

BST 140.651 Midterm Exam

Notes:

- You may use your one 8.5 by 11 formula sheet.
- Please use only the basic mathematical functions on your calculator.
- Show your work on all questions. Simple “yes” or “no” answers will be graded as if blank.
- Please be neat and write legibly. Use the back of the pages if necessary.
- There are 3 questions one per page, each with multiple parts.
- Good luck!

signature and **printed name**

1. Short answer questions - 9 points each

- a. Is there anything wrong with this statement?

The probability that an overweight person has sleep apnea is 5%. The probability that an overweight person has restless leg syndrome is 1%. Therefore, there is a 6% probability that an overweight person has one of these sleep diseases.

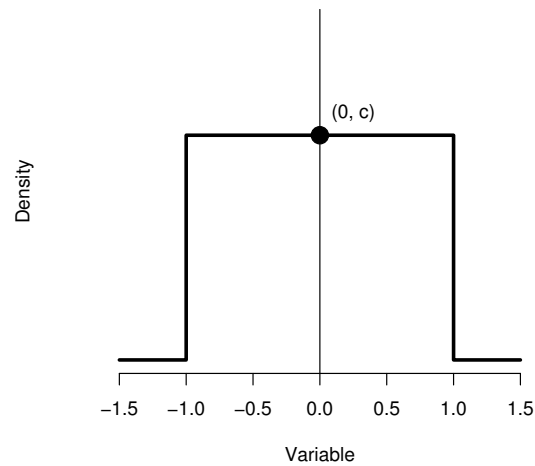
Explain your answer briefly.

- b. Suppose that X_1, \dots, X_{10} are iid $N(\mu_1, \sigma_1)$ mutually independent of Y_1, \dots, Y_{15} , which are iid $N(\mu_2, \sigma_2)$. What is the variance of $5(\bar{X} - \bar{Y})$?

- c. When calculating the sample variance, why is it customary to divide the sum of squared deviations from the mean by $(n - 1)$ rather than n ? (Be brief.)

- d. The number of female children in households with two children follows a probability distribution with population mean 1 and population variance .6. What is the population mean and variance of the number of male children and why? (Be brief).

- e. Researchers studying brain volume found that in a random sample of 16 that the average loss in grey matter volume as a person aged four years was $.1mm^3$ with a standard deviation of $.04mm^3$. Calculate the standard error of the mean. Describe (briefly) what $.1mm^3$ and your calculated standard error estimate.



2. The figure above depicts a density that has a constant height c and is positive between -1 and 1 .
- (9 points) What value of c makes this function a valid density?
 - (9 points) Argue (you need not calculate) what the mean of this density must be.
 - (9 points) What is the 95^{th} percentile of this distribution?
 - (10 points) The variance of this density is $1/3$. Suppose that we sample 10 observations from this density 1,000 times and take the sample mean of each of the collection of the 10 observations, resulting in 1,000 sample means. What number would the standard deviation of these 1,000 number likely be close to?

3. Researchers are interested in a new blood test for diagnosing Kryptonite poisoning (a rare disease). For this test a *positive* result is supposed to indicate the *presence* of Kryptonite poisoning. A study found that 85% of patients who are known to have the disease were *positive* on the blood test. In contrast, 21% of individuals who are known not to have the disease, were *positive* on the blood test.
- a. (9 points) A person has a positive blood test result. Interpret this positive test result without knowledge of the disease prevalence.
 - b. (9 points) Given that the prevalence of the disease is 10% in a subject's population with a positive test result, calculate the probability that the person has the disease.