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Warming up

1.1 What is the Problem?

**1.2 Quality and Types of Errors - part 1**

1.2 Quality and Types of Errors - part 2

1.3 Elements of the Estimation Problem

**Assessment**Graded Assignment due Feb 8, 2017 17:30 IST **Q&A Forum****Feedback**

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## Exercises: Random errors

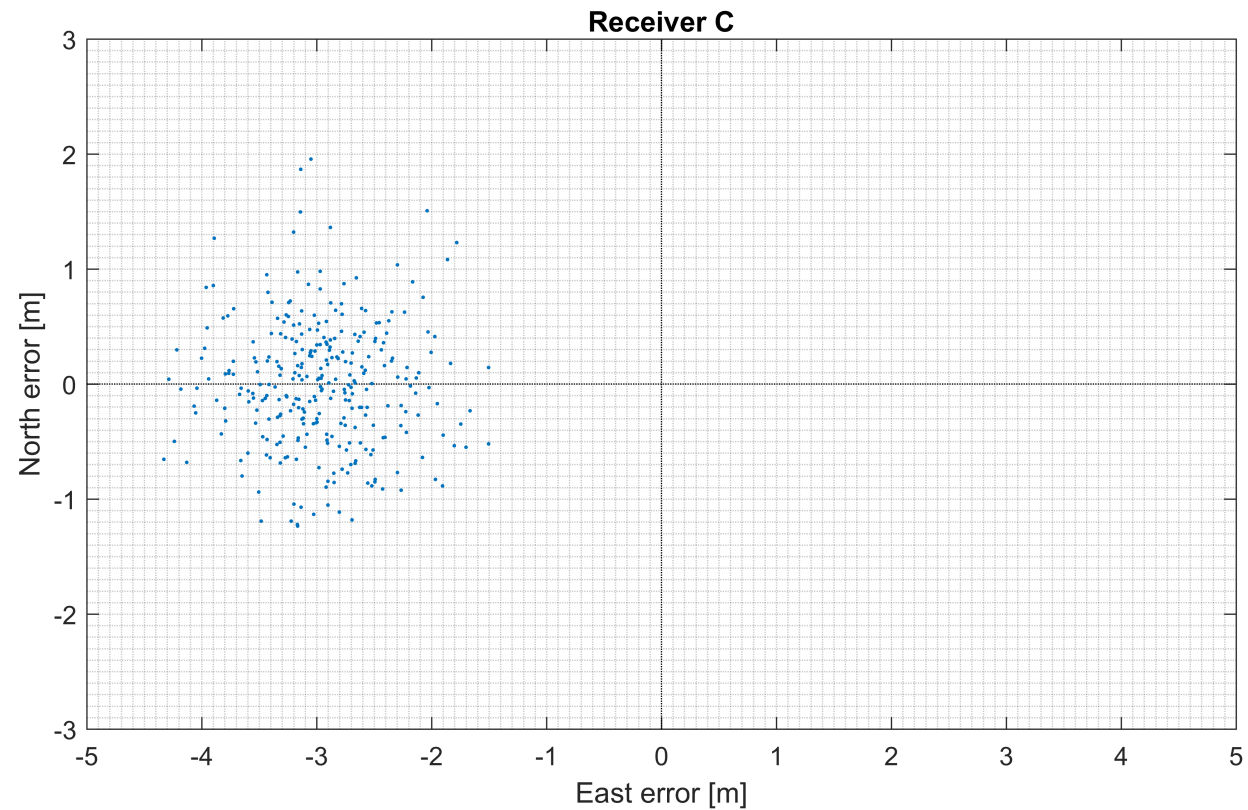
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### GPS positioning

5/5 points (ungraded)

The figure shows the errors in a set of estimated GPS positions. Values specific for this receiver may be graphically derived.

- ▶ 3. Least Squares Estimation (LSE)
- ▶ 4. Best Linear Unbiased Estimation (BLUE)
- ▶ Pre-knowledge Mathematics
- ▶ MATLAB Learning Content



1. What is the standard deviation for the East error ( $\sigma_E$ ) (in meters)?

0.5 ▼

✓ Answer: 0.5

2. What is the standard deviation for the North error  $\sigma_N$  (in meters)? (up to 1 digit)

✓ Answer: 0.5

3. What is the absolute value of the mean error (in meters)?

✓ Answer: 3

4. This mean error is due to:

✓ Answer: a systematic bias

5. What is the probability that the absolute value of the North error is larger than  $\sigma_N$ ?

✓ Answer: 0.32

? **Hint (1 of 4):** Question 1: Only look at the values on the 'East-West' axis. The range from  $\pm 1$  times the standard deviation includes roughly 68% of all values.

[Next Hint](#)

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✓ Correct (5/5 points)

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OUTLIER INFLUENCE (EXTERNAL RESOURCE)

## Outlier Influence

In this demo you will calculate the influence of one bad data point. What will happen to the mean and standard deviation? What will be the influence when you have only a small data set? To find out, finish the Matlab code below.

You may also copy the Matlab code below to the Matlab Online environment.

### Your Solution

 Save  Reset  MATLAB Documentation (<https://www.mathworks.com/help/>)

```
1 %% The following two lines will generate a random data set
2 %% with random errors, with variance of 0.3 m2
3 x      = mvnrnd(0,0.3,500);
4
5 %% task 1. compute the mean and standard deviations (std)
6 %% of the data set
7 x_mean  = mean(x)
8 x_std   = std(x)
9
10 %% Now we add a blunder (outlier) in the data.
11 x_outlier = x;
12 outlier    = 10;
13 x_outlier(10) = x_outlier(10)+outlier;
14
15 %% task 2. Find the new std and mean of the new data set with the blunder.
16 x_outlier_mean = mean(x_outlier);
17 x_outlier_std  = std(x_outlier);
18
19 %% Now we shorten the data set to the first 10 entries. This will affect the
20 %% influence of the outlier on the mean and std.
21 x_outlier_10   = x_outlier(1:10);
22
23 %% task 3. Find the new std and mean of the shorter data set with the blunder.
```

```
24 x_outlier_10_mean= mean(x_outlier_10);  
25 x_outlier_10_std = std(x_outlier_10);  
26  
27 %% task 4. Run the code and compare the means and standard deviations  
28 %% You will see that the influence is larger in case of fewer observations.
```

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