

# CO327 (2022Spring) Assignment 4

Lecturer: Andersen Ang

May 11, 2022

- Assignment deadline: June-14 23:55.
- Submit your electronic copy (in a single PDF) to the dropbox in Waterloo LEARN.

## 1 Resource allocation (20 points)

### 1.1 Voting visit (7 points)

You are the next US presidential candidate. You must decide which states to visit in the 10 days before the election. Your goal is to increase the number of votes by the largest possible amount. Your election team provide you the following data

State	Vote ( $\times 10^3$ ) increase by visit	Days required for visit
1	10	4
2	20	3
3	40	3
4	90	4
5	30	3
6	10	1

Formulate this problem. State clearly your decision variable(s), objective function and constraint(s). Solve this problem: which states should be visited? How many votes will be generated by these visits?

### 1.2 Voting visit and ads (13 points)

Now you are down to the last 5 days of the campaign. You have \$300000 left and three key states appear likely to swing the election one way or other. Each state can be visited, or a TV ad series can be purchased. Your election team provide you the following data

State	Action	Vote ( $\times 10^3$ ) increase by visit	Days required for visit	Cost ( $\times 10^3$ )
1	Visit	100	4	200
1	Ads	50	0	100
2	Visit	80	4	150
2	Ads	40	0	90
3	Visit	20	1	45
3	Ads	15	0	30

Now assume

- Case a: visit and ads on the same state are not mutually exclusive (6 points)
- Case b: visit and ads on the same state are mutually exclusive (7 points)

Formulate these problems. State clearly your decision variable(s), objective function and constraint(s).

\* You do not need to solve the program.

## 2 Stock trader problem (20 points)

You are a wall street trader, your job is to determine when to buy or sell stock. You are given a price chart showing the price of a list of stocks within a period of time. You want to maximize your net profit by choosing certain days to buy and sell stocks.

There are three rules in stock market:

- You cannot sell a stock if you do not own any.
- You can either buy, sell or do nothing on each day; you cannot buy and sell the same stock on the same day.
- You can only buy or sell **one unit** of stock each time.

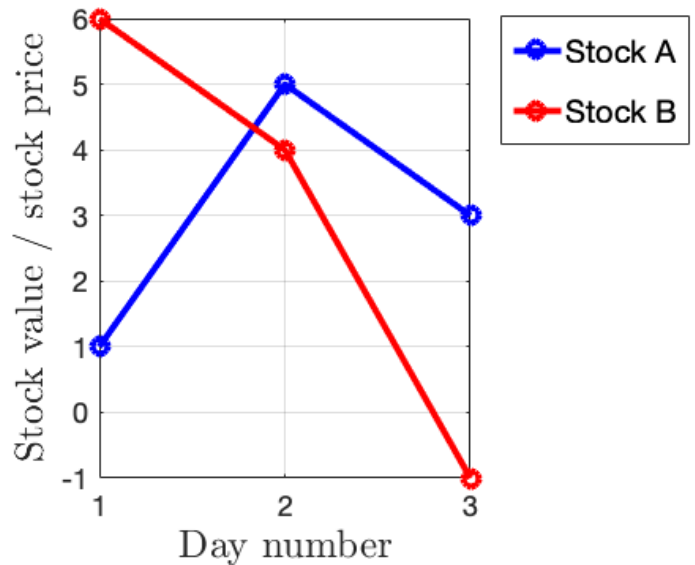
You start with no money. You borrow money from the bank to buy stock, and you have to return the borrowed money (with no interest).

**Example** For the price graph on the right, an optimal solution is

Day	1	2	3
Action	Buy A	Sell A	Do nothing

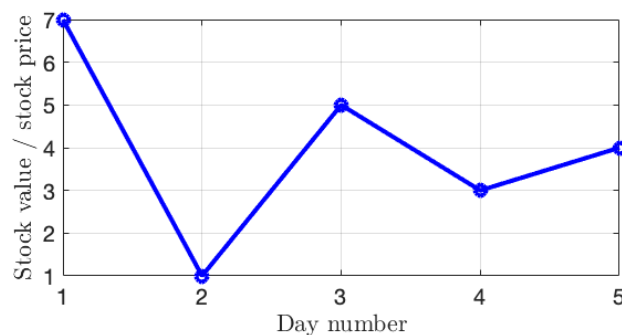
Explanation

- You buy 1 unit of stock A at day 1. Now your net gain is -1.
- You sell 1 unit of stock A at day 2. Now your net gain is  $-1+5 = 4$ .
- At day 3, as you do not have stock A in your hand, you choose to do nothing.
- For stock B, after viewing the price graph, you decided not to touch it completely (do nothing on stock B for the three days).



**Question 1** Formulate the above trading problem on the two stocks as a binary integer program. State clearly and explain your variable(s), your cost function and constraint(s). \* Note that the BIP should have the same optimal solution as stated above.

**Question 2** Another stock trader focus on a single stock over a longer period of time. The figure below shows the stock price. Solve the stock trading problem. Write down the optimization problem, state clearly and explain your variable(s), your cost function and constraint(s), and solve the program.



END.