

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:

```
1 #include <iostream>
2 #include <cmath>
3
4 double norm_cdf(double x) {
5     return 0.5 * std::erfc(-x / std::sqrt(2.0));
6 }
7
8 double bsPrice(double S0, double K, double T,
9               double sigma, double r_d, double r_f) {
10     double sigmaSqrtT = sigma * std::sqrt(T);
11     double d1 = (std::log(S0 / K) + (r_d - r_f + 0.5 * sigma * sigma) * T) /
12               sigmaSqrtT;
13     double d2 = d1 - sigmaSqrtT;
14     return S0 * std::exp(-r_f * T) * norm_cdf(d1)
15           - K * std::exp(-r_d * T) * norm_cdf(d2);
16 }
17
18 int main() {
19     double S0 = 1.1779;           // Spot rate EUR/USD
20     double K = 1.1728;           // Strike
21     double T = 7.0 / 365.0;       // Time to maturity (7 days)
22     double sigma = 0.0914;        // Implied volatility (9.14%)
23     double r_d = 0.0215;          // EUR interest rate
24     double r_f = 0.0433;          // USD interest rate
25
26     double price = bsPrice(S0, K, T, sigma, r_d, r_f);
27
28     std::cout << "Call Price = " << price << std::endl;
29     return 0;
30 }
```

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.

EUR/USD Options expiring 2025-07-08 (7 Days)

O/N1W2W1M2M3M6M12M

EUR/USD1.1779

USD/JPY143.67

GBP/USD1.3741

USD/CHF0.7921

USD/CAD1.3608

AUD/USD0.6573

NZD/USD0.6094

EUR/CAD1.6029

EUR/CHF0.9330

EUR/GBP0.8572

PUT OPTIONS

Delta	Price	Strike	Price	Delta	Imp Vol.
-0.10	0.00070	1.1588	0.02025	0.90	9.35%
-0.25	0.00227	1.1685	0.01212	0.75	9.15%
-0.35	0.00357	1.1728	0.00916	0.65	9.14%
-0.50	0.00608	1.1785	0.00596	0.50	9.23%
-0.65	0.00974	1.1845	0.00358	0.35	9.51%
-0.75	0.01328	1.1892	0.00233	0.25	9.75%
-0.90	0.02290	1.2006	0.00073	0.09	10.24%

CALL OPTIONS

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