Topics 3
Principle of asset valuation

EE431

Semester 1/2017

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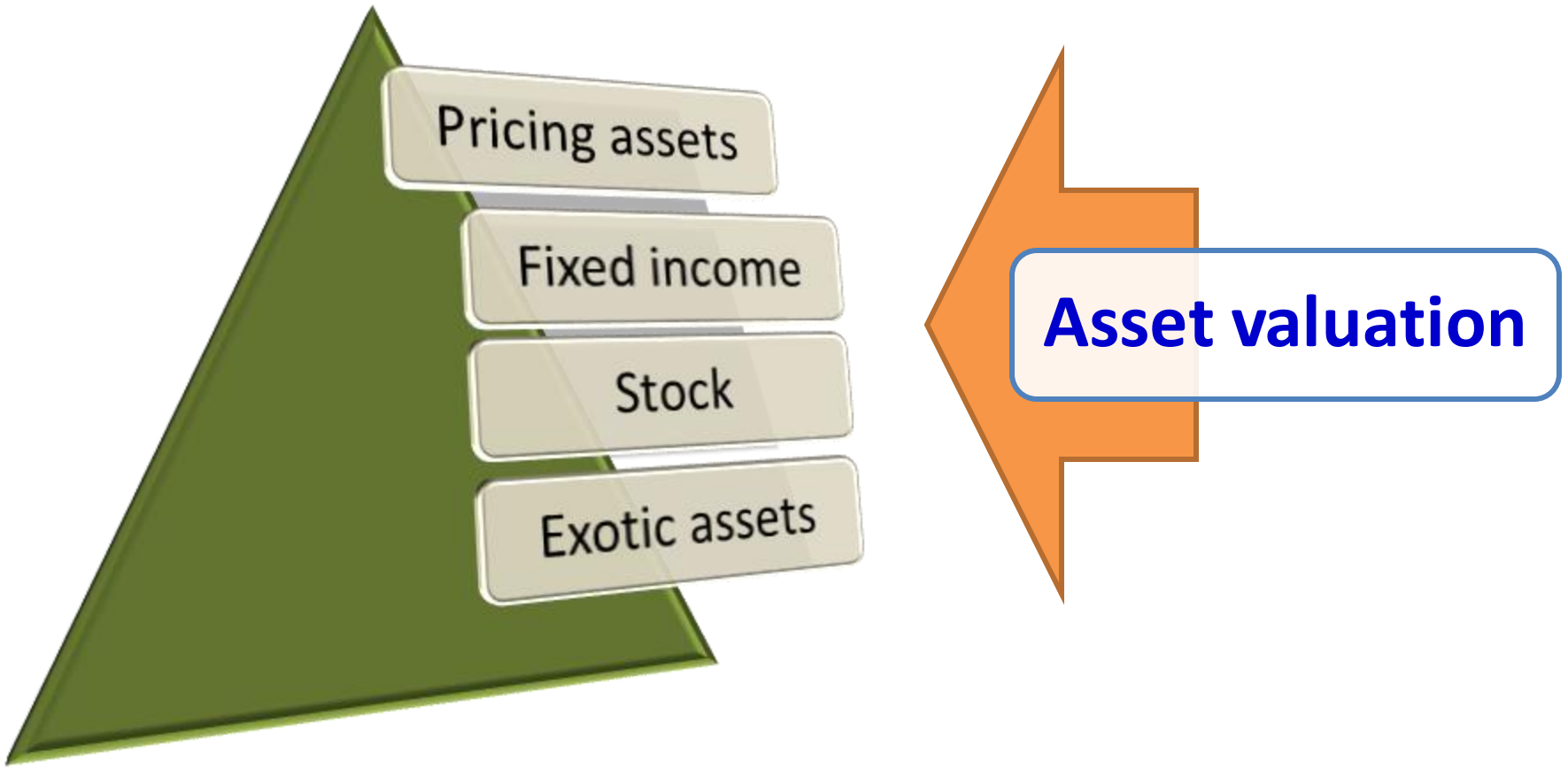
Roadmaps: *Principle of asset valuation*



Financial asset as an *apple* tree.

- Apple tree
  - Giving “apples” over time
  - Amount of apples might be certain/uncertain
- Asset
  - payment of cash-flow/pay-off in the future.
  - Risky and riskless cash-flow.

Valuation of an apple tree v.s. Valuation of cash-flow/pay-off

Principle of asset valuation 1

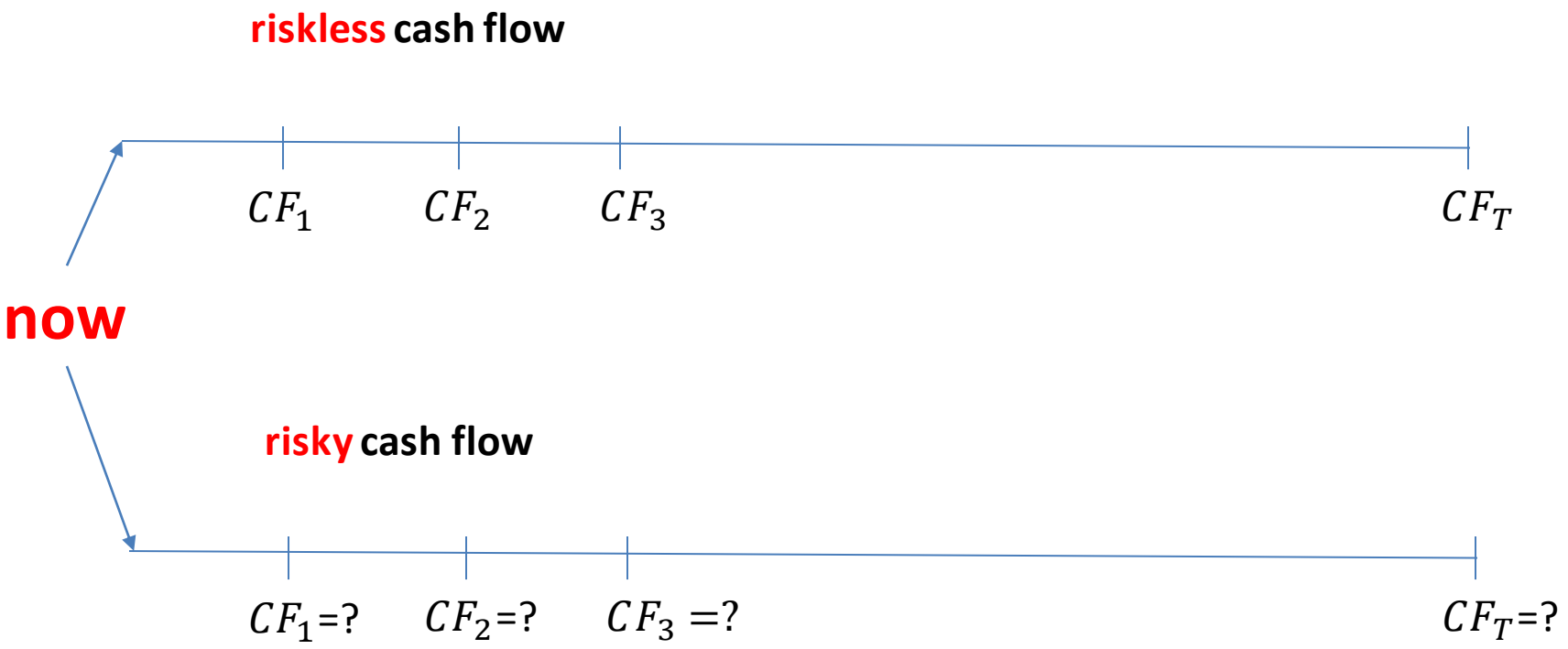
Asset valuation = *sum* of the *present value* of the *"remaining"* future cash flow delivered.

Remaining: Paid cash-flow do not matter!

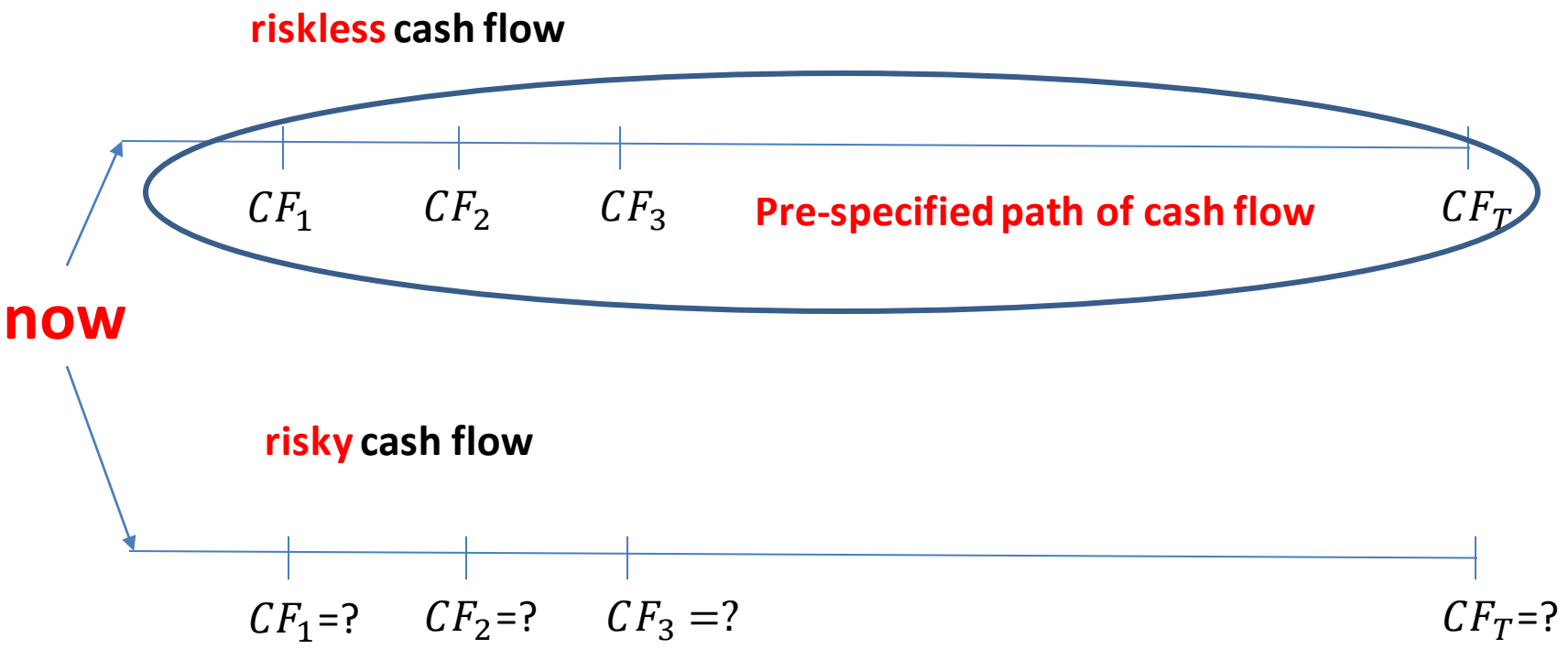
Principle of asset valuation 1

- Present value of the future cash flow?
  - Remaining cash flow to be delivered in the future.
  - Intuitively, direct sum doesn't make sense because of the time value of money.
    - Technically, for an infinite period of payment, direct sum does not produced a converged sum.
  - Future value must adjusted into the present value using a discount rate (r)
    - Required rate of return on investment

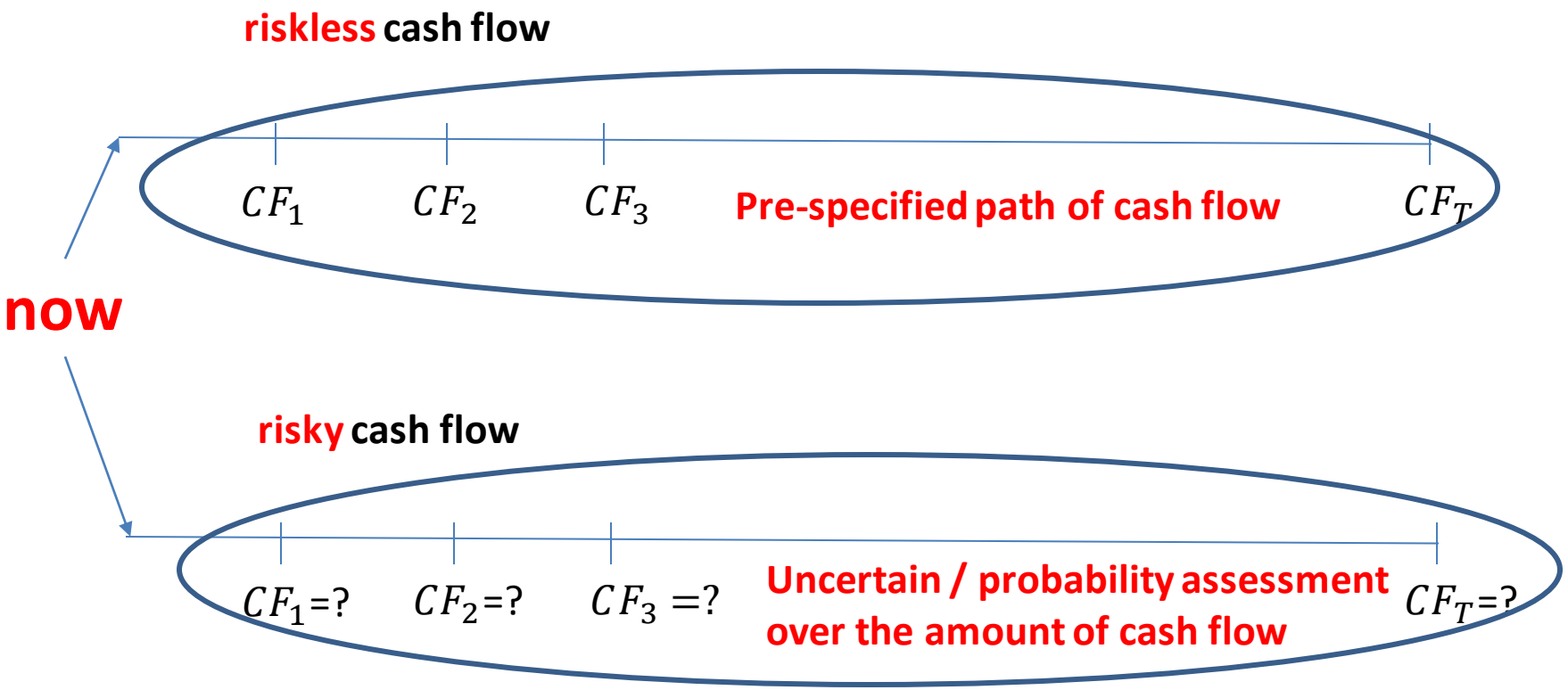
Risky and Riskless cash-flow



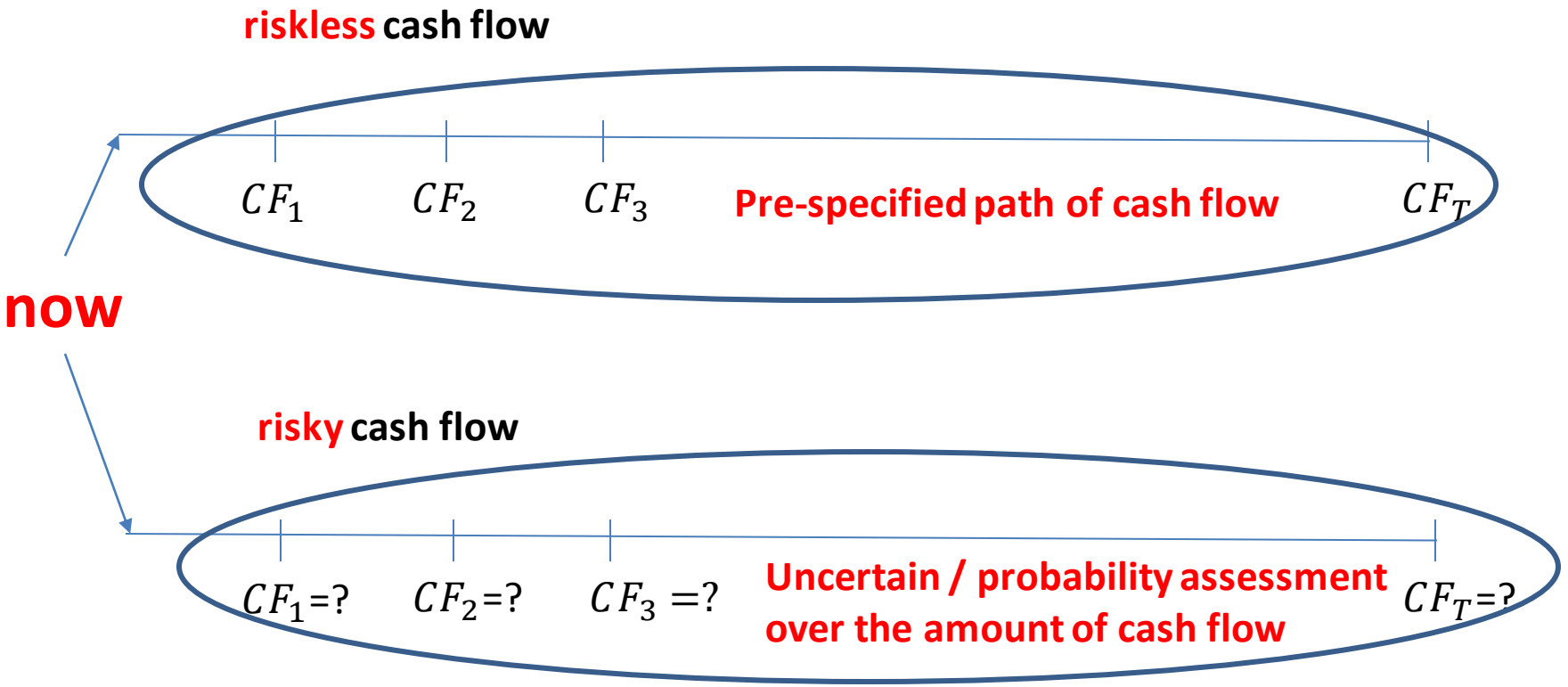
Risky and Riskless cash-flow



Risky and Riskless cash-flow



Risky and Riskless cash-flow



Single discount rate?: No, discount rate must reflect the nature of cash-flow received. Discount rate *must price-in risk* of the asset; the required rate of return.

Principle of asset valuation 1

- Valuation of asset with *riskless* cash flow

  r_f = discount rate for riskless asset

  – T finite period of cash flow

$$V_t = \frac{CF_1}{1+r_f} + \frac{CF_2}{(1+r_f)^2} + \cdots + \frac{CF_T}{(1+r_f)^T}$$

  – Infinite period of cash flow

$$V_t = \lim_{T\to\infty}\left(\frac{CF_1}{1+r_f} + \frac{CF_2}{(1+r_f)^2} + \cdots + \frac{CF_T}{(1+r_f)^T}\right)$$

Principle of asset valuation 1

- Valuation of asset with risky cash flow

Approach 1: Risk-adjusted discount rate method

$$V_t^j = \frac{E(CF_1)}{1+r_j} + \frac{E(CF_2)}{(1+r_j)^2} + \cdots + \frac{E(CF_T)}{(1+r_j)^T}$$

$$r_j = r_f + premium$$

Principle of asset valuation 1

Approach 2: Cash-flow adjusted method

$$V_t^j = \frac{E(CF_1) - \varphi}{1 + r_f} + \frac{E(CF_2) - \varphi}{(1 + r_f)^2} + \cdots + \frac{E(CF_T) - \varphi}{(1 + r_f)^T}$$

φ = adjustment factor

In practice: riskless/risky assets

- Riskless cash-flow = T-bill
  - Shot-term asset: T is very short!
  - Certain cash-flow asset, but longer "T", could be subjected to inflation risk and liquidity risk. Discount rate must be priced in accordingly.

- Risky cash-flow = Stock
  - Required rate of return: Beta-CAPM

Efficient market: pricing = "fair"/"fundamental" valuation

- Price of an asset reflects the fair value
  - Price < value ➔ buy more, price goes up.
  - Price > value ➔ sell out, price goes down.

- When price moves too far away from the fundamental value, we call "bubble".
  - Tulip bubble
  - Jap90 bubble
  - Dot-com bubble v.s. US House price bubble

Cautionary notes

- Asset pricing/valuation is NOT to explain how price is determined.
  - Asset pricing only tells us about the method that financial economists use to calculate the fair price of an asset.
  - This can be thought as a formula.

Cautionary notes

- Asset price determination will be relying on demand and supply of assets.
- Mechanically,
  - Each investor evaluates the value of asset using their own (*subjective*) discount rates ➔ demand for assets
  - Equilibrium price is determined by D = S.
    - Low valuation investors move out, only high-valuation investor stays. Price reflects the highest bid.
- Asset pricing formula only tells us the relationship between market price and market discount rate.

Example: riskless cash flow

- An asset is assumed to repay $100 to the holder one year from now. Current market price is assume to be $90. Calculate the market discount rate of the asset.

Example: risky cash flow

- Assuming on year from now, an asset is expected to repay $100 with the chance of 75%, and nothing with the chance of 25%. Suppose that current trading price is $50. Calculate the market discount rate of the asset. What about the spread?

Principle of asset valuation 2

Equivalent assets should be priced the same.

Equivalent assets

- Assets with the *identical* structure of cash-flow are called equivalent assets.

- Obvious, so why do we discuss about this?

Consider two primitive assets "A and B"

- Asset A: Govt 1 year zero-coupon (discount rate = 10%)
  - Cash flow = 110
  - Pricing today = 100.
- Asset B : Govt 2 year zero-coupon (discount rate = 15%)
  - Cash flow = 132.25
  - Pricing today = 100.

Now consider "C"

- Asset C: Asset with pre-specified payment
  - Cash-flow in 1st year = 55
  - Cash-flow in 2nd year = 132.25
- Never been traded before! (NO, market price can be observed.)
- How do we price "C"?

Replicating cash flow payments of Asset C.

- Having looked closedly, we note that cash flow of "C" can be replicated by the following method:

  half unit of A + one unit of B

- If you construct a portfolio with half unit of A and one unit of B, you would receive the cash flow payments, *exactly* equal to Asset C.

Equivalent asset should be priced the same.

- Then, price of asset "C" should be the same as price (cost) of the constructed portfolio.

$$P_c = \frac{1}{2} P_a + P_b$$

- Otherwise, arbitrage opportunity exists.
  - **Think about the law of price.**

Equivalent asset as a foundation for financial engineering!

- Most structured products/exotic assets are designed to give complicate pattern of cash-flow.

- One way to calculate its fair valuation is to *"STRIP"* those assets into pieces of basic (primitive) assets whose combination generate the identical pattern of cash-flow as those exotic assets.
  - *Replicating* cash-flow the structured asset with multiple assets whose underlying price are known.