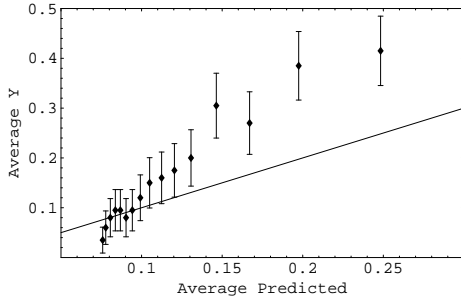
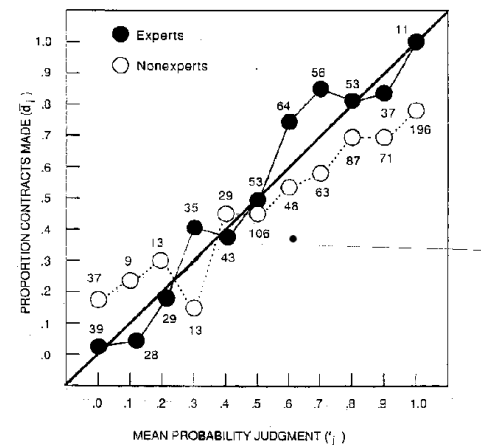


Talk on Calibration by Dean Foster



- Works well for big data since only costs a few more degrees of freedom.
- “Variable selection in data mining: Building a predictive model for bankruptcy,” Foster and Stine, *JASA*, 2004.

- “Precision and Accuracy of Judgmental Estimation,” Foster and Yaniv, *Journal of Behavioral Decision Making* (1997).
- “Graininess of Judgment Under Uncertainty: An Accuracy - informativeness Tradeoff,” Foster and Yaniv *Journal of Experimental Psychology: General*, 1995.
- We looked at confidence intervals.
- Humans actually are responding to the social utility function.



“Suppose in a long (conceptually infinite) sequence of weather forecasts, we look at all those days for which the forecast probability of precipitation was, say, close to some given value p and then determine the long run proportion f of such days on which the forecast event (rain) in fact occurred. If $f = p$ the forecaster may be termed well calibrated.”

Phillip Dawid

- “Asymptotic Calibration,” Foster and Vohra, *Biometrika*, 1998.
- “A proof of Calibration via Blackwell’s Approachability Theorem,” Foster *GEB* 1999.
- “Regret in the On-line Decision Problem,” Foster and Vohra, *GEB* 1999. (See also *AI-STATS* 2012 and *MOR* 2014.)
- “Deterministic Calibration and Nash Equilibrium” Foster and Kakade, *COLT*, 2004.

Convergence to Correlated Equilibrium

- “Calibrated Learning and Correlated Equilibrium,” Foster and Vohra *Games and Economic Behavior*, 1997.
 - Playing calibrated forecasts will lead to correlated equilibria
 - Playing no-internal regret actions will converge to correlated equilibria
- Extended in “A general class of adaptive strategies,” by Hart and Mas-Colell 2001.

“If there is intelligent life on other planets, in a majority of them, they would have discovered correlated equilibrium before Nash equilibrium.”

Roger Myerson

Convergence to Nash Equilibrium



- Yes: You can learn NE from a grain of truth. (Kalai and Lehrer, 1993).
- No: Not exactly. (Nachbar 1997, Foster and Young 2001)
- Yes: Via exhaustive search—i.e. very slowly. (Foster and Young, 2006)
- No: Hart and Mas-Colell 2011.
- Yes: Via public, deterministic calibration which is very slow (Foster and Kakade, 2008, Foster and Hart, 2016)
- For all but the smallest games, it is basically no.

Recommendations

- Use isotonic link functions to calibrate regressions
- Use fixed point based calibration for time series
- Use no-internal regret for game theory
- Let go of Nash equilibrium