# pDimensions_bid_ask

September 7, 2016

## 1 BSDE

In [1]:
```
from BSDE import *
from AmericanOption import *
```

### 1.1 Let's try with the following example from Xia's Msc

Payoff : geometric average Option type : European call Bid-Ask, ie different interest rates He gets a price of 2.70, whereas the following gives us 3.35 in average

Actually, I think this is what we should get, as the tenant of the option uses R to borrow and hedge his risk. Using R in B-S model (the 7 assets are independant so we have a closed formula), we get a price of 3.30 .

I can implement other example from articles for p Dimensions for bid-ask problem, but I have not find any .

In [6]:
```
%%timeit

T = 0.5
m = 4
p = 7
K = 100.
r = 0.04
R = 0.06
M = np.eye(p)
S_init = 100.
mu = 0.06
sigma = 0.2
N = 10000
Q = 0.
RF_n_estimators = 100
RF_max_leaf_nodes = 10

test_hd = BsdeHD(T, K, M, mu, Q, sigma, S_init, r, R)

print(test_hd.get_price(N,m, RF_n_estimators,RF_max_leaf_nodes,
                        option_type = 'call', option_payoff='geometric', oType= 'European', n_picard=5
```

```
3.42521438924
3.39490947424
3.35757310854
3.30787570573
1 loop, best of 3: 7min 39s per loop
```

In [7]:
```
M_run = 20

        T = 0.5
        m = 4
        p = 7
        K = 100.
        r = 0.04
        R = 0.06
        M = np.eye(p)
        S_init = 100.
        mu = 0.06
        sigma = 0.2
        N = 10000
        Q = 0.
        RF_n_estimators = 100
        RF_max_leaf_nodes = 10

        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 = 'geometric', oType= 'European', n_picar
        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 = 3.38468405454
std = 0.0346809009399
min = 3.31806309153
max = 3.45577767316
```

## 1.2 Conclusion

The Method seems good, both in bid-ask model, and one interest rate model, even if more statistics are needed to get a rigorous conclusion. However, the next steps could be the following :

- Variance reduction
- performance enhancement, timing is high, even if picard_iteration is demanding