Math 10 MPS - Homework 3 Answers

1. A student has a 90% chance of getting to class on time on Monday and a 70% chance of getting to class on time on Tuesday. Assuming these are independent events, determine the following probabilities:

   a. The student is on time both Monday and Tuesday. **(.9)(.7)=.63**

   b. The student is on time at least once (Monday or Tuesday). **.9+.7-.63 = .97**

   c. The student is late both days. **1-.97=.03 or (.1)(.3)=.03**

2. A class has 10 students, 6 females and 4 males. 3 students will be sampled without replacement for a group presentation.

   a. Construct a tree diagram of all possibilities (there will be 8 total branches at the end)

```
                 6/10 /                          4/10 \
                     /                                \
                   [F]                                [M]
          5/9/            4/9\              6/9 /            3/9\
           /                 \                /                 \
          [F]               [M]              [F]                [M]
    4/8/   4/8\       5/8/     3/8\     5/8/    3/8\      6/8/    2/8\
     /         \       /          \      /         \       /          \
    [F]        [M]    [F]         [M]   [F]        [M]    [F]         [M]
 120/720  120/720  120/720   72/720  120/720   72/720   72/720    24/720
```

   b. **b.** Find the following probabilities:

      i. All male students in the group presentation.

      24/720 = 1/30=.0333

      ii. Exactly 2 female students in the group presentation.

      (120+120+120)/720 = 360/720 = 1/2 = .5000

      iii. At least 2 female students in the group presentation.

      (120+120+120+120)/720 = 480/720 = 2/3 = .6667

3. 20% of professional cyclists are using a performance enhancing drug. A test for the drug has been developed that has a 60% chance of correctly detecting the drug(true positive). However, the test will come out positive in 2% of cyclists who do not use the drug (false positive).

a. Construct a tree diagram where the first set of branches are cyclist with and without the drug, and the 2nd set is whether or not they test positive.

b. From the tree diagram create a contingency table.

```
          /         \
      .20 /           \ .80
      (D+)            (D-)
       / \             / \
  .60 /   \ .40   .02/     \ .98
  (T+)   (T-)    (T+)     (T-)
  .120   .080    .016     .784
```

	D+	D-	total
T+	.120	.016	.136
T-	.080	.784	.864
total	.200	.800	1.000

P(D+|T+) = .120/.136=88.2%

c. What percentage of cyclists will test positive for the drug?

13.6%

d. If a cyclist tests positive, what is the probability that the cyclist really used the drug?

.120/.136=88.2%

4. We wish to determine the morale for a certain company. We give each of the workers a questionnaire and from their answers we can determine the level of their morale, whether it is 'Low', 'Medium ' or 'High'; also noted is the 'worker type' for each of the workers. For each worker type, the frequencies corresponding to the different levels of morale are given below.

WORKER MORALE

Worker Type	Low	Medium	High	**TOTAL**
Executive	1	14	35	**50**
Upper Management	5	30	65	**100**
Lower Management	5	40	55	**100**
Non-Management	354	196	450	**1000**
TOTAL	**365**	**280**	**605**	**1250**

a. We randomly select 1 worker from this population. What is the probability that the worker selected

- is an executive? **50/1250 = 4%**
- is an executive with medium morale? **14/1250 = 1.12%**
- is an executive or has medium morale? **(50+280-14)/1250 = 316/1250 = 25.3%**
- is an executive, given the information that the worker has medium morale.
  14/280 = 5%

b. Given the information that the selected worker is an executive, what is the probability that the worker

- has medium morale? **14/50 = 28%**
- has high morale? **35/50 = 70%**

c. Are the following events independent or dependent? Explain your answer:

- is an executive', 'has medium morale', are these independent?
  not independent P(E|M)=5% ≠P(E) = 4%
- is an executive', 'has high morale', are these independent?
  not independent P(H|E)=70% ≠P(H) = 605/1250 = 48.4%

5. Explain the difference between population parameters and sample statistics. What symbols do we use for the mean and standard deviation for each of these?
Parameters are fixed values that are determined by the population. (μ, σ)
Statistics are calculated from the sample and can change when different samples are taken (X-bar, s)

6. Consider the following probability distribution function of the random variable X which represents the number of bedrooms in a neighborhood's homes:

X	P(X)	xp(x)	(x-μ)	(x-μ)^2	(x-μ)^{2}p(x)
0	0.05	**0.0**	**-2.8**	**7.84**	**0.392**
1	0.1	**0.1**	**-1.8**	**3.24**	**0.324**
2	0.2	**0.4**	**-0.8**	**0.64**	**0.128**
3	0.4	**1.2**	**0.2**	**0.04**	**0.016**
4	0.15	**0.6**	**1.2**	**1.44**	**0.216**
5	**0.1**	**0.5**	**2.2**	**4.84**	**0.484**
		2.8			**1.56**

a. Fill in the missing P(X)
0.1
b. Find the population mean of X.
μ = 2.8 bedrooms
c. Find the population variance and standard deviation of X.
σ^2 = 1.56 σ = 1.249

7. 10% of all children at large urban elementary school district have been diagnosed with learning disabilities. 10 children are randomly and independently selected from this school district.

a. Let X = the number of children with learning disabilities in the sample. What type of random variable is this?
Binomial n=10, p=.10

b. Find the mean and standard deviation of X.
μ=(10)(.1)=1 σ^2=(10)(.1)(.9)=.9 σ = sqrt(.9) = .949

c. Find the probability that exactly 2 of these selected children have a learning disability.
from table: P(X=2)=.194

d. Find the probability that at least 1 of these children has a learning disability.
from table: P(X>=1) = 1-P(X=0) = 1-.349 = .651

e. Find the probability that less than 3 of these children have a learning disability.
from table: P(X<3) = .349+.387+.194 = .93