(Q2)

Likelihood $p(x|\theta, n) = \text{Multinomial}$

Prior $p(\theta|\alpha) = \text{Dirichlet}$

Posterior $p(\theta|x, n, \alpha) = \frac{p(x|\theta)p(\theta)}{p(x)} = \underline{\text{Dirichlet}}$

- A Dirichlet distribution where the parameterization

is $\alpha^{\text{posterior}} = (\alpha_1 + x_1, \alpha_2 + x_2, \ldots, \alpha_k + x_k)$

This is because since:

Proportionality

$p(\theta|x, n, \alpha) \propto p(\theta|\alpha)p(x|\theta, n)$