

## Three power laws in a racetrack betting market and simple voting model

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We study the ordering process of horses in racetrack betting markets in Japan Racing Association. Horses are ranked according to the win bet fractions. As the vote progresses, the horses move on the win bet fraction axis. The phase separation between the winning horses and the losing ones occurs.

We see a scale invariant relation between the cumulative distribution function of the winning horse  $x_1$  and that of the losing horse  $x_0$ .  $x_1 \propto x_0^\alpha$  holds in the small win bet fraction region. We find two other power laws which characterize the betting process. Both the fluctuation of the win bet fractions and the degree of the phase separation depends on the number of vote  $t$  as  $t^{-\gamma}$ . We also see the emergence of the efficiency of the market as we approach the start of the race.

We introduce a simple voting model and discuss these behaviors. There are three types of betters, independent, herding and fundamental. Based on the power laws in the voting process we estimate the component ratio. The ratio of the independent voters, whose votes are not affected by others' choices, is about a quarter. The remaining voters are herding whose decisions are determined by others' choice. Contrary to exchange or stock markets, the appearance of the fundamental voters, who utilize the discrepancy between the present win bet fraction and the true win probability, occurs only in the late stage of the betting process.