

A Process for Selecting a Life Insurance Contract

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Abstract

In the market for life insurance, individuals face many product alternatives, however, little guidance is provided in product selection other than basic descriptions of plan benefits and costs. While objective criteria are important to the purchase decision, an individual's subjective valuation of all criteria, objective and subjective, play the pivotal role. A multi-attribute life insurance contract choice model is presented to assist an individual in the problem of choosing the optimal life insurance contract conditional upon the preference set of the individual. The analytic hierarchy process is employed to structure the decision and determine the optimal life insurance contract.

Introduction

The selection of the best life insurance contract has been a problem confronted by researchers who have offered consumers numerical recipes to solve for the contract of best value or lowest cost. Kensicki (1974), Babbel (1978), and Babbel and Staking (1983) have used net present value analysis to measure the cost of a life insurance contract, while the interest-adjusted net payment and surrender cost indices are well known methods to evaluate a life insurance contract's projected cost.¹ There also exist a text of positive, theoretical literature that describe optimal life insurance purchasing behavior when a consumer is faced with an uncertain lifetime.² However, there is no decision model that integrates an individual's objectives and constraints with respect to the choice of the best life insurance product.

This article posits such a decision model. The determination of an individual's optimal life insurance contract among competing contracts is resolved through the analytic hierarchy process (AHP). It is shown that the AHP, as a decision-making methodology, unifies the characteristics of life insurance contracts with an individual's preference set to create a determinate

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¹See Mehr and Gustavson (1987). Moreover, Belth (1966) offers the level price method which measures a policy's expected average cost by considering the probability of policyholder survival and policy lapsation.

²For example, Yaari (1965), Hakansson (1969), Fischer (1973), Richard (1975), Moffet (1978), Campbell (1980), and most recently Babbel and Ohtsuka (1989).

model which assists an individual in selecting a life insurance contract while considering simultaneously the ordering of all characteristics important to the individual.

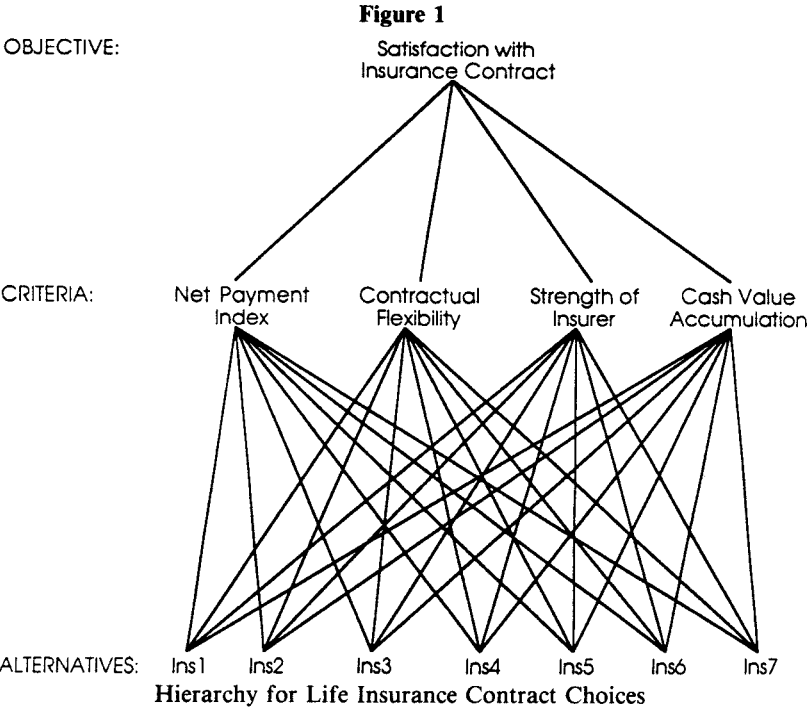
AHP Methodology and the Life Insurance Contract Choice Model

The AHP assists an individual in a decision-making process by decomposing a problem into a hierarchic structure of objectives, criteria, and alternatives. Recently, the AHP was employed by Khaksari, Kamath, and Grieves (1989) to the asset allocation problem faced by a portfolio manager. In this article the problem introduced is the selection of the appropriate life insurance contract given a set of competing contracts from which to choose. Associated with this problem are many subjective and objective criteria important to a decision-maker. For example, the value placed on the contractual provisions within the insurance contract is subjective, while the projected interest-adjusted net payment index and cash value accumulation after n years are objective. However, comparisons among subjective and objective criteria by an individual are inherently judgmental reflecting a preference ordering after all comparisons among the criteria have been held. Thus, an individual's subjective valuation of both objective and subjective criteria is captured in the life insurance contract choice model. Multiple criteria weights are derived through the AHP by incorporating the decision-maker's judgments into an objective ratio scale through pairwise comparisons of preference orderings.³ Structure is given to this process by the problem objective (the top level of the hierarchy), and the underlying criteria.

The hierarchical structure of the multi-attribute life insurance contract choice decision is illustrated in Figure 1. In the context of life insurance contract choice, the objective is the individual's expected satisfaction with the life insurance contract which is dependent on the first level of the hierarchy: the net payment index, financial strength of the insurer, contractual features, and cash value accumulation. In this example, these four criteria were determined by the author to be important, however other criteria may be important to another, and the model would be altered to reflect the addition or deletion of such criteria. The second level of the hierarchy contains the alternative life insurance contracts.

The AHP is carried out by the individual through a pairwise comparison of the attributes at each level of the hierarchy. That is, the individual assesses the relative importance of one attribute with respect to another which is quantified through a pairwise comparison scale (see Table 1). For example, a ratio of nine means that the first attribute is absolutely more important than the second and so forth. All the ratios are stored in a criteria matrix which is positive reciprocal: all diagonal elements equal one, elements above the diagonal range in integers from one to nine and their reciprocals, and the j, i

³ An exposition on AHP can be found in Saaty (1980) or Saaty and Vargas (1982). For details on the axioms of AHP see Saaty (1986).



element below the diagonal is the reciprocal of the i,j element above the diagonal.

At each level of the hierarchy weights of relative importance represented by the eigenvector *w* are determined from the solution to the equation

$$(A - \lambda * I)w = 0 \tag{1}$$

Table 1
Importance Scale

Intensity of Importance	Definition
1	Equal importance
3	Weak importance of one over another
5	Strong importance of one over another
7	Demonstrated importance
9	Absolute importance
2,4,6,8	Intermediate values between adjacent judgments
Reciprocals	If attribute <i>i</i> has one of the above non-zero numbers assigned when compared with activity <i>j</i> , then <i>j</i> has the reciprocal value when compared to <i>i</i> .

where A is the $n \times n$ criteria matrix of pairwise comparisons over the n objects, I is the $n \times n$ identity matrix, and λ^* is the eigenvalue which is the solution to the characteristic polynomial of A .⁴ For the life insurance contract choice model the first level of the hierarchy is comprised of four criteria which will reveal a 4×1 column vector of importance weights. The eigenvectors for the second level of the hierarchy represent importance weights of each of the m insurance contract alternatives with respect to the four characteristics of the first hierarchy. This will yield a $m \times 4$ matrix of eigenvectors for the second level of the hierarchy. The overall ranking of each life insurance contract is accomplished by pre-multiplying the 4×1 column vector of importance weights from the first hierarchy by the $m \times 4$ matrix of second level eigenvectors. The result is a $m \times 1$ vector which ranks the m contracts from highest to lowest satisfaction.

Implementation of the Model

To illustrate the life insurance contract choice model consider a 35-year old male confronted with the decision of choosing the appropriate life insurance contract given a pre-established need of \$100,000 in death benefits. The decision-maker must choose among a non-random set of seven life insurance contracts, two yearly renewable term to age 75 contracts, three whole life contracts, and two universal life contracts where (1) the policy data were obtained from the 1989 edition of *Best's Flitcraft Compend*, and (2) insurer's financial strength is approximated by its Best's Rating which were obtained from the 1989 *Best's Reports: Life and Health Edition*. Each insurer had a Best's Rating of A+ in 1989. Net payment indices and cash values after 20 years are listed in Table 2. Table 3 summarizes the contractual features.

The process begins with the decision-maker undertaking a pairwise comparison of the attributes at each level of the hierarchy depicted in Figure 1. The criteria matrices for the decision-maker offered seven different life insurance contracts are contained in Table 4.

Criteria matrix 1 gives the comparison of relative importance for the four characteristics at the first level of the hierarchy. For example, the decision-maker places equal importance on the net payment index and cash value accumulation, therefore, a ratio of 1/1 is assigned to the appropriate element of the matrix. For criteria matrix 1, equation (1) is solved to obtain the vector of relative importance weights,⁵

$$\begin{array}{l} \text{Net Payment} \\ \text{Contractual Flexibility} \\ \text{Insurer Strength} \\ \text{Cash Value Accumulation} \end{array} \begin{bmatrix} .401 \\ .103 \\ .076 \\ .097 \end{bmatrix} \quad (V1)$$

⁴The characteristic polynomial of A is the determinant of $A - \lambda$.

⁵*Expert Choice* software was used to carry out the pairwise comparison and solve for the eigenvectors and eigenvalues.

Table 2
Net Payment Index and Total Cash Value
for the Contractual Choice Set

Choice Set	Policy Type	Net Pay*	Total Cash Value*
Ins1	Yearly Term	2.47	0
Ins2	Yearly Term	2.74	0
Ins3	Whole Life	6.23	48,227
Ins4	Whole Life	6.10	53,200
Ins5	Whole Life	5.65	56,305
Ins6	Universal Life	10.50	40,265
Ins7	Universal Life	10.50	44,235

*The interest-adjusted net payment index at 5% and expected total cash value in the 20th policy year include scheduled dividends, if any, and the current mortality, interest, and expense assumptions for the universal life contracts.

Table 3
Selected Contractual Provisions for the
Contractual Choice Set

	Contestible Period	Reinstatement Period	Suicide Period	Conversion	Policy Loan Rate	Non-Med Limit
Ins1	2-year	3-year	2-year	Yes, to a permanent plan	—	none
Ins2	2-year	5-year	2-year	Yes, to a permanent plan	—	200,000
Ins3	2-year	5-year	2-year	Yes, to a higher premium	variable	100,000
Ins4	2-year	5-year	2-year	Yes, to a higher premium	variable	150,000
Ins5	2-year	5-year	no restriction	Yes, to a higher premium	variable	99,999
Ins6*	2-year	5-year	2-year	no	8%	99,999
Ins7*	2-year	2-year	2-year	no	8%	none

*Ins6 and Ins7 are the universal life contracts, with additional differentiating characteristics of a flexible premium and flexible death benefit.

Table 4
Criteria Matrices

Criteria Matrix 1: Comparison of Characteristics with Respect to Overall Satisfaction with an Insurance Contract.

	Net Pay	Flexibility	Strength	Cash Value
Net Pay	1	5	4	1
Flexible	1/5	1	2	1/5
Strength	1/4	1/2	1	1/5
Cash Value	1	5	5	1

Net Pay is the interest-adjusted projected Net Payment Index in the 20th policy year.

Flexibility considers the contractual features.

Strength is the financial strength of the insurer measured by Best's Rating. Cash Value is the projected total cash value in the 20th policy year.

Criteria Matrix 2: Comparison of Insurance Contract Choices with Respect to the Net Payment Index.

	Ins1	Ins2	Ins3	Ins4	Ins5	Ins6	Ins7
	1	2	4	5	4	6	7
Ins2	1/2	1	4	1	4	7	7
Ins3	1/4	1/4	1	1/2	1/3	4	4
Ins4	1/5	1	2	1	1/3	5	5
Ins5	1/4	1/4	3	3	1	5	5
Ins6	1/6	1/7	1/4	1/5	1/5	1	1
Ins7	1/7	1/7	1/4	1/5	1/5	1	1

Criteria Matrix 3: Comparison of Insurance Contract Choices with Respect to Contractual Flexibility.

	Ins1	Ins2	Ins3	Ins4	Ins5	Ins6	Ins7
Ins1	1	1	1	1	1	1/4	1/4
Ins2	1	1	1	1	1	1/4	1/4
Ins3	1	1	1	1	1	1/4	1/4
Ins4	1	1	1	1	1	1/4	1/4
Ins5	1	1	1	1	1	1/4	1/4
Ins6	4	4	4	4	4	1	1
Ins7	4	4	4	4	4	1	1

Criteria Matrix 4: Comparison of Insurance Contract Choices with Respect to Financial Strength.

	InsB	Ins2	Ins3	Ins4	Ins5	Ins6	Ins7
Ins1	1	1	1	1	1	1	1
Ins2	1	1	1	1	1	1	1
Ins3	1	1	1	1	1	1	1
Ins4	1	1	1	1	1	1	1
Ins5	1	1	1	1	1	1	1
Ins6	1	1	1	1	1	1	1
Ins7	1	1	1	1	1	1	1

Criteria Matrix 5: Comparison of Insurance Contract Choices with Respect to Cash Value.

	Ins1	Ins2	Ins3	Ins4	Ins5	Ins6	Ins7
Ins1	1	1	1/7	1/8	1/9	1/6	1/7
Ins2	1	1	1/7	1/8	1/9	1/6	1/7
Ins3	7	7	1	1/3	1/4	3	2
Ins4	8	8	3	1	1/3	4	4
Ins5	9	9	4	3	1	1/5	1/5
Ins6	6	6	1/3	1/4	5	1	1/2
Ins7	7	7	1/2	1/4	5	2	1

In this example, the decision-maker has weighted cash value accumulation slightly more important than contractual cost. Contractual flexibility and strength of the insurer are considerably less important to the decision-maker than cash value accumulation and contractual cost.

Criteria matrices 2 through 5 contain the relative importance of the alternative contract choices with respect to each of the first level criteria. The associated eigenvectors, eigenvalues and consistency indices for these four matrices are shown in Table 5.⁶ The eigenvectors are interpreted as the relative priority of the insurance contracts with respect to each characteristic. For example, Ins1 had the highest priority for the net payment criterion. In other words, Ins1 is the most preferred contract with respect to this measure of contractual cost. Moreover, each insurer has an A+ Best's Rating and the eigenvector associated with financial strength reflects this equality among the contracts.

Table 5
The Eigenvectors, Eigenvalues, and Consistency Indices

	Net Pay	Flexibility	Strength	Cash Value
Ins1	.355	.077	.143	.022
Ins2	.241	.077	.143	.022
Ins3	.074	.077	.143	.140
Ins4	.120	.077	.143	.246
Ins5	.153	.077	.143	.393
Ins6	.029	.308	.143	.076
Ins7	.028	.308	.143	.102
λ^*	7.492	7.0	7.0	7.426
C.I.	.082	.000	.000	.071

To arrive at an overall ranking of the competing contracts the 7 x 4 matrix in Table 5 is post-multiplied by the 4 x 1 vector at (V1). The result is an overall priority vector,

$$\begin{array}{l}
 \text{Ins1} \\
 \text{Ins2} \\
 \text{Ins3} \\
 \text{Ins4} \\
 \text{Ins5} \\
 \text{Ins6} \\
 \text{Ins7}
 \end{array}
 \begin{bmatrix}
 .170 \\
 .125 \\
 .107 \\
 .170 \\
 .245 \\
 .086 \\
 .097
 \end{bmatrix}
 \quad (V2)$$

⁶The consistency index (C.I.) is a measure of the inconsistency in judgment, i.e., the intransitiveness of preferences. It is calculated as $C.I. = (\lambda^* - n)/(n - 1)$ where n is the number of objects being compared. As suggested by Saaty (1982), a consistency index $\leq .10$ is sufficient to assert the decision-maker's orderings are consistent.

with an overall consistency index of .050. Therefore, the preferences of the individual are consistent, and the optimal insurance contract for the decision-maker is the whole life contract sold by Ins5.

Conclusion

A multi-attribute life insurance contract choice model has been presented to assist an individual in choosing the best life insurance contract given the individual's preferences toward the criteria relevant to the decision. The complexity of the decision requires a decision model which considers an individual's unique circumstances, objectives, and constraints. The model presented in this article represents a practical integration of the textbook methods to evaluate the cost of a life insurance contract, the qualitative components of the contract, and the individual's subjective valuation of all relevant factors.

Four criteria were used to illustrate the operation of the decision model demonstrated in this article. However, the analytic hierarchy process is sufficiently flexible to allow other criteria to influence another individual's optimal life insurance contract selection.

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