Financial Engineering

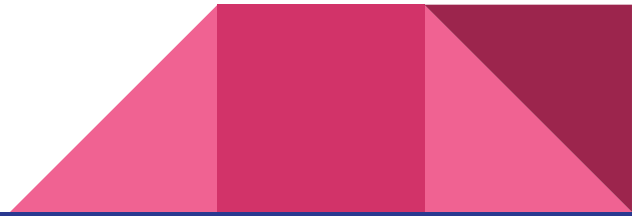
Basic Concepts

Financial Engineering - Concept

Financial engineering encompasses a broad, multidisciplinary field of study and practice that, essentially, applies an engineering approach and methodology to the world of finance.

It integrates and utilizes information obtained from different fields, such as economics, mathematics, computer science, and financial theory.

Financial engineering is used in a wide variety of areas in the financial services industry, including corporate finance, arbitrage trading, risk management, and the creation of financial derivative products.

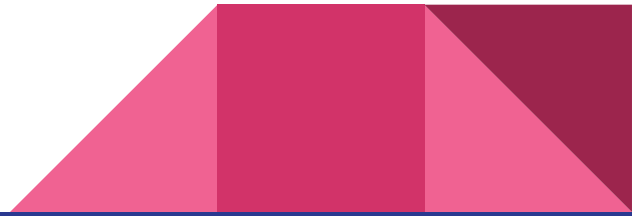


Finance Is All About Numbers

Financial engineering is aimed at solving specific tasks in Finance. As a general concept, these tasks are related to maximization of financial profit.

Since profit has numerical value, these tasks usually can be formulated in measurable (mathematical) terms and solved using logical approaches and programming.

Economical science has developed well recognized and widely used models and approaches to solving financial problems. Anyone with mathematical and engineering background can apply these general principles in real-life situations.



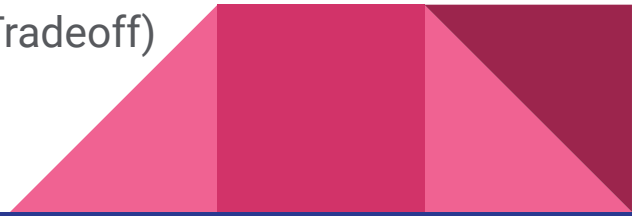
Basic Principles

Finance is a zero-sum game (“there is no free lunch”)

A dollar today is worth more than dollar tomorrow (Time Value of Money)

Market participants act in an economically reasonable manner (Rational Behaviour)

The higher the expected return, the higher the risk (Risk-Return Tradeoff)



A Bit More Technical

Let us define the function Profit (Underlying), where “Profit” is some metric of profit, or payment, and “Underlying” is a basic isolated variable, on which that metric depends.

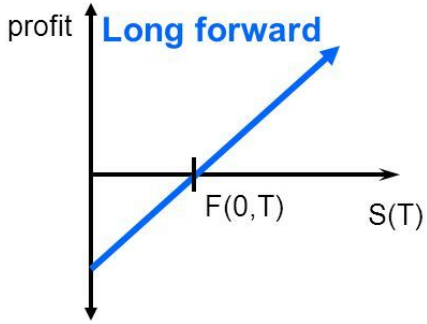
Example: your profit depends on number of hours you devoted to the job in a given week.

This function is continuous and according to Kolmogorov-Arnold representation theorem, can be represented as a finite composition of continuous functions of a single variable and the binary operation of addition.

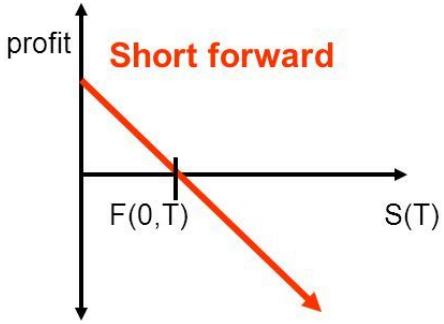
And here basic linear financial instruments, such as forwards and swaps, come into play.

$$f(\mathbf{x}) = f(x_1, \ldots, x_n) = \sum_{q=0}^{2n} \Phi_q \left(\sum_{p=1}^{n} \phi_{q,p}(x_p) \right)$$

Forwards

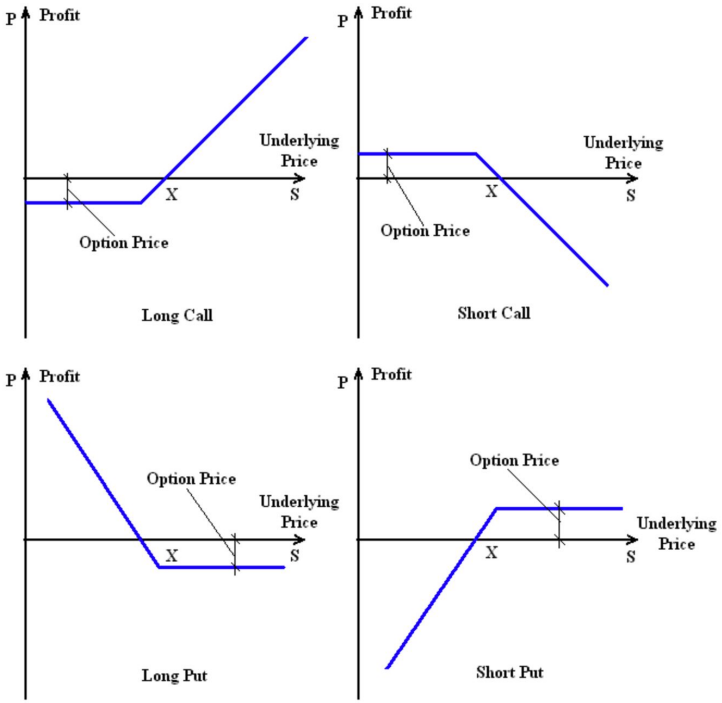


The long profits if the spot price at delivery, S(T), exceeds the original forward price, F(0,T).

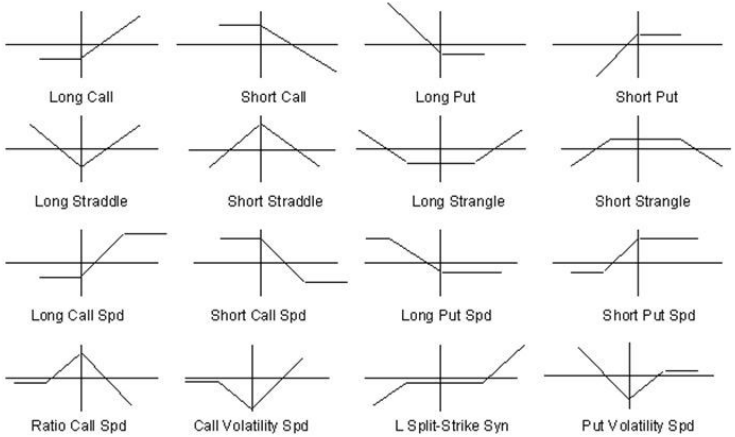


The short profits if the price at delivery, S(T), is below the original forward price, F(0,T).

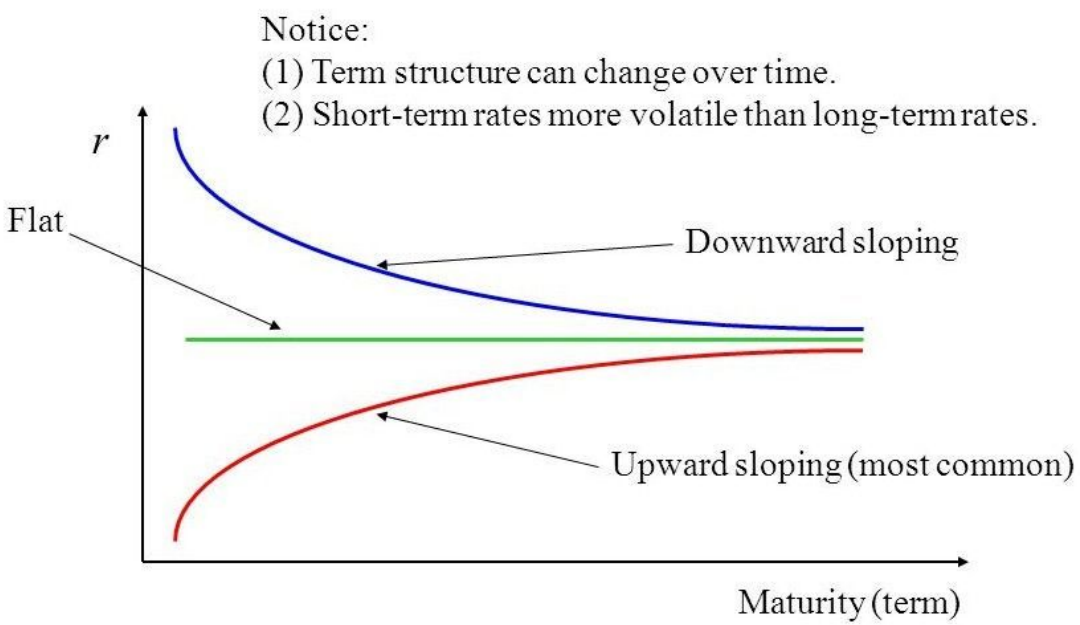
Options



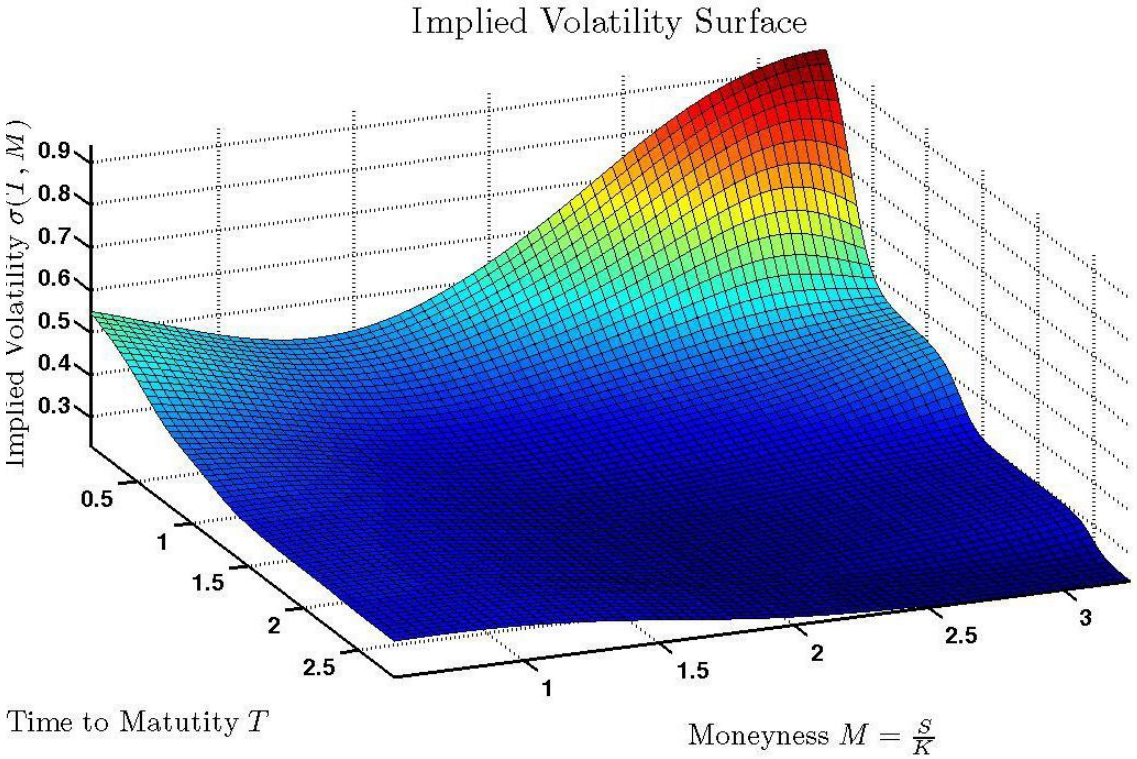
Some Options Strategy Payoffs



Interest Rates Curves



Volatility Surface



Questions and Answers