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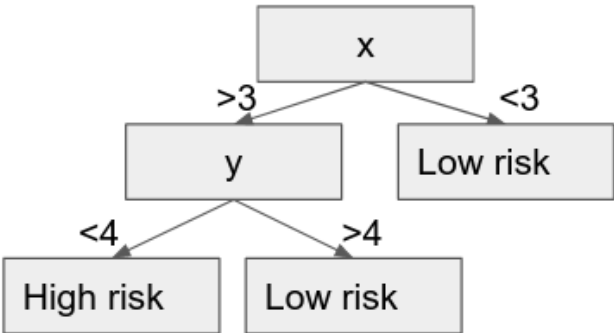
GRADE  
83.33%

# ML Interpretation

TOTAL POINTS 6

1. You train the random forest pictured below and it gets a c-index of 0.90. After shuffling the values for x, your dataset is the following. What is the variable importance for x? 1 / 1 point

ID	x	y	death
1	2	3	1
2	4	5	0
3	1	2	1
4	5	2	0



- ☐ -0.05
- ☐ 0.1
- ☐ 0.5

☒ 0.65

✓ **Correct**

Explanation: We need to calculate the new C-index. The prediction for 1 is low risk, the prediction for 2 is low risk, the prediction for 3 low risk, and the prediction for 4 is high risk. The permissible pairs are (1, 2), (1, 4), (3, 2), (3, 4). All of these are risk ties except for (3, 4) and (1, 4), which are not concordant. Therefore the c-index is  $0.5(2) / 4 = 0.25$ . Therefore the difference between the original C-index and the new one is  $0.9 - 0.25 = 0.65$ , so the answer is D.

2. Say you have trained a decision tree which never splits on a variable X. What will be the variable importance for X using the permutation method? **1 / 1 point**

☐ 0.5

☐ A random number between 0 and 1

☒ 0

☐ There is too little information to say

✓ **Correct**

Explanation: You might think that we don't have enough information to say since you don't even know the metric being used to compute the variable importance. However, since the tree never splits on X, we know that even if we permute the values of X in the dataset, this will never change any prediction. Therefore, no matter what metric we use the variable importance will be 0, since there will be no change in the model output. Therefore the answer is C.

3. We have the following table the output of a model f on an example using subsets of the variable. What is the Shapley value for s\_BP? **1 / 1 point**

Feature Set	Output
{}	0.5
{s_BP}	0.7
{d_BP}	0.6
{s_BP, d_BP}	0.65

- ☐ 0.0
- ☐ 0.2
- ☐ 0.05
- ☒ 0.125

✓ **Correct**

Explanation: We already know the value for  $s_{BP}$  is 0.125 from the last problem. We compute the shapley value for  $d_{BP}$  similarly: if it comes first, it gets + 0.15. If it comes after  $s_{BP}$  it gets -0.05. Therefore the average is  $\frac{1}{2}(0.15 - 0.05) = 0.05$ . The sum of these is 0.15, so the answer is A. Note that if we add this to the baseline, the output of  $\{\}$ , we get  $0.5 + 0.15 = 0.65$ , which is the original output. This is not a coincidence, in fact. The sum of the shapley values plus the baseline will always equal the output. This is a consequence of the weighting scheme. If you want, try proving it when there are only 2 variables, and work your way up to the general case!

4. We have the following table the output of a model  $f$  on an example using subsets of the variable. What is the sum of the Shapley value for  $s_{BP}$  and  $d_{BP}$ ?

0 / 1 point

Feature Set	Output
$\{\}$	0.5
$\{s_{BP}\}$	0.7
$\{d_{BP}\}$	0.6
$\{s_{BP}, d_{BP}\}$	0.65

- ☐ 0.0
- ☐ 0.2

☒ 0.05

☐ 0.125

 **Incorrect**

5. Could the following table of outputs be given by a linear model with no interactions (assume not including a feature means setting it to 0)?

**1 / 1 point**

Feature Set	Output
{}	0.5
{s_BP}	0.7
{d_BP}	0.6
{s_BP, d_BP}	0.65

☐ Yes

☒ No

 **Correct**

Explanation: The answer is no. We see that when only adding d\_BP, the output goes up, so the coefficient for it must be positive. We also see that when only adding s\_BP the output increases, so the coefficient must be positive. However, when we add d\_BP to the output with s\_BP, the output goes down, a contradiction, since we already know the coefficient for d\_BP is positive. This suggests that there must be at least an interaction between s\_BP and d\_BP.

6. Now assume we add Age as a variable. What is the new Shapley value for s\_BP?

**1 / 1 point**

Feature Set	Output
{}	0.5
{s_BP}	0.7
{d_BP}	0.6
{d_Age}	0.7
{s_BP, d_BP}	0.65
{s_BP, Age}	0.7

Feature Set	Output
{d_BP, Age}	0.8
{d_BP, s_BP, Age}	0.85

- ☐ 0.0
- ☒ 0.09
- ☐ 0.125
- ☐ 0.20



**Correct**

Explanation: This computation will be a bit more involved. We see that if s\_BP comes first, we get +0.2. If s\_BP comes after d\_BP, then we get +0.05, as before. If s\_BP comes after Age, it gets + 0.0. Finally, if it comes after both d\_BP and Age, it gets +0.05. Now we have to take a weighted average. The probability s\_BP comes first is  $\frac{1}{3}$ , the probability it comes last is  $\frac{1}{3}$ , and the probability it comes after d\_BP is  $\frac{1}{6}$  and after Age is  $\frac{1}{6}$ . Now, the weighted average is  $\frac{1}{3}(0.2) + \frac{1}{6}(0.05) + \frac{1}{6}(0.0) + \frac{1}{6}(0.05) \sim 0.09$ , so the answer is B.