Finance with Big Data

# Week 1: Introduction

## Finance 101

### Outline

* What is an asset?
* Present Value
* Time Value of Money
* Risk
* Compounding
* Inflation

### Finance = Valuation of Assets

A diagram of a company

Description automatically generated

* Finance’s primary function is the valuation of **business activities**.
* All business activities reduce to two functions:
  + **Growth wealth** (create value, i.e., creating assets)
  + **Management wealth** (acquiring, selling assets)
* Financially, business decisions start with the valuation of assets:
  + You can’t create and manage what you can’t measure
* Value is an objective measure, often determined by the financial market
* Valuation ⇒ central question of finance

## What is an Asset?

* Business entity
* Property, plant and equipment
* Patents, R&D
* Stocks, bonds, options, etc.
* Knowledge, reputation, opportunties

From a financial perspective, an asset is a **sequence** of cash-flows (CF)

### Examples

* Boeing is evaluating whether to proceed with development of a new airplane. R&D expected to take 3 years and cost: $850 million. Unit cost of production: $33 million. Expected sales: 30 planes every year at an average price of $41 million.
* Firms in the S&P 500 are expected to earn, collectively, $66 this year and to pay dividends of $24 per share.
* You were just hired by Google. Your initial pay package includes a grant of 50,000 stock options with a strike price of $24.92 and an expiration date of 10 years. Google’s stock price has varied between $16.08 and $26.03 during the past two years.

### Valuation of Assets

Sequences of cash-flows are the basic building blocks of finance.

We value an asset in the following manner:

A graph with arrows and a line

Description automatically generated

* Always draw a timeline to visualize the timing of cash-flows
* Key question: what is ?

## Present Value

### The Present Value Operator

* Key question: what is ?
  + What factors are involved in determining the value of any object?
  + How is value determined?
* Two distinct cases:
  + No uncertainty: we have a complete solution
  + Uncertainty: we have a partial solution
* Value is determined the same way, but we want to understand how.

### Key insights

Two important characteristics of a cash-flows: **Time** and **Risk**

#### time value of money

* Which would you prefer?
  + $1000 today
  + $1000 in 1 year
  + $1000 in 100 years
* How much would you value those contracts?

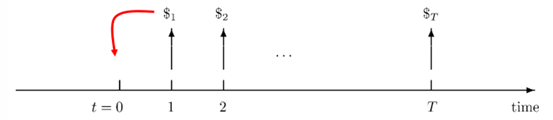
Insight: cash-flows at different dates are like different currencies?

* How to manipulate different foreign currencies?
  + €150 + $300 = ??
* We cannot add currencies without first converting into common currency
* Example: we choose to compute everything in €, with $1 = €0.95

€150 +$300×(€0,95/$) = €435

⇒ Same idea for cash-flows at different dates!

* Once exchange rates are given, adding cash-flows is trivial



* A reference date should be picked, in general t=0 or today
* Future cash-flows can then be converted to present value:

Example:

* Suppose we have the following exchange rates:
* Asset: Google wants to launch a project in Machine Learning (=Asset)
  + Requires an initial investment of $10M (at t=0)
  + Generates cash-flows of $5M at t=1 and $7M at t = 2
* What is the present value of this asset?
* Suppose now that Google can pay for the investment two years from now, at the end of the project. What’s the new present value?

## Time value of Money

* Implicit assumptions
  + Cash-flows are known (magnitudes, signs, timing)
  + exchange rates are known
* Do these assumptions hold in practice?
* Let’s focus now on exchange rates

⇒ Where do they come from, how are they determined?

Why $1 today should be worth more than $1 in the future?

* Opportunity cost of capital: expected return on equivalent investments in financial markets
* With $1 today, you could invest in a safe asset with interest rate r

in year in year 1  
 in year in year 2  
 in year in year

* Equivalence of $1 today and any single choice above
* r is called the risk-free rate, or rf

Why $1 today should be worth more than $1 in the future?

⇒ You can inverse the relationship:

in year in year 1  
 in year in year 2  
 in year in year

* These are our exchange rates or discount factors

### Safe Asset

A graph of a number of numbers and a line

Description automatically generated with medium confidenceA graph showing the growth of the stock market

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* What determines exchange rates (with no uncertainty)?
* How evolves the risk-free rate during crisis? Why?

#### Complete Solution

We now have an explicit expression for the value of an asset (with no uncertainty)

Example 1. (Safe asset) An asset yields cash-flow in one year with a sure value of $1,000. How much is it worth today?

* Suppose that assets/cash-flows traded in the financial market with the same timing and risk (i.e., no risk) offer a return of 5% (e.g., one-year US Treasury bonds, yielding a sure annual interest of 5%)
* $952 is the asset’s current market value.

## Risk

* Two contracts. Which one do you prefer?
  + $1000 probability = 1
  + $2000 probability = 0.5
    - $0 probability = 0.5
* How much would you value these contracts?

Why $1 with no risk should be worth than (expected) $1 with risk? ⇒ Risk-aversion

* Expected utility theory is the leading model of consistent decision making under uncertainty: investors evaluate each gamble not by its expected payoff, but by its expected utility.

### Expected utility theory