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## Initialize variables

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```
clear; clc; close all;
rng(1);
N_list = [5, 10, 20, 40, 60, 80, 100, 500, 1000, 10000];
M = 100;

% For a Gaussian with known sigma
% MLE of mean = sample mean

var_pr1 = 1;
mu_data = 10;
var_data = 16;
mu_pr1 = 10.5;

err_MLE = zeros(M,length(N_list));
err_MAP1 = zeros(M,length(N_list));
err_MAP2 = zeros(M,length(N_list));
```

## Loop through the input

---

```
for iter = 1:length(N_list)
    N = N_list(iter);
    sample_var = var_data / N;
    for i = 1:M
```

## Draw data samples

---

```
X = (randn(N, 1) * 4) + 10;
```

## Calculate MLE

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For Guassian, MLE of mean with known sigma will be the sample mean

```
sample_mean = mean(X);
```

## Calculate the estimate of MAP1

---

For a Gaussian Prior, The posterior will be a gaussian, with mean and variance as discussed in the lecture.

```
gaussian_mu = ((sample_mean*var_pr1)+(mu_pr1*sample_var))/(sample_var + var_pr1);
```

### Calculate the estimate of MAP2

In this case, the Posterior will be a refined Gaussian, truncated about the mean.

```
if(gaussian_mu < 9.5)
    trunc_gauss = 9.5;
elseif(gaussian_mu > 11.5)
    trunc_gauss = 11.5;
else
    trunc_gauss = gaussian_mu;
end
```

### Update errors in the matrices

```
err1 = abs(sample_mean - mu_data)/mu_data;
err2 = abs(gaussian_mu - mu_data)/mu_data;
err3 = abs(trunc_gauss - mu_data)/mu_data;
err_MLE(i, iter) = err1;
err_MAP1(i, iter) = err2;
err_MAP2(i, iter) = err3;
```

```
end
end
```

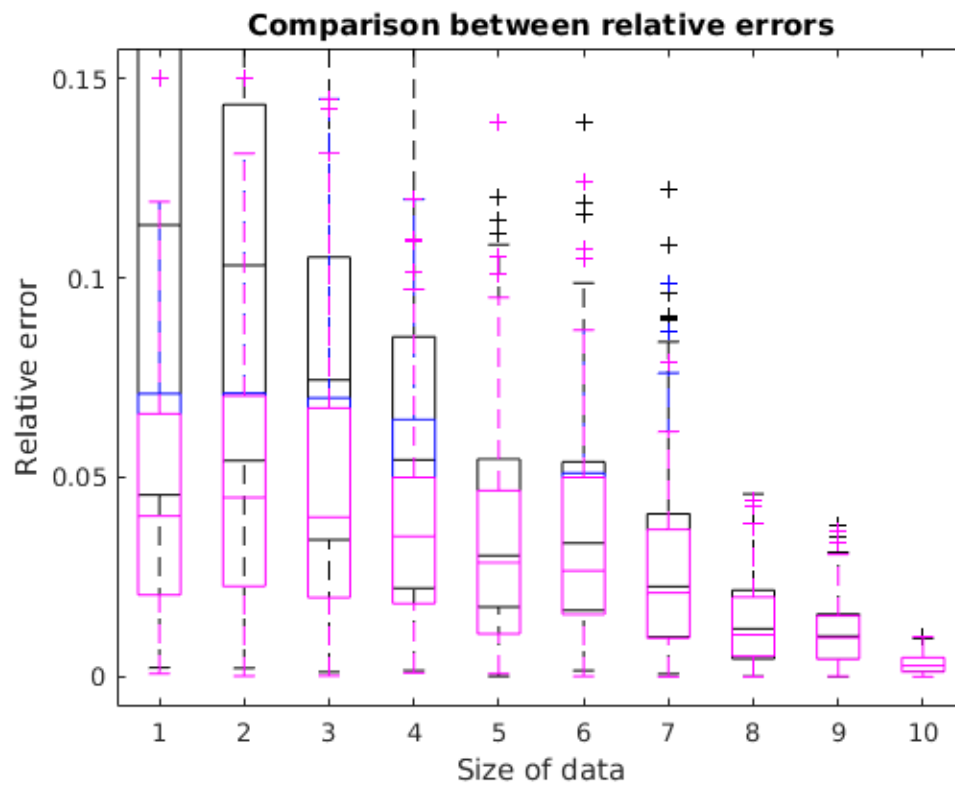
### Plot the data!

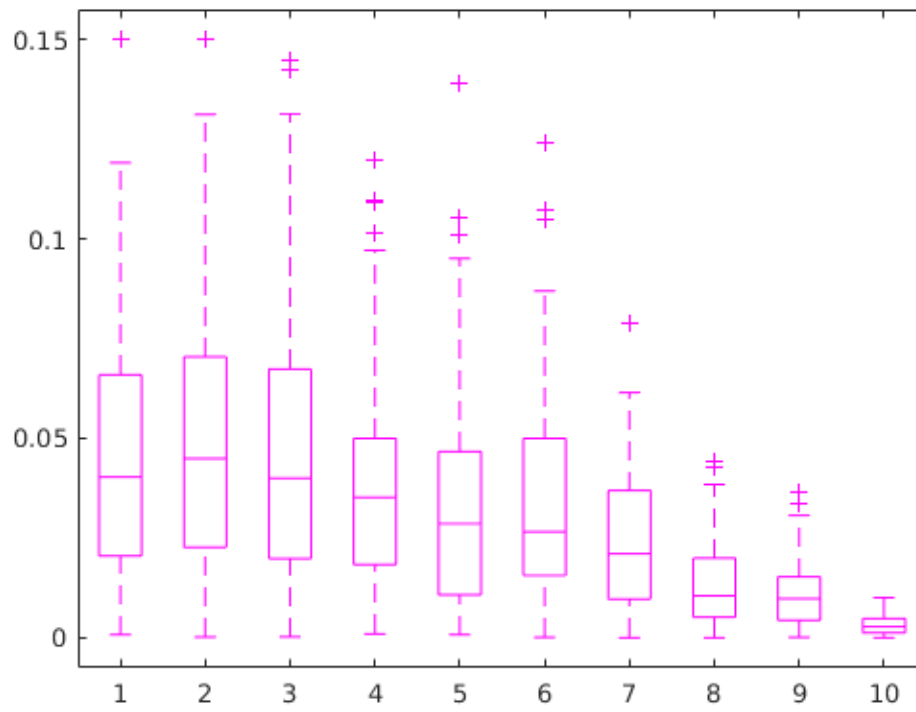
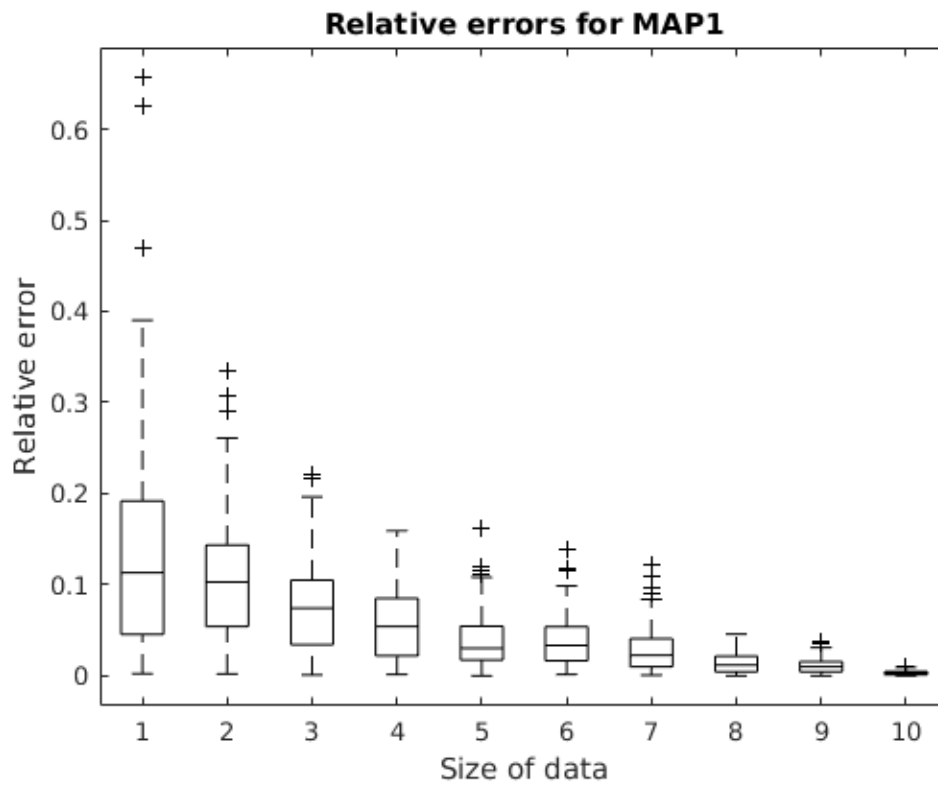
```
figure(1);
boxplot(err_MLE, 'COLOR', 'k', 'Symbol', 'k+');
hold on;
boxplot(err_MAP1, 'COLOR', 'b', 'Symbol', 'b+');
hold on;
boxplot(err_MAP2, 'COLOR', 'm', 'Symbol', 'm+');
hold on;
xlabel('Size of data');
ylabel('Relative error');
title('Comparison between relative errors');

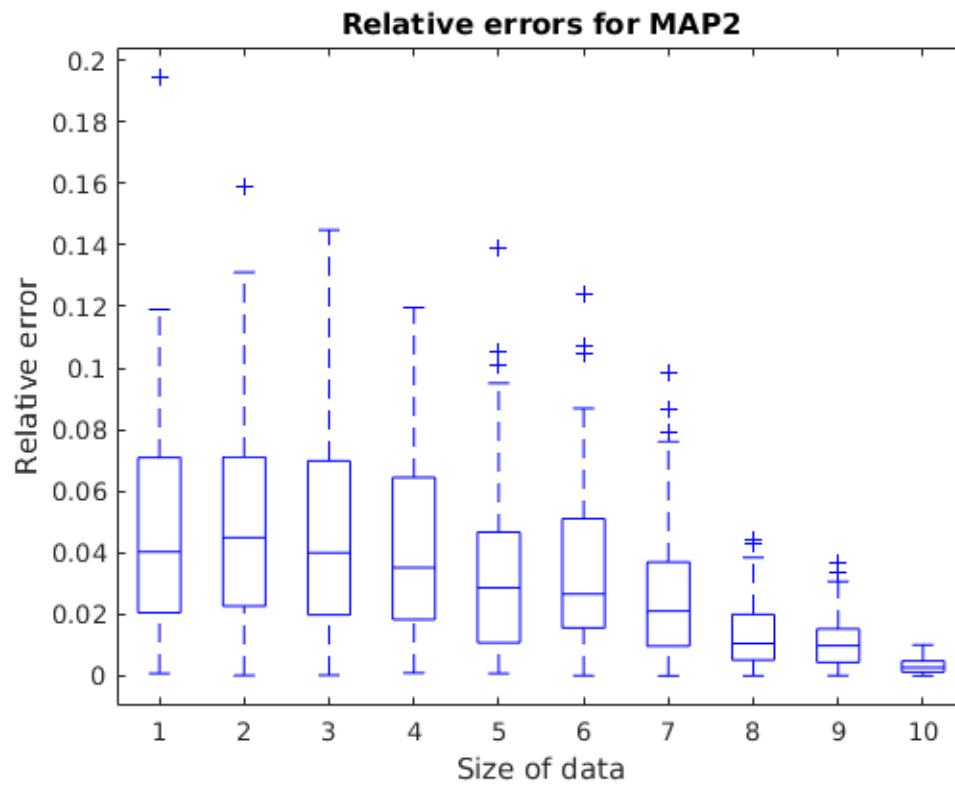
figure(2);
boxplot(err_MLE, 'COLOR', 'k', 'Symbol', 'k+');
hold on;
xlabel('Size of data');
ylabel('Relative error');
title('Relative errors for MLE');

figure(3);
boxplot(err_MAP1, 'COLOR', 'b', 'Symbol', 'b+');
hold on;
```

```
xlabel('Size of data');  
ylabel('Relative error');  
title('Relative errors for MAP1');  
  
figure(4);  
boxplot(err_MAP2, 'COLOR', 'm', 'Symbol', 'm+');  
hold on;  
xlabel('Size of data');  
ylabel('Relative error');  
title('Relative errors for MAP2');
```







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Published with MATLAB® R2015b