**深 圳 大 学 实 验 报 告**

**课程名称：­ 概率论与数理统计**

**实验项目名称： 基于图表分析的条件概率的验证**

**学院： 电子与信息工程学院**

**专业： 电子信息工程**

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**班级： 06**

**实验时间： 2023年9月30日——10月29日**

**实验报告提交时间： 10月29日**

**教务处制**

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| Aim of Experiment:   1. Learn to master the flow of drawing in python and use it to visualize the results. 2. Learn to use python to solve for conditional probabilities. 3. Verify the stability of frequency under multiple times and deepen the understanding of the relationship between frequency and probability. 4. Deepen your understanding of Bayes' rules. |
| Experiment Content:  1.Now consider a fair die. Each face has probability 1/6. We simulate n die rolls and plot the empirical probability of each face, alongside the theoretical probability.  2. There are two urs A and B. Urn A contains rA red balls and WA white balls whereas urn B contains rg red balls and wp white balls. One of the ums is picked at random and then one balls picked at random from this um. Write a function conditional\_probability that calculates the conditional probability that the randomly chosen ball belonged to urn A given that it is white  3. Learn to draw graphs to visualize the probability of students spending different time on study and the probability of getting high scores.  Finally, conditional probability expression is used to find the conditional probability of students learning different times under the condition of getting high scores and using Bayes' law to obtain the conditional probability of high score under different learning times. |
| Experiment Process：   1. Die rolls    1. Now consider a fair die. Each face has probability 1/6. We simulate n die rolls and plot the empirical probability of each face, alongside the theoretical probability    2. Experimental process thinking:   The np library is used to randomly generate n numbers between 1 and 6, and then the number of occurrences of each number is counted, and then the probability of each number of cycles in this matrix is calculated, and the result is shown in a chart.   * 1. Concrete code implementation:   # This is a decorator that creates the slider  @widgets.interact(n=(10,1000),continuous\_update=False)  def probability\_plot(n):  """  input: n (generate n random die rolls)  output: Count (counting the occurance of each event )  ""”  # Simulate n die rolls  rolls = np.random.randint(1, 7, n)    # Count the occurrences of each face  Count = np.zeros((6, n))  for i in range(6):  Count[i] = np.cumsum(rolls == (i + 1))  # plot the empirical values  for i in range(6):  Prob = Count[i]/np.arange(1,n+1)  plt.plot(np.arange(1, n + 1), Prob, linewidth=2.0, label='Face '+str(i+1))  plt.plot(range(0, n), [1 / 6] \* n, 'k', linewidth=3.0, label='Theoretical probability')  plt.title("Empirical and theoretical probabilities of the 6 faces")  plt.xlabel('Number of Iterations')  plt.ylabel('Probability')  plt.xlim([1, n])  plt.ylim([0, 1])  plt.legend()  plt.show()   * 1. Next consider the event E={2,4,6} that the outcome is even. Clearly P(E)=3/6=1/2=0.5.   The next cell simulates n die rolls and plots the theoretical and empirical probabilities of E.  # This is a decorator that creates the slider  @widgets.interact(n=(10,10000),continuous\_update=False)  def probability\_plot\_B(n):  """  input: n (generate n random die rolls)  output: Prob\_E (calculating the probability of even throw's)  hint: counting the events of even numbers  """  rolls=np.random.randint(1,7,n)  Count=np.cumsum(rolls%2==0)  Prob\_E=Count/np.arange(1,n+1)  # plot  plt.plot(range(1,n+1),Prob\_E, 'b', linewidth= 2,label='Empirical probability')  plt.plot(range(1,n+1), [1 / 2] \* n, 'k', linewidth= 2, label='Theoretical probability')  plt.xlabel('Number of Iterations')  plt.ylabel('Probability')  plt.title("Odds of rolling an even number")  plt.xlim([1, n])  plt.ylim([0, 1])  plt.legend()  plt.show()   1. Conditional Probability and Baye's Rule   ①Experimental process thinking:  First, let's write down the conditional probability expression:  conditional\_prob = (prob\_A \* prob\_white\_given\_A) / ((prob\_A \* prob\_white\_given\_A) + (prob\_B \* prob\_white\_given\_B))  Use the probability given by the question to calculate the variable value in the expression one by one, and finally bring it into the expression, and output the value  ②Concrete code implementation：  def conditional\_\_probability(rA, wA, rB, wB):  # inputs: all of them are of type 'float'  # output: a variable of type 'float'  # Calculate the probability of selecting urn A  prob\_A = 1 / 2  # Calculate the probability of selecting a white ball from urn A  prob\_white\_given\_A = wA / (rA + wA)  # Calculate the probability of selecting urn B  prob\_B = 1 / 2  # Calculate the probability of selecting a white ball from urn B  prob\_white\_given\_B = wB / (rB + wB)  # Calculate the conditional probability using Bayes' theorem  conditional\_prob = (prob\_A \* prob\_white\_given\_A) / ((prob\_A \* prob\_white\_given\_A) + (prob\_B \* prob\_white\_given\_B))  return conditional\_prob Conditional probability analysis for math scoresTo visualize the code for the data in the math database, and calculate the required conditional probability and use Bayes' rules to find another conditional probability.  * 1. Experimental process thinking:   Learn the analytical methods in lecture5 and apply them to the analysis of this mathematical database.  After classifying time into intervals, divide the number of people in each interval by the total number of people to get the probability of learning time in that interval.  Similarly, divide the number of people who get a high score by the total number of people to find the probability of getting a high score.  Finally, divide the number of people who get high scores in each period by the number of people who get high scores, you can get the conditional probability of each period under the condition of getting high scores.  Finally, using the conditional probability in the third step and our prior number of high scores, we can obtain the conditional probability of high scores under certain conditions within a certain period of time according to Bayes' rules |
| Data Logging and Processing:  1. Die rolls    From the chart, we can clearly see that the frequency of each surface oscillates up and down around 0.2, and gradually stabilizes towards 0.2 as the frequency increases. It is proved that the color son is even and fair.    From the chart, we can clearly see that the frequency of each surface oscillates up and down around 0.5, and gradually stabilizes towards 0.5 as the frequency increases. It is proved that the color son is even and fair. 2.Conditional probability analysis for math scoresThe probability that students study at different timesHistogram of probability of getting a high score.     Under the condition of high score, learn the conditional probability of different times |
| Experimental Results and Analysis:   1. In this experiment, the biggest harvest is that I learned to use matplotlib.pyplot library to draw graphs, which can intuitively show our experimental data and results. 2. As experiment 1 again demonstrates, when there are enough experiments, the frequency tends to stabilize close to the probability. 3. This experiment further deepened my understanding of conditional probability, especially the use of histograms to express probability intuitively |
| 指导教师批阅意见：  成绩评定：  指导教师签字：  年 月 日 |
| 备注： |

注：1、报告内的项目或内容设置，可根据实际情况加以调整和补充。

2、教师批改学生实验报告时间应在学生提交实验报告时间后10日内。