

# Web Appendix for “A Descriptive Study of High Frequency Trade and Quote Option Data from OPRA”

Torben Andersen<sup>a</sup>, Ilya Archakov<sup>b\*</sup>, Leon Grund<sup>b</sup>,  
Nikolaus Hautsch<sup>b</sup>, Sergey Nasekin<sup>c</sup>, Ingmar Nolte<sup>c</sup>,  
Manh Cuong Pham<sup>c†</sup>, Stephen Taylor<sup>c</sup> and Viktor Todorov<sup>a</sup>

<sup>a</sup>*Northwestern University, Kellogg School of Management*

<sup>b</sup>*University of Vienna, Department of Statistics and Operations Research*

<sup>c</sup>*Lancaster University, Department of Accounting and Finance*

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## Abstract

A web appendix with supplementary materials for the paper “A Descriptive Study of High Frequency Trade and Quote Data from OPRA”.

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\*Corresponding author. Email: ilya.archakov@univie.ac.at. Tel: +43 1 4277 38686.

†Corresponding author. Email: m.c.pham@lancaster.ac.uk. Tel: +44 1524 594816.

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## 1 Aggregate Statistics for OPRA records

Here we present the top underlying equities ranked by the average number of daily records among those represented in OPRA database for the period January 1st, 2015 - August 31st, 2015. We provide the corresponding lists for each of the GICS sectors as well as the separate ranking for underlying exchange traded funds. The data on industries and equity names is taken from S&P Global Market Intelligence database. In what follows, we pick several representative equities and more closely inspect the corresponding intra-daily option data.

## Sector: Energy

Ticker	Company name	Industry	OPRA records statistics (×1000)						
			Mean	Min	Quant25	Median	Quant75	Max	
1	SLB	Schlumberger Limited	Oil and Gas Equipment and Services	41659.8	19003.3	32969.2	39316.6	49267.5	71823.0
2	XOM	Exxon Mobil Corporation	Integrated Oil and Gas	31764.1	12650.5	22656.6	29341.7	37062.5	89753.1
3	EOG	EOG Resources, Inc.	Oil and Gas Exploration and Production	29941.2	10651.3	22530.1	28318.7	35570.9	83491.4
4	HAL	Halliburton Company	Oil and Gas Equipment and Services	28498.7	11659.3	20234.2	25542.3	35324.6	68924.0
5	CVX	Chevron Corporation	Integrated Oil and Gas	28095.2	10054.5	19229.8	24577.7	31581.0	111122.5
6	APC	Anadarko Petroleum Corporation	Oil and Gas Exploration and Production	26122.0	11050.0	19783.0	24946.4	30451.5	56321.1
7	VLO	Valero Energy Corporation	Oil and Gas Refining and Marketing	23138.7	8884.3	16783.8	20026.2	24846.1	61998.2
8	APA	Apache Corporation	Oil and Gas Exploration and Production	22543.1	8720.6	15497.5	21182.7	27052.4	51545.9
9	TSO	Tesoro Corporation	Oil and Gas Refining and Marketing	21604.3	8112.2	17367.3	20460.3	25134.6	53805.4
10	COP	ConocoPhillips	Oil and Gas Exploration and Production	21478.8	6390.2	13704.7	18611.6	27602.9	60937.1
11	OXY	Occidental Petroleum Corporation	Integrated Oil and Gas	20090.6	6541.5	11845.9	16142.2	24389.0	73790.5
12	DVN	Devon Energy Corporation	Oil and Gas Exploration and Production	18555.0	7880.7	14013.0	18021.1	22789.0	37543.2
13	HES	Hess Corporation	Oil and Gas Exploration and Production	14803.4	6507.1	11743.4	13806.0	17584.6	29481.6
14	LNG	Cheniere Energy, Inc.	Oil and Gas Storage and Transportation	13177.8	3721.6	9346.1	11602.1	15757.5	32894.8
15	NOV	National Oilwell Varco, Inc.	Oil and Gas Equipment and Services	12427.9	5185.0	9369.0	11853.6	14408.8	49295.8
16	CHK	Chesapeake Energy Corporation	Oil and Gas Exploration and Production	9487.3	2983.6	6299.6	8742.8	11747.6	27819.6
17	WMB	The Williams Companies, Inc.	Oil and Gas Storage and Transportation	8749.2	2823.3	5915.6	7941.1	11258.0	21995.1
18	MRO	Marathon Oil Corporation	Oil and Gas Exploration and Production	8336.4	3239.9	5785.5	7849.6	10103.3	19839.7
19	WLL	Whiting Petroleum Corporation	Oil and Gas Exploration and Production	8284.3	2950.0	5413.6	7237.8	9946.5	24518.7
20	PXD	Pioneer Natural Resources Company	Oil and Gas Exploration and Production	8123.5	3427.6	5552.4	7249.4	10337.1	20663.0
21	SU	Suncor Energy Inc.	Integrated Oil and Gas	8030.3	3388.9	5949.5	7672.2	9746.1	19130.8
22	RIG	Transocean Ltd.	Oil and Gas Drilling	5914.6	2015.6	4236.2	5402.9	7129.8	16499.8
23	NE	Noble Corporation plc	Oil and Gas Drilling	5472.4	1735.9	3849.0	5044.8	6415.8	28459.2
24	PSX	Phillips 66	Oil and Gas Refining and Marketing	5238.6	2110.1	3688.4	4909.3	6248.6	16216.0
25	SWN	Southwestern Energy Company	Oil and Gas Exploration and Production	5096.8	2326.7	3892.2	4886.0	5810.6	10466.1
26	WFT	Weatherford International plc	Oil and Gas Equipment and Services	4997.5	2156.1	3846.1	4692.7	5825.7	9670.3
27	KMI	Kinder Morgan, Inc.	Oil and Gas Storage and Transportation	4591.1	2113.3	3387.5	4242.2	5400.4	10383.1
28	MPC	Marathon Petroleum Corporation	Oil and Gas Refining and Marketing	4389.2	1770.2	3491.6	4104.2	5213.5	11176.3
29	HFC	HollyFrontier Corporation	Oil and Gas Refining and Marketing	4147.2	1662.9	3090.4	3905.7	4916.0	9197.9
30	CNX	CONSOL Energy Inc.	Coal and Consumable Fuels	4033.9	1773.8	2965.1	3743.8	4711.2	9637.0

## Sector: Materials

Ticker	Company name	Industry	OPRA records statistics (×1000)					
			Mean	Min	Quant25	Median	Quant75	Max
1 DD	E. I. du Pont de Nemours and Company	Diversified Chemicals	16301.9	673.9	11633.7	15124.5	19492.5	46221.6
2 DOW	The Dow Chemical Company	Diversified Chemicals	16238.7	4210.3	10843.9	14715.4	20821.5	39661.7
3 CF	CF Industries Holdings, Inc.	Fertilizers and Agricultural Chemicals	15494.6	4805.9	11910.5	14742.4	18442.0	31471.8
4 FCX	FreeportMcMoRan Inc.	Copper	15314.6	7030.0	11287.2	13556.6	17964.8	43791.8
5 NEM	Newmont Mining Corporation	Gold	15061.2	5063.6	11073.0	14184.6	18690.4	31896.2
6 X	United States Steel Corporation	Steel	13803.6	5451.7	10478.8	13075.8	16050.8	32964.8
7 MON	Monsanto Company	Fertilizers and Agricultural Chemicals	9920.9	3708.3	6822.1	9426.2	12102.2	24616.2
8 NUE	Nucor Corporation	Steel	9019.3	3578.7	6104.0	8473.0	11131.0	20003.7
9 GG	Goldcorp Inc.	Gold	8819.5	2734.5	5614.9	8065.5	11093.6	21565.3
10 AA	Alcoa Corporation	Aluminum	7873.7	2820.4	4892.6	6752.5	9598.4	26043.2
11 AEM	Agnico Eagle Mines Limited	Gold	7432.0	2909.3	5547.9	6946.7	9129.3	16254.1
12 ABX	Barrick Gold Corporation	Gold	6966.5	2607.1	5076.9	6826.2	8641.8	13621.2
13 MOS	The Mosaic Company	Fertilizers and Agricultural Chemicals	5636.3	1977.2	4023.3	5240.3	6816.6	14458.7
14 POT	Potash Corporation of Saskatchewan Inc.	Fertilizers and Agricultural Chemicals	5315.5	2542.5	4123.3	5179.8	6107.9	11497.4
15 IP	International Paper Company	Paper Packaging	4576.5	1617.3	2709.2	3849.1	5400.6	23157.3
16 CLF	Cliffs Natural Resources Inc.	Steel	3437.9	836.6	1923.4	2882.9	4559.7	11934.3
17 AGU	Agrium Inc.	Fertilizers and Agricultural Chemicals	3350.6	1330.2	2598.6	3152.4	3824.3	8801.5
18 EMN	Eastman Chemical Company	Diversified Chemicals	1859.0	773.5	1389.5	1777.1	2147.0	4275.5
19 LYB	LyondellBasell Industries N.V.	Commodity Chemicals	1836.6	654.2	1275.8	1725.8	2326.4	4604.4
20 AKS	AK Steel Holding Corporation	Steel	1732.5	745.4	1235.2	1547.9	2154.3	3968.4
21 APD	Air Products and Chemicals, Inc.	Industrial Gases	1408.7	570.9	951.5	1309.8	1756.6	4161.0
22 AUW	Yamana Gold Inc.	Gold	1369.8	368.2	866.8	1226.6	1671.1	4134.2
23 RGLD	Royal Gold, Inc.	Gold	1334.9	611.0	981.8	1298.1	1640.4	2484.4
24 SCCO	Southern Copper Corporation	Copper	1263.1	602.6	954.7	1194.3	1510.8	3227.4
25 SHW	The SherwinWilliams Company	Specialty Chemicals	1258.1	509.7	842.0	1087.9	1358.2	7295.0
26 ASH	Ashland Global Holdings Inc.	Specialty Chemicals	1255.5	383.8	841.3	1226.1	1608.0	3096.8
27 CENX	Century Aluminum Company	Aluminum	1180.1	554.7	941.0	1093.8	1392.3	3252.5
28 NEU	NewMarket Corporation	Specialty Chemicals	1160.7	278.1	747.4	973.2	1444.6	3405.4
29 EXP	Eagle Materials Inc.	Construction Materials	1096.7	412.8	791.1	974.0	1299.5	2751.2
30 GRA	W. R. Grace & Co.	Specialty Chemicals	1045.9	418.5	764.4	985.3	1235.8	4655.9

## Sector: Industrials

Ticker	Company name	Industry	OPRA records statistics (×1000)						
			Mean	Min	Quant25	Median	Quant75	Max	
1	AAL	American Airlines Group Inc.	Airlines	31525.8	13422.0	24965.0	29679.9	36529.4	92054.8
2	UAL	United Continental Holdings, Inc.	Airlines	29193.1	12761.1	23855.4	27432.6	32876.2	63699.4
3	CAT	Caterpillar Inc.	Construction Machinery and Heavy Trucks	28459.1	12928.7	20683.2	26549.3	33074.2	78849.5
4	BA	The Boeing Company	Aerospace and Defense	23866.2	11311.9	17424.7	22331.8	27139.3	61973.3
5	DAL	Delta Air Lines, Inc.	Airlines	22327.0	9050.4	18041.2	20268.1	25361.3	53669.5
6	UNP	Union Pacific Corporation	Railroads	22217.5	8466.6	15491.6	19846.6	25895.6	50960.0
7	DE	Deere & Company	Agricultural and Farm Machinery	13993.3	6962.8	10910.3	12847.5	15642.2	35706.0
8	SCTY	Solarcity Corp.	Electrical Equipment	13828.3	6353.5	10220.3	12748.0	16135.7	37539.9
9	UPS	United Parcel Service, Inc.	Air Freight and Logistics	12030.8	5759.1	8469.7	10585.1	13353.5	60906.8
10	UTX	United Technologies Corporation	Aerospace and Defense	11795.4	4262.0	7929.1	10153.3	13830.9	46745.0
11	FDX	FedEx Corporation	Air Freight and Logistics	11781.6	3842.4	8663.3	10230.4	13789.0	33982.3
12	MMM	3M Company	Industrial Conglomerates	10712.3	4168.5	7006.6	9379.1	12038.3	53630.5
13	GE	General Electric Company	Industrial Conglomerates	9830.4	3934.9	6679.5	8910.1	11856.5	33150.9
14	URI	United Rentals, Inc.	Trading Companies and Distributors	7026.9	2474.4	4811.5	6100.1	8379.8	21464.3
15	LUV	Southwest Airlines Co.	Airlines	6991.4	2794.2	4858.4	6216.0	8102.8	17654.7
16	CMI	Cummins Inc.	Construction Machinery and Heavy Trucks	6254.8	2503.5	4437.8	5754.3	7153.6	23267.5
17	NSC	Norfolk Southern Corporation	Railroads	6164.2	2385.4	4149.2	5536.5	7072.0	21617.8
18	JOY	JOY Global, Inc.	Machinery	4605.5	1702.3	3606.8	4332.6	5432.7	11328.8
19	ETN	Eaton Corporation plc	Electrical Components and Equipment	4300.3	1818.4	3181.8	4030.8	5016.7	13126.6
20	CBI	Chicago Bridge & Iron Company N.V.	Construction and Engineering	4131.2	1660.0	2732.9	3634.2	4895.2	11664.4
21	FLR	Fluor Corporation	Construction and Engineering	3909.3	1616.7	2721.1	3728.6	4978.8	7925.8
22	CSX	CSX Corporation	Railroads	3618.8	1277.9	2563.8	3297.9	4239.8	9459.1
23	HON	Honeywell International Inc.	Industrial Conglomerates	3590.4	1477.5	2518.9	3183.4	4375.9	10077.5
24	KSU	Kansas City Southern	Railroads	3373.6	1163.2	2215.1	2875.7	4061.3	10420.6
25	TRN	Trinity Industries, Inc.	Construction Machinery and Heavy Trucks	3021.1	1205.1	2328.1	2859.6	3594.3	7352.6
26	TASR	Taser International, Inc.	Aerospace & Defense	2962.1	1049.9	1812.5	2526.8	3536.3	12735.1
27	RTN	Raytheon Company	Aerospace and Defense	2602.5	1250.1	1880.0	2369.6	2984.1	7192.2
28	HTZ	Hertz Global Holdings, Inc.	Trucking	2577.3	996.8	1712.2	2393.3	3272.4	7067.6
29	LMT	Lockheed Martin Corporation	Aerospace and Defense	2419.8	1206.6	1715.4	2086.4	2709.1	9193.1
30	CP	Canadian Pacific Railway Limited	Railroads	2078.8	543.5	1591.1	2058.2	2497.1	4344.2

## Sector: Consumer Discretionary

Ticker	Company name	Industry	OPRA records statistics (×1000)						
			Mean	Min	Quant25	Median	Quant75	Max	
1	NFLX	Netflix, Inc.	Internet and Direct Marketing Retail	162216.3	62200.4	116205.7	138936.0	188018.3	511506.3
2	PCLN	The Priceline Group Inc.	Internet and Direct Marketing Retail	148893.0	58673.0	110644.4	136107.0	169396.2	396564.0
3	AMZN	Amazon.com, Inc.	Internet and Direct Marketing Retail	101380.1	39527.6	71144.7	88008.8	112102.2	333330.3
4	TSLA	Tesla, Inc.	Automobile Manufacturers	76911.7	33393.8	55918.9	69513.4	89124.6	185857.9
5	CMG	Chipotle Mexican Grill, Inc.	Restaurants	48124.2	16389.0	33570.1	42472.0	58021.6	141625.1
6	DIS	The Walt Disney Company	Movies and Entertainment	25945.9	10332.3	17385.1	22587.1	30601.5	88537.5
7	HD	The Home Depot, Inc.	Home Improvement Retail	24006.6	12333.7	17704.4	22204.3	28158.8	75200.8
8	WYNN	Wynn Resorts, Limited	Casinos and Gaming	23648.2	11675.0	17449.8	21244.7	27353.8	53717.1
9	GPRO	GoPro, Inc.	Consumer Electronics	21844.9	5563.5	11582.7	16606.8	26733.1	93478.6
10	SBUX	Starbucks Corporation	Restaurants	21724.1	6646.1	14647.4	20210.7	27062.9	62922.7
11	LVS	Las Vegas Sands Corp.	Casinos and Gaming	19629.4	7442.5	14902.9	18959.7	24098.2	39867.2
12	MCD	McDonald's Corporation	Restaurants	18418.4	7114.9	14382.6	17115.1	20205.6	59688.0
13	TGT	Target Corporation	General Merchandise Stores	17954.1	6683.3	12888.6	16056.1	19972.2	55637.5
14	NKE	NIKE, Inc.	Footwear	16200.2	5732.7	11167.2	15035.4	19308.3	56774.0
15	YUM	Yum! Brands, Inc.	Restaurants	13176.1	3762.6	9587.7	12535.9	15415.1	39090.4
16	LULU	Lululemon Athletica Inc.	Apparel, Accessories and Luxury Goods	12185.6	5290.4	8903.7	11252.6	14071.2	46477.2
17	GM	General Motors Company	Automobile Manufacturers	11887.8	4892.3	8149.9	10486.7	14361.1	31754.9
18	TWX	Time Warner Inc.	Movies and Entertainment	11688.2	3614.1	6543.4	9430.2	13913.7	45216.2
19	CBS	CBS Corporation	Broadcasting	10376.8	4482.1	7949.0	9801.2	12120.8	29636.8
20	BBY	Best Buy Co., Inc.	Computer and Electronics Retail	9362.8	3571.6	6433.7	8468.5	11013.2	28978.8
21	UA	Under Armour, Inc.	Apparel, Accessories and Luxury Goods	8841.9	4170.9	6038.6	7877.6	10370.7	30665.3
22	BBBY	Bed Bath & Beyond Inc.	Home Furnishing Retail	8534.7	3383.8	6275.1	8060.8	10301.3	24285.9
23	MGM	MGM Resorts International	Casinos and Gaming	8143.2	2998.0	5290.5	7244.4	9767.5	28323.4
24	KORS	Michael Kors Holdings Limited	Apparel, Accessories and Luxury Goods	7828.1	3843.3	5604.8	7355.9	9049.9	23391.5
25	GME	GameStop Corp.	Computer and Electronics Retail	7476.2	2596.7	4981.7	6637.8	9364.0	20514.5
26	EXPE	Expedia, Inc.	Internet and Direct Marketing Retail	7377.9	2926.4	5147.3	6758.3	8872.9	23837.9
27	ANF	Abercrombie & Fitch Co.	Apparel Retail	7121.1	2747.9	4459.0	6079.3	8200.8	29549.4
28	GPS	The Gap, Inc.	Apparel Retail	6948.1	2795.6	5298.1	6481.3	8107.9	18638.0
29	M	Macy's, Inc.	Department Stores	6675.5	1717.8	2982.6	4772.5	9338.3	30833.2
30	AZO	AutoZone, Inc.	Automotive Retail	6458.6	2515.1	4773.7	5646.9	6836.2	31859.9

## Sector: Consumer Staples

Ticker	Company name	Industry	OPRA records statistics (×1000)						
			Mean	Min	Quant25	Median	Quant75	Max	
1	GMCR	Keurig Green Mountain, Inc.	Food Products	24557.9	4986.0	11724.7	18075.8	33535.7	85810.3
2	PG	The Procter & Gamble Company	Household Products	22194.1	8312.5	15536.0	20799.0	25488.1	72278.7
3	WMT	WalMart Stores, Inc.	Hypermarkets and Super Centers	20171.7	7704.7	14987.2	17753.2	23830.2	69979.2
4	PEP	Pepsico, Inc.	Soft Drinks	18348.7	6537.6	13319.5	17111.5	21076.2	52039.0
5	WBA	Walgreens Boots Alliance, Inc.	Drug Retail	16850.2	7455.6	12849.0	15795.0	19257.7	44412.2
6	KO	The CocaCola Company	Soft Drinks	15203.2	6017.6	10766.9	13842.4	18576.7	44771.5
7	CVS	CVS Health Corporation	Drug Retail	13383.4	4423.8	9261.1	11953.1	15649.8	38195.6
8	WFM	Whole Foods Market, Inc.	Food Retail	12445.2	4489.1	9296.6	11743.3	14827.4	42590.7
9	COST	Costco Wholesale Corporation	Hypermarkets and Super Centers	12161.1	5221.2	8948.0	11158.4	13516.3	47448.3
10	HLF	Herbalife Ltd.	Personal Products	10445.9	3157.3	6252.1	8129.2	11676.1	43805.0
11	PM	Philip Morris International Inc.	Tobacco	9408.3	2990.8	6677.6	8584.2	10768.5	33104.9
12	MNST	Monster Beverage Corporation	Soft Drinks	8321.7	2733.6	5969.5	7550.6	9467.1	33057.0
13	CL	ColgatePalmolive Company	Household Products	8116.7	3162.0	5629.0	7174.2	9677.3	22978.2
14	ADM	ArcherDanielsMidland Company	Agricultural Products	7787.7	3290.6	5528.7	7233.7	9360.6	23531.7
15	MO	Altria Group, Inc.	Tobacco	6534.4	2270.2	4750.8	5946.4	7464.1	22816.1
16	NUS	Nu Skin Enterprises, Inc.	Personal Products	3115.4	773.3	1474.7	2936.7	3790.3	17115.9
17	MDLZ	Mondelez International, Inc.	Packaged Foods and Meats	2673.8	1088.0	1774.6	2257.1	3065.1	12679.2
18	KR	The Kroger Co.	Food Retail	1836.4	567.4	1361.3	1665.9	2040.0	5075.8
19	TSN	Tyson Foods, Inc.	Packaged Foods and Meats	1649.6	733.7	1194.7	1463.3	1881.4	5235.1
20	RAD	Rite Aid Corporation	Drug Retail	1600.7	635.0	1048.0	1338.9	2053.4	3842.6
21	EL	The Estée Lauder Companies Inc.	Personal Products	1224.1	626.6	932.4	1111.7	1355.3	4633.0
22	AVP	Avon Products, Inc.	Personal Products	1184.7	400.8	821.3	1035.9	1409.4	3604.8
23	TAP	Molson Coors Brewing Company	Brewers	1093.6	419.2	818.5	1021.2	1268.4	4311.4
24	STZ	Constellation Brands, Inc.	Distillers and Vintners	1086.6	405.8	800.0	1022.7	1337.4	2641.8
25	SAM	The Boston Beer Company, Inc.	Brewers	1045.2	472.2	764.1	958.0	1192.5	7525.4
26	GIS	General Mills, Inc.	Packaged Foods and Meats	1040.9	327.3	654.7	915.6	1313.3	2777.2
27	KMB	KimberlyClark Corporation	Household Products	1021.0	420.8	697.5	910.9	1253.3	2582.7
28	HSY	The Hershey Company	Packaged Foods and Meats	1009.8	244.8	705.4	960.0	1218.5	3970.0
29	CAG	Conagra Brands, Inc.	Packaged Foods and Meats	964.4	394.4	690.1	847.1	1058.8	3871.4
30	SY Y	Sysco Corporation	Food Distributors	933.9	278.0	559.0	797.7	1185.4	3665.2

## Sector: Healthcare

Ticker	Company name	Industry	OPRA records statistics ( $\times 1000$ )						
			Mean	Min	Quant25	Median	Quant75	Max	
1	GILD	Gilead Sciences, Inc.	Biotechnology	29564.3	10199.4	21960.7	27065.9	34501.9	69350.6
2	REGN	Regeneron Pharmaceuticals, Inc.	Biotechnology	29204.3	9.7	18638.6	24583.6	33414.4	128092.6
3	CELG	Celgene Corporation	Biotechnology	26413.8	10032.7	19964.4	24781.9	30201.1	63302.1
4	BIIB	Biogen Inc.	Biotechnology	25172.8	9586.7	16379.2	22811.6	30435.6	68692.2
5	ICPT	Intercept Pharmaceuticals, Inc.	Biotechnology	18461.3	8766.9	12663.5	16787.3	21839.1	53437.9
6	MRK	Merck & Co., Inc.	Pharmaceuticals	18115.9	3853.7	12220.6	15959.1	22367.0	53678.8
7	ISRG	Intuitive Surgical, Inc.	Healthcare Equipment	17736.1	6259.4	11100.9	15002.9	21166.5	58623.3
8	AMGN	Amgen Inc.	Biotechnology	17690.3	7669.6	12419.5	16338.9	21221.7	54820.1
9	JNJ	Johnson & Johnson	Pharmaceuticals	16648.3	6363.2	11545.3	14792.1	18448.8	68019.1
10	ESRX	Express Scripts Holding Company	Healthcare Services	12949.4	4487.9	9974.7	11900.3	15008.9	30969.0
11	LLY	Eli Lilly and Company	Pharmaceuticals	12906.9	2389.1	8841.6	11538.3	15567.5	48048.4
12	MDT	Medtronic plc	Healthcare Equipment	11822.1	5468.5	8563.3	10691.9	14160.1	30686.2
13	UNH	UnitedHealth Group Incorporated	Managed Healthcare	11781.8	3415.7	8842.0	10761.0	13914.7	29940.4
14	PFE	Pfizer Inc.	Pharmaceuticals	11151.9	5243.8	8111.9	10090.6	13666.0	30249.5
15	BMJ	BristolMyers Squibb Company	Pharmaceuticals	9989.5	2503.9	6935.0	9018.0	12037.4	32063.8
16	AET	Aetna Inc.	Managed Healthcare	9315.6	2752.7	6497.0	8411.0	11437.5	20897.5
17	AGN	Allergan plc	Pharmaceuticals	9137.9	6.8	3685.6	5749.9	10610.2	58747.9
18	ABBV	AbbVie Inc.	Biotechnology	8697.7	3357.9	6086.9	8084.6	10719.3	19483.7
19	ALXN	Alexion Pharmaceuticals, Inc.	Biotechnology	7060.9	3315.4	5401.2	6552.3	7615.0	21758.7
20	VRX	Valeant Pharmaceuticals International, Inc.	Pharmaceuticals	6640.7	1599.7	4031.9	5206.0	7202.5	39399.5
21	PBYI	Puma Biotechnology, Inc.	Biotechnology	6394.0	1662.9	4318.9	5994.0	8190.3	19680.3
22	ATHN	athenahealth, Inc.	Health Care Technology	6205.8	1016.8	3576.5	5553.7	7581.9	19833.6
23	ANTM	Anthem, Inc.	Managed Healthcare	5549.8	1775.5	3534.7	4999.8	6771.0	18116.4
24	ABT	Abbott Laboratories	Healthcare Equipment	5348.5	1909.8	3493.7	4681.5	5949.3	19660.0
25	BAX	Baxter International Inc.	Healthcare Equipment	5244.3	658.4	3667.4	5185.5	6974.4	11191.3
26	ILMN	Illumina, Inc.	Life Sciences Tools and Services	4886.8	1849.1	3310.3	4400.6	5837.9	15878.9
27	MNK	Mallinckrodt Public Limited Company	Pharmaceuticals	4330.3	1601.9	3158.1	3871.2	4985.2	15379.5
28	HUM	Humana Inc.	Managed Healthcare	4321.1	1357.2	2599.4	3493.5	4854.0	18968.9
29	VRTX	Vertex Pharmaceuticals Incorporated	Biotechnology	4303.2	7.5	2959.8	4165.6	5313.1	13845.6
30	HCA	HCA Healthcare, Inc.	Healthcare Facilities	4160.1	1915.8	2993.3	3768.8	4834.1	13323.3



## Sector: Financials

Ticker	Company name	Industry	OPRA records statistics (×1000)						
			Mean	Min	Quant25	Median	Quant75	Max	
1	JPM	JPMorgan Chase & Co.	Diversified Banks	32209.0	12326.0	22951.3	28121.0	37830.9	126982.8
2	C	Citigroup Inc.	Diversified Banks	30164.3	11735.8	21207.8	27468.3	35227.6	91950.7
3	BAC	Bank of America Corporation	Diversified Banks	24726.8	9977.1	16432.9	21924.8	29904.3	83237.8
4	AXP	American Express Company	Consumer Finance	18952.6	8358.8	14078.3	17781.4	22318.8	48064.2
5	WFC	Wells Fargo & Company	Diversified Banks	16137.4	6252.1	11776.0	14830.9	18807.9	39908.0
6	GS	The Goldman Sachs Group, Inc.	Investment Banking and Brokerage	14392.3	6932.7	11170.0	13550.0	15903.4	49840.6
7	AIG	American International Group, Inc.	Multiline Insurance	13291.6	6719.5	10187.6	12137.9	14768.6	36599.5
8	MS	Morgan Stanley	Investment Banking and Brokerage	11349.6	4952.7	8341.6	10513.1	13292.9	33553.1
9	BX	The Blackstone Group L.P.	Asset Management and Custody Banks	10717.4	2971.9	7042.8	9586.2	13117.9	32013.6
10	MET	MetLife, Inc.	Life and Health Insurance	10480.6	4466.2	7811.6	9654.6	12080.0	28321.3
11	COF	Capital One Financial Corporation	Consumer Finance	8488.5	1557.5	5131.3	8398.1	10870.9	26237.6
12	USB	U.S. Bancorp	Diversified Banks	7263.3	2675.1	4641.8	5607.0	8627.0	25970.4
13	ETFC	E*TRADE Financial Corporation	Investment Banking and Brokerage	4443.6	1533.5	3019.9	4007.0	5586.6	13347.7
14	BK	The Bank of New York Mellon Corporation	Asset Management and Custody Banks	4212.4	1507.4	3037.2	3915.7	5042.2	12801.9
15	HIG	The Hartford Financial Services Group, Inc.	Multiline Insurance	4179.5	1525.9	2858.9	3539.4	5355.3	13431.9
16	CME	CME Group Inc.	Financial Exchanges and Data	3981.3	1503.1	2961.5	3691.7	4346.8	16968.5
17	DFS	Discover Financial Services	Consumer Finance	3170.5	1302.1	2131.7	2760.2	3666.7	11393.9
18	PRU	Prudential Financial, Inc.	Life and Health Insurance	2908.6	961.6	2253.7	2708.3	3283.0	9253.1
19	STI	SunTrust Banks, Inc.	Regional Banks	2458.3	952.3	1784.3	2382.2	2972.1	5594.8
20	PNC	The PNC Financial Services Group, Inc.	Regional Banks	2251.4	1184.1	1711.6	2106.8	2561.7	4902.9
21	BBT	BB&T Corporation	Regional Banks	2180.3	875.9	1583.2	1952.7	2492.1	6078.3
22	STT	State Street Corporation	Asset Management and Custody Banks	1992.4	858.2	1433.6	1866.3	2393.9	5653.2
23	AFSI	AmTrust Financial Services, Inc.	Property and Casualty Insurance	1912.3	424.0	1472.1	1840.9	2166.4	4612.2
24	CIT	CIT Group Inc.	Regional Banks	1907.8	496.3	1244.7	1659.4	2264.1	6261.6
25	CMA	Comerica Incorporated	Regional Banks	1809.1	414.1	1240.6	1600.7	2411.6	4709.7
26	GNW	Genworth Financial, Inc.	Life and Health Insurance	1739.2	544.4	1231.7	1560.5	2054.2	5655.7
27	BLK	BlackRock, Inc.	Asset Management and Custody Banks	1701.4	454.5	980.0	1532.8	2148.3	6703.7
28	AFL	Aflac Incorporated	Life and Health Insurance	1428.8	589.3	1056.3	1287.7	1654.5	4276.0
29	OCN	Ocwen Financial Corporation	Thriffs and Mortgage Finance	1425.9	442.3	888.7	1180.0	1668.0	5398.5
30	ALL	The Allstate Corporation	Property and Casualty Insurance	1317.1	571.0	882.1	1172.4	1537.2	5182.4

## Sector: Information Technology

Ticker	Company name	Industry	OPRA records statistics ( $\times 1000$ )						
			Mean	Min	Quant25	Median	Quant75	Max	
1	AAPL	Apple Inc.	Technology Hardware, Storage and Peripherals	226936.0	100857.3	158998.5	206803.7	274690.8	495277.5
2	FB	Facebook, Inc.	Internet Software and Services	133854.4	71075.5	104110.2	126258.8	152182.1	249652.0
3	GOOGL	Alphabet Inc.	Internet Software and Services	76206.1	34253.5	47979.9	62459.3	86357.4	370023.1
4	GOOG	Alphabet Inc.	Internet Software and Services	67254.4	12671.4	42788.1	54158.0	72037.5	389116.5
5	TWTR	Twitter, Inc.	Internet Software and Services	46237.1	14450.4	30915.5	43506.9	57197.3	111478.1
6	MSFT	Microsoft Corporation	Systems Software	39928.9	17110.0	27111.5	36020.5	47124.7	102253.4
7	LNKD	Linkedin Corp.	Internet Software & Services	35543.1	13787.1	28085.5	34080.1	40930.5	95048.9
8	INTC	Intel Corporation	Semiconductors	25100.5	11903.2	18431.7	22374.4	29958.2	79104.9
9	SNDK	Sandisk Corp.	Computers & Peripherals	23903.0	10982.1	18571.1	22110.7	28350.9	51975.9
10	QCOM	QUALCOMM Incorporated	Semiconductors	23037.2	9538.6	17319.7	21365.0	26895.3	56123.4
11	YHOO	Yahoo, Inc.	Internet Software & Services	22447.4	7550.1	13920.2	20129.0	27529.8	96883.4
12	MU	Micron Technology, Inc.	Semiconductors	22106.3	7092.2	15593.7	19569.6	26225.2	53500.7
13	MA	Mastercard Incorporated	Data Processing and Outsourced Services	21304.7	9004.8	16458.5	19698.4	24777.4	45323.2
14	V	Visa Inc.	Data Processing and Outsourced Services	20782.2	7700.8	14937.8	18440.5	24300.6	69432.6
15	STX	Seagate Technology plc	Technology Hardware, Storage and Peripherals	17818.3	6773.7	13279.8	16588.1	20708.2	40793.1
16	CSCO	Cisco Systems, Inc.	Communications Equipment	17573.9	8249.7	12569.2	15779.1	20346.8	42705.7
17	IBM	International Business Machines Corporation	IT Consulting and Other Services	17258.2	7396.1	12799.3	15431.1	18894.0	68434.9
18	CRM	Salesforce.com, inc.	Application Software	16569.8	3805.0	7153.2	14507.4	22980.0	64704.8
19	ORCL	Oracle Corporation	Systems Software	16490.6	6364.3	12093.9	14703.3	19560.4	44978.9
20	WDC	Western Digital Corporation	Technology Hardware, Storage and Peripherals	16174.8	7489.2	12600.4	14948.1	19331.4	35020.6
21	FEYE	FireEye, Inc.	Systems Software	16105.1	6362.2	11610.6	14027.9	18415.9	36201.2
22	Z	Zillow Group, Inc.	Internet Software and Services	15770.2	58.4	11538.5	15095.9	19036.1	56213.7
23	EBAY	eBay Inc.	Internet Software and Services	15124.9	3030.4	10420.5	15136.0	18699.5	39952.4
24	AMBA	Ambarella, Inc.	Semiconductors	14020.2	3191.1	7041.0	9186.1	20864.9	57570.2
25	HPQ	HP Inc.	Technology Hardware, Storage and Peripherals	13350.9	3618.2	7983.7	11246.2	16928.5	33426.6
26	FSLR	First Solar, Inc.	Semiconductors	11327.2	3337.0	7181.3	9799.9	14545.1	31139.8
27	EA	Electronic Arts Inc.	Home Entertainment Software	11184.7	4515.2	7923.2	9857.8	13549.8	34585.7
28	TXN	Texas Instruments Incorporated	Semiconductors	11120.6	2930.8	6688.6	9295.6	13756.3	38707.5
29	SWKS	Skyworks Solutions, Inc.	Semiconductors	10828.2	3185.0	7255.2	9258.2	12834.8	36250.6
30	AKAM	Akamai Technologies, Inc.	Internet Software and Services	10226.0	4541.8	7321.2	9059.8	12036.1	25197.1

## Sector: Telecommunication Services

Ticker	Company name	Industry	OPRA records statistics ( $\times 1000$ )						
			Mean	Min	Quant25	Median	Quant75	Max	
1	VZ	Verizon Communications Inc.	Integrated Telecommunication Services	16966.5	6555.1	12053.6	15252.4	20016.9	55165.4
2	T	AT&T Inc.	Integrated Telecommunication Services	14622.6	5900.6	10416.2	12879.5	16674.3	54133.9
3	TMUS	TMobile US, Inc.	Wireless Telecommunication Services	3856.9	834.2	2194.7	3613.8	4860.5	13038.9
4	S	Sprint Corporation	Wireless Telecommunication Services	1580.6	406.7	962.8	1304.3	2120.1	4439.9
5	CTL	CenturyLink, Inc.	Integrated Telecommunication Services	1165.5	479.0	870.0	1092.9	1389.1	2413.9
6	LVLTL	Level 3 Communications, Inc.	Alternative Carriers	888.4	236.4	444.3	636.1	1067.9	4080.9
7	WIN	Windstream Holdings, Inc.	Integrated Telecommunication Services	486.2	145.8	285.4	361.6	566.4	4031.0
8	IQNT	Inteliquent, Inc.	Diversified Telecommunication Services	358.6	113.7	231.2	308.3	411.4	2443.5
9	FTR	Frontier Communications Corporation	Integrated Telecommunication Services	237.8	108.3	160.1	197.0	291.6	788.3
10	GSAT	Globalstar, Inc.	Alternative Carriers	183.6	76.6	130.9	167.8	209.8	737.9
11	LMOS	Lumos Networks Corp.	Alternative Carriers	158.9	50.0	106.0	149.6	193.9	459.3
12	CALL	magicJack VocalTec Ltd.	Alternative Carriers	140.5	68.3	111.4	137.4	157.5	308.7
13	STRP	Straight Path Communications Inc.	Alternative Carriers	140.1	32.5	72.1	105.1	167.9	458.4
14	BCE	BCE Inc.	Integrated Telecommunication Services	136.1	49.0	97.3	122.0	160.6	352.4
15	IDT	IDT Corporation	Integrated Telecommunication Services	122.2	34.4	93.7	113.2	146.6	395.1
16	SHEN	Shenandoah Telecommunications Company	Wireless Telecommunication Services	101.0	14.7	49.8	87.4	135.1	340.5
17	WIFI	Boingo Wireless, Inc.	Wireless Telecommunication Services	83.0	35.9	62.5	76.7	100.8	209.3
18	ZAYO	Zayo Group Holdings, Inc.	Alternative Carriers	82.7	20.0	59.6	77.4	98.7	210.4
19	IRDM	Iridium Communications Inc.	Alternative Carriers	81.7	37.8	61.2	74.9	94.2	308.9
20	TDS	Telephone and Data Systems, Inc.	Wireless Telecommunication Services	81.6	34.3	56.1	72.8	99.1	220.2
21	TU	TELUS Corporation	Integrated Telecommunication Services	81.3	21.8	60.8	73.5	88.3	461.1
22	RCI	Rogers Communications Inc.	Wireless Telecommunication Services	79.2	30.4	52.8	67.4	83.1	541.8
23	I	Intelsat S.A.	Alternative Carriers	75.0	41.6	59.3	70.6	84.0	242.0
24	CCOI	Cogent Communications Holdings, Inc.	Alternative Carriers	72.0	34.6	54.8	65.4	84.9	307.5
25	GNCMA	General Communication	Diversified Telecommunication Services	66.2	21.4	51.7	61.4	78.5	174.0
26	NTLS	Ntelos Holdings Corp.	Wireless Telecommunication Services	59.3	21.7	35.8	49.5	66.0	300.5
27	CNSL	Consolidated Communications Holdings, Inc.	Integrated Telecommunication Services	58.9	23.9	47.8	56.6	64.5	164.5
28	USM	United States Cellular Corporation	Wireless Telecommunication Services	46.9	20.8	33.9	40.4	51.7	160.8
29	SAAS	Incontact, Inc.	Diversified Telecommunication Services	42.7	22.5	33.4	39.8	48.8	138.4
30	VG	Vonage Holdings Corp.	Alternative Carriers	38.2	15.4	30.3	35.0	43.3	110.3

## Sector: Utilities

Ticker	Company name	Industry	OPRA records statistics ( $\times 1000$ )						
			Mean	Min	Quant25	Median	Quant75	Max	
1	SO	The Southern Company	Electric Utilities	2213.7	1064.7	1733.6	2105.5	2649.6	5370.4
2	EXC	Exelon Corporation	Electric Utilities	2071.1	712.6	1276.9	1926.3	2623.3	5473.1
3	DUK	Duke Energy Corporation	Electric Utilities	1880.5	928.0	1509.8	1823.5	2150.7	3583.1
4	ED	Consolidated Edison, Inc.	MultiUtilities	1420.5	664.1	1109.1	1364.2	1661.7	2639.7
5	D	Dominion Energy, Inc.	MultiUtilities	1053.2	480.0	810.4	1013.3	1243.5	2657.2
6	NRG	NRG Energy, Inc.	Independent Power Producers and Energy Traders	867.5	356.2	698.8	825.2	1045.0	1685.7
7	AEP	American Electric Power Company, Inc.	Electric Utilities	836.7	289.4	663.0	800.1	946.8	2128.7
8	EIX	Edison International	Electric Utilities	745.3	349.5	577.9	707.0	866.6	1509.2
9	FE	FirstEnergy Corp.	Electric Utilities	729.3	294.9	548.5	697.0	865.1	1915.8
10	NEE	NextEra Energy, Inc.	Electric Utilities	711.7	345.0	539.2	644.0	804.4	2051.7
11	ETR	Entergy Corporation	Electric Utilities	639.7	203.4	453.1	610.7	812.5	1422.3
12	NI	NiSource Inc.	MultiUtilities	623.0	113.8	317.5	524.0	908.0	1595.5
13	CPN	Calpine Corporation	Independent Power Producers and Energy Traders	613.1	300.5	490.9	572.0	693.2	1490.5
14	SRE	Sempra Energy	MultiUtilities	426.3	175.6	305.0	380.9	497.9	964.8
15	PPL	PPL Corporation	Electric Utilities	408.8	79.0	300.1	399.1	477.4	1056.1
16	AES	The AES Corporation	Independent Power Producers and Energy Traders	372.9	181.7	292.3	356.2	423.6	896.6
17	CNP	CenterPoint Energy, Inc.	MultiUtilities	303.9	140.9	248.1	295.1	346.5	741.9
18	PCG	PG&E Corporation	Electric Utilities	223.4	112.3	173.9	208.1	253.0	483.6
19	DTE	DTE Energy Company	MultiUtilities	200.0	69.4	139.9	187.5	249.8	455.0
20	TERP	TerraForm Power, Inc.	Renewable Electricity	198.3	71.9	127.9	163.4	228.4	878.8
21	STR	Questar Corp.	Gas Utilities	180.1	67.1	140.9	175.7	210.0	341.1
22	PEG	Public Service Enterprise Group Incorporated	MultiUtilities	168.8	65.4	118.1	151.6	206.7	537.9
23	WEC	WEC Energy Group, Inc.	MultiUtilities	147.2	40.9	119.5	140.6	171.8	372.0
24	DYN	Dynegy Inc.	Independent Power Producers and Energy Traders	126.0	59.3	90.1	111.8	156.3	480.0
25	PEGI	Pattern Energy Group Inc.	Renewable Electricity	123.1	48.2	85.6	105.0	141.5	379.9
26	NFG	National Fuel Gas Company	Gas Utilities	121.0	37.1	90.0	113.1	146.3	409.4
27	NU	Eversource Energy	Electric Utilities	109.9	54.2	75.4	108.1	125.0	363.1
28	AEE	Ameren Corporation	MultiUtilities	109.7	38.3	83.9	101.0	126.1	383.6
29	TE	Teco Energy, Inc.	Multi-Utilities	103.5	42.5	76.9	92.0	107.5	643.0
30	SPH	Suburban Propane Partners, L.P.	Gas Utilities	97.4	46.2	73.2	86.7	104.6	408.2

## Sector: Real Estate

Ticker	Company name	Industry	OPRA records statistics (×1000)						
			Mean	Min	Quant25	Median	Quant75	Max	
1	AMT	American Tower Corporation	Specialized REITs	3186.9	1345.3	2335.0	2897.6	3724.0	9947.3
2	SPG	Simon Property Group, Inc.	Retail REITs	2423.8	993.3	1852.4	2227.1	2676.7	14151.6
3	WY	Weyerhaeuser Co.	Specialized REITs	1579.3	739.1	1226.1	1429.0	1821.9	5488.0
4	EQIX	Equinix, Inc.	Specialized REITs	1381.0	429.9	828.1	1167.4	1728.9	8911.0
5	AVB	AvalonBay Communities, Inc.	Residential REITs	1364.5	558.7	1043.7	1285.3	1680.9	3316.7
6	HCN	Welltower Inc.	Healthcare REITs	765.2	256.6	517.7	719.2	939.4	1754.9
7	CCI	Crown Castle International Corp.	Specialized REITs	746.5	376.7	560.5	711.2	936.3	1507.1
8	GGP	GGP Inc.	Retail REITs	624.6	229.5	501.4	573.9	723.7	2087.6
9	ASPS	Altisource Portfolio Solutions S.A.	Real Estate Services	583.1	142.6	341.8	464.3	653.0	5110.9
10	PSA	Public Storage	Specialized REITs	528.1	281.2	412.8	474.3	549.4	2499.3
11	OUT	Outfront Media Inc.	Specialized REITs	447.0	129.9	242.6	303.3	413.2	1441.1
12	CBG	CBRE Group, Inc.	Real Estate Services	434.1	180.7	350.8	405.1	499.6	1128.7
13	RLGY	Realty Holdings Corp.	Real Estate Services	430.1	223.2	340.3	399.2	495.9	1073.0
14	SBAC	SBA Communications Corporation	Specialized REITs	426.9	213.4	323.0	408.5	490.4	1071.8
15	PLD	Prologis, Inc.	Industrial REITs	385.5	202.0	310.5	362.5	443.4	886.9
16	EQR	Equity Residential	Residential REITs	373.7	175.9	292.9	357.6	434.2	797.5
17	SLG	SL Green Realty Corp.	Office REITs	358.2	139.2	268.4	320.8	425.9	757.4
18	JOE	The St. Joe Company	Diversified Real Estate Activities	351.6	181.8	279.2	329.3	402.0	718.2
19	VNO	Vornado Realty Trust	Office REITs	342.7	87.5	272.7	328.8	404.8	665.8
20	IRM	Iron Mountain Incorporated	Specialized REITs	328.4	153.4	254.9	310.1	377.7	864.9
21	HCP	HCP, Inc.	Healthcare REITs	317.8	131.3	245.4	301.0	373.7	1062.0
22	JLL	Jones Lang LaSalle Incorporated	Real Estate Services	315.0	92.5	240.3	295.6	370.0	941.9
23	HST	Host Hotels & Resorts, Inc.	Hotel and Resort REITs	307.3	125.8	235.4	296.8	362.3	670.6
24	BXP	Boston Properties, Inc.	Office REITs	301.7	101.4	236.5	285.6	351.2	1109.6
25	LAMR	Lamar Advertising Company	Specialized REITs	292.5	116.6	190.2	287.2	363.0	1051.5
26	VTR	Ventas, Inc.	Healthcare REITs	285.8	15.1	205.1	289.0	352.2	563.6
27	CXW	CoreCivic, Inc.	Specialized REITs	280.0	91.0	219.8	269.8	325.5	595.9
28	DLR	Digital Realty Trust, Inc.	Specialized REITs	269.9	69.5	186.5	244.8	339.1	817.8
29	FRT	Federal Realty Investment Trust	Retail REITs	227.5	52.0	137.4	209.7	293.4	603.7
30	ESS	Essex Property Trust, Inc.	Residential REITs	210.9	65.8	164.1	201.3	240.8	615.4

## Exchange Traded Funds

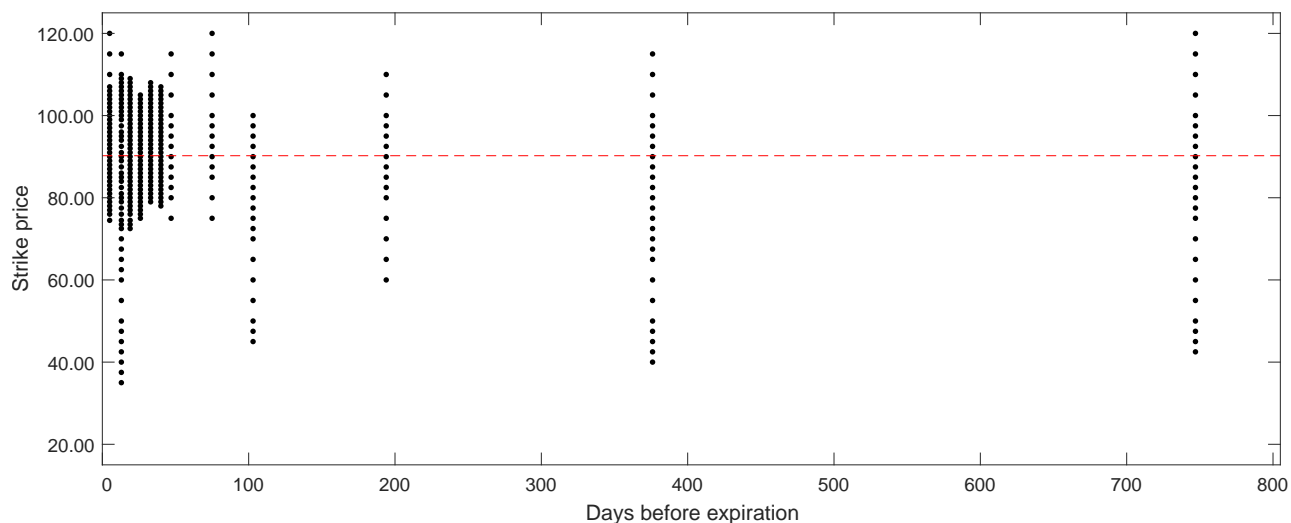
Ticker	Fund name	Exchange	OPRA records statistics ( $\times 1000$ )						
			Mean	Min	Quant25	Median	Quant75	Max	
1	SPY	SPDR S&P 500 ETF Trust	ARCA	520689.9	184877.8	304901.5	420672.3	647937.1	2542062.3
2	IWM	iShares Trust iShares Russell 2000 ETF	ARCA	230380.6	82295.9	143655.1	210362.6	276089.8	733134.3
3	QQQ	PowerShares QQQ Trust, Series 1	NasdaqGM	169727.9	57487.0	104716.4	137414.6	214915.0	627140.3
4	VXX	iPath S&P 500 VIX ShortTerm Futures ETN	ARCA	97596.9	31645.4	50562.3	76790.7	117801.0	341039.3
5	GLD	SPDR Gold Trust	ARCA	77171.4	26530.0	52316.3	69405.2	97314.5	209314.7
6	DIA	SPDR Dow Jones Industrial Average ETF Trust	ARCA	76716.5	27922.3	51161.7	67939.1	92138.9	297988.5
7	UVXY	ProShares Trust II ProShares Ultra VIX ShortTerm Futures ETF	ARCA	57785.1	7240.9	26835.4	48048.0	78662.7	228054.1
8	XLE	The Select Sector SPDR Trust The Energy Select Sector SPDR Fund	ARCA	42901.9	20302.8	31040.1	37857.4	53001.3	199276.8
9	TLT	iShares Trust iShares 20+ Year Treasury Bond ETF	NasdaqGM	36456.9	16940.5	27949.7	34804.0	43830.9	81398.9
10	TBT	ProShares Trust ProShares UltraShort 20+ Year Treasury	ARCA	30502.0	9568.9	20364.5	27365.3	38708.1	76074.6
11	USO	United States Oil Fund LP	ARCA	26730.9	11090.2	20697.7	24726.7	31094.9	86479.1
12	XOP	SPDR Series Trust SPDR S&P Oil & Gas Exploration & Production ETF	ARCA	24612.5	7463.4	18793.7	24328.0	29598.2	52463.1
13	SVXY	ProShares Trust II ProShares Short VIX ShortTerm Futures ETF	ARCA	24056.3	5170.9	14033.5	19817.1	29975.5	101168.9
14	FAS	Direxion Shares ETF Trust Direxion Daily Financial Bull 3X Shares	ARCA	23296.1	5815.7	12964.4	20332.8	29662.0	76257.7
15	FXE	CurrencyShares Euro Trust	ARCA	22569.1	5795.6	13735.5	21951.0	29763.3	61619.1
16	TNA	Direxion Shares ETF Trust Direxion Daily Small Cap Bull 3X Shares	ARCA	21035.5	9211.9	15080.0	18834.4	24702.9	54063.8
17	EEM	iShares, Inc. iShares MSCI Emerging Markets ETF	ARCA	18378.4	7922.9	12709.2	15858.2	21571.0	45093.2
18	FXI	iShares Trust iShares China LargeCap ETF	ARCA	18363.3	5364.2	12603.0	16084.4	21482.5	59070.7
19	EWZ	iShares, Inc. iShares MSCI Brazil Capped ETF	ARCA	17307.8	8332.8	13971.0	16469.5	20276.3	29178.9
20	EFA	iShares Trust iShares MSCI EAFE ETF	ARCA	15785.2	5443.3	10746.0	14886.1	19220.3	37287.3
21	IBB	iShares Trust iShares Nasdaq Biotechnology ETF	NasdaqGM	15668.4	6095.8	10794.7	13571.3	17593.8	53942.8
22	IYR	iShares Trust iShares U.S. Real Estate ETF	ARCA	14079.9	4916.2	11076.4	13440.6	16620.7	31092.1
23	XLV	The Select Sector SPDR Trust The Health Care Select Sector SPDR Fund	ARCA	13841.0	4479.3	9357.0	12053.9	16880.4	40986.2
24	XLY	The Select Sector SPDR Trust The Consumer Discretionary Select Sector SPDR Fund	ARCA	13672.3	5876.7	8840.9	11827.2	16189.2	47362.0
25	GDX	VanEck Vectors ETF Trust VanEck Vectors Gold Miners ETF	ARCA	13527.5	4577.6	8485.7	12744.8	18413.8	29170.2
26	SSO	ProShares Trust ProShares Ultra S&P500	ARCA	13483.5	3501.0	9101.8	12712.9	16345.2	46099.1
27	XRT	SPDR Series Trust SPDR S&P Retail ETF	ARCA	13440.2	4156.8	9811.3	11738.7	15389.9	35442.6
28	TQQQ	ProShares Trust ProShares UltraPro QQQ	NasdaqGM	11668.1	3146.4	7112.0	9531.8	13593.6	59255.1
29	UPRO	ProShares Trust ProShares UltraPro S&P500	ARCA	10469.4	3053.0	6546.8	9027.5	12659.0	40829.2
30	XLU	The Select Sector SPDR Trust The Utilities Select Sector SPDR Fund	ARCA	10149.6	3017.9	7398.8	9583.7	12166.6	20438.6

## 2 Overview of the selected sample

In this section, we provide summary of option contracts that includes all available strikes and expiration dates for the selected underlying assets from our sample (see Table 1) on January 5th, 2015.

Sector	Asset class	Ticker	Name	Industry	Average records (per day)
Consumer staples	Equity	PG	The Procter & Gamble Company	Personal Products	22,194,052
	Equity	WMT	Wal-Mart Stores, Inc.	Discount, Variety Stores	20,171,655
	Equity	K	Kellogg Company	Processed & Packaged Goods	5,461,349
	ETF	XLP	Consumer Staples Select Sector SPDR Fund		5,517,801
Energy	Equity	XOM	Exxon Mobil Corporation	Major Integrated Oil & Gas	31,764,057
	Equity	CVX	Chevron Corporation	Major Integrated Oil & Gas	28,095,240
	Equity	MPC	Marathon Petroleum Corporation	Oil & Gas Refining & Marketing	4,389,222
	ETF	XLE	Energy Select Sector SPDR Fund		42,901,922
Financial	Equity	JPM	JPMorgan Chase & Co.	Money Center Banks	32,209,032
	Equity	BAC	Bank of America Corp	Money Center Banks	24,726,836
	Equity	BLK	BlackRock Inc	Asset Management	1,701,449
	ETF	XLF	Financial Select Sector SPDR Fund		7,465,856
Technology	Equity	AAPL	Apple Inc.	Electronic Equipment	226,899,902
	Equity	GOOG	Alphabet Inc.	Internet Information Providers	61,812,973
	Equity	EA	Electronic Arts Inc.	Multimedia & Graphics Software	11,184,655
	ETF	XLK	Technology Select Sector SPDR Fund		6,963,341
Global	ETF	SPY	SPDR S&P 500 ETF		520,264,103

**Table 1:** List of the underlying assets

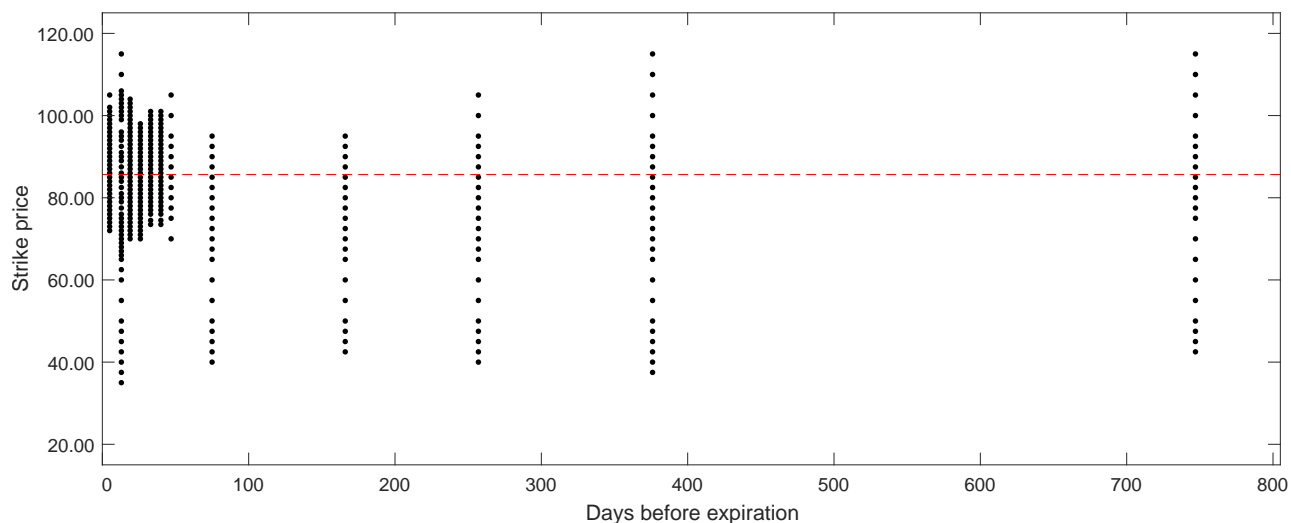


**Figure 1:** Option contracts for PG traded on 05/01/2015. Each dot corresponds to put and call contracts with specific time-to-maturity and strike (on the horizontal and vertical axes respectively). Red dashed line indicates the underlying spot price that is defined as PG open price on 05/01/2015. Remark: only those contracts are shown for which quotes or trades are recorded in the OPRA database.

Days until expiration	Min strike	Max strike	Number of contracts
4	74.50	120.00	37
12	35.00	115.00	50
18	72.50	109.00	40
25	75.00	105.00	31
32	79.00	108.00	30
39	78.00	107.00	30
46	75.00	115.00	13
74	75.00	120.00	13
102	45.00	100.00	19
193	60.00	110.00	15
375	40.00	115.00	25
746	42.50	120.00	23

**Table 2:** Summary of option contracts with existent quote or trade records for PG on 05/01/2015.

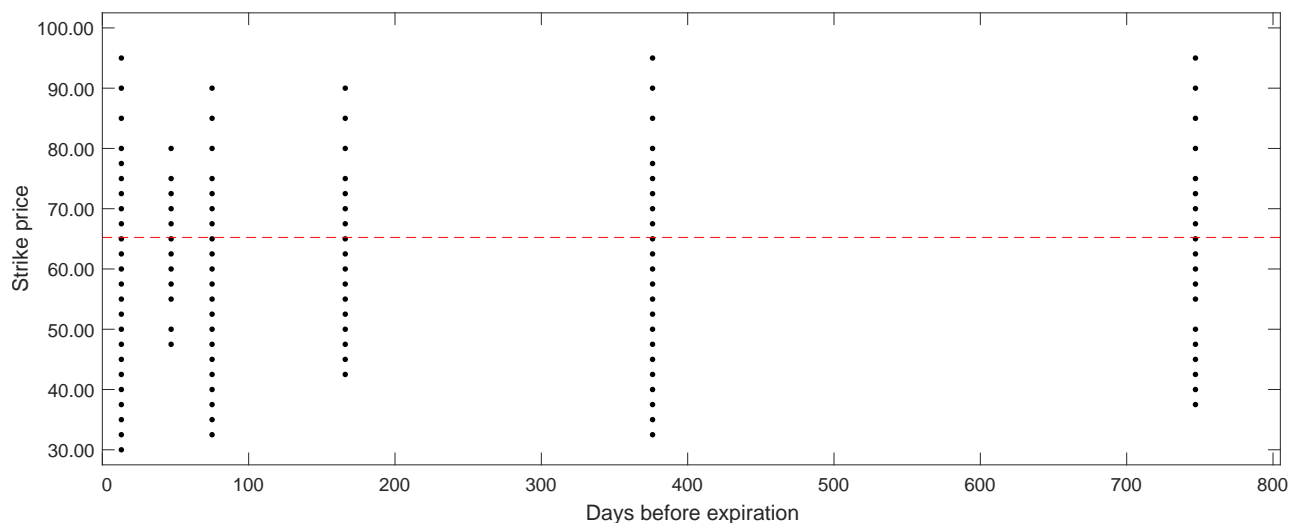




**Figure 2:** Option contracts for WMT traded on 05/01/2015. Each dot corresponds to put and call contracts with specific time-to-maturity and strike (on the horizontal and vertical axes respectively). Red dashed line indicates the underlying spot price that is defined as WMT open price on 05/01/2015. Remark: only those contracts are shown for which quotes or trades are recorded in the OPRA database.

Days until expiration	Min strike	Max strike	Number of contracts
4	72.00	105.00	34
12	35.00	115.00	55
18	70.00	104.00	40
25	70.00	98.00	32
32	73.50	101.00	30
39	73.50	101.00	30
46	70.00	105.00	12
74	40.00	95.00	20
165	42.50	95.00	19
256	40.00	105.00	22
375	37.50	115.00	25
746	42.50	115.00	21

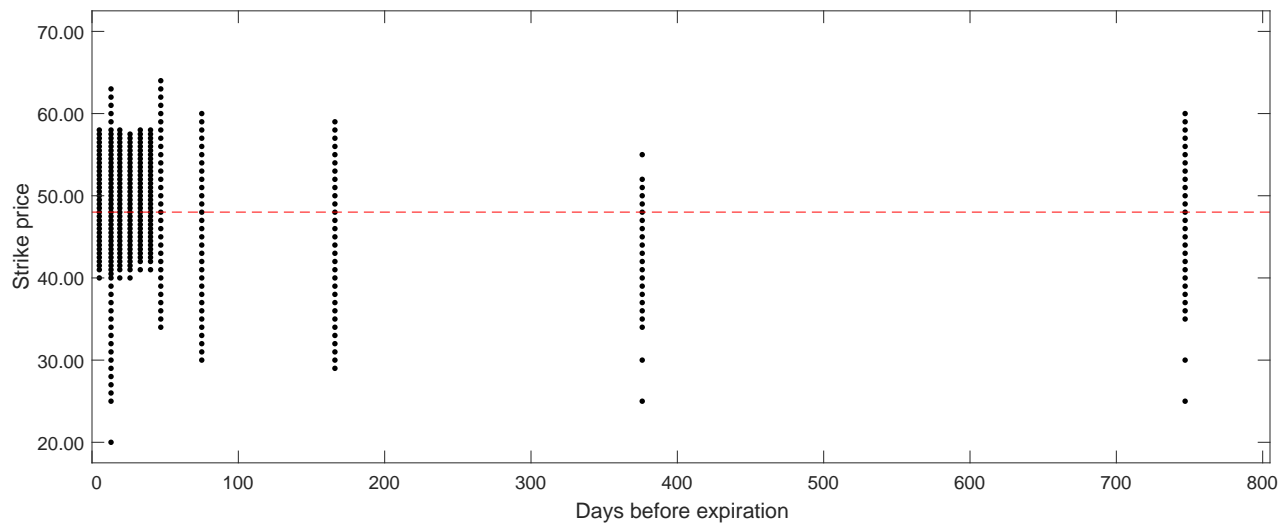
**Table 3:** Summary of option contracts with existent quote or trade records for WMT on 05/01/2015.



**Figure 3:** Option contracts for K traded on 05/01/2015. Each dot corresponds to put and call contracts with specific time-to-maturity and strike (on the horizontal and vertical axes respectively). Red dashed line indicates the underlying spot price that is defined as K open price on 05/01/2015. Remark: only those contracts are shown for which quotes or trades are recorded in the OPRA database.

Days until expiration	Min strike	Max strike	Number of contracts
12	30.00	95.00	24
46	47.50	80.00	12
74	32.50	90.00	21
165	42.50	90.00	17
375	32.50	95.00	23
746	37.50	95.00	19

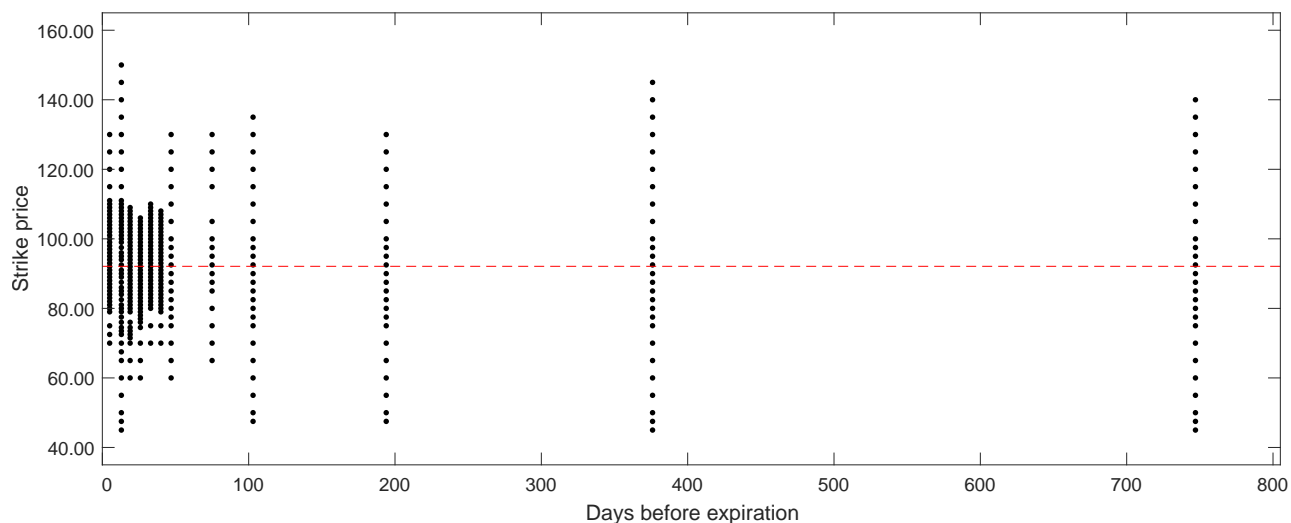
**Table 4:** Summary of option contracts with existent quote or trade records for K on 05/01/2015.



**Figure 4:** Option contracts for XLP traded on 05/01/2015. Each dot corresponds to put and call contracts with specific time-to-maturity and strike (on the horizontal and vertical axes respectively). Red dashed line indicates the underlying spot price that is defined as XLP open price on 05/01/2015. Remark: only those contracts are shown for which quotes or trades are recorded in the OPRA database.

Days until expiration	Min strike	Max strike	Number of contracts
4	40.00	58.00	36
12	20.00	63.00	58
18	40.00	58.00	36
25	40.00	57.50	35
32	41.00	58.00	34
39	41.00	58.00	34
46	34.00	64.00	31
74	30.00	60.00	31
165	29.00	59.00	31
375	25.00	55.00	22
746	25.00	60.00	28

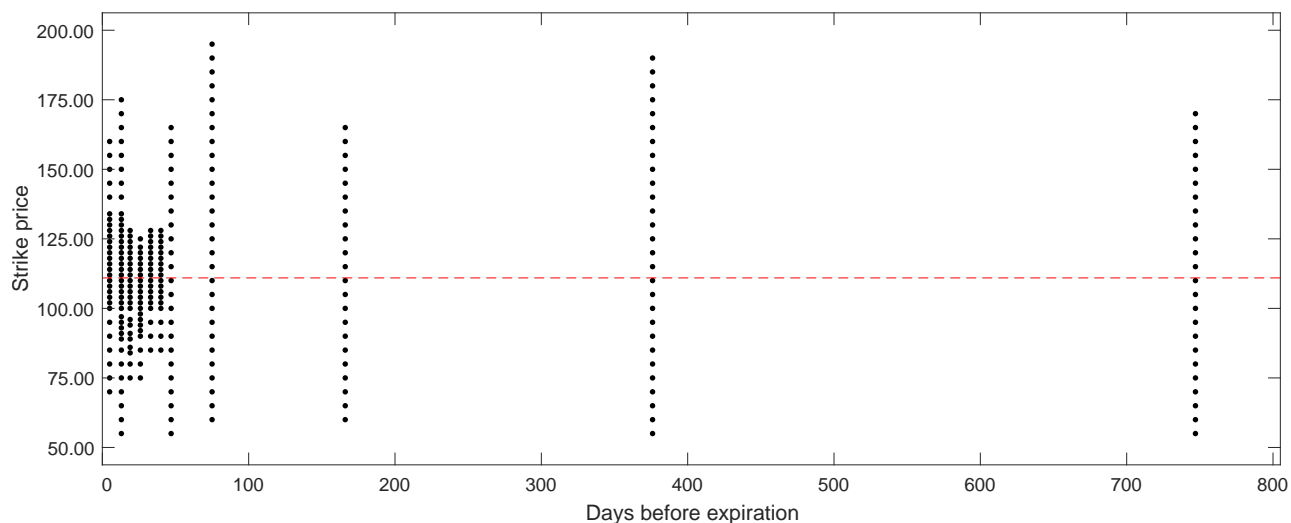
**Table 5:** Summary of option contracts with existent quote or trade records for XLP on 05/01/2015.



**Figure 5:** Option contracts for XOM traded on 05/01/2015. Each dot corresponds to put and call contracts with specific time-to-maturity and strike (on the horizontal and vertical axes respectively). Red dashed line indicates the underlying spot price that is defined as XOM open price on 05/01/2015. Remark: only those contracts are shown for which quotes or trades are recorded in the OPRA database.

Days until expiration	Min strike	Max strike	Number of contracts
4	70.00	130.00	40
12	45.00	150.00	53
18	60.00	109.00	43
25	60.00	106.00	36
32	70.00	110.00	33
39	70.00	108.00	32
46	60.00	130.00	20
74	65.00	130.00	16
102	47.50	135.00	24
193	47.50	130.00	23
375	45.00	145.00	27
746	45.00	140.00	26

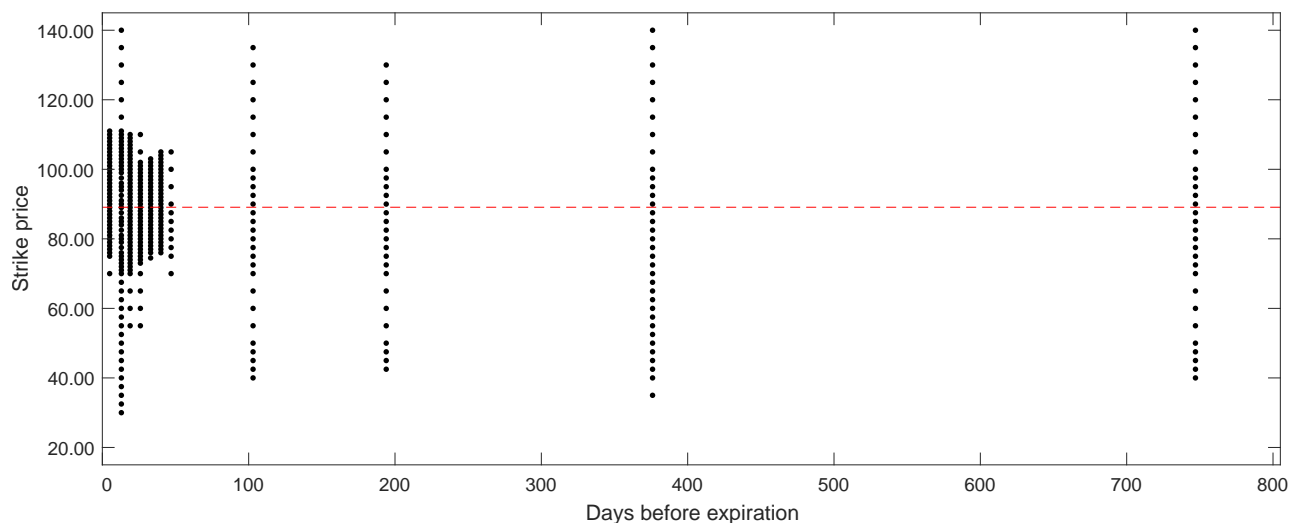
**Table 6:** Summary of option contracts with existent quote or trade records for XOM on 05/01/2015.



**Figure 6:** Option contracts for CVX traded on 05/01/2015. Each dot corresponds to put and call contracts with specific time-to-maturity and strike (on the horizontal and vertical axes respectively). Red dashed line indicates the underlying spot price that is defined as CVX open price on 05/01/2015. Remark: only those contracts are shown for which quotes or trades are recorded in the OPRA database.

Days until expiration	Min strike	Max strike	Number of contracts
4	70.00	160.00	49
12	55.00	175.00	63
18	75.00	128.00	42
25	75.00	125.00	37
32	85.00	129.00	34
39	85.00	129.00	34
46	55.00	165.00	23
74	60.00	195.00	28
165	60.00	165.00	22
375	55.00	190.00	28
746	55.00	170.00	24

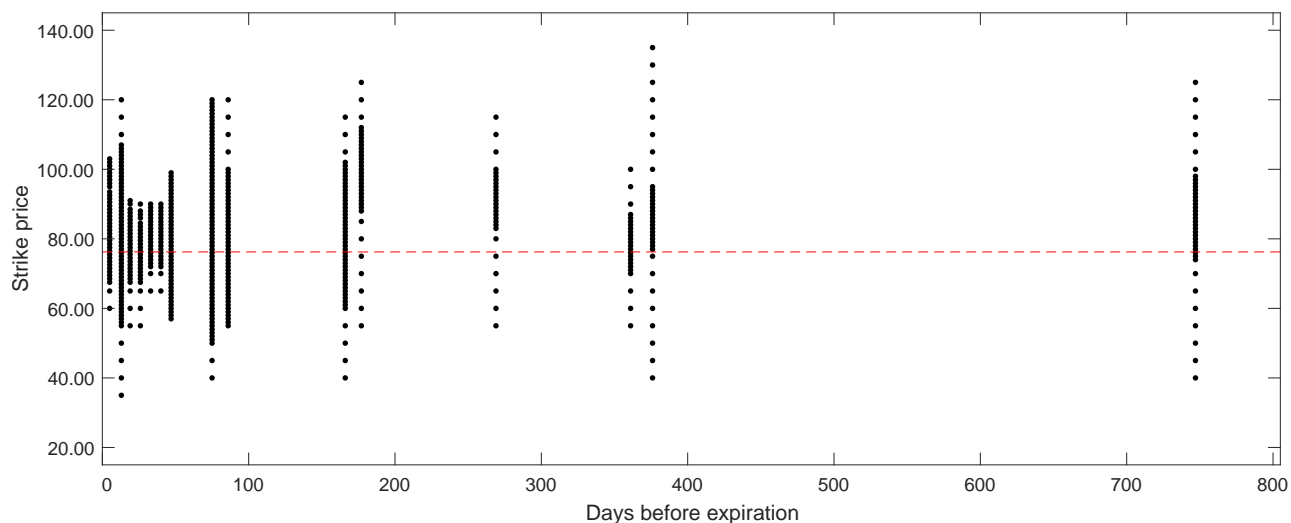
**Table 7:** Summary of option contracts with existent quote or trade records for CVX on 05/01/2015.



**Figure 7:** Option contracts for MPC traded on 05/01/2015. Each dot corresponds to put and call contracts with specific time-to-maturity and strike (on the horizontal and vertical axes respectively). Red dashed line indicates the underlying spot price that is defined as MPC open price on 05/01/2015. Remark: only those contracts are shown for which quotes or trades are recorded in the OPRA database.

Days until expiration	Min strike	Max strike	Number of contracts
4	70.00	111.00	38
12	30.00	140.00	64
18	55.00	110.00	49
25	55.00	110.00	38
32	74.50	103.00	30
39	76.00	105.00	30
46	70.00	105.00	11
102	40.00	135.00	28
193	42.50	130.00	26
375	35.00	140.00	34
746	40.00	140.00	29

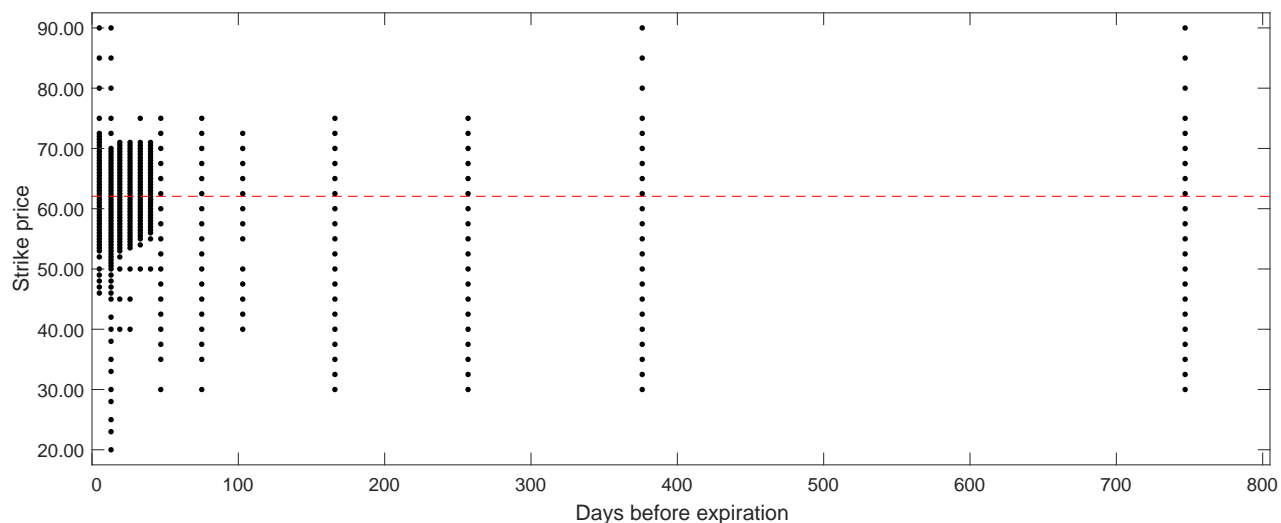
**Table 8:** Summary of option contracts with existent quote or trade records for MPC on 05/01/2015.



**Figure 8:** Option contracts for XLE traded on 05/01/2015. Each dot corresponds to put and call contracts with specific time-to-maturity and strike (on the horizontal and vertical axes respectively). Red dashed line indicates the underlying spot price that is defined as XLE open price on 05/01/2015. Remark: only those contracts are shown for which quotes or trades are recorded in the OPRA database.

Days until expiration	Min strike	Max strike	Number of contracts
4	60.00	103.00	65
12	35.00	120.00	90
18	55.00	91.00	49
25	55.00	90.00	43
32	65.00	90.00	37
39	65.00	90.00	36
46	57.00	99.00	51
74	40.00	120.00	73
85	55.00	120.00	50
165	40.00	115.00	57
176	55.00	125.00	35
268	55.00	115.00	27
360	55.00	100.00	24
375	40.00	135.00	35
746	40.00	125.00	38

**Table 9:** Summary of option contracts with existent quote or trade records for XLE on 05/01/2015.

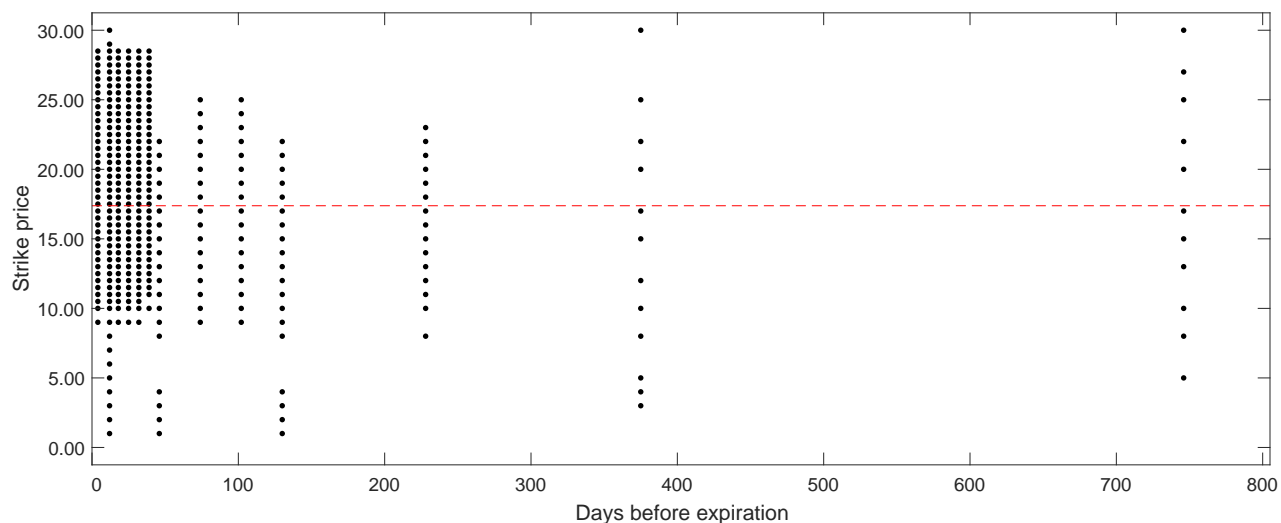


**Figure 9:** Option contracts for JPM traded on 05/01/2015. Each dot corresponds to put and call contracts with specific time-to-maturity and strike (on the horizontal and vertical axes respectively). Red dashed line indicates the underlying spot price that is defined as JPM open price on 05/01/2015. Remark: only those contracts are shown for which quotes or trades are recorded in the OPRA database.

Days until expiration	Min strike	Max strike	Number of contracts
4	46.00	90.00	50
12	20.00	90.00	61
18	40.00	71.00	41
25	40.00	71.00	39
32	50.00	75.00	36
39	50.00	71.00	33
46	30.00	75.00	18
74	30.00	75.00	18
102	40.00	72.50	13
165	30.00	75.00	19
256	30.00	75.00	19
375	30.00	90.00	22
746	30.00	90.00	22

**Table 10:** Summary of option contracts with existent quote or trade records for JPM on 05/01/2015.

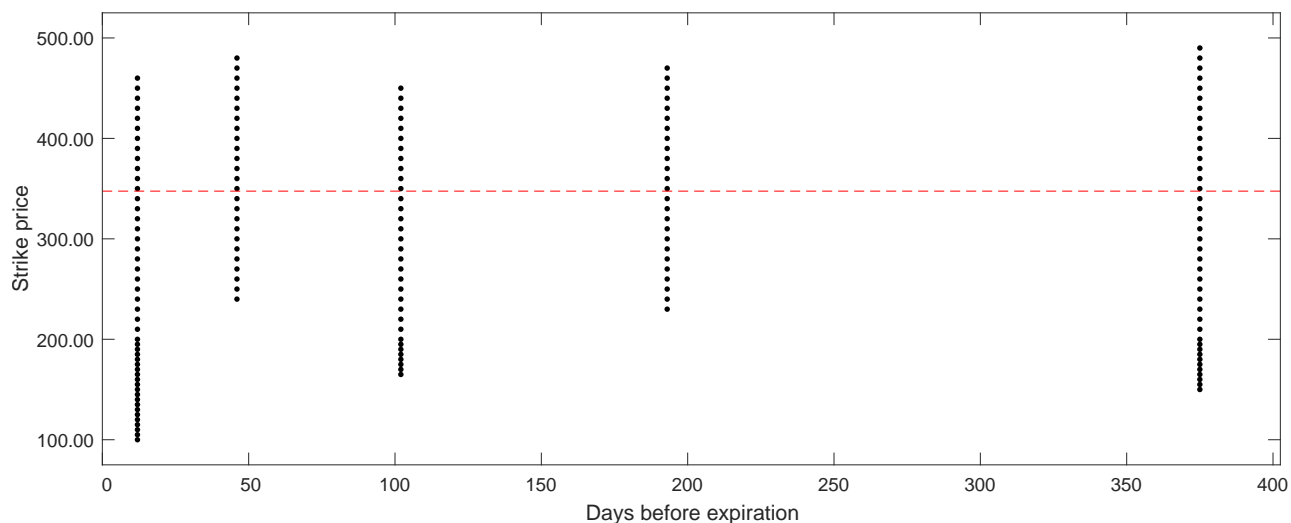




**Figure 10:** Option contracts for BAC traded on 06/01/2015. Each dot corresponds to put and call contracts with specific time-to-maturity and strike (on the horizontal and vertical axes respectively). Red dashed line indicates the underlying spot price that is defined as BAC open price on 06/01/2015. Remark: only those contracts are shown for which quotes or trades are recorded in the OPRA database.

Days until expiration	Min strike	Max strike	Number of contracts
3	9.00	28.50	39
11	1.00	30.00	49
17	9.00	28.50	39
24	9.00	28.50	39
31	9.00	28.50	39
38	10.00	28.50	37
45	1.00	22.00	19
73	9.00	25.00	17
101	9.00	25.00	17
129	1.00	22.00	19
227	8.00	23.00	15
374	3.00	30.00	12
745	5.00	30.00	11

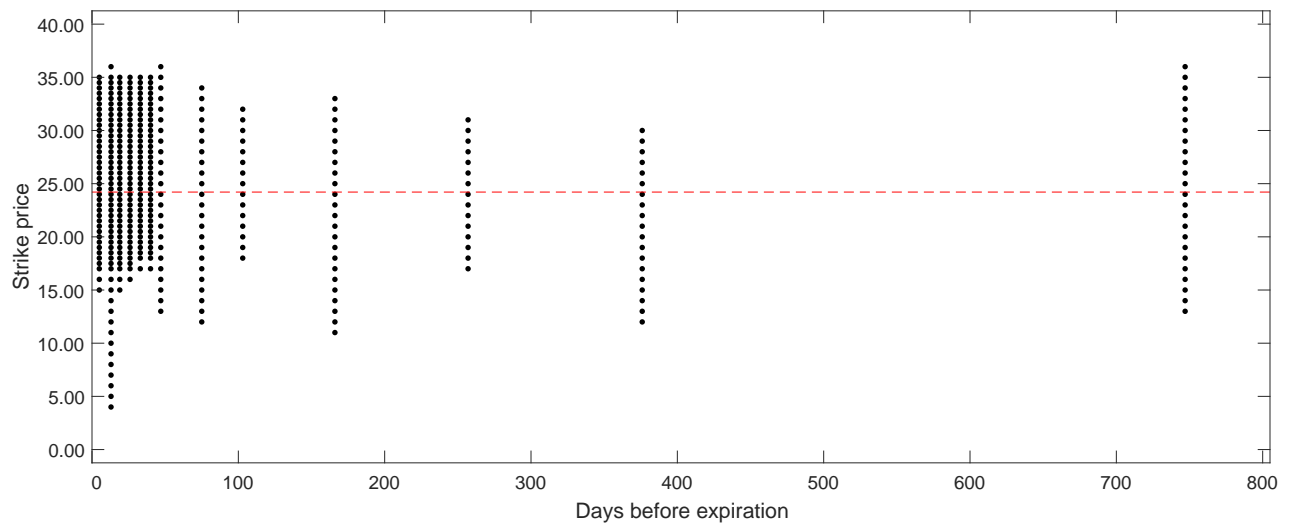
**Table 11:** Summary of option contracts with existent quote or trade records for BAC on 06/01/2015.



**Figure 11:** Option contracts for BLK traded on 06/01/2015. Each dot corresponds to put and call contracts with specific time-to-maturity and strike (on the horizontal and vertical axes respectively). Red dashed line indicates the underlying spot price that is defined as BLK open price on 06/01/2015. Remark: only those contracts are shown for which quotes or trades are recorded in the OPRA database.

Days until expiration	Min strike	Max strike	Number of contracts
11	100.00	460.00	47
45	240.00	480.00	25
101	165.00	450.00	33
192	230.00	470.00	25
374	150.00	490.00	40

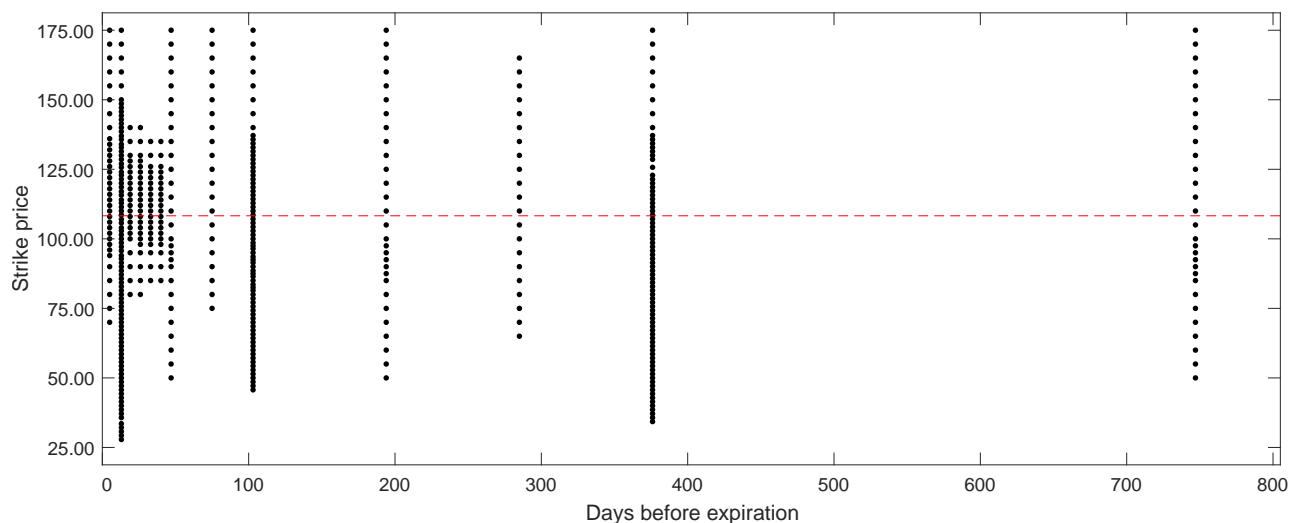
**Table 12:** Summary of option contracts with existent quote or trade records for BLK on 06/01/2015.



**Figure 12:** Option contracts for XLF traded on 05/01/2015. Each dot corresponds to put and call contracts with specific time-to-maturity and strike (on the horizontal and vertical axes respectively). Red dashed line indicates the underlying spot price that is defined as XLF open price on 05/01/2015. Remark: only those contracts are shown for which quotes or trades are recorded in the OPRA database.

Days until expiration	Min strike	Max strike	Number of contracts
4	15.00	35.00	39
12	4.00	36.00	51
18	15.00	35.00	39
25	16.00	35.00	38
32	17.00	35.00	36
39	17.00	35.00	36
46	13.00	36.00	24
74	12.00	34.00	23
102	18.00	32.00	15
165	11.00	33.00	23
256	17.00	31.00	15
375	12.00	30.00	19
746	13.00	36.00	24

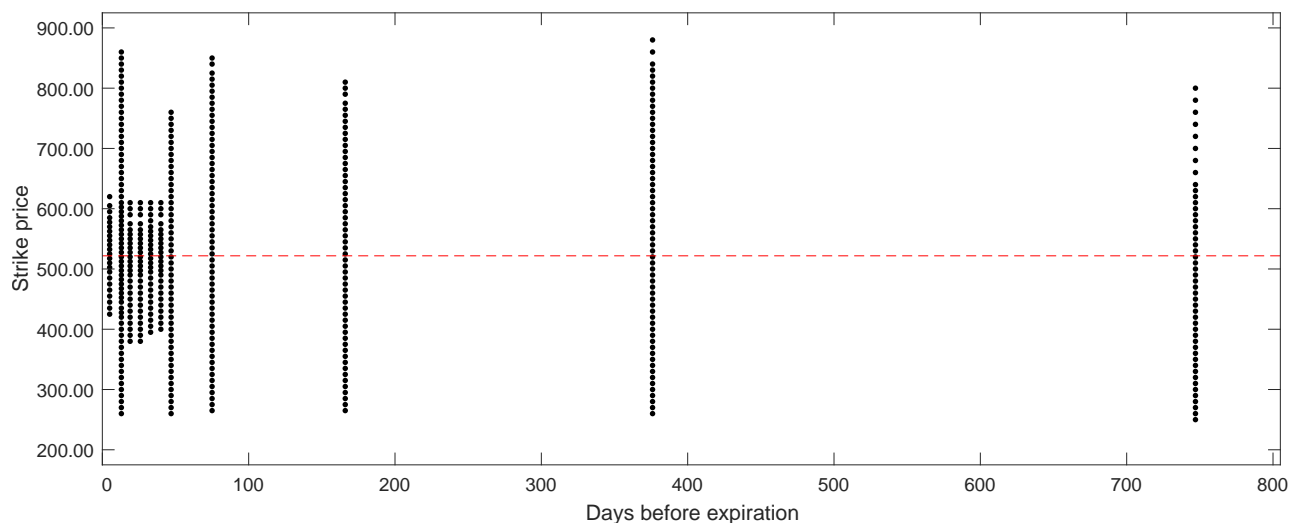
**Table 13:** Summary of option contracts with existent quote or trade records for XLF on 05/01/2015.



**Figure 13:** Option contracts for AAPL traded on 05/01/2015. Each dot corresponds to put and call contracts with specific time-to-maturity and strike (on the horizontal and vertical axes respectively). Red dashed line indicates the underlying spot price that is defined as AAPL open price on 05/01/2015. Remark: only those contracts are shown for which quotes or trades are recorded in the OPRA database.

Days until expiration	Min strike	Max strike	Number of contracts
4	70.00	175.00	56
12	27.86	175.00	195
18	80.00	140.00	39
25	80.00	140.00	38
32	85.00	135.00	35
39	85.00	135.00	35
46	50.00	175.00	28
74	75.00	175.00	21
102	45.71	175.00	120
193	50.00	175.00	29
284	65.00	165.00	21
375	34.29	175.00	88
746	50.00	175.00	29

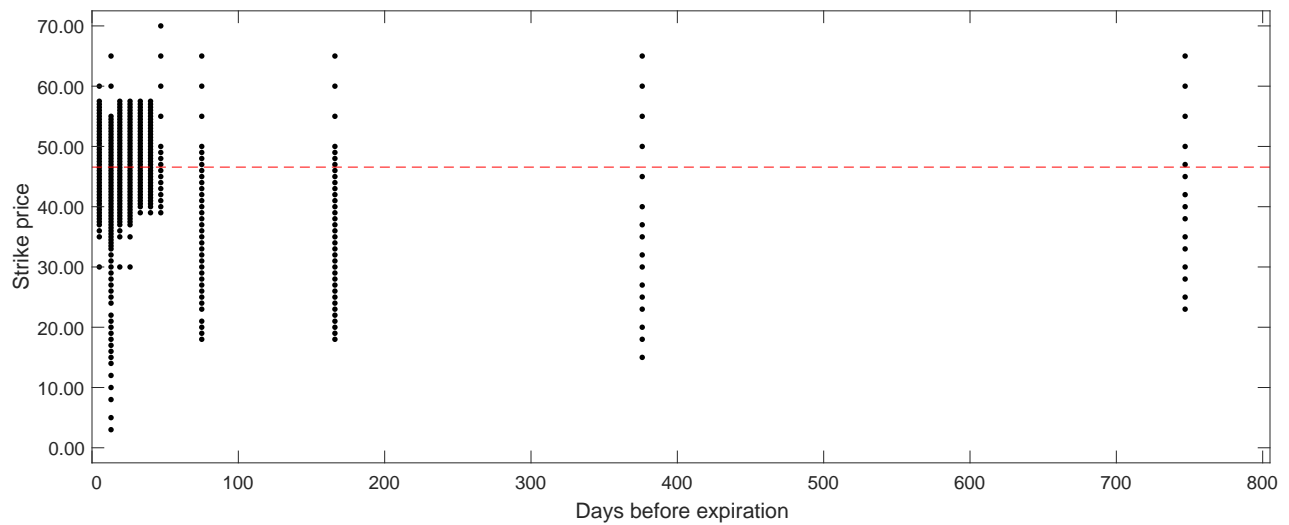
**Table 14:** Summary of option contracts with existent quote or trade records for AAPL on 05/01/2015.



**Figure 14:** Option contracts for GOOG traded on 05/01/2015. Each dot corresponds to put and call contracts with specific time-to-maturity and strike (on the horizontal and vertical axes respectively). Red dashed line indicates the underlying spot price that is defined as GOOG open price on 05/01/2015. Remark: only those contracts are shown for which quotes or trades are recorded in the OPRA database.

Days until expiration	Min strike	Max strike	Number of contracts
4	425.00	620.00	57
12	260.00	860.00	151
18	380.00	610.00	60
25	380.00	610.00	59
32	395.00	610.00	56
39	400.00	610.00	55
46	260.00	760.00	101
74	265.00	850.00	116
165	265.00	810.00	107
375	260.00	880.00	104
746	250.00	800.00	48

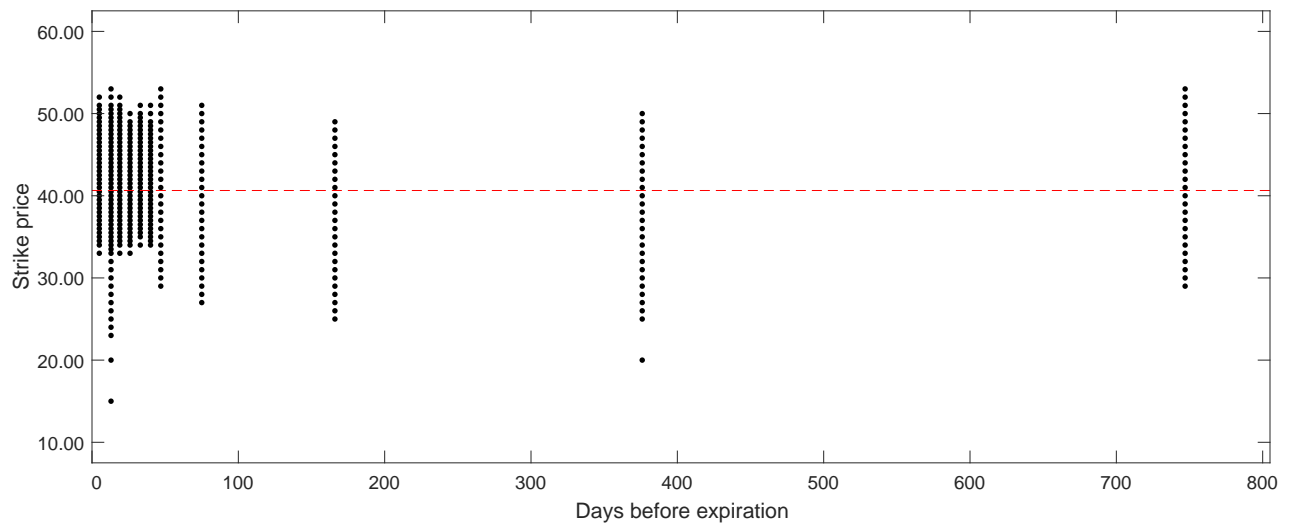
**Table 15:** Summary of option contracts with existent quote or trade records for GOOG on 05/01/2015.



**Figure 15:** Option contracts for EA traded on 05/01/2015. Each dot corresponds to put and call contracts with specific time-to-maturity and strike (on the horizontal and vertical axes respectively). Red dashed line indicates the underlying spot price that is defined as EA open price on 05/01/2015. Remark: only those contracts are shown for which quotes or trades are recorded in the OPRA database.

Days until expiration	Min strike	Max strike	Number of contracts
4	30.00	60.00	46
12	3.00	65.00	70
18	30.00	57.50	45
25	30.00	57.50	44
32	39.00	57.50	37
39	39.00	57.50	37
46	39.00	70.00	16
74	18.00	65.00	35
165	18.00	65.00	36
375	15.00	65.00	16
746	23.00	65.00	15

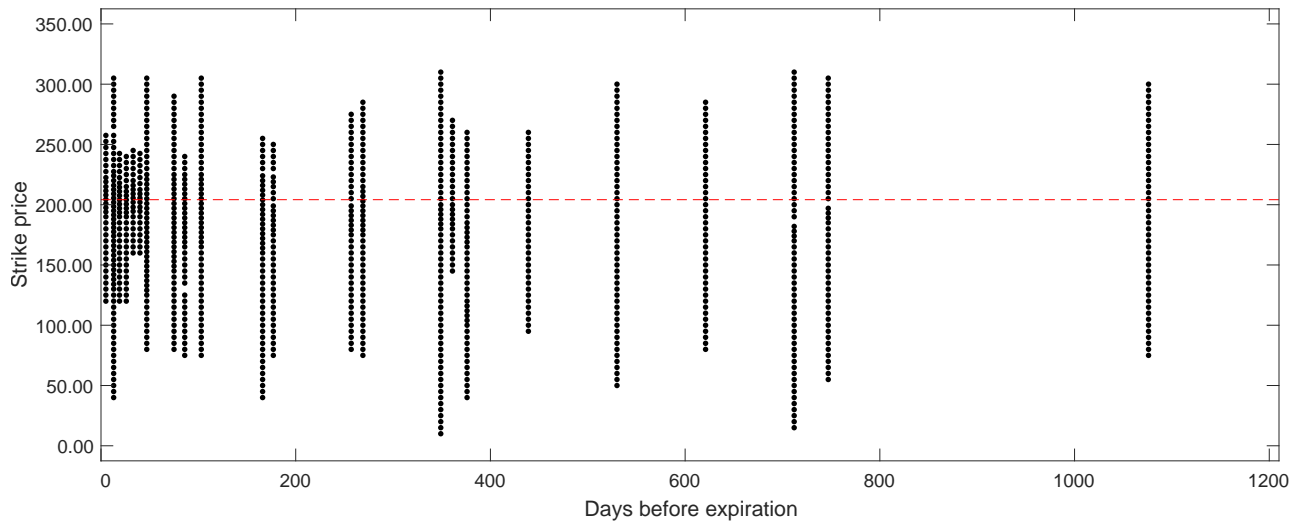
**Table 16:** Summary of option contracts with existent quote or trade records for EA on 05/01/2015.



**Figure 16:** Option contracts for XLK traded on 05/01/2015. Each dot corresponds to put and call contracts with specific time-to-maturity and strike (on the horizontal and vertical axes respectively). Red dashed line indicates the underlying spot price that is defined as XLK open price on 05/01/2015. Remark: only those contracts are shown for which quotes or trades are recorded in the OPRA database.

Days until expiration	Min strike	Max strike	Number of contracts
4	33.00	52.00	37
12	15.00	53.00	51
18	33.00	52.00	37
25	33.00	50.00	33
32	34.00	51.00	33
39	34.00	51.00	33
46	29.00	53.00	25
74	27.00	51.00	25
165	25.00	49.00	25
375	20.00	50.00	27
746	29.00	53.00	25

**Table 17:** Summary of option contracts with existent quote or trade records for XLK on 05/01/2015.



**Figure 17:** Option contracts for SPY traded on 05/01/2015. Each dot corresponds to put and call contracts with specific time-to-maturity and strike (on the horizontal and vertical axes respectively). Red dashed line indicates the underlying spot price that is defined as SPY open price on 05/01/2015. Remark: only those contracts are shown for which quotes or trades are recorded in the OPRA database.

Days until expiration	Min strike	Max strike	Number of contracts
4	120.00	260.00	84
12	40.00	305.00	182
18	120.00	245.00	76
25	120.00	240.00	67
32	160.00	245.00	60
39	160.00	245.00	58
46	80.00	305.00	126
74	80.00	290.00	107
85	75.00	240.00	80
102	75.00	305.00	95
165	40.00	255.00	94
176	75.00	250.00	64
256	80.00	275.00	60
268	75.00	285.00	74
348	10.00	310.00	78
360	145.00	270.00	42
375	40.00	260.00	76
438	95.00	260.00	34
529	50.00	300.00	51
620	80.00	285.00	42
711	15.00	310.00	70
746	55.00	305.00	60
1075	75.00	300.00	46

**Table 18:** Summary of option contracts with existent quote or trade records for SPY on 05/01/2015.