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MBA 6103 Statistics for Data Analytics and Visualization

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Module 6 Assignment

1. A study by the Illinois Department of Transportation concluded that 76.2% of front seat occupants wore seat belts. That is, both occupants of the front seat were using their seat belts. Suppose we decide to compare that information with current usage using the binomial probability distribution. We select a sample of 12 vehicles.
   1. What is the probability that the front seat occupants in exactly 7 of the 12 vehicles are wearing seat belts?

9.02%

* 1. What is the probability that at most 7 of the 12 front seat occupants are wearing seat belts?

13.39%

* 1. What is the probability that at least 7 of the 12 front seat occupants are wearing seat belts?

95.63%

1. An item such as an increase in taxes, recall of elected officials, or an expansion of public services can be placed on the ballot if the petition contains the required number of valid signatures. Signatures are collected on pages, with each page containing 200 signatures. Unfortunately, many people will sign a petition even though they are not registered to vote in a particular district, or they will sign the petition more than once. This means that some signatures are invalid. How can we use the binomial probability distribution to help election auditors determine if checking a random sample of signature pages is as effective as checking all the signatures? At a recent professional meeting, election officials reported using two approaches to validate signatures: (a) check five signatures and reject the entire page if two or more signatures were invalid, or (b) check 10 signatures and reject the page if three or more are invalid. In order to investigate these methods, a random sample of pages from the last election were checked. Staff selected 14 pages from the Avondale district (2800 signatures), nine pages from the Midway district (1800 signatures), and seven pages from the Kingston district (1400 signatures). The staff found 142 of the signatures in Avondale were invalid, 170 of the signatures in Midway were invalid, and 276 signatures in Kingston were invalid.
   1. Use these data to evaluate the two approaches by reporting the probability of rejecting a page under each of the approaches.

|  |  |  |
| --- | --- | --- |
| District | Approach\_A | Approach\_B |
| Avondale | 0.0232 | 0.012 |
| Midway | 0.0735 | 0.061 |
| Kingston | 0.2569 | 0.3136 |

* 1. Would you get about the same results by examining every single signature?

You would not get the exact same results as shown in the table above. For example, the rejection probability for Avondale district is 5.07% when the staff checked every single signature on fourteen pages, however Approach\_a shows a rejection probability of 2.32% and Approach\_b 1.20%.

1. If there are twelve cars crossing a bridge per minute on average, use the poisson probability distribution to find the following probability:
   1. Seventeen or more cars crossing the bridge in a particular minute?

10.13%

1. Suppose a baseball player has a p=.300 batting average. Use the poisson probability distribution to find the following probabilities:
   1. 1 hit during a game?

22.22%

* 1. 1 hit during 10 games?

14.94%

1. Suppose the average number of home runs per game across all teams during the baseball season was 2.075. Use the Poisson distribution to determine the following probabilities:
   1. What is the probably that no home runs will be hit in a game?

12.56%

* 1. What is the probably that one home run will be hit in a game?

26.05%

* 1. What is the probability that 3 or less home runs will be hit in a game?

84.33%

* 1. What is the probability that at least 2 home runs will be hit in a game?

61.39%

1. Assume that the test scores of a college entrance exam fits a normal distribution. Furthermore, the mean test score is 72, and the standard deviation is 15.2.
   1. What is the percentage of students scoring 84 or more in the exam?

21.49%

1. The heights of adult men in the United States are approximately normally distributed with a mean of 70 inches and a standard deviation of 3 inches.
   1. A man is randomly selected. His height is 6 feet. What percentile will he be?

74.75th percentile

1. As part of its quality assurance program, the Autolite Battery Company conducts tests on battery life. For a particular D-cell alkaline battery, the mean life is 19 hours. The useful life of the battery follows a normal distribution with a standard deviation of 1.2 hours.
   1. Exactly 95% of the batteries are estimated to fail between what two values?

16.648 & 21.352