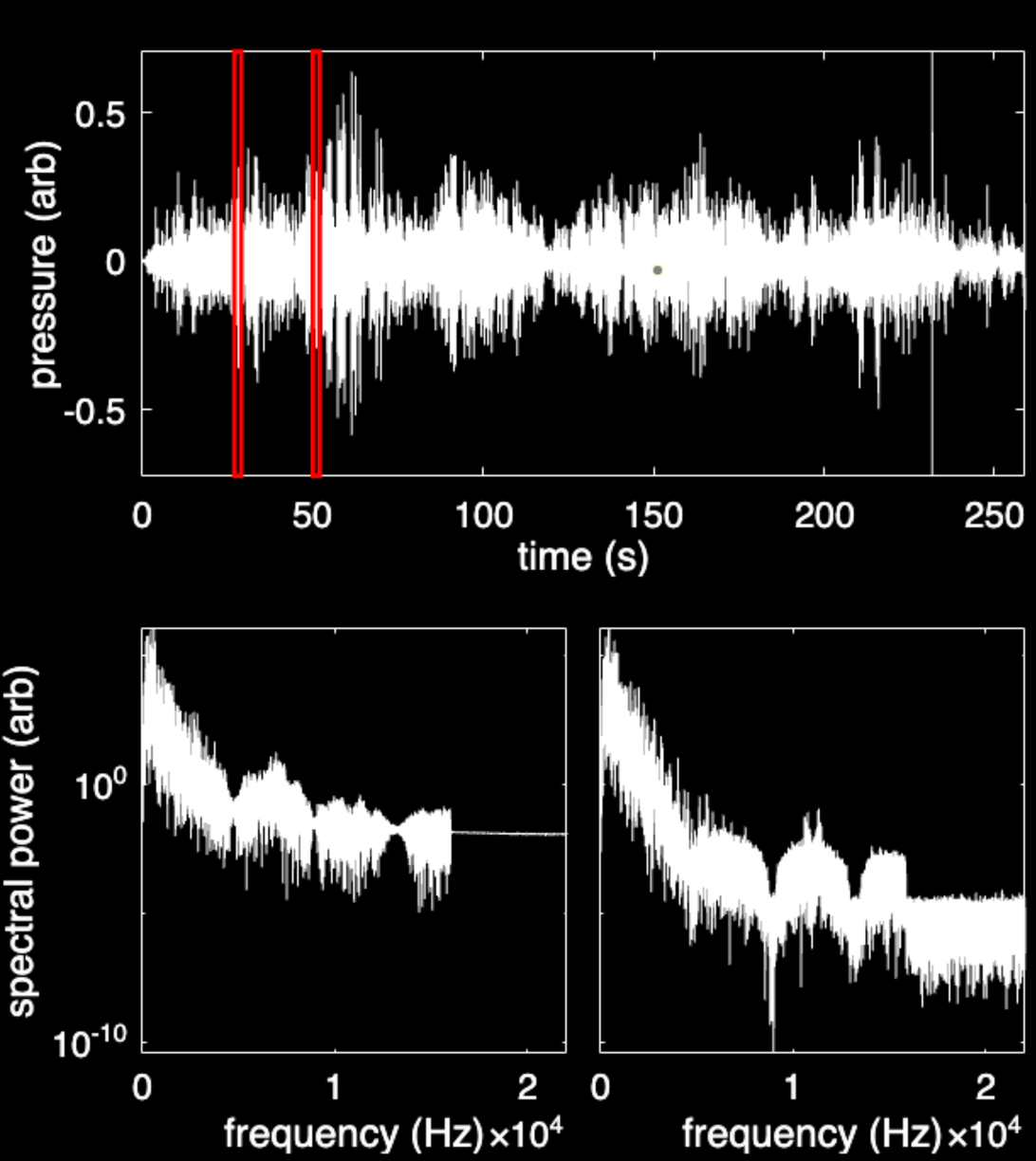
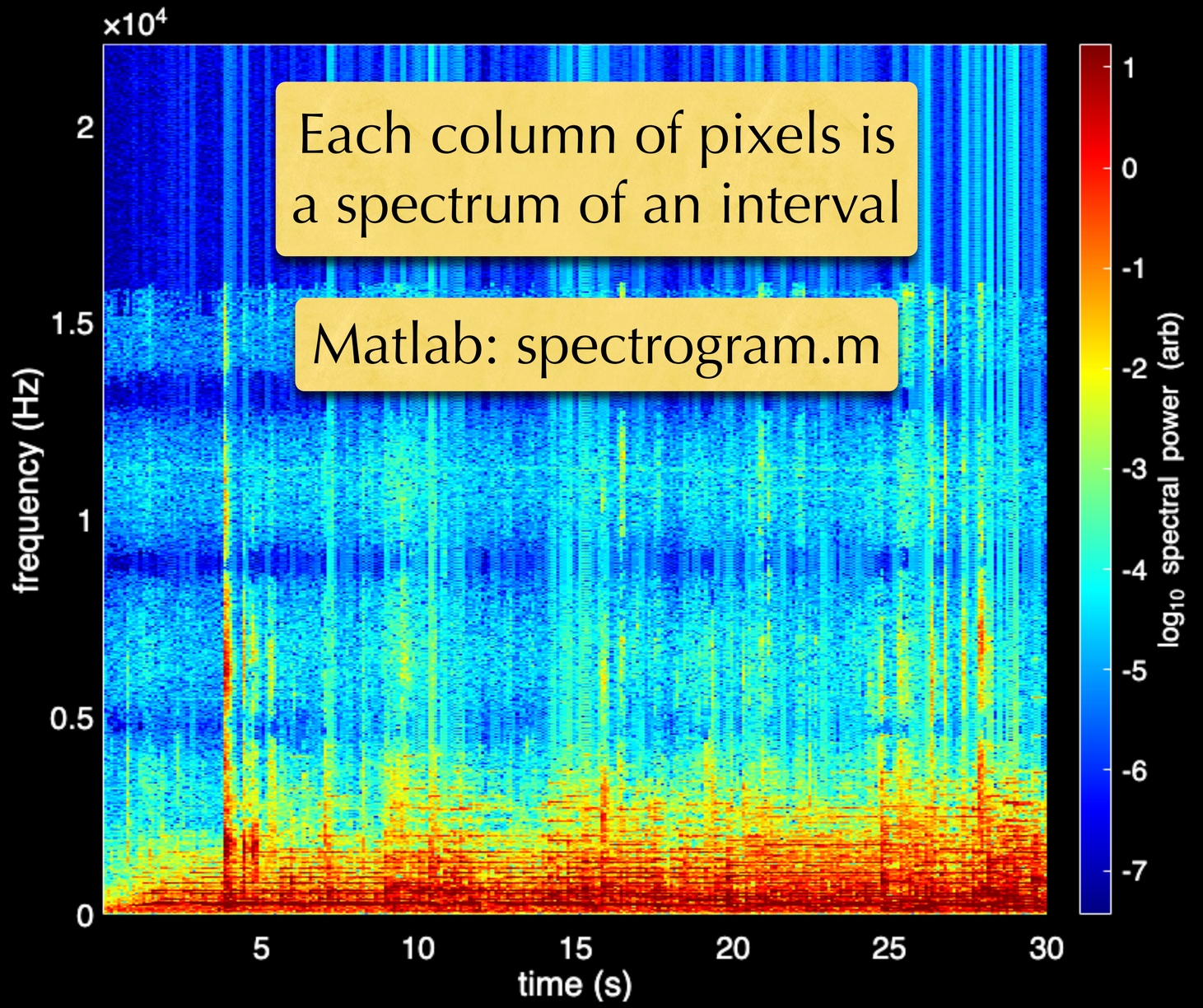
Spectrograms show frequency variation over time

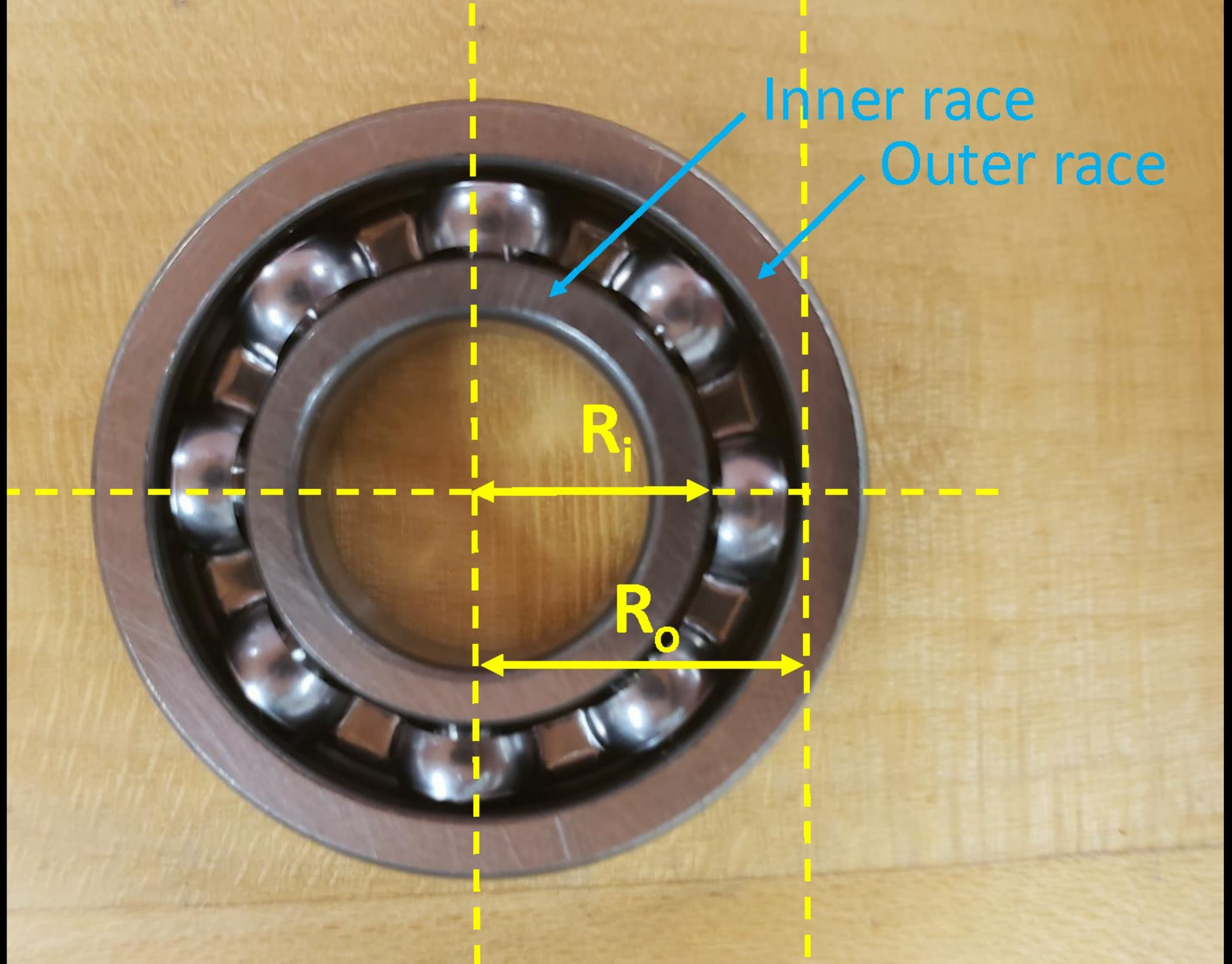


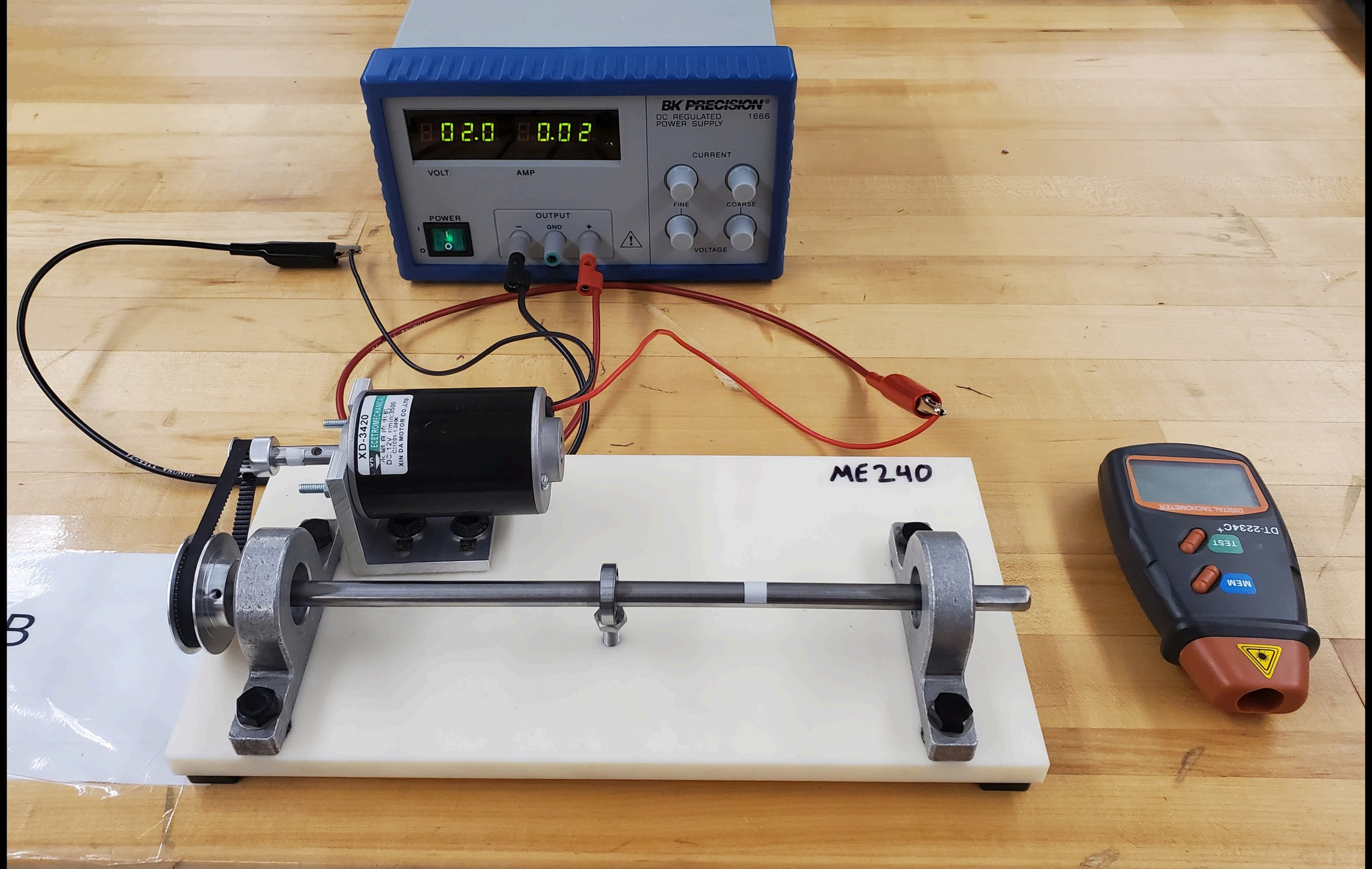


Each column of pixels is a spectrum of an interval

Matlab: spectrogram.m

GCEA
First Act
MUSICIAN
FAD044
First Act
MUSICIAN


Inner race
Outer race
R_i
R_o

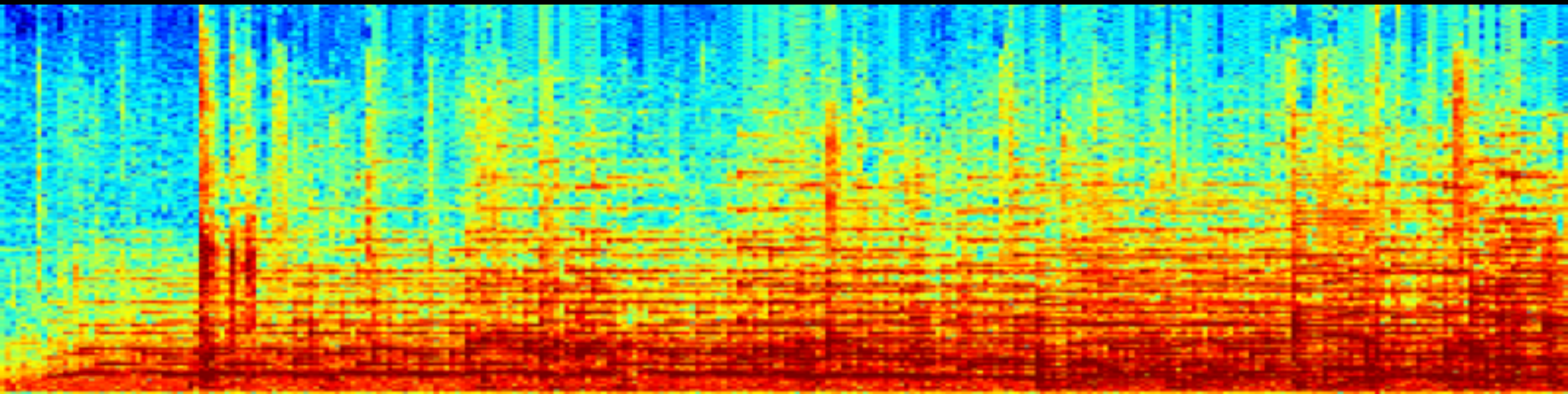

BK PRECISION
DC REGULATED POWER SUPPLY
1666
02.0
0.02
VOLT.
AMP
CURRENT
FINE
COARSE
VOLTAGE
POWER
OUTPUT
GND
XD-3420
DC 12V
XIN DA MOTOR CO.,Ltd
ME240
DIGITAL TACHOMETER
DT-2234C+
TEST
MEM

Writing a results section

Explain your measurements and how they address the question(s) you were trying to answer / problem(s) you were trying to solve

- Write a few sentences describing the implications of each plot
- Don’t repeat what’s in the captions; explain at a higher level
- Present sufficient evidence to convince other engineers that you answered the question / solved the problem — or explain why it wasn’t possible

Statistical Analysis of Experimental Data
Wheeler & Ganji Chapter 6



The power of statistics

- How can we estimate the true value of a measured quantity? How can we estimate its variability?
- How can we use existing data to predict the values of future measurements? What range should we expect?
- How can we make predictions about a large population from a few measurements?

Vocabulary of statistics

- **population** (n): the entire collection of objects or observations under consideration
  - e.g., every autumn day in Rochester history
- **sample** (n): a representative subset of the population
  - e.g., 3 October in each year 1871-2021
  - In analog-to-digital conversion, a “sample” usually means one measurement, but here, it usually means a group of measurements
- **random variable** (n): a numerically valued function defined for the population, typically dependent on too many factors to be totally predictable
  - e.g., daily high temperature
- **measurand** (n): measured value
- **statistic** (n): a numerical attribute of the sample or population

Common statistics

- **sample mean** $\bar{x} = \dfrac{x_1 + x_2 + \ldots + x_n}{n} = \sum_{i=1} n \dfrac{x_i}{n}$ — yet-to-be-specified measurand; n: size of sample
- **population mean** $\mu = \sum_{i=1}^{N} \dfrac{x_i}{N}$ — N: size of population ($N \geq n$)

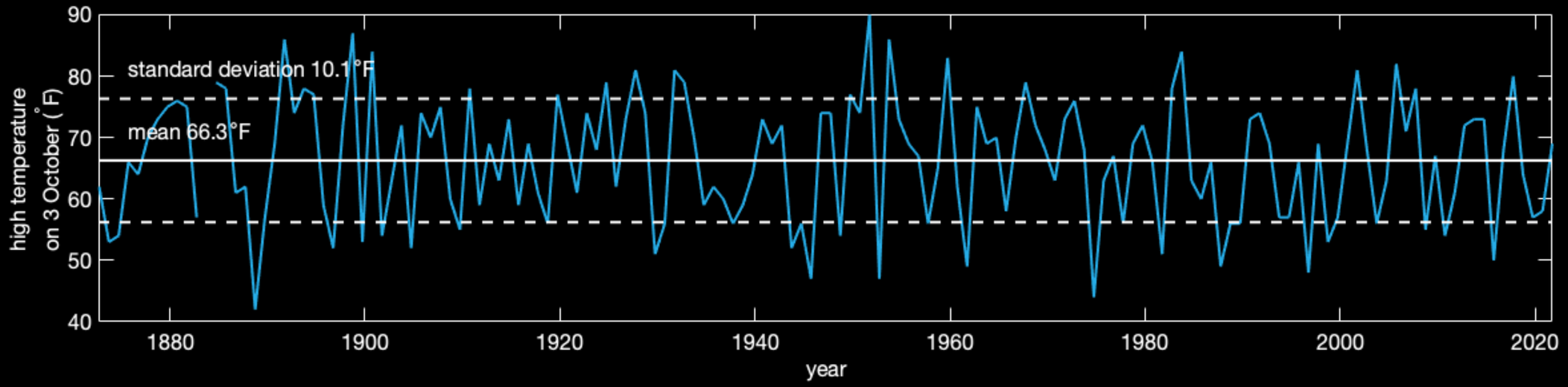
- **median**: the value at the center when measurands are sorted
- **mode**: the most common measurand value

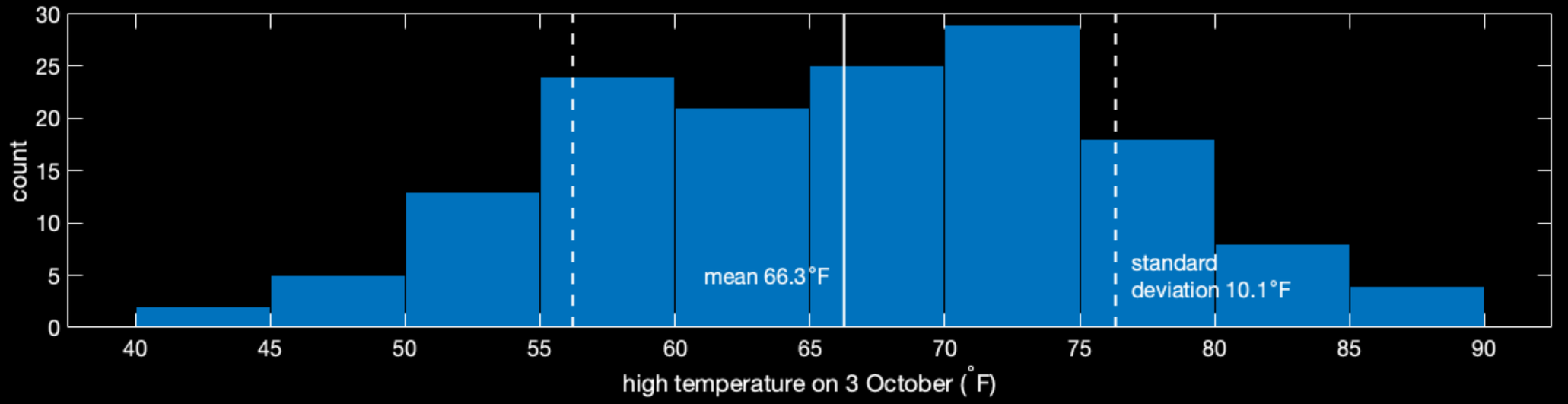
- Mean, median, and mode give simple estimates of the true value and of what to expect from future measurements.

Common statistics

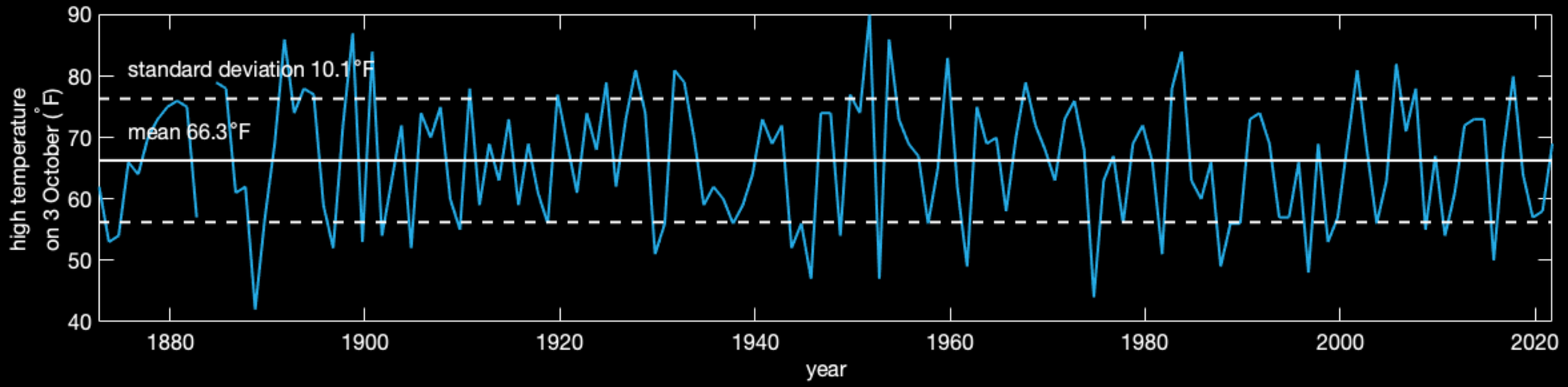
- **sample standard deviation**: $S = \sqrt{\sum_{i=1}^{n} \frac{(x_i - \bar{x})^2}{n-1}}$
- **population standard deviation**: $\sigma = \sqrt{\sum_{i=1}^{N} \frac{(x_i - \mu)^2}{N}}$
- The “sample variance” is S^2, and the “population variance” is σ^2.
- Standard deviation gives a simple estimate of variability.
- Often specify quantities as mean ± standard deviation

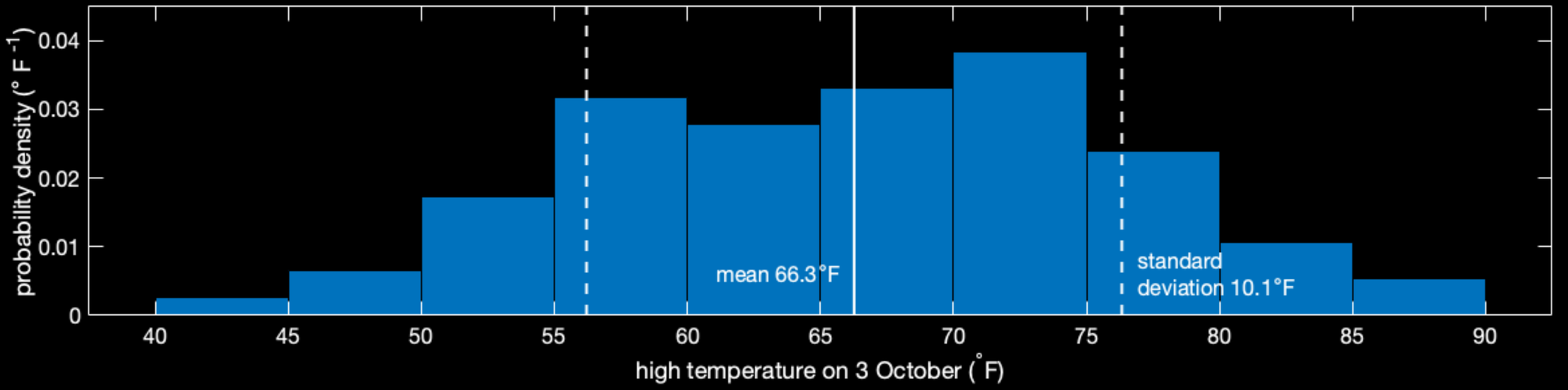
Rochester's weather on 3 October





Rochester's weather on 3 October





Style and tone

- Use journalistic language: direct, declarative, factual
  - State important ideas prominently and early
  - *Nature, Science, The Economist, NY Times, NPR, National Geographic*
- First-person is OK: “We measured…”
- Experiments are done, so use past tense (except when making predictions, etc.)
- Avoid passive voice
- Be concise (“due to the fact that” → “because”; “a variety of” → give a list)
- Avoid unnecessary jargon or complexity
- Use acronyms sparingly, defining each in words the first time it is used
- Do not use contractions

Math

- Define every math symbol in words the first time it is used (and perhaps in captions).
- Each math symbol must have exactly one meaning and be consistent (X is not x).
- Include units and be mindful of significant digits.
- Make denominators clear: $AB^{-1}C^{-2}$ or $A/(BC^2)$ or AC^2/B but not A/BC^2.
- In derivations, skip algebra but include physical concepts and approximations.
- Print short expressions inline; set off expressions that are long or will be referenced.
- Use automatic numbering of equations…
  - … but do not number equations that are not referenced.

Word location & sentence structure

- Each sentence should begin with a topic (old and familiar), then end with a point (new and important)
- New information in one sentence should become old information in the next
- And likewise for paragraphs
- Keep sentences simple and clear
- Clarity trumps perfect grammar
  - "This is the kind of pedantry up with which I shall not put!" –Winston Churchill
- Repeat technical, key words exactly and throughout; synonyms can confuse non-experts