Portfolio selection:

- Portfolio Selection: to find the best investment strategy in some financial market.
- Individuals make decision according to:
  - market environment, assets and price processes;
  - feasible decisions: trading rules and constraints;
  - criterion for comparison/optimality.
Course Participants

- Student 1: Name A, Grade 12, Score 90
- Student 2: Name B, Grade 11, Score 85
- Student 3: Name C, Grade 10, Score 80
- Student 4: Name D, Grade 9, Score 75

Course Details:
- Exam Date: 3rd December
- Exam Format: Multiple Choice
- Textbook: Mathematics for All

Graph Details:
- Y-axis: Scores
- X-axis: Participants
- Title: Course Performance
High-frequency trading and dark markets
- New challenges for financial mathematics -

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Expected utility maximization

- The expected utility maximization problem:
  \[ \max \ E[u_0(c) + u_1(X_1)] \]
  s.t. \[ X_1 = \phi^0(1 + r_f) + \sum_{i=1}^{n} \phi^i(1 + R^i) \]
  \[ \phi^0 + \sum_{i=1}^{n} \phi^i = x_0 - c, \]
  \( c \): consumption at time \( t = 0 \); \( u_r(\cdot) \): utility function.

- We can firstly fix \( c \) and optimize \( E[u_1(X_1)] \) by
  \[ \max \ E[u_1(\phi^0(1 + r_f) + \sum_{i=1}^{n} \phi^i(1 + R^i))] \]
  s.t. \[ \phi^0 + \sum_{i=1}^{n} \phi^i = x_0 - c, \]

and then find the optimal \( c \) by \( \max u_0(c) + V_1(c) \).
How are modern markets organized?

- Traders submit orders to a Limit Order Book ("market place")
- Market orders ("liquidity consumption"): order to buy/sell at the best available price, immediate execution
- Limit orders ("liquidity provision"): order to buy/sell at a pre-specified limit price, future execution
- Unexecuted orders are stored in an LOB
- May orders be cancelled before execution
- Often, orders are flagged (name, fill-or-kill, ...)

