Questionnaire on Real-World Optimization Problems

Both professionals in industry and in research work with optimization problems. To improve the practical use of our research we (the evolutionary optimization research community) would like to align our research more closely to the problems faced by industry practitioners. To this end, we would like to ask you for your help by filling out this questionnaire about real-world optimization problems.

If you provide information about your problem:
- the research community will develop algorithms that are more useful for your problem
- the outcome of this questionnaire will give you an overview of what problems your colleagues face

INSTRUCTIONS

If you work on multiple similar optimization problems, please select ONE REPRESENTATIVE CASE. If you work on multiple different optimization problems and you would like to give insight on more than one problem, we would be extremely grateful if you took the time to fill in the questionnaire multiple times.

If you don't know or cannot answer the optional questions, please leave them blank.

This questionnaire takes approximately 20 minutes. Please note that the number of sections mentioned on the bottom of the page says 13 but you will be skipping sections depending on your answers, so you will not have to go through all of them.

For more information see https://sites.google.com/view/macoda-rwp
*Required

Q1. Problem name *

Problem description

Q2. Problem domain

For example, manufacturing, logistics, scheduling, finance & economics, computer science, robotics, mechanical engineering, medical engineering, aerospace engineering.

Q3. Which parts of your problem are publicly available? *

Please select what is available for your problem. If you have a scaled-down version of the problem that is publicly available to analyze its characteristics, please choose "Scaled-down problem". Any references to the available information can be included in the "References" question below.

Tick all that apply.

- [ ] None
- [ ] Problem definition
- [ ] Optimization results
- [ ] Scaled-down problem
- [ ] Implementation of the objective and constraint functions
- [ ] I do not know

Other: [ ] _____

Q4. References

Please give the references to additional information about your problem (for example, Journal paper, Conference paper Technical paper, Newsletter, Webpage). These references can be cited in publications presenting the results of the survey.

Problem type

Q5. Do any of your problem properties change over time? *

That is, is your problem dynamic? Check all that apply. If the problem is not dynamic, choose "No".

Tick all that apply.

- [ ] No
- [ ] Variables
- [ ] Constraints
- [ ] Objectives
- [ ] I do not know

Q6. What variable types does your problem contain? *

Mark only one oval.

- ◯ Continuous and/or discrete (ordinal/categorical) variables *Skip to question 7*
- ◯ Permutation/combinatorial variables *Skip to question 13*
- ◯ A mixture of the above *Skip to question 14*

Information about variables (continuous and discrete)

The following questions are about the variables to be optimized, that is, only controllable variables.

Q7. How many variables does your problem have in total? *

For dynamic problems give the largest count.

_____

Q8. How many continuous variables does your problem have? *

If there are no continuous variables, please write 0. For dynamic problems give the largest count.

_____

Q9. How many ordinal variables does your problem have? *

Ordinal variables are discrete numbers with order like 1, 2, 3, 4 (for example, number of pipes). If there are no ordinal variables, please write 0. For dynamic problems give the largest count.

_____

Q10. If there are ordinal variables, what is their maximal cardinality?

Cardinality is the number of possible values (for example, 5 in the case of {1, 2, 3, 4, 5}, 2 in the case of a binary variable). With multiple ordinal variables, give the cardinality of the one with maximal cardinality.

Tick all that apply.

- [ ] 2 (binary variable)
- [ ] Between 3 and 10
- [ ] Between 11 and 100
- [ ] Between 101 and 1,000
- [ ] Between 1001 and 10,000
- [ ] More than 10,000
- [ ] I do not know

Q11. How many categorical variables does your problem have? *

Categorical variables mean variables without order (for example, color, type of material). If there is no categorical variable, please write 0. For dynamic problems give the largest count.

_____

Q12. If there are categorical variables, what is their maximal cardinality?

Cardinality is the number of possible values (for example, 3 in the case of {red, blue, yellow}). With multiple categorical variables, give the cardinality of the one with maximal cardinality.

Tick all that apply.

- [ ] 2 (binary variable)
- [ ] Between 3 and 10
- [ ] Between 11 and 100
- [ ] Between 101 and 1,000
- [ ] Between 1,001 and 10,000
- [ ] More than 10,000
- [ ] I do not know

Skip to question 21

Information about variables (permutation/combinatorial)

Q13. How many variables does your problem have? *

For example, a 500-item knapsack problem has 500 variables. A 30-city traveling salesperson problem has 30 variables. For dynamic problems give the largest count.

_____

Skip to question 21

Information about variables (all types)

The following questions are about the variables to be optimized, that is, only controllable variables.

Q14. How many variables does your problem have in total? *

For dynamic problems give the largest count.

_____

Q15. How many continuous variables does your problem have? *

If there are no continuous variables, please write 0. For dynamic problems give the largest count.

_____

Q16. How many ordinal variables does your problem have? *

Ordinal variables mean discrete numbers with order like 1, 2, 3, 4 (for example, number of pipes). If there are no ordinal variables, please write 0. For dynamic problems give the largest count.

_____

Q17. If there are ordinal variables, what is their maximal cardinality?

Cardinality is the number of possible values (for example, 5 in the case of {1, 2, 3, 4, 5}, 2 in the case of a binary variable). With multiple ordinal variables, give the cardinality of the one with maximal cardinality.

Tick all that apply.

- [ ] 2 (binary variable)
- [ ] Between 3 and 10
- [ ] Between 11 and 100
- [ ] Between 101 and 1,000
- [ ] Between 1001 and 10,000
- [ ] More than 10,000
- [ ] I do not know

Q18. How many categorical variables does your problem have? *

Categorical variables are variables without order (for example, color, type of materials). If there are no categorical variables, please write 0. For dynamic problems give the largest count.

_____

Q19. If there are categorical variables, what is their maximal cardinality?

Cardinality is the number of possible values (for example, 3 in the case of {red, blue, yellow}). With multiple categorical variables, give the cardinality of the one with maximal cardinality.

Tick all that apply.

- [ ] 2 (binary variable)
- [ ] Between 3 and 10
- [ ] Between 11 and 100
- [ ] Between 101 and 1,000
- [ ] Between 1,001 and 10,000
- [ ] More than 10,000
- [ ] I do not know

Q20. How many permutation and/or combinatorial variables does your problem have? *

For example, a 500-item knapsack problem has 500 variables. A 30-city travel salesman problem has 30 variables. For dynamic problems give the largest count.

_____

Skip to question 21

Information about constraints

Q21. Does your problem have any constraints? *

Without counting box constraints on the variables (lower and upper bounds on the variables).

Mark only one oval.

- ◯ Yes
- ◯ No *Skip to question 28*

Information about constraints (cont.)

Q22. How many constraints does your problem have? *

Without counting box constraints on the variables (lower and upper bounds on the variables). For dynamic problems give the largest count.

_____

Q23. How many equality constraints does your problem have?

If there are no equality constraints, please write 0. For dynamic problems give the largest count.

_____

Q24. How many inequality constraints does your problem have?

Without counting box constraints on the variables (lower and upper bounds on the variables). If there are no inequality constraints, please write 0. For dynamic problems give the largest count.

_____

Q25. Can all solutions be evaluated? *

Please select "No" in case the evaluation of solutions can fail for some solutions (possibly due to constraints being violated).

Mark only one oval.

- ◯ Yes
- ◯ No
- ◯ I do not know

Q26. How long does it take to evaluate each constraint? *

Please give the amount for each constraint separately (unless all are computed together). In case the evaluation time for a constraint is variable, give the maximum amount.

Tick all that apply.

- ☐ Less than one second
- ☐ Between one second and one minute
- ☐ Between one minute and one hour
- ☐ Between one hour and one day
- ☐ More than one day
- ☐ I do not know

Q27. Do you have any additional information about the constraints?

Number of active constraints, hard/soft constraints, linear or non-linear constraints, etc. The feasibility ratio (that is, the number of feasible solutions that satisfy all the constraints / the number of all solutions).

_____

_____

_____

_____

_____

Information about objectives

Q28. How many objectives does your problem have? *

For dynamic problems give the largest count.

Mark only one oval.

- ◯ One (Single-objective problem) *Skip to question 29*
- ◯ More than one (Multi-objective problem) *Skip to question 43*

Information about a single-objective problem

Q29. What property does the objective have? *

An objective is black-box if we can evaluate it, but do not have any further information about it (for example, objectives computed by simulators are usually black boxes).

Tick all that apply.

- ☐ Continuous
- ☐ Discrete (binary, integer, categorical)
- ☐ Stochastic (noisy or uncertain)
- ☐ Black-box
- ☐ None of the above
- ☐ I do not know

Other: ☐ _____

Q30. If the objective is discrete, what is its cardinality?

Cardinality is the number of possible values. For dynamic problems give the largest count.

_____

Q31. Are the objective bounds known? *

The values do not have to be attainable.

Mark only one oval.

- Both bounds known
- One bound known
- Both bounds unknown
- I do not know

Q32. Do you have a known target to reach in the objective space? *

Mark only one oval.

- Yes
- No
- I do not know

Q33. How long does it take to evaluate the objective? *

In case the evaluation time is variable, give the maximum amount.

Mark only one oval.

- Less than one second
- Between one second and one minute
- Between one minute and one hour
- Between one hour and one day
- More than one day
- I do not know

Q34. How many solution evaluations are 'allowed' for your problem? *

What is the limit on the number of evaluations (if there is one)?

Mark only one oval.

- ◯ Less than 100 evaluations
- ◯ Between 101 and 1,000 evaluations
- ◯ Between 1,001 and 10,000 evaluations
- ◯ Between 10,001 and 100,000 evaluations
- ◯ Between 100,001 1,000,000 evaluations
- ◯ More than 1,000,000 evaluations
- ◯ No limitation
- ◯ I do not know

Q35. Are there any known feasible solutions? *

Mark only one oval.

- ◯ Yes
- ◯ No
- ◯ I do not know

Q36. Are there any known optimal solutions? *

Mark only one oval.

- ◯ Yes
- ◯ No
- ◯ I do not know

Topology of the search and objective spaces (for a single-objective problem)

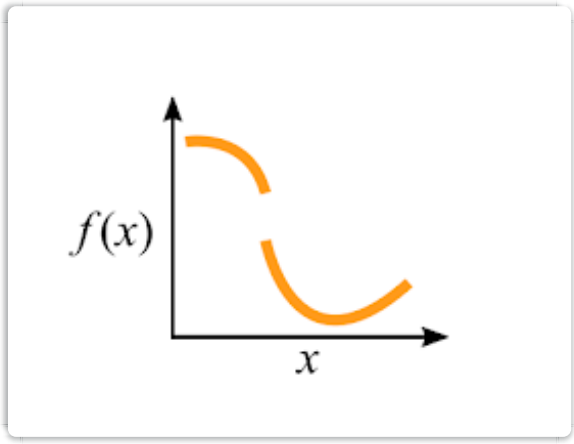
Q37. Is the gradient information analytically available? *

Mark only one oval.

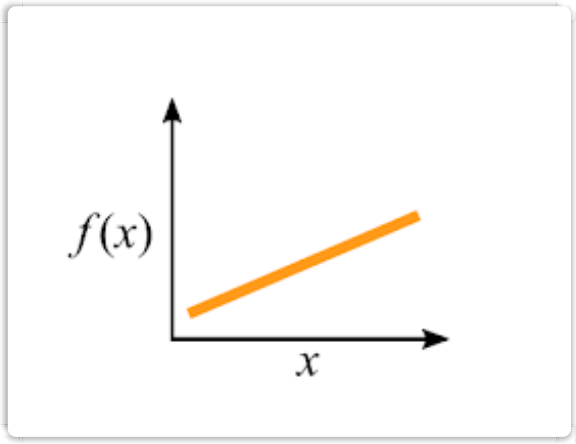
- Yes
- No
- I do not know

Q38. Is the objective function discontinuous/linear/convex/concave? *

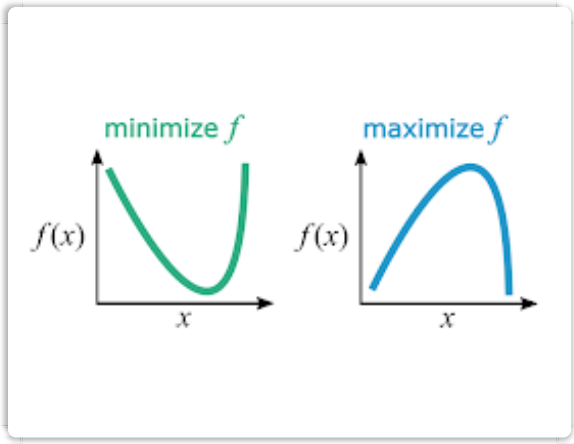
Tick all that apply.



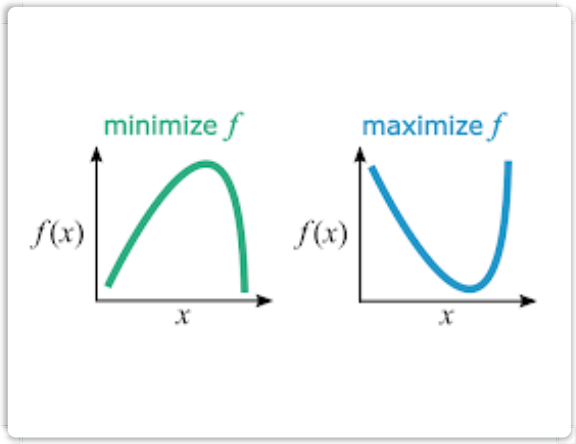
☐ Discontinuous



☐ Linear



☐ Convex for a minimization problem (concave for a maximization problem)



☐ Concave for a minimization problem (convex for a maximization problem)

☐ None of the above

☐ I do not know

Q39. Do different solutions map to the same objective value? *

Mark only one oval.

- Yes
- No
- I do not know

Q40. Is the problem separable? *

Separability means that you can optimize each variable individually (if the separability is partial, this holds for just some variables).

Mark only one oval.

- Yes, all the variables are separable
- Partially separable (some variables are separable)
- No
- I do not know

Q41. Is the problem badly conditioned (ill-conditioned)? *

A problem is badly conditioned if, starting from the same point (in the decision space), moving in one direction would give you a small difference in the objective value, but going into another direction would give you a very large difference in the objective value.

Mark only one oval.

- Yes
- No
- I do not know

Q42. Do you have any additional information about the objective?

Is there a global structure to the problem? Is the noise/some other property localized? ...

Skip to question 68

Information about a multi-objective problem

Q43. How many objectives does your problem have? *

For dynamic problems give the largest count.

Q44. How many continuous objectives does your problem have?

If there are no continuous objectives, please write 0. For dynamic problems give the largest count.

Q45. How many discrete objectives does your problem have?

If there are no discrete objectives, please write 0. For dynamic problems give the largest count.

Q46. If there are discrete objectives, what is their maximal cardinality?

Cardinality is the number of possible values. With multiple discrete objectives, give the cardinality of the one with maximal cardinality.

Q47. How many stochastic (noisy, uncertain) objectives does your problem have?

If there are no stochastic objectives, please write 0. For dynamic problems give the largest count.

Q48. How many black-box objectives does your problem have?

An objective is black-box if we can evaluate it, but do not have any further information about it (for example, simulators are usually black boxes). If there are no black-box objectives, please write 0. For dynamic problems give the largest count.

Q49. Are the objective bounds known? *

The values do not have to be attainable.

Mark only one oval.

- ◯ All bounds known
- ◯ Some bounds known
- ◯ All bounds unknown
- ◯ I do not know

Q50. Are there any positive correlations between objectives? *

A positive correlation means that improving one objective also improves at least one other objective.

Mark only one oval.

- ◯ Yes, some objectives are positively correlated everywhere
- ◯ Yes, some objectives are positively correlated close to the Pareto front
- ◯ Yes, some objectives are positively correlated far away from the Pareto front
- ◯ No
- ◯ I do not know

Q51. If there are positively correlated objectives, how many are there?

If you have more groups of correlated objectives, give the largest count. For dynamic problems give the largest count.

Q52. Are some objectives more important than others? *

Mark only one oval.

- Yes
- No
- I do not know

Q53. Do you have a known target to reach in the objective space? *

Mark only one oval.

- Yes
- No
- I do not know

Q54. How long does it take to evaluate each objective? *

Please give the amount for each objective separately (unless all are computed together). In case the evaluation time for an objective is variable, give the maximum amount.

Tick all that apply.

- [ ] Less than one second
- [ ] Between one second and one minute
- [ ] Between one minute and one hour
- [ ] Between one hour and one day
- [ ] More than one day
- [ ] I do not know

Q55. How many solution evaluations are 'allowed' for your problem? *

What is the limit on the number of evaluations (if there is one)?

Mark only one oval.

- ◯ Less than 100 evaluations
- ◯ Between 101 and 1,000 evaluations
- ◯ Between 1,001 and 10,000 evaluations
- ◯ Between 10,001 and 100,000 evaluations
- ◯ Between 100,001 and 1,000,000 evaluations
- ◯ More than 1,000,000 evaluations
- ◯ No limitation
- ◯ I do not know

Q56. Are there any known feasible solutions? *

Mark only one oval.

- ◯ Yes
- ◯ No
- ◯ I do not know

Q57. Are there any known optimal solutions? *

Mark only one oval.

- ◯ Yes
- ◯ No
- ◯ I do not know

Topology of the search and objective spaces (for a multi-objective problem)

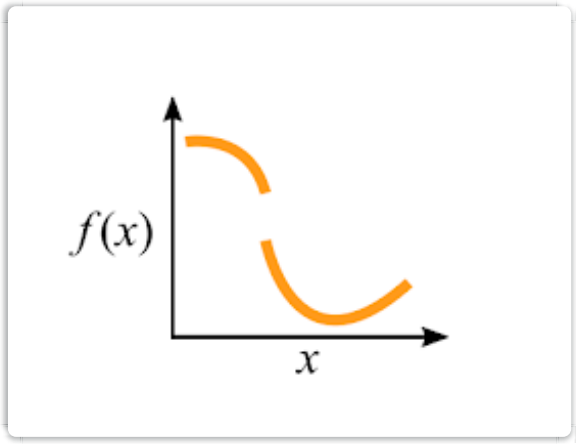
Q58. Is the gradient information analytically available? *

Mark only one oval.

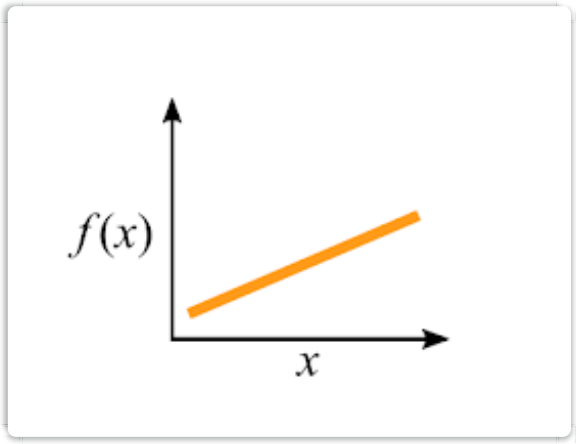
- ◯ Yes, it is available for all objectives
- ◯ Partially available (available for some objectives)
- ◯ No
- ◯ I do not know

Q59. Are any of the objectives discontinuous/linear/convex/concave? *

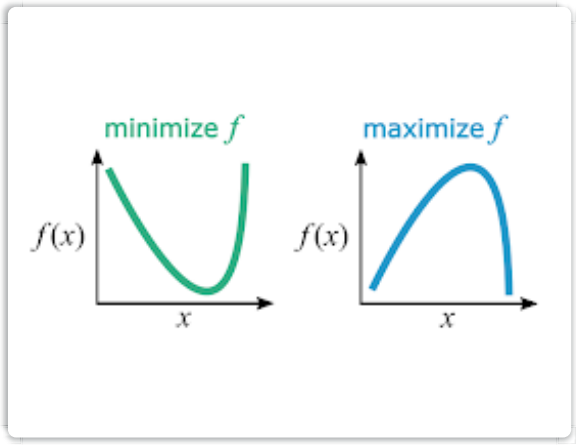
Tick all that apply.



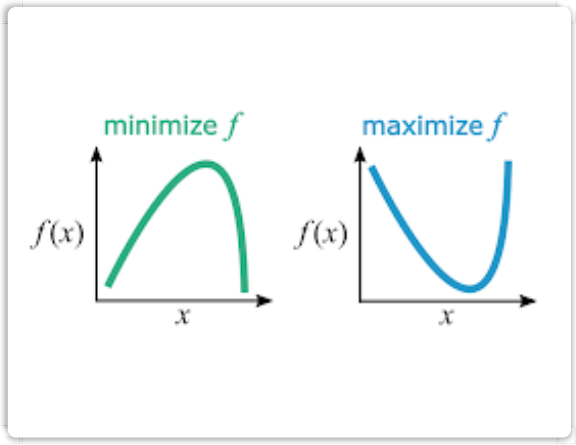
☐ Discontinuous



☐ Linear



☐ Convex for a minimization problem (concave for a maximization problem)



☐ Concave for a minimization problem (convex for a maximization problem)

☐ None of the above

☐ I do not know

Q60. Is the Pareto set in the variable space disconnected? *

Mark only one oval.

- Yes
- No
- I do not know

Q61. Do different solutions map to the same points in the objective space? *

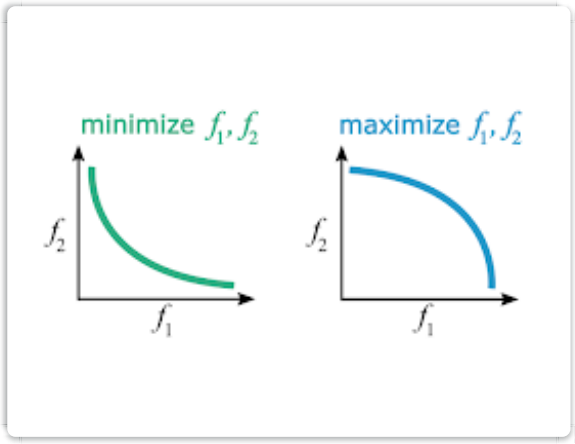
Mark only one oval.

- Yes
- No
- I do not know

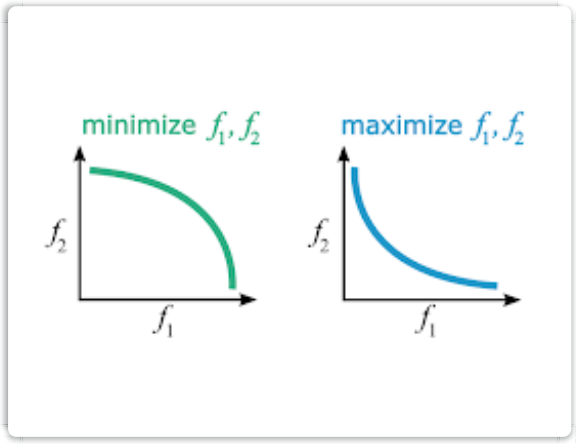
Q62. Is the Pareto front in the objective space convex/concave/linear/mixed? *

The Pareto front is the image of the Pareto optimal solutions in the objective space.

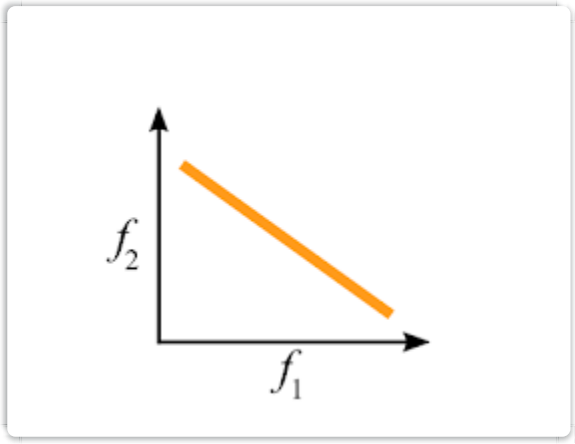
Mark only one oval.



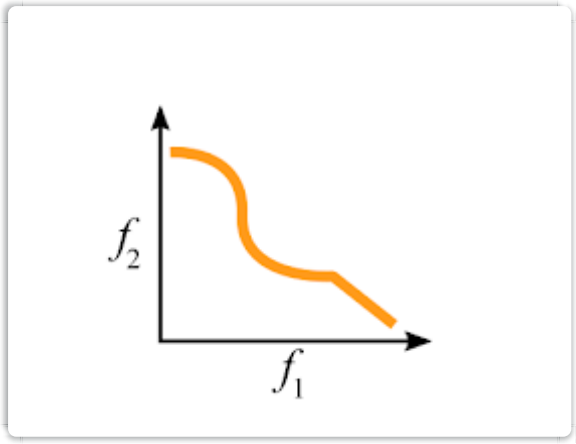
Convex



Concave



Linear



Mixed

None of the above

I do not know

Q63. Is the Pareto front in the objective space disconnected? *

Mark only one oval.

- Yes
- No
- I do not know

Q64. Does the Pareto front have knee points? *

Knee points are 'bulges' in the Pareto front. That is, knee points are a subset of Pareto optimal solutions for which an improvement in one objective will result in a severe degradation in at least another one.

Mark only one oval.

- Yes
- No
- I do not know

Q65. Is the problem badly conditioned (ill-conditioned) for at least one of the objectives?

A problem is badly conditioned if, starting from the same point (in the decision space), moving in one direction would give you a small difference in the objective values, but going into another direction would give you a very large difference in the objective values.

Mark only one oval.

- Yes
- No
- I do not know

Q66. Is at least one of the objectives separable? *

Separability means that you can optimize each variable individually (if the separability is partial, this holds for just some variables).

Mark only one oval.

- ◯ Yes, all the variables are separable for at least one objective
- ◯ Partially separable (some variables are separable for at least one objective)
- ◯ No
- ◯ I do not know

Q67. Do you have any additional information about objectives?

If there is some correlation among objectives, what type is it? Is there a global structure to the problem? Is the noise/some other property localized? ...

Final Questions

Q68. What kinds of methods have you used to solve your problem?

For example, gradient-based method, simulated annealing, multiobjective evolutionary algorithm. Specific names like NSGA-II are also okay.

Q69. Contact person

If you are filling this questionnaire using only information about the problem provided in some publication, please add (from paper)" after your name.

_____

Q70. Would you be willing to collaborate with evolutionary computation researchers to solve your problem in the future?

Mark only one oval.

- ◯ Yes
- ◯ No
- ◯ Other: _____

Q71. Email address

Your email address will only be used for future communication about this survey and possible collaboration (if so indicated above).

_____

Q72. Can we list your name in the acknowledgement of our publications/reports based on this survey? *

Mark only one oval.

- ◯ I wish to be acknowledged for the participation in this survey if possible
- ◯ I wish to be anonymous

Q73. Do you have any comments?

Did you find the questionnaire easy to answer? If not, which were the difficult/unclear questions? What questions did you miss? Any other suggestions?

Thanks a lot for your answers!