

Public vs Private Investments

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Optimizing Markets through Investments

Previously

In the manufacturing simulation, we had:

- ▶ a set of manufacturers with a consistent range of efficiencies
- ▶ profits being reinvested into manufacturing capacities

The result:

- ▶ matching supply and demand at the lowest unit cost

Investments

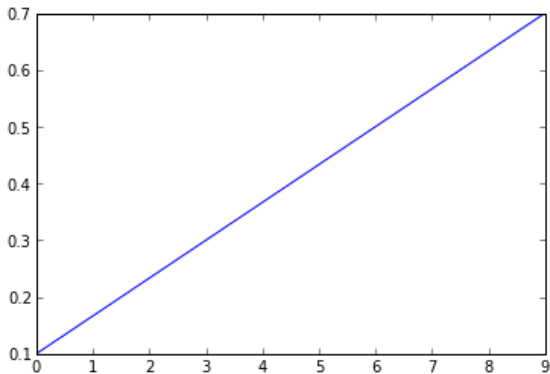
Setting:

- ▶ annual “projects” (manufacturing in rapidly changing markets)
- ▶ investors predicting the yield on each project
- ▶ predicted yield is normally distributed around actual yield
- ▶ different investors have different error terms

Simplifications:

- ▶ each investor picks exactly one project each year and invests a fixed fraction of their wealth in it

```
1 N = 10
2 # uncertainty = 0.3*abs(randn(N))**.5
3 uncertainty = linspace(0.1,0.7,N)
4 uncertainty = numpy.sort(uncertainty)
5 plot(uncertainty)
```



Private Investors

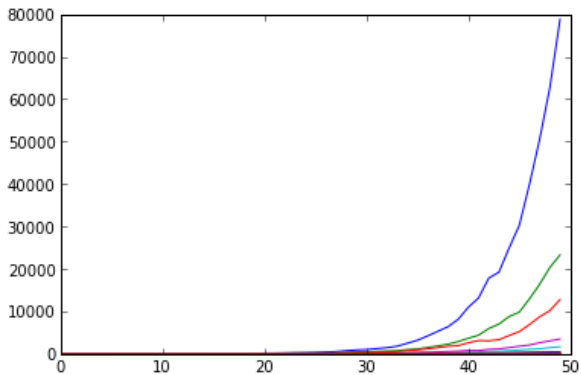
For private investors, the entire benefit (return on investment) accrues to the investor.

This means that investors making good decisions will have more money to invest next time.

```
1 wealth = ones(N)
2 wealth_over_time = []
3 frac = 0.5
4 for y in range(50):
5     M = 15
6     yields = randn(M)*0.3
7     predicted = yields[:,newaxis] + randn(M,N)*uncertainty[newaxis
8         ,:]
9     selected = argmax(predicted,axis=0)
10    wealth = (1.0-frac)*wealth + frac*(1.0+yields[selected])*wealth
11    wealth_over_time.append(wealth.copy())
wealth_over_time = array(wealth_over_time)
```



```
1 for i in range(N):  
2     plot(wealth_over_time[:,i])
```



Observations

- ▶ Wealth of the investor with the best ability to predict yield increases fastest.
- ▶ The market rewards ability to predict well.
- ▶ Predictive ability is similar to lower unit costs in manufacturing.

Public Investors

A second model of investments is public investments.

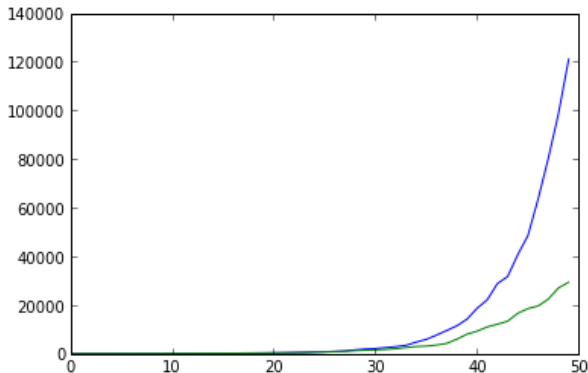
Here, a set of experts are given an annual budget to invest in the market based on their yield predictions.

At the end of the year, all the returns on the investments are gathered together into a single budget and equally distributed again for next year.

```
1 wealth = ones(N)
2 wealth_over_time2 = []
3 frac = 0.5
4 for y in range(50):
5     M = 15
6     yields = randn(M)*0.3
7     predicted = yields[:,newaxis] + randn(M,N)*uncertainty[newaxis
8         ,:]
9     selected = argmax(predicted,axis=0)
10    wealth = (1.0-frac)*wealth + frac*(1.0+yields[selected])*wealth
11    wealth[:] = mean(wealth)
12    wealth_over_time2.append(wealth.copy())
wealth_over_time2 = array(wealth_over_time2)
```

Let us plot the total wealth generated by the two approaches.

```
1 plot((sum(wealth_over_time,axis=1)),color='blue')  
2 plot((sum(wealth_over_time2,axis=1)),color='green')
```



Observations

- ▶ rewarding private investors results in best predictors becoming wealthiest
- ▶ rewarding best predictors results in higher overall growth

QUESTION

Why do we compare total wealth in the two schemes? What does that actually reflect?

With private investments, the best investors accumulate the wealth. Is this a good thing?

Attacks on public investors

The public investment schemes are easy to attack.

- ▶ Investors are rewarded by something other (and of smaller value) than ROI.
- ▶ Possible attacks:
 - ▶ bribery: pay public investors to make suboptimal decisions
 - ▶ fraud: misrepresent yields
 - ▶ rent seeking, lobbying: convince politicians to alter yield estimates
 - ▶ These attacks are difficult/impossible in the private investor scheme, since companies actually need to realize the ROI in payouts.

QUESTION

Can you design a public investment scheme that mimics the success of the private investment scheme?

How can you make it attack proof?