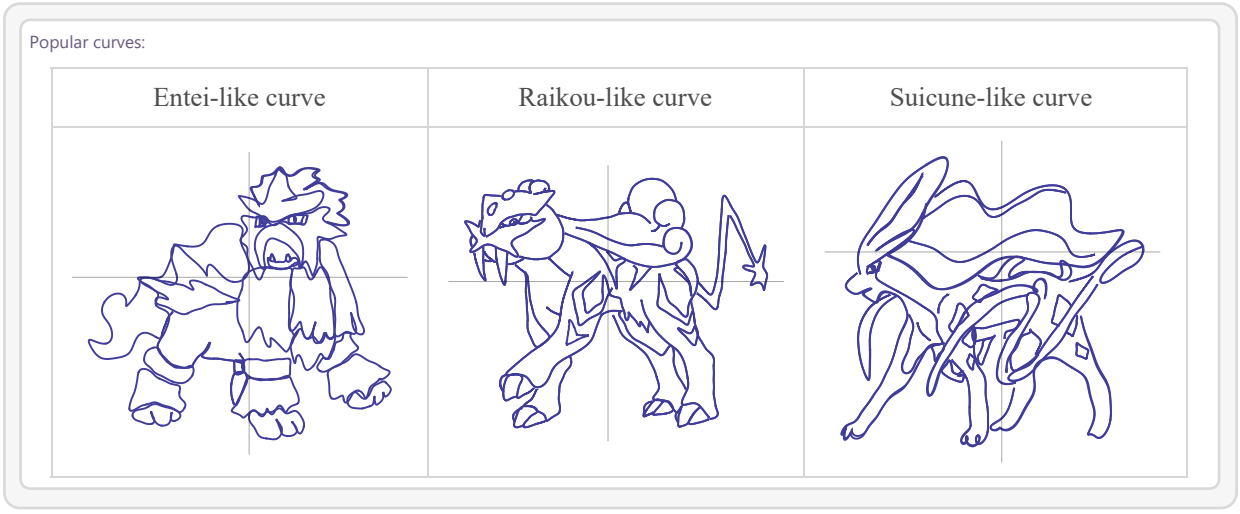
MATH:1260 Pokémath
The Mathematics of Pokémon Go®

Week 7 Monday, Spring 24



Plan for Today

- Module 2: Gotta Catch 'Em All!®
  - More on Basic Probability Principle
  - Probability Defined
  - Addition Rule

Class Reminders

- GW6 in discussion Thursday
- HW4 due Wednesday at midnight

Definitions

A random experiment has outcomes that we can not predict.

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

The possible results of a trial are called outcomes.

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

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

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 $\frac{n(E)}{n(S)}$

Examples

Suppose I randomly pick one of the Johto pokemon from my bag. I have 286 Johto Pokémon® in my bag. 41 of those are legendary. If i pick one, what is the probability it is a Legendary? **Does the Basic Probability Principle apply here?**

$\frac{41}{286}$

Remember from last week, there were seven ways to get at least one shiny in three checks. Does that mean there is a 7/8 chance any time you shiny check 3 Pokemon that you will find a shiny?

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

shiny vs nonshiny are not equally likely outcomes

Example

I have 353 Shiny Pokémon® in my bag. Suppose I draw one shiny at random.

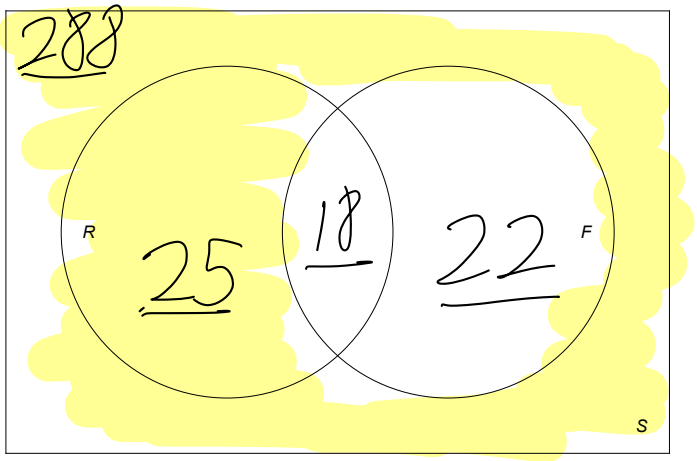
Of that set, 43 are Normal type, 40 are Flying type, 18 are Normal and Flying Type.

Notation:

S is the Sample Space

R is Normal

F is Flying



Probability of R $43/353$

Probability of F? $40/353$

Probability of R ∩ F? $18/353$

Probability of R ∪ F? $65/353$

TopHat. What is the probability of F^C?

$313/353$

Formal Definition of Probability

P is a function from events to the numbers between 0 and 1 with the following properties:

- P(S) = 1. → 100% probability of landing in the sample space.
- if A and B are disjoint events, $P(A \cup B)=P(A)+P(B)$
  - This is known as the "addition rule for disjoint sets"

Intuition

E is an event, a subset of possible outcomes.

P(E) is the probability that one of the outcomes that is in this subset will occur (in a single trial).

Example: Addition Rule for Disjoint Events

The experiment is " check the species of the next **starter** Pokémon® to spawn".

The sample space?

{Pokemon | starter}

Some events:

F = {Fire Type} What is P(F)? 1/3

W = {Water Type} What is P(W)? 1/3

Are F and W disjoint? Yes

F ∪ W is the event that the Pokémon® who spawns is a Fire Type or Water Type. What is P(F ∪ W)?

$\frac{1}{3} + \frac{1}{3} = \frac{2}{3}$

What if the experiment is changed to be "check the species of the next Pokémon® to spawn"?

Several problems. Including F and W are no longer disjoint.

General Addition Rule

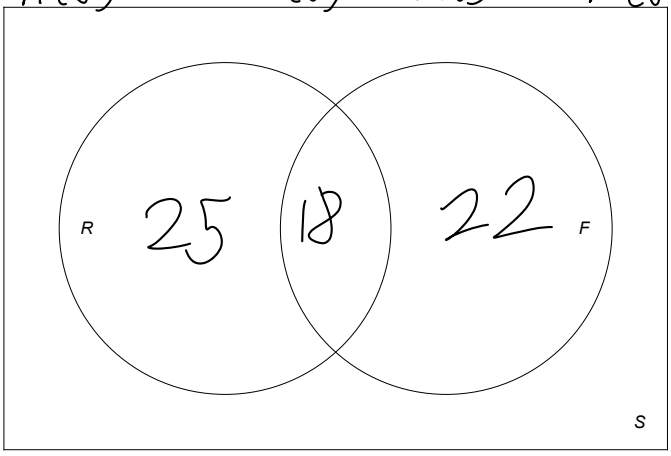
What if my sets are not disjoint? Recall, I have 353 Shiny Pokémon® in my bag. Suppose I draw one shiny at random.

Of that set, 43 are Normal type, 40 are Flying type, 18 are Normal and Flying Type.

We need the general addition rule:
$P(R \cup F) = P(R) + P(F) - P(R \cap F)$

Does this formula remind you of anything?

$$\frac{n(R \cup F)}{n(S)} = \frac{n(R)}{n(S)} + \frac{n(F)}{n(S)} - \frac{n(R \cap F)}{n(S)}$$



$\Rightarrow \frac{65}{353}$

$$P(R \cup F) = \frac{43}{353} + \frac{40}{353} - \frac{18}{353} = \frac{65}{353}$$

Complement Rule

$P(R^C)$?

Can you guess what the complement rule might be?

$$\frac{n(R^C)}{n(S)} = \frac{n(S)}{n(S)} - \frac{n(R)}{n(S)}$$

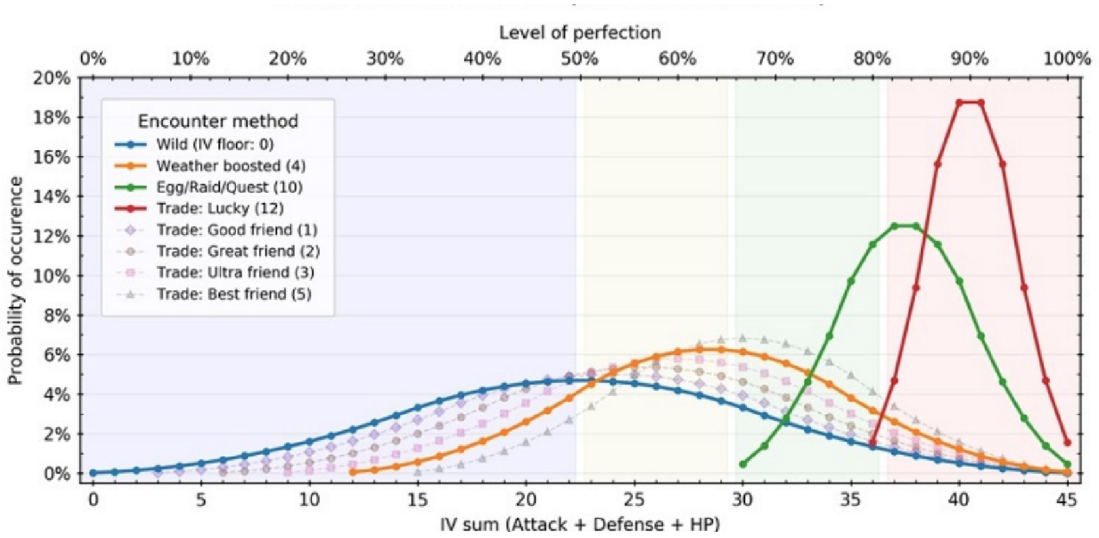
$$P(R^C) = P(S) - P(R)$$

$$P(R^C) = 1 - P(R)$$

IVs

Each IV can be a value from 0 to 15. So there are 4096 possible IVs.

The sum can be a value from 0 to 45 but not all sums are equally likely...



What is the probability of a 4* in a Lucky Trade?

What is the probability of a 2* in a Lucky Trade?

What is the probability of a 3* in a Lucky Trade?