Brandon Tran

Physics 111B

**Error Analysis Exercise**

**Problem 1.**

so then

**Problem 2.**

We are given that we have two measurements of distance and their associated errors, namely, and . Assuming that the individuals measurements A and B are independent of each other and that the desired quantity x is a function of A and B, i.e. x(A,B), then the contribution of measurement A and B to the error are and .

Now the contributions add in quadrature so the total error of x is:

a) For the function x(A,B)=A+B, we have that and . So we have and . Then the total error is:

b)Similarly, for the function x(A,B)=A-B, we have that and are also the same. So we have and . Then the total error is the same as part a, which is:

c) For the function x(A,B)=2A+2B, we have that and . So we have and . Then the total error is:

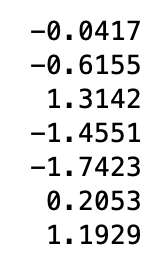
d)For the function x(A,B)=A\*B, we have that and . So we have and . Then the total error is:

**Problem 3.**

1. The uncertainty in which mean is determined is for a population standard deviation of 2.

When the distribution of the population is normal, then the distribution of the sample mean is also normal. For a normal population distribution with mean μ and standard deviation σ, the distribution of the sample mean is normal, with mean μ and standard deviation . This result follows from the fact that any ***linear combination****of independent normal random variables is also normally distributed*.

2. Using Matlab’s randn function, I generated the list of seven numbers with mean 0 and standard deviation 1,



The mean of the list is -0.3414. The standard deviation is 1.4621. The standard error on the mean is 0.378.

3.



Using Matlab’s h.Values function, we find that there are 682 within one uncertainty of the mean. And there are 970 within 2 uncertainty of the mean

4. We start with a population mean and standard deviation of 0 and 1, respectively

For **N=10**, we expect the sample to have:

Now I generated a list of N=10 random numbers using the randn function and found that it gave:



Using Matlab’s h.Values function, we find that there are 687 within one uncertainty of the mean. And there are 941 within 2 uncertainty of the mean.

For **N=20**, we expect the sample to have:

Now I generated a list of N=20 random numbers using the randn function and found that it gave:



Using Matlab’s h.Values function, we find that there are 669 within one uncertainty of the mean. And there are 954 within 2 uncertainty of the mean.

For **N=100**, we expect the sample to have:

Now I generated a list of N=100 random numbers using the randn function and found that it gave:



Using Matlab’s h.Values function, we find that there are 688 within one uncertainty of the mean. And there are 958 within 2 uncertainty of the mean.

For **N=1000**, we expect the sample to have:

Now I generated a list of N=1000 random numbers using the randn function and found that it gave:



Using Matlab’s h.Values function, we find that there are 677 within one uncertainty of the mean. And there are 956 within 2 uncertainty of the mean.

**Problem 4.**

1. The mean of an exponential distribution should be

or more generally for a distribution of the form λ the mean is λ and the standard deviation is .

The error on the mean for an experiment with N=200 random samples should be

λ

2.

**Problem 5.**

1.



2. Using Matlab’s fitdist function, we find that the mean of the data is 1.2027 and the standard deviation is 0.1038.

3.



The fitted curve gives a mean of 1.20268 and a standard deviation of 0.103837 whereas the

4.

**Problem 6.**

1.

and

where N is the pair of points and . So for A and B, we get



2.

3.

4. The weighted least squares method for a linear fit (y=A+Bx) gives the following equations

and

where and . So for A and B, we get

So the slope and intercept of the best-fit line using the weighted least-squares method are 1.504 and 0.0611, respectively. Here’s the following graph:



**Problem 7.**

1. Using the propagation of error rules, for a function , the error is

2. In an experiment we find that . Using the propagation of error rules, for a function , the error is

In this case A is and is the error associated with which I will now refer to as Now in this case, and So the error associated with is

So we have that