Optimal System Design-12 Homework

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1. Dairy Farm Problem

1.1 Problem Definition

- maximize Profit P
- Find the optimal L, R, and N, and the resulting profit P

1.2 Equation

- define the equation of profit and cost

$$Profit = 2MN \quad = 2 * 100\sqrt{A/N} * N \ = 200\sqrt{\frac{2RL_{side} + \pi R^2}{N}}N \quad = 200\sqrt{RN(2L_{side} + \pi R)} = f(L_{side}, R, N) \quad = f(\boldsymbol{x}) \ Cost = 2000N + 1$$

- Optimization problem is written as below

$$\text{Minimize:} \quad \mathcal{J} = f(\boldsymbol{x}) \ \text{ subject to:} \quad g(\boldsymbol{x}) \leq 10^5$$

1.3 Theoretical approach

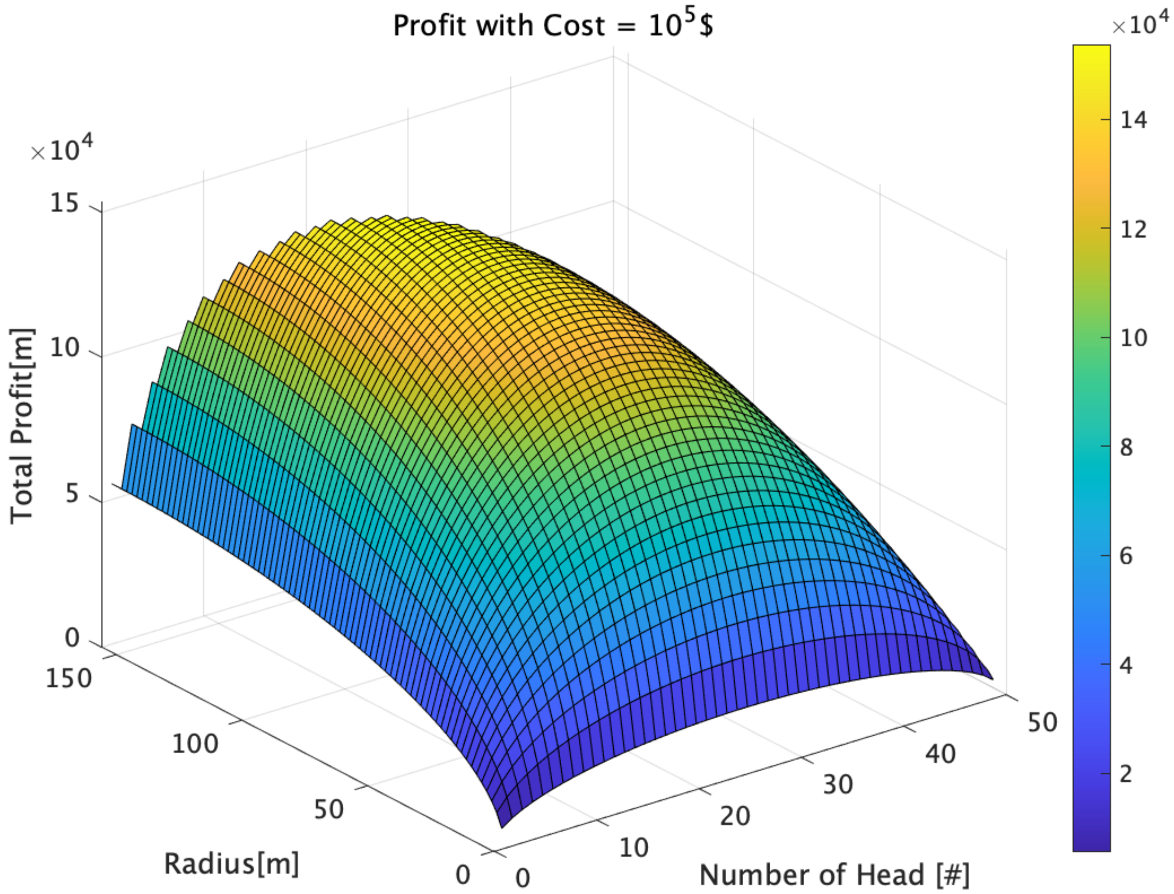
Length of the side can be calculated if maximum cost is defined as a costant value.

$$2000N + 200L_{side} + 200\pi R = C \ L \quad = C/200 - \pi R - 10N = g'(R, N)$$

Here we can modify objective function $f(x)$ as below

$$\mathcal{J} = f(x) = f(R, N)$$

Now we can draw surface plot and find the maximum profit.



Results

There is slight errors caused by computation derivation.

- Radius = 103.5 [m]
- Length = 4.8 [m]
- [#] of head = 17
- Profit = 1.5351 x 10^5 [$]

2. Todai Lecture Communication problem

2.1 Problem Definition

2.2 Equation

$$\text{Minimize:} \quad \mathcal{J} = \boldsymbol{c}^T \boldsymbol{x} \ \text{ subject to:} \quad \mathbb{A}\boldsymbol{x} \leq \boldsymbol{b} \quad \boldsymbol{0} \leq \boldsymbol{x} \leq \boldsymbol{u}$$

2.3 Computation method

- MATLAB
- x = linprog(f,A,b,Aeq,beq)

```
%% Initial Setting
c = [0.02, 0, 0.01, 0.01, 0.01, 0, 0.04, 0.01, 0.03, 0.01];
b = [200; 300; 100; 0; 0; -400; -200];
u = [175, 50, 200, 150, 100, 75, 200, 150, 200, 175];
A = [1, 1, 0, 0, 0, 0, 0, 0, 0, 0;
     0, 0, 1, 1, 0, 0, 0, 0, 0, 0;
     0, 0, 0, 0, 1, 1, 0, 0, 0, 0;
    -1, 0,-1, 0, 0, 0, 1, 1, 0, 0;
     0, 0, 0,-1,-1, 0, 0, 0, 1, 1;
     0,-1, 0, 0, 0, 0,-1, 0,-1, 0;
     0, 0, 0, 0, 0,-1, 0,-1, 0,-1];

options = optimoptions('linprog','Display','iter');

%% Calculation
x = linprog(c,A,b,[],[],u*0,u,options);
J = c * x;
x, J
```

we gained optimized solution. x =[150 ,50 ,150 ,150 ,25 ,75 ,175 ,125 ,175 ,0]

J = 19.7500