Math 263, Section 5 **Name**_____
Second Test Spring 2014
75 minutes; total 125 points.

1. (**12 points**) The Physicians' Health Study of 22,000 male physicians attempted to determine whether aspirin prevented heart attacks. A randomly selected group of 11,000 physicians took an aspirin every day, while the other 11,000 took a placebo. At the end of the study, the physicians who had taken aspirins had had significantly fewer heart attacks.

(a) Was this study an experiment ____ or an observational study____? (*Check one*)

(b) Which of the following statements explain why we *cannot* conclude from this study that *all* adults should take an aspirin every day?

Mark each statement **T** (True) if it provides a valid explanation, or **F** (False) if it does not:

____The study included only physicians and different results might occur in individuals in other occupations

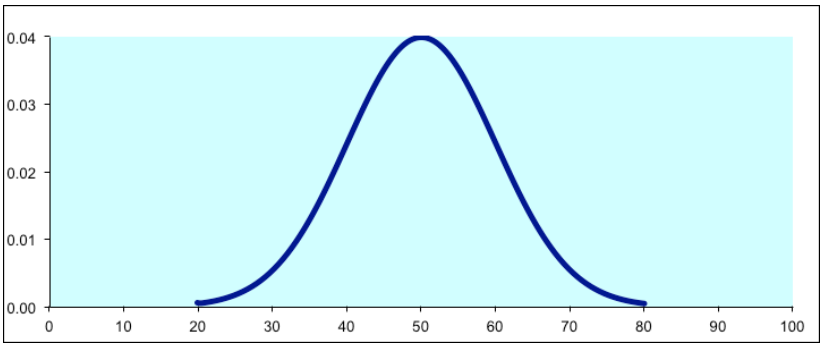
____The study included only males and different results might occur in females.

____Although aspirin may reduce heart attacks, it maybe harmful to health in other ways.

____The physicians given aspirin were selected randomly.

2. (**5 points**) Which of the following is the best estimate of the standard deviation of the following distribution?[1] (*Circle one answer*)

(a) 5
(b) 10
(c) 30
(d) 40
(e) 50
(f) 60



3. (**5 points**) A school has 20 classrooms with 30 students in each. The School Board asks for a random sample of 40 students in the school. The principal directed a teacher in each of the 20 classrooms to select randomly two of the students in that class; these 40 students constitute the sample.[2] Does this procedure give a simple random sample of students from the school? (*Circle one answer*)

(a) No, because not every sample of 40 had the same chance of being selected.

(b) No, because not all the students had the same chance of being selected.

(c) No, because the teachers were not randomly selected.

(d) Yes, because each student had the same chance of being selected.

(e) Yes, because each student was randomly selected in the classroom.

[1] CB, 1997
[2] Based on CB, 1998.

4. (**15 points)** A manufacturing company wants to be sure that the parts received from a supplier meet the standard required. Rather than inspecting all the incoming parts, which would be too time-consuming, the company designs a quality control program in which they inspect a random sample of 10 parts in each shipment. The company rejects the shipment if the sample contains one or more defective parts. Shipments actually contain 2% defective parts.

(a) What is the probability that the company accepts a shipment? (*Show work*)

(b) What is the probability that the company rejects a shipment? (*Show work)*

(c) What is effect of the following policies:

(i) A new program is instituted at the supplier's manufacturing plant, thereby reducing the proportion of defective parts in the original shipment. (All other values remain the same.) What is the effect on the probability of acceptance you found part (a)?

Increases: ____ Decreases: ____ Remains same:____ (*check one; no reasons needed*.)

(ii) You hire a new quality control engineer, who increases the number of parts sampled. (All other values remain the same.) What is effect on the probability of acceptance you found part (a)?

Increases: ____ Decreases: ____ Remains same:____ (*check one; no reasons needed*.)

5. (**15 points**) We buy milk by volume (in quarts and gallons) but dairy farmers produce it by weight in pounds. Ayrshire cows average 47 pounds of milk a day, with standard deviation 6 pounds. Jersey cows average 43 pounds a day, with standard deviation 5 pounds. (Ayrshires and Jerseys are two different breeds of cows.) Milk production from each breed is normally distributed. Assume the sum or difference of two normal distributions is also normal.

Select one Ayrshire cow and one Jersey cow at random. Let M be the random variable giving the difference in daily milk production of these two cows, with the Jersey cow's production subtracted from the Ayrshire's production. *Show work in answering these questions:*

(a) What the mean of M?

(b) What is the standard deviation of M?

(c) What is the probability that the Jersey cow gives more milk than the Ayrshire?

6. (**20 points)** Ebola is a rare infectious disease that can pass from monkeys to humans and is often fatal. It has been described by the World Health Organization as "one of the most virulent viral diseases known to humankind."[3] There are several subtypes, the most lethal subtype being Ebo-Z. The total numbers of cases reported by the CDC[4], separated by subtype, are given in the table.[5]

Ebola cases, 1976-2012	Ebola subtypes	
	Ebo-Z	Other subtype
Deaths	1092	469
Total number of cases	1391	928

(a) If a randomly selected Ebola case is selected, what is the probability that it was caused by Ebo-Z? (*Leave your answer as a fraction.)*

(b) Knowing that Ebo-Z is the most lethal subtype of Ebola, if you randomly selected one of the Ebola cases that died, would you expect the probability that this case was caused by Ebo-Z to be larger ____ or smaller ____than your answer to part (a)?
Reason:

(c) Let Z be the event that a case is caused by the Ebo-Z virus and let D be the event that an Ebola patient dies. Find each of the following and say what it means in words:
Leave your answers as fractions.

(i) $P(D) =$

Meaning:

(ii) $P(Z|D) =$

Meaning:

(iii) $P(D|Z) =$

Meaning:

(d) Are death and Ebo-Z independent?
Yes ___ No____ (check one)
Reason:

[3] http://www.who.int/csr/disease/ebola/en/
[4] http://www.cdc.gov, "Known Cases and Outbreaks of Ebola Hemorrhagic Fever"
[5] From "Filovirus Haemorrhagic Fevers Guidelines", 2008, MSF, Esther Sterk, Medical Doctor1st Draft, English MSF

7. (**18 points)** The 2010 US census reported that 13.9% of US adults identified themselves as of Hispanic origin.

(a) A polling company surveys a random sample of 1100 US adults.

(i) What shape is the sampling distribution of proportions?

(ii) What is the mean of the sampling distribution?

(iii) What is the standard error (standard deviation) of the sampling distribution?

(b) What is the probability that fewer than 12% of the sample of 1100 US adults identify themselves as Hispanic?
(*Show work.*)

(c) If the polling company is worried that they may not get a balanced representation of Hispanic views from such a sample, what option do they have if they do not want to increase the sample size?

8. (**35 points)** A museum raises money by selling memberships. There are different levels of membership corresponding to different donations. The table shows what percent of the members choose each level.[6]

Membership category	Donation, dollars	Percent of members
Individual	50	50%
Family	100	30%
Sponsor	250	15%
Patron	500	4%
Benefactor	1000	1%

During a fund drive, the museum gets 100 new members a week.

- Consider each set of 100 donations as a random sample of all donations.
- You are given that the variance of this distribution is 35,520.

(a) What is the mean donation? (*Show work*.)

(b) What is the standard deviation of the donations? (*Show work*.)

(c) Is the distribution shown in the table normal?
Yes____ No_____

(d) Consider a particular week's sample of 100 donations. Do you expect the sample to be normally distributed?
Yes____ No_____
What is the approximate mean of the sample?

What is the approximate standard deviation of the sample?

Problem continues on next page ➔

[6] Based on Stats: *Data and Models,* De Veaux, Velleman, Bock, 3rd ed, Addison Wesley, 2012.

Problem 8 continued

(e) Consider the means of all samples of 100 weekly donations. Do you expect these means to be normally distributed?

Yes____ No_____

What is the mean of this distribution?

What is the standard deviation of this distribution?

(f) During a membership drive, one of the museum's phone volunteers sets herself a goal of getting a total of $10,000 from the first 100 new members she enrolls. Considering the 100 new members as a random sample of all members, what is the probability that she reaches her goal?

(g) The top 10% of the phone volunteers, based on the total donations from their first 100 new members, are awarded a certificate. What is the minimum earning that would lead to a certificate?