

Analysis of Filpkart Big Billion Sale Data Project Report

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Problem Definition: Business analysis of Flipkart Big Billion data. Analysis on trends, and a market pulse on products.

Problem motivation: Understanding the trends during Flipkart Big Billion Days. Better understanding of company policy across products and competitor behavior.

Design goals, features supported:

- 1) a) Top 10 products with price trending downwards by category.
b) Top 10 products with price trending upwards by category.
- 2) Which categories have the highest discount?
- 3) a) Does Rating affect the discount percentage for products within a category?
b) Does Rating affect the discount percentage for each category within the dataset?
- 4) a) Mobile companies with maximum discount. b) Mobile companies with minimum discount
- 5) Trends for discounts on mobiles Vs. laptop & tablets for the same company
- 6) What is the confidence score of each company's monitor price with corresponding TV price.
- 7) Top 2 companies with max discount percentage for HDD and SSD 1000 reviews and >4 rating having similar specifications.
- 8) Which companies have mobile phones with consecutive increase in discount rates with less than a certain rating X.
- 9) Fluctuation of each company's aggregate discount rate over all the products during the sale. Consider companies with more than N products.
- 10) Trends for prices between laptops and accessories (peripherals) over the time period.
- 11) Analysis of companies changing their discount rates over the time period based on competitors' rates for products with the same hardware and software specifications for Mobiles and Laptops.
- 12) Changes in discount rates based on increase in number of reviews/rating for each product over the given time period for various product and companies.
- 13) Volatility of discount rates for stable products Vs. newly introduced products. Will use number of ratings/reviews as an indicator for new & old products.
- 14) Variations in discount rate of different models of the same product for a company over the given time period.

Approach High-level design:

- Use Spark to process the dataset & deduce the analysis for each feature.
- Big Data platforms used: Spark Dataframes
- Data sources and data models: Flipkart Big Billion Days prices (Products under Electronics Category) <https://www.kaggle.com/datasets/kiranbudati/mobile-prices-flipkart> List of Electronics products from Flipkart catalog over 10 days of Flipkart Big Billion Days. Structured data in a relational data model.

Evaluation approach Experiment plan:

- Split the dataset into small & large datasets.
- Use small dataset for development of analysis model.
- Use large dataset for complete analysis.

Performance metrics for success:

- Patterns observed should be similar between small & large datasets. Time taken for small & large datasets.
- Feature metrics for success: Similarity between outputs obtained with small & large datasets.

Question 1: a) Top 5 products with price trending downwards by category.

Time taken to run this code for medium dataset – 2:25

When I did re-partition based on category it took – 4:15.

category	name	perc_decrease_in_price	Date_at_min_Price	Date_at_max_Price
laptops	ASUS ROG Flow X13 Ryzen 7 Octa Core 6800HS - (16 GB/1 TB SSD/Windows 11 Home/AMD Radeon AMD) GV301RA-L...	53.6528298422284	2022-09-30	2022-09-23
laptops	Lenovo Core i3 11th Gen - (8 GB/512 GB SSD/Windows 11 Home) TB15 Thin and Light Laptop	47.4370799841764	2022-09-30	2022-09-23
laptops	Lenovo IdeaPad Core i3 10th Gen - (4 GB/256 GB SSD/Windows 11 Home) 15ITL05 Thin and Light Laptop	46.690940244163635	2022-09-26	2022-09-23
laptops	Lenovo IdeaPad Flex 5 Core i3 10th Gen - (4 GB/256 GB SSD/Windows 10 Home) 14ITL05_2 in 1 Laptop	31.31347908417972	2022-09-28	2022-09-26
laptops	HP Core i3 11th Gen - (8 GB/256 GB SSD/Windows 11 Home) 14es- dy2506TU Thin and Light Laptop	30.979228486646885	2022-09-30	2022-09-24
mobiles	Realme C30 - Locked with Airtel Prepaid (Lake Blue, 32 GB)	31.728514277831426	2022-09-25	2022-09-23
mobiles	Realme Note 11 (Starburst White, 64 GB)	31.012834046335907	2022-09-30	2022-09-26
mobiles	realme C30 (Bamboo Green, 32 GB)	28.753594199274907	2022-09-25	2022-09-23
mobiles	realme C30 (Denim Black, 32 GB)	28.753594199274907	2022-09-25	2022-09-23
mobiles	realme C30 (Lake Blue, 32 GB)	28.753594199274907	2022-09-25	2022-09-23
peripherals	Videocool 10000 mAh Power Bank (10 W)	77.8222222222222	2022-09-30	2022-09-27
peripherals	Power Up 10000 mAh Power Bank	77.72202929842088	2022-09-30	2022-09-26
peripherals	13-H1-13 Pro 8 GB MicroSD Card Class 10 48 MB/s Memory Card	76.03464870067373	2022-09-30	2022-09-26
peripherals	13-H1-13 Pro 32 GB MicroSD Card Class 10 48 MB/s Memory Card	75.4531722043807	2022-09-30	2022-09-26
peripherals	XCCES 16GB 16 GB MicroSD Card Class 10 80 MB/s Memory Card	75.34580960130187	2022-09-30	2022-09-26
tvs	SAMSUNG 138 cm (55 inch) Ultra HD (4K) LED Smart Tizen TV	75.15502273666804	2022-09-26	2022-09-23
tvs	SAMSUNG 163 cm (65 inch) Ultra HD (4K) LED Smart Tizen TV	69.58465697870902	2022-09-30	2022-09-24
tvs	SAMSUNG 125 cm (50 inch) Ultra HD (4K) LED Smart Tizen TV	61.8752978544083	2022-09-26	2022-09-23
tvs	SAMSUNG Q Series 163 cm (65 inch) QLED Ultra HD (4K) Smart Tizen TV	61.7755362072627	2022-09-29	2022-09-23
tvs	SAMSUNG Series 7 138 cm (55 inch) Ultra HD (4K) LED Smart Tizen TV	58.17471937530503	2022-09-30	2022-09-26

b) Top 10 products with price trending upwards by category.

Time taken to run this code for medium dataset – 2:13

When I did re-partition based on category it took – 4:00.

category	name	Increase in price	Date at min Price	Date at max Price
laptops	ASUS ROG Flow X13 (2022) Core i9 12th Gen - (16 GB/1 TB SSD/Windows 11 Home/4 GB Graphics/NVIDIA GeForce RTX 3080) ROG Flow X13 (2022) Core i9 12th Gen - (16 GB/1 TB SSD/Windows 11 Home/4 GB Graphics/NVIDIA GeForce RTX 3080)	40.31478208767651	2022-09-25	2022-09-26
laptops	ASUS VivoBook 15 (2022) Core i5 10th Gen - (8 GB/512 GB SSD/Windows 11 Home) X515DA-B542WS X515DA-B542WS X515DA-B542WS	37.39488280510825	2022-09-23	2022-09-24
laptops	DELL Vostro Core i3 10th Gen - (8 GB/512 GB SSD/Windows 11 Home) Vostro 3401 Thin and Light Laptop	37.14515261273	2022-09-24	2022-09-26
laptops	ASUS VivoBook 15 Core i5 10th Gen - (8 GB/512 GB SSD/Windows 11 Home) X515DA-B542WS X515DA-B542WS X515DA-B542WS	30.97103297504099	2022-09-24	2022-09-29
laptops	Lenovo Core i3 11th Gen - (4 GB/256 GB SSD/Windows 10 Home) V15 ITL G2 Thin and Light Laptop	28.5740774074074073	2022-09-25	2022-09-29
laptops	Lenovo IdeaPad S340 5 Core i5 10th Gen - (8 GB/512 GB SSD/Windows 10 Home/4 GB Graphics/NVIDIA GeForce RTX 3050) IdeaPad S340 5 Core i5 10th Gen - (8 GB/512 GB SSD/Windows 10 Home/4 GB Graphics/NVIDIA GeForce RTX 3050)	25.282238827920656	2022-09-25	2022-09-28
laptops	Lenovo IdeaPad Slim 3 Core i5 10th Gen - (8 GB/512 GB SSD/Windows 11 Home) 3511Thin and Light Laptop	23.6520747010054204	2022-09-23	2022-09-30
laptops	DELL Inspiron Core i3 11th Gen - (8 GB/512 GB SSD/Windows 11 Home) Inspiron 3511Thin and Light Laptop	23.618159610521428	2022-09-23	2022-09-30
laptops	Lenovo IdeaPad Slim 3 Core i3 11th Gen - (8 GB/512 GB SSD/Windows 11 Home) 31W801QJIN 81W801QJIN Laptop	22.9029023882362	2022-09-25	2022-09-27
laptops	Lenovo Core i5 11th Gen - (8 GB/512 GB SSD/Windows 11 Home) 81W801QJIN 81W801QJIN Laptop	22.6295297025704	2022-09-23	2022-09-25
mobiles	REDMI Note 11S (Space Black, 128 GB)	24.144006857469403	2022-09-25	2022-09-27
mobiles	SAMSUNG Galaxy M33 5G (Emerald Brown, 128 GB)	23.076153807690382	2022-09-25	2022-09-30
mobiles	Realme C30 - Locked with Airtel Prepaid (Bamboo Green, 32 GB)	22.659790592280043	2022-09-24	2022-09-28
mobiles	Realme C30 - Locked with Airtel Prepaid (Denim Black, 32 GB)	22.659790592280043	2022-09-25	2022-09-28
mobiles	Oppo K10 (Black Carbon, 128 GB)	19.12889935256033	2022-09-28	2022-09-29
mobiles	realme 9i 5G (Soulful Blue, 64 GB)	16.66777785185679	2022-09-25	2022-09-26
mobiles	IQOO 16 4GB (Raven Black, 128 GB)	16.4410687044466	2022-09-24	2022-09-27
mobiles	Redmi 9A Sport (Coral Green, 32 GB)	15.305734903152299	2022-09-29	2022-09-30
mobiles	Redmi 9A (Nature Green, 32 GB)	15.19944179557672	2022-09-23	2022-09-24
mobiles	SAMSUNG Galaxy S22 Plus 5G (Phantom Black, 128 GB)	14.285918370262433	2022-09-24	2022-09-27
mobiles	SAMSUNG Galaxy S22 Plus 5G (Green, 128 GB)	14.285918370262433	2022-09-24	2022-09-26
mobiles	SAMSUNG Galaxy S22 Plus 5G (Phantom White, 128 GB)	14.285918370262433	2022-09-25	2022-09-28
peripherals	MOTOROLA Face 200 (BH4W47) Wired Headset	61.759161025711184	2022-09-26	2022-09-30
peripherals	Portronics POM-678 Coach Headset	52.099136490280695	2022-09-26	2022-09-27
peripherals	Cosmic Byte Spider Wired Gaming Headset	46.375038921174495	2022-09-28	2022-09-29
peripherals	ASUS SU050 480 GB Laptop, Desktop, All in One PC's, Servers Internal Solid State Drive (SSD) (SU050)	46.05442177114507	2022-09-26	2022-09-27
peripherals	Ptron Basspod P25+ with 50hrs Playback, 12m Driver, EMC, Movie Mode, Touch Controls Bluetooth Headset	45.492110369921166	2022-09-26	2022-09-27
peripherals	Calmate 10000 mAh Power Bank (15 W, Fast Charging)	44.49938321536906	2022-09-26	2022-09-27
peripherals	DELL AL12 Lightning iPhone Wired Headset	43.57262103508425	2022-09-26	2022-09-28
peripherals	Sandisk SDCA48-128G-135 128 GB Pen Drive	42.72401433691756	2022-09-26	2022-09-27
peripherals	Portronics Ear 1 Wired Headset	40.27777777777778	2022-09-26	2022-09-27
peripherals	Mivi DuoPods H8 True Wireless Bluetooth Earbuds with Qualcomm Aptx, Studio Sound, Powerful Bass, 30 Hours of Battery and Ear pods with Touch Control Bluetooth	39.299065420560744	2022-09-27	2022-09-30
tvs	Cocoon Frameless 164 cm (65 inch) Ultra HD (4K) LED Smart Google TV with 3 Years Warranty	48.00048000480005	2022-09-28	2022-09-30
tvs	Hisense 139 cm (55 inch) Ultra HD (4K) LED Smart Google TV with 102W 360° 360° Dolby Vision and ...	35.71938848406916	2022-09-28	2022-09-30
tvs	KOGAM 139 cm (55 inch) QLED Ultra HD (4K) Smart Google TV With Dolby Atmos & Dolby Vision	35.000583343055716	2022-09-23	2022-09-29
tvs	SONY 164 cm (65 inch) Ultra HD (4K) LED Smart Android TV	34.56640388114008	2022-09-23	2022-09-26
tvs	Lg All-in-One 80 cm (32 inch) HD Ready LED Smart WebOS TV	25.839523380568	2022-09-28	2022-09-30
tvs	Conqap 80 cm (32 inch) HD Ready LED TV	25.003125390673837	2022-09-24	2022-09-27
tvs	Nokia 80 cm (32 inch) HD Ready LED Smart Android TV	23.61275088547816	2022-09-26	2022-09-27
tvs	iMEE Elite 108 cm (43 inch) HD Ready LED Smart Android TV with with SRS Surround Sound (BEE 5 Star)	21.800872034881394	2022-09-24	2022-09-26
tvs	Conqap 127 cm (50 inch) Ultra HD (4K) LED Smart Android TV	21.429336762027216	2022-09-25	2022-09-26
tvs	Conqap 108 cm (43 inch) Full HD LED Smart Android TV	21.053739670508975	2022-09-25	2022-09-28

Products with higher price in Big Billion days than Non Big Billion days

Time taken to run this code for medium dataset – 3:25

When I did re-partition based on category it took – 4:15.

Below table shows Categories and products whose Big Billion days price is higher than normal days					
category	name		Decreased	BB_Price	Bn_Price
peripherals	Ubon UB-31 Earfit Bass Sound Earphone Wired Headset		0.8502994011976048	167.0	25.0
peripherals	Onikuma K10 7.1 Wired Gaming Headset		0.6540977298961139	2599.0	899.0
peripherals	GIZMOBITZ 10400 mAh Power Bank		0.5543199315654406	1169.0	521.0
peripherals	KDM LOVE SERIES Wired Headset		0.5497835497835498	231.0	104.0
peripherals	Syska 10000 mAh Power Bank (Fast Charging)		0.5487411233053583	1549.0	699.0
tvs	acer i series 80 cm (32 inch) HD Ready LED Smart Android TV with Android 11 (2022 Model)		0.49979899994975	19990.0	9999.0
mobiles	vivo Y31 (Racing Black, 128 GB)		0.3968277208394385	20490.0	12359.0
tvs	Infinix X1 80 cm (32 inch) HD Ready LED Smart Android TV with Eye Care Technology		0.3750234389649353	15999.0	9999.0
tvs	Haier 109 cm (43 inch) Full HD LED Smart TV		0.366663042296401	45985.0	29124.0
laptops	ASUS ZenBook Pro 15 Core i7 8th Gen - (16 GB/1 TB SSD/Windows 10 Home/4 GB Graphics) UX580GE-E2014T La...		0.3628222056375227	174190.0	110990.0
tvs	SAMSUNG Q60RAK 123 cm (49 inch) QLED Ultra HD (4K) Smart Tizen TV		0.3618017212949074	93999.0	59990.0
tvs	Infinix X1 108 cm (43 inch) Full HD LED Smart Android TV with Eye Care Technology		0.34001360054402174	24999.0	16499.0
laptops	HP Victus Ryzen 5 Hexa Core 5600H - (8 GB/512 GB SSD/Windows 10 Home/4 GB Graphics/AMD Radeon RX 5500M...)		0.33782968151256965	71243.0	47175.0
laptops	DELL Inspiron Core i5 11th Gen - (8 GB/1 TB HDD/256 GB SSD/Windows 11 Home/2 GB Graphics) Inspiron 351...		0.3223907081787385	61990.0	42005.0
laptops	DELL Inspiron Core i5 11th Gen - (16 GB/512 GB SSD/Windows 11 Home) Inspiron 5518 Thin and Light Lapt...		0.3064133521683856	70790.0	49099.0
laptops	ASUS ZenBook Duo 14 (2021) Touch Panel Core i7 11th Gen - (16 GB/1 TB SSD/Windows 10 Home/2 GB Graphic...		0.2729224376731302	144400.0	104990.0
mobiles	REDMI Note 11S (Space Black, 64 GB)		0.27001350067503377	19999.0	14599.0
mobiles	OPPO F19s (Glowing Black, 128 GB)		0.25012506253126565	19990.0	14990.0
mobiles	OPPO F19s (Glowing Gold, 128 GB)		0.25012506253126565	19990.0	14990.0
mobiles	realme 8i (Space Purple, 64 GB)		0.25001785841845847	13999.0	10499.0
mobiles	realme 8i (Space Black, 64 GB)		0.25001785841845847	13999.0	10499.0

Below table shows Categories and count of products whose Big Billion days price is higher than normal days					
category count(name)					
peripherals 1338					
mobiles 419					
tvs 248					
laptops 276					

Products with lower price in Big Billion days than Non Big Billion days

Time taken to run this code for medium dataset – 2:13

category	name		Decreased	BB Price	Bn Price
laptops	DELL Inspiron Core i5 11th Gen - (8 GB/1 TB HDD/256 GB SSD/Windows 11 Home/2 GB Graphics) Inspiron 351...		0.3223907081787385	61990.0	42005.0
laptops	DELL Inspiron Core i5 11th Gen - (16 GB/512 GB SSD/Windows 11 Home) Inspiron 5518 Thin and Light Lapt...		0.3064133521683856	70790.0	49099.0
laptops	ASUS ZenBook Duo 14 (2021) Touch Panel Core i7 11th Gen - (16 GB/1 TB SSD/Windows 10 Home/2 GB Graphic...		0.2729224376731302	144400.0	104990.0
laptops	HP Celeron Dual Core - (8 GB/256 GB SSD/Windows 11 Home) 14s-dq3037tu Thin and Light Laptop		0.24418156101324417	38885.0	29390.0
laptops	HP Victus Ryzen 5 Hexa Core 5600H - (8 GB/512 GB SSD/Windows 10 Home/4 GB Graphics/AMD Radeon RX 5500M...)		0.22237974257119997	71243.0	55400.0
mobiles	vivo Y31 (Racing Black, 128 GB)		0.3968277208394385	20490.0	12359.0
mobiles	REDMI Note 11S (Space Black, 64 GB)		0.27001350067503377	19999.0	14599.0
mobiles	realme 8i (Space Black, 64 GB)		0.25001785841845847	13999.0	10499.0
mobiles	realme 8i (Space Purple, 64 GB)		0.25001785841845847	13999.0	10499.0
mobiles	realme C21Y (Cross Blue, 32 GB)		0.21054847878724076	9499.0	7499.0
mobiles	realme C21Y (Cross Black, 32 GB)		0.21054847878724076	9499.0	7499.0
peripherals	Onikuma K10 7.1 Wired Gaming Headset		0.6540977298961139	2599.0	899.0
peripherals	GIZMOBITZ 10400 mAh Power Bank		0.5543199315654406	1169.0	521.0
peripherals	KDM LOVE SERIES Wired Headset		0.5497835497835498	231.0	104.0
peripherals	Syska 10000 mAh Power Bank (Fast Charging)		0.5487411233053583	1549.0	699.0
peripherals	PHILIPS 5200 mAh Power Bank		0.5297233666862861	1699.0	799.0
tvs	acer i series 80 cm (32 inch) HD Ready LED Smart Android TV with Android 11 (2022 Model)		0.49979899994975	19990.0	9999.0
tvs	Infinix X1 80 cm (32 inch) HD Ready LED Smart Android TV with Eye Care Technology		0.3750234389649353	15999.0	9999.0
tvs	Haier 109 cm (43 inch) Full HD LED Smart TV		0.366663042296401	45985.0	29124.0
tvs	SAMSUNG Q60RAK 123 cm (49 inch) QLED Ultra HD (4K) Smart Tizen TV		0.3618017212949074	93999.0	59990.0
tvs	Infinix X1 108 cm (43 inch) Full HD LED Smart Android TV with Eye Care Technology		0.34001360054402174	24999.0	16499.0

Below table shows Categories and count of products whose Big Billion days price is higher than normal days					
category count(name)					
peripherals 1116					
mobiles 319					
tvs 226					
laptops 205					

2) Which categories have the highest discount?

Time taken to run this code for medium dataset – 25 sec

Categories with max discounts	
category	discount
peripherals	77.82222222222222
other_electronics	50.02084201750729
tablet	17.158947368421053
mobiles	36.75783855903936
tvs	75.15502273666804
laptops	53.65282988422284

3) Does Rating affect the discount percentage for products within a category?

Time taken to run this code for medium dataset – 4:09

```

Below table have category and number of products with increase in rating and increase in price
+-----+-----+
|   category|No_of_pro_increase_in_price|
+-----+-----+
|peripherals|          10|
|    mobiles|          23|
|       tvs|           6|
|    laptops|          14|
+-----+-----+

```

```

Below table have category and number of products with increase in rating and decrease in price
+-----+-----+
|   category|No_of_pro_increase_in_price|
+-----+-----+
|peripherals|           1|
|    mobiles|           8|
|       tvs|           5|
+-----+-----+

```

Time taken to run this code for medium dataset – 4:01

```

Below table have category and number of products with decrease in rating and increase in price
+-----+-----+
|   category|prd_Count|
+-----+-----+
|peripherals|        9|
|    mobiles|       14|
|       tvs|        6|
|    laptops|       14|
+-----+-----+

Below table have category and number of products with decrease in rating and decrease in price
+-----+-----+
|   category|prd_Count|
+-----+-----+
|peripherals|        1|
|    mobiles|        8|
|       tvs|        5|
+-----+-----+

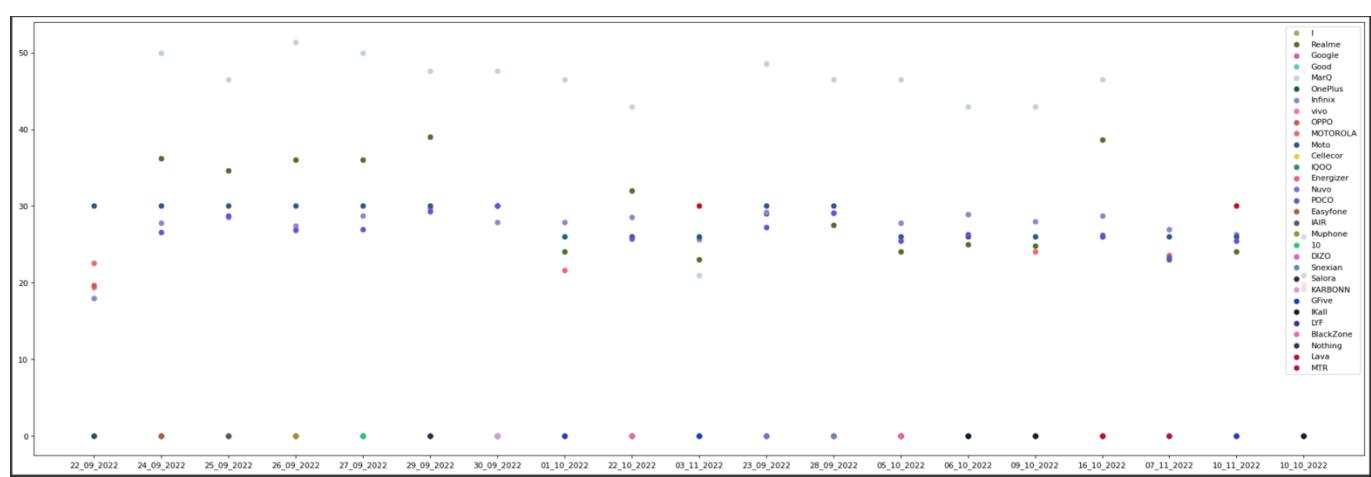
```

Q4)

Big billion days:

Mobiles:

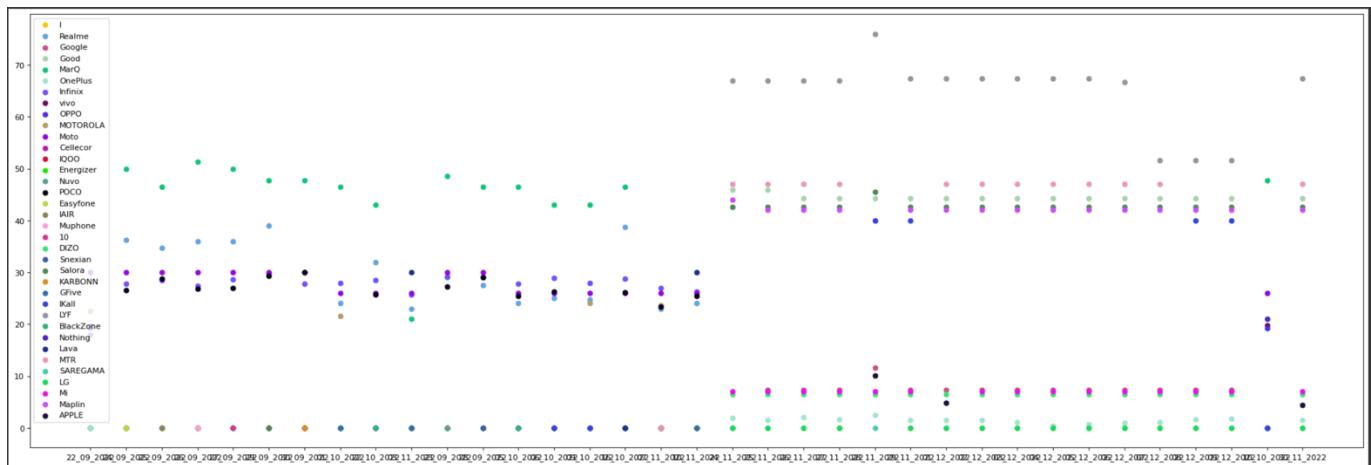
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Overall:

Mobiles:

Time: 0:00:04.042148 seconds



Q5)

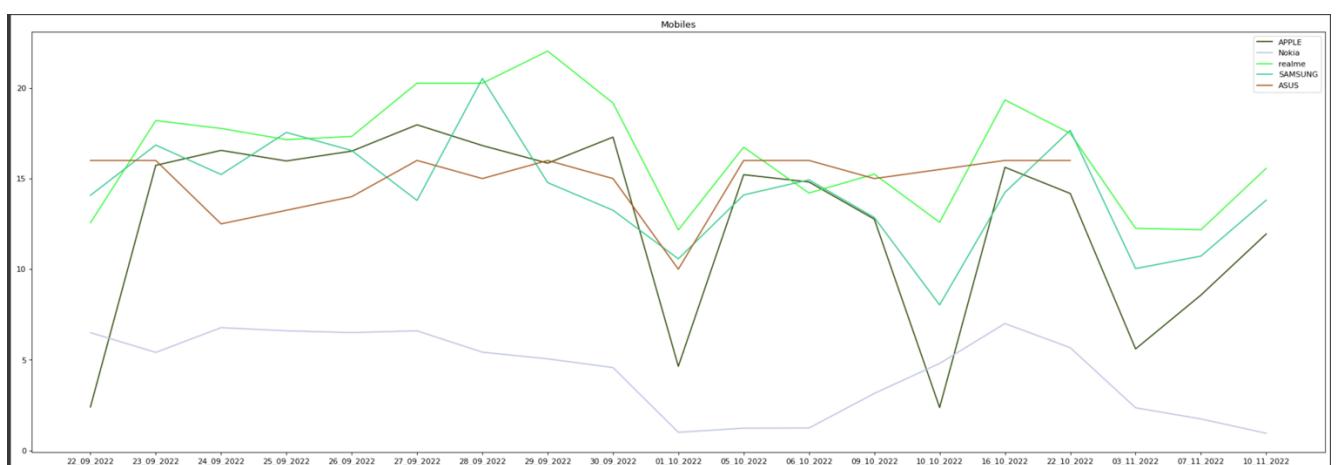
Big billion days:

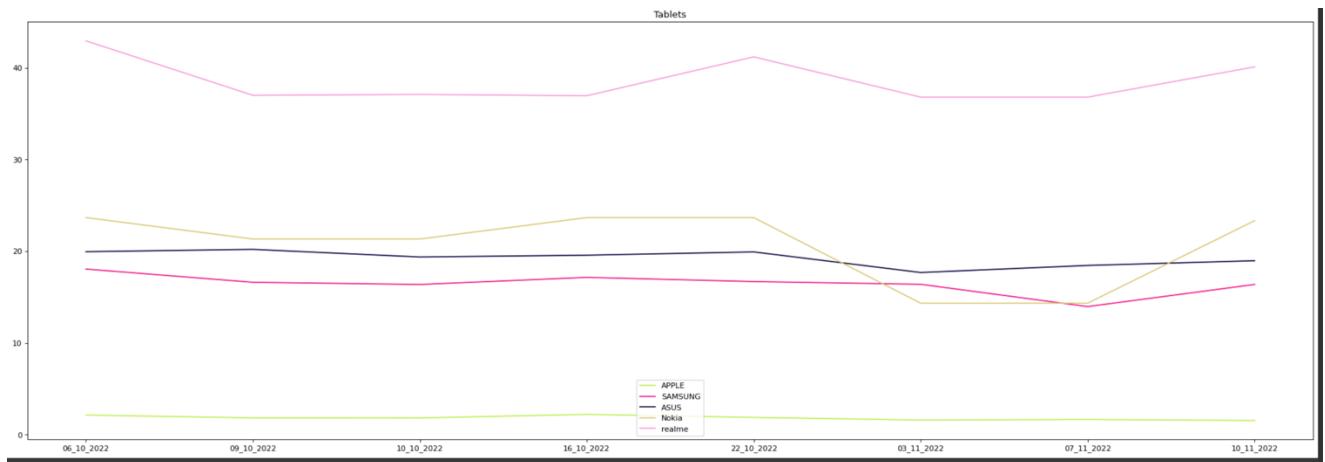
Laptops:

Tablets:

Common companies: {'realme', 'SAMSUNG', 'APPLE', 'ASUS', 'Nokia'}

Time: 0:00:01.904087 seconds





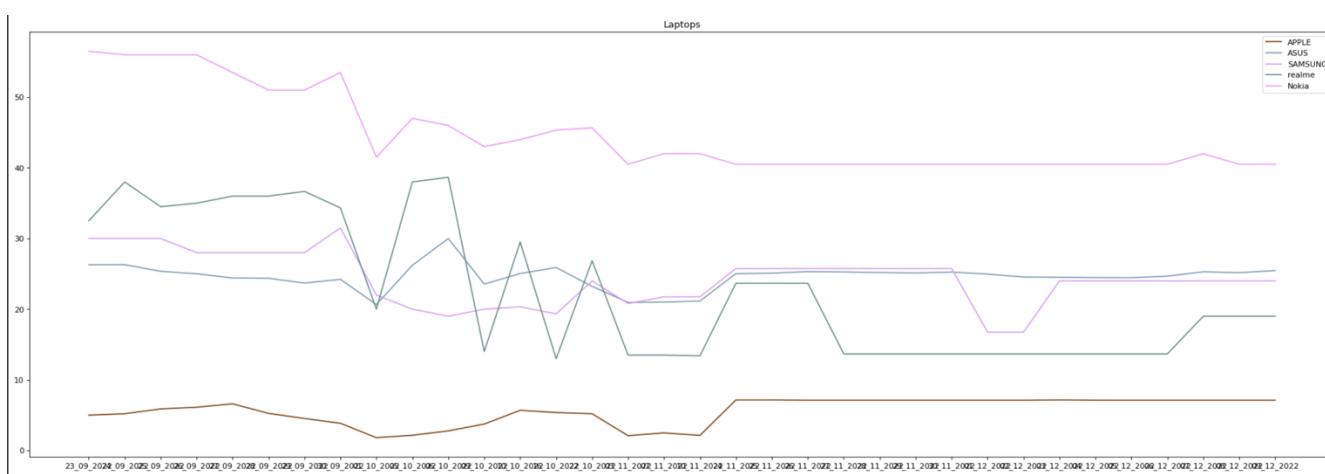
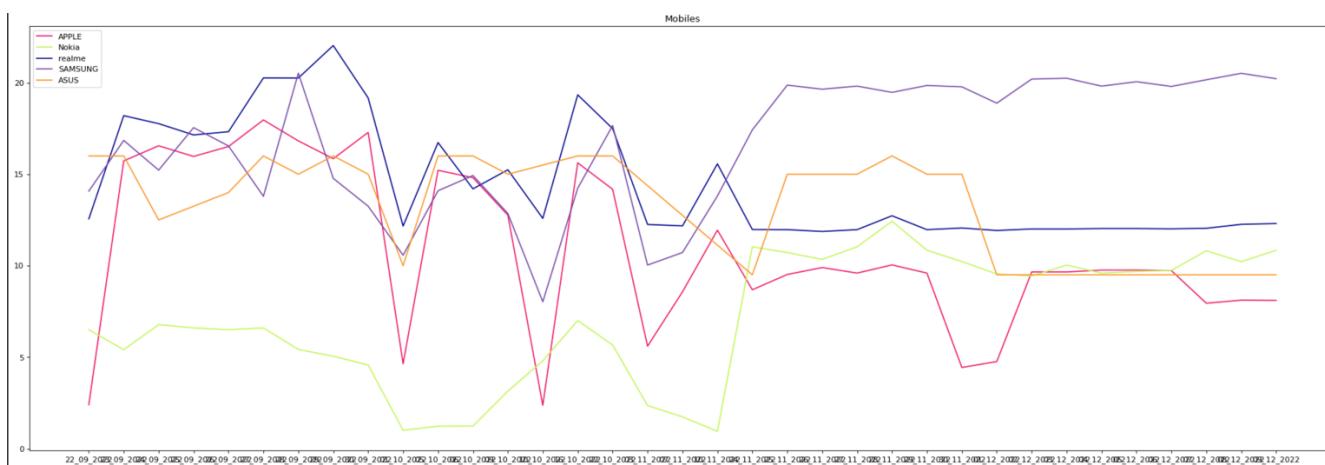
Overall:

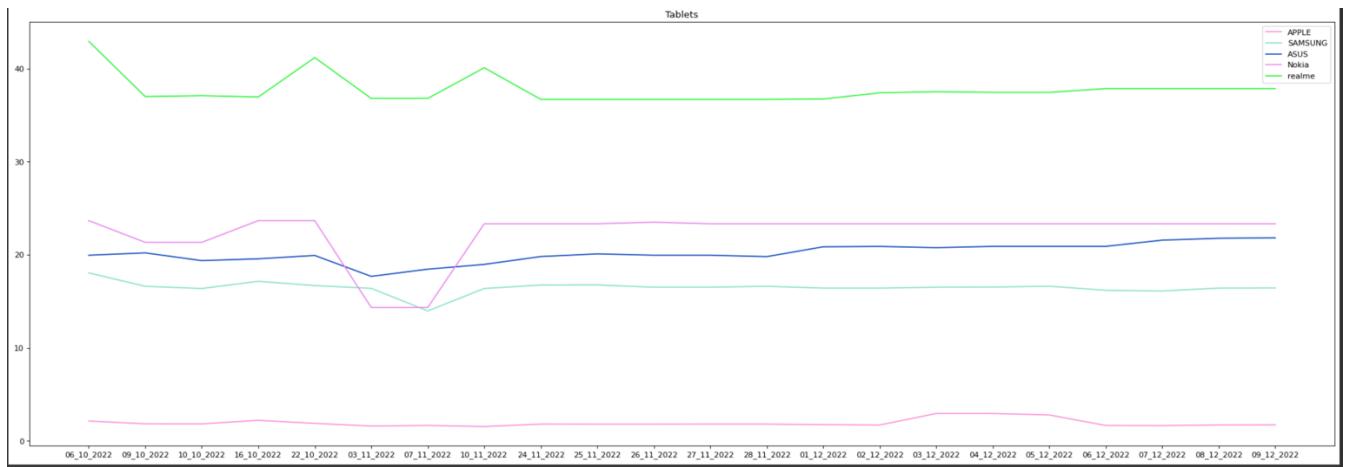
Laptops:

Tablets:

Common companies: {'realme', 'SAMSUNG', 'APPLE', 'ASUS', 'Nokia'}

Time: 0:00:03.638495 seconds





6) What is the confidence score of each company's monitor price with corresponding TV price.

Time taken to run this code for medium dataset – 1:25

company	screen_size	screen_type	tv_price	monitor_price
LG	0	FULL HD	103990.0	11899.0

Q7)

Big billion days:

HDD:

Specification: ["'Capacity: 2 TB'"]
 Most discount for this spec: 49% from Vendor TOSHIBA
 Second most discount for this spec: 47% from Vendor WD

Specification: ["'Capacity: 1.5 TB'"]
 Most discount for this spec: 30% from Vendor WD

Specification: ["'Capacity: 5 TB'"]
 Most discount for this spec: 57% from Vendor WD
 Second most discount for this spec: 33% from Vendor Seagate

Specification: ["'Capacity: 1 TB'"]
 Most discount for this spec: 53% from Vendor WD
 Second most discount for this spec: 48% from Vendor TOSHIBA

Specification: ["'Capacity: 4 TB'"]
 Most discount for this spec: 55% from Vendor WD
 Second most discount for this spec: 54% from Vendor Seagate

Specification: ["'Capacity: 3 TB'"]
 Most discount for this spec: 25% from Vendor WD

Time: 0:00:01.095378 seconds

Overall:

HDD:

Specification: ["'Capacity: 2 TB'"]

Most discount for this spec: 49% from Vendor TOSHIBA
Second most discount for this spec: 47% from Vendor WD

Specification: ["'Capacity: 1.5 TB'"]
Most discount for this spec: 30% from Vendor WD

Specification: ["'Capacity: 5 TB'"]
Most discount for this spec: 57% from Vendor WD
Second most discount for this spec: 33% from Vendor Seagate

Specification: ["'Capacity: 1 TB'"]
Most discount for this spec: 53% from Vendor WD
Second most discount for this spec: 48% from Vendor TOSHIBA

Specification: ["'Capacity: 4 TB'"]
Most discount for this spec: 55% from Vendor WD
Second most discount for this spec: 54% from Vendor Seagate

Specification: ["'Capacity: 3 TB'"]
Most discount for this spec: 25% from Vendor WD

Time: 0:00:02.163306 seconds

Q8)

Big billion days:

Companies which had a strict discount increase over the time period under rating threshold:

vivo: 2% increase

Companies which had a net discount increase at some point under rating threshold:

vivo: 2% increase
realme: 1% increase
ANGAGE: 6% increase
Time: 0:00:01.459261 seconds

Overall:

Companies which had a strict discount increase over the time period under rating threshold:

vivo: 2% increase

Companies which had a net discount increase at some point under rating threshold:

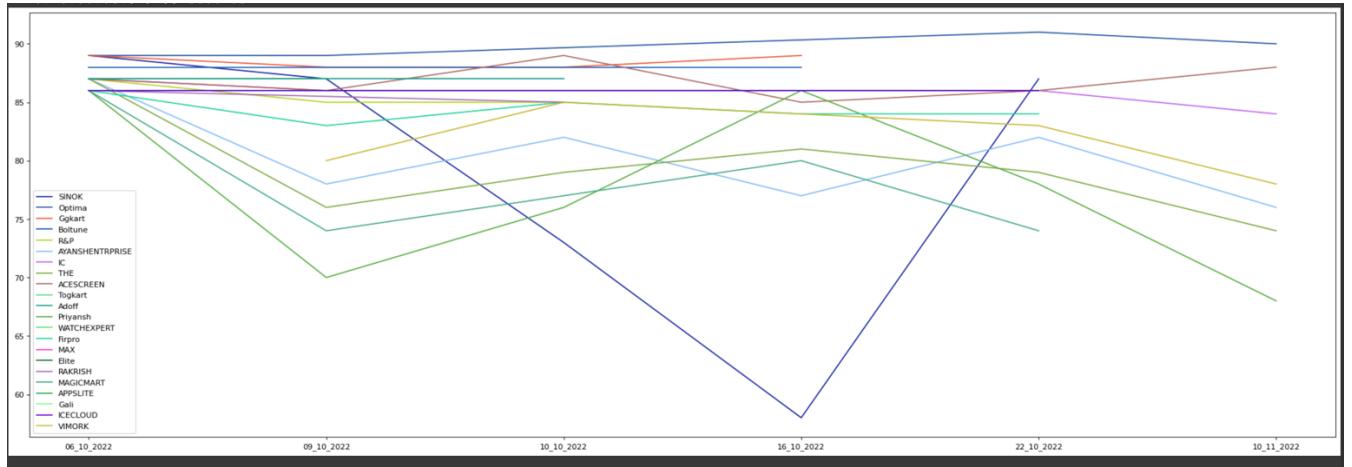
vivo: 2% increase
Cellecor: 26% increase
realme: 1% increase
Itel: 38% increase
GREENBERRI: 42% increase
IKall: 40% increase
ANGAGE: 39% increase
LYF: 76% increase
GFive: 50% increase
KARBONN: 12% increase
Kechaoda: 42% increase

I: 40% increase
 REDMI: 16% increase
 Snexian: 50% increase
 LAVA: 18% increase
 Time: 0:00:02.256852 seconds

Q9)

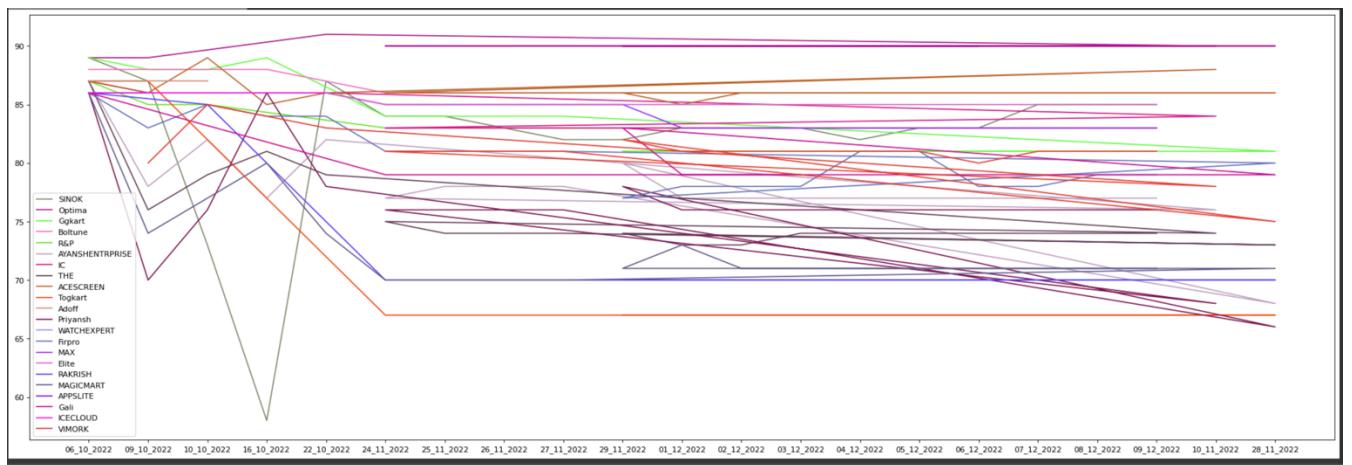
Big billion days:

Scanning products across common days for all categories: ['16_10_2022.csv', '10_11_2022.csv', '10_10_2022.csv', '06_10_2022.csv', '09_10_2022.csv', '22_10_2022.csv']
 Time: 0:00:06.530219 seconds



Overall:

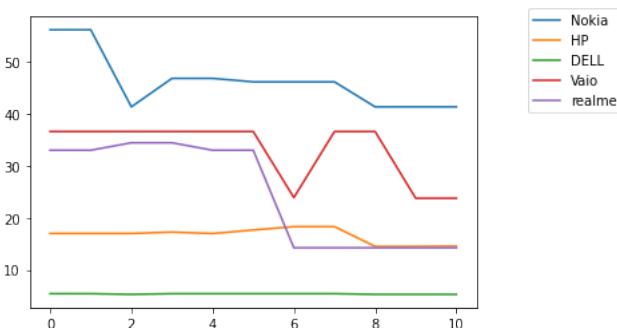
Scanning products across common days for all categories: ['05_12_2022.csv', '27_11_2022.csv', '09_12_2022.csv', '09_10_2022.csv', '07_12_2022.csv', '22_10_2022.csv', '10_11_2022.csv', '10_10_2022.csv', '06_12_2022.csv', '29_11_2022.csv', '26_11_2022.csv', '16_10_2022.csv', '08_12_2022.csv', '02_12_2022.csv', '04_12_2022.csv', '25_11_2022.csv', '28_11_2022.csv', '01_12_2022.csv', '06_10_2022.csv', '24_11_2022.csv', '03_12_2022.csv']
 Time: 0:00:20.688150 seconds



Q11)

Analysis of companies changing their discount rates over the time period based on competitors' rates for products with the same hardware and software specifications for Mobiles and Laptops.

```
{'GB SSD': '512', 'RAM': '8 GB DDR4', 'Processor': '', 'Operating System': ''}
+-----+
-----+-----+
-----+
|name
|Brand |off_list
|
+-----+
-----+-----+
-----+
|Nokia PureBook S14 Core i5 10th Gen - (8 GB/512 GB SSD/Windows 10 Home)
NKi510TL85S Thin and Light Lap...|Nokia |[56.14082, 56.14082, 41.338844,
46.80624, 46.80624, 46.139484, 46.139484, 46.139484, 41.338844,
41.338844] |
|HP Pavilion Core i5 12th Gen - (8 GB/512 GB SSD/Windows 11 Home) 15-
EG2009TU Thin and Light Laptop |HP |[17.030567, 17.030567,
17.030567, 17.294424, 17.018694, 17.690207, 18.337973, 18.337973,
14.543728, 14.5503235, 14.589902] |
|DELL Inspiron Core i5 11th Gen - (8 GB/512 GB SSD/Windows 11 Home/2 GB
Graphics) Inspiron 5518 Thin an...|DELL |[5.467396, 5.467396, 5.3340445,
5.467396, 5.467396, 5.467396, 5.467396, 5.3340445, 5.3340445,
5.3340445] |
|Vaio E Series Ryzen 7 Quad Core 3700U - (8 GB/512 GB SSD/Windows 10 Home)
NE15V2IN027P Thin and Light ...|Vaio |[36.601395, 36.601395, 36.601395,
36.601395, 36.601395, 23.919043, 36.601395, 36.601395, 23.78762,
23.78762] |
|realme Book(Slim) Intel Evo Core i5 11th Gen - (8 GB/512 GB SSD/Windows 10
Home) RMNB1002 Thin and Lig...|realme|[33.01333, 33.01333, 34.44192,
34.44192, 33.01333, 33.01333, 14.285918, 14.285918, 14.285918,
14.285918] |
+-----+
-----+-----+
-----+
```



Time taken to complete Q11 in seconds:114.30418610572815

Q12)

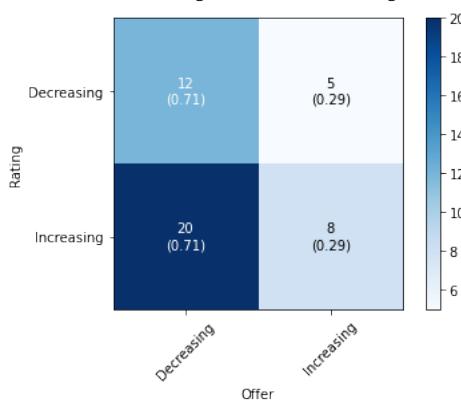
Changes in discount rates based on increase in number of reviews/rating for each product over the given time period for various product and companies.

```
{'GB SSD': '512', 'RAM': '16 GB ', 'Processor': 'Intel Core i', 'Operating
System': '64 bit Windows'}
+-----+-----+-----+
```

Rating	Offer	count
Decreasing	Decreasing	12
Decreasing	Increasing	5
Increasing	Increasing	8
Increasing	Decreasing	20

Brand	Rating	Offer	count
ASUS	Decreasing	Increasing	2
ASUS	Increasing	Decreasing	4
ASUS	Increasing	Increasing	4
ASUS	Decreasing	Decreasing	2
DELL	Decreasing	Increasing	2
DELL	Increasing	Decreasing	1
DELL	Decreasing	Decreasing	3
GIGABYTE	Increasing	Decreasing	1
HP	Increasing	Decreasing	7
HP	Increasing	Increasing	3
HP	Decreasing	Decreasing	2
Infinix	Increasing	Decreasing	2
Infinix	Decreasing	Increasing	1
Lenovo	Increasing	Decreasing	1
Lenovo	Decreasing	Decreasing	2
MSI	Increasing	Decreasing	2
MSI	Decreasing	Decreasing	3
MSI	Increasing	Increasing	1
SAMSUNG	Increasing	Decreasing	1
acer	Increasing	Decreasing	1

	Rating	Offer	count
0	Decreasing	Decreasing	12
1	Decreasing	Increasing	5
2	Increasing	Decreasing	20
3	Increasing	Increasing	8



Time taken to complete Q12 190.90622091293335

Q13)

```
#####
Volatility of discount rates for stable products Vs. newly introduced
products. Will use number of ratings/reviews as an indicator for new & old
products.
```

```

{'GB SSD': '', 'RAM': '', 'Processor': '', 'Operating System': ''}
+-----+
-----+-----+-----+-----+
-----+-----+-----+-----+
-----+-----+-----+-----+
-----+-----+-----+-----+
-----+-----+-----+-----+
|name
|total_ratings|total_reviews|rating|created_at|Brand |off      |GB SSD|RAM
|Processor           |Operating System
|off_list
|rating_sliding                               |Offer      |Rating?
|IsStableProduct|OfferVolatility   |Volatilile|
+-----+
-----+-----+-----+-----+
-----+-----+-----+-----+
-----+-----+-----+-----+
-----+-----+-----+-----+
-----+-----+-----+-----+
-----+-----+-----+-----+
|ASUS Vivobook 14 Pentium Quad Core - (8 GB/256 GB SSD/Windows 11 Home)
E410KA-EK101WS Thin and Light L...|14.0          |0.0        |4.5      |2022-
11-10|ASUS    |10.002501|256     |8 GB DDR4           |Intel Pentium Quad
Core|64 bit Windows 11|[18.83971, 10.252563, 10.252563, 10.002501,
10.002501]
|[4.4, 4.4, 4.4, 4.4]
|Decreasing|Increasing|No          |3.898210201112322 |Yes      |
|acer Predator Helios 300 Core i7 12th Gen - (16 GB/1 TB SSD/Windows 11
Home/8 GB Graphics/NVIDIA GeFor...|0.0          |0.0        |0.0      |2022-
11-10|acer    |5.004525 |NA       |16 GB DDR5           |Intel Core i7
|64 bit Windows 11|[10.261078, 5.004525, 5.0545254, 12.876476, 5.0545254,
10.312361, 12.876476, 4.804524, 5.004525, 5.004525, 5.004525]
|[0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 4.7, 0.0, 0.0, 0.0, 0.0,
0.0]|Decreasing|NoChange |No          |3.4255154691851546|Yes      |
|ASUS Ryzen 5 Hexa Core - (8 GB/1 TB HDD/256 GB SSD/Windows 10 Home)
KM513UA-BQ512TS Thin and Light Lap...|0.0          |0.0        |0.0      |
|2022-11-10|ASUS    |0.5298013|256     |8 GB DDR4           |AMD Ryzen 5 Hexa
Core|64 bit Windows 10|[5.6357617, 5.6357617, 5.6357617, 0.5298013,
0.66225165, 0.66225165, 0.5298013, 0.5298013, 0.5298013]
|[0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0]
|Decreasing|NoChange |No          |2.5314827205108275|Yes      |
|ASUS TUF GAMING A17 Ryzen 7 Octa Core 4800H - (8 GB/512 GB SSD/Windows 11
Home/4 GB Graphics/NVIDIA Ge...|0.0          |0.0        |0.0      |2022-11-
10|ASUS    |13.685651|512     |8 GB DDR4           |AMD Ryzen 7 Octa Core|64
bit Windows 11|[27.476576, 13.685651, 13.685651, 13.685651]
|[0.0, 0.0, 0.0]
|Decreasing|NoChange |No          |6.895462512969971 |Yes      |
|DELL Vostro Core i3 10th Gen - (8 GB/1 TB HDD/Windows 10 Home) Vostro 3401
Thin and Light Laptop         |2020.0        |200.0      |4.0      |2022-11-
10|DELL    |17.346882|NA       |8 GB DDR4           |Intel Core i3           |64
bit Windows 10|[26.830164, 36.001614, 36.001614, 18.695086, 18.695086,
17.108425, 18.695086, 18.695086, 17.346882, 17.346882, 17.346882]
|[4.0, 4.0, 4.0, 4.0, 4.0, 4.0, 4.0, 4.0, 4.0, 4.0, 4.0,
4.0]|Decreasing|NoChange |Yes          |7.402295743615427 |Yes      |
|ASUS Zenbook 14 ScreenPad Touch Panel Core i5 11th Gen - (8 GB/512 GB
SSD/Windows 10 Home/2 GB Graphic...|56.0          |6.0        |4.2
|2022-10-09|ASUS    |28.020542|512     |8 GB LPDDR4X          |Intel Core i5
|64 bit Windows 10|[33.420128, 33.420128, 33.420128, 28.020542, 28.020542,
28.020542]

```

I [4.3, 4.3, 4.3, 4.1, 4.2, 4.2]						
Decreasing Decreasing No		12.9574749021502686	Yes			
ASUS Zenbook Flip 13 OLED Touch Panel Intel EVO Core i5 11th Gen - (8 GB/512 GB SSD/Windows 10 Home) U... 15.0		12.0		14.5		
2022-11-10 ASUS 31.626635 512 8 GB DDR4			Intel Core i5			
64 bit Windows 10 [42.128826, 42.128826, 31.712112, 42.128826, 31.712112, 42.128826, 31.626635, 42.056385, 31.626635, 42.056385, 31.626635]						
[4.1, 4.1, 4.4, 4.1, 4.5, 4.1, 4.5, 4.1, 4.1, 4.5, 4.1, 4.5, 4.1,						
4.5] Decreasing Increasing No		15.4542690647214425	Yes			
APPLE 2021 Macbook Pro M1 Pro - (16 GB/1 TB SSD/Mac OS Monterey) MK1F3HN/A						
100.0 14.0 14.7 2022-10-22 APPLE 5.390535 NA 16						
GB Unified Memory Apple M1 Pro		Mac OS		[0.038476337,		
0.038476337, 0.038476337, 0.038476337, 0.038476337, 0.038476337,						
0.038476337, 5.390535, 5.390535, 5.390535, 5.390535] [4.8, 4.8, 4.8, 4.8,						
4.8, 4.8, 4.8, 4.8, 4.8, 4.8, 4.7] Increasing Decreasing No						
2.7002472236058956 Yes						
DELL Ryzen 5 Quad Core 3450U - (8 GB/256 GB SSD/Windows 11 Home) Vostro						
3400 Thin and Light Laptop 0.0 0.0 0.0 2022-						
11-10 DELL 31.59649 256 8 GB DDR4			AMD Ryzen 5 Quad Core			
64 bit Windows 11 [23.526316, 28.964912, 29.14035, 29.14035, 29.14035,						
29.14035, 31.59649, 31.59649]						
[0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0]						
Increasing NoChange No		12.493340642385608	Yes			
HP Core i5 11th Gen - (8 GB/512 GB SSD/Windows 11 Home) 15s-du3517TU Thin						
and Light Laptop 887.0 77.0 4.2 2022-11-						
10 HP 22.403843 512 8 GB DDR4			Intel Core i5			
bit Windows 11 [28.659988, 28.659988, 22.54635, 22.54635, 22.54635,						
22.54635, 22.54635, 22.403843, 22.403843, 22.403843, 22.403843]						
[4.2, 4.2, 4.2, 4.2, 4.2, 4.2, 4.2, 4.2, 4.2, 4.2,						
4.2] Decreasing NoChange Yes		12.4996121600976933	Yes			
Lenovo IdeaPad Gaming Core i5 11th Gen - (8 GB/512 GB SSD/Windows 11						
Home/4 GB Graphics/NVIDIA GeForce... 2044.0 175.0 4.3						
2022-11-10 Lenovo 28.09208 512 8 GB DDR4			Intel Core i5			
64 bit Windows 11 [37.716217, 37.716217, 36.285603, 36.415657, 36.415657,						
36.415657, 28.612303, 28.612303, 28.482248, 28.482248, 28.09208]						
[4.3, 4.4, 4.4, 4.4, 4.3, 4.3, 4.3, 4.3, 4.3, 4.3,						
4.3] Decreasing NoChange Yes		14.4009867219167615	Yes			
ASUS VivoBook 15 Core i3 10th Gen - (4 GB/1 TB HDD/Windows 10 Home)						
X515JA-BR381T Thin and Light Lapt... 4538.0 529.0 3.7						
2022-11-10 ASUS 22.732439 NA 4 GB DDR4			Intel Core i3			
64 bit Windows 10 [27.079775, 27.079775, 27.079775, 27.079775, 27.079775,						
26.835814, 22.959764, 21.823141, 22.732439, 22.732439, 22.732439]						
[3.7, 3.7, 3.7, 3.7, 3.7, 3.7, 3.7, 3.7, 3.7, 3.7,						
3.7] Decreasing NoChange Yes		12.338243386560806	Yes			
Lenovo Thinkbook Convertible Core i7 11th Gen - (16 GB/512 GB SSD/Windows						
10 Home) TB14s ITL Yoga 2 in... 47.0 8.0 4.2 2022-10-						
06 Lenovo 22.613405 512 16 GB DDR4			Intel Core i7			
bit Windows 10 [7.1160297, 7.1160297, 7.1160297, 7.1160297, 7.1160297,						
22.613405, 22.613405]						
[4.2, 4.2, 4.2, 4.2, 4.2, 4.2]						
Increasing NoChange No		17.561944934762241	Yes			
MSI Core i7 11th Gen - (8 GB/512 GB SSD/Windows 10 Home/4 GB						
Graphics/NVIDIA GeForce GTX 1650 MAX Q/14... 48.0 1.0						
4.5 2022-11-10 MSI 33.337036 512 8 GB DDR4			Intel Core			
i7 64 bit Windows 10 [24.558285, 24.558285, 21.113457, 31.22569,						
31.22569, 31.22569, 35.67063, 35.67063, 33.337036, 33.337036, 33.337036]						
[4.8, 4.8, 4.8, 4.5, 4.5, 4.6, 4.6, 4.5, 4.5,						
4.5] Increasing Decreasing No		14.877570677016445	Yes			
acer Nitro 5 Ryzen 5 Hexa Core 5600H - (16 GB/1 TB HDD/512 GB SSD/Windows						
11 Home/6 GB Graphics/NVIDIA... 0.0 0.0 0.0 2022-11-						
10 acer 0.0 512 16 GB DDR4			AMD Ryzen 5 Hexa Core			
64						

bit Windows 11 [23.160948, 23.160948, 23.160948, 23.160948, 0.0, 23.160948, 22.776329, 22.776329, 0.0, 0.0, 0.0]
[0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0]
Decreasing NoChange No 11.630742449525098 Yes
ASUS ROG Strix G15 (2022) Ryzen 7 Octa Core AMD R7-6800H - (16 GB/512 GB SSD/Windows 11 Home/4 GB Gra... 11.0 1.0 4.8 2022-11-10 ASUS 22.22387 512 16 GB DDR5 AMD Ryzen 7 Octa Core
Windows 11 [32.032482, 32.032482, 32.032482, 32.032482, 32.032482, 32.032482, 32.032482, 22.482363, 20.541393, 22.482363, 15.790661, 22.22387]
[5.0, 5.0, 5.0, 5.0, 5.0, 4.4, 4.8, 4.4, 4.8, 4.8]
4.8] Decreasing Decreasing No 6.187064540380358 Yes
ASUS Vivobook 15 Ryzen 3 Dual Core AMD R3-3250U - (8 GB/512 GB SSD/Windows 11 Home) M515DA-BQ332WS Thi... 337.0 43.0 4.4 2022-11-10 ASUS 25.537348 512 8 GB DDR4 AMD Ryzen 3 Dual Core
Windows 11 [42.77506, 25.537348, 25.75016, 25.75016, 25.537348, 25.537348, 25.537348, 25.537348]
[0.0, 4.3, 4.4, 4.4, 4.4, 4.4, 4.4]
Decreasing Increasing No 6.489205998157531 Yes
Avita Liber Core i7 8th Gen - (8 GB/256 GB SSD/Windows 10 Home) NS14A2IN241P Thin and Light Laptop 0.0 0.0 0.0
2022-10-16 Avita 38.029755 256 8 GB DDR4 Intel Core i7
64 bit Windows 10 [39.154896, 39.154896, 38.029755, 38.029755, 38.029755, 7.5009375, 38.029755, 16.87586, 38.029755]
[0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0]
Decreasing NoChange No 11.781980855111705 Yes
DELL Inspiron Core i3 11th Gen - (8 GB/1 TB HDD/256 GB SSD/Windows 10 Home) Inspiron 3511 Thin and Lig... 9.0 0.0 4.3
2022-11-10 DELL 8.021684 256 8 GB DDR4 Intel Core i3
64 bit Windows 10 [15.208446, 8.2173815, 15.029522, 15.208446, 15.208446, 15.208446, 8.021684, 8.021684, 8.021684]
[4.3, 4.3, 4.3, 4.3, 4.3, 4.3, 4.3, 4.3, 4.3, 4.3]
4.3] Decreasing NoChange No 3.7179215943450674 Yes
Lenovo IdeaPad Ryzen 5 Hexa Core 5500U - (8 GB/512 GB SSD/Windows 10 Home) IdeaPad 5 15ALC05 Thin and ... 106.0 14.0 4.1 2022-11-07 Lenovo 25.929237 512 8 GB DDR4 AMD Ryzen 5 Hexa Core 64
bit Windows 10 [42.6619, 42.6619, 42.6619, 42.6619, 31.166178, 26.056967, 8.289692, 8.289692, 29.761145, 25.929237, 25.929237]
[4.2, 4.2, 4.2, 4.2, 4.3, 4.2, 4.2, 4.2, 4.2, 4.1,
4.1] Decreasing Decreasing No 12.777606359934675 Yes

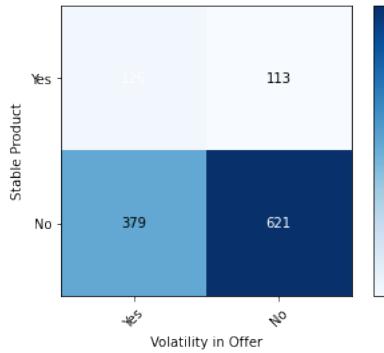
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-----+-----+-----+-----+-----+-----
-----+-----+-----+-----+-----+-----
-----+-----+-----+-----+-----+-----
-----+-----+-----+-----+-----+-----
-----+-----+-----+-----+-----+-----
only showing top 20 rows

IsStableProduct Volatile count
No No 621
No Yes 379
Yes Yes 126
Yes No 113

IsStableProduct Rating? Offer count
No Increasing Decreasing 147

No	Increasing	Increasing	29	
No	Decreasing	Increasing	39	
No	Decreasing	Decreasing	94	
Yes	Decreasing	Decreasing	18	
Yes	Decreasing	Increasing	3	
Yes	Increasing	Decreasing	11	
Yes	Increasing	Increasing	4	

	IsStableProduct	Volatile	count
0	No	No	621
1	No	Yes	379
2	Yes	No	113
3	Yes	Yes	126



Time taken to complete Q13 in seconds : 228.39871096611023

14) Variations in discount rate of different models of the same product for a company over the given time period.

Time taken to run this code for medium dataset – 1:37

name	company	price	off	desc
APPLE iPhone 13 Mini (Midnight, 256 GB)	APPLE	68990.0	7.0	Minimum offer price is given
APPLE iPhone 13 Mini (Blue, 256 GB)	APPLE	68990.0	7.0	Minimum offer price is given
APPLE iPhone 12 Mini (White, 64 GB)	APPLE	37990.0	36.0	Maximum offer price is given
APPLE iPhone 12 Mini (Black, 64 GB)	APPLE	37990.0	36.0	Maximum offer price is given
APPLE iPhone 13 Mini ((PRODUCT)RED, 256 GB)	APPLE	68990.0	7.0	Minimum offer price is given
APPLE iPhone 13 Mini (Pink, 256 GB)	APPLE	68990.0	7.0	Minimum offer price is given
APPLE iPhone 13 Mini (Starlight, 256 GB)	APPLE	68990.0	7.0	Minimum offer price is given
ASUS ROG Phone 3 (Black, 128 GB)	ASUS	46999.0	16.0	Maximum offer price is given
ASUS ROG 5s (Black, 128 GB)	ASUS	46999.0	16.0	Maximum offer price is given
ASUS ROG 5s (Phantom Black, 256 GB)	ASUS	57999.0	9.0	Minimum offer price is given
BlackZone ECO X	BlackZone	1380.0	6.0	Maximum offer price is given
BlackZone ECO X	BlackZone	1439.0	2.0	Minimum offer price is given
DIZO Star 500	DIZO	1799.0	10.0	Maximum offer price is given
DIZO Star 500	DIZO	1799.0	10.0	Minimum offer price is given
GREENBERRI F1	GREENBERRI	1399.0	6.0	Minimum offer price is given
GREENBERRI F1	GREENBERRI	1399.0	6.0	Maximum offer price is given
GREENBERRI FOLD	GREENBERRI	1399.0	6.0	Maximum offer price is given
GREENBERRI FOLD	GREENBERRI	1399.0	6.0	Minimum offer price is given
Good One Magic	Good	1450.0	3.0	Minimum offer price is given
Good One FLIP	Good	1399.0	6.0	Maximum offer price is given
Google Pixel 6a (Chalk, 128 GB)	Google	34199.0	22.0	Minimum offer price is given
Google Pixel 6a (Chalk, 128 GB)	Google	34199.0	22.0	Maximum offer price is given
Google Pixel 6a (Charcoal, 128 GB)	Google	34199.0	22.0	Maximum offer price is given
Google Pixel 6a (Charcoal, 128 GB)	Google	34199.0	22.0	Minimum offer price is given
Grabo G350	Grabo	799.0	2.0	Minimum offer price is given
Grabo ECO 1.8	Grabo	719.0	5.0	Maximum offer price is given
I Kall K444	I	999.0	9.0	Minimum offer price is given
I Kall K444	I	999.0	9.0	Maximum offer price is given
IAIR D24	IAIR	989.0	1.0	Minimum offer price is given
IAIR D25	IAIR	1098.0	35.0	Maximum offer price is given
IQOO Z5 5G (Cyber Grid, 128 GB)	IQOO	23990.0	4.0	Maximum offer price is given
IQOO Z5 5G (Cyber Grid, 128 GB)	IQOO	23990.0	4.0	Minimum offer price is given
Infinix Zero 5G (Cosmic Black, 128 GB)	Infinix	14999.0	40.0	Maximum offer price is given
Infinix Smart 5A (Ocean Wave, 32 GB)	Infinix	7199.0	10.0	Minimum offer price is given
Infinix Smart 5A (Midnight Black, 32 GB)	Infinix	7199.0	10.0	Minimum offer price is given
Infinix Smart 5A (Quetzal Cyan, 32 GB)	Infinix	7199.0	10.0	Minimum offer price is given
Itel A48 (Gradation Green, 32 GB)	Itel	5890.0	1.0	Minimum offer price is given
Itel VisionZS (Deep Blue, 32 GB)	Itel	5980.0	14.0	Maximum offer price is given
Itel IT2163	Itel	1080.0	1.0	Minimum offer price is given
KARBONN Jumbo K9	KARBONN	1289.0	3.0	Minimum offer price is given
KARBONN Jumbo K9	KARBONN	1290.0	7.0	Maximum offer price is given
Kechaoda A27	Kechaoda	1075.0	9.0	Maximum offer price is given