1. Gini impurity

$$Q_m = 1 - \sum_{i=1}^{k} p_i^2$$

Entropy

$$Q_m - \sum_{i=1}^{k} p \log_2 p$$

Misclassification rate

$$Q_m = 1 - \max_i p_i$$

Gini impurity

A: $1 - (\frac{5}{18})^2 - (\frac{5}{18})^2 - (\frac{4}{9})^2 = 0.6481$

B: $1 - (\frac{2}{5})^2 - 0^2 - (\frac{3}{5})^2 = 0.48$

C: $1 - (\frac{1}{8})^2 - (\frac{5}{8})^2 - (\frac{1}{4})^2 = 0.5312$

Overall: $\frac{10}{18} \times 0.48 + \frac{8}{18} \times 0.5312 = 0.5028$

Entropy:

$$A: -\left(\frac{5}{18}\right)\log_2\left(\frac{5}{18}\right) - \left(\frac{5}{18}\right)\log_2\left(\frac{5}{18}\right) - \left(\frac{4}{9}\right)\log_2\left(\frac{4}{9}\right) = 1.5466$$

$$B: -\left(\frac{2}{5}\right)\log_2\left(\frac{2}{5}\right) - 0 - \left(\frac{3}{5}\right)\log_2\left(\frac{3}{5}\right) = 0.9710$$

$$C: -\left(\frac{1}{8}\right)\log_2\left(\frac{1}{8}\right) - \left(\frac{5}{8}\right)\log_2\left(\frac{5}{8}\right) - \left(\frac{1}{4}\right)\log_2\left(\frac{1}{4}\right) = 1.2988$$

Overall: $\frac{10}{18} \times 0.9710 + \frac{8}{18} \times 1.2988 = 1.1167$

Misclasification rate:

$$A: 1 - \frac{4}{9} = 0.5556$$

$$B: 1 - \frac{3}{5} = \frac{2}{5}$$

$$C: 1 - \frac{5}{8} = \frac{3}{8}$$

overall: $\frac{10}{18} \times \frac{2}{5} + \frac{8}{18} \times \frac{3}{8} = 0.3889$

2.

$x \leq 5$

$$\bar{y} = \frac{1}{7}(2 + 3 + 2.5 + 1 + 2.3 + 2.8 + 1.5) = 2.1571$$

$$MSE = \frac{1}{7}\left[(2-\bar{y})^2 + (3-\bar{y})^2 + \cdots (1.5-\bar{y})^2\right] = 0.4367$$

$x > 5$

$$\bar{y} = \frac{1}{6}(2.6 + 3.5 + 4 + 3.5 + 5 + 4.5) = 3.85$$

$$MSE = \frac{1}{6}\left[(2.6-\bar{y})^2 + (3.5-\bar{y})^2 + \cdots + (4.5-\bar{y})^2\right]$$
$$= 0.5958$$

Overall

$$MSE = \frac{7}{13} \times 0.4367 + \frac{6}{13} \times 0.5958$$
$$= 0.5102$$

Root

$$\bar{y} = \frac{1}{13}(2 + 3 + 2.5 + \cdots 4.5) = 2.9385$$

$$MSE = \frac{1}{13}\left[(2-\bar{y})^2 + (3-\bar{y})^2 + \cdots (4.5-\bar{y})^2\right] = 1.2224$$