

K.K. Gan
Physics 416
Problem Set 2
Due April 16, 2012

- 1) Taylor, Problem 10.3, page 241.
- 2) Taylor, Problem 11.3, page 256.
- 3) A telemarketer made 100 calls in one day with a 10% success rate of making a sell. What is the error on the success rate?
- 4) The sun emits an enormous number of neutrinos. Assume that 10^6 solar neutrinos uniformly pass through a square with an area of 1 m^2 each μsec . Inside the square is a neutrino detector with an area of 1 mm^2 . Assume Poisson statistics for this problem.
 - a) What is the average number of neutrinos going through the detector each μsec ?
 - b) What is the probability that no neutrinos go through the detector in a μsec ?
 - c) What is the probability that ≥ 2 neutrinos go through the particle detector in a μsec ?
 - d) How big should the detector be (in mm^2) if we want ≥ 2 particles per μsec to pass through the detector with a probability of 95%?
- 5) Suppose a missile defense system destroys an incoming missile 95% of the time.
 - a) If an evil country launches 20 missiles what is the probability that the missile defense system will destroy all of the incoming missiles?
 - b) How many missiles have to be launched to have a 50% chance of at least one missile making it through the defense system?Note: this problem can be done using either binomial or Poisson statistics.
- 6) Assuming a Gaussian probability distribution answer the following questions
(Use Tables in *Taylor Appendix A and/or B*):
 - a) What is the probability of a value lying more than 1.5σ from the mean?
 - b) What is the probability of a value lying $\geq 1.5\sigma$ above the mean?
 - c) What is the probability of a value lying $\leq 1.5\sigma$ below the mean?
 - d) What is the probability of a value, y , lying in the range $\mu - \sigma \leq y \leq \mu + 2\sigma$?
 - e) What is the probability of a value, y , lying in the range $\mu + \sigma \leq y \leq \mu + 2\sigma$?For this problem μ is the mean of the Gaussian and σ is its standard deviation.
- 7) Taylor, Problem 5.12, page 156.
- 8) Suppose 100 six sided dice are tossed. Assume that the faces are labeled by one through six dots. Let Y_i be the number of dots on the i th ($i=1$ to 100) die.
 - a) What is the average number of dots expected for a single dice?
 - b) What is the variance of the numbers of dots expected for a single dice?
 - c) Use the Central Limit Theorem to estimate the probability that the sum of the Y_i 's exceeds 400.

9) A Central Limit Theorem problem. When a certain chemical product is prepared the amount of a certain impurity is a random variable with a mean of 4 grams and a standard deviation of 2 grams. If 100 independent batches of the chemical are produced what is the (approximate) probability of the average amount of the impurity in the 100-batch sample being more than 4.5 grams?