

**NEW YORK STATE
TEACHERS' RETIREMENT SYSTEM**

MEMORANDUM

To: Retirement Board Date: October 26, 2017
From: R. Young
Subject: Lowering the System's Valuation Rate of Interest Assumption
Cc: T. Lee, J. Indelicato, S. Pangburn, J. Fesmire

The Valuation Rate of Interest Assumption

The valuation rate of interest, or discount rate, is used to determine the present value of future benefit payments calculated within the actuarial valuation. It is the single most important actuarial assumption, and has a dramatic impact on the actuarial valuation results, including the employer contribution rate (ECR). Even a small change in the rate can lead to a meaningful change in the ECR. Lowering the interest rate assumption has the effect of increasing plan liabilities, and ultimately the ECR, and vice versa. Lowering this assumption implies the System expects to earn less money on its investments in the future and will therefore require higher contributions.

The history of NYSTRS valuation rate of interest assumption since 1980 is as follows:

<i>NYSTRS History of the Valuation Rate of Interest Assumption</i>	
<u>Fiscal Year</u>	<u>Return Assumption</u>
1980	4.50%
1981	6.75%
1982	6.75%
1983	6.75%
1984	6.75%
1985	7.25%
1986	7.25%
1987	7.25%
1988 – 2014	8.00%
2015	7.50%
2016	7.50%

The System's current valuation rate of interest assumption is 7.50% per annum.

A decrease in the rate to 7.25% is recommended at this time.

Asset Allocation

The System’s current asset allocation, approved by the Retirement Board at its meeting on August 2, 2017, is provided below. This allocation is set by the Retirement Board and reviewed annually. Asset allocation changes, if any, are typically of an incremental nature and not large in scale.

<i>Asset Class</i>	<i>Allocation Target Percentage</i>	<i>Permitted Range</i>
Domestic Equity	35.0%	31.0% – 39.0%
International Equity	18.0%	14.0% – 22.0%
Real Estate	11.0%	6.0% – 16.0%
Private Equity	<u>8.0%</u>	3.0% – 13.0%
<i>Total Equity</i>	72.0%	
Domestic Fixed Income	16.0%	12.0% – 20.0%
Global Fixed Income	2.0%	0.0% – 3.0%
Real Estate Debt	7.0%	3.0% – 11.0%
High Yield Bonds	1.0%	0.0% - 3.0%
Private Debt	1.0%	0.0% - 5.0%
Cash Equivalents	<u>1.0%</u>	0.0% – 4.0%
<i>Total Fixed Income</i>	28.0%	

Historical Rates of Return

The System’s historical annualized rates of return, net of expenses, for periods ending on June 30, 2017, are provided in the table below.

<i>NYSTRS Historical Annualized Rates of Return through June 30, 2017</i>	
<u>Return Period</u>	<u>Annualized Rate of Return (net of expenses)</u>
1 year	12.5%
3 years	6.6
5 years	10.2
10 years	5.6
15 years	7.8
20 years	7.2
25 years	8.7
30 years	8.8

Expected Returns

The System's investment consultant, AON Hewitt, annually provides their long-term expected rates of return and standard deviations, by asset class. These projected returns represent their current expectations over a 30-year time horizon. Combined together, along with corresponding asset class correlations, the expected annual rate of return for the total portfolio is 6.7% on a geometric basis and 7.4% on an arithmetic basis. AON Hewitt's exhibit illustrating this outcome is attached to this memo as Attachment 1.

Although AON Hewitt is the System's investment consultant, there are many investment consultants in the industry, each with their own return expectations. In order to obtain an overview of the marketplace, the System also looked at the results of the 2017 Horizon Actuarial Survey. Horizon surveys investment consultants and provides data with respect to the average of their investment return expectations by asset class. For the 2017 Horizon survey 12 investment consultants provided long-term (20-year) investment return forecasts. Using the average return projections by asset class from the Horizon survey, AON Hewitt re-ran the return expectations for our asset allocation resulting in an expected rate of return of 7.6% on a geometric basis and 8.2% on an arithmetic basis. This result is attached to this memo as Attachment 2. AON Hewitt's capital market assumptions are on the more conservative side of the industry overall.

Additionally useful in this regard are stochastic simulations that Segal Consulting performed for the System. In the stochastic simulation modeling over ten thousand different future investment outcomes are generated based on the System's specific asset allocation. In one simulation set the AON Hewitt capital market assumption projections were used, and in another the Horizon Survey capital market assumption projections were used. Segal Consulting's Report "Updated Stochastic Projections – September 2017" is attached to the memo as Attachment 3.

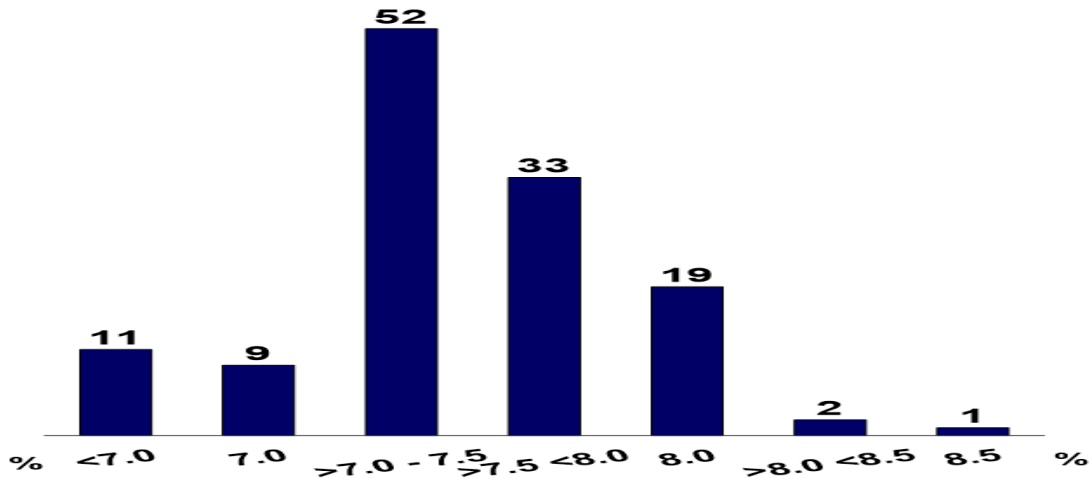
- The stochastic simulation run using AON Hewitt's capital market assumptions produced a return set with a distribution that had a 50th percentile that settled around a return of 6.8% in 20 years. The returns' 25th to 75th percentile range was 4.9% to 8.8%.
- The stochastic simulation run using the Horizon survey capital market assumptions produced a return set with a distribution that had a 50th percentile that settled around a return of 7.5% in 20 years. The returns' 25th to 75th percentile range was 5.7% to 9.4%.

Other Retirement Systems

The trend across the country has been the lowering of investment return assumptions. The National Association of State Retirement Administrators (NASRA) maintains a public fund database providing data on 127 of the state (and some large municipal) retirement systems. According to the most recent NASRA Issue Brief on the subject (February 2017), almost three-fourths of survey participants have lowered their assumed rate of return since 2010.

The bar graph below from the NASRA Issue Brief shows the distribution of investment return assumptions used. Whereas an 8.0% assumption was the most common in 2010 (and had the tallest bar in this chart), assumptions beginning with a “7” are now by far the most common. The “>7.0%-7.5%” bar is now the tallest in the chart. The average return assumption used is now 7.52% (median of 7.50%), a significant drop from an average of 7.91% in 2010.

Distribution of Investment Return Assumptions – February 2017 (NASRA Issue Brief)



Large public funds CalPERS and CalSTRS are both in the midst of lowering their assumed rates of return to 7.0% over three years and two years, respectively. Locally in New York State, the New York State and Local Retirement System and the New York City Retirement System both use an assumption of 7.0%.

Impact on the Employer Contribution Rate (ECR)

The current ECR is **9.80%** of pay (the result of the June 30, 2016 actuarial valuation, applicable to fiscal year '17-'18 salaries). At this time our estimate of the next ECR (the result of the June 30, 2017 actuarial valuation) using the 7.25% return assumption, is between **10.5% and 11.0%** of pay. The increase in the rate due to the lowering of the valuation rate of interest was somewhat mitigated by investment gains recognized in the actuarial valuation.

Valuation Interest Rate Conclusion

AON Hewitt is at the more conservative or pessimistic end of the investment return projection spectrum, in comparison to the projections of their peers. Focusing on the geometric static long-term return projections and the stochastic simulation results, in general terms AON Hewitt has a long-term projected return for our asset allocation of around 6.8%, and the Horizon Actuarial Survey produces a long-term projected return of around 7.5%. I recommend being between these two results. Additionally I would keep this assumption to the nearest 0.25% so as not to imply precision in an assumption that is clearly not intended to be precise. Based on these results I recommend a lowering of the investment return assumption from 7.50% to 7.25% to be

first utilized with the actuarial valuation as of June 30, 2017, for the ECR applicable to the salary year beginning July 1, 2018.

Impact on other economic assumptions

There are several other economic assumptions that relate to the assumed investment rate of return and for completeness they have also been examined. The recommendation for each of these other economic assumptions is as follows:

- Assumption for Inflation – Inflation assumption is lowered from 2.5% to 2.25%.
- Salary Scale – no change is recommended at this time.
- Assumed COLA - no change at this time, remains at 1.5%.
- “Hurdle rate” for the actuarial value of assets method – this rate is equal to the assumed rate of return and will therefore change as appropriate.

Unless specifically stated herein, all other assumptions remain unchanged from the “Report on the 2015 Recommended Actuarial Assumptions” issued October 15, 2015.

30-Year Return Update: Geometric and Arithmetic Averages

Asset Class	New Target	2Q17 Return Assumptions		Risk Assumptions
		Geometric	Arithmetic	2Q17
U.S. Equity ¹	35%	6.7%	8.1%	18.0%
Non-U.S. Equity ²	18%	7.5%	9.6%	21.7%
Real Estate Equity ³	11%	5.8%	6.5%	12.3%
Private Equity	8%	8.6%	11.2%	24.5%
Private Debt	1%	6.6%	7.1%	10.0%
Core U.S. Fixed Income	16%	3.7%	3.8%	5.0%
Global Fixed Income ⁴	2%	3.4%	3.5%	4.0%
Real Estate Debt ⁵	7%	4.9%	5.0%	5.5%
High Yield Bonds	1%	5.4%	6.1%	12.0%
Cash Equivalents	1%	2.8%	2.8%	2.0%
Total NYSTRS⁶	100%	6.7%	7.4%	12.4%

1 Modeled as 80% large cap / 20% small cap

2 Modeled as 75% non-US developed markets / 25% emerging markets

3 Modeled as 80% broad market private real estate / 20% REITs

4 Modeled as 60% Non-US developed bonds (hedged) / 40% core US fixed income

5 Includes investment grade and non-investment grade exposures; modeled at an 80/20 mix

6 Inflation is 2.2%

Horizon Survey 2017 Assumptions (20-Year)

Asset Class	New Target	Return Assumptions		Risk Assumptions
		Geometric	Arithmetic	
U.S. Equity ¹	35%	8.0%	9.3%	17.1%
Non-U.S. Equity ²	18%	8.1%	9.8%	19.4%
Real Estate Equity ³	11%	6.7%	7.7%	14.5%
Private Equity	8%	10.1%	12.2%	22.0%
Private Debt	1%	6.6%	7.1%	10.0%
Core U.S. Fixed Income	16%	4.4%	4.6%	5.5%
Global Fixed Income ⁴	2%	3.9%	4.1%	6.0%
Real Estate Debt ⁵	7%	5.3%	5.5%	6.0%
High Yield Bonds	1%	6.2%	6.7%	10.6%
Cash Equivalents	1%	3.2%	3.3%	3.0%
Total NYSTRS⁶	100%	7.6%	8.2%	11.6%

1 Modeled as 80% large cap / 20% small cap

2 Modeled as 75% non-US developed markets / 25% emerging markets

3 Modeled as 100% real estate

4 Modeled as 60% Non-US developed bonds (hedged) / 40% core US fixed income

5 Includes investment grade and non-investment grade exposures; modeled at an 80/20 mix

6 Inflation is 2.4%

New York State Teachers' Retirement System

**Updated Stochastic Projections
September 2017**

Capital Market Assumptions (CMAs)

- The analysis provided in July was updated based on the following:
 - Aon Hewitt's 2Q17 CMAs (30-year assumptions)
 - Horizon's 2017 Survey of CMAs (20-year assumptions)
- NYSTRS' target asset allocation was updated to remove 1% from real estate debt and add 1% to private debt. The updated allocation is shown below:

Asset Class	Target Asset Allocation
U.S Equities	35%
Non-U.S. Equities	18%
Real Estate Equity	11%
Private Equity	8%
Core U.S. Fixed Income	16%
Global Fixed Income	2%
Real Estate Debt	7%
Private Debt	1%
High Yield Bonds	1%
Cash Equivalents	1%

Assumed Rate of Investment Return

- The following table shows the probability of meeting or exceeding a given investment return assumption, based on Aon Hewitt's CMAs.

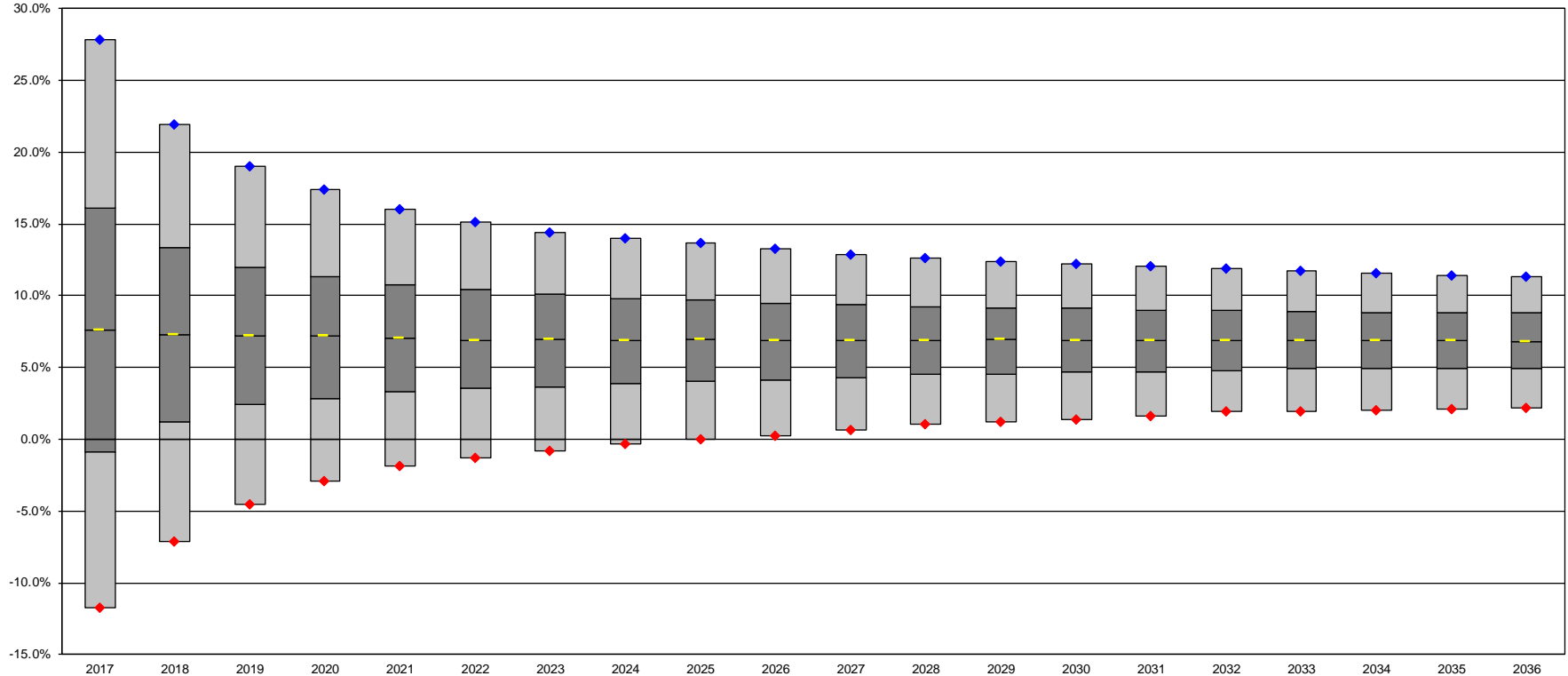
Probabilities of Meeting Alternative Investment Return Assumptions					
Investment Return Assumption	6.79%	7.00%	7.25%	7.50%	7.75%
Probability of meeting or exceeding assumption	50%	46%	42%	38%	34%

- The following table shows the probability of meeting or exceeding a given investment return assumption, based on Horizon's 2017 Survey of CMAs.

Probabilities of Meeting Alternative Investment Return Assumptions					
Investment Return Assumption		7.00%	7.25%	7.50%	7.75%
Probability of meeting or exceeding assumption		58%	54%	50%	47%

Investment Return Aon Hewitt CMAs

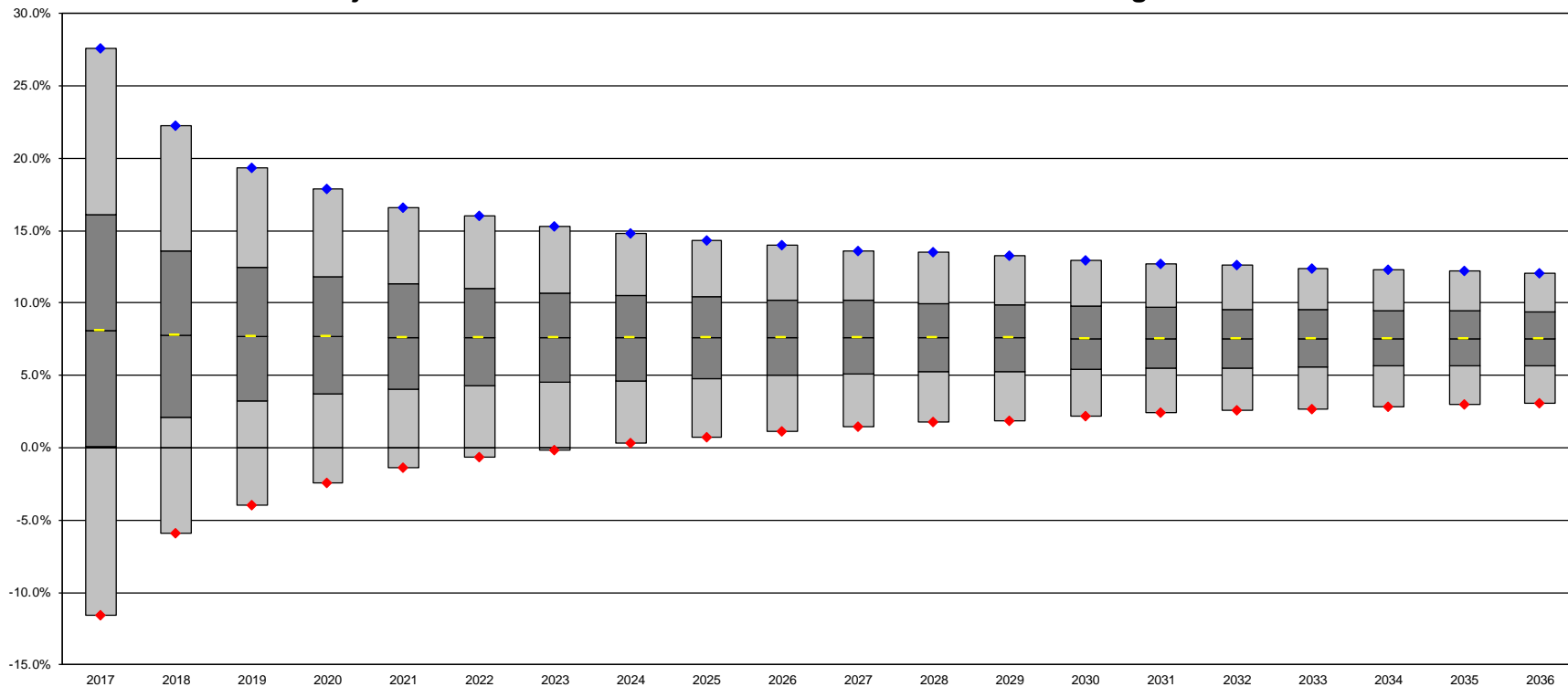
Projected Cumulative Investment Return for Plan Years Ending June 30



	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036
◆ 95th	27.9%	22.0%	19.0%	17.4%	16.1%	15.1%	14.4%	14.0%	13.7%	13.3%	12.8%	12.6%	12.4%	12.2%	12.0%	11.9%	11.7%	11.6%	11.4%	11.4%
— 75th	16.1%	13.4%	12.0%	11.3%	10.7%	10.4%	10.1%	9.8%	9.7%	9.5%	9.4%	9.2%	9.2%	9.2%	9.0%	9.0%	8.9%	8.8%	8.8%	8.8%
— 50th	7.6%	7.3%	7.2%	7.2%	7.1%	6.9%	7.0%	6.9%	6.9%	6.9%	6.9%	6.9%	6.9%	6.9%	6.9%	6.9%	6.9%	6.9%	6.9%	6.8%
— 25th	-0.9%	1.2%	2.4%	2.9%	3.3%	3.6%	3.6%	3.9%	4.1%	4.1%	4.3%	4.5%	4.5%	4.7%	4.7%	4.8%	4.9%	4.9%	4.9%	4.9%
◆ 5th	-11.7%	-7.1%	-4.5%	-3.0%	-1.8%	-1.3%	-0.8%	-0.3%	0.0%	0.3%	0.6%	1.0%	1.2%	1.4%	1.6%	1.9%	1.9%	2.0%	2.1%	2.2%

Investment Return Horizon Survey CMAs

Projected Cumulative Investment Return for Plan Years Ending June 30



	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036
◆ 95th	27.6%	22.2%	19.3%	17.9%	16.6%	16.0%	15.3%	14.8%	14.3%	14.0%	13.6%	13.5%	13.2%	12.9%	12.7%	12.6%	12.4%	12.3%	12.2%	12.1%
— 75th	16.1%	13.6%	12.4%	11.8%	11.3%	11.0%	10.7%	10.5%	10.4%	10.2%	10.2%	10.0%	9.9%	9.8%	9.7%	9.6%	9.6%	9.5%	9.4%	9.4%
— 50th	8.1%	7.8%	7.7%	7.7%	7.6%	7.6%	7.6%	7.6%	7.6%	7.6%	7.6%	7.6%	7.6%	7.6%	7.5%	7.5%	7.5%	7.6%	7.6%	7.5%
— 25th	0.1%	2.1%	3.2%	3.7%	4.0%	4.3%	4.5%	4.6%	4.8%	5.0%	5.1%	5.3%	5.3%	5.4%	5.5%	5.5%	5.6%	5.6%	5.7%	5.7%
◆ 5th	-11.6%	-5.9%	-4.0%	-2.5%	-1.3%	-0.7%	-0.1%	0.3%	0.7%	1.1%	1.5%	1.8%	1.9%	2.2%	2.4%	2.6%	2.7%	2.8%	3.0%	3.1%

2017 Horizon Survey Capital Market Assumptions

- Composite assumptions of 12 respondents that provided 20-year returns
- 20-year geometric and arithmetic averages and standard deviations:

Asset Class	Arithmetic Return	Geometric Return	Standard Deviation
U.S. Large Cap Equities	9.12%	7.83%	16.58%
U.S. Small/Mid Cap Equities	10.33%	8.40%	20.22%
Non-U.S. Equities – Developed	9.42%	7.64%	18.86%
Non-U.S. Equities – Emerging Market	11.83%	8.69%	25.42%
Real Estate	7.82%	6.69%	14.52%
Private Equity	12.59%	10.07%	21.98%
Core U.S. Fixed Income	4.59%	4.42%	5.50%
Global Fixed Income	3.74%	3.47%	7.36%
High Yield Bonds	6.80%	6.20%	10.61%
Cash Equivalents	3.25%	3.23%	2.97%

- Simulated returns were reduced by 22 basis points to reflect investment expenses.

Capital Market Assumptions (cont'd)

➤ Correlation coefficients:

	Large Cap	Small/ Mid Cap	Intl Developed	Intl EM	Real Estate	Private Equity	U.S. Fixed Income	Intl Fixed Income	High Yield Bonds	Cash
Large Cap	1.00									
Small/ Mid Cap	0.88	1.00								
Intl Developed	0.81	0.75	1.00							
Intl EM	0.72	0.69	0.79	1.00						
Real Estate	0.43	0.43	0.39	0.34	1.00					
Private Equity	0.73	0.71	0.70	0.65	0.40	1.00				
U.S. Fixed Income	0.13	0.08	0.14	0.13	0.07	0.04	1.00			
Intl Fixed Income	0.15	0.09	0.30	0.22	0.05	0.07	0.56	1.00		
High Yield Bonds	0.62	0.61	0.61	0.63	0.32	0.51	0.36	0.21	1.00	
Cash	-0.10	-0.13	-0.08	-0.08	0.01	-0.10	0.35	0.23	-0.05	1.00