PHY 743 Statistics and Probability Homework 2

1. A 1 mL radioactive sample is pipetted into a tesst tube for counting . The precision of the pipette is specified as +/-2%, and 5,000 counts are recorded from the sample. (a) What is the uncertainty in sample counts per mL? (b) Compare this to the uncertainty of counts that would be obtained without the pipetting uncertainty.
2. A sample is counted using a "narrow" pulse height analyzer window and net sample and background counts are $S_N$ = 500 counts and $B_N$ = 200 counts, respectively. The sample is counted with the same system, but using a "wide" window and the net sample and background counts are $S_W$ = 800 counts and $B_W$ = 400 counts, respectively. Which window setting offers the statistical advantage?
3. Use the $\chi^2$ test to determine the likelihood that the following set of 20 counting measurements were obtained from a Poisson distribution.

| | |
|---|---|
| 3875 | 3575 |
| 3949 | 4023 |
| 3621 | 3314 |
| 3817 | 3612 |
| 3790 | 3705 |
| 3902 | 3412 |
| 3851 | 3520 |
| 3798 | 3743 |
| 3833 | 3622 |
| 3864 | 3514 |

4. (a) A set of 13 measurements are made on a physical quantity, The following values are obtained: 0,1,2,3,…..,12. Estimate the mean x(bar), the spread σ and the accuracy of the mean *u*.
5. (b) A new set of 36 measurements are made with the result that the values 0,1,2,3,….,12 occur 0,1,2,….,5,6,5,….1,0 times respectively. Estimate the mean x(bar), the spread σ and the accuracy of the mean *u*.
   (c) The function y(x) Is defined as y=1/L for 0 <= (less than or equal to) x <= L; y = 0 otherwise. Find the average value of x, and the spread σ for this distribution.
   (d) Repeat (c), but for the function $y = 4x/L^2$ for 0 <= x <= L/2; $y = 4(L-x)/L^2$ for L/2 <= x <= L; y = 0 otherwise.
   (e) Compare your answers for (a) and (c), and for (b) and (d).
6. By measuring yourself with three different rulers, you obtain the following estimates of your height: 165 +/- 1.0, 164.9 +/- 0.5, and 165.6 +/- 0.1 cm. What is the best estimate of your height, and how accurate is it?
7. Two experiments attempt to measure the same quantity, and obtain the results 0.9 +/- 0.1 and 1.4 +/- 0.2. Decide whether these are consistent by looking up probabilities in the tails of Gaussian distributions, for an appropriate variable.