***Continuously compounded returns***

Continuously compounded (cc) returns are defined as:

Annual continuously compounded returns are equivalent to annualised percentage rates (APR’s) with a compounding period that is not per month, nor per day nor per second but infinitely small or continuous.

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***Converting Between Continuous and Effective Returns***

Continuously Compounding to Effective Discretely Compounding Return:

Effective Discretely Compounding to Continuously Compounding Return:

Note that the above equations assume that each return is measured over the same time. So both the and are annual, for example.

|  |  |  |
| --- | --- | --- |
| **Different Return Quotations Equivalent** | | |
| **to an Effective Annual Rate of 10%** | | |
| Quote type | Return (%pa) | Symbol |
| Effective annual rate | 10 |  |
| APR compounding per annum | 10 |  |
| APR compounding semi-annually | 9.761769634 |  |
| APR compounding quarterly | 9.645475634 |  |
| APR compounding monthly | 9.568968515 |  |
| APR compounding daily | 9.532279763 |  |
| APR compounding hourly | 9.531070550 |  |
| APR compounding per minute | 9.531018861 |  |
| APR compounding per second | 9.531018227 |  |
| Continuously compounded annual rate | 9.531017980 |  |
|  | | |

***Adjusting for Time: Compounding Up and Down***

Turning a continuously compounded **monthly** return into an **annual** return is very easy, just multiply by 12. This is compounding up:

To compound down from an annual rate to a daily rate where there are 365 days in the year, just divide by 365.

***Present Values with Continuously Compounding Returns***

Since is equivalent to , then:

***Calculation Example: Present Value of a Single Cash Flow***

**Question**: What is the present value of $100 received in 5 years when continuously compounded interest rates are 8% pa?

**Answer**:

***Calculation Example: Future Value of a Single Cash Flow***

**Question**: You have $100 in the bank. Interest rates are 8% pa. How much will you have in the bank after 5 years?

**Answer**:

***Total, Capital and Income returns with continuous compounding***

This also holds after raising both sides to the power of Euler’s number ‘e’:

***Present Value Formulas: Cont. Comp. Rates***





***Present Value Formulas: Effective Rates***



