General solution to a linear payout schedule problem for multiple-tournament competition of arbitrary size

Junior, Siri

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Abstract

A general equation is derived for payouts to individuals in a multiple-tournament competition of arbitrary size. It is correct and good.

1. Introduction

A general payout structure is proposed for a multi-tournament competition of arbitrary size.

2. Derivation

The following properties are desired for such a payout schedule:

1. A person in last place in a given tournament should receive no payout.
2. There should be a linear increase in payout as rank in a tournament increases, and the winner in a tournament should receive a payout equal to $2*B/n_{tourney}$, where B is a single person's buy-in for the competition and $n_{tourney}$ is the number of tournaments that comprise the competition. This property ensures that a first place finish in all tournaments in a competition ensures a doubling of the buy-in as payout.

We define the increment between payouts as I, the number of players as n_{player}, the place in tournament i as P_i, and B_{total} as the total amount of money from all players ($B*n_{player}$).

As stated above, the last place person receives no payout, and a player in a higher places receives a payout equal to $(n_{player}-P)*I$.

It is clear that the total buy-in from all players needs to be divided into equal partitions, and distributed such that last place receives 0I, second to last place receives 1I, and so on up to first place. So, the increment is equal to the payout for a given tournament ($B_{total}/n_{tourney}$) divided by the following sum,

$$Number\ of\ increments = \sum_{i=1..n} n-1$$

which is equal to $0.5{n_{player}}^2 - 0.5n_{player}$. From this it follows that

$$I = \frac{B*n_{player}}{n_{tourney}(0.5{n_{player}}^2 - 0.5n_{player})}.$$

This simplifies to

$$I = \frac{B}{n_{tourney}(0.5n_{player} - 0.5)}.$$

The payout in a single tournament is then equal to

$$Payout_{tourney} = \frac{B(n_{player} - P)}{n_{tourney}(0.5n_{player} - 0.5)}$$

and an individual's total payout for the competition is equal to

$$Payout_{competition} = \frac{B(n_{tourney}n_{player} - \sum_i P_i)}{n_{tourney}(0.5n_{player} - 0.5)}.$$

3. Conclusions

This is correct and good.