ECE 50024

Homework 6

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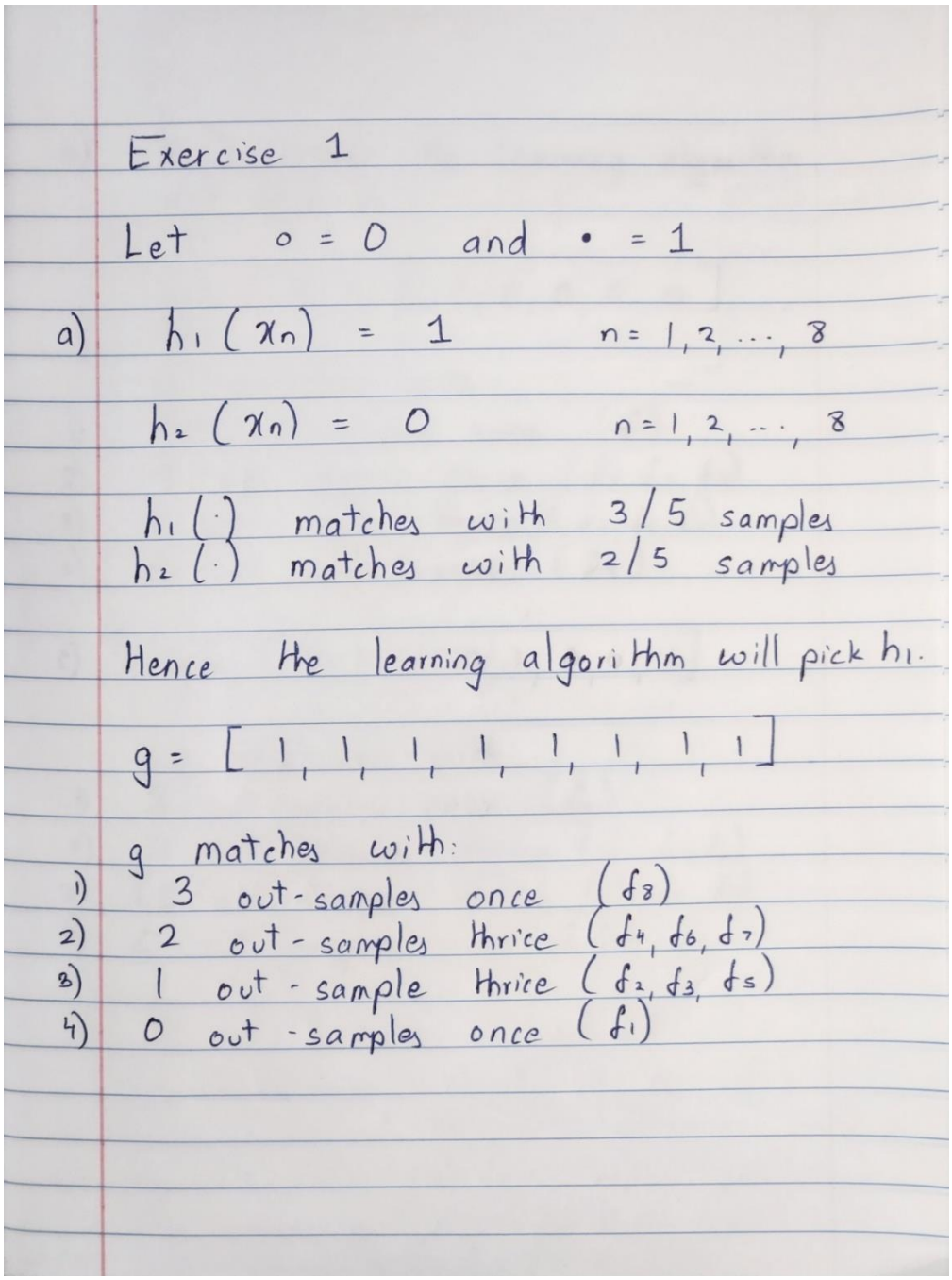
Exercise 1:



Exercise 1

Let o = 0 and • = 1

a) $h_1(x_n) = 1 \quad n = 1, 2, \ldots, 8$

$h_2(x_n) = 0 \quad n = 1, 2, \ldots, 8$

$h_1(\cdot)$ matches with 3/5 samples
$h_2(\cdot)$ matches with 2/5 samples

Hence the learning algorithm will pick h_1.

$g = [1, 1, 1, 1, 1, 1, 1, 1]$

g matches with:

1) 3 out-samples once (f_8)
2) 2 out-samples thrice (f_4, f_6, f_7)
3) 1 out-sample thrice (f_2, f_3, f_5)
4) 0 out-samples once (f_1)

b) In this case, the learning algorithm will pick h_2

$g = [0, 0, 0, 0, 0, 0, 0, 0]$

g matches with

1) 3 out samples once (f_1)
2) 2 out samples thrice (f_2, f_3, f_5)
3) 1 out sample thrice (f_4, f_6, f_7)
4) 0 out samples once (f_8)

c) $g = [0, 1, 1, 0, 1, 0, 0, 1]$

g matches with

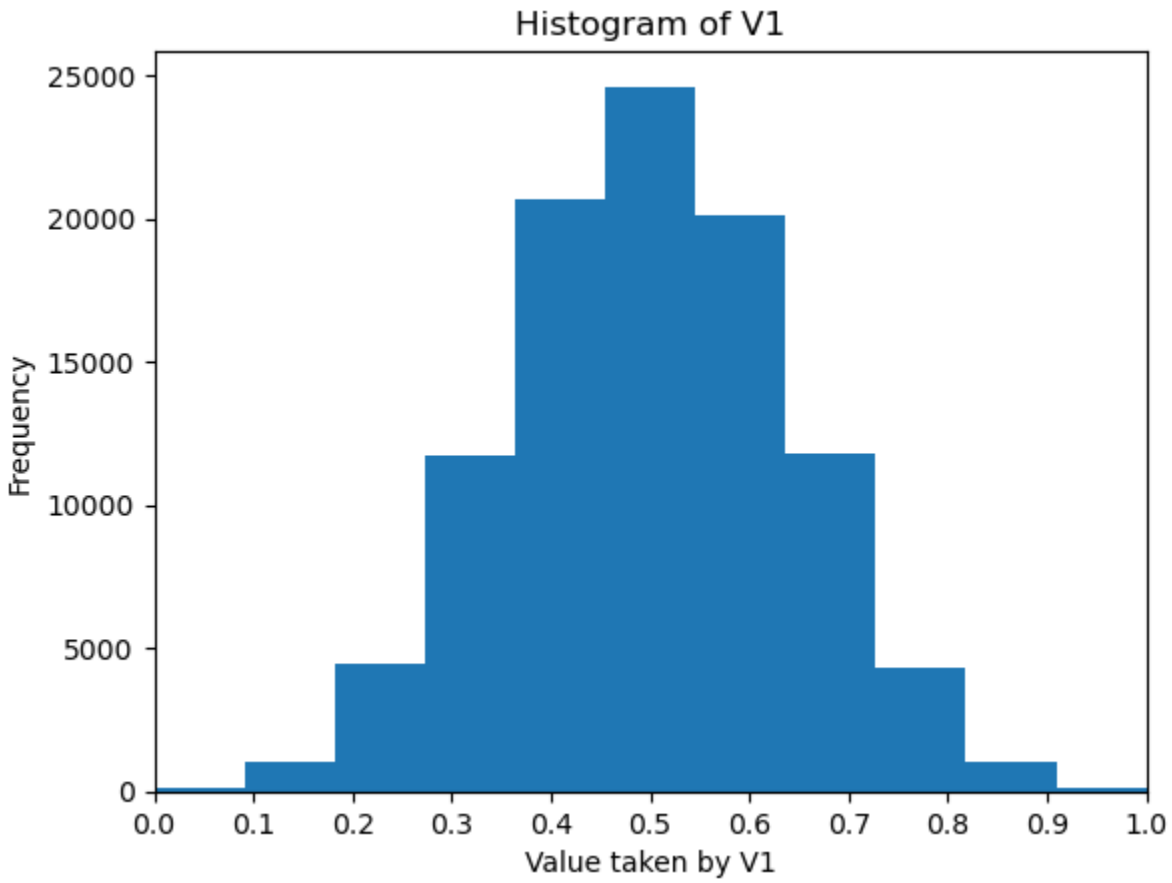
1) 3 out samples once (f_2)
2) 2 out samples thrice (f_1, f_4, f_6)
3) 1 out sample thrice (f_3, f_5, f_8)
4) 0 out samples once (f_7)

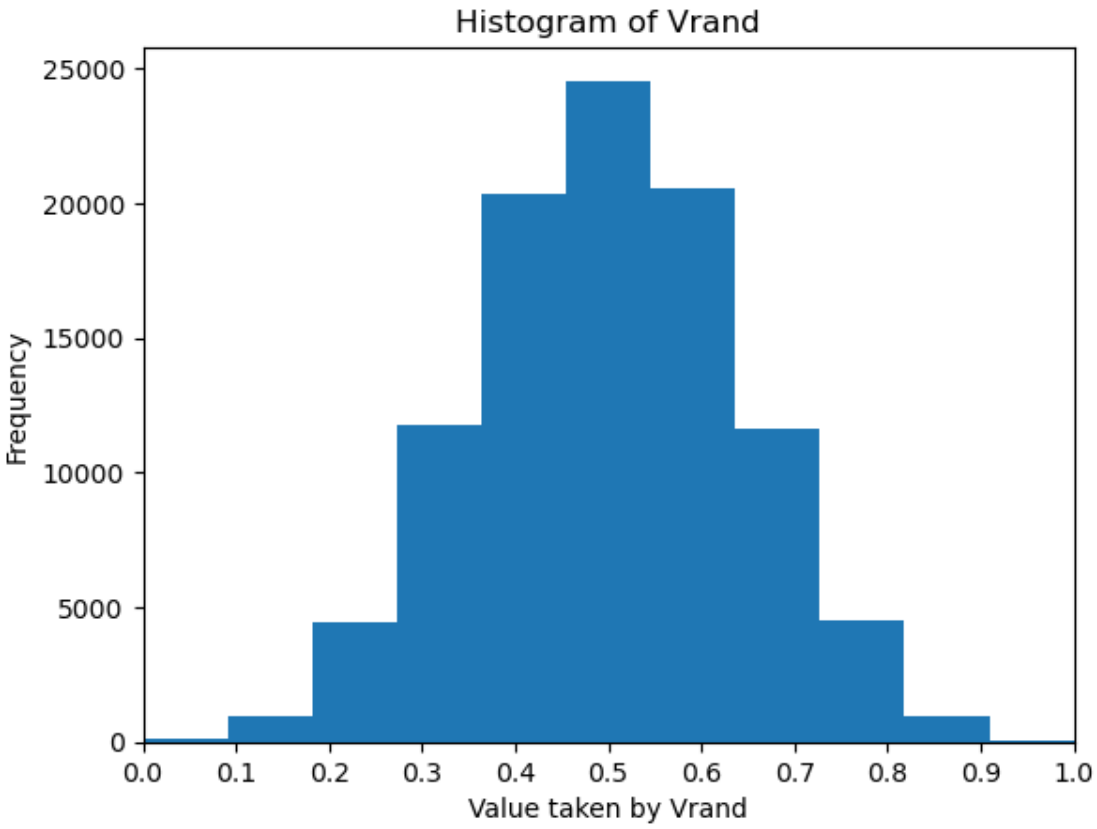
Exercise 2:

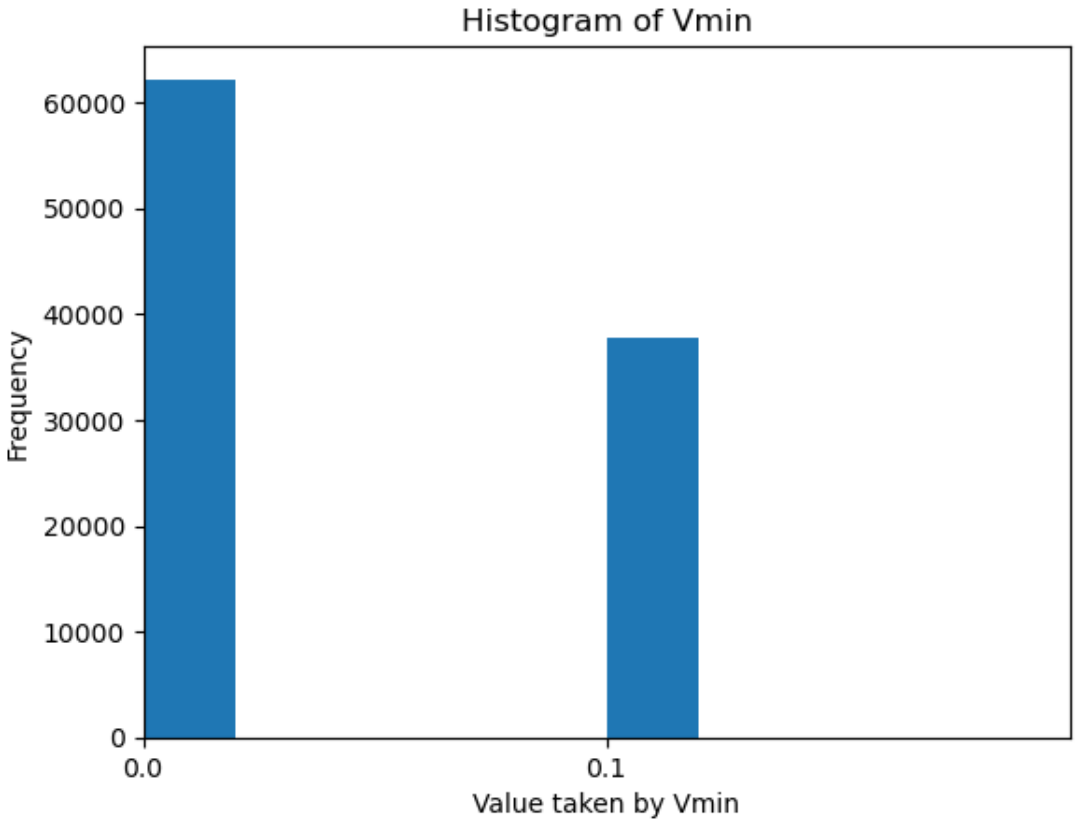
a) As all the three coins we pick are fair coins, the probability that we get a head on each of them is same and is equal to 0.5.

$$\mu_1 = 0.5$$
$$\mu_{rand} = 0.5$$
$$\mu_{min} = 0.5$$

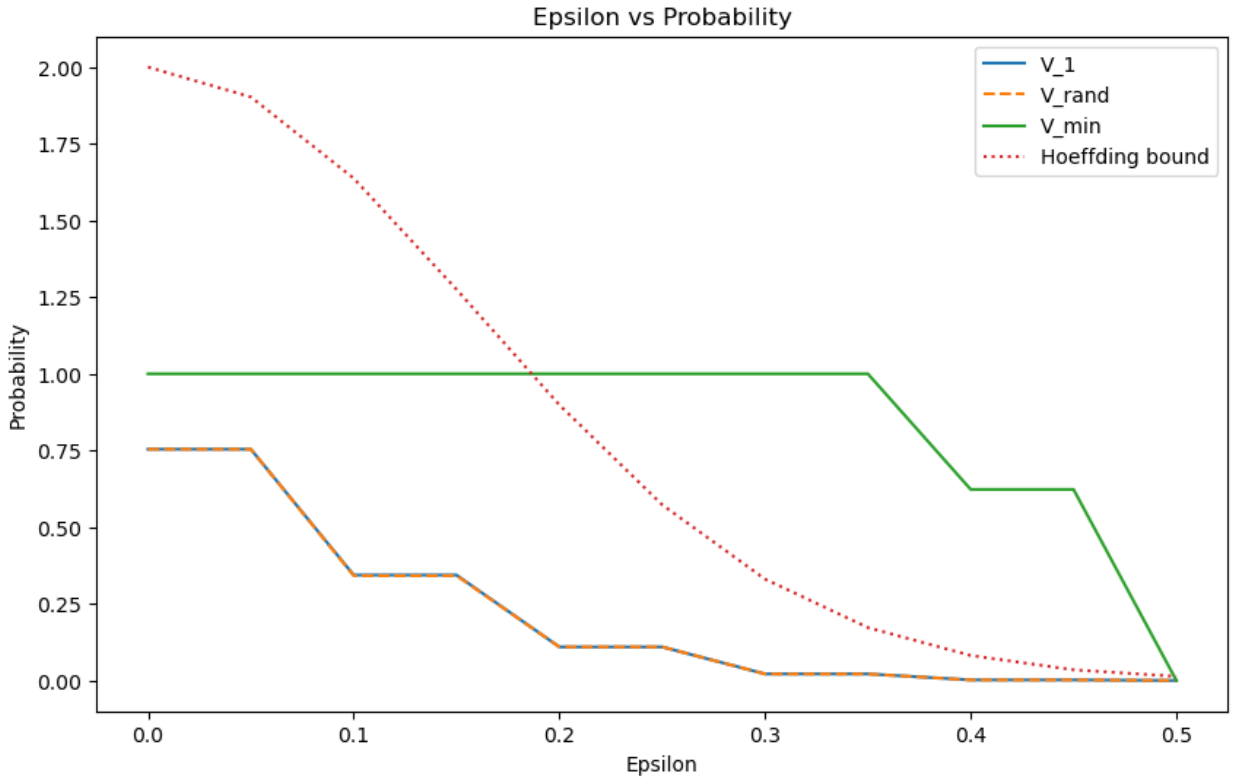
b) Histograms of the random variables




Histogram of Vrand
Frequency
25000
20000
15000
10000
5000
0
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
Value taken by Vrand


Histogram of Vmin
Frequency
60000
50000
40000
30000
20000
10000
0
0.0
0.1
Value taken by Vmin

c) Hoeffding's inequality for the 3 coins



Note: The curves for V_1 and V_{rand} coincide.

d) The coins $coin_1$ and $coin_{rand}$ follow the Hoeffding bound, while $coin_{min}$ does not. This is because the coins $coin_1$ and $coin_{rand}$ are selected before we look at the data, while $coin_{min}$ is selected after we have the data. Hoeffding inequality is valid only if we apply it before we look at the data.

APPENDIX