



## MITx: 6.041x Introduction to Probability - The Science of Uncertainty



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## Unit 3: Counting &gt; Lec. 4: Counting &gt; Lec 4 Counting vertical5

**Exercise: Counting partitions**

(3/3 points)

We have 9 distinct items and three persons. Alice is to get 2 items, Bob is to get 3 items, and Charlie is to get 4 items.

1. As just discussed, this can be done in  $\frac{a!}{b! 3! 4!}$  ways. Find  $a$  and  $b$ .

 $a =$ 

9



Answer: 9

 $b =$ 

2



Answer: 2

2. A different way of generating the desired partition is as follows. We first choose 2 items to give to Alice. This can be done in  $\binom{c}{d}$  different ways. Find  $c$  and  $d$ . (There are 2 possible values of  $d$  that are correct. Enter the smaller value.)

 $c =$ 

9



Answer: 9

 $d =$ 

2



Answer: 2

3. Having given 2 items to the Alice, we now give 3 items to Bob. This can be done in  $\binom{e}{f}$  ways. Find  $e$  and  $f$ . (There are 2 possible values of  $f$  that are correct. Enter the smaller value.)

 $e =$ 

7



Answer: 7

 $f =$ 

3



Answer: 3

Verify that the answer from part 1 agrees with the answer that you get by combining parts 2 and 3.

Answer:

1. By the multinomial formula,  $a = 9$  and  $b = 2$ .

2. We want the number of ways of choosing 2 items out of 9 items. This is the number of 2-element subsets of a 9-element set, so that  $c = 9$  and  $d = 2$ .

3. We have 7 remaining items out of which we need to choose 3.  
Hence,  $e = 7$  and  $f = 3$ .

From part 1, the number of ways of splitting up the 9 items between Alice, Bob, and Charlie in the specified manner is  $\frac{9!}{2!3!4!}$ .

In parts 2 and 3, we calculate this answer in a different way. Let us now verify that the two methods produce the same answer.

From part 2, we can first give Alice her 2 items in  $\binom{9}{2} = \frac{9!}{2!7!}$  ways. Then, from part 3, we can give Bob his 3 items from the remaining 7 items in  $\binom{7}{3} = \frac{7!}{3!4!}$  ways. Finally, Charlie's 4 items are exactly the 4 items that remain, so there is only 1 way to give him his items. Combining these steps, we have a total of

$$\frac{9!}{2!7!} \cdot \frac{7!}{3!4!} \cdot 1 = \frac{9!}{2!3!4!}$$

ways, which agrees with the answer from part 1.

*You have used 1 of 2 submissions*

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