Abstract. In this chapter, we present an approach based on AHP and fuzzy multiobjective programming (FMOP) to attain the convergence of suitability and optimality in portfolio selection. We use a typology of investors with a view to discriminate among investors types and asset clusters categorized on the basis of three evaluation indices. The local weights (performance scores) of each asset within a cluster with respect to the four key criteria, namely, return, risk, liquidity and suitability are calculated using AHP. These weights are used as coefficients of the objective functions corresponding to the four criteria in the multiobjective programming model. The multiobjective programming model is transformed into a weighted additive model using the weights (relative importance) of the four key criteria that directly influence the asset allocation decision. These criteria weights are also calculated using AHP. To improve portfolio performance on individual objective(s) as per investor preferences, we use an interactive fuzzy programming approach.

8.1 AHP Model for Suitability and Optimality Considerations

As discussed in the previous chapter, we use the following triadic typology of investor behavior: return seekers, safety seekers and liquidity seekers. Further, we use the following three clusters of assets as obtained in previous chapter.

(i) \textit{Cluster 1: liquid assets}
Assets in Cluster 1 are categorized as liquid assets, as mean value for liquidity is the highest in this cluster. This cluster is typified by low but widely varying returns.

(ii) \textit{Cluster 2: high-yield assets}
Assets in Cluster 2 are categorized as high-yielding ones, since they have rather high returns. On the expected lines of return/risk relationship, these assets also show high standard deviation. Although, investors may gain from
the high returns, they also have to endure the high risk. However, these assets have low liquidity amongst all the clusters indicating that high-yielding investment involves a longer time horizon.

(iii) **Cluster 3: less risky assets**
Assets in Cluster 3 are categorized as less risky assets, since compared to other clusters, these assets manifest the lowest standard deviation for the cluster. The return is not high but medium. The liquidity is medium too.

These asset clusters have a *prima facie* suitability for the above stated investor types. We calculate the local weights (performance scores) of each asset within a cluster with respect to key asset allocation criteria and the weights (relative importance) of the key criteria when making the asset allocation decision using AHP. The AHP model used here comprises five levels of hierarchy. Level 1 represents the overall goal, i.e. Asset Allocation. Level 2 represents the key criteria (Return, Risk, Liquidity and Suitability) that directly influence the goal. At level 3, Return criterion is broken into Short Term Return, Long Term Return and Forecasted Return; Risk criterion is broken into Standard Deviation, Risk Tolerance and Microeconomic Risk; Suitability criterion is broken into Income and Savings, Investment Objectives and Investing Experience. At level 4, suitability subcriteria are further broken into 11 subcriteria that may affect the choice of assets. At the bottom level of the hierarchy, the alternatives (i.e., assets) are listed (please refer to Fig. 8.1 for complete structural hierarchy).

Note that to determine the local weights of the assets with respect to the quantitative measures of performance, namely, short term return, long term return, risk (standard deviation) and liquidity, we have relied on actual data, that is, the past performance of the assets. The question for pairwise comparison of quantitative criteria can be considered as:

‘Of two elements $i$ and $j$, how many times $i$ is preferred to $j$’

If the values for the alternatives $i$ and $j$ are, respectively, $w_i$ and $w_j$, the preference of the alternative $i$ to $j$ is equal to $w_i/w_j$. Therefore, the pairwise comparison matrix is

$$
\begin{pmatrix}
\frac{w_1}{w_1} & \frac{w_1}{w_2} & \ldots & \frac{w_1}{w_n} \\
\frac{w_2}{w_1} & \frac{w_2}{w_2} & \ldots & \frac{w_2}{w_n} \\
\vdots & \vdots & \ddots & \vdots \\
\frac{w_n}{w_1} & \frac{w_n}{w_2} & \ldots & \frac{w_n}{w_n}
\end{pmatrix}
$$

As this matrix is consistent, the weight of $i$-th element is its relative normalized amount, i.e., $\frac{w_i}{\sum_{i=1}^{n} w_i}$

The priority of the alternative $i$ to $j$ for negative criterion, such as risk, is equal to $w_j/w_i$. The pairwise comparison matrix is therefore