Assignment No:3

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Likelihood Function

```
function [outputArg] = likelihood(snrSamples,range)
    % Task 2
    meanSnr = measurementFunction(range);
    outputArg = (1/meanSnr)*exp(-snrSamples/meanSnr);
end
```

Measurement Function

```
function meanSnr = measurementFunction(range)
    % Task 1
    range_0 = 10.0;
    meanSnr = ((range_0./range).^2);
end
```

Main Function

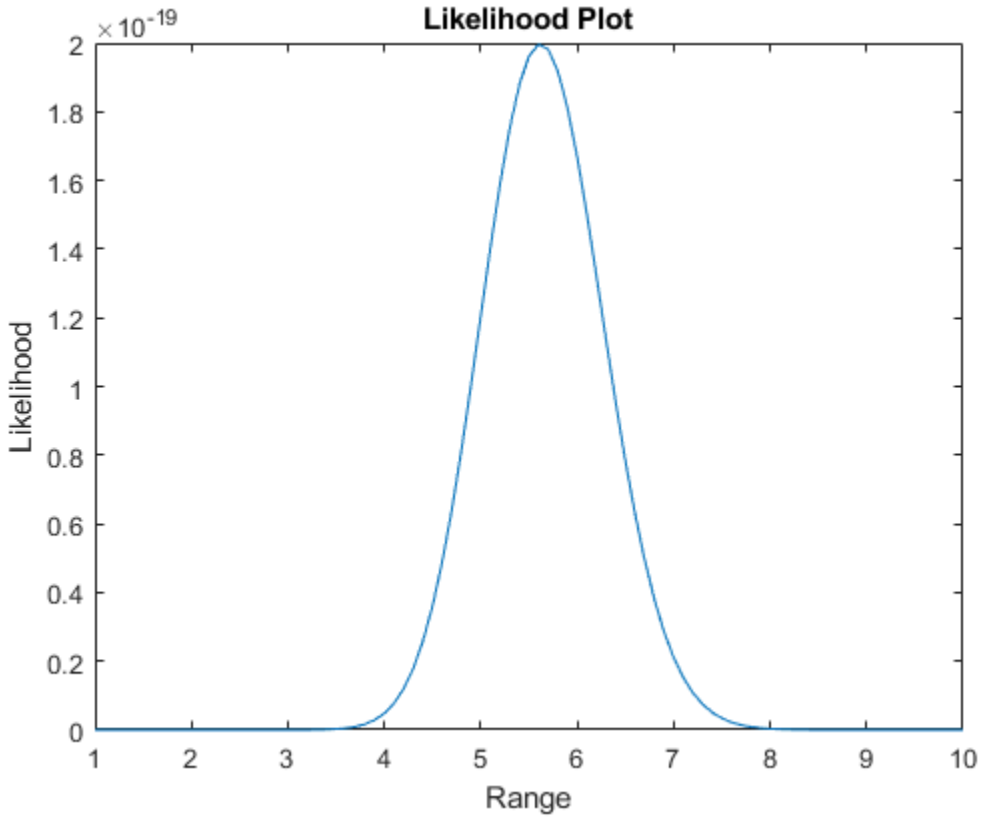
```
close all
clear all
load('data.mat')

% TIP: Use figure handles and fmin, example:
funcHandle = @(x)-sin(x);
maxim = fminbnd(funcHandle,0,pi);
% Maximum comes out at pi/2 as expected
```

Plot the likelihood as a function of range Task 3

```
figure;
Samples = data;
range = 1:0.1:10;
range_0 = 10;
likeLihood = zeros(length(range),1);
```

```
ele = 1;
for r=range
    LikeL = likelihood(Samples, r);
    likeLihood(ele) = prod(LikeL, 'all');
    ele = ele + 1;
end
plot(range, likeLihood);
title('Likelihood Plot');
xlabel('Range');
ylabel('Likelihood');
```



Find maximum likelihood estimate

```
% Task 4
fhandle = @(r) -prod(likelihood(Samples, r), 'all');
mleEstimate = fminbnd(fhandle, 1, 10)
```

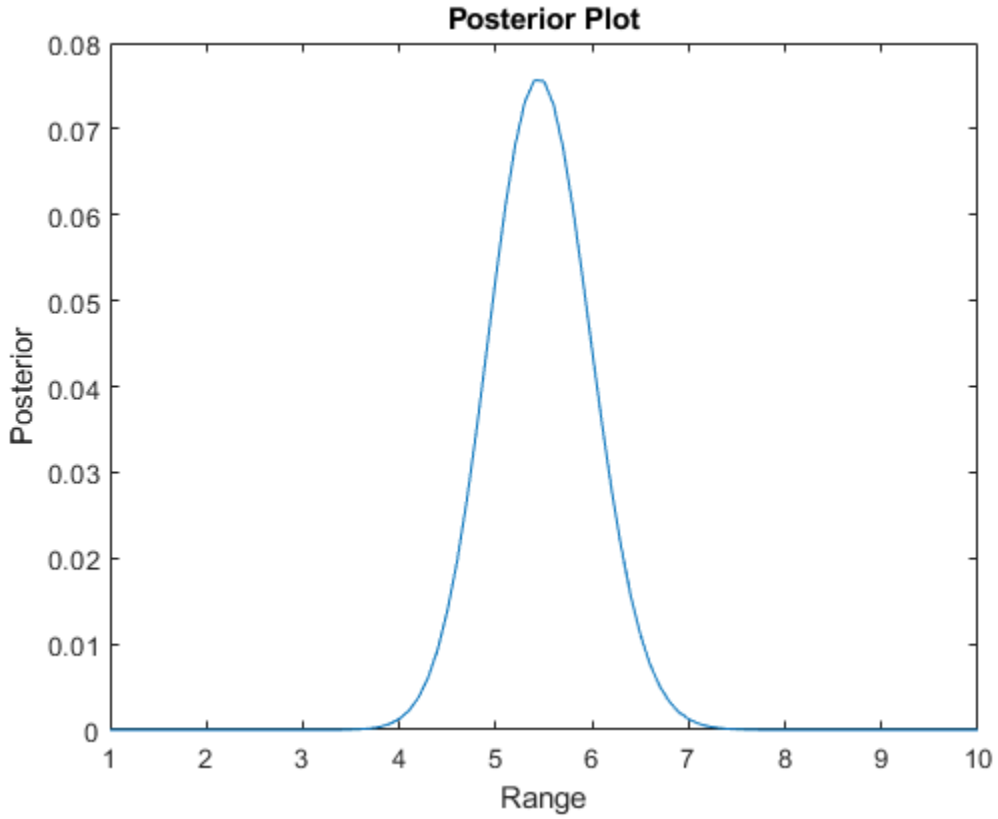
```
mleEstimate =

    5.6190
```

Plot the posterior as a function of range Task 5

```
figure;
```

```
posterior = zeros(length(range),1);
ele = 1;
for r=range
    posterior(ele) = prod(likelihood(Samples, r), 'all')*(1/sqrt(2*pi))*exp(-
(r-5)^2/(2));
    ele = ele +1;
end
posterior = posterior/sum(posterior);
plot(range, posterior);
title('Posterior Plot');
xlabel('Range');
ylabel('Posterior');
```



Find maximum as posteriori estimate Task 6

```
priorMean = 5;
priorStd = 1;

fmap = @(r) -prod(likelihood(Samples, r), 'all')*(1/sqrt(2*pi))*exp(-(r-5)^2/
(2));
mapEstimate = fminbnd(fmap, 1, 10)
```

```
mapEstimate =

    5.4458
```

How does it vary in comparison to the maximum likelihood estimate? Task 7

In Maximum a Posteriori, a prior knowledge about the parameter is included while calculating it, while there is no prior included in Maximum Likelihood Estimation. Therefore the mapEstimation achieves better or nearer value to the real parameter.

Find least squares estimate Task 8

```
lsEstimate = sqrt(range_0^2/mean(Samples))
```

```
lsEstimate =

    5.6190
```

Find the MMSE estimate Task 9

```
mmseEstimate = sum(posterior.*range')
```

```
mmseEstimate =

    5.4649
```

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