4. You've fit a Cox model on 2 features: age and smoking status. The coefficients of these features are:  $eta_{age} = 0.9$  and  $eta_{smoker} = 10.0$ . What is the hazard ratio between Person 1, a 40 year old non-smoker, and Person 2, a 30 year old smoker? Recall that Cox Proportional Hazards assumes a model of the form:  $h(t) = \lambda_0(t)e^{(eta_{age} imes Age + eta_{smoker} imes Smoker)}$ We're asking you to find the ratio:  $\frac{h_1(t)}{h_2(t)}$ 0.36

1/1 point

1/1 point

1/1 point

1/1 point

1/1 point

1/1 point

 $\frac{h_1(t)}{h_2(t)} = \frac{e^{(0.9 \times 40 + 10 \times 0)}}{e^{(0.9 \times 30 + 10 \times 1)}} = e^{(36 - (27 + 10))}$  $\frac{h_1(t)}{h_2(t)} = e^{(-1)} = 0.36$ 5. You've fit a cox model and have the following coefficients:  $\beta_{female} = -1.0$  $\beta_{age}=1.0$ ,  $\beta_{BP}=0.6$  $h(t) = \lambda_0(t)e^{((\beta_{female} \times female) + (\beta_{age} \times Age) + (\beta_{BP} \times BP))}$ Which of the following interpretations is most correct?

Note that the effect of increasing a feature x by 1 unit will be to multiply the hazard by  $e^{(eta_x)}$  .

Since  $e^{(0)}=1$ , a coefficient less than 0 (a negative coefficient) reduces the hazard. A coefficient greater than 0

Therefore the only correct interpretation is that being a female decreases the hazard, since  $eta_{female} < 0$ .

(positive) increases the hazard.

All other things held equal, having lower age increases your risk

O All other things held equal, having higher BP decreases your risk

All other things held equal, being a female decreases your risk

2 None of the above

6. Assume  $h_1(t) = t$ , and  $h_2(t) = 1.0$ . At which time T > 0 does  $S_1(T) = S_2(T)$ ?

✓ Correct Remember that the Cumulative hazard is the integral from 0 to t of the hazard function. Using calculus, one can see that the cumulative hazard for Person 1 is 0.5t^2 and for person 2, the cumulative hazard is t.

give you t = 1.

0 1

0.5

✓ Correct

0 2.64

O 2.7

✓ Correct

So we just compute:

 $\frac{h_1(t)}{h_1(t)} = \frac{\lambda_0(t)e^{(\beta_{age}\times Age_1 + \beta_{smoker}\times Smoker_1)}}{\lambda_0(t)e^{(\beta_{age}\times Age_1 + \beta_{smoker}\times Smoker_2)}}$ 

When we take the ratio, the  $\lambda_0$  will drop out.

ID Outcome 3 1 2 4 3 8 4 6+

7. Using the Nelson-Aalen estimator estimate H(7), the value of the cumulative hazard at t=7 for this dataset.

Since  $S(t) = \exp(-H(t))$ , the survival functions are equal if and only if the cumulative hazard is equal.

Setting these equal to each other, we get t = 2. A common mistake is just to set the hazards equal, which would

0 8/11 O 5/9

✓ Correct

The Nelson-Aalen estimator is:

 $H(t) = \sum_{i=0}^{t} \frac{d_i}{n_i}$ 

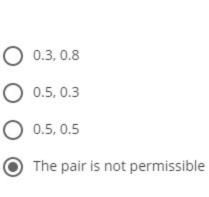
7/12

Patient 1

Evaluating this for t=7, we get

 $\frac{d_3}{n_3} + \frac{d_4}{n_4} = \frac{1}{4} + \frac{1}{3} = \frac{7}{12}$ 

Т 10



who had a worse outcome.

Outcome

4

0.3, 0.8

0.5, 0.3

0.5, 0.5

ID

1



Score

1.6

The pair is in fact not permissible. Since Patient 2 was censored before Patient 1 had the event, we cannot say

Patient 2

2 6+ 1.2 3 5 0.8

9. Compute the Harrell C-index for the following dataset and risk scores:

4	7	0.1	
Step 1: Find	d all the permissible pair	S	
Step 2: of the	he permissible pairs, de	termine which ones are o	oncordant
Step 3: of t	he permissible pairs, de	termine which ones are r	isk ties.
Harrell	's c-index = $\frac{cond}{c}$	$\frac{vordant+0.5  imes risktic}{permissible}$	e <u>s</u>

0.8 0.7

✓ Correct The permissible pairs are (1, 2), (1, 3), (1, 4), (2, 3), (3, 4).

0 1.0

Of these, the concordant ones are (1, 2), (1, 3), (1, 4), and (3, 4). Since there are no ties, the harrell's c-index is the number of concordant pairs over the number of permissible pairs, which is  $\frac{4}{5} = 0.8$ .