Name: _____ Date: _____
AT Statistics Practice

Probability Rules

1. If P(A) = 0.26 and P(B) = 0.41 and P(A∩B) = 0.1, find the following:
   (a) P(A ∪ B) = 0.57
   (b) P(B | A) = .3846
   (c) Are A and B disjoint events? Why or why not? No, P(A∩B) = .1 ≠ 0.
   (d) Are A and B independent events? Why or why not? No, P(B|A) = .3846 ≠ P(B) = .41 and P(A|B) = .2439 ≠ P(A) = .26

2. If P(G) = 0.42, P(M) = 0.33 and G and M are independent, find the following:

   (a) P(G ∩ M) = P(G) · P(M) = .42 · .33 = .1386
   (b) P(G | M) = P(G) = .42
   (c) P(M | G) = P(M) = .33
   (d) P(G ∪ M) = P(G) + P(M) − P(G∩M) = .42 + .33 − .1386 = .6114

3. If P(W) = 0.6 and P(J) = 0.34 and P(J | W) = 0.2, find the following:

   (a) P(W and J) = P(J|W) · P(W) = .2 · .6 = .12
   (b) P(W or J) = P(W) + P(J) − P(W∩J) = .6 + .34 − .12 = .82

4. If P(Y) = 0.45 and P(L) = 0.60 and P(Y ∩ L) = 0.22, find the following:

   (a) P(Y ∪ L) = P(Y) + P(L) − P(Y∩L) = .45 + .60 − .22 = .83
   (b) P(L | Y) = P(L∩Y) ÷ P(Y) = .22 ÷ .45 = .4889
   (c) Are Y and L disjoint events? Why or why not? No P(Y∩L) = .22 ≠ 0.
   (d) Are Y and L independent events? Why or why not? No P(L|Y) = .4889 ≠ P(L) = .6 and P(Y|L) = .3667 ≠ P(Y) = .45.

5. If P(D) = 0.32, P(R) = 0.13 and D and R are disjoint, what is the probability of D or R?
   P(D∪R) = P(D) + P(R) = .32 + .13 = .45

6. If P(T) = 0.51 and P(B) = 0.28 and P(B|T) = 0.18, find the following:

   (a) P(T and B) = P(B|T) · P(T) = .18 · .51 = .0918
   (b) P(T or B) = P(T) + P(B) − P(B∩T) = .51 + .18 − .0918 = .5982

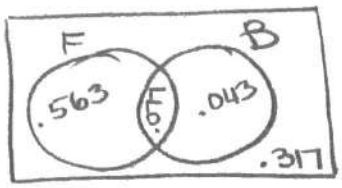
7. Suppose in a lab 24% of the mice are albino, 56% are brown, and the rest are grey. What is the probability that a randomly selected mouse is:

   (a) Grey 1 − .24 − .56 = .2
   (b) Not albino 1 − .24 = .76
   (c) Grey or Albino .2 + .24 = .44
   (d) If the type of mouse is independent of the next what is the probability that:
   (e) 2 randomly selected mice are both brown? .56 · .56 = .3136
   (f) 2 randomly selected mice are albino then brown? .24 · .56 = .1344

(g) 2 randomly selected mice are albino and grey? $.24 \cdot .2 + .2 \cdot .24 = .096$
(h) 2 randomly selected mice are not grey? $.8 \cdot .8 = .64$
(i) At least 1 out of 4 randomly selected mice is albino? $1 - P(\text{none}) = 1 - (.76)^4 = .6064$
(j) The first albino mouse is the 5th one selected?
$.76 \cdot .76 \cdot .76 \cdot .76 \cdot .24 = .0801$

8. In the parking lot of a large mall 64% of cars are foreign made, 12% are the color blue and 7.7% are blue and foreign made cars.

Draw a Venn Diagram



What is the probability that a randomly selected car was:

(a) A foreign car or a blue car? $P(F \cup B) = .64 + .12 - .077 = .683$
(b) Not a foreign car and a blue car? $P(F^c \cap B) = .043$
(c) A foreign car given it was blue? $P(F|B) = .077/.12 = .6417$
(d) Not blue given it was not a foreign car? $P(B^c|F^c) = .317/.36 = .8806$
(e) Is being a foreign car and being blue mutually exclusive? NO. independent? Yes. $P(F|B) = P(F)$ $.6417 = .64$ ✓
$P(B|F) = P(B)$ $.12 = .12$ ✓

9. The following table shows the breakdown of gender and degree among a university's faculty.

	Masters	Doctorate
Male	18	28
Female	8	12

What is the probability that a randomly selected professor is:

(a) Male and has a Doctorate $\frac{28}{66}$
(b) Male or has a Doctorate $58/66$
(c) Is a Male given they have a Doctorate $28/40$
(d) A female with a Master's degree $8/20$
(e) Is gender and degree independent? Yes Disjoint? NO

0. If $P(A) = 0.48$ and $P(B) = 0.67$ and $P(A \cap B) = 0.22$, find the following:

(a) $P(A \cup B) = .93$
(b) $P(A \cup B^C) = .55$
(c) $P(A^C \cap B) = .45$
(d) $P(B|A) = .4583$
(e) $P(A^C|B^C) = .2121$
(f) Are A and B disjoint events? Why or why not? No $P(A \cap B) = .22 \neq 0$
(g) Are A and B independent events? Why or why not? No.

11. If P(G) = 0.18, P(M) = 0.24 and G and M are independent, what's the probability of G and M?

.18 · .24 = .0432

12. If P(W) = 0.61 and P(J) = 0.45 and P(J|W) = 0.2, find the following:

(a) P(W and J) = P(J|W) · P(W) = .2 · .61 = .122

(b) P(W or J) = .61 + .45 − .122 = .938

13. If P(D) = 0.48, P(R) = 0.25 and D and R are disjoint, what is the probability of D or R?

.48 + .25 = .73

14. Suppose in a library 23% of the books are children's books, 42% of the books are adult fiction, and the rest are non-fiction.

What is the probability that a randomly selected book is:

(a) Non-fiction .35

(b) Not a children's book .77

(c) A children's book or an adult fiction .65

(d) If the type of book is independent of the next what is the probability that:

(e) 2 randomly selected books are both children's books? $.23^2 = .0529$

(f) 2 randomly selected books are fiction then non-fiction? .42 · .35 = .147

(g) 2 randomly selected books are children's and adult fiction? 2(.23)(.42) = .1932

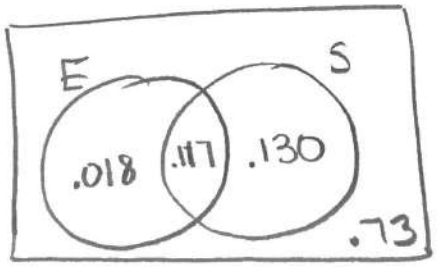
(h) 2 randomly selected books are not adult fiction? $.58^2 = .3364$

(i) At least 1 out of 4 randomly selected books is a children's book? $1-(.77)^4 = .6485$

(j) The first non-fiction book is the 5th one selected? $(.65)^4(.35) = .0625$

15. In a large university 13.5% of the students take economics, 24.7% of the students take statistics, and 11.7% take economics and statistics.

Draw a Venn Diagram



What is the probability that a randomly selected student:

(a) Took economics or statistics? .265

(b) Didn't take economics but did take statistics? .130

(c) Didn't take economics or didn't take statistics? .883

(d) That took statistics didn't take economics? .5263

(e) Didn't take statistics given they took economics? .1333

(f) Is taking statistics and economics mutually exclusive? No. independent? No

$P(E|S) \stackrel{?}{=} P(E)$

$\frac{.117}{.247} = .135$

$.47 \neq .135$

$P(S|E) = P(S)$

$\frac{.117}{.135} = .247$

16. The following table shows the results of survey that asked people whether they were involved in any type of charity work.

	Frequently	Occasionally	Not at all	Total
Male	221	456	795	1472
Female	207	430	741	1378
Total	428	886	1536	2850

What is the probability that:

(a) a randomly selected person is male and frequently involved in charity work?
(b) a randomly selected person is male or occasionally involved in charity work?
(c) a randomly selected person is female or not involved in charity work?
(d) a randomly selected person is male given they frequently involved in charity work?
(e) a randomly selected female is occasionally involved in charity work?
(f) a person not involved in charity is female?
(g) Is gender and involvement in charity independent? Disjoint?

(a) $P(M \cap Fr) = \boxed{\frac{221}{2850}}$

(b) $P(M \cup O) = P(M) + P(O) - P(M \cap O)$
$= \frac{1472}{2850} + \frac{886}{2850} - \frac{456}{2850}$
$= \boxed{\frac{1902}{2850}}$

(c) $P(Fe \cup N) = P(Fe) + P(N) - P(Fe \cap N)$
$= \frac{1378}{2850} + \frac{1536}{2850} - \frac{741}{2850}$
$= \boxed{\frac{2173}{2850}}$

(d) $P(M \mid Fr) = \frac{P(M \cap Fr)}{P(Fr)} = \boxed{\frac{221}{428}}$

(e) $P(O \mid Fe) = \frac{P(O \cap Fe)}{P(Fe)} = \boxed{\frac{430}{1378}}$

(f) $P(Fe \mid N) = \frac{P(Fe \cap N)}{P(N)} = \boxed{\frac{741}{1536}}$

(g) $P(Fe \mid N) = P(Fe)$ AND $P(N \mid Fe) = P(N)$

$\frac{741}{1536} = \frac{1378}{2850}$
$.482 = .483$ ✓

$\frac{741}{1378} = \frac{1536}{2850}$
$.538 = .539$ ✓

Yes, they are independent.

$P(Fe \cap N) = \frac{741}{2850} \neq 0$

The events are not disjoint.