# Homework for Day 6 Name: Tiffany Nguyen

#### Inferential statistics

1. Drinking water standards require that the level of chlorite in drinking water be less than 1.0 milligrams/liter. A test is performed to see if the drinking water of a town meets the standards. Let *c* be the amount of chlorite in the drinking water.

H0: c = 1.0

H1: c < 1.0

Null hypothesis: The level of chlorite in drinking water is legal at 1.0 mg/l.

Alternative hypothesis: The level of chlorite in drinking water is not legal, which is less than 1.0 mg/l.

This is a one-tailed test.

2. If the heating and cooling system in a building is performing correctly, the temperature inside should be 21°C. The temperature of several rooms in the building is measured over several days, and the true average temperature *t* of the rooms in the building.

H0: t = 21

H1: t ≠ 21

Null hypothesis: The average temperature of the rooms inside is 21°C.

Alternative hypothesis: The average temperature of the rooms inside is not 21°C

This is a two-tailed test.

3. John wants to see if his performance in a video game has improved. His baseline score is 2400. He plays the game a few more times and finds the average of his new scores. Let *s* (for score) be his new performance level.

H0: s = 2400

H1: s > 2400

Null hypothesis: John has not improved and has a performance score of 2400.

Alternative hypothesis: John has improved and has a performance score of more than 2400.

This is a one-tailed test.

4. A processing plant fills bottles of wine. If the processing plant is doing things right, each bottle gets 750 milliliters of wine. Several bottles of wine that the processing plant filled were opened and the amount of wine in each was carefully measured. Let *w* be the average of the amount of wine in all the bottles the plant fills.

H0: w = 750

H1: w ≠ 750

Null hypothesis: The average amount of wine in each the bottle is 750.

Alternative hypothesis: The average amount of wine in each bottle is not 750.

This is a two-tailed test.

#### Probability Theory

1. Austin has many contacts in his contact list. He has the telephone number for 70% of his contacts. He has an e-mail address and a telephone number for 50% of his contacts. He picks a contact from his list at random and discovers that he has the telephone number for that one. What is the probability that he also has the e-mail address for that one, too?

0.5 \* 0.7 = 0.35

2. Beth has downloaded many songs. 40% of her songs are country and western songs. Of the country and western songs, 60% are by male vocal artists. She picks one of her songs at random. What is the probability that it is a country and western song by a male vocal artist?

0.6 \* 0.4 = 0.24

3. Carl has installed an intruder detection system near his garage. It will get a clear picture of the intruder 90% of the time if the intruder attempts to enter during sunlight, 75% of the time if the intruder attempts to enter during rainy weather during the day, and 60% of the time if the intruder attempts to enter at night. However, only 5% of intruders will try to enter during sunlight, 25 % of intruders will try to enter during rainy weather during the day, and 70% of intruders will try to enter during the night. An intruder enters and the system provides a clear picture. What is the probability that the intruder entered at night?

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Sunlight | Rain | Night |  |
| Caught | .045 | .1875 | .042 | .6525 |
| Not Caught |  |  |  |  |
| Total | .05 | .25 | .7 |  |

.42 / .6525 ≈ .644

4. A fair coin is flipped seven times. What is the probability that there will be at least five tails in a row?

P(A) =

5. David has an urn. Inside the urn 96 balls. Some are blue balls and the rest are red balls. Each ball is either stone or glass. Picking a blue ball is independent of picking a stone ball. The probability of picking a blue ball is . The probability of picking a stone ball is .

|  |  |  |  |
| --- | --- | --- | --- |
|  | Blue | Red |  |
| Stone | 10 | 30 | 40 |
| Glass | 14 | 42 | 56 |
|  | 24 | 72 | 96 |

1. how many blue stone balls are in the urn?

10

1. What is the probability of picking a glass red ball?

7/16

1. What is the probability of picking a blue or glass ball?

11/16

1. A ball is picked and it is a glass ball. What is the probability that it is also red?

3/4

6. Son has an urn filled with balls. The balls are either white, green, or red. The balls are either metal, glass, or plastic. There are 20 red glass balls in the urn.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | White | Green | Red |  |
| Metal | 5 | 5 | 10 | 20 |
| Glass | 80 | 0 | 20 | 100 |
| Plastic | 25 | 45 | 10 | 80 |
|  | 110 | 50 | 40 | 200 |

1. The probability of picking a red glass ball is twice the probability of picking a red plastic ball. How many red plastic balls are in the urn?

10

1. The probability of picking a glass ball, given that the ball is red, is one-half. How may red metal balls are in the urn?

10

1. The probability of picking a white ball, given that the ball is metal, is the same as the probability of picking a green ball, given that the ball is metal, but is only half of the probability of picking a red ball, given that the ball is metal. How many metal balls are in the urn?

20

1. The probability of picking a metal ball, given that the ball is green, is . How many green balls are in the urn?

50

1. Picking a metal ball is independent of picking a green ball. How many balls are in the urn?

200

1. Picking a green ball and picking a glass ball are mutually exclusive. How many green plastic balls are in the urn?

45

1. Picking a glass ball is independent of picking a red ball. How many glass balls are in the urn?

100

1. How many white plastic balls are in the urn?

25

1. What is the probability of picking a plastic ball?

80/200 = 2/5

1. What is the probability of picking a red ball, given that the ball is plastic?

1/8

1. Are “picking a red ball” and “picking a plastic ball” independent?

No

1. What is the probability of picking a metal or red ball?

1/4

1. What is the probability of picking a glass ball, given that the ball is metal or red?

1/4

1. What is the probability of picking a plastic or red ball, given that the ball is glass or white?

9/26

7. Suppose the random variable *X* has the distribution function given in the table to the right.

|  |  |
| --- | --- |
| *x* |  |
| 0 | 0.1 |
| 3 | 0.3 |
| 4 | 0.1 |
| 7 | 0.5 |

a. Find

3 \* 0.3 + 4 \* 0.1 + 7 \* 0.5 = 4.8

b. Let . Find

9.8

c. Let . Find

4.8 \* 3 = 14.4

d. Find . Hint: First write out the table for the distribution function for .

9 \* 0.3 + 16 \* 0.1 + 49 \* 0.5 = 28.8

8. Let *Y* and *W* be random variables with distribution functions as given in the tables to the right.

|  |  |
| --- | --- |
| *w* |  |
| -1 | 0.1 |
| 0 | 0.2 |
| 1 | 0.2 |
| 2 | 0.5 |

|  |  |
| --- | --- |
| *y* |  |
| -2 | 0.1 |
| -1 | 0.1 |
| 0 | 0.3 |
| 1 | 0.5 |

a. Find

-2 \* 0.1 – 1 \* 0.1 + 1 \* 0.5 = 0.2

b. Find

1.1

Let .

c. What’s the range of *X*?

{-3, -2, -1, 0, 1, 2, 3}

d. Suppose that *Y* and *W* are independent. Fill out the table for distribution function for *X*.

|  |  |
| --- | --- |
| *x* |  |
| -3 | .01 |
| -2 | .03 |
| -1 | .07 |
| 0 | .18 |
| 1 | .21 |
| 2 | .25 |
| 3 | .25 |

e. Compute the expected value of *X*

1.3

f. Verify that

1.1 + 0.2 = 1.3