THE PENNSYLVANIA STATE UNIVERSITY
SCHREYER HONORS COLLEGE

THE SAM AND IRENE BLACK SCHOOL OF BUSINESS

The Influence of Influencers: How Twitter Groups Affect Company Performance

RYAN A. SCOTT
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Reviewed and approved* by the following:

Babajide Osatuyi
Associate Professor of Management Information Systems
Thesis Supervisor

Matthew Swinarski
Associate Professor of Management Information Systems
Honors Adviser

* Electronic approvals are on file.

ABSTRACT

Social media has increasingly grown in use by individuals and corporations to disperse messages. Recently, organizations have relied on social media influencers to attempt to improve brand performance and awareness. This work investigates the extent to which Twitter users, including influencers, average consumers, and companies describe and predict company performance across several industries. Sentiment polarity (positive, neutral, or negative) is being investigated against stock pricing and indexed search engine volume (Google Trends) to determine the extent of the relationship. Granger Causality tests were utilized to determine the direction of lag between variables. The paper finds that there exists a consistent, significant positive correlation between influencers' feelings about brands on Twitter and Google Search volume across all industries.

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Chapter 1

Introduction

Social media has increasingly grown in use by individuals and corporations to disperse messages. Recently, organizations have relied on social media influencers and popular users to attempt to improve brand images (Singh, Crisafulli, Quamina, & Xue, 2020). This has led many to wonder what extent social media has on overall brand images and company performance. If correlated, corporations can utilize this information to increase profitability and better understand the best techniques when developing a social media strategy. In addition, shareholders can better predict financial investments based on additional information readily available.

Stock prices can show the access to cash an organization has and the expected growth of an entity, hence being a common measure of company financial performance. Previous research has shown changes in stock prices can be affected by numerous factors, including prior news stories from traditional outlets (Li, Wu, & Wang, 2020). Additionally, studies have been performed looking at social media's influence from the perspective of the average consumer and the company itself. These findings have discovered that there exists a significant connection between both the public and company's Tweets and its relative impact on stock performance. (Osatuyi & Yoosefi, 2019; Derakhshan & Hamid, 2019). Therefore, this allows one to accurately predict the financial success of the company based on Twitter data.

Google Search Trends is an indexed database of the popularity of search terms and phrases on the Google S

Search platform. This platform allows one to gain an understanding of popular search queries over any specified timeframe. This tool was utilized for this study as Google is the world's largest search engine, accounting for 92.18% of the worldwide market (Law, 2022). This choice ensures the most accurate data source due to its expansive market share. In addition, Google/Google Trends can associate search queries with classification techniques to ensure precise term-matching. For example, the term "Amazon" could relate to the company or other results that share the word, such as the Amazon rainforest. Google Trends would segregate those two search queries, creating a more robust dataset.

This research aims to bridge this knowledge gap to identify the extent of impact influencers have on brand performance and image, in comparison to prior studies that have had a focus on all public Tweets and self-published company Tweets. In addition, it also considers whether there exists a disparate impact across differing industries. This research will identify any potential trends in market conditions for various organizations in several sectors (technology, retail, and e-commerce) across social media users and social media influencers.

With this information in mind, the paper hypothesizes there exists a correlation between influencers' Tweets and stock prices/Google Search volume. In addition, it also adds that there exists no difference in these findings across varying industries. These will allow for a better understanding of how influencers affect consumer behavior and allow organizations to better understand the use cases of social media.

The results of this research are intended to provide a clearer picture of the role that influencers have on social media users' feelings about brands. It will provide an understanding of whether such users have as much impact as average social media users. Potential applications of this research would enable organizations to better understand whether they should continue to

work with influencers to positively impact the brand while providing areas for future research opportunities.

The rest of this paper is structured as follows: Chapter 2 presents a literature review of relevant studies previously performed and establishes the merit of the study. Chapter 3 details the methodology used to gather data for the study and combine information from multiple sources of information. Chapter 4 explains the statistical analysis performed on the dataset to identify any potential trends/correlations. Finally, Chapters 5 and 6 feature a discussion of the results and a conclusion with identification of future work that can be completed.

Chapter 2

Literature Review

Social media platforms provide access to a wide range of audiences, making them increasingly common for organizations to join to disperse intended messages, resulting in a shift in marketing strategies from more traditional mediums of the past (Gao, Zhang, Chen, & Liang, 2018). As more users join platforms, micro-influencers that are localized to certain groups of individuals have become widespread practice for brands in their verticals to partner with to disseminate desirable brand knowledge. These strategies have provided organizations the ability to hyper-localize messages to focused audience groups (e.g., expecting mothers, college students, etc.). This means that individuals are now subject to more interaction with brands than ever before, which theoretically could affect the success of the brand from a financial and functional perspective. Existing research details the influence of social media on organizations and a link to company success.

Social Media Strategy

Social media is loosely defined as "a group of Internet-based applications that build on the ideological and technological foundations of Web 2.0 and allow the creation and exchange of user-generated content" (Andreas & Haenlein, 2010). These platforms take a wide range of applications of this definition and serve fundamentally different purposes depending on the platform's intentions and mission. For example, Twitter, a microblogging service, typically appeals to urban, 18–29-year-olds. Whereas Pinterest, a catalog-based photo-sharing site,

typically is utilized by women under fifty (Gambo & Ozad, 2020). As such, brands are able to reach unique, targeted markets by utilizing various social media platforms.

Previously, social media was utilized by firms as a data source to analyze past behaviors and trends. However, a shift has occurred which has allowed firms to have a more active involvement on platforms (Lamberton & Stephen, 2016). Social media sites serve as the medium to engage all users in centralized platforms. This has allowed companies to establish long-term relations with customers by interacting with consumers directly on the platform. This shift has re-defined the use case of social media for businesses, allowing for it to become a strategic advantage of the company (Lamberton & Stephen, 2016).

Commonly, social media use for organizations is typically measured by public engagement measures including likes, shares, comments, and follows and their growth (decline) factors. Firms taking advantage of social media hope to greater expand their audience (Gao, Zhang, Chen, & Liang, 2018) while improving the image and impact of their brand. (Naylor, Lamberton, P, & West, 2012). However, recent studies have concluded that social media, has a limited impact on overall company sales (Darby & Herway, 2013). As such, brands have developed a new strategy to introduce micro-influencers in attempts to influence consumer thoughts (Khamis, Lawrence, & Welling, 2017).

Social Media and Company Performance

Many studies have considered the impact of social media users' thoughts about a brand and their daily stock price return. Many are able to conclude there exists a relationship between changes in the stock market and the opinions of individuals on social media sites, such as Twitter

(Piñeiro-Chousa, Vizcaíno-González, & Pérez-Pico, 2017). These results suggest that sentiment can be a useful tool for predicting future pricing of the stock prices and should be actively considered by potential investors looking at firms. In particular, user sentiment was featured as a prominent predictor in five out of eight models that were created. However, many research studies have focused on all users as a whole, rather than identifying the impact of specific types of users (company, average consumer, and network influencers).

In addition to daily stock returns, limited existing research has also considered the impact of social media sentiment for changes in Google Search volume via the Google Trends index. Preliminary research has provided evidence that there exists a link between data from Google Trends and happiness sentiment from Twitter (Zhang, Zhang, Shen, & Zhang, 2018). It also noted that results may not be applied to long-term predictions as longer-term focuses increase error rates and present erratic results. However, this research still suggests a link between Google Trends data and Twitter sentiment as a high-level user perspective (Zhang, Zhang, Shen, & Zhang, 2018).

Chapter 3

Method

3.1 Data Collection

To examine the relationship between user type (self, average consumer, influencer), search volume index, and stock prices data from Twitter, Yahoo Finance, and Google Trends was collected. Twitter data was collected using R Studio and academictwitteR (Barrie & Ho, 2021). A selection of companies that met the following criteria were candidates for inclusion:

1. Top ranking Fortune 500 Company
2. Publicly traded in the United States
3. Across differing industries
4. Has Twitter profile

From this, three companies were selected for examination: Walmart (Rank 1), Amazon (Rank 2), and Apple (Rank 3) based on the mentioned criteria (Fortune, 2022). All Tweets were collected from 2021 (January 1-December 31) that were posted or tagged by the organization as shown in Table 1. Stock prices for the respective companies were collected from Yahoo Finance. In addition, Google Search volume was collected from Google Trends. All data was collected at day-level and used a key to merge data sets from multiple sources. Data was only retained from active trading days, resulting in 252 days of Tweets, Google Trend, and stock data. It is critical to note that Apple does not utilize their Twitter page therefore no company-made Tweets exist for this organization.

Table 1: Tweet Volume by Organization for 2021

Organization	Tweet Volume	Fortune Ranking
Walmart	810,471	1
Apple	1,822,887	2
Amazon	4,419,166	3

3.2 Data Enrichments

Tweet text data was enriched with a polarized sentiment score using SentimentR (Rinker, 2021). This allows for an understanding of the users' emotions about a particular company. From this, Tweet ID data was imported to NodeXL Pro, an Excel-based social media Analysis Tool (Smith, et al., 2010). Within NodeXL Pro, the betweenness centrality metric, which determines how often a node (user) lies on a path between other nodes, is computed to determine the top influencers in the network (Kustudic, Xue, Zhong, Tan, & Niu, 2021). With this, all users were classified as the company itself, Average Consumer, or an Influencer. A random sample of 33,333 Tweets per available user group was compiled for each organization.

3.3 Research Variables

Predictor variables of Average Consumer Tweet sentiment, influencer Tweet sentiment, and company Tweet sentiment were paired with the target variables adjusted stock close price and daily Google Trend data. Polarized sentiment data ranges from -1 to +1. As such, -1, identifying a negative tone, 0 identifying a neutral tone, and +1 identifying a positive tone based on the words/context of the Tweet.

In order to determine the financial effects of Twitter, stock prices are being utilized, specifically adjusted daily close. It was chosen to study adjusted daily close figures, compared to close values, as this figure incorporates dividends, stock splits, and new stock offerings to determine actual stock value. Google Trend data is provided as an index on a relative scale ranging from 0 to 100. This figure is based on the number of times users search for a given term, phrase, or letter(s). Data is categorized for accuracy (e.g., Apple as in fruit versus Apple as in the company). A value of one hundred indicates that on a given day, the supplied search value is most frequently searched for in comparison of other recent days.

Table 2: Research Variables

Variable	**Operationalization**	**Description**	**How Measured**
Search Traffic Index	Volume	The relative volume of search volume.	Google Trend Index
Stock Market Performance	Daily Closing Price	The adjusted stock price at the close of each day	Adjusted daily stock price
Motivational	Emotion	The polarity of Tweets per day	Polarity measured as positive (1), neutral (0), and negative (-1)

Chapter 4

Analysis

This study makes use of the Granger Causality test, which is a hypothesis test that is used to determine whether the lag of one time-series variable can be utilized to forecast another. This allows one to determine the direction of the cause between sets of variables. The Granger Causality test allows researchers to examine if prior values of X are a statistically significant predictor of Y. Its null hypothesis states the coefficient values of prior values of X are zero and therefore cannot predict Y. As such, time series X, would not Granger-cause time series Y. The test can determine if changes in one variable statistically occur prior to another.

For this study, this can be utilized to examine if changes in sentiment across user types precede changes in stock prices and Google Trend data. In addition, it can also be used to determine whether stock price and Google Trend data influence sentiment about the brand on Twitter. An example of a Granger Causality test is shown in Figure 1.

```
Granger causality test

Model 1: AvgConsumer_Sentiment ~ Lags(AvgConsumer_Sentiment, 1:3) + Lags(Google_Trend, 1:3)
Model 2: AvgConsumer_Sentiment ~ Lags(AvgConsumer_Sentiment, 1:3)
  Res.Df Df      F  Pr(>F)
1    241
2    244 -3 2.4322 0.06569 .
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1
```

Figure 1: Granger Causality Test Output

Figure 1 shows an output Apple in identifying if adjusted close influences average consumer sentiment. With an f-value of 2.433, this creates a p-value of .06569. In this example, one can reject the null hypothesis and support the alternative at the 90% confidence level. This

implies that a change in the adjusted close price of Apple's stock can lead to a change in the average consumer's feelings about the brand.

Chapter 5

Results

5.1 Descriptive Statistics

All companies share several overlapping characteristics. The company sentiment is often much higher than average in comparison to the other groups when available. This implies the company is more likely than the other users to talk about themselves positively. Both average consumer and influencer sentiment scores are often slightly positively skewed, ranging from 5%-6.5% mean scores with small standard deviations. All groups have polarized days, with some resulting in low negative average sentiment polarity and others having high positive measures. Google Trend Data varies slightly between companies, with those more tech-based companies (Amazon and Apple) having higher average search volume scores in comparison to traditional brick-and-mortar locations.

Table 3: Descriptive Statistics of Predictor Variables for Walmart

Variables (per day)	Mean	Minimum	Maximum	Standard Deviation
Average Consumer Sentiment	0.0497	-0.1383	0.4834	0.0688
Company Sentiment	0.1400	-0.1857	0.4150	0.0744
Influencer Sentiment	0.0597	-0.2829	0.3807	0.0706
Adjusted Close	139.45	124.60	149.72	5.21
Google Trend	43.07	27.00	89.00	8.28

Table 4: Descriptive Statistics of Predictor Variables for Apple

Variables (per day)	Mean	Minimum	Maximum	Standard Deviation
Average Consumer Sentiment	0.0534	-0.3162	0.3158	0.0652
Company Sentiment	N/A	N/A	N/A	N/A
Influencer Sentiment	0.0656	-0.2526	0.3274	0.05353
Adjusted Close	140.08	115.50	179.84	14.65
Google Trend	60.09	35.00	100.00	14.40

Table 5: Descriptive Statistics of Predictor Variables for Amazon

Variables (per day)	Mean	Minimum	Maximum	Standard Deviation
Average Consumer Sentiment	0.0828	-0.3536	0.4716	0.0765
Company Sentiment	0.1726	-0.0871	0.4585	0.0690
Influencer Sentiment	0.0886	-0.3050	0.2939	0.0630
Adjusted Close	3343.90	2951.95	3731.41	160.36
Google Trend	67.54	58.00	100.00	7.77

5.2 Google Search Volume

Table 6 displays summarized Granger Causality P-Values for Google Trend Data across all companies in the study. All companies show influencers have a significant impact on influencing Google Search volume (Walmart: p=.09974; Apple: p=.09235; Amazon: p=.0646) at the 90% confidence level. In addition, for Apple, average consumers have a significant impact on Google Search volume as well (p=.003152). For Amazon, Company and Google Search volume both show significance, but as it is noted that they both cause each other, there can exist a degree of multicollinearity for these making both results a potential false-positive. As such, these results

suggest that Influencers can influence how often individuals search about organizations across all industries. Specific to Apple, average consumers can also influence the rate at which people search company, adding an additional source to influencing search volume.

Table 6: Granger Causality Probability for Google Search Volume

Company	Average Consumer does not Granger Cause Google Trend	Google Trend does not Granger Cause Average Consumer	Company does not Granger Cause Google Trend	Google Trend does not Granger Cause Company	Influencer does not Granger Cause Google Trend	Google Trend does not Granger Cause Influencer
Walmart	0.4281	0.1241	0.7476	0.8349	0.0997***	0.3194
Apple	0.0032*	0.2855	N/A	N/A	0.0924***	0.6749
Amazon	0.4959	0.3416	0.0895***	0.04369**	0.0646***	0.3001

Significance: *=.01; **=.05; ***=.1

5.3 Stocks

Table 7 (below) displays a summarized Granger Causality P-Values for Adjusted Close Stock Data across all companies in the study. Results are mixed throughout various industries picked for the study. Walmart shows significance in adjusted close influencing average consumer sentiment (p=.02216) at the 95% confidence level, and the company influencing adjusted close values (p=.07677) at the 90% confidence level. These aim to suggest that the stock price affects the views of the average consumer, while the sentiment of the company influences the stock price. For Apple, influencer viewpoints are shown to lag changes in adjusted close values (p=.01127) at the 95% confidence level. Amazon shows the average consumer sentiment can lead to changes in stock values (p=.09757) at the 90% confidence level and adjusted close values affect influencer viewpoints (p=.03628) at the 95% confidence level. These results aim to suggest that the average consumer, influencers, and stock prices can have impacts

on each other, as shown in two out of three industries. While less common, the company Tweets themselves can have an impact on stock performance, but it was only demonstrated in one of three testing companies/regions.

Table 7: Granger Causality Probability for Stock Performance

Company	**Average Consumer does not Granger Cause Adj. Close**	**Adj. Close does not Granger Cause Average Consumer**	**Company does not Granger Cause Adj. Close**	**Adj. Close does not Granger Cause Company**	**Influencer does not Granger Cause Adj. Close**	**Adj. Close does not Granger Cause Influencer**
Walmart	0.3896	0.0222**	0.0768***	0.3030	0.1959	0.6995
Apple	0.1345	0.5438	N/A	N/A	0.0113**	0.9703
Amazon	0.0976***	0.2200	0.2048	0.9515	0.1973	0.0363**

Significance: *=.01; **=.05; ***=.1

Chapter 6

Discussion

This paper aimed to investigate the relationship between influencers, average consumers, and companies' viewpoints on Twitter and the relative effect on brand performance and financial performance as measured through Google Search volume and stock returns. The results introduce areas of potential research and expansion of the study to learn more about the topic and actively apply its findings to business management strategies. As per the approach of previous studies, data was collected about various company industries and the classified sentiment as compared to financial and branding metrics. Rather than examining all Tweets combined or looking at the self-made company Tweets, this study identified a different study group: network influencers determined by betweenness centrality paired with Granger Causality to determine the direction of lag between the response and explanatory variables.

This study finds that influencers have significant impact on changes in Google Trends data. This implies that as influencers Tweet more positively about brands, more people search online for these organizations. As such, if an organization wants to increase the number of people looking to learn more about them online, utilizing influencers to disperse this message would be a logical choice. In addition, this message spreads equally well across all industries, meaning it would not be limited to certain types of organizations. Social media is an effective choice for organizations to further the impact of their brand and all types of companies should actively consider working with network influencers for their brand. It is critical to accurately classify influencers in the network, as traditional users have a much more limited impact. In fact, average consumers were only significant in increasing Google Search volume in one of three testing organizations: Apple. This may be due to Apple's lack of self-published Tweets, which

would place average consumers to have a much more involved role in spreading messages about the company, rather than having an official page for consumers to reference.

The study has presented mixed sources of influence for impacts on changes in stock returns. Apple is the only organization that showed an impact on influencers and changes in stock prices. This may be due to Apple not having direct self-published company Tweets, forcing users to rely on other individuals rather than the company itself. Similar to findings in Google Search volume, organizations that do not publish Tweets themselves often follow different user groups than average organizations that self-publish Tweets. Walmart and Amazon both had a group of people that influenced stock prices as well as one group that stock prices influenced their opinions, however, they exist upon distinct groups for each company. For Walmart, stock performance influences average consumers, and the company's Tweets influence stock prices. In comparison, Amazon notes that average consumers affect stock prices and stock prices affect influencers. Overall, this implies that companies that do not publish Tweets rely on influencers to spread their messages and influence stock pricing. However, companies that do actively publish Tweets themselves have distinct groups that make an impact on stock performance depending on the industry of the company.

6.1 Limitations and Future Research

It is critical to identify several points of interest that may limit the applications of this research. First, while three companies were utilized, it only selected one from each industry due to Twitter API limits. Companies were selected that would have a significant conversation about them on Twitter due to their Fortune 500 ranking. Second, the dataset collection was focused

solely on a one-year timeframe. This decision was made per prior research studies' methodology and the cyclical nature of the stock market (Osatuyi & Yoosefi, 2019). This, as well, was impacted by the Twitter API limits on the number of Tweets that were available to be pulled in. Third, Apple lacked company-published Tweets, which made it more difficult to attribute the impact of these Tweets as a comparison point was lost, making it unknown if certain events were by chance, due to the industry, or truly impactful. Future research studies could aim to incorporate additional organizations within the stated industries of interest while expanding the sheer count of industries included. In addition, Google Trends data, Tweets, and stock performance data is readily available for many years, which could be added to increase the results' robustness.

Chapter 7

Conclusion

Being able to understand what type and how users affect company performance and branding can be a useful tool. This paper hypothesized that there would exist a significant impact of influencers' thoughts on Google Search volume and stock prices with no differences between industries. It was determined via the Granger Causality test that there exists a significant impact on influencers' feelings and search volume per Google Trends data. In addition, there is no difference in the positive (or negative) impact influencers can have on the search volume between industries, therefore, supporting the hypothesis. On the other hand, stock data has mixed responses. For certain industries/companies, there does exist a connection between stock returns and influencer sentiment, however, other industries rely on other user groups, disproving the second hypothesis.

These results suggest that influencers have significant impacts on Google Search volumes and are effective resources for companies to utilize to drive traffic to their brand. It also suggests that stock returns vary depending on the industry and that certain groups of individuals have more control/influence in affecting stock returns than others. With these statistically significant findings in mind, businesses have the ability to select communication streams that will positively impact their business the most. In addition, investors can understand organizations to monitor to optimize their financial gains.

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ACADEMIC VITA

Ryan A. Scott

EDUCATION

Penn State Erie, The Behrend College, Black School of Business **Graduation: May 2023**
Honors Bachelor of Science Management Information System
Schreyer Honors College and Behrend Honors Program

PROFESSIONAL EXPERIENCE

PPG Pittsburgh, PA
IT Business Analyst *May 2021 – Present*

- Led use-case development of business intelligence software through mock setup of SAP Analytics Cloud and presented efficiency/feasibility findings to the executive leadership team.
- Met with stakeholders to develop feedback application to improve product quality control using Microsoft PowerApps and Agile methodology while earning Lean Six Sigma Yellow Belt.
- Worked with project leadership to create and disseminate email communications to 4,000 stakeholders while designing a project website available to 55,000 employees.

The Empower Group **Erie, PA**
Owner *Apr 2020 – Present*

- Developed a line of handmade products and utilized search engine optimization techniques to organically rank within the first page of Etsy.
- Generated over 2,200 product purchases and $88,000 in sales within 6 months of opening.
- Designed sales automation process to improve backend fulfillment increasing output by 22%.
- Managed sales processes for accounts to achieve revenue goals while maintaining a 5-star rating.

Overland Auto Sales **Erie, PA**
Marketing Specialist *Jun 2016 – Mar 2020*

- Collected and analyzed data on customer demographics, preferences, needs, and buying habits to identify potential market trends and factors affecting product demand.
- Led branding development team to create updated logo, search engine optimization improvements, and marketing campaign using Facebook Advertising and Google My Business.
- Increased audience reach on Facebook from 300 to over 1100 peoples.
- Tracked sales and website metrics earning product certification from Google Analytics.

COLLEGIATE EXPERIENCE

Penn State Erie, The Behrend College **Erie, PA**
Lead Undergraduate Researcher *January 2021 – Present*

- Conducted research and presented at national conferences concerning a data-based approach to social media use and its relative marketing power across four research papers.
- Supervised research for student projects and provided advice on statistical models within R.
- Directed preliminary research to develop four funded individual grant proposals totaling $8,500.

Penn State Erie, The Behrend College **Erie, PA**
Lead Business Tutor *December 2020 – Present*
- Provided tutoring services for business courses across Management Information Systems, Accounting, and Finance to students.
- Mentored five business student tutors and provided training, advice, and feedback as needed.
- Led a 50-person review session for students using a self-developed lesson plan.

PROFESSIONAL SERVICE

Lake Erie Litter Project **Erie, PA**
Data Consultant *Aug 2021 – Present*
- Met with project stakeholders to define project scope and outline business requirements.
- Identified a preferred solution that was cost-effective and architecturally capable.
- Developed Microsoft Power BI data model and dashboard to display sustainability research findings using Power Query and DAX scripting.

Partnership Erie **Erie, PA**
IT Consultant *Aug 2020 – Present*
- Collaborated with six nonprofit organizations to create websites using WordPress and CSS.
- Onboarded nonprofits while evaluating current client websites and defining project scopes.
- Mentored four students and provided training on web design and accessibility best practices.

PROFESSIONAL CERTIFICATIONS

- MarkLogic for Business Users, MarkLogic *2022*
- Google Analytics – Beginners, Google *2021*
- Google Analytics – Advanced, Google *2021*
- Lean Six Sigma Yellow Belt, PPG *2021*

RESEARCH PAPERS

- Organizational Effects of the Ukrainian/Russian War on Twitter User Sentiment and Financial Performance (under peer review for submission to *Computers in Human Behavior*)
- Influential Influencers: Social Media Influencers' Impact on Company Performance (under peer review for *Schreyer Honor College eHT Collection*)
- The sentiment of Cloud Computing Services across Social Media Platforms (in preparation for submission to *HICCS*).
- Relative Impacts of AI Art on the Traditional Art Industry on Twitter (in preparation for submission to *Decision Science Institute*)
- Combatting Disinformation on Social Media in Communities of Color (in preparation for submission to *Decision Science Institute*)

CONFERENCE PRESENTATIONS

- Ryan Scott and Babajide Osatuyi (2022). Influential Influencers: Social Media Influencers' Impact on Company Performance, Decision Science Institute, Houston, TX
- Ryan Scott, Samuel Andrew, and Kaylyn Wheeler (2021). Use of WordPress within Nonprofit institutions, Penn State Business Student Conference, Erie, PA
- Ryan Scott (2020). Impacts of Providing Pro Bono Consulting Services to Nonprofit Institutions, Penn State Business Student Conference, Erie, PA

GRANTS

- Penn State Undergraduate Research Grant, $1,500 (Funded) *2022*
- Schreyer Honors College Research Grant, $1,500 (Funded) *2022*
- Penn State Undergraduate Summer Research Grant, $4,000 (Funded) *2022*
- Penn State Undergraduate Research Grant, $1,500 (Funded) *2021*

AWARDS

- Schreyer Honors College, Penn State University *2019-2023*
- Dean's List, Penn State Erie *2019-2023*
- Outstanding Management Information System Student, Penn State Erie *2022*
- Lawrence and Elizabeth Held Scholarship, Penn State Erie *2020-2022*
- Academic Excellence Scholarship, Penn State Erie *2019-2022*
- Honors Scholarship, Penn State Erie *2019-2022*
- Behrend Honors Program, Penn State Erie *2019-2021*
- Recognition of Service, Paula S. Cousins Ovarian and Endometrial Cancer Foundation *2021*

MEMBERSHIPS AND INVOLVEMENT

- Business Analyst Center of Practice, PPG *September 2022-Present*
- Student Membership, Decision Science Institute *August 2022-Present*
- Young Professional Network, PPG *May 2021-Present*
- Schreyer Honors College, Penn State *August 2019-Present*

SOFTWARE SKILLS AND ABILITIES

- Proficient in CSS, DAX, Google Analytics, HTML, MarkLogic (NoSQL), Microsoft Power BI, NeuralTools, NodeXL Pro, Office 365, Python, R, SAP Analytics Cloud, SAP S/4HANA, SPSS, StatTools, SQL, and Tableau.