# The project

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## 1 introduction to the approaches

We use 2 approaches to solve this problem. The first one is iteration method and the second one is lp-based method. In iteration method, we update our answer, and continue it until it does not change considerably. In the lp-based method, we use some linear inequalities to limit our answer, and then, find the answer by a linear solver.

## 2 Iteration method for question 1

In this method, we consider an array $v$ of length 110 that for $0 \leqslant i \leqslant 99$, $v[i] = 0$, and for $100 \leqslant i \leqslant 105$, $v[i] = i$. Then, in each step, for $0 \leqslant i \leqslant 99$, we update $v[i]$ by formula $v[i] = max(i, (x[i+3]+x[i+5]+x[i+6]+3*x[0])/6)$, when $x[] = v[]$ at the beginning of the step. The amount $(x[i+3]+x[i+5]+x[i+6]+3*x[0])/6$ refers to the estimated profit we will have if continue to the game when we have $i$ dollars. We do this algorithm until the amount of update of $v[]$ becomes very small. In other words, we do this algorithm until $\sum|x[i] - v[i]| \leqq \epsilon$, that $\epsilon$ is a very small number.

## 3 Iteration method for question 2

The iterative method for the second question is like this method for the first equation, with some trivial differences. We consider an array $v$ of length 125 that for $0 \leqslant i \leqslant 99$, $v[i] = 0$, and for $100 \leqslant i \leqslant 115$, $v[i] = i$. Then, in each step, for $0 \leqslant i \leqslant 99$, we update $v[i]$ by formula $v[i] = max(i, (4*x[i+4]+2*x[i+9]+x[i+6]+9*x[0])/16$, when $x[] = v[]$ at the beginning of the step. We this algorithm until the amount of update of $v[]$ becomes very small.

# 4 lp-based method for the question 1

As we said before, we use inequalities in this method to find the answer. Again, we define an array $v$ of length 110 that all of its cells are 0. We want that each cell of $v$ has its largest amount. In other words, we want that each cell cannot be updated(like the first section). Therefore, for each $0 \leqslant i \leqslant 99$, we should have this inequality: $v[i] \geqslant (v[i+3]+v[i+5]+v[i+6]+3*v[0])/6$. We add all of these inequalities to a linear model and then find the maximum answer for $v[0]$. For the second question, the inequalities are $v[i] \geqslant (4*v[i+4]+2*v[i+9]+v[i+6]+9*v[0])/16$.