ILLC Project Course in Information Theory

Crash course

13 January – 17 January 2014
12:00 to 14:00

Student presentations

27 January – 31 January 2014
12:00 to 14:00

Location

ILLC, room F1.15,
Science Park 107, Amsterdam

Materials

informationtheory.weebly.com

Contact

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Monday

Probability theory
Uncertainty and coding

Tuesday

The weak law of large numbers
The source coding theorem

Wednesday

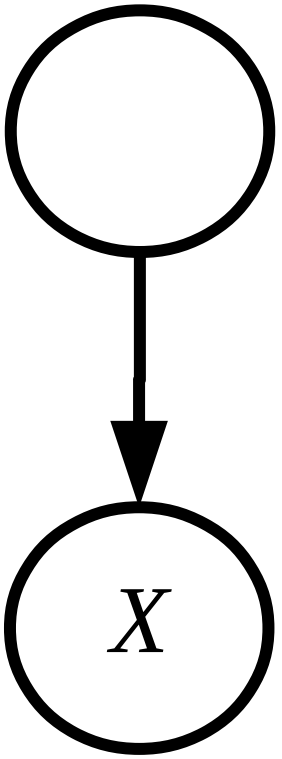
Random processes
Arithmetic coding

Thursday

Divergence
Kelly Gambling

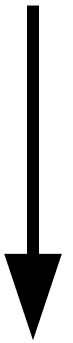
Friday

Kolmogorov Complexity
The limits of statistics



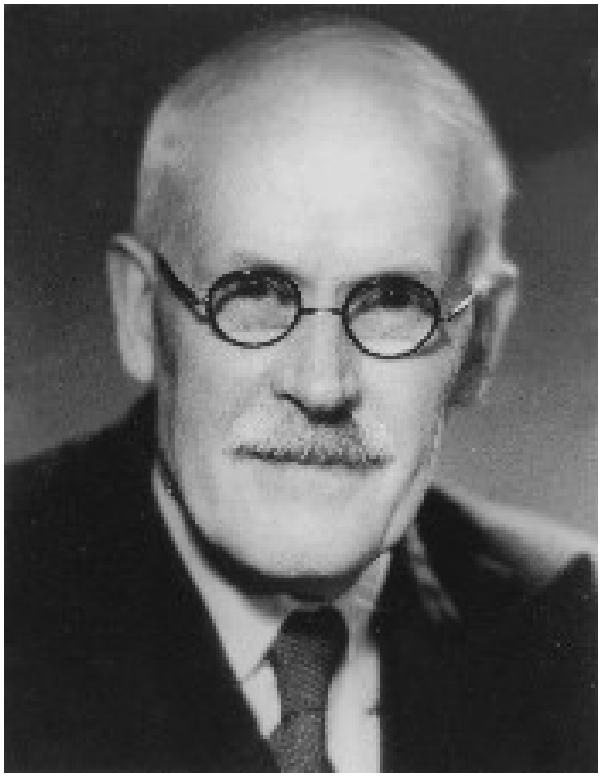
E.g.,

0.7



[0, 1, 0, 1, 1, 1, 0, 1]

Parameters are random variables.



Harold Jeffreys, Edwin Jaynes, Dennis Lindley, and others.

No they're not.

Ronald Fisher, John Maynard Keynes, Karl Popper, and others.

Laplace:

If the sun has come up k times in the past, it will come up again tomorrow with probability

$$\frac{k+1}{n+2}$$

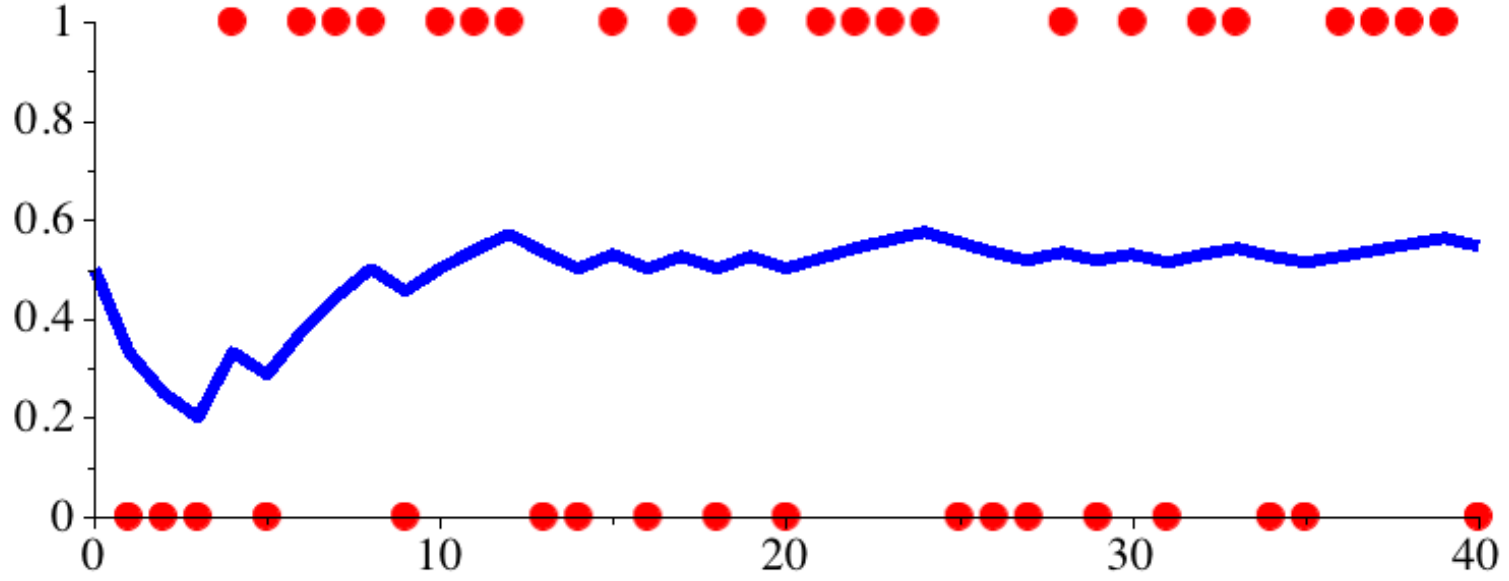
Pierre-Simon Laplace:
Essai philosophique sur les probabilités (1814)

Laplace:

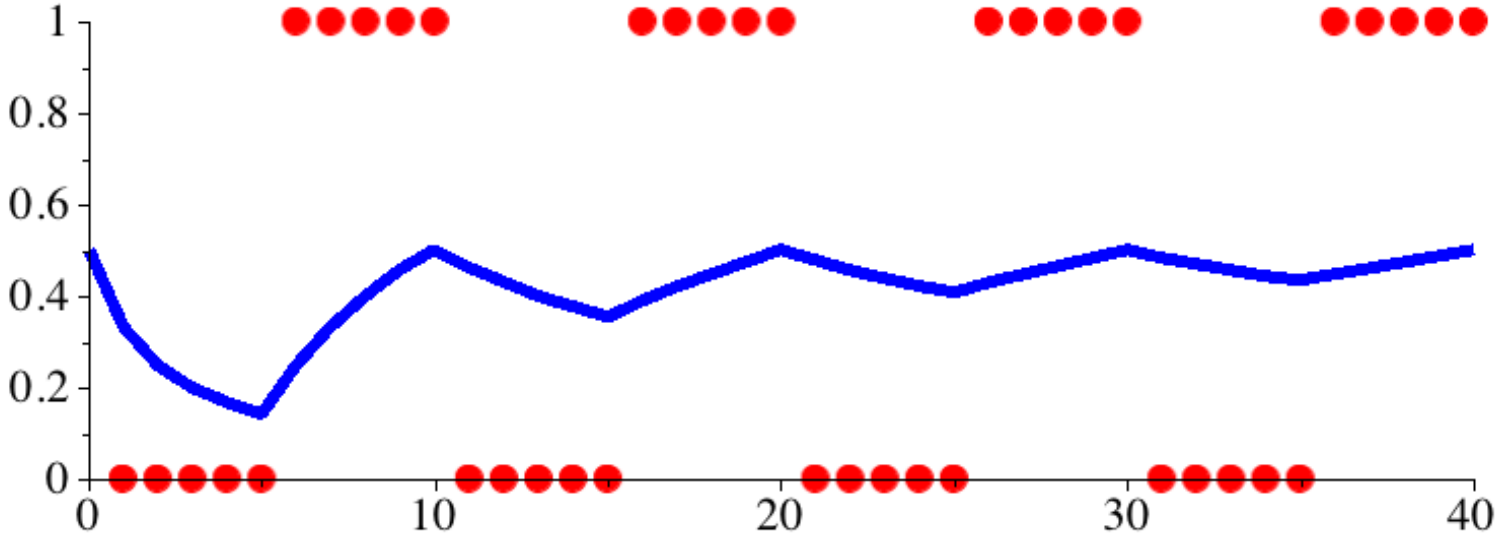
If the weather has been cold on k days out of n, then it will be cold again tomorrow with probability

$$\frac{k+1}{n+2}$$

Pierre-Simon Laplace:
Essai philosophique sur les probabilités (1814)



0, 0, 0, 1, 0, 1, 1, 1, 0, 1, 1, 1, 0, 0, 1, 0, 1, 0, 1, …



0, 0, 0, 0, 0, 1, 1, 1, 1, 1, 0, 0, 0, 0, 0, 1, 1, 1, 1, …

The German tank problem

I have a sequence of natural numbers: 1, 2, 3, …, n.

The number 17 is on my list.

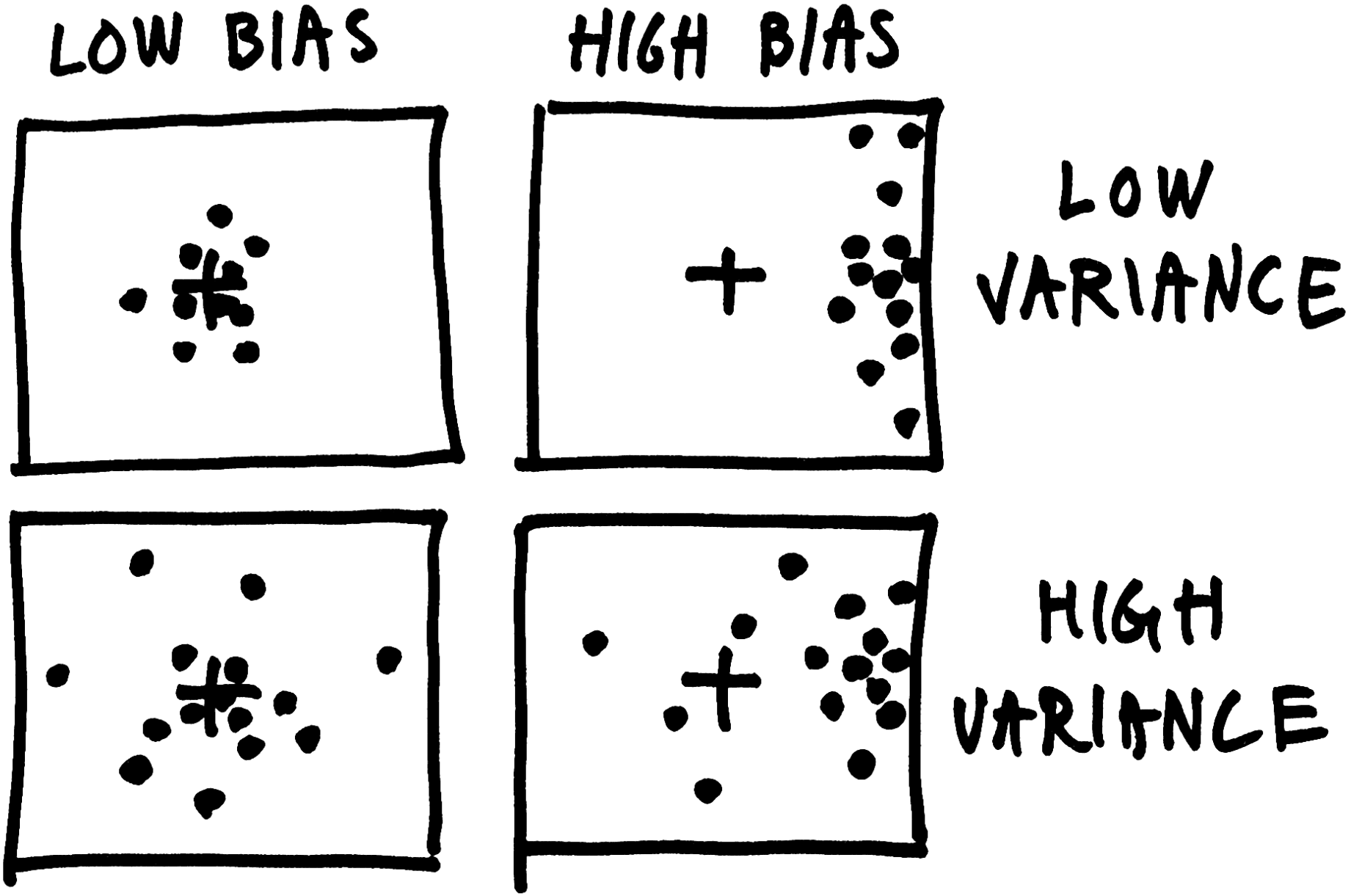
What is n?

(A simplified version of)
The James-Stein paradox

A random variable follows a normal distribution with an unknown mean.

You get the single data point $X = 17$.

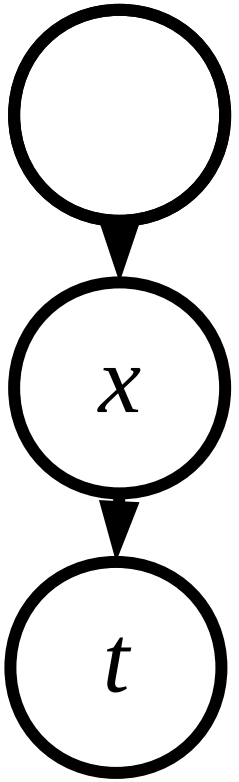
What is the mean of the distribution?


LOW BIAS
HIGH BIAS
LOW VARIANCE
HIGH VARIANCE

$$\text{Bias}^2[t;\ \ ] == (\text{E}[t] - \ \ )^2$$

$$\text{VAR}[t] == \text{E}[(t - \text{E}[t])^2]$$

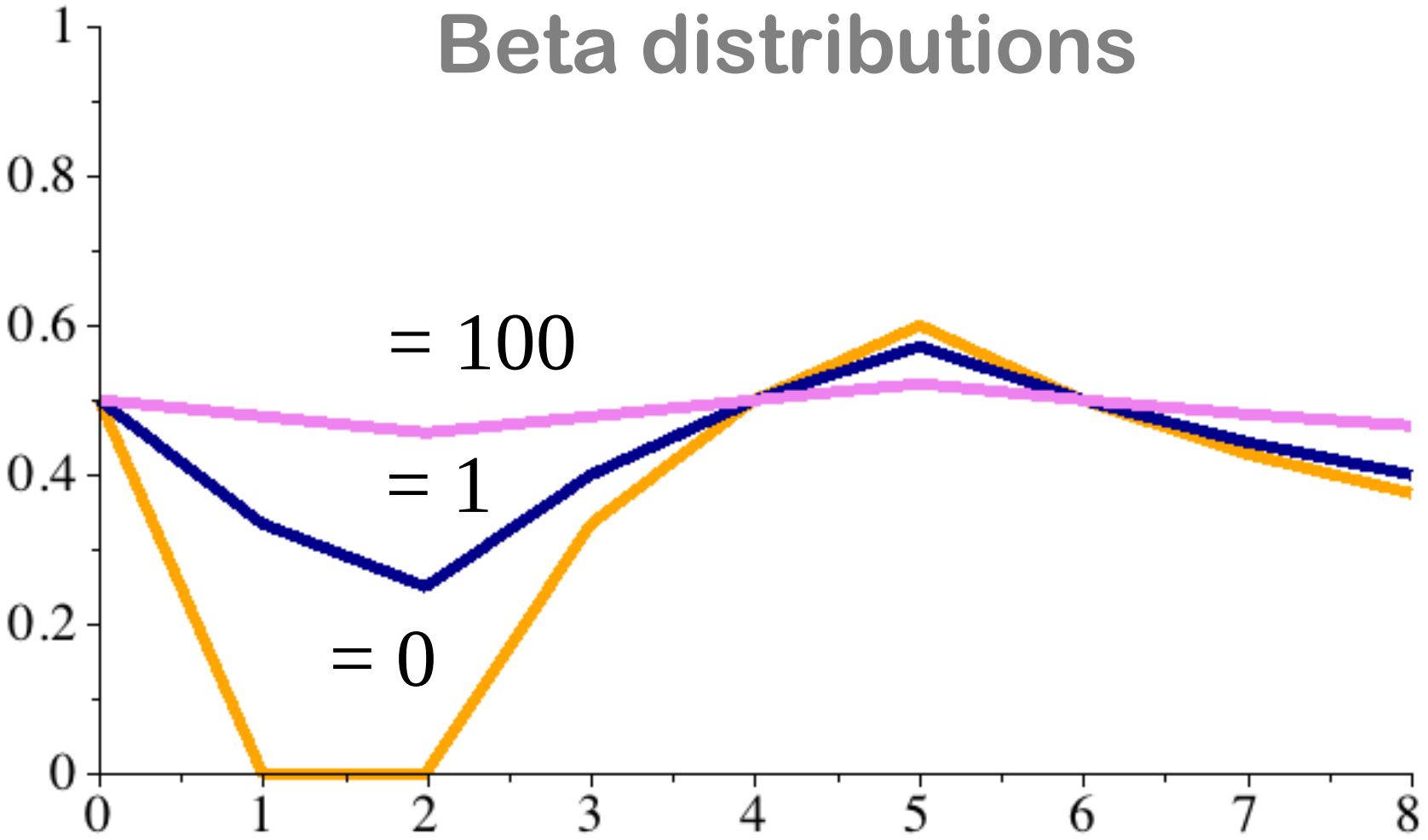
$$\text{MSE}[t;\ \ ] == \text{E}[(t - \ \ )^2]$$



The bias-variance tradeoff:

$$\text{MSE}[t;\ \ ] == \text{Bias}^2[t;\ \ ] + \text{VAR}[t]$$

Beta distributions



$$\frac{k +}{n +}$$

So what
(the hell)
is statistics?