

Some Thoughts on Modeling and Liquidity



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When is it Useful to Build a Model

- The situation is complicated enough that it requires a construction that can track and compute more variables than you can handle with a desk calculator
- The matter is important (or interesting enough) to devote the needed time
- It is possible to populate the model



Probabilistic vs. Deterministic

- Dynamic/probabilistic vs. Deterministic
 - Probabilistic models are often better but are much more complicated
 - Populating model is more difficult as probability distributions may be difficult to estimate and correlations not well understood
 - Could lead to a “false sense of security” if not careful
 - A deterministic model is often good enough



Observations

- Expected value: Very often don't need a complicated model as expected values generally add and results can be seen intuitive
- Sometimes a model is very useful
 - Many variables
 - Sub-variables are interesting
 - Sensitivity analysis
- A deterministic model is often sufficient for this



Observations

- Examples
 - Valuation
 - Effects of law or accounting changes
 - Estimating the effects of merger
 - Analysis of several but not highly variable cash flows



Observations

- Variance: A model almost always provides a deeper and better understanding than other methods
 - Variances are much harder to compute as they are second moments
 - The implications of variances are more difficult to assess and need to be thought of as probability distributions
- Probabilistic models tend to work better here



Observations - Variance

- Hedge analysis
 - Reinsurance
 - Futures
- Active life type issues such as warrantees or bond defaults
- Probability of ruin



Things to model

- Income statement and Balance Sheet
 - STAT/GAAP/ECONOMIC
 - Schedule P
- Reinsurance recoveries
 - XOL
 - Aggregate Stop Loss
 - Corridor deductibles
- Cash Flow
- Surplus
- Frequency/Severity/Large Loss/Catastrophe
- Rate of return



More Things to Model

- Ground-Up Asbestos Exposure
- Ground-Up Pollution Exposure
- Y2K Liability
- Tobacco Liability



Some Common types of models

- Spread Sheets
- DFA
- Simulation
- Active life
- Stress Tests
- Mathematical such as Differential/Integral Equations



Base Case Assumptions

■ Investment yield on bonds	6.00%
■ Investment yield on cash	3.00%
■ Bad debt ratio	Various
■ Lag of ceded payments in months	2.0
■ Percent decline in stock market	0.0%
■ Reserve deficiency	0%

Base Case Balance Sheets

Balance Sheet		2006	2007	2008	2009	2010	2011
Assets		Q4	Q4	Q4	Q4	Q4	Q4
	Line numbers correspond to PC Annual Statement 2000.						
	Book Value of:						
1	Bonds	538,754	607,185	496,998	493,337	487,882	485,951
2	Stocks	260,936	105,717	89,791	74,496	73,991	73,485
4	Real Estate	56,853	49,673	33,797	25,000	25,000	25,000
5	Cash	15,421	19,266	17,588	17,346	17,269	21,671
6	Other invested assets	120,308	76,194	40,979	22,322	16,179	16,179
8	Aggregate write-ins	0	0	0	0	0	0
9	Total cash and invested assets	992,271	858,035	679,153	632,501	620,321	622,286
10	Uncollected Premiums	52,507	35,695	3,076	0	0	0
10.2	Ceded Unearned Premiums	65,096	1,005	365	0	0	0
10.3	Accrued retrospective premiums	41,232	26,530	16,833	11,230	7,351	4,861
11	Funds held	0	0	0	0	0	0
13	Reinsurance receivable on loss and LAE paid	197,235	23,449	59,580	57,400	50,852	47,285
13.1	Reinsurance receivable on assumed loss and LAE paid	0	4,228	11,890	16,372	18,910	20,453
14	Reinsurance recoverable on direct loss and LAE reserves	1,211,923	974,886	806,124	689,412	609,927	554,632
14.1	Reinsurance recoverable on assumed loss and LAE reserves	103,876	86,962	56,314	38,389	28,236	22,065
15	EDP Equipment	2,048	733	126	0	0	0
16	Interest, dividends, real estate income due and accrued	10,289	0	0	0	0	0
20	Other assets (nonadmitted or otherwise)	82,716	59,407	42,658	33,515	28,023	9,988
22	Total of all assets	2,759,192	2,070,930	1,676,118	1,478,819	1,363,620	1,281,571
		2006	2007	2008	2009	2010	2011
Liabilities		Q4	Q4	Q4	Q4	Q4	Q4
1	Gross Losses and Loss Adjustment Expenses	1,940,897	1,480,604	1,128,298	921,752	780,657	684,084
1.1	Reinsurance Payable	0	0	0	0	0	0
1.2	Gross Losses and Loss Adjustment Expenses on Assumed Reinsurance	338,828	322,109	300,359	286,623	278,169	272,363
3	Contingent Commissions	0	0	0	0	0	0
4	Other Expenses	0	0	0	0	0	0
5	Taxes (x FIT), licenses, fees	0	0	0	0	0	0
6	Federal taxes	0	0	0	0	0	0
7	Borrowed Money	0	0	0	0	0	0
9	Gross Unearned Premiums	142,908	12,616	4,582	0	0	0
11	Funds held on reinsurance treaties	65,905	52,891	52,580	69,249	87,644	102,839
12	Funds held on account of others	0	0	0	0	0	0
14	Provision for reinsurance	50,838	37,642	25,229	18,581	13,601	11,174
22	Aggregate write-ins for liabilities	154,461	122,974	102,322	88,528	76,918	47,989
23	Total Liabilities	2,693,837	2,028,836	1,613,370	1,384,733	1,236,990	1,118,449
27	Surplus as regards policyholders	65,355	42,094	62,749	94,086	126,630	163,121



Example: Analysis of surplus Changes

- Base case
- 2 month to 6 month lag for reinsurance collectibles
- Stock market: 50% loss on yield
- Investment rate decreases 6%/3% to 4%/1.5% (new investments)
- Reinsurance bad debt 0% to 10%
- 10% reserve adverse development (on payments per year)

Scenario 2: Reinsurance Lags 6 Months

Balance Sheet		2006	2007	2008	2009	2010	2011
Assets		Q4	Q4	Q4	Q4	Q4	Q4
	Line numbers correspond to PC Annual Statement 2000.						
	Book Value of:						
1	Bonds	538,754	493,911	426,389	426,389	426,389	426,389
2	Stocks	260,936	105,717	89,791	74,496	73,991	73,485
4	Real Estate	56,853	49,673	33,797	25,000	25,000	25,000
5	Cash	15,421	17,583	16,512	29,203	34,203	42,500
6	Other invested assets	120,308	76,194	40,979	22,322	16,179	16,179
8	Aggregate write-ins	0	0	0	0	0	0
9	Total cash and invested assets	992,271	743,078	607,469	577,410	575,762	583,553
10	Uncollected Premiums	52,507	35,695	3,076	0	0	0
10.2	Ceded Unearned Premiums	65,096	1,005	365	0	0	0
10.3	Accrued retrospective premiums	41,232	26,530	16,833	11,230	7,351	4,861
11	Funds held	0	0	0	0	0	0
13	Reinsurance receivable on loss and LAE paid	197,235	134,034	121,692	99,060	78,674	66,331
13.1	Reinsurance receivable on assumed loss and LAE paid	0	4,228	11,890	16,372	18,910	20,453
14	Reinsurance recoverable on direct loss and LAE reserves	1,211,923	974,886	806,124	689,412	609,927	554,632
14.1	Reinsurance recoverable on assumed loss and LAE reserves	103,876	86,962	56,314	38,389	28,236	22,065
15	EDP Equipment	2,048	733	126	0	0	0
16	Interest, dividends, real estate income due and accrued	10,289	0	0	0	0	0
20	Other assets (nonadmitted or otherwise)	82,716	59,407	42,658	33,515	28,023	9,988
22	Total of all assets	2,759,192	2,066,558	1,666,547	1,465,388	1,346,882	1,261,883
		2006	2007	2008	2009	2010	2011
	Liabilities	Q4	Q4	Q4	Q4	Q4	Q4
1	Gross Losses and Loss Adjustment Expenses	1,940,897	1,480,604	1,128,298	921,752	780,657	684,084
1.1	Reinsurance Payable	0	0	0	0	0	0
1.2	Gross Losses and Loss Adjustment Expenses on Assumed Reinsurance	338,828	322,109	300,359	286,623	278,169	272,363
3	Contingent Commissions	0	0	0	0	0	0
4	Other Expenses	0	0	0	0	0	0
5	Taxes (x FIT), licenses, fees	0	0	0	0	0	0
6	Federal taxes	0	0	0	0	0	0
7	Borrowed Money	0	0	0	0	0	0
9	Gross Unearned Premiums	142,908	12,616	4,582	0	0	0
11	Funds held on reinsurance treaties	65,905	52,891	52,580	69,249	87,644	102,839
12	Funds held on account of others	0	0	0	0	0	0
14	Provision for reinsurance	50,838	37,642	25,229	18,581	13,601	11,174
22	Aggregate write-ins for liabilities	154,461	122,974	102,322	88,528	76,918	47,989
23	Total Liabilities	2,693,837	2,028,836	1,613,370	1,384,733	1,236,990	1,118,449
27	Surplus as regards policyholders	65,355	37,722	53,177	80,655	109,892	143,434

Scenario 3: Stocks Decline 50%

Balance Sheet		2006	2007	2008	2009	2010	2011
Assets		Q4	Q4	Q4	Q4	Q4	Q4
	Line numbers correspond to PC Annual Statement 2000.						
	Book Value of:						
1	Bonds	538,754	462,721	386,630	386,630	386,630	386,630
2	Stocks	260,936	105,717	89,791	74,496	73,991	73,485
4	Real Estate	56,853	49,673	33,797	25,000	25,000	25,000
5	Cash	15,421	17,138	15,945	20,238	22,356	27,684
6	Other invested assets	120,308	76,194	40,979	22,322	16,179	16,179
8	Aggregate write-ins	0	0	0	0	0	0
9	Total cash and invested assets	992,271	711,443	567,142	528,687	524,156	528,978
10	Uncollected Premiums	52,507	35,695	3,076	0	0	0
10.2	Ceded Unearned Premiums	65,096	1,005	365	0	0	0
10.3	Accrued retrospective premiums	41,232	26,530	16,833	11,230	7,351	4,861
11	Funds held	0	0	0	0	0	0
13	Reinsurance receivable on loss and LAE paid	197,235	134,034	121,692	99,060	78,674	66,331
13.1	Reinsurance receivable on assumed loss and LAE paid	0	4,228	11,890	16,372	18,910	20,453
14	Reinsurance recoverable on direct loss and LAE reserves	1,211,923	974,886	806,124	689,412	609,927	554,632
14.1	Reinsurance recoverable on assumed loss and LAE reserves	103,876	86,962	56,314	38,389	28,236	22,065
15	EDP Equipment	2,048	733	126	0	0	0
16	Interest, dividends, real estate income due and accrued	10,289	0	0	0	0	0
20	Other assets (nonadmitted or otherwise)	82,716	59,407	42,658	33,515	28,023	9,988
22	Total of all assets	2,759,192	2,034,923	1,626,220	1,416,665	1,295,276	1,207,309
		2006	2007	2008	2009	2010	2011
	Liabilities	Q4	Q4	Q4	Q4	Q4	Q4
1	Gross Losses and Loss Adjustment Expenses	1,940,897	1,480,604	1,128,298	921,752	780,657	684,084
1.1	Reinsurance Payable	0	0	0	0	0	0
1.2	Gross Losses and Loss Adjustment Expenses on Assumed Reinsurance	338,828	322,109	300,359	286,623	278,169	272,363
3	Contingent Commissions	0	0	0	0	0	0
4	Other Expenses	0	0	0	0	0	0
5	Taxes (x FIT), licenses, fees	0	0	0	0	0	0
6	Federal taxes	0	0	0	0	0	0
7	Borrowed Money	0	0	0	0	0	0
9	Gross Unearned Premiums	142,908	12,616	4,582	0	0	0
11	Funds held on reinsurance treaties	65,905	52,891	52,580	69,249	87,644	102,839
12	Funds held on account of others	0	0	0	0	0	0
14	Provision for reinsurance	50,838	37,642	25,229	18,581	13,601	11,174
22	Aggregate write-ins for liabilities	154,461	122,974	102,322	88,528	76,918	47,989
23	Total Liabilities	2,693,837	2,028,836	1,613,370	1,384,733	1,236,990	1,118,449
27	Surplus as regards policyholders	65,355	6,087	12,851	31,932	58,287	88,859

Scenario 4: Investment and Cash Yields Decrease

Balance Sheet		2006	2007	2008	2009	2010	2011
Assets		Q4	Q4	Q4	Q4	Q4	Q4
Line numbers correspond to PC Annual Statement 2000.							
Book Value of:							
1	Bonds	538,754	455,322	369,979	365,930	359,348	353,949
2	Stocks	260,936	105,717	89,791	74,496	73,991	73,485
4	Real Estate	56,853	49,673	33,797	25,000	25,000	25,000
5	Cash	15,421	14,692	13,818	13,661	13,597	15,222
6	Other invested assets	120,308	76,194	40,979	22,322	16,179	16,179
8	Aggregate write-ins	0	0	0	0	0	0
9	Total cash and invested assets	992,271	701,598	548,364	501,409	488,115	483,835
10	Uncollected Premiums	52,507	35,695	3,076	0	0	0
10.2	Ceded Unearned Premiums	65,096	1,005	365	0	0	0
10.3	Accrued retrospective premiums	41,232	26,530	16,833	11,230	7,351	4,861
11	Funds held	0	0	0	0	0	0
13	Reinsurance receivable on loss and LAE paid	197,235	134,034	121,692	99,060	78,674	66,331
13.1	Reinsurance receivable on assumed loss and LAE paid	0	4,228	11,890	16,372	18,910	20,453
14	Reinsurance recoverable on direct loss and LAE reserves	1,211,923	974,886	806,124	689,412	609,927	554,632
14.1	Reinsurance recoverable on assumed loss and LAE reserves	103,876	86,962	56,314	38,389	28,236	22,065
15	EDP Equipment	2,048	733	126	0	0	0
16	Interest, dividends, real estate income due and accrued	10,289	0	0	0	0	0
20	Other assets (nonadmitted or otherwise)	82,716	59,407	42,658	33,515	28,023	9,988
22	Total of all assets	2,759,192	2,025,078	1,607,442	1,389,387	1,259,235	1,162,165
Liabilities		2006	2007	2008	2009	2010	2011
		Q4	Q4	Q4	Q4	Q4	Q4
1	Gross Losses and Loss Adjustment Expenses	1,940,897	1,480,604	1,128,298	921,752	780,657	684,084
1.1	Reinsurance Payable	0	0	0	0	0	0
1.2	Gross Losses and Loss Adjustment Expenses on Assumed Reinsurance	338,828	322,109	300,359	286,623	278,169	272,363
3	Contingent Commissions	0	0	0	0	0	0
4	Other Expenses	0	0	0	0	0	0
5	Taxes (x FIT), licenses, fees	0	0	0	0	0	0
6	Federal taxes	0	0	0	0	0	0
7	Borrowed Money	0	0	0	0	0	0
9	Gross Unearned Premiums	142,908	12,616	4,582	0	0	0
11	Funds held on reinsurance treaties	65,905	52,891	52,580	69,249	87,644	102,839
12	Funds held on account of others	0	0	0	0	0	0
14	Provision for reinsurance	50,838	37,642	25,229	18,581	13,601	11,174
22	Aggregate write-ins for liabilities	154,461	122,974	102,322	88,528	76,918	47,989
23	Total Liabilities	2,693,837	2,028,836	1,613,370	1,384,733	1,236,990	1,118,449
27	Surplus as regards policyholders	65,355	-3,758	-5,927	4,654	22,245	43,716

Scenario 5: Bad Debt Ratio of 10%

Balance Sheet		2006	2006	2006	2006	2006	2006
Assets		Q4	Q4	Q4	Q4	Q4	Q4
	Line numbers correspond to PC Annual Statement 2000.						
	Book Value of:						
1	Bonds	538,754	422,347	317,681	299,347	281,908	269,484
2	Stocks	260,936	105,717	89,791	74,496	73,991	73,485
4	Real Estate	56,853	49,673	33,797	25,000	25,000	25,000
5	Cash	15,421	14,404	13,323	13,020	12,845	12,700
6	Other invested assets	120,308	76,194	40,979	22,322	16,179	16,179
8	Aggregate write-ins	0	0	0	0	0	0
9	Total cash and invested assets	992,271	668,336	495,571	434,186	409,922	396,848
10	Uncollected Premiums	52,507	35,695	3,076	0	0	0
10.2	Ceded Unearned Premiums	65,096	1,005	365	0	0	0
10.3	Accrued retrospective premiums	41,232	26,530	16,833	11,230	7,351	4,861
11	Funds held	0	0	0	0	0	0
13	Reinsurance receivable on loss and LAE paid	197,235	134,034	121,692	99,060	78,674	66,331
13.1	Reinsurance receivable on assumed loss and LAE paid	0	4,228	11,890	16,372	18,910	20,453
14	Reinsurance recoverable on direct loss and LAE reserves	1,211,923	974,886	806,124	689,412	609,927	554,632
14.1	Reinsurance recoverable on assumed loss and LAE reserves	103,876	86,962	56,314	38,389	28,236	22,065
15	EDP Equipment	2,048	733	126	0	0	0
16	Interest, dividends, real estate income due and accrued	10,289	0	0	0	0	0
20	Other assets (nonadmitted or otherwise)	82,716	59,407	42,658	33,515	28,023	9,988
22	Total of all assets	2,759,192	1,991,816	1,554,649	1,322,163	1,181,042	1,075,178
		2006	2006	2006	2006	2006	2006
Liabilities		Q4	Q4	Q4	Q4	Q4	Q4
1	Gross Losses and Loss Adjustment Expenses	1,940,897	1,480,604	1,128,298	921,752	780,657	684,084
1.1	Reinsurance Payable	0	0	0	0	0	0
1.2	Gross Losses and Loss Adjustment Expenses on Assumed Reinsurance	338,828	322,109	300,359	286,623	278,169	272,363
3	Contingent Commissions	0	0	0	0	0	0
4	Other Expenses	0	0	0	0	0	0
5	Taxes (x FIT), licenses, fees	0	0	0	0	0	0
6	Federal taxes	0	0	0	0	0	0
7	Borrowed Money	0	0	0	0	0	0
9	Gross Unearned Premiums	142,908	12,616	4,582	0	0	0
11	Funds held on reinsurance treaties	65,905	52,891	52,580	69,249	87,644	102,839
12	Funds held on account of others	0	0	0	0	0	0
14	Provision for reinsurance	50,838	37,642	25,229	18,581	13,601	11,174
22	Aggregate write-ins for liabilities	154,461	122,974	102,322	88,528	76,918	47,989
23	Total Liabilities	2,693,837	2,028,836	1,613,370	1,384,733	1,236,990	1,118,449
27	Surplus as regards policyholders	65,355	-37,020	-58,720	-62,570	-55,947	-43,271

Scenario 6: Reserves Increase 10%

Balance Sheet		2006	2007	2008	2009	2010	2011
Assets		Q4	Q4	Q4	Q4	Q4	Q4
	Line numbers correspond to PC Annual Statement 2000.						
	Book Value of:						
1	Bonds	538,754	384,872	262,573	232,753	206,180	185,956
2	Stocks	260,936	105,717	89,791	74,496	73,991	73,485
4	Real Estate	56,853	49,673	33,797	25,000	25,000	25,000
5	Cash	15,421	14,066	12,799	12,375	12,108	11,883
6	Other invested assets	120,308	76,194	40,979	22,322	16,179	16,179
8	Aggregate write-ins	0	0	0	0	0	0
9	Total cash and invested assets	992,271	630,522	439,939	366,946	333,458	312,504
10	Uncollected Premiums	52,507	35,695	3,076	0	0	0
10.2	Ceded Unearned Premiums	65,096	1,005	365	0	0	0
10.3	Accrued retrospective premiums	41,232	26,530	16,833	11,230	7,351	4,861
11	Funds held	0	0	0	0	0	0
13	Reinsurance receivable on loss and LAE paid	197,235	148,494	130,076	104,600	82,315	68,883
13.1	Reinsurance receivable on assumed loss and LAE paid	0	4,228	11,890	16,372	18,910	20,453
14	Reinsurance recoverable on direct loss and LAE reserves	1,211,923	952,086	764,773	635,711	548,130	487,267
14.1	Reinsurance recoverable on assumed loss and LAE reserves	103,876	86,962	56,314	38,389	28,236	22,065
15	EDP Equipment	2,048	733	126	0	0	0
16	Interest, dividends, real estate income due and accrued	10,289	0	0	0	0	0
20	Other assets (nonadmitted or otherwise)	82,716	59,407	42,658	33,515	28,023	9,988
22	Total of all assets	2,759,192	1,945,662	1,466,050	1,206,763	1,046,423	926,022
		2006	2007	2008	2009	2010	2011
	Liabilities	Q4	Q4	Q4	Q4	Q4	Q4
1	Gross Losses and Loss Adjustment Expenses	1,940,897	1,437,370	1,045,829	815,816	658,944	551,427
1.1	Reinsurance Payable	0	0	0	0	0	0
1.2	Gross Losses and Loss Adjustment Expenses on Assumed Reinsurance	338,828	322,109	300,359	286,623	278,169	272,363
3	Contingent Commissions	0	0	0	0	0	0
4	Other Expenses	0	0	0	0	0	0
5	Taxes (x FIT), licenses, fees	0	0	0	0	0	0
6	Federal taxes	0	0	0	0	0	0
7	Borrowed Money	0	0	0	0	0	0
9	Gross Unearned Premiums	142,908	12,616	4,582	0	0	0
11	Funds held on reinsurance treaties	65,905	52,891	52,580	69,249	87,644	102,839
12	Funds held on account of others	0	0	0	0	0	0
14	Provision for reinsurance	50,838	37,642	25,229	18,581	13,601	11,174
22	Aggregate write-ins for liabilities	154,461	122,974	102,322	88,528	76,918	47,989
23	Total Liabilities	2,693,837	1,985,602	1,530,900	1,278,797	1,115,276	985,792
27	Surplus as regards policyholders	65,355	-39,940	-64,850	-72,034	-68,853	-59,771



Summary of Scenarios

Key Assumption	Base Case	Reinsurance Collections Lags 6 mos	Stocks Decline 50%	Bonds and Cash Yields from 6/3 to 4/1.5	Bad Debt 10%	Reserves Increase 10%
Beginning Surplus	65,355					
Ending Surplus	163,121	143,434	88,859	43,716	-43,271	-59,771
Surplus Change		-19,687	-54,575	-45,144	-86,987	-16,499

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