Age Banding: A Model for Planning Retirement Needs

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The age-banded model provides a new approach to planning for retirement needs. The model reduces errors in estimating expenses, provides an algorithm to calculate the replacement ratio, allows easier incorporation of long term care benefits and significantly reduces funding needs. Two situations are used to illustrate the model, a couple nearing retirement and a younger single person. Compared to the traditional approach, results from the age-banded model show funding needs of the near-retirement couple are reduced by over 16% and contributions for the younger person are reduced by 42%. In both cases the consequent increase in risk exposure is very low. Recommendations for case-specific risk management tools are presented.
Keywords: *Retirement planning, replacement ratio, retirement fund, inflation, asset allocation*

Traditional Approach to Retirement Planning

The traditional view of retirement planning generally begins with an estimation of the client's income immediately prior to retirement. The estimation depends on such variables as career path, industry condition, marital status. Planners then adjust this income downward by perhaps 10%-35% (termed the replacement ratio) to reflect the income necessary to maintain the client's standard of living and to incorporate reductions in taxes and other work-related expenses that cease upon retirement.

The next step is to approximate the life expectancy, adjusted for the client's current health and medical history. Planners then extrapolate annual living expenses through the years in retirement, assuming that living expenses increase at the rate of inflation as measured by the Consumer Price Index (CPI). Planners generally recommend that funds for retirement expenses be invested in lower risk securities. Using the rates earned in such investments, the amount of money the client needs to accumulate at retirement can then be estimated. Finally, planners estimate how much the client needs to save every year until retirement so that the savings can accumulate into the required retirement fund.

There are four inherent weaknesses to the traditional approach to retirement planning:

1. Assuming that all living expenses during retirement increase at the overall rate of inflation.

2. Estimating retirement expenses as a fixed percentage of pre-retirement expenses

3. Investing retirement funds in low return assets.

4. Failing to consider contingencies such as Long Term Care (LTC) plans.

The first weakness, that expenses increase at the inflation rate (CPI) during retirement, assumes that these expenses follow a simple dynamic. Stern (2000) and Tiffany (2003) both use the CPI inflation rate to estimate retirement expenses. Smith (1997) considers issues in estimating retirement expenses and spending estimates using the same inflation rate. The widespread use of the CPI rate to estimate expenses is well documented (Bell and Rauf (1998), Hager (1999), Levy and Young (2002) and Tiffany (2003). However, a closer observation of the spending patterns during retirement reveal that expenses do not follow this simple linearity. Retirees will tend to spend more on leisure immediately after retirement than at more advanced ages, because many leisure activities are not possible at advanced age.

However, older people generally spend more on health related costs. The Health Insurance Association of America (2002) reports that health-related costs increased by over 10% per year during the decades of the 1970s and 80s. In the 90s, while the rate of growth in hospital costs decreased to about 5% to 6% per year, prescription drugs increased by 16% annually. Healthcare costs are projected to increase at higher rates according to reports from United States Department of Health and Human Services (2001) and The Centers for Medicare and Medicaid Services, Office of the Actuary (2002).

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Similarly, recreation costs have increased at an annual rate of 7.14% between 1990 and 1998 (United States Census Bureau Statistical Abstract (2000). Thus, the bundling of all retirement expenses creates a problem for the planner since the substantially higher inflation rates for leisure and healthcare over the last 15 years cannot be explicitly used to extrapolate these components of expenses.

The second weakness in the traditional method is the lack of a definitive method to reduce pre-retirement income to an amount sufficient to maintain the existing lifestyle during retirement; the percentage by which the income is reduced is referred as the replacement ratio. Traditionally, planners extrapolate current income to determine pre-retirement income and the living standard that such income may support. Next, planners consider the expected lifestyle change and then estimate the replacement ratio. Problems regarding calculation of the replacement ratio have received considerable attention (Palmer (1994), Anonymous (1998), Stern (2000) and Levy and Young (2002)). The lack of an objective estimation technique exposes the estimate to an error from bias in the planner's own position, whether conservative or aggressive. Even modest errors in estimating pre-retirement income and expenses at the initial stage of retirement increase greatly when extrapolated into the future.

A third weakness is the placement of funds in conservative and low-risk investments. Retirees are generally more risk-averse because they resist a loss in the standard of living during retirement; however, to be invested in low-risk, low-yield securities for long time periods belies the basic relationship between investment horizons and risk tolerance. This is problematic if investment returns are lower than the inflation rate of some categories of expenses. The need to diversify across asset classes for retirement planning has been widely studied. Both Smith (1997) and Stein (1999) observe the problems in excess allocation in bonds while Blair and Sellars (1995), Everett and Anthony (1996) and Betts (2003) all note the importance of including stocks in retirement portfolios. Benartzi and Thaler (1999) attribute the lack of higher-yielding assets such as stocks to client ignorance about the relationship between long-term portfolio horizons and asset returns.

An explicit risk analysis should be conducted if any proposed method advocates greater risk-bearing for retirees. In addition, when considering low-risk securities, planners need to consider that the historic average rate of return may create problems of timing market entry when prevailing rates are lower than the historic average. An expansive study of the problem of retirement portfolio risk increases due to additional equity assets and issues regarding the management of risk can be found in Blair and Sellars (1995).

According to Haas (2001), "… determining what it will take to maintain your client's standard of living is important in the financial-advising process and is greatly desired. Replacement ratio and actual expense are two methods that can be used to determine a client's retirement income needs in order for him to maintain his pre-retirement standard of living." Tacchino and Saltzmann (1999) also note that planners may use either the replacement ratio or expense method to determine retirement expenses and that a conservative replacement ratio is generally 80 percent. In the age-banded model, the expense method of estimating retirement expenses is used.

The fourth weakness of traditional planning concerns the lack of ease in incorporating contingency instruments such as long-term care plans. Under the traditional technique of lumping all living expenses in retirement, planners can neither isolate nor integrate the differential cost-benefits of such policies. LTC policies have separate features such as adult day care, home services, nursing home care, which vary by policy. The inability of the traditional method to incorporate the timing and the extent of the policy benefits and costs becomes another source of error.

Defining the Age-Banded Model

In developing the age-banded model, some simplifying assumptions are made. One assumption is that a typical retiree lives about 30 years in retirement, presumably age 65 to 95. Another assumption is that a retiree goes through a lifestyle change every ten years, at ages 65, 75 and 85.

Steps followed in constructing the age-banded model are:
1) Segregate expenses are into categories: taxes, living expenses, healthcare, leisure are used in the model
2) Calculate anticipated expenses in the year of expected retirement for each category using the appropriate rate of inflation for that category
3) Adjust these category amounts to reflect post retirement lifestyle changes. The model as illustrated allows for lifestyle changes at three different points in retirement.
4) Extrapolate these post-retirement expenses through 30 years of retirement, using appropriate rates of inflation for each category
5) Calculate the present value of the post-retirement expenses to arrive at an amount sufficient to fund expenses for the following decade
6) Discount each of these amounts back to the year of retirement using rates appropriate to the risk level and term of the invested amount.

7) Add these amounts to arrive at the amount of funds needed at retirement.
8) Calculate the amount of periodic savings required during the working years to accumulate to the required retirement fund.

Application of Age-Banded Model

For the first illustration of the model, assume that the client is a couple, Mr. & Mrs. Smith, both 60 years old and expecting to retire in 5 years. Pre-retirement expenses are segregated into four groups: taxes, basic living, leisure, and health care; however the model could incorporate more categories of expenses. The current annual expenses for the Smiths' just prior to retirement at age 65 are shown in Table 1 as well as the projected expenses using the inflation rate appropriate to each expense category.

Table 1
Expenses at Time of Retirement at Age 65

	Expenses at Age 60	Yearly Growth Rate	Expenses at Age 65
Age-banded method			
Taxes	28,000	3%	32,452
Basic Living	36,000	3%	41,724
Healthcare	6,000	7%	8,418
Leisure	5,000	7%	7,015
Total	75,000		89,609
Traditional method	75,000	3%	86,925

Table 2 illustrates how differential inflation rates are used to adjust the expenses for the first decade of retirement in the age-banded model.

Table 2
Expense Projections for Age 66-75

	Taxes	Basic Living	Health care	Leisure	Total
	Inflation Factor				
	3%	3%	7%	7%	
Age	16226	29207	9681	10523	65702
66	16713	30083	10358	11259	68413
67	17214	30985	11083	12047	71330
68	17731	31915	11859	12891	74395
69	18263	32873	12689	13793	77617
70	18810	33859	13578	14758	81005
71	19375	34874	14528	15791	84569
72	19956	35921	15545	16897	84569
73	20555	36998	16633	18080	92266
74	21171	38108	17798	19345	96422
75	21806	39251	19043	20699	100801

Adjusting for lifestyle changes at and during retirement

The usual next step is to estimate the replacement ratio in order to adjust expenses downward reflecting the lower anticipated expenses during retirement. No algorithm exists to aid planners in this adjustment; it is customary to adjust these expenses downward by about 10%-35%. Table 3 shows the adjusted expense estimates for the Smiths as they commence retirement.

Table 3
Adjustments for Lifestyle Changes

	Retirement Expenses at Age 65	Lifestyle factor adjustments Age 65	Retirement Expenses Age 66	Lifestyle factor adjustments Age 75	Retirement Expenses Age 75	Lifestyle factor adjustments Age 85	Retirement Expenses at Age 85
Age-banded method							
Taxes	32,452	0.50	16,226	1.00	21,806	1.00	29,306
Basic Living	41,724	0.70	29,207	0.80	31,401	0.90	37,981
Healthcare	8,418	1.15	9,681	1.20	22,852	1.25	56,192
Leisure	7,015	1.50	10,523	0.50	10,350	0.25	5,090
Total	89,609		65,637		86,408		128,568
Traditional method	86,925	.8	69,540	.8	93,456	.8	125,597

In this example, a conservative 20% reduction (Tacchino and Saltzmann, 1999) is assumed for the traditional model. In the age-banded model, it is assumed that the commencement of retirement is a lifestyle adjustment resulting in a change in each expense category. The first phase of retirement is assumed to commence when the individual retires. This phase is identified not only by a marked increase in leisure-related expenses, but also by a significant decrease in taxes and a moderate decrease in basic living expenses. A significant change in basic living expenses may occur when the residential mortgage is paid off. While some clients may have paid off their mortgage fully before retirement, others may do so within the first 10-15 years.

Phase two can be thought of as a transitional phase with reductions in leisure expenses and further increases in medical expenses. The third and last phase is marked by a sharp increase in healthcare expenses, negligible leisure expenses, and possibly small changes in basic living expenses.

The lifestyle change is reflected in the adjustment factors, with 1.0 representing no change. Leisure related expenses increase 50% upon retirement; hence the factor for leisure is 1.5. The factor for taxes is 0.5 to reflect the elimination of FICA and reduction in taxes on salaries. The basic living expense factor is 0.7, reflecting reductions in work-related expense and the possibility that the mortgage may be paid off during the decade. Finally, the health factor is 1.15 to reflect expected minimal increases in health care expenses during the first decade in retirement.

As noted earlier, leisure and health related costs have increased at a rate of about 7% per year over the last 15 years. For the age-banded model, it is assumed that projected health and leisure expenses increase at a compound rate of 7%, while basic living expenses and taxes are projected to increase at the standard 3% inflation rate

This method of segmenting expenses into categories and then projecting their future values has certain implications. Alternative lifestyles during retirement can be evaluated by comparing expense patterns. Observing various expense configurations can lead to greater control over the finances since the benefit of altering life styles can be considered in terms of affordability. Further, segmentation allows the observation of the proportional affects of component expenses over time.

Healthcare expenses provide a good example of the potential of the age-banded model. While planners may advise that larger outlays for healthcare will be nececessary for the later years of retirement, they cannot explicitly capture the dynamics of that advice in their expense projections. By the age-banding technique, planners can consider the relationship among aging, need for health care and inflation in healthcare costs.

Table 4 shows the traditionally computed projection of expenses during retirement. These projections are simply the annually compounded values of the pre-retirement expenses, using the overall rate of inflation. Table 4 also shows the expense projections by the age banding technique.

The comparison in Table 5 shows the impact of the differential inflation levels. Since the growth rates of expenses projected by the age-banded method are greater, the age-banded expense estimates are higher than their traditional counterparts. The age-banded estimates of retirement expenses are higher after age 85; thus a significant portion of expenses are being allocated to the latter stages of life, which reflects the greater estimation accuracy of the proposed model.

**Table 4**
Projected Expenses for Three Decades

| | | Age-banded Method for Projecting Expenses | | |
Age	Traditional Method	Age 65-75	Age 75-85	Age 85-95
65	69540	*65637*		
66	71626	68413		
67	73775	71330		
68	75988	74395		
69	78268	77617		
70	80616	81005		
71	83034	84569		
72	85525	88319		
73	88091	92266		
74	90734	96422		
75	93456	100801	*86409*	
76	96260		90329	
77	99147		94461	
78	102122		98815	
79	105185		103406	
80	108341		108249	
81	111591		113360	
82	114939		118753	
83	118387		124449	
84	121939		130464	
85	125597		136819	*128568*
86	129365			134877
87	133246			141546
88	137243			148599
89	141361			156059
90	145601			163954
91	149969			172311
92	154468			181159
93	159102			190530
94	163876			200458
95	168792			210978

Table 5
Comparison of growth in retirement expenses between traditional and age-banded methods

Age	Traditional Method	Age-banded Method	Percentage Difference (Traditional – Age-Banded)
66	71,626	68,413	4.70%
75	93,456	100,801	-7.29%
76	96,260	90,329	6.57%
85	125,597	136,819	-8.20%
86	129,365	134,877	-4.09%
95	168,792	210,978	-20.00%

A benefit of the age-banded model is the ability to observe the dynamics in expense components during retirement. Figure 1 illustrates this benefit.

Figure 1.
Expenditure Categories as Percentage of Total Expenses by Age
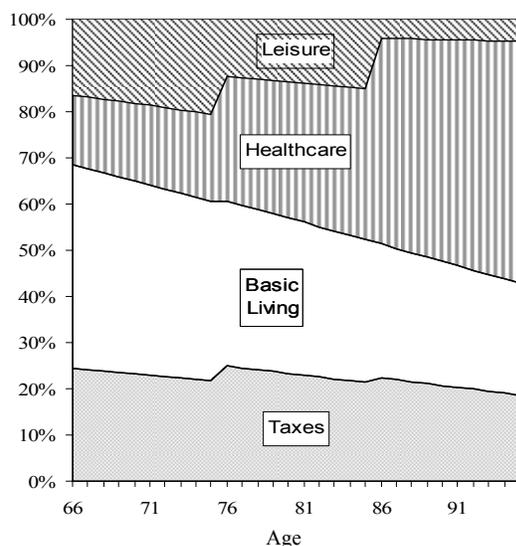
At this point the effects of the traditional bundling of expenses can be observed. Such a method induces estimation error problems at each stage. The traditional method prevents the incorporation of contingent policies like long term care. In the age banded model, the segmentation of retirement provides that opportunity. For example, care features such as adult day care and home health care are more likely to be a choice in the transitional decade while nursing home

care is a more likely scenario in the latter decades. If the Smiths carry a LTC policy, the planner can change the medical factors to reflect the clients' health and also compare health expenses to LTC benefits. This process can be further adjusted by decomposing medical expenses into sub-components such as prescription drugs and, hospitalization and integrating them with the policy features. Alternatively, an approximate estimate can also be obtained by adjusting downward the lifestyle change factors for healthcare costs. Carrying a LTC policy should have a significant impact on the amount of funding required for retirement, given the significant increases in costs of healthcare and the greater amounts of healthcare consumed at the later stages of life.

Investing the portfolio.
In the traditional approach, planners generally assume a high degree of risk aversion for retirees and advocate low return investments. This assumption allows planners to use a proxy rate such as the U.S. Treasury bond rate, 6% in this example, to discount the projected income requirement in order to determine the amount needed to fund the retirement. Using the traditional method for the Smiths, Table 6 shows their income requirement as $1,030,474. As reported in Table 4, their annual expenses begin at $69,540 at age 65 and increase at the CPI rate of 3% annually. Investment returns are assumed to be 6%. In order to meet their funding requirement under this method, they need to have on hand at retirement the present value of their future expenses discounted at 6%. Since they are presently age 60, their current need is the present value of that amount discounted for the 5 years remaining until retirement.

Table 6
Retirement Funding Needs

Traditional Method	Discount rate %	Amount needed
age 65		
Present value at age 65 of projected expenses from Table 4	6	1,379,006
age 60		
Present value at age 60 of amount needed at age 65	6	1,030,474
Age-Banded Method		
age 65		
Present value at age 65 of ten years of projected expenses from Table 4	6	602,102
age 60		
Present value at age 60 of amount needed at age 65	6	449,926
age 75		
Present value at age 75 of ten years of projected expenses from Table 4	8	805,644
age 70		
Present value at age 70 of amount needed at age 75	6	602,024
age 85		
Present value at age 85 of ten years of projected expenses from Table 4	10	1,222,067
age 80		
Present value at age 80 of amount needed at age 85	6	913,199

To compute the required retirement fund using the age-banding technique, three portfolios are constructed, each dedicated to funding expenses for one of the three phases. This segregation has another major benefit; the planner has 15-25 years to manage the performance of the latter two portfolios. For the Smiths, the portfolio for the first decade needs to be fully accumulated in 5 years while the subsequent two portfolios have 15 and 25-year terms, respectively. The benefit of this separation is that it allows the retiree to seek higher rates for the longer-term portfolios. In turn, it is assumed that the higher rates will help to mitigate the effects of escalating health care costs.

Risk considerations.
Since seeking higher rates means assuming higher risk, careful risk analysis is necessary. However, from a behavioral perspective, it may be difficult to persuade a retiree, during a period of disappointing market performance, to consider purchasing equities for a retirement portfolio. To address this concern, it is assumed that the dedicated portfolios be fully funded five years before they are actually needed. For example, the funds needed for expenses for the 76-85 and 86-95 decades be in safe investments at age 70 and 80, respectively. This can be considered as an additional cushion to allay the risk perceptions of individuals. Table 6, shows the amounts needed to be accumulated at ages 60, 70 and 80 to fund retirement expenses for the three decades beginning at age 66, 76 and 86. A 6% rate of growth is assumed for the funds during the "cushion" years of ages 60 to 65 and 70 to 75.

At age 60, the Smiths need to have the funds earmarked for the first decade in a safe investment. For the next two portfolios and excluding the cushioned years, the Smiths have 10 years and 20 years, respectively, to accumulate the necessary funds. Assume that the Smiths seek a return of 8% for the second portfolio and 10% for the final portfolio. These return expectations are more consistent with the investment term and are also amenable to client-specific adjustments.

For simplicity, assume that the Smiths will use only two classes of assets as investment vehicles, lower risk bonds and large cap stocks. It is assumed that the bond rate is 6% and the large cap stock rate is 11.5%. The assumed returns are based on the average returns for 1926-2002 for AAA-rated bonds and the S&P 500 stocks, respectively. Table 7 shows the amount of funds that the Smiths should need at age 60 to fund all three portfolios. In this example, the amount of $449,926 is placed in a low-risk investment, while the rest can be invested at somewhat higher rates.

Table 7
Amount Needed at Age 60 for Age-Banded Model

Age	Amount Needed at Beginning of Decade	Earnings Rate %	Amount Needed At Age 60
60	449,926		449,926
70	602,102	8	278,890
80	901,439	10	133,993
		Total	862,809

The two methods began with the same retirement expenses; the expenses for the age-banded method become considerably higher at the latter stages of retirement. However, the age-banded method leads to a smaller funding requirement; $167,665 less ($1,030,474 - $862,809) than the traditional method. Age banding not only provides a more accurate portrayal of expenses, but also leads to a significant reduction in funding needs

Age-Banded Model –Alternative Application
Assume for the sake of comparison that a 35-year old, Ms. Jones, faces the same retirement expenses as the Smiths. For Ms. Jones, the funds required for the three portfolios are 30, 40 and 50 years away. Since this is a more distant period, Ms. Jones does not need the five-year safety cushion as she has ample time to manage portfolio risk. Also assume that, because of her age, Ms. Jones is willing to take more risk than the Smiths and to include small cap stocks in her portfolio. The three portfolios with terms of 30, 40 and 50 years, can be expected to earn average returns of 12% (same as the traditional), 13.5% and 15%, respectively. Table 8 shows the contributions that Ms. Jones will need to make annually to fund her retirement portfolio for both methods. The required return will depend both on the client's risk tolerance and the amount that can be contributed towards retirement.

Table8
Annual Contribution Required for Ms. Jones

	Amount Needed At Age 65	Earnings Rate %	Annual Contribution Required
Age-banded method			
30 yrs later (age 65)	596,175	12	2,470
40 yrs later (age 75)	796,720	13.5	683
50 yrs later (age 85)	1,206,746	15	167
		Total	3,321
Traditional method			
30 yrs later (age 65)	1,379,006	0.12	5,714

The method results in a reduction of 42% ($3321 compared to $5714) in annual contribution for Ms. Jones. For an investor with lower risk tolerance, lower required rates of return may be expected. As long as the portfolio funding needs are considered to be 30 to 50 years away, in contrast to the 30-year traditional time frame, the required contributions will be lower for the age-banded model. Further, given the long-term perspective, the client has ample time to manage her portfolio's risk and return.

Risk Analysis

Consistent with their age and lifestyle, retirees are especially averse to increasing their portfolio risk. They understand that a loss in their portfolio would reduce their living standards. Table 9 shows the difference in risk between the traditional and age-banded methods for both Ms. Jones and the Smiths.

Table 9
Risk Analysis

	Bonds	Large Caps	Small Caps	Portfolio Risk
The Smiths				
Traditional Method	100%	0	0	7.96%
Age-banded Method	78.79%	21.21%	0	10.07%
Ms. Jones				
Traditional Method	0	100%	0	20.40%
Age-banded Method	0	85%	15%	22.95%

The portfolio standard deviation is used as the measure for risk. The historic standard deviations used in the computation for the long term bond, large caps and small caps are 7.96%, 20.4% and 40.44% respectively. The correlation between bonds and stocks are assumed at 0.80 and large caps compared to small caps are assumed to be 0.90. The correlations are higher than what is generally known; the difference is intentional. Even with this overestimation error, the increase in the "alternative" portfolio risk is still quite low.

The 2.5 percentage point increase in risk for Ms. Jones is contained entirely in the portfolios dedicated to the last two decades of retirement since the returns for the initial portfolio is the same for both methods. This provides Ms. Jones with a 40 to 55 year window to manage this increase in risk. On the other hand, the effect of the 42% reduction in contributions is immediate in terms of added utility.

For the Smiths, too, the portfolio risk increases by about 2 percentage points as shown in Table 9. Given the advanced age of the Smiths, a more detailed discussion of the increase in risk is desirable. First observe that about 52% of the Smiths' portfolio is dedicated to funding the first phase (ages 66 to 75) of retirement. Since this period has the same characteristics as the traditional portfolio, there is no difference in risk. The Smiths' immediate retirement needs for the next 15 years are as assured as in the traditional portfolio. Decomposing the risk further, it is observed that the risk increase is derived equally from the composition changes in the second and third dedicated portfolios. The benefit of a reduced retirement funding need is the opportunity of assuming additional risk. However, this assumption of additional risk and its consequences must be managed over the 10 to 35 year period from age 70 to age 95. As with Ms. Jones, however, the benefit of a fund which requires about 16% less in contribution than that computed by the traditional method is immediate.

The Smiths' portfolios include a five-year cushion for risk management. The investment advisor has time to monitor the performances of the dedicated portfolios and make appropriate readjustment decisions as business cycles and portfolio values dictate.

The reduction in expense estimation error considerably increases the chance of plan success, which also aids in reducing risk. The age-banded method provides the Smiths with a savings of about $167,000. If the Smiths set away $50,000 each in two 6% bonds maturing in 15 (age 75) and 25 (age 85) years, the investments would be worth $120,000 and $215,000 respectively. Such an investment would dramatically reduce the increase in risk. Further, the Smiths would still retain a savings of $67,000 in funding their retirement plans.

If a client has sufficient funds, then retirement is unlikely to lead to financial worries. The age-banded model provides advisors with a way to fund retirement that help clients with wealth constraints to also plan effectively while retaining the ability for greater risk control.

Adapting the Model to Individual Clients
Adjustment for income. If individuals expect to receive income in the form of fixed annuities such as social security or other benefits, such income can be subtracted from expenses before computing funding needs. However, if the annuity was in the form of a guaranteed annuity contract but was issued by a firm with some default risk, then that stream of cash flow would need to be adjusted for the default risk before income netting.

Atypical cases. Unusual circumstances should be considered; spouses may vary greatly in age or one of the partners may experience the onset of serious illness at an earlier stage in retirement. The model allows easy adjustments for such unique circumstances. For example, the retirement period can be adjusted to a

shorter or longer time period to accommodate varying ages of spouses or greater longevity of life. If contingencies such as premature health problems are expected, the factors can be changed to reflect such events. Unlike the traditional method, if unexpected changes occur, the segmenting of the retirement years into phases with changing factors provides the planner with a robust tool to make adjustments. The separation into phases, the lifestyle change factors and the differential inflation rates can be used in different combinations to address unique circumstances that arise for various retirees.

Point Estimates. In considering differential inflation rates for categories of expenses, the planner may wish to use an estimation range such as 6% to 9% instead of the 7% point estimate. Since predicted rates may contain error, using point estimates may expose the client to four different sources of estimation errors, rather than one. Moreover, range estimates will allow financial planners to work within ranges of projected expenses and thereby cushion the effects of estimation errors. More astute planners may also use statistical analysis such as expected values, dispersion, z-statistics, to further mitigate the effects of estimation errors.

Micro-Management. The "decade" approach to age banding is flexible and can be changed to any other time span such as one year, five years, just as medical costs can be broken down to its component costs. Such micro-analysis should considerably increase the efficacy of the model. However, micromanagement requires additional effort.

Mathematical Modeling. Note that the model is very amenable to mathematical modeling in a continuous time framework as the four expense categories can be depicted as continuously differentiable functions or functions that may be smoothed for differentiation. However, the desirability and usefulness of such rigor is debatable when applications are so subjective.

Conclusion

The age-banded method of retirement planning presented in this paper shows planners an alternative way of thinking about retirement planning. The method provides marked benefits over the traditional plan in terms of more accurate expense projections, smaller resource requirements and greater flexibility in managing risk. When applying this model, there are two additional points to consider; first, a planner adopting this method needs to continuously monitor and manage the portfolio over time since the portfolio is dynamic, and, second, planners need to understand that portfolio returns are uncertain and that their clients may very well live a much longer life than assumed.

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