# Report Group XX : Add Greeks to binomial tree engines

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## Increasing the size of the columns by 2 nodes:

The *BinomialTree* is a base class for all type of trees. In order to increase the size of the tree we changed its function *size(i).* At column *i* the number of nodes is no longer *i+1* but *i+3*, the two additional nodes correspond to the price perturbations required to compute delta and gamma at time step *i*.

## Adapting the index of the nodes to the extra nodes:

The computation of the underlying prices at node *(i,index)* depends on the values of both *i* and *index* where *i* is the column or the time step number and *index* is the number of the nodes located at the *ith* time step. For a given *i, the index* goes from *0 to i+2.* After increasing the size of the tree by two nodes, the real *index* needed for the underlying calculation was shifted by 1. To get back the right underlying price, as it was given by the original structure, we had to shift back *index* value by 1. Through all the derived binomial trees classes the *underlying(i,index)* function was modified to account for the aforementioned issue. We created a *new\_index = index – 1* which substitute the the old *index* in calculating the underlying price.

### EqualProbabilitiesBinomialTree:

At *i = 0 :*

Using the formula, we get: ; ;

Then,