**INSTRUCTIONS**

**Knapsack Problems And Markets**

**Summary**

In 5 replications, you will be able to trade shares in an online marketplace. The shares are bets on items. The bets pay off $1 each if the corresponding item is in the solution of a “knapsack problem,” which is a problem where one is asked to find the right items from a collection of possible items that fit a given knapsack while maximising its value.

During online trading, you have access to another website where you can try out solutions to the knapsack problem at hand, to determine which shares (bets) are likely to pay off. You earn money by buying the right shares while selling the shares corresponding to items that are not in the optimal knapsack. You will also earn a fixed $2 reward per suggested solution you submit online to the knapsack problem (whether correct or not).

Earnings cumulate across replications. Your earnings in each replication will depend on your final holdings of shares for that replication, changes in cash holdings, and the reward for submitting a suggested solution. In addition to a sign-up reward of $5, cumulative earnings should average about $40, though they could be lower or higher depending on how good you are at solving knapsack problems, share prices and trading skill.

**Setting: Knapsack Problems**

In knapsack problems, one is given a list of items and asked to optimally load them in a knapsack. Each item has a *weight* and a *value*. The knapsack has a *weight limitation* that may prevent one from loading all items in the knapsack. Given this limitation, one is asked to determine the optimal load, i.e., the combination of items to be put in the knapsack that maximises total value. The total value of a proposed knapsack equals the sum of the values of the individual items.

In each of five replications (plus a practice replication) you can see the corresponding knapsack problem online*,* at <http://tinyurl.com/investAUS>. Log into the website with the ID and password you are given, and navigate to “Play Knapsack Game,” where you pick the problem corresponding to the replication (see below for a list of problem identifiers). Here is how the interface looks:



You can try for yourself which items you think should be in the knapsack, by moving the items you want in the knapsack in the “IN” panel, while keeping the others in the “OUT” panel (which is to the right in the above picture, but at other times will be to the left). Items are identified by their WEIGHT (their size increases with weight) and VALUE (their colour changes from blue to green as value increases). Before the replication ends, you should SUBMIT your suggested solution by clicking on the “**Submit**” button. You only have a limited time – as much time as you are allowed to trade (see below). (There is a white bar next to the submit button which indicates “Time Remaining”; please ignore it.) You earn a fixed dollar amount ($2) when you submit your suggested solution, whether your suggestion is correct or not.

**Trading in Online Sharemarkets**

The main way you earn money is by *trading in a marketplace where shares are bought and sold that are bets on which items belong in the truly best knapsack* (we know which one that is). There will be one set of shares for each item in the knapsack problem. Shares are identified by the weight and value of the corresponding item (e.g., the heaviest item in the above problem is called 1204\_206) and ordered by either increasing or decreasing weight. After markets close, one unit of the shares that are bets on items that are in the optimal knapsack pays $1. All other shares expire worthless.

You access markets as follows. You log onto <http://tinyurl.com/flexemarketsAUS> using the same ID and password you use to see the knapsack problem itself. You navigate to the corresponding marketplace (see below for a list of marketplace names for each replication). Once in the marketplace, you see one share market for each item. You use cash to buy shares and receive cash when you sell shares. You will be given ample opportunity to practice submitting orders so you will know how to buy and sell. (See below for more information about trading.)

You earn money by buying shares that are bets on items in the optimal knapsack, since they pay a dividend of $1 (while the other shares expire worthless). You also earn money by selling shares and keeping the proceeds as cash, or by buying low and selling high. Your final earnings consist of (i) earnings from your successful bets (shares of the “in” items), plus (ii) the change in cash over the trading period (if you end up with less cash than you started with, the amount will be subtracted from the money earned with the “in” shares). You are permitted to buy bets on items you don’t really think are in the optimal knapsack but that you expect to increase in price; you merely sell them once the price has increased and before trading ends.

The marketplace is open for a pre-determined time, indicated in the message pane of the trading window.

**TABLE WITH REPLICATIONS PROBLEM AND MARKETPLACE NAMES**

|  |  |  |  |
| --- | --- | --- | --- |
| REPLICATION | Knapsack Problem Name | Marketplace Name | Allocated Time |
| Practice | Practice | KPE-Practice | 55 mins |
| 1 | KP-1 | KPE-1 | ≤15 mins |
| 2 | KP-2 | KPE-2 | ≤15 mins |
| 3 | KP-3 | KPE-3 | ≤15 mins |
| 4 | KP-4 | KPE-4 | ≤15 mins |
| 5 | KP-5 | KPE-5 | ≤15 mins |

**TIMELINE­­**

**Trading**

Trading takes place through an electronic trading platform called *Flex-E-Markets*. You submit *limit orders*, which are orders to buy or sell at a price you determine, or at a better price. Transactions take place from the moment a buy order with a higher price crosses a sell order with a lower price. Orders remain valid until you cancel them or the marketplace closes. You will be given ample opportunity to train yourself in submitting and canceling orders.