# Data Science & AI — Hinglish

# Probability & Statistics
# Introduction to Sampling Distribution

DPP

**1.** A sample analysis of examination results of 500 students, it was found that 220 students have failed, 170 have secured a third class, 90 have secured a second class and the rest, a first class. Do these figures support the general belief that above categories are in the ratio 4 : 3 : 2 : 1 respectively ? (The tabular value of $\chi^2$ for d.f. 3 at 5% level of significance is 7.81).

**2.** What is $\chi^2$– test?

A die is thrown 90 times what the following results:

| Face: | 1 | 2 | 3 | 4 | 5 | 6 | Total |
|---|---|---|---|---|---|---|---|
| Frequency | 10 | 12 | 16 | 14 | 18 | 20 | 90 |

Use $\chi^2$-test to test whether these data are consistent with the hypothesis that die is unbiased.

Given $\chi^2_{0.05} \equiv 11.07$ for 5 degrees of freedom.

**3.** A survey of 320 families with 5 children shows the following distribution:

| No. of boys & girls | 5 boys & 0 girl | 4 boys & 1 girl | 3 boys & 2 girl | 2 boys & 3 girl | 1 boys & 4 girl | 0 boys & 5 girl | Total |
|---|---|---|---|---|---|---|---|
| No. of families | 18 | 56 | 110 | 88 | 40 | 8 | 320 |

Given that values of $\chi^2$ for 5 degrees of freedom are 11.1 and 15.1at 0.05 and 0.01 significance level respectively,test the hypothesis that male and female birth are equally probable.

4. A chemical extraction plant processes sea water to collect sodium chloride and magnesium. It is known that sea water contains sodium chloride, magnesium and other elements in the ratio 62:4: 34. A sample of 200 tonnes of sea water has resulted in 130 tonnes of sodium chloride and 6 tonnes of magnesium. Are these data consistent with the known composition of sea water at 5% level of significance? (Given that the tabular value of $\chi^2$ is 5.991 for 2 degree of freedom).

**5.** 4 coins were tossed at a time and this operation is repeated 160 times. It is found that 4 heads occur 6 times, 3 heads occur 43 times, 2 heads occur 69 times, one head occur 34 times. Discuss whether the coin may be regarded as unbiased?

6. 200 digits are chosen at random from a set of tables. The frequencies of the digits were:

| Digits | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|---|---|
| Frequency | 18 | 19 | 23 | 21 | 16 | 25 | 22 | 20 | 21 | 15 |

Use $\chi^2$-test to assess the correctness of the hypothesis that the digits were distributed in equal numbers in the table, given that the value of $\chi^2$ are respectively 16.9, 18.3 and 19.7 for 9, 10 and 11 degrees of freedom at 5% level of significance.

**7.** A genetical law says that children having one parent of blood group M and the other parent of blood group N will always be one of the three blood groups M, MN, N and that the average no. of children in these groups will be in the ratio 1:2:1. The report on an experiment states as follows: "Of 162 children having one M parent and one N parent, 28.4% were found to be of group M. 42% of group MN and the rest of the group N." Do the data in the report conform to the expected genetic ratio 1:2:1?

8. Every clinical thermometer is classified into one of the four categories A, B. C and D on the

basis of inspection and test. From past experience, it is known that thermometers produced by a certain manufacturer are distributed among the four categories in the following proportions:

| Category | A | B | C | D |
|---|---|---|---|---|
| Proportion | 0.87 | 0.09 | 0.03 | 0.01 |

A new lot of 1336 thermometers is submitted by the manufacturer for inspection and test and the following distribution into four categories results :

| Category | A | B | C | D |
|---|---|---|---|---|
| No. of the thermometers | 1188 | 91 | 47 | 10 |

Does this new lot of thermometers differ from the previous experience with regards to proportion of thermometers in each category?

# Answer Key

1. No
2. Yes
3. $H_0$ accepted at 1% level of significance and rejected at 5% level of significance
4. $\chi^2 = 1.025$, Yes
5. Coin is unbiased
6. $H_0$ accepted at 5% level
7. $H_0$ accepted at 5% level
8. $H_0$ rejected at 5% level

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