Homework 3

1. A problem for people trying to understand the level of gun violence in the United States is that while gun-related homicides are almost always reported to or discovered by police, incidents of gun violence that do not result in injury or death often are not. ShotSpotter (http://www.shotspotter.com/) is a gunshot detection system that detects and conveys the location of gunfire or other weapon fire using acoustic, optical, and other types of sensors, as well as a combination of such sensors. It has been adopted by more than 90 jurisdictions in the United States, including in New York City. Economists Jillian Carr and Jennifer Doleac investigated the connection between shots identified by ShotSpotter and resultant reports to police, and found that 12% of gunfire incidents result in a 911 call. Say that in a particular city on a particular day there are 7 gunfire incidents detected by ShotSpotter. Assume that these can be viewed as a random sample of such incidents.

(a) What is the exact probability that exactly three of the incidents result in a 911 call?
(b) What is the exact probability that at least two of the incidents result in a 911 call?
(c) What is the expected number of incidents that result in a 911 call? What is the standard deviation of the number of incidents that result in a 911 call?
(d) Say there are 500 gunfire incidents in a particular city in 2018. What is the probability that fewer than 50 of them result in a 911 call? An approximate answer is good enough here.

2. According to admissions statistics, the Stern MBA class of 2020 has an average GMAT score of 716, with standard deviation 33.4. Assume that the GMAT scores follow a normal distribution.

(a) What is the probability of a randomly chosen student’s GMAT score being greater than 740?
(b) What is the probability of a randomly chosen student’s GMAT score being less than 690?
(c) What is the probability that the average GMAT score of the five members of a randomly selected study group is less than 690?
(d) A member of the class of 2019 says that her class is smarter than this year’s Stern class, claiming an average GMAT score of 718. A member of Stern’s class of 2020 replies that “There are just as many really smart people in my class,” claiming that both classes have the same probability of finding a student with GMAT greater than 760. Assuming that this statement is true, what is the standard deviation of GMAT scores for the students from the class of 2019?

3. According to surveys administered by O’Reilly Media and Burtch Works, the median base salary of mid-level data scientists in the United States is $126,000, and 25% of such people earn less than $91,000. Assume that salaries follow a normal distribution.

(a) What is the probability that a randomly chosen data scientist earns less than $145,000 in salary?

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(b) What is the probability that a randomly chosen data scientist earns more than $100,000 in salary?

(c) What is the probability that the average salary of a group of six randomly selected data scientists is between $110,000 and $150,000?

(d) Say we didn’t assume that the salaries were normally distributed. According to available figures, 10% of data scientists earn less than $50,000 in salary, 15% earn more than $190,000, and 2% earn more than $290,000. Based on what you’ve been told, describe what you think the distribution of salaries looks like.

Homework due: October 25

Note: You will not get your graded homework back before the midterm exam, so I suggest that you make a photocopy of your homework (or keep the computer file) before you hand it in. I will be giving out a copy of the answers (and posting them on the class web site) in class on October 25, so you can see how you did from them. Note that no late assignments will be accepted after the answers are handed out.