

# Stat 330

## Homework 3

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1)

(a)  $\text{Im}(X) = \{0, 1, 2, 3\}$

(b)  $P(X = 0) = \{GGG\} = \frac{3}{7} * \frac{2}{6} * \frac{1}{5} = \frac{1}{35}$

$$P(X = 1) = \{RGG\} = \frac{4}{7} * \frac{3}{6} * \frac{2}{5} = \frac{4}{35}$$

$$P(X = 2) = \{RRG\} = \frac{4}{7} * \frac{3}{6} * \frac{3}{5} = \frac{6}{35}$$

$$P(X = 3) = \{RRR\} = \frac{4}{7} * \frac{3}{6} * \frac{2}{5} = \frac{4}{35}$$

(c) 

x	0	1	2	3
$P_X(x)$	1/35	4/35	6/35	4/35

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2)

(a) 

x	-2	-1	0	1	2
$P_X(x)$	0.1	0.3	0.3	0.1	0.2

(b)  $P(A|B) = P(A \cap B) / P(B) = .28 / .7 = .4$

(c)  $P(B|A) = P(A \cap B) / P(A) = .28 / .4 = .7$

(d) A test for independance is if  $P(A|B) = P(A)$  and  $P(B|A) = P(B)$

As the above tests hold, these two events are **independent**.

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3)

(a) When drawing from the first urn, the chances are:

Red:  $2/6$ , White:  $4/6$ .

If a red is transferred, when drawing from urn 2 the chances are:

Red:  $4/5$ , **White:  $1/5$** .

If a white is transferred, when drawing from urn 2 the chances are:

Red:  $3/5$ , **White:  $2/5$** .

Drawing from urn 1 affects drawing from the second, and must be considered.

Thus, the cumulative chance of selecting white from urn 2 is:

$$\frac{2}{6} * \frac{1}{5} + \frac{4}{6} * \frac{2}{5} = \mathbf{1/3}$$

(b) The two events are not independent, as drawing from the first urn affects the chances of drawing from the second.

Using the values calculated above,

$$P(W2|R1) = \frac{2}{6} * \frac{1}{5} = 1/15$$

$$P(W2|W1) = \frac{4}{6} * \frac{2}{5} = 4/15$$

If the events were independent, the two resulting values would be equivalent.

4)

	$D(.15)$	$\bar{D}(.85)$	$Total$
$Pos$	.98	.10	?
$Neg$	?	?	?
$Total$	?	?	

$$P(Pos \cap D) = (.98)(.15) = .147$$

$$P(Pos \cap \bar{D}) = (.10)(.85) = .085$$

$$(a) P(Pos) = .147 + .085 = \mathbf{.232}$$

$$(b) P(D|Pos) = .147 / .232 = \mathbf{.634}$$

$$(c) P(\bar{D}|Pos) = .085 / .232 = \mathbf{.366}$$

5)  $P(Sys) = P(1st \cap 2nd)$

$$P(1st) = 1 - P(\overline{1st}) = 1 - P(\bar{1} \cap \bar{2} \cap \bar{3}) = 1 - (.3)(.3)(.3) = 0.973$$

$$P(2nd) = 1 - P(\overline{2nd}) = 1 - P(\bar{4} \cap \bar{5}) = 1 - (.3)(.3) = 0.91$$

$$P(1st \cap 2nd) = P(1st) * P(2nd) = 0.973 * 0.91 = \mathbf{0.885}$$

6)

(a)  $P(\text{Sys}) = P(A) * P(B) = .95 * .9 = \mathbf{.855}$

(b)  $P(\text{Sys}) = 1 - P(\overline{Top} \cap \overline{Bottom}) \Rightarrow$

$P(\text{Top}) = P(A) * P(B) = .95 * .9 = .855$

$P(\text{Bottom}) = P(C) * P(D) = .8 * .7 = .56$

$P(\text{Sys}) = 1 - (1 - .855)(1 - .56) = \mathbf{.9362}$

(c)  $P(\text{Sys}) = 1 - P(\overline{A} \cap \overline{B} \cap \overline{C}) = 1 - (1 - .95)(1 - .9)(1 - .8) = \mathbf{.999}$