

Olympic Host City

The host city for an Olympic Games is determined after a series of presentations and of votes by non-voting members of the International Olympic Committee (IOC). In 2008, seven cities initially applied to host the 2016 Olympic Games: Baku (Azerbaijan), Chicago (U.S.), Doha (Qatar), Madrid (Spain), Prague (Czech Republic), Rio de Janeiro (Brazil), and Tokyo (Japan). From these applicants, the IOC executive board allowed Chicago, Madrid, Rio, and Tokyo to go forward with their applications and become candidate host cities. Eventually the cities each had ten official delegates from the host country make a 45 minute presentation to the IOC in October of 2009. The presentations were immediately followed by questions from the IOC and then a vote by secret ballot was held where IOC members from all countries not bidding to host cast a single vote on their top choice. The host city that received the fewest vote was removed as a candidate and a new vote was immediately taken. The process was repeated until a winning candidate was determined.

| | Round 1 | Round 2 | Round 3 |
|----------------|---------|---------|---------|
| Chicago | 18 | - | - |
| Madrid | 28 | 29 | 32 |
| Rio de Janeiro | 26 | 46 | 66 |
| Tokyo | 22 | 20 | - |

- (1) How can we tell that the IOC does not use exactly a Hare system for this vote even though we only see voter's first place vote? Assuming that the IOC did in fact use a Hare system but that there was a recording error in the second round of voting, what are the likely possible vote totals that should have been recorded?
- (2) Assuming that voters who had Madrid or Rio as their first place vote never changed their preferences, what information can we definitively infer about how the voters who initially voted for Chicago or Tokyo would have filled out a preference list ballot.
- (3) What information can we **not** discern about the voters' ballots?
- (4) Even though it appears likely, can we be sure there would be a Condorcet winner? If yes, explain why. If not, create a preference list ballot that would agree with these votes totals (assuming that 2 Tokyo voters who switched to Rio in round 2) but would not yield a Condorcet winner.
- (5) Why do we know that Madrid could **not** be the Condorcet winner no matter how the preference list ballots looked? Would it be possible for Chicago, the first eliminated city, to have been the Condorcet winner? If so, create a preference list ballot that would have the first place votes agree with round 1 and have Chicago as the Condorcet winner.