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18b-016-se

Assignment 3

Complete Code:

```python
import numpy as np
from scipy.optimize import linprog

print("-----------SIMPLEX METHOD-------------")
print("Select simplex method of \n1) Maximization\n2) Minimization")
select = int(input("Enter 1 or 2 for selection "))


def Maximization():
    print("-----------You selected MAXIMIZATION SIMPLEX METHOD-------------")
    print("")

    # Create objective function
    C = []
    z_n = int(input("Enter size of objective function "))

    for i in range(z_n):
        z_input = eval(input("Enter coefficeints of objective function ")) * -1
        C.append(z_input)
    C = np.array(C)

    print(" Coefficient of your objective function are ", C)
    print("")

    # Create contrains and take only coefficeints of contrains
    a_n = int(input("Enter number of contrains "))
    A = []
    for i in range(a_n):
        temp = []
        print("")
        print("Constraint number ", i)
        for j in range(z_n):
            a_input = eval(input("Enter coefficeint of constranis "))
            temp.append(a_input)
        A.append(temp)

    A = np.array(A)

    b = np.identity(z_n, dtype=int)
    b = b * -1
    Z = np.concatenate((A, b))
    print("Coefficients of your constraints are ", Z)
```

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```
    # Take contants(b) of the the contrains
    B = []
    print("")
    for i in range(a_n):
        b_input = int(input("Enter contants value "))
        B.append(b_input)

    for i in range(z_n):
        B.append(0)

    B = np.array(B)
    print("Constants of your constraints are ", B)

    # Solving for simplex method
    res = linprog(C, A_ub=Z, b_ub=B)

    # Print results
    print("")
    print('Optimal value:', round(res.fun * -1, ndigits=2),
          '\nx values:', res.x,
          '\nSlack values', res.slack[:a_n],
          '\nNumber of iterations performed:', res.nit)


def Minimization():
    print("-----------You selected MINIMIZATION SIMPLEX METHOD-------------")
    print("")

    # Create objective function
    C = []
    z_n = int(input("Enter size of objective function "))

    for i in range(z_n):
        z_input = eval(input("Enter coefficeints of objective function "))
        C.append(z_input)
    C = np.array(C)

    print(" Coefficient of your objective function are ", C)
    print("")
```

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```
# Create contrains and take only coefficeints of contrains
a_n = int(input("Enter number of contrains "))
A = []
for i in range(a_n):
    temp = []
    print("")
    print("Constraint number ", i)
    for j in range(z_n):
        a_input = eval(input("Enter coefficeint of constranis ")) * -1
        temp.append(a_input)
    A.append(temp)

A = np.array(A)

b = np.identity(z_n, dtype=int)
b = b * -1
Z = np.concatenate((A, b))
print("Coefficients of your constraints are ", Z)

# Take contants(b) of the the contrains
B = []
print("")
for i in range(a_n):
    b_input = int(input("Enter contants value ")) * -1
    B.append(b_input)

for i in range(z_n):
    B.append(0)

B = np.array(B)
print("Constants of your constraints are ", B)

# Solving for simplex method
res = linprog(C, A_ub=Z, b_ub=B, method='simplex', )

# Print results
print("")
print('Optimal value:', round(res.fun, ndigits=2),
      '\nx values:', res.x,
      '\nSlack values', res.slack[:a_n],
      '\nNumber of iterations performed:', res.nit)
```

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```
if select == 1:
    Maximization()
elif select == 2:
    Minimization()
else:
    print("Please Enter correct number for selection")
```

Steps of Running program:

1. Enter 1 or 2 for selecting Maximization or Minimization.
2. Enter the size of your objective function. For example, if $z = 2x1 + 10x2 + 8x3$. Then size is 3.
3. Enter coefficients of your objective function. If we take above example then coefficients are 2 , 10 , 8.
4. Enter number of constraints you have in your question.
5. Enter coefficients of your constraints. But not enter constants(b) in this step.
6. Now enter constants(b) of your constraints.
7. And finally, you get the answer.

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MAXIMIZATION:

Let solve a maximization problem:

Question:

$$\text{Maximize } Z = 3x_1 + 5x_2 + 4x_3$$
$$\text{Subject to, } 2x_1 + 3x_2 \leq 8$$
$$2x_1 + 5x_3 \leq 10$$
$$3x_1 + 2x_2 + 4x_3 \leq 15$$
$$x_1 \geq 0, x_2 \geq 0, x_3 \geq 0$$

Answer:

Decision Variables	Optimum value
x_1	0
x_2	8/3
x_3	2
Z	64/3

Slack variable	status
$s_1 = 0$	scarce
$s_2 = 0$	Scarce
$s_3 = 5/3$	Abundant

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Solve with our program and the Output is:

```
----------SIMPLEX METHOD-------------
Select simplex method of
1) Maximization
2) Minimization
Enter 1 or 2 for selection 1
----------You selected MAXIMIZATION SIMPLEX METHOD-------------

Enter size of objective function 3
Enter coefficeints of objective function 3
Enter coefficeints of objective function 5
Enter coefficeints of objective function 4
 Coefficient of your objective function are  [-3 -5 -4]

Enter number of contrains 3

Constraint number  0
Enter coefficeint of constranis 2
Enter coefficeint of constranis 3
Enter coefficeint of constranis 0

Constraint number  1
Enter coefficeint of constranis 2
Enter coefficeint of constranis 0
Enter coefficeint of constranis 5

Constraint number  2
Enter coefficeint of constranis 3
Enter coefficeint of constranis 2
Enter coefficeint of constranis 4
Coefficients of your constraints are  [[ 2  3  0]
 [ 2  0  5]
 [ 3  2  4]
 [-1  0  0]
 [ 0 -1  0]
 [ 0  0 -1]]

Enter contants value 8
Enter contants value 10
Enter contants value 15
Constants of your constraints are  [ 8 10 15  0  0  0]

Optimal value: 21.33
x values: [0.         2.66666667 2.        ]
Slack values [0.         0.         1.66666667]
Number of iterations performed: 2

Process finished with exit code 0
```

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Optimal Value (z) = 21.33 = 64/3

X1 = 0
X2 = 2.666 = 8/3

X3 = 2

S1 = 0

S2 = 0

S3 = 1.666 = 5/3

Number of iterations performed 2

All answers are matched with the above answers in the table.

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MINIMIZATION:

Let solve a minimization problem:

Question:

$$\text{Minimize } Z = 5x_1 - 4x_2 + 6x_3 - 8x_4$$

Subject to,

$$x_1 + 2x_2 + 2x_3 + 4x_4 \leq 40$$
$$2x_1 - x_2 + x_3 + 2x_4 \leq 8$$
$$-4x_1 + 2x_2 - x_3 + x_4 \geq -10$$
$$x_1, x_2, x_3, x_4 \geq 0$$

Answer:

Decision Variables	Optimum value
x_1	0
x_2	6
x_3	0
x_4	7
Z	-80

Slack variable	status
$s_1 = 0$	scarce
$s_2 = 0$	Scarce
$s_3 = 29$	Abundant

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Solve with our program and the Output is:

```
-----------SIMPLEX METHOD-------------
Select simplex method of
1) Maximization
2) Minimization
Enter 1 or 2 for selection 2
-----------You selected MINIMIZATION SIMPLEX METHOD------------

Enter size of objective function 4
Enter coefficeints of objective function 5
Enter coefficeints of objective function -4
Enter coefficeints of objective function 6
Enter coefficeints of objective function -8
 Coefficient of your objective function are  [ 5 -4  6 -8]

Enter number of contrains 3

Constraint number  0
Enter coefficeint of constranis 1
Enter coefficeint of constranis 2
Enter coefficeint of constranis 2
Enter coefficeint of constranis 4

Constraint number  1
Enter coefficeint of constranis 2
Enter coefficeint of constranis -1
Enter coefficeint of constranis 1
Enter coefficeint of constranis 2

Constraint number  2
Enter coefficeint of constranis -4
Enter coefficeint of constranis 2
Enter coefficeint of constranis -1
Enter coefficeint of constranis 1
Coefficients of your constraints are  [[-1 -2 -2 -4]
 [-2  1 -1 -2]
 [ 4 -2  1 -1]
 [-1  0  0  0]
 [ 0 -1  0  0]
 [ 0  0 -1  0]
 [ 0  0  0 -1]]

Enter contants value 40
Enter contants value 8
Enter contants value -10
Constants of your constraints are  [-40  -8  10   0   0   0   0]

Optimal value: -80.0
x values: [0. 6. 0. 7.]
Slack values [29.  0.]
Number of iterations performed: 2
```

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Optimal Value (z) = -80

X1 = 0
X2 = 6

X3 = 0

X4 = 7

S1 = 0

S2 = 0

S3 = 29

Number of iterations performed 2

All answers are matched with the above answers in the table.