



# Understanding Corporate Bankruptcy

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# About Me

- Six years experience across banking and startup finance
  - Leveraged Loan Underwriting
  - Cash Flow Forecasting
- Active personal investor



# We Work, Once Valued at \$47 Billion, Files for Bankruptcy

The flexible-workspace company filed for chapter 11 as it struggles with many unprofitable locations

By *Alexander Gladstone, Alexander Saei*

Updated Nov. 7, 2023 9:20 am ET | **WSJ PRO**

Oct. 15, 2023

## Rite Aid, Facing Slumping Sales and Opioid Suits, Files for Bankruptcy

The pharmacy chain, one of the country's largest, faces more than a thousand lawsuits that say it filled illegal prescriptions for painkillers.

By JORDYN HOLMAN and LAUREN HIRSCH



**BANKRUPTCY**  
**SVB Financial Files for Chapter 11 Bankruptcy Protection**  
Silicon Valley Bank, now under the control of the Federal Deposit Insurance Corp., isn't part of the chapter 11 filing

*By Alexander Saeedi*  
Updated March 17, 2023 11:52 am ET | **WSJ PRO**

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SVB Financial Group said Friday that wealth-management firm SVB Private is no longer affiliated with the parent company. PHOTO: RINGO CHUI/ZUMA PRESS

# BANKRUPTCIES ALL AROUND

## Bed Bath & Beyond Shares Have Finally Been Extinguished

For the true believers who made Bed Bath & Beyond a meme stock, a reckoning is now at hand

By *Alexander Gladstone*

Updated Sept. 29, 2023 5:56 pm ET | **WSJ PRO**

### THE WALL STREET JOURNAL.

**China Property Bonds Looked Cheap at 20 Cents on the Dollar. They Weren't.**

Distressed-debt funds lost big after betting on a turnaround in the sector

Dozens of Chinese property companies have defaulted on their bonds over the last two years, but only a handful have paid investors back any money. BLOOMBERG NEWS

## America Has a Bankruptcy Problem

Sonal Basak and Amelia Pollard, Bloomberg News



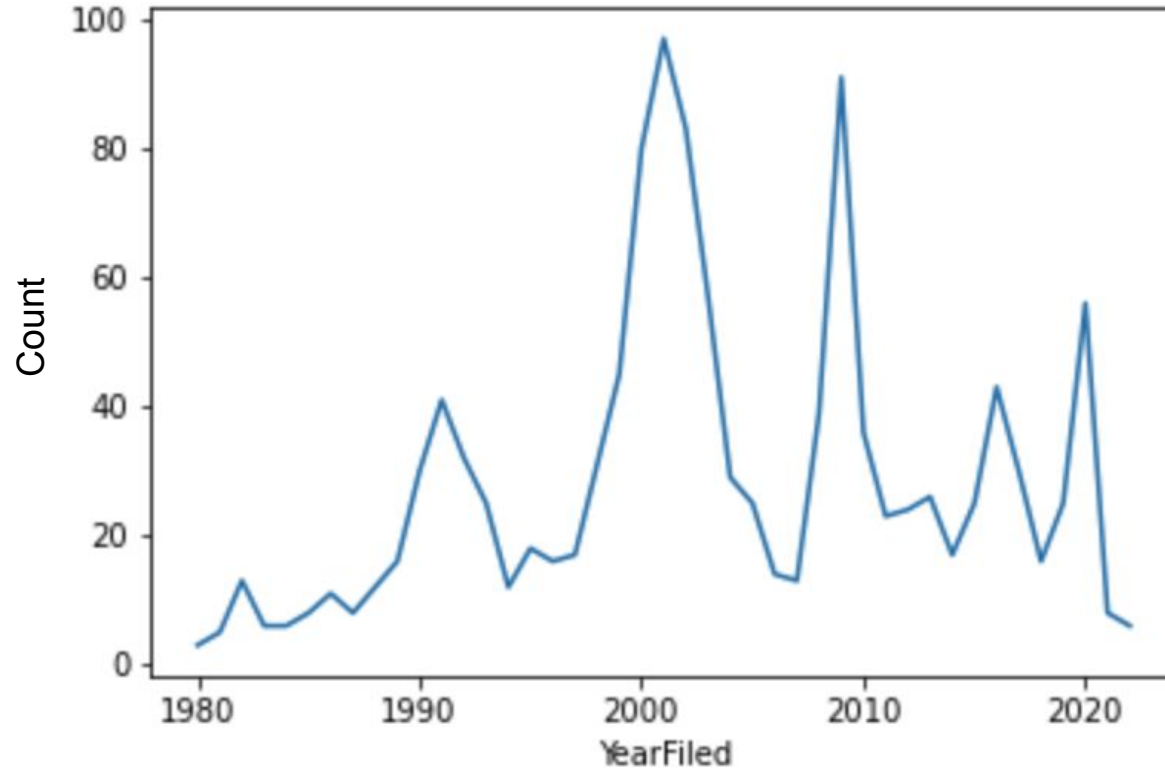
A "Store Closing" banner on a Bed Bath & Beyond store in Farmingdale, New York, U.S. on Friday, Jan. 6, 2023. Bed Bath & Beyond Inc. called off a proposed debt exchange and said it might not be able to continue as a going concern, bringing another U.S. retail chain to the precipice of bankruptcy. Photographer: Johnny Manwell/Bloomberg - Bloomberg

# Non-Technical Overview

- I want to better understand bankruptcy and try to predict future Bankruptcies in the S&P 500
- **Proposed Solution:**
  - How can I use Machine Learning to better understand and categorize past bankruptcies?
  - How could I use this to identify potential bankruptcies among public companies?
- **Estimate of potential impact:**
  - Support policymakers to take appropriate steps to reduce losses and societal damage
  - Early warning for operators and investors

# Two Data Sources

# Bankruptcy cases by year (UFL Bankruptcy Database)



# XBRL API (eXtensible Business Reporting Language)



## WEWORK INC. CONSOLIDATED STATEMENTS OF OPERATIONS

(Amounts in millions, except share and per share amounts)	Year Ended December 31,		
	2022	2021	2020
Revenue <sup>(1)</sup>	\$ 5,243	\$ 2,570	\$ 3,416
Expenses:			
Location operating expenses—cost of revenue (exclusive of depreciation and amortization of \$602, \$672 and \$715 for the years ended December 31, 2022, 2021 and 2020, respectively, shown separately below)	2,914	3,085	3,543
Pre-opening location expenses	121	159	273
Selling, general and administrative expenses	735	1,011	1,605
Restructuring and other related (gains) costs	(200)	434	207
Impairment expense/(gain on sale) of goodwill, intangibles	625	870	1,356
Depreciation and amortization	641	709	779
Total expenses <sup>(1)</sup>	4,836	6,268	7,763
Loss from operations	(1,591)	(3,698)	(4,347)
Interest and other income (expenses), net:			
Income (loss) from equity method and other investments	(17)	(16)	(45)
Interest expense (including related party expenses of \$390 December 31, 2022, 2021 and 2020, respectively. See Note 18) <sup>(1)</sup>	(516)	(455)	(331)
Interest income	9	19	17
Foreign currency gain (loss)	(185)	(134)	149
Gain (loss) from change in fair value of warrant liabilities (in of none, \$(345) and \$820 for the years ended December 31, 2022, 2021 and 2020, respectively. See Note 18) <sup>(1)</sup>	11	(343)	820
Loss on extinguishment of debt	—	—	(77)
Total interest and other income (expenses), net	(698)	(931)	533
Pre-tax loss	(2,289)	(4,629)	(3,814)
Income tax benefit (provision)	(6)	(3)	(20)
Net loss	(2,295)	(4,632)	(3,834)
Net loss attributable to noncontrolling interests:			
Redeemable noncontrolling interests — mezzanine	54	139	676
Noncontrolling interest — equity	207	54	29
Net loss attributable to WeWork Inc.	\$ (2,034)	\$ (4,439)	\$ (3,129)
Net loss per share attributable to Class A and Class B common stockholders (see Note 25):			
Basic	\$ (2.67)	\$ (18.38)	\$ (22.24)
Diluted	\$ (2.67)	\$ (18.38)	\$ (22.24)
Weighted-average shares used to compute net loss per share attributable to Class A and Class B common stockholders, basic and diluted	761,845,605	263,584,930	140,680,131

Attributes	
Revenues	
Tag	us-gaap:Revenues
Fact	3,245,000,000
Period	12 months ending 12/31/2022
Measure	USD
Scale	Millions
Decimals	Millions
Balance	Credit
Sign	Positive
Type	Monetary Item Type

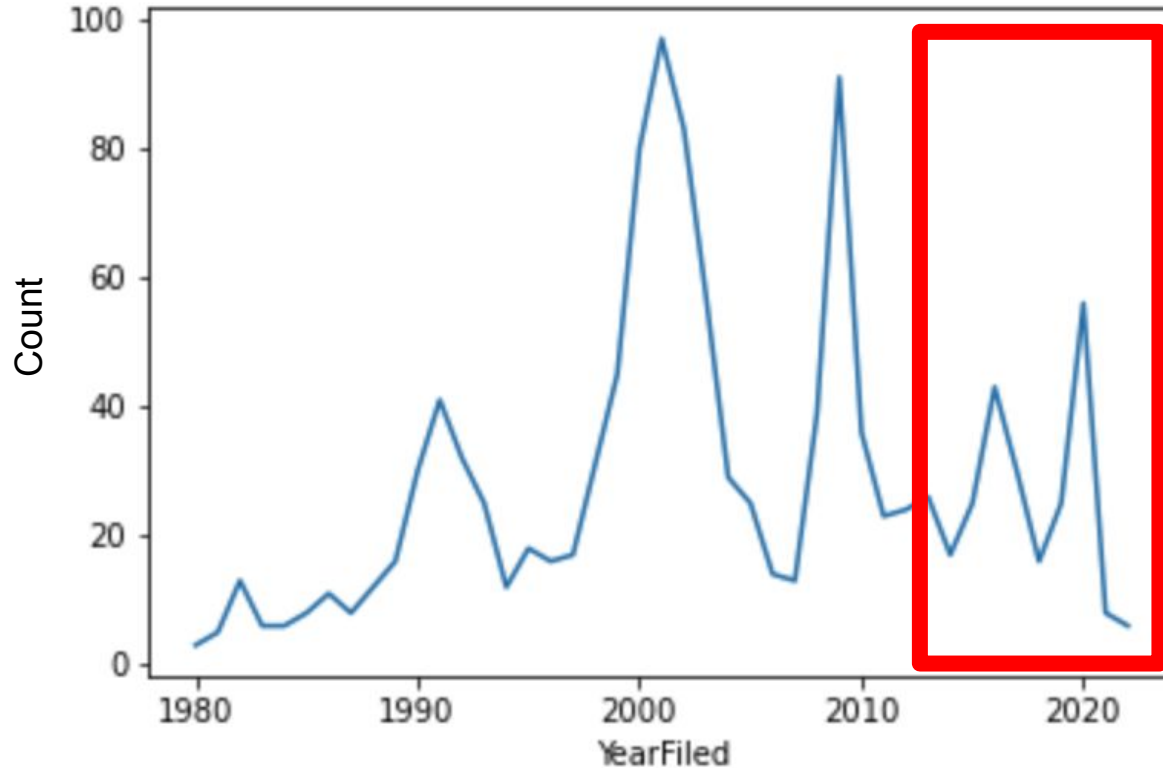
(1) See Note 27 for disclosure of related party amounts.

The accompanying notes are an integral part of these Consolidated Financial Statements.



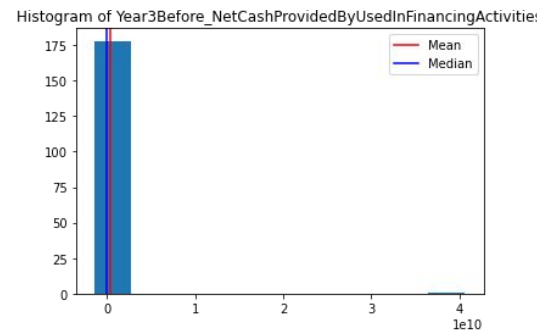
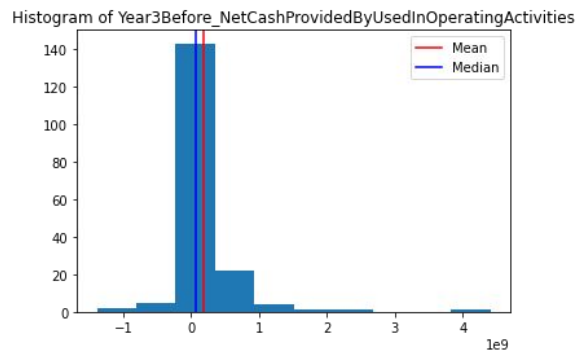
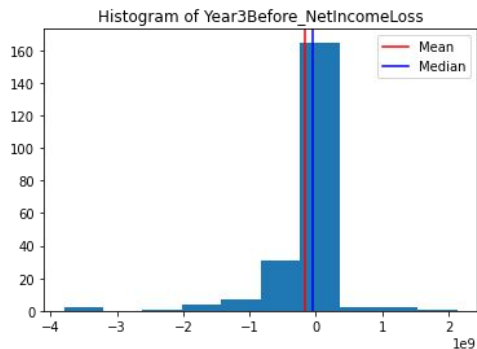


# Bankruptcy cases by year (UFL Bankruptcy Database)

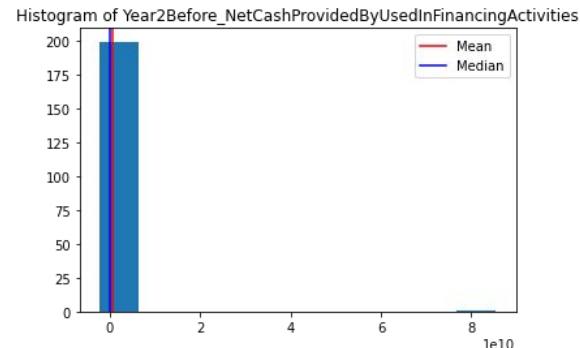
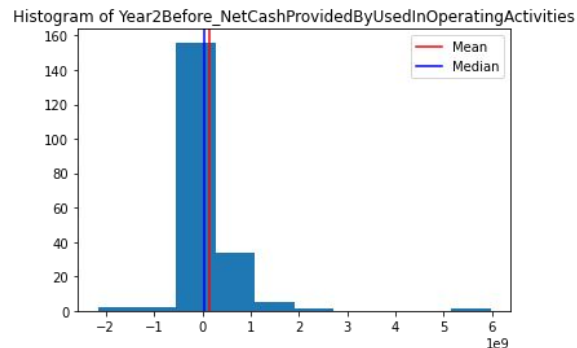
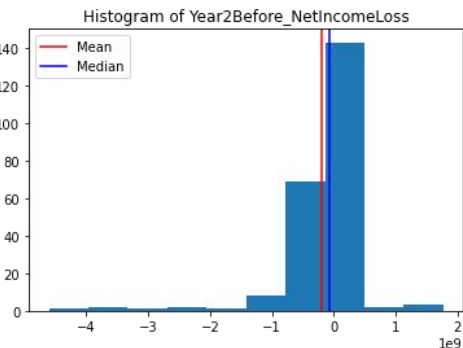


How can I better understand bankruptcies?

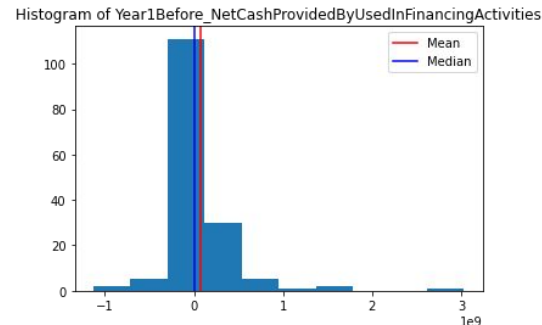
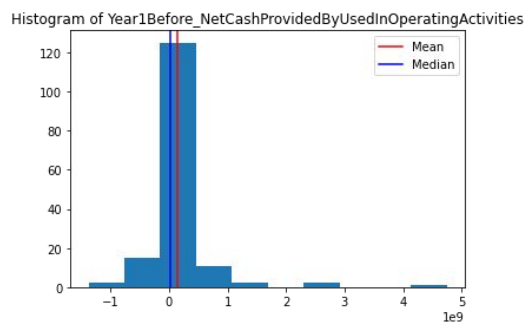
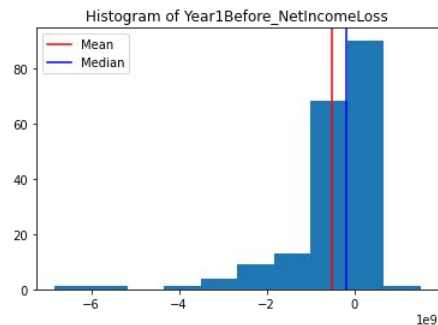
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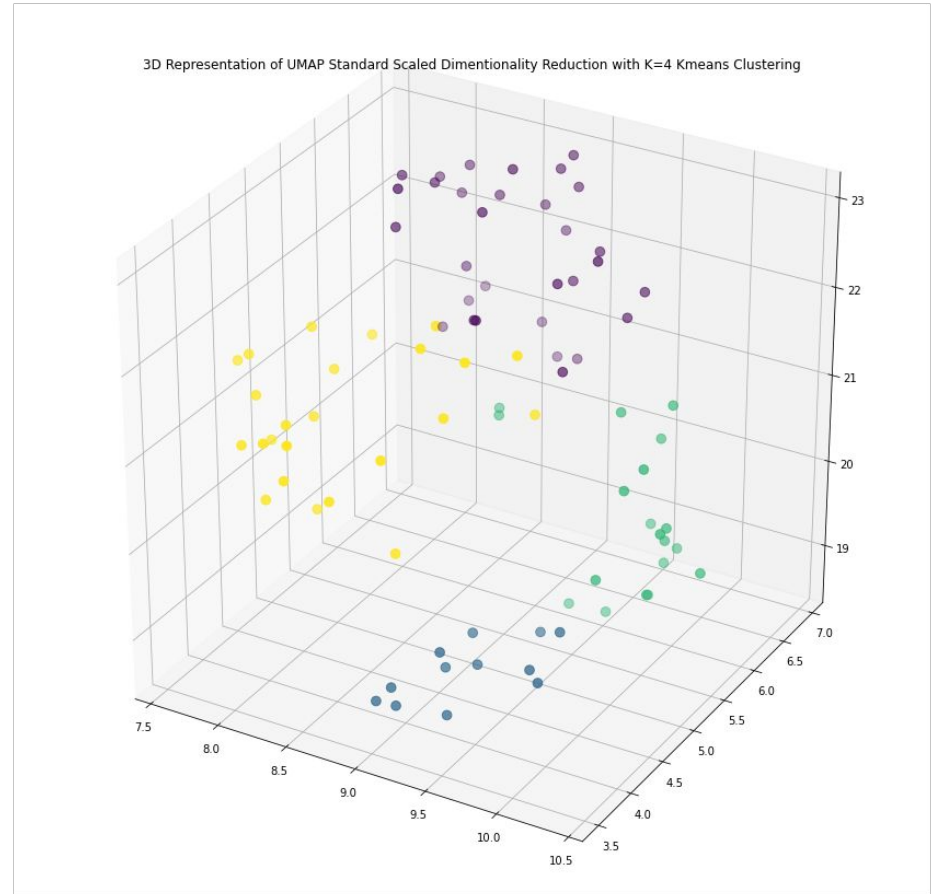


1



# Clustering Analysis

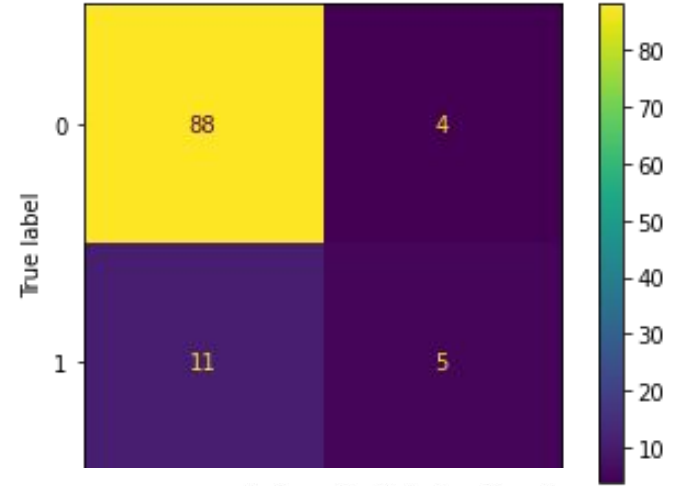
- Group 0:
  - Small companies in size
- Group 1:
  - Large Companies
  - Defined by highest median revenue, assets, etc.
  - Pos. Op CF
- Group 2:
  - Large historical losses, but better in recent term
- Group 3:
  - Small revenues, large losses
  - Pos. Op CF



Is this data predictive?

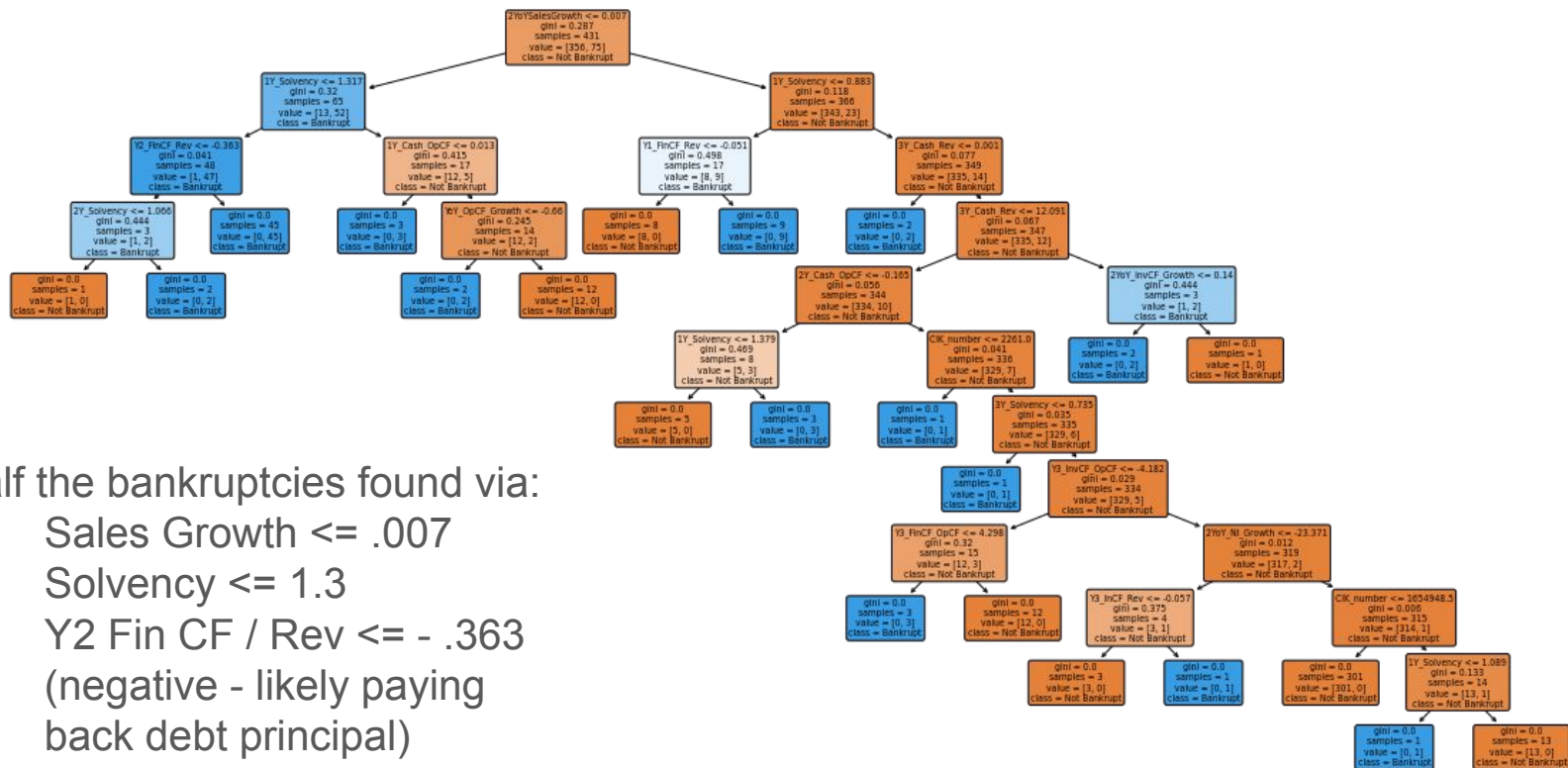
# Try 1: Logistic Regression

- 11/16 classified as False Negatives
- F-1 of 0.81
- Accuracy not a good metric
  - Missed 11 / 16 bankruptcies
- Recall: .06 - not a very sensitive classifier
  - Bankruptcy is hard to spot!
  - Model not very sensitive
- Interesting insight: ratio of Investing cash flow to operating cash flow was an important decision point for the model



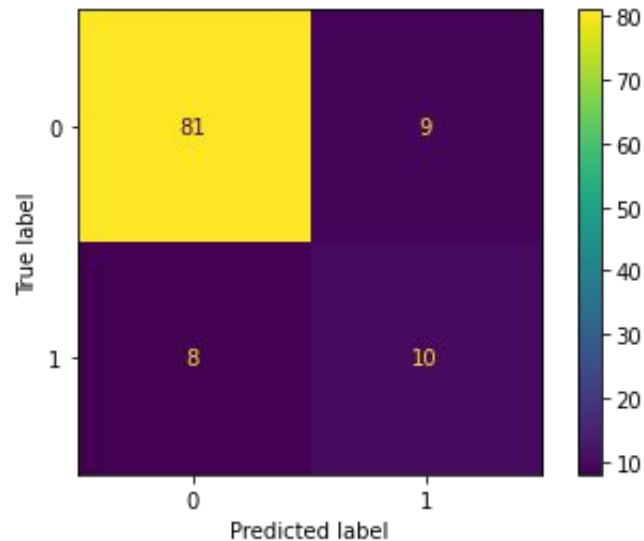
	Feature	Coefficient	odds_ratio
2	2YoYSalesGrowth	0.002609	1.002613
14	Y2_InvCF_OpCF	0.001041	1.001041
15	Y3_InvCF_OpCF	0.000946	1.000946
13	Y1_InvCF_OpCF	0.000498	1.000498
11	Y2_FinCF_Rev	0.000483	1.000483
7	Y1_InCF_Rev	0.000438	1.000438
23	YoY_FinCF_Growth	0.000354	1.000354
8	Y2_InCF_Rev	0.000299	1.000299
24	2YoY_FinCF_Growth	0.000245	1.000245
22	2YoY_InvCF_Growth	0.000183	1.000183

# Try 2: Decision Tree Analysis



## Try 2: Decision Tree

- 10/18 test bankruptcies classified correctly
- F-1 of 0.84
- Bankruptcy Recall .06 -> .56



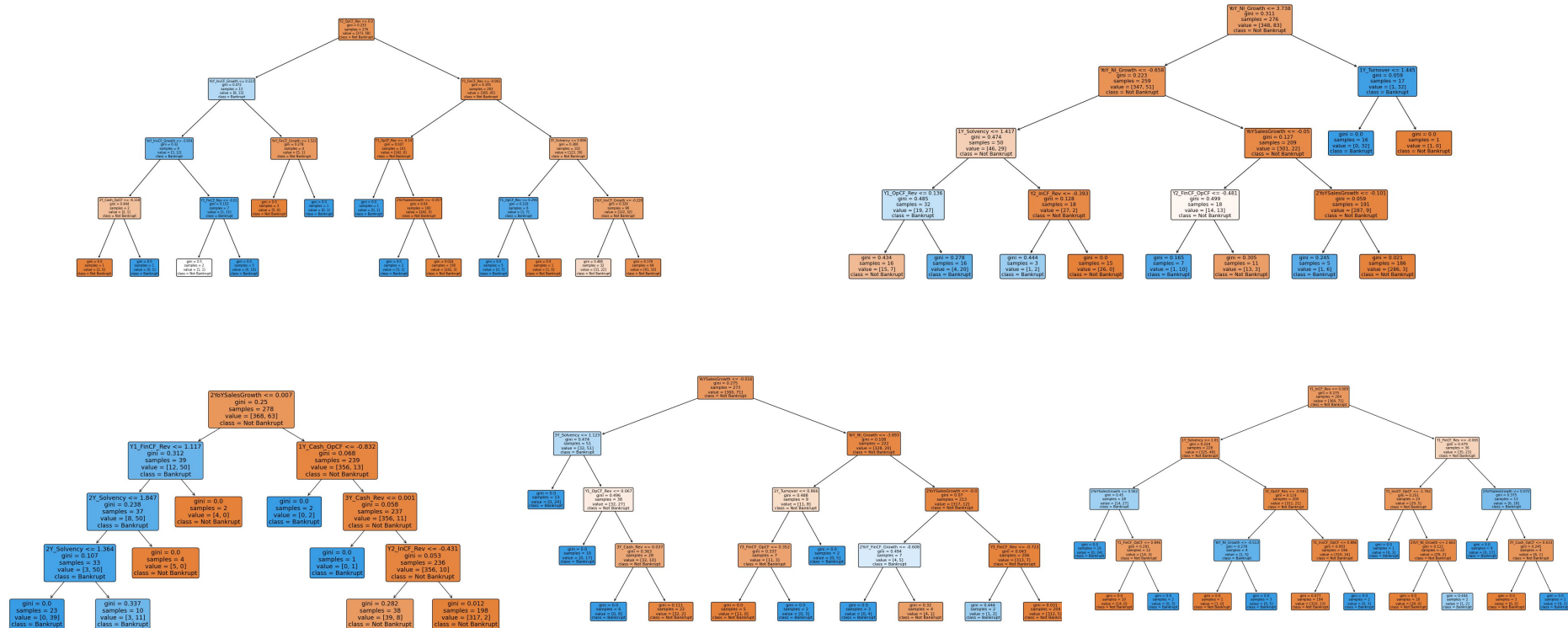


# Preliminary Conclusions

- Clustering: Grouped companies largely by size (\$)
  - Interesting nuance between those with Positive Operating CF vs not
- Logistic Regression Predictions:
  - Surprised by the lack of predictiveness
  - Ratio of Operating CF to Investing CF as 2nd-5th most predictive is interesting
- Analysis useful for generating interesting leads for further study
- Bankruptcy data is nonlinear
  - Logistic Regression won't be much help
  - Decision Trees / RF may be useful

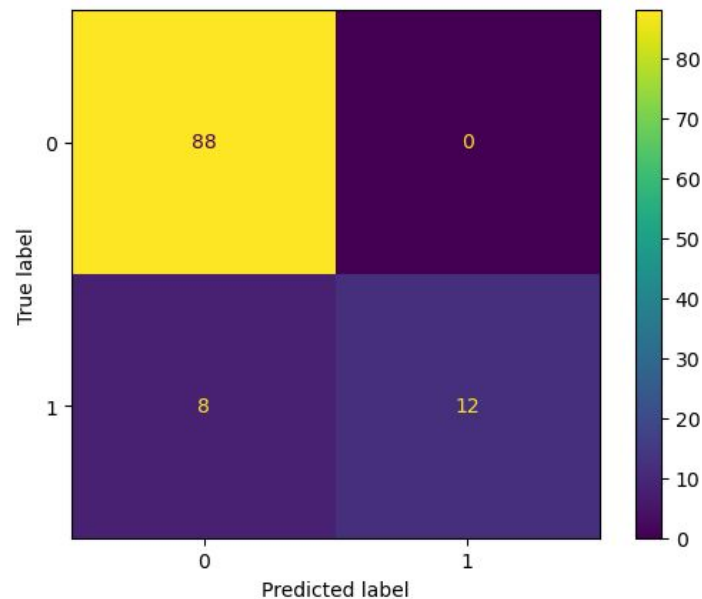
# Random Forest

# First 5 Trees in My Random Forest



# Random Forest Results

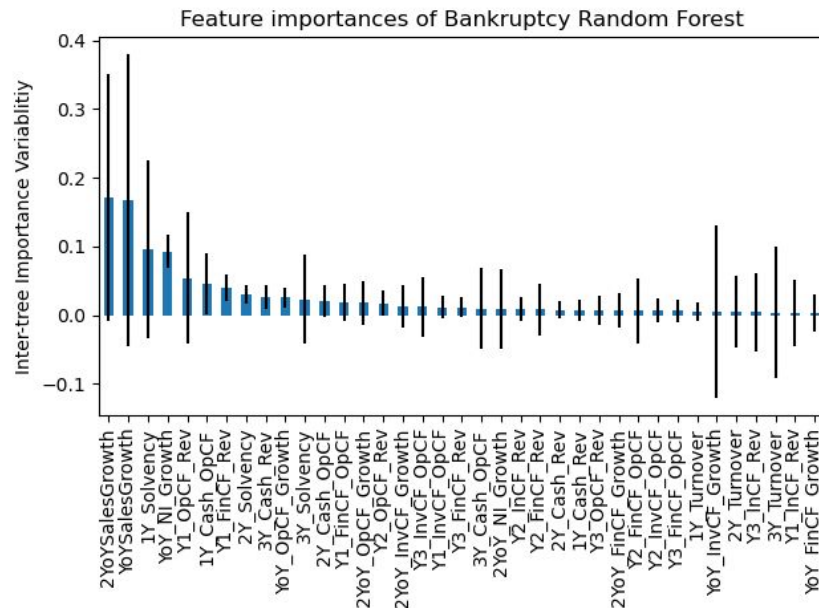
- 12 / 20 correctly classified bankruptcies!
- F-1 score of 0.93
- Recall: 0.6 (up from .56 DT recall)
  - 10x improvement over Logistic Regression
  - Model much more sensitive, but still not perfect



# So... Who's at risk?

## Top 20 at risk companies in S&P 500

	Company	Probability of Bankruptcy
244	PRUDENTIAL FINANCIAL, INC.	0.390663
142	Cincinnati Financial Corporation	0.357819
314	Aflac Incorporated	0.355694
77	AT&T INC.	0.350401
352	INTEL CORPORATION	0.337078
420	Carnival Corporation	0.328483
112	APA CORPORATION	0.325019
83	AMERICAN WATER WORKS COMPANY, INC.	0.301681
80	ALTRIA GROUP, INC.	0.283334
59	First Solar, Inc.	0.275236
18	CAMDEN PROPERTY TRUST	0.265954
188	HASBRO, INC.	0.261368
237	ALASKA AIR GROUP, INC.	0.250042
298	BIOGEN INC.	0.243005
271	NORWEGIAN CRUISE LINE HOLDINGS LTD.	0.231913
121	L3HARRIS TECHNOLOGIES, INC.	0.212080
163	WYNN RESORTS, LIMITED	0.211447
434	PERKINELMER, INC.	0.196584
390	Whirlpool Corporation	0.192590
116	STANLEY BLACK & DECKER, INC.	0.188489



Demo