FX Option Pricing Example – EUR/USD

July 1, 2025

Overview

This document demonstrates the pricing of a short-term EUR/USD foreign exchange (FX) call option using the Garman–Kohlhagen adaptation of the Black–Scholes model. The data is based on real CME option quotes for the week of July 1, 2025.

C++ Implementation

The following code implements the analytical formula for pricing an FX European call option:

```
#include <iostream>
  #include <cmath>
  double norm_cdf(double x) {
      return 0.5 * std::erfc(-x / std::sqrt(2.0));
5
6
  double bsPrice(double SO, double K, double T,
                  double sigma, double r_d, double r_f) {
      double sigmaSqrtT = sigma * std::sqrt(T);
10
      double d1 = (std::log(S0 / K) + (r_d - r_f + 0.5 * sigma * sigma) * T) /
11
          sigmaSqrtT;
      double d2 = d1 - sigmaSqrtT;
13
      return S0 * std::exp(-r_f * T) * norm_cdf(d1)
            - K * std::exp(-r_d * T) * norm_cdf(d2);
14
15
  }
16
  int main() {
17
      double S0
                    = 1.1779;
                                      // Spot rate EUR/USD
18
                   = 1.1728;
                                      // Strike
      double K
19
                   = 7.0 / 365.0;
                                      // Time to maturity (7 days)
20
      double T
      double sigma = 0.0914;
                                      // Implied volatility (9.14%)
21
                                      // EUR interest rate
                  = 0.0215;
      double r_d
                                      // USD interest rate
                    = 0.0433;
23
      double r_f
24
      double price = bsPrice(S0, K, T, sigma, r_d, r_f);
25
26
      std::cout << "Call_Price_=_" << price << std::endl;
27
      return 0;
28
  }
29
```

Listing 1: Black-Scholes Pricing for EUR/USD Call Option

Input Parameters

As of July 1, 2025, the following market data was used:

- Spot FX rate $S_0 = 1.1779$
- Strike price K = 1.1728
- Time to expiry: $T = \frac{7}{365} \approx 0.01918$ years (for expiry on July 8, 2025)
- Implied volatility $\sigma = 9.14\%$
- EUR interest rate $r_d = 2.15\%$ (ECB MRO)
- USD interest rate $r_f = 4.33\%$ (Fed Effective Rate)

Market Snapshot and Volatility Source

The implied volatility used was taken from the Investing.com's options chain for EUR/USD options expiring on July 8, 2025, as shown below.

The row corresponding to a strike of 1.1728 shows an implied volatility of 9.14%, which we used as input for our model. The market mid-price for the option is approximately 0.00916, and our model returned a price of 0.00852, showing very close alignment.

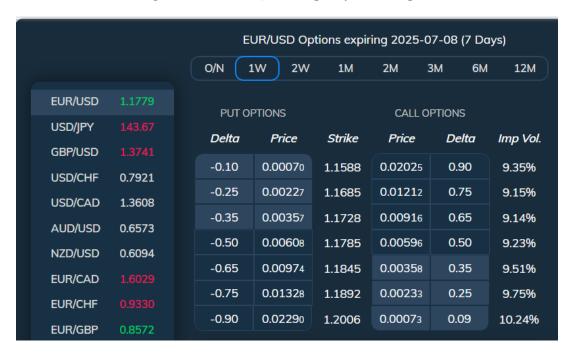


Figure 1: CME EUR/USD Options Chain Snapshot (Expiring July 8, 2025)