Bid-Ask Spread Trading Simulation

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(1) Consider a simple scenario:

- one tradeable asset
- many competing other traders
- set bid-ask
- make highest profit

(2) Tradeable asset A is liquid:

► fundamental asset value is fixed but unknown to traders

► asset price p_t can be $\{£90, £100, £110\}$ per unit with 33.3% probability

(3) N market participants

► each sets spread S_i

► timing is synchronous

► trade at date-1 and date-2

► each transaction in 10 units of asset

$$\boxed{\textbf{Equally-informed Traders}}$$

Market has equal expectation about fundamental value

$$\text{expected price} \quad = \quad 33.33\% \times \pounds 90 + 33.33\% \times \pounds 100 + 33.33\% \times \pounds 110$$

high bid (low ask)
- better margin
- lower quantity

profit is twice the following (at date-1 and date-2):

$$\underbrace{\left[\text{expected price} - \overset{\uparrow}{\frac{\text{spread}}{2}}\right] \times \overset{\downarrow}{\text{quantity-bought}}}_{\text{high margin but fewer transactions}} + \underbrace{\left[\text{expected price} + \overset{\uparrow}{\frac{\text{spread}}{2}}\right] \times \overset{\downarrow}{\text{quantity-sold}}}_{\text{high margin but fewer transactions}}$$

Your team's analysis (accurately) indicates that the fundamental value is likely to be above market's expectation

$$\text{potential value} \quad = \quad \begin{cases} \pounds 110 & \text{with probability } 70\% \\ \pounds 100 & \text{with probability } 20\% \\ \pounds 90 & \text{with probability } 10\% \end{cases}$$

$$\boxed{\textbf{Trade-offs}}$$

Spread
- aggressive spread increases profit at date-1
- lowers profit at date-2 as market discovers private information
- no-trade leads to loss of business (uninformed traders)

Profit is,

$$\underbrace{\overset{\uparrow}{\text{quantity}_1} \times \text{margin}_1}_{\text{date-1}} + \underbrace{\overset{\downarrow}{\text{quantity}_2} \times \text{margin}_2}_{\text{date-2}}$$

Trading Simulation

► Asset value: Sum of 14 random numbers
► Each between $1 and $3
► Min: $14, Max: $42, Mid-range: $28

Timing: Three Rounds

1. Each group received one number at the beginning of round 1
2. Submit Quotes, Trades happen, Order Book clears the market
3. Two random number (#11/14, #12/14) are revealed
4. Submit Quotes, Trades happen
5. Two random number (#13/14, #14/14) are revealed
6. Submit Quotes, Trades happen

Set bid-ask (two decimal points) at each round to earn highest profit over all rounds combined.
https://www.5minutefinance.org/concepts/the-limit-order-book

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- numerical example
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