

Do large cities spawn thunderstorms?

Bruce Marron

Can cityscapes **influence** weather?



Can cityscapes **influence** weather?
Can cityscapes **generate** weather?



Cities and thunderstorms

Can cityscapes **influence** weather?

Can cityscapes **generate** weather?

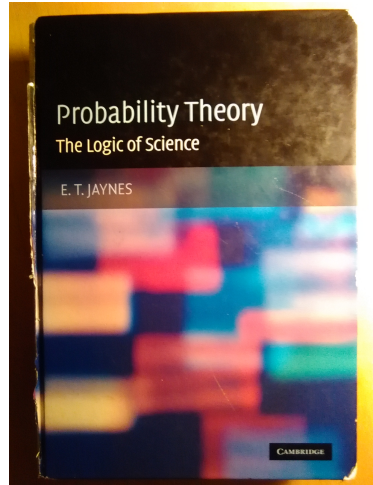
Can cityscapes **cause** thunderstorms?



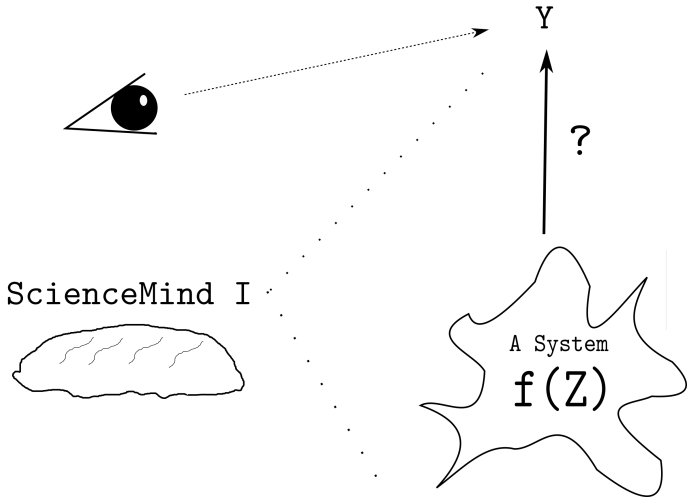
The logic of science: From Reality to models and back again

"In virtually all real problems of scientific inference...the problem facing the scientist is of the inverse type: Given the data D , what is the probability that some hypothesis H is true?"

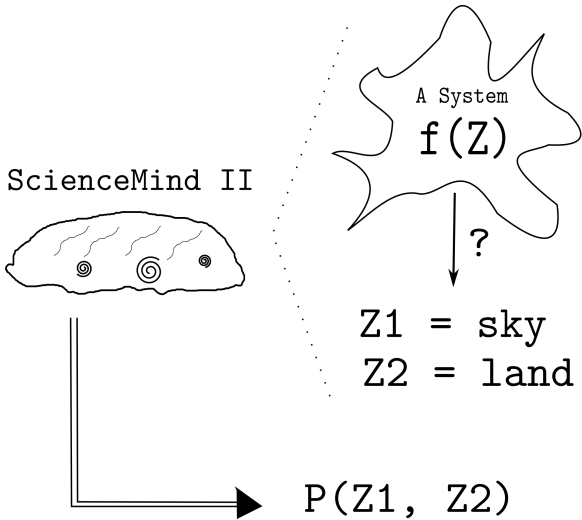
— E.T. Jaynes (2003, p.85)



$Y = \{\text{thunderstorm events}\}$



Cities and thunderstorms



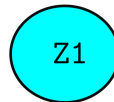
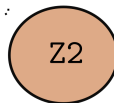
$Z1 = \{\text{atmospheric conditions}\}$

$Z2 = \{\text{land use and land cover}\}$

ScienceMind III



$H_0 :$



$$P(Z1, Z2) = P(Z2)P(Z1 | Z2)$$

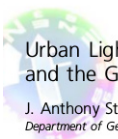
Climatic Change (2012) 113:481–498
DOI 10.1007/s10584-011-0324-1

Urban-induced thunderstorm modification in the Southeast United States

Walker S. Ashley · Mace L. Bentley · J. Anthony Stallins

... "substantive evidence of urban effects
on thunderstorm frequency and severity" ...

Geography Compass 2/3 (2008): 620–639, 10.1111/j.1749-8198.2008.00110.x



Urban Lightning: Current Research, Methods, and the Geographical Perspective

J. Anthony Stallins* and L. Shea Rose
Department of Geography, Florida State University

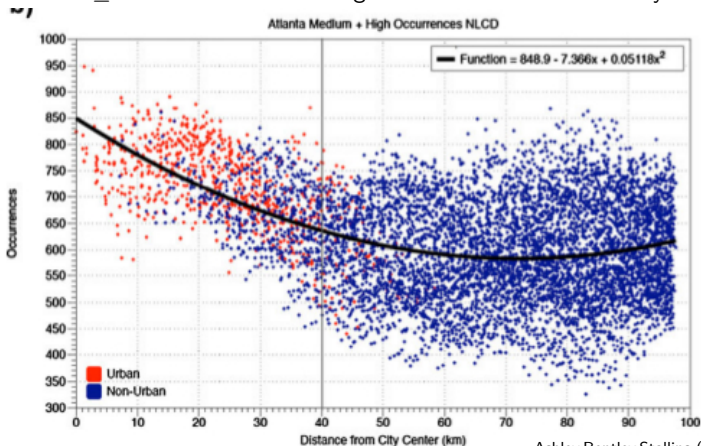
"Urban lightning research is still in the
descriptive, pattern-identifying stage,
with some inroads into mechanism."

Cities and thunderstorms

$$P(Z1, Z2) = P(Z2)P(Z1|PZ2)$$

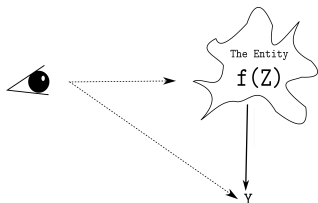
(dBZ = decibels radar reflectivity \Rightarrow Z1; NLCD code \Rightarrow Z2)

Occurrences ≥ 40 dBZ for each 2-km grid cell vs. distance from city center



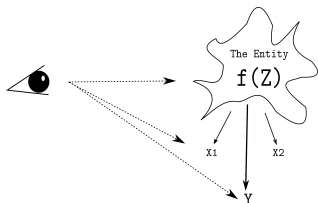
Ashley, Bentley, Stallins (2012)

Scientific Inference: From reality to models and back again



- We observe an entity in Nature that we suspect generates non-random patterns of information
- Our states of knowledge about the causal relationships and processes, $f(\cdot)$, that are operating as well as about the inputs, Z , are limited; often severely
- We assume that some observable outcome, Y , is causally related to the entity as $f(Z) \implies \{Y\}$

Scientific inference: From reality to models and back again



- We assume that some observable and measurable attributes (data), $\{X1, X2\}$ are logically related to the entity's internal processes as, $\{X1, X2\}|f(Z)$
- Lacking full knowledge of the entity's processes, we use a probability model and consider $X1, X2, Y$ as random variables with a joint probability distribution function
- Lacking complete datasets, we accept sampled datasets
- We make inductive inferences from the sampled datasets back to $f(Z)$ by assuming sampling distributions, evaluating our prior knowledge, and using the (weaker) syllogisms of plausible reasoning coupled with probability theory