Eggs in Baskets

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An old adage says you shouldn't put all your eggs in one basket. That is to prevent the disaster of losing all your eggs if that one basket falls. For investors, that means spread your investments around so that if one investment is doing badly, it won't ruin you.

Suppose the number of eggs is e, and the number of baskets is b, and the eggs are equally divided among the baskets. So the number of eggs in each basket is e/b. Suppose the probability of dropping any specific basket and breaking all the eggs in it is p. Your average loss is

$$(e/b \times p) \times b \;=\; e \times p$$

Your loss does not depend on how many baskets you use. With more baskets, if you drop a basket, your loss is less. But with more baskets, there's more chance of dropping one or more baskets.

In the previous calculation, the probability of dropping a basket was the same for each basket. Now suppose different baskets have different probabilities of being dropped; perhaps each basket is carried by a different person, and some people are clumsier than others. Suppose you have 12 eggs and 3 baskets, and the probability of dropping basket A is 20%, and the probability of dropping basket B is 25%, and the probability of dropping basket C is 30%. If you put 4 eggs in each basket, your average loss is

$$4 \times 20\% + 4 \times 25\% + 4 \times 30\% \;=\; 3 \text{ eggs}$$

If you put all your eggs in basket A, your average loss is

$$12 \times 20\% + 0 \times 25\% + 0 \times 30\% \;=\; 2.4 \text{ eggs}$$

You should put all your eggs in the most secure basket in order to minimize the average loss.

We have been implicitly assuming that the probability of dropping a basket is independent of the probability of dropping another basket. For eggs, I think the probabilities might be quite dependent. Whatever causes a basket to drop might cause more than one basket to drop. The same for investments: stocks tend to rise and fall together.

Let's look at an example. Suppose there are 12 eggs and 1 basket, with all 12 eggs in it, and the probability of dropping the basket and breaking the eggs is 25%. Then the average loss is $12 \times 25\% = 3$ eggs. Now suppose there are 12 eggs and 3 baskets, with 4 eggs in each basket, and the probability of dropping each basket is 25%, independent of the probability of dropping the other baskets. Then, according to our earlier calculation, the average loss is $12 \times 25\%$, which is again 3 eggs. Finally, suppose there are 12 eggs and 3 baskets, with 4 eggs in each basket, but this time, more realistically, the probability of dropping each basket is not independent of the probability of dropping the other baskets. Suppose the probability of dropping 0 baskets is 25%, the probability of dropping 1 basket is 25%, the probability of dropping 2 baskets is 25%, and the probability of dropping all 3 baskets is 25%. Then the average loss is

$$0 \times 25\% + 4 \times 25\% + 8 \times 25\% + 12 \times 25\% \;=\; 6 \text{ eggs}$$

Sometimes it is best to put all your eggs in one basket. Don't believe financial advisors who say otherwise.

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