

PHYS 451: Quantum Mechanics I - Spring 2017
Homework #1, due Thursday January 19 in class

Review of elementary probability theory

1. Suppose you have two independent measurements of some physical quantity. Let us call the results of these measurements X_1 and X_2 . The quantity is known to lie in the interval $[0, 1]$ and is uniformly distributed in this interval. What is the probability that

- (a) $X_1 + X_2 < 1/2$
- (b) $X_1 X_2 < 1/2$
- (c) $|X_1 - X_2| < 1/2$
- (d) $\max(X_1, X_2) < 1/2$
- (e) $\min(X_1, X_2) < 1/2$
- (f) $X_1 < 1/2$ and $1 - X_2 < 1/2$ (both conditions are satisfied)

2. Suppose a physical quantity m may take integer values in the range

$$-M, \dots, M$$

where M is some positive integer. Each value is known to be equally probable.

- (a) Find probability $P(m)$
- (b) What is the average value $\langle m \rangle$?
- (c) What is the variance $\langle m^2 \rangle$?
- (d) What is the uncertainty Δm ?

To make the exercise more fun I ask you to evaluate all sums by yourselves (i.e. do not use reference books or web)

3. Suppose that the wave function of a particle is given by

$$\psi(x, t) = A \frac{e^{ikx - \nu(t-t_0)}}{\sqrt{b^2 + x^2}},$$

where A , b , k , ν , and t_0 are some real numbers.

- (a) Find the normalization constant, A
- (b) What is the most probable position of the particle?
- (c) What is the average position of the particle, $\langle x \rangle$?
- (d) What is uncertainty in the position of the particle, Δx ?