Automated Discovery of Test Statistics

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Test Statistics

$H_0: \bar{X}_1 > \bar{X}_2 = 0$

t = \frac{\bar{X}_1 - \bar{X}_2}{SE}$

p-value
We are the FIRST to automate the discovery of test statistics

This complex feat previously only done by humans
We Satisfy 4 Humie Criteria

(B) The result is equal to or better than a result that was accepted as a new scientific result at the time when it was published in a peer-reviewed scientific journal. ➡️ FIRST TIME

(D) The result is publishable in its own right as a new scientific result independent of the fact that the result was mechanically created. ➡️ 100s of NEW STATISTICS

(E) The result is equal to or better than the most recent human-created solution to a long-standing problem for which there has been a succession of increasingly better human-created solutions. ➡️ GENERATED BETTER SOLUTIONS

(G) The result solves a problem of indisputable difficulty in its field. ➡️ TEST STATISTIC DISCOVERY IS TEDIOUS
Why Human Competitive?

• New statistics are **needed more than ever**, with data exploding in quantity, volume, and complexity.

• The field of mathematical statistics is **shrinking**.

• This task is done by hand on pencil and paper and is thus extremely **laborious**.

• Despite the ubiquity of computers, **no automated method exists**… until now!

• Automation will greatly **accelerate** the discovery of new test statistics.
Why Human Competitive?

General Multi-Objective Fitness Function

- Power
- Type I Error
- Scale Invariant
- Simple
Why the Best Humie entry?

- **First time in history** a machine has invented new test statistics in a fully **automated** manner.

- Several important **challenges** met and overcome:
  - Engine for generating mathematical candidates
  - General fitness function that allows for innovation.
  - System for tinkering with test statistics as a human would.

- Most ML/AI solutions develop a **model** of data with **clear** objective criteria.

- **Test statistics are much harder**... system must know what makes a good statistic.
Why the Best Humie Entry?

Impact

New Test Statistic

Biology, Chemistry, Engineering, Physics, Medicine
Acknowledgments

• AutoStats Team
  – Randy Olson, Yong Chen, Moshe Sipper

• NIH grants AI11679, LM012601, LM010098

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