1dimension_BSDE

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```
In [1]: from BSDE import *
        from AmericanOption import *
        import warnings
        warnings.filterwarnings("ignore")
```

0.1 1D european call option with different interest rates

Reference Price : 7.15 (Black-Scholes) _____

0.1.1 Using LSM

```
In [2]: T = 0.5
        m = 6
        K = 100
        S0 = 100
        sigma = 0.2
        r = 0.04
        N = 10000
        mu = 0.06
        R = 0.06
        q = 0.
        RF_n_trees = 100
        RF_max_leaf_nodes = 50
```

```
In [3]: M_run = 20

        a = np.zeros(M_run)
        for i in range (M_run):
            test = BSDE (S0, K, T, mu, sigma, q)
            a[i] = test.get_price_lsm(R, r, N, m, oType = "European")
        min_a = min(a)
        max_a = max(a)
        mean_a = np.mean(a)
        std_a = np.std(a)
        print ("mean = " + str(mean_a))
        print ("std = " + str(std_a))
        print ("min = " + str(min_a))
        print ("max = " + str(max_a))
```

```
mean = 7.19746568856
std = 0.0928440647899
min = 7.03586872887
max = 7.34249957199
```

0.1.2 Using RandomForest

```
In [4]: M_run = 20

        a = np.zeros(M_run)
        for i in range (M_run):
            test = BSDE (S0, K, T, mu, sigma, q)
            a[i] = test.get_price_RF(R, r, N, m, oType = 'European')
        min_a = min(a)
        max_a = max(a)
        mean_a = np.mean(a)
        std_a = np.std(a)
        print ("mean = " + str(mean_a))
        print ("std = " + str(std_a))
        print ("min = " + str(min_a))
        print ("max = " + str(max_a))
```

```
mean = 7.22296927156
std = 0.110848562063
min = 7.01081755601
max = 7.47076250335
```

0.2 1D european combined call option with different interest rates

Reference Price : 2.95 (Gobet)

```
In [5]: T = 0.25
        m = 6
        K = 100
        S0 = 100
        sigma = 0.2
        r = 0.01
        N = 10000
        mu = 0.05
        R = 0.06
        q = 0.
        RF_n_trees = 100
        RF_max_leaf_nodes = 50
```

0.2.1 Using LSM

```
In [6]: M_run = 20

        a = np.zeros(M_run)
        for i in range (M_run):
            test = BSDE (S0, K, T, mu, sigma, q)
            a[i] = test.get_price_lsm(R, r, N, m, oPayoff = "call combination", oType = "European")
        min_a = min(a)
        max_a = max(a)
        mean_a = np.mean(a)
        std_a = np.std(a)
        print ("mean = " + str(mean_a))
        print ("std = " + str(std_a))
        print ("min = " + str(min_a))
        print ("max = " + str(max_a))
```

```
mean = 2.77808009334
std = 0.0319749152948
min = 2.7122404761
max = 2.84009700784
```

0.2.2 Using RF

```
In [7]: M_run = 20

        a = np.zeros(M_run)
        for i in range (M_run):
            test = BSDE (S0, K, T, mu, sigma, q)
            a[i] = test.get_price_RF(R, r, N, m,oPayoff = "call combination", oType = 'European')
        min_a = min(a)
        max_a = max(a)
        mean_a = np.mean(a)
        std_a = np.std(a)
        print ("mean = " + str(mean_a))
        print ("std = " + str(std_a))
        print ("min = " + str(min_a))
        print ("max = " + str(max_a))
```

```
mean = 2.79147632385
std = 0.0448490329195
min = 2.66671451516
max = 2.85766191283
```

0.3 p Dimensions max call option

Reference Price : 23.052 (Glasserman)

```
In [10]: from BSDE import *

         T = 3
         m = 8
         p = 5
         K = 100.
         r = 0.05
         R = 0.05
         M = np.eye(p)
         S_init = 100.
         mu = 0.05
         sigma = 0.2
         N = 4000
         Q = 0.1
         RF_n_estimators = 100
         RF_max_leaf_nodes = 50
```

```
In [12]: M_run = 20

         a = np.zeros(M_run)
```

```
for i in range (M_run):
    test_hd = BsdeHD(T, K, M, mu, Q, sigma, S_init, r, R)
    a[i] = test_hd.get_price(N,m, RF_n_estimators,RF_max_leaf_nodes,
                  option_type = 'call', option_payoff = 'max', oType= 'European', n_picard= 10

min_a = min(a)
max_a = max(a)
mean_a = np.mean(a)
std_a = np.std(a)
print ("mean = " + str(mean_a))
print ("std = " + str(std_a))
print ("min = " + str(min_a))
print ("max = " + str(max_a))
```

```
mean = 22.8492092684
std = 0.342877130217
min = 21.907038331
max = 23.5028304485
```