MATHEMATICAL FINANCE PROJECT 1

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Date: 01 Febuary, 2018

QUESTION 1:

A certificate of deposit (CD) is a certificate issued by a bank to a person depositing money for a specified length of time. That is, it is a savings certificate having a fixed maturity date and a specified fixed interest rate. It restricts access to the funds until the maturity date of the investment.

The interest on CD is compounded periodically—typically daily, monthly or semi-annually. So the longer one leaves his\her money in a CD, the larger his\her return will be. However, CDs aren't a way to get rich quick as one may think.

For example, a $1500 investment with a 1.5% rate compounded daily for 5 years will result in only a $116.823 return. So, at the end of the term of the CD, you would be paid $1616.823, principal plus interest. Thus, the more you invest, the more you make. A $2500 investment with same interest with same interest rate and term would result in $2694.706.

So, if one is looking for a way to invest money but aren't looking to take any risks, CDs are a great way to go even though returns may not be as high (see above examples) as riskier investment options.

When you purchase a fixed rate CD you are locked in at the lower rate. Alternatively, if rates increase, the financial institution may be able to "call" (CALLABLE CD), meaning they may terminate your investment rather than continuing paying you higher rates.

CDs come in a variety of forms from LIQUID, BUMP-UP to BROHERED CDS.

QUESTION 2:

Our main bank of consideration in this report is WELL FARGO bank
https://www.wellsfargo.com/savings-cds/certificate-of-deposit/

The interest rates and APYs displayed in this site are for the Wells Fargo Bank locations in Tennessee. Current deposit rates are for 01/27/2018 – 02/02/2018.

Minimum deposit = $2500, interest rate (nominal) = 0.05%, APY = 0.05% i.e., APY = 0.05 = (1 + 0.0005/12)^{12x1} – 1

So for a $10000 investment (deposit) in Wells bank, the payoff after 1 year with monthly compounding will be 10000(1 + 0.0005/12)^{12x1} = 10005.

Lets now compare the interest set by Wells Fargo bank with another bank. We next consider the MARCUS BANK https://www.marcus.com/us/en/savings/high-yield-cds which provides a minimum deposit of $2500 with an APY = 1.80%. So for an investment of $10000 in this bank, the payoff is 10000(1 + 0.0180/12)^{12x1} = 10181.

We can calculate the interest rate (nominal) as follows: 12((0.018+1)^{1/12}-1) = 0.01785 or we can compute the discount factor that is 10000/10181 = 0.982221786 and then compute the interest rate, see Fixed Income Securities by Pietro Veronesi page 36 equation (2.6)

We can make more comparison by considering other banks such as JPMorgan Chase Bank and Citi Bank see http://www.magnifymoney.com/blog/reviews/chase-cd-rates334381940/ and the previous link.

QUESTION 3:

When you pull out early, banks typically charge you a penalty that amounts to some of the interest you would have earned if you held the CD to maturity. You might see it quoted as "**90 days of interest" .** Some of these penalties include:

- For early withdrawal and the penalty for long term CDs is typically six months of interest.
- The typical early withdrawal penalty for CD with a maturity of one year or less is three months worth of interest.
- For a CD with a maturity of a year or more, the typical early withdrawal penalty equals six months worth of interest.
- Most institutions take (partly of fully) the principal of the investor who withdraw from CDs early, haven't yet earned enough interest to cover the penalty fees which results in a negative return for some investors.

N.B: There is no maximum penalty amount and it's not always the highest yielding CDs that pay the most penalty as the following table shows:

Bank	City	Yield (%)	Penalty	Penalty on $10000 deposit

Chase	Nationwide	1,25	$25 + 3% of withdrawal amount	$325.00
Presidential FSB	Washington D.C. metro	2,50	24 months interest	$506.25
Astorial FS&LA	New York metro	3.25	360 days interest	$325.00

QUESTION 4:

CDs offer higher interest rates than savings accounts because the investor does not have access to his money for a very long period of time (time value of money) as little as six months or as much as five years and the interest rates do not fluctuate once set unless you take CDs with variable rates. Thus the longer the time horizon, the greater the interest rate you will be paid. This is contrary to savings accounts where you add and withdraw money as you wish, but interest are low and fluctuate.

QUESTION 5:

"FDIC" insured means the U.S government insures your deposit if the bank default (fails to pay your payoff).

QUESTION 6:

Some banks do not have a minimum but in general it is $1000 for big banks.

QUESTION 7:

Ideally, the bank favors long term CDs because they have the investor's money for a long period of time, so the bank can reinvest and reinvest the money thus making more and more profit with the investor's money before the maturity date reaches. Thus, the bank will eventually offer higher interest to long terms CDs than short term CDs.

QUESTION 8: Same explanation as in question 7 above. The longer the term of the CDs the more it makes money. It also makes money with short term CDs but not as much as long term.

REFERENCES:

- Pietro Veronesi: Fixed Income Securities, Wiley & sons, UK., 2010.
- http://www.magnifymoney.com/blog/reviews/chase-cd-rates334381940/
- https://www.marcus.com/us/en/savings/high-yield-cds
- https://www.wellsfargo.com/savings-cds/certificate-of-deposit/