 1-objective 6-variable UserProblem ( 53.00%), 1.56s passed...
GA on 1-objective 6-variable UserProblem ( 54.00%), 1.59s passed...
GA on 1-objective 6-variable UserProblem ( 55.00%), 1.62s passed...
GA on 1-objective 6-variable UserProblem ( 56.00%), 1.66s passed...
GA on 1-objective 6-variable UserProblem ( 57.00%), 1.70s passed...
GA on 1-objective 6-variable UserProblem ( 58.00%), 1.73s passed...
GA on 1-objective 6-variable UserProblem ( 59.00%), 1.76s passed...
GA on 1-objective 6-variable UserProblem ( 60.00%), 1.79s passed...
GA on 1-objective 6-variable UserProblem ( 61.00%), 1.82s passed...
GA on 1-objective 6-variable UserProblem ( 62.00%), 1.85s passed...
GA on 1-objective 6-variable UserProblem ( 63.00%), 1.88s passed...
GA on 1-objective 6-variable UserProblem ( 64.00%), 1.91s passed...
GA on 1-objective 6-variable UserProblem ( 65.00%), 1.94s passed...
GA on 1-objective 6-variable UserProblem ( 66.00%), 1.97s passed...
GA on 1-objective 6-variable UserProblem ( 67.00%), 2.00s passed...
GA on 1-objective 6-variable UserProblem ( 68.00%), 2.03s passed...
GA on 1-objective 6-variable UserProblem ( 69.00%), 2.07s passed...
GA on 1-objective 6-variable UserProblem ( 70.00%), 2.10s passed...
GA on 1-objective 6-variable UserProblem ( 71.00%), 2.13s passed...
GA on 1-objective 6-variable UserProblem ( 72.00%), 2.15s passed...
GA on 1-objective 6-variable UserProblem ( 73.00%), 2.18s passed...
GA on 1-objective 6-variable UserProblem ( 74.00%), 2.21s passed...
GA on 1-objective 6-variable UserProblem ( 75.00%), 2.24s passed...
GA on 1-objective 6-variable UserProblem ( 76.00%), 2.27s passed...
GA on 1-objective 6-variable UserProblem ( 77.00%), 2.30s passed...
GA on 1-objective 6-variable UserProblem ( 78.00%), 2.33s passed...
GA on 1-objective 6-variable UserProblem ( 79.00%), 2.35s passed...
GA on 1-objective 6-variable UserProblem ( 80.00%), 2.39s passed...
GA on 1-objective 6-variable UserProblem ( 81.00%), 2.42s passed...
GA on 1-objective 6-variable UserProblem ( 82.00%), 2.45s passed...
GA on 1-objective 6-variable UserProblem ( 83.00%), 2.48s passed...
GA on 1-objective 6-variable UserProblem ( 84.00%), 2.51s passed...
GA on 1-objective 6-variable UserProblem ( 85.00%), 2.54s passed...
GA on 1-objective 6-variable UserProblem ( 86.00%), 2.57s passed...
GA on 1-objective 6-variable UserProblem ( 87.00%), 2.60s passed...
GA on 1-objective 6-variable UserProblem ( 88.00%), 2.63s passed...
GA on 1-objective 6-variable UserProblem ( 89.00%), 2.66s passed...
GA on 1-objective 6-variable UserProblem ( 90.00%), 2.69s passed...
GA on 1-objective 6-variable UserProblem ( 91.00%), 2.72s passed...
```

```
GA on 1-objective 6-variable UserProblem ( 92.00%), 2.75s passed...
GA on 1-objective 6-variable UserProblem ( 93.00%), 2.78s passed...
GA on 1-objective 6-variable UserProblem ( 94.00%), 2.81s passed...
GA on 1-objective 6-variable UserProblem ( 95.00%), 2.84s passed...
GA on 1-objective 6-variable UserProblem ( 96.00%), 2.87s passed...
GA on 1-objective 6-variable UserProblem ( 97.00%), 2.89s passed...
GA on 1-objective 6-variable UserProblem ( 98.00%), 2.92s passed...
GA on 1-objective 6-variable UserProblem ( 99.00%), 2.95s passed...
GA on 1-objective 6-variable UserProblem (100.00%), 2.98s passed...
Design found:
    0.3515    0.3299    0.3402

    0.3333    0.3333    0.3333

Objective value: 30.660667
Sensitivity function values:
0.000050 -0.000045 -0.000005
```



Myelomatosis example, p = (-2, 3)

The model used for this example from Royston and Altman included other covariates, but it is still interesting to look at the fractional polynomial in isolation.

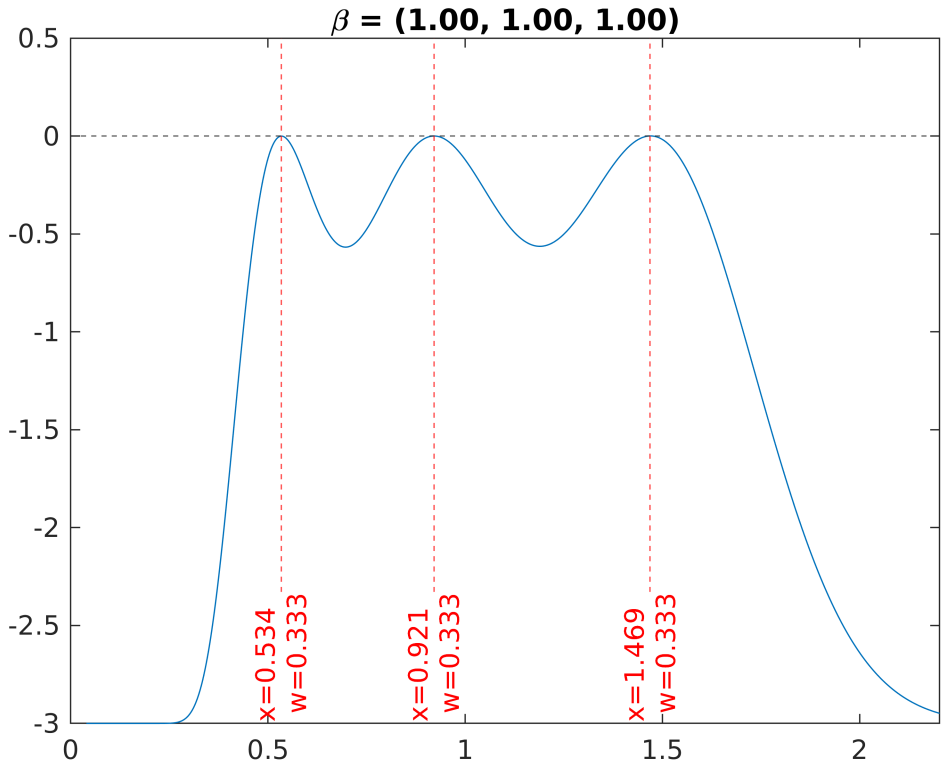
```
powers = [-2, 3];
```

```
% simple case
beta = [1,1,1];
pts = 3;
sens = true;
```

```
int = [0, 100];

[obj, xi] = DoptFracPoly(beta, powers, pts, sens, algo, int);
```

```
GA on 1-objective 6-variable UserProblem (  1.00%), 0.04s passed...
GA on 1-objective 6-variable UserProblem (  2.00%), 0.08s passed...
GA on 1-objective 6-variable UserProblem (  3.00%), 0.11s passed...
GA on 1-objective 6-variable UserProblem (  4.00%), 0.14s passed...
GA on 1-objective 6-variable UserProblem (  5.00%), 0.17s passed...
GA on 1-objective 6-variable UserProblem (  6.00%), 0.20s passed...
GA on 1-objective 6-variable UserProblem (  7.00%), 0.23s passed...
GA on 1-objective 6-variable UserProblem (  8.00%), 0.26s passed...
GA on 1-objective 6-variable UserProblem (  9.00%), 0.29s passed...
GA on 1-objective 6-variable UserProblem ( 10.00%), 0.32s passed...
GA on 1-objective 6-variable UserProblem ( 11.00%), 0.35s passed...
GA on 1-objective 6-variable UserProblem ( 12.00%), 0.38s passed...
GA on 1-objective 6-variable UserProblem ( 13.00%), 0.41s passed...
GA on 1-objective 6-variable UserProblem ( 14.00%), 0.44s passed...
GA on 1-objective 6-variable UserProblem ( 15.00%), 0.47s passed...
GA on 1-objective 6-variable UserProblem ( 16.00%), 0.50s passed...
GA on 1-objective 6-variable UserProblem ( 17.00%), 0.53s passed...
GA on 1-objective 6-variable UserProblem ( 18.00%), 0.56s passed...
GA on 1-objective 6-variable UserProblem ( 19.00%), 0.59s passed...
GA on 1-objective 6-variable UserProblem ( 20.00%), 0.62s passed...
GA on 1-objective 6-variable UserProblem ( 21.00%), 0.65s passed...
GA on 1-objective 6-variable UserProblem ( 22.00%), 0.68s passed...
GA on 1-objective 6-variable UserProblem ( 23.00%), 0.71s passed...
GA on 1-objective 6-variable UserProblem ( 24.00%), 0.74s passed...
GA on 1-objective 6-variable UserProblem ( 25.00%), 0.77s passed...
GA on 1-objective 6-variable UserProblem ( 26.00%), 0.80s passed...
GA on 1-objective 6-variable UserProblem ( 27.00%), 0.83s passed...
GA on 1-objective 6-variable UserProblem ( 28.00%), 0.86s passed...
GA on 1-objective 6-variable UserProblem ( 29.00%), 0.89s passed...
GA on 1-objective 6-variable UserProblem ( 30.00%), 0.92s passed...
GA on 1-objective 6-variable UserProblem ( 31.00%), 0.95s passed...
GA on 1-objective 6-variable UserProblem ( 32.00%), 0.99s passed...
GA on 1-objective 6-variable UserProblem ( 33.00%), 1.02s passed...
GA on 1-objective 6-variable UserProblem ( 34.00%), 1.05s passed...
GA on 1-objective 6-variable UserProblem ( 35.00%), 1.08s passed...
GA on 1-objective 6-variable UserProblem ( 36.00%), 1.11s passed...
GA on 1-objective 6-variable UserProblem ( 37.00%), 1.14s passed...
GA on 1-objective 6-variable UserProblem ( 38.00%), 1.17s passed...
GA on 1-objective 6-variable UserProblem ( 39.00%), 1.20s passed...
GA on 1-objective 6-variable UserProblem ( 40.00%), 1.23s passed...
GA on 1-objective 6-variable UserProblem ( 41.00%), 1.26s passed...
GA on 1-objective 6-variable UserProblem ( 42.00%), 1.29s passed...
GA on 1-objective 6-variable UserProblem ( 43.00%), 1.32s passed...
GA on 1-objective 6-variable UserProblem ( 44.00%), 1.35s passed...
GA on 1-objective 6-variable UserProblem ( 45.00%), 1.38s passed...
GA on 1-objective 6-variable UserProblem ( 46.00%), 1.42s passed...
GA on 1-objective 6-variable UserProblem ( 47.00%), 1.46s passed...
GA on 1-objective 6-variable UserProblem ( 48.00%), 1.49s passed...
GA on 1-objective 6-variable UserProblem ( 49.00%), 1.52s passed...
GA on 1-objective 6-variable UserProblem ( 50.00%), 1.56s passed...
GA on 1-objective 6-variable UserProblem ( 51.00%), 1.59s passed...
GA on 1-objective 6-variable UserProblem ( 52.00%), 1.62s passed...
GA on 1-objective 6-variable UserProblem ( 53.00%), 1.65s passed...
GA on 1-objective 6-variable UserProblem ( 54.00%), 1.68s passed...
GA on 1-objective 6-variable UserProblem ( 55.00%), 1.71s passed...
GA on 1-objective 6-variable UserProblem ( 56.00%), 1.74s passed...
GA on 1-objective 6-variable UserProblem ( 57.00%), 1.77s passed...
GA on 1-objective 6-variable UserProblem ( 58.00%), 1.80s passed...
GA on 1-objective 6-variable UserProblem ( 59.00%), 1.84s passed...
GA on 1-objective 6-variable UserProblem ( 60.00%), 1.87s passed...
```

```
GA on 1-objective 6-variable UserProblem ( 61.00%), 1.90s passed...
GA on 1-objective 6-variable UserProblem ( 62.00%), 1.93s passed...
GA on 1-objective 6-variable UserProblem ( 63.00%), 1.96s passed...
GA on 1-objective 6-variable UserProblem ( 64.00%), 1.99s passed...
GA on 1-objective 6-variable UserProblem ( 65.00%), 2.02s passed...
GA on 1-objective 6-variable UserProblem ( 66.00%), 2.05s passed...
GA on 1-objective 6-variable UserProblem ( 67.00%), 2.08s passed...
GA on 1-objective 6-variable UserProblem ( 68.00%), 2.12s passed...
GA on 1-objective 6-variable UserProblem ( 69.00%), 2.15s passed...
GA on 1-objective 6-variable UserProblem ( 70.00%), 2.18s passed...
GA on 1-objective 6-variable UserProblem ( 71.00%), 2.21s passed...
GA on 1-objective 6-variable UserProblem ( 72.00%), 2.25s passed...
GA on 1-objective 6-variable UserProblem ( 73.00%), 2.28s passed...
GA on 1-objective 6-variable UserProblem ( 74.00%), 2.31s passed...
GA on 1-objective 6-variable UserProblem ( 75.00%), 2.34s passed...
GA on 1-objective 6-variable UserProblem ( 76.00%), 2.37s passed...
GA on 1-objective 6-variable UserProblem ( 77.00%), 2.40s passed...
GA on 1-objective 6-variable UserProblem ( 78.00%), 2.43s passed...
GA on 1-objective 6-variable UserProblem ( 79.00%), 2.46s passed...
GA on 1-objective 6-variable UserProblem ( 80.00%), 2.49s passed...
GA on 1-objective 6-variable UserProblem ( 81.00%), 2.53s passed...
GA on 1-objective 6-variable UserProblem ( 82.00%), 2.56s passed...
GA on 1-objective 6-variable UserProblem ( 83.00%), 2.59s passed...
GA on 1-objective 6-variable UserProblem ( 84.00%), 2.62s passed...
GA on 1-objective 6-variable UserProblem ( 85.00%), 2.66s passed...
GA on 1-objective 6-variable UserProblem ( 86.00%), 2.69s passed...
GA on 1-objective 6-variable UserProblem ( 87.00%), 2.73s passed...
GA on 1-objective 6-variable UserProblem ( 88.00%), 2.77s passed...
GA on 1-objective 6-variable UserProblem ( 89.00%), 2.81s passed...
GA on 1-objective 6-variable UserProblem ( 90.00%), 2.85s passed...
GA on 1-objective 6-variable UserProblem ( 91.00%), 2.89s passed...
GA on 1-objective 6-variable UserProblem ( 92.00%), 2.92s passed...
GA on 1-objective 6-variable UserProblem ( 93.00%), 2.96s passed...
GA on 1-objective 6-variable UserProblem ( 94.00%), 2.99s passed...
GA on 1-objective 6-variable UserProblem ( 95.00%), 3.02s passed...
GA on 1-objective 6-variable UserProblem ( 96.00%), 3.05s passed...
GA on 1-objective 6-variable UserProblem ( 97.00%), 3.08s passed...
GA on 1-objective 6-variable UserProblem ( 98.00%), 3.11s passed...
GA on 1-objective 6-variable UserProblem ( 99.00%), 3.14s passed...
GA on 1-objective 6-variable UserProblem (100.00%), 3.17s passed...
Design found:
    0.5337    1.4686    0.9209

    0.3334    0.3333    0.3333

Objective value: 12.425009
Sensitivity function values:
-0.000448 0.000398 0.000049
```




```
% some coefficients lead to a 4 point design
beta = [-5,1,1];
pts = 4;
[obj, xi] = DoptFracPoly(beta, powers, pts, sens, algo, int);
```

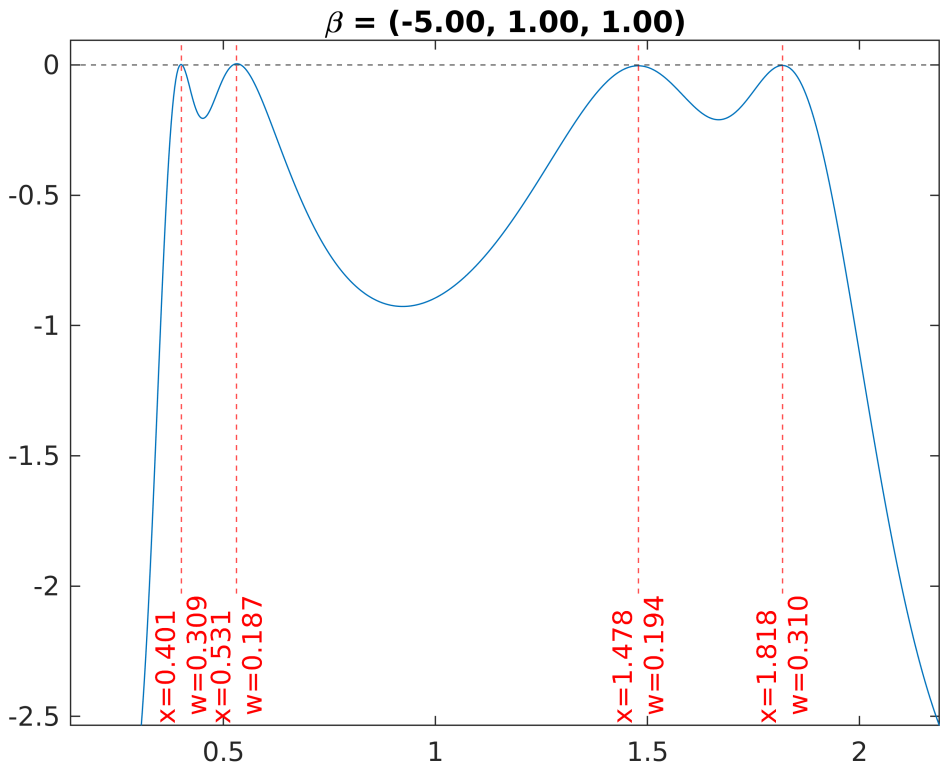
```
GA on 1-objective 8-variable UserProblem (  1.00%), 0.04s passed...
GA on 1-objective 8-variable UserProblem (  2.00%), 0.08s passed...
GA on 1-objective 8-variable UserProblem (  3.00%), 0.12s passed...
GA on 1-objective 8-variable UserProblem (  4.00%), 0.15s passed...
GA on 1-objective 8-variable UserProblem (  5.00%), 0.19s passed...
GA on 1-objective 8-variable UserProblem (  6.00%), 0.22s passed...
GA on 1-objective 8-variable UserProblem (  7.00%), 0.25s passed...
GA on 1-objective 8-variable UserProblem (  8.00%), 0.29s passed...
GA on 1-objective 8-variable UserProblem (  9.00%), 0.32s passed...
GA on 1-objective 8-variable UserProblem ( 10.00%), 0.36s passed...
GA on 1-objective 8-variable UserProblem ( 11.00%), 0.40s passed...
GA on 1-objective 8-variable UserProblem ( 12.00%), 0.43s passed...
GA on 1-objective 8-variable UserProblem ( 13.00%), 0.46s passed...
GA on 1-objective 8-variable UserProblem ( 14.00%), 0.50s passed...
GA on 1-objective 8-variable UserProblem ( 15.00%), 0.53s passed...
GA on 1-objective 8-variable UserProblem ( 16.00%), 0.57s passed...
GA on 1-objective 8-variable UserProblem ( 17.00%), 0.60s passed...
GA on 1-objective 8-variable UserProblem ( 18.00%), 0.63s passed...
GA on 1-objective 8-variable UserProblem ( 19.00%), 0.67s passed...
GA on 1-objective 8-variable UserProblem ( 20.00%), 0.70s passed...
GA on 1-objective 8-variable UserProblem ( 21.00%), 0.73s passed...
GA on 1-objective 8-variable UserProblem ( 22.00%), 0.77s passed...
GA on 1-objective 8-variable UserProblem ( 23.00%), 0.80s passed...
GA on 1-objective 8-variable UserProblem ( 24.00%), 0.84s passed...
GA on 1-objective 8-variable UserProblem ( 25.00%), 0.88s passed...
GA on 1-objective 8-variable UserProblem ( 26.00%), 0.91s passed...
```

```
GA on 1-objective 8-variable UserProblem ( 27.00%), 0.94s passed...
GA on 1-objective 8-variable UserProblem ( 28.00%), 0.98s passed...
GA on 1-objective 8-variable UserProblem ( 29.00%), 1.01s passed...
GA on 1-objective 8-variable UserProblem ( 30.00%), 1.06s passed...
GA on 1-objective 8-variable UserProblem ( 31.00%), 1.09s passed...
GA on 1-objective 8-variable UserProblem ( 32.00%), 1.12s passed...
GA on 1-objective 8-variable UserProblem ( 33.00%), 1.16s passed...
GA on 1-objective 8-variable UserProblem ( 34.00%), 1.19s passed...
GA on 1-objective 8-variable UserProblem ( 35.00%), 1.22s passed...
GA on 1-objective 8-variable UserProblem ( 36.00%), 1.26s passed...
GA on 1-objective 8-variable UserProblem ( 37.00%), 1.30s passed...
GA on 1-objective 8-variable UserProblem ( 38.00%), 1.33s passed...
GA on 1-objective 8-variable UserProblem ( 39.00%), 1.37s passed...
GA on 1-objective 8-variable UserProblem ( 40.00%), 1.40s passed...
GA on 1-objective 8-variable UserProblem ( 41.00%), 1.43s passed...
GA on 1-objective 8-variable UserProblem ( 42.00%), 1.47s passed...
GA on 1-objective 8-variable UserProblem ( 43.00%), 1.50s passed...
GA on 1-objective 8-variable UserProblem ( 44.00%), 1.53s passed...
GA on 1-objective 8-variable UserProblem ( 45.00%), 1.57s passed...
GA on 1-objective 8-variable UserProblem ( 46.00%), 1.60s passed...
GA on 1-objective 8-variable UserProblem ( 47.00%), 1.63s passed...
GA on 1-objective 8-variable UserProblem ( 48.00%), 1.67s passed...
GA on 1-objective 8-variable UserProblem ( 49.00%), 1.71s passed...
GA on 1-objective 8-variable UserProblem ( 50.00%), 1.74s passed...
GA on 1-objective 8-variable UserProblem ( 51.00%), 1.77s passed...
GA on 1-objective 8-variable UserProblem ( 52.00%), 1.82s passed...
GA on 1-objective 8-variable UserProblem ( 53.00%), 1.86s passed...
GA on 1-objective 8-variable UserProblem ( 54.00%), 1.89s passed...
GA on 1-objective 8-variable UserProblem ( 55.00%), 1.92s passed...
GA on 1-objective 8-variable UserProblem ( 56.00%), 1.96s passed...
GA on 1-objective 8-variable UserProblem ( 57.00%), 1.99s passed...
GA on 1-objective 8-variable UserProblem ( 58.00%), 2.02s passed...
GA on 1-objective 8-variable UserProblem ( 59.00%), 2.06s passed...
GA on 1-objective 8-variable UserProblem ( 60.00%), 2.09s passed...
GA on 1-objective 8-variable UserProblem ( 61.00%), 2.12s passed...
GA on 1-objective 8-variable UserProblem ( 62.00%), 2.16s passed...
GA on 1-objective 8-variable UserProblem ( 63.00%), 2.21s passed...
GA on 1-objective 8-variable UserProblem ( 64.00%), 2.24s passed...
GA on 1-objective 8-variable UserProblem ( 65.00%), 2.28s passed...
GA on 1-objective 8-variable UserProblem ( 66.00%), 2.31s passed...
GA on 1-objective 8-variable UserProblem ( 67.00%), 2.34s passed...
GA on 1-objective 8-variable UserProblem ( 68.00%), 2.38s passed...
GA on 1-objective 8-variable UserProblem ( 69.00%), 2.41s passed...
GA on 1-objective 8-variable UserProblem ( 70.00%), 2.45s passed...
GA on 1-objective 8-variable UserProblem ( 71.00%), 2.49s passed...
GA on 1-objective 8-variable UserProblem ( 72.00%), 2.52s passed...
GA on 1-objective 8-variable UserProblem ( 73.00%), 2.55s passed...
GA on 1-objective 8-variable UserProblem ( 74.00%), 2.58s passed...
GA on 1-objective 8-variable UserProblem ( 75.00%), 2.62s passed...
GA on 1-objective 8-variable UserProblem ( 76.00%), 2.65s passed...
GA on 1-objective 8-variable UserProblem ( 77.00%), 2.68s passed...
GA on 1-objective 8-variable UserProblem ( 78.00%), 2.72s passed...
GA on 1-objective 8-variable UserProblem ( 79.00%), 2.75s passed...
GA on 1-objective 8-variable UserProblem ( 80.00%), 2.78s passed...
GA on 1-objective 8-variable UserProblem ( 81.00%), 2.81s passed...
GA on 1-objective 8-variable UserProblem ( 82.00%), 2.85s passed...
GA on 1-objective 8-variable UserProblem ( 83.00%), 2.88s passed...
GA on 1-objective 8-variable UserProblem ( 84.00%), 2.93s passed...
GA on 1-objective 8-variable UserProblem ( 85.00%), 2.96s passed...
GA on 1-objective 8-variable UserProblem ( 86.00%), 2.99s passed...
GA on 1-objective 8-variable UserProblem ( 87.00%), 3.02s passed...
GA on 1-objective 8-variable UserProblem ( 88.00%), 3.06s passed...
GA on 1-objective 8-variable UserProblem ( 89.00%), 3.09s passed...
GA on 1-objective 8-variable UserProblem ( 90.00%), 3.13s passed...
```

```
GA on 1-objective 8-variable UserProblem ( 91.00%), 3.17s passed...
GA on 1-objective 8-variable UserProblem ( 92.00%), 3.20s passed...
GA on 1-objective 8-variable UserProblem ( 93.00%), 3.23s passed...
GA on 1-objective 8-variable UserProblem ( 94.00%), 3.26s passed...
GA on 1-objective 8-variable UserProblem ( 95.00%), 3.30s passed...
GA on 1-objective 8-variable UserProblem ( 96.00%), 3.33s passed...
GA on 1-objective 8-variable UserProblem ( 97.00%), 3.36s passed...
GA on 1-objective 8-variable UserProblem ( 98.00%), 3.40s passed...
GA on 1-objective 8-variable UserProblem ( 99.00%), 3.43s passed...
GA on 1-objective 8-variable UserProblem (100.00%), 3.46s passed...
Design found:
    1.4785    0.4006    1.8184    0.5310

    0.1938    0.3093    0.3101    0.1868

Objective value: 3.029756
Sensitivity function values:
-0.003463 0.001702 -0.002153 0.004349
```

```
beta = [100.3, -34.5, 3.5];
pts = 3;
[obj, xi] = DoptFracPoly(beta, powers, pts, sens, algo, int);
```

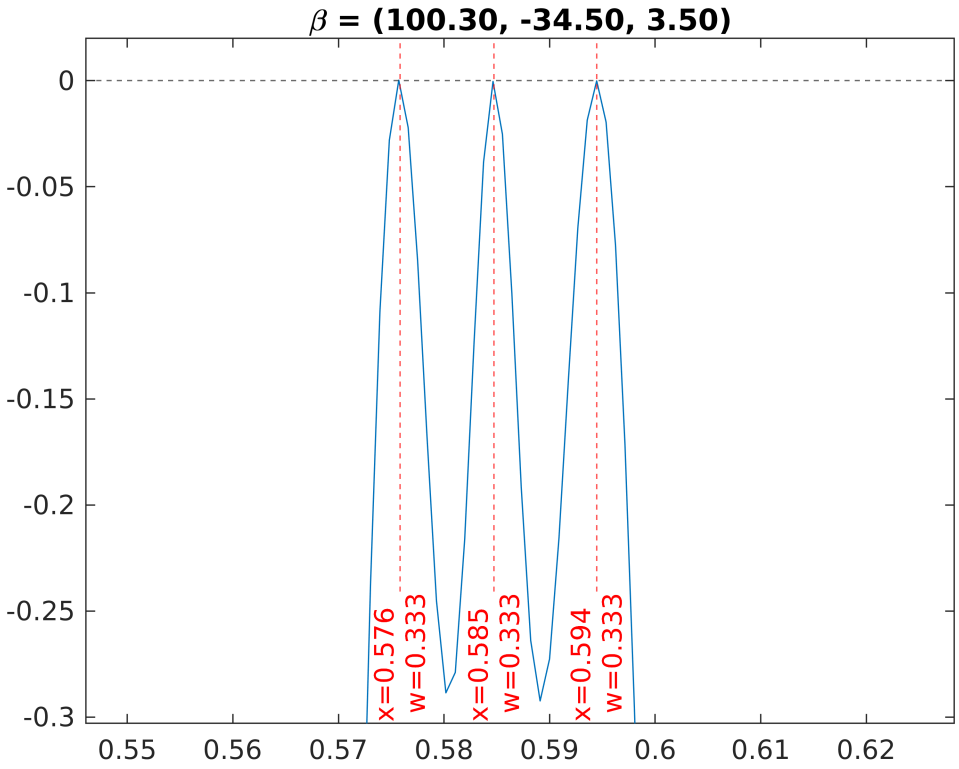
```
GA on 1-objective 6-variable UserProblem (  1.00%), 0.04s passed...
GA on 1-objective 6-variable UserProblem (  2.00%), 0.08s passed...
```




```
GA on 1-objective 6-variable UserProblem (  3.00%), 0.12s passed...
GA on 1-objective 6-variable UserProblem (  4.00%), 0.15s passed...
GA on 1-objective 6-variable UserProblem (  5.00%), 0.18s passed...
GA on 1-objective 6-variable UserProblem (  6.00%), 0.22s passed...
GA on 1-objective 6-variable UserProblem (  7.00%), 0.25s passed...
GA on 1-objective 6-variable UserProblem (  8.00%), 0.28s passed...
GA on 1-objective 6-variable UserProblem (  9.00%), 0.31s passed...
```

```
GA on 1-objective 6-variable UserProblem ( 10.00%), 0.34s passed...
GA on 1-objective 6-variable UserProblem ( 11.00%), 0.37s passed...
GA on 1-objective 6-variable UserProblem ( 12.00%), 0.40s passed...
GA on 1-objective 6-variable UserProblem ( 13.00%), 0.43s passed...
GA on 1-objective 6-variable UserProblem ( 14.00%), 0.46s passed...
GA on 1-objective 6-variable UserProblem ( 15.00%), 0.49s passed...
GA on 1-objective 6-variable UserProblem ( 16.00%), 0.52s passed...
GA on 1-objective 6-variable UserProblem ( 17.00%), 0.56s passed...
GA on 1-objective 6-variable UserProblem ( 18.00%), 0.59s passed...
GA on 1-objective 6-variable UserProblem ( 19.00%), 0.62s passed...
GA on 1-objective 6-variable UserProblem ( 20.00%), 0.65s passed...
GA on 1-objective 6-variable UserProblem ( 21.00%), 0.68s passed...
GA on 1-objective 6-variable UserProblem ( 22.00%), 0.71s passed...
GA on 1-objective 6-variable UserProblem ( 23.00%), 0.74s passed...
GA on 1-objective 6-variable UserProblem ( 24.00%), 0.77s passed...
GA on 1-objective 6-variable UserProblem ( 25.00%), 0.80s passed...
GA on 1-objective 6-variable UserProblem ( 26.00%), 0.83s passed...
GA on 1-objective 6-variable UserProblem ( 27.00%), 0.86s passed...
GA on 1-objective 6-variable UserProblem ( 28.00%), 0.89s passed...
GA on 1-objective 6-variable UserProblem ( 29.00%), 0.92s passed...
GA on 1-objective 6-variable UserProblem ( 30.00%), 0.95s passed...
GA on 1-objective 6-variable UserProblem ( 31.00%), 0.98s passed...
GA on 1-objective 6-variable UserProblem ( 32.00%), 1.01s passed...
GA on 1-objective 6-variable UserProblem ( 33.00%), 1.04s passed...
GA on 1-objective 6-variable UserProblem ( 34.00%), 1.07s passed...
GA on 1-objective 6-variable UserProblem ( 35.00%), 1.10s passed...
GA on 1-objective 6-variable UserProblem ( 36.00%), 1.13s passed...
GA on 1-objective 6-variable UserProblem ( 37.00%), 1.16s passed...
GA on 1-objective 6-variable UserProblem ( 38.00%), 1.19s passed...
GA on 1-objective 6-variable UserProblem ( 39.00%), 1.22s passed...
GA on 1-objective 6-variable UserProblem ( 40.00%), 1.25s passed...
GA on 1-objective 6-variable UserProblem ( 41.00%), 1.28s passed...
GA on 1-objective 6-variable UserProblem ( 42.00%), 1.31s passed...
GA on 1-objective 6-variable UserProblem ( 43.00%), 1.34s passed...
GA on 1-objective 6-variable UserProblem ( 44.00%), 1.37s passed...
GA on 1-objective 6-variable UserProblem ( 45.00%), 1.40s passed...
GA on 1-objective 6-variable UserProblem ( 46.00%), 1.43s passed...
GA on 1-objective 6-variable UserProblem ( 47.00%), 1.46s passed...
GA on 1-objective 6-variable UserProblem ( 48.00%), 1.49s passed...
GA on 1-objective 6-variable UserProblem ( 49.00%), 1.52s passed...
GA on 1-objective 6-variable UserProblem ( 50.00%), 1.55s passed...
GA on 1-objective 6-variable UserProblem ( 51.00%), 1.58s passed...
GA on 1-objective 6-variable UserProblem ( 52.00%), 1.61s passed...
GA on 1-objective 6-variable UserProblem ( 53.00%), 1.65s passed...
GA on 1-objective 6-variable UserProblem ( 54.00%), 1.68s passed...
GA on 1-objective 6-variable UserProblem ( 55.00%), 1.71s passed...
GA on 1-objective 6-variable UserProblem ( 56.00%), 1.74s passed...
GA on 1-objective 6-variable UserProblem ( 57.00%), 1.77s passed...
GA on 1-objective 6-variable UserProblem ( 58.00%), 1.80s passed...
GA on 1-objective 6-variable UserProblem ( 59.00%), 1.83s passed...
GA on 1-objective 6-variable UserProblem ( 60.00%), 1.86s passed...
GA on 1-objective 6-variable UserProblem ( 61.00%), 1.89s passed...
GA on 1-objective 6-variable UserProblem ( 62.00%), 1.91s passed...
GA on 1-objective 6-variable UserProblem ( 63.00%), 1.94s passed...
GA on 1-objective 6-variable UserProblem ( 64.00%), 1.98s passed...
GA on 1-objective 6-variable UserProblem ( 65.00%), 2.00s passed...
GA on 1-objective 6-variable UserProblem ( 66.00%), 2.03s passed...
GA on 1-objective 6-variable UserProblem ( 67.00%), 2.06s passed...
GA on 1-objective 6-variable UserProblem ( 68.00%), 2.09s passed...
GA on 1-objective 6-variable UserProblem ( 69.00%), 2.12s passed...
GA on 1-objective 6-variable UserProblem ( 70.00%), 2.15s passed...
GA on 1-objective 6-variable UserProblem ( 71.00%), 2.18s passed...
GA on 1-objective 6-variable UserProblem ( 72.00%), 2.21s passed...
GA on 1-objective 6-variable UserProblem ( 73.00%), 2.24s passed...
```

```
GA on 1-objective 6-variable UserProblem ( 74.00%), 2.27s passed...
GA on 1-objective 6-variable UserProblem ( 75.00%), 2.30s passed...
GA on 1-objective 6-variable UserProblem ( 76.00%), 2.34s passed...
GA on 1-objective 6-variable UserProblem ( 77.00%), 2.37s passed...
GA on 1-objective 6-variable UserProblem ( 78.00%), 2.40s passed...
GA on 1-objective 6-variable UserProblem ( 79.00%), 2.43s passed...
GA on 1-objective 6-variable UserProblem ( 80.00%), 2.46s passed...
GA on 1-objective 6-variable UserProblem ( 81.00%), 2.49s passed...
GA on 1-objective 6-variable UserProblem ( 82.00%), 2.52s passed...
GA on 1-objective 6-variable UserProblem ( 83.00%), 2.55s passed...
GA on 1-objective 6-variable UserProblem ( 84.00%), 2.58s passed...
GA on 1-objective 6-variable UserProblem ( 85.00%), 2.61s passed...
GA on 1-objective 6-variable UserProblem ( 86.00%), 2.64s passed...
GA on 1-objective 6-variable UserProblem ( 87.00%), 2.67s passed...
GA on 1-objective 6-variable UserProblem ( 88.00%), 2.70s passed...
GA on 1-objective 6-variable UserProblem ( 89.00%), 2.73s passed...
GA on 1-objective 6-variable UserProblem ( 90.00%), 2.76s passed...
GA on 1-objective 6-variable UserProblem ( 91.00%), 2.79s passed...
GA on 1-objective 6-variable UserProblem ( 92.00%), 2.82s passed...
GA on 1-objective 6-variable UserProblem ( 93.00%), 2.85s passed...
GA on 1-objective 6-variable UserProblem ( 94.00%), 2.88s passed...
GA on 1-objective 6-variable UserProblem ( 95.00%), 2.91s passed...
GA on 1-objective 6-variable UserProblem ( 96.00%), 2.94s passed...
GA on 1-objective 6-variable UserProblem ( 97.00%), 2.97s passed...
GA on 1-objective 6-variable UserProblem ( 98.00%), 3.00s passed...
GA on 1-objective 6-variable UserProblem ( 99.00%), 3.03s passed...
GA on 1-objective 6-variable UserProblem (100.00%), 3.06s passed...
Design found:
    0.5758    0.5945    0.5847

    0.3333    0.3333    0.3333

Objective value: 30.438724
Sensitivity function values:
0.000064 -0.000080 0.000016
```


β = (100.30, -34.50, 3.50)
0
-0.05
-0.1
-0.15
-0.2
-0.25
-0.3
0.55
0.56
0.57
0.58
0.59
0.6
0.61
0.62
x=0.576
w=0.333
x=0.585
w=0.333
x=0.594
w=0.333