財務演算法期中作業
Black-Scholes Model Calculation

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Class架構介紹

Classes:

1. class OptionCalculator
   提供以下兩個class會用到的計算工具

2. class CallOptionCalculator : public OptionCalculator
   計算Black-Scholes call option 相關資訊

3. class PutOptionCalculator : public OptionCalculator
   計算Black-Scholes put option 相關資訊

class CallOptionCalculator 功能介紹

繼承class OptionCalculator的工具，計算B-S model call option相關數值

Funstions:

1. double calculate_call_price()
   計算call option的價格

2. void calculate_all_greeks()
   計算call option的各式greeks

3. double calculate_implied_volatility(const double& option_price)
   給定此Option的市場Premium，計算Implied Volatility

class PutOptionCalculator功能介紹

繼承class OptionCalculator的工具，計算B-S model put option相關數值

funstions:

1. double calculate_put_price()
   計算put option的價格

2. void calculate_all_greeks()
   計算put option的各式greeks

結果展示

```cpp
int main() {
    cout << "===========================================" << endl;
    // Calculate Black-Scholes call option price, greeks and implied volatility given market premium.
    // Inputs: stock_price, strike_price, time_to_expiry, risk_free_rate, volatility
    CallOptionCalculator callOptionCalculator(50, 50, 0.5, 0.1, 0.1);
    cout << "Call Price: " << callOptionCalculator.calculate_call_price() << endl;
    callOptionCalculator.calculate_all_greeks();
    callOptionCalculator.calculate_implied_volatility(2.5);  // Inputs: Premium

    cout << "===========================================" << endl;

    // Calculate Black-Scholes put option price and greeks.
    // Inputs: stock_price, strike_price, time_to_expiry, risk_free_rate, volatility
    PutOptionCalculator putOptionCalculator(100, 100, 1, 0.1, 0.1);
    cout << "Put Price: " << putOptionCalculator.calculate_put_price() << endl;
    putOptionCalculator.calculate_all_greeks();
    cout << "===========================================" << endl;

    return 0;
}
```

```
===========================
Call Price: 2.92514
Delta: 0.771096
Gamma: 0.085655
Vega: 10.7069
Theta: -4.63366
Rho: 17.8148
Implied Volatility:0.0500427
===========================
Put Price: 0.791893
Delta: -0.146859
Gamma: 0.0229882
Vega: 22.9882
Theta: 0.398369
Rho: -15.4778
===========================
```