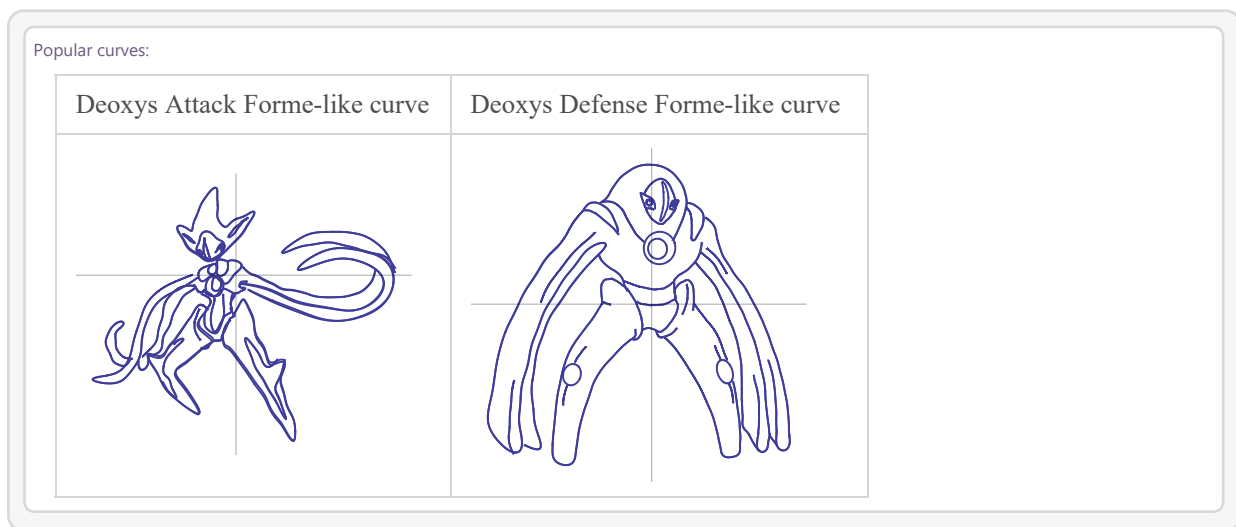


MATH:1260 Pokémath

The Mathematics of Pokémon Go[®]

Week 6 Wednesday, Spring 24



Plan for Today

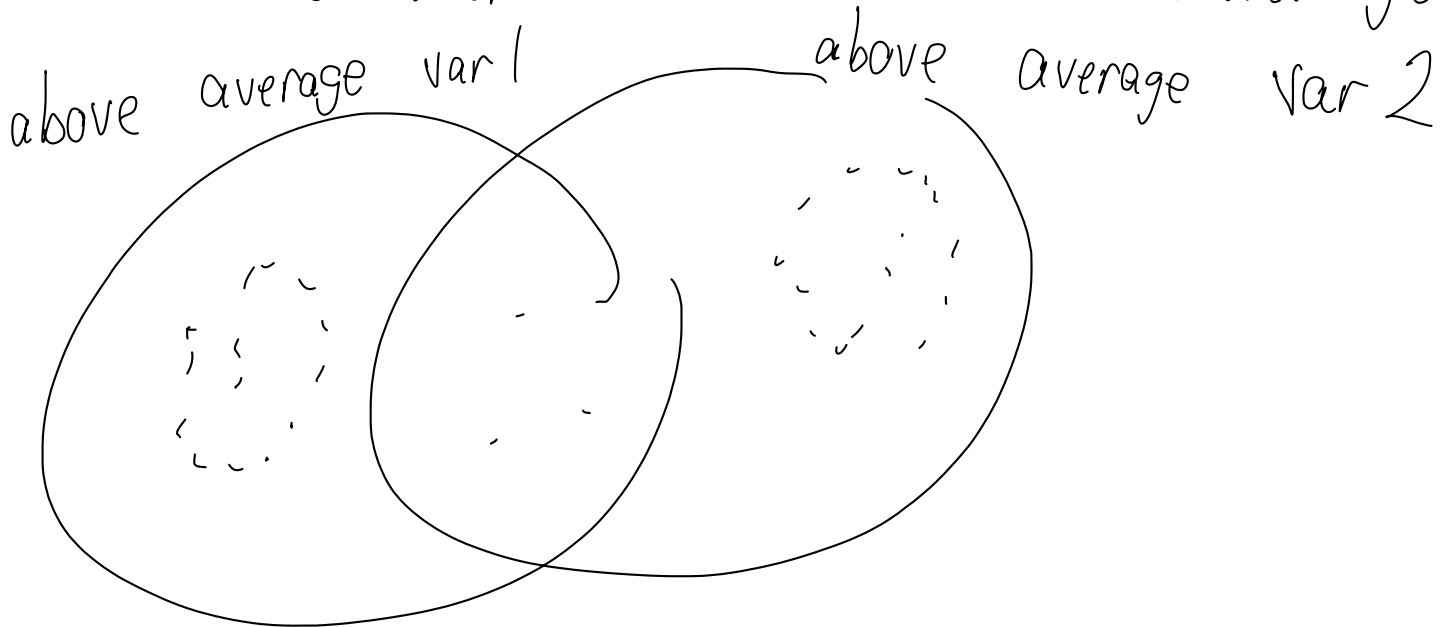
- Module 2: Gotta Catch 'Em All!®
 - Equally Likely Outcomes and The Basic Probability Principle
 - Probability Defined
-

Class Reminders

- GW5 tomorrow in discussion.
- HW4 due Wednesday Feb 28.

- Project 1 Stage 3 is due tonight at midnight

- Office hour after class on Wednesdays



Definitions

A **random experiment** has outcomes that we can not predict.

Throwing a Pokeball at a Pokemon

A single repetition of a random experiment is called a **trial**.

One throw

The possible results of a trial are called **outcomes**.

Catch

The SET of all possible outcomes is called the **sample space**.

{Catch, Escape, Critical Catch, Run Away}

An **event** is a **subset** of the sample space that contains all **outcomes** from inside the sample space that meet some **requirement**.

The event that the Pokemon is caught

{Catch, Critical Catch}

An experiment can be more complicated!

s=shiny, n=nonshiny

Suppose I catch three Eevee today and check which are shiny.

Notation: The event that the first is nonshiny, the second is shiny, and the third is nonshiny is written

nsn

Using this notation, what is the sample space?

$S = \{nnn, nns, nsn, snn, nss, sns, ssn, sss\}$

Events

An **event** is a subset of the sample space! $S = \{nnn, nns, nsn, snn, nss, sns, ssn, sss\}$

Examples

The first Eevee is Shiny

$$F = \{snn, ssn, sns, sss\}$$

I catch exactly two shiny Eevees

$$T = \{nss, sns, ssn\}$$

I catch at least one shiny Eevee

$$A = \{nns, nsn, snn, nss, sns, ssn, sss\}$$

Or, we can apply our set theory knowledge from Module 1!

Let $\text{unlucky} = \{nnn\}$.

Then $A = \text{unlucky}^c = \{nns, nsn, snn, nss, sns, ssn, sss\}$

Recall our notation for the count of elements in a set B is $n(B)$

Venn Diagram

The first Eevee is Shiny

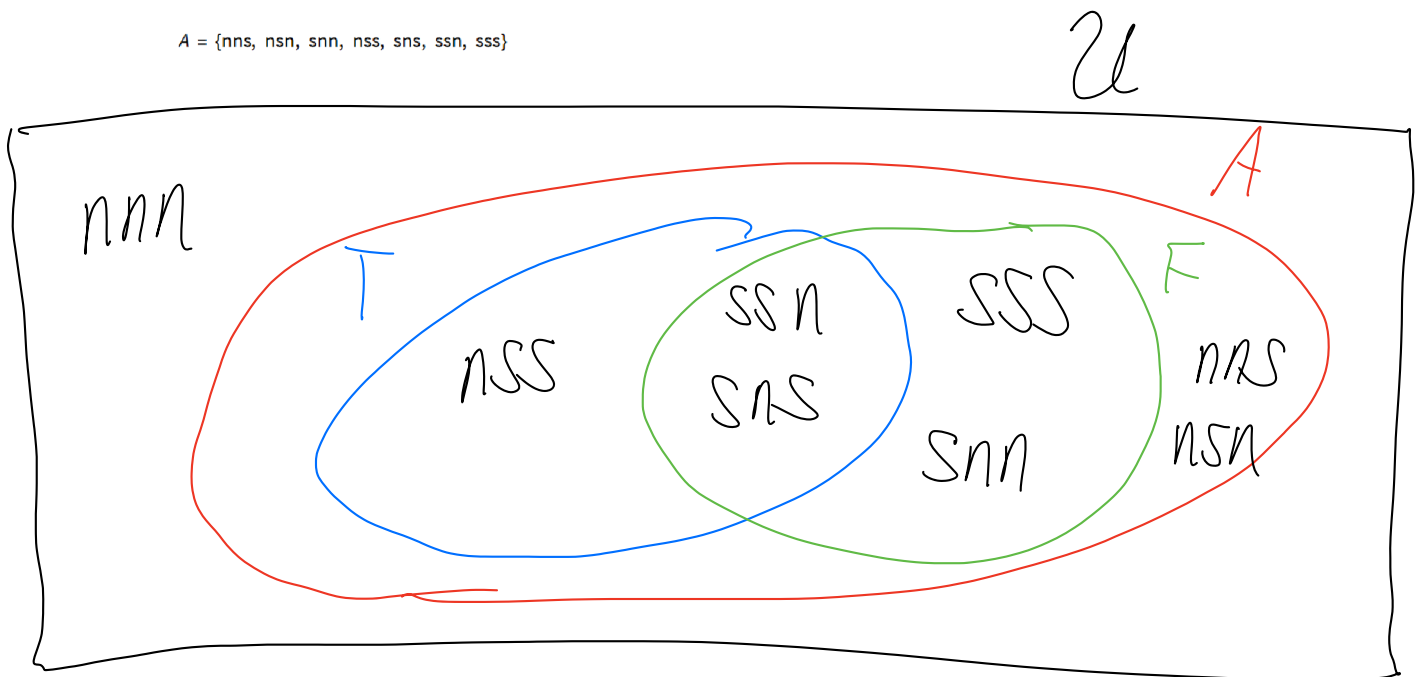
$$F = \{\text{snn}, \text{ssn}, \text{sns}, \text{sss}\}$$

I catch exactly two shiny Eevees

$$T = \{\text{nss}, \text{sns}, \text{ssn}\}$$

I catch at least one shiny Eevee

$$A = \{\text{nns}, \text{nsn}, \text{snn}, \text{nss}, \text{sns}, \text{ssn}, \text{sss}\}$$



$\{nnn, nns, nsn, snn, nss, sns, ssn, sss\}$

Events are sets!

The first Eevee is Shiny

$$F = \{snn, ssn, sns, sss\}$$

I catch exactly two shiny Eevees

$$T = \{nss, sns, ssn\}$$

I catch at least one shiny Eevee

$$A = \{nns, nsn, snn, nss, sns, ssn, sss\}$$

What is F^C ?

in words? The first Eevee is **not** shiny

in set notation? $\{nnn, nns, nsn, nss\}$

What is $F \cap T$?

in words? The first Eevee is shiny **and** I catch exactly two shiny Eevees.

in set notation? $\{sns, ssn\}$

What is $F \cup T$?

in words? First Eevee is shiny **or** I catch exactly two shiny Eevees

in set notation? $\{snn, ssn, sns, sss, nss\}$

What is $A \cup T$? = A

in words? I catch at least one shiny Eevee

in set notation? A

What is $F \cap A$?

in words? (TopHat) The first Eevee I caught is shiny

in set notation? F

Relative Frequency

If we perform an experiment many, many times, the proportion of times an event occurs will get closer and closer to some fraction.

That fraction is our intuition for the **probability** of that event.

Example: Shiny Rate?

<https://thesilphroad.com/science/reflecting-pokemon-go-shiny-rates-iii-base-rate>

SILPH STUDY: #035

PUBLISHED: 12.28.2020

REFLECTING ON POKÉMON GO SHINY RATES III: THE BASE RATE

New Project Design

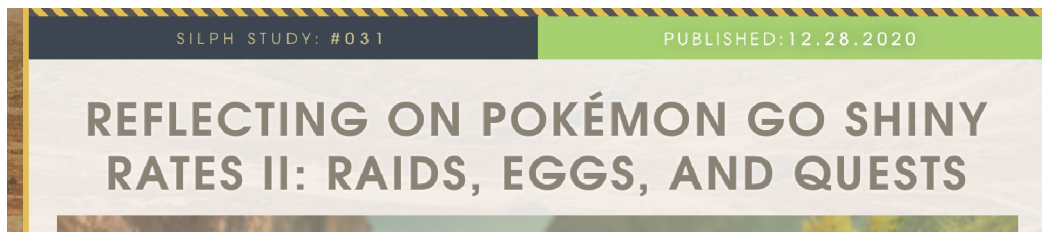
100,492

198

The proportion of shiny in this data set is $198/100,492$ or about $.0019703$

Probabilities are often rounded, since they only represent a chance of something happening, rather than a guarantee. You can think of the shiny odds as 200 shiny Pokemon in 100,000 encounters. This is $.2\%$

Legendary Shiny Pokemon in Raids?



SPECIES	SEEN	SHINY	
Cresselia	5,235	237	
Giratina (Altered)	947	44	
Groudon	2,755	158	
Heatran	1,062	57	
Ho-Oh	4,974	256	
Kyogre	7,661	381	
Latias	1,902	106	
Latios	2,125	109	
Lugia	4,245	220	
Mewtwo	2,410	134	
Rayquaza	5,544	306	
Regice	714	35	
Regirock	634	35	
Registeel	819	40	
Total	41,027	2,118	

TopHat: What proportion of legendary raids in this data set were shiny?

Formal Definition of Probability

A **probability function** is a function from the set of events (subsets of the sample space meeting some requirement) to the numbers between 0 and 1 with the following properties:

- $P(S)=1$, where S is the whole sample space.
- if A and B are disjoint events, $P(A \cup B)=P(A)+P(B)$

Basic Probability Principle

Let S be a sample space of equally likely outcomes. Let event E be a subset of S .

The probability of event E is $\frac{n(E)}{n(S)}$

Suppose I randomly pick one of the normal type pokemon from my bag. I have 183 normal pokemon in my bag, 16 are Eevees.

There were seven ways to get at least one shiny in three catches. Does that mean there is a $7/8$ chance will catch at least one shiny Eevee?

No! Because the events are not equally likely!