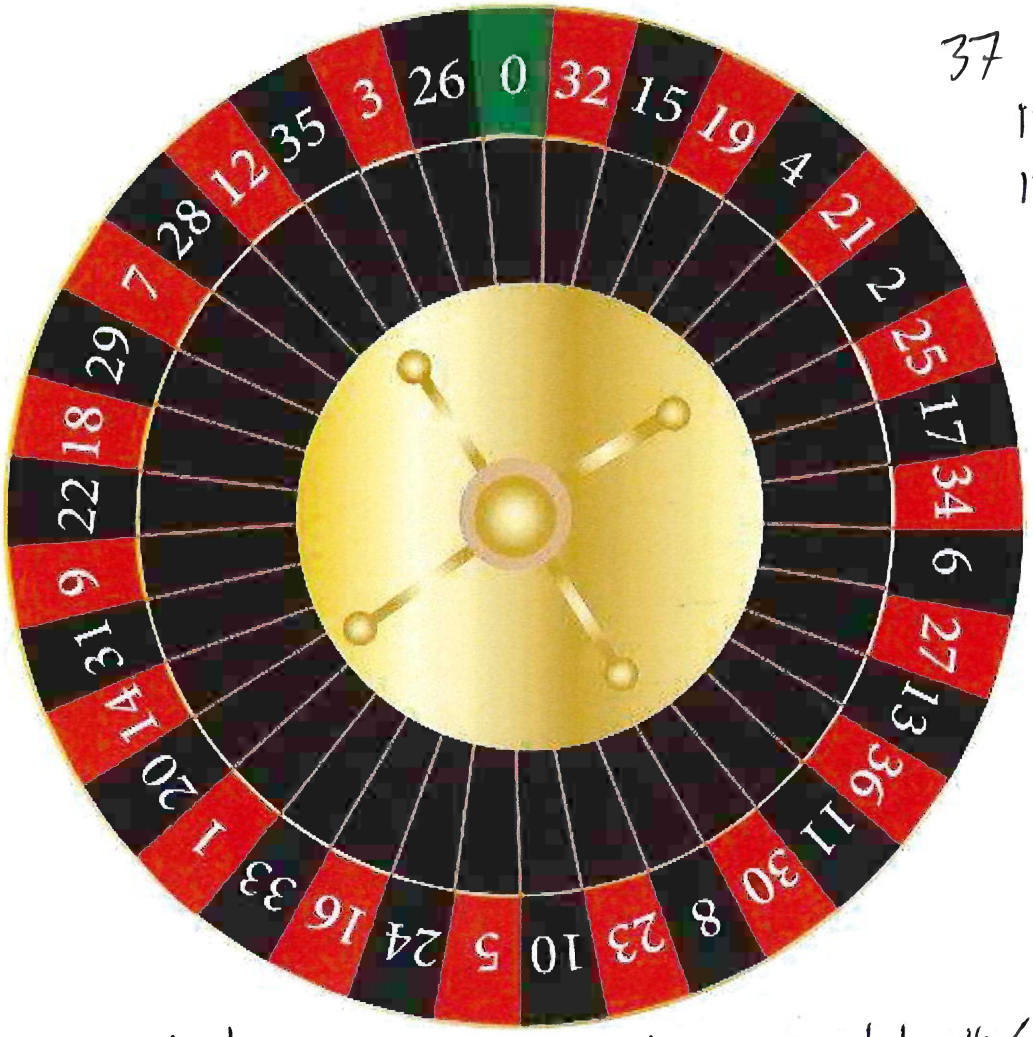
Thu 30 Jan 41 97 14

Random walk example in money space – roulette

Three different ways of computing probabilities
- Direct "brute force"
- Central limit theorem (numerical integration)
- Simplified approximation




37 pockets
18 red
18 black
1 green

$\mathcal{E}$: Spin wheel  X: Measure pocket #/colour

$A = \{0, 1, 2, \ldots 36\}$

"Fair" wheel  $p = 1/37$

$\mathcal{F} = A$  $P(A) = P(0 \text{ or } 1 \text{ or } \ldots \text{ or } 36)$

$= p_0 + p_1 + \cdots p_{36} = 37p = 1$

## Game

Event $\mathcal{F} = \{\text{red, black, green}\}$

Place £5 bet on black

Win: get back £10

Lose: get back £0

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$P_{win} = 18/37 = P_{red}$ ...

$P_{lose} = 1 - P_{win} = 19/37$ ...

$= 18/37 + 1/37 = P_{black} + P_{green}$

$G_{win} = +5$

$G_{lose} = -5$

**Gain G:** Money we back minus money we spend (can be negative)

$G(N, W) = 10W - 5N$

$$P_W = \binom{N}{W} P_{win}^{W} P_{lose}^{N-W} = \binom{N}{W} \frac{18^W 19^{N-W}}{37^N}$$

$N = 5$ $P_0 = \binom{N}{0} \left(\frac{19}{37}\right)^5 \approx 0.036$

$P_1 = \ldots$

$P_2 = \ldots$

$P_3 = \binom{5}{3} \frac{18^3 19^2}{37^5} = 10 \frac{18^3 19^2}{37^5} \approx 0.304$

$P_4 = \ldots$

$P_5 = \ldots$

Automate!