## 1 Non Parametric Tests

1. The entries into a shopping center through the three available doors have been monitored in order to increase accessibility. A survey on a random sample of 201 customers gave the following results:

| Door number | 1 | 2 | 3 |
| :--- | :---: | :---: | :---: |
| No. of incoming customers | 83 | 62 | 56 |

According to the observed evidence, it was stated that there was no preference for any particular door. Comment performing an appropriate test, at the 5\% level.
2. An insurance company sets the premium system for a certain risk under the hypothesis that the annual number of claims per policy follows a Poisson distribution with parameter $\lambda=0.2$. A random sample of 1000 policies from the previous year gave the following results:

| No. claims per policy | 0 | 1 | 2 | 3 |
| :--- | :---: | :---: | :---: | :---: |
| No. of policiess | 800 | 175 | 21 | 4 |

Does the sample confirm the company's hypothesis?
3. The number of customers that visited a certain shop during the last month has been recorded in the table below, where customers are classified into four grups, according to the time of the visit:

|  |  |  |  |  |
| :--- | :---: | :---: | :---: | :---: |
| Time interval | $[9,12)$ | $[12,14)$ | $[14,17)$ | $[17,19]$ |
| No. of customers | 150 | 220 | 235 | 195 |

The shop manager believes that the number of customers visiting the shop is roughly constant along the day. Test the belief of the manager at the $5 \%$ level, considering that the shop is open non-stop $9 \mathrm{am}-7 \mathrm{pm}$.
4. A certain bank collected data on waiting times in the queue for a random sample of 500 customers, having observed a total waiting time of 2500 minutes, divided as follows:

|  |  |  |  |  |  |  |
| :--- | :---: | :---: | :---: | :---: | :---: | :---: |
| Waiting time (minutes) | $[0,3)$ | $[3,6)$ | $[6,9)$ | $[9,12)$ | $[12,15)$ | $\geqslant 15$ |
| No. of customers | 205 | 135 | 80 | 34 | 26 | 20 |

Test, at the $10 \%$ level, the hypothesis that the waiting times follow an exponential distribution.
5. A survey about football team preferences gave the following results:

|  | Team |  |  |
| :--- | :---: | :---: | :---: |
| Age | Porto | Benfica | Sporting |
|  |  |  | 50 |
| 35 or less | 75 | 75 | 100 |
| More than 35 | 75 | 125 |  |

Could you conclude that the preferences are independent of age?
6. Students were assigned to three test rooms according to alphabetical order, having obtained the following results:

| Final mark | Room A | Room B | Room C |
| :--- | :---: | :---: | :---: |
|  |  |  |  |
| Pass | 44 | 37 | 23 |
| Fail | 36 | 33 | 27 |

Test, at the $5 \%$ level, the independence between the final mark and the name of the student.
7. The number of typing errors per page in a book is usually modelled using a Poisson distribution. A random sample of 100 pages form a book gave the following results:

|  |  |  |  |  |
| :--- | :---: | :---: | :---: | :---: |
| No. of errors | 0 | 1 | 2 | 3 |
| No. of pages | 63 | 25 | 8 | 2 |

a) Test the hypothesis, at the $1 \%$ level, that the number of typing errors per page follows a Poisson distribution with parameter $\lambda=0.4$.
$b$ ) Answer again question $a$ ) without specifying a value for $\lambda$.
8. The number of car accidents per week on a certain highway can be modelled using a Poisson distribution. Given below are the observations from a random sample of 80 weeks:

| No. of accidents per week | 0 | 1 | 2 | 3 | 4 | 5 |
| :--- | :---: | :---: | :---: | :---: | :---: | :---: |
| No. of weeks | 23 | 22 | 18 | 15 | 1 | 1 |

At the $5 \%$ level, test the hypothesis that the number of accidents per week follows a Poisson distribution of parameter equal to 1.5 .
9. The efficacy of attack of a team in a handball game is measured as the number of goals over the number of attacks. A random sample of 100 matches gave the following results, divided into the two parts of the match:

|  | Efficacy of attack |  |  |  |
| :---: | :---: | :---: | :---: | :---: |
|  | $<\mathbf{0 . 2 5}$ | $\mathbf{0 . 2 5 - 0 . 5}$ | $\mathbf{0 . 5 - 0 . 7 5}$ | $>\mathbf{0 . 7 5}$ |
| First part of match | 20 | 35 | 35 | 10 |
| Second part of match | 15 | 25 | 40 | 20 |

a) At the $5 \%$ level, say if you agree with the following statement: "The efficacy of attack in the first part of the match is uniformly distributed between 0 and 1 ".
b) Would you say that the efficacy of attack is independent of the part of the match?
10. A ski-rental shop offers different types of equipments. Data on weekly hires were collected on a random sample of 500 customers, having obtained the following results:

|  |  |  |  |
| :---: | :---: | :---: | :---: |
| Monday-Friday | 150 | Snowborad | Sledges |
| Weekend | 70 | 110 | 90 |

a) At the $5 \%$ level, say if you agree with the following statement: "Monday to Friday, snowboard and sledges are equally requested, while skis are requested two times more than snowboards".
b) Would you say that the preferences about the type of equipment change at weekends?

