# Chapter 3: Quantitative Foundations

## Demonstrate knowledge of returns based on notional principal

### Recognize and apply the concept of forward contracts

Return=(Ending Value – Starting Value)∕Starting Value

### Define and apply the concepts of notional principal and full collateralization for forward contracts

To provide greater economic meanings, the return is often expressed on a fully collateralized basis. Fully collateralized: a position assumed to paired with a quantity of capital equal in value to the notional principal of contract

### Calculate the log return to a fully collateralized derivatives position

A fully collateralized position has 2 components of return

1. Change in value of derivative
2. Any return on collateral

where R is the change of derivatives price divided by previous price or notional value

### Calculate the log return to a partially collateralized derivatives position

Where l is the leverage

## Demonstrate knowledge of the internal rate of return (IRR) approach to alternative investment analysis

### Define and calculate the IRR

### Define and calculate the four types of IRR based on time periods for which cash flows are available and their relationship to valuation of alternative investments

There are four types of IRR based on time periods for which cash flows are available

1. Lifetime IRRs: contains all cash flows, realized or anticipated, occurring over investment’s entire life
2. Since-inception IRR: commonly used as a measure of fund performance rather than performance of an individual investment
3. Interim IRR: IRR based on realized cash flows from an investment and its current estimated residual value. The key to an interim IRR is that generally T would not be termination of investment; thus is an estimated value rather than realized cash flow.
4. Point-to-point IRR: calculation of performance over part of an investment’s life. All cash flows are based on realized or appraised values rather than expected cash flow over investment’s projected life

## Demonstrate knowledge of problems with the use of IRR in alternative investment analysis

### Recognize complex cash flow patterns, and discuss their effect on the computation and interpretation of IRRs

De **complex** **cash** **flow** **pattern**: investment involving either borrowing or multiple sign changes

Def **borrowing** **type** **cash** **flow** **pattern**: begins with one or more cash inflows and followed only by cash outflows

Def **multiple** **sign** **change** **cash** **flow pattern**: investment would be a natural resource investment involving: negative initial CFs from purchasing equipment and land to set up an operation such as mining; positive interim CFs from operations; and negative terminal CFs from ceasing operation and restoration expenses

1. In case of borrowing type CF pattern: there is a unique solution of IRR
2. In case of multiple sign change CF pattern: whenever there is more than one sign change in CF stream, more than one IRR may exist

### Discuss the challenges (e.g., scale differences) of comparing investments based on IRRs

The major challenge with comparing IRRs across investments occurs when investments have scale difference, which are when investments have unequal sizes and/or timing of their CFs. For example, $20 on $100 vs $150,000 on $1,000,000

Another challenge to IRR involves aggregation: relationship between IRRs of individual investments and IRR of combined CFs of investments. E.g. to combine IRR1=10% and IRR2=20%

### Discuss the reinvestment assumption inherent in the IRR and how it is addressed by the modified IRR

Even if all investments have simplified CF patterns without borrowing or multiple sign change problems, the IRR does NOT necessarily rank investments accurately

The use of IRR to rank investment alternatives is often said to rely on reinvestment rate assumptions, assumptions of rate at which any CFs not invested in particular investment or received during investment’s life can be reinvested during investment’s lifetime

### Compare and calculate time-weighted and dollar-weighted returns

**Time**-**weighted** **returns**: averaged returns that assume no cash was contributed or withdrawn during averaging period, after initial investment

For example, if we use time-weighted returns over 6-year period, the average annual return is

In effect, the time-weighted return assumes that a single investment was made at beginning of period and was allowed to grow with positive returns and decline with negative returns until the end of measurement period, with no cash withdrawals or additional contributions

**Dollar**-**weighted** **returns**: averaged returns that are adjusted for and therefore reflect when cash has been contributed or withdrawn during averaging period

Investment managers are best evaluated on time-weighted returns, as these managers should not be held accountable for CF decisions of their investors

## Demonstrate knowledge of the distribution of cash waterfall

### Explain the distribution of cash waterfall provision of a limited partnership agreement

Cash inflows to a fund in excess of costs of investment and expenses of fund represent waterfall that is distributed to GPs and LPs

Def **carried** **interest**: same as incentive fee or performance-based fee, which is a portion of profit paid to GPs as compensation for their services

Def **hurdle** **rate**: a return level that LPs must receive before GPs begin to receive incentive fees

Def **catch**-**up** **provision**: permits the fund manager to receive a large share of profits once hurdle rate of return has bene achieved and passed

Def **vesting**: process of granting full ownership of conferred rights, such as incentive fees

Def **clawback** **clause**: designed to return incentive fees to LPs when early profits are followed by subsequent losses

### Discuss factors (e.g., management fees, incentive-based fees) to consider in a fund’s compensation structure and the potential effects of decisions regarding compensation structure

Def **management** **fees**: regular fees that are paid from the fund to fund managers based on size of the fund, rather than profitability of the fund; used to cover the basic costs of running and administrating personnel; expenses related to development of investments

GP’s investment in fund: amount of capital they contribute to fund’s pool of capital

Def **incentive**-**based** or **performance**-**based** **fees**: critical part of compensation structure

### Discuss and calculate fund-as-a-whole carried interest and deal-by-deal carried interest

**Carried** **interest** can be **fund**-**as**-**a-whole** carried interest: based on aggregated profits and losses across all investments; or can be structured as **deal-by-deal carried interest**, based on performance of each individual investment

### Define and apply clawback provisions

The idea of typical clawback provisions is that incentive fees distributed to managers are returned when a firm experiences losses after profits so that the total incentive fees paid, ignoring the time value of money, are equal to the incentive fees that would be due if all profits and losses had occurred simultaneously

The goal of clawback provision is to protect the economic split agreed between GP and LP

Clawback typically refer to GP clawback, or corrective payments to prevent a windfall to fund manager

### Compare and apply hard and soft hurdle rates and their sequences of distribution

Sequence of cash distributions with a hard hurdle rate is as follows:

1. Capital is returned to LP till their investment has been repaid
2. Profits are distributed only to LP till hurdle rate is reached
3. Additional profits are split such that the fund manager receives an incentive fee only on profits in excess of hurdle rate

Def soft hurdle rate: allows fund manager to earn an incentive fee on all profits, given hurdle rate has been achieved. A soft hurdle has a catch-up provision that can be viewed as providing fund manager with a disproportionate share of excess profits till manager has received the incentive fee on all profits.

1. Capital is returned to LP till their investment has been repaid
2. Profits are distributed only to LP till hurdle rate is reached
3. Additional profits are split, with a high proportion going to fund manager till the fund manager receives an incentive fee on all the profits

Def catch-up provision: once fund manager has been paid an incentive fee on all previous profits, additional profits are split using incentive fees

### Discuss the potential effects of incentive fees on decision-making, and their optionlike nature

Incentive fees are long call options to GPs, where underlying assets=fund’s net asset value; time to expiration = time until next incentive fee is calculated; strike price = net asset value of fund at start of period in absence of hurdle rate

A hurdle rate may be viewed as increasing strike price of incentive fee call option. A hurdle rate increases the amount by which the net asset value of fund must rise before fund manager receives an incentive fee. The higher the hurdle rate, the lower the value of call option