



Bookmarks

► Introduction

## ▼ Part 1: Probability and Inference

## Week 1: Introduction to Probability

Exercises due Sep 22, 2016 at 02:30 IST



## Week 1: Probability Spaces and Events

Exercises due Sep 22, 2016 at 02:30 IST



## Week 1: Random Variables

Exercises due Sep 22, 2016 at 02:30 IST



## Week 2: Jointly Distributed Random Variables

Exercises due Sep 29, 2016 at 02:30 IST



## Week 2: Conditioning on Events

Exercises due Sep 29, 2016 at 02:30 IST



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## Homework Problem: Ainsley Works on Problem Sets

(10/10 points)

Ainsley sits down on Sunday night to finish  $S$  problem sets, where  $S$  is a random variable that is equally likely to be 1, 2, 3, or 4. She learns  $C$  concepts from the problem sets and drinks  $D$  energy drinks to stay awake, where  $C$  and  $D$  are random and depend on how many problem sets she does. You know that  $p_{C|S}(c|s) = 1/(2s + 1)$  for  $c \in \{0, 1, \dots, 2s\}$ . For each problem set she completes, regardless of concepts learned, she independently decides to have an energy drink with probability  $q$ . That is, the number of energy drinks she has is binomial with parameters  $q$  and  $S$ :

$$p_{D|S}(d|s) = \begin{cases} \binom{s}{d} q^d (1 - q)^{s-d} & d \in \{0, \dots, s\} \\ 0 & \text{otherwise} \end{cases}$$

where  $\binom{n}{k} = \frac{n!}{k! (n-k)!}$ .








- (a) Does the conditional entropy  $H(C|S = s)$  decrease, stay the same, or increase as  $s$  increases from 1 to 4?



It decreases.




It stays the same


**Week 2: Homework 1**Homework due Sep 29, 2016 at 02:30 IST **Week 3: Inference with Bayes' Theorem for Random Variables**Exercises due Oct 06, 2016 at 02:30 IST **Week 3: Independence Structure**Exercises due Oct 06, 2016 at 02:30 IST **Week 3: Homework 2**Homework due Oct 06, 2016 at 02:30 IST **Notation Summary Up Through Week 3****Weeks 3 and 4: Mini-project on Movie Recommendations**Mini-projects due Oct 13, 2016 at 02:30 IST **Week 4: Decisions and Expectations**Exercises due Oct 13, 2016 at 02:30 IST **Week 4: Measuring Randomness**Exercises due Oct 13, 2016 at 02:30 IST **Week 4: Towards Infinity in Modeling Uncertainty**☒ It increases. 


- **(b)** The next morning, her roommate notices that Ainsley drank  $d$  energy drinks. What is the expected number of concepts that she learned?

You should derive a general expression for this although in the answer boxes below we only ask you to evaluate the expression for specific choices of  $d$  and  $q$ . If your general expression is correct, your answers to these should also be correct.

(Please be precise with at least 3 decimal places, unless of course the answer doesn't need that many decimal places. You could also put a fraction.)

When  $q = .2$ ,  $\mathbb{E}[C|D = 1] =$   

When  $q = .5$ ,  $\mathbb{E}[C|D = 2] =$   

When  $q = .7$ ,  $\mathbb{E}[C|D = 3] =$   

- **(c)** Is the mutual information  $I(C; D)$  greater than, less than, or equal to zero? You should assume that  $q$  lies in the range  $0 < q < 1$ .

☒ Greater than 0 ☐ Less than 0

Exercises due Oct 13, 2016 at  
02:30 IST

**Week 4: Homework 3**

Homework due Oct 13, 2016 at  
02:30 IST



- Part 2: Inference in Graphical Models

☐ Equal to 0

*You have used 2 of 5 submissions*

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