RISE OF THE RED DRAGON

BIA 600

DATA VISUALIZATION

AMD V INTEL

PROF MUELLER

GROUP NO. 9

PRUDHVI PARUCHURI

NIKHIL BHUTA

JIGYASU WALIA

HARSHIL JARIWALA

UTTAM REDDY

HARSHA

OBJECTIVE STATEMENT

Despite the public popularity, AMD is still struggling to capture the market entirely.

AMD produces budget-friendly chips for consumers such as light users, heavy users, gamers, and content creators, yet it cannot match INTEL in terms of net sales and profits. During the year 2016-2018, both INTEL and AMD could surpass their previous numbers significantly. Yet, AMD could not rise to the same level as INTEL because of the public popularity that INTEL gained because of the reliability and performance they offered throughout the years.

AMD spent a lot on their R&D even when they were going through a monetary crisis, and that paid off well when they launched the entire Ryzen lineup. The product of this development was that the chipsets were not lagging in terms of performance, reliability, and affordability. They could even create a niche market for consumers with low spending capacity, thus undercutting INTEL.

We aim to analytically compare these two organizations based on their financials, product performance, and share price values, thus giving the readers an insight as to what happened to INTEL and AMD throughout 2016-2020 and giving them a better understanding of how AMD is rising from its ashes aiming to surpass INTEL.

DATA SOURCES USED THROUGHOUT THE REPORT

FINANCIAL DATA:

Financials of intel and AMD were obtained from their official website as listed below:

Intel: Financial Results:: Intel Corporation (INTC)

AMD: Historical Financials:: Advanced Micro Devices, Inc. (AMD)

SHARE MARKET DATA:

We also have data from the NASDAQ official website of historical share price data for AMD and INTEL.

Advanced Micro Devices, Inc. Common Stock (AMD) Historical Data | Nasdaq

Intel Corporation Common Stock (INTC) Historical Data | Nasdaq

PRODUCT DATA:

We have also obtained product data of both AMD and INTEL from the following sources:

AMD: Processor Specifications | AMD

INTEL: GitHub - toUpperCase78/intel-processors: Datasets for All Manufactured Intel Processors

OVERVIEW

Any discussion about processors is incomplete without Intel and AMD. These two have been competing for a long time, which drives them to perform better and bring state-of-the-art products for the end-users in this ever-evolving world of innovative technology.

In this project, we have made a toe-to-toe comparison between these two juggernauts in the microprocessor market. We have compared the performance of many of their products and the andncial capabilities of these two companies and tried to predict what the near future has in store for them.

We used three leading technologies: Excel, Tableau, and python for Analyzing data. For descriptive analysis of the data, we used Excel and Tableau to understand the market standing and how AMD rose to power. For predictive analysis, we used the Linear Regression algorithm to create a model which can predict data.

In excel, we have generated line graphs and column graphs that show the difference between AMD and INTEL. In Tableau, we have used dashboards to compare the product performance of the two, comparing their prices in the market and direct product to the product comparison.

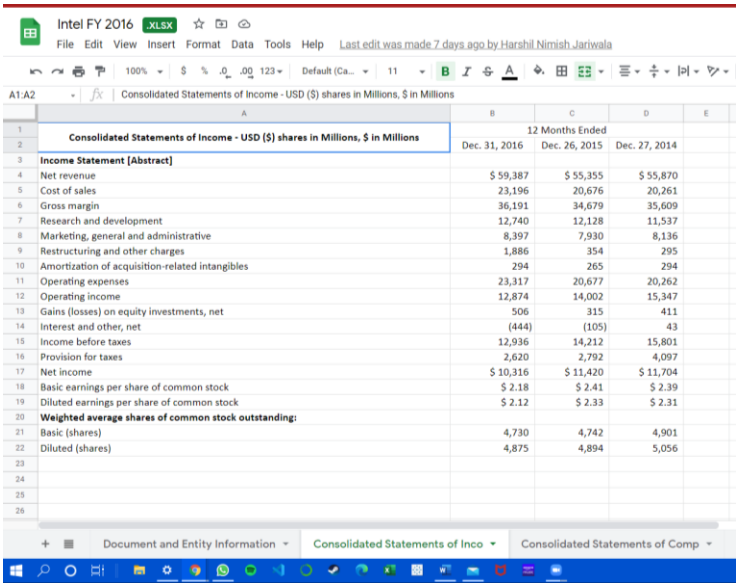
In addition to that, we have also done a trendline graph in Tableau, taking the average of opening price and closing price and then plotting it and forecasting the same for 2022 Q4.

In python, we took stock market historical data from the year 2016 to today. We created a model using the 'learn library in python to create a Linear regression model to predict future data utilizing the closing price.

DATASET OVERVIEW

FINANCIAL DATA:

Using INTEL and AMD's site, we had access to financial datasets for both companies right from 2016. In addition to this, we collected quarterly data. We included data for net income, sales income, gross margin, operating income, and R&D. we collated data from all the years and used that to come to our hypothesis.



Intel FY 2016 .XLSX

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A1:A2 Consolidated Statements of Income - USD ($) shares in Millions, $ in Millions

Consolidated Statements of Income - USD ($) shares in Millions, $ in Millions	12 Months Ended		
	Dec. 31, 2016	Dec. 26, 2015	Dec. 27, 2014
Income Statement [Abstract]			
Net revenue	$ 59,387	$ 55,355	$ 55,870
Cost of sales	23,196	20,676	20,261
Gross margin	36,191	34,679	35,609
Research and development	12,740	12,128	11,537
Marketing, general and administrative	8,397	7,930	8,136
Restructuring and other charges	1,886	354	295
Amortization of acquisition-related intangibles	294	265	294
Operating expenses	23,317	20,677	20,262
Operating income	12,874	14,002	15,347
Gains (losses) on equity investments, net	506	315	411
Interest and other, net	(444)	(105)	43
Income before taxes	12,936	14,212	15,801
Provision for taxes	2,620	2,792	4,097
Net income	$ 10,316	$ 11,420	$ 11,704
Basic earnings per share of common stock	$ 2.18	$ 2.41	$ 2.39
Diluted earnings per share of common stock	$ 2.12	$ 2.33	$ 2.31
Weighted average shares of common stock outstanding:			
Basic (shares)	4,730	4,742	4,901
Diluted (shares)	4,875	4,894	5,056

Document and Entity Information | Consolidated Statements of Inco | Consolidated Statements of Comp

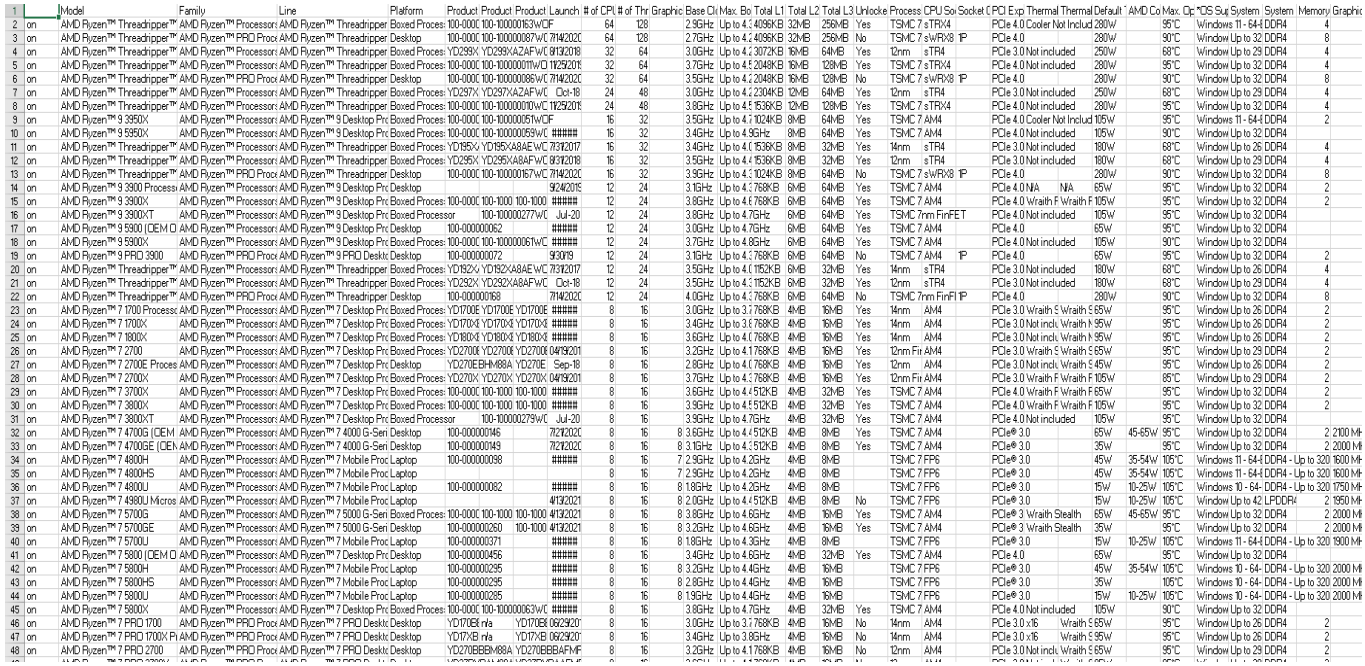
SHARE MARKET DATA:

In NASDAQ data, we have the columns Date, Close/Last, Volume, Open, High, Low. Close describes the closing price of the stock on the day. High, low, openly express the highest price in the day, the lowest price in the day, and the day's opening price. The below represents how the data looks like:

	Date	Close/Last	Volume	Open	High	Low
0	11/29/2021	$160.24	88748220	$159.37	$161.19	$158.7901
1	11/26/2021	$156.81	76959750	$159.565	$160.45	$156.36
2	11/24/2021	$161.94	69463620	$160.75	$162.14	$159.64
3	11/23/2021	$161.41	96041900	$161.12	$161.8	$159.0601
4	11/22/2021	$161.02	117467900	$161.68	$165.7	$161
...	...	...	...	...	...	...
1253	12/06/2016	$27.4875	104642240	$27.375	$27.59	$27.2975
1254	12/05/2016	$27.2775	136455520	$27.5	$27.5075	$27.0625
1255	12/02/2016	$27.475	105925280	$27.2925	$27.5225	$27.2125
1256	12/01/2016	$27.3725	148138080	$27.5912	$27.735	$27.2575
1257	11/30/2016	$27.63	144605800	$27.9	$28.05	$27.5675

PRODUCT SPECIFICATION DATA:

In this dataset, we have gathered data about product specifications, including the name of the processor, the number of cores, maximum retail price, single-threaded performance (ST score), and multi-threaded performance (MT Score). The number of seats is directly related to the multi-core performance and the price of the product.



	Model	Family	Line	Platform	Product	Product	Product	Launch	# of CPU	# of Thr	Graphic	Base Cl	Max. Bo	Total L1	Total L2	Total L3	Unlocke	Process	CPU Soi	Socket C	PCI Exp	Thermal	Thermal	Default '	AMD Co	Max. Op	*OS Sup	System	System	Memory	Graphic
2	on	AMD Ryzen™ Threadripper™	AMD Ryzen™ Processors	AMD Ryzen™ Threadripper	Boxed Proces	100-0000	100-100000163WOF		64	128		2.9GHz	Up to 4.2	4096KB	32MB	256MB	Yes	TSMC 7 nm	sTRX4		PCIe 4.0	Cooler Not	Includ	280W		95°C	Window	Up to 32	DDR4	4	
3	on	AMD Ryzen™ Threadripper™	AMD Ryzen™ PRO Proce	AMD Ryzen™ Threadripper	Desktop	100-0000	100-100000087WOF	7/14/2020	64	128		2.7GHz	Up to 4.2	4096KB	32MB	256MB	No	TSMC 7 nm	sWRX8	TP	PCIe 4.0			280W		90°C	Window	Up to 32	DDR4	8	
4	on	AMD Ryzen™ Threadripper™	AMD Ryzen™ Processors	AMD Ryzen™ Threadripper	Boxed Proces	YD299X	YD299XAZAFWOF	8/13/2018	32	64		3.0GHz	Up to 4.2	3072KB	16MB	64MB	Yes	12nm	sTR4		PCIe 3.0	Not included		250W		68°C	Window	Up to 29	DDR4	4	
5	on	AMD Ryzen™ Threadripper™	AMD Ryzen™ Processors	AMD Ryzen™ Threadripper	Boxed Proces	100-0000	100-100000111WOF	11/29/2018	32	64		3.7GHz	Up to 4.5	2048KB	16MB	128MB	Yes	TSMC 7 nm	sTRX4		PCIe 4.0	Not included		280W		95°C	Window	Up to 32	DDR4	4	
6	on	AMD Ryzen™ Threadripper™	AMD Ryzen™ PRO Proce	AMD Ryzen™ Threadripper	Desktop	100-0000	100-100000086WOF	7/14/2020	32	64		3.5GHz	Up to 4.2	2048KB	16MB	128MB	No	TSMC 7 nm	sWRX8	TP	PCIe 4.0			280W		90°C	Window	Up to 32	DDR4	8	
7	on	AMD Ryzen™ Threadripper™	AMD Ryzen™ Processors	AMD Ryzen™ Threadripper	Boxed Proces	YD297X	YD297XAZAFWOF	Oct-18	24	48		3.0GHz	Up to 4.2	2304KB	12MB	64MB	Yes	12nm	sTR4		PCIe 3.0	Not included		250W		68°C	Window	Up to 29	DDR4	4	
8	on	AMD Ryzen™ Threadripper™	AMD Ryzen™ Processors	AMD Ryzen™ Threadripper	Boxed Proces	100-0000	100-100000010WOF	11/29/2018	24	48		3.8GHz	Up to 4.5	1536KB	12MB	128MB	Yes	TSMC 7 nm	sTRX4		PCIe 4.0	Not included		280W		95°C	Window	Up to 32	DDR4	4	
9	on	AMD Ryzen™ 9 3950X	AMD Ryzen™ Processors	AMD Ryzen™ 9 Desktop Pro	Boxed Proces	100-0000	100-100000051WOF		16	32		3.5GHz	Up to 4.7	1024KB	8MB	64MB	Yes	TSMC 7 nm	AM4		PCIe 4.0	Cooler Not	Includ	105W		95°C	Windows	Up to 32	DDR4	2	
10	on	AMD Ryzen™ 9 5950X	AMD Ryzen™ Processors	AMD Ryzen™ 9 Desktop Pro	Boxed Proces	100-0000	100-100000059WOF	######	16	32		3.4GHz	Up to 4.9	GHz	8MB	64MB	Yes	TSMC 7 nm	AM4		PCIe 4.0	Not included		105W		90°C	Window	Up to 32	DDR4		
11	on	AMD Ryzen™ Threadripper™	AMD Ryzen™ Processors	AMD Ryzen™ Threadripper	Boxed Proces	YD195X	YD195XA8AEWOF	7/31/2017	16	32		3.4GHz	Up to 4.0	1536KB	8MB	32MB	Yes	14nm	sTR4		PCIe 3.0	Not included		180W		68°C	Window	Up to 26	DDR4	4	
12	on	AMD Ryzen™ Threadripper™	AMD Ryzen™ Processors	AMD Ryzen™ Threadripper	Boxed Proces	YD295X	YD295XA8AFWOF	8/13/2018	16	32		3.5GHz	Up to 4.4	1536KB	8MB	32MB	Yes	12nm	sTR4		PCIe 3.0	Not included		180W		68°C	Window	Up to 29	DDR4	4	
13	on	AMD Ryzen™ Threadripper™	AMD Ryzen™ PRO Proce	AMD Ryzen™ Threadripper	Desktop	100-0000	100-100000167WOF	7/14/2020	16	32		3.9GHz	Up to 4.3	1024KB	8MB	64MB	No	TSMC 7 nm	sWRX8	TP	PCIe 4.0			280W		90°C	Window	Up to 32	DDR4	8	
14	on	AMD Ryzen™ 9 3900 Processo	AMD Ryzen™ Processors	AMD Ryzen™ 9 Desktop Pro	Desktop			9/24/2019	12	24		3.1GHz	Up to 4.3	768KB	6MB	64MB	Yes	TSMC 7 nm	AM4		PCIe 4.0	N/A	N/A	65W		95°C	Window	Up to 32	DDR4	2	
15	on	AMD Ryzen™ 9 3900X	AMD Ryzen™ Processors	AMD Ryzen™ 9 Desktop Pro	Boxed Proces	100-0000	100-1000	100-1000	######	12	24		3.8GHz	Up to 4.6	768KB	6MB	64MB	Yes	TSMC 7 nm	AM4		PCIe 4.0	Wraith P	Wraith P	105W		95°C	Window	Up to 32	DDR4	2	
16	on	AMD Ryzen™ 9 3900XT	AMD Ryzen™ Processors	AMD Ryzen™ 9 Desktop Pro	Boxed Processor		100-100000277WOF	Jul-20	12	24		3.8GHz	Up to 4.7	GHz	6MB	64MB	Yes	TSMC 7nm FinFET			PCIe 4.0	Not included		105W		95°C	Window	Up to 32	DDR4		
17	on	AMD Ryzen™ 9 5900 (OEM O	AMD Ryzen™ Processors	AMD Ryzen™ 9 Desktop Pro	Desktop	100-000000062		######	12	24		3.0GHz	Up to 4.7	GHz	6MB	64MB	Yes	TSMC 7 nm	AM4		PCIe 4.0			65W		95°C	Window	Up to 32	DDR4		
18	on	AMD Ryzen™ 9 5900X	AMD Ryzen™ Processors	AMD Ryzen™ 9 Desktop Pro	Boxed Proces	100-0000	100-100000061WOF	######	12	24		3.7GHz	Up to 4.8	GHz	6MB	64MB	Yes	TSMC 7 nm	AM4		PCIe 4.0	Not included		105W		90°C	Window	Up to 32	DDR4		
19	on	AMD Ryzen™ 9 PRO 3900	AMD Ryzen™ PRO Proce	AMD Ryzen™ 9 PRO Deskto	Desktop	100-000000072		9/30/19	12	24		3.1GHz	Up to 4.3	768KB	6MB	64MB	No	TSMC 7 nm	AM4	TP	PCIe 4.0			65W		95°C	Window	Up to 32	DDR4	2	
20	on	AMD Ryzen™ Threadripper™	AMD Ryzen™ Processors	AMD Ryzen™ Threadripper	Boxed Proces	YD192X	YD192XA8AEWOF	7/31/2017	12	24		3.5GHz	Up to 4.0	1152KB	6MB	32MB	Yes	14nm	sTR4		PCIe 3.0	Not included		180W		68°C	Window	Up to 26	DDR4	4	
21	on	AMD Ryzen™ Threadripper™	AMD Ryzen™ Processors	AMD Ryzen™ Threadripper	Boxed Proces	YD292X	YD292XA8AFWOF	Oct-18	12	24		3.5GHz	Up to 4.2	1152KB	6MB	32MB	Yes	12nm	sTR4		PCIe 3.0	Not included		180W		68°C	Window	Up to 29	DDR4	4	
22	on	AMD Ryzen™ Threadripper™	AMD Ryzen™ PRO Proce	AMD Ryzen™ Threadripper	Desktop	100-000000168		7/14/2020	12	24		4.0GHz	Up to 4.2	768KB	6MB	64MB	No	TSMC 7nm FinFl		TP	PCIe 4.0			280W		90°C	Window	Up to 32	DDR4	8	
23	on	AMD Ryzen™ 7 1700 Processo	AMD Ryzen™ Processors	AMD Ryzen™ 7 Desktop Pro	Boxed Proces	YD1700E	YD1700EBBAEBOX	######	8	16		3.0GHz	Up to 3.7	768KB	4MB	16MB	Yes	14nm	AM4		PCIe 3.0	Wraith S		65W		95°C	Window	Up to 26	DDR4	2	
24	on	AMD Ryzen™ 7 1700X	AMD Ryzen™ Processors	AMD Ryzen™ 7 Desktop Pro	Boxed Proces	YD170X	YD170XBBAEWOF	######	8	16		3.4GHz	Up to 3.8	768KB	4MB	16MB	Yes	14nm	AM4		PCIe 3.0	Not incl	Wraith P	95W		95°C	Window	Up to 26	DDR4	2	
25	on	AMD Ryzen™ 7 1800X	AMD Ryzen™ Processors	AMD Ryzen™ 7 Desktop Pro	Boxed Proces	YD180X	YD180XBBAEWOF	######	8	16		3.6GHz	Up to 4.0	768KB	4MB	16MB	Yes	14nm	AM4		PCIe 3.0	Not incl	Wraith P	95W		95°C	Window	Up to 26	DDR4	2	
26	on	AMD Ryzen™ 7 2700	AMD Ryzen™ Processors	AMD Ryzen™ 7 Desktop Pro	Boxed Proces	YD2700B	YD2700BBAFBOX	04/19/2018	8	16		3.2GHz	Up to 4.1	768KB	4MB	16MB	Yes	12nm Fin	AM4		PCIe 3.0	Wraith S	Wraith S	65W		95°C	Window	Up to 29	DDR4	2	
27	on	AMD Ryzen™ 7 2700E Proces	AMD Ryzen™ Processors	AMD Ryzen™ 7 Desktop Pro	Desktop	YD270EBBHM88A	YD270E	Sep-18	8	16		2.8GHz	Up to 4.0	768KB	4MB	16MB	Yes	12nm	AM4		PCIe 3.0	Not incl	Wraith S	45W		95°C	Window	Up to 26	DDR4	2	
28	on	AMD Ryzen™ 7 2700X	AMD Ryzen™ Processors	AMD Ryzen™ 7 Desktop Pro	Boxed Proces	YD270X	YD270XBBAFBOX	04/19/2018	8	16		3.7GHz	Up to 4.3	768KB	4MB	16MB	Yes	12nm Fin	AM4		PCIe 3.0	Wraith P	Wraith P	105W		85°C	Window	Up to 29	DDR4	2	
29	on	AMD Ryzen™ 7 3700X	AMD Ryzen™ Processors	AMD Ryzen™ 7 Desktop Pro	Boxed Proces	100-0000	100-1000	100-1000	######	8	16		3.6GHz	Up to 4.4	512KB	4MB	32MB	Yes	TSMC 7 nm	AM4		PCIe 4.0	Wraith P	Wraith P	65W		95°C	Window	Up to 32	DDR4	2	
30	on	AMD Ryzen™ 7 3800X	AMD Ryzen™ Processors	AMD Ryzen™ 7 Desktop Pro	Boxed Proces	100-0000	100-1000	100-1000	######	8	16		3.9GHz	Up to 4.5	512KB	4MB	32MB	Yes	TSMC 7 nm	AM4		PCIe 4.0	Wraith P	Wraith P	105W		95°C	Window	Up to 32	DDR4	2	
31	on	AMD Ryzen™ 7 3800XT	AMD Ryzen™ Processors	AMD Ryzen™ 7 Desktop Pro	Boxed Processor		100-100000279WOF	Jul-20	8	16		3.9GHz	Up to 4.7	GHz	4MB	32MB	Yes	TSMC 7 nm	AM4		PCIe 4.0	Not included		105W		95°C	Window	Up to 32	DDR4		
32	on	AMD Ryzen™ 7 4700G (OEM	AMD Ryzen™ Processors	AMD Ryzen™ 7 4000 G-Seri	Desktop	100-000000146		7/21/2020	8	16	8	3.6GHz	Up to 4.4	512KB	4MB	8MB	Yes	TSMC 7 nm	AM4		PCIe® 3.0			65W	45-65W	95°C	Window	Up to 32	DDR4	2	2100 MH
33	on	AMD Ryzen™ 7 4700GE (OEN	AMD Ryzen™ Processors	AMD Ryzen™ 7 4000 G-Seri	Desktop	100-000000149		7/21/2020	8	16	8	3.1GHz	Up to 4.3	512KB	4MB	8MB	Yes	TSMC 7 nm	AM4		PCIe® 3.0			35W		95°C	Window	Up to 32	DDR4	2	2000 MH
34	on	AMD Ryzen™ 7 4800H	AMD Ryzen™ Processors	AMD Ryzen™ 7 Mobile Proc	Laptop	100-000000098		######	8	16	7	2.9GHz	Up to 4.2	GHz	4MB	8MB		TSMC 7 nm	FP6		PCIe® 3.0			45W	35-54W	105°C	Windows	Up to 32	DDR4 - Up to 320	1600 MH
35	on	AMD Ryzen™ 7 4800HS	AMD Ryzen™ Processors	AMD Ryzen™ 7 Mobile Proc	Laptop				8	16	7	2.9GHz	Up to 4.2	GHz	4MB	8MB		TSMC 7 nm	FP6		PCIe® 3.0			45W	35-54W	105°C	Windows	Up to 32	DDR4 - Up to 320	1600 MH
36	on	AMD Ryzen™ 7 4800U	AMD Ryzen™ Processors	AMD Ryzen™ 7 Mobile Proc	Laptop	100-000000082		######	8	16	8	1.8GHz	Up to 4.2	GHz	4MB	8MB		TSMC 7 nm	FP6		PCIe® 3.0			15W	10-25W	105°C	Windows	Up to 32	DDR4 - Up to 320	1750 MH
37	on	AMD Ryzen™ 7 4980U Micros	AMD Ryzen™ Processors	AMD Ryzen™ 7 Mobile Proc	Laptop			4/13/2021	8	16	8	2.0GHz	Up to 4.4	512KB	4MB	8MB	No	TSMC 7 nm	FP6		PCIe® 3.0			15W	10-25W	105°C	Window	Up to 42	LPDDR4	2	1950 MH
38	on	AMD Ryzen™ 7 5700G	AMD Ryzen™ Processors	AMD Ryzen™ 7 5000 G-Seri	Boxed Proces	100-0000	100-1000	100-1000	4/13/2021	8	16	8	3.8GHz	Up to 4.6	GHz	4MB	16MB	Yes	TSMC 7 nm	AM4		PCIe® 3	Wraith	Stealth	65W	45-65W	95°C	Window	Up to 32	DDR4	2	2000 MH
39	on	AMD Ryzen™ 7 5700GE	AMD Ryzen™ Processors	AMD Ryzen™ 7 5000 G-Seri	Desktop	100-000000260		100-1000	4/13/2021	8	16	8	3.2GHz	Up to 4.6	GHz	4MB	16MB	Yes	TSMC 7 nm	AM4		PCIe® 3	Wraith	Stealth	35W		95°C	Window	Up to 32	DDR4	2	2000 MH
40	on	AMD Ryzen™ 7 5700U	AMD Ryzen™ Processors	AMD Ryzen™ 7 Mobile Proc	Laptop	100-000000371		######	8	16	8	1.8GHz	Up to 4.3	GHz	4MB	8MB		TSMC 7 nm	FP6		PCIe® 3.0			15W	10-25W	105°C	Windows	Up to 32	DDR4 - Up to 320	1900 MH
41	on	AMD Ryzen™ 7 5800 (OEM O	AMD Ryzen™ Processors	AMD Ryzen™ 7 Desktop Pro	Desktop	100-000000456		######	8	16		3.4GHz	Up to 4.6	GHz	4MB	32MB	Yes	TSMC 7 nm	AM4		PCIe 4.0			65W		95°C	Window	Up to 32	DDR4		
42	on	AMD Ryzen™ 7 5800H	AMD Ryzen™ Processors	AMD Ryzen™ 7 Mobile Proc	Laptop	100-000000295		######	8	16	8	3.2GHz	Up to 4.4	GHz	4MB	16MB		TSMC 7 nm	FP6		PCIe® 3.0			45W	35-54W	105°C	Windows	Up to 32	DDR4 - Up to 320	2000 MH
43	on	AMD Ryzen™ 7 5800HS	AMD Ryzen™ Processors	AMD Ryzen™ 7 Mobile Proc	Laptop	100-000000295		######	8	16	8	2.8GHz	Up to 4.4	GHz	4MB	16MB		TSMC 7 nm	FP6		PCIe® 3.0			35W		105°C	Windows	Up to 32	DDR4 - Up to 320	2000 MH
44	on	AMD Ryzen™ 7 5800U	AMD Ryzen™ Processors	AMD Ryzen™ 7 Mobile Proc	Laptop	100-000000285		######	8	16	8	1.9GHz	Up to 4.4	GHz	4MB	16MB		TSMC 7 nm	FP6		PCIe® 3.0			15W	10-25W	105°C	Windows	Up to 32	DDR4 - Up to 320	2000 MH
45	on	AMD Ryzen™ 7 5800X	AMD Ryzen™ Processors	AMD Ryzen™ 7 Desktop Pro	Boxed Proces	100-0000	100-100000063WOF	######	8	16		3.8GHz	Up to 4.7	GHz	4MB	32MB	Yes	TSMC 7 nm	AM4		PCIe 4.0	Not included		105W		90°C	Window	Up to 32	DDR4		
46	on	AMD Ryzen™ 7 PRO 1700	AMD Ryzen™ PRO Proce	AMD Ryzen™ 7 PRO Deskto	Desktop	YD170BE	n/a	09/29/2017	8	16		3.0GHz	Up to 3.7	768KB	4MB	16MB	No	14nm	AM4		PCIe 3.0	x16	Wraith S	65W		95°C	Window	Up to 26	DDR4	2	
47	on	AMD Ryzen™ 7 PRO 1700X Pr	AMD Ryzen™ PRO Proce	AMD Ryzen™ 7 PRO Deskto	Desktop	YD17XB	n/a	09/29/2017	8	16		3.4GHz	Up to 3.8	GHz	4MB	16MB	No	14nm	AM4		PCIe 3.0	x16		95W		95°C	Window	Up to 26	DDR4	2	
48	on	AMD Ryzen™ 7 PRO 2700	AMD Ryzen™ PRO Proce	AMD Ryzen™ 7 PRO Deskto	Desktop	YD270BBBEM88A		YD270BBBAFMPD	8	16		3.2GHz	Up to 4.1	768KB	4MB	16MB	No	12nm	AM4		PCIe 3.0	Not incl	Wraith S	65W		95°C	Window	Up to 29	DDR4	2	

REPORT

After going through the data and analyzing it, we have made some conclusions presented in the section. As per our findings, AMD was incurring heavy losses from 2014 to 2017; to overcome this, AMD spent $1160 Million on R&D, which took them out of loss and on the road to profit. AMD also had a change in management where Lisa Su came in as CEO, which did wonders for them.

Although it has a considerable market share, INTEL is becoming complacent in its approach and thus vulnerable to AMD'S attack. AMD has become extremely popular due to its low prices, thus undercutting INTEL. They have improved and put out better performance results than intel, visible through their product comparison. AMD'S popularity and people's choice are also evident through their share market standing compared to INTEL. This was visible when we plotted them both on Tableau and used our model on python.

Through forecasting, we were also able to understand that AMD'S share price will keep rising while INTEL's is looking to be stagnant.

Even though the above is true, the financials tell a different story which suggests INTEL is still a giant of the semiconductor world and hold a massive advantage over AMD in monetary terms as they are in a different league altogether with their sales income and net income.

Although there is a reasonable gap between the two, an analysis that stands out is that when we took a ratio and percentage of how much both spend on R&D concerning their net revenue, we realized AMD pays a more significant rate than INTEL does. This is a big reason for the exponential rise of AMD. INTEL tends to spend about a constant amount on R&D.

INTEL has seen a drop in net income from 2019 to 2020, which is unusual but can be explained by the factors stated above. In comparison, AMD has come from a loss of 660 million to a profit of 2490 million in 5 years.

In terms of desktop and mobile processor performance, we can see that the Ryzen series has improved performance in almost all benchmarks. Thein the last three years multi-core version has been the best in the segment. Heavy users and content creators who use applications that require high processing power are inclined to buy an AMD processor than an Intel. Consumers who game also prefer to use AMD's lineup. Many blogs and articles have been published stating that AMD has been a better processor overall and winning.

VISUALIZATION

LINK TO INTEL V AMD VISUALIZATION EXCEL

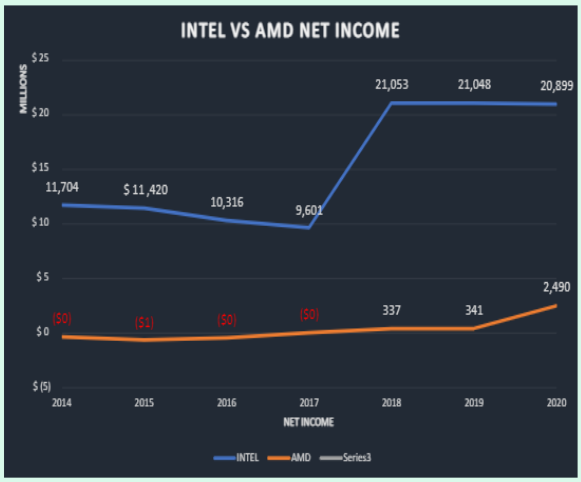
https://stevens0-my.sharepoint.com/:x:/g/personal/nbhuta_stevens_edu/Ed25wNpOLnFOkSUGCW-3V7YBxRbNwm_GEbthUJ0nEZY42Q?e=siGeds

NET INCOME

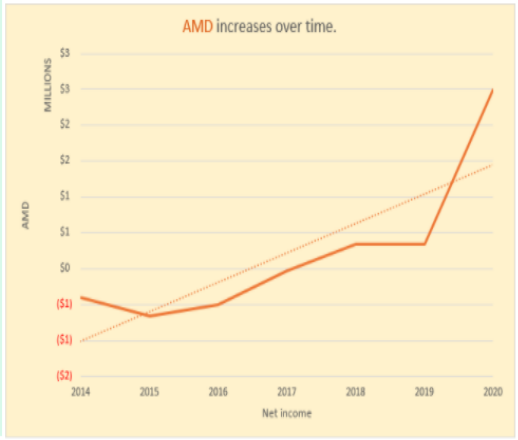
We can see that the net income for INTEL was very high as compared to AMD. Although AMD's revenue is significantly less, they had losses until 2017, and they stand exponential profit. By the year 2020, they had a profit of $2490 million. In contrast, Intel has seen a dip in net income from 2019 to 2020.

NET INCOME

NET INCOME	2014	2015	2016	2017	2018	2019	2020
INTEL	$ 11,704	$ 11,420	$ 10,316	$ 9,601	$ 21,053	$ 21,048	$ 20,899
AMD	($403)	($660)	($497)	($33)	$337	$341	$2,490



Row Labels	Average of AMD
2014	($403)
2015	($660)
2016	($497)
2017	($33)
2018	$337
2019	$341
2020	$2,490
Grand Total	$225



GROSS MARGIN

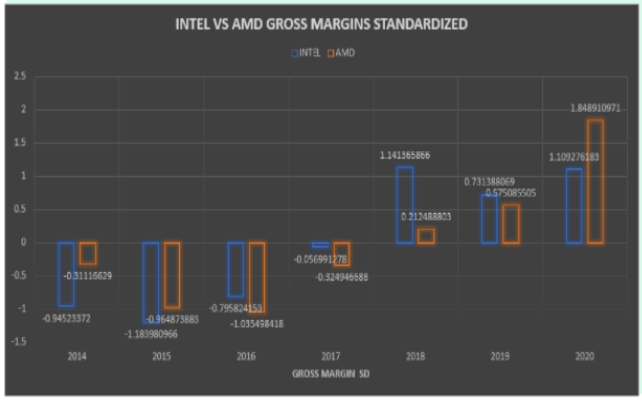
We wanted to compare the gross margin on an equal basis, so we used a standardized technique using the mean and standard deviation. Based on this, we can see from the data that intel had been low from the year 2014-2016 but for the next few years they had a nice gross margin until 2020 when AMD had a huge boost. In the year 2017-2018, INTEL's gross margin rocketed.

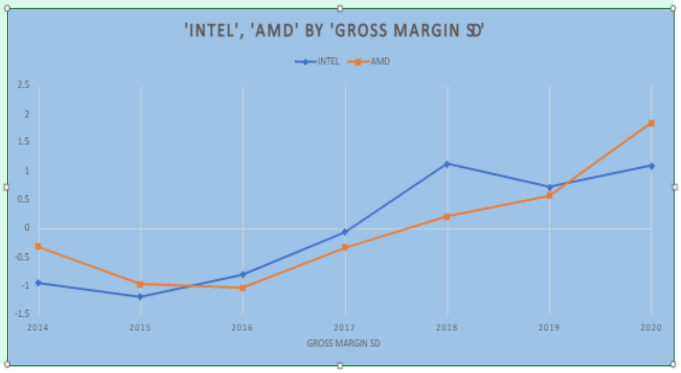
GROSS MARGIN

GROSS MARGIN	2014	2015	2016	2017	2018	2019	2020
INTEL	35,609	34,679	36,191	39,069	43,737	42,140	43,612
AMD	1,839	1,080	998	1,823	2,447	2,868	4,347

GROSS MARGIN SD	2014	2015	2016	2017	2018	2019	2020
INTEL	-0.94523372	-1.183980966	-0.795824153	-0.056991278	1.14136587	0.731388069	1.109276183
AMD	-0.31116629	-0.964873883	-1.035498418	-0.324946688	0.2124888	0.575085505	1.848910971

INTEL MEAN	39,291
AMD MEAN	2,200
INTEL SD	3895.332891
AMD SD	1161.069581





OPERATING INCOME

We have used this data from INTEL and AMD to show the difference between their operating income. We can see how INTEL is operating on a larger scale. We can see that even though their operating income has decreased from 2014 – 2016 eventually they had a better operating income from then on. AMD on the other hand had lower operating costs than intel every year but they had very good profits in the year 2020. In the year 2014, they had their lowest and their highest operating income in the year 2020.

OPERATING INCOME

OPERATING INCOME	2014	2015	2016	2017	2018	2019	2020
INTEL	$ 15,347	$ 14,002	$ 12,874	$ 17,936	$ 23,316	$ 22,035	$ 23,678
AMD	$155	$481	$372	$204	$451	$631	$1,369

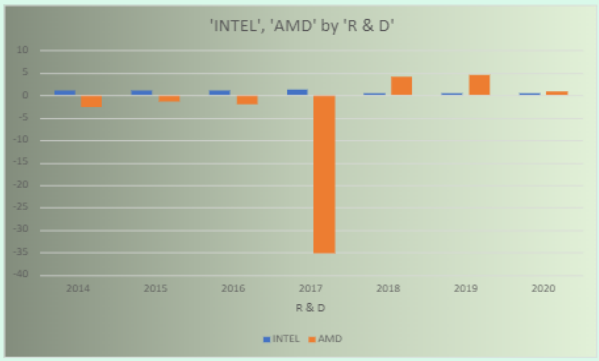
RESEARCH AND DEVELOPMENT

In R&D, we have observed a crucial detail from the Research. Despite huge losses AMD invested in Research of product development. As we can see, in 2017, they had spent a staggering amount of $1160 million on research even when they had less income. It eventually started having an income of $2490 million and spent a $1982 million in the year 2020 of the income on R&D.

RESEARCH AND DEVELOPMENT

R & D	2014	2015	2016	2017	2018	2019	2020
INTEL	0.986	1.01	1.118	1.202	0.54799791	0.54813	0.55204
AMD	($2.66)	($1)	($2)	($35)	$4	$5	$1

INTEL MEAN	$ 1
INTEL SD	0.291793044
AMD MEAN	($5)
AMD SD	13.8128395



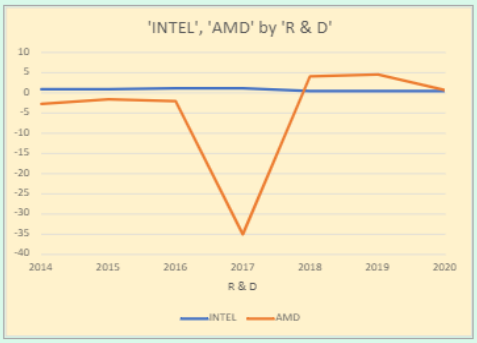
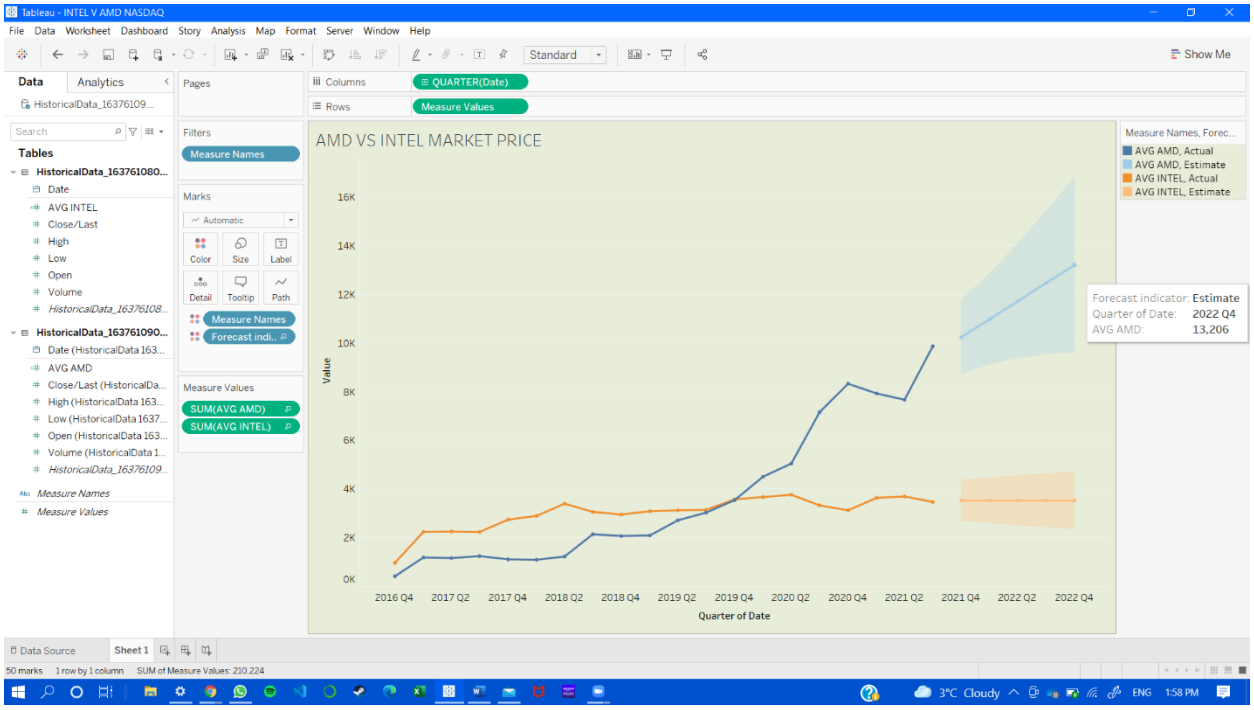


TABLEAU ANALYSIS

AMD V INTEL NASDAQ SHARE MARKET ANALYSIS AND PREDICTION

We have considered data from NASDAQ for AMD and INTEL from 2016 to 2021. We have created a calculated field in tableau to correctly determine the trajectory of the AMD and INTEL stock. For that, we have taken the average of the day open and closed prices. After plotting the above, we have used forecasting to determine the stock prices calculated field till Q4 of 2022. We can clearly see AMD is going to see tremendous growth.



AMD V INTEL PRODUCT COMPARISON ON TABLEAU

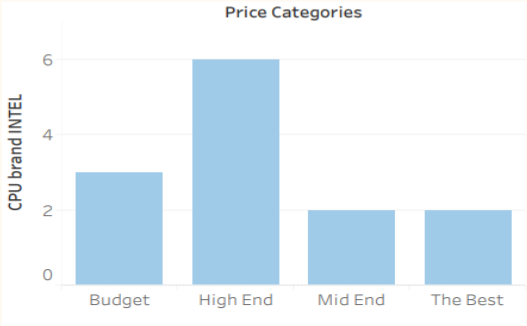
In the Red vs. Blue dashboard below, we have collected the data of AMD and INTEL's current running CPUs Multi-threading performance and single threading performance of their respective CPUs. As we can see the Ryzen CPUs perform much better than their counterparts and are considerably cheaper as well.

The Bar graph shows the price categories of their CPU's representing their price being its high end, mid-end, the best.

RED VS BLUE

AMD CPUs	MT Pe..	Msrp ..	ST Perf
RYZEN 9 5950X	16,920	799	1,692
RYZEN 7 5800X	10,451	449	1,675
RYZEN 9 5900X	14,168	549	1,668
RYZEN 5 5600X	8,155	299	1,614
RYZEN 7 3800X	8,912	399	1,290
RYZEN 9 3900X	14,168	499	1,281
RYZEN THREA..	19,846	1,399	1,280
RYZEN THREA..	22,322	1,999	1,260
RYZEN 7 3700X	8,455	329	1,225
RYZEN THREA..	25,047	3,990	1,209
RYZEN 5 3600	6,694	199	1,205
RYZEN 3 3100	4,685	99	1,124
RYZEN 5 2600	5,263	199	968
RYZEN 5 1600	4,907	119	898

Intel CPUs	MT Pe..	Msrp ..	ST Perf
I3-10100	4,080	152	1,106
I5-9400	4,570	182	1,058
I5-10400	5,668	182	1,114
I5-10600K	7,005	262	1,313
I7-9700K	7,217	409	1,285
I7-10700K	8,956	374	1,346
I9-9900K	8,618	499	1,319
I9-10850K	10,592	453	1,365
I9-10900K	10,924	488	1,402
I9-10900X	10,569	590	1,159
I9-10920X	12,935	689	1,217
I9-10940X	13,261	784	1,155
I9-10980XE	15,563	979	1,159

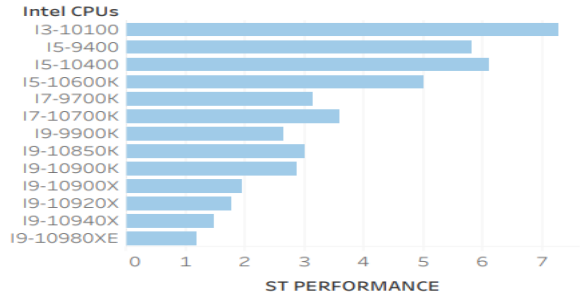


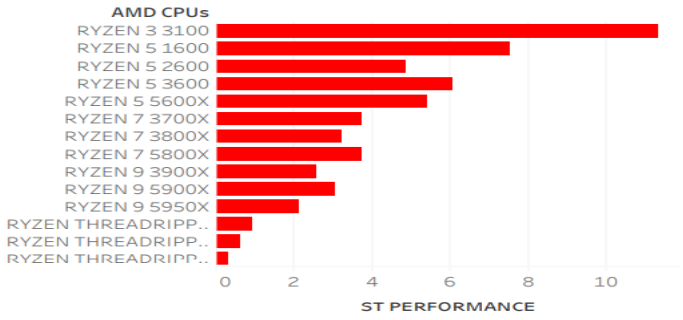
AMD VS INTEL SINGLE THREADED PERFORMANCE

The above screenshot has both the no. of cores on the left-hand side and the Single thread on the right. The Core table is a table in ascending order. The lowest number of cores a CPU has is 4 in the standard budget model (Intel i3- 10100), and the product with 18 cores (Intel i9-10980xe) is the best model available in the market and is expensive as well. The AMD CPU is also the same as the INTEL model taken in ascending order, four cores being the lowest model available have 4 cores (Ryzen 3 3100) and 64 cores being the highest number of cores a CPU can have in RYZEN (Ryzen Thread ripper).

Intel CPUs	
I3-10100	4
I5-9400	6
I5-10400	6
I5-10600K	6
I7-9700K	8
I7-10700K	8
I9-9900K	8
I9-10850K	10
I9-10900K	10
I9-10900X	10
I9-10920X	12
I9-10940X	14
I9-10980XE	18

AMD CPUs	
RYZEN 3 3100	4
RYZEN 5 1600	6
RYZEN 5 2600	6
RYZEN 5 3600	6
RYZEN 5 5600X	6
RYZEN 7 3700X	8
RYZEN 7 3800X	8
RYZEN 7 5800X	8
RYZEN 9 3900X	12
RYZEN 9 5900X	12
RYZEN 9 5950X	16
RYZEN THREA..	24
RYZEN THREA..	32
RYZEN THREA..	64





PREDICTING STOCK PRICES USING LINEAR REGRESSION IN PYTHON

For prediction, we used Linear Regression in the learn python library. This will take data from a similar source to NASDAQ, 'yfinance' (Yahoo Finance), a python library. It gives us stock market data from a specified set of times. We created a function that will learn from the historical closing data and predict the next day's price when we are t the previous day's closing price. It will c create a plot of all the predicted values and actual values. The model can be used to predict the next day's stock market closing price with utmost accuracy. We made use of '**Google Collab'** for this part of our project. We chose the 'yfinance' as we get clean data that can be directly used in prediction.

The first step is to get the data with only the 'Close' data, then we shift the index datasets dataset and get ten different columns for making better training data. When we go, we get null values, and we remove them. After that, we fit the data with a linear regression model from the 'sklearn' library. Now we have a model which can predict the price given a closing price. We provide the entire dataset again to expect this time and plot the predicted values on a graph using the 'pandas' library.

Link to the Google Collab worksheet:
https://colab.research.google.com/drive/1LLjdyPoWcdij3kp61SJtOVBWu-okPS1R?usp=sharing

projection.ipynb

File Edit View Insert Runtime Tools Help Last saved at 3:46 PM

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RAM Disk Editing

```
pip install yfinance
```

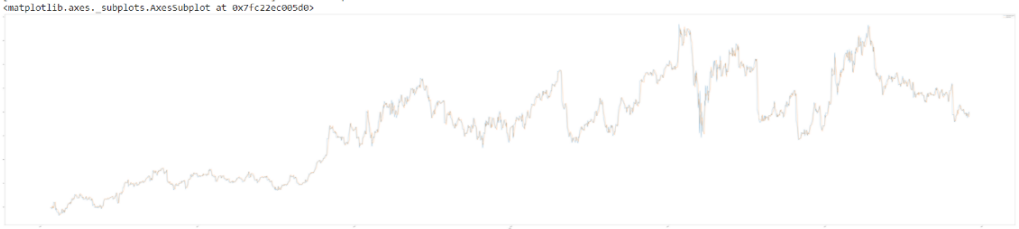
```
Collecting yfinance
  Downloading yfinance-0.1.67-py2.py3-none-any.whl (25 kB)
Collecting lxml>=4.5.1
  Downloading lxml-4.6.4-cp37-cp37m-manylinux_2_17_x86_64.manylinux2014_x86_64.manylinux_2_24_x86_64.whl (6.3 MB)
     |████████████████████████████████| 6.3 MB 19.8 MB/s
Requirement already satisfied: numpy>=1.15 in /usr/local/lib/python3.7/dist-packages (from yfinance) (1.19.5)
Requirement already satisfied: multitasking>=0.0.7 in /usr/local/lib/python3.7/dist-packages (from yfinance) (0.0.10)
Requirement already satisfied: requests>=2.20 in /usr/local/lib/python3.7/dist-packages (from yfinance) (2.23.0)
Requirement already satisfied: pandas>=0.24 in /usr/local/lib/python3.7/dist-packages (from yfinance) (1.1.5)
Requirement already satisfied: pytz>=2017.2 in /usr/local/lib/python3.7/dist-packages (from pandas>=0.24->yfinance) (2018.9)
Requirement already satisfied: python-dateutil>=2.7.3 in /usr/local/lib/python3.7/dist-packages (from pandas>=0.24->yfinance) (2.8.2)
Requirement already satisfied: six>=1.5 in /usr/local/lib/python3.7/dist-packages (from python-dateutil>=2.7.3->pandas>=0.24->yfinance) (1.15.0)
Requirement already satisfied: chardet<4,>=3.0.2 in /usr/local/lib/python3.7/dist-packages (from requests>=2.20->yfinance) (3.0.4)
Requirement already satisfied: urllib3!=1.25.0,!=1.25.1,<1.26,>=1.21.1 in /usr/local/lib/python3.7/dist-packages (from requests>=2.20->yfinance) (1.24.3)
Requirement already satisfied: idna<3,>=2.5 in /usr/local/lib/python3.7/dist-packages (from requests>=2.20->yfinance) (2.10)
Requirement already satisfied: certifi>=2017.4.17 in /usr/local/lib/python3.7/dist-packages (from requests>=2.20->yfinance) (2021.10.8)
Installing collected packages: lxml, yfinance
  Attempting uninstall: lxml
    Found existing installation: lxml 4.2.6
    Uninstalling lxml-4.2.6:
      Successfully uninstalled lxml-4.2.6
Successfully installed lxml-4.6.4 yfinance-0.1.67
```

[3]
```
import pandas as pd
import yfinance as yf
import datetime
import numpy as np
```

[4]
```
def predictions(company):
    dataset=yf.download(company,start='2016-01-07',  end='2022-01-07')[['Close']]
    dataset=pd.concat([dataset, dataset.shift(), dataset.shift(2),dataset.shift(3),dataset.shift(4),dataset.shift(5),
               dataset.shift(6),dataset.shift(7),dataset.shift(8),dataset.shift(9),dataset.shift(10)], axis=1).dropna()
    dataset.columns=list(range(0,11))
    dataset.rename(columns={0:'actual_stock_price'},inplace=True)
    from sklearn.linear_model import LinearRegression
    lr=LinearRegression()
    lr.fit(dataset[list(range(1,11))],dataset['actual_stock_price'])
    dataset['predictions']=lr.predict(dataset[list(range(1,11))])
    plott=dataset[['actual_stock_price','predictions']].plot(figsize=(200,50))
    return(plott)
```

[5]
```
predictions('INTC')
```

```
[*********************100%**********************]  1 of 1 completed
<matplotlib.axes._subplots.AxesSubplot at 0x7fc22ec005d0>
```



[6]
```
predictions('AMD')
```

```
[*********************100%**********************]  1 of 1 completed
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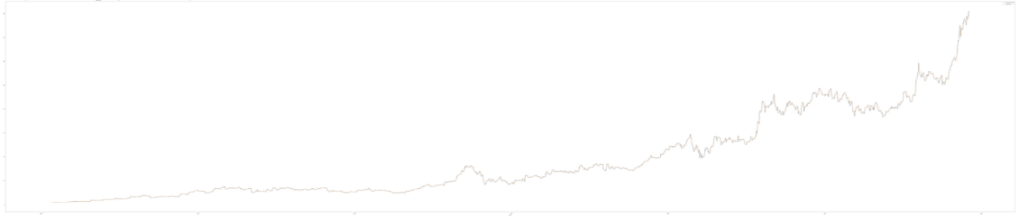

DATA CLEANING

We sourced all our data from Intel's and AMD's official websites, and we carefully studied the data and picked out the relevant information we needed to proceed with this project. Then we got rid of the data which did not apply to this project, such as goodwill, retirement benefit plans, etc., and further divided the remaining data into numerical and non-numerical bits where we got rid of the extra spaces, separated numbers from words, removed unnecessary commas and points. As we proceeded with the project, we also felt the need for the share price of both the companies, so we also included the NASDAQ data. Luckily, that was already formatted according to our needs. We then collated the data and got all the financial sheets for all the years into one so we could use this to plot our analysis.

Description of the Project

The project deals with how AMD has started to prove its worth as a solid competitor to INTEL in financials and market standing.

Descriptive analytics uses data to understand past and current business performance and make informed decisions, the most used and most well-understood type of analytics. The project is more of a descriptive analysis. We are using all the historical data to learn about AMD's performance Research over the years while comparing it with its direct competitor INTEL. We have compared how much each company earned (net income), how much they spent on Research and development, gross margin, operating income. We have also learned about product differences between the two lineups, showing how each company evolved with its technology. For example, AMD produced 12nm chips (AMD Ryzen 7 3700U) while INTEL has made 14nm chips (Intel Core i7-10510U).

Predictive analytics seeks to predict the future by examining historical data, detecting patterns or relationships in these data, and then extrapolating these relationships forward in time. The project also deals with predictive analytics. We used Linear Regression, a popular machine learning technique, to generate a model that will predict future stock market closing prices when we give it an input closing price. We have also used Tableau in which we have predicted stock market price up until 2022 Q4.

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