

6. Time value of money, investment project valuation. (DCF, NPV, IRR)

The same notional received today and in one year time is not valued the same by investor. The idea of time value of money incorporates concept of compound interest (or interests on interest) as well as discount factor for the valuation of future inflows or outflows. In order to evaluate a project having multiple asynchronous cash flows you need to:

- Understand the principle of compounded interests, interest rate / discount factor, frequency of compounding and continuous interest (limiting case of increasing compounding frequency)
 - Understand concept of annuity and how to calculate its present and future value given interest rate / discount factor
 - Understand the methodology of discounted cash flow (DCF) and how to make investment decision between 2 projects based on their net present value (NPV)
 - Understand the concept of internal rate of return (IRR) and payback period (PB) and why IRR, PB and NPV can give different ranking of investment projects.
- a) Consider an investment of 100 that pays 6% semiannually (3% every half year) for 5 years with the proceeds reinvested. Calculate in R the future value of such investment. Calculate the same in case of quarterly and monthly proceeds (1,5% and 0,25% each period respectively). Calculate the future value in case of continuous interest and compare the result of the above.
- b) Consider an investment of 100 that pays 5 annually for the next 30 years. If the proceeds could be reinvested at risk free rate of 3% compute the future value of investment in 30 years. What would be the net present value (NPV) of such investment (assume discount rate = risk free rate). What would be the NPV of similar investment that pays perpetually?
- c) Consider investment that pays 100 in 10 years and costs 80 now. Compute annually compounded rate of return or internal rate of return (IRR) for such investment. What are the IRR's of investments described in b)?
- d) Consider 2 investment projects with following projected payoffs at the end of each year in the environment with risk free rate of 6% per year:

	Year 0 (now)	Year 1	Year 2	Year 3	Year 4	Year 5
Project 1	-1000	1250	10	10	20	20
Project 2	-1000	-10	0	10	20	2000

Compute NPV, IRR and PB for both projects and decide which one should be chosen based on each method. For the above write general R function that can accept different amount of projects / periods (as a matrix input) as well as risk free rate parameter and calculate and print NPV, IRR, PB as well as ranking based on each of them.

- e) Discuss other methods of project valuation and compare their advantages and disadvantages
- f) Simulate series of yearly log returns of 2 assets for 10 years from standard normal distribution with mean 3%, volatility 30% each and correlation 60%. Compute time series of log returns for portfolio having 50% of each asset (hint: it is not weighted average).

References:

- Brealey, Richard A., et al. Principles of corporate finance. Tata McGraw-Hill Education, 2012.