



BioPhirma Fraud Analytics

Team 7

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Agenda

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- **Executive Summary**
- **Business Problem Setting**
- **Problem Statement**
 - Managerial Question
 - Analytical Question
- **Key Data Sources Overview**
- **Preliminary Analysis**
- **Violation Analysis**
- **Red Flags**
- **Recommendations**
- **Future Considerations**
- **Appendix**

Business Case

Business Problem

- To facilitate the purchasing for different labs, BioPhirma has issued P-cards to its employees at each lab.
- Management conducts periodic reviews of the transactions.
- Recently an anonymous tip suggested that some of the cardholders may have violated the policies and committed fraud.

Main Findings

- Using some keywords (based on unallowable purchases) could be useful in detecting transaction violations.
- Violations in single transaction limit and monthly transaction limit.
- Possible split transaction violations.

Data Used

- Company management provided us 79,085 transactions made using a BioPhirma P-card during the 2019 fiscal year with a total spend for the year of \$19,861,981.



Recommendations

- Notification system for red flags employees judged by multiple violation criteria.
- Vendor Contacts and limit transaction.

Current Situation

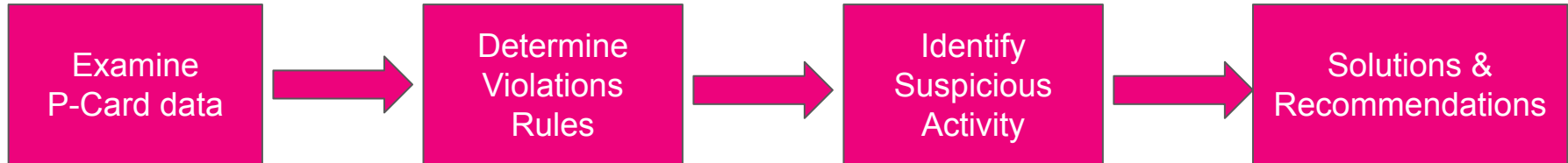
Business Overview

- BioPhirma is a healthcare pioneer involved in drug discovery with more than 25000 employees worldwide.
- To facilitate the purchase of items for different labs, BioPhirma has issued P-cards to its employees.
- Employees must use P-card following the company policies

Problem Statement

- BioPhirma recently received an anonymous complaint from a whistleblower who claims fraudulent activities have occurred from employee P-Card usage.
- BioPhirma's CEO, CFO, and BOD want to validate these claims by hiring us to investigate past transactions and flagging any violations that have occurred.

P-Card Suspicious Transaction Identification Process



Problem Statement

- **Managerial question**
 - What are the main causes behind P-card related violations and how can BioPharma limit these violations from occurring?
- **Analytical question**
 - Who are the top employees that have violated P-card policies?
 - What departments are the key offenders of P-card policies?
 - What and how keywords can be used to determine fraudulent transactions?
 - How to use TF-IDF to ascertain the importance of keywords for fraud detection?



Key Data Sources

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Handling Data

Problems in Data

- Data Types were not universal.
 - Money datatype was changed to a float for graphical use.
 - Used ::money::numeric::float8 to convert data type
- Some comments are NULL and contain multiple stop words.

	fullname	total_amount
0	Evans, Manuel	\$238,709.79
1	Matthews, Giana	\$41,678.88
2	Hawkins, Jeremiah	\$19,694.31
3	Valenzuela, Avery	\$13,352.45
4	Case, Matteo	\$12,936.07

Data Sources Used

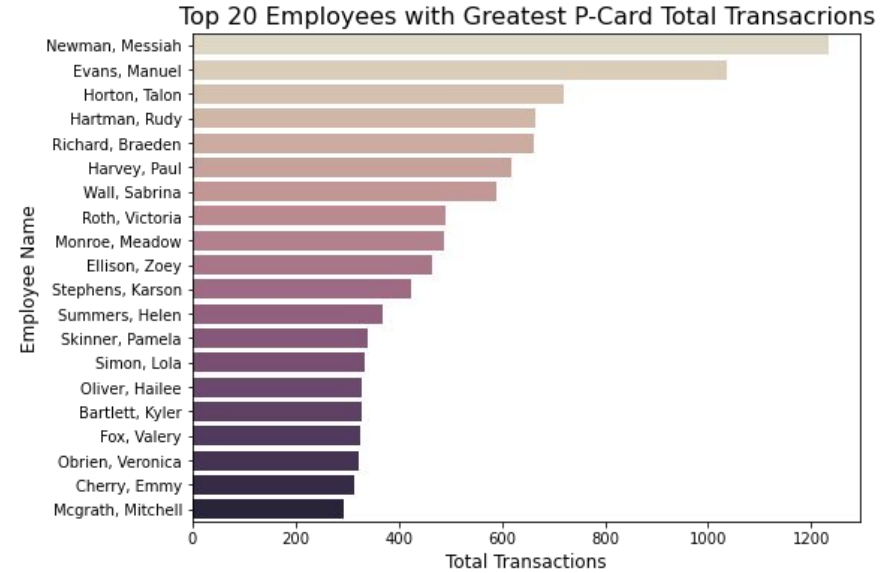
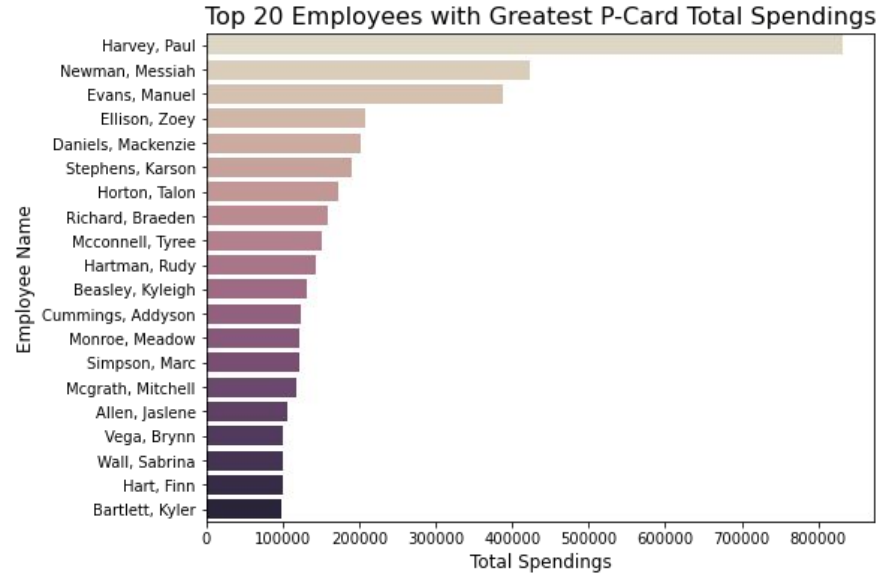
Tables	Number of Records	Number of Variables	Used
transactions	81929	23	Yes
users	1189	10	Yes
vendors	10628	7	Yes

Description of Data

- Company management provided us 79,085 transactions made using a BioPhirma P-card during the 2019 fiscal year with a total spend for the year of \$19,861,981.
- 40 variables were provided, divided by multiple tables that included primary and foreign keys.

Preliminary Analysis

Employee Analysis



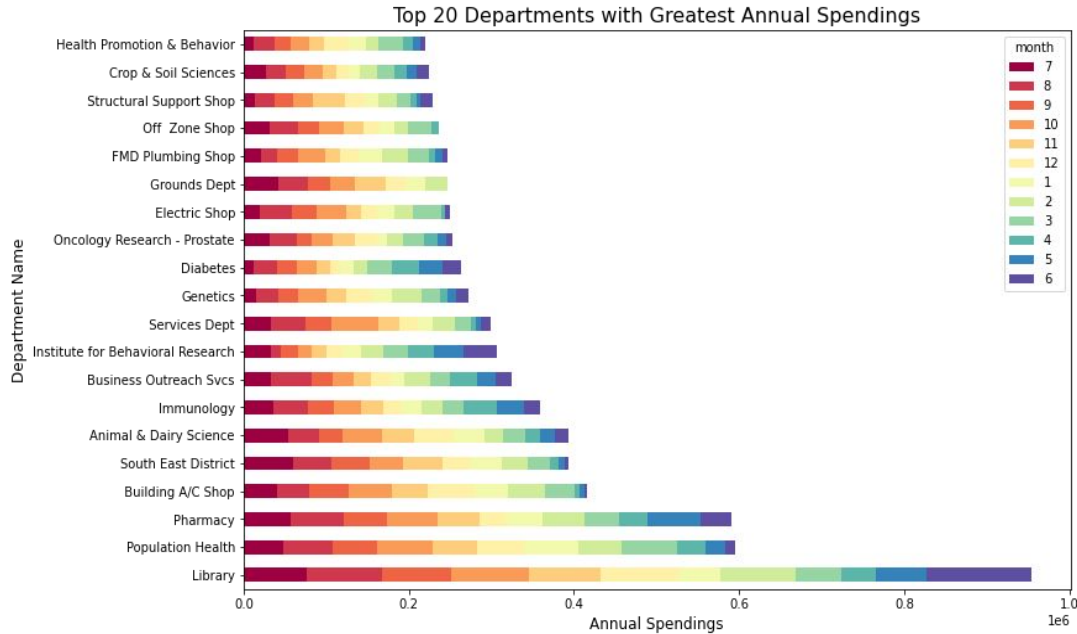
Findings

- Based on the top 20 employees sorted by total spendings and a total number of transactions, some employees only exist in one of the top 20.
- Usually, the employees with higher total spendings would have a higher total number of transactions, in order to avoid violating transaction limits. Thus, some employees look suspicious.

Preliminary Analysis

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Month and Department Analysis



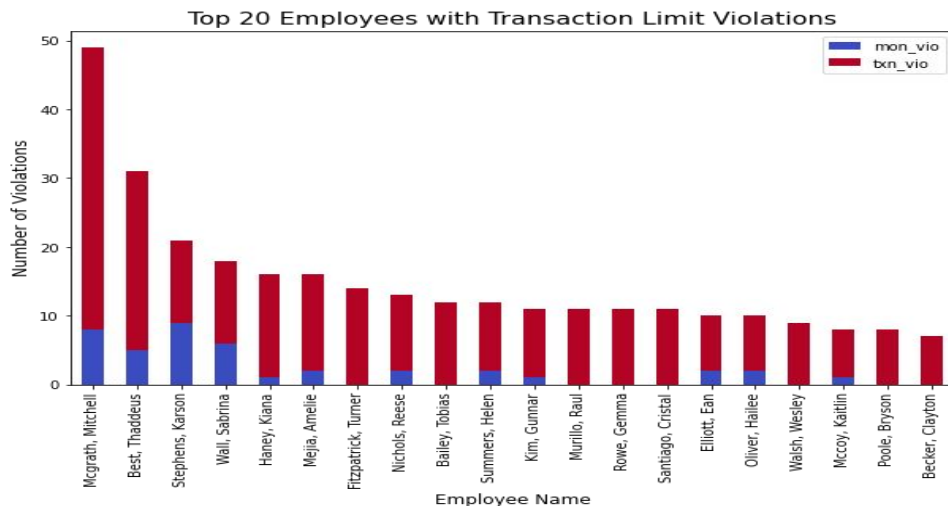
Findings

- Library department has the highest total annual spendings (much higher than the second-highest spendings of the Population Health department).
- Looks suspicious since BioPhirma is a biomedical company.

Violation Analysis

Transaction Limit Violation Analysis

Total Violation of Transaction Limit by Employee



Single Transaction Limit Levels

Single Transaction Limit	num_emp
\$250	8
\$500	19
\$1000	282
\$1500	53
\$2000	34
\$2500	739
\$5000	54

Transaction Violation Criteria

- More numbers of violations on the Single Transaction Limit conducted would result in more number of violations on the Monthly Transaction Limit (\$10,000).
- Some of the employees also appear on the top 20 lists shown before, which confirmed the suspicions we had.

Split Transaction Violation Analysis

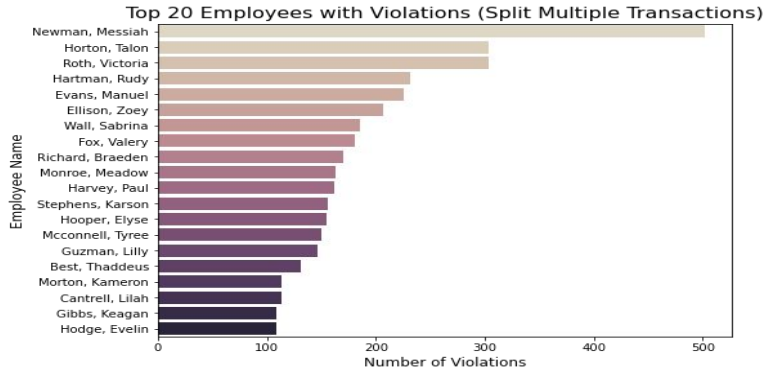
Findings

- The total number each month is gradually decreasing from the beginning of the fiscal year to the end.
- Employees who potentially split between two or more transactions with the same vendor on the same date would also potentially split between two or more vendors by one employee on the same day.
- Some employees also appear on the top 20 lists before.

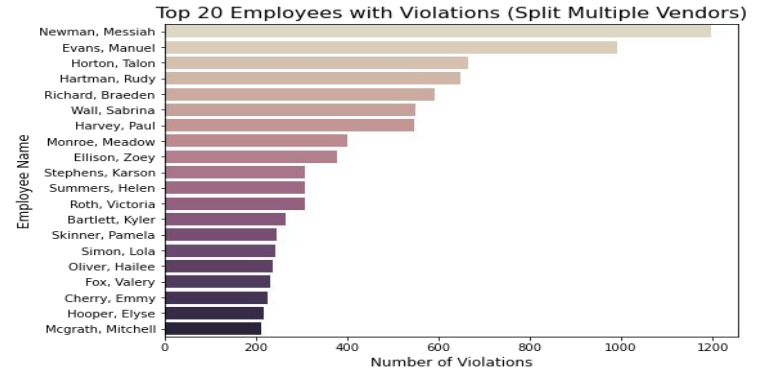
Total Number of Violations Each Month



Split between two or more Transactions



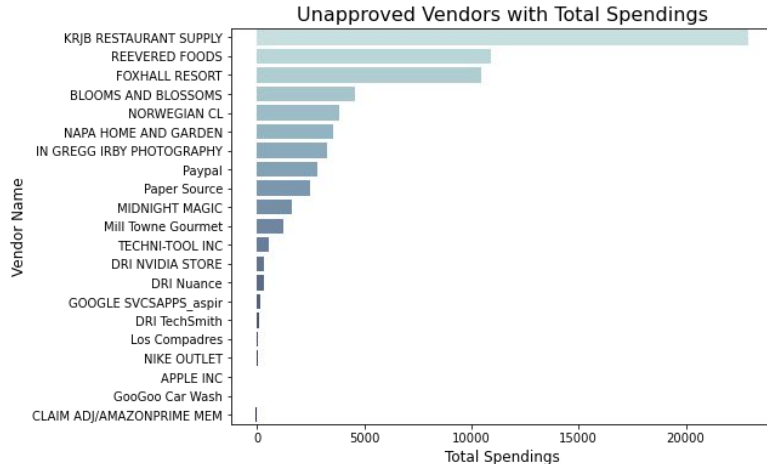
Split between two or more Vendors



Unapproved Vendors and Signoff Analysis

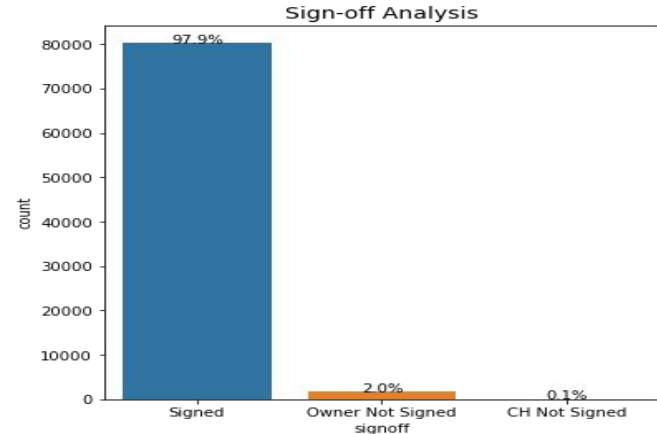
Unapproved Vendor Analysis

- We have identified 21 unapproved vendors.
- The highest total amount for the unapproved vendor is \$22,912 by KRJB Restaurant Supply
- The lowest total amount is (-\$60) by CLAIM ADJ/AMAZON PRIME MEM, which indicates the vendor refunded the money to the P-card holder.
- Vaughn Preston and Case Matteo get these refunds



Signoff Analysis

- Cardholder not signed and Owner signed: 0
- Department Supervisor (Owner) only not signed: 1,650 transactions
- Both Cardholder and Supervisor not signed: 42 transactions
- Signed by both: 77,393 transactions



Violation Analysis

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Text Analysis

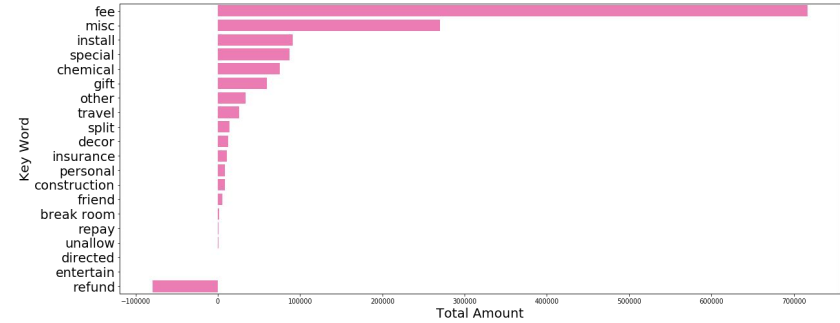
Keyword Analysis

- Using the table called Allowable and Unallowable Purchases table, keywords were derived.
- The key terms are ordered by how much they cost BioPhirma.
- Can be used as a financial justification to investigate violations.

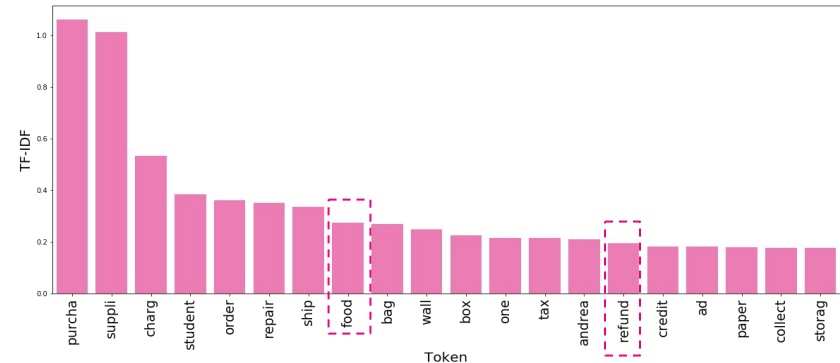
TF-IDF

- TF-IDF increases when a rare term is present in a document(one employee's comments) especially if it occurs a lot while it is low when a word is absent or common across all comments in the dataset.
- This measure can be used to identify key/special terms for each employee and inform us of possible violations.

Most Frequent Key Word by Item Total



TF-IDF for Evans, Manuel



Word Cloud



Red Flags

Suspicious Employees

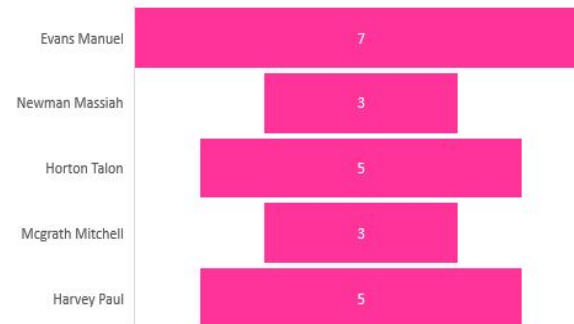
Top 5 Suspicious Employees

1. **Evans, Manuel**
 - a. Number 2 in Monthly Transaction Limit Violations
 - b. Number 1 in no comments per transaction; Number 1 in no comments by total amounts
 - c. Number 2 in the split between two or more vendors by one employee on the same day
 - d. Number 2 in P-card spending; Number 3 in Number of P-card transactions
 - e. Number 5 in the split between two or more transactions by one employee with the same vendor on the same date
2. **Newman, Massisah**
 - a. Number 4 in Violations of Monthly Transaction Limit
 - b. Number 1 in split violations on the same day and from the same vendor
 - c. Number 2 in P-card spending and transactions
3. **Horton, Talon**
 - a. Number 3 and 2 in split violations on the same day and from the same vendor
 - b. Number 8 in Violations of the Monthly Transaction Limit Policy
 - c. Number 7 in P-card spending; Number 3 in Number of P-card transactions
4. **Mcgrath, Mitchell**
 - a. Number 1 in Single and Monthly Transaction Limit Violations
 - b. Number 20 in split violations on the same day
 - c. Number 15 in P-card spending and transactions
5. **Harvey, Paul**
 - a. Number 9 in no comments by total amounts
 - b. Number 7 and 11 in split violations on the same day and from the same vendor
 - c. Number 1 and 6 in P-card spending and transactions

Suspicion Criteria

- Employees must at least be in one of the Top 20 of a violations category.
- Consider Employees with multiple violation criteria.

Count of Violation Criteria



Recommendations

Key Findings & Recommendations

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Overall Findings

- Keywords analysis, based on unallowable purchases, could be useful in detecting transaction violations.
- Library, Population health, and Pharmacy are the top three departments with the greatest annual spending.
- More than 50% of the top 20 employees with the highest number of P-card violations are within top employees with the greatest amount of spending or number of total transactions.
- No P-card transaction has occurred during weekends. The total number of transactions is smaller during the early month of January and also from late April through the end of June.
- For split transactions, top 10 employees by the number of violations found in potential split by more than one vendor were also found in potential split by more than one transaction.

Tactical Recommendations

- Continuous use of selected keywords as KPI to track potential violations before they occur. Can be used to determine how widespread violations are.
- Monthly notifications with top 20 vendors to emphasize P-card policies. If continuous top 20 placements occur, escalate to meetings discussing SLAs.
- Contact top 20 red flag employees judged by various violation criteria and remind them of P-card policies.
 - Employment violation notice to be issued If violations are repeated by the identified employees.
 - A process implemented on a rolling monthly basis, with a three-strike policy
- Implement policy where transactions are not approved until comments are made.
 - Comments can be flagged to identify potential violations beforehand.

Long-Term Recommendations

- Additional data we could use:

Variable	Reasoning
Employee Position	This could help to determine if certain roles/positions commit more violations and then conduct root cause analysis to understand the relations between employee level and violations.
Txn Category	This could help to determine which category items (i.e. beverage, entertainment) are mostly related to overall violations and on that basis understand the root cause of these category transactions.

- Add a purchase category column for employees to fill in, according to the allowable purchase list.
- Cases of fraud/identity theft on p-cards so increase the security of the cards.
- Set time limit for when department owners have to sign off transactions after card-holders have signed off.
- Deactivate cards of those who have more than a set threshold of transactions in a day.

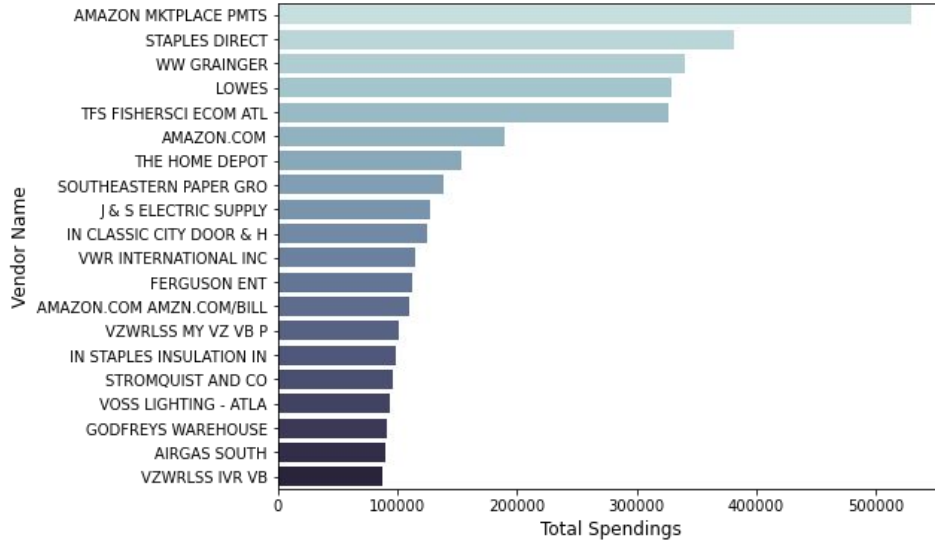
Thank You

Q&A

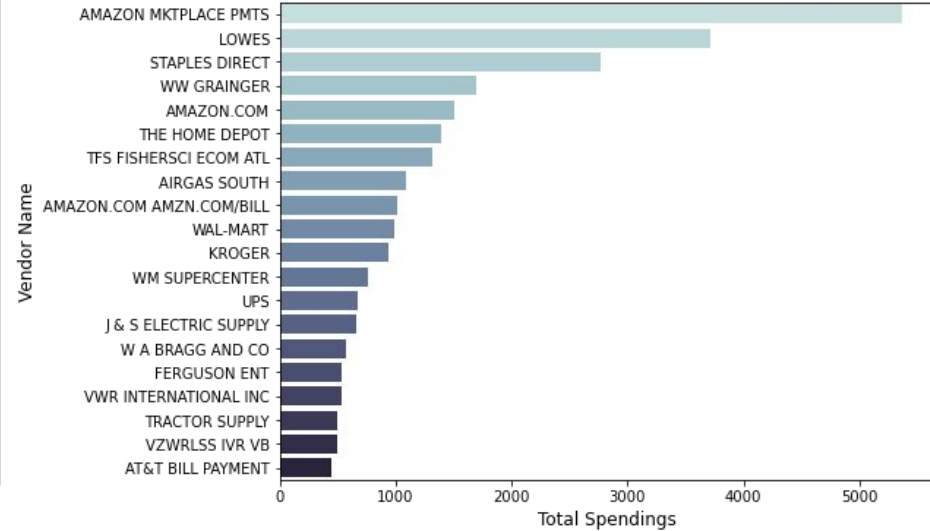
Appendix:

Vendor Analysis

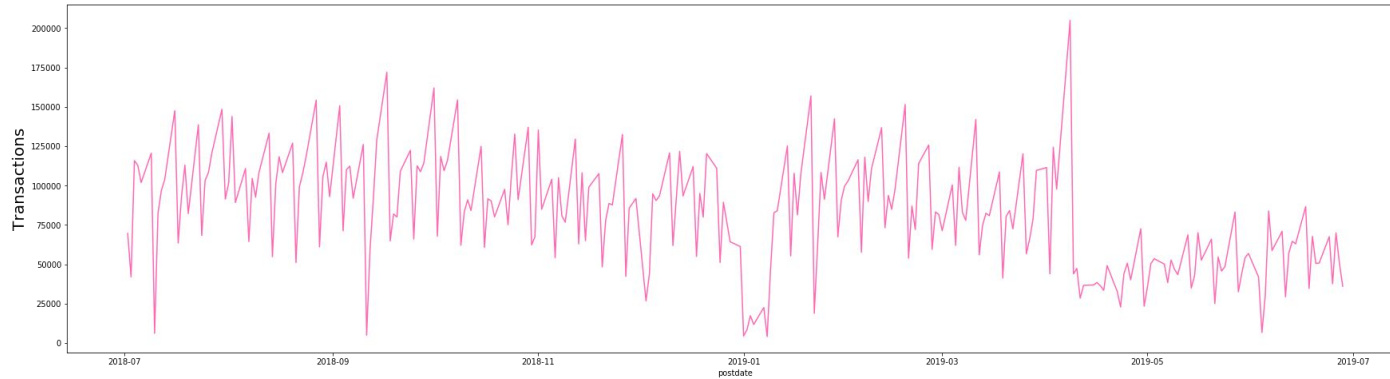
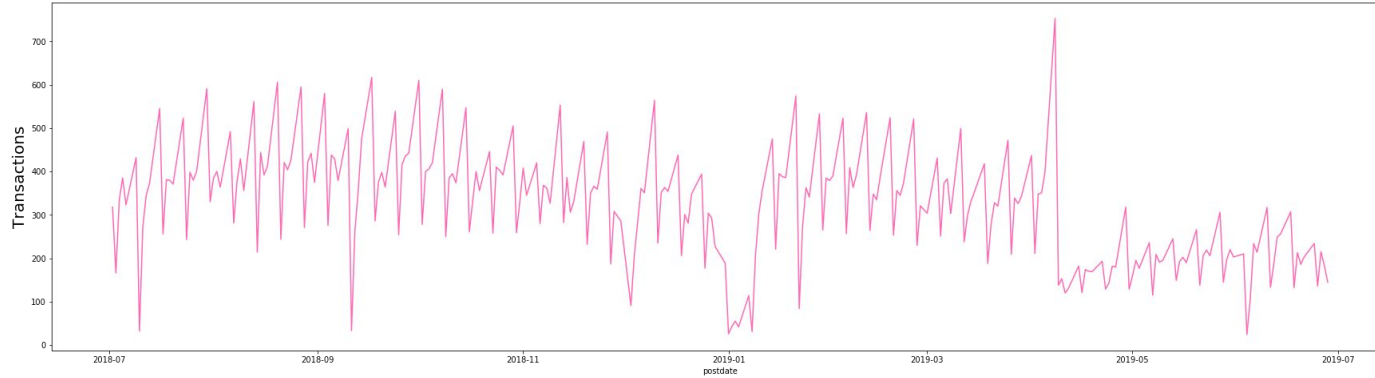
Top 20 Vendors with Greatest P-Card Total Spendings

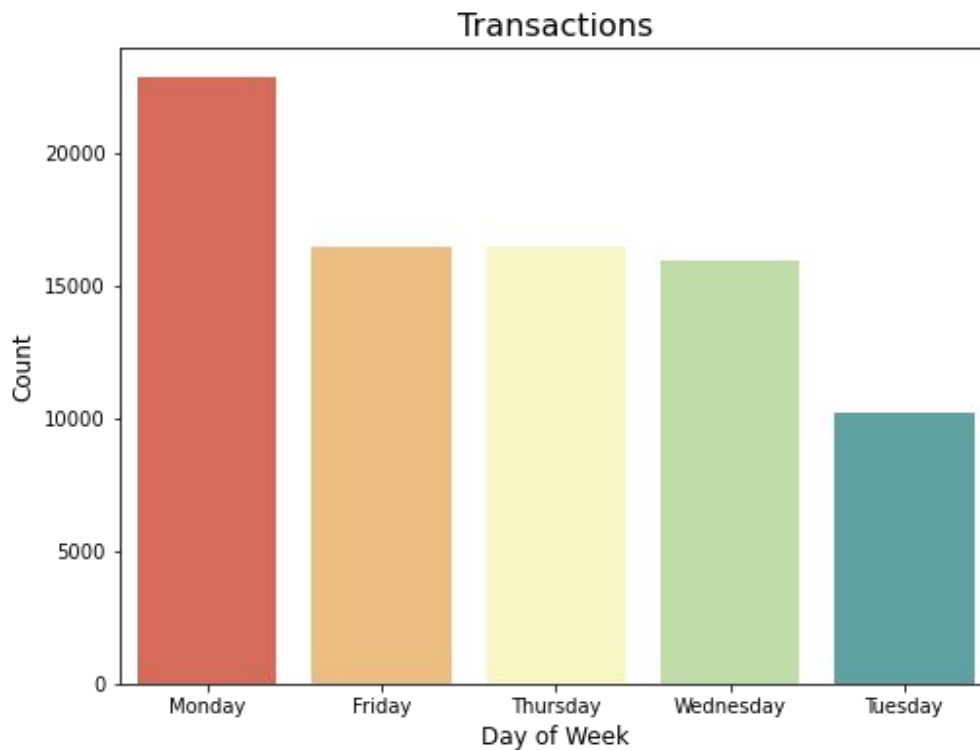


Top 20 Vendors with Greatest P-Card Total Transactions

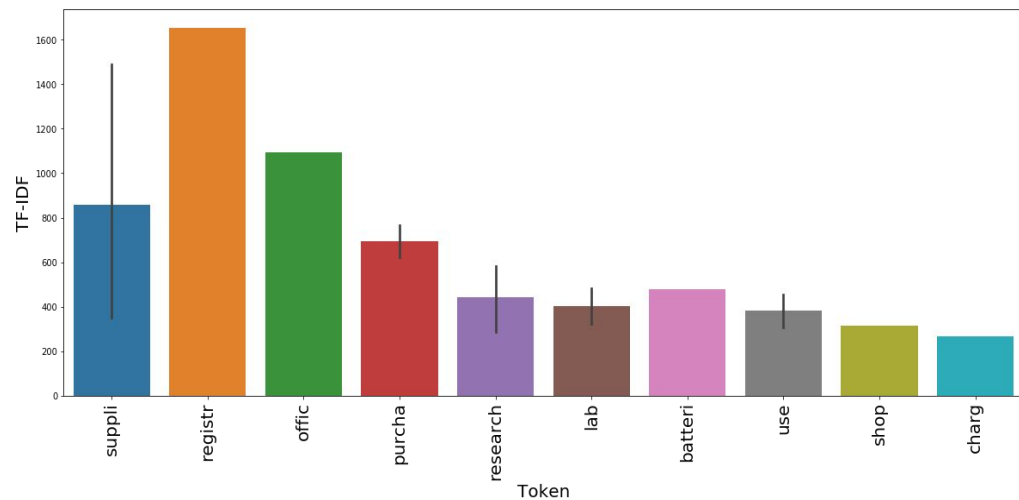
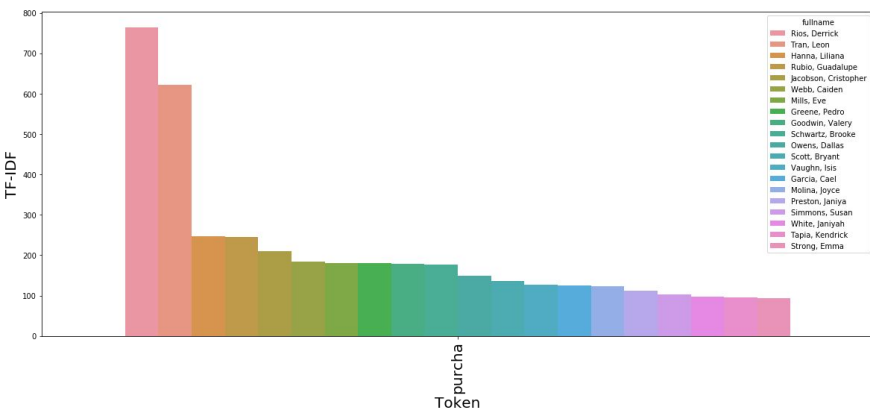


Time-Series Analysis



Day of Week Analysis

TF-IDF Overall Analysis



Keyword Analysis

Allowable purchases	Unallowable purchases
<ul style="list-style-type: none"> ▶ Advertising ▶ Appliances ▶ Auto parts ▶ Books ▶ Bulk fuel ▶ Car washes for inventoried vehicles ▶ Compressed gases ▶ Equipment rental < 90 days ▶ Food and catering ▶ Lab and research supplies ▶ Live animals and specimens ▶ Non-inventoried equipment ▶ Office filing cabinets ▶ Office supplies ▶ Postage ▶ Printing ▶ Recurring charges for BioPharma cell phones ▶ Rentals < 90 days ▶ Registration fees ▶ Repairs, maintenance and service agreements ▶ Software ▶ Subscriptions ▶ Temporary staffing services ▶ Utilities 	<ul style="list-style-type: none"> ▶ Alcoholic beverages and tobacco ▶ Asbestos removal ▶ Break room supplies ▶ Cash advances, cash refunds and store credits ▶ Chemicals ▶ Construction, infrastructure repairs and renovation ▶ Decorations or flowers ▶ Employee travel-related vehicle rental ▶ Entertainment ▶ Firearms and explosives ▶ Installment purchases ▶ Insurance payments