2. Plotting and fitting of Multinomial distribution and graphical representation of probabilities.

The multinomial distribution is a multivariate generalization of the binomial distribution. Consider a trial that results in exactly one of some fixed finite number k of possible outcomes, with probabilities $p_1, p_2, \dots, p_k$ (so that $p_i \geq 0$ for $i = 1, \dots, k$ and $\sum i{=}1kpi{=}1$), and there are n independent trials. Then let the random variables X_i indicate the number of times outcome number i was observed over the n trials. Then $X = (X_1, X_2, \dots, X_k)$ follows a multinomial distribution with parameters n and $\boldsymbol{p}$, where $\boldsymbol{p} = (p_1, p_2, \dots, p_k)$.

Multinomial Distribution Formula

$$p(x_1, x_2 \dots \dots . x_k) = \left[\frac{n!}{x_1!.x_2!.\dots\dots\dots x_k!}\right].p_1^{x_1}.p_2^{x_2} \dots \dots . p_k^{x_k}$$

$$\mathrm{Cov}(X_i, X_j) = -np_ip_j \quad (i \neq j)$$

When $X = (x_1, x_2, \dots, x_k)$ follows a multinomial distribution with the PMF given above, X_i follows a binomial distribution with n trials and success probability p_i.

how to implement in excel

Multinomial = MULTINOMIAL(X1,X2,X3)

Probability = MULTINOMIAL*PRODUCT(p1^X1,p2^X2,p3^X3)

		1st Case	2nd Case	3rd Case
Red	X1	4	3	2
Green	X2	0	1	1
Blue	X3	6	3	2
P_Red	P1	0.375	0.375	0.375
P_Green	P2	0.125	0.125	0.125
P_Blue	P3	0.5	0.5	0.5
	Multinomial	210	140	30
	P1^X1	0.019775391	0.052734375	0.140625
	P2^X2	1	0.125	0.125
	P3^X3	0.015625	0.125	0.25
	Probability	0.064888	0.115356445	0.131835938

Multinomial	multinomial Distribution Probability(p)
210	0.064888
140	0.115356445
30	0.131835938