Note: You are free to use (e.g. copy verbatim) any text in black. All text in red indicates areas where you need to insert your own work.

Experiment #1: Random processes and the normal distribution

Reading for this lab:
Sections 1-5 of the uncertainty analysis notes that are posted to Blackboard.

Introduction:
A random process is either a result of a complex phenomenon that is too difficult to measure or calculate, such as the wind over every square foot of the country, or the result of a process that is truly and fundamentally random, such as radioactive decay. A very common function that describes some random processes is the normal distribution. The goal of this lab is to determine whether the processes we measure today can be described by a normal distribution or whether they should be described by something else.

Experimental setup:
This lab consists of measuring four random processes: a collection of rocks, a number generator based on summing the numbers from a randomly selected book page, and the lateral and longitudinal position scatter in the trajectory of metal spheres fired from a cannon.

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Instructions:

Describe in more detail specifically what you did for the following four experiments.

Experiment 1: the masses of a collection of gravel rocks.

Experiment 2: Conduct 50 trials where you randomly pick a page from the "A Modern Course in Statistical Physics" textbook between pages 100 and 600, and where you sum the last two digits of the page number. Alternate right and left pages in the book on successive trials.

Experiments 3 & 4: Set up a cannon to launch projectiles safely across the room. Due to small variations in the system, the landing point of the projectiles will not be identical. Measure the lateral and longitudinal positions of the projectile's initial contact point with the ground for at least 30 shots, though 50 shots would be better.

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Data and Analysis:

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Instructions:

Record all of the data from your experiments in a spreadsheet (you will want a different sheet for each of these three experiments so you don't confuse the data). For each experiment, determine the best method for binning the data and making a histogram. Plot each histogram and determine whether a normal distribution is a good description of it by over-plotting the best-fit normal distribution.

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Conclusion:

In this lab we made measurements of four different random processes. The individual measurements were binned according to the log-rule, as defined in section 4 of the uncertainty analysis notes. For each distribution a best-fit normal distribution was calculated.

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Instructions:

State what you found for each process, stating whether you think a normal distribution is a good fit or not. If it is a good fit, in your opinion, justify this by identifying particular aspects of your experimental distribution that compare nicely to the normal distribution. If you believe the normal distribution is not a good match for your data, describe what characteristics of your experimental distribution stand out as significantly different.

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