Problem A: Hair Pulling To Line Your Nest

Some birds regularly use hair from mammals for the construction of their nests. One reason may be to help insulate a nest in a colder region. There is also speculation that the hair may also deter parasites or predators. Where do birds obtain the hair they use in their nests? In one of the better titled papers, the authors note that some birds have been observed pulling hair from live animals[1], and the author's informal process of gaining information reveals that many birds from the genus *Paridae* have been observed snatching hair from live mammals. The authors note this phenomenon seems to be better documented in popular literature than in the scientific literature, and there are a number of videos available demonstrating the behavior[2,3].

This is a puzzling practice. The birds are taking a nontrivial risk in order to obtain hair to use in their nests rather than searching for hair that has been shed or snagged in vegetation. This implies that the risks associated with approaching larger mammals is worthwhile given the benefit it provides in increasing the probability of survival of their young. It raises many questions about the balance between the risks and benefits of finding and using hair for nest construction.

To explore this phenomenon construct a mathematical model that incorporates the behavior in a population of birds. What does the model imply about the relative benefits compared to the risks? Assuming the primary benefit is the insulating value of using the hair what are the local climate conditions when hair snatching (kleptotrichy) is beneficial? If you know the balance between the risks and thermal benefits, can you use local observations to determine if there are other benefits for using hair in a nest? For example, if hair snatching is observed in a region in which the thermal benefits do not indicate hair snatching is advantageous what can you say about the magnitude of the impact of the other potential benefits?

REFERENCES

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[2]   Tufted Titmouse likes my hair! https://www.youtube.com/watch?v=SoAPQpYlIjc . Accessed 6 August 2021.

[3]   Titmouse Pulling Fur. https://www.youtube.com/watch?v=AR01loEInPE . Accessed 6 August 2021.

Problem B: Throw The Bike Or Throw The Race

In the 2021 Brabantse Pijl Dames bicycle race, sprinter Demi Vollering was leading the race but lost when Ruth Winder came from behind at the last moment[1,2]. Demi Vollering begun to celebrate too soon when Ruth Winder pushed her bike forward (known as a "bike throw" [3]), her front wheel crossed the finish line millimeters ahead of Vollering's wheel. The finish of the race was so close that most people, including Winder, assumed that Vollering won. It was not until after the official finish line records were reviewed that Winder was declared the winner.

The source of confusion was described by a reporter, Mikkel Conde, who said, "I'm trying to wrap my head around how it's possible to be ahead right before the line, lose on the line and then immediately be ahead again right after the line." [1] In this case the "line" consists of two wide white lines on either side of the official finish line. From photographs taken by press officials Vollering appeared to be ahead at the start of the first white line and ahead at the end of the second white line. At the official finish line between them, though, Winder was ahead.

This example highlights how important the bike throw can be at the finish of a bike race. The question your team should explore **through use of a mathematical model** is to determine just how precise the timing must be for the bike throw to be effective. When should a rider stop pedaling and shift her weight backwards to thrust the bike forward? What is the best position for the cyclist and what are the trade-offs for a more precarious hand position that might provide more movement at the expense of less control? Also, what is the time interval that a professional cyclist must exploit for this move to be effective? Additionally, what is the maximum amount of time that can be made up? You should keep in mind that professional cyclists are moving at a speed where friction can be considerable which may impact the timing when the rider should stop pedaling and thrust the bicycle forward.

REFERENCES

[1]   Demi Vollering celebrates victory too soon at Brabantse Pijl Dames, Kirsten Frattini, https://www.cyclingnews.com/news/demi-vollering-celebrates-victory-too-soon-at-brabantse-pijl-dames/ , last accessed 31 July 2021.

[2]   'I thought I won this sprint...apparently not' - Photo finish leaves Demi Vollering regretting finish line celebration," Alex Ballinger, https://www.cyclingweekly.com/news/racing/i-thought-i-won-this-sprint-apparently-not-photo-finish-leaves-demi-vollering-regretting-finish-line-celebration-496392, last accessed 31 July 2021.

[3]   How to Throw Bike When Finishing a Race | Road Cycling, https://www.youtube.com/watch?v=9tUJYjBdxGU , last accessed 31 July 2021.

Problem C: Submitted a Tweet, Now What?

There are a wide variety of approaches that social media platforms use to moderate the information posted on their systems. The approaches vary by platform and change over time[1]. For example, one platform may simply censor information deemed inappropriate, while another site may include a warning that the information shared is inaccurate. Despite these efforts people using the site may still fall into the trap of confirmation bias or simply become isolated within a network of like-minded individuals. At the same time, other people using the site adapt and make use of code words or other techniques to reduce the effectiveness of the moderation efforts.

The question to explore is how effective are the different approaches to content moderation? There have been many mathematical models developed to explore how information is shared among a large number of people. In this case, though, the focus is on how the sharing of misinformation can be impacted by different moderation techniques. In particular, given a large population in which a single issue has divided people into at least two groups, how can the number of people within the groups change. Specifically, do the moderation methods impact the movement of people between the groups? What happens when you make changes to the assumptions used to construct your model and how sensitive are the results to your assumptions?

Your model should examine the role of at least two different content moderation techniques, censoring information and providing warning notices. You may include the use of other content moderation techniques, but if you do then provide a clear description of the methods and also provide a discussion how the interaction of all of the different methods impact and influence each other as well as different points of view within the population. An exploration of what happens when the content moderation techniques change in time is an optional aspect to explore if you are able to determine how to adapt your model in the given time frame.

REFERENCES

[1]   Why The History Of Content Moderation Matters, Kate Klonick, https://www.techdirt.com/articles/20180129/21074939116/why-history-content-moderation-matters.shtml , last accessed 31 July 2021.

DISCLAIMER

Sharing information is a basic practice we share as human beings. Because of its central role in how we interact the topic can generate fierce passions, and there are a wide variety of viewpoints that extend to many extremes. The ability that some media platforms have to alter and influence the way information is shared is a current topic that has societal and political dimensions. It is an important topic that can elicit an immediate and strong response that depends on our personal beliefs as well as past experiences. Please read the guidelines carefully and focus on the mathematical implications of varying content moderation practices. Your report should be centered on the demonstrated results and implications of your modeling efforts.