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18. Most casinos have roulette wheels. In North America, these wheels have 38 slots, numbered 1 to 36, 0, and 00. The 0 and 00 slots are coloured green. Half of the remaining slots are red and the other half are black. A ball rolls around the wheel and players bet on which slot the ball will stop in. If a player guesses correctly, the casino pays out according to the type of bet.

a) Calculate the house advantage, which is the casino's profit, as a percent of the total amount wagered for each of the following bets. Assume that players place their bets randomly.

i) single number bet, payout ratio 35:1

ii) red number bet, payout ratio 1:1

iii) odd number bet, payout ratio 1:1

iv) 6-number group, payout ratio 5:1

v) 12-number group, payout ratio 2:1

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$\frac{\text{Theoretic Payout} - \text{Casino Payout}}{n(S)}$

= House Advantage

a) i) single number bet

Theoretic payout ratio: $P(\text{single}) = \frac{1}{38}$, odds against = 37:1

Casino Payout: 35:1

$\text{House Advantage} = \frac{37 - 35}{38}$

$= \frac{2}{38}$

$\doteq 0.0526$

ii) red number bet

Theoretic Payout Ratio: $P(\text{red}) = \frac{18}{38}$, odds against: 20:18

Casino Payout Ratio: 1:1, 18:18

House Advantage $\frac{20 - 18}{38}$

$= \frac{2}{38}$

$\doteq 0.0526$

iii) odd number bet

Theoretic Payout Ratio: $P(\text{odd}) = \frac{18}{38}$, odds against: 20:18

Casino Payout Ratio: 1:1, 18:18

House Advantage $\frac{20 - 18}{38}$

$= \frac{2}{38}$

$\doteq 0.0526$

iv) 6 number group:

Theoretic Payout Ratio: $P(\text{6-number}) = \frac{6}{38}$, odds against = 32:6

Casino Payout Ratio: 5:1, 30:6

House Advantage: $\frac{32 - 30}{38}$

$= \frac{2}{38}$

$\doteq 0.0526$

v) 12-number group.

Theoretic Payout Ratio: $\frac{12}{38}$, odds against = 26:12

Casino Payout Ratio: 2:1, 24:12

$\text{House Advantage} = \frac{26 - 24}{38}$

$= \frac{2}{38}$

$\doteq 0.0526$.