

Question no 3: You now decide to try out a decision tree induction algorithm to see if it can out perform your favourite concept learning algorithm. You decide to use 10 fold cross validation. The error rates for the 10 cross validation folds for the two algorithms are shown in Table 1.

CV Fold	Favourite Algorithm	Decision Tree Induction
1	8.89%	9.3%
2	9.52%	9.48%
3	8.13%	9.12%
4	9.48%	9.13%
5	10.12%	9.98%
6	10.23%	11.01%
7	8.56%	9.02%
8	9.12%	8.56%
9	9.23%	9.23%
10	9.11%	9.08%

1. Calculate the difference in error rates for each fold:

$$\text{Difference} = \text{Favourite Algorithm} - \text{Decision Tree Induction}$$

$$\begin{aligned}
 1 & \longrightarrow (0.0889 - 0.093) = -0.0041 \\
 2 & \longrightarrow (0.0952 - 0.0948) = 0.0004 \\
 3 & \longrightarrow (0.0813 - 0.0912) = -0.0099 \\
 4 & \longrightarrow (0.0948 - 0.0913) = -0.0099 \\
 5 & \longrightarrow (0.1012 - 0.0998) = 0.0014 \\
 6 & \longrightarrow (0.1023 - 0.1101) = -0.0078 \\
 7 & \longrightarrow (0.0856 - 0.0902) = -0.0046 \\
 8 & \longrightarrow (0.0912 - 0.0856) = 0.0056 \\
 9 & \longrightarrow (0.0923 - 0.0923) = -0.0000 \\
 10 & \longrightarrow (0.0911 - 0.0908) = 0.0003
 \end{aligned}$$

2. Calculate the mean of these differences.

$$\begin{aligned}\textbf{Mean Difference (d): } & \text{Sum of differences / Number of folds} \\ & (-0.0041 + 0.0004 - 0.0099 + 0.0035 + 0.0014 - 0.0078 - 0.0046 + 0.0056 - 0.0000 + \\ & 0.0003) / 10 \\ & = -0.0152 / 10 \\ & = -0.00152\end{aligned}$$

The mean difference is negative, mean that the "Favourite Algorithm" has a slightly higher error rate on average than the "Decision Tree Induction" algorithm.

Since the mean difference is negative, the favorite algorithm does not appear to outperform the decision tree algorithm. Therefore, the confidence level for this is very low.