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```
%%Assignment 1
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```

1a

```
clear
clc
global S0 r sigma T K
S0=100;   %Initial stock price
K=90; %Strike price
r=0.02; %risk-free rate
h=0.25; %length of the period in years
T=4; %# of periods
u=exp((r*h)+0.2*sqrt(h));   %up move
d=exp((r*h)-0.2*sqrt(h)); %down move

% Straddle is long call and long put on the same strike.
% The sum of the two values should lead to value of straddle

[~,optionprice1,hedgeportfoliostock1,hedgeportfolioriskfree1]=...
    EuropeanPricing(S0,@CallPayoff,r,h,u,d,T,0,[]);
[~,optionprice2,hedgeportfoliostock2,hedgeportfolioriskfree2]=...
    EuropeanPricing(S0,@PutPayoff,r,h,u,d,T,0,[]);

straddlePrice = optionprice1{T+1,1} + optionprice2{T+1,1};

straddlePrice
```

```
straddlePrice =

   18.4891
```

```
        *So the straddle Price is 18.4891*
```

1b

```
S0=100;
K=90;
T = 40;
r=0.02;
h = 0.025;
u=exp((r*h)+0.2*sqrt(h));
d=exp((r*h)-0.2*sqrt(h));

[~,optionprice1,hedgeportfoliostock1,hedgeportfolioriskfree1]=...
    EuropeanPricing(S0,@CallPayoff,r,h,u,d,T,0,[]);
[stockprice2,optionprice2,hedgeportfoliostock2,hedgeportfolioriskfree2]=...
    EuropeanPricing(S0,@PutPayoff,r,h,u,d,T,0,[]);

straddlePrice = optionprice1{T+1,1} + optionprice2{T+1,1}
```

```
straddlePrice =

   17.7555
```

So the straddle Price is 17.7555

1c

```
%Binary Payoff - If above K, option returns is K. If less than K,
 option
%returns 0s
S0=100;   %Initial stock price
K=90; %Strike price
r=0.02; %risk-free rate
h=0.25; %length of the period in years
T=4; %# of periods
u=exp((r*h)+0.2*sqrt(h));   %up move
d=exp((r*h)-0.2*sqrt(h)); %down move

[stockprice1,optionprice1,hedgeportfoliostock1,hedgeportfolioriskfree1]=...
    EuropeanPricing(S0,@BinaryPayoff,r,h,u,d,T,0,[]);

binaryCallPrice = optionprice1{T+1,1}
```

```
binaryCallPrice =

   63.6274
```

The binary call option price is 63.6274

2a

American Option

```
K=10;
r = 0.01;
h = 1/365;
S0 = 10;
T=250;
u=exp((r*h)+0.15*sqrt(h));
d=exp((r*h)-0.15*sqrt(h));

[~,callPrices,hedgeportfoliostock,hedgeportfolioriskfree,exerciseDate]=...
    AmericanPricing(S0,@CallPayoff,r,h,u,d,T,0,[]);
callPrices{T+1,1}

[~,putPrices,hedgeportfoliostock1,hedgeportfolioriskfree1,exerciseDate1]=...
    AmericanPricing(S0,@PutPayoff,r,h,u,d,T,0,[]);
putPrices{T+1,1}
```

```
ans =

    0.5286


ans =

    0.4653
```

Price of American Call Option is 0.5286 Price of American Call Option is 0.4653

3a

Discrete Dividends Option

```
S0=10;   %Initial stock price
K=10; %Strike price
r=0.02; %risk-free rate
h=1/365; %length of the period in years
T=200; %# of periods
u=exp(0.2*sqrt(h));   %up move
d=exp(-0.2*sqrt(h)); %down move
delta = 0.05;
DivDate = [50,100,150];

[stockprice,putPrice,hedgeportfoliostock,hedgeportfolioriskfree,exerciseDate]=...

 DiscreteDividendsPricing(S0,@PutPayoff,'American',r,h,u,d,DivDate,delta,T);
putPrice{T+1,1}
[stockprice1,callPrice,hedgeportfoliostock1,hedgeportfolioriskfree1,exerciseDate1]
```

```
 DiscreteDividendsPricing(S0,@CallPayoff,'American',r,h,u,d,DivDate,delta,T);
callPrice{T+1,1}
```

```
ans =

    1.4560


ans =

    0.3399
```

American Put option with dividend is worth 1.456 American Call option with dividend is worth 0.3399

3b

```
S0=10;   %Initial stock price
K=10; %Strike price
r=0.02; %risk-free rate
h=1/365; %length of the period in years
T=200; %# of periods
u=exp(0.2*sqrt(h));   %up move
d=exp(-0.2*sqrt(h)); %down move
delta = 0.05;
DivDate = [50,100,150];

[stockprice1,straddlePrice,hedgeportfoliostock,hedgeportfolioriskfree,exerciseDate

 DiscreteDividendsPricing(S0,@StraddlePayoff,'American',r,h,u,d,DivDate,delta,T);
straddlePrice{T+1,1}
```

```
ans =

    1.6420
```

The American straddle price with dividend is 1.642. It is less than the sum of call and put american option with dividend. This is because the when looked at it seperately, we can excercise the put and call at seperate dates to maximize the returns, which is not possible in a straddle, as we exercise both components at the same time

4

Asian Options

```
S0=200;   %Initial stock price
K=220; %Strike price
r=0.02; %risk-free rate
sigma = 0.2; %standard deviation
```

```
h=1/365; %length of the period in years
T=1; %# of periods
NoOfPaths = 100000;

randn('seed',0);
pathPayoffs = zeros(NoOfPaths,1);

for path = 1:NoOfPaths
    stockPrices = GenerateStockPath(S0,r,T,h,sigma);
    pathPayoffs(path) = max(mean(stockPrices)-K,0);
end
montecarloprice = mean(pathPayoffs) * exp(-r * T)

sd = std(pathPayoffs * exp(-r * T))/sqrt(length(pathPayoffs));
CIInterval = [montecarloprice - (1.96*sd),montecarloprice + (1.96*sd)]
```

```
montecarloprice =

    3.2299


CIInterval =

    3.1749    3.2849
```

The monte carlo price is 3.2299 The Confidence interval at 95% confidence is (3.1749,3.2849)

5a

American Option LMC

```
S0=200;   %Initial stock price
K=220; %Strike price
r=0.1; %risk-free rate
sigma = 0.3; %standard deviation
N=250; %length of the period in years
T=1; %# of periods
NoOfPaths = 100000;

randn('seed',0);
price = LSLeastSquares(N,NoOfPaths)
```

```
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price =

   22.2625
```

```
%price from the Least squares calculation is 22.2625
%
```

5b

```
S0=200;   %Initial stock price
K=220; %Strike price
r=0.1; %risk-free rate
sigma = 0.3; %standard deviation
N=250; %length of the period in years
T=1; %# of periods

NoOfPaths = [10 100 1000 10000 100000];
priceResult = zeros(5,2);
priceResult(:,1) = NoOfPaths;
for pathCount = 1:length(priceResult)
    priceResult(pathCount,2) =
 LSLeastSquares(N,priceResult(pathCount,1));
end
bar(priceResult(:,2))
set(gca,'xticklabel',NoOfPaths)

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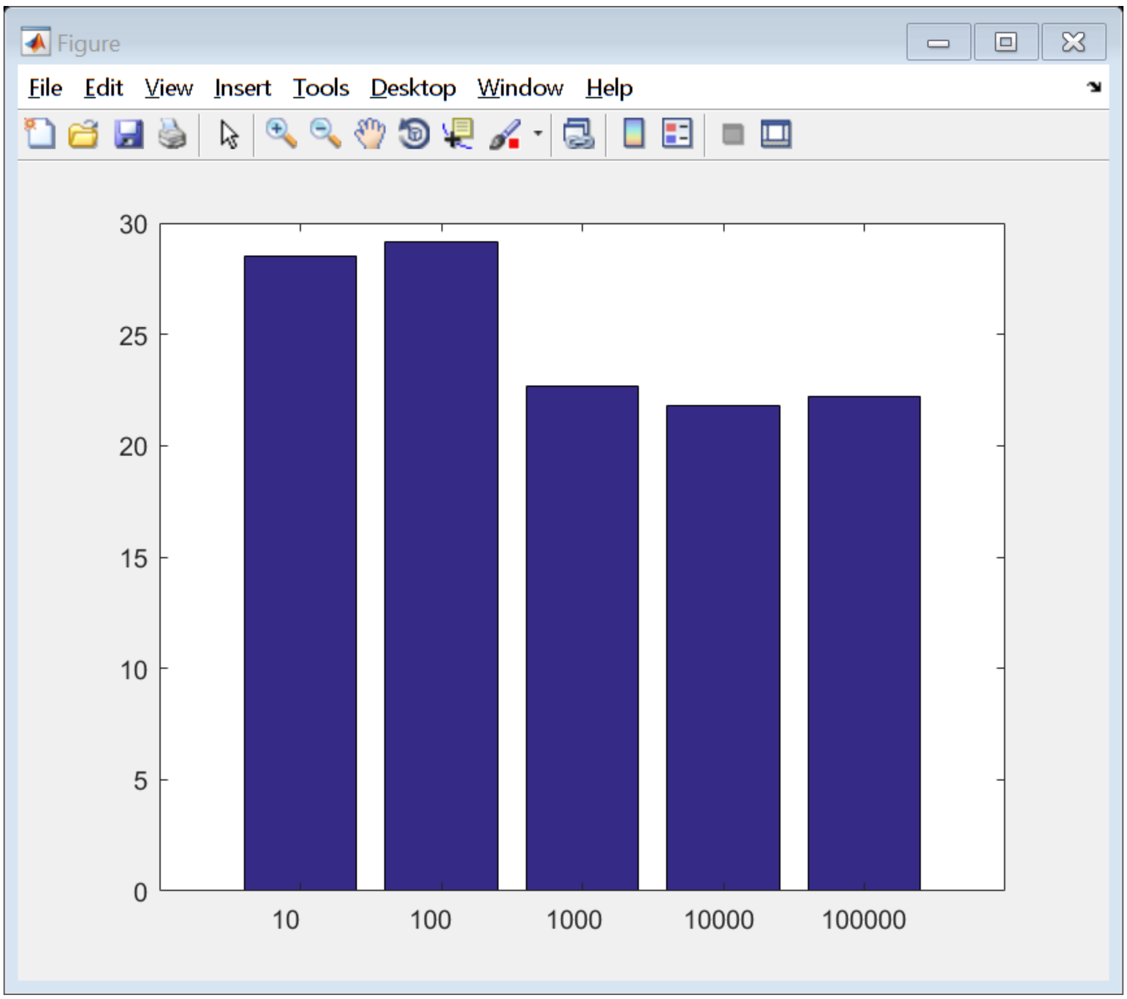

5c

```
S0=200;   %Initial stock price
K=220; %Strike price
r=0.1; %risk-free rate
sigma = 0.3; %standard deviation
NoOfPaths=100000; %length of the period in years
T=1; %# of periods

N = [3 10 100 250 1000];
priceResult = zeros(5,2);
priceResult(:,1) = N;
for pathCount = 1:length(priceResult)
    priceResult(pathCount,2) =
 LSLeastSquares(priceResult(pathCount,1),NoOfPaths);
end
bar(priceResult(:,2))
set(gca,'xticklabel',N)
```

```
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