E7. Equation Summary

(1) Future value, annual compounding

$$FV = PV(1+r)^n$$

(2) Future value, general compounding

$$FV = PV\left(1+\frac{r}{m}\right)^{mn}$$

(3) Effective annual interest rate (APY)

$$r_e = \left(1+\frac{r}{m}\right)^m - 1$$

(4) Future value, continuous compounding

$$FV = PVe^{rn}$$

(5-6) Future value of:

(5) Annuity (Deposit/pmt gets no interest)

$$FV = PMT\left(\frac{(1+r)^n - 1}{r}\right)$$

(6) Annuity due (Deposit/pmt does earn interest)

$$FV = PMT\left(\frac{(1+r)^n - 1}{r}\right)(1+r)$$

(7) Present value, annual compounding

$$PV = \frac{FV}{(1+r)^n}$$

(9-10) Present value of: (Required nest egg to live off PMT in retirement)

(9) Annuity

$$PV = PMT\left(\frac{(1+r)^n - 1}{r(1+r)^n}\right)$$

(10) Annuity due

$$PV = PMT\left(\frac{(1+r)^n - 1}{r(1+r)^{n-1}}\right)$$

(11) Annuity payments for: (Required payment for simple interest loan)

(11a) Annuity PV

$$PMT = PV\left(\frac{r(1+r)^n}{(1+r)^n - 1}\right)$$

(11b) Annuity due PV

$$PMT = PV\left(\frac{r(1+r)^{n-1}}{(1+r)^n - 1}\right)$$

(12) Annuity payments for: (Required annual savings to reach nest egg)

(12a) Annuity FV

$$PMT = FV\left(\frac{r}{(1+r)^n - 1}\right)$$

(12b) Annuity due FV

$$PMT = FV\left(\frac{r}{(1+r)^n - 1}\right)\left(\frac{1}{1+r}\right)$$

(13) Present value of perpetuity

$$PV = \frac{PMT}{r}$$

(14) Net present value of series of cash flows

$$NPV = \sum_{i=0}^{n} \frac{C_i}{(1+r)^i}$$

(15) Internal Rate of Return (Yield)

r that solves $NPV = 0$

where:
- FV = future value
- PV = present value
- PMT = uniform payment/investment each period
- m = number of periods of compounding per year
- n = number of years of compounding
- r = annual interest rate (APR)
- r_e = effective annual interest rate (APY)
- e = natural logarithm (2.71828)
- C_i = cash flow in year i