MATH 3339
Statistics for the Sciences
Live Lecture Help

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Session 2

Office Hours: see schedule in the "Office Hours" channel on Teams
Course webpage: www.casa.uh.edu

Email policy

When you email me you **MUST** include the following

- MATH 3339 Section 20024 and a description of your issue in the **Subject Line**
- Your name and ID# in the **Body**
- Complete sentences, punctuation, and paragraph breaks
- Email messages to the class will be sent to your Exchange account (user@cougarnet.uh.edu)

Correspondence Etiquette

Things to know about contacting your instructor:

- Teams chat messages are not appropriate unless told otherwise by your instructor
- In my case, Teams messages are only appropriate if I initiate there (for instance to schedule a meeting) or when following my directions regarding Office Hours
- Your instructor is Dr. Lastname if they have a PhD (I do) or Professor Lastname otherwise
- People like a greeting

Using R and R-Studio

1. Download R from https://cran.r-project.org/
2. Download R-Studio from https://www.rstudio.com/

Outline

1. Recap
2. Examples
3. Student submitted questions

Assigning probabilities

- **Classical method** is used when all the experimental outcomes are equally likely. If n experimental outcomes are possible, a probability of $1/n$ is assigned to each experimental outcome. Example: Drawing a card from a standard deck of 52 cards. Each card has a 1/52 probability of being selected.

- **Relative frequency method** is appropriate when data are available to estimate the proportion of the time the experimental outcome or collection of outcomes (event) will occur if the experiment is repeated a large number of times. That is for any event, E, probability of E is

$$P(E) = \frac{\text{number of times E occurs}}{\text{total number of observations}} = \frac{\#(E)}{N}$$

- $P(E)$ is defined in the probability model for any event E that is a subset of Ω.

Permutations

If we wish to compute the number of outcomes when r objects are to be selected from a set of n objects where the order of selection is important, we call this the number of **permutations**. The number of permutations is given by

$$nPr = P_r^n = \frac{n!}{(n-r)!}$$

- Where $n! = n(n-1)(n-2)\cdots(2)(1)$
- Rcode: $n!$ = factorial(n)

Combinations

If we wish to count the ways of selecting r objects from a (usually larger) set of n objects, this is the number of **combinations**. The number of combinations of n objects taken r unordered at a time is

$$nCr = C_r^n = \binom{n}{r} = \frac{n!}{r!(n-r)!}$$

Rcode: choose(n,r)

Example

1. Among 12 electrical components 4 are known not to function. If 6 components are randomly selected, how many ways can we have less than 2 of components not functioning?

12 total w/ 4 bad and 8 good, we choose 6

What is total # of ways to choose 6 out 12 components $\binom{12}{6}$

We want # combinations w/ fewer than 2 bad.

This means we must account for 1 bad and 0 bad

$$\binom{4}{0}\binom{8}{6} + \binom{4}{1}\binom{8}{5}$$

```
> choose(4,0)*choose(8,6)+choose(4,1)*choose(8,5)
[1] 252
```

Counting Example

2. Suppose we select randomly 6 marbles drawn from a bag containing 9 white and 7 black marbles. What is the probability that at least 2 of the marbles drawn are white?

Let W dente # of white marbles, B # of black marbles

Want $$P(W \geq 2) = P\big((W=2) \cup (W=3) \cup (W=4) \cup (W=5) \cup (W=6)\big)$$

$$= P(W=2) + P(W=3) + P(W=4) + P(W=5) + P(W=6)$$

$$= \sum_{k=2}^{6} P(W=k)$$

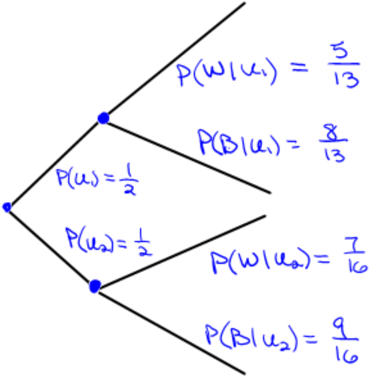
or $$P(W \geq 2) = 1 - P(W \leq 1) = 1 - P(W=0) - P(W=1)$$

$$= 1 - \frac{\binom{9}{0}\binom{7}{6}}{\binom{16}{6}} - \frac{\binom{9}{1}\binom{7}{5}}{\binom{16}{6}}$$

```
> 1-(choose(9,0)*choose(7,6)+choose(9,1)*choose(7,5))/choos
e(16,6)
[1] 0.9755245
```

Example of Tree Diagram

Urn 1 contains 5 white and 8 blue marbles. Urn 2 contains 7 white and 9 blue marbles. One of the two urns is chosen at random with one as likely to be chosen as the other. An urn is selected at random and then a marble is drawn from the chosen urn. Draw a probability tree diagram to show all the outcomes the experiment. In Latex, "\cup" = "$\cup$" and "\cap" = "$\cap$"



$$P(U_1 \cap W) = P(U_1)\cdot P(W|U_1) = \frac{1}{2}\cdot\frac{5}{13} = \frac{5}{26}$$

$$P(U_1 \cap B) = \frac{1}{2}\cdot\frac{8}{13} = \frac{8}{26}$$

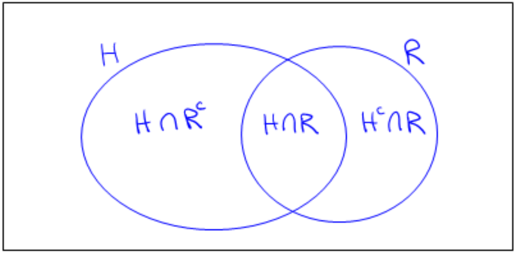
$$P(U_2 \cap W) = \frac{1}{2}\cdot\frac{7}{16} = \frac{7}{32}$$

$$P(U_2 \cap B) = \frac{1}{2}\cdot\frac{9}{16} = \frac{9}{32}$$

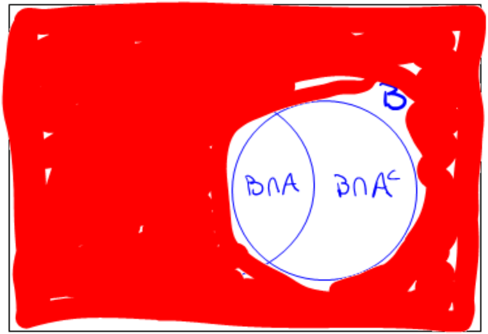
The probability that a randomly selected person has high blood pressure (the event H) is P(H) = 0.5 and the probability that a randomly selected person is a runner (the event R) is P(R) = 0.4. The probability that a randomly selected person has high blood pressure and is a runner is 0.2. Find the probability that a randomly selected person either has high blood pressure or is a runner or both.

$$P(H) = 0.5, \quad P(R) = 0.4, \quad P(H \cap R) = 0.2$$

$$P(H \cup R) = P(H) + P(R) - P(H \cap R)$$
$$= P(H \cap R^c) + P(H \cap R) + P(H^c \cap R)$$



$$P(A \mid B) = \frac{P(A \cap B)}{P(B)}$$



can you explain what a proper set is, a subset, and an element?

$$\Omega = \{1,2,3,4,5,6,7,8,9,10\}$$

Let $A = \{2,4,7,9,10\}$

Let $B = \{2,7,10\}$

Is $7 \in A$? yes

Is $B \subseteq A$? Yes since if $b \in B$ then $b \in A$

Is $B \subset A$? Yes since if $b \in B$ then $b \in A$ but $9 \in A$ and $9 \notin B$

An experimenter is randomly sampling 4 objects in order from among 61 objects. What is the total number of samples in the sample space?

1 7 57 60

60 7 57 1

$$\sum_{k=2}^{4} P(W=k)$$ What does this mean?

$\sum$ means we are adding

What will we add? $P(W=k)$

beginning w/ $k=2$ and k counts up to 4

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