Lab 04: elements of corrections

Q1 :

```
12 projects
  Project_id  Nb_votes    Cost
0    proj-01       195  100000
1    proj-02       167   30000
2    proj-03       262   15000
3    proj-04       227  415000
4    proj-05       110    6000
```

Q2 : 1880 Parisian voted.
The total cost of projects is 1319000 euros.

Q3 :

	Project_id	Nb_votes	Cost	Ratio_voters
0	proj-01	195	100000	0.103723
1	proj-02	167	30000	0.088830
2	proj-03	262	15000	0.139362
3	proj-04	227	415000	0.120745
4	proj-05	110	6000	0.058511
5	proj-06	75	10000	0.039894
6	proj-07	191	25000	0.101596
7	proj-08	180	170000	0.095745
8	proj-09	195	490000	0.103723
9	proj-10	81	18000	0.043085
10	proj-11	85	35000	0.045213
11	proj-12	112	5000	0.059574

Q4 : Project(s) proj-03 received 14.0% of votes

Q5 : Project(s) proj-06 received 4.0% of votes

Q6 :

```
     con: array([], dtype=float64)
     fun: -0.8005537041784158
 message: 'Optimization terminated successfully.'
     nit: 12
   slack: array([0.])
  status: 0
 success: True
       x: array([1.        , 1.        , 1.        , 0.20722892, 1.        ,
       1.        , 1.        , 1.        , 0.        , 1.        ,
       1.        , 1.        ])
```

Q7 :

```
Optimal objective function: -0.8005537041784158 vs -0.8005537041784158
```

Q8 :

```
10 selected projects:
    -proj-01
    -proj-02
    -proj-03
    -proj-05
    -proj-06
    -proj-07
    -proj-08
    -proj-10
    -proj-11
    -proj-12
```

Q9 :

```
The selected projects cost a total of 414000 euros
78.0% of voters are satisfied
```

Q10 :

```
      con: array([], dtype=float64)
      fun: -0.8005537041992195
  message: 'Optimization terminated successfully.'
      nit: 6
    slack: array([9.73927672e-05])
   status: 0
  success: True
        x: array([1.00000000e+00, 1.00000000e+00, 1.00000000e+00, 2.07228915e-01,
       1.00000000e+00, 1.00000000e+00, 1.00000000e+00, 1.00000000e+00,
       1.09059852e-10, 1.00000000e+00, 1.00000000e+00, 1.00000000e+00])

10 selected projects:
    -proj-01
    -proj-02
    -proj-03
    -proj-05
    -proj-06
    -proj-07
    -proj-08
    -proj-10
    -proj-11
    -proj-12
The selected projects cost a total of 414000 euros
78.0% of voters are satisfied
```

Q11 :

```
2 projects selected by Paris:
    -proj-03
    -proj-04
The selected projects cost a total of 430000 euros
26.0% of voters are satisfied
```

Q12 :

```
Brute-force among 4096 possible solutions
10 selected projects:
    -proj-01
    -proj-02
    -proj-03
    -proj-05
    -proj-06
    -proj-07
    -proj-08
    -proj-10
    -proj-11
    -proj-12
The selected projects cost a total of 414000 euros
78.0% of voters are satisfied
```

Q13 :

```
0. Brute force
32 possible solutions
2 selected projects:
    -proj-01
    -proj-03
The selected projects cost a total of 227885 euros
55.0% of voters are satisfied

1. Paris approach
1 project(s) selected by Paris:
    -proj-03
The selected projects cost a total of 173569 euros
37.0% of voters are satisfied
```

```
2. Interior point
     con: array([], dtype=float64)
     fun: -0.7237722875015217
 message: 'Optimization terminated successfully.'
     nit: 5
   slack: array([-2.81285029e-05])
  status: 0
 success: True
       x: array([1.00000000e+00, 1.19777985e-10, 1.00000000e+00, 6.28329373e-01,
       1.75731516e-10])

3 selected projects:
    -proj-01
    -proj-03
    -proj-04
The selected projects cost a total of 660962 euros
82.0% of voters are satisfied
```