Analysis of Variance (ANOVA)

$S_1 = \mu_1 \quad S_2 = \mu_2 \quad S_3 = \mu_3 \quad S_4 = \mu_4$

Null Hypothesis, H_0 : $\mu_1 = \mu_2 = \mu_3 = \mu_4$

Alternate " , H_A : $\mu_1 \neq \mu_2 \neq \mu_3 \neq \mu_4$

$$\text{f-test} = \frac{\text{Mean}_{SS_{b/w}}}{\text{Mean}_{SS_{within}}}$$

$SS_{b/w}$ = Sum of Square b/w the samples

SS_{within} = " " within " "

Mean of each group

$$SS_{Between} = \sum n_i (\overline{x_i} - GM)^2$$

Grand Mean

Total no. of observation

$$SS_{within} = \sum (x_i - \mu)^2$$

$\overline{x_1} = 7$, $\overline{x_2} = 5.6$, $\overline{x_3} = 6$, $\overline{x_4} = 6.16$

Grand Mean, $GM = 6.2$

$$
\begin{aligned}
SS_{b/w} &= \sum n_i\left(\overline{x_i} - GM\right)^2 \\
&= \Big[\, 5 \times (7 - 6.2)^2 + 6 \times (5.6 - 6.2)^2 \\
&\quad + 7 * (6 - 6.2)^2 + 6 \times (6.1 - 6.2)^2 \,\Big] \\
&= 5.7
\end{aligned}
$$

$$\text{Mean } SS_{b/w} = \frac{SS_{b/w}}{k-1}$$

$$= \frac{5.7}{3} = 1.9$$

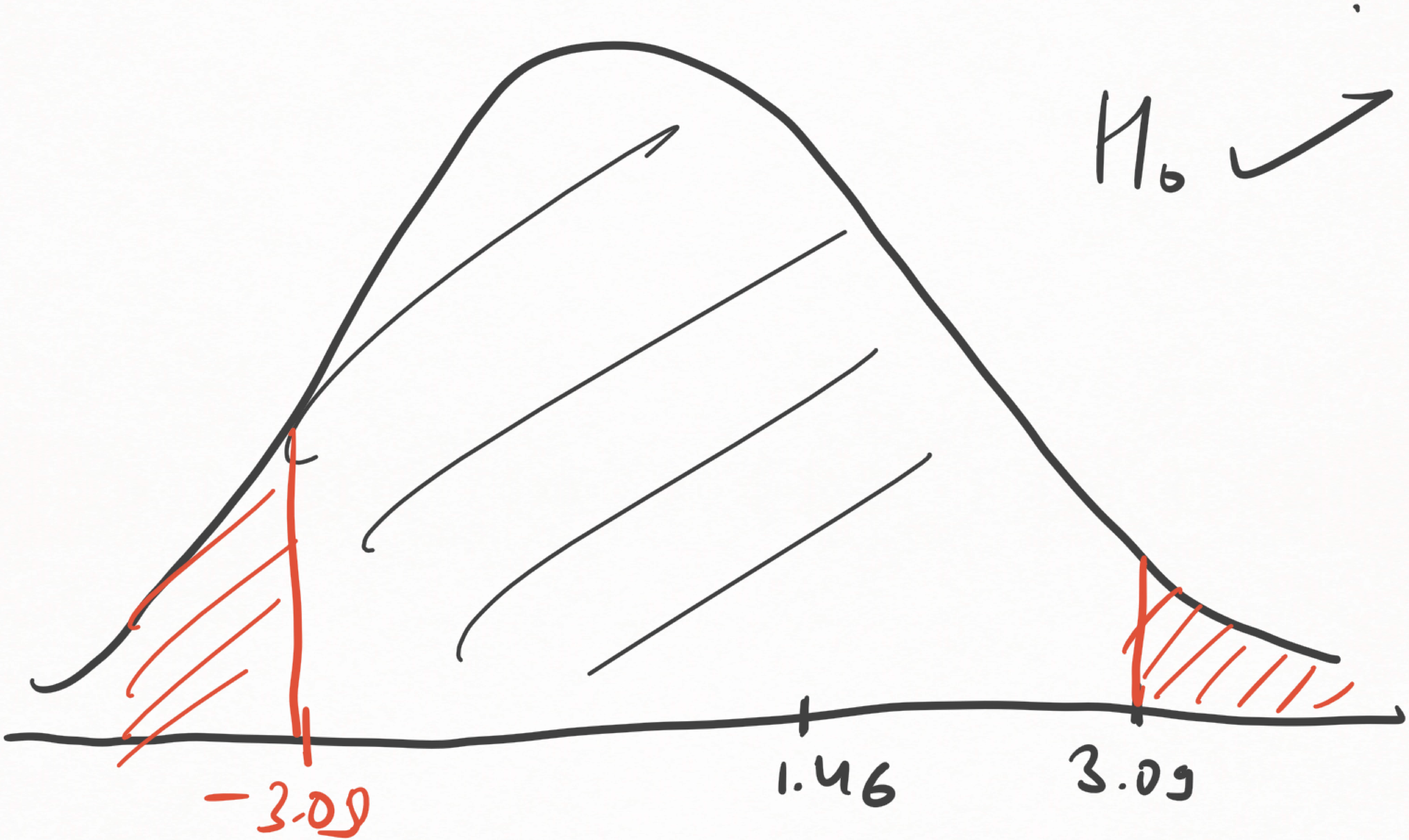
$$SS_{within} = 10 + 5.3 + 8 + 2.8$$

$$= 26.1$$

$$\text{Mean } SS_{within} = SS_{within} / N-k = \frac{26.1}{24-4} = 1.30$$

$$f\text{-test} = \frac{1.90}{1.30} = 1.46$$

$$f_{0.05} = 3.09$$



H_0 ✓
-3.09
1.46
3.09

Chi-Square (Goodness of fit)

H_0: Proportion of dogs is equal to the survey data. $(O = E)$

H_A: Proportion of dogs is not equal to the survey data. $(O \neq E)$

$E(1 \text{ dog}) = 0.60$ $\quad$ $O(1 \text{ dog}) = 73$

$E(2 \text{ dogs}) = 0.28$ $\quad$ $O(2 \text{ dog}) = 38$

$E(3 \text{ or more}) = 0.12$ $\quad$ $O(3 \text{ or more}) = 18$

$$\chi^2 = \sum \frac{(O-E)^2}{E}$$

	1 Dog	2 Dog	3 or more
Observed	73	38	18
Expected	$0.6 \times 129 = 77.4$	$0.28 \times 129 = 36.1$	$0.12 \times 129 = 15.4$
$(O-E)$	-4.4	1.9	2.6

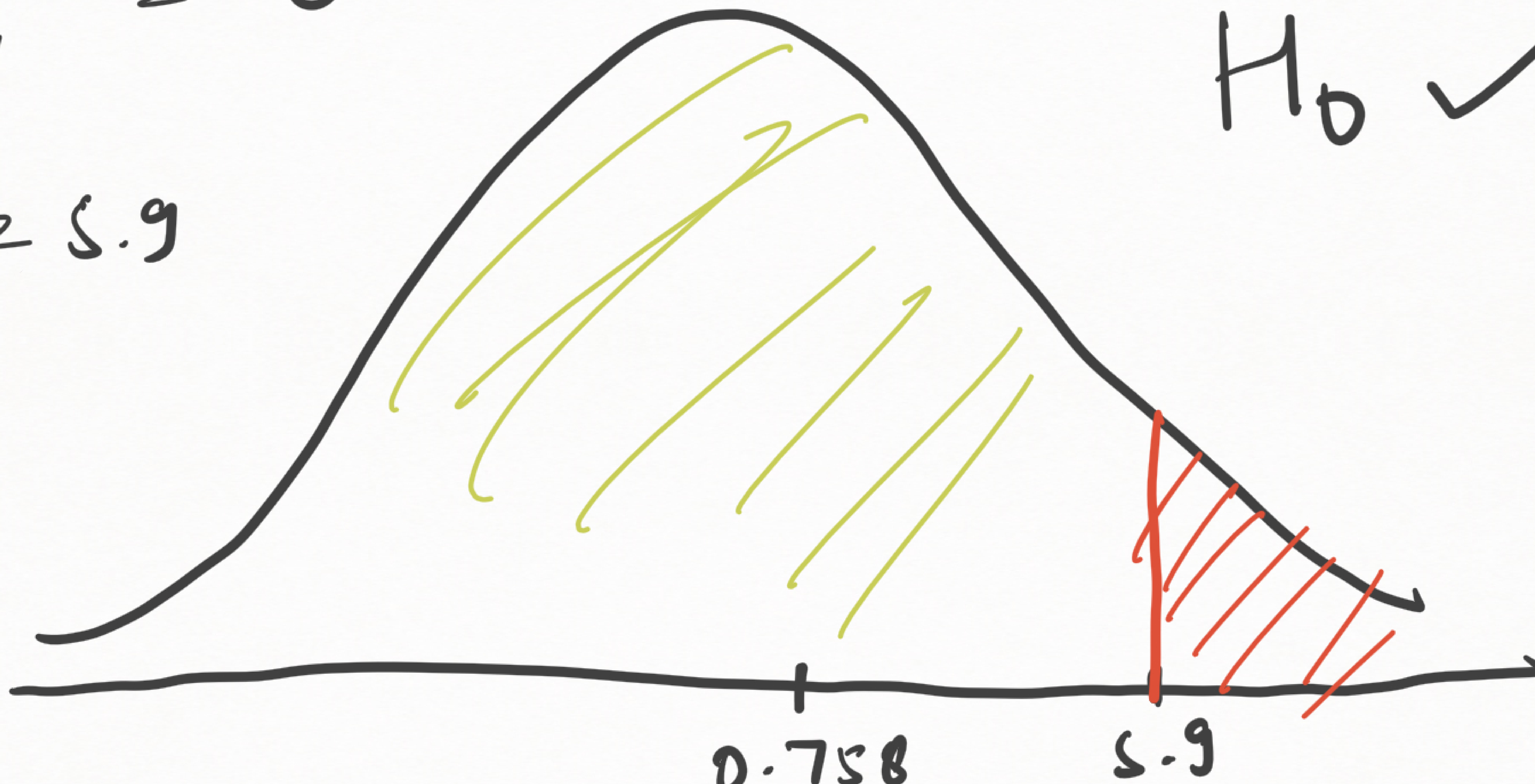
$$\chi^2 = \sum \frac{(O-E)^2}{E} = \frac{(-4.4)^2}{77.4} + \frac{(1.9)^2}{36.1} + \frac{(2.6)^2}{15.4}$$

$df = 3 - 1 = 2$

$\chi^2 = 0.758$

H_0 ✓

$\chi^2_{0.05} = 5.9$



PDF of B.D $\Rightarrow P(X=k) = {}^{N}C_{k}\,(p)^{k}\,(q)^{N-k}$

$N \rightarrow$ No. of trials

$k \rightarrow$ Total no. of desired outcomes

$p \rightarrow$ Probability of success in 1 trial

$q \rightarrow 1-p$

$N = 30$

$K = 10$

$p = 0.2$

$q = 0$

$$P(X \geq 1) = P(X = 1)$$

$$+ P(X = 2) +$$

$$P(X = 3) +$$

$$P(X = 4)$$

$$P(X \geq 1) = 1 - P(X = 0)$$

Q.)

5. The government of state union has declared a free medical insurance for below poverty line population by using following assumptions:

   a. In every year, there can be at most one patient who needs medical insurance in a family.
   b. In every year, the probability of a medical emergency is 0.05.
   c. The number of patients in every year is independent.

Using the assumptions, calculate the probability that there are fewer than 3 patients in a 10 years period in one family.

Sol:

$N = 10$, $K =$ less than 3, $p = 0.05$

$$P(k < 2) = P(k=0) + P(k=1)$$
$$+ P(k=2)$$

Poisson Dist.

$$P(X=k) = \frac{\mu^k \cdot e^{-\mu}}{k!}$$

$$P(X=0) = \frac{2^0 \cdot e^{-2}}{0!}$$

$$P(X \geq 2) = P(X=2) + P(X=3) + \_\_\_.$$

$$\_\_\_ \quad . \quad \_\_\_$$

$$P(X \geq 2) = 1 - \left[P(X=0) + P(X=1)\right]$$

9. The number of pizzas sold per day by a food zone "Pazzi per Pizza" follows a poisson distribution at a rate of 76 pizzas per day. What is the probability that the number of pizza sales exceeds 80 in a day. Write Python code to calculate the probability

$k > 80, \quad \mu = 76$

1. From the pack of 52 cards, three cards are drawn randomly without replacement then what is the probability that one card is a diamond, one card is a heart and one is spade?

Sol:

$$P(E) = \frac{E}{S}$$

Sample Size = $^{52}C_3$

E = event of getting 1 diamond, 1 spade, and 1 heart

$= {}^{13}C_1 \times {}^{13}C_1 \times {}^{13}C_1$

$= \left(\frac{13}{1}\right) \times 13 \times 13$

$$P(E) = \frac{E}{S}$$

$$= \frac{13 \times 13 \times 13}{{}^{52}C_3}$$

$$= 0.099$$