**Code: 001**

List<Double> lowerLimit = Arrays.*asList*(100.0, 100.0, 1.0, 3000.0, 1500.0, 50.0, 12.0, 400.0) ;

List<Double> upperLimit = Arrays.*asList*(500.0, 500.0, 10.0, 4500.0, 2500.0, 70.0, 22.0, 600.0) ;

Genetic Parameter

crossoverProbability = 0.8 ;

crossoverDistributionIndex = 20.0 ;

mutationProbability = 0.4 / problem.getNumberOfVariables() ;

mutationDistributionIndex = 20.0 ;

setMaxEvaluations(1000)

setPopulationSize(200)

Result

Hypervolume (N) : 0.6804864266125821

Hypervolume : 0.0

Epsilon (N) : 0.24685663388433865

Epsilon : 2.4274947712934214

GD (N) : 0.1932387770473695

GD : 2.1770275324689634

IGD (N) : 0.22120566018190826

IGD : 2.352831236148987

IGD+ (N) : 0.09995309720111396

IGD+ : 0.9871747472385449

Spread (N) : 0.9574121778653819

Spread : 0.9600234280528163

Error ratio : 1.0

Code 002

List<Double> lowerLimit = Arrays.*asList*(100.0, 100.0, 1.0, 3000.0, 1500.0, 50.0, 12.0, 400.0) ;

List<Double> upperLimit = Arrays.*asList*(500.0, 500.0, 10.0, 4500.0, 2500.0, 70.0, 22.0, 600.0) ;

|  |  |
| --- | --- |
| Population Set | 100 |
| Maximum Generation | 250 |
| Crossover Probability | 0.8 |
| Mutation Probability | 0.05 |

Hypervolume (N) : 0.04752353954434643

Hypervolume : 0.0

Epsilon (N) : 0.7551341972996319

Epsilon : 8.636554300103992

GD (N) : 0.5664302737086275

GD : 6.1893534450565735

IGD (N) : 0.4241725795810447

IGD : 4.578494864086982

IGD+ (N) : 0.7188590135351841

IGD+ : 7.7552150862674125

Spread (N) : 0.7382810082996324

Spread : 0.7528379770884324

Error ratio : 1.0

15.994503517848443 21.151006089517793

29.250175665330932 9.944354302250229

20.248156760413053 14.378476891522457

39.39291098369151 7.831860345595663

11.376430887523977 51.03020494850959

34.669386391012964 9.29957670154104

13.502191813909313 25.592883446408365

Code 003

List<Double> lowerLimit = Arrays.*asList*(100.0, 100.0, 1.0, 3000.0, 1500.0, 50.0, 12.0, 400.0) ;

List<Double> upperLimit = Arrays.*asList*(500.0, 500.0, 10.0, 4500.0, 2500.0, 70.0, 22.0, 600.0) ;

|  |  |
| --- | --- |
| Population Set | 200 |
| Maximum Generation | 500 |
| Crossover Probability | 0.8 |
| Mutation Probability | 0.2 |

Hypervolume (N) : 0.0

Hypervolume : 0.0

Epsilon (N) : 0.8522396870770969

Epsilon : 9.747160651002037

GD (N) : 1.0443737967762616

GD : 11.904946765564274

IGD (N) : 0.49812599120499806

IGD : 5.3468381420495525

IGD+ (N) : 0.739204549028858

IGD+ : 7.810944400003183

Spread (N) : 0.8236711058358543

Spread : 0.8397800486751615

Error ratio : 1.0

12.208310481274323 93.3231282257913

12.676007518388964 67.54863803442987

15.042946929622776 20.82085917978138

13.897740757213317 26.944073210378733

23.447915328214997 15.489083242420502

29.272822956270797 -1.6905332100340016

22.642083619389687 19.53069719810174

27.630853819946964 13.452815064111698

Code 004

List<Double> lowerLimit = Arrays.*asList*(100.0, 100.0, 1.0, 3000.0, 1500.0, 50.0, 12.0, 400.0) ;

List<Double> upperLimit = Arrays.*asList*(500.0, 500.0, 10.0, 4500.0, 2500.0, 70.0, 22.0, 600.0) ;

|  |  |
| --- | --- |
| Population Set | 200 |
| Maximum Generation | 500 |
| Crossover Probability | 0.8 |
| Mutation Probability | 0.4 |

Hypervolume (N) : 0.0

Hypervolume : 0.0

Epsilon (N) : 1.0193277073031421

Epsilon : 11.658165032394816

GD (N) : 1.8176450698883104

GD : 20.728561509253282

IGD (N) : 0.5517310939300656

IGD : 6.1376437664812515

IGD+ (N) : 0.9056682344478056

IGD+ : 10.064003475199394

Spread (N) : 1.127889154775694

Spread : 1.1402427074914796

Error ratio : 1.0

15.975747216125356 20.77535252551697

31.69065038793089 16.567758462795307

22.84881932263539 16.820653320271646

12.047531704407483 178.83586446281726

37.17970980936806 7.320998878724493

21.08589473167137 19.19278329144749

14.306319017918668 33.71698070906023

15.519869451645246 29.484659906394054

Code 005

List<Double> lowerLimit = Arrays.*asList*(100.0, 100.0, 1.0, 3000.0, 1500.0, 50.0, 12.0, 400.0) ;

List<Double> upperLimit = Arrays.*asList*(500.0, 500.0, 10.0, 4500.0, 2500.0, 70.0, 22.0, 600.0) ;

|  |  |
| --- | --- |
| Population Set | 500 |
| Maximum Generation | 2000 |
| Crossover Probability | 0.8 |
| Mutation Probability | 0.4 |

Hypervolume (N) : 0.015099101583223362

Hypervolume : 0.0

Epsilon (N) : 0.6915287695356731

Epsilon : 6.800232369016843

GD (N) : 1.0239090866400098

GD : 11.664877711054924

IGD (N) : 0.3452747584885136

IGD : 3.6100043028950624

IGD+ (N) : 0.4629829346119763

IGD+ : 4.780794537369203

Spread (N) : 1.053091452977794

Spread : 1.0661880707490539

Error ratio : 1.0

12.268178470392806 95.59176502373687

17.501517704168776 22.492835284259353

17.501517704168776 22.492835284259353

22.629365057621033 21.809654638012553

22.815261340910002 2.6995875985285123

17.501517704168776 22.492835284259353

13.300589882173586 25.897094256828638

Code 006

List<Double> lowerLimit = Arrays.*asList*(100.0, 100.0, 1.0, 3000.0, 1500.0, 50.0, 12.0, 400.0) ;

List<Double> upperLimit = Arrays.*asList*(500.0, 500.0, 10.0, 4500.0, 2500.0, 70.0, 22.0, 600.0) ;

|  |  |
| --- | --- |
| Population Set | 500 |
| Maximum Generation | 2000 |
| Crossover Probability | 0.8 |
| Mutation Probability | 0.4 |

Hypervolume : 0.0

Epsilon (N) : 0.4398067658182988

Epsilon : 4.324893390969649

GD (N) : 0.5342085272540285

GD : 6.054903981073588

IGD (N) : 0.24291797668377502

IGD : 2.5778794891587236

IGD+ (N) : 0.3098404487107303

IGD+ : 3.177284099633164

Spread (N) : 0.6415806080290531

Spread : 0.6636254573629332

Error ratio : 1.0

12.069557609438114 32.21859450685105

10.100204444327693 38.40433719533676

9.75591723223899 46.778858310375206

30.414753372417255 4.093775578509637

25.816908211337825 6.800182103708239

13.867373635192951 12.023110118466443

20.339922362862808 8.928228789239835