

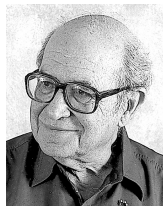
Review of Jacob Cohen's The Earth is Round ($p < .05$)

Will Quinlan

October 7, 2024

An Introduction to Cohen's Paper

- ▶ Scientific advancement has been hindered by null hypothesis testing (NHST)
- ▶ Researchers often misinterpret p-values resulting in mistakes in what can be concluded
- ▶ Critique the "ritualization" of NHST
- ▶ Focus on real-world relevance



- ▶ Argues for better scientific practices

On Null Hypothesis Significance Testing

- ▶ Definition: Method of statistical inference by which an experimental factor is tested against a hypothesis of no effect or no relationship based on a given observation
 - ▶ In other words: Null vs Alternate
- ▶ Decisions are determined by the significance threshold
- ▶ NHST dominates science
- ▶ If one presents a significant result of a known fact like "The Earth is round," nothing is gained

A Ritualization of Reasoning ($p < .05$)

- ▶ Cohen argues against the rigid reliance on p-values
- ▶ Standard p-value of .05
- ▶ Dichotomous reject-accept decision
- ▶ "The primary aim of a scientific experiment is not to precipitate decisions, but to make an appropriate adjustment in the degree to which one . . . believes the hypothesis . . . being tested" - Bill Rozeboom (1960)

Misinterpretation of p-values

- ▶ Consider a Scenario
 - ▶ A scientist believes a certain disease does not exist
 - ▶ $H_0: P = 0$
 - ▶ He draws a random sample of 30 cases and finds that 1 person has the disease
 - ▶ $P_S = 1/30 = .033$
- ▶ Does H_0 need testing with a chi-square? How about a Fischer exact test??
- ▶ Cohen among many other scientists knows that academia would complain unless this result had a p-value attached to it

So, what is wrong?

- ▶ We think NHST tells us, "Given these data, what is the probability that H_0 is true?"
- ▶ What NHST actually tells us, "Given that H_0 is true, what is the probability of these (or more extreme) data?" before asking your question
- ▶ Academics have railed against NHST for many years before Cohen's paper
 - ▶ "a potent but sterile intellectual rake who leaves in his merry path a long train of ravished maidens but no viable scientific offspring" - Meehl in 1967
 - ▶ Joseph Berkson attacked NHST in 1938
 - ▶ Lancelot Hogben's book-length critique appeared in 1957

The Permanent Illusion

- ▶ Many believe the level of significance at which H_0 is rejected is the probability that it is correct
- ▶ Syllogistic Reasoning according to Aristotle
 - ▶ If the null hypothesis is correct, then this datum (D) can not occur
 - ▶ D has, however, occurred
 - ▶ Therefore, the null hypothesis is false.
- ▶ This is an example of a modus tollens syllogism, denying the antecedent by denying the consequent
 - ▶ If P, then Q
 - ▶ Not Q (Q is false)
 - ▶ Therefore, not P (P is false)

Probabilistic Syllogism

- ▶ What if the syllogism is probabilistic?
 - ▶ If the null hypothesis is correct, then these data are highly unlikely
 - ▶ These data have occurred
 - ▶ Therefore, the null hypothesis is highly unlikely
- ▶ This makes the syllogism formally invalid
 - ▶ If P, then Q is likely
 - ▶ Not Q
 - ▶ Therefore, P is unlikely

Examples of Syllogisms

- ▶ Some Examples:
 - ▶ If a person is a Martian, then he is not a member of Congress
 - ▶ This person is a member of Congress
 - ▶ Therefore, he is not a Martian
- ▶ How about this one?
 - ▶ If a person is an American, then he is not a member of Congress
 - ▶ This person is a member of Congress
 - ▶ Therefore, he is not an American

Examples of Syllogisms cont.

- ▶ What about now?
 - ▶ If a person is an American, then he is probably not a member of Congress
 - ▶ This person is a member of Congress
 - ▶ Therefore, he is probably not an American
- ▶ This last one?
 - ▶ If H_0 is true, then this result (statistical significance) would probably not occur
 - ▶ This result has occurred
 - ▶ Therefore, H_0 is probably not true

$$P(D|H_0) \neq P(H_0|D)$$

► Schizophrenic

Result	Normal	Schiz	Total
Negative Test (Normal)	949	1	950
Positive Test (Schiz)	30	20	50
Total	979	21	1,000

The Illusion of Proof

- ▶ Virtual participants: put questions into the Q/A window in WebEx
- ▶ In-person participants: walk to a microphone and wait to be called upon before asking your question
- ▶ Lunch on your own (Student Union food court right next door)x
- ▶ Coffee/cookies available during the poster session (11:30–13:30)
- ▶ Training workshops:
 - ▶ Each workshop has its own (webex meeting) room
 - ▶ Virtual participants please mute yourself in each session.

The Illusion of Proof

- ▶ Virtual participants: put questions into the Q/A window in WebEx
- ▶ In-person participants: walk to a microphone and wait to be called upon before asking your question
- ▶ Lunch on your own (Student Union food court right next door)x
- ▶ Coffee/cookies available during the poster session (11:30–13:30)
- ▶ Training workshops:
 - ▶ Each workshop has its own (webex meeting) room
 - ▶ Virtual participants please mute yourself in each session.

The Illusion of Proof

- ▶ Virtual participants: put questions into the Q/A window in WebEx
- ▶ In-person participants: walk to a microphone and wait to be called upon before asking your question
- ▶ Lunch on your own (Student Union food court right next door)x
- ▶ Coffee/cookies available during the poster session (11:30–13:30)
- ▶ Training workshops:
 - ▶ Each workshop has its own (webex meeting) room
 - ▶ Virtual participants please mute yourself in each session.

The Illusion of Proof

- ▶ Virtual participants: put questions into the Q/A window in WebEx
- ▶ In-person participants: walk to a microphone and wait to be called upon before asking your question
- ▶ Lunch on your own (Student Union food court right next door)x
- ▶ Coffee/cookies available during the poster session (11:30–13:30)
- ▶ Training workshops:
 - ▶ Each workshop has its own (webex meeting) room
 - ▶ Virtual participants please mute yourself in each session.

The Illusion of Proof

- ▶ Virtual participants: put questions into the Q/A window in WebEx
- ▶ In-person participants: walk to a microphone and wait to be called upon before asking your question
- ▶ Lunch on your own (Student Union food court right next door)x
- ▶ Coffee/cookies available during the poster session (11:30–13:30)
- ▶ Training workshops:
 - ▶ Each workshop has its own (webex meeting) room
 - ▶ Virtual participants please mute yourself in each session.

The Illusion of Proof

- ▶ Virtual participants: put questions into the Q/A window in WebEx
- ▶ In-person participants: walk to a microphone and wait to be called upon before asking your question
- ▶ Lunch on your own (Student Union food court right next door)x
- ▶ Coffee/cookies available during the poster session (11:30–13:30)
- ▶ Training workshops:
 - ▶ Each workshop has its own (webex meeting) room
 - ▶ Virtual participants please mute yourself in each session.

The Illusion of Proof

- ▶ Virtual participants: put questions into the Q/A window in WebEx
- ▶ In-person participants: walk to a microphone and wait to be called upon before asking your question
- ▶ Lunch on your own (Student Union food court right next door)x
- ▶ Coffee/cookies available during the poster session (11:30–13:30)
- ▶ Training workshops:
 - ▶ Each workshop has its own (webex meeting) room
 - ▶ Virtual participants please mute yourself in each session.

The Illusion of Proof

- ▶ Virtual participants: put questions into the Q/A window in WebEx
- ▶ In-person participants: walk to a microphone and wait to be called upon before asking your question
- ▶ Lunch on your own (Student Union food court right next door)x
- ▶ Coffee/cookies available during the poster session (11:30–13:30)
- ▶ Training workshops:
 - ▶ Each workshop has its own (webex meeting) room
 - ▶ Virtual participants please mute yourself in each session.

The Illusion of Proof

- ▶ Virtual participants: put questions into the Q/A window in WebEx
- ▶ In-person participants: walk to a microphone and wait to be called upon before asking your question
- ▶ Lunch on your own (Student Union food court right next door)x
- ▶ Coffee/cookies available during the poster session (11:30–13:30)
- ▶ Training workshops:
 - ▶ Each workshop has its own (webex meeting) room
 - ▶ Virtual participants please mute yourself in each session.

The Illusion of Proof

- ▶ Virtual participants: put questions into the Q/A window in WebEx
- ▶ In-person participants: walk to a microphone and wait to be called upon before asking your question
- ▶ Lunch on your own (Student Union food court right next door)x
- ▶ Coffee/cookies available during the poster session (11:30–13:30)
- ▶ Training workshops:
 - ▶ Each workshop has its own (webex meeting) room
 - ▶ Virtual participants please mute yourself in each session.

The Illusion of Proof

- ▶ Virtual participants: put questions into the Q/A window in WebEx
- ▶ In-person participants: walk to a microphone and wait to be called upon before asking your question
- ▶ Lunch on your own (Student Union food court right next door)x
- ▶ Coffee/cookies available during the poster session (11:30–13:30)
- ▶ Training workshops:
 - ▶ Each workshop has its own (webex meeting) room
 - ▶ Virtual participants please mute yourself in each session.

The Illusion of Proof

- ▶ Virtual participants: put questions into the Q/A window in WebEx
- ▶ In-person participants: walk to a microphone and wait to be called upon before asking your question
- ▶ Lunch on your own (Student Union food court right next door)x
- ▶ Coffee/cookies available during the poster session (11:30–13:30)
- ▶ Training workshops:
 - ▶ Each workshop has its own (webex meeting) room
 - ▶ Virtual participants please mute yourself in each session.