Machine learning Assignment no -7

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$$SBAF = \frac{1}{1 + kx^{\alpha}(1-x)^{1-\alpha}}$$

(1)

Show that SBAF is the solution to the first order differential equation:

$$f(x, y) = dy/dx = \frac{y(1-y)}{x(1-x)} * (\alpha - x) \quad (2)$$

solution:

$$y = \frac{1}{1 + kx^{\alpha}(1-x)^{1-\alpha}} \quad (3)$$

$$lny = ln1 - ln(1 + kx^{\alpha}(1-x)^{1-\alpha}) \quad (4)$$

$$= -ln(1 + kx^{\alpha}(1-k)^{1-\alpha}) \quad (5)$$

$$1/y \;\; dy/dx = -\frac{1}{(1 + kx^{\alpha}(1-x)^{1-\alpha})}. \; [k\alpha x^{\alpha-1}(1-x)^{1-\alpha} - kx^{\alpha}(1-\alpha)(1-x)^{1-\alpha-1}] \quad (6)$$

$$= -\frac{k}{(1 + kx^{\alpha}(1-x)^{1-\alpha})}. \; [\alpha x^{\alpha-1}(1-x)^{1-\alpha} - (1-\alpha)x^{\alpha}(1-x)^{-\alpha}] \quad (7)$$

$$dy/dx \;\; = y \;\; [\frac{\alpha}{x} - (1-\alpha)\frac{1}{1-x}] \;\; kx^{\alpha}(1-x)^{1-\alpha} \quad (8)$$

$$= y \; [\frac{\alpha(1-x) - (1-\alpha)x}{x(1-x)}] \; kx^{\alpha}(1-x)^{1-\alpha} \quad (9)$$

$$= \; y^2 \; [\frac{\alpha - x}{x(1-x)}] \; kx^{\alpha}(1-x)^{1-\alpha} \quad (10)$$

$$= \ y^2 \ [\frac{\alpha - x}{x(1-x)}] \ \ kx^{\alpha}(1-x)^{1-\alpha} \tag{11}$$

$$We \ know, \ y = \frac{1}{1 + kx^{\alpha}(1-x)^{1-\alpha}} \tag{12}$$

$$=> \ kx^{\alpha}(1-x)^{1-\alpha} = \frac{1-y}{y} \tag{13}$$

$$Substituiting \ the \ value \ from \ equation, \quad dy/dx \ = \ y^2 . \frac{\alpha - x}{x(1-x)} . \ \frac{1-y}{y} \tag{14}$$

$$= \ \frac{y(1-y)}{x(1-x)} . \ (\alpha - x) \tag{15}$$