# FIN325 - Homework 3
## Due : February 17

## Problem 1 (30pts)

A corporation is considering investing into and exploiting a quarry at an initial cost of $90M. It expects to generate $100M in incremental FCFFs in year 1 and 2. Then the quarry will need to be shut down and cleaned up, in keeping with local regulations. Clean up will cost the firm $111M in year 3. Show graphically that the IRR of this investment project is NOT well defined.

## Problem 2 (35pts)

A lender has agreed to issue a fully amortizing bond with face value $100M, twenty yearly payments, and an interest rate of 10%. Payments will grow by $g\%$ a year for 10 years. After year 10, payments are flat. (So year 11 payment is the same as year 10, as are all subsequent payments)

1. If $g = 1\%$, what is the bond's outstanding principal at the start of year 5?

2. Above what growth rate does the bond begin to feature negative amortization, holding the interest rate the same?

## Problem 3 (Monte Carlo, 35 pts)

Consider an investment project which yields cash flows for up to 20 years. Starting the project costs $500,000$. The project's subsequent cash flows follow what is called a *Markov Process* where the probability distribution of next year's cash flow depends on this year's cash flow. Markov processes try and capture in a parsimonious fashion the possibility that good times or bad times may be persistent. In the first year, the project's cash flow is $50,000$ with certainty. Each year, there is a 2% probability that next year's cash flow will be zero. Once it is becomes zero, it stays there for ever. In this context, zero is called an *absorbing state*.

If this year's cash flow is not zero yet, then there is a 10% probability that next year's cash flow will be higher by 10%, and a 10% probability that it will be lower by 10%. With the remaining probability, namely 78% ($= 100 - 2 - 10 - 10$), the cash flow is unchanged.

1. Use Excel's random number generator to simulate 500 possible cash flow paths for the project. To make your life easier below, make sure to include the initial $500,000$ outlay in year 0.

2. Use these 500 simulated histories to estimate the expected value of the cash flow in each of the project's year. (That is, for each year, average cash flow values across histories.)

3. Assuming a discount rate of 10%, calculate the net present value of the project using your estimates of expectations.

4. Now calculate the present value of each history separately using the same discount rate, and calculate the average of the 500 resulting values. Is the final result the same as in the previous question?

5. Estimate the project's IRR using your simulated estimate of the expected value of the cash flow in each period.

6. Now calculate the IRR associated with each of the histories you generated.[1] Then calculate the average of the resulting 500 IRRs. Do you get the same value as in the previous question?

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[1]Warning: sometimes Excel's IRR function gets stuck, basically because it is not "trained" to look for very negative IRRs. Long story short, if that happens, write, say, IRR(A1:A20,-0.8), rather than simply IRR(A1:A20), which will start the search at -80%.