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## Statistics for laboratory scientists

### Solutions for the homework problems for lecture 5

1.
  - a.  $\Pr(F_2 \text{ seed is smooth}) = 3/4 = 75\%$
  - b.  $\Pr(F_2 \text{ seed has genotype } \mathbf{Aa}) = 1/2 = 50\%$
  - c.  $\Pr(F_2 \text{ seed has genotype } \mathbf{Aa} \mid \text{it is smooth}) = (1/2)/(3/4) = 2/3$   
= (approx) 67%
  - d.  $\Pr(F_3 \text{ seed is smooth} \mid F_2 \text{ has genotype } \mathbf{AA}) = 100\%$
  - e.  $\Pr(F_3 \text{ seed is smooth} \mid F_2 \text{ has genotype } \mathbf{Aa}) = 3/4 = 75\%$
  - f.  $\Pr(F_3 \text{ seed is smooth})$   
=  $\Pr(F_3 \text{ is smooth} \mid F_2 \text{ is } \mathbf{AA}) \times \Pr(F_2 \text{ is } \mathbf{AA}) + \Pr(F_3 \text{ is smooth} \mid F_2 \text{ is } \mathbf{Aa}) \times \Pr(F_2 \text{ is } \mathbf{Aa}) + \Pr(F_3 \text{ is smooth} \mid F_2 \text{ is } \mathbf{aa}) \times \Pr(F_2 \text{ is } \mathbf{aa})$   
=  $[1 \times (1/4)] + [(3/4) \times (1/2)] + [0 \times (1/4)] = 5/8 = 62.5\%$
  - g.  $\Pr(F_3 \text{ seed is smooth} \mid F_2 \text{ is smooth})$   
=  $\Pr(F_3 \text{ is smooth} \mid F_2 \text{ is } \mathbf{AA}) \times \Pr(F_2 \text{ is } \mathbf{AA} \mid F_2 \text{ is smooth}) + \Pr(F_3 \text{ is smooth} \mid F_2 \text{ is } \mathbf{Aa}) \times \Pr(F_2 \text{ is } \mathbf{Aa} \mid F_2 \text{ is smooth})$   
=  $[1 \times (1/3)] + [(3/4) \times (2/3)] = 5/6 = (\text{approx}) 83.3\%$
2.
  - a.  $(5/10) \times (5/10) = 1/4 = 25\%$
  - b. 100%
  - c. If 1st ball was blue, then we must be drawing from urn A, and so  $\Pr(\text{2nd is red} \mid \text{1st is blue}) = 50\%$ .
  - d.  $\Pr(\text{2nd is red and 1st is red}) = \Pr(\text{both are red and coin was heads}) + \Pr(\text{both are red and coin was tails}) = \Pr(\text{coin was$

heads) x Pr(both red | coin heads) + Pr(coin tails) x Pr(both red | coin tails) =  $(1/2) \times (1/4) + (1/2) \times 1 = 1/8 + 1/2 = 5/8 = 63\%$ .

Similarly, Pr(1st is red) =  $(1/2) \times (1/2) + (1/2) \times 1 = 1/4 + 1/2 = 3/4 = 75\%$ .

Thus, Pr(2nd is red | 1st is red) =  $(5/8) / (3/4) = 5/6 = 83\%$ .

3.

a.  $4/52 = 1/13 = 7.7\%$

b.  $1/13 = 7.7\%$

c.  $2/50 = 1/25 = 4\%$

d. Pr(all are Jacks) = Pr(1st is Jack) x Pr(2nd is Jack | 1st is Jack) x Pr(3rd is Jack | 1st two are Jacks) =  $(4/52) \times (3/51) \times (2/50) = 3/16575$ .

e.  $(48/52) \times (47/51) \times (46/50) = 78\%$

f. Pr(at least one is a Jack) =  $1 - \text{Pr(none are Jacks)} = 22\%$ .

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Last modified: Wed Feb 22 09:44:38  
EST 2006