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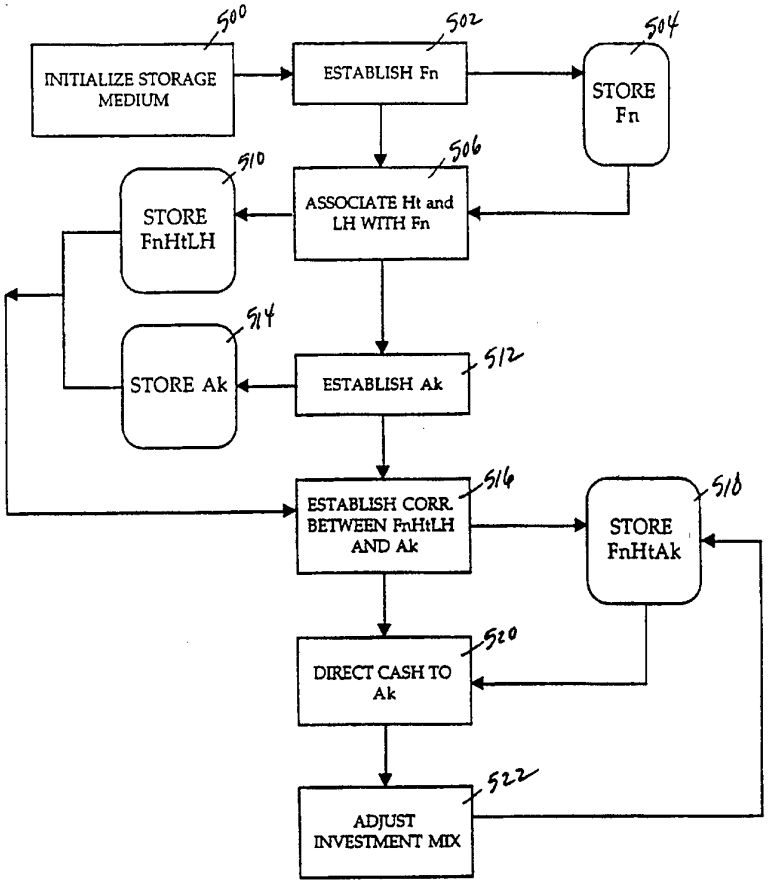
(54) **Title:** INVESTMENT FUND MANAGEMENT METHOD AND SYSTEM

(57) **Abstract**

Method and system for management of an investment fund over a specified life, or time horizon H_t, for that fund. Generally, the system includes an investment fund F_n having a fixed time horizon H_t and an associated length to horizon L_H. The fund F_n includes several investment assets A_k, which may be contained within investment portfolios P_m, which meet some criteria defining predetermined asset characteristics. Cash is directed to selected ones of the assets, or portfolios, to establish an investment mix for the investment fund F_n. An important aspect of the invention is adjustment of the investment mix in accordance with some criteria related to the time horizon H_t, preferably related to the diminishing length to horizon L_H, of the investment fund F_n. Thus, as the investment fund matures, the investment mix is changed.



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INVESTMENT FUND MANAGEMENT METHOD AND SYSTEM

BACKGROUND OF THE INVENTION

The present invention relates generally to the field of business systems, and specifically relates to the field of investment fund management systems.

Long-term investment plans, such as pension plans, enable an investor to save for retirement. Pension plans typically are divided into two types: defined benefit plans; and defined contribution plans. A defined benefit plan involves a promise made by an employer of a lifetime definite benefit paid to the recipient after retirement. The employer funds the promise by investing in trust for the recipient. In a defined contribution plan, the employer and/or the employees contribute a definite amount of money to an investment plan. The benefit paid after retirement is uncertain; it is determined by the performance of the investment plan. 401K plans are an example of defined contribution plans.

In a typical defined contribution plan, the employer establishes a group of investment funds of specified characteristics, from which the employee may select. The group of funds typically is diverse, including funds specializing in bonds, stocks, money markets, and other asset classes, or combinations of asset classes. These funds may be collective investment funds or mutual funds, managed by the employer or by a third party.

An employee typically invests in a fund having characteristics matching his or her investment preferences, such as high-risk/high expected return or low-risk/low expected return. Over time, as the employee's investment preferences change, that

employee may move his or her investment from one fund to another to reflect a change in preferences. But because the typical employee generally is not a trained investment expert, it is possible that sub-optimal selections may be made from among the funds, and that the selections are not optimally revised over time.

Many employees in defined contribution plans do not appreciate that investments with high-risk and high expected return -- such as equity securities -- may be appropriate even for risk averse investors if their time horizons are sufficiently far in the future, and if the investment is properly diversified. Thus, many employees tend to invest more conservatively than an investment expert would do under like circumstances. Because conservative investments generally have low returns over the long term, an unnecessarily risk-averse strategy may be expected to produce disappointing long-term performance.

Many employees in defined contribution plans do not possess sufficient expertise to select investment funds to match their risk preferences, even when their risk preferences are appropriate. As a result, investments may be selected that either expose an employee to unexpected risks, or expose the employee to unexpectedly low returns.

Finally, many employees in defined contribution plans do not possess sufficient expertise, or wish to devote sufficient time and attention, to appropriately revise their selection of funds as market conditions change, and as their own life circumstances change. If an employee neglects to revise his or her investments, or revises them inappropriately -- perhaps due to emotions of fear or greed -- that employee will be exposed to unexpected and inappropriate risks when market conditions change, or when his or her own life circumstances change.

The typical employee generally is unwilling to pay the costs to obtain private professional investment advice, or may be unaware that it is available. The typical employer generally is unwilling to provide advice to employees, either due to a lack of sufficient expertise, or due to an unwillingness to bear potential legal liabilities. Thus, there remains a need for a system and method for a typical employee in a defined contribution plan to make appropriate investments, to reflect appropriate long-term trade-offs of risk and return, to select investments that accurately reflect those trade-offs, and to revise those investments through time in response to changing market conditions and the employee's changing preferences.

SUMMARY OF THE INVENTION

The present invention relates to a method and system for managing one or more investment funds over a specified life of that fund. The data processing method of the present invention involves determining a time horizon H_t associated with each investment fund F_n. The time horizon H_t defines the expected date at which cash may need to be withdrawn from the fund and has an associated parameter L_H representative of the length of time remaining between the present and the time horizon H_t. A plurality of investment assets are stored, together with information regarding each asset. These assets may be maintained within portfolios, each portfolio having a predetermined characteristic, thus the compilation of associated assets may reflect or establish the portfolio characteristic.

Cash initially is directed to selected ones of the assets or portfolios, to establish an investment mix. The investment mix is adjusted at periodic intervals in accordance with some criteria that is related to the diminishing length to time horizon L_H. The criteria may include a change in risk tolerance R_I, as a function of the remaining length to time horizon L_H, associated with each fund. Typically, the

R_I value decreases as the fund approaches the time horizon H_t. The criteria may include other processes or rates that are keyed to the time horizon of the fund.

The assets or portfolios included in each investment fund may be correlated to the fund based on factors in addition to L_H and H_t, such as initial risk tolerance R_I, and/or some predetermined investment criteria L_I. The predetermined investment criteria L_I may include such criteria as invest only in equity securities, diversify across a minimum number of asset classes, invest a percentage in money market instruments, and the like. In addition, individual portfolio characteristics may be based on several criteria, including expected volatility of the investment assets, expected responsiveness of the investment assets to market conditions, and expected return on the investment assets.

The present invention also is directed to a data processing system that corresponds to and performs the above described method. The invention is described in further detail in the following drawings and detailed description.

BRIEF DESCRIPTION OF THE FIGURES

FIGURE 1 depicts an exemplary investment fund structure embodying the present invention.

FIGURE 2 depicts a shift in distribution of cash among the portfolios of an exemplary fund, over the life of the fund, in accordance with the present invention.

FIGURE 3 depicts a block diagram of an exemplary data processing system embodying the present invention.

FIGURE 4 depicts a flow chart of an embodiment of the present invention.

FIGURES 5A-5D depict return-to-risk charts of exemplary funds managed in accordance with the present invention.

FIGURE 6 depicts a flow chart of an embodiment of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

The present invention is a system and method for managing investment funds wherein each fund has a fixed time horizon H_t and a diminishing length to horizon L_H. That is, the fund is managed by manipulating the investment mix of the fund in accordance with some criteria related to the diminishing length to horizon L_H of the fund.

Generally, the method includes establishing an investment fund F_n with a fixed time horizon H_t and a diminishing length to horizon L_H. A relationship is established between at least one investment asset and the fund in accordance with a first set of criteria. One or more investment assets may be contained in a portfolio, which portfolio may be in some relationship with the fund. Cash may be directed to selected ones of the assets or portfolios to establish an investment mix for the investment fund. An important aspect of the invention is adjustment of the investment mix in accordance with some criteria related to the diminishing length to horizon L_H of the investment fund F_n. Thus, as the investment fund matures, the investment mix is changed within the fund.

One exemplary manner in which the investment mix may change over the life of the fund is to change the distribution of new cash across the portfolios as such cash is invested in the fund or otherwise becomes available. Another manner is to

change the asset or portfolio mix by exchanging assets or portfolios having one type of characteristic for assets or portfolios having a different type of characteristic. Typically, the investment strategy of an investment fund will become more conservative as it approaches maturity and the distribution of cash among the assets or the mix of portfolios reflects that change in the fund.

FIGURE 1 graphically depicts an exemplary investment fund structure embodying the present invention. As shown, a plurality of investment funds F_n are made available to individual investors. Each fund has an associated time horizon H_t, which indicates the date that the individual investor anticipates receiving money from the fund. The time horizon H_t preferably is expressed in terms of a specific calendar date for maturity. Also associated with each fund F_n is a length to horizon L_H which represents the remaining time between the present and the time horizon H_t.

In an alternative embodiment, each fund F_n also may have an associated risk tolerance value R_I, representative of whether the individual investor generally has a conservative or aggressive investment strategy. In another embodiment, an individual investor may impose other constraints for a particular fund, such as designation of allowable investments. For example, an investor may designate that the fund should consist only of domestic investments, or the fund should contain a predominant portion of portfolios directed to a specified technology or industry. In this manner, some funds of a specific time horizon H_t may be established which are tailored in accordance with investor-specified attributes.

A relationship may be established between one or more investment portfolios P_m and each investment fund F_n. The portfolio P_m has an associated portfolio characteristic, or parameter, that may be predetermined either by the fund manager or by the individual investor. The portfolio characteristic typically is determined by

or defines the type of assets constituting the portfolio. These assets may be characterized by such factors as the expected volatility of the investments, the expected responsiveness to market conditions, and expected return on the investments. Thus, an investment fund F_n having a particular time horizon H_t typically consists of several portfolios, each portfolio having a different characteristic. Alternatively, a relationship is established between one or more investment asset A_k, without the use of a portfolio. In that embodiment, each investment asset A_k is handled in a manner similar to a portfolio P_m.

The portfolios P_m of FIGURE 1 may each consist of one or more investment asset A_k, or an asset mix, each representing a major asset class. These assets may include securities, such as stocks, bonds, and the like and may be combined in a manner that achieves the predetermined portfolio characteristic.

In one embodiment, and as shown in FIGURE 2, each fund F_n may include a portion known as present value of future cash flow P_{vf}. This portion represents a "phantom asset", or the total value of all future cash flows that are expected to be received for the fund F_n. In that illustrated embodiment, the fund F_n has a current balance C_B representative of the current value of the portfolios (P_1-P_5), including any cash available for investing. Available cash is removed from the P_{vf} as it becomes available for investing in the portfolios of the particular fund F_n.

An important aspect of the present invention is maintaining a total fund balance, including P_{vf} and C_B, of a particular fund, while changing the investment mix of that fund over the time horizon for that fund. One way in which the present system may administer the investment funds, each fund having a fixed time horizon, is to adjust the investment mix in accordance with some identified criteria.

In one embodiment of the invention, and as depicted in FIGURE 2, the investment mix is adjusted by adjusting the percentage of available cash distributed among the portfolios P_m in each fund F_n. As shown, cash initially is invested in the portfolios P_1 - P_5 in accordance with a certain percentage. In the illustrated embodiment, P_1 has a relatively high-risk characteristic, whereas P_5 has a relatively low-risk characteristic. While the fund is young, i.e., the P_{Vf} (60%) is greater than the cash balance C_B (40%), the individual portfolios have a greater relative percentage of cash invested in the higher-risk portfolios P_1 and P_2. Over the maturity of the fund, the cash is distributed among the portfolios such that near the time horizon for the fund, the portfolios have a greater relative percentage of value invested in the lower-risk portfolios P_4 and P_5.

In a preferred embodiment, the change in distribution of available cash may be a function of not only length to horizon L_H but also of risk tolerance R_I, as previously described, associated with the particular fund. Other processes that consider the time horizon of the fund may be used in conjunction with the present system.

In another embodiment, the portfolio mix or asset mix for a given fund is adjusted as a function of the length to horizon L_H by exchanging individual ones of the portfolios P_m or investment assets A_k for portfolios or investment assets having different characteristics. Typically the exchange is between portfolios or assets having higher-risk characteristics for ones having lower-risk characteristics. As with the illustrated embodiment of FIGURE 2, these changes may be made as some function of the time horizon and risk tolerance R_I, depending on the particular system.

The hardware environment of the present system is depicted generally in FIGURE 3. As shown, the system 410 includes an input device 400, such as a

keyboard, in communication with a computer 402, including a processor 404 and at least one memory device 406. The elements of the present system 410 may be embodied in one or more processors 404, one or more devices that constitute the processor 404, or any other standard hardware devices commercially available. The system 410 also may include a display device 408 for generating a display of one or more of the outputs of the present system.

FIGURE 4 depicts a flow chart of one embodiment of the present system. In the illustrated system, the storage medium 406 is initialized 500 by the processor 404 or by some other device in the computer 402. One or more investment funds F_n are established 502 by the processor 404 and stored 504 in the storage medium 406. A time horizon H_t and a length to horizon L_H are associated 506 with each of the stored investment funds F_n, and the data $F_nH_tL_H$ is stored 510 in the storage medium 406. At the same time, or at a separate time, one or more investment asset A_k may be established 512 and stored 514 on the storage medium. Alternatively, step 512 may include establishing a portfolio P_m having one or more assets A_k.

The processor 402 establishes 516 a correlation between the stored $F_nH_tL_H$ data and the stored A_k or P_m data, and that correlated data is stored 518 in the storage medium. The processor 402 directs 520 available cash funds to the investment assets A_k or portfolios P_m associated with each fund F_n and according to the length to horizon L_H associated with each fund F_n, as described in detail above. The initial distribution 520 of cash among the investment assets A_k or portfolios P_m establishes the investment mix of each fund F_n. It is this investment mix that is adjusted 522 in accordance with some predetermined criteria, as described in further detail below, which criteria also is a function of the length to horizon L_H associated with the fund F_n.

In one embodiment of the present invention, as described above, the system 410 includes a single storage medium 406 that is used to store the output of each of the elements of the system. In alternative embodiments, the system 410 may include a plurality of storage media, each of which may be used to store the output generated by different ones of the elements. Thus, reference to a storage medium includes the same or different storage media for purposes of the present invention.

In a preferred embodiment, the criteria by which the investment mix is adjusted 522 is a rate of risk tolerance R_I that is related to the investment fund F_n as a function of the length to horizon L_H associated with that fund F_n.

There may be a correlation between the expected risk of an investment and the expected return on investment. By associating the time horizon H_t with a risk indicator, such as R_I, it may be possible to decrease the amount of risk in investments over the life of a particular fund. For example, a fund F_1 that has an H_t of 40 years may have an initial investment mix that has high expected risk because the investor has high risk tolerance R_I. Conversely, a fund F_2 may have an associated H_t of 10, in which the R_I is quite low, leading to conservative investment mix.

In practicing a preferred embodiment of the present invention, and as shown in FIGURES 5A - 5D, once a fund F_n is established, the risk tolerance R_I shifts over time for that fund, without transferring any cash out of the fund. The illustrated fund F_n has a time horizon H_t of 40 years. In the first year, FIGURE 5A, the R_I is high, thus the investment mix will reflect the aggressive investment approach. Over time, as L_H diminishes, the R_I shifts and the fund becomes more risk averse, as illustrated in FIGURE 5B. Over time, the R_I for the fund F_n decreases until a more conservative, or less aggressive, investment mix is achieved, as illustrated in

FIGURES 5C and 5D. The R_I remains fixed, i.e., conservative or aggressive, but the level shifts over the diminishing length to horizon L_H.

FIGURE 6 depicts a general flow chart of a preferred embodiment of practicing the adjusting step 522 of the present invention. In the illustrated embodiment, information is obtained 700 from an individual investor regarding investor portfolio information and market data 800 is obtained regarding the market. The step of obtaining 700 investor portfolio information includes establishing a current portfolio 702, which becomes the repository for assets and cash. Investor assumption data may also be obtained 704.

The step of obtaining 700 investor portfolio information also includes obtaining 706 risk tolerance data. Such data includes both the investor policy risk tolerance, which typically is a measure of an aggressive/conservative investment policy on behalf of the investor, and a market response coefficient, which typically is a measure of whether the investor is generally contrary, market neutral, or insurance oriented. An investor risk tolerance R_I is determined 708, which may be used in determining 812 portfolio risk, described in further detail below.

Finally, the step of obtaining 700 investor portfolio information may include obtaining 710 contribution data. That data may include such factors as the investor's current salary, expected growth rate of that salary, the investor's contribution rate, any matching funds contributed by a third source, the investment horizon H_t, plus any outstanding or current fund balance. Other factors may be included or omitted as appropriate for an individual investor or system. Each of these factors may be used, in combination or individually, to calculate 712 the anticipated cash flow stream for the investor.

The step of obtaining 800 market data preferably includes the steps of obtaining 802 interest rate data and obtaining 804 other market data. The step of obtaining 802 interest rate data may include calculating 806 some discount function that then may be used, in

combination with the anticipated cash flow stream produced in step 712, to determine 808 the present value of future cash flow P_{vf}, in the form of future cash flows.

The step of obtaining 804 other market data may include determining market risk premiums, expected returns, and transaction costs associated with buying/selling portfolios and/or individual assets, which may include obtaining alphas for each portfolio and/or each asset. An alpha is defined as the difference between the investor's expected return and the observed market consensus expected return for any particular portfolio or asset. Other values may be obtained 804 as appropriate for the particular system and investors. The market data may be used to forecast 810 market risks and returns, and to determine 812 the portfolio risk.

The fund then is optimized 900 in accordance with any commercially available optimizer program or system, such as AAT, available from Scientific Press (So. San Francisco, CA). Inputs to an optimizer program 900 typically include a lower bound, which may be set to be that portion of the portfolio which represents the present value of all future contributions to the portfolio by the investor, or set in accordance with the investors' desired minimal exposure to an asset class or portfolio. Optimizers 900 typically also include an upper bound, which represents a maximum exposure that any investor wishes to have to one or more asset classes or portfolios. Other inputs of available optimizers typically include: asset and/or portfolio characteristics, such as expected returns, risks, and correlations; transactions costs of all types; current holdings; and investor risk tolerance. Other parameters may be considered or omitted, depending upon the particular optimizer used in conjunction with the present invention.

The present system may further include creating 902 an investor trade list. The trade list may be in the form of output from the optimizer 900, and lists the assets that need to be exchanged to obtain an optimal mix of investments. The investor portfolio may then be rebalanced 904, then maintained 906 for a specified

period, such as for one month. Typically, trade lists are a necessary part of the process even when trading activity is motivated by contributions or withdrawals of cash.

While one particular embodiment of the invention has been described in detail, it will be understood that the invention may be implemented through alternative embodiments. Thus, the scope of the invention is not intended to be limited to the embodiments described above, but is to be defined by the appended claims.

What is claimed is:

CLAIMS

1. A data processing method for administering a plurality of investment funds, each fund having an associated investor and associated cash, the method comprising:

A. determining a time horizon H_t, associated with each investment fund;

B. storing information representative of a plurality of investment assets in a first storage medium;

C. establishing a relationship between at least one of the investment assets with each investment fund in accordance with a first set of criteria, the first set of criteria including length to horizon L_H;

D. directing the cash to selected ones of the investment assets to establish an investment mix;

E. adjusting the investment mix over the length to horizon L_H in accordance with a second set of criteria related to a decreasing length to horizon L_H.

2. The method of claim 1, further comprising a plurality of investment portfolios, each portfolio including at least one investment asset and having at least one predetermined portfolio characteristic.

3. The method of claim 2, wherein the step of establishing a relationship comprises establishing a relationship between at least one of the investment portfolios with each investment fund in accordance with the first set of criteria.

4. The method of claim 3, wherein the step of directing cash comprises directing cash to selected ones of the portfolios.

5. The method of claim 2, further comprising the step of determining the portfolio characteristic based on a third set of criteria.

6. The method of claim 5, wherein the third set of criteria comprises one from the group comprising: volatility of the investment asset; responsiveness of the investment asset to market conditions; and, expected return on the investment asset.

7. The method of claim 1, wherein the first set of criteria comprises at least one from the group comprising: an investor risk tolerance R_I; and, a predetermined investment criteria.

8. The method of claim 1, further comprising the steps of:

generating a cash flow P_{Vf} value representative of a present value of future cash flow and a cash balance C_B value correlated with each P_{Vf} value representative of a current cash balance, including available cash, associated with each investment fund; and

storing the P_{Vf} and C_B values in a second storage medium.

9. The method of claim 8, wherein the second set of criteria comprises a change in a risk tolerance R_I as a function of the decreasing length to horizon L_H associated with each investment fund.

10. The method of claim 9, wherein the step of adjusting the investment mix further comprises directing the available cash, at predetermined time intervals, among the investment assets for each investment fund in accordance with the stored R_I.

11. The method of claim 10, further comprising the step of decreasing the R_I value at predetermined time intervals.

12. The method of claim 8, further comprising the steps of:

updating the P_{Vf} value and the C_B value; and

storing the updated values on a storage medium.

13. The method of claim 1, wherein the step of adjusting the investment mix comprises:

exchanging at least one investment asset having a first characteristic with another asset having a second characteristic in one of the investment funds in accordance with the second set of criteria.

14. The method of claim 13, wherein the second set of criteria comprises a change in a risk tolerance R_I as a function of the decreasing length to horizon L_H associated with each investment fund.

15. The method of claim 14, further comprising decreasing the R_I value at predetermined time intervals.

16. The method of claim 2, wherein the step of adjusting the investment mix comprises:

exchanging at least one investment asset having a first characteristic with another asset having a second characteristic in one of the investment funds in accordance with the second set of criteria.

17. The method of claim 16, wherein the second set of criteria comprises a change in a risk tolerance R_I as a function of the decreasing length to horizon L_H, associated with each investment fund.

18. The method of claim 17, further comprising decreasing the R_I value at predetermined time intervals.

19. A data processing system for managing investments for investors, comprising:

A. at least one storage medium for storing data representative of a plurality of investment funds;

B. initializing means for initializing the storage medium;

C. first processor means for associating time horizon data representative of a fixed time horizon H_t and length to horizon data L_H representative of time remaining to the time horizon H_t with selected ones of the investment funds, and for storing the associated time horizon data and length to horizon data on the storage medium;

D. second processor means for processing asset data representative of a plurality of investment assets, for associating selected ones of the investment assets with selected ones of the investment funds, and for storing the associated investment assets on the storage medium;

E. third processor means, in communication with the first and the second processor means, for establishing an investment mix associated with each investment fund, including means for directing cash investments to selected ones of the investment assets, and for storing the associated investment mix on the storage medium; and

F. fourth processor means, in communication with the third processor means, responsive to the length to horizon data, for adjusting the investment mix.

20. The data processing system of claim 19, further comprising:

fifth processor means, in communication with the fourth processor means, for processing risk data representative of a rate of risk tolerance R_I related to the investment fund as a function of the stored length to horizon data.

21. The data processing system of claim 20, wherein the third processor means further comprises means, in communication with the fifth processor means, for allocating the cash data among selected ones of the investment assets in accordance with the risk data.

22. The data processing system of claim 19, wherein the second processor means comprises means for processing portfolio data representative of a plurality of portfolios, each having at least one investment asset, for associating selected ones of the portfolios with selected ones of the investment funds, and for storing the associated portfolios on the storage medium.

23. The data processing system of claim 22, further comprising:

fifth processor means, in communication with the fourth processor means, for processing risk data representative of a risk tolerance value R_I related to the investment fund as a function of the stored length to horizon data.

24. The data processing system of claim 23, wherein the third processor means further comprises means, in communication with the fifth processor means, for allocating the cash data among selected ones of the portfolios in accordance with the risk data.

25. The data processing system of claim 19, wherein the initializing means further comprises, means for creating locations on the storage medium for storing data representative of:

(a) a present value of future cash flow P_{Vf} asset associated with each investment fund; and

(b) risk tolerance R_I associated with each investor.

26. The data processing system of claim 25, wherein the third processor means further comprises means for directly correlating the P_{Vf} data with the cash data such that a decrease in the P_{Vf} data results in a corresponding increase in the cash data.

27. The data processing system of claim 19, wherein the second processor means further comprises:

(a) means for inputting and storing on the storage medium data regarding a plurality of asset classes; and

(b) means for establishing correlations among the asset classes.

28. The data processing system of claim 27, wherein the second processor means further comprises means for inputting and storing on the storage medium data representative of expected volatility of selected ones of the asset classes.

29. The data processing system of claim 19, wherein the second processor means further comprises means for inputting and storing on the storage medium data regarding predetermined limitations associated with each investment fund.

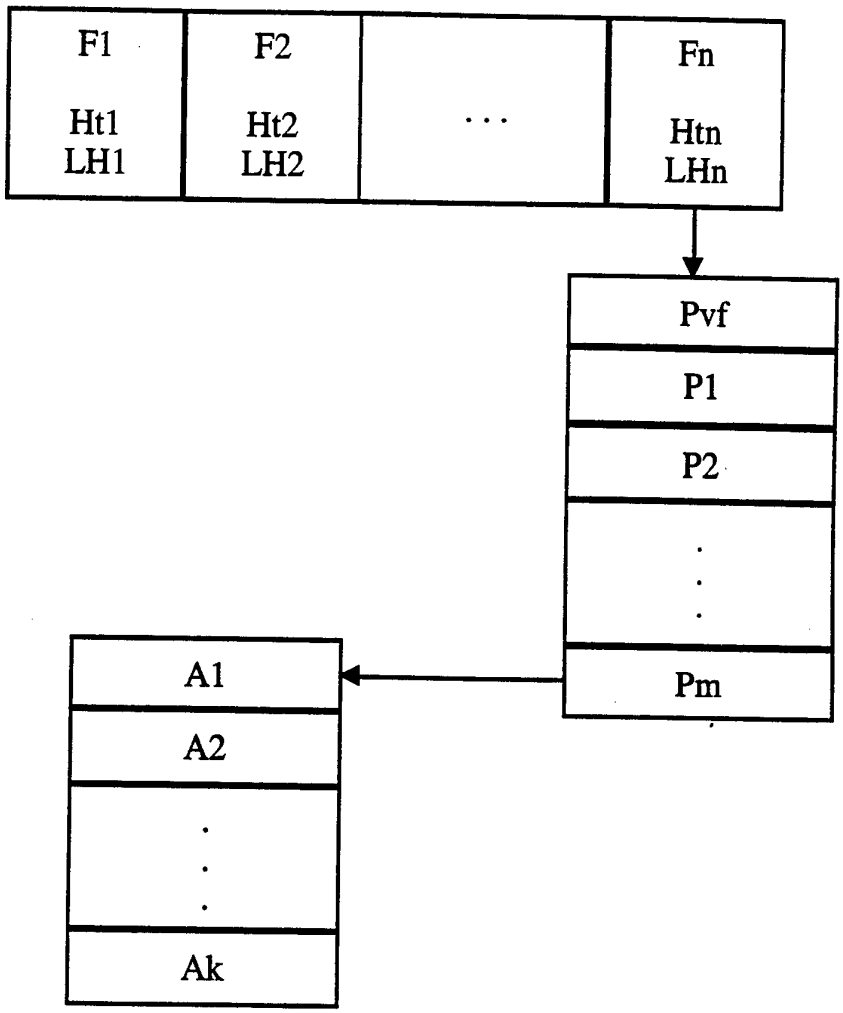


FIGURE 1

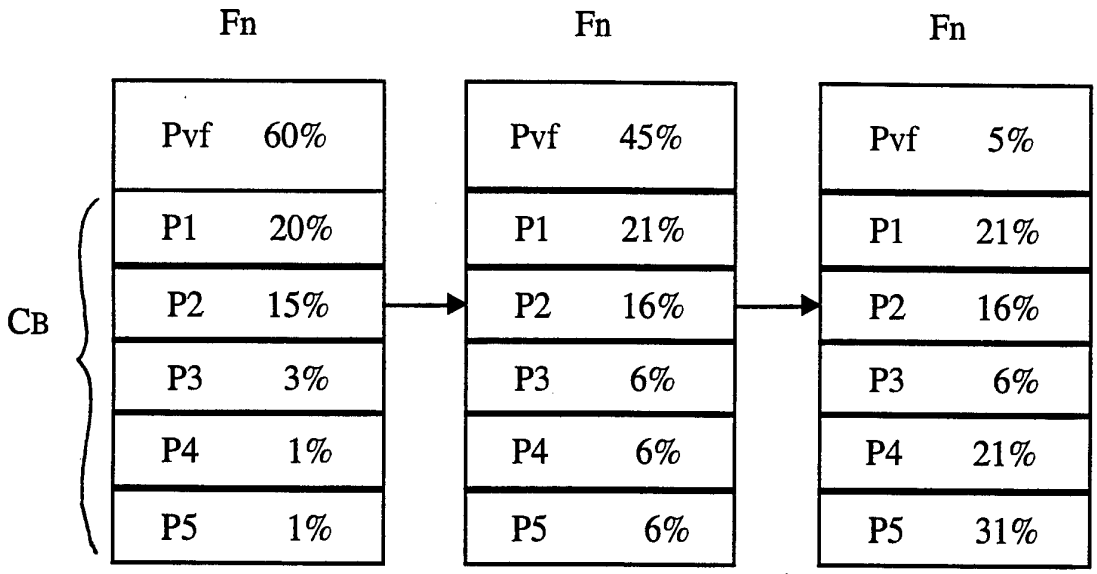


FIGURE 2

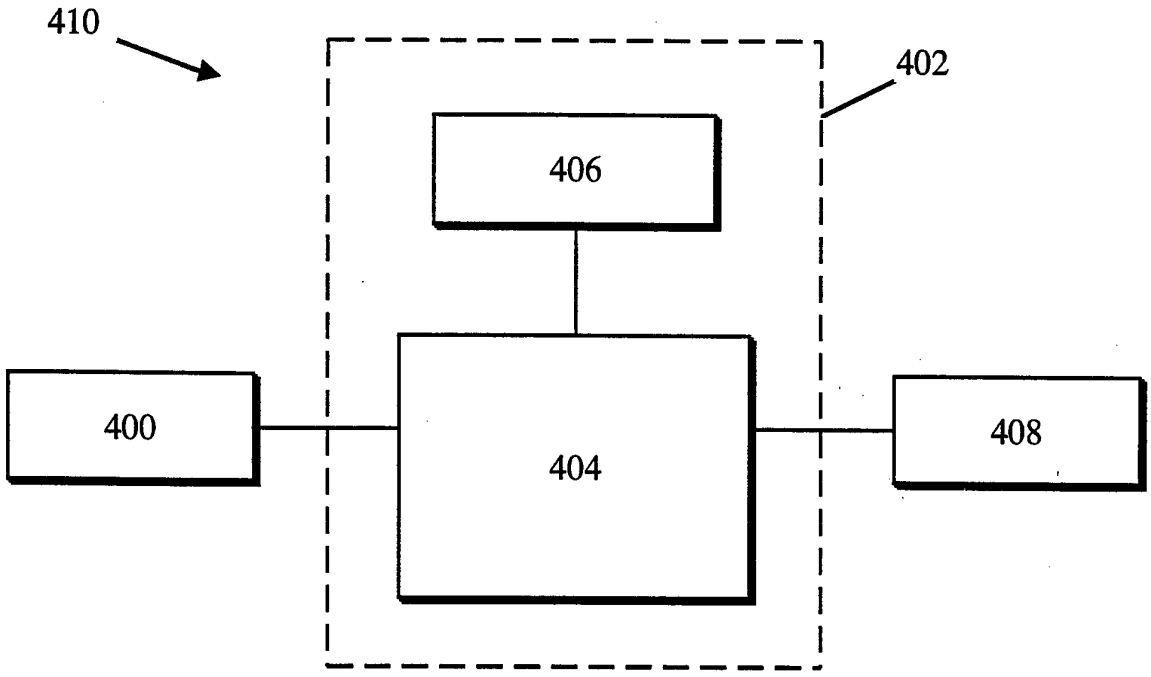
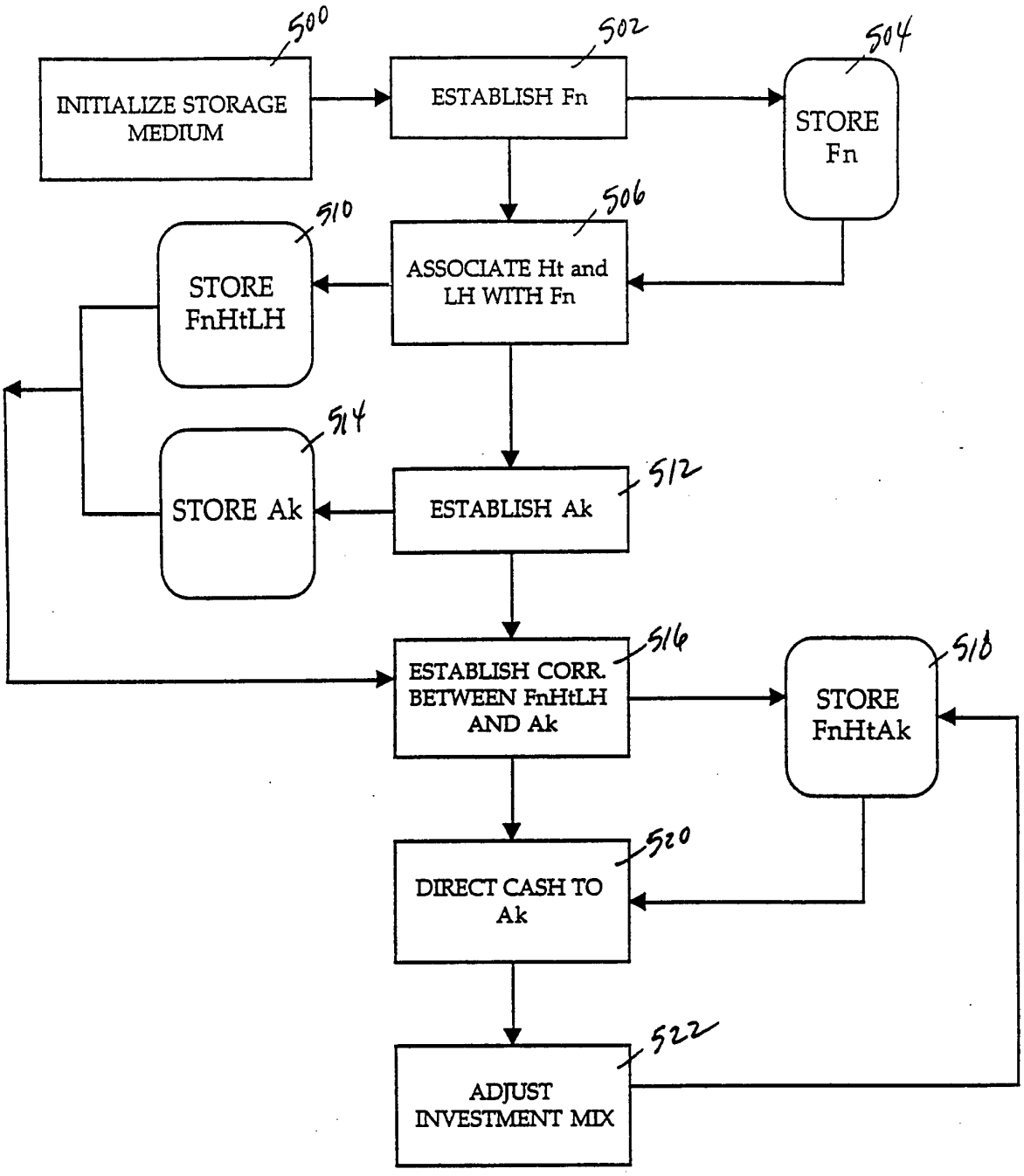


FIGURE 3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INITIALIZE STORAGE MEDIUM
502
ESTABLISH Fn
504
STORE Fn
506
ASSOCIATE Ht and LH WITH Fn
510
STORE FnHtLH
514
STORE Ak
512
ESTABLISH Ak
516
ESTABLISH CORR. BETWEEN FnHtLH AND Ak
518
STORE FnHtAk
520
DIRECT CASH TO Ak
522
ADJUST INVESTMENT MIX

FIGURE 4



FIG. 5A

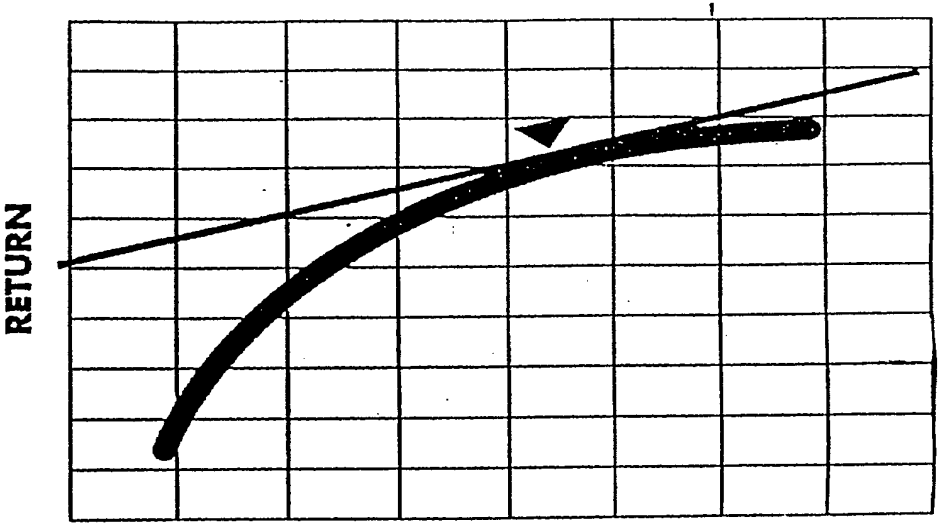

FIG. 5B



FIG. 5C

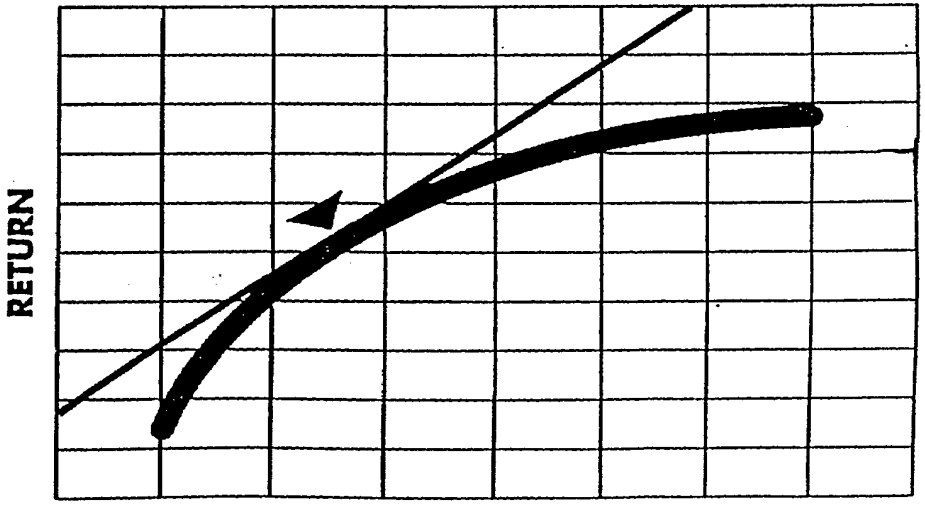

FIG. 5D

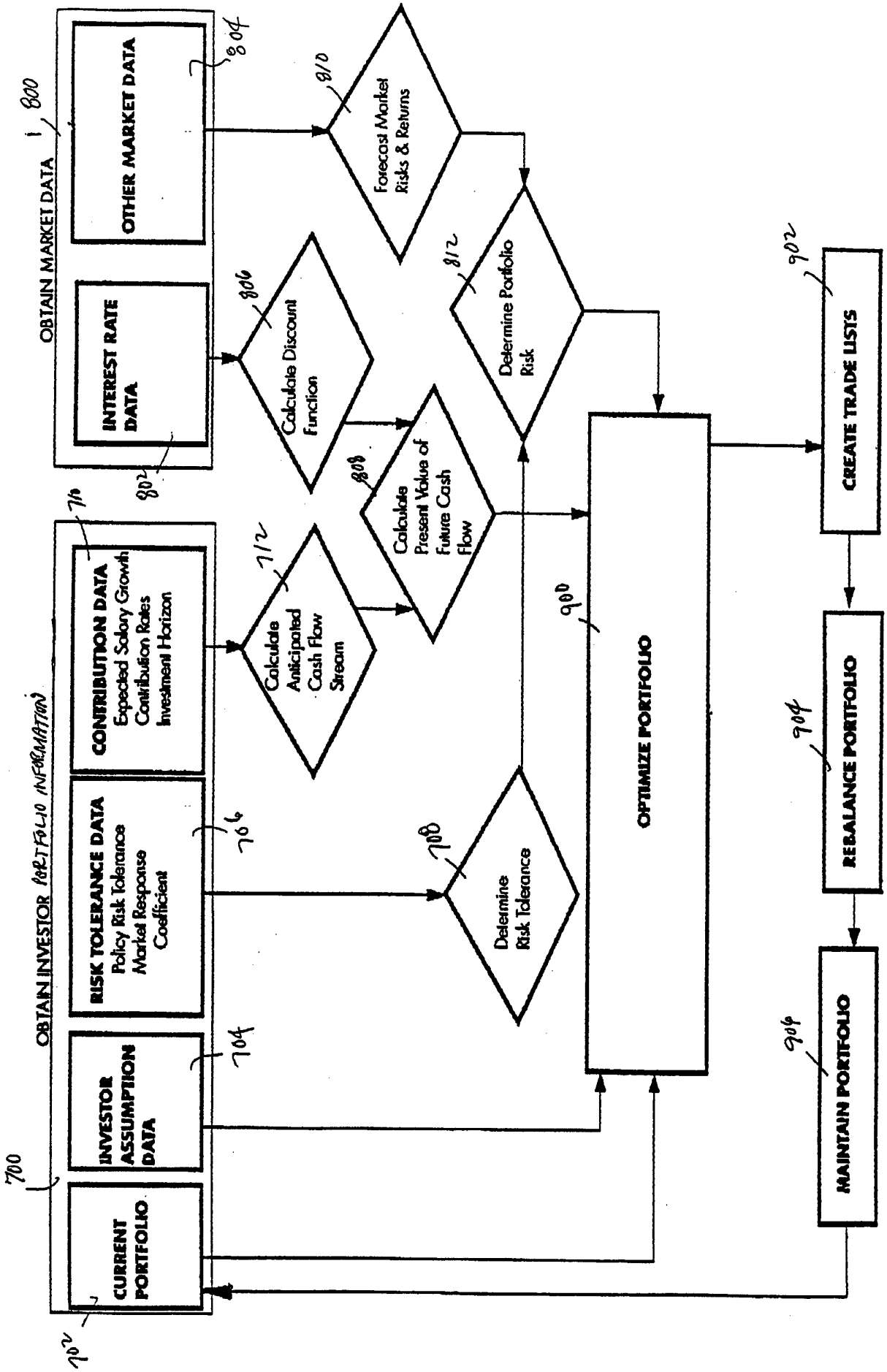
OBTAIN INVESTOR PORTFOLIO INFORMATION
700
CURRENT PORTFOLIO
INVESTOR ASSUMPTION DATA
RISK TOLERANCE DATA
Policy Risk Tolerance
Market Response Coefficient
CONTRIBUTION DATA
Expected Salary Growth
Contribution Rates
Investment Horizon
OBTAIN MARKET DATA
800
INTEREST RATE DATA
OTHER MARKET DATA
Calculate Discount Function
Calculate Present Value of Future Cash Flow
Calculate Anticipated Cash Flow Stream
Forecast Market Risks & Returns
Determine Portfolio Risk
Determine Risk Tolerance
OPTIMIZE PORTFOLIO
CREATE TRADE LISTS
REBALANCE PORTFOLIO
MAINTAIN PORTFOLIO

FIGURE 6