Homework 9: Arbitrage and Your 2/C Loan

Midshipmen receive a Second Class loan of about \$35,000 during their second class year. This loan is an extraordinary opportunity to generate income without risk, i.e., there is an arbitrage opportunity. The reason for this opportunity stems from the fact that the loan has an interest rate that is lower than the market rate. By investing in the market at a relatively high rate of return we can receive a payoff that is higher than the investment.

We'll assume our loan has the following characteristics:

- We may borrow \$35,000 at 0.5% interest for a total of 7 years
- The interest on the loan begins to accrue immediately, but no payment is due for the first 2 years
- An annual loan payment, due at the end of the 3rd — 7th years is 20% of the principal with interest, say approximately \$7250 per year (or \$36,250 total)
- The loan **must** be paid back in full after 7 years

The objective of this project is to construct a portfolio that maximizes your profit over the 7 year life of the loan. In order to do this we will look at the historical behavior of stocks. We will construct a portfolio made up of bonds, stocks, and CDs.

(1) In order to do this you should write a function called `portfolio`

The inputs to this function are structs representing information about the bond, stock and CD. You can assume that they have the following fields

- bond
  - `y` (annual yield)
  - `n` (number of **years**)
  - `c` (annual coupon rate).
- stock:
  - `u` (up factor)
  - `d` (down factor)
  - `p` (chance of up tick)
- cd:
  - `y` (Annual Percentage Yield)

The function portfolio has a signature of the following form

```
function v = portfolio(bond, stock, cd, amounts)
...CODE...
end
```

The variable `amounts` is probability vector that represents what fraction of the portfolio is made up of each of the given assets. So a portfolio that is 20% bonds, 50% stocks and 30% CDs will have `amounts = [0.2, 0.5, 0.3]`. The vector `v` is the value of the portfolio at times $t = 0, 1, \cdots, 7$ years. The function should simulate the portfolio given the amounts and the information in the `bond`, `stock`, `cd` variables. Note that the simulation needs to create a sample stock path with time steps of **one day**.

(2) Now assume that a stock there is a stock with $u = 1.0230$, $d = 0.9775$ and $p = 0.51$. Suppose that the yield on a 7-year coupon bearing bond is 1.66% with a coupon of 3.125 per \$100 face value, and that there is an APY on your CD of 1.75%. Using the function portfolio write a script called `myloan.m` that does the following. Choose any division of your \$35,000 and place it in each of the above asests. Simulate the beahvior of the portfolio over 10,000 possible paths of the stock price.

Compute the average value of your portfolio at the end of the simulation.

How much did you make?

Make sure to comment your code thoroughly.