

# Re: Probabilities and complex numbers.

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  - *Date:* Fri, 15 Jul 2005 11:06:11 -0500
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"novelo" <[novelo@xxxxxxxx](mailto:novelo@xxxxxxxx)> wrote in [news:1120806462.919092.187420@z14g2000cwz.googlegroups.com](mailto:news:1120806462.919092.187420@z14g2000cwz.googlegroups.com):

- > I've never seen probability at school and if someone can help me,
- > you'll make my day for today! The problem is the following.
- >
- > A box contains 2 red balls and 3 white balls. A trial is to take one
- > ball at random out of the box. Repeat this trial 4 times, without
- > putting balls back to the box that have previously been taken out.
- >
- > 1) The probability for which two red balls are included in the set of 4
- > balls taken out is = ?
- > 2) Subject to the condition that the ball taken out in the first trial
- > is a white ball, the "conditional probability" for which 2 red balls
- > are included in the set of 4 balls taken out is?
- >
- >
- > If someone was able to explain me what is a conditional probability,
- > that will be very helpful.
- >
- > ...

A very concrete way to understand it is with a tree diagram showing all possible ordered drawings of balls. At each stage, there are (potentially) 2 possible outcomes for the ball to be drawn, either R or W, so the tree has at most 2 branches at each node. The branches are (in general) not equally likely, but each branch is easily assigned a probability based on the ratio of the number of balls remaining of that color to the total number of balls remaining. So for example, at the root node (first ball not yet drawn), there are 2 branches, labelled R,W, with probability  $2/5$  assigned to the R branch and  $3/5$  to the W branch. Each of the 2 new nodes also has 2 branches but the probabilities for these branches depends on the new ratios at the node being branched from. After the tree is fully drawn, the outcomes of interest are the complete paths which satisfy the specified condition (exactly 2 red balls). For each path, the probability of that path occurring is the product of the probabilities of the branches on that path. The probability for the event in question is the sum of the path probabilities for the paths that satisfy that event. So the path probabilities are computed as products, and then you sum the resulting

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products over all paths that match your event (2 red balls).

This approach is only practical when the number of nodes is reasonably small. For this problem, since the number stages (balls to be drawn) is 4 and since there are most 2 branches at each stage, the total number of nodes is at most  $1 + 2 + 4 + 8 + 16$  which is 31. Actually it will be less since for some nodes there will be only 1 branch (if only 1 color is left at that node).

Just to give an example of 1 complete path, take the sequence RWRW. For that path the branch probabilities are  $2/5, 3/4, 2/3, 1$  so the probability for that path is the product  $2/5 * 3/4 * 2/3 * 1 = 1/5$ . If you work out the probabilities for all the other paths for which the number of red balls is 2 and add the results, you get your answer.

The concept of conditional probability can also be understood with the tree method. If there is an additional condition which must be satisfied, then some of the branches will be eliminated and others will be forced. If a branch is eliminated (based on the specified condition) it gets a new probability of 0 (and the branch need not be drawn). On the other hand, if a branch is forced, then it gets a probability of 1, so in this case, the ratio is not relevant since the specified condition overrides the ratio and forces a probability of 1 for that branch.

So for example, for the problem at hand, the path RWRW is eliminated but the path WRWR has conditional probability  $1 * 2/4 * 1/3 * 1/2 = 1/12$  (notice the 1 in the first factor) whereas the absolute probability (if no condition was specified) would have been  $3/5 * 2/4 * 1/3 * 1/2 = 1/20$ .

I think the tree approach, while tedious and not very sophisticated, is key to understanding the basic concepts, so in the early stages of learning probability, it's important to get experience with this method, provided the tree is not too big.

Ok, having said that, there is a sneaky way to avoid doing a 4 stage tree, by first solving a different problem, Think about the 5th ball. If we forget the first 4 balls (don't even look at them), what is the probability that the 5th ball is: (1) red? (2) white? This is easy since effectively it's the same as just drawing 1 ball. Next think about how the results for the 5th ball affect the event in question for the first 4 balls. But I recommend doing the 4 stage tree anyway before trying this shortcut, if only to verify.

Perhaps these trees will help you see the forest.

— quasi

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### • *References:*

Re: Probabilities and complex numbers.

◆ **Probabilities and complex numbers.**

◇ *From:* novelo

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