# 2020 Level I Fact Sheet

## Key Facts & Formulas for the CFA® Exam

Approved Prep Provider CFA Institute

## Ethical and Professional Standards

**I(A) Knowledge of the law:** comply with the strictest law; disassociate from violations.
**I(B) Independence and objectivity**: do not offer, solicit or accept gifts; but small token gifts are ok.
**I(C) Misrepresentation**: do not guarantee performance; avoid plagiarism.
**I(D) Misconduct**: do not behave in a manner that affects your professional reputation or integrity.
**II(A) Material nonpublic information**: do not act or help others to act on this information; but mosaic theory is not a violation.
**II(B) Market manipulation**: do not manipulate prices/trading volumes to mislead others; do not spread false rumors.
**III(A) Loyalty, prudence, and care**: place client's interest before employer's or your interests.
**III(B) Fair dealing**: treat all client's fairly; disseminate investment recommendations and changes simultaneously.
**III(C) Suitability**: in advisory relationships, understand client's risk profile, develop and update an IPS periodically; in fund/index management, ensure investments are consistent with stated mandate.
**III(D) Performance presentation**: do not misstate performance; make detailed information available on request.
**III(E) Preservation of confidentiality**: maintain confidentiality of clients; unless disclosure is required by law, information concerns illegal activities, client permits the disclosure.
**IV(A) Loyalty**: do not harm your employer; obtain written consent before starting an independent practice; do not take confidential information when leaving.
**IV(B) Additional compensation arrangements**: do not accept compensation arrangements that will create a conflict of interest with your employer; but you may accept if written consent is obtained from all parties involved.
**IV(C) Responsibilities of supervisors**: prevent employees under your supervision from violating laws.
**V(A) Diligence and reasonable basis**: have a reasonable and adequate basis for any analysis, recommendation or action.
**V(B) Communication with clients and prospective clients**: distinguish between fact and opinion; make appropriate disclosures.
**V(C) Record retention**: maintain records to support your analysis.
**VI(A) Disclosure of conflicts**: disclose conflict of interest in plain language.
**VI(B) Priority of transactions**: client transactions come before employer transactions which come before personal transactions.
**VI(C) Referral fees**: disclose referral arrangements to clients and employers.
**VII(A) Conduct as participants in CFA Institute programs**: don't cheat on the exams; keep exam information confidential.
**VII(B) Reference to CFA Institute, the CFA designation, and the CFA program**: don't brag, references to partial designation not allowed.

**GIPS**

- The GIPS standards were created to avoid misrepresentation of performance.
- A composite is an aggregation of one or more portfolios managed according to a similar investment mandate, objective, or strategy.
- Verification is performed by an independent third party with respect to an entire firm. It is not done on composites, or individual departments.
- Nine major sections of the GIPS standards are - fundamentals of compliance, input data, calculation methodology, composite construction, disclosures, presentation and reporting, real estate, private equity, and wrap fee/separately managed account portfolios

## Quantitative Methods

**Components of interest rates**
Interest rate = real risk-free rate + inflation premium + default risk premium + liquidity premium + maturity premium
Nominal interest rate = real risk-free rate + inflation premium

**Stated annual rate** does not consider the effect of compounding.
**Effective annual rate** considers compounding

With periodic compounding, $EAR = \left(1 + \frac{\text{stated annual rate}}{m}\right)^{m} - 1$
With continuous compounding, $EAR = e^{\text{stated annual rate}} - 1$
**Future value**: value to which an investment will grow after one or more compounding periods. $FV = PV\ (1 + I/Y)^{N}$
**Present value:** current value of some future cash flow.
$PV = FV / (1 + I/Y)^{N}$

**Annuity:** series of equal cash flows at regular intervals.

- **Ordinary annuity:** cash flows occur at the end of time periods.
- **Annuity due**: cash flows occur at the start of time periods.

**Perpetuity:** annuity with never ending cash flows. $PV = \frac{PMT}{I/Y}$
**Net present value (NPV):** present value of a project's cash inflows minus the present value of its cash outflows.
$NPV = CF0 + \left[\frac{CF1}{(1+r)^{1}}\right] + \left[\frac{CF2}{(1+r)^{2}}\right] + \left[\frac{CF3}{(1+r)^{3}}\right]$

**Internal rate of return (IRR):** discount rate that makes the NPV equal to zero.
$CF0 = \left[\frac{CF1}{(1+IRR)^{1}}\right] + \left[\frac{CF2}{(1+IRR)^{2}}\right] + \left[\frac{CF3}{(1+IRR)^{3}}\right]$

**Holding period return:** total return for holding an investment over a given time period. $HPR = \frac{P_1 - P_0 + I_1}{P_0}$
**Money weighted rate of return:** the IRR of a project.

**Time weighted rate of return**: compound growth rate at which $1 invested in a portfolio grows over a given measurement period.

**Yield measures for money market instruments**
Bank discount yield (BDY) $= \left(\frac{D}{F}\right) * \left(\frac{360}{t}\right)$
Holding period yield (HPY) $= \frac{P_1 - P_0 + I_1}{P_0}$
Effective annual yield (EAY) $= (1 + HPY)^{\frac{365}{t}} - 1$
Money market yield (MMY) $= HPY \times \frac{360}{t}$
Bond-equivalent yield = 2 x Semi-annual YTM

**Arithmetic mean:** sum of all the observations divided by the total number of observations. $\mu = \frac{\sum_{i=1}^{N} X_i}{N}$

**Geometric mean:** used to calculate compound growth rate.
$R_G = [(1 + R1)\ (1 + R2) \ldots \ldots (1 + Rn)]^{1/n} - 1$

**Weighted mean:** different observations are given different weights as per their proportional influence on the mean. $\bar{X}_w = \sum_{i=1}^{n} w_i X_i$

**Harmonic mean:** used to find average purchase price for equal periodic investments. $X_H = n / \sum_{i=1}^{n} \left(\frac{1}{X_i}\right)$

**Position of a percentile in a data set:** $L_y = (n+1)\ y\ /100$

**Range** = maximum value – minimum value

**Mean absolute deviation (MAD):** average of the absolute values of deviations from the mean. MAD $= [\sum_{i=1}^{n}|X_i - \bar{X}|]/n$

**Variance:** mean of the squared deviations from the arithmetic mean.

Population variance $\sigma^2 = \sum_{i=0}^{N}(X_i - \mu)^2 / N$
Sample variance $s^2 = \sum_{i=0}^{n}(X_i - \bar{X})^2 / (n-1)$

**Standard deviation:** square root of variance.

**Coefficient of variation:** measures the risk per unit of return; lower value is better. CV $= \frac{s}{\bar{X}}$

**Sharpe ratio:** measures excess return per unit of risk; higher value is better. $S_p = \frac{\bar{R}_p - \bar{R}_F}{s_p}$

**Odds for an event** = P (E) / [1 – P (E)]
**Odds against an event** = [1 – P (E)] / P(E)

**Multiplication rule:** used to determine the joint probability of two events. P (AB) = P (A | B) P (B)
**Addition rule:** used to determine the probability that at least one of the events will occur. P (A or B) = P(A) + P(B) – P(AB)

**Total probability rule:** used to calculate the unconditional probability of an event, given conditional probabilities.
$P(A) = P(A|B_1)P(B_1) + P(A|B_2)P(B_2) + ... + P(A|B_n)P(B_n)$

**Covariance:** measure of how two variables move together.
Cov (X,Y) = E[X - E(X)] [Y - E(Y)]

**Correlation:** standardized measure of the linear relationship between two variables; covariance divided by product of two standard deviations.
Corr (X,Y) = Cov (X,Y) / σ (X) σ (Y)

**Expected value of a random variable:** probability-weighted average of the possible outcomes of the random variable.
$E(X) = X_1P(X_1) + X_2P(X_2) + ... + X_nP(X_n)$

**Expected returns and the variance of a 2-asset portfolio**
$E(R_P) = w_1 E(R_1) + w_2 E(R_2)$
$\sigma^2(R_P) = w_1^2\sigma_1^2(R_1) + w_2^2\sigma_2^2(R_2) + 2w_1w_2\rho(R_1, R_2)\sigma(R_1)\sigma(R_2)$

**Bayes' formula:** used to update the probability of an event based on new information. $P(E|I) = \frac{P(I|E)}{P(I)} \times P(E)$

**Expected value of a binomial variable**= np
**Variance of a binomial variable**= np(1-p)

**Probabilities for a binomial distribution** $P(x) = {}_nC_x\, p^x (1-p)^{n-x}$

**Probabilities for a continuous uniform distribution**
$P(x_1 \le X \le x_2) = \frac{x_2 - x_1}{b-a}$

**Normal distribution**: completely described by mean (μ) and variance ($\sigma^2$). Has a skewness of 0 and a kurtosis of 3.
Confidence intervals for a normal distribution are:

- 90% of all observations are in the interval x ± 1.65s.
- 95% of all observations are in the interval x ± 1.96s.
- 99% of all observations are in the interval x ± 2.58s.

**Computing Z-scores (std normal distribution):** $Z = \frac{(X-\mu)}{\sigma}$

**Safety first ratio:** used to measure shortfall risk; higher number is preferred. $SF_{ratio} = \frac{E(R_P) - R_T}{\sigma_P}$
**Continuously compounded rate of return:** r = ln (HPR +1)

**Sampling distribution:** If we draw samples of the same size several times and calculate the sample statistic. The sample statistic will be different each time. The distribution of values of the sample statistic is called a sampling distribution.

**Sampling error:** difference between a sample statistic and the corresponding population parameter.
Sampling error of the mean $= \bar{x} - \mu$

**Central limit theorem:** if we draw a sample from a population with mean μ and variance $\sigma^2$, the sampling distribution of the sample mean:

- will be normally distributed.
- will have a mean of μ.
- will have a variance of $\sigma^2/n$.

**Standard error of the sample mean:** standard deviation of the distribution of the sample means.

- if population variance is known, $\sigma_{\bar{X}} = \frac{\sigma}{\sqrt{n}}$
- if population variance is unknown, $s_{\bar{X}} = \frac{s}{\sqrt{n}}$

**Confidence intervals:** range of values, within which the actual value of the parameter will lie with a given probability.

- if population variance is known, CI $= \bar{X} \pm z_{\alpha/2}\frac{\sigma}{\sqrt{n}}$
- if population variance is unknown, CI $= \bar{X} \pm t_{\alpha/2}\frac{s}{\sqrt{n}}$

**Null hypothesis ($H_0$):** hypothesis that the researcher wants to reject. It should always include the 'equal to' condition.
**Alternative hypothesis ($H_a$):** hypothesis that the researcher wants to prove.

**One-tailed tests:** we are assessing if the value of a population parameter is greater than or less than a hypothesized value.
**Two-tailed tests:** we are assessing if the value of a population parameter is different from a hypothesized value.

**Test statistic** calculated from sample data and is compared to a critical value to decide whether or not we can reject the null hypothesis.
$z - \text{statistic} = \frac{\bar{X} - \mu_0}{\sigma/\sqrt{n}}$
$t - \text{statistic} = \frac{\bar{X} - \mu_0}{s/\sqrt{n}}$

**Type I error**: reject a true null hypothesis.
**Type II error:** fail to reject a false null hypothesis.

**Level of significance (α) =** (1 – level of confidence) = P(Type I error)
**Power of a test** = 1 – P(Type II error)