Estimation, Information Fusion and Machine Learning - Exercise 3

Table of Contents

Name: Abhishek Ganesh, Mat. No.: 429205

"Likelihood.m"

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

"measurementFunction.m"

```matlab
function meanSnr = measurementFunction(range)
    % Task 1
    r_0 = 10.0;
    meanSnr = (r_0/range)^2;
end
```

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

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

Plot the likelihood as a function of range Task 3

```matlab
figure;
range_r = 1:0.1:10;
```

```
r_0 = 10;
ll = zeros(length(range_r),1);
i = 1;
for r=range_r
    likelihood_values = likelihood(data, r);
    ll(i) = prod(likelihood_values, 'all');
    i = i + 1;
end
plot(range_r, ll);
ylabel('Likelihood v/s Range');
xlabel('Range');
title('Likelihood Plot');
```
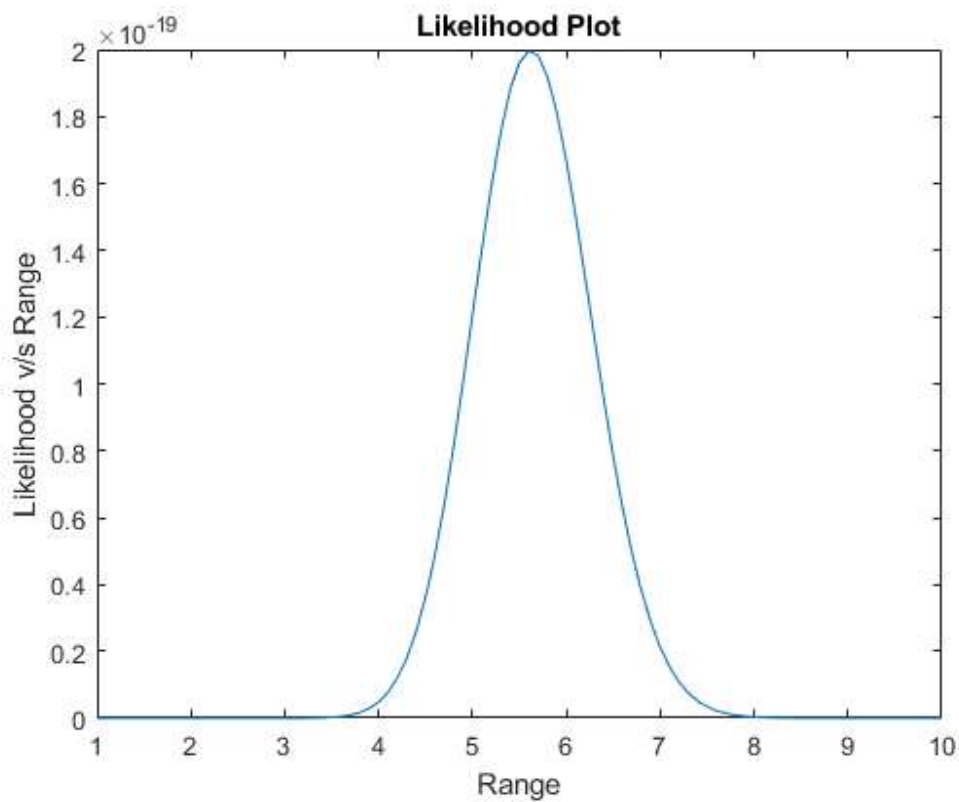

Find maximum likelihood estimate Task 4

```
fhandle = @(r) -prod(likelihood(data, r), 'all');
mleEstimate = fminbnd(fhandle, 1, 10)
```
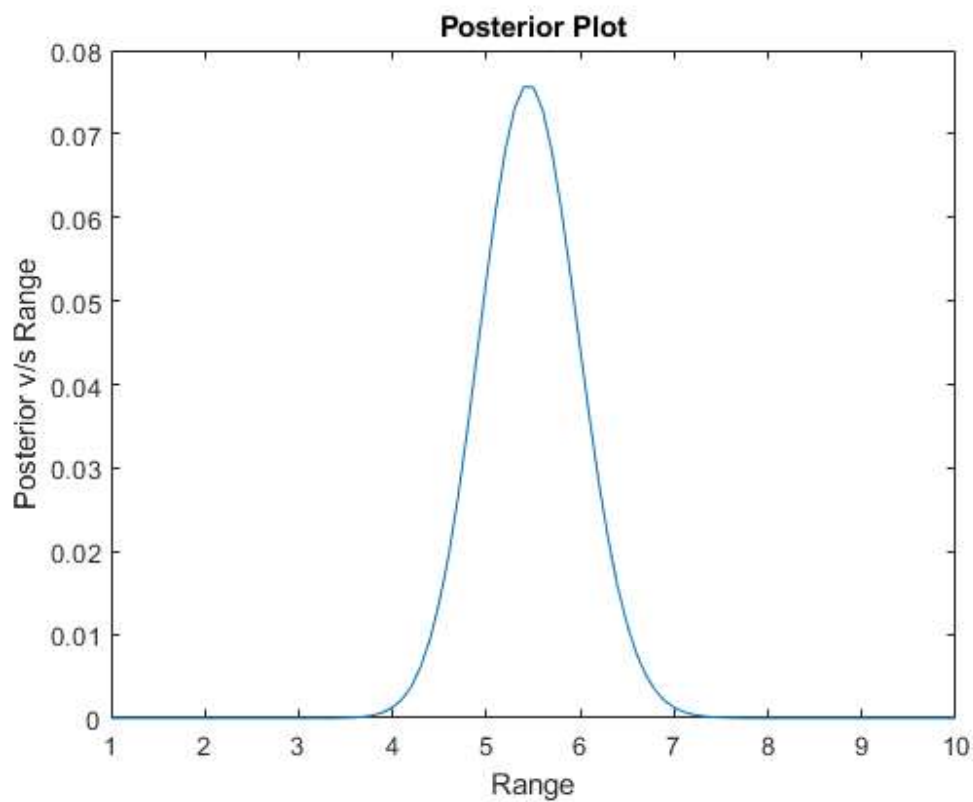
mleEstimate =

    5.6190

Plot the posterior as a function of range Task 5

```
figure;
```

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


Find maximum as posteriori estimate Task 6

```
priorMean = 5;
priorStd = 1;

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


mapEstimate =

    5.4458
```

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

```
%%Maximum-A-Posteriori includes a prior knowledge about the parameter in
 the calculation of posterior while there is no prior included in Maximum
 Likelihood Estimation. Therefore the MAP Estimator is closer to the mean
 value as compared to the MLE Estimator.
```

Find least squares estimate Task 8

```
lsEstimate = sqrt(r_0^2/mean(data))
```

lsEstimate =

*   5.6190*

Find the MMSE estimate Task 9

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

mmseEstimate =

*   5.4649*

Published with MATLAB® R2021b