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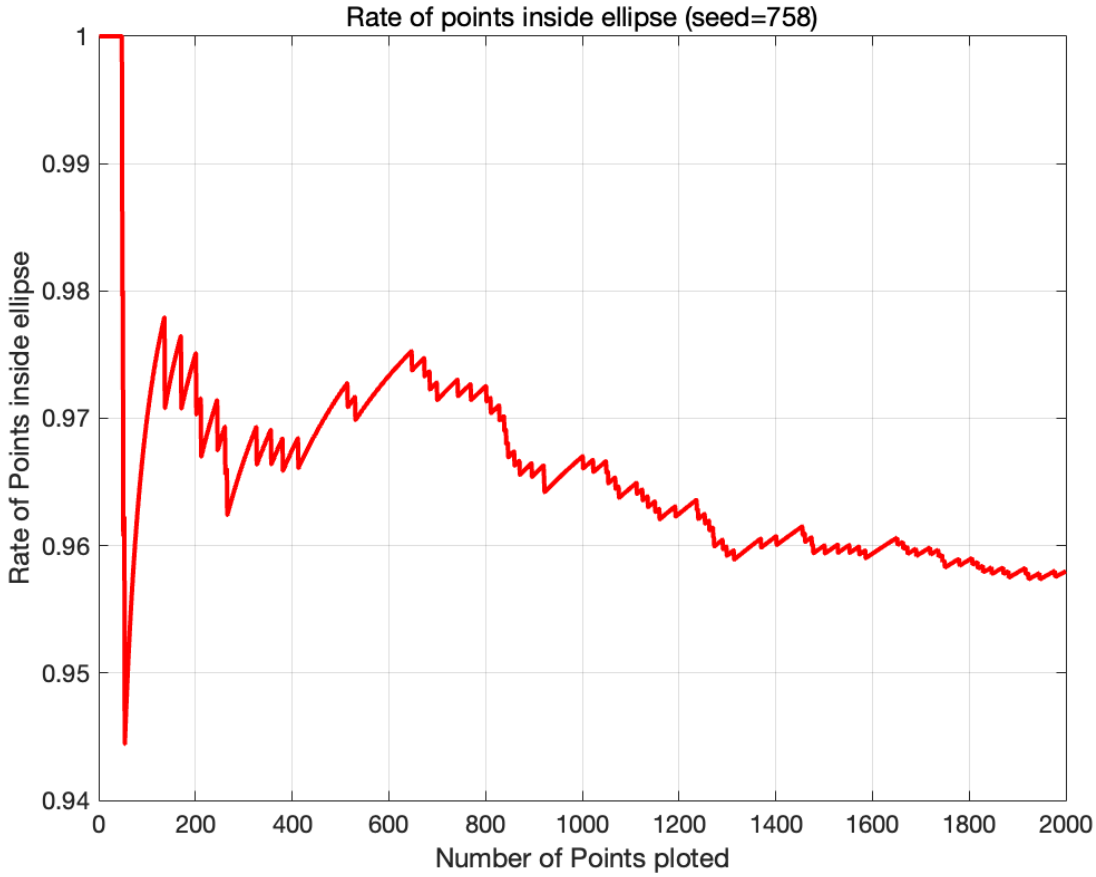
Question 1

```
close all;
nSamples=2000;
seed=758;
rand('seed',seed);
Ninside=0;
rateInside=zeros(nSamples,1);

for n=1:nSamples
 d=rand(1,1);
    x=4*d-2;
    d=rand(1,1);
    y=2*d-1;
    if((x^2+y^2)<=4)
        Ninside=Ninside+1;
    end
    rateInside(n)=Ninside/n
end

plot(rateInside,'r-','linewidth',2);
title(sprintf('Rate of points inside ellipse (seed=%d)',seed));
xlabel('Number of Points ploted');
ylabel('Rate of Points inside ellipse');
grid on

pause

print -dpsc2 dart.eps
close
```


Rate of points inside ellipse (seed=758)
Rate of Points inside ellipse
Number of Points ploted
1
0.99
0.98
0.97
0.96
0.95
0.94
0
200
400
600
800
1000
1200
1400
1600
1800
2000

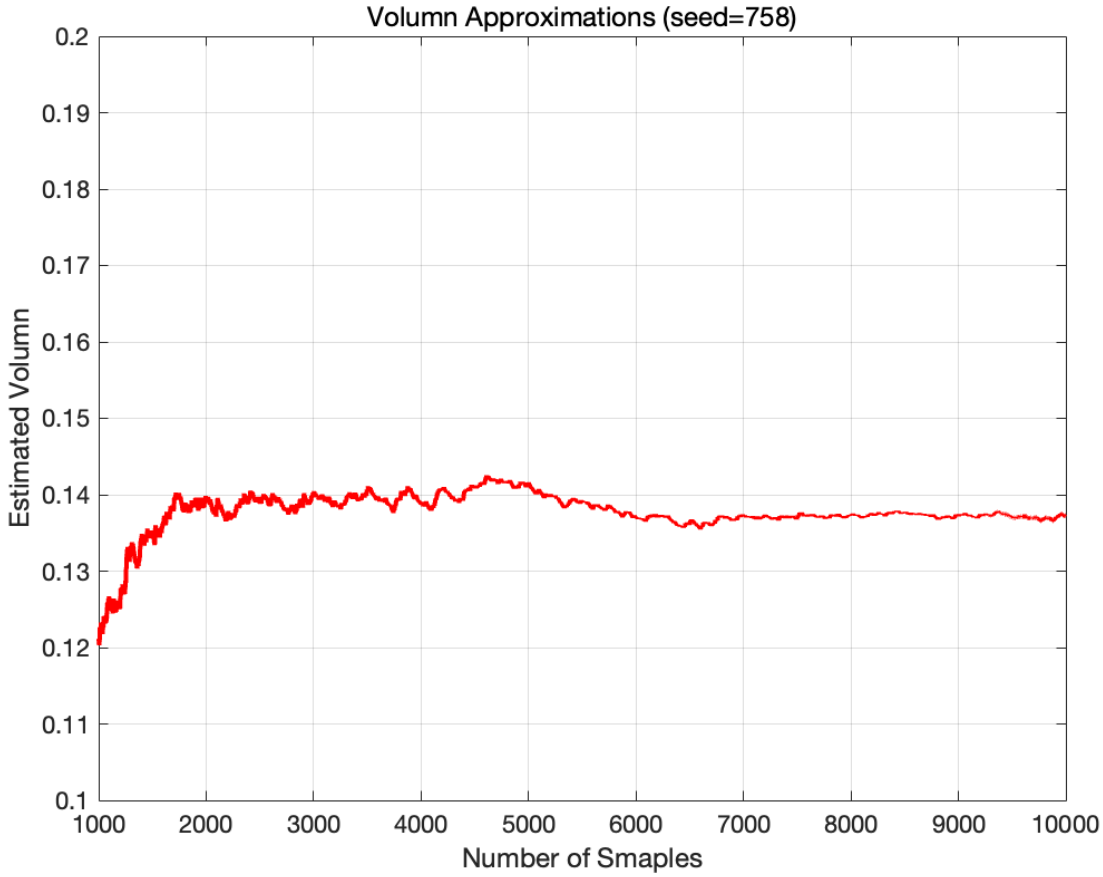
Question 2

```
close all;
nSample=10000;
seed=758;
rand('seed',seed);
Nsatisfied=0;
proportion=0;

for m=1:nSample
    d=rand(1,1);
    if((40*(d^2)+7)>(43*d))
        Nsatisfied=Nsatisfied+1;
    end
    if(m==1000)
        proportion=Nsatisfied/m;
        printf('Number of points = %d, proportion satisfied = %f',m,proportion)
    end
end
proportion=Nsatisfied/10000;
sprintf('Number of points = 10000, proportion satisfied = %f',proportion)
```

- Number of points = 1000, proportion satisfied = 0.327000
- Number of points = 10000, proportion satisfied = 0.332400

Question 3

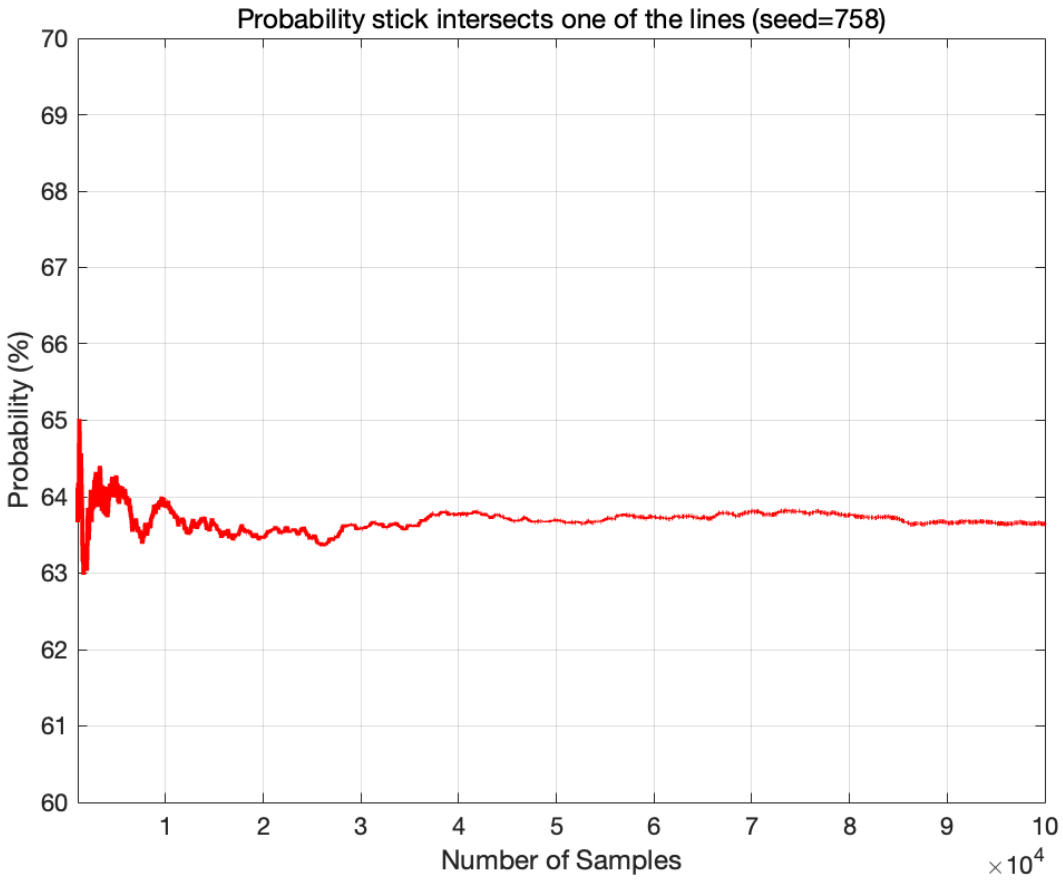
```
close all;
nSamples=10000;
seed=758;
rand('seed',seed);
Ninside=0;
Volumn=zeros(nSamples,1);

for m=1:nSamples
   x=rand(1,1);
   y=rand(1,1);
   z=rand(1,1);
   if(((x^2+sin(y))<=z) & ((x-z+exp(y))<=1))
       Ninside=Ninside+1;
   end
   Volumn(m)=Ninside/m;
end

plot(Volumn,'r-','linewidth',2);
title(sprintf('Volumn Approximations (seed=%d)',seed));
xlabel('Number of Smaples');
ylabel('Estimated Volumn');
axis([1000,10000 0.1 0.2]);
grid on

pause
print -dpsc2 volumn.eps
close
```


Volumn Approximations (seed=758)
Estimated Volumn
Number of Smaples
0.2
0.19
0.18
0.17
0.16
0.15
0.14
0.13
0.12
0.11
0.1
1000
2000
3000
4000
5000
6000
7000
8000
9000
10000

Question 4

```
close all;
nSamples=100000;
seed=758;
rand('seed',seed);
count=0;  % count stores the number of satisfied samples
Pvalue=zeros(nSamples,1);  % Pvalue stores the probabilities wrt number of samples

% Set the coordinate on the board, and assume that the two parallel lines
%   are y=0 and y=1. Since the board are infinitely on x and y direction,
%   therefore, when make a random point, x-value for the point is not
%   important, we only need to randomize the y-value of the point and the
%   direction of the stick.
for m=1:nSamples
    % we first random select the y-value of the center of the stick
    y=rand(1,1);
    % then we get the direction of the stick
    r=rand(1,1);
    % Due to the symmetry, we only need to random the direction in [0,pi)
    d=pi*r;
    % since the stick is unit long, only y(center)=0.5 and d=pi/2 can
    % intersects both parallel lines. We can separate the problem into 3
    % cases.

    % first case is y==0.5
    % this case, stick has no way to intersects one of the lines, thus
    % nothing changes.

    if(y>0.5)
        % in this case, stick can only intersects with the upper line, or
        % does not intersect with any lines.
        % len is the distance from center to the nearest line
        len = 1-y;
        % angle is the angle between the stick and the norm of the line
        angle = abs(pi/2 - d);
        if((0.5*cos(angle))>=len)
            % in this case stick intersects with the upper line
            count=count+1;
        end
    elseif(y<0.5)
        % similar to the previous case, but this time is lower line.
        % len is the distance from center to the nearest line
        len = y;
        % angle is the angle between the stick and the norm of the line
        angle = (pi/2 - d);
        if((0.5*cos(angle))>=len)
            % in this case stick intersects with the lower line
            count=count+1;
        end
    end
    % Pvalue stores the percentage, so 100 is multiplied
```

```
    Pvalue(m)=(count/m)*100;
end

plot(Pvalue,'r-','linewidth',2);
title(sprintf('Probability stick intersects one of the lines (seed=%d)',seed));
xlabel('Number of Samples');
ylabel('Probability (%)');
axis([1000,100000,60,70]);
grid on

pause
print -dpsc2 prob.eps
close
```


Probability stick intersects one of the lines (seed=758)
Probability (%)
70
69
68
67
66
65
64
63
62
61
60
1
2
3
4
5
6
7
8
9
10
Number of Samples
×10^4