**The analytical NES value of aREA**

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Here the analytical NES value of aREA is derived.

The expression signature is transformed into S after rank transformation and quantile transformation. The ES and NES are calculated based on the signature S.

The ES value is calculated based on the following formula:

The ES value have two parts, and :

Both and follows normal distribution, which is proved bellow: is the sum of some weighted , and . It is known that the sum of variables from normal distribution also follows the normal distribution with means equal to the sum of the variables’ means and variance equal to the sum of the variables’ variance. Thus

Similarly,

Thus, the ES is the sum of two variables comes from two normal distribution, it is easy to know

Finally

Thus

or in the full expression