Homework 5

Due April 30, 2014

Please make sure to explain your answers to each of the following questions. Remember: a correct numerical answer without explanation is worth no points! Write up your answers legibly and logically. The not-to-turn-in problems provide additional practice and are important to preparing for exams.

1. Section 5.1 Exercise 9
2. Section 5.1 Exercise 24
3. Section 5.1 Exercise 25
4. Section 5.1 Exercise 38
5. Section 6.2 Exercise 30 (Exercise 29 in the online edition)
6. In class we showed for the Pokemon Collector that

   $$\mathbb{P}(X \geq 2nH_n) \leq 1/2$$

   and that

   $$\mathbb{P}(|X - nH_n| \geq 2n) \leq 1/2$$

   where n is the number of different types of Pokemon, X is the number of Pokemon encountered until we have caught them all and $H_n = \sum_{k=1}^{n} 1/k$ is the nth harmonic number. Successfully upload a program for Problem 52 on Probability Online and use this program to estimate the actual values for these probabilities. Compare your estimates to the above bounds.
7. One technique to estimate the charge of an electron works as follows: over time t, the average current at a given point is a random variable given by $I_t = eN/t$ where e is the charge of an electron and N is the number of electrons passing by that point. We can readily measure I and t. Here, N can be modeled as a Poisson random variable with parameter λt where λ is unknown.

(a) Find the standard deviation of the current at time t in terms of e, t and λ.

(b) We can estimate $\mu_{I_t} = \mathbb{E}(I_t)$ by physical experiments. Using (a), find e in terms of other variables.

Problems **not** to turn in (Items with * go beyond practice):

1. Section 5.1 Exercises 1 and 2
2. Section 5.1 Exercise 18
3. Section 5.1 Exercises 26 and 31
4. Section 5.1 Exercise 39
5. $*$ Section 6.1 Exercise 33
6. $*$ Section 6.1 Exercise 34