UWorld | FINANCE

SimpleSheets™+

CFA® Exam Formulas | Level 1

2026 Edition

SimpleSheets+

Formulas at Your Fingertips

Quantitative Methods - Prereadings

Common Probability Distributions

- Discrete Uniform Distribution

  F(x) = *n* × p(x) for the *n*th observation.

- Binomial Distribution

  $P(X=x) = {}_nC_x (p)^x (1 - p)^{n-x}$

  where:
  p = probability of success
  1 – p = probability of failure
  ${}_nC_x$ = number of possible combinations of having *x* successes in *n* trials. Stated differently, it is the number of ways to choose *x* from *n* when the order does not matter.

- Mean of a Binomial Random Variable

  $\overline{B(n,p)} = np$

- Variance of a Binomial Random Variable

  $\sigma_x^2 = n \times p \times (1 - p)$

- The Continuous Uniform Distribution

  P(X < a), P (X > b) = 0

  $P(x_1 \leq X \leq x_2) = \frac{x_2 - x_1}{b - a}$

- Confidence Intervals

  For a random variable X that follows the normal distribution:
  The 90% confidence interval is $\bar{x} - 1.65s$ to $\bar{x} + 1.65s$
  The 95% confidence interval is $\bar{x} - 1.96s$ to $\bar{x} + 1.96s$
  The 99% confidence interval is $\bar{x} - 2.58s$ to $\bar{x} + 2.58s$

  The following probability statements can be made about normal distributions

  - Approximately 50% of all observations lie in the interval $\mu \pm (2/3)\sigma$
  - Approximately 68% of all observations lie in the interval $\mu \pm 1\sigma$
  - Approximately 95% of all observations lie in the interval $\mu \pm 2\sigma$
  - Approximately 99% of all observations lie in the interval $\mu \pm 3\sigma$

- z-Score

  z = (observed value – population mean)/standard deviation
  $= (x - \mu)/\sigma$

- Continuously Compounded Returns

  $EAR = e^{r_{cc}} - 1$ $\quad r_{cc}$ = continuously compounded annual rate

  $r_{cc} = \ln(1 + HPR)$

  (1 + HPR) simply equals (V_t/V_0). Therefore, the continuously compounded rate of return can also be calculated as:

  $r_{cc} = \ln\left(\frac{V_t}{V_0}\right)$

  $HPR_t = e^{r_{cc} \times t} - 1$

Sampling and Estimation

- Sampling Error

  Sampling error of the mean = Sample mean − Population mean
  $= \bar{x} - \mu$

- Standard Error of Sample Mean when Population Variance is known

  $\sigma_{\bar{x}} = \frac{\sigma}{\sqrt{n}}$

  where:
  $\sigma_{\bar{x}}$ = the standard error of the sample mean
  σ = the population standard deviation
  n = the sample size

- Standard Error of Sample Mean when Population Variance is not known

  $s_{\bar{x}} = \frac{s}{\sqrt{n}}$

  where:
  $s_{\bar{x}}$ = standard error of sample mean
  s = sample standard deviation

- Confidence Intervals

  Point estimate ± (reliability factor × standard error)

  where:
  Point estimate = value of the sample statistic that is used to estimate the population parameter
  Reliability factor = a number based on the assumed distribution of the point estimate and the level of confidence for the interval (1 – α)
  Standard error = the standard error of the sample statistic (point estimate)

  $\bar{x} \pm z_{\alpha/2} \frac{\sigma}{\sqrt{n}}$

  where:
  $\bar{x}$ = The sample mean (point estimate of population mean)
  $z_{\alpha/2}$ = The standard normal random variable for which the probability of an observation lying in either tail is σ / 2 (reliability factor)
  $\frac{\sigma}{\sqrt{n}}$ = The standard error of the sample mean

  $\bar{x} \pm t_{\frac{\alpha}{2}} \frac{s}{\sqrt{n}}$

  where:
  $\bar{x}$ = sample mean (the point estimate of the population mean)
  $t_{\frac{\alpha}{2}}$ = the t-reliability factor
  $\frac{s}{\sqrt{n}}$ = standard error of the sample mean
  s = sample standard deviation

Quantitative Methods

Rates and Returns

- Arithmetic Mean

  $\mu = \sum_{i=1}^{N} x_i / N$ for a population

  $\overline{X} = \sum_{i=1}^{n} x_i / n$ for a sample

- Weighted Mean

  $\overline{X}_w = \sum_{i=1}^{n} w_i X_i$

- Geometric Mean

  $\overline{X}_G = \left[\prod_{i=1}^{n}(1+X_i)\right]^{\frac{1}{n}} - 1$

  which can be alternatively written for portfolio returns as:

  $R_G = \sqrt[n]{(1+R_1)(1+R_2)\ldots(1+R_n)} - 1$

- Holding Period Return

  $R = \frac{P_t - P_{t-1} + D_t}{P_{t-1}} = \frac{P_t - P_{t-1}}{P_{t-1}} + \frac{D_t}{P_{t-1}} = \text{Capital gain + Dividend yield}$

  $= \frac{P_T + D_T}{P_0} - 1$

  where:
  P_t = Price at the end of the period
  P_{t-1} = Price at the beginning of the period
  D_t = Dividend for the period

- Holding Period Returns for more than One Period

  $R = [(1+R_1) \times (1+R_2) \times \ldots \times (1+R_n)] - 1$

  where:
  $R_1, R_2, \ldots, R_n$ are sub-period returns

- Geometric Mean Return

  $R = \{[(1+R_1) \times (1+R_2) \times \ldots \times (1+R_n)]^{1/n}\} - 1$

- Time Weighted Rate of Return
  If we have annual returns data, the annualized time-weighted return can be calculated as the geometric mean of N annual returns, as follows:

  $r_{TW} = [(1+r_1) \times (1+r_2) \times \ldots \times (1+r_N)]^{1/N} - 1$

- Annualized Return

  $r_{annual} = (1 + r_{period})^n - 1$

  where:
  r = Return on investment
  n = Number of periods in a year

- Harmonic Return

  $\overline{X}_H = \frac{n}{\sum_{i=1}^{n}(1/X_i)}$ with $X_i > 0$

The Time Value of Money in Finance

- Effective Annual Rates

  $EAR = (1 + \text{Periodic interest rate})^N - 1$

- The Future Value of a Single Cash Flow

  $FV_N = PV(1+r)^N$

- The Present Value of a Single Cash Flow

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

- The Present and Future Value of an Ordinary Annuity

  $PV_{Annuity}$: # periods N; % interest per period I/Y; amount $PMT \rightarrow PV$

  $FV_{Annuity}$: # periods N; % interest per period I/Y; amount $PMT \rightarrow FV$

- The Present and Future Value of an Annuity Due

  $PV_{\text{Annuity Due}} = PV_{\text{Ordinary Annuity}} \times (1 + r)$

  $FV_{\text{Annuity Due}} = FV_{\text{Ordinary Annuity}} \times (1 + r)$

- Present Value of a Perpetuity

  $PV_{Perpetuity} = \frac{PMT}{I/Y}$

- Continuous Compounding and Future Values

  $FV_N = PVe^{r_s \times N}$

- PV of a Coupon Bond (v1, p51, Eq 6)

  $PV = \frac{PMT_1}{(1+r)^1} + \frac{PMT_2}{(1+r)^2} + \frac{PMT_3}{(1+r)^3} + \ldots \frac{(PMT_N + FV_N)}{(1+r)^N}$

- Periodic Payment for fully amortizing loan (v1, p54, Eq 8):

  $A = \frac{r \times \text{Principal}}{1 - (1+r)^{-N}}$

- Equity with a constant dividend (v1, p56, Eq 10)

  $PV_t = \frac{D_t}{r}$

- Equity with a dividend with constant growth (v1, p57, Eq 14)

  $PV_t = \frac{D_{t+1}}{(r-g)}$

- Bond Implied Return (v1, p61, Eq 18)

  $r = \left(\frac{FV_t}{PV}\right)^{\frac{1}{t}} - 1$

- Equity Implied Return (v1, p65, Eq 21)

  $r = \frac{D_{t+1}}{PV_t}$

- Equity Implied Growth (v1, p65, Eq 22)

  $g = r - \frac{D_{t+1}}{PV_t}$

Statistical Measures of Asset Returns

- Quantiles

  $L_y = (n+1)\frac{y}{100}$

- Mean Absolute Deviation

  $MAD = \frac{\sum_{i=1}^{n}\left|X_i - \overline{X}_i\right|}{n}$

- Sample Variance

  $S^2 = \frac{\sum_{i=1}^{n}\left(X_i - \overline{X}\right)^2}{n-1}$

  $S = \sqrt{S^2}$

- Geometric Mean

  $X_G = \overline{X} - \frac{S^2}{2}$

- Target Downside Deviation

  $S_{Target} = \sqrt{\frac{\sum_{\text{for } X_i \le B}^{n}(X_i - B)^2}{n-1}}$

- Coefficient of Variation

  $CV = \frac{S}{\overline{X}}$

- Skewness

  $skewness = \left(\frac{1}{n}\right)\frac{\sum_{i=1}(X_i - \overline{X})^3}{S^3}$