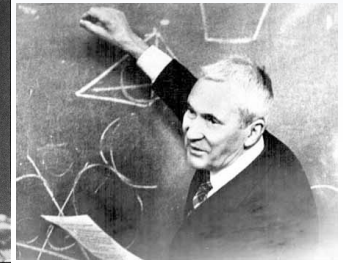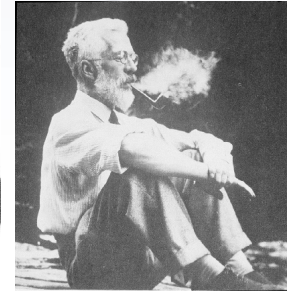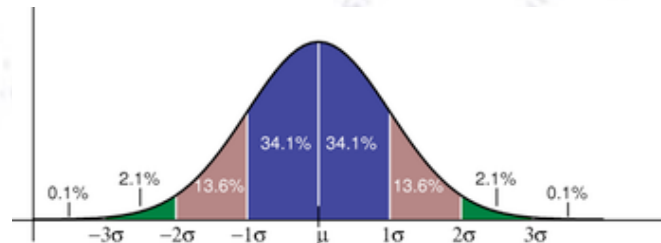# Applied Statistics

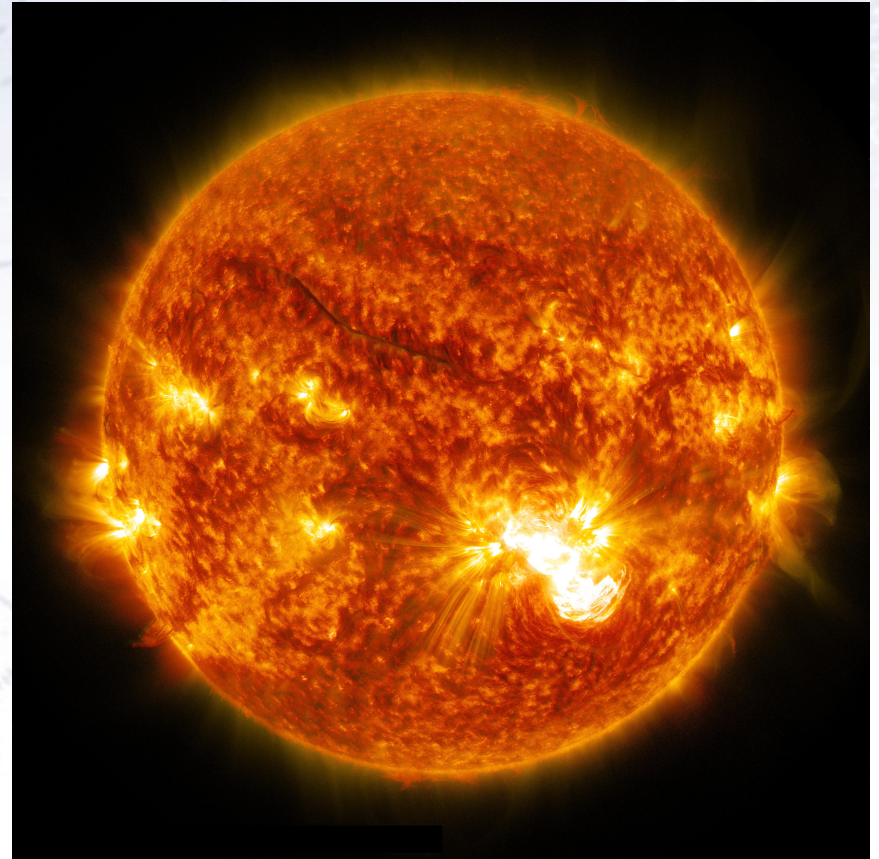## On Coincidences

Troels C. Petersen (NBI)

"Statistics is merely a quantisation of common sense"

Coincidence?

Seen from the Earth, the angular sizes of the Moon and Sun are uncorrelated, but:
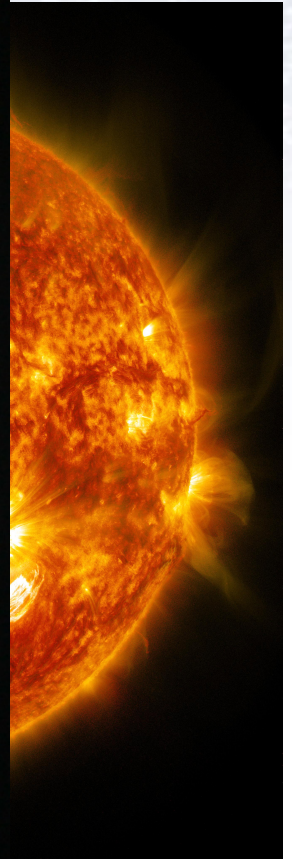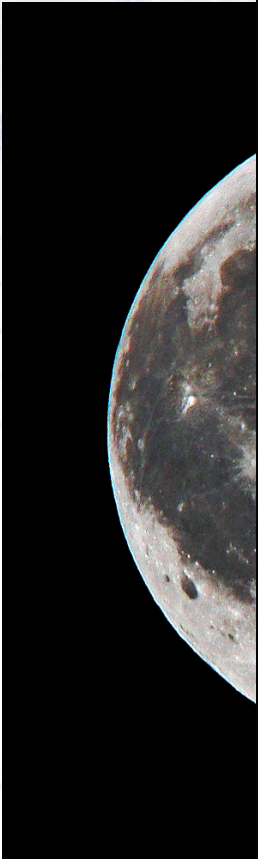

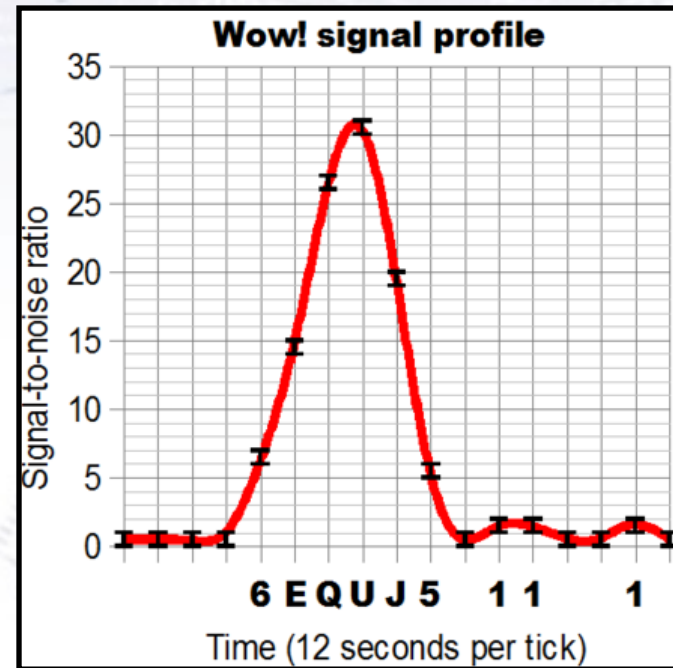$$\theta_{moon} = 0.558°$$

$$\theta_{sun} = 0.545°$$

Coincidence?

Seen from t... ...elated, but:

$(\theta_{moon} - \theta_{sun}) / \theta_{moon} = 0.023$

Signal???

One should always be careful of not being fooled by spurious signal, effects of apparatus or unknown backgrounds.
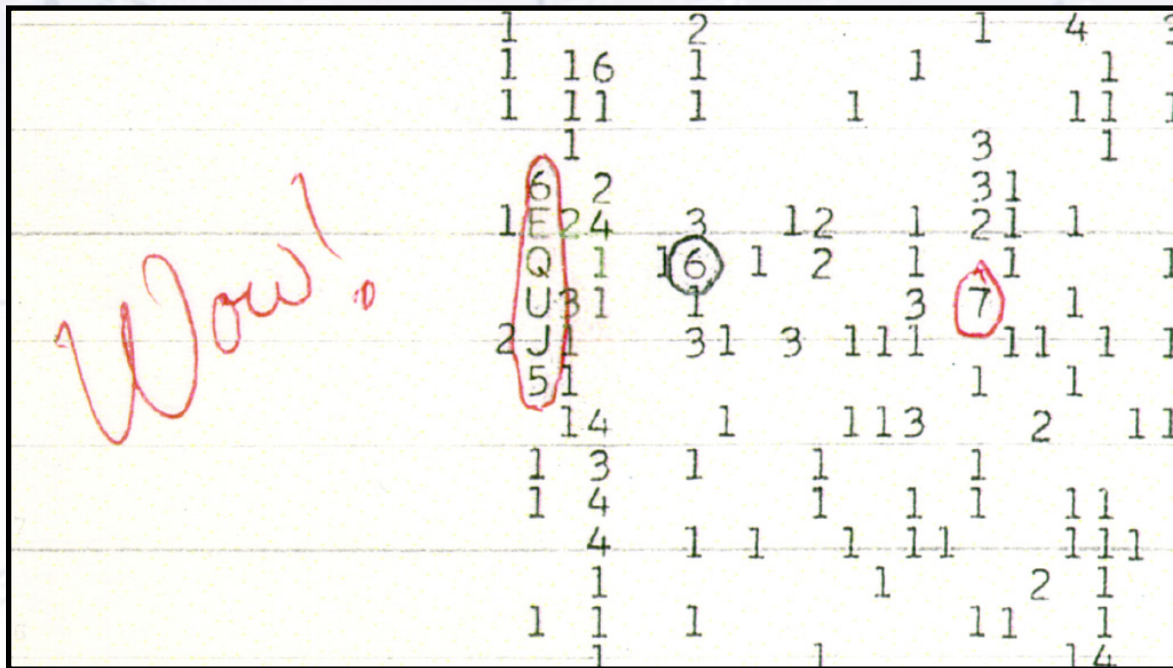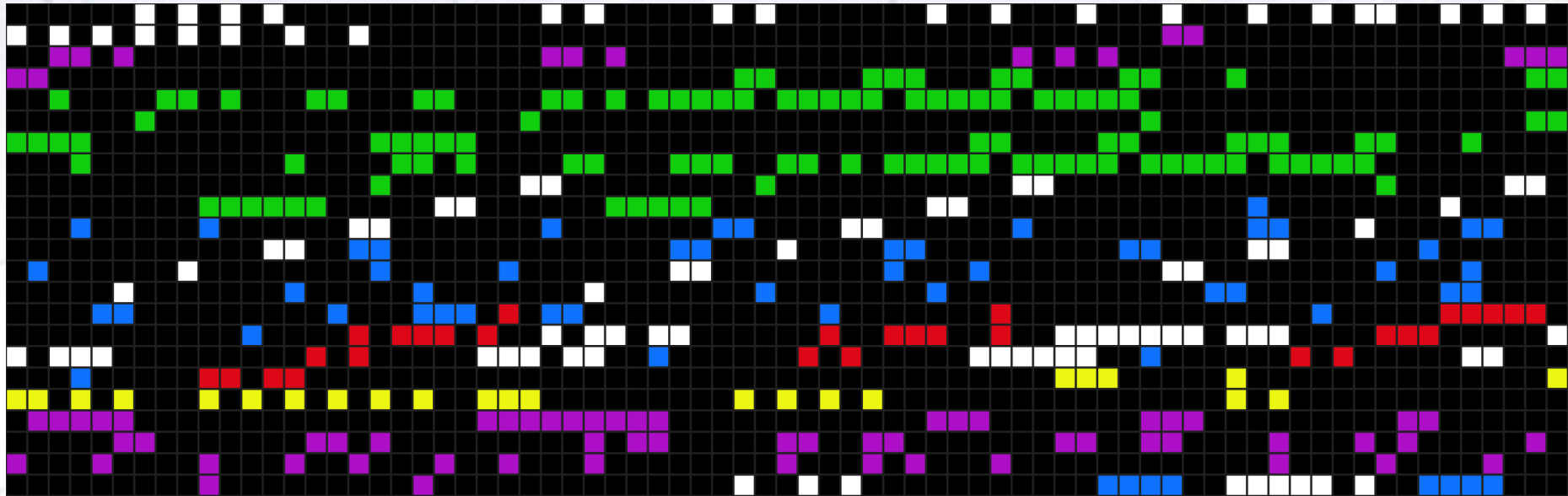

Given Earth's rotation, an extraterrestrial signal was expected to be 72s long and only observed in one (of 50) 10kHz bands - exactly like observed!

The signal could have been produced by an unknown (human) background.

Random???

You sit and play around with a large radio telescope (as one does!), and you receive 1679 data points that you (wisely) decide to plot in a (random?) format:

Is this random noise, or is there some pattern to it? Well, that is hypothesis testing, as we have two hypothesis:

H_0 - Null: It is random.

H_1 - Alternative: It is not random.

How would you test this?

Random???

It becomes very clear, that this is NOT random. That does not prove that it is anything interesting, but simply that you didn't pick up pure noise in your apparatus.

You realise the "right" format (23 rows x 73 columns), and suddenly a message appears… The Arecibo message (sent into space in 1974).

https://en.wikipedia.org/wiki/Arecibo_message
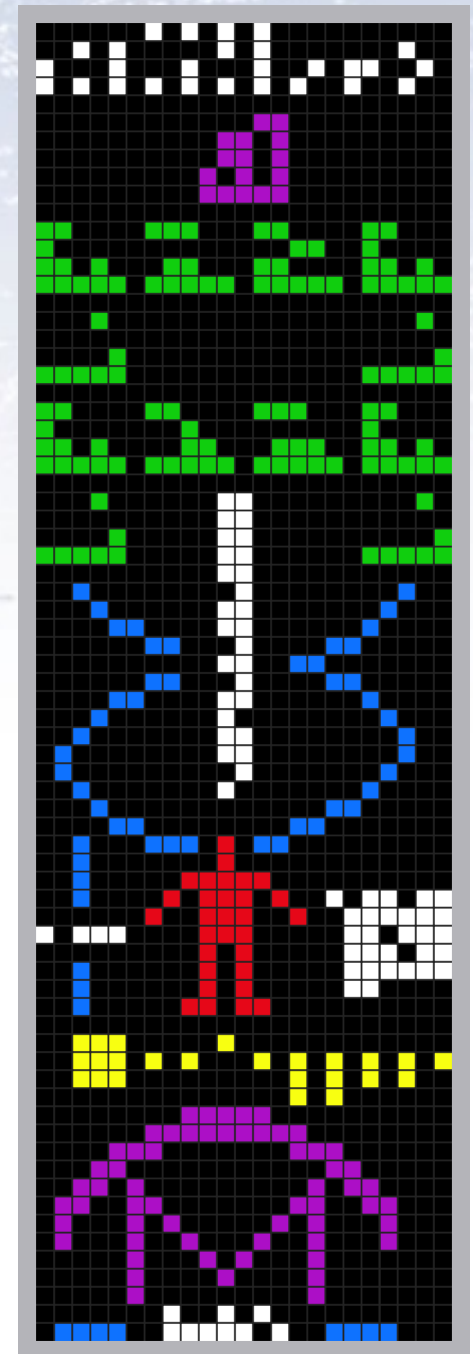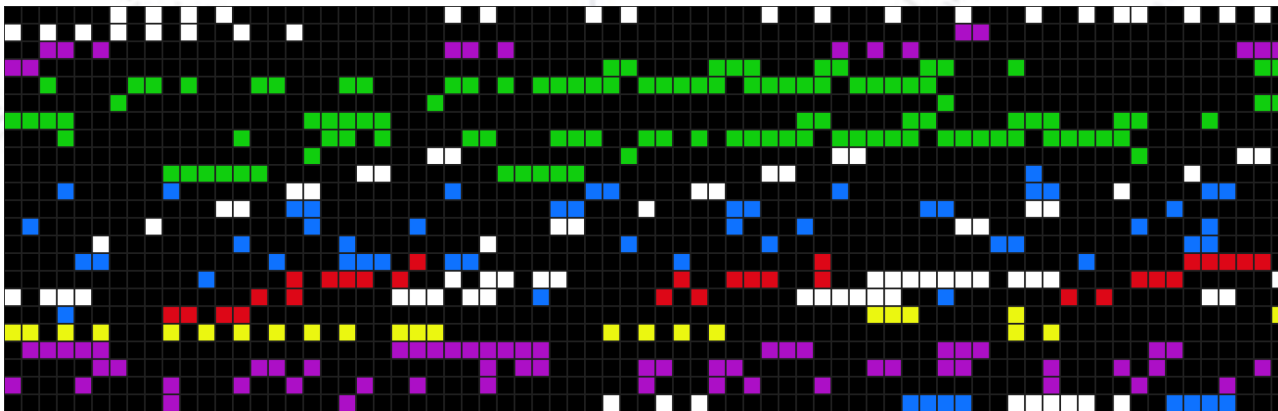
Coincidence?

"Coincidences, in general, are great stumbling-blocks in the way of that class of thinkers who have been educated to know nothing of the theory of probabilities [and statistics (red.)] - that theory to which the most glorious objects of human research are indebted for the most glorious of illustration."

[Edgar Allan Poe, The Murders in the Rue Morgue]

> The aim of science in general and statistics in particular is
> **NOT to be misled by coincidences,**
> but rather to calculate probabilities and judge their significance.