Solutions Manual to Accompany

Modern Engineering Statistics

Contents

(b) (student exercise)

3.73. Assume $X \sim N(\mu, \sigma^2)$. Obtain $E(X^2)$ as a function of μ and σ^2.

Solution:
Since $\sigma^2 = E(X^2) - (E(X))^2 = E(X^2) - \mu^2$, it follows that $E(X^2) = \sigma^2 + \mu^2$.

3.75. Assume that 10 individuals are to be tested for a certain type of contagious illness and a blood test is to be performed, initially for the entire group. That is, the blood samples will be combined and tested, as it is suspected that no one has the illness, so there will be a cost saving by performing a combined test. If that test is positive, then each individual will be tested. If the probability that a person has an illness is .006 for each of the 10 individuals, can the probability that the test shows a positive result be determined from the information given? If not, what additional information is needed?

Solution:
The probability cannot be determined from the information that is given. There are two important pieces of information that are missing: (1) what is the probability of the test showing positive when illness is present, and (2) since this is a contagious disease, have any of the 10 people who are being tested previously been in contact with at least one member of the group?

3.77. Becoming proficient at statistical thinking is more important than the mastery of any particular statistical technique. Consider the following. There are certain organizations that have limited their memberships to males and have not had female members. A person applies for membership with his or her height indicated, but gender not filled in. Since the name "Kim" can signify either a man or a woman, the membership committee is unsure of the gender of an applicant with this first name. The person's height is given as 5 ft 7 1/2 in. The mean heights of all men and all women are of course known (approximately), and assume that the standard deviations are also known approximately. Assume that heights are approximately normally distributed for each population and explain how the methods of this chapter might be used to determine whether the applicant is more likely a woman or a man.

Solution:
Two sets of Z-scores might be computed, with each pair obtained so as to give $P(67 \text{ inches} \leq \text{height} \leq 68 \text{ inches})$ for men and for women, with the choice determined from the larger of the two probabilities.

3.79. Service calls come to a maintenance center in accordance with a Poisson process at a rate of $\lambda = 2.5$ calls every 5 minutes. What is the probability that at least one call comes in 1 minute?

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S = 0.00901890  R-Sq = 80.2% R-Sq(adj) = 79.4%
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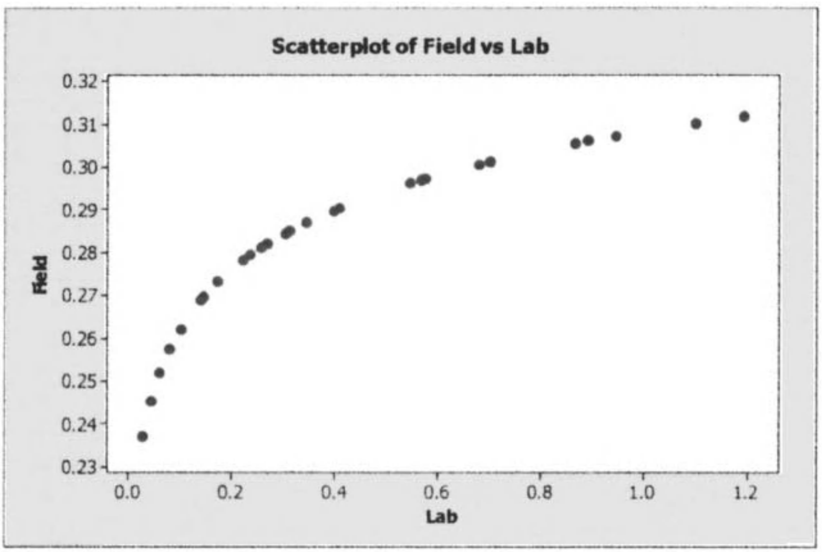
This suggests a moderately strong linear relationship between the two sets of measurements, although the strength of the relationship might not be sufficient for the intended use of the equation. Now construct a scatter plot of field versus lab. What lesson have you learned?

Solution:

The scatterplot given below shows that a linear regression model with only a linear term should not be fit as clearly there is no straight-line relationship.



17.5. What is the purpose in studying Bayes' rule in Chapter 3 and other probabilistic ideas and methods when these methods are not used directly in subsequent chapters?

Solution:
Probability forms the basis for statistical inference. Even though Bayes' Rule and other probability tools were not used directly in subsequent chapters, they are frequently needed in engineering disciplines and in other fields.

17.7. A small company suspects that one of its two plants is considerably more efficient than the other plant, especially in regard to nonconforming units. There is one particular product that has been especially troublesome for the first plant to produce, with the percentage of units that are nonconforming running at over 2% for that plant. The number of nonconforming units of the type in question is tabulated for a period of two weeks, with the following results.

Plant	Number Inspected	Number of Nonconforming Units
1	6420	130
2	7024	102

(a) A company employee will perform a test of the equality of the percentage of nonconforming units, which of course is the null hypothesis. What can be said about the inherent truth or falsity of the hypothesis for this scenario?

(b) There are three possible ways of performing the analysis. Name them. Which method would you suggest be employed?

(c) Use the method that you selected in part (b) and perform the analysis.

Solution:
(a) The null hypothesis is almost certainly false, as two percentages are not going to be equal if more than two decimal places are used.

(b) A test for the equality of two proportions (i.e., a Z-test) could be performed, or a test of proportions but without assuming approximate normality, or a contingency table analysis could be performed, after first constructing the table.

(c) The latter would be a reasonable choice as none of the counts are small. The analysis, given below, motivates a conclusion that the plants differ in terms of the percentage of nonconforming units,