ODDS ADJUSTMENTS BY AMERICAN HORSE-RACE BETTORS

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In horse-race betting, the odds on the various horses in any race are a functioning of the proportion of the total money that is bet on each and hence are socially determined. On the other hand, the objective probability for winners from any group of horses is given a posteriori by the percentage of winners. Thus the odds express (reciprocally) a psychological probability while the percentage of winners at any odds group measures the true probability; any consistent discrepancy between the two may cast light not only on the specific topics of horse-race betting and gambling but on the more general field of the psychology of probabilities.

Becknell noted with her idealogies of probability that in many situations not the probability but the judgment of the probability is the critical variable.[1] Goodfellow[2] and Fernberger[3] have experimentally shown that such ideologies may influence ESP results. More recently Preston and Baratta have demonstrated a systematized undervaluation of large probabilities and an overvaluation of small, with the indifference-point falling near the geometric mean of their series in an experimental situation and have discussed certain parallels in adaptation-levels.[4] This study may help to determine the universality of their effect by submitting it to a complex, non-laboratory test.

Betting on horse-races offers *per se* specific but non-trivial psychological problems. Undoubtedly the most common form of gambling, it has assumed such proportions as to be a major socio-economic problem and to constitute large portions of the revenue of condoning states.[5] Gambling has been analyzed for knowledge of psychological and economic processes,[6] and pathological gambling has been clinically studied.[7] The emotionally rich background of fate and money makes this a promising field for observing variety in personality.

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[1] E. A. Becknell, Probability: A function of ideology, this JOURNAL, 53, 1940, 604-609.

[2] L. D. Goodfellow, A psychological interpretation of the results of the Zenith radio experiments in telepathy, *J. Exper. Psychol.,* 23, 1938, 601-632.

[3] S. W. Fernberger, 'Extra-sensory perceptions' or instructions?, *ibid.,* 22, 1938, 602-607.

[4] M. G. Preston and P. Baratta, An experimental study of the auction-value of an uncertain outcome, this JOURNAL, 61, 1948, 183-193.

[5] See W. Steigleman, *Horseracing,* 1947, 27. In 1946 over $1,700,000,000 were bet in the pari-mutuel machines. Of this amount, nineteen states retained $80,000,000. Several times this amount is bet with illegal bookies.

[6] E. M. Riddle, Aggressive behavior in a small social group, *Arch. Psychol.,* 12, 1925 (no 78), 1-196; J. von Neuman and O. Morgenstern, *Theory of Games and Economic Behavior,* 1944, 1-641.

[7] O. Fenichel, *The Psychoanalytic Theory of Neurosis,* 1945, 372 f.

In any investigation of gambling, insight and direction may be gained from such clinical and descriptive works as *The Gambler* by Dostoevski. The briefest perusal reveals that not all forms of gambling are psychologically equivalent. Games of chance may be placed in a hierarchy of skills. The conative predictions of the fall of dice contrast with the cognitive factors involved in skillful poker-playing. Many people bet on horse-races because of an—be it as it may—uncritical, egotistical rationality as to their ability to select winners through handicapping procedures. In so far as a cognitive function is involved in any situation one may question the psychological applicability of the term 'gambling.' The most tentative list of ideologies involved in horse-race betting would, however, touch upon fundamental philosophies of probability and mathematical expectation, and few of the systems of betting neglect to give some consideration to the judgment of the odds of the selections; some employ them exclusively, as, for example, when a system permits only the favorites at odds exceeding a fixed value to be selected.

The pari-mutuel system employed at the race-tracks requires explanation. All the money bet on prospective winners of a race is pooled and a percentage (ranging from 7 to 15) known as the 'take' is deducted as revenue for the track and for state or local government. The holders of the winning tickets receive the remainder. The odds on any horse shown on the totalizator at the track are computed by subtracting the sum bet on the horse from the pool after take and dividing by the sum bet on the horse. Thus for each dollar the amount actually returned is the odds *plus* one, the one being the dollar bet. To preserve the relationship of the mathematical expectation as being the amount wagered divided by the odds, where the odds are the reciprocal of the probability, this value of the track-odds-plus-one will be referred to as *the odds* throughout this paper.

When betting is begun on a race, experts' opinions of the true odds on each horse are shown and the totalizator keeps the bettors informed, at about 90-second intervals, until the race starts, as to the correct odds calculated approximately from the actual money bet. No pennies, and in some states, no nickels are returned on a two-dollar bet, the stray change going into another track or state fund. In the parlance of the race-course this is termed 'breakage' to the nickel or dime.[8]

In this study, the winners and number of horses at each odds were tallied for 519 races of the 1947 spring meets of Churchill Downs, Belmont and Hialeah and for selected odds-groups (one to eleven and sixteen to twenty-one) for an additional 867 races of all tracks for the first eight days of August 1947.[9] All data were proportionately weighted

[8] For a more complete description of the pari-mutuel system see Steigleman, *op. cit.*, 17-27.

[9] *Daily Racing Form Chart Book*, 53, 1947, nos. 1, 3, 4, and 11.

as to have arisen from 1386 races, that for odds groups 11-16 and above 21 being multiplied by the ratio 1386/519.

If the psychological odds equaled the a posteriori given by the reciprocal of the percentage winners, the product of the number of winners and their odds would equal the number of entries at each odds-group after correction of the odds had been made for loss due to breakage and take. If the product exceeds the number of entries, the psychological odds were too large: if the product is less than the number of entries, the odds were too small. Breakage, causing a larger percentage loss at the small odds than at the large, was adjusted-for by assuming continuous odds rather than odds falling into five-cent intervals. The average take, proportionate at all the odds, was computed from the data as being 13%.[10]

The arithmetic mean of the geometric means of the odds posted at the track for each of a sample of 42 races was obtained as 10.5; the theoretical minimum for the geometric mean of the track odds in a single race with nine horses—the average-size field in this study—is approximately 7.8, and both values are, of course, larger if track-odds-plus-one are used.

Results. The results are best shown by Fig. 1. Here it may be seen that the curve formed by the product of the number of winners times the actual odds falls below the curve for the number of entries throughout the series. When, however, the odds are corrected for breakage and take, the product consistently exceeds the number of entries at the short odds and is less than the entries at the longer odds. The point of equality by linear interpolation is 6.1, or at a probability value of 0.16. This indifference-point in track odds (to which the bettors react) is 5.1, with a reciprocal of 0.20. Thus *below* 0.16 or 0.20 the translated psychological probabilities are too large; *above,* too small. The reciprocal of the average geometric mean of the track odds of a sample of races is 0.095, and the maximum for any one nine-horse race is 0.13.

Discussion. All the factors, rational and irrational, which enter into the determination of the odds on horses tend to operate in such a manner as properly to measure the horses' chances. Errors in separate events cancel in the average so that the psychological odds almost coincide with the a posteriori odds. The near congruence of the curves of Fig. 1 attests to the skill of the handicappers and patrons at handicapping the horses.

[10] In any race it may be shown that the relationship exists between the odds and the take of $1/0_1 + 1/0_2 + 1/0_3 \ldots + 1/0_n = 1/(1 - y)$ where $0_1, 0_2, 0_3, \ldots 0_n$ are the track-odds-plus-one for n horses corrected for breakage, and y is the fractional take. The average value for y for several races follows from summing both sides of the equation.

Just as necessary and psychologically as remarkable, the money wagered at each odds is such as to preserve the relationship. The final odds are the summative result of both the skill in estimating chances, *i.e.* adjusting the odds, and also the proper proportion of the patrons wagering the correct amounts at each odds to preserve them. That the number of bettors preferring each odds-group and the amount they bet are in the

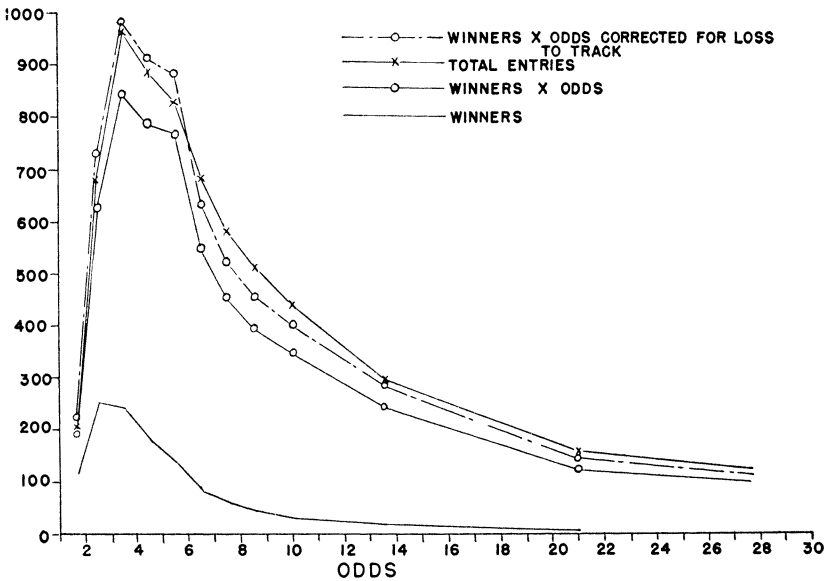


FIG. 1. NUMBER OF ENTRIES, WINNERS, AND WINNERS-TIMES-ODDS FOR EVERY ODDS-GROUP

correct proportion may be the result of several ideologies or to one group with the conscious system of betting on horses on which the track odds become more than the handicappers'.

By the nature of the odds, a greater amount is wagered on the short-odded horses than the long-odded; though the amount is greater, it is not great enough, and too much is wagered on long-odded horses. A direct comparison with the results of Preston and Baratta is made difficult by the complexity of the situation. At the same time, whether the effect is regarded as a constant error in the judgment of odds or as a preference of odds, the effect may be considered the same as Preston and Baratta's, with even the point of indifference being approximately the same. That the principle holds in this non-laboratory situation suggests its universality.

The fundamental difference of dealing with odds instead of probabilities is just one feature which made the outcome less predictable. That the point of equality should be approximately equal to that of these writers (cf. footnote p. 292) when it is translated into probability-values calls for further consideration. The nearness of this value to theirs, whereas any measure of the geometric mean is widely divergent, suggests a constancy of the point of indifference which may be relatively independent of the geometric mean.[11]

Summary and Conclusions

(1) The socially determined odds on horses in races are, on the average, correct reflections of the horses' chances.

(2) There is, however, a systematic undervaluation of the chances of short-odded horses and overvaluation of those of long-odded horses.

(3) The indifference-point occurs at odds of 6.1 or of 5.1 when track odds are used.

(4) When these values for the indifference-point are reciprocally translated into probabilities, they correspond to that found in a recent experimental work as between 0.05 and 0.25.

(5) Contrary to the study cited as relating this principle to adaptation-level theory, it is suggested that this indifference-point may not be related simply to the geometric mean of the choices.

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[11] Since this manuscript was submitted the statistical work was repeated upon all the races of August 1934. While our primary aim was not to corroborate the results of the original investigation, that end was also served. The results were nearly as identical as could have been expected had they arisen from the same data; the curves were practically congruent and the indifference point fell at 0.18 compared to 0.16. If the theory of adaptation-level applies to this error in judgment, the amount of money the bettors have (Preston and Baratta's "endowment background") should influence the indifference-point. It was assumed that in 1934 the bettors were in a state of impecunity relative to their lush affluency of 1947 and the study was made to determine any difference in their adjustment of odds. That the point proved invariant under these diverse economic conditions lends weight to the suggestion in the original study of an unexpected constancy of the point of indifference.