

Treasury Model

Targeting criteria T1.T:

- a) The scenario set should reasonably reflect history, with some allowance for more extreme high and low interest rate environments
- b) Upper Bound:
 - i. [18%] is \geq [99.5%]-tile on the 1Y yield fan chart, and no more than [0.5%] of scenarios have 1Y yields that go above [18%] in the first 30 years
 - ii. [17%] is \geq [99.5%]-tile on the 20Y yield fan chart, and no more than [0.5%] of scenarios have 20Y yields that go above [17%] in the first 30 years

Evaluation statistics T1.E:

Review maximum sojourn length for high interest rates ($> 17\%$)

Targeting criteria T2.T:

Apply the following guidance for negative interest rates:

- a) Maturities less than 20 years could experience negative interest rates
- b) Interest rates may remain negative for multi-year time periods
- c) 1Y rates should not be lower than -1.0%
- d) 20Y rates should not be lower than 0.0%

Evaluation statistics T2.E:

- e) Frequency of low rates:
 - i. Review the frequency of negative rates for 1Y rate
 - ii. Review the frequency of negative rates and rates below 1% for 20Y rate
- f) Review Maximum sojourn length for low interest rates ($< 0\%$)

Targeting criteria T3.T:

- a) Review initial actual vs. fitted spot curve differences for a sampling of 5 dates representing different shapes and rate levels for the entire curve and review fitted curves qualitatively to confirm they stylistically mimic the different actual yield curve shapes
- b) The frequency of different yield curve shapes in early durations should be reasonable considering the shape of the starting yield curve (e.g., a flatter yield curve leads to more inversions).
- c) The steady state curve has normal shape (not inverted for short maturities, longer vs shorter maturities, or between long maturities)

Evaluation statistics T3.E:

- d) Review upper and lower bound for 20Y-1Y in low, moderate, and high interest rate environments. Compare to historical.
- e) Review worse-than-history frequencies for 20Y-1Y in low, moderate, and high interest rate environments. Compare to historical.

Targeting criteria T4.T:

- a) At least 7.5% of scenarios need a 10-year geometric average of the 20-year UST below **1.45%**
- b) At least 3.75% of scenarios need a 30-year geometric average of the 20-year UST below **1.95%**

Note: As part of the model acceptance process, a given calibration of the GOES will be tested at multiple starting dates. This criteria is relevant for the 12/31/20 starting yield curve.

Targeting criteria T5.T:

- a) For each scenario, calculate the geometric average of the [20-year] UST yield over the first [10] and [30] years of the projection.
- b) Calculate the [1st] and [99th] percentiles of the distribution of geometric average rates (for both the 10 and 30-year horizons).
- c) Look up criteria based on the starting level of the 20-year UST yield (interpolate if necessary).

Starting Yield of 20Y UST	10Y, 1st Percentile	10Y, 99th Percentile	30Y, 1st Percentile	30Y, 99th Percentile
1%	0.94%	3.43%	1.50%	6.25%
2%	1.23%	5.05%	1.68%	7.71%
3%	1.62%	6.55%	1.86%	8.72%
4%	2.15%	7.74%	2.06%	9.62%
5%	2.66%	8.87%	2.26%	10.46%
6%	3.15%	9.96%	2.50%	11.16%
7%	3.63%	11.03%	2.78%	11.61%
8%	4.10%	12.07%	3.06%	11.99%
9%	4.64%	13.08%	3.34%	12.25%
10%	5.21%	14.01%	3.65%	12.63%

Evaluation statistics T5.E:

d) Use the Academy approach to determine parameters for 15th and 85th percentiles to expand the criteria table to also include conditions on moderate rate.

Evaluation statistics T6.E:

Mean reversion benchmark:

i. 50th percentile $1.31\% < 1Y \text{ rate} < 3.35\%$

ii. 50th percentile $3.35\% < 20Y \text{ rate} < 4.89\%$

Ranges based on 15 year half-life for consistency with AAA recommendation.

Evaluation statistics T7.E:

Note that the buckets refer to starting yield level and the desired range percentages refer to the annualized standard deviation of monthly yield changes.

		Historical		
Rate	Bucket (BOM)	Stat	Desired Range	
[Chg1Y]	<= [3%]	0.59%	0.30%	to 0.89%
	> [3%] to <= [8%]	1.16%	0.58%	to 1.73%
	> [8%]	3.35%	1.67%	to 5.02%
[Chg20Y]	<= [3%]	0.61%	0.31%	to 0.92%
	> [3%] to <= [8%]	0.75%	0.37%	to 1.12%
	> [8%]	1.56%	0.78%	to 2.33%

Equity Model

Targeting criteria E1.T:

Use updated Large Capitalization (S&P 500) equity fund Gross Wealth Factors (GWFs) developed by the American Academy of Actuaries based on an average of reference models as a calibration targets.

Criteria based on Average GWF*												
Percentile	Gross Wealth Factor (GWF)						Geometric Average Return (GAVG)					
	1 years	5 years	10 years	20 years	30 years	50 years	1 years	5 years	10 years	20 years	30 years	50 years
0	0.46	0.25	0.22	0.25	0.29	0.46	-54.4%	-24.5%	-14.1%	-6.6%	-4.0%	-1.6%
1	0.70	0.58	0.60	0.79	1.15	2.82	-29.8%	-10.4%	-5.0%	-1.1%	0.5%	2.1%
5	0.82	0.80	0.91	1.36	2.20	6.38	-17.8%	-4.5%	-0.9%	1.6%	2.7%	3.8%
10	0.88	0.93	1.12	1.81	3.08	9.78	-11.7%	-1.5%	1.1%	3.0%	3.8%	4.7%
15	0.92	1.02	1.28	2.18	3.84	12.94	-7.6%	0.4%	2.5%	4.0%	4.6%	5.3%
25	0.99	1.18	1.54	2.81	5.26	19.23	-1.5%	3.3%	4.4%	5.3%	5.7%	6.1%
30	1.01	1.24	1.66	3.12	6.01	22.79	1.1%	4.4%	5.2%	5.9%	6.2%	6.5%
50	1.09	1.48	2.15	4.47	9.23	39.98	9.3%	8.1%	7.9%	7.8%	7.7%	7.7%
70	1.17	1.74	2.71	6.30	14.12	68.89	17.2%	11.7%	10.5%	9.6%	9.2%	8.8%
75	1.19	1.82	2.89	6.93	15.88	80.22	19.4%	12.7%	11.2%	10.2%	9.7%	9.2%
85	1.25	2.02	3.36	8.69	21.06	115.31	24.8%	15.0%	12.9%	11.4%	10.7%	10.0%
90	1.28	2.15	3.71	10.09	25.20	147.92	28.4%	16.6%	14.0%	12.3%	11.4%	10.5%
95	1.34	2.37	4.30	12.33	33.19	210.72	34.2%	18.8%	15.7%	13.4%	12.4%	11.3%
99	1.45	2.82	5.64	18.18	53.74	397.23	45.3%	23.1%	18.9%	15.6%	14.2%	12.7%
100	1.76	4.20	8.98	42.03	140.72	1676.94	75.8%	33.3%	24.6%	20.6%	17.9%	16.0%
mean	1.09	1.52	2.31	5.38	12.38	65.77	8.9%	8.7%	8.8%	8.8%	8.7%	8.7%

[AAA Equity GWF Acceptance Criteria 031424](#)

Sharpe ratios for equities other than S&P should be within 5% of S&P Sharpe ratio.

Evaluation statistics E1.E:

Review 0.5th percentile, comparing to [0.54/0.58/0.62] for 1/5/10-year WF.

Targeting criteria E2.T:

Target the below correlations between interest rates and equity returns under low rate/low equity return and high rate/low equity return quadrants at the 10 and 30 year time horizon.

Tail GWF Target	10 Years	30 Years
Low Rate/Low Equity quadrant	0.81 ² - 0.87 ¹	1.82 - 2.12 ¹
High Rate/Low Equity quadrant	0.87 ¹ - 1.02	2.12 ¹ - 2.71

Corporate Model

Targeting criteria C1.T:

- a) Set steady state excess return targets for each bond fund according to the criteria below.

Criteria

Steady state targets (bps)	IG 1-5	IG 5-10	IG Long	HY
Target OAS (avg. VM-20 ult. spread at [12/31/21])	107	141	163	448
Target Excess Return (Target OAS * Excess Return % of OAS)	80	79	66	240
Criteria for avg. annualized Excess Return in years [20-30]	80 -[10]	79 -[10]	66 -[10]	240 -[20]

- b) Average annualized excess returns for each bond fund in years 20 through 30 of the projection should be no greater than the steady state excess returns, but no less than the steady state excess returns minus a buffer

Evaluation statistics C2.E:

Bond Fund	Median			Midpoint month Desired Range
	Month [0]	Month [1200]	Midpoint	
IG 1-5	Median _[0]	Median _[1200]	Avg(Median _[0] , Median _[1200])	[22] to [26]
IG 5-10	Median _[0]	Median _[1200]	Avg(Median _[0] , Median _[1200])	[22] to [26]
IG Long	Median _[0]	Median _[1200]	Avg(Median _[0] , Median _[1200])	[22] to [26]
HY	Median _[0]	Median _[1200]	Avg(Median _[0] , Median _[1200])	[22] to [26]

Evaluation statistic C3.E:

There should be some scenarios that include periods where credit losses are greater than credit spreads. In other words, there should be some cases where the return on a corporate bond is less than a comparable UST bond.