Information Cascades

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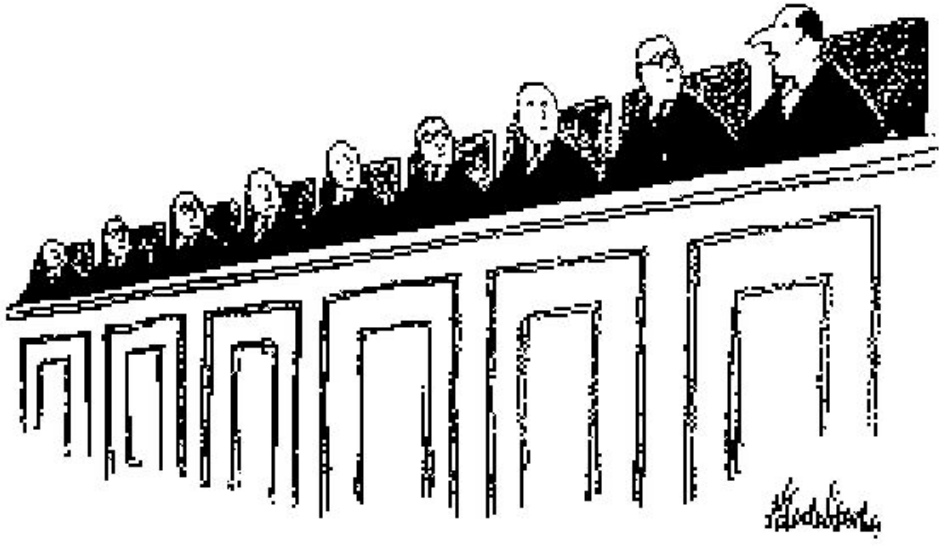


"Well heck! If all you smart cookies agree, who am I to dissent?"

Intro: Following the crowd

- How do conforming beliefs emerge when people are connected by a network?
- When people influence each other's perceptions and decisions, individual behavior can aggregate and produce population-wide consensus (group-think)
- In a network-like structure, there are settings where it may be rational to imitate the choices of others even if an individual's private signals suggest a different choice
- An information cascade has the potential to occur when people make decisions sequentially
    - Later decision makers see previous decisions made, and can infer something about what the earlier people know from

A simple herding experiment

- **An urn has three marbles in it: The urn is either ‘majority-red’ or ‘majority-blue’ with equal probability (½)**
- **Students sequentially draw a marble from the urn in private, put it back in the urn, then make a guess about whether the urn is majority-red or majority blue.**
- **Each guess is publicly announced to the class**

A simple herding experiment

- **The First Student: guesses the urn is majority whatever color he/she sees**
- **Second student:**
  - **If same color is drawn as the first student:**
    - **student makes the same guess as the first student.**
  - **If the student draws the opposite color:**
    - **The student is indifferent in his/her guess.**
    - **We'll assume the second student guesses whatever color he/she draws, so that the second guess conveys perfect information to following students**

A simple herding experiment

- Assume first and second student both guess majority blue:
  - Regardless of what the third student draws, rationally he/she must guess blue (Bayes rule)
- Fourth Student and onward:
  - Having heard three blues in a row, the fourth student's guess must also be blue regardless of what is drawn.
  - Rationally, it is deducible that he first two guesses convey that the first two marbles drawn are blue
  - Whichever color the student draws, it will be outweighed by the two blue draws by the first 2 students
- This experiment shows how an information cascade can emerge, as every student after student 3 rationally guesses blue regardless of his/her draw

Bayes Rule

$$P(A|B) = \frac{P(B|A)P(A)}{P(B)}$$

Students should guess majority blue if: P(majority blue| what has been seen and heard) > 1/2

Note: P(draw blue|majority blue) = 2/3 = P(draw red|majority red)

Assume first two students draw blue. Intuitively, it is rational for both students to guess majority blue. (easy to plug into bayes rule).

Assume third student draws red: the student knows the first two students drew blue, so he can use Bayes rule to figure out what guess to make:

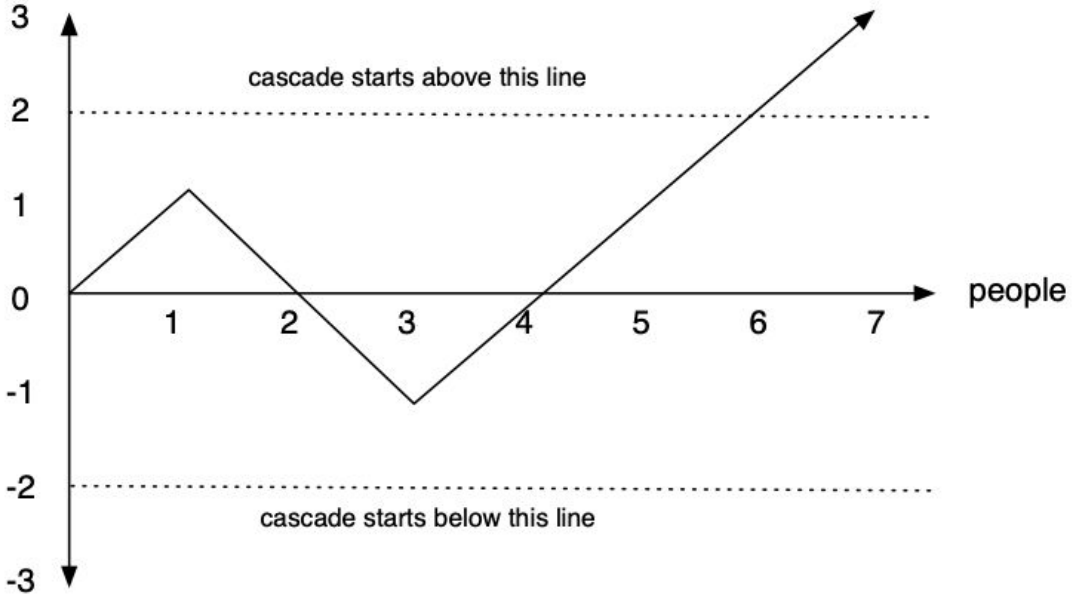
$$\Pr[\textit{majority-blue} \mid \textit{blue, blue, red}] = \frac{\Pr[\textit{majority-blue}] \cdot \Pr[\textit{blue, blue, red} \mid \textit{majority-blue}]}{\Pr[\textit{blue, blue, red}]}.$$

(16.7)

$$\Pr[\textit{majority-blue} \mid \textit{blue, blue, red}] = \frac{\frac{4}{27} \cdot \frac{1}{2}}{\frac{1}{9}} = \frac{2}{3}.$$

General Formation of Cascades:

- Y axis - the difference between majority red and majority blue guesses.
- In this case, the first two students draw blue then red
- The third and fourth students draw red then blue, then players 5 and 6 both draw blue.
- Bayes rule shows that an information cascade must form after the 6th student
- More generally, a cascade will form whenever the difference in guesses for red and blue reaches 2



Properties of Information Cascades:

1) Cascades can be **wrong**:
    a) There is a chance the first two blue draws were from a majority red urn.
    b) Rational sequential decision making can thus form wrong beliefs amongst a whole population.
2) Cascades can be **fragile**:
    a) Assume the first two students draw blue. From then on there would be an information cascade and students after would rationally be led to guess majority-blue.
    b) Imagine student 51 draws a red marble, then cheats and shows student 52 the marble.
        i) If student 52 were then to draw another red marble student 52 would now be able to deduce that that two players have drawn blue, and two players have drawn red. Thus the information cascade could break, as student 52 would now be indifferent towards choosing blue and red.
3) Cascades can be **based on very little information**:
    a) It only takes the first two students drawing blue for a whole class to predict majority blue

Extensions of Information Cascades

- Innovation: People sequentially choose to adopt or not adopt an innovation based on private beliefs of the utility of an innovation, leading to a similar model as the urn experiment
- Politics: Opinion formation and social media
- Markets
- Overall, a network structure where the sequential formation of opinions uses the signals of others as well as private information can lead to the emergence of information cascades

Extensions of Information Cascades

- Consider the following example:
  - A hiring committee is deciding whether to make a job offer to candidate A or B.
  - The hiring committee goes around the table, where each member expresses their opinion.
  - If participants assume they have roughly equal insight into the problem, then a cascade can quickly develop.
- If a few people initially favor A, others may be led to conclude they should favor A, even if they initially preferred B.
- The issue is not only one of social pressure to conform to the majority, but in fact a rational approach to decision making (due to the assumption everyone has equal information about the problem).