Student handout

You have a system that consists of two identical (fair) six-sided dice. Imagine that you will perform an experiment where you roll the pair of dice together and record the observable: the norm of the difference between the values displayed by the two dice.

1. What are the possible results of the observable for each roll?

2. What is the theoretical probability of measuring each of those results? Assume the results are fair.

   Plot a probability histogram. Use your histogram to make a guess about where the average value is and the standard deviation.

3. Use your theoretical probabilities to determine a theoretical average value of the observable (*the expectation value*)? Indicate the expectation value on your histogram.

4. Use your theoretical probabilities to determine the standard deviation (the *uncertainty*) of the distribution of possible results. Indicate the uncertainty on your histogram.

5. Challenge: Use

   a) Dirac bra-ket notation
   b) matrices

   to represent:

   - the possible states of the dice after a measurement is made;
   - the state of the dice when you're shaking them up in your hand;
   - an operator that represents the norm of the difference of the dice.