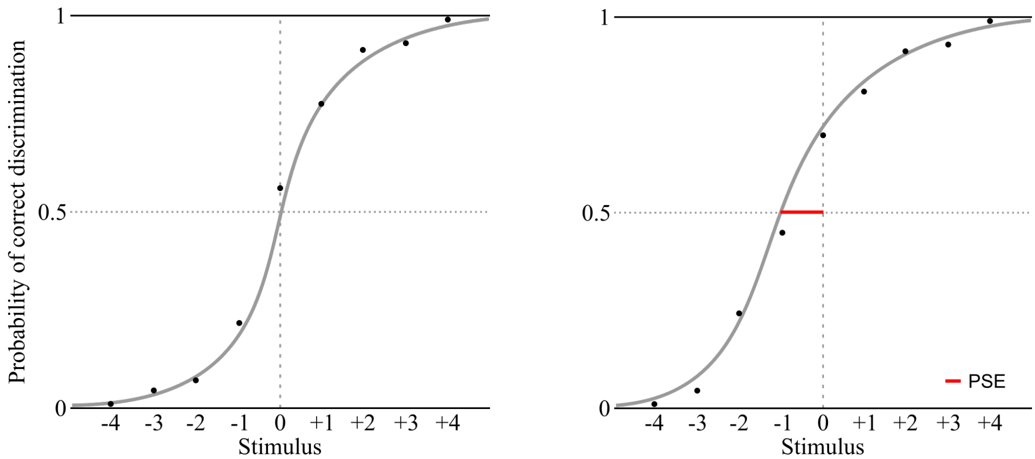
B. Online appendix: psychometric function

The Psychometric Function (PF) is the central analysis tool of psychophysics – *the scientific discipline that explores the connection between physical stimuli and subjectiveresponses* (Klein, 2001). Typical tasks in psychophysics are *detection* task – used to identify the thresholds of human perception, for instance using sound or visual stimuli – and *discrimination* task – used to investigate the way in which two stimuli are compared, for instance when comparing the weight of two objects, or, in economics, the value of two goods Lunn and Somerville (2015).

The PF is an estimated curve relating the varying stimulus (in abscissa) to a measure of the subject response (in ordinate). An example can make things clear. Consider an experiment in which a single subject is asked to state which of two object of unknown weight, i and j, is the heaviest, with no possibility to state indifference. The weight difference between i and j is varied across trials, such that for a single subject judgments are recorded for each level of the weight difference. This is called a two-alternative forced choice (2AFC) design. If we code a correct response as 1 and an incorrect one as 0, we can build a psychometric function that relates the stimulus (the weight difference, centered on zero) to the probability of a correct response. We expect a subject to make few mistakes when the weight difference is large, and to be more and more confused as the weight difference approaches zero. Given this structure, the function has a sigmoid shape, and can be fitted using logit or probit maximum likelihood estimation (Figure B.7, left).



(a) From data to PF

(b) Point of Subjective Equality

Figure B.7: Psychometric Function and related measures

The interest of estimating a PF is to derive individual measures of the subject response. Of particular interest is the *point of subjective equality* (PSE) (Figure B.7, right). The PSE is the level of the stimulus for which a subject estimated PF crosses the 50% probability line. This is the difference in weight between the two objects for which the subject feels they have the same weight. For an unbiased subject, this corresponds to an objective difference of zero; but subjects might have biases. For instance, subjects might judge the bigger object as the heaviest, even when the objective weight of the two objects is the same. Figure B.7, left shows an unbiased subject (PSE = 0), while on the right the subject is biased: she perceives weights as being equal when the objectively measured ones are not.

If the PF is estimated using logit, then the probability of a correct discrimination is given by

$$\ln\left[\frac{Pr(y_i = \textit{correct})}{1 - Pr(y_i = \textit{correct}}\right] = \beta + \gamma \times \textit{stimulus}.$$

The PSE can hence be measured as the point in which the estimated PF crosses the 50% probability line, i.e. when $Pr(y_i = \textit{correct}) = 0.5$. By substituting and solving for *stimulus*, it can be found that

$$PSE = \frac{\beta}{\gamma},$$

i.e., the PSE depends both on the estimated constant *and* slope of the PF.

PFs can be fitted to individual subjects, as in this example, or, using the appropriate estimation techniques, to groups of several subjects and conditioning on other observable characteristics of the subject and the task. Detailed guides as to how to correctly estimate PFs are given, among others, by Wichmann and Hill (2001); Klein (2001). For an application to economics, see Lunn and Somerville (2015).