AS Further STATS 1

October 2021

1. $n = 40$ $P = 0.04$ not germinate

(a) $r = {}_{40}C_2\ 0.96^{38}\ 0.04^2 \times 125$

$= 0.264558330 2 \times 125$

$= 33.06979128 \Rightarrow 33.07$ to 2 d.p.

If we take all values from 125 to get 5 or more it leaves 2.63

(b) H_0: B (40, 0.04) is a suitable model
H_1: B(40, 0.04) is not a suitable model

Each cell must have an expected frequency more than 5, so need to merge the last 2 cells

$$\sum \frac{O_i^2}{E_i} - N$$

O_i	15	35	38	22	15
E_i	24.42	40.70	33.07	17.45	9.36
O_i^2/E_i					

$134.7518437 - 125 = 9.7518436 65$

5 - 1 = 4 degrees of freedom

χ^2_4 at 5% = 9.488

9.75 > 9.488 evidence to reject H_0, model not appropriate

1c

$$\frac{\text{Total number not germinate}}{\text{Total number of seeds}}$$

$$= \frac{0\times15 + 1\times35 + 2\times38 + 3\times22 + 4\times10 + 5\times5}{40\times125}$$

$$= 0.0484$$

2a $R \sim Po(28)$

(a) $P(R \geq 23) = 0.851706486$

$A \sim Po(16)$

(b) So $A + R \sim Po(44)$

$P(A+R = 42) = 0.058664711882$

(c) $P((A+R) < 80) = 0.183205795$

(d) So let $Y \sim B(150, 0.1832)$

use Poisson Approximation so that

$B \sim Po(27.48)$

$P((B) \geq 25) = 0.708$

(d) $H_0 : R \sim Po(3 \times 28)$ $R \sim Po(84)$ $\lambda = 84$
$H_1 : \lambda < 84$

$P(R \leq 67) / R \sim Po(84) = 0.032446146$

As the result is less than 5% then the result is significant, the system is working slower today.

3(a) $E(X) = -1/10$

(b) $Var(X) = E(X^2) - (E(X))^2$

$8.79 = E(X^2) - (-1/10)^2$

$E(X^2) = \frac{44}{5}$

(c) $4a + b = 0.75 \Rightarrow b = 0.75 - 4a$

$5a + b + c = 1$

$10a + 4c = 2$ $\qquad c = \frac{1 - 7a}{2}$

So $5a + 0.75 - 4a + \frac{1 - 7a}{2} = 1$

$10a + \frac{3}{2} - 8a + 1 - 7a = 2$

$1/2 = 5a$

$a = 1/10$

$b = 0.35$

$c = 0.15$

(3)

y	-2	-1	0	1	2
$P(Y=y)$	0.3	0.1	0.35	0.1	0.15

x	-3	-2	-1	0	2	5
$P(X=x)$	0.3	0.15	0.1	0.15	0.1	0.2

$W > 1$

$W > 3W - 8$

$8 > 2W$

$4 > W$

$W = Y - X$

X \ Y	-2	-1	0	1	2
5	-7	-6	-5	-4	-3
2	-4	-3	-2	-1	0
0	-2	-1	0	1	2
-1	-1	0	1	2	3
-2	0	1	2	3	4
-3	1	2	3	4	5

$$1 - \Big(P(X=-2) \times P(Y=2) + P(X=3) \times P(Y=1) + P(X=-3) \times P(Y=2) \Big)$$

$$1 - (0.15 \times 0.15 + 0.3 \times 0.1 + 0.3 \times 0.15) = 0.9025$$

4. (a) Expected fraction bonds × fraction 45–75

Total $a+b-\cancel{c}+\cancel{c}+c+d-\cancel{5q}+\cancel{5q}$

$= a+b+c+d$

$$\frac{a+c}{a+b+c+d} \times \frac{c+d-\cancel{5q}+\cancel{5q}}{a+b+c+d}$$

$$\frac{(a+c)(c+d)}{(a+b+c+d)^2} \times (a+b+c+d)$$

↖ to give expected total number

$$c - \frac{(a+c)(c+d)}{(a+b+c+d)^{*}}$$

$$\frac{\cancel{ac}+bc+c^2+\cancel{cd}-\cancel{ac}-ad-c^2-\cancel{cd}}{(a+b+c+d)^{*}}$$

$$\frac{\cancel{c^2}+bc-ad-\cancel{c^2}}{(a+b+c+d)^{*}}$$

45 5% level

H_0 : This is a good model for the main type of investment

H_1 : This is not a good model

$$\nu = (3-1)(2-1) = \underline{\underline{2}}$$

$$\chi^2_{2,0.05} = 5.991$$

As the actual value is greater than this, then there is a higher deviation from the model than is allowed, so we would reject the null in favour of the alternative, there is not a relationship between age and investment type.