Diversification

Asset return characteristics

Buy an asset (e.g. a stock) at $t = 0$ at price P_0. At time $t = 1$,

- its cash flow (dividend) is D_1, and
- its price is P_1

(both are random variables). The risk-free rate is r_F.

Realized return: $\boxed{r_1 = \frac{D_1+P_1}{P_0} - 1}$ Returns comes from both dividends and capital gains.

Expected return: $\boxed{E[r_1] = \frac{E[D_1]+E[P_1]}{P_0} - 1}$

Excess return: (realized) $\boxed{r_1 - r_F}$

Risk premium: (expected excess return) $\boxed{E[r_1] - r_F}$

Mean (average) return: $\boxed{\bar{r} = E[r] = \frac{1}{T}\sum_{t=1}^{T} r_t}$

Would be same as the expected return $E[r_t]$ if expected returns are constant for all t.

Options

Options: Derivative contracts specifying **a right** to **buy (call option)** or **sell (put option)** an underlying asset at a specified price K (the **strike/exercise price**) on or before a specified date T (the **expiration/maturity date**).

- **Call option**:: right to buy the underlying asset at the strike price.
- **Put option**:: right to sell the underlying asset at the strike price.

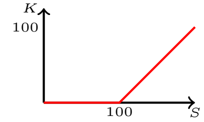
Exercise style:

- **American option**:: can be exercised at any time before expiration.
- **European option**:: can only be exercised at expiration.

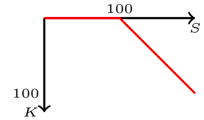
Option Payoff curves

- S: Price of the underlying asset at expiration
- K: Strike price of option
- Payoff ≠ Profit. To get profit (net payoff), need to subtract the option's cost.

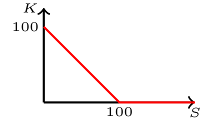
Payoff of buying a Call
$\max(0, S - K)$



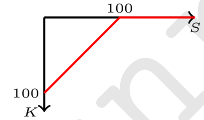
Payoff of selling a Call
$-\max(0, S - K)$



Payoff of buying a Put
$\max(0, K - S)$

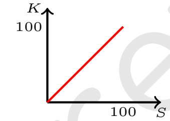


Payoff of selling a Put
$-\max(0, K - S)$

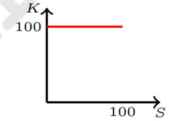


Payoff curves of other assets that can be used with options:

Payoff of underlying asset



Payoff of a \$100 FV ZC Bond



Option payoff and profit

- r: Risk-free interest rate (EAR)
- C: Call option price
- P: Put option price

Call option:

	$S < K$	$S = K$	$S > K$
Payoff	0	0	$S - K$
Profit	$-C(1+r)^T$	$-C(1+r)^T$	$S - K - C(1+r)$

Put option:

	$S < K$	$S = K$	$S > K$
Payoff	$K - S$	0	0
Profit	$K - S - P(1+r)^T$	$-P(1+r)^T$	$-P(1+r)$