# Quiz 1 Hints and Comments

Stat 134, Spring 2020, Kolesnik

2/8/2020

These hints and comments are meant to help you fix your work if you missed any questions. They contain common sources of error and hints to push you in the right direction.

**Question 1 Hints**:

**A**: Try using the multiplication rule for $P(R_1 \cap R_2)$, which says that for two events $A$ and $B$, $P(A \cap B) = P(A)P(B|A)$. Which event, $R_1$ or $R_2$ should we let be $A$?

Many of you forgot the multiplication rule and instead opted for $P(R_1 \cap R_2) = P(R_1) + P(R_2) - P(R_1 \cup R_2)$, which is true, but only complicates your work. ($P(R_2)$ and $P(R_1 \cup R_2)$, themselves, need to be found through paritioning and/or the multiplication rule.)

**B**: Try approaching $P(R_2 \cap R_3)$ by finding a partition of the event $R_2 \cap R_3$. If you had the other version of the quiz, try finding a partition of the event $R_3$ in order to find $P(R_3)$.

One common mistake among those of you who were asked to find $P(R_2 \cap R_3)$ was to approach it by starting with $P(R_2 \cap R_3) = P(R_2)P(R_3|R_2)$. This approach is unhelpful, because assuming $R_2$ has happened doesn't let us know how many red balls are now in the urn, for there could be $r+1$ or $r+2$ red balls now in the urn, and therefore there is no short answer to $P(R_3|R_2)$. We also need to know whether $R_1$ happened or not.

For those among you who were asked to find $P(R_3)$, recall that a partition is an exhaustive list of all the mutually ways that a given event can occur. The partition you try to find here should invlove all events $R_1, R_2,$ and $R_3$ and also some of their complementary events. For example, $R_3$ happens if the event $R_1 \cap R_2^c \cap R_3$ occurs. What are the rest of the ways?

**C**: Show the equality of $P(R_1 \cap R_2)$ and $P(R_2 \cap R_3)$ by simplifying. Some of you didn't show that these probabilities are equal, despite having the right approach to finding each one.

Comments:

**1.** Some of you included an extra step in the tree diagram that doesn't exist. It is important to realize that the balls in the urn are fixed at the start of the process with $r$ red and $b$ blue, and this initial state isn't determined by chance (you many take this as a given)

**2.** Read the question carefully. Many mistakes arose from not taking the time to fully understand what happens after you take a particular ball out. When a ball is drawn from the urn, is is put back in the urn along with *another* ball of the same color. This means that the number of balls in the urn increases by 1 with every draw. Some of your answers had denominators like $\frac{(\ldots)}{(r+b)^3}$, whch suggested that you didn't understand this.

**Question 2 Hints**:

If you did not get the question fully correct, both of these hints apply to you.

**A**: To organize your thoughts it would help to create some notation for the events. Such as, let $L_i$ be the event that the plane is actually in location $i$, and let $E$ be the event that the plane is not found while searching at location 1 (or 2 if you had that quiz version). What is the problem asking you in terms of these events?

A big source of your confusion was not making clear notation for yourselves at the beginning. There were many answers with notation like $P($ not 1 $)$, making it unclear to yourselves whether this event means the plane is not at location 1, or location 1 was searched and the plane wasn't found there.

**B**: Apply Bayes Rule to the event given the condition. That us use bayes rule to expand $P(L_2|E) = ....$ Recall that a useful version of bayes rule is $P(A|B) = P(A)P(B|A)/\sum_i P(B_i)$, where the $B_i$s form a partition of $B$.

If you do the expansion suggested above, you will encouter a term like $P(E|L_2)$, where $E$ is the event that the plane is not found at location 1, and $L_2$ is the event that the plane is *located* at location 2. If the plane is located at location 2, then the plane will trivially not be found at location 1, so what is $P(E|L_2)$?

Additionally, make sure that a partition of $E$ (event that the plane isn't found at location 1) should include the event that the plance is indeed located at location 1, but the searching team didn't find it.