

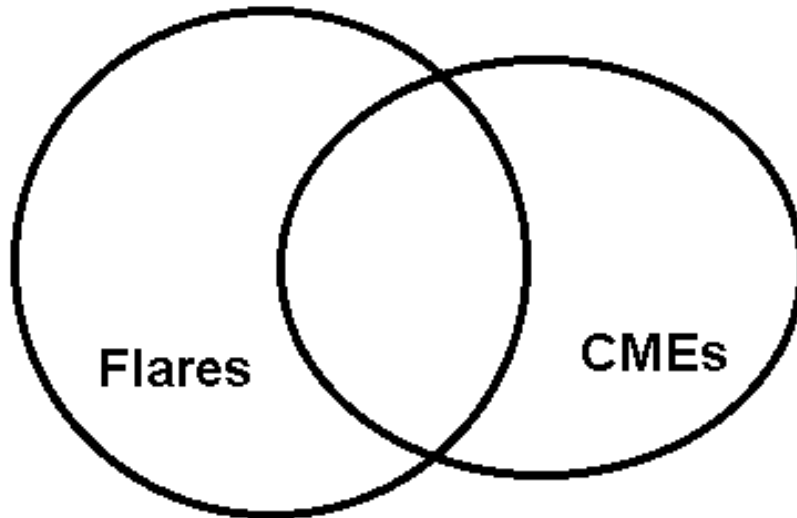
Predicting CMEs and Flares

Solar flares are violent releases of energy from the sun that last 10 to 20 minutes and produce intense flashes of x-rays. Some of these flares can cause radio interference, and problems with communication satellites. Coronal mass ejections (CMEs) are enormous releases of matter (plasma) from the sun that travel at nearly a million miles per hour to Earth. CMEs can cause the Northern Lights and sometimes result in electrical power blackouts.

During a particular month of solar activity, the following events were recorded:

Solar Flares	22
CME s	12
Both flares and CMEs	7

A scientist decides to analyze the results to come up with an early-warning alert system. He wants to use CMEs to predict when solar flares will happen, and he wants to use flares to predict when CMEs will happen. His first step is to construct a Venn Diagram to display the data. Place the data in the correct locations.

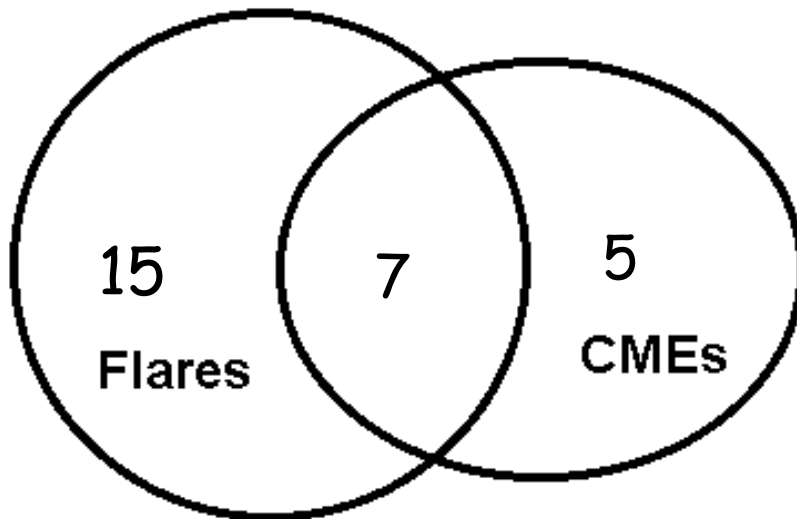


Problem 1 - What do the non-overlapping parts of the diagram represent?

Problem 2 - Based on this data, if you see a flare on the sun, what is the probability that a CME will also occur?

Problem 3 - Based on this data, if you see a CME, what is the probability that a flare will also occur?

Problem 4 - In your own words, explain which early warning system gives you the best prediction of what a particular kind of solar storm will occur.



Problem 1 - What do the non-overlapping parts of the diagram represent?

Answer: They represent solar storm events where only CMEs are seen, or only flares are seen but not both happening at the same time.

Problem 2 - Based on this data, if you see a flare on the sun, what is the probability that a CME will also occur?

Answer: The number of flares that occur at the same time as a CME is 7, so $7/12$ is the probability that if you see a flare, you will also see a CME.

Problem 3 - Based on this data, if you see a CME, what is the probability that a flare will also occur?

Answer: There are 22 CMEs so the probability is $7/22$ that, given you see a CME you will also see a flare.

Problem 4 - In your own words, explain which early warning system gives you the best prediction of what a particular kind of solar storm will occur.

Answer: Because $7/12$ is larger than $7/22$, an early warning system that uses flares to predict CMEs will be more reliable than a system that uses CMEs to predict flares. This means that you have a better chance of predicting when an electrical outage (caused by a CME) will occur than when a satellite problem (caused by a flare) will occur using these warning systems.