CMU MSP Capstone Kickoff

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Agenda

- Intro to PFG
- Quantitative Investing
- Project Overviews
- Ways of Working

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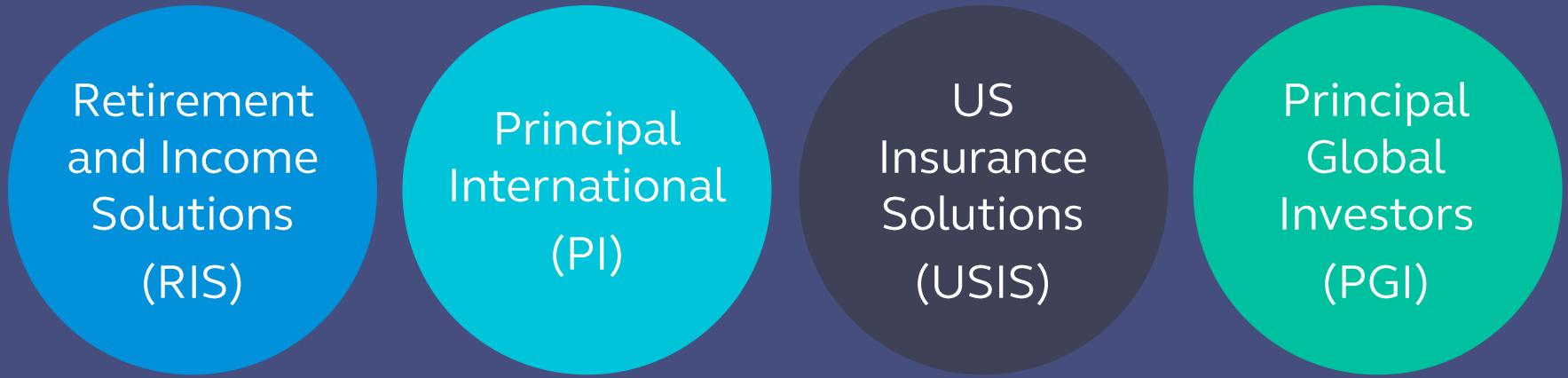
Principal Financial Group: Four Lines of Business



… with $703 billion in assets under management along with other Corporate and Supporting services…

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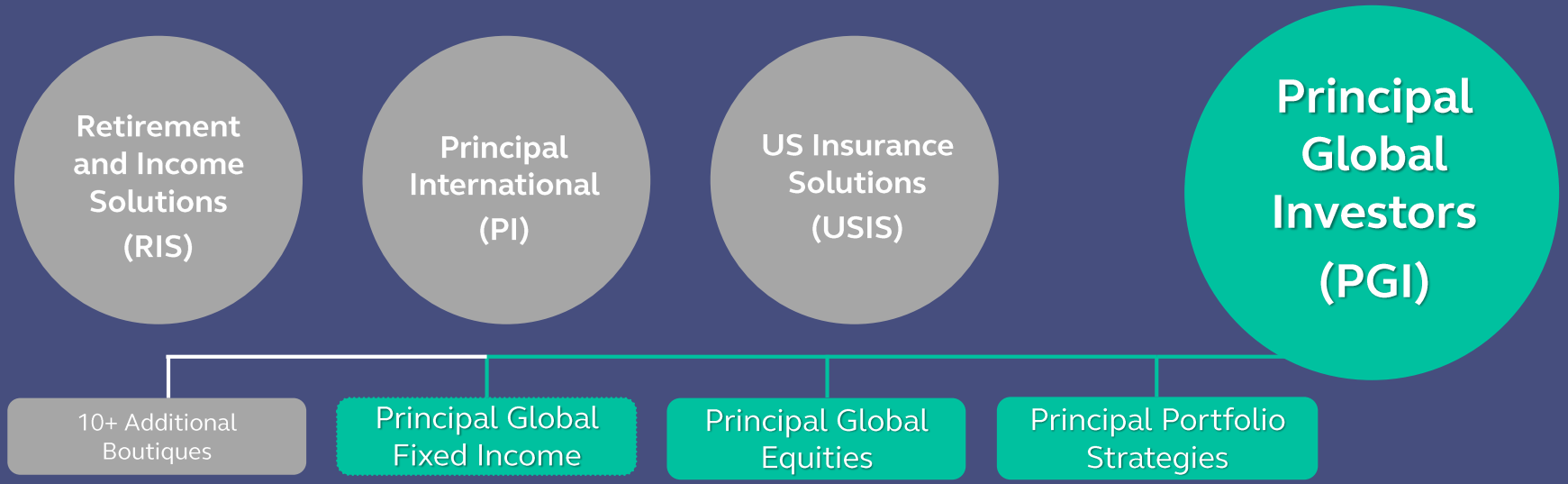
PGI has specialized investment boutiques

…of which US $451.7 billion in assets managed by PGI.



Data Science team is not limited to, but currently focuses on serving PGFI, PGE, and PPS

Global Company Making a Global Impact

Serving clients in over 70 countries

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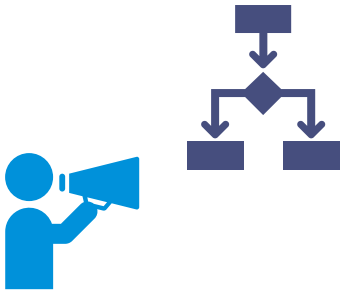
Data Science & Operations Research

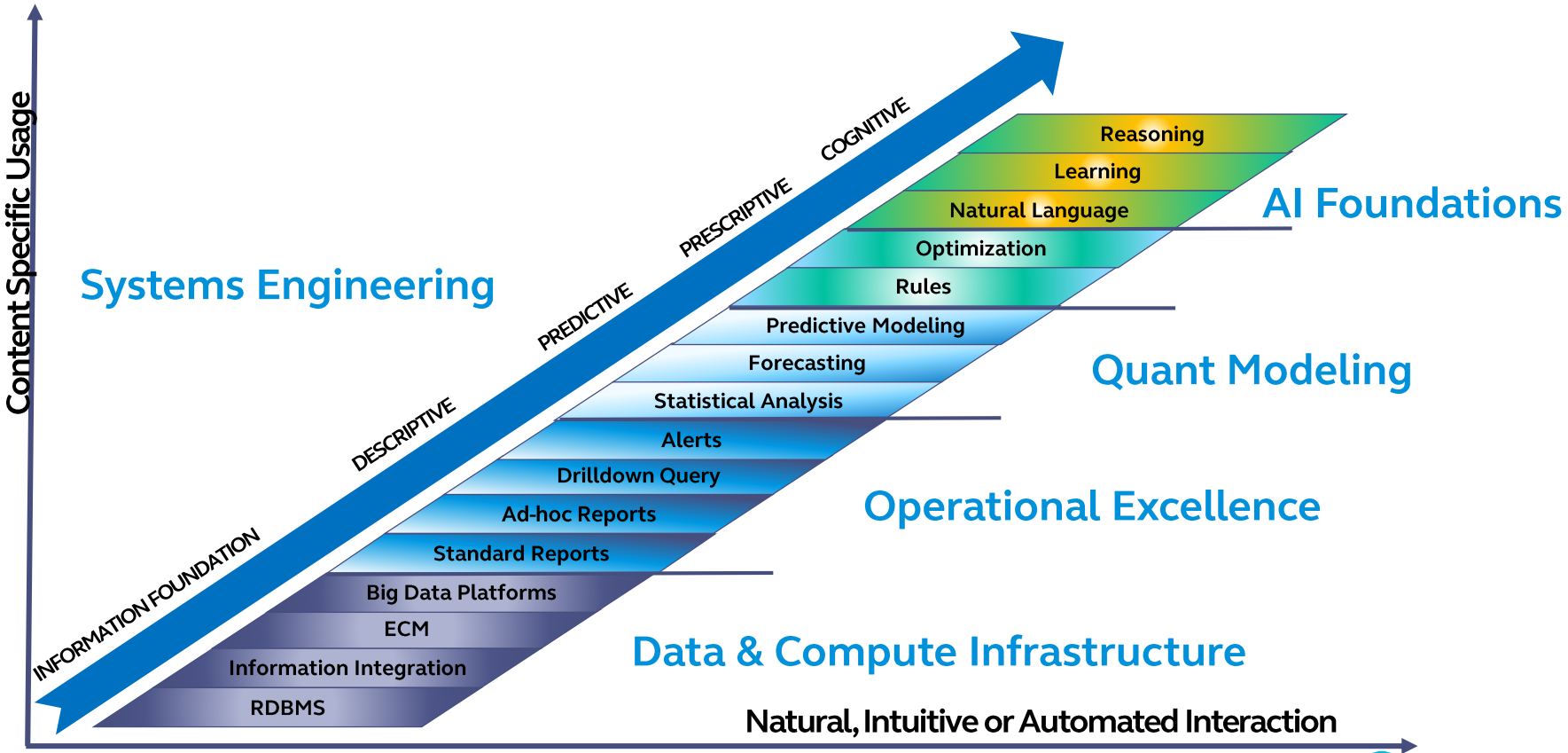
- Strategic “crowdsourcing” model with universities and external partners

- Focus on quantitative research and process improvement



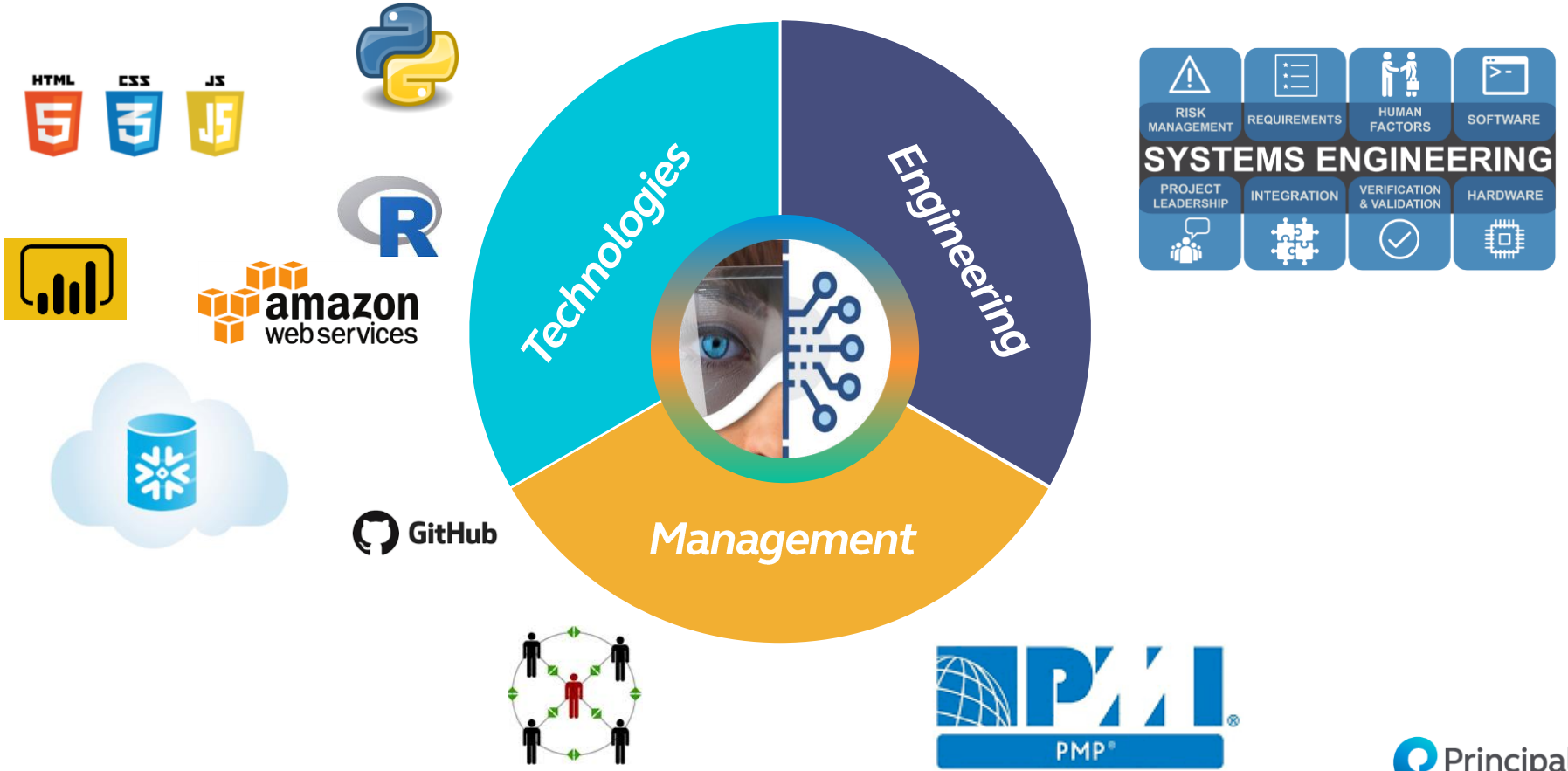
- Frequent use of project management, statistical and machine learning, and optimization techniques

The DS team leverages the analytics spectrum



Source: IBM 2013, A New Era of Smart

Mastery in Diversified Tools and Paradigms

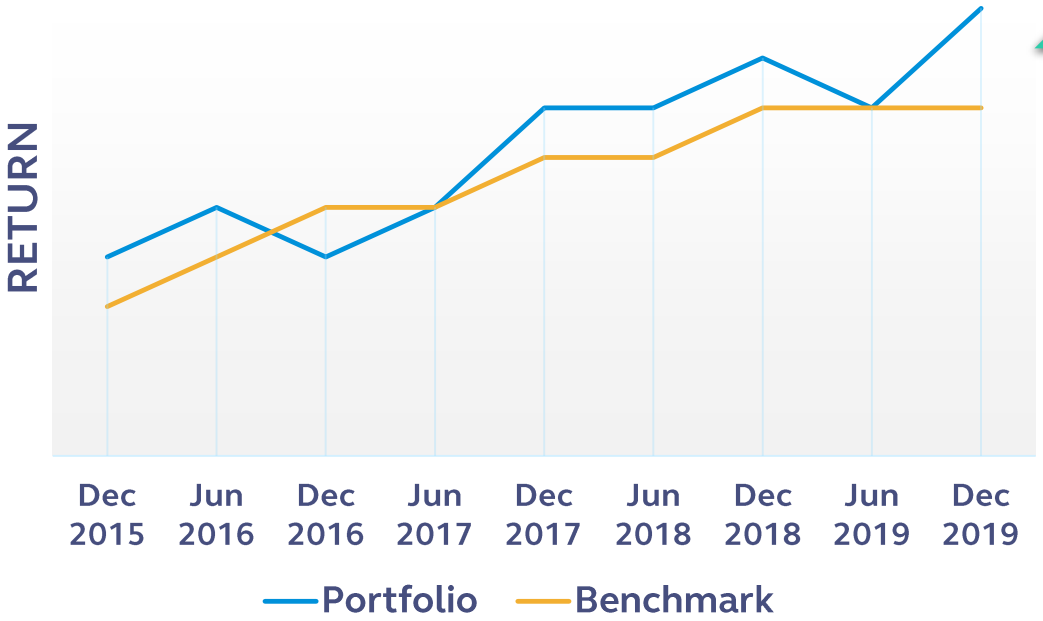


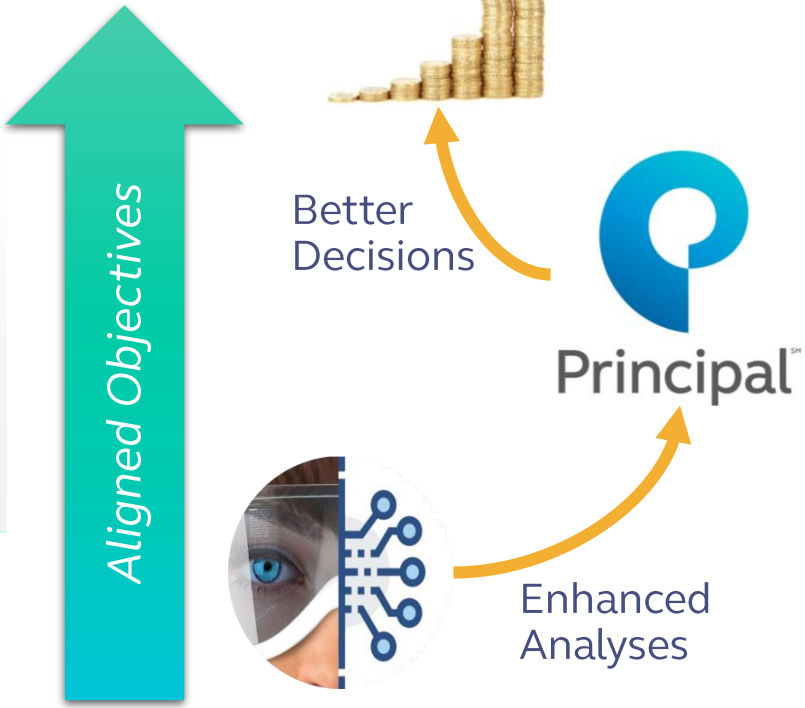
Systems Engineering in Data Science

- Good data scientists need to have the right scientific processes to tackle problems effectively
- But, having the right scientific tools doesn't always mean that they can be implemented in a cookie cutter way
- Many factors come into play – practical, circumstantial, organizational – wisdom and flexibility are needed to balance the science with the practice

Improving performance is our primary goal

$$= max(return), given\ constraints$$





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- **Quantitative Investing**
- Project Overviews
- Ways of Working

Key Terminology

Portfolio: A weighted allocation to individual stocks, bonds, or other assets.

Example: 50% AAPL & 50% GOOG

Asset Allocation: Distributing capital to a number of alternative assets. Decisions often based on human judgement, portfolio optimization, or rules-based methods.

Example: Stock allocation, sector allocation, or factor allocation.

Factor: A numeric attribute that can be measured for each asset at each point in time. Decades of industry and academic research have focused on identifying the factors that can explain historic returns or predict future returns.

Example: Book-to-Price ratio (Book Value / Market Value) is a factor describing a stock's valuation.

Key Terminology - Performance

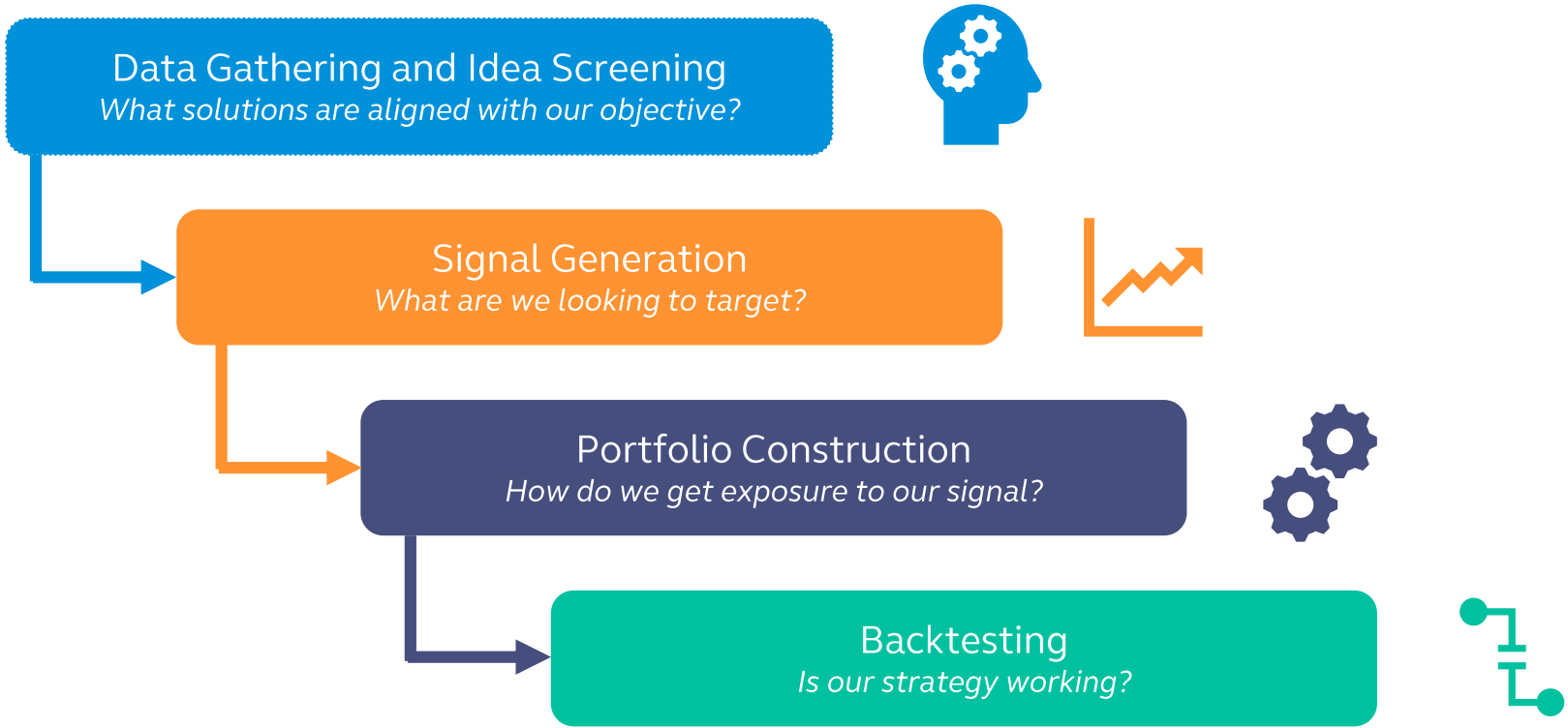
Return: Change in value of an asset (or portfolio) over a fixed horizon. If income or dividends included, normally referred to as a total return.

Volatility: Measure of variability of an asset's returns, usually the standard deviation. Most common measure of investment risk.

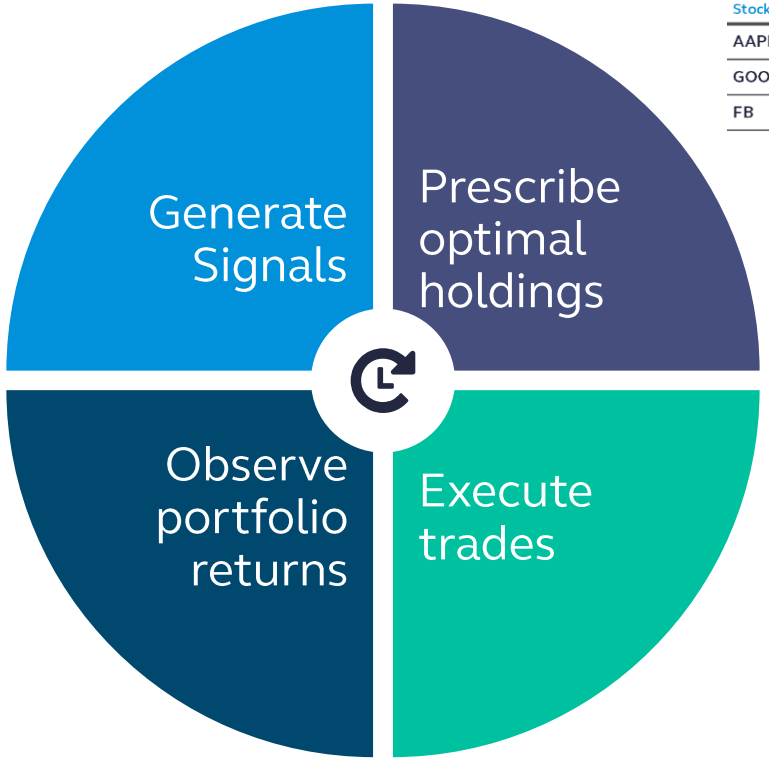
Excess Return: Return of an asset (or portfolio) above or below a market benchmark.

Example: Apple reutrns 5%, S&P 500 returns 3%. Apple has excess return of 2%.

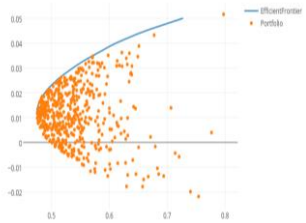
The Quantitative Strategy Lifecycle



Mapping signals into investment decisions



Stock	Weight
AAPL	0.4
GOOG	0.25
FB	0.35



Sell 1000 S&P 500 futures to hedge portfolio 25%.

Sell 100 shares of AAPL & buy 200 shares GOOG.

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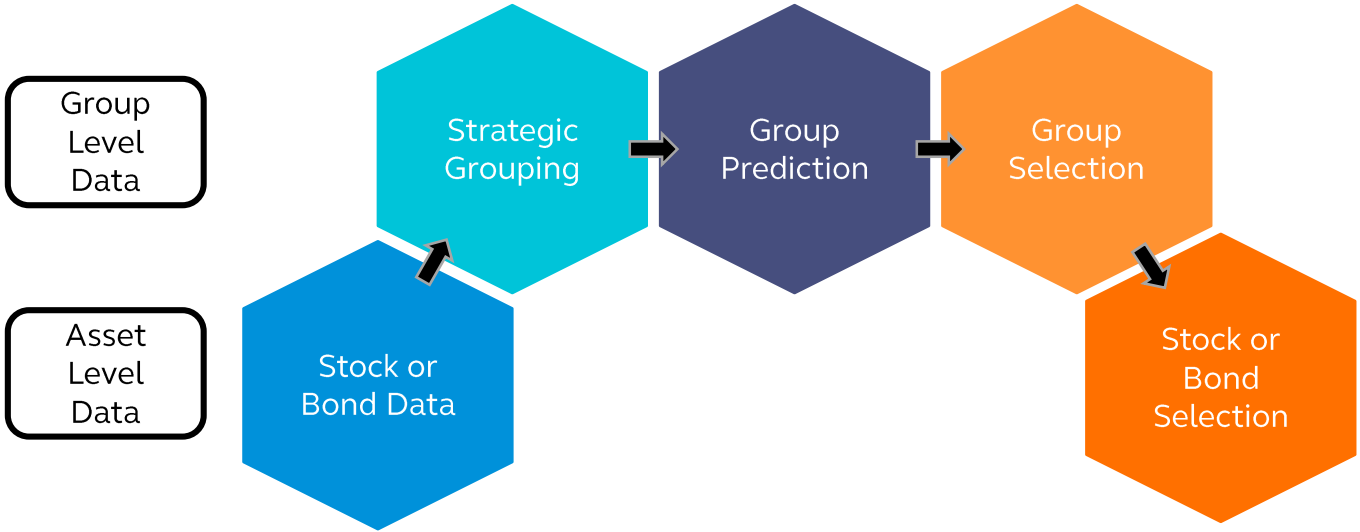
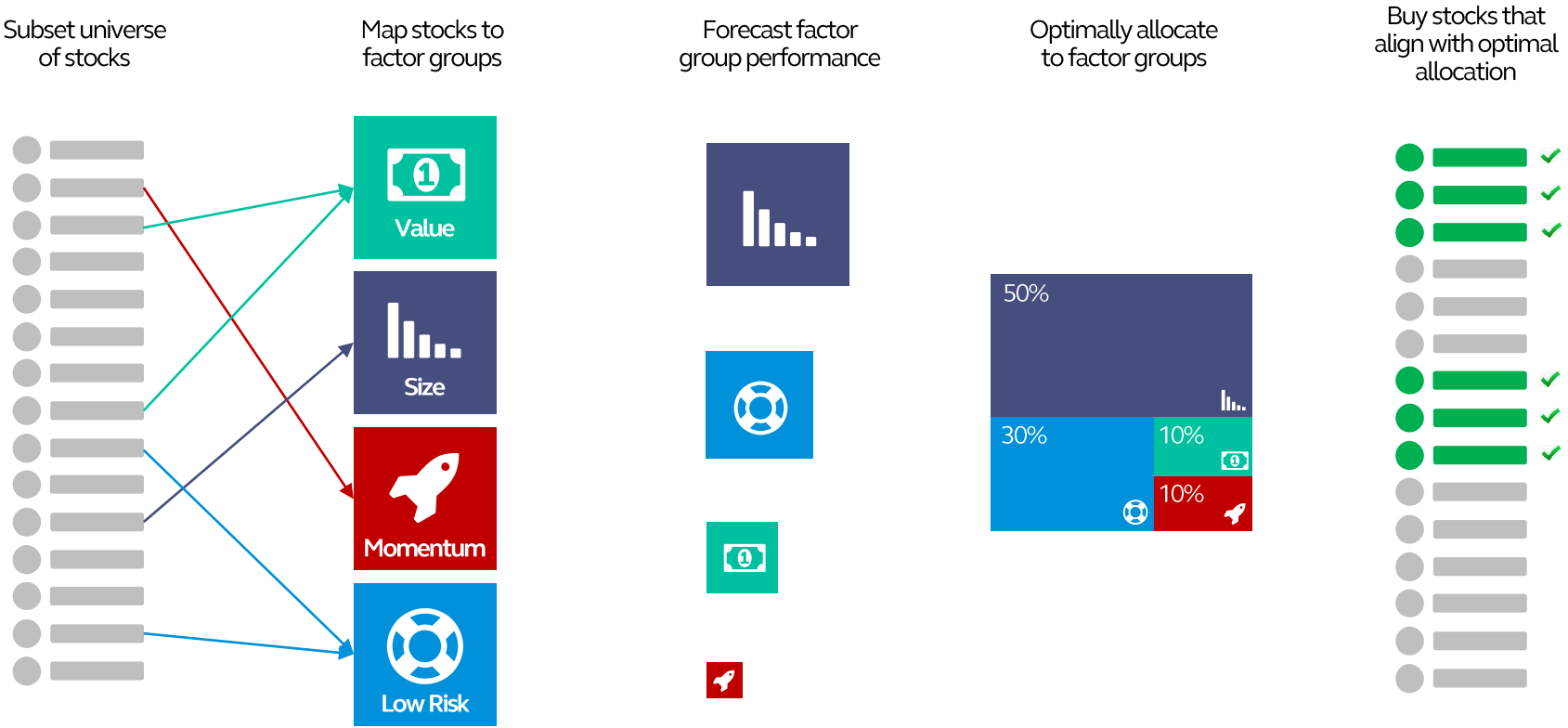
A unifying framework for many quant problems

Solving the problem in a lower dimension

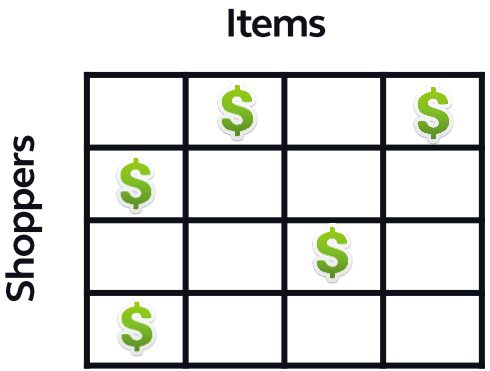


An example applied to “factor” group allocation



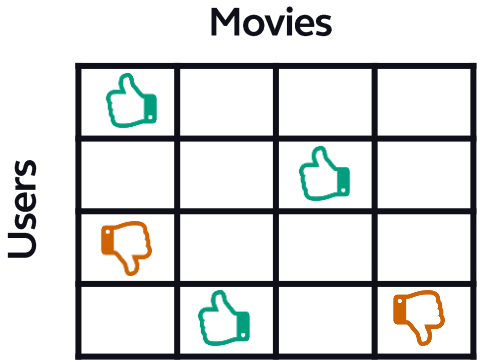
Investing Through a Recommender Systems Lens

at Amazon…



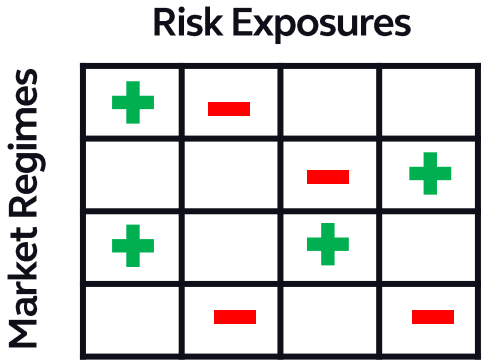
What item for the current shopper?

at Netflix…



What movie for the current user?

PGI



What risks will the current market reward or penalize?

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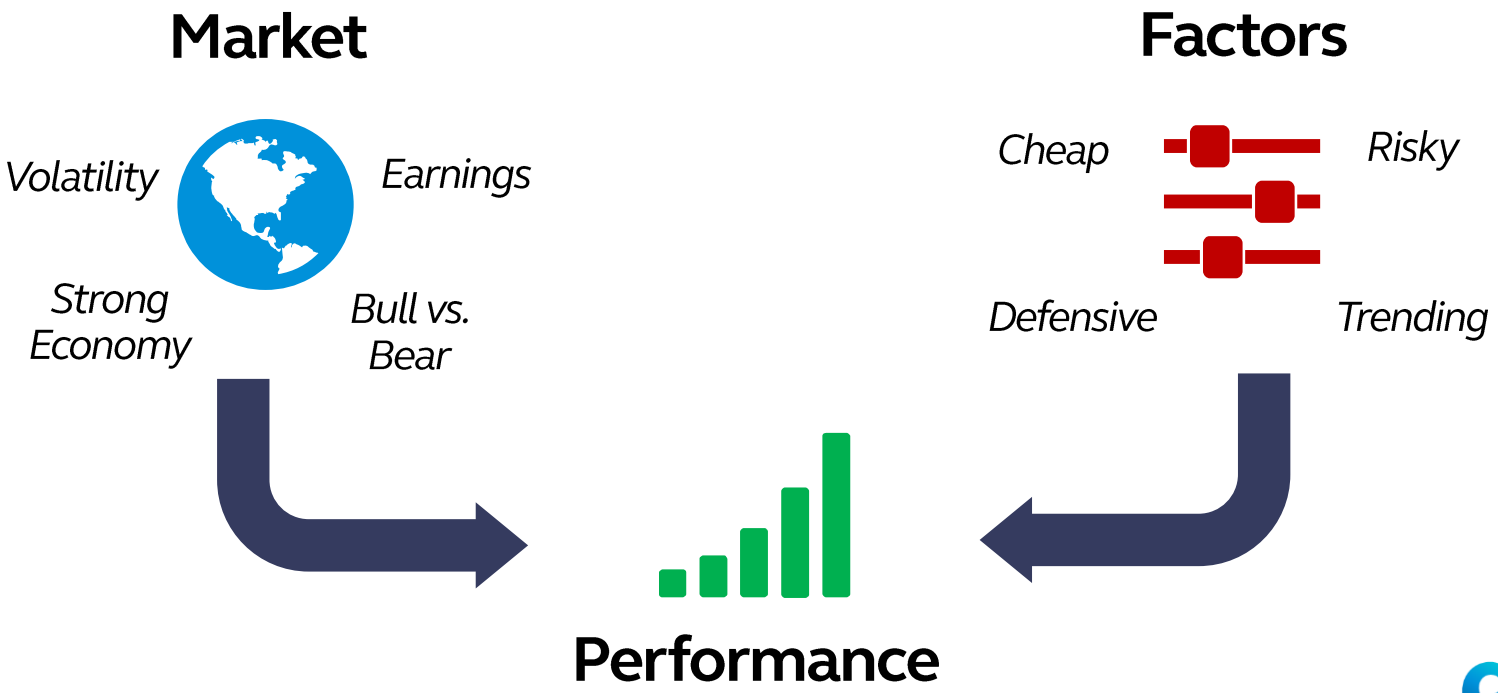
Pick factors, not individual stocks or bonds

The characteristics of your portfolio must be fit for the current market



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Project 1: Sector & Industry Allocation Model

Situation

Equity portfolios have exposures (i.e. allocations) to many sectors. These exposures impact portfolio performance.

Complication

We do not currently have the research or tools to take data-driven active positions (i.e. bets) in sectors or industries.

Mission

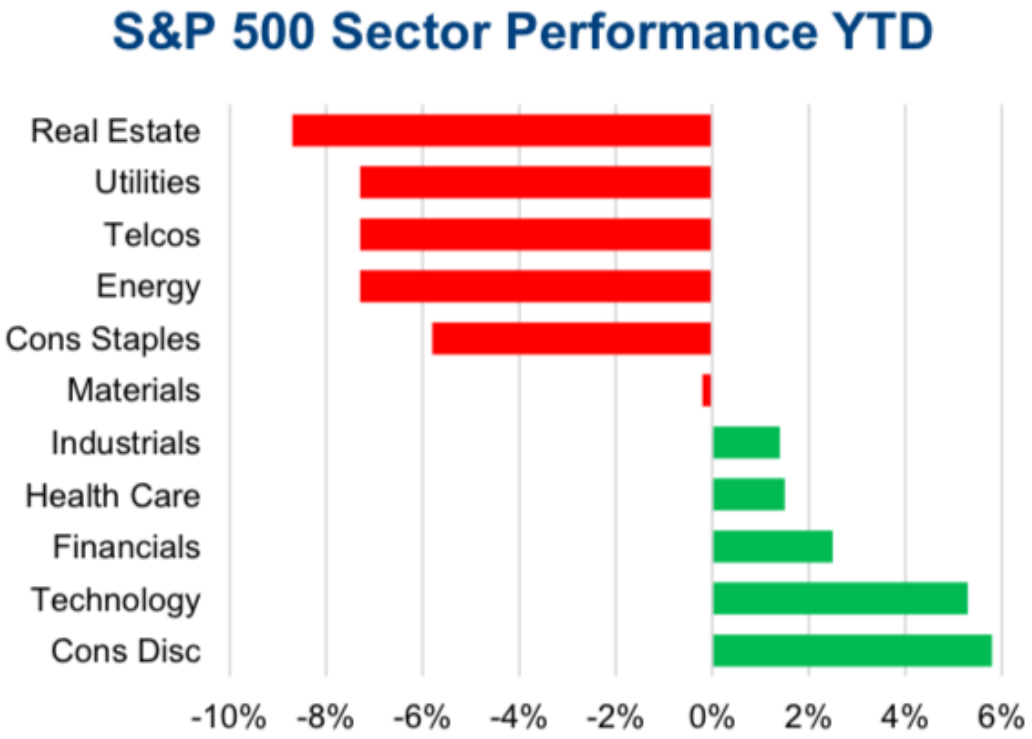
Develop a model that recommends the right sector allocations for the current market.

An ontology for companies in the stock market

Source: MSCI, Global Industry Classification Standard

Risks and performance drivers are different for each company or market segment.

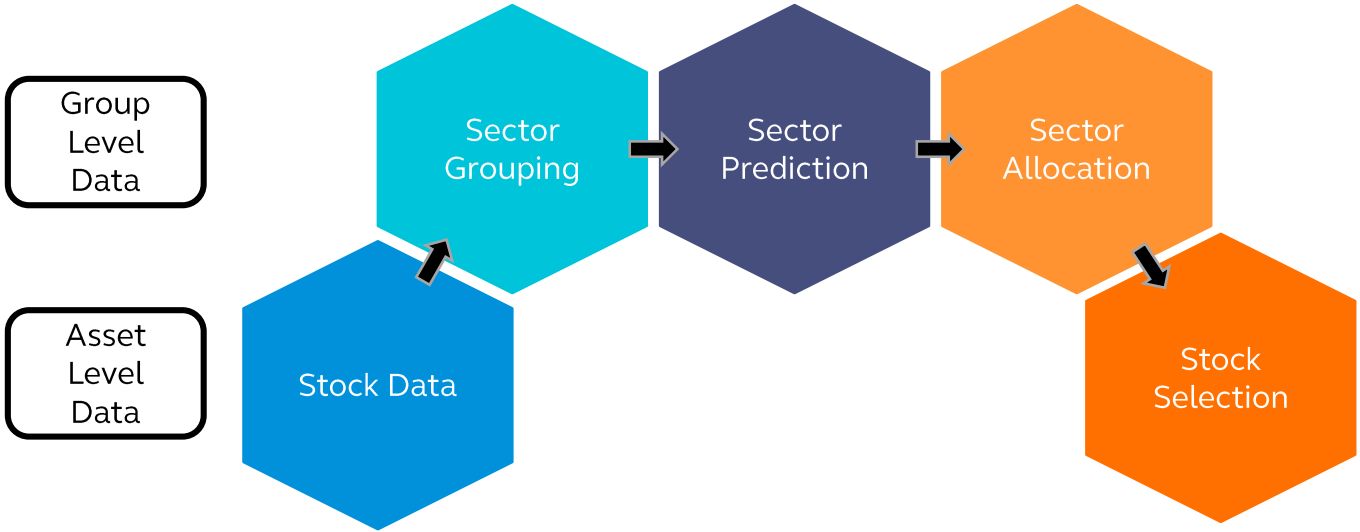
Sector positions can make or break a portfolio



Source: https://www.seeitmarket.com/sector-performance-recap-outlook-rising-yields-weigh-in-17875/

Project 1: Sector & Industry Allocation Model

Solving the problem in a lower dimension



Project 2: OAS & OAD Allocation Model

Situation

Interest rate risk (Duration or OAD) and Credit Risk (Spread or OAS) are the main drivers of returns in corporate bond markets.

Complication

These risks are not always rewarded. The returns of these groups exhibit a time-varying and regime-dependent structure.

Mission

Develop a model that recommends the right risk exposures for the current market regime.

What is “Fixed Income”?

“Fixed Income” is a blanket term for many types of assets; to name a few, Corporate Bonds, Government Bonds, and Mortgage-Backed Securities.

Fixed Income securities typically offer smaller returns than stocks, but also significantly less risk.


Government Bonds


MBS


Corporate Credit


Emerging Markets

Corporate Credit is debt issued by companies

Corporate Credit

Corporate Credit encapsulates bonds issued by corporations. They can be:

- **High Yield** – Riskier bonds with higher returns

OR

- **Investment Grade** – Safer bonds with lower returns

Key Terminology

Duration: The time, in years, for an investors to recoup their initial investment in a bond. Also measures a security's sensitivity to changes in Treasury rates.

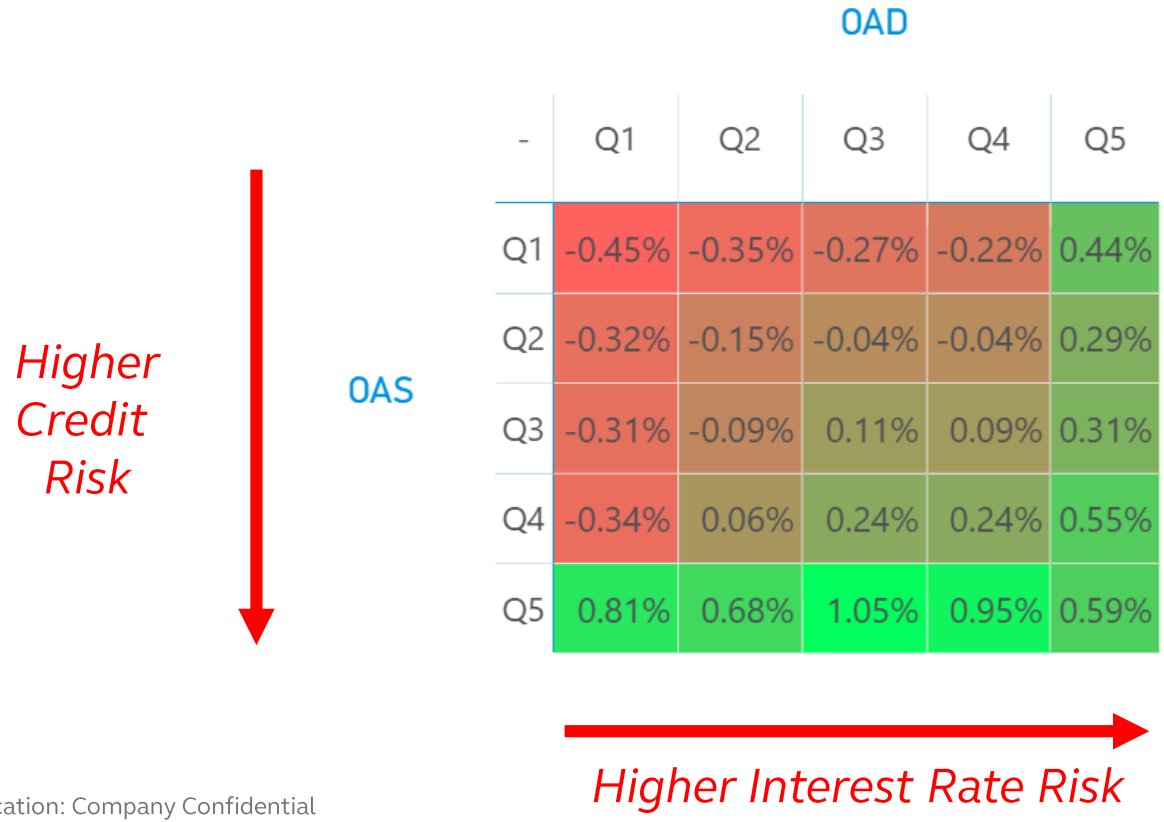
Option-Adjusted Duration (OAD): A bond's duration, accounting for embedded call options.

Spread: The difference in yield between a bond and a risk-free asset to compensate investors for credit risk. (i.e. the probability that the bond defaults.)

Option-Adjusted Spread (OAS): A more sophisticated measure of spread adjusted for embedded call options.

Excess Returns by OAS & OAD Quintiles

2007 - 2019



-	Q1	Q2	Q3	Q4	Q5
Q1	-0.45%	-0.35%	-0.27%	-0.22%	0.44%
Q2	-0.32%	-0.15%	-0.04%	-0.04%	0.29%
Q3	-0.31%	-0.09%	0.11%	0.09%	0.31%
Q4	-0.34%	0.06%	0.24%	0.24%	0.55%
Q5	0.81%	0.68%	1.05%	0.95%	0.59%

Excess Returns by OAS & OAD Quintiles

2007 – 2008: Entering the financial crisis

OAD

OAS	Q1	Q2	Q3	Q4	Q5
Q1	3.15%	2.94%	2.38%	1.69%	2.21%
Q2	2.77%	2.02%	0.88%	-0.12%	-1.10%
Q3	2.65%	1.06%	0.49%	-1.25%	-1.56%
Q4	1.41%	0.41%	-1.01%	-1.96%	-1.94%
Q5	0.48%	-1.11%	-2.36%	-2.29%	-3.22%

Excess Returns by OAS & OAD Quintiles

2009 – 2011: Recovery from the financial crisis

OAD

OAS	Q1	Q2	Q3	Q4	Q5
Q1	-1.65%	-1.38%	-0.85%	-0.71%	-0.76%
Q2	-1.77%	-1.13%	-0.21%	0.21%	1.24%
Q3	-1.57%	-0.79%	0.06%	0.54%	1.68%
Q4	-1.39%	-0.40%	0.56%	0.96%	2.16%
Q5	1.62%	1.27%	2.76%	2.51%	1.72%

Excess Returns by OAS & OAD Quintiles

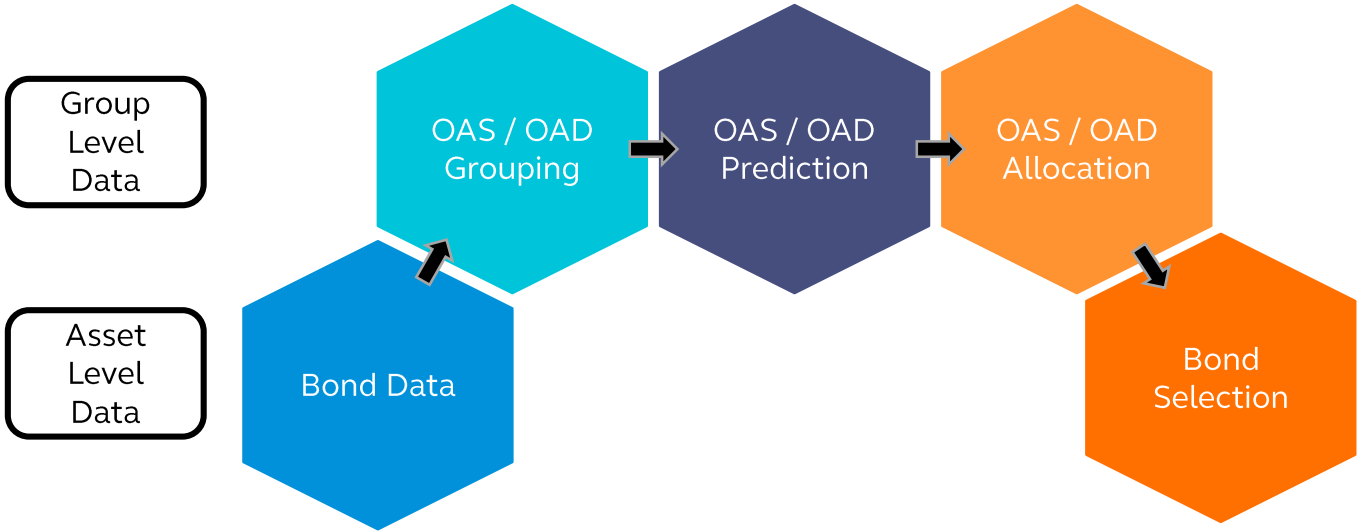
2016 – 2019: Recent performance

OAD

OAS	Q1	Q2	Q3	Q4	Q5
Q1	0.13%	0.06%	-0.11%	-0.60%	-0.65%
Q2	0.24%	0.17%	0.06%	-0.13%	-0.55%
Q3	0.39%	0.31%	0.21%	-0.01%	-0.25%
Q4	0.58%	0.50%	0.35%	0.18%	-0.04%
Q5	1.07%	1.01%	0.84%	0.86%	0.54%

Project 2: OAS & OAD Allocation Model

Solving the problem in a lower dimension



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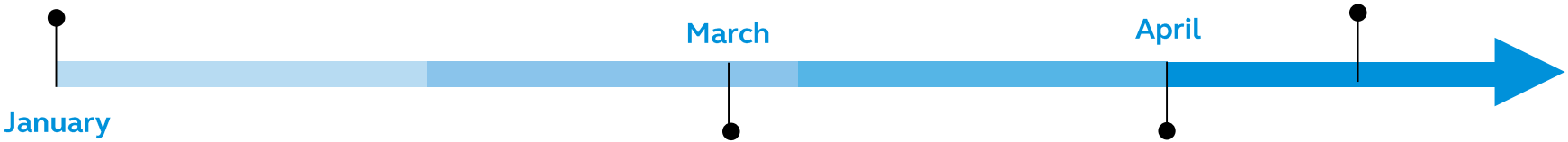
- **Ways of Working**

Project Timeline

Project Start
Description of problem and expectations. Gain access to data and computing resources.

Project End
Submit final project deliverables.



Early Prototypes & Midpoint Presentations
A chance for the teams to update stakeholders on progress made up to this point

Final Presentations
Teams showcase their work to PMs, Analysts, and Data Scientists at PGI

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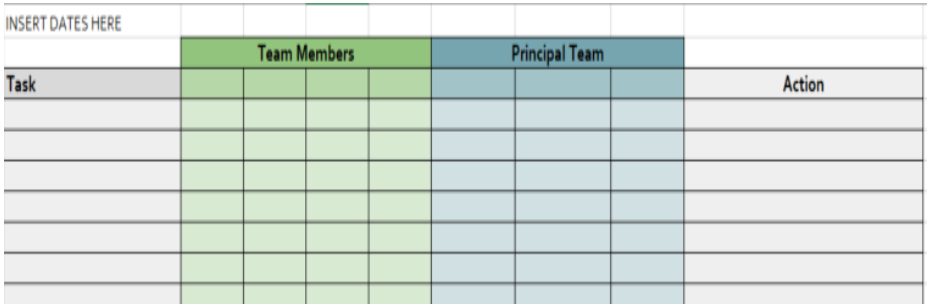
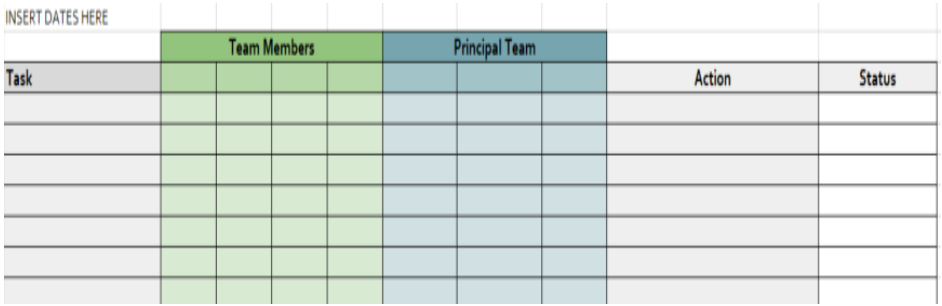
RASIC Charts

Forward



Backward



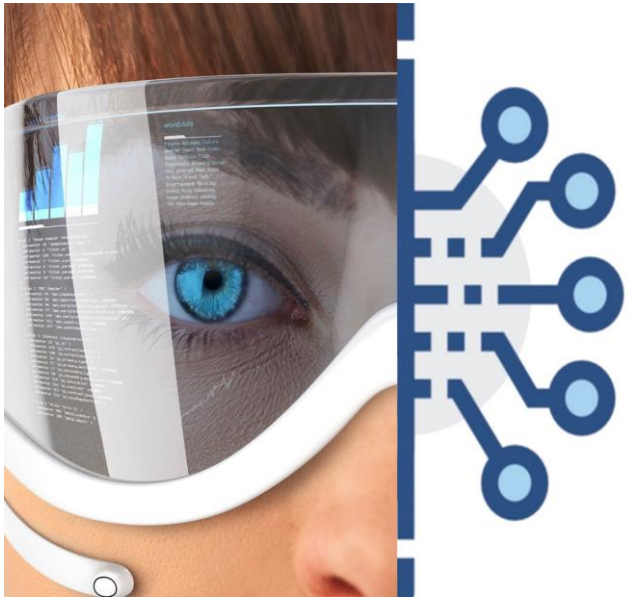
The RASIC charts will guide your weekly activities, help you distribute work, and keep the team on track toward the project deliverables.

Weekly Updates

We will hold weekly update meetings with key stakeholders via WebEx.

These meetings, along with the RASIC charts, will demonstrate the work completed the previous week and the work to be completed the following week.

We encourage you to treat these as preparation for your Final presentation. Do these well and you could potentially use some of your weekly slides in the bigger presentation.

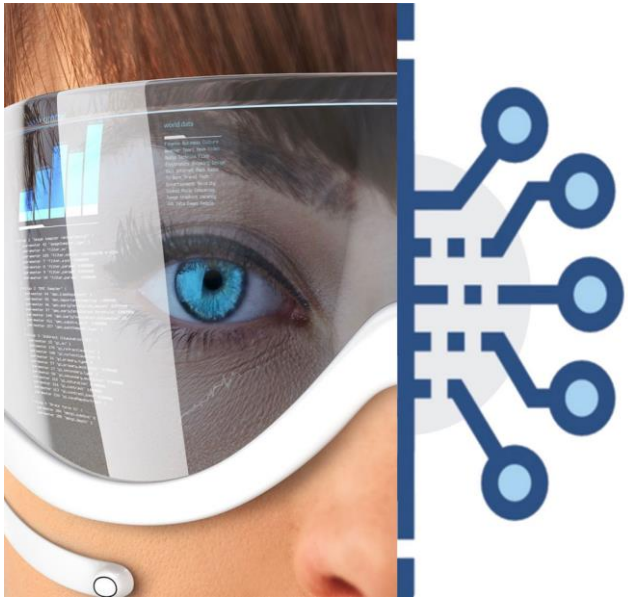


Midpoint and Final Presentation

These will be larger presentations done midway through and at the end of the project.

They will include a larger group of stakeholders. They will serve to align the whole of the stakeholder group on progress made and next steps.

Plan to spend some time these!



Technology

Data

PostgreSQL

Compute

amazon web services

Viz / UI

Microsoft Power BI

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Conventions & Reproducibility

1. Version control: Private Github repos set up for each team. Track your changes and provide meaningful commit messages.

2. Code Conventions: Comments for all major code chunks. Follow a style guide (e.g. PEP8 for python). Implement your pipeline using our abstract base classes.

3. Environments: Package management can be a headache. Keep a gold standard virtual environment for yourself and your team.

4. Data traceability: Try to isolate data transformations. Don't extract flat files from the source, build the source into your pipeline.

Thank you!

Please email me if you have any questions about these projects or our team.

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