



Grant Thornton

Visualizing Fraud in Your Data

NY/NJ Intergovernmental Audit Forum

Thursday, September 26th, 2019



Today's Topics

- Introduction to Data Visualization
- Benefits of Data Visualization
- Choosing the Right Tool
- Best Practices
- Detecting and Preventing Fraud Through Data Visualization





The goal is to turn data into information, and
information into insight.

—Carly Fiorina

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Introduction to Data Visualization

FRAUD RISK ASSESSMENT

Rule-Based
Analytics



Known Patterns

Anomaly Detection
Analytics



Unknown Patterns

Predictive
Analytics



Complex Patterns

Network / Link
Analytics



Linked Patterns

Text Analytics



Text Patterns

Common Fraud

Criminal Fraud

Organized Fraud

Introduction to Data Visualization

- Data visualization is the graphical representation of data.
- By using visual elements like charts, graphs, and maps, data visualization tools provide an accessible way to quickly understand trends, outliers, and patterns in data—especially for busy decision-makers.



Introduction to Data Visualization



Can You Spot the Outliers?

A1	Cardholder Name																											
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z		
1	Cardhol	Administra	Administra	EMPLO	Acct La	CARD_I	LIMIT	TRX_LI	Transac	Transac	Post Da	Transac	Expendi	Day of	Purchas	Debit A	AMOUN	Credit A	Discour	Tax	TAX_FV	Transac	Mercha	M				
2	Cardholde	Administra	Administra	16084	9472	10104	20000	3500	1.36E+08	#####	#####	17:18:47	#####	Wednesda	Unknown	2.46	2.46	0	1	0.246	0	Fees	CONVENIE	Ke				
3	Cardholde	Administra	Administra	6204	9472	10104	20000	3500	1.36E+08	#####	#####	7:13:09	#####	Wednesda	Unknown	0.53	0.53	0	1	5.30E-02	0	Fees	CONVENIE	Te				
4	Cardholde	Administra	Operation:	23957	6768	10022	20000	3500	1.36E+08	#####	#####	11:05:34	#####	Sunday	Unknown	0.61	0.61	0	1		0	Fees	INTERNAT	No				
5	Cardholde	Administra	Administra	11632	2198				1.37E+08	#####	#####	16:04:31	#####	Monday	Unknown	26.78		0	0			Purchase	DEBIT TO PU					
6	Cardholde	Administra	Administra	23165	2198				1.37E+08	#####	#####	15:29:17	#####	Monday	Unknown	10.99		0	0			Purchase	DEBIT TO PU					
7	Cardholde	Administra	Administra	23608	2198				1.37E+08	#####	#####	21:58:01	#####	Monday	Unknown	11.64		0	0			Purchase	DEBIT TO PU					
8	Cardholde	Administra	Administra	8320	2198				1.37E+08	#####	#####	15:57:44	#####	Monday	Unknown	3988.89		0	0	398.889		Purchase	DEBIT TO IW					
9	Cardholde	Administra	Administra	21666	2198				1.37E+08	#####	#####	2:35:43	#####	Monday	Unknown	1168.18		0	0	116.818		Purchase	DEBIT TO IW					
10	Cardholde	Administra	Administra	5789	2198				1.37E+08	#####	#####	22:28:57	#####	Monday	Unknown	238.78		0	0	23.878		Purchase	DEBIT TO IH					
11	Cardholde	Administra	Administra	13036	2198				1.37E+08	#####	#####	3:26:12	#####	Monday	Unknown	2561.71		0	0	256.171		Purchase	DEBIT TO IH					
12	Cardholde	Administra	Administra	5208	2198				1.37E+08	#####	#####	15:34:55	#####	Monday	Unknown	16.72		0	0	1.672		Purchase	DEBIT TO IAr					
13	Cardholde	Administra	Administra	12164	2198				1.37E+08	#####	#####	15:35:02	#####	Monday	Unknown	3.84		0	0	0.384		Purchase	DEBIT TO IAr					
14	Cardholde	Administra	Administra	3324	2198				1.37E+08	#####	#####	7:55:31	#####	Monday	Unknown	205.08		0	0	20.508		Purchase	DEBIT TO I Ca					
15	Cardholde	Administra	Operation:	8259	6768	10022	20000	3500	1.37E+08	#####	#####	11:56:01	#####	Monday	Unknown	11.2	11.2	0	0	1.12	0	Fees	INTERNAT	Cc				
16	Cardholde	Administra	Program S	21662	4150	10091	20000	3500	1.37E+08	#####	#####	13:46:08	#####	Monday	Unknown	2.32	2.32	0	0	0.232	0	Fees	INTERNAT	Cc				
17	Cardholde	Administra	Operation:	13344	6768	10022	20000	3500	1.37E+08	#####	#####	16:08:30	#####	Thursday	Unknown	8.66	8.66	0	0	0.866	0	Fees	INTERNAT	Di				
18	Cardholde	Administra	Program S	23068	4150	10091	20000	3500	1.37E+08	#####	#####	23:06:58	#####	Tuesday	Unknown	1.91	1.91	0	0	0.191	0	Fees	INTERNAT	De				
19	Cardholde	Administra	Administra	19943	2198				1.38E+08	#####	#####	20:35:11	#####	Wednesda	Unknown	94		0	0	9.4		Purchase	DEBIT TO IFlo					
20	Cardholde	Administra	Administra	8747	2198				1.38E+08	#####	#####	12:46:14	#####	Thursday	Unknown	584.5		0	0	58.45		Purchase	DEBIT TO I Ge					
21	Cardholde	Administra	Administra	6734	2198				1.38E+08	#####	#####	18:08:58	#####	Thursday	Unknown	54.03		0	0	5.403		Purchase	DEBIT TO IH					
22	Cardholde	Administra	Administra	5421	2198				1.38E+08	#####	#####	0:59:19	#####	Monday	Unknown	72.98		0	0	7.298		Purchase	DEBIT TO IH					
23	Cardholde	Administra	Administra	17751	2198				1.38E+08	#####	#####	21:17:18	#####	Wednesda	Unknown	216.2		0	0	21.62		Purchase	DEBIT TO IH					
24	Cardholde	Administra	Administra	10888	2198				1.38E+08	#####	#####	22:15:28	#####	Friday	Unknown	14.19		0	0	1.419		Purchase	DEBIT TO IH					
25	Cardholde	Administra	Administra	10672	2198				1.38E+08	#####	#####	11:07:06	#####	Tuesday	Unknown	30		0	0	3		Purchase	DEBIT TO IH					
26	Cardholde	Administra	Administra	1350	2198				1.38E+08	#####	#####	2:09:10	#####	Wednesda	Unknown	40.93		0	0	4.093		Purchase	DEBIT TO IH					
27	Cardholde	Administra	Administra	19253	2198				1.39E+08	#####	#####	8:56:26	#####	Friday	Unknown	157.8		0	0	15.78		Purchase	DEBIT TO IH					
28	Cardholde	Office of L	Administra	5949	2198				1.39E+08	#####	#####	2:07:24	#####	Monday	Unknown	363		0	1	36.3		Purchase	DEBIT TO IH					
29	Cardholde	Office of L	Administra	24334	2198				1.39E+08	#####	#####	3:34:31	#####	Wednesda	Unknown	36.6		0	1	3.66		Purchase	DEBIT TO IH					
30	Cardholde	Office of L	Administra	8020	2198				1.39E+08	#####	#####	17:17:05	#####	Monday	Unknown	59.5		0	1	5.95		Purchase	DEBIT TO IH					

How About Now?

Program Integrity: Purchase Card - Split Transaction Transactions

Choose Applicable

Fraud Test

Split Transaction

Transaction Amount

\$-3,689.28

\$8,324.00

MCC Class

[All]

Mcc Description

[All]

Cardholder Division

[All]

Transaction Date

10/1/2014

3/31/2017

Z Score

-0.74

12.00

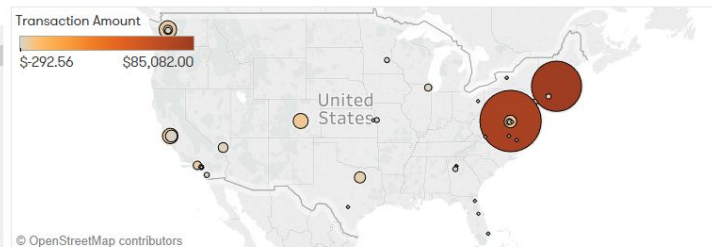
Top Cardholders by Transaction Count

Cardholder Name	Count
Cardholder 187	66
Cardholder 180	58
Cardholder 70	31
Cardholder 21	28
Cardholder 105	23
Cardholder 3	20
Cardholder 103	19
Cardholder 47	19
Cardholder 198	17

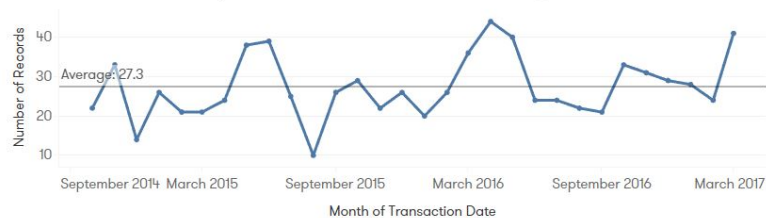
Top Cardholders by Amount

Cardholder Name	Amount
Cardholder 180	\$20,774.33
Cardholder 187	\$19,181.61
Cardholder 70	\$11,401.59
Cardholder 47	\$11,173.20
Cardholder 3	\$10,116.26
Cardholder 147	\$9,300.00
Cardholder 105	\$8,600.43
Cardholder 38	\$7,547.00
Cardholder 18	\$6,457.55
Cardholder 198	\$6,126.50
Cardholder 21	\$5,669.33

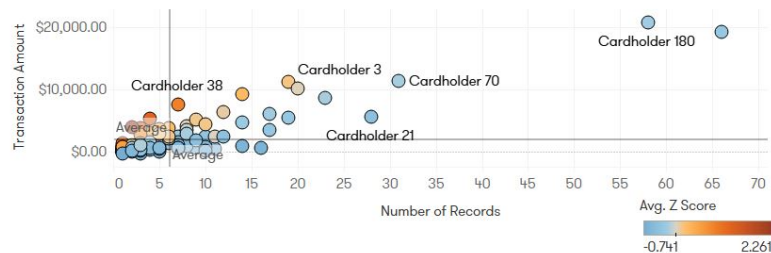
Split Transaction Locations and Amount



Total Split Transaction Transactions by Month



Transaction Amount vs. Number of Records



Today's Topics

- Introduction to Data Visualization
- **Benefits of Data Visualization**
- Choosing the Right Tool
- Best Practices
- Detecting and Preventing Fraud Through Data Visualization





Benefits of Data Visualization

Leveraging data visualization can empower an organization to take advantage of the numerous benefits; a few are outlined below.



Today's Topics

- Introduction to Data Visualization
- Benefits of Data Visualization
- **Choosing the Right Tool**
- Best Practices
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Choosing the Right Tool

When choosing a tool to visualize your data as part of your anti-fraud efforts, you should consider several factors that can help optimize performance and provide the highest return on investment (ROI) for the fraud problem or problems at hand.



Data Size & Complexity



Data Sources



Data Transformation



Real-Time Access



The Scope Triangle

Today's Topics

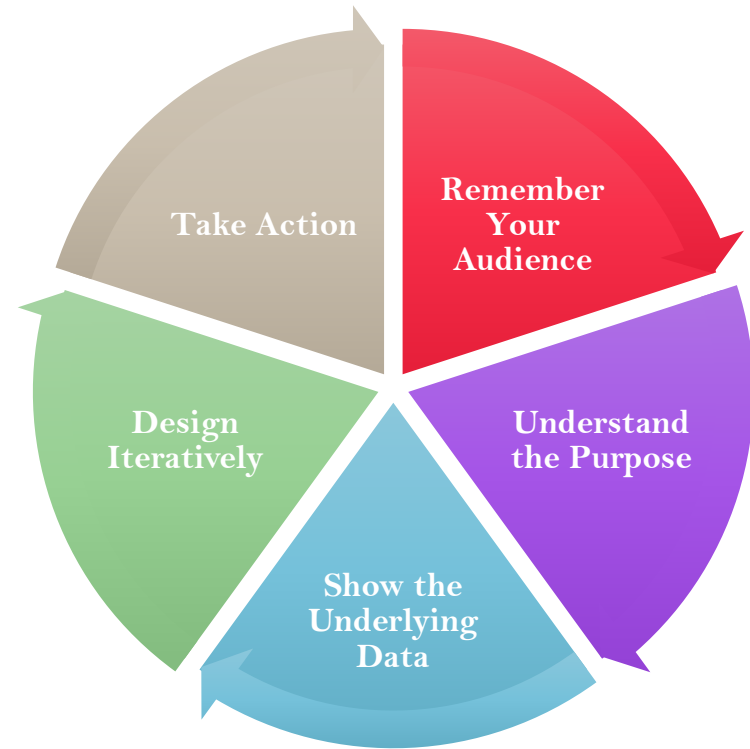
- Introduction to Data Visualization
- Benefits of Data Visualization
- Choosing the Right Tool
- **Best Practices**
- Detecting and Preventing Fraud Through Data Visualization



Best Practices for Data Visualization

There are such things as good and bad data visualizations.

To the right are **five best practices** to keep in mind so that your data visualization is useful and clear—and to ensure that you are effectively telling your fraud story.



Common Mistakes

Visualization mistakes can be grouped into two main categories:

Design Mistakes

- Arranging information poorly
- Exceeding a single screen
- Misusing or overusing color
- Cluttering the display with visual effects
- Designing an unattractive display

Information Mistakes

- Inadequate context for the data
- Displaying excessive detail or precision
- Expressing measures indirectly
- Misreading your audience

London

51.51 N, 0.13 W

Mon 9 Dec @ 16:02:42

Go to Map - Go to Grid - Change City

WEATHER STATIONS (MULTIPLE SOURCES)

STATION	WIND SPEED	WIND GUSTS	DIRECTION	TEMPERATURE	HUMIDITY	RAIN TODAY	PRESSURE	FORECAST
CASA Office: Bloomsbury W1	8 mph	9 mph	SE ↘	11.5 °C	76%	0.0 mm	1027.9 mbar	Clear Night
Lambeth Meters: Brixton SW9	4.3 mph	4.3 mph	SW ↙	11.0 °C	83%	0.0 mm	1026.4 mbar	Clear Night
Hampstead NW3	3.6 mph	3.6 mph	S ↑	9.8 °C	84%	0.0 mm	1029.0 mbar	Clear Night

WEATHER (METAR)

London City Airport
Mostly clear SW at 3 mph 11 C

FORECAST (YAHOO! WTH)

Mon 10 C Mostly Clear
Tue 9 C Partly Cloudy

TUBE LINE STATUS (TfL)

Bakerloo	Good Service
Central	Good Service
Circle	Good Service
District	Good Service
H & C	Good Service
Jubilee	Good Service
Metropolitan	Good Service
Northern	Good Service
Piccadilly	Good Service
Victoria	Good Service
W & C	Good Service
Overground	Good Service
DLR	Good Service

BIKE SHARING (TfL)

4.3 % Stations Full
4.9 % Stations Empty
7354 Bikes Available
430 Bikes or Docks Faulty



IN SERVICE (TfL)

7197 London buses
378 Underground trains

RADS (CASA)

CASA Office Desk ↑
6 cpm (uncalibrated)

AIR POLLUTION (DEFRA)

$\mu\text{g}/\text{h}^3$ TIME AVERG	OZONE	NO ₂	SO ₂	PM _{2.5}	PM ₁₀
Bloomsbury	13	38	4	9	10
Marylebone Rd	9	16	26	22	34
N Kensington	14	40	?	12	18

RIVER LEVEL (PLA)

Thames (Tower Pier)
4.13 metres

STOCKS (YAHOO)

FTSE 100 Index
6552.34
+0.35 (0.01%)

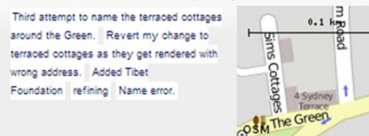
RANDOM TRAFFIC CAMERAS (TfL)



BBC LONDON NEWS (BBC)



OPENSTREETMAP UPDATES (OSM)



ELECTRICITY (N.Grid)

Demand (Great Britain)
48211 MW

MOOD (LSE MAPPING)

8% unhappier than the long term average for here
13% happier than the whole country right now

TWITTER TRENDS FOR LONDON

MPs #NFL Christmas #Confident Xmas #ashes London
#RIPAlexTurner #12DaysOfJonesDAY9 Waca

Mistakes in This Visualization

- Wasted space on top
- Too much information at once
- Extremely cluttered
- May not be correctly considering audience
- Large use of unrelated color, no clear indication of meaning
- Repetitive information
- Poor choice of visualizations

Program Integrity: Vendor - All Records Transactions

Choose Applicable

Fraud Test:

BOC Roll Up Name: (All) Org-Roll Up: (All)

All Records

Expense: (\$15,423) \$15,016,090 Transaction Date: 1/2/2015 12/25/2018

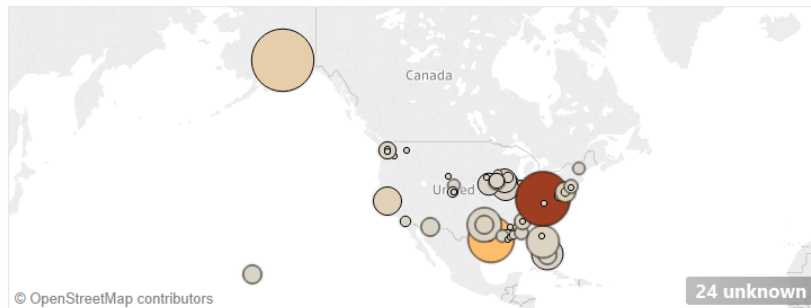
Top Vendors by Amount

Vendor	Amount
Vendor 184	\$32,883,728
Vendor 161	\$10,493,262
Vendor 186	\$4,863,751
Vendor 115	\$3,814,741
Vendor 154	\$2,007,532
Vendor 98	\$1,657,517
Vendor 53	\$1,609,559
Vendor 18	\$1,303,694
Vendor 36	\$1,210,670
Vendor 84	\$797,999
Vendor 163	\$769,245

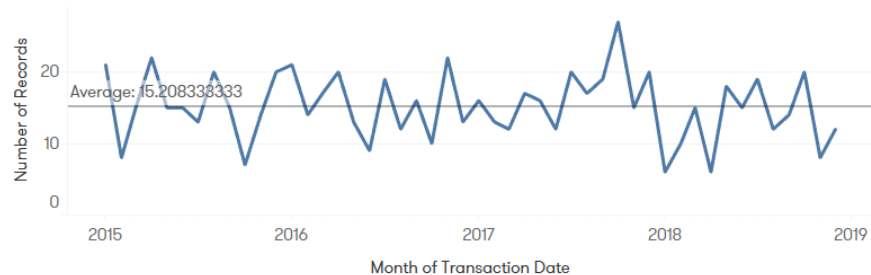
Top Vendors by Number of Records

Vendor	Number of Records
Vendor 53	103
Vendor 31	31
Vendor 115	29
Vendor 57	22
Vendor 136	21
Vendor 186	19
Vendor 163	18
Vendor 18	18
Vendor 44	16
Vendor 107	15
Vendor 108	15

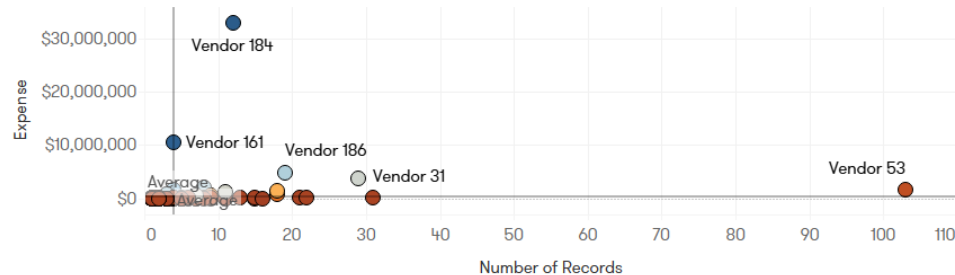
All Records Locations and Amount



Total Vendor Transactions by Month



Expense vs. Number of Records



Visualization Types

Strategic

- Provide quick overview to monitor health and opportunities
- Focus on high-level performance measures

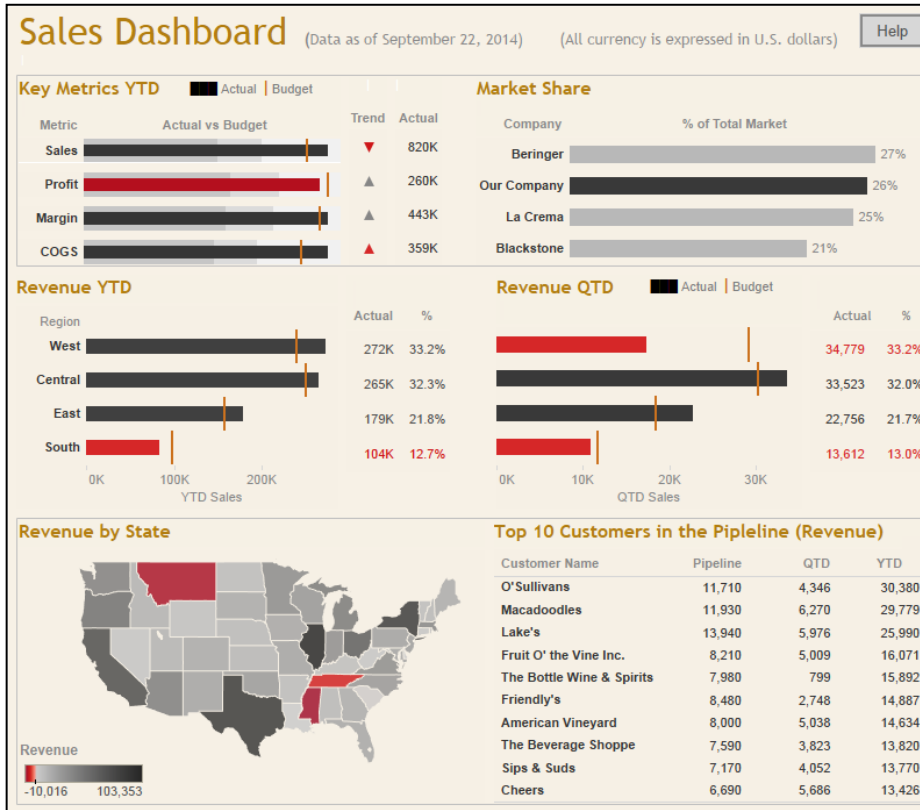
Operational

- Used mainly for monitoring operations
- Dynamic and immediate in nature

Analytical

- Require additional context (comparison, history, evaluations)
- Highly interactive

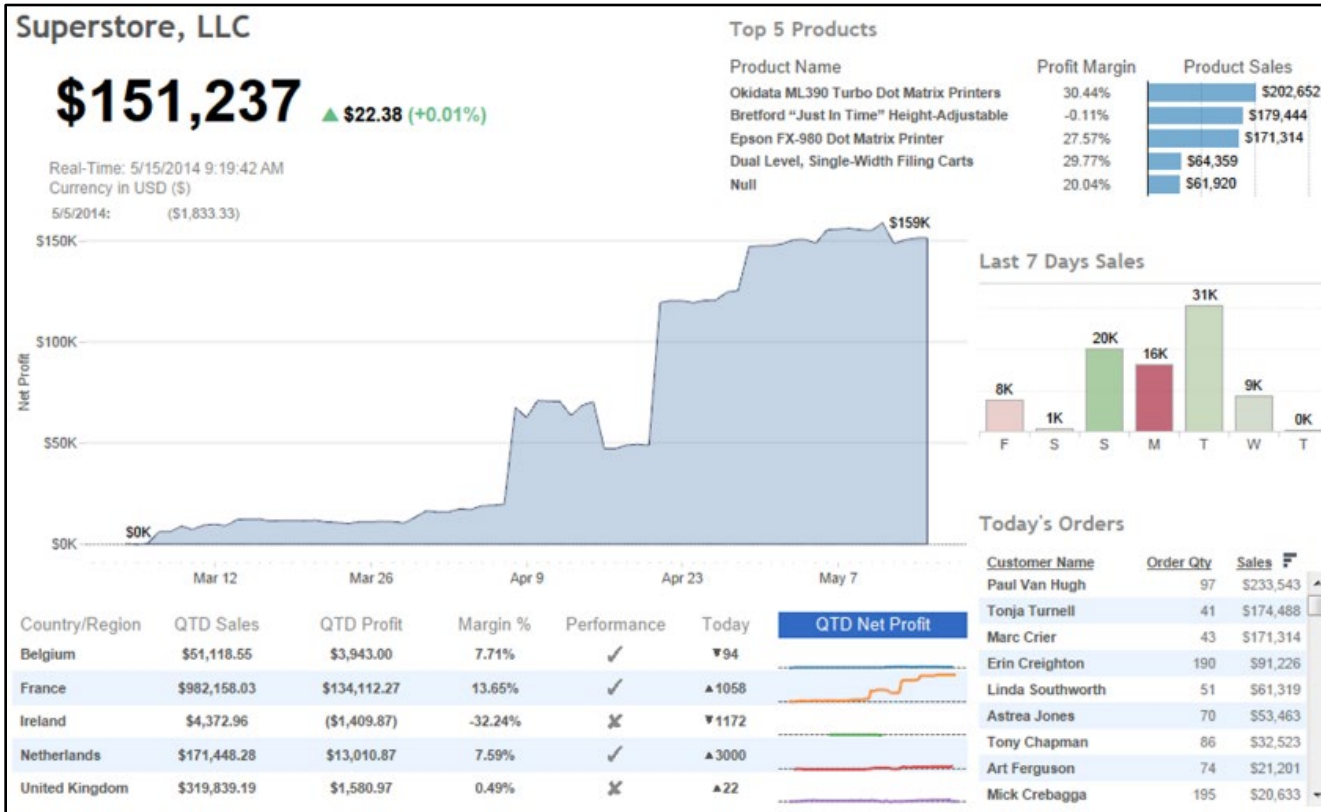
Visualization Types



Strategic

- Most important information only
- Color used sparingly
- No clutter

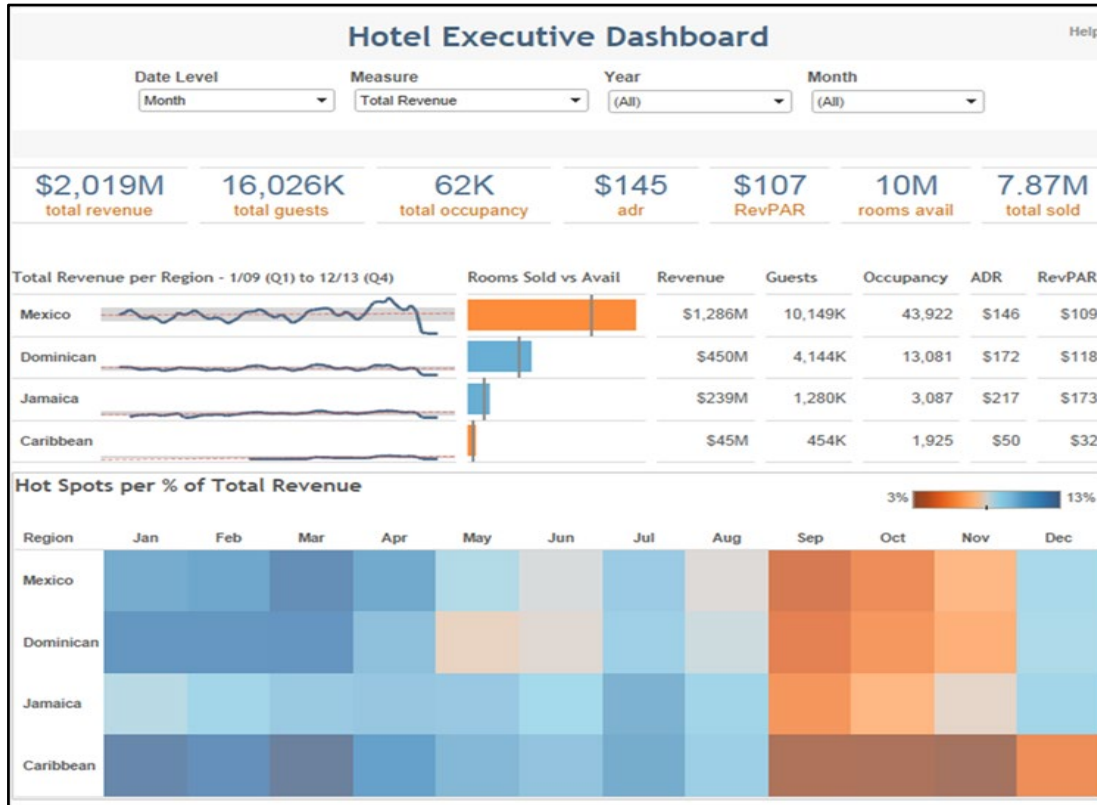
Visualization Types



Operational

- Frequent information updates
- Immediately monitor information

Visualization Types



Analytical

- Identify seasonality and opportunities
- Light borders, logical groupings
- Use of heat maps

Today's Topics

- Introduction to Data Visualization
- Benefits of Data Visualization
- Choosing the Right Tool
- Best Practices
- **Detecting and Preventing Fraud Through Data Visualization**



Detecting and Preventing Fraud

Case Study 1

What?

- **Do you know whether fraud is being committed with your organization's company credit cards or purchase/travel cards?**
- Grant Thornton performed a fraud risk assessment for an organization related to its card purchases; this assessment was paired with an effort to leverage analytical tools and methodologies to help mitigate risk within this area.
- **Metrics Available:** Holiday and weekend transactions, personnel holding multiple cards, tax charged.

How?

- Data related to cardholders and financial records were blended in order to evaluate questionable transactions that should be pulled for additional research; this practice effectively lowered the organization's fraud risk related to improper card usage.
- The Grant Thornton team used Alteryx, a multi-purpose, self-service analytics platform, for data cleansing, blending, and preparation.
- The team also leveraged Tableau for the development of the visual analytics storyline, using its interactive dashboard capabilities to identify suspicious transactions.

Title	Spending Profile by Position and	Holiday Transactions	Personnel With Multiple Payment	Top Spending by Merchant &	Weekend Transactions	Me Tra
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Holiday Transactions

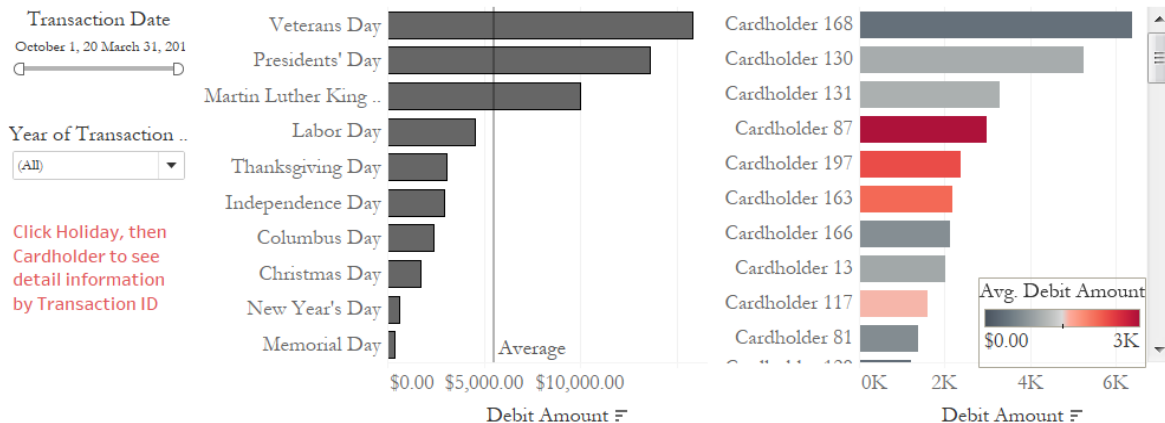
Transactions made on Federal Holidays (including days on which the holiday is "observed") need to be subjected to a high level of scrutiny to ensure that they are not made for personal use. Use the filters and graphs to navigate through all transactions that were made on a Federal Holiday.

Holiday Spending

\$55,006.57

of Transactions

18,394



Transaction..	Day of Transacti..	Cardholder	Card Acco..	MCC Description	Merchant	Debit Amou..	Credit Amou..
136226029	October 13, 2014	Cardholder 212	0702	DIRECT MARKET..	Merchant 1318	\$541.00	\$0.00
137259504	October 13, 2014	Cardholder 114	7592	TELECOMMUNIC..	Merchant 257	\$741.98	\$0.00
137715658	November 11, 2..	Cardholder 129	3041	CATERERS	Merchant 1114	\$220.50	\$0.00
137715659	November 11, 2..	Cardholder 129	3041	CATERERS	Merchant 1114	\$220.50	\$0.00
137718827	November 11, 2..	Cardholder 51	6681	COMPUTER MAI..	Merchant 1554	\$5.57	\$0.00
137722845	November 11, 2..	Cardholder 117	9002	COMPUTER MAI..	Merchant 1554	\$1,605.26	\$0.00
137723860	November 11, 2..	Cardholder 105	1258	BUSINESS SERVI..	Merchant 1645	\$0.00	(\$72.98)
137726515	November 11, 2..	Cardholder 168	7288	TELECOMMUNIC..	Merchant 256	\$192.80	\$0.00
137726516	November 11, 2..	Cardholder 168	7288	TELECOMMUNIC..	Merchant 256	\$52.88	\$0.00
137730942	November 11, 2..	Cardholder 4	1771	STATIONERY. OF..	Merchant 546	\$126.72	\$0.00

Benefits Achieved

- The dashboards created allow for more effective research into questionable card transactions, replacing a process that had been performed manually.
- The solution provides a set of formalized investigative procedures that standardize the tests and checks used at all levels.

Detecting and Preventing Fraud

Case Study 2

What?

- **Do you work with third parties, such as medical providers or vendors? Do you know if they are committing fraud against your organization?**
- We performed a fraud risk assessment for an organization related to payments to medical providers; this assessment was paired with an effort to leverage analytical tools to help detect suspicious providers.
- **High-Risk Medical Services Selected:**
Chiropractic, sleep study, acupuncture, physical therapy, drug testing, radiation oncology
- Data was aggregated by provider, aligned to specific fraud schemes, and then tests were developed to identify suspicious providers.
- The Grant Thornton team leveraged Tableau for the development of the visual analytics storyline, using its interactive dashboard capabilities to identify suspicious providers.

Detecting and Preventing Fraud

Case Study 2

Medical Service	Fraud Scheme	Test
<ul style="list-style-type: none">• Acupuncture• Chiropractic• Physical Therapy	<ul style="list-style-type: none">• Billing timed codes that amount to over 24 hours per day	<ul style="list-style-type: none">• Avg. # of minutes billed per day• Avg. # of visits billed per day• % of days billing over 6 hours
<ul style="list-style-type: none">• Drug Test	<ul style="list-style-type: none">• Redundant or excessive testing	<ul style="list-style-type: none">• Avg. # of drug test procedures per patient• Single visits with more than one drug test
<ul style="list-style-type: none">• Sleep Study• Chiropractic	<ul style="list-style-type: none">• Submitting multiple claims for one visit	<ul style="list-style-type: none">• % of visits with more than one claim per visit• % of duplicate billing without required modifier

Detecting and Preventing Fraud

Case Study 2



425

Providers



182k Claims



20k Patients



\$69M Dollars

Model	Model (# of Tests)	Total # Providers Reviewed	Total # Providers Flagged	Total \$ Paid to Flagged Providers
Acupuncture	55	389	59	\$9,933,009
Chiropractor	78	565	48	\$5,220,429
Drug Testing	52	323	30	\$7,055,697
Radiation Oncology	53	1,080	240	\$40,863,485
Physical Therapy	78	4,723	102	\$16,805,660
Sleep	54	210	20	\$2,297,172

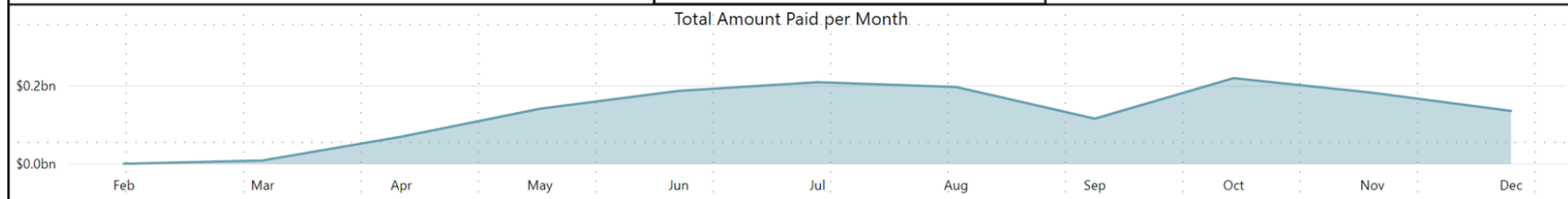
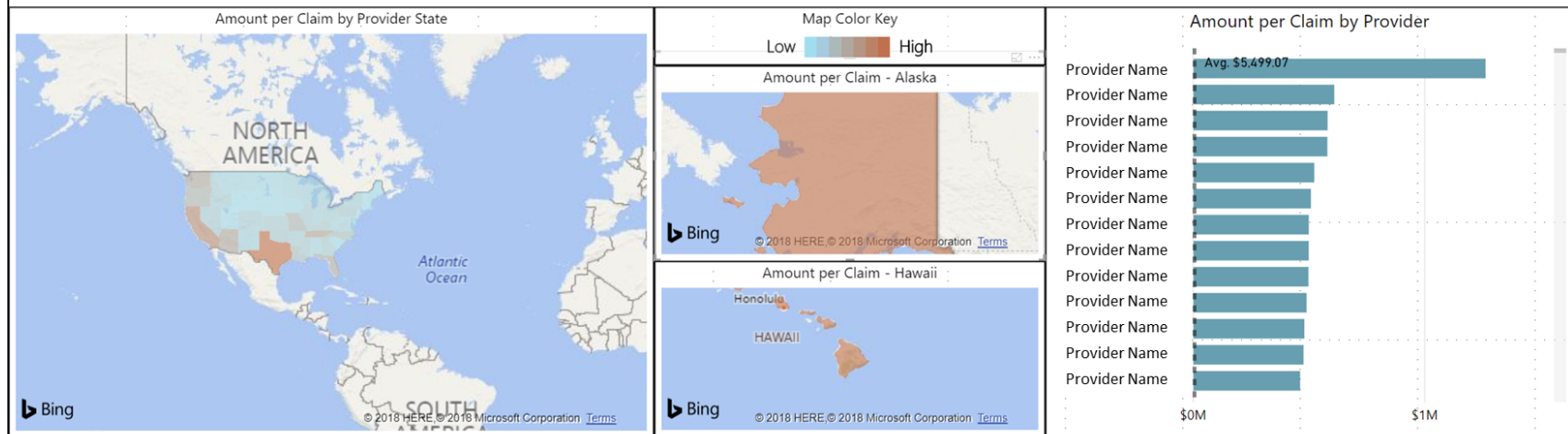
*Totals are inclusive of duplicate patients across models due to overlapping procedures.



Fraud Scheme: Provider bills for services not rendered by consistently billing for more services per visit than were received by patient.



CPT Code All	Show Acupuncture <input type="checkbox"/> Yes <input type="checkbox"/> No	Show Chiropractic <input type="checkbox"/> Yes <input type="checkbox"/> No	Show Drug Testing <input type="checkbox"/> Yes <input type="checkbox"/> No	# Of Claims 1.00 1265.00	Total \$ Paid \$0.00 \$1,638,000.0
Claim Type All	Show PT/OT/Rehab <input type="checkbox"/> Yes <input type="checkbox"/> No	Show Radiation Onc... <input type="checkbox"/> Yes <input type="checkbox"/> No	Show Sleep Studies <input type="checkbox"/> Yes <input type="checkbox"/> No	# of Vets 1.00 1265.00	Max \$ Paid \$0.00 \$1,638,000.0





Detecting and Preventing Fraud

Case Study 3

Challenge

A worker's compensation office required insights into whether there were any indications of FWA by employee claimants, medical providers and law firms.

While the client maintained data sets across a variety of source systems, they required the application of analytics to better understand potential FWA in order to identify fraud prevention and detection processes.

At the time of engagement, the client was not leveraging data visualizations or the application of robust analytics to review / monitor their data to glean insights into potentially fraudulent activities.

Detecting and Preventing Fraud

Case Study 3

Solution

Developed visualizations leveraging Tableau to identify anomalies within the data that merit further review. In addition, they helped to serve as a guide for further analysis, tracking and monitoring of claims payments.

Through the application of simple visualization capabilities within Tableau (such as bar charts, scatter plots, geospatial maps), we could identify insights, many of which were not identifiable without the visualizations

The visualizations provided immediate insights into areas of potential FWA, that can be prioritized for immediate action versus those to begin performing continuous monitoring moving forward.

Detecting and Preventing Fraud

Case Study 3



Figure 3: Active Claims Receiving Payments

Contact Information



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