



The Sun is an active star that produces solar flares (F) and explosions of gas (C). Astronomers keep watch for these events because they can harm satellites and astronauts in space. Predicting when the next storm will happen is not easy to do. The problems below are solved by writing out all of the possibilities, then calculating the probability of the particular outcome!

*Photo of a coronal mass ejection courtesy SOHO/NASA.*

**Problem 1** – During a particularly intense week for solar storms, three flares were spotted along with two massive gas cloud explosions. Work out all of the possible ways that 3 Fs and 2 Cs can be separately distributed among 7 days. Examples include C C X X X X X and F F F X X X X.

What is the probability (as a fraction) that none of these events occurred on Friday?

Inquiry: Does the probability matter if we select any one of the other 6 days?

## Answer Key

1 – Here we have to distribute 2 cloud events (C) among 7 days. For advanced students, there are  $7! / (2! 5!) = 7 \times 6 / 2 = 21$  possibilities which the students will work out by hand, in this case starting with Monday as the first place in the sequence:

C C X X X X X	X C C X X X X	X X C C X X X	X X X C C X X
C X C X X X X	X C X C X X X	X X C X C X X	X X X C X C X
C X X C X X X	X C X X C X X	X X C X X C X	X X X C X C X
C X X X C X X	X C X X X C X	X X C X X X C	X X X X C C X
C X X X X C X	X C X X X X C		X X X X C X C
C X X X X X C			X X X X X C C

Next, we have to distribute 3 flares (F) among 7 days. There will be  $7! / (3! 4!) = (7 \times 6 \times 5) / (3 \times 2) = 35$  possibilities as follows:

F F F X X X X	F X X F F X X	X F F F X X X	X X F F F X X
F F X F X X X	F X X F X F X	X F F X F X X	X X F F X F X
F F X X F X X	F X X F X F X	X F F X X F X	X X F F X X F
F F X X X F X	F X X X F F X	X F F X X X F	X X F X F F X
F F X X X X F	F X X X F X F	X F X F F X X	X X F X F X F
F X F F X X X	F X X X X F F	X F X F X F X	X X F X X F F
F X F X F X X		X F X F X X F	X X X F F F X
F X F X X F X		X F X X F F X	X X X F F X F
F X F X X X F		X F X X F X F	X X X F X F F
		X F X X X F F	X X X X F F F

For each cloud event (21 possibilities) there are 35 possibilities for flare events, so the total number of arrangements is  $21 \times 35 = 735$ . Friday is the fifth location in each sequence.

The number of sequences of cloud events in which no cloud appears in the fifth slot is highlighted in red. There are 15 possibilities. For the solar flares, there are 20 possibilities, so because these are independent, the total number is  $15 \times 20 = 300$ . So, the probability that there will be no solar storms on Friday is  $300/735$

**Inquiry** – Students may redo the calculation for any of the other days. The resulting probability should always be  $300/735$ . This is because the events are not correlated with any particular day, so the day choice is random as well.