Causal and inferential relations between substantive theory, statistical hypothesis, and observational data:

![Diagram showing the relationship between substantive theory, statistical hypothesis, and observations]

- **Corroborated problem:** Appraising theory by facts (Metatheorist’s and logician’s concern)
- **Inferential statistics problem:** Estimating parameters from sample (Statistician’s concern)

Based on Fig. 2 in Meehl (1990) Appraising and amending theories: The strategy of Lakatosian defense and two principles that warrant using it. *Psychological Inquiry, 1*, 108–141, 173–180.

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Four figures of the implicative syllogism:

<table>
<thead>
<tr>
<th>I</th>
<th>II</th>
<th>III</th>
<th>IV</th>
</tr>
</thead>
<tbody>
<tr>
<td>( p \supset q )</td>
<td>( p \supset q )</td>
<td>( p \supset q )</td>
<td>( p \supset q )</td>
</tr>
<tr>
<td>( p )</td>
<td>( \neg p )</td>
<td>( q )</td>
<td>( \neg q )</td>
</tr>
<tr>
<td>( \therefore q )</td>
<td>( \therefore \neg q )</td>
<td>( \therefore p )</td>
<td>( \therefore \neg p )</td>
</tr>
</tbody>
</table>

- **Modus ponens**
  - (valid)
- **Denying the antecedent**
  - (invalid)
- **Affirming the consequent**
  - (invalid)
- **Modus tollens**
  - (valid)
Corroboration formula for appraising theories:

\[ T \cdot [T_{aux} \cdot C_p \cdot A_I \cdot C_n] \rightarrow (O_1 \supset O_2) \]

where:

- **T**: The theory of interest
- **T_{aux}**: Auxiliary theories relied on in the particular experiment
- **C_p**: Ceteris paribus clause
- **A_I**: Instrumental auxiliaries
- **C_n**: The particulars stated
- **O_1**: An observation
- **O_2**: Another observation

Selected references:


Meehl, P. E. (1997). The problem is epistemology, not statistics: Replace significance tests by confidence intervals and quantify accuracy of risky numerical predictions. In L. L. Harlow, S. A. Mulaik, & J.H. Steiger (Eds.), *What if there were no significance tests?* (pp. 393-425). Mahwah, NJ: Erlbaum.*

* These reprints are available at [http://meehl.umn.edu](http://meehl.umn.edu)
Written on blackboard:

Diagram:

```
Diagram:

TOSS

NPP
Confirm H*
Strong

NHST
Refute H₀
Weak

(NPP = Numerical Point Prediction)

Bayes' formula:

\[
p(h_i/e) = \frac{P_i p(e/h_i)}{P_i p(e/h_i) + \sum_j P_j p(e/h_j)}
\]
```

Abstract for Dr. Meehl’s talk to CCS 1/30/03:

Critique of Null Hypothesis Significance Testing

Null hypothesis significance testing (NHST) is usually not a good method for appraising psychological theories in the “soft” fields, because H₀ is quasi-always false; thus, whether one refutes H₀ depends more on the power function than on whether the theory is true or false. In the advanced sciences (e.g., physics) where theories are strong enough to make numerical point predictions, refuting a statistical hypothesis H* speaks against the theory; hence high statistical power puts a theory at high risk. We should be careful not to conflate the probability of a statistical hypothesis H with the probability of a substantive causal theory T which is almost never equivalent to H. Psychologists should try to invent theories strong enough to make point or narrow interval predictions rather than the weak prediction that the difference between two groups is on one side of zero.
Outline of PEM’s talk if needed:

Weak/Strong --- Power
T ≠ H
Meehl’s Sc theory: syllogism
Crud factor, 2 pots
Confirmation formula: Schachter
Box score 7:3
Agronomy, pharmacology
Meta-analysis
Cliometrics

(afterthought: should have mentioned “magic” of .05 level)