





Radboud University Nijmegen

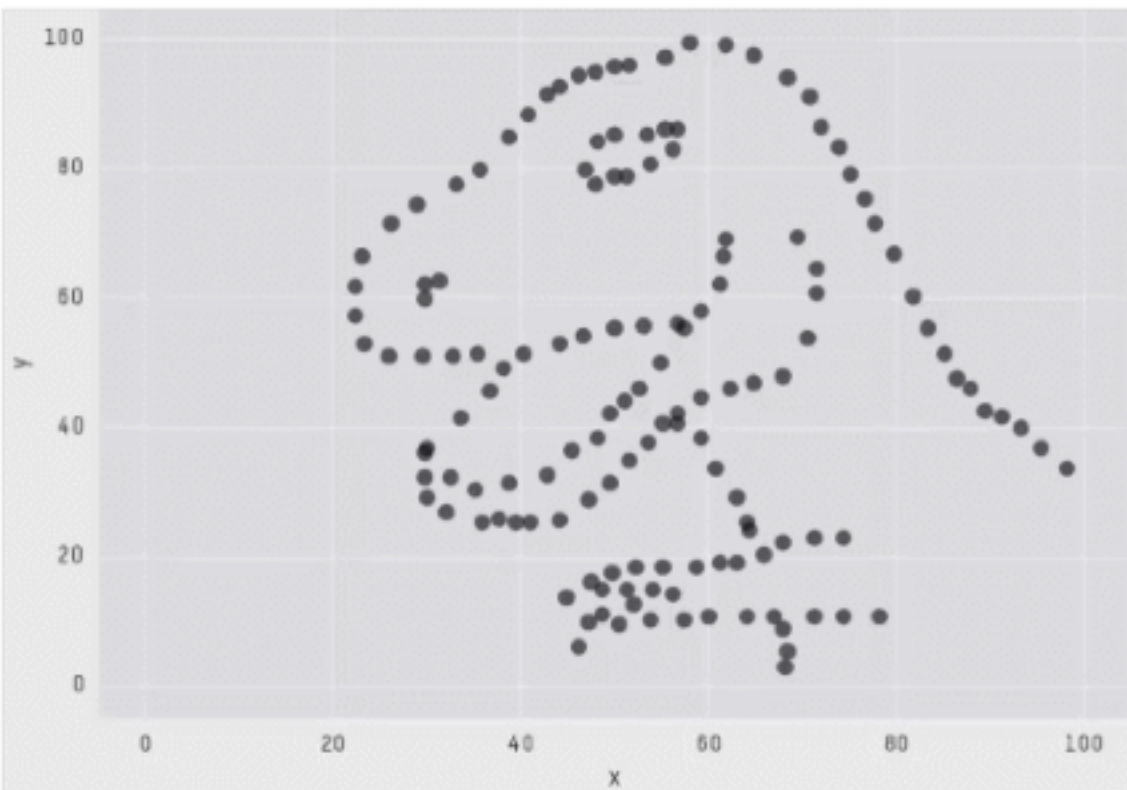




Behavioral Science Institute



**“Analyse then Aggregate!”**  
**same stats - different patterns**



X Mean: 54.2659224

Y Mean: 47.8313999

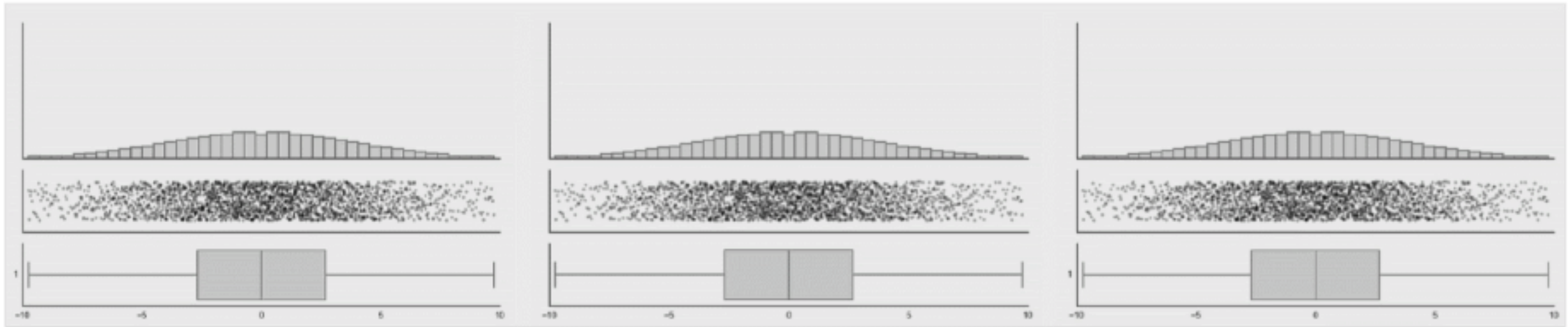
X SD : 16.7649829

Y SD : 26.9342120

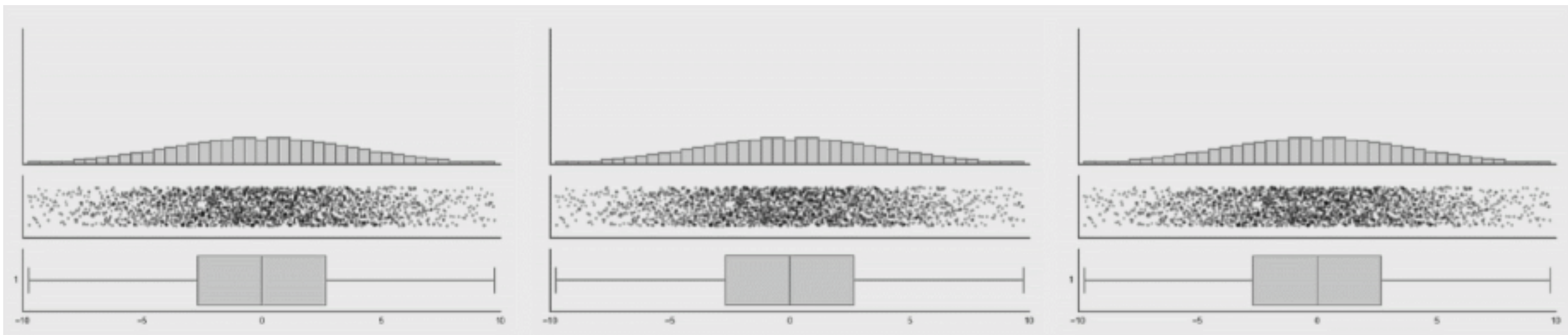
Corr. : -0.0642526

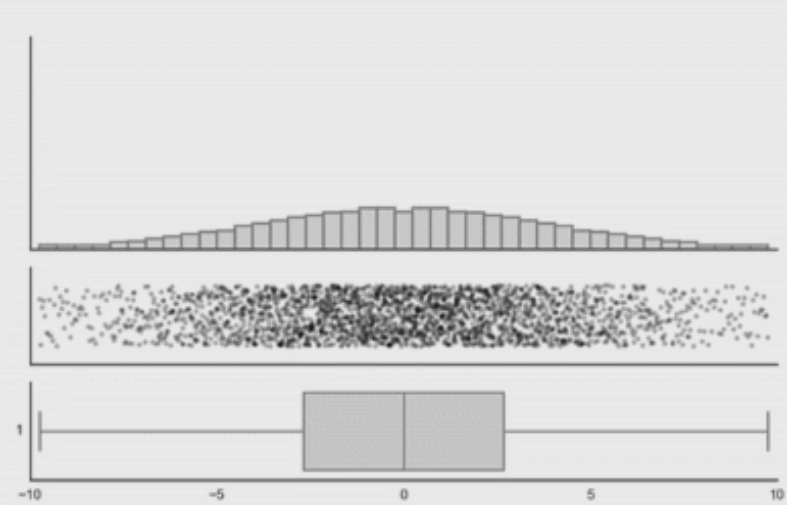
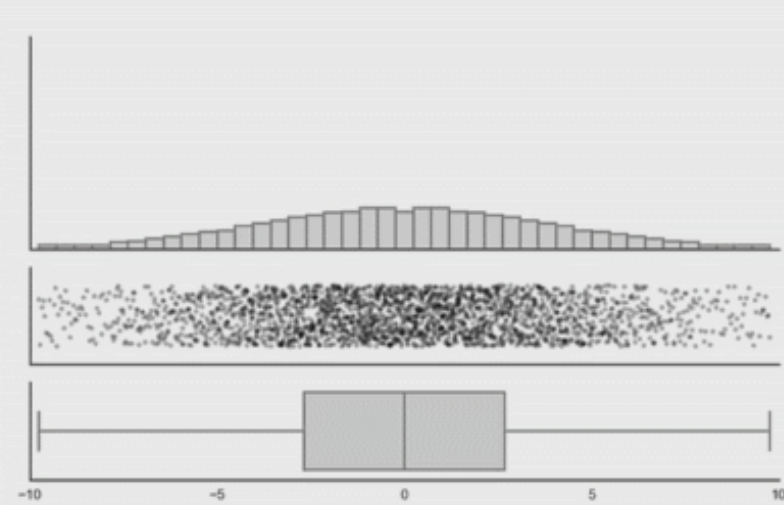
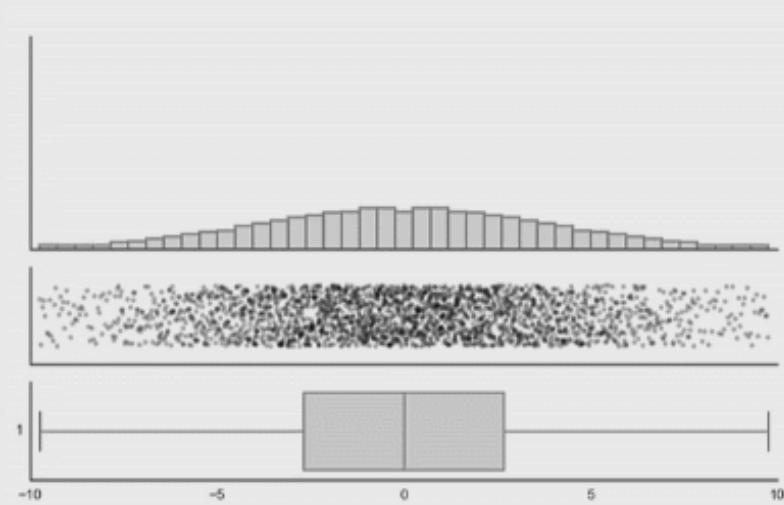
<https://www.autodesk.com/publications/samestat>



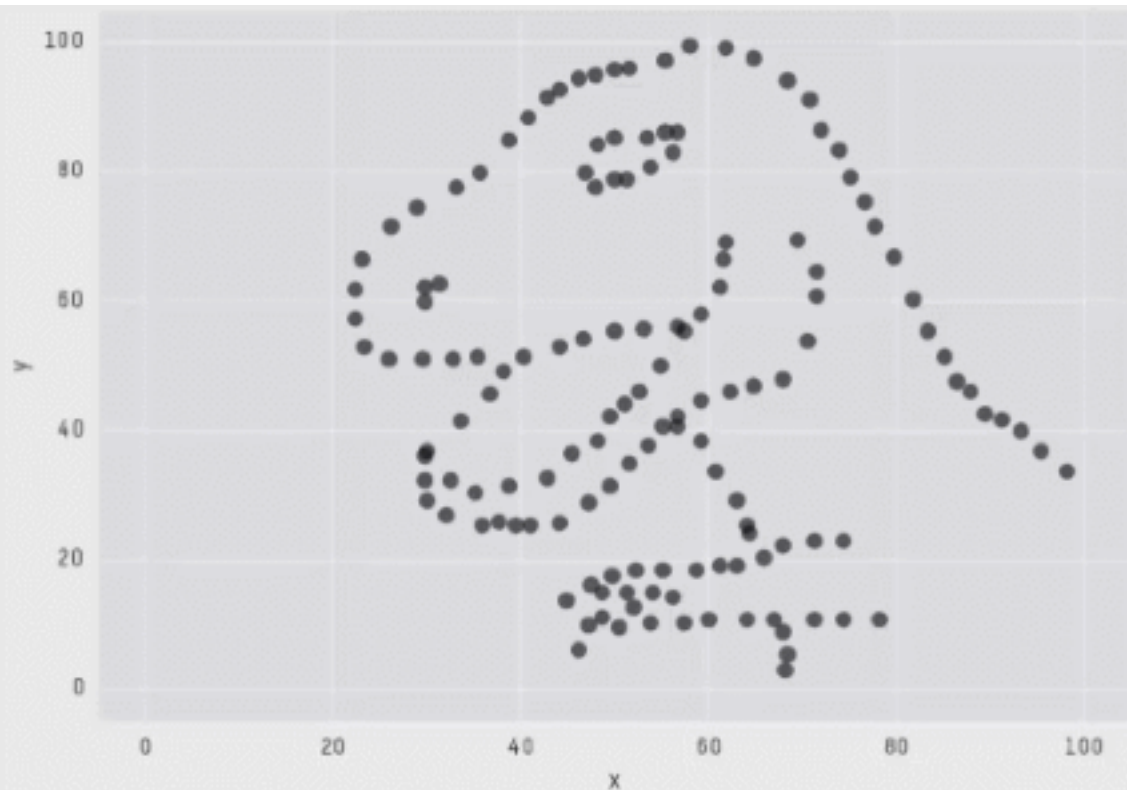


Matejka, J., & Fitzmaurice, G. (2017, May). Same Stats, Different Graphs: Generating Datasets with Varied Appearance and Identical Statistics through Simulated Annealing. In *Proceedings of the 2017 CHI Conference on Human Factors in Computing Systems*









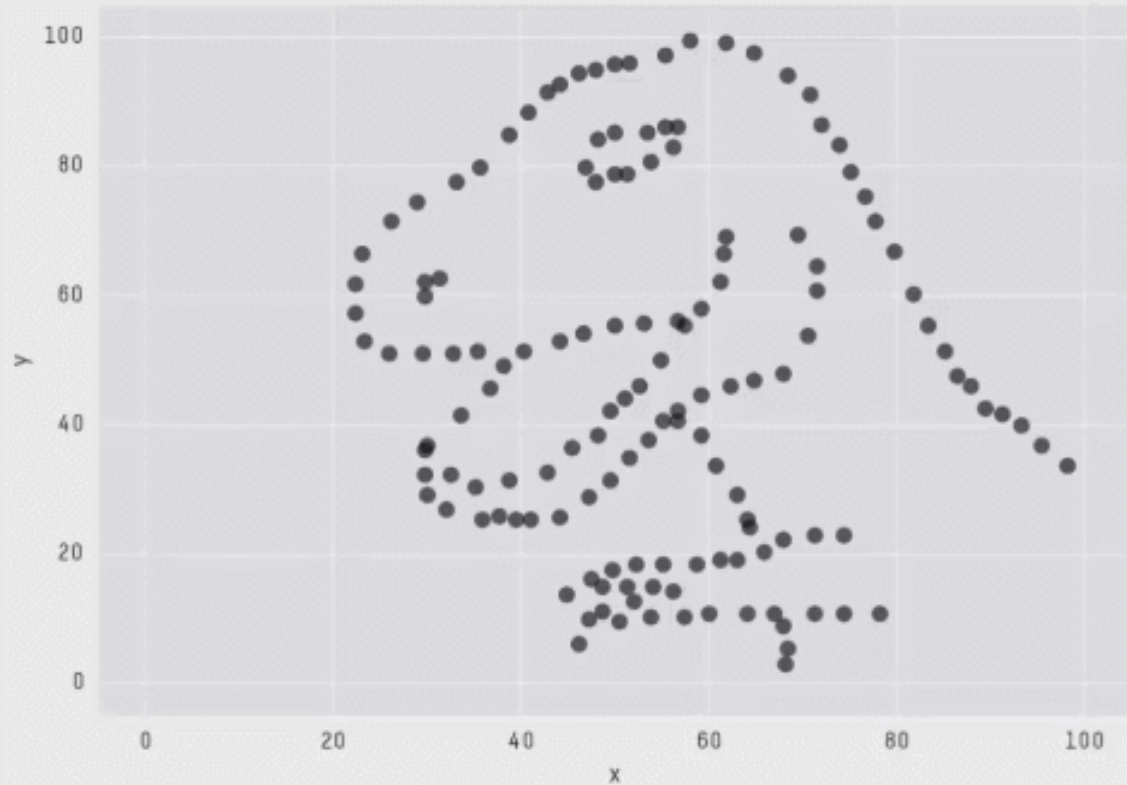
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Fundamental problems for main-stream Social & Life Sciences



Press, W. H. (2014). Reproducibility Now at Risk? Paper presented at the Symposium on Evidence in the Natural Sciences New York, NY.

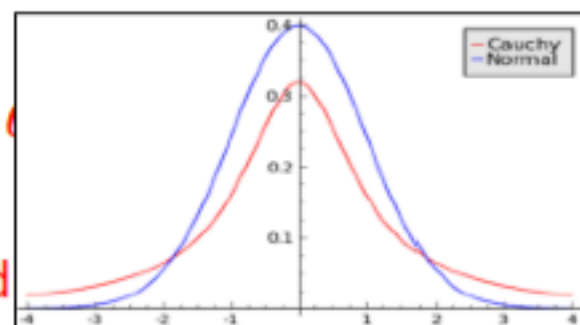
<https://www.simonsfoundation.org/event/symposium-on-evidence-in-the-natural-sciences/>

Most of this talk is about human frailties, but some deeper foundational issues are also worth mentioning.

$y = f(x)$  “Discover”  $f$  by controlling  $x$ , measuring  $y$

$y = f(x; \theta)$  But  $f$  also depends on unknown parameters  $\theta$  must be determined from the data.

$y = f(x; \theta, R)$  Of course the result also depends on random variables  $R$  in an arbitrarily nonlinear way – which we often linearize to “additive noise”.



$\langle y \rangle \approx \langle f(x; \theta, R) \rangle$  So we are now measuring relations between expectations – if they exist (cf. Cauchy distribution).

$\langle y(S) \rangle \approx \langle f(x; \theta, R, S) \rangle$  Systematic errors are additional long-term random variables that don't average away.

$$P_{Y(S)}(y(S)) = \langle f(y, x; \theta, R, S) \rangle$$

Finally,  $y$  may itself be intrinsically probabilistic, as in quantum measurement or classical chaos (e.g., turbulence).