Investing:
Sustainable Funds vs Index Funds

David Still
Anton Diez
Akshay Jindal
Moses Devanesan

Topics of Analysis

- Is there a price to be paid by investing in ESG mutual funds?
  - Actively managed funds tend to underperform compared to passively managed funds a regular basis.

Fees

- **Actively Managed Funds:** 1%-2% per year
- **Passively Managed Funds**: 0%-0.2% per year
- **Load-end Funds**: 4%-8% sales charge of investment

Taxes

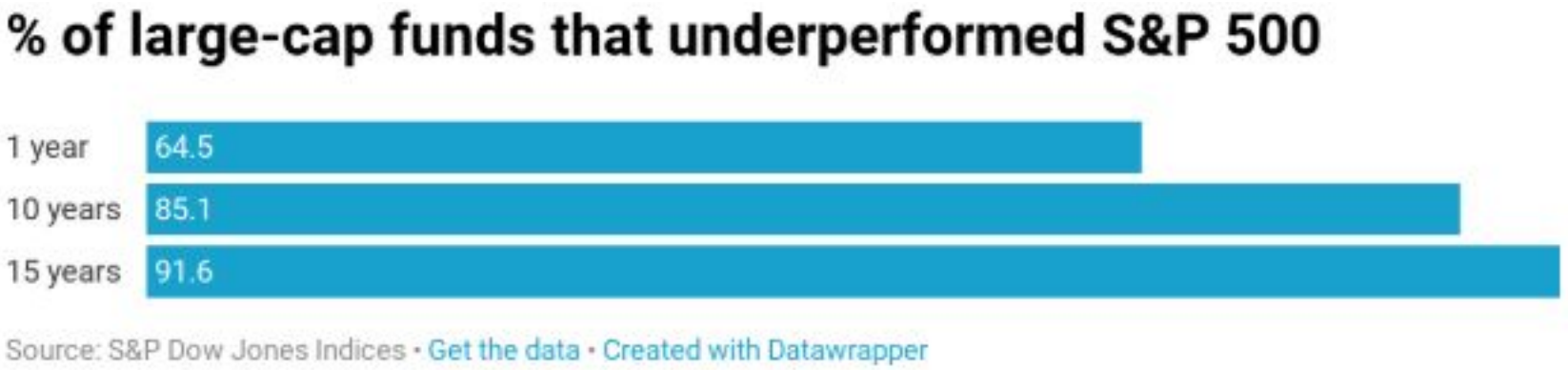
- **Active Managers**: High frequency of buying/selling positions
- **Index Fund Managers**: Lower frequency of buying/selling positions

Market Efficiency

- Difficult to identify undervalued companies

Topics of Analysis - Continued

- S&P Dow Jones Indices Released a report in 2019 on how actively managed funds performed against the benchmark:
  - 85.1% of funds underperformed in the last 10 years:



How do ESG funds perform against the Market?

Hypothesis

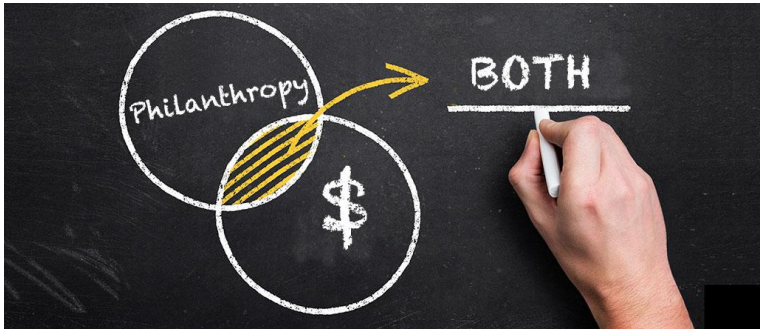
- Is there a price to be paid by investing in ESG mutual funds?
  - At least 50% of the sustainable funds will underperform the S&P 500 over a 10 year period

- Is there a large opportunity cost associated with investing in sustainable mutual funds?
  - Yes, given the reasons mentioned earlier (taxes, fees, market efficiency)

- Do sustainable funds have an overall better ESG rating compared to S&P 500?
  - Yes, the S&P 500 includes companies from many different industries (while ESG funds tend to be more selective)

What is ESG?

- Environmental
  - Reducing Carbon footprint, Climate change policies, renewable energy
- Social
  - Employment Diversity, Ethical Supply-chain, Public stance on social issues
- Governance
  - Relationship history with SEC, Executive fair compensation, Transparency with shareholders



Sources and Libraries

- Data:
  - Barrons, Morningstar, Bloomberg

- Libraries:
  - Pandas, Pathlib, numpy, matplotlib, Hvplot, Altair, Bokeh,

Topic Analysis

- Various portfolio metrics of Mutual Funds
- Evaluate risk and category types of Mutual Funds
- Understand ESG metrics of Mutual Funds
- Quantify mutual funds performance metrics

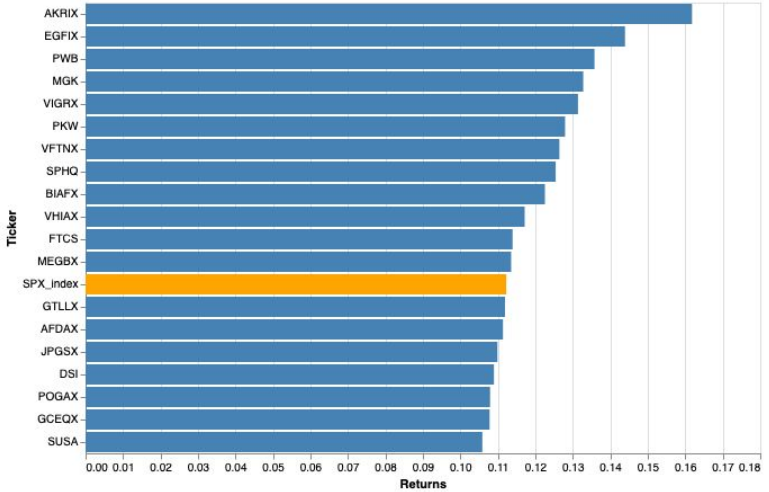
Portfolio Performance

Research Questions

- **How do mutual funds with strong ESG investment policies compare to respective benchmark (i.e S&P 500)?**
- **What is the relationship between fund performance and standard deviation of the Top 20 Funds?**
- **What is the correlation between the Top 20 Funds?**

S&P Outperforms Most of the Sustainable Funds

- Out of 129 funds that we analyzed, the S&P 500 had the *13th highest* annual return between 2010 and 2020 at 11.2%.
- The average return for the entire group was nearly half that at 6.9%.
- This would indicate that most investors incurred a large opportunity cost by choosing to invest in sustainable funds (unless you happened to have chosen one of the top performing ones.)



Summary Statistics All Funds

- mean 0.068975
- min -0.018684
- 25% 0.045105
- 50% 0.069260
- 75% 0.091184
- max 0.16180

Code

Libraries:

- Pandas, altaris

Methodology:

- Create DF to calculate the performance
- Sort by top 20 Funds

Visualization:

- Altaris Plot for Performance to highlight benchmark

Filter by Top 20 Performing Funds

```
#Grab the 'Returns' and 'Name' columns
top_funds = combined.loc[:, ['Returns', 'Name']]

#Drop the extra 'Names' columns
top_funds.drop(columns=['Name'], inplace=True)

# Filter down to 20 highest performing funds
top_funds_perf_df = top_funds.nlargest(20, 'Returns')
```

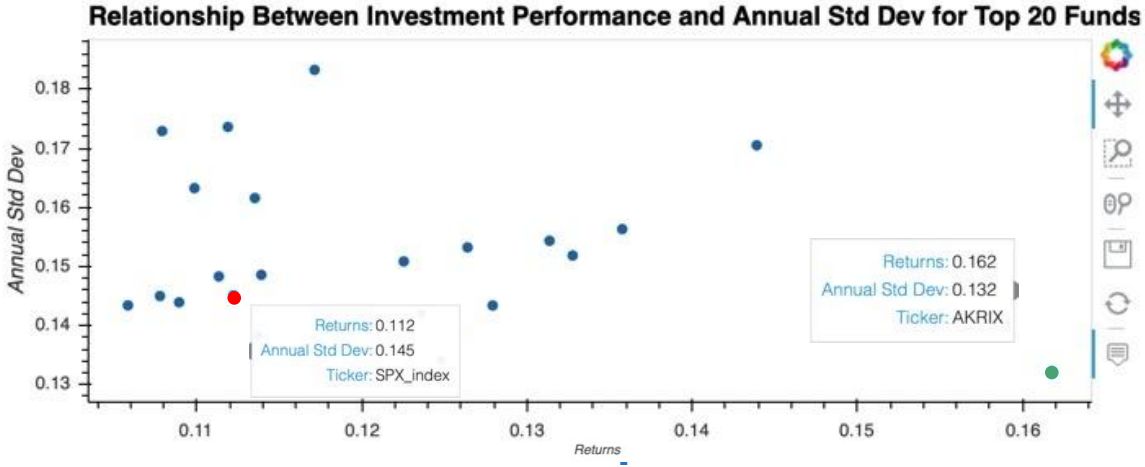
Plotting the returns of the top 20 funds

```
top_20 = top_funds_perf_df.reset_index()

top_performer_table =  alt.Chart(top_20_descending).mark_bar().encode(
    x='Returns:Q',
    y= alt.Y('Ticker:N', sort='-x'),
    # The highlight will be set on the result of a conditional statement
    color=alt.condition(
        alt.datum.Ticker == 'SPX_index',  # If the year is 1810 this test returns True,
        alt.value('orange'),     # which sets the bar orange.
        alt.value('steelblue')   # And if it's not true it sets the bar steelblue.
    )
).properties(width=600)
top_performer_table
```

Investment Performance and Annual Std of Top Funds

- The best performing funds tended to have lower annual standard deviations while the lower performing fund had higher standard deviations.
- The S&P 500 had a lower annual standard deviation than about half the funds (highlighted in red).
- Akre Focus Fund, ticker symbol AKRIK, not only had the highest annual returns but also had the lowest annual standard deviation. This fund does not have a sustainable mandate, but rather concentrates in fewer positions.



Code

Libraries:

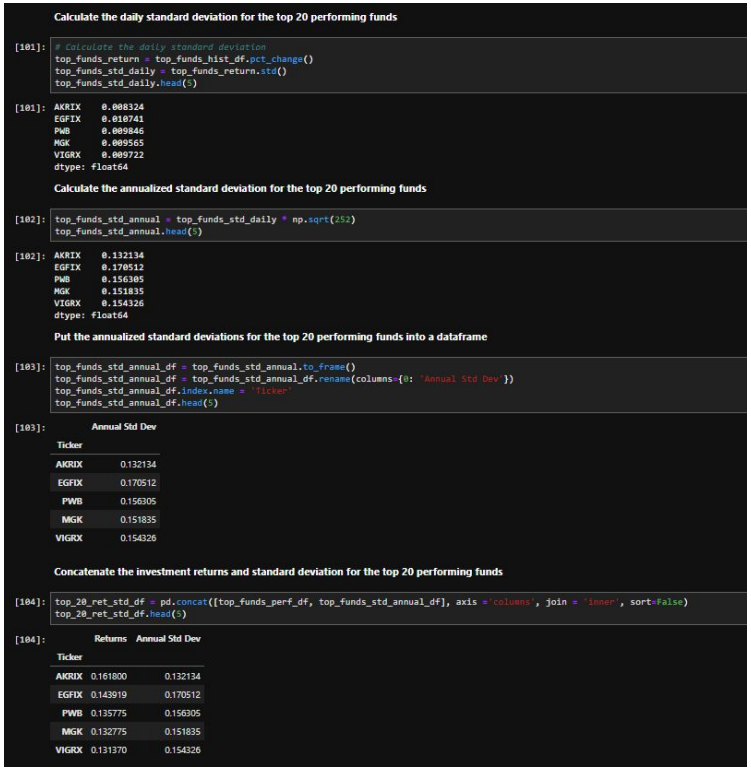
- Pandas and hvplot

Methodology:

- Created DF for Top 20 Funds
- Calculated Annual Std Dev and Returns

Visualization:

- Scatter Plot for Performance and Annual Std Dev



Calculate the daily standard deviation for the top 20 performing funds

```
[101]: # Calculate the daily standard deviation
top_funds_return = top_funds_hist_df.pct_change()
top_funds_std_daily = top_funds_return.std()
top_funds_std_daily.head(5)
```

```
[101]: AKRIX    0.008324
EGFIX    0.010741
PWB      0.009846
MGK      0.009565
VIGRX    0.009722
dtype: float64
```

Calculate the annualized standard deviation for the top 20 performing funds

```
[102]: top_funds_std_annual = top_funds_std_daily * np.sqrt(252)
top_funds_std_annual.head(5)
```

```
[102]: AKRIX    0.132134
EGFIX    0.170512
PWB      0.156305
MGK      0.151835
VIGRX    0.154326
dtype: float64
```

Put the annualized standard deviations for the top 20 performing funds into a dataframe

```
[103]: top_funds_std_annual_df = top_funds_std_annual.to_frame()
top_funds_std_annual_df = top_funds_std_annual_df.rename(columns={0: 'Annual Std Dev'})
top_funds_std_annual_df.index.name = 'Ticker'
top_funds_std_annual_df.head(5)
```

[103]:

Ticker	Annual Std Dev
AKRIX	0.132134
EGFIX	0.170512
PWB	0.156305
MGK	0.151835
VIGRX	0.154326

Concatenate the investment returns and standard deviation for the top 20 performing funds

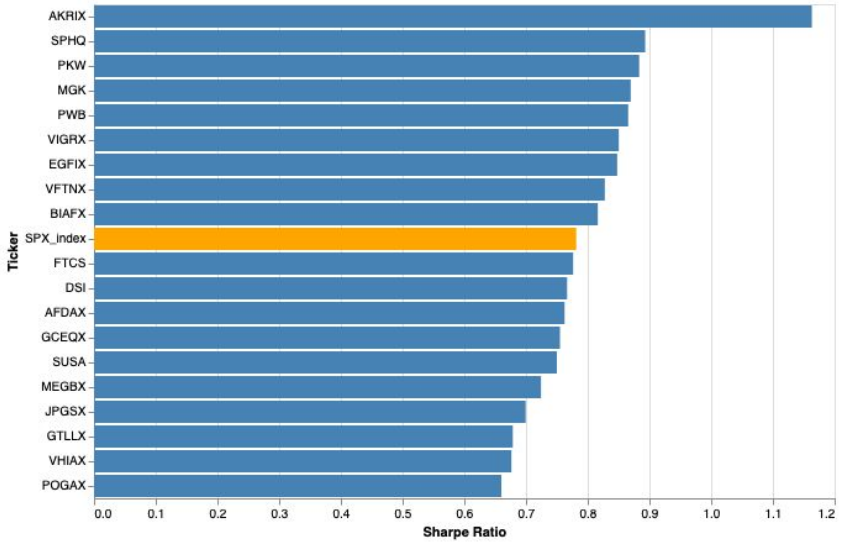
```
[104]: top_20_ret_std_df = pd.concat([top_funds_perf_df, top_funds_std_annual_df], axis ='columns', join = 'inner', sort=False)
top_20_ret_std_df.head(5)
```

[104]:

Ticker	Returns	Annual Std Dev
AKRIX	0.161800	0.132134
EGFIX	0.143919	0.170512
PWB	0.135775	0.156305
MGK	0.132775	0.151835
VIGRX	0.131370	0.154326

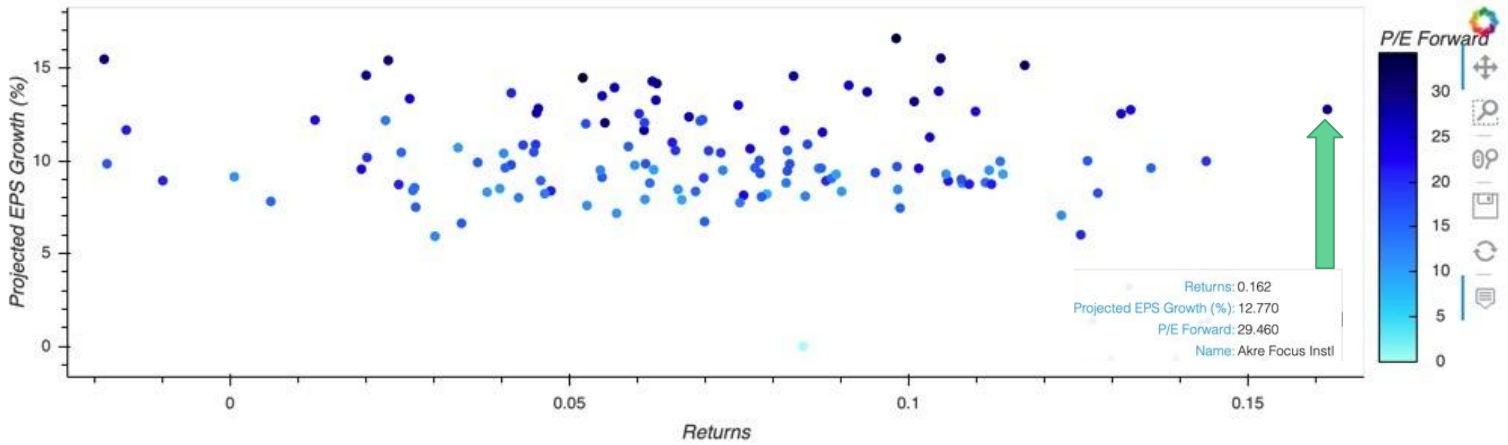
Sharpe ratios of the Top Performing Funds

- AKRIX had the highest sharpe ratio at 1.18. This fund's rare combination of high returns and lower standard deviation set it apart from the others.
- The S&P 500 performed fairly well compared to the top 20 as well. It's ranking was the 10th highest.



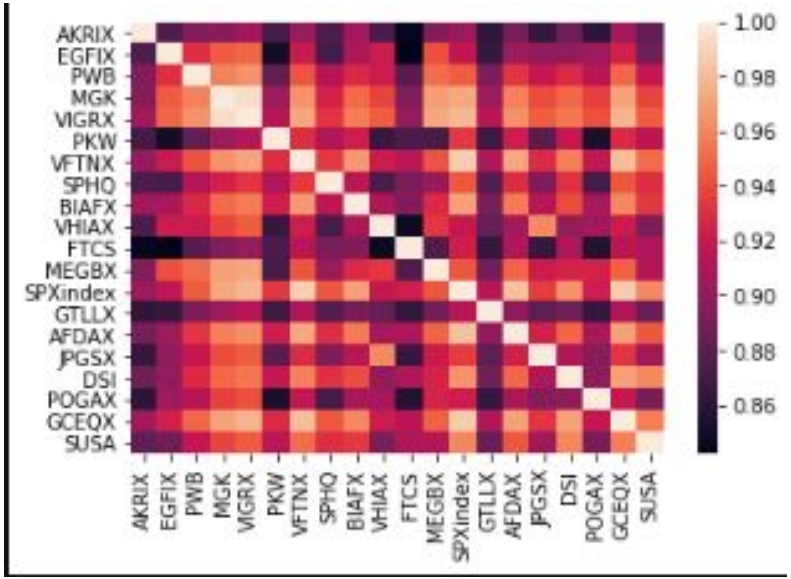
Comparing EPS Growth, Returns, P/E Ratio for all Mutual Funds

- Projected EPS growth and P/E Forward are correlated.
- Akre Focus Fund, ticker symbol AKRIK, has a relatively high P/E Forward ratio and Projected EPS Growth.
- Performance is not necessarily driven by high multiples.



Correlation Analysis

- The correlation among the top 20 funds was quite high.
- The lowest correlation between the any two funds, AKRIX and SUSA, was 0.84. AKRIX was the best performing fund in the group while SUSA was worst performing, indicating less overlap among portfolio holdings.



Code

Libraries:

- Pandas and Seaborn

Methodology:

- Created DF for Top 20 Funds
- Calculated Annual Std Dev and Returns

Visualization:

- Bar graph for performance graph and Scatter plot for EPS, Returns, and P/E Ratio

```
# Define function to create plot
# Std_plot = pd.DataFrame(top_20_ret_std_df_plot).sort_values(["years", "sales"])

# Create plot
plot = px.scatter(
    top_20_ret_std_df,
    x=top_20_ret_std_df.index,
    y="Annual Std Dev",
    size='Returns',
    title="Relationship Between Investment Performance and Annual Std Dev for Top 20 Funds",
)
```

```
pane_total = pn.pane.Plotly(plot)
pane_total
```

Correlation Analysis Between the Top 20 Funds

```
correlation = top_funds_return.corr()
correlation.head(5)
```

	AKRIX	EGFIX	PWB	MGK	VIGRX	PKW	VFTNX	SPHQ	BIAFX	VHIAX	FTCS	MEGBX	SPXindex	GTLLX	AFDAX	JPGSX	DSI	POGAX	GCEQX
AKRIX	1.000000	0.875071	0.894734	0.896173	0.906797	0.870704	0.902294	0.874448	0.905842	0.874161	0.844612	0.894090	0.903791	0.862555	0.890686	0.864642	0.886262	0.861024	0.905679
EGFIX	0.875071	1.000000	0.931534	0.945947	0.949225	0.850711	0.920529	0.871253	0.908450	0.921874	0.842185	0.942339	0.917753	0.865483	0.903666	0.899946	0.899871	0.903874	0.924756
PWB	0.894734	0.931534	1.000000	0.959231	0.964340	0.882099	0.943718	0.912072	0.928040	0.921487	0.879046	0.951908	0.946769	0.892566	0.933191	0.918610	0.928859	0.913940	0.949526
MGK	0.896173	0.945947	0.959231	1.000000	0.994661	0.903612	0.965077	0.924924	0.951005	0.938389	0.894425	0.969236	0.972736	0.903895	0.958141	0.941205	0.950223	0.937188	0.971223
VIGRX	0.906797	0.949225	0.964340	0.994661	1.000000	0.912570	0.972185	0.933024	0.957041	0.946695	0.901834	0.972294	0.979055	0.914331	0.963905	0.946851	0.955546	0.942608	0.977255

Creating a heatmap for the correlation analysis

```
heat_map = sns.heatmap(correlation)
```

Risk Valuation

Research Questions

What are the various fund categories of the list of 128 mutual funds?

What is the average risk rating for each fund category?

Additional Information

How does Morningstar define “risk rating”?

- Morningstar risk rating ranks publicly traded mutual funds and ETFs based on the fund’s past performance
- Funds with less than three years of performance history are not rated

How does Morningstar place a fund in a category type?

- Broken into peer groups based on fund holdings
- 64 different type of categories

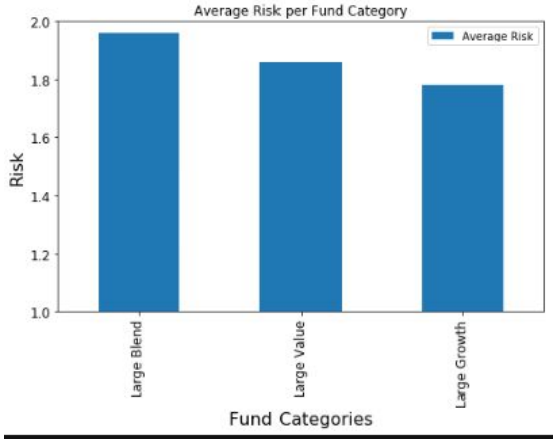
Expected vs Actual Results

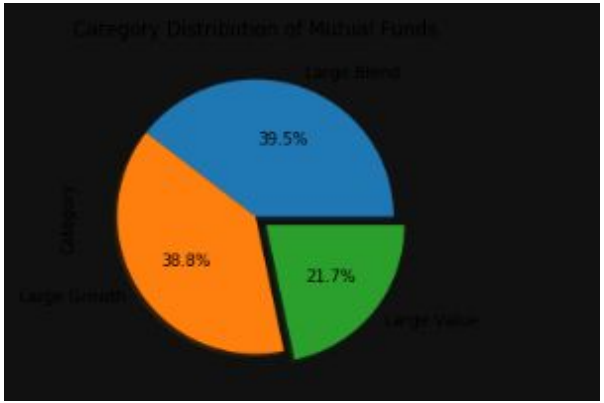
Expected:

- Majority of funds:
  - Low risk
  - Large growth

Actual:

- Majority of funds:
  - Between Below Average and Average Risk (1.86)
  - Large Blend
- Large Growth Funds will incur less risk





Code

Libraries:

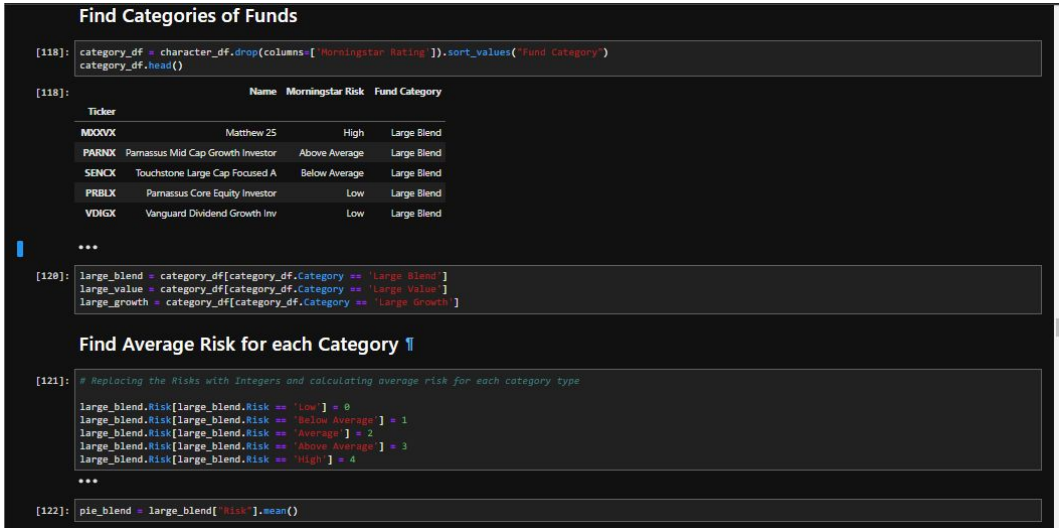
- Pandas, Hvplot

Methodology:

- Created DF for all funds for Risk and Category
- Associated each ‘risk-type’ to a value

Visualization:

- Bar graph and Pie chart from Hvplot



Find Categories of Funds

```
[118]: category_df = character_df.drop(columns=['Morningstar Rating']).sort_values("Fund Category")
       category_df.head()
```

[118]:

Ticker	Name	Morningstar Risk	Fund Category
MDXVX	Matthew 25	High	Large Blend
PARNX	Parnassus Mid Cap Growth Investor	Above Average	Large Blend
SENCX	Touchstone Large Cap Focused A	Below Average	Large Blend
PRBLX	Parnassus Core Equity Investor	Low	Large Blend
VDIGX	Vanguard Dividend Growth Inv	Low	Large Blend

```
[120]: large_blend = category_df[category_df.Category == 'Large Blend']
       large_value = category_df[category_df.Category == 'Large Value']
       large_growth = category_df[category_df.Category == 'Large Growth']
```

Find Average Risk for each Category

```
[121]: # Replacing the Risks with Integers and calculating average risk for each category type

       large_blend.Risk[large_blend.Risk == 'Low'] = 0
       large_blend.Risk[large_blend.Risk == 'Below Average'] = 1
       large_blend.Risk[large_blend.Risk == 'Average'] = 2
       large_blend.Risk[large_blend.Risk == 'Above Average'] = 3
       large_blend.Risk[large_blend.Risk == 'High'] = 4
```

```
[122]: pie_blend = large_blend["Risk"].mean()
```

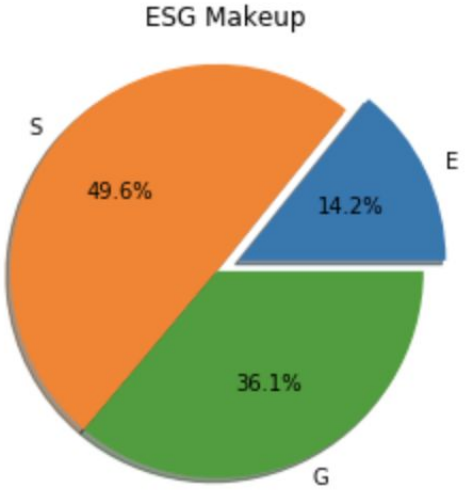
ESG Valuation

Research Questions

- **How do E, S and G values compare to each other?**
- **Of the funds that outperform the index, which of the sustainability metrics do the funds score highest in?**
- **From the 3 metrics, how much variance is there between the metrics ?**

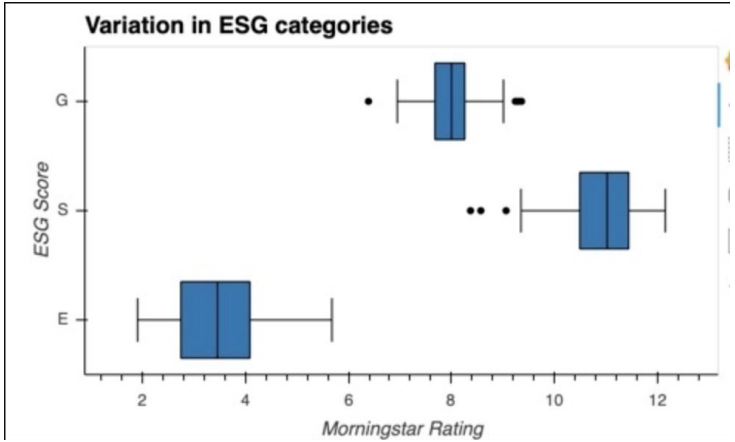
Results

- The Environmental metric of the ESG rating makes up a considerably smaller portion of the ESG rating, meaning that the funds have a lower rating in the Environmental category.
- The lower rating corresponds to lower risk, meaning that the E of ESG is the least risky out of all the metrics.



Results

- There is the least variation within the Governance category, and it also has the most outliers
- The most variation is within the Environmental category, however there are no outliers
- The two higher rated metrics both have outliers, with the G having more above its range, and the S having all of its below its range



Additional Information

- Why is the risk in the Environmental metric much lower than the other ESG metrics?
  - Eighty percent of the world's largest companies are reporting exposure to physical or market transition risks associated with climate change and a similar share are engaging in reducing corporate emissions
  - As Climate change continues, companies face more risk in the form of natural disaster that holds financial implications for infrastructure as well as property

Code

Libraries:

- Pandas, matplotlib, hvplot

Methodology:

- Created DF of Top 20 ESG Funds as well as their ESG data to compare against each other

Visualization:

- Pie chart showing average E:S:G and box and whisker to show the variance of each metric

ESG Analysis

```
[ ]: ESG = combined[['E','S','G','Total ESG Score']]
     ESG_Top20 = ESG.join(top_funds_perf_df, how='inner')
     ESG_Refined = ESG_Top20.sort_values(by='Returns', ascending=False)
     ESG_Refined
```

```
[ ]: ## Lower scores mean less risk
     labels = 'E','S','G'
     sizes = [ESG_Refined['E'].mean(), ESG_Refined['S'].mean(), ESG_Refined['G'].mean()]
     explode = (0.12, 0, 0)

     fig1, ax1 = plt.subplots()
     ax1.pie(sizes, explode=explode, labels=labels, autopct='%1.1f%%',
             shadow=True, startangle=0)
     ax1.axis('equal')
     ax1.set_title('ESG Makeup')
     plt.show()
```

Shows that companies are most proficient in the E category, Environmental

```
[ ]: import hvplot
     SDplot = combined[['E','S','G']].copy()
     columns = ['E', 'S', 'G']
     ESG_plot = SDplot.hvplot.box()
     ESG_plot
```

Conclusion

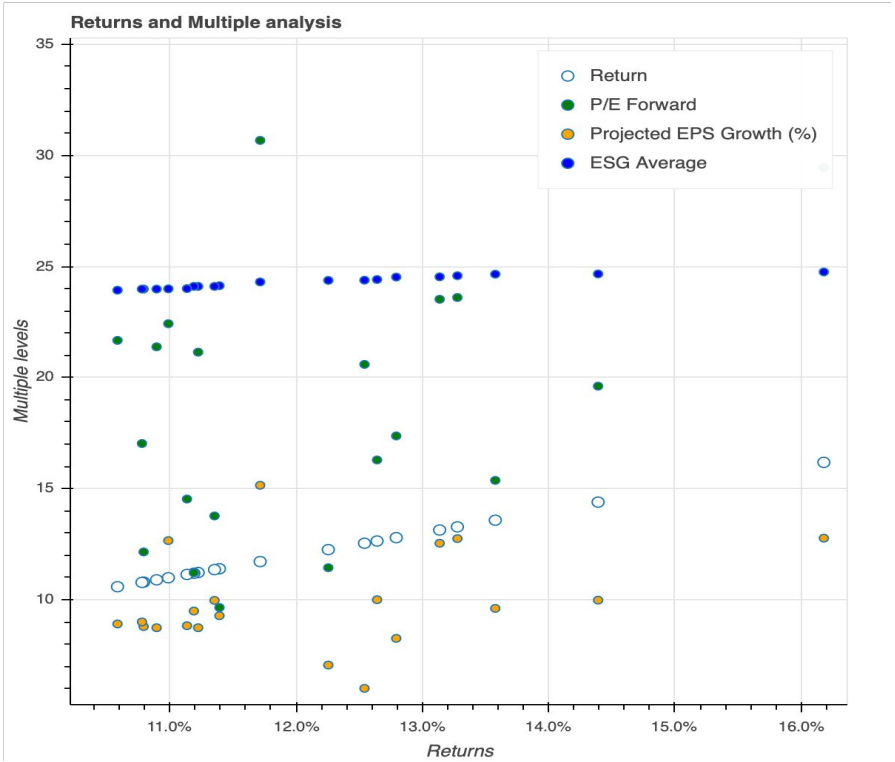
Ending Results

- Only **5 out of 20 top performing mutual funds** have sustainable mandates
  - S&P 500 index has comparable ESG ratings compared to the 5 funds
  - Funds without sustainable mandates contain companies that have already begun implementing sustainable policies

- The remaining 15 funds that do not have sustainable mandates all score highly because they contain *asset light businesses*.
  - When your biggest asset is intellectual capital, you naturally will not have a large environmental footprint.

- Out of 129 funds that we analyzed, the **S&P 500 had the 13th highest annual return** between 2010 and 2020 at 11.2%. The average return for the entire group was 6.9%.
  - There is a large opportunity cost for people investing in sustainable funds

Interactive Investing Tool



Citations

- https://www.spglobal.com/en/research-insights/articles/understanding-the-e-in-esg
- https://www.cnbc.com/2019/03/15/active-fund-managers-trail-the-sp-500-for-the-ninth-year-in-a-row-in-triumph-for-indexing.html
- https://www.morningstar.com/
- https://www.barrons.com/articles/top-esg-funds-our-annual-ranking-finds-sustainable-funds-are-increasingly-beating-the-market-51579301101