

.5cm

1. I have a random variable with PDF xe^{-x} for $x \geq 0$ and 0 otherwise. Prove that this is a valid PDF, and give the mean, mode and variance.
2. You have a Poisson distribution, and take samples 4,5,9,3. What is the maximum likelihood estimate? No short cuts! What is a 95% confidence interval for this parameter?
3. The Albany School of Witchcraft claims that their classes increase the “Magic Quotient” (MQ) of their students. Witches outside of the school have an average MQ of 10, with an unknown standard deviation. You test the MQ of 6 students and receive the following MQs

MQ

9

12

14

13

9

12

Is this enough information to tell that ASW’s classes work, with confidence level .05? Use a Z and T test and compare the answers. Which do you think is more accurate?

4. A well-known study examined the number of children who sleep with different levels of ambient light in an attempt to explore whether nighttime ambient light affects vision. In a survey, researchers found that 9 of 172 children who slept in darkness developed myopia, and 31 of 232 who slept with a small night-light developed myopia. Construct a contingency table and test for an association between nighttime ambient light and myopia using chi squared with significance level $\alpha = 0.05$

5. $z = x^2 - xy - 2y^2$. Take $x = s + t$, $y = st$

What are $\frac{\partial z}{\partial s}$ and $\frac{\partial z}{\partial t}$?

6. The HAART data gives before and after measurements for 5 individuals. Calculate the best fit line and correlation coefficient.

Before	After
7.4	3.7
5.1	2.6
6.9	3.4
7.2	3.6
1.4	0.7

7. The minimum inhibitory concentration (MIC) of a new antibiotic is measured in 10 bacterial colonies. Two additional, independent studies, are conducted and the MIC is measured in another 10 bacterial colonies in each of these studies. Suppose that the MIC is well described by a normal random variable with unknown mean and with standard deviation $0.043 \mu\text{g/mL}$. What is the probability that at least one of the sample means from these three studies deviates by more than $0.01 \mu\text{g/mL}$ from the true population mean?