**深 圳 大 学 实 验 报 告**

**课程名称：­ Probability & Statistics**

**实验项目名称：Conditional Probability and Bayes Rule**

**学院： College of Electronic and Information Engineering**

**专业： Electronic Information Engineering**

**指导教师： Changsheng CHEN**

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**班级： Wenhua Honors Class**

**实验时间： 2023.10.20**

**实验报告提交时间： 2023.10.29**

**教务处制**

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| Aim of Experiment:  • Get familiar with the Matplotlib and NumPy and pandas.  • Know how to compute conditional probability in Python and analysis  for math scores**.**  • Apply Bayes rule to a practical problem with Python. |
| Experiment Content:  **1. Die Rolls**  **Exercise 1:**  Now consider a fair die. Each face has probability . We simulate 𝑛 die rolls and plot the empirical probability of each face, alongside the theoretical probability.  **Exercise 2:**  Next consider the event 𝐸= {2,4,6} that the outcome is even. Clearly 𝑃(𝐸)= = =0.5 .  The next cell simulates 𝑛 die rolls and plots the theoretical and empirical probabilities of 𝐸. 2. Conditional Probability and Baye's Rule **Exercise:**  There are two urns 𝐴 and 𝐵. Urn 𝐴 contains 𝑟𝐴 red balls and 𝑤𝐴 white balls whereas urn 𝐵 contains 𝑟𝐵 red balls and 𝑤𝐵 white balls. One of the urns is picked at random and then one ball is picked at random from this urn. Write a function conditional\_probability that calculates the conditional probability that the randomly chosen ball belonged to urn 𝐴 given that it is white. Assume that 𝑟𝐴𝑤𝐴 ≠ 𝑟𝐵𝑤𝐵.  **3. Conditional probability analysis for math scores**  **Exercise:**  Please try the same analysis for the students’ math scores following the same process conducted for Portuguese scores shown in Sec. 5 in "Experiment 2\_Lecture" Notebook. Insert new cells below to finish the process. |
| Experiment Process：  **1. Die Rolls**  **Exercise 1:**  My thinking:  Get the rolls face randomly. Then, count each face’s occurrence number and sum up and form a list.  As the cod behind, I insert the number of each face in the head of the corresponding sample list. It is an important step. The codes are as follows.    **Exercise 2:**  The Exercise2 is similar to Exercise1. Its objective is to calculate the possibility of event E which contains three faces. Therefore, I just need to change the judgmental way of counting. The codes are as follows.  This task just like the coin flips, there are only “two ways” this can happen. Thus, the probability counting goes easily. |
| 2. Conditional Probability and Baye's Rule **Exercise:**  After calculating, the meaning of the question can be shown by the formula bellow: . The codes are as follows:    **3. Conditional probability analysis for math scores**  **Exercise:**    The exercise is aimed to try the same analysis for the students’ math scores following the same process conducted for Portuguese scores shown in Sec. 5 in "Experiment 2\_Lecture" Notebook.  I first calculate the probability that a student's study-time falls in an interval by    And the codes are as follows.  Let us call scores of at least 15 "high". Next I calculate the probability of a student getting a high score by  And the codes are as follows.  We can also calculate the possibility of the various study-intervals when the student scored high by  And the codes are as follows.  After getting 、 and ,  we have had three parameters of Bayes rule. Then we can use the formula  to calculate the probability that a student gets a score greater than 15 given that they studied for a particular period of time. And the codes are as follows. |
| Data Logging and Processing:  **1. Die Rolls**  **Exercise 1:**    After running the code, we can get a figure which reflects that frequency of different points changes with n. When setting the maximum n to 1000, we can find that the empirical probabilities of the 6 faces get closer to theoretical probabilities as n gets larger.  **Exercise 2:**      In this exercise, the program simulates 𝑛 die rolls and plots the theoretical and empirical probabilities of 𝐸. Obviously, the empirical probability is approximately equal to the theoretical probability. 2. Conditional Probability and Baye's Rule **Exercise:**  Firstly, I use the Baye’s Rule calculate the question and get a formula. So, I can easily use program to get the answer    **3. Conditional probability analysis for math scores**  **Exercise:**  After running the above codes, we can get a figure about probability of the various study intervals.    We can note that the largest number of students studied between two and five hours, and the smallest studied over 10 hours. And the following figure is about probability of a student scored high or low.    It seems clear that the probability of a student scored low is larger than the probability of a student scored high. At the same time, we can get the figure about the probability of the various study-intervals when the student scored high.    It looks interesting. Roughly speaking, within the students scored high, the longer students study, the more likely they are to score high. However, once they study over 5 hours, their probabilities of scoring high decline. And if we use Bayes rule, we will get a more unexpected result .The figure below for more details. |
| Experimental Results and Analysis:  **Results:**  The program goes well  **Analysis**  • Get familiar with the Matplotlib and NumPy and pandas.  • Know how to compute conditional probability in Python and analysis  for math scores**.**  • Apply Bayes rule to a practical problem with Python.  • Deepen my understanding and application of Bayes rule.   * Using python more practised * Get to know how to analyse real problems in python by using abundant library function. |
| 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。