Back to the Future: When to Buy and Sell?

J.-S. Roger Jang (張智星)
jang@mirlab.org
http://mirlab.org/jang
MIR Lab, CSIE Dept.
National Taiwan University

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Introduction

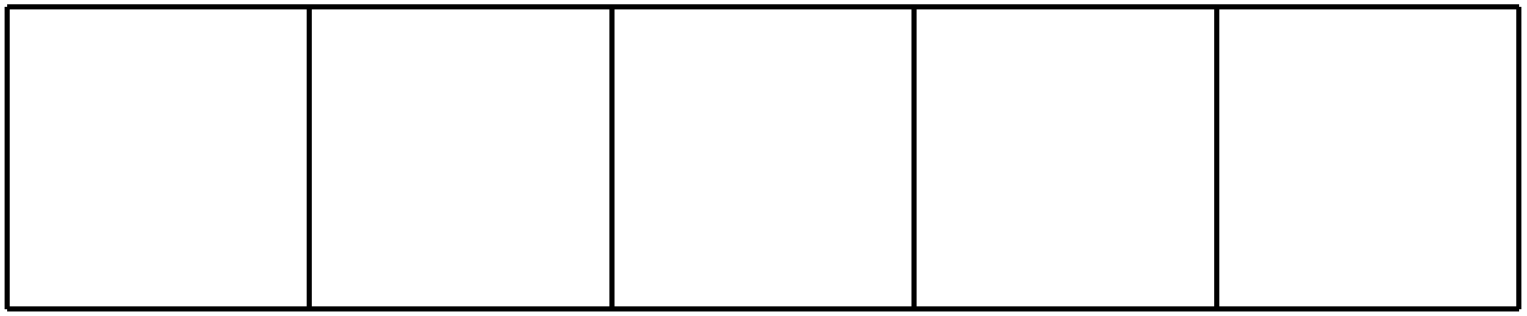
- Why “Back to the Future”?
- Problem: Given the price of a stock over a span of time, how can you determine when to “buy” and “sell” to maximize the overall return?
  - Assumptions
    - Each day has a single price for a stock.
    - You can buy or sell only once in a day.
    - You can always get the transaction done.
    - Transaction fee applies.
    - Always “buy all” or “sell all”.
- Analytic solution exists ➔ DP!

DP Formula for Trading

Quiz!

- Notations
  - p_i: stock price at stage i
  - s_i: max. stockholding at stage i
  - c_i: max. cash at stage i, with c_1 being the initial cash
- Recurrent formula

s: s_1 s_2 s_3 s_4 s_5 s_6



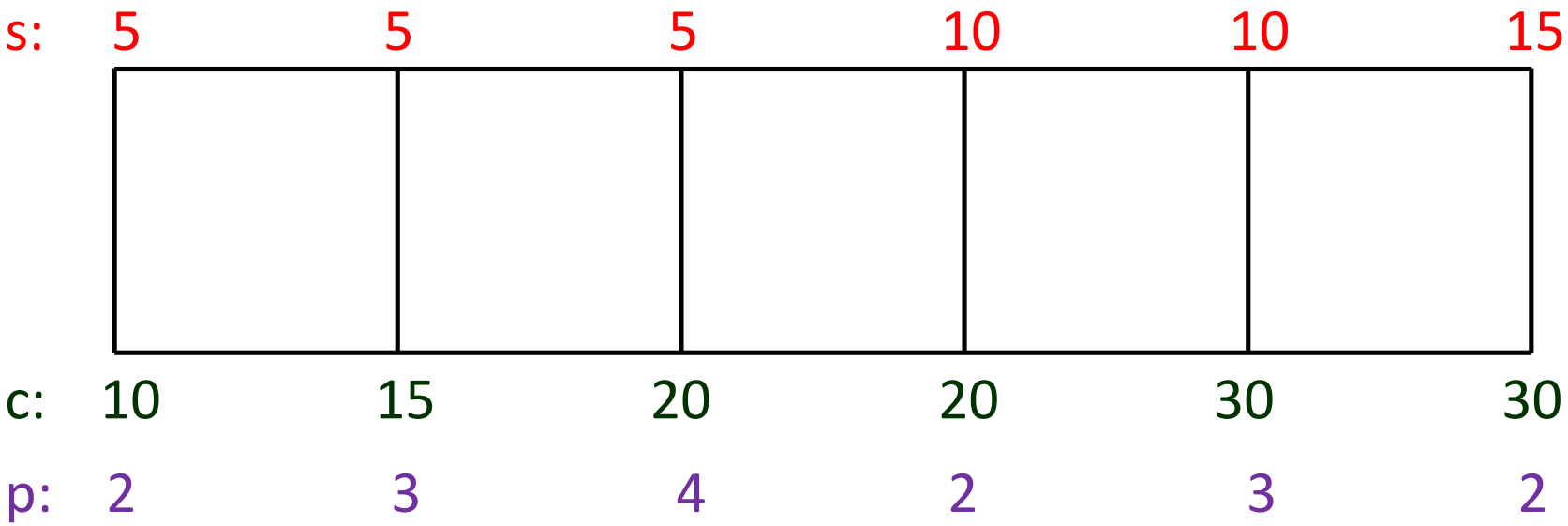
c: c_1 c_2 c_3 c_4 c_5 c_6

p: p_1 p_2 p_3 p_4 p_5 p_6

Example of DP for Trading

Quiz!

- Given p = [2 3 4 2 3 2], c_1=10
- Compute c_i and s_i, i=1~6
- Recurrent formula

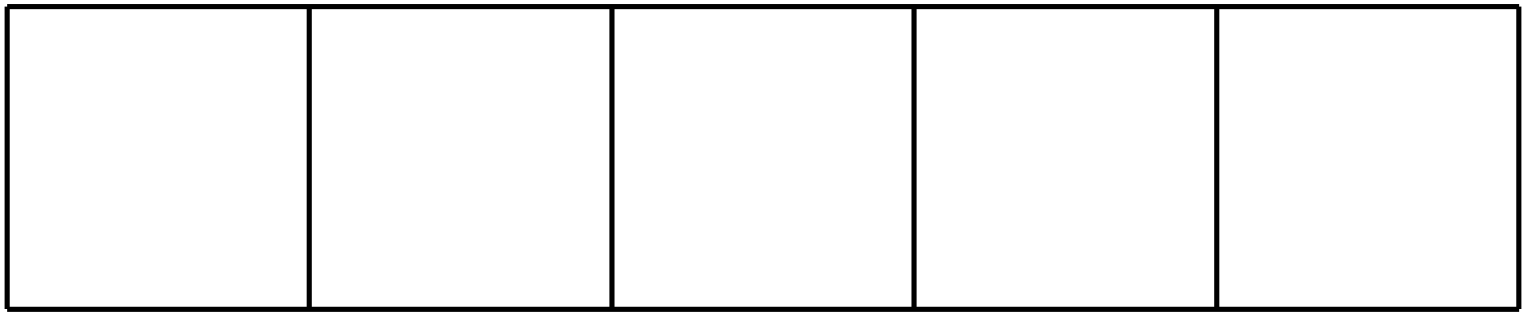


DP Formula for Trading, with Transaction Fee

- Notations: same as before
  - ρ: rate for transaction fee
- Recurrent formula

Quiz!

s: s_1 s_2 s_3 s_4 s_5 s_6



c: c_1 c_2 c_3 c_4 c_5 c_6

p: p_1 p_2 p_3 p_4 p_5 p_6

Extension

- Can this DP be extended to multiple stocks?
  - Problem: Give the price info of 4 stocks over n days, can you find the best timings for “buy” and “sell” for each stock, such that the overall return is maximized?
- Other extensions
  - Different transaction fee rates for “buy” and “sell”?
  - Cash is better than stock?
    - 例如：一年至少保留30天擁有現金
  - Other reasonable constraints, please let me know!
    - Better make DP not applicable directly!

Our homework!