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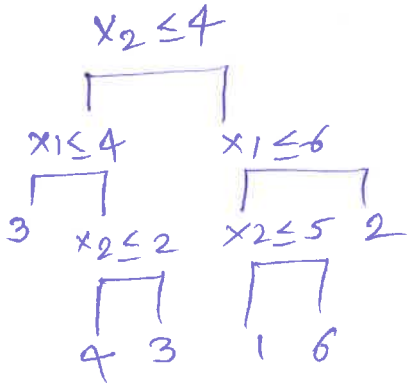
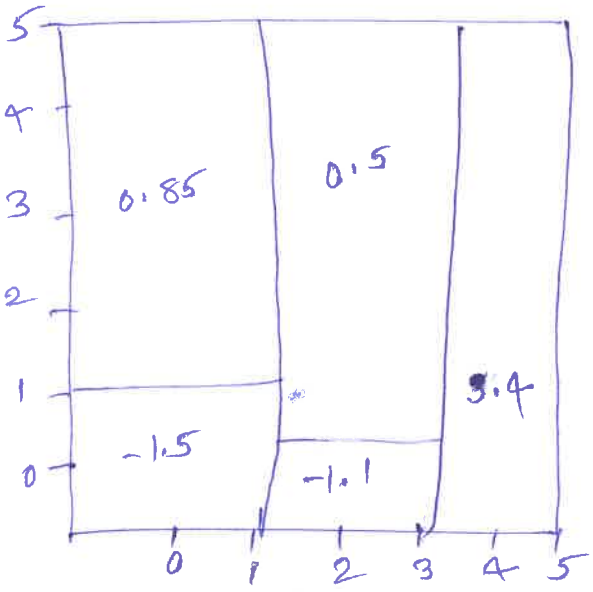
HW-7

1)

a) from given,



b) from given,



3) a
By observing above, majority vote approach × (RED) as it is the most commonly occuring class among 10 predictions, since there are more predictions that are ~~>~~ 0.5 than there are estimates that are ~~>~~ > 0.5 (0.5, 0.8, 0.85, 0.9) i.e 6 for Red vs 4 for Green

the avg probability approach takes the average of the 10 estimates. the average from this set of estimates is 0.55, resulting in a final classification of Green since the average estimate is > 0.5

4)

step1 :- Age :- age of each participant

step2 :- F=0 :- mean of all ages

$$F_0 = 35.36$$

step3 :- pseudo Residual 0 = Age - F0

ID	Age	F0	Pseudo Residual 0
1	12	35.36	-23.36
2	13	35.36	-22.36
3	14	35.36	-21.36
4	16	35.36	-19.36
5	20	35.36	-15.36
6	24	35.36	-11.36
7	32	35.36	-3.36
8	45	35.36	9.64
9	65	35.36	29.64
10	73	35.36	37.64
11	75	35.36	39.64

step4:- h_0 = mean of all ages in each leaf.

Root

{-23.36, -22.36, -21.36, -19.36, -15.36, -11.36, -3.36, 9.64, 29.64, 37.64, 39.64}

product A == N (F)

{-23.36, -22.36, -21.36, -15.36, -3.36}

product A == Y (T)

{-19.36, -11.36, 9.64, 29.64, 37.64, 39.64}

↓

mean value for each leaf ⇒ -17.16

↓

mean value for each leaf ⇒ 14.30

ID	AGE	F_0	Pseudo Residual 0	f_{10}
1	12	35.36	-23.36	-17.16
2	13	35.36	-22.36	-17.16
3	14	35.36	-21.36	-17.16
4	16	35.36	-19.36	14.30
5	20	35.36	-15.36	-17.16
6	24	35.36	-11.36	14.30
7	32	35.36	-3.36	-17.16
8	45	35.36	9.64	14.30
9	65	35.36	29.64	14.30
10	73	35.36	37.64	14.30
11	75		39.64	14.30

steps:- gamma 0 = 1 (by default)

step6:- F1 = F0 + h0

ID	AGE	F0	pseudo Residual 0	h0	gamma0	F1
1	12	35.36	-23.36	-17.16	1	18.2
2	13	35.36	-22.36	-17.16	1	18.2
3	14	35.36	-21.36	-17.16	1	18.2
4	16	35.36	-19.36	14.30	1	21.06
5	20	35.36	-15.36	-17.16	1	18.2
6	24	35.36	-11.36	14.30	1	21.06
7	32	35.36	-3.36	-17.16	1	18.2
8	45	35.36	9.64	14.30	1	21.06
9	65	35.36	29.64	14.30	1	21.06
10	73	35.36	37.64	14.30	1	21.06
11	75	35.36	39.64			

step7:- pseudo Residual 1 = Pesudo Residual 0 - h0

pseudo Residual1
-6.2
-5.2
-4.2
-33.66
1.8
-25.66
13.8
-4.66
15.34
23.34
25.34

step8:- h_1 = mean of all ages in each leaf

{ -6.2, -5.2, -4.2, -33.66, 1.8, -25.66, 13.8, -4.66, 15.34, 23.34, 25.34 }

product B == N(F)

{ -33.66, -25.66, 13.8, -4.66, 23.34, 25.34 }

mean = -0.25

product B == Y(T)

{ -6.2, -5.2, -4.2, 1.8, 15.34 }

mean = 0.308

step9:- gamma 1 = 1

∴

ID	F1	Pseudo Residual 1	h1	gamma 1
1	18.2	-6.2	0.308	1
2	18.2	-5.2	0.308	1
3	18.2	-4.2	0.308	1
4	18.2	-33.66	-0.25	1
5	18.2	1.8	0.308	
6	18.2	-25.66	-0.25	1
7	18.2	13.8	-0.25	1
8	18.2	-4.66	-0.25	1
9	18.2	15.34	0.38	1
10	18.2	23.34	-0.25	1
11	18.2	25.34	-0.25	1

step 10:- F2 = F1 + h1

ID	AGE	F0	PR0	h0	gamma0	F1	PR1	h1	gamma1	F2
1	12	35.36	-23.36	-17.16	1	15.2	-6.2	0.308	1	18.508
2	13	35.36	-22.36	-17.16	1	18.2	-5.2	0.308	1	18.508
3	14	35.36	-21.36	-17.16	1	18.2	-4.2	0.308	1	18.508
4	16	35.36	-19.36	14.30	1	21.06	-33.66	+0.25	1	20.81
5	20	35.36	-15.36	-17.16	1	18.2	1.8	0.38	1	18.508
6	24	35.36	-11.36	14.30	1	21.06	-25.66	-0.25	1	20.81
7	32	35.36	-3.36	-17.16	1	18.2	13.8	-0.25	1	20.81
8	45	35.36	9.64	14.30	1	21.06	-4.66	-0.25	1	20.81
9	65	35.36	29.64	14.30	1	21.06	15.34	0.38	1	18.508
10	73	35.36	37.64	14.30	1	21.06	23.34	-0.25	1	20.81
11	75	35.36	39.64	14.30	1	21.06	25.34	-0.25	1	20.81

(2)

Consider the Gini index, classification error, and entropy in a simple classification setting with two classes. Create a single plot that displays each of these quantities as a function of ˆpm1. The x-axis should display ˆpm1, ranging from 0 to 1, and the y-axis should display the value of the Gini index, classification error, and entropy. (Note: you may use R to make this plot

```
pm <- seq(0, 1, 0.001)

# Classification error
class_error <- 1 - pmax(pm, 1-pm)

# Gini index
gini_index <- 2*pm*(1-pm)

# Cross entropy
cross_entropy <- -((pm*log(pm))+((1-pm)*log(1-pm)))

matplot(pm, cbind(class_error, gini_index, cross_entropy), col=c("black", "green", "orange
legend("topright",pch=19,col=c("black", "green", "orange"), legend=c("Classification_Error
```

Console Terminal Jobs

```
R is free software and comes with ABSOLUTELY NO WARRANTY.
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  Natural language support but running in an English locale

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'help.start()' for an HTML browser interface to help.
Type 'q()' to quit R.

[Workspace loaded from ~/.RData]

> pm <- seq(0, 1, 0.001)
> # Classification error
> class_error <- 1 - pmax(pm, 1-pm)
> # Gini index
> gini_index <- 2*pm*(1-pm)
> # Cross entropy
> cross_entropy <- -((pm*log(pm))+((1-pm)*log(1-pm)))
> matplot(pm, cbind(class_error, gini_index, cross_entropy), col=c("black", "green", "orange"),
 ylab = "Split Criterion")
> legend("topright",pch=19,col=c("black", "green", "orange"), legend=c("Classification_Error_Rat
e","Gini_Index","Cross-entropy"))
>
```