Columbia University

Actuarial Science Integrated Project

Group Six

"Variability of Universal Life Cash Flows under Higher Risk Investment Strategies"

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Contents

1. Introduction

Given the current low interest rate environment, life insurance companies are reevaluating the cost/benefits of higher yielding bond allocations. This project studied the offsetting elements of higher nominal yields, greater credit loss expectations, and higher capital requirements on the profitability of the insurer that pursues a high yield investment strategy. Product development and pricing experience was gained from the development and pricing of a simple Universal Life product for use in the analysis. Profitability measures were developed for a simple Universal Life product and measured to assess the impact of a higher yield investment strategy. The effects of credit rating migration on credit loss rates and bond capital charges were examined. Deterministic stress testing was applied to determine the impact on profitability at select times in the product life cycle. The project allowed for the assessment of the possibility for customer friendly product price changes, driven by a higher yielding investment strategy, and determined if increased profits could be shared with customers and used to improve competitiveness and take market share.

2. Actuarial Guidelines

While working on the model, we reviewed standards developed by American Academy of Actuaries.

- Actuarial Standard of Practice No. 7

This actuarial standard of practice (ASOP) provides guidance to actuaries who perform professional services involving the analysis of asset, policy, or other liability cash flows for life,

health, or property/casualty insurers. The standard is applicable when actuaries are working on either of the following:

a. determination of reserve adequacy;

b. determination of capital adequacy;

c. product development or ratemaking studies;

d. evaluations of investment strategy;

e. financial projections or forecasts;

f. actuarial appraisals;

g. testing of future charges or benefits that may vary at the discretion of the insurer (for example, policyholder dividend scales and other nonguaranteed elements of the insurer's liabilities).

- Actuarial Standard of Practice No 41

This actuarial standard of practice (ASOP) provides guidance to actuaries with respect to actuarial communications and applies to actuaries issuing actuarial communications within any practice area. The guideline states that in an actuarial report, the actuary should mentions the actuarial findings and identify the methods, procedures, assumptions, and data used by the actuary with sufficient clarity that another actuary qualified in the same practice area could make an objective appraisal of the reasonableness of the actuary's work as presented in the actuarial report.

3. Assumptions/Methodology

In order to compare the profitability of two investment strategies for the simple Universal Life product we designed and developed two models, a liability cash flow model and bond cash flow model. After integrating the two models, we tested the insurer's profitability when investing in both an investment grade bond portfolio and a high yield bond portfolio. Our analysis studied the offsetting elements of higher nominal yields, greater credit loss expectations and the higher capital requirements associated with high yield bonds.

a. Product Design

Our model assumed that an annual premium of $15,000 is paid at the beginning of each policy year. A minimum interest rate of 2% is credited to the account value after deducting premium load and cost of insurance. The surrender charge is the surrender rate times the annual premium, and the cash value is the account value after deducting the surrender charge.

The key assumptions of our liability model are summarized below:

- 20-year Universal Life Insurance Policy

- An annual Premium of $15,000 to be paid in the beginning of each year.

- A benefit of $1,000,000 paid at the beginning of the year on death of the policyholder.

- A guaranteed crediting rate of 2% each year for 20 years (the length of the cash flow analysis).

- Acquisition expenses, renewal commissions, premium tax and maintenance expenses are charged to the policyholder.

- Surrender charge is 1.5 of premium for the first 5 years, and then declining linearly to 0 for the remaining 15 years.

In order to calculate the account value and cash value, we derived the following formulae:

- Cost of insurance $COI_t = q_{x+t} \times (b_t - AV_{t-1} - P_t)$

  Where COI_t is Cost of Insurance in year t, P_t is Premium received in year t

  b_t is Death Benefit in year t, q_{x+t} is mortality rate in year t for a person currently aged x

- Interest earned $\qquad I_t = (AV_{t-1} + P_t - COI_t) \times i$

  AV_{t-1} is account value in t-1 year, i is credited interest rate.

- Account value $\quad AV_t = AV_{t-1} + P_t - COI_t + I_t$

- Cash value $\quad CV_t = AV_t - P_t \times SF_t$

  SF_t is surrender factor in year t.

Based on the above formulae, we calculated 20 year cash flow for the account value and the customer's cash value.

  b. Investment assumptions

Our investment strategy was to hold all bonds except defaulted bonds, which were sold the year of default with proceeds reinvested net of credit losses in accordance with the appropriate

investment strategy. All purchases were 20-year corporate bonds with the desired initial rating. Sufficient 20 year corporate bonds diversified by industry were assumed to be available to accomplish the B bond investment strategy. Risk free interest rates and credit yield spreads as of January 31, 2013 were assumed to remain constant during the 20 year modeled period. Credit loss rates were based on historical experience as studied by Moody's Annual Default Study: *Corporate Default and Recovery Rates 1920-2011* (see Appendix A). The market value of the bond portfolio is limited to required reserves and capital, and all excess interest from the bond portfolio would be distributed to the insurance company. The cash flow distributed to the insurance company fed our profit calculations.

c. Profit Test

Our first steps in testing the profitability of the universal life insurance product was to derive formulae for calculating distributable earnings and develop different criteria to analyze the profitability.

The distributable earnings was calculated by deducting expenses, mortality costs, lapses and the change of reserves from the premium received while adding the interest earned.

The Actuarial assumptions and Formulae for calculating expenses, mortality cost, lapses and reserves are as follows:

i. Assumptions:

- Number of insurance policies at year 0 (L_0) is 10000

- Experienced mortality rate: 40% of ILT mortality at age 20 graded to 100% at age 40

- Acquisition expenses: Acq_0=125%, $Acq_t = 0$ $(where\ t > 0)$

- Renewal commissions: RC_t=10% (where t > 0)

- Premium tax rate: $Ptax_t$ =2%

- Maintenance expenses $Mantainence_t$ =75/year

- NAIC Capital requirement is 0.4% for A rated bonds and 10% for B rated bonds

ii. Formulae:

- Expenses: $$e_t = P_t \times (Acq_t + RC_t + Ptax_t) + L_t \times Mantainence_t$$

  L_t is the number of active insurance policies in year t.

- Mortality Cost: $$Mort_t = b_t \times Mortality\ Decrement_t$$

- Lapse Cost: $$Lapse_t = CV_t \times Lapse\ Decrement_t$$

- Reserve &Capital charge: $$V_t = 0.5 \times (AV_t + CV_t) \times L_{t+1} \times 1.05$$

  1.05 is the capital charge assumption.

- Interest: $$I_t = (P_t \times L_t - e_t - Mort_t) \times i$$

- Earnings: $$Earn_t = P_t \times L_t - e_t - Mort_t - Lapse_t + I_t - (V_t - V_{t-1})$$

Using the above formulae, we calculated the 20-year cash flow for distributable earnings. We then evaluated the insurer's profit using three measurements:

- The Internal Rate of Return (IRR): Interest rate at which the expected present value of profits at issue is zero.

- Break Even years: The first year for which the expected present value of profits at issue through that year is non-negative.

- Profit Margin: Present value of distributable earnings divided by the present value of premium.

d. Product Redesign

During the product design process, we tracked the profitability after each change. The primary standard we used for evaluating profit was IRR. The following table shows our product redesign process by tracking the IRR through each revision to the product design assumptions.

Table 1 Assumption revisions and value of IRR

	Initial assumption	Revised assumption	IRR
			-0.61%
Credited Interest	4%	2%	5.03%
Investment Interest Earned	$5.5\% \times (\text{Premium} - \text{Expense} - \text{Mortality Cost} + Reserve_{t-1})$	(B Bond Interest Yield-Credit loss rate) $\times Reserve_{t-1}$	0.81%
Acquisition Expenses	175%	125%	3.52%
Renewal expenses	10%	3%	7.07%
Premium Load	0	20% of premium in year 1, level 5% of premium in renewal years	11.56%
Surrender Charge Pattern	125% of premium in year 1, grading to 0 at year 21	150% of premium in first 5 years, then grading to 0 at year 21	14.51%

e. Static Model

Assuming bond ratings remained static over time, we considered three bond investment portfolios. The following table shows profit test results for each investment strategy assuming that bond credit ratings remain static from the time the bond was purchased.

Table 2 Static model results for three investment scenarios

Scenarios Assuming Static Credit Ratings	Interest Offered	Interest Earned (Net of static credit loss)	IRR	Break Even Year	Profit Margin
100% A bond	2%	3.78%	15.42%	8	0.069
100% B bond	2%	4.60%	14.51%	11	0.106
50% A bond 50% B bond	2%	4.20%	14.81%	10	0.088

Although the B bond investment strategy had a higher yield net of historical credit losses, 4.60% versus 3.78% for the A bond portfolio, bond capital requirements significantly reduced the profitability of the lower credit quality bond portfolio. The A bond investment portfolio's IRR, therefore, outperformed the B bond strategy by 91 basis points when we assume that bond credit ratings are static.

This initial analysis assumed that bond capital charges and credit losses were based on the credit ratings at time of purchase. We then ran a more sophisticated profitability analysis considering credit rating migrations of the bonds held, which is the subject of the next section. When credit migration is considered, the disparity in profitability between the two portfolios was more pronounced.

4. Analysis of Investment Strategies

When comparing different investment strategies effects on the cash distributions to the insurance company, we used internal rate of return (IRR) as the primary profit metric. Insurance company profits were affected by a combination of bond yields, credit losses, and capital requirements. Although bond yields depended on the initial credit quality at time of bond purchase, dynamic credit loss rates and capital requirements are based on the current credit ratings of the bonds held. Each year, a portion of the bond portfolio migrated to higher and lower credit ratings as analysts at rating agencies change their ratings on individual bonds. Our analysis applied historical credit rating migration patterns, default rates, and credit loss rates (Moody's Annual Default Study: *Corporate Default and Recovery Rates, 1920-2011*) in our modeled scenarios.

The IRR of the Universal Life product was more significantly affected by credit rating migration and capital requirements when investing in lower rated bonds as displayed in the table below.

Table 3
Attribution of Baseline Internal Rate of Return

Attribution of Baseline IRR		IRR		Comments
Credit Loss Rate	Bond Capital Requirement	A Bond	B Bond	
None	None	16.0%	30.5%	
Based on Rating at Purchase	None	15.7%	20.1%	
Considers Rating Migration	None	15.0%	16.0%	
Based on Rating at Purchase	Based on Rating at Purchase	15.4%	14.5%	Static Model
Considers Rating Migration	Based on Rating at Purchase	14.7%	10.9%	Reconciled
Considers Rating Migration	**Considers Rating Migration**	**14.4%**	**7.4%**	**Baseline**

Note: Attribution in the table above was possible in large part to the use of two parallel models, one using static credit losses and the second including the effects of credit rating migration. Parallel models helped us challenge our assumptions, reevaluate our methodology, and improved our confidence in the accuracy of the output. Much was learned from the reconciliation of the two models.

If credit losses and bond capital charges are ignored, the IRR of both the A bond investment strategy, 16.0%, and the IRR of the B Bond investment strategy, 30.5%, would be vastly overstated. For the B bond investment portfolio, an overwhelming majority of the ultimate reduction in IRR is attributable to credit losses, 18.1%, with the remaining 5.0% reduction attributable to NAIC bond capital requirements[1]. It is important to note that significant increase in credit losses due to ratings migration especially with regards to the B Bond investment strategy.

Although an insurer may be indifferent between the A bond investment strategy's 15.4% IRR and a 14.5% B bond investment strategy in a world where bonds held always remained at their initial rating, ratings migration dramatically increased credit losses and bond capital requirements. Ratings migration reduced the A bond strategy IRR 100 basis points and reduced the B bond strategy 710 basis points. In our resulting baseline scenario offering the policyholder a 2.0% crediting rate, a strategy of investing exclusively in A rated bonds resulted in an IRR of 14.4% compared to a significantly lower IRR of 7.4% when investing exclusively in B rated bonds when the model was enhanced to consider the importance of ratings migration.

The B bond investment strategy became further unattractive when we deterministically stressed credit defaults and associated credit losses using recession scenarios. Although a number of recessions are already built into the average annual historical default and credit loss data used in

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[1] The 18.1% reduction in IRR is the sum of a 14.5% reduction in IRR due to credit losses (30.5% less 16.0% in the table) without capital requirements plus an additional 3.6% reduction in IRR due to credit losses related to rating migration (14.5% less 10.9%) when the bond portfolio is enlarged due to bond capital requirements. The 5.0% reduction in IRR attributable to bond capital requirements is the sum of the 1.5% reduction in IRR due to capital charges based on ratings at time of purchase (16.0% less 14.5%) plus the 3.5% reduction in IRR due to capital charges related to ratings migration (10.9% less 7.4%).

the model, we recognized that the timing of a recession on the growing investment portfolio could influence the IRR of the product. A recession scenario was simulated by doubling the default and credit loss rates, and we applied this stress scenario at three separate times as presented in the following table. Because the portfolio was growing and a higher proportion of bonds had migrated to lower quality bonds, a recession in years 19 and 20 had a more significant impact on IRR than in earlier years, especially for the B bond investment strategy.

Table 4

Credit Stress Scenarios

IRR	A bond	B bond
Baseline	14.4%	7.4%
Credit Losses Double Year 5 and 6	14.3%	5.0%
Credit Losses Double Year 11 and 12	14.3%	3.3%
Credit Losses Double Year 19 and 20	14.2%	1.6%

The B bond investment strategy was especially affected by a recession scenario in later years because a large proportion of bonds had migrated to lower ratings. Credit rating migration from B ratings at time of purchase to Caa or lower ratings resulted in $138.3 million, or 14.3% of bonds held having Caa or lower ratings at year 20. In contrast, the investment strategy of investing in bonds exclusively rated A at time of purchase resulted in holding only $9.1 million bonds with a current rating of Caa or below, or 1.0% of bonds held, at year 20. Bonds rated Caa or lower had significantly higher default and credit loss rates (see Appendix A, "Average One Year Rates").

5. Conclusion

If bonds held always remained at their initial rating, we would be indifferent between the A bond investment strategy and a B bond investment strategy, but ratings migration dramatically affects credit losses and bond capital requirements. After considering credit ratings migration of bonds held over the 20 year assumed life of the universal life product, the baseline IRR of the B bond investment strategy measurably underperformed the A bond portfolio. A stressed B bond investment strategy would have significant further downside effects on IRR. In contrast, insurer profits remained relatively unaffected from the same credit stresses using an A bond investment strategy. Therefore between these two alternatives, we recommend an A bond investment strategy, which offers higher expected returns and lower downside risk from stressed credit scenarios related to untimely recessions. This is consistent with the conclusions reached by many insurers in the last 12 months, i.e., that risk premiums for low rated bonds are insufficient to justify their purchase.

In actual practice, a variety of investment strategies would be explored. Insurers would not limit their investments to corporate bonds or to only two credit ratings of corporate bonds. It would be a mistake to conclude from the results presented above that intermediate rated corporate bonds would underperform an A bond investment strategy simply because the B bond investment strategy underperformed. For example, Ba rated bonds have less than half the capital requirements of B rated bonds, less credit migration to lower bond ratings, lower credit losses, and currently significantly higher yield spreads net of historical credit losses. Each investment strategy needs to be evaluated separately. Further, it is important to recognize that because yield spread relationships between different credit ratings are not static, the relative

profitability of investment strategies will change over time. The optimum investment strategy will vary depending on the yields offered for different rating categories at different points in the investment life of the product. While we recognize these caveats, our analysis did offer significant insight into the drivers of insurer profitability, provided us experience challenging assumptions, and encouraged competence in reconciling the output of parallel models.

6. Appendices

Appendix A: Credit Loss Rates

Appendix B: Meeting Minutes/Agenda

Appendix C: Project Charter

Appendix A. Credit Loss Rates

Average One Year Rates							
	Caaa-C	**B**	**BB**	**BBB**	**A**	**AA**	**AAA**
Credit Loss	12.2%	2.9%	0.7%	0.1%	0.1%	0.0%	0.0%
Default	13.4%	4.1%	1.4%	0.3%	0.1%	0.1%	0.0%
Loss/Default	90.9%	71.3%	48.5%	41.9%	50.0%	20.9%	N/A

Note: Derived from Moody's Annual Default Study*: Corporate Default and Recovery Rates, 1920-2011* with the assumption that all bonds whose ratings were withdrawn by Moody's maintained credit losses and default rates equivalent to rated bonds.

Rating Migration of $1000 Bond Portfolio over 20 Years									
Defaulted Bonds Sold and Reinvested Net of Credit Losses									
Rating at Purchase	**Credit Loss**	**Caaa-C**	**B**	**BB**	**BBB**	**A**	**AA**	**AAA**	**Total**
A	59	18	58	113	261	335	137	18	1,000
Ba	290	51	141	182	196	107	30	4	1,000
B	532	57	136	117	97	46	13	2	1,000

Note: There were no principal additions to the example portfolio displayed above.

Appendix B. Meeting Minutes/Agenda

Minutes from Meeting One, Group Six

February 1, 2013

During the introductory meeting, we reviewed the following topics:

- The objectives and scope of the project.

- The output requirements for the entire project including the need for a charter with timeline. After the meeting it was agreed that we will alternate writing the agenda and minutes. Tom Dunn will write the agenda before the second meeting and minutes after the second meeting. Abhishek will write the agenda before the third meeting and the minutes after the third meeting...

- Tom Dunn will research historical interest rates, defaults and loss severities for the second meeting.

- We agreed to meet the following week. Before the meeting, Bob will attempt to obtain a sample universal life contract and provide some contract assumptions.

Minutes from Meeting Two, Group Six

February 8, 2013

During the second meeting, we reviewed the following topics:

- Historical corporate yield spreads, historical default and severity experience, and historical maturity spreads and trends. Credit yield spreads have narrowed from higher historical levels experienced during recessions and credit crises. Maturity yield spreads have widened.

  - After the meeting, Tom called David Chiu at Moody's to confirm the rating agency's methodology for measuring loss severity. Moody's loss rates are based on trading prices 30 days after monetary default reflecting investor forward looking expectations of recovery. Moody's maintains the B bonds in the original cohort after the first year even if a rating migration takes place. Moody's does not include technical defaults in its study.
  - Moody's confirmed that Table 22 of the Default and Recovery study, "Average Cumulative Credit Loss Rates by Letter Rating, 1982-2011" implies that a buy and hold portfolio of B rated corporate bonds would have lost 2.62% of the portfolio value due to defaults during the first year, 6.3% by the end of the second year, 9.94% by the end of the third year, 13.05% by the end of the fourth year, and 15.77% by the end of the fifth year. In contrast, A rated bonds lost only 0.52% of their value due to credit losses during an average five year period.
  - Five year cumulative loss rates calculated by Moody's are significantly less than if a one year default rate was compounded for five years. Stronger credits in the cohort may enjoy upward migration while remaining in the measurement cohort. For example, the one year 10.9% Caa-C credit loss rate compounded for five years would be 67.8%. However, Moody's presented the average five year compounded loss rate as 33.61% because bonds that defaulted in year one remain in the denominator of the cohort in subsequent years, which simulates the loss in value of a portfolio of Caa-C bonds held for the average 5 year period of the study.

- Since credit spreads tend to increase during recessions and credit crises, Tom will calculate correlations of historical corporate yield spreads with monetary defaults for the next meeting.

- Timeline and draft of the charter. Bob will send some comments on the objectives, scope, approach and conclusions, and Tom will revise.

- Abhishek will begin the liability cash flow model.

- Abhishek will write the agenda and minutes for the third meeting

- We agreed to meet Friday, February 15th at 11 a.m. Tom sent Prajwal Kilari a request for a meeting room in Lewisohn hall.

Minutes from Meeting Three, Group Six

February 15, 2013

During the Third meeting, the following topics are discussed:

Liability Side:
- Understanding the Liability model Abhishek and Canning are supposed to build:
    1. Life table
    2. Mortality Decrement Table
    3. Lapse rates
    4. Premium calculations.
    5. Adjustments of expenses
    6. Calculations of reserved and capital

- We then talked about IRR, and how much a company should aim for .

2. The asset side:
    Bob then talked about the asset side which Tom is suppose to work on and how to build a portfolio of that.

    It was about an hour and a half meeting in which we discussed how we can start with the model and Bob also explained us the formulae used for calculation of the aforesaid.

Minutes from Meeting Four, Group Six

March 1, 2013

During the Fourth meeting, the following topics are discussed:

1. Liability Side:
- Reviewed the Liability model Abhishek and Canning built over the last week, made the following adjustments:

	Previous calculation	**Adjustments**
The Cost of Insurance	q(20+t)*(Benefit-AV(t))	q(20+t)*(Benefit-Premium(t))
The Reserve and Capital in the end of year t	0.5*(CV(t)+AV(t))*1.05*l(t)	0.5*(CV(t)+AV(t))*1.05*l(t+1)
The lapse decrement	first year 0.2, second year 0.1, rest of the year 0.05	first year 0.2, second year 0.1, rest of the year 0.05, and the year 20 surrender everyone
The IRR calculation	Include 21 years	Include only 20 years

And then analyzed the reasonability about the updated IRR we got, which was **-0.5902633%**

- Redesigned the product by changing the following actuarial assumptions and finally got a more profitable product with a reasonable IRR:

Number of changes we made	**Content of Changes**	**Track of IRR**
0	Originally	-0.36%
1	Increased the Interest margin by 0.5	0.53%
2	Decreased the First year acquisition cost from 175% to 125%	3.61%
3	Changed Surrender charge pattern to: first 5 year level 1.5, then uniformly decreased to 0 at year 21	4.58%
4	Decreased the first 10 years' renewal cost from 10% to 3%	8.33%

5	Added a premium load: first year 20% and the rest years 5% level	16.02%

- Bob suggested Abhishek and Canning to add two more criteria for testing the profit of this product, which are break-even year and the ratio of PV (distributable income) and PV(premium).
2. The asset side:
- Talked about the Asset Model Tom established over the last two weeks, which is mainly dealing with the historical default rate and credit loss data.
- Bob and Tom went over the excel about average one-year letter rating migration rates, the historical default rate and credit loss for A bond and B bond that we are going to invest.
- Summarized the mechanism of the outstanding principal deterioration of bonds. The outstanding principal invested in the bond = Initial Principal*coupon rate*(1- default rate).

3. Integration of the Asset and Liability side
- Bob suggested Abhishek and Canning develop two more scenarios of analysis by making adjustments to the account value, the earning interest rate and the reserve and capital variable based on the two kinds of bond we are planning to invest, then carry out distributable income analysis and profit analysis accordingly.
- Bob and Tom will discuss the asset model further.

4. Tom will write the agenda and minutes for the next meeting

5. We agreed to meet next Friday, March 8th at 10 a.m. Tom will sent Prajwal Kilari a request for a meeting room in Lewisohn hall.

Minutes from Meeting Five, Group Six

March 15, 2013

During the fifth meeting, we reviewed the following topics:

- The midterm presentation should provide a quick review of where we are with respect to the plan, what has been done, issues outstanding, and how we are going to bring the project to a conclusion. We will provide a general overview of the product and income model without getting into all the details. The PowerPoint presentation will include a screen shot of the final income statement, and a screen shot of the policy value and morbidity account values. The product design, pricing and patterns of returns made sense and are not unusual. Testing of the patterns allowed us to revise the product. The objective of the asset model was to reflect cost of borrowings, invest net cash from insurance writings, and track earnings on investments based on current and expected corporate yields net of credit losses . Credit losses reflect long-term historical rating migration patterns, and associated defaults and recoveries. The presentation will include a screen shot of a summary page that includes defaults and interest. The presentation will end with a page listing next steps.

- Changes to liability model.

- Changes to asset model.

- Integration of the two models.

- Canning will make changes to the liability cash flow model and run an A and B test.

- Tom will revise the asset model and incorporate both models into one integrated model.

- Tom will write the agenda and minutes for this fifth meeting. Canning will write the agenda and minutes for the meeting on Monday, March 18th and Abhishek will write the agenda and minutes for the following meeting.

- We agreed to meet Monday, March 18th at 10 a.m. and call Bob at 646-812-1130. Prajwal Kilari reserved meeting room 504F in Lewisohn Hall from 10 a.m. to noon.

Minutes from Meeting Six, Group Six

March 18, 2013

During the Sixth meeting, we reviewed the following topics:

- Changes to the Asset model:

  In the integrated model, the summery of Cash value Tab, Tom will make change to the Borrowing or Cash received column. Which should subtract the distributable earning in the profit test tab. The negative numbers in the distributable earnings column means we should put money in, while the positive numbers means we can take cash out.

- Change to the Liability Model

  Canning will rerun the profit test model, testing the profit under the 100% A bond, 100% B bond, and a 50% A+50% B bond scenarios. With each of the scenario, based on the information from Tom's Asset model, then make reasonable changes to the credited interest rate to redesign a profitable and competitive product.

- Tom and Canning will update the integration of the two models based on the above changes.
- We will go through the presentation slides for this project.
- Abhishek will write the agenda and meeting minutes for the 8th meeting.

Minutes from Meeting Seven, Group Six

March 20, 2013

During the call, we reviewed the following topics:

- Tom will revise the Summary Cash Flow worksheet so that interest in excess of reserves and capital will be distributed back to the company rather than be reinvested in the bond portfolio.

- The model's interest calculations are a sufficient alternative to bond tranche accounting.

- Tom will review historical default and credit loss patterns, check when the bond portfolio is most susceptible to stress, and conduct stress tests. Based on our initial observations, Bob suggested doubling the defaults and credit losses for two years.

- Tom will send the midterm presentation draft PowerPoint deck to Bob for review.

- Abhishek will write the agenda and minutes for the next meeting, which will be during the first week of April.

Minutes from Meeting Eight, Group Six

April 12, 2013

Time: April 5, 2013, 10:00-11:30 am.

Place: Lewisohn Hall

During the eighth meeting, we reviewed the following topics:

1. Mid term presentation – we discussed on how we performed for the mid term presentation.
2. Discussed the result from the integration of the model, and how the IRR is effected when we use combination of A and B bonds.
3. Discovered a difference in interest earned when the models were integrated which made us talk about the formulae used for calculation of reserves and capital, migration of bonds, credit losses etc.
   We also talked about a double counting of small portion of annual credit losses, and Bob then explained us the reason and how we can deal with it.
4. Bob gave us suggestions on how we can work on the asset model and run a basic profit test, testing various credited and earned rates with the associated capital charge, and discuss the results in the next meeting.

Minutes from Meeting Nine, Group Six

April 12, 2013

Time: April 12, 2013, 9:30-11:00 am.

Place: Lewisohn Hall

During the ninth meeting, we reviewed the following topics:

5. Go through the results we got from the latest integrated model:
   Compared the results from integrated model with the static model, and also emphasized the important impact of bond migration rate on the change of bond quality, which affect the bond yield rate in return.
6. Discussed the result from stress tests, compared the stress effects on A and B bonds. For B bond, the stress tests show results of 7.4-5-3.3-1.6, which brings really significant drops. Bob suggest that we should add more explanatory notes on the results we got.
7. Brought an overview about the project. First, we should think about the variables in the product design. There are two moving components in the UL product, which are customer value and profitability. Then we should decide what investment portfolio we should have by establishing a simple asset valuation model first, which contains the analysis about long-term rate, net yield rate and static capital charge of bonds. Next, we moving forward to consider the impact of credit loss, migration rate, etc. And according to our final results, we can draw a conclusion that the insurance company should stay with the A bond portfolio.
8. Bob gave us some revision suggestions on our mid-term presentation slides and the timeline about our project. And we are expected to finish our first draft for our final report around April 20th.

Minutes from Meeting Ten, Group Six

April 19, 2013

During the meeting, we reviewed the following topics:

- Tom will include a model validation table in the investment slides.

- Canning and Abhishek will update a few slides.

- Bob discussed the history of off-the-shelf pricing testing software and key software development consultants. Pricing actuaries add value by challenging the assumptions and challenging the output.

- We discussed a timeline for drafting a final report, editing, and sending to Bob.

Agenda for Meeting Two, Group Six

February 8, 2013

1. Review Historical Interest Rate, Default and Recovery experience. (10 minutes)

2. Statement of Charter and Timeline. (15 minutes)
    a. Review the initial draft of the Project Charter.
    b. Agree on preliminary strategy to approach the project – milestones.
    c. Identify any areas that may be particularly challenging.
    d. Expected level of detail.

3. Questions regarding lapse rate expectations and allocation of management costs. (10 minutes)

4. Upcoming week: tasks to be completed in week three.

Agenda for Meeting Three, Group Six

February 15, 2013

Time: March1 Friday, 10:00 am—12:20 am

Place: Lewisohn Hall, meeting room 504F

Name: Bob, Abhishek, Canning, Tom

1. Understanding of the Liabilities model. (50 minutes)

2. Understanding of the asset model. (15 mins)

3. Understanding the whole point of our project and discuss about how an insurance company really does the aforesaid.

Agenda for Meeting Four, Group Six

March 1, 2013

Time: March1 Friday, 10:00 am—12:20 am

Place: Lewisohn Hall, meeting room 504F

Name: Bob, Abhishek, Canning, Tom

1. Reviewed liability model, made several adjustments to the actuarial assumptions of the model. (50 minutes)

2. Reviewed the asset model, go over the historical rating immigration rates, credit default rates, credit loss and historical loss rate (50 minutes)

3. Questions regarding the distributable incomes, the IRR in the liability model (10 minutes)

4. Upcoming week: tasks to be completed in week six.

Agenda for Meeting Five, Group Six

March 15, 2013

1. Discuss midterm presentation. (10 minutes)

2. Discuss changes to liability model. (10 minutes)

3. Discuss changes to asset model. (30 minutes)

4. Plan for integration of the two models. (10 minutes)

5. Upcoming week: tasks to be completed in following week.

Agenda for Meeting Six, Group Six

March 18, 2013

1. Discuss the changes to the integrated model. (30 minutes)
2. Discuss changes to profit testing. (20minutes)
3. Discuss changes to the integrated model. (30 minutes)
4. Go through the presentation PowerPoint Slide draft.(10 min)
5. Upcoming week: tasks to be completed in following week.

Agenda for Meeting Seven, Group Six

Wednesday, March 20, 2013

Time: 3 p.m — 5 p.m.

Place: Conference Call

Name: Bob Stein, Tom Dunn

1. Discuss model calculations (115 minutes).
    a. Summary Cash Flow worksheet fund flow
    b. Asset Cash Flow worksheet interest calculations
    c. Structure of the model versus tranche accounting
    d. Lapse Rate calculations

2. Discuss midterm presentation. (5 minutes)

3. Upcoming week: tasks to be completed.

Agenda for Meeting Eight, Group Six

Friday, April 5, 2013

Time: 10:00 am — 11:30 a.m.

Place: Lewison Hall

Name: Bob Stein, Tom Dunn, Canning Yang, Abhishek Tayal

1. Discuss the mid term presentation (20 minutes).

2. Work on the integration of the asset and liability model. (30 minutes)

3. Some suggestions on how to work on the interest rates, when using different combination on A and B Bonds. (30 minutes)

4. The tasks for next week. (10 minutes)

Agenda for Meeting Nine, Group Six

Friday, April 12, 2013

Time: 9:30 — 11:00 a.m.

Place: Lewison Hall

Name: Bob Stein, Tom Dunn, Canning Yang

1. Discuss the stress test results (20 minutes).

2. Provide an overview of the project, what we have done, what we need to include and summarize in our final report and presentation. (30 minutes)

3. Some suggestions on our mid-term presentation slides from Bob. (30 minutes)

4. The tasks for next week. (10 minutes)

Agenda for Meeting Ten, Group Six

Friday, April 19, 2013

Time: 10 a.m — 11:30 a.m.

Place: 504f Lewisohn

Name: Bob Stein, Abhishek, Tayal, Canning Yang, Tom Dunn

1. Discuss final slides (70 minutes).
   a. Objectives, Background, Introductory slides
   b. Liability Model
   c. Investments and Conclusions

2. Discuss final report timeline. (5 minutes)

3. Upcoming week: tasks to be completed.

Appendix B. Meeting Minutes/Agenda

Project Charter

Group 6

Project Title: "Variability of Universal Life Cash Flows under Higher Risk Investment Strategies"

Students:	Abhishek Tayal	at2842@columbia.edu	
	Canning Yang	cy2315@columbia.edu	
	Tom Dunn, CFA	tpd2111@columbia.edu	(609) 865-2529
Mentor:	Bob Stein, CFA, FSA	steinro2@aol.com	(646)-812-1130

Introduction and project objectives

Given the current low interest rate environment, life insurance companies are reevaluating the cost/benefit of higher yielding bond allocations. This project will study the offsetting elements of higher nominal yields, greater default expectations, and higher capital requirements on the profitability of the insurer that pursues a high yield strategy. Profitability measures will be developed for a simple Universal Life product and be compared across a range of investment strategies to assess the impact of alternative strategies.

Primary project objectives include:
- Development and pricing of a simple Universal Life product for use in the analysis; this will provide realistic product development and pricing experience
- Definition of alternative investment strategies
- Evaluation of the effects of alternative strategies on insurer profitability
- Assessment of the possibility for product price changes, driven by alternative strategies, to determine if increased profits could be used to improve competitiveness and take market share

Scope and approach

Evaluate whether better cash flow outcomes can be achieved by increasing investment risks under a range of possible interest rate, default and loss severity scenarios. The following key steps will be completed in this analysis:

- Define the structure of a simple Universal Life contract, including all contract elements and all policyholder experience assumptions.

- Build liability cash flow models, including some of the dynamics of lapses and interest rates for Universal Life contracts.
- Build bond cash flow models to test income, default losses and reinvestment capabilities. Again, the cash flows would need to be dynamic with respect to interest rates.
- Integrate the two models over a simplified range of specific interest rate scenarios for investment grade and junk bonds. This would enable future cash flows to be examined to see if new strategies produced better (risk adjusted) results. Definition of key cash flow measures would be needed to support a conclusion.

This will provide a foundation for discussing current challenges to achieving desired performance levels, the development of suggestions for improving performance in the future, and the likely range of challenges being faced in today's low interest rate environment.

Success indicators

This project will be successful if the following occurs:
- UL product is designed and priced that produces reasonable profitability measures
- Alternative investment strategies and assumptions are defined and tested Management actions in response to changed profitability outcomes are identified and considered

Constraints and risks to the project

The following could prevent the project from accomplishing its objectives:
- A reasonable product cannot be developed and priced
- Alternative strategies cannot be defined in terms of reasonable nominal yields, default provisions and capital charges
- The modeling, especially dynamic lapse assumptions and default outcomes, prove to be too complex to model in the time allowed

The team believes that these risks are well understood and can be effectively managed.

Appendix C: Project Charter

Week	Week ending	Project activities and deliverables	Responsible persons
1	February 1, 2013	Initial meeting. Define project.	Bob Stein
2	February 8, 2013	Research historical interest rates, spreads, defaults and loss history.	Tom Dunn
3	February 15, 2013	Initial model of Universal Life cash flows.	Abhishek Tayal, Canning Yang
4	February 22, 2013	Initial model of bond investment cash flows under various interest rate, default and loss severity scenarios.	Tom Dunn
5	March 1, 2013	Revised model of Universal Life cash flows.	Abhishek Tayal, Canning Yang
6	March 8, 2013	Revised model of bond investment cash flows under various interest rate, default and loss severity scenarios.	Tom Dunn
7	March 15, 2013	Integration of models	All
8	March 22, 2013	Integration of models	All
9	March 29, 2013	Integration of models	All
10	April 5, 2013	Analysis of results.	All
11	April 12, 2013	Analysis of results.	All
12	April 19, 2013	Prepare writeup.	All
13	April 26, 2013	Prepare writeup.	All
14	May 3, 2013	Complete Writeup/Presentation	All