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## 7. Exercise: Multiple observations

Exercises due Apr 8, 2020 05:29 IST **Completed**

### Exercise: Multiple observations

2/2 points (graded)

Consider a model involving multiple observations of the form  $X_i = c_i \Theta + W_i$ ,  $i = 1, 2, \dots, n$ , where  $\Theta, W_1, \dots, W_n$  are independent (not necessarily normal) random variables and the  $c_i$ 's are known nonzero constants. Assume that  $\Theta$  has positive variance.

a) Are the random variables  $X_i, i = 1, 2, \dots, n$ , independent?

No

✓ Answer: No

b) Are the random variables  $X_i, i = 1, 2, \dots, n$ , conditionally independent given  $\Theta$ ?

Yes

✓ Answer: Yes

### Solution:

a) The  $X_i$ 's are dependent because they are all affected by  $\Theta$ . For a mathematical derivation, you can consider the zero mean case and check that

$$\mathbf{E}[X_1 X_2] = c_1 c_2 \mathbf{E}[\Theta^2] \neq 0, \text{ whereas } \mathbf{E}[X_1] \mathbf{E}[X_2] = 0.$$

b) If we are given that  $\Theta = \theta$ , then  $X_i = c_i \theta + W_i$ . In the conditional universe,  $\theta$  is now a number. Furthermore, the  $W_i$ 's are independent. Thus, the  $X_i$ 's (which are equal to  $W_i$  plus a number) are also (conditionally) independent.

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You have used 1 of 1 attempt

**i** Answers are displayed within the problem



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💬 Intuition behind this question.

3 new\_ 6

? b) could've been clearer on "... conditionally independent given Theta"

The question b) would've been clear if the statement said: "given that Theta assumes a value of little thet...

1

? Question a)

Why  $E[X_1]E[X_2]=0$  ?

1 new\_ 3

✓ "Positive variance" definition

Hi, just to be sure that I correctly understand it. Is it a term or what do we mean under "positive variance..."

2

?  $\Theta$ 's positive variance.

Why are we assuming that  $\Theta$  has positive variance? Since variance cannot be negative, it only means that...

2

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