# ECON 233 Finance 1- Week 3

Drishan Banerjee

Department of Economics
UC Santa Cruz

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# What is an annuity?

- A **finite series of equal payments that occur at regular intervals.**
- Constant amount, constant intervals, finite number of periods.
- First payment occurs one period from now (ordinary annuity).
- This can also be rephrased as ”first payment occurs at the end of current period”.
- PV= $\frac{C}{(1+r)} + \frac{C}{(1+r)^2} + \cdots + \frac{C}{(1+r)^N}$

# Annuity Due

- A **finite series of equal payments that occur at regular intervals**.
- Unlike an Ordinary annuity, the first payment occurs in the current period.
- Rephrased as "first payment occurs at the start of current period".
- PV= $C + \frac{C}{(1+r)} + \frac{C}{(1+r)^2} + \cdots + \frac{C}{(1+r)^{N-1}}$
- $PV_{\text{annuity due}} = PV_{\text{ordinary annutiy}}(1+r)$
- I don't like memorizing formulae. Sum of GP series.

# APR and EAY

- **Annual Percentage Rate-** simple yearly cost of borrowing (or return on lending) without accounting for compounding within the year.
- APR = $i \times 12$ where $i$ is the interest rate charged per month.
- **Effective Annual Yield** True cost of borrowing accounding for compounding within the year.
- 1+EAY = $\left(1 + \frac{r}{12}\right)^{12}$
- If bank charges 1% per month, what is APR?

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# Arithmetic Mean and Geometric Mean Return

- **Arithmetic Average Return** - Simple average of periodic returns. = $\frac{(r_1 + r_2 + \cdots + r_N)}{N}$
- Ignores compounding. Treats every period's capital as the same as if it had no effect from the gains or losses from the previous period.
- **Geometric average return** - actual return once you account from the compounding growth.
- What is the constant hypothetical return ($\rho$) that would give you the same return as your actual return.
- $(1+\rho)^N = (1+r_1)(1+r_2)...(1+r_N)$
- Reflects how returns build on one another (losses reduce the base for future gains).

# Why is the arithmetic greater than the geometric average rate of return?

- A loss of any percentage hits you harder than a gain of the same percentage.
- Arithmetic means ignores the base effect and cancels out gains and losses of equal percentage.
- Question - If you have invested $100 in a stock and every alternate day the stock gains and loses 10%. How do you think the graph of the stock going to look like?
- What is the arithmetic mean return?

# Inflation Rate and real returns

- Inflation erodes the value of money over time.
- Nominal returns need to be adjusted for inflation to understand what your real returns are. Actual purchasing power.
- $1 + r_{real} = \frac{1 + r_{nom}}{1 + \pi}$
- What are the real returns of holding cash?
- What are the real returns of an asset whose nominal returns are exactly the same as the inflation rate? What about gold?
- What happens to investors purchasing power growth when their investment's nominal returns stay the same but inflation rises?

# Risk and reward tradeoff

- Higher returns generally are associated with greater risk.
- Lower risk investments tend to offer lower returns.
- Suppose there are two assets, priced at $100, both with identical returns - gives you 20% ($20) after a year but one is riskier, which one would you buy?
- The safer asset's price will increase leading to lower returns.
- If an asset is riskier, they need to compensate the buyer of that asset to hold this extra risk in the form of higher returns.
- SP500 vs 10 year US treasury vs 1 year US treasury.