:: Collaborations ::

:: Continuous Compounding Interest Rates ::

Usually we consider interest rates as being calculated on a yearly, monthly or even weekly basis, i.e. compounded once per annum, per month or per week. In financial mathematics, however, continuously compounded interest rates are more commonly used in pricing options and other derivatives. Therefore it is important to get acquainted to the conversion between continuously and discretely compounded rates.

Previously (see **article**),we learned how to calculate present value from future value and vice versa. For an amount P invested for t years at rate R_n and compounding n times per annum, this becomes

$$P\left(1+\frac{R_n}{n}\right)^{nt}$$

For **continous compounding**, it was shown that an amount P invested for t years at rate R_c gives

$$P \exp(R_c\, t)$$

Therefore for given discrete compounding rate or continous compounding rate, one can easily convert one into another by equating the previous two expressions:

$$P\left(1+\frac{R_n}{n}\right)^{nt} = P \exp(R_c\, t)$$

gives

$$R_c = n \ln\left(1+\frac{R_n}{n}\right)$$

or

$$R_n = n\left(e^{R_c/n} - 1\right)$$

Also,a rate with compounding frequency of n1 can be easily converted into another with compounding frequency of n2:

$$P\left(1+\frac{R_{n1}}{n1}\right)^{n1\,t} = P\left(1+\frac{R_{n2}}{n2}\right)^{n2\,t}$$

giving

$$R_{n2} = \left[\left(1+\frac{R_{n1}}{n1}\right)^{n1/n2} - 1\right] n2$$

A good example is the interest rates quoted by credit cards issued by most retail banks. For example, do you know how much your credit card issuer is charging you per month on your outstanding loan at an AER (Annual Equivalent Rate) of 19.9%? (AER is the rate as if charged and

compounded on an annual basis)

Answer: 1.52%

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