



## Exceptional & Rich ® U.S. 500 Factor Simulations

### Sandbox

AlphaBlock's "open indexing" is a systematic, scientific, and replicable method, which is based on a mathematical innovation [1][2][3][4][5][6][7][8][9][10] that allows for the construction of smart beta portfolios that are less concentrated, recover faster after a market fall and improve on the limitations of the current indexing methods [11][12][13]. The Exceptional & Rich [E&R] Indices Sandbox is a codebase that executes the following three steps. First; downloads yahoo EOD [end of day] closing price data. Second; generates relative performance rankings [detailed in the codebase]. Third; creates portfolios using these rankings. The portfolios are not rebalanced and are held for 3 holding periods [1, 2, and 3 years].

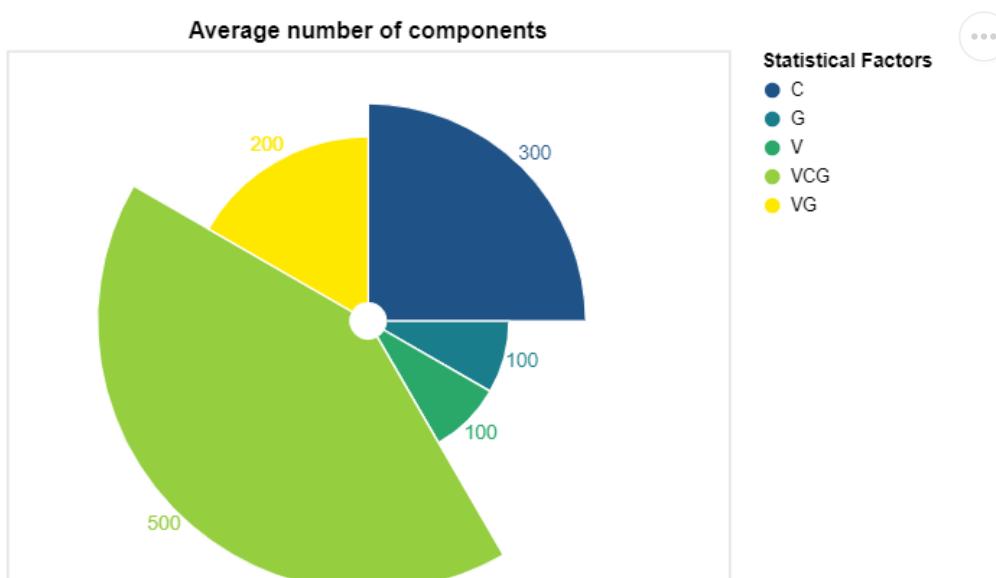
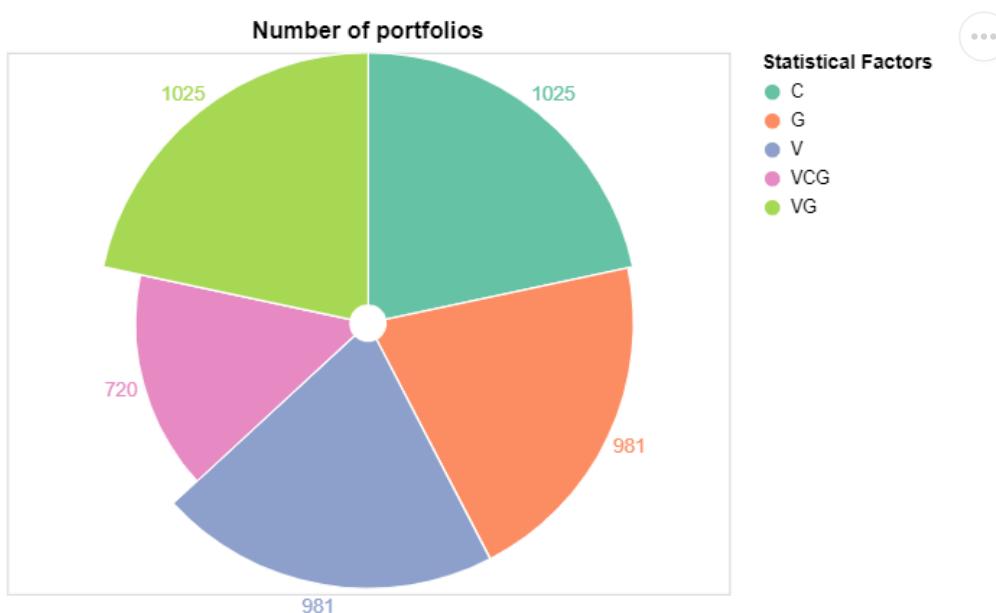
The method tests the following statistical factors. Value - if ranking is equal or below 20 i.e. bottom quintile [V]. Core - if ranking is between 20 and 80 i.e. rest quintiles ignoring top and bottom quintile [C]. Growth - if ranking is equal or above 80 i.e. top quintile [G]. The following types of portfolios are generated: Value [V], Core [C], Growth [G], Value Growth i.e. top and bottom quintile [VG], All quintiles [VCG]. Based on this data the following files are created: Summary Table, Index Drawdown, Index Draw Down Curve plot, and Daily Return. If the input type is All (VCG) the code will generate an unequal weighted portfolio with value and growth having 40% each and core only 20%. All other types of portfolios are equal weighted.

Exceptional & Rich U.S. 500 consists of the 500 large cap equity in United States. The sandbox studies the following factor portfolios with their respective number of components. The VCG 500, G 100, V 100, VG 200, and C 300. The benchmark for the group is S&P 500. 4732 simulations were run. On average, the factor models delivered an annualized excess return up to 9% for the study period of 6 years since 2016. G 100 was the top performer across different periods and rankings. G, VCG, and VG had the highest Annualized Excess Returns and highest Information Ratios among the five factors with Tracking Errors in the range of 5% to 8%. VG and C had the least Tracking Error, while V 100 had the least Information Ratio among all the factors. The sandbox continued to highlight the poor performance of Value [V], the neutrality of Core [C], and the superior risk-return tradeoff with Growth [G], Value Growth [VG], and the Value Core Growth [VCG] method. The VCG had the highest number of components among all the factors and hence was the best overall factor model to compare with the benchmark.

### 1: Input Data

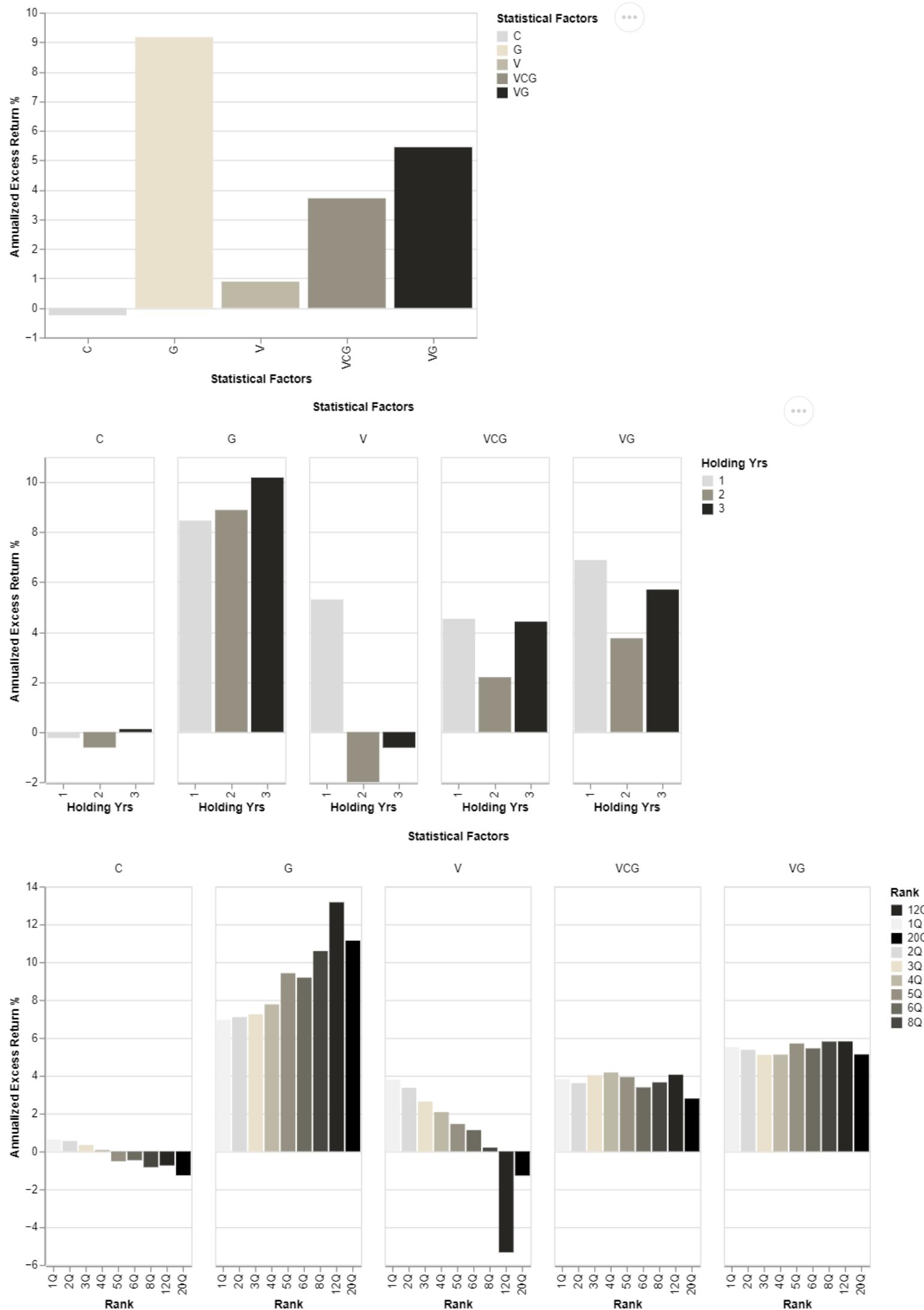
Input data defines the Exceptional & Rich Model, benchmark, inception point, number of components and the number of simulations run.

Group name	Benchmark	Total number of portfolios	Number of components	Portfolios starting year
Exceptional & Rich U.S. 500	S&P 500	4732	500	2016



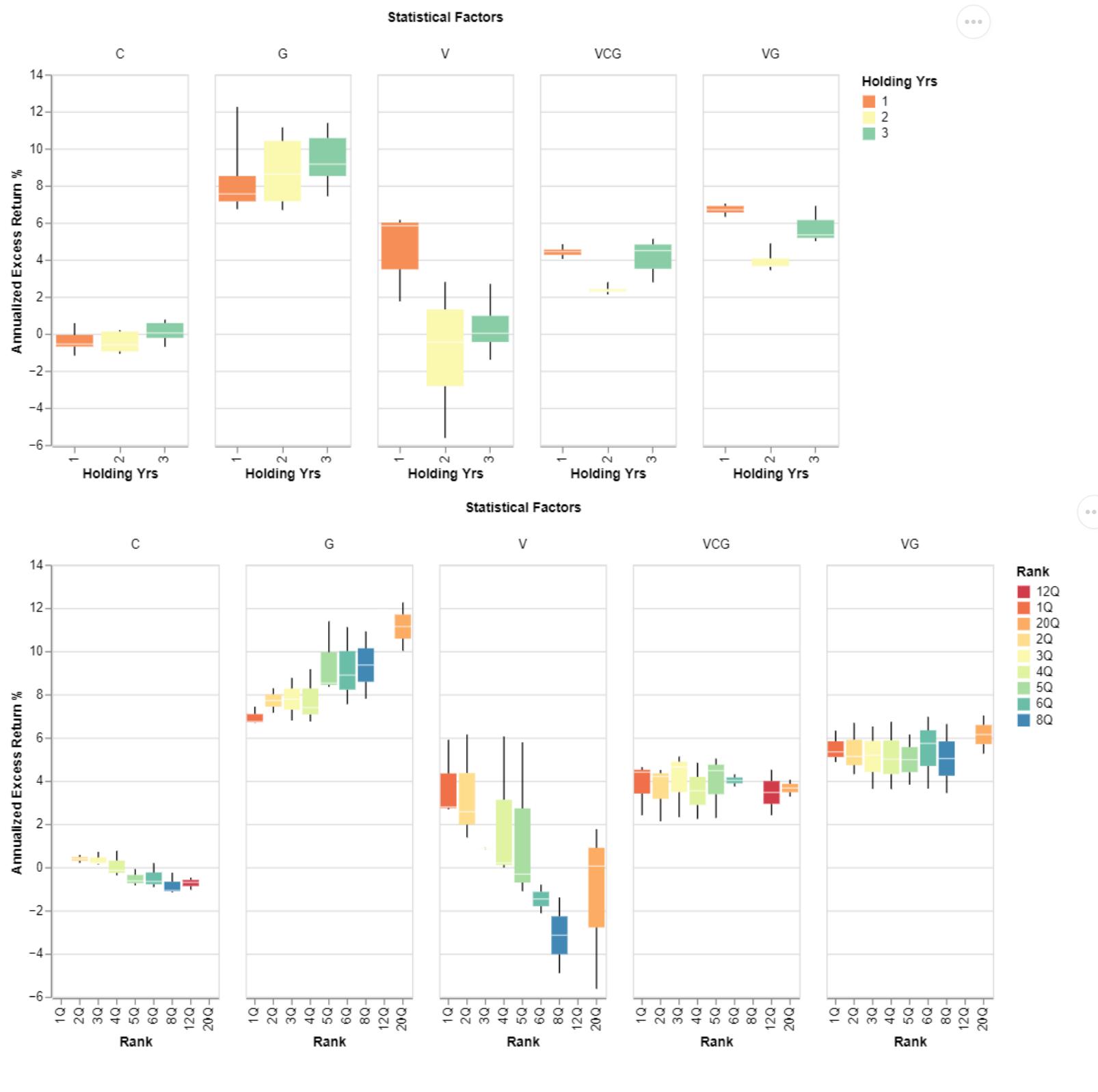
## 2: Average Annualized Excess Return Histograms for Various Factors

The histogram illustrates the average Annualized Excess Returns for the various statistical factors, across the three different holding periods and for the respective quarterly proxy ranking periods.



### 3: Quartile BoxPlots for Annualized Excess Returns

The Boxplots show minimum, first quartile, median, third quartile, and maximum annualized Excess Return for various statistical factors, for different holding periods, and for the respective quarterly proxy rankings. The outliers were removed from the data.

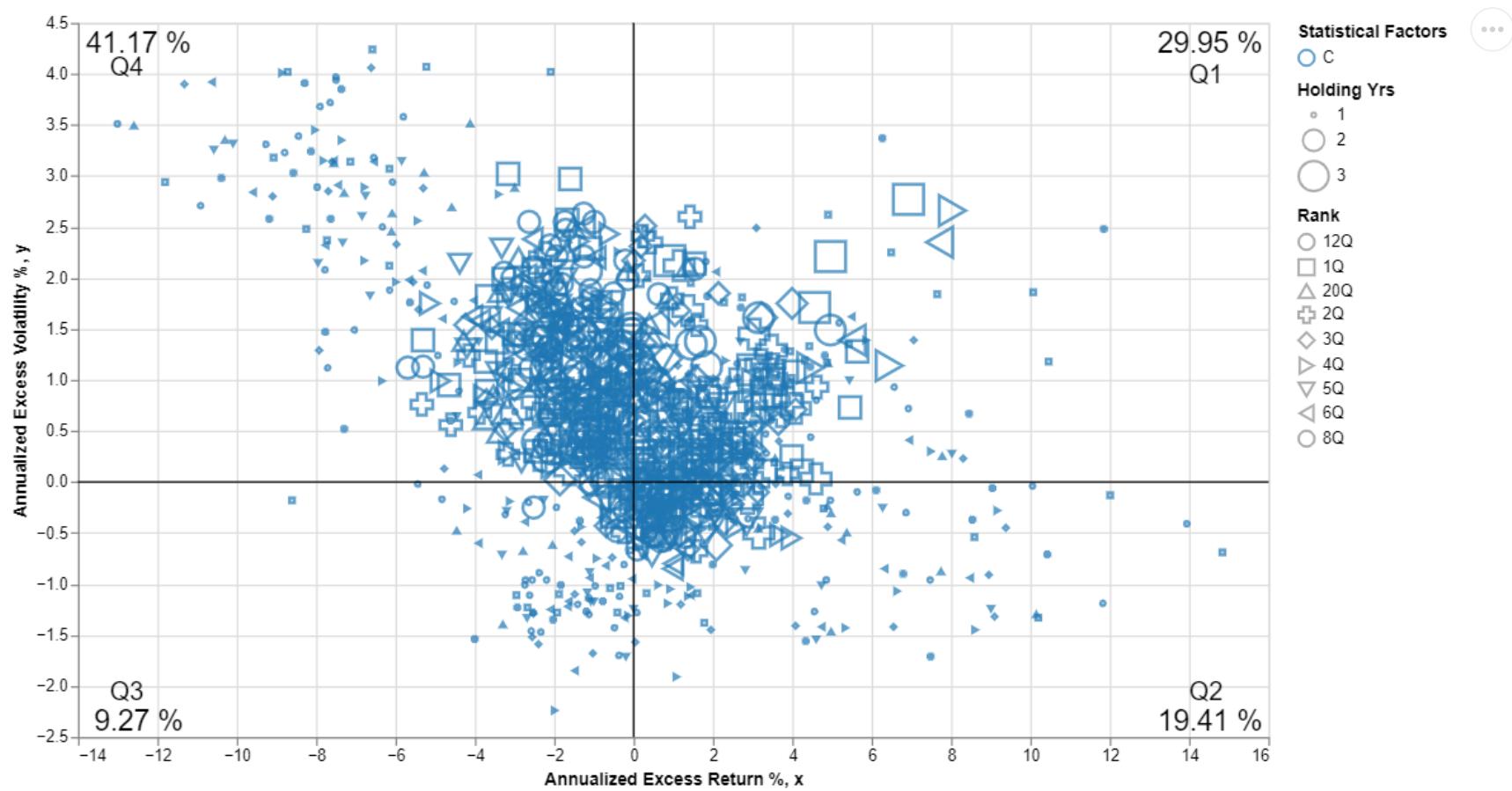
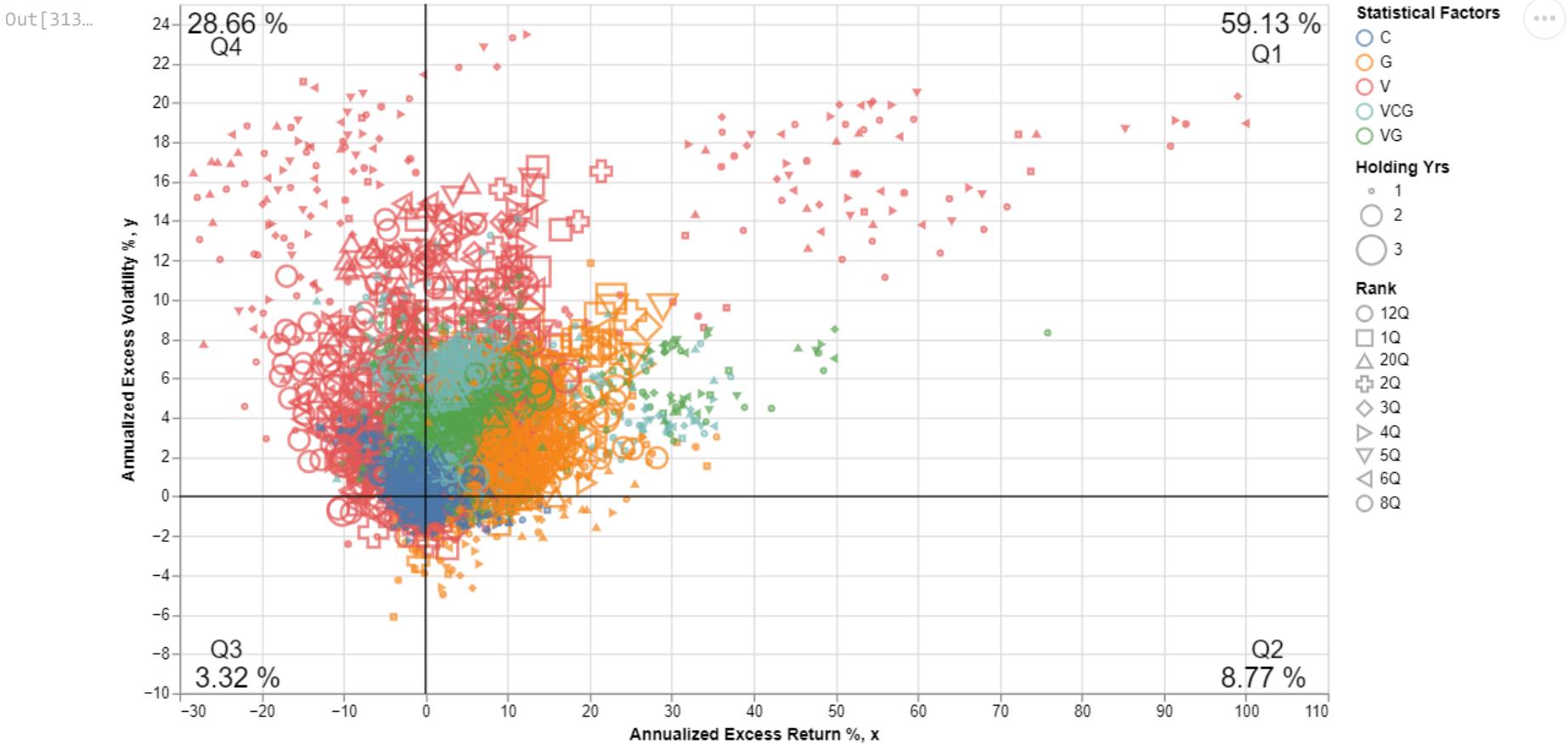


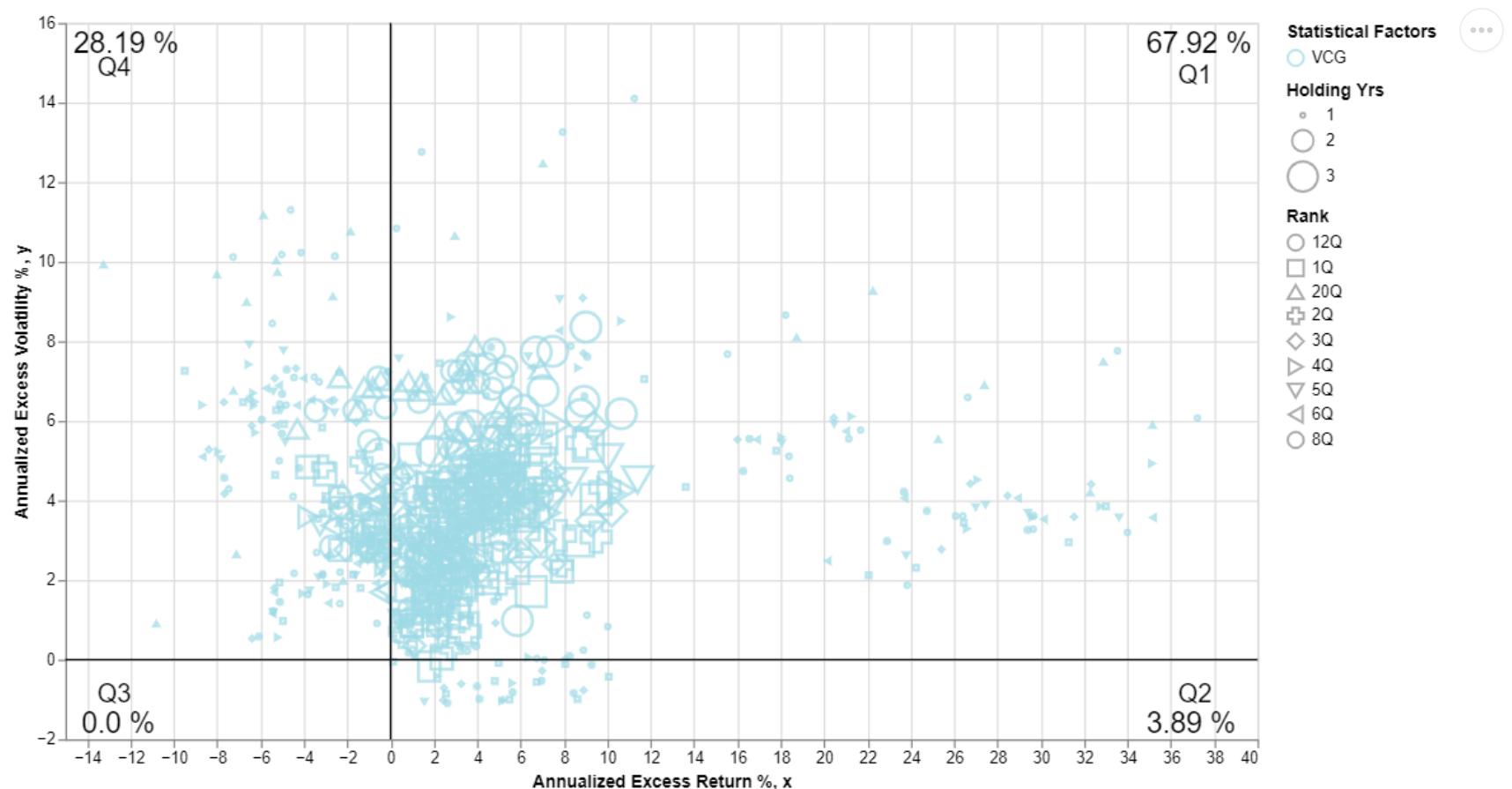
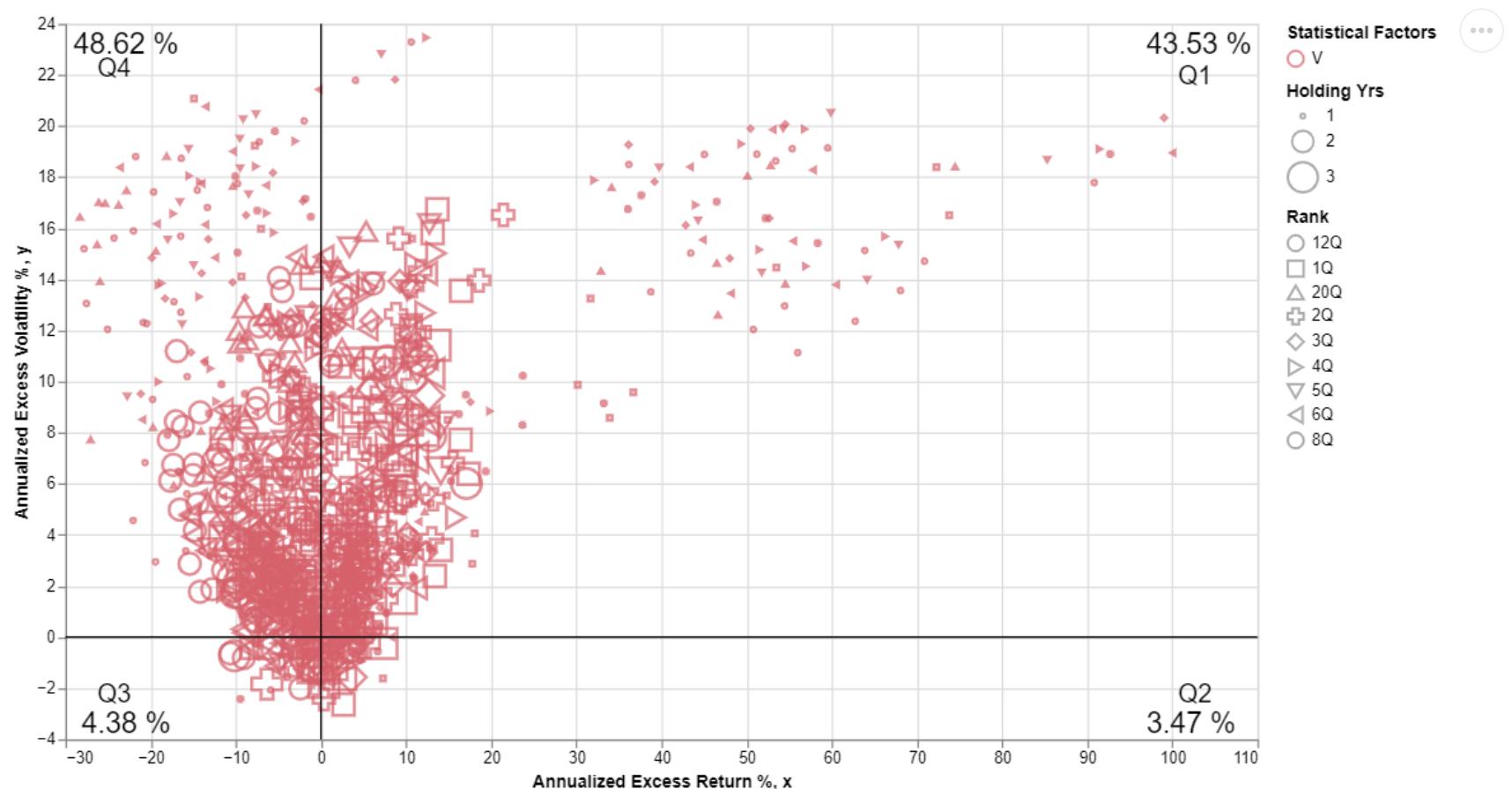
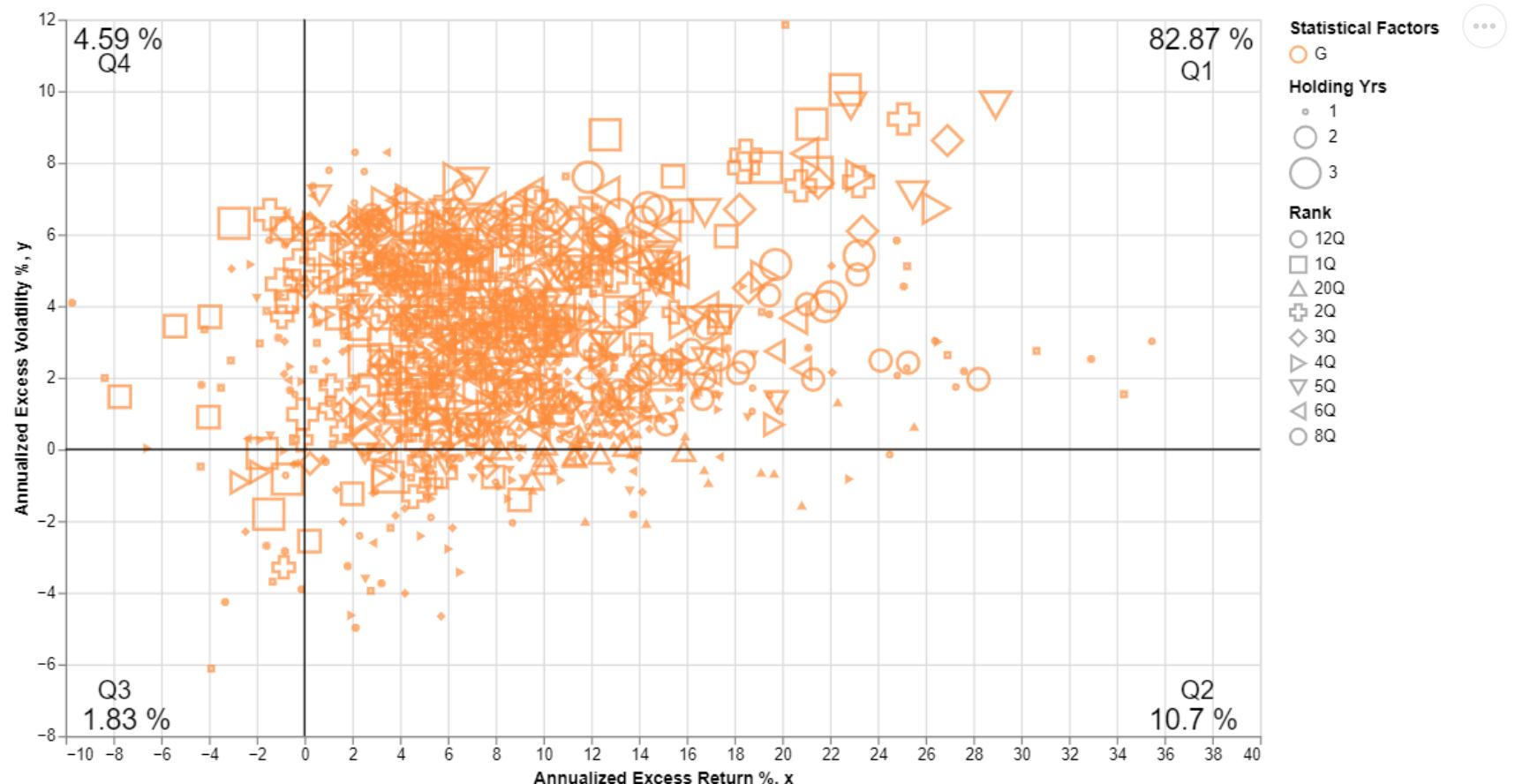
## 4: Cartesian Plots for various Statistical Measures

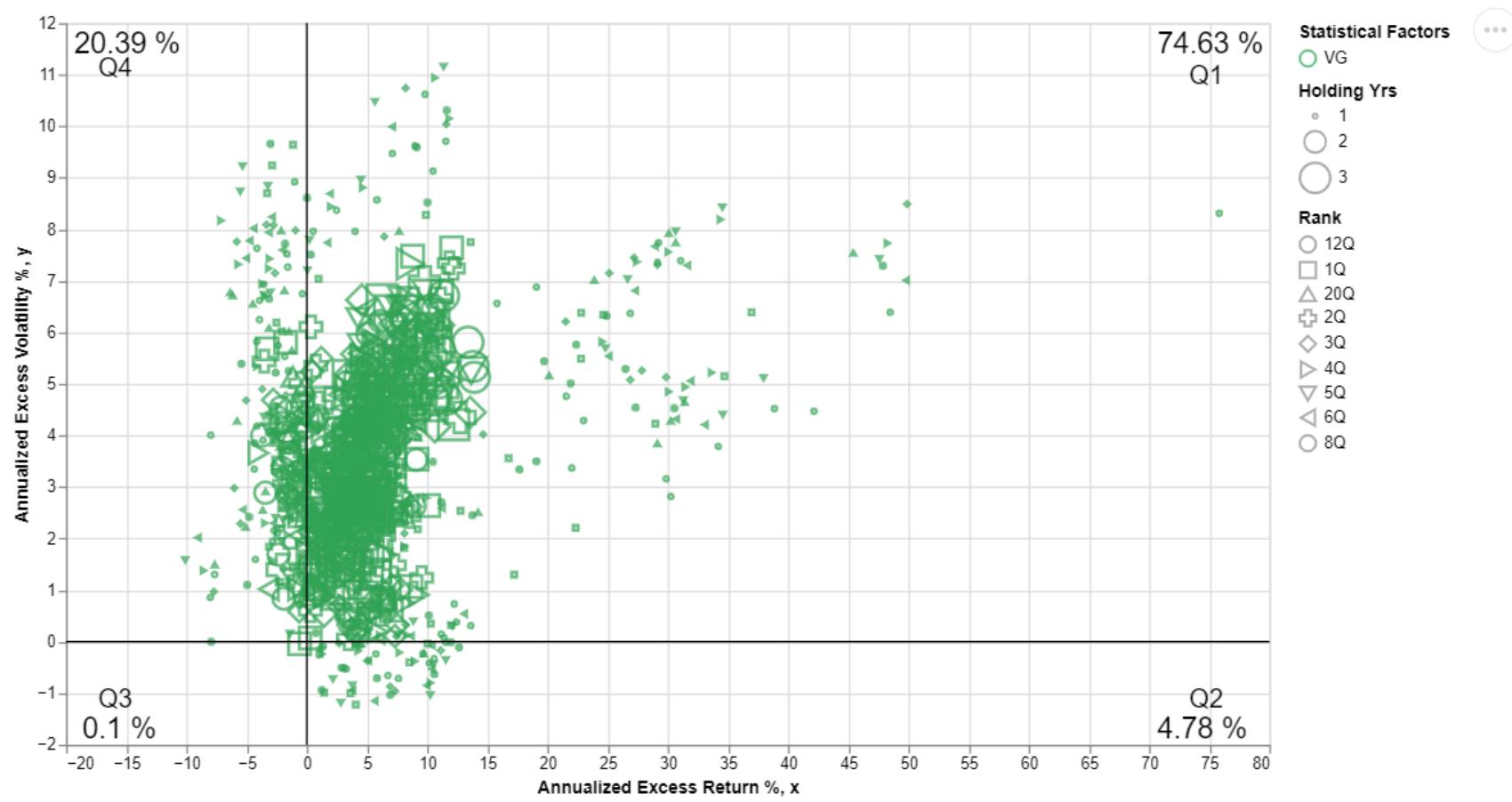
The Cartesian plots below illustrate Annualized Excess Returns vs. Annualized Excess Volatility, Information Ratio vs. Annualized Excess Returns, Annualized Excess Volatility vs. Information Ratio, Alpha vs. Beta and Tracking Error vs Information Ratio plotted for different statistical factors, for different holding periods and for respective quarterly proxy rankings.

### 4.1: Annualized Excess Return vs. Annualized Excess Volatility

The Cartesian chart of Annualized Excess Return vs. Annualized Excess Volatility plotted for different statistical factors, for different holding periods and for respective quarterly proxy rankings.

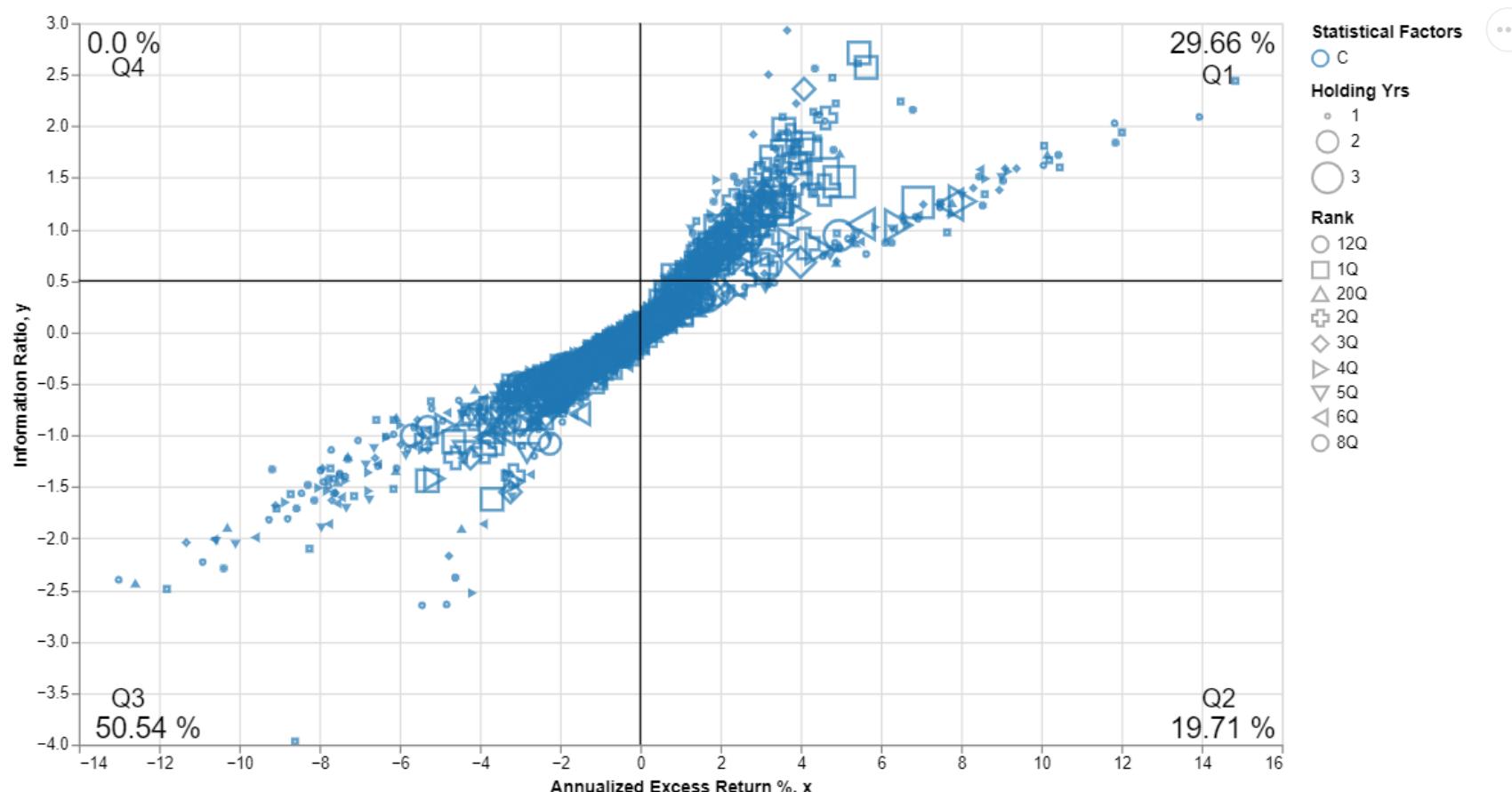
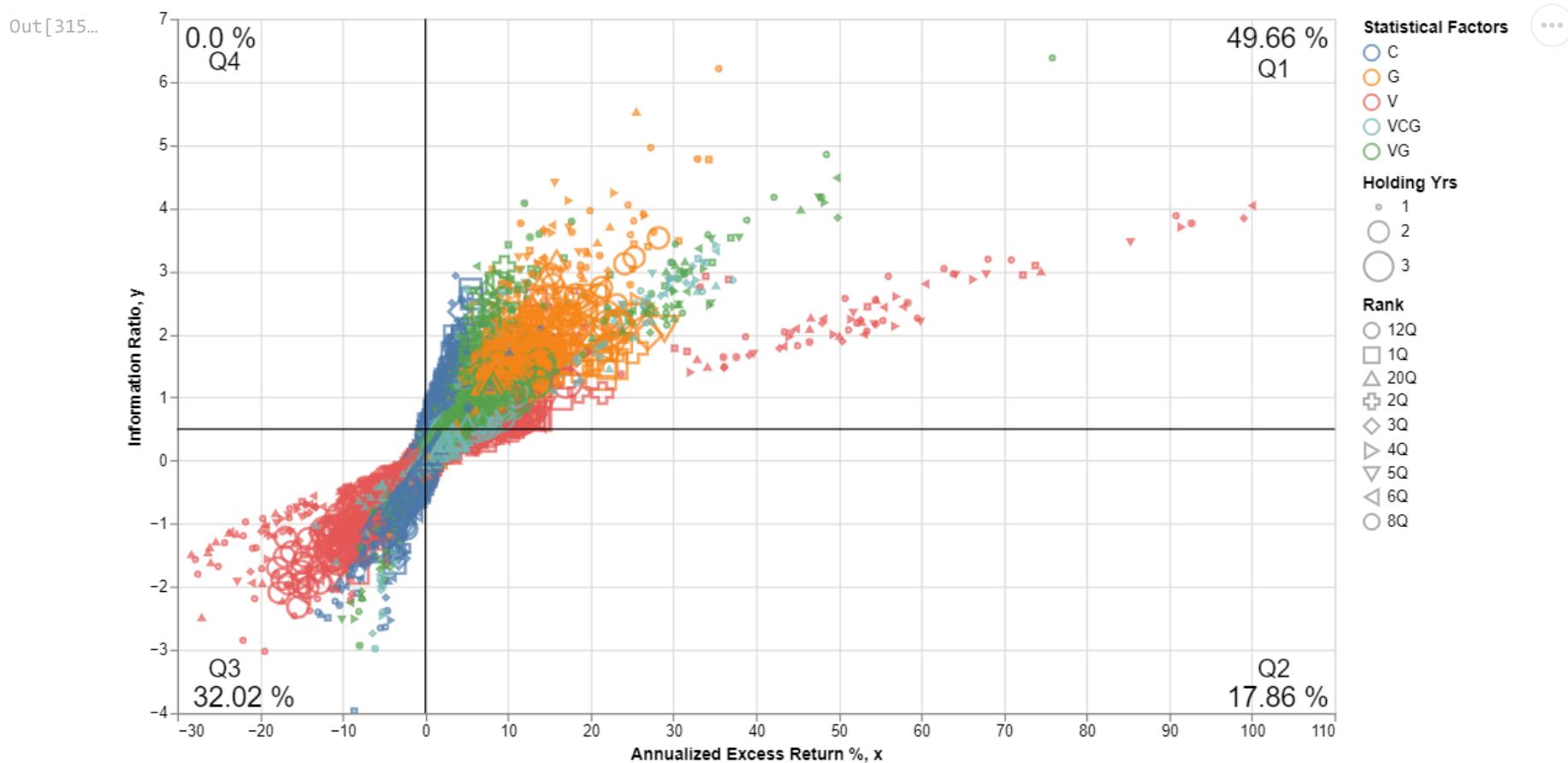


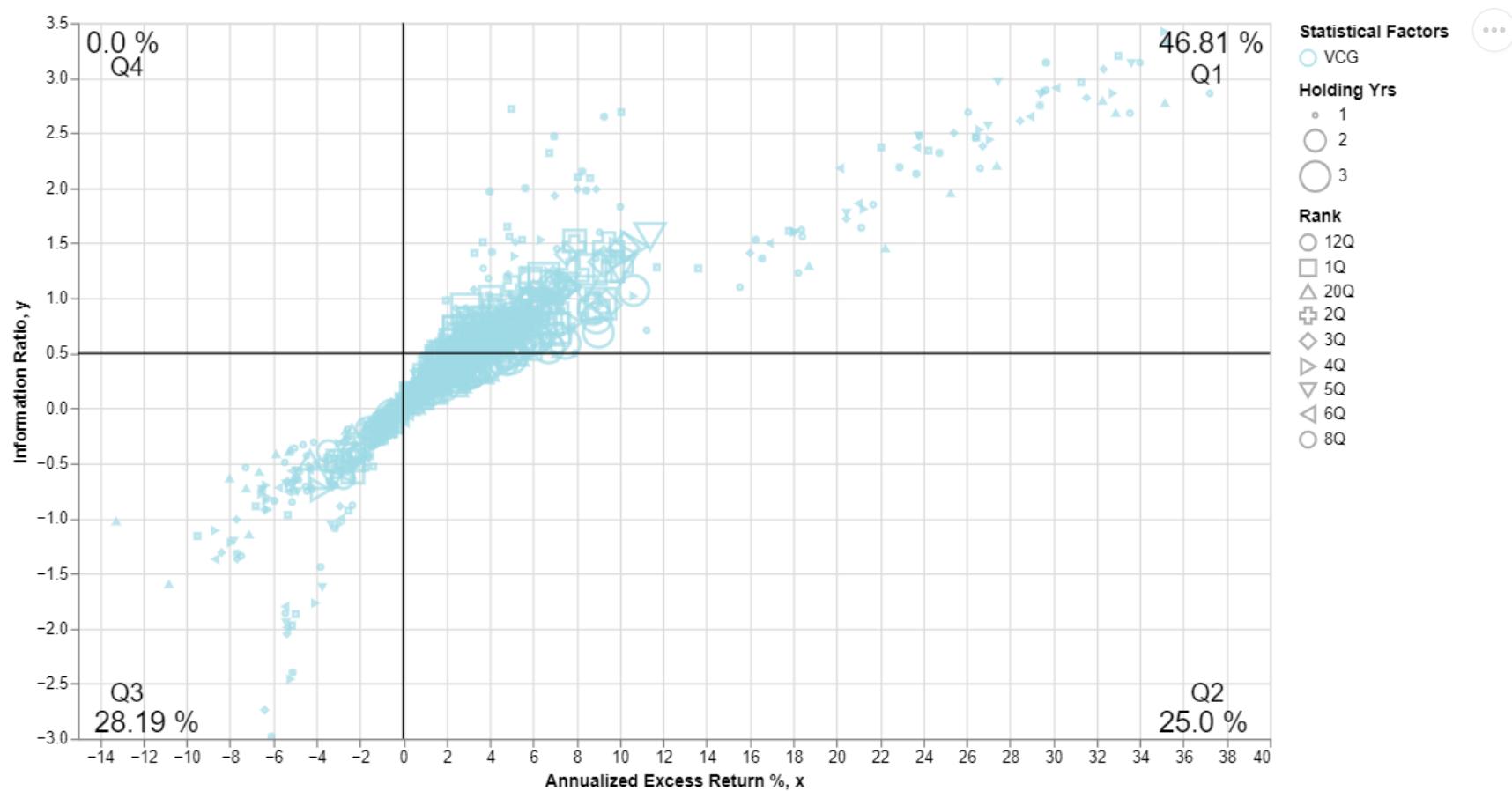
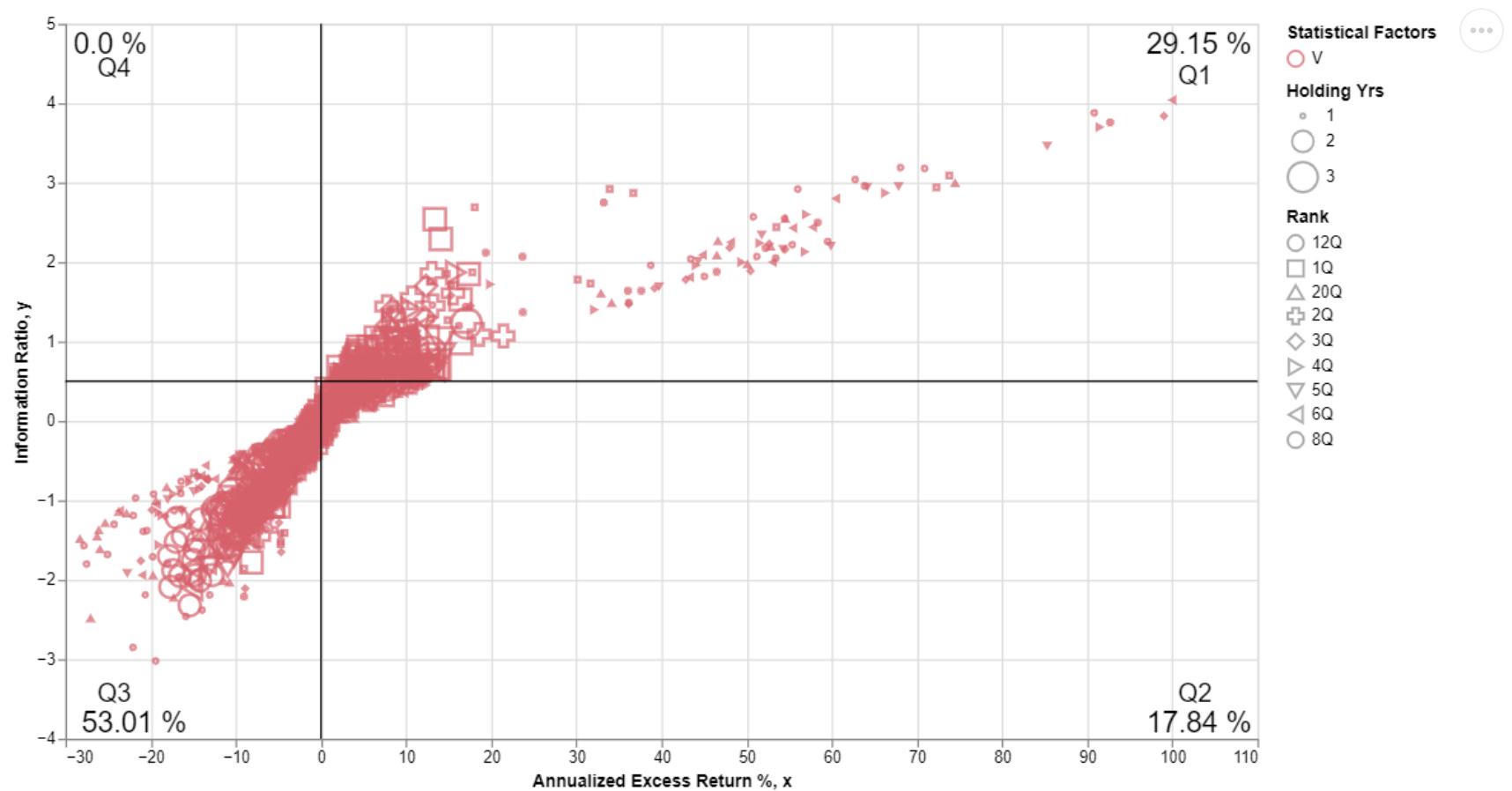
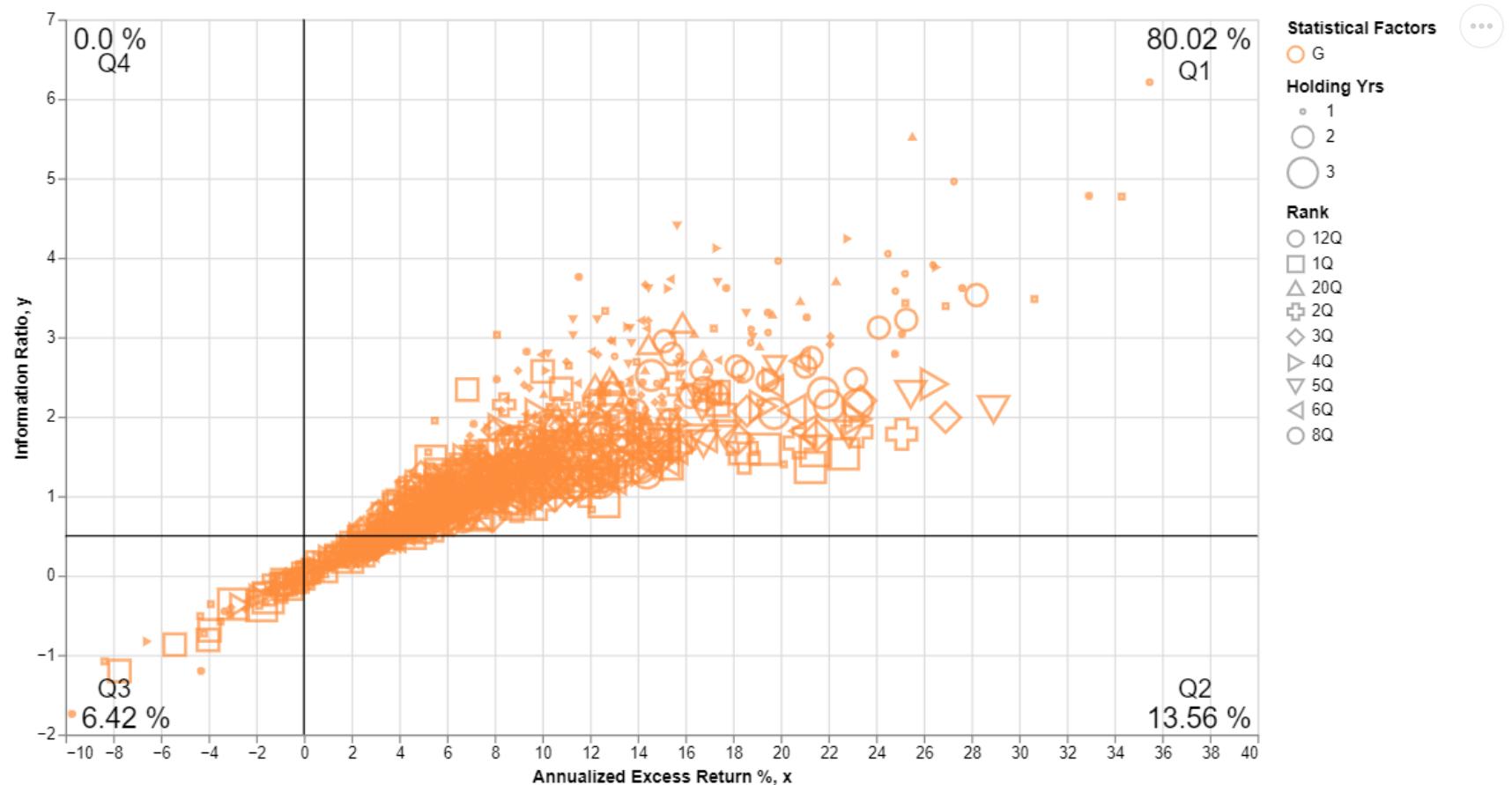


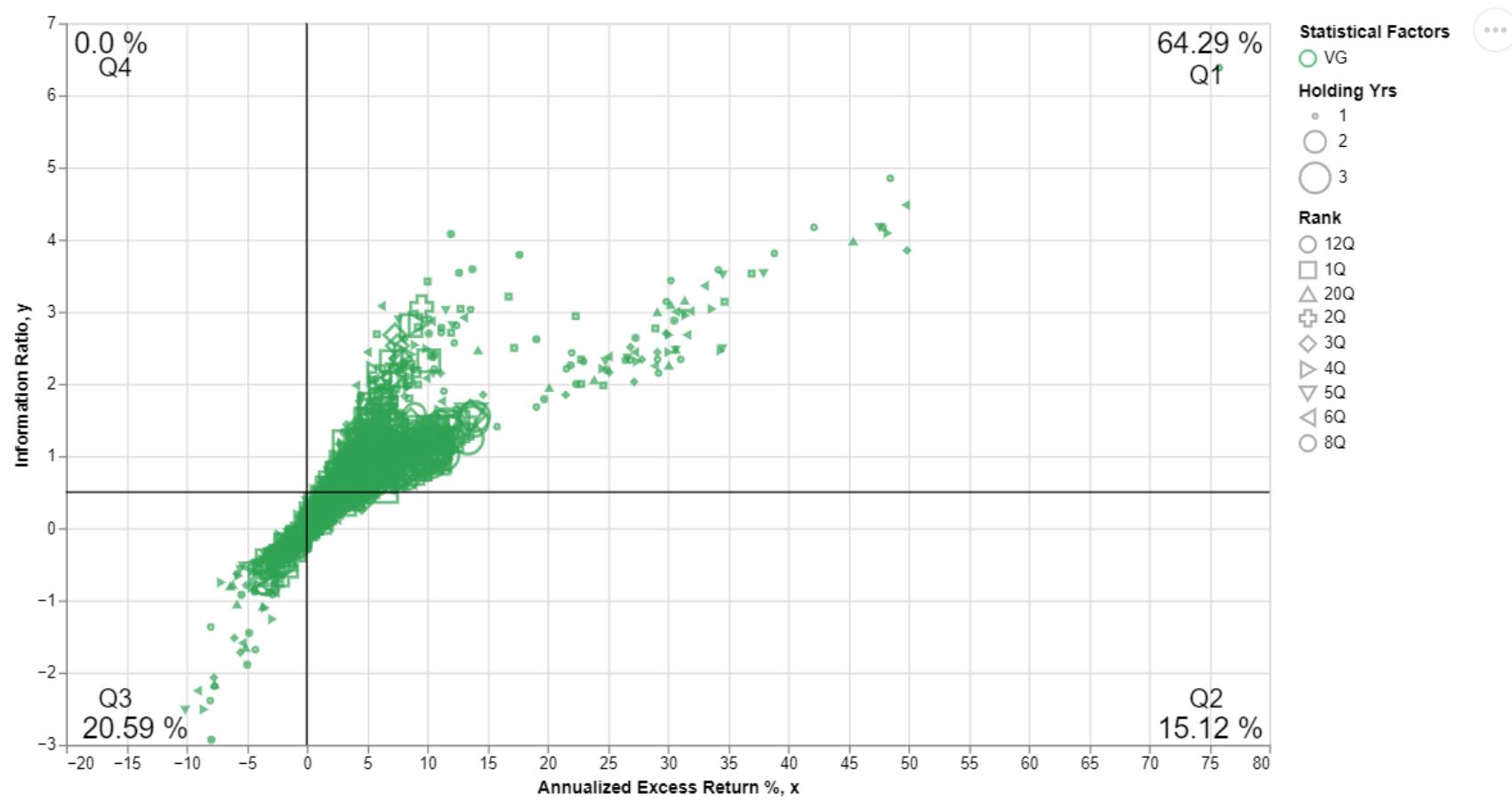


#### 4.2: Annualized Excess Return vs. Information Ratio

The Cartesian chart of Annualized Excess Return vs. Information Ratio plotted for different statistical factors, for different holding periods and for respective quarterly proxy rankings.

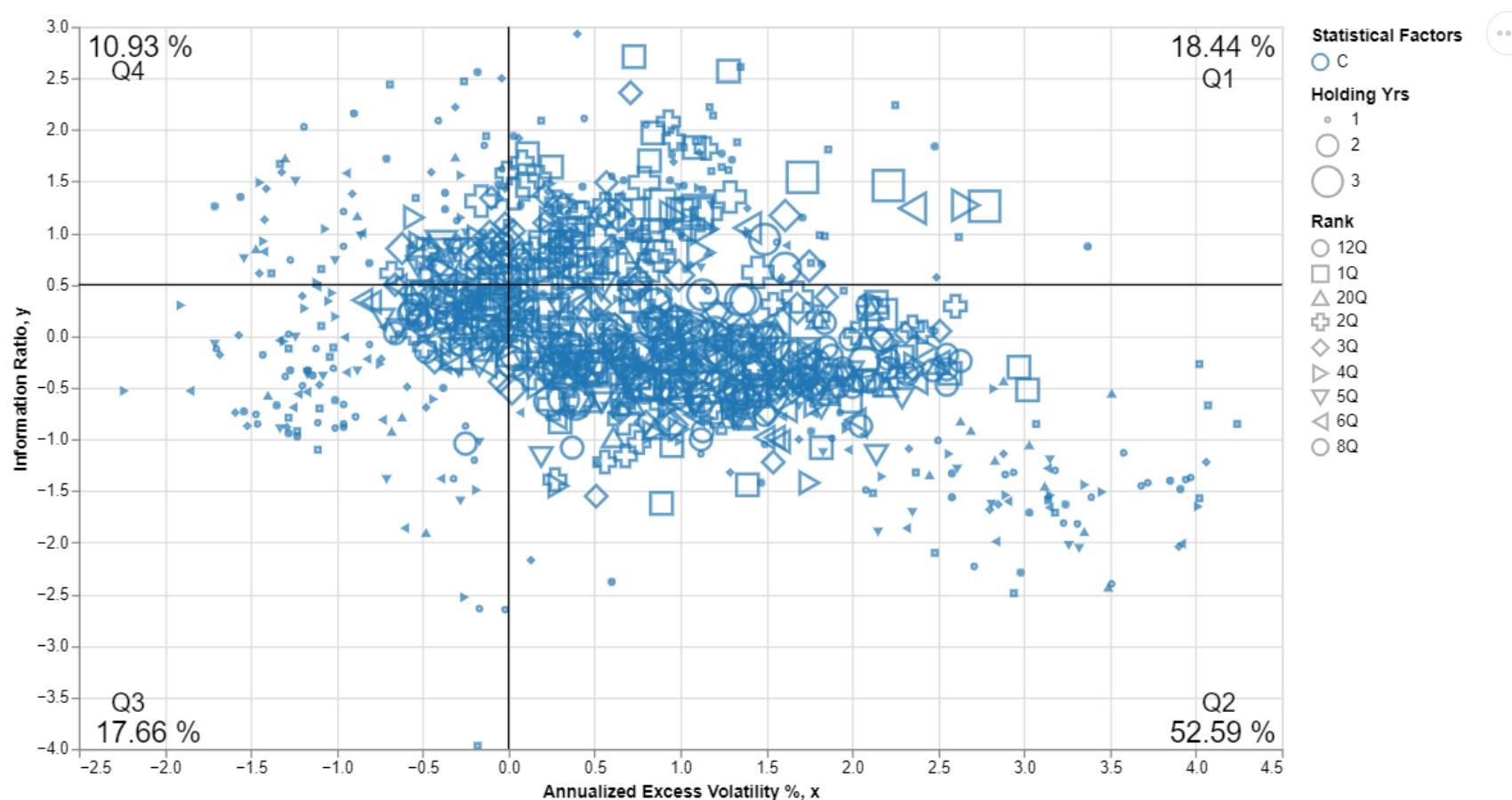
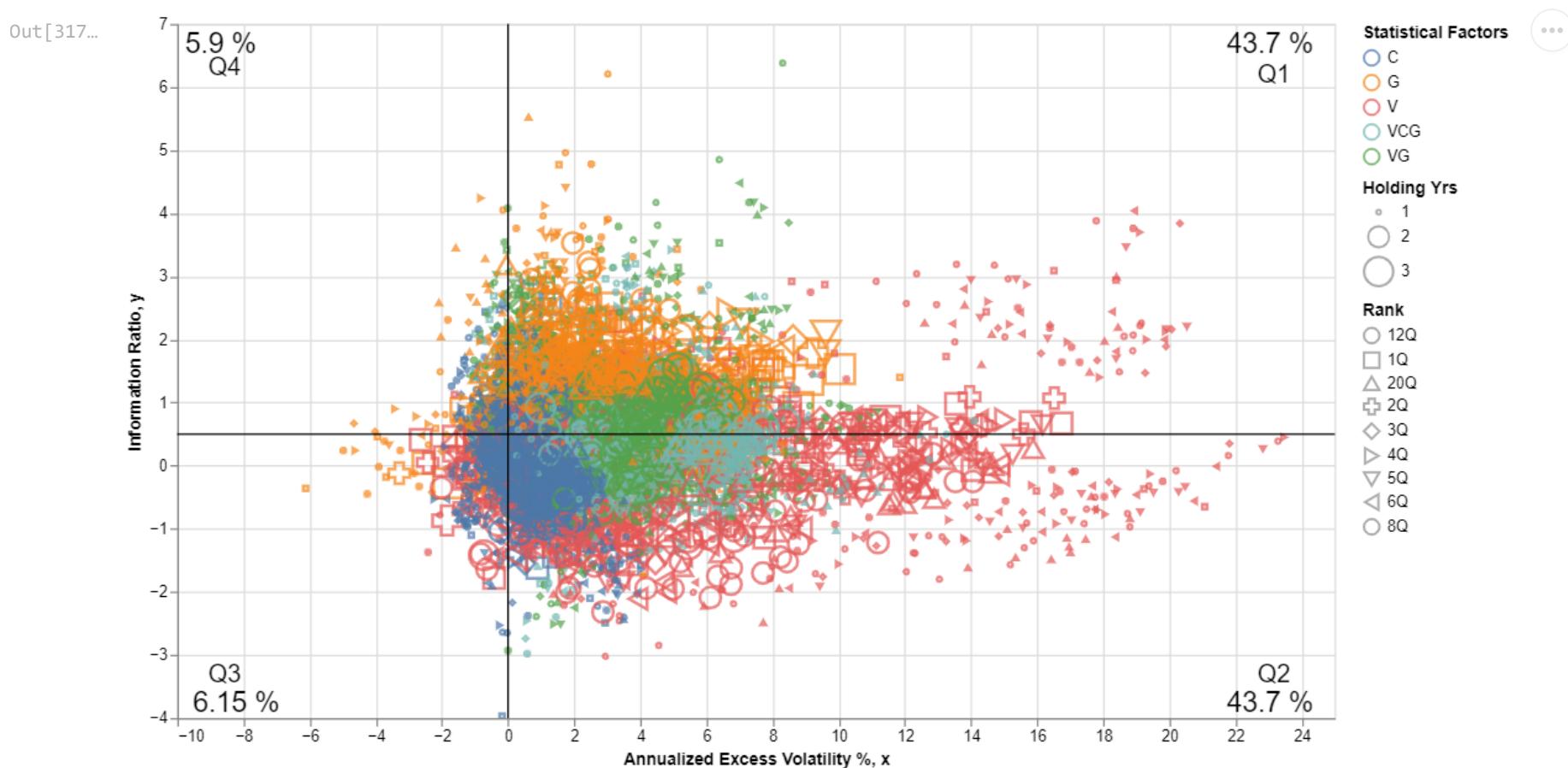


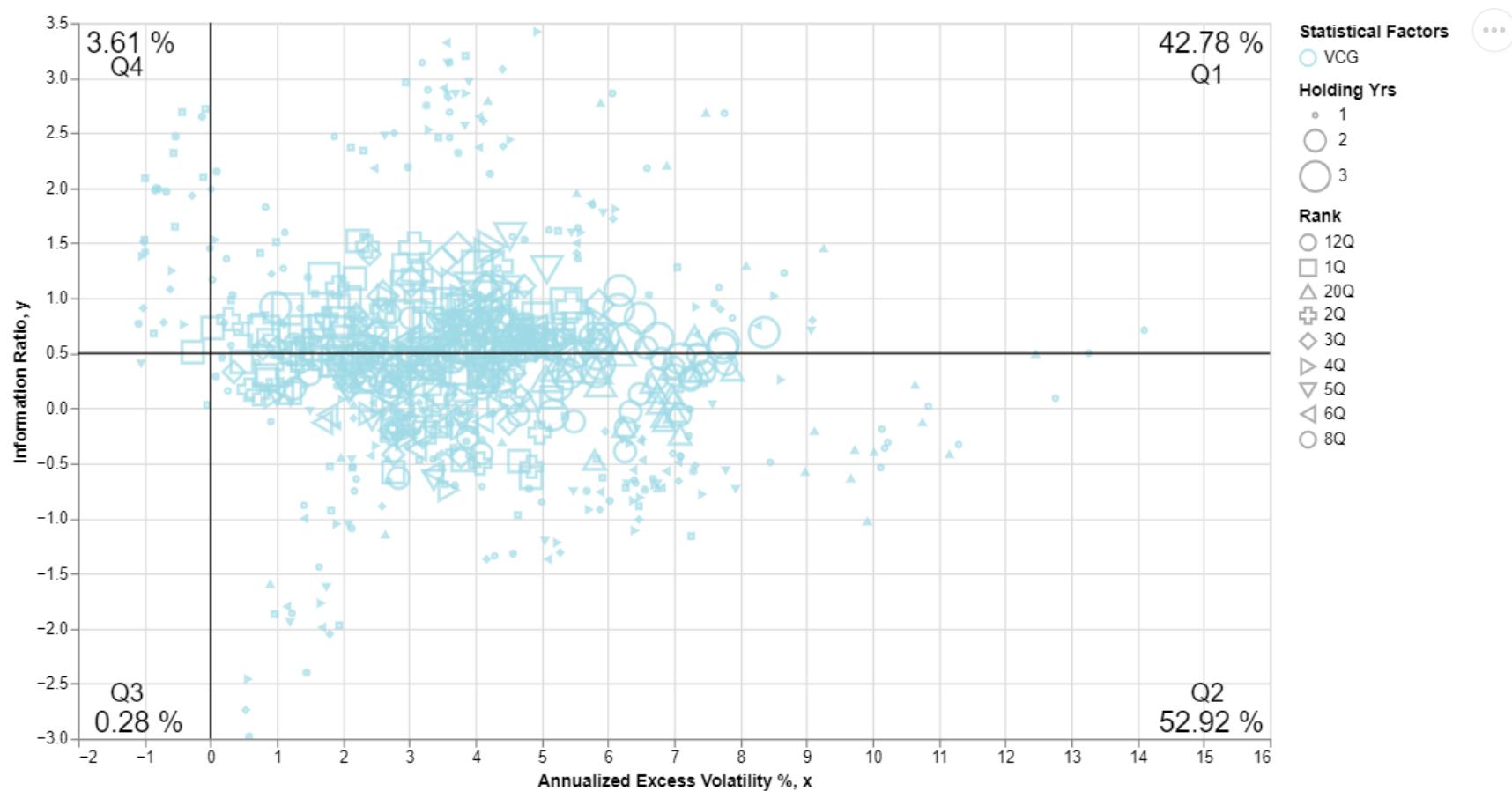
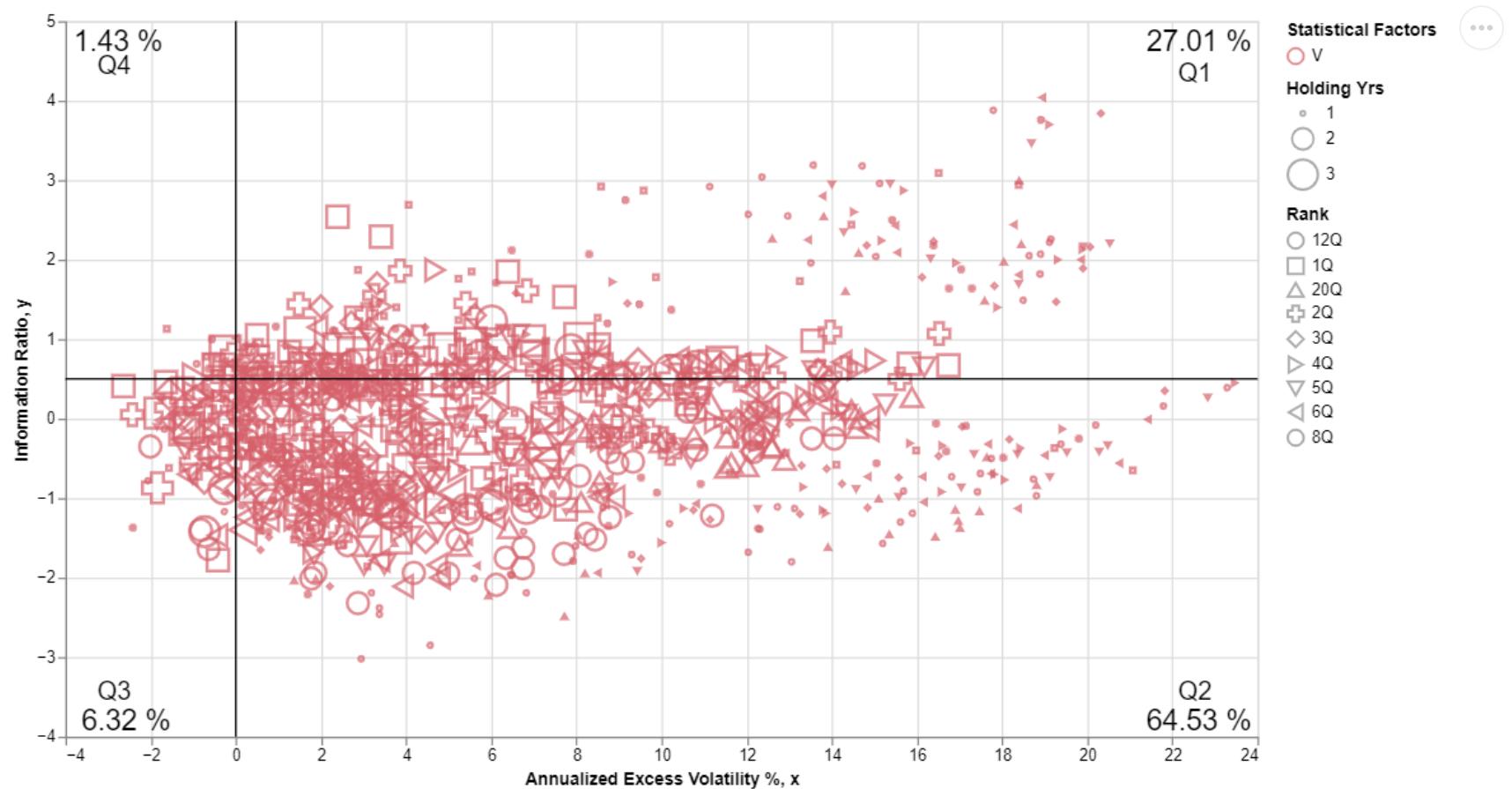
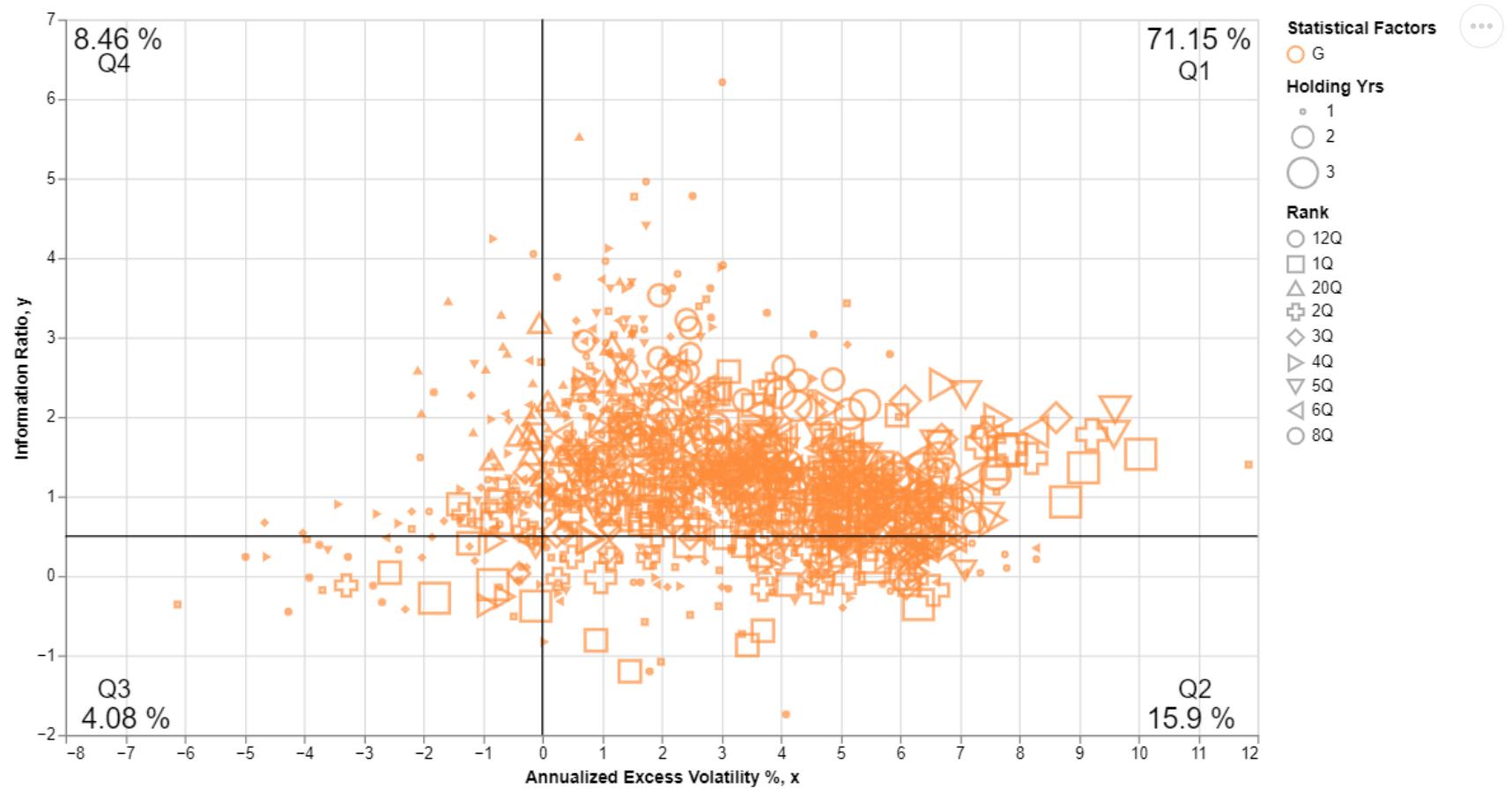


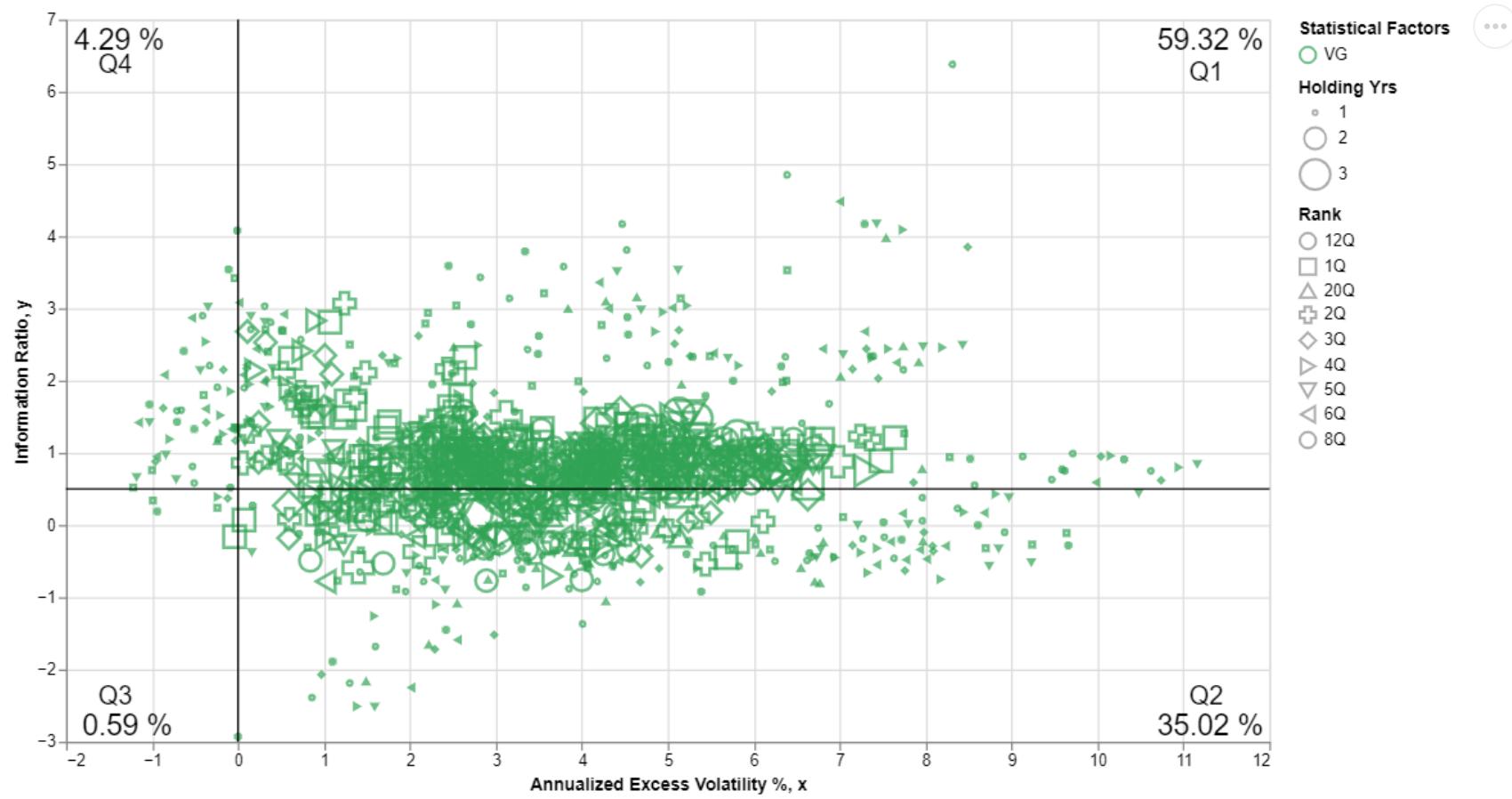


#### 4.3: Annualized Excess Volatility vs. Information Ratio

The Cartesian chart of Annualized Excess Volatility vs. Information Ratio plotted for different statistical factors, for different holding periods and for respective quarterly proxy rankings.

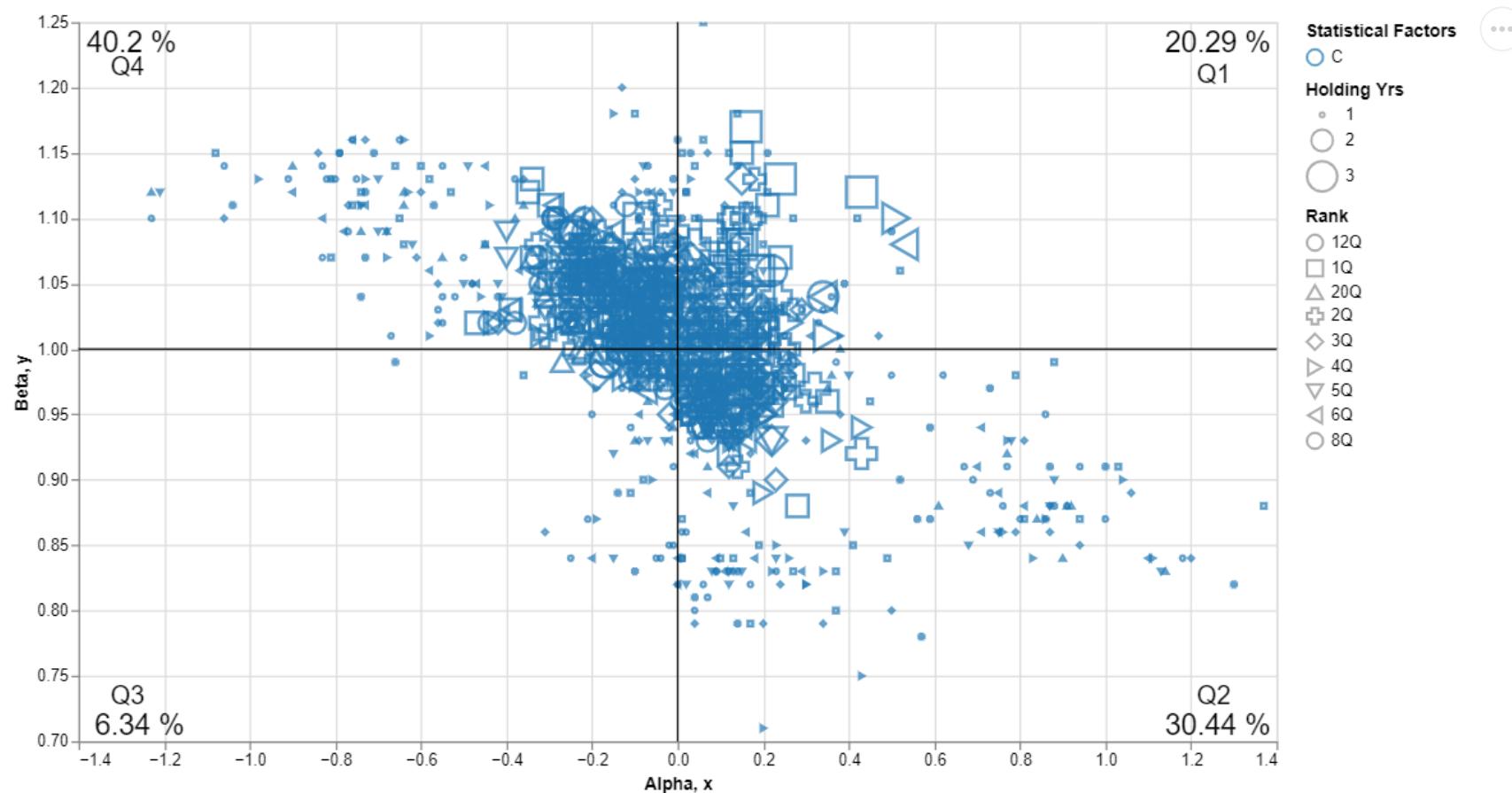
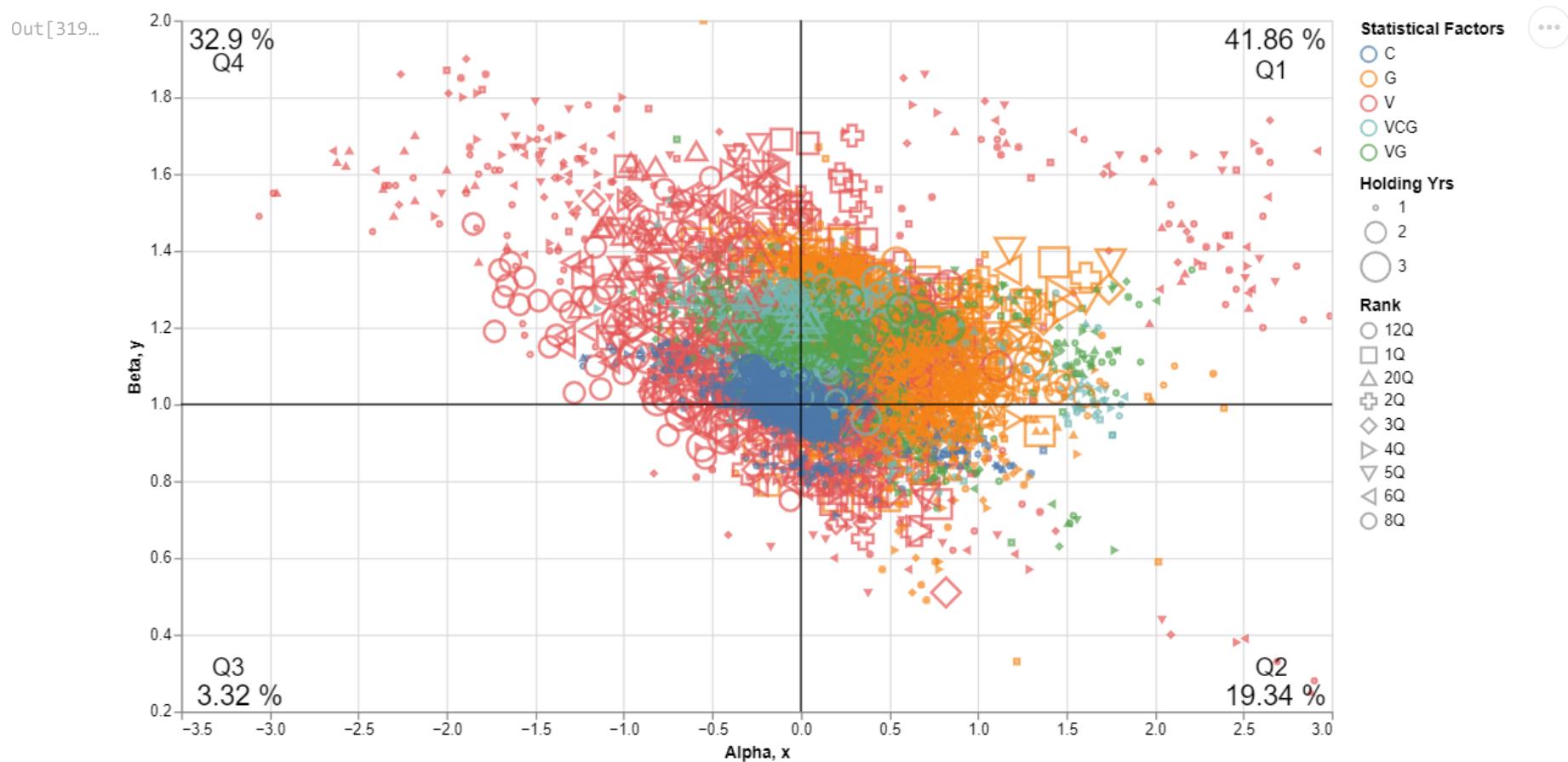


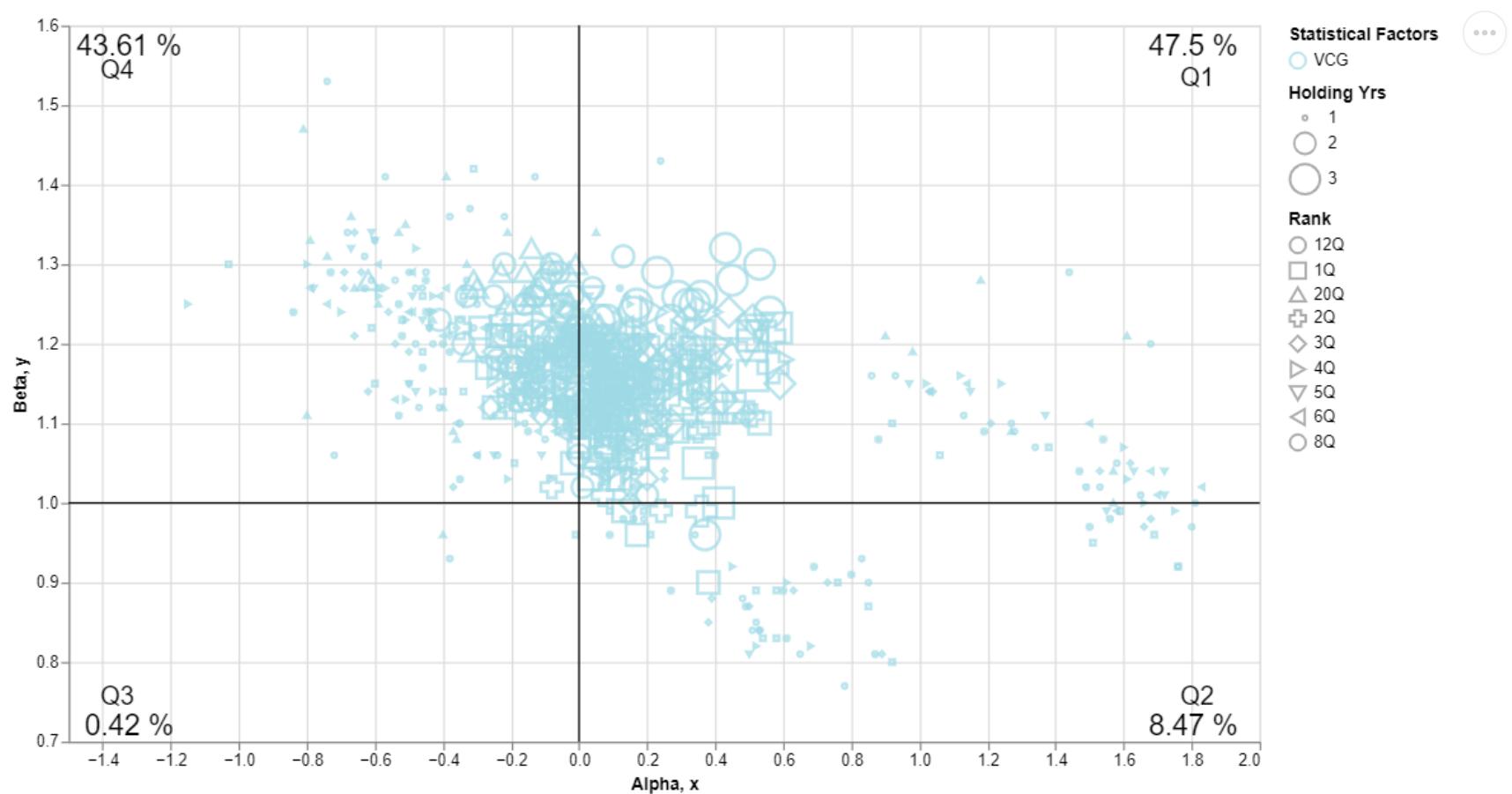
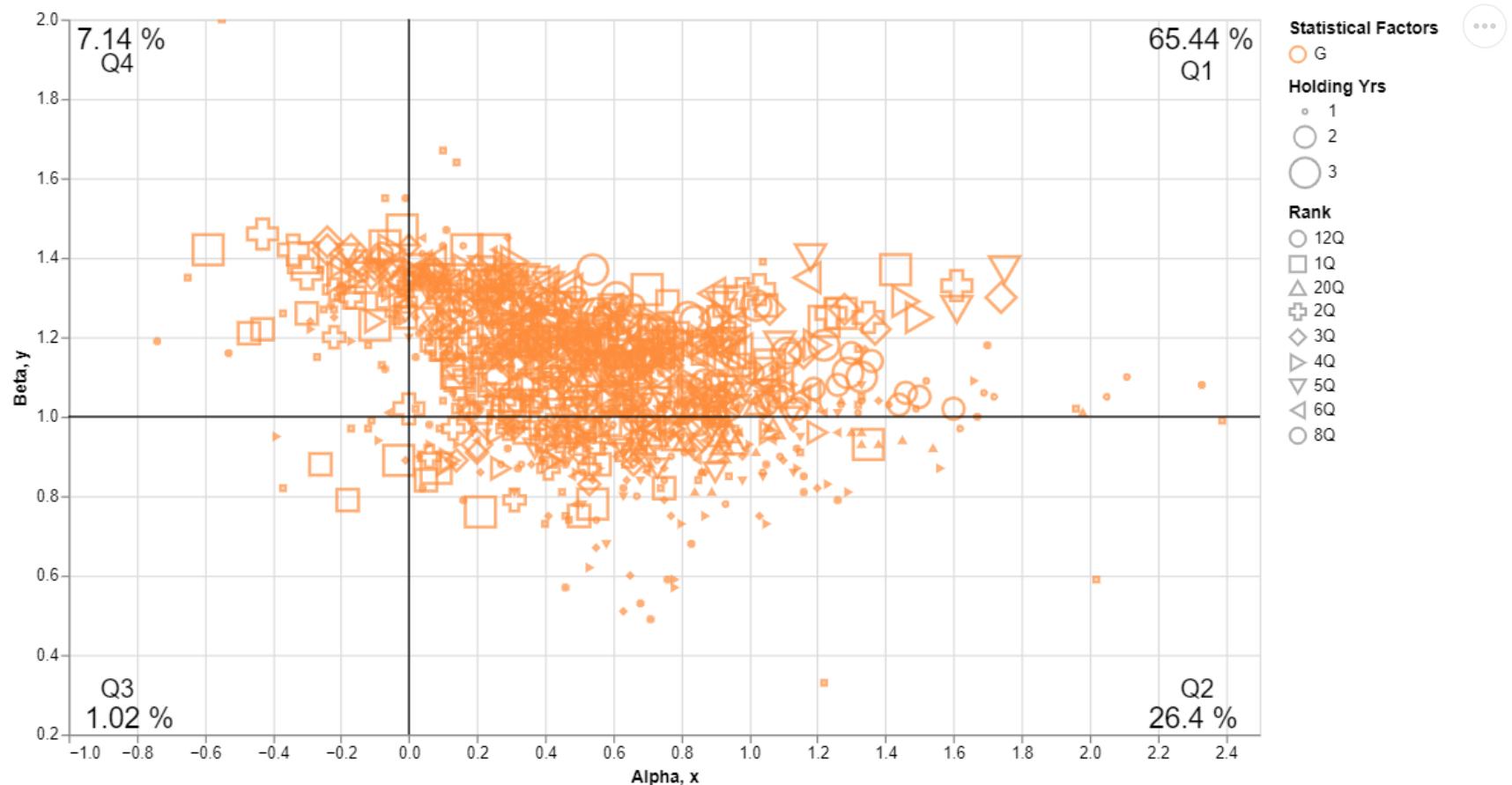


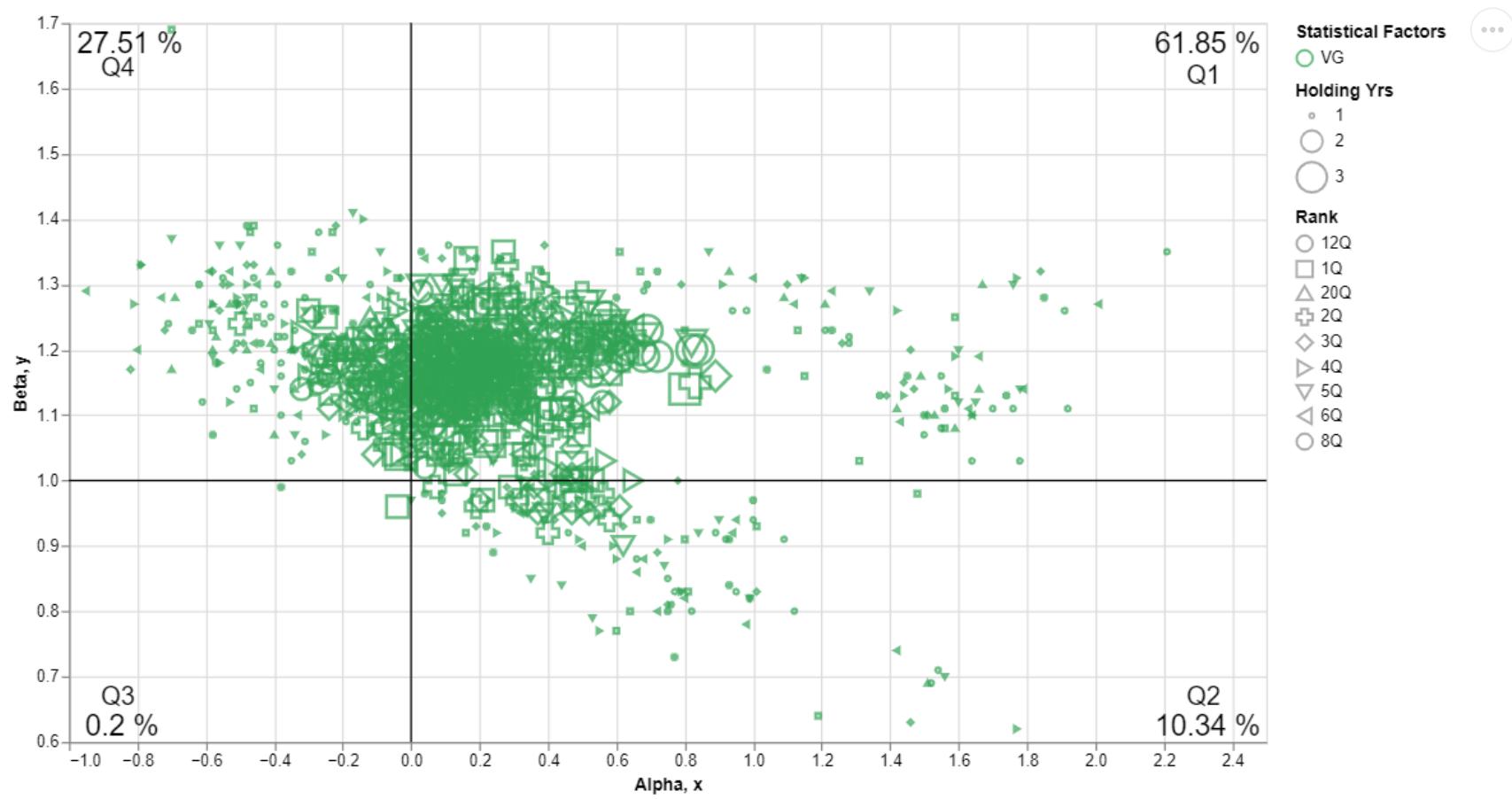


#### 4.4: Alpha vs. Beta

The Cartesian chart of Alpha vs. Beta plotted for different statistical factors, for different holding periods and for respective quarterly proxy rankings.

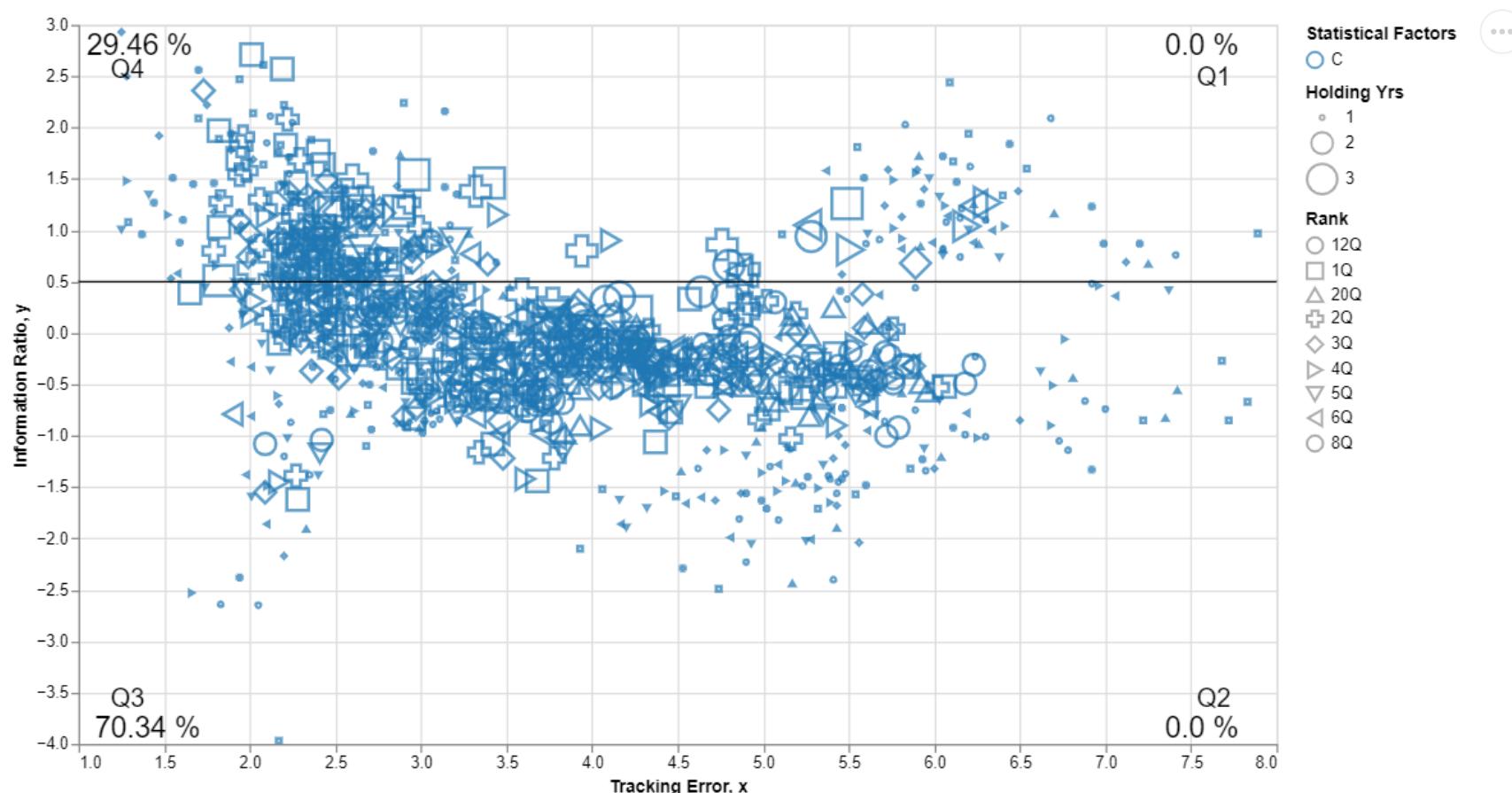
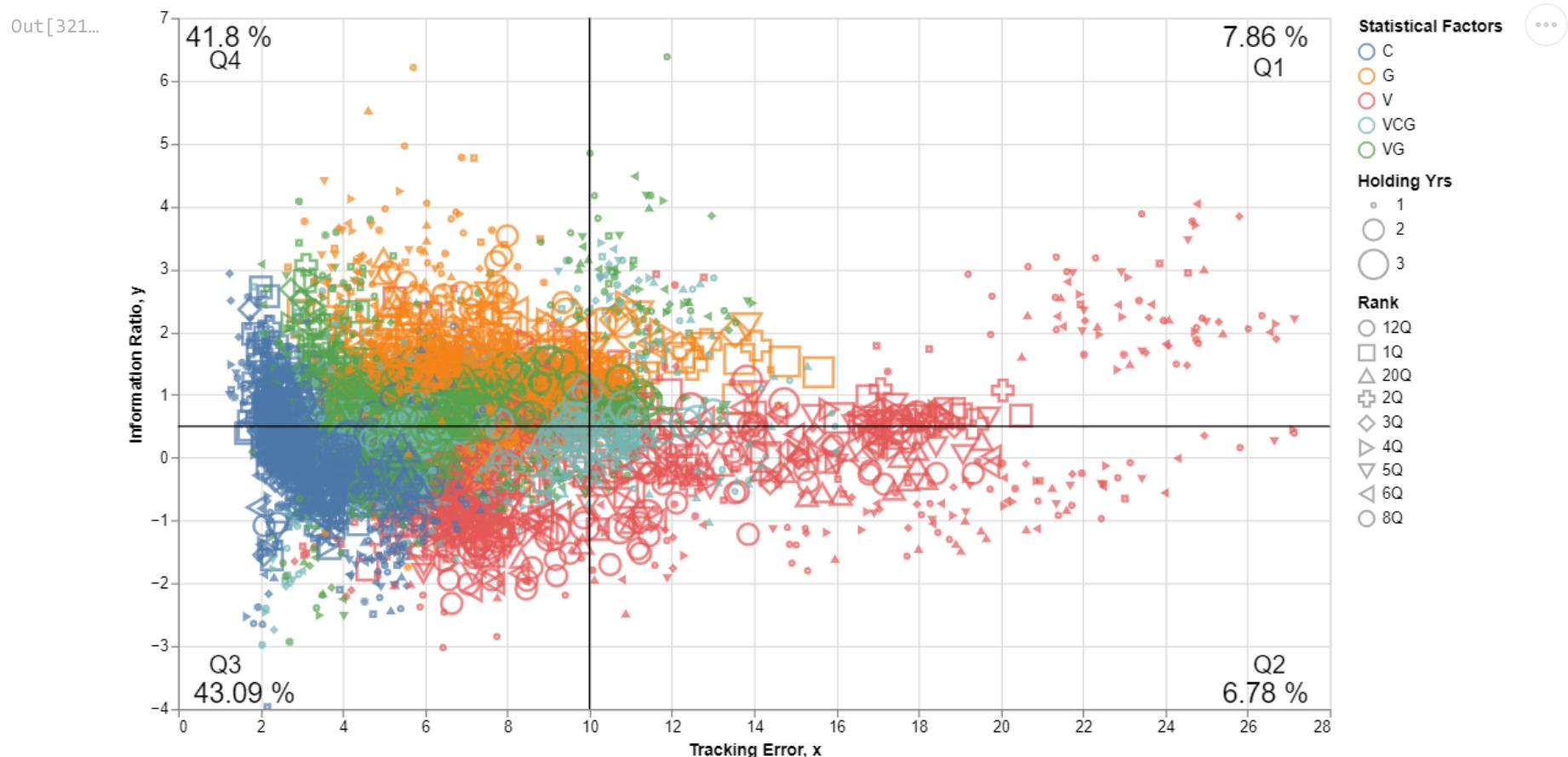


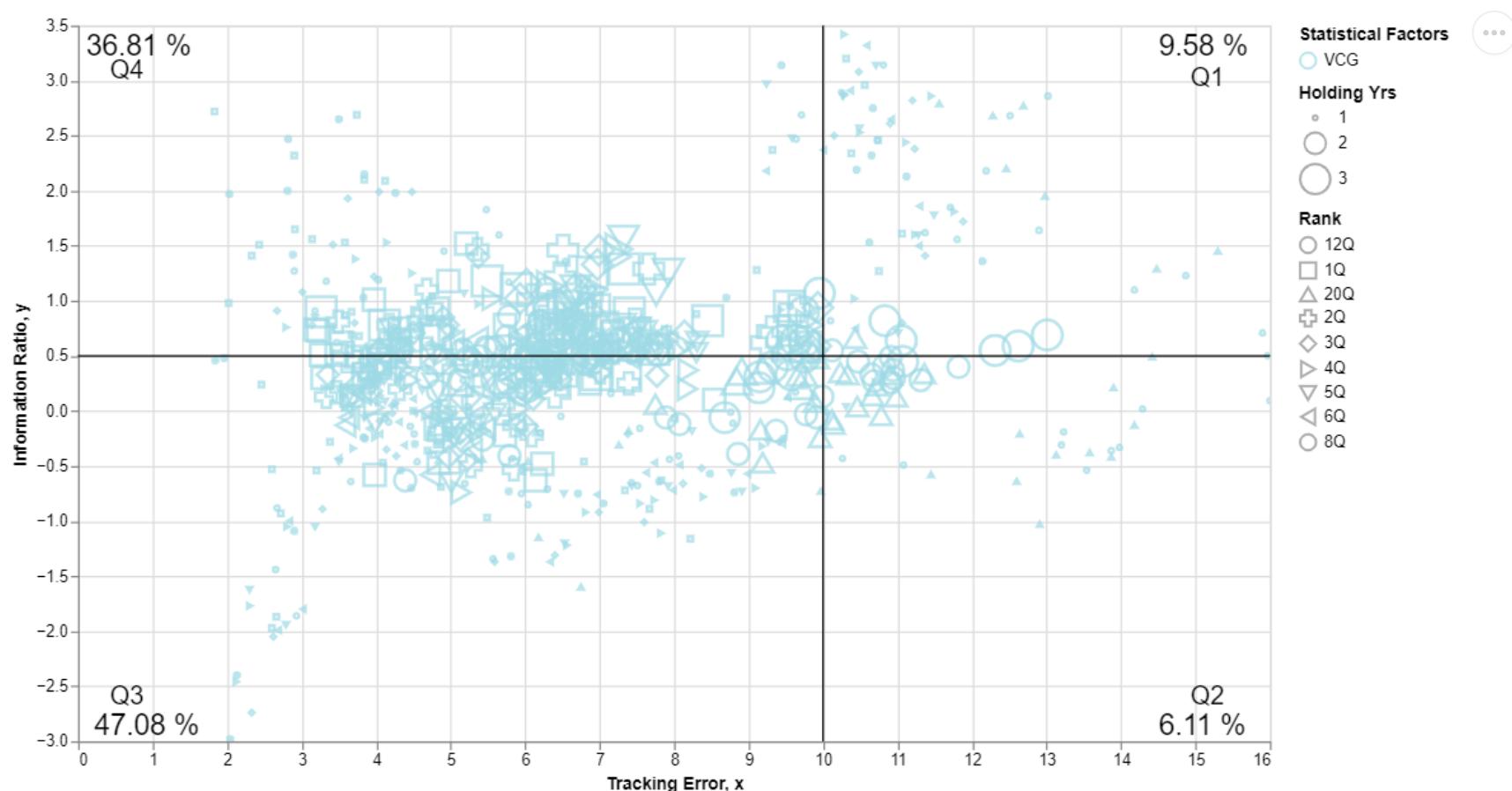
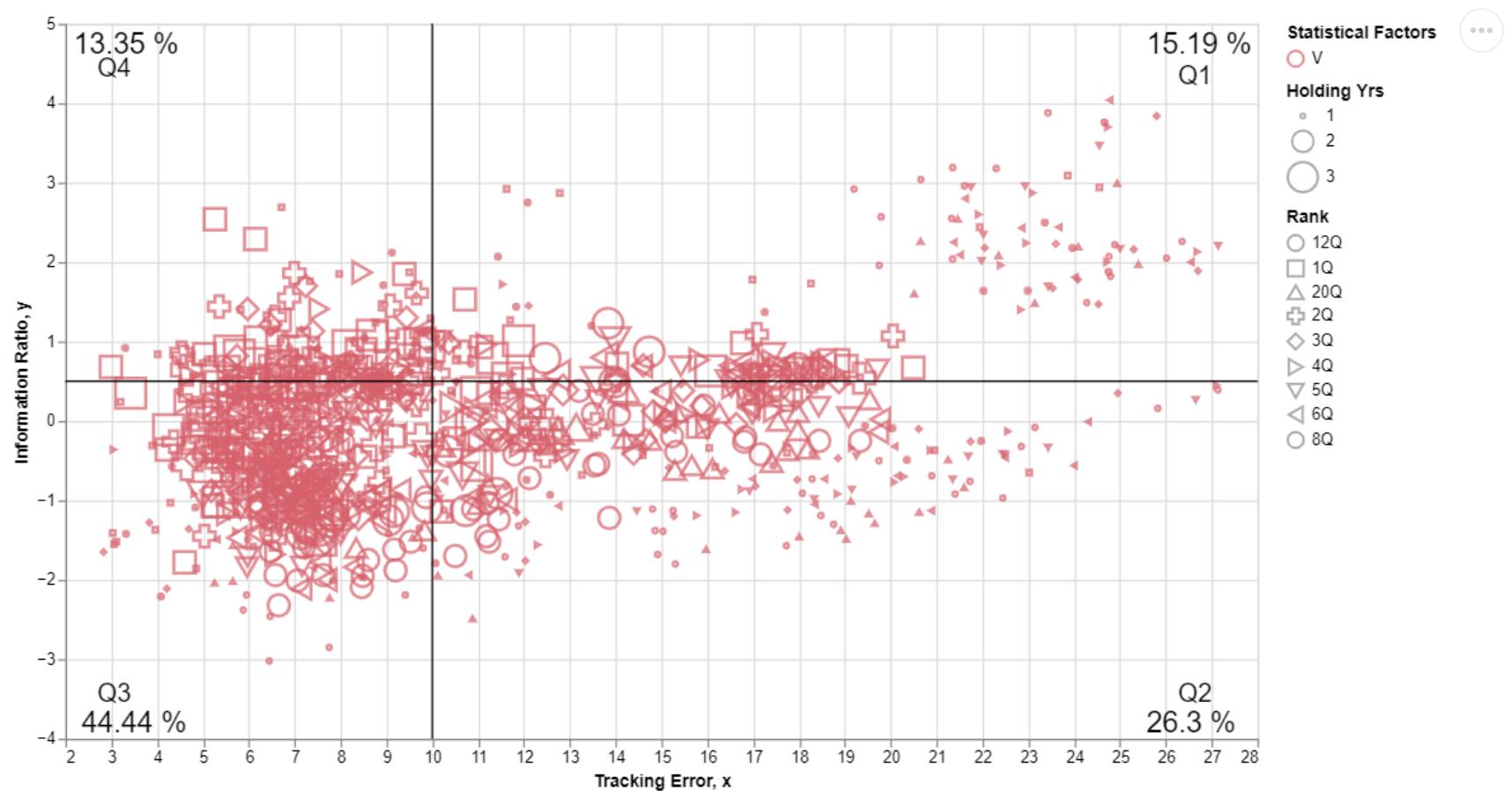
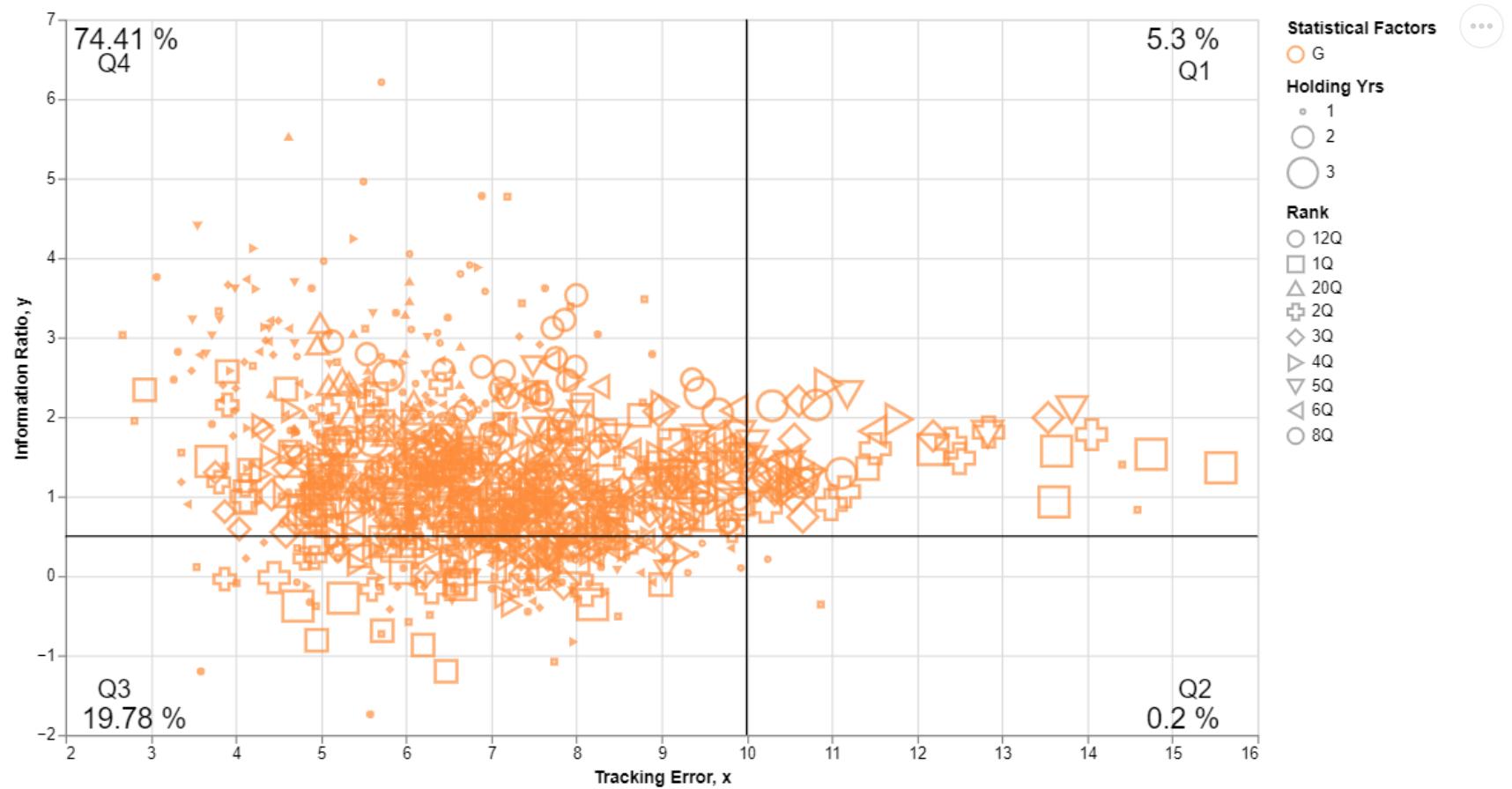


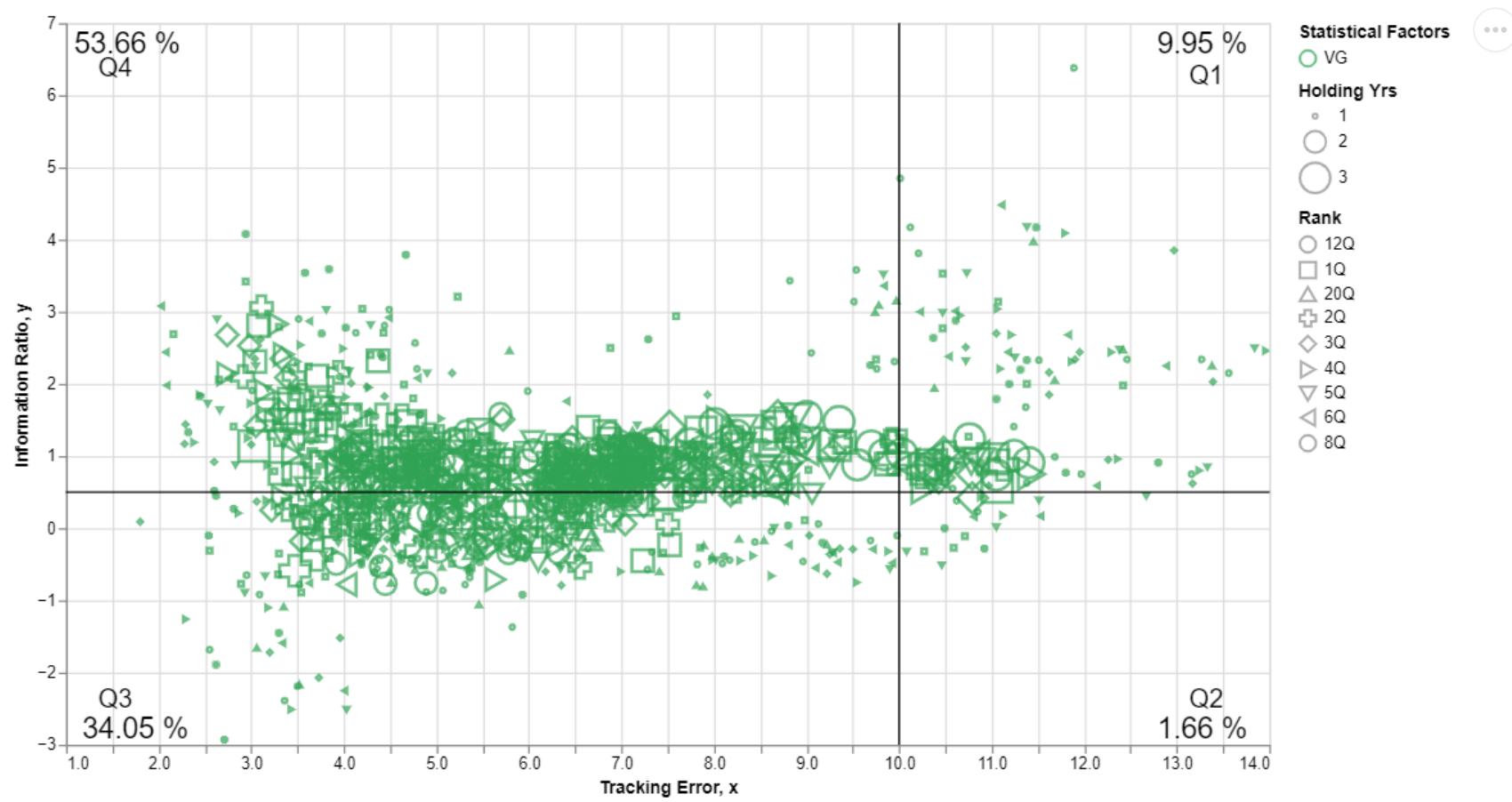


#### 4.5: Tracking Error vs. Information Ratio

The Cartesian chart of Tracking Error vs. Information Ratio plotted for different statistical factors, for different holding periods and for respective quarterly proxy rankings.







#### 4.6: Cartesian Cluster Analysis

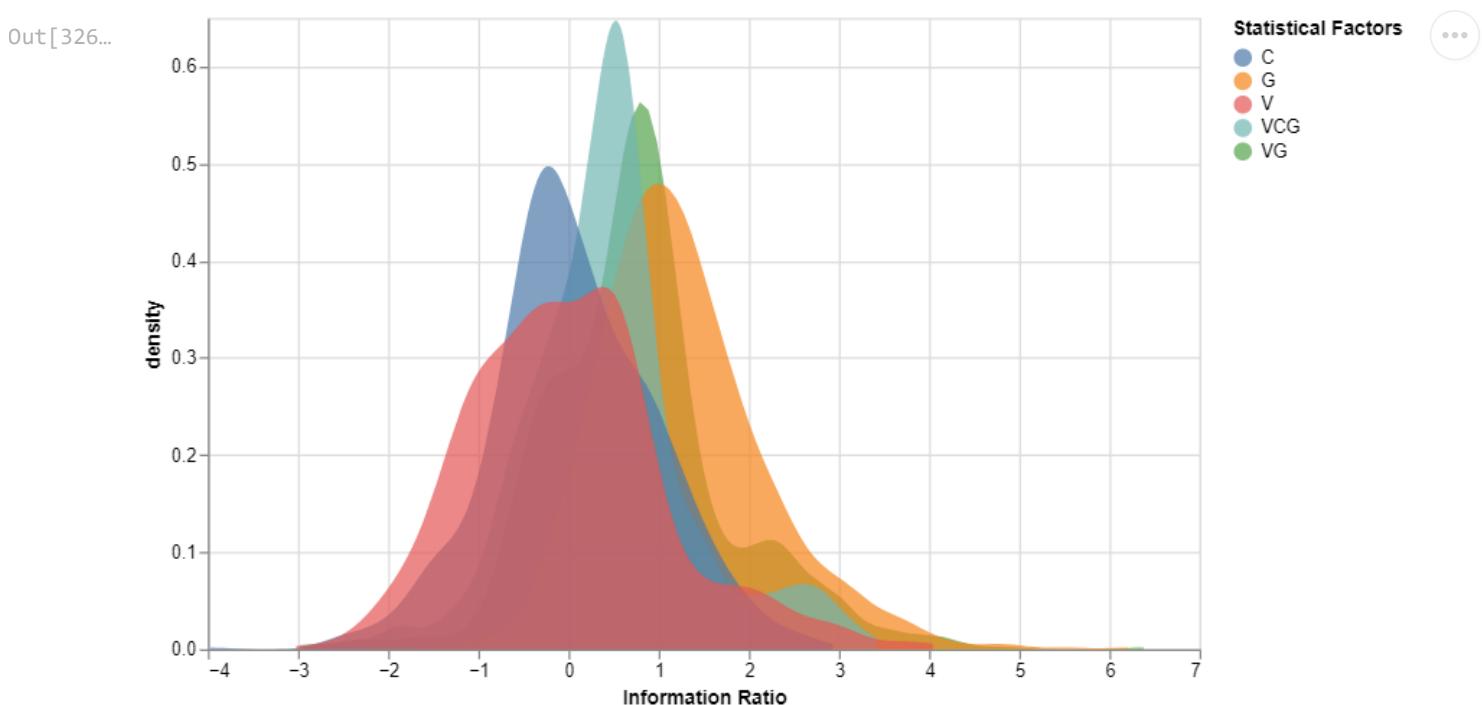
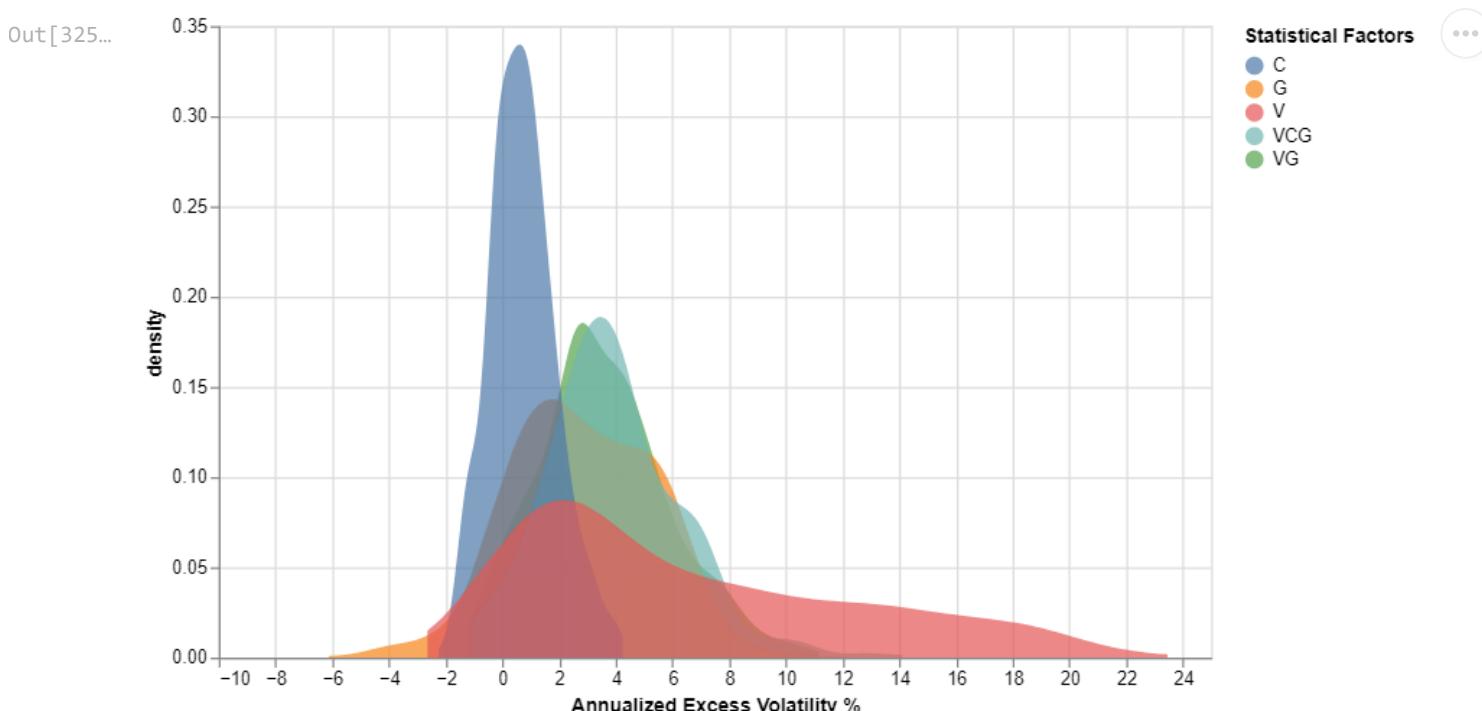
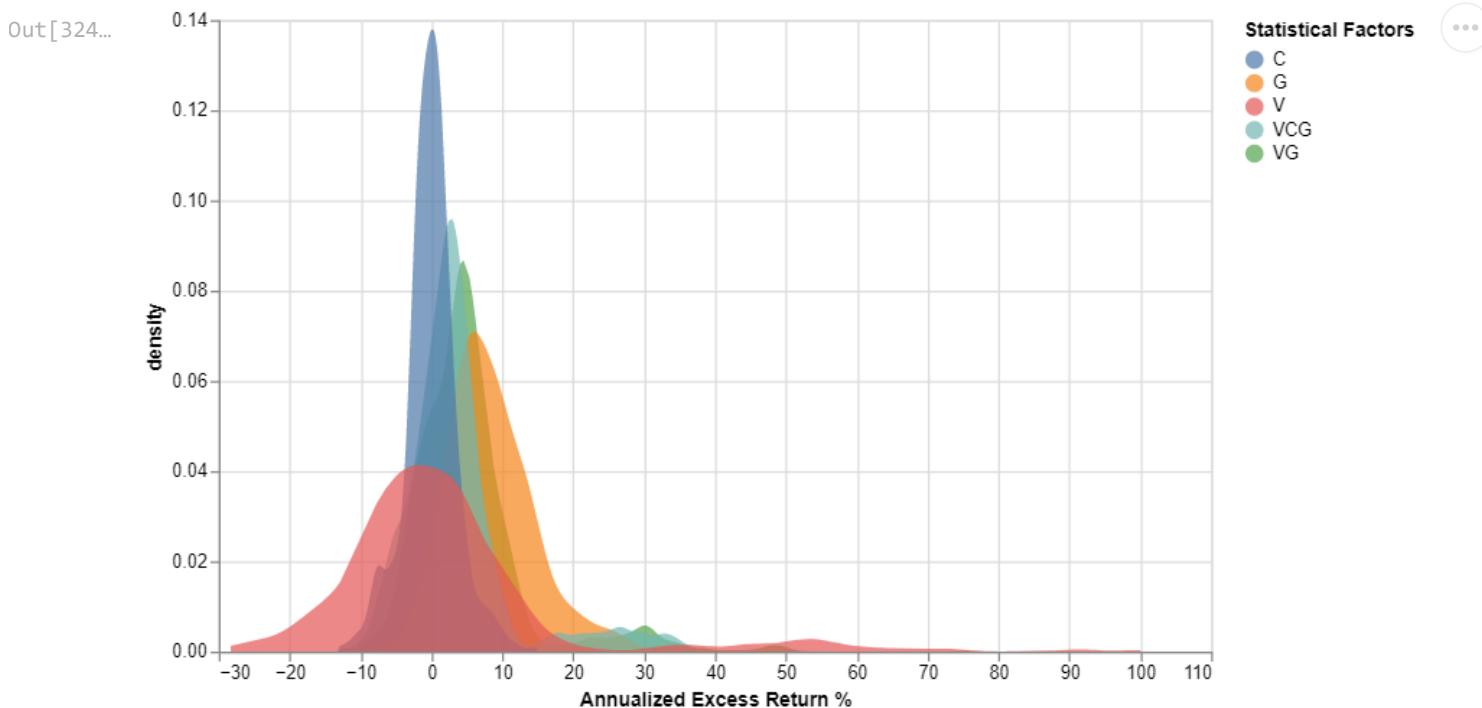
The table below carries the cluster analysis across four quadrants, highlighting positive and negative skew in the dataset, and risk-return characteristics of the various statistical factors. Overall, the VCG factor shows robustness across statistical metrics, while C and V statistical factors are with the most risk and skew.

Statistics	Statistical Factors	Q1	Q2	Q3	Q4	Q1+Q2	Q2+Q3	Q3+Q4	Q4+Q1	Q1+Q3	Q2+Q4
Annualized Excess Return % vs. Annualized Excess Volatility %	C	29.85 %	19.41 %	9.27 %	41.17 %	49.26%	28.68%	50.44%	71.02%	39.12%	60.58%
	G	82.77 %	10.7 %	1.83 %	4.59 %	93.47%	12.53%	6.42%	87.36%	84.6%	15.29%
	V	43.43 %	3.47 %	4.38 %	48.62 %	46.9%	7.85%	53.0%	92.05%	47.81%	52.09%
	VCG	67.92 %	3.89 %	0.0 %	28.19 %	71.81%	3.89%	28.19%	96.11%	67.92%	32.08%
	VG	74.63 %	4.78 %	0.1 %	20.39 %	79.41%	4.88%	20.49%	95.02%	74.73%	25.17%
Annualized Excess Return % vs. Information Ratio	C	29.46 %	19.71 %	50.54 %	0.0 %	49.17%	70.25%	50.54%	29.46%	80.0%	19.71%
	G	79.71 %	13.56 %	6.42 %	0.0 %	93.27%	19.98%	6.42%	79.71%	86.13%	13.56%
	V	28.54 %	17.84 %	53.01 %	0.0 %	46.38%	70.85%	53.01%	28.54%	81.55%	17.84%
	VCG	46.39 %	25.0 %	28.19 %	0.0 %	71.39%	53.19%	28.19%	46.39%	74.58%	25.0%
	VG	63.61 %	15.12 %	20.59 %	0.0 %	78.73%	35.71%	20.59%	63.61%	84.2%	15.12%
Annualized Excess Volatility % vs. Information Ratio	C	18.44 %	52.59 %	17.66 %	10.93 %	71.03%	70.25%	28.59%	29.37%	36.1%	63.52%
	G	71.15 %	15.9 %	4.08 %	8.46 %	87.05%	19.98%	12.54%	79.61%	75.23%	24.36%
	V	27.01 %	64.53 %	6.32 %	1.43 %	91.54%	70.85%	7.75%	28.44%	33.33%	65.96%
	VCG	42.78 %	52.92 %	0.28 %	3.61 %	95.7%	53.2%	3.89%	46.39%	43.06%	56.53%
	VG	59.32 %	35.02 %	0.59 %	4.29 %	94.34%	35.61%	4.88%	63.61%	59.91%	39.31%
Alpha vs. Beta	C	17.46 %	30.44 %	6.34 %	40.2 %	47.9%	36.78%	46.54%	57.66%	23.8%	70.64%
	G	63.71 %	26.4 %	1.02 %	7.14 %	90.11%	27.42%	8.16%	70.85%	64.73%	33.54%
	V	23.14 %	18.04 %	7.85 %	48.83 %	41.18%	25.89%	56.68%	71.97%	30.99%	66.87%
	VCG	45.69 %	8.47 %	0.42 %	43.61 %	54.16%	8.89%	44.03%	89.3%	46.11%	52.08%
	VG	60.59 %	10.34 %	0.2 %	27.51 %	70.93%	10.54%	27.71%	88.1%	60.79%	37.85%
Tracking Error vs. Information Ratio	C	0.0 %	0.0 %	70.34 %	29.46 %	0.0%	70.34%	99.8%	29.46%	70.34%	29.46%
	G	5.3 %	0.2 %	19.78 %	74.41 %	5.5%	19.98%	94.19%	79.71%	25.08%	74.61%
	V	15.19 %	26.3 %	44.44 %	13.35 %	41.49%	70.74%	57.79%	28.54%	59.63%	39.65%
	VCG	9.58 %	6.11 %	47.08 %	36.81 %	15.69%	53.19%	83.89%	46.39%	56.66%	42.92%
	VG	9.95 %	1.66 %	34.05 %	53.66 %	11.61%	35.71%	87.71%	63.61%	44.0%	55.32%

## 5: Statistical Distributions

### 5.1: Area Charts

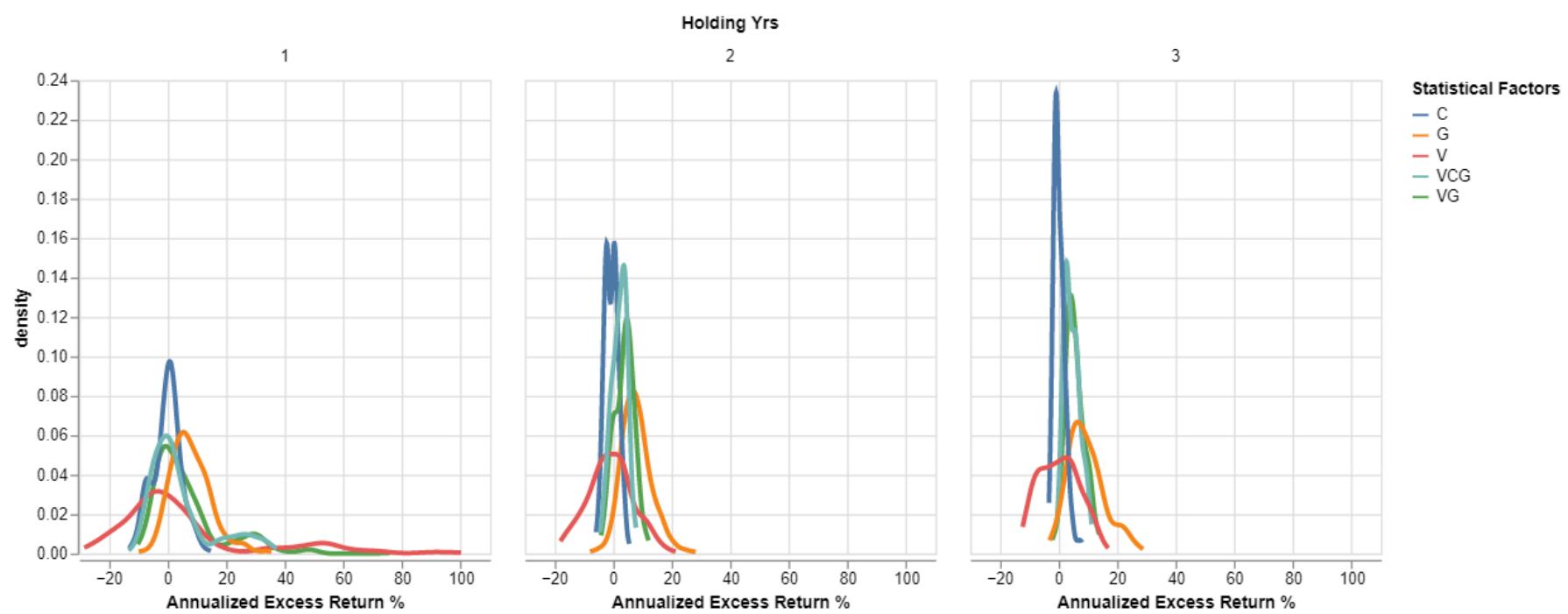
The area charts below showcase the distribution of Annualized Excess Return, Annualized Excess Volatility and Information Ratio across various statistical factors.



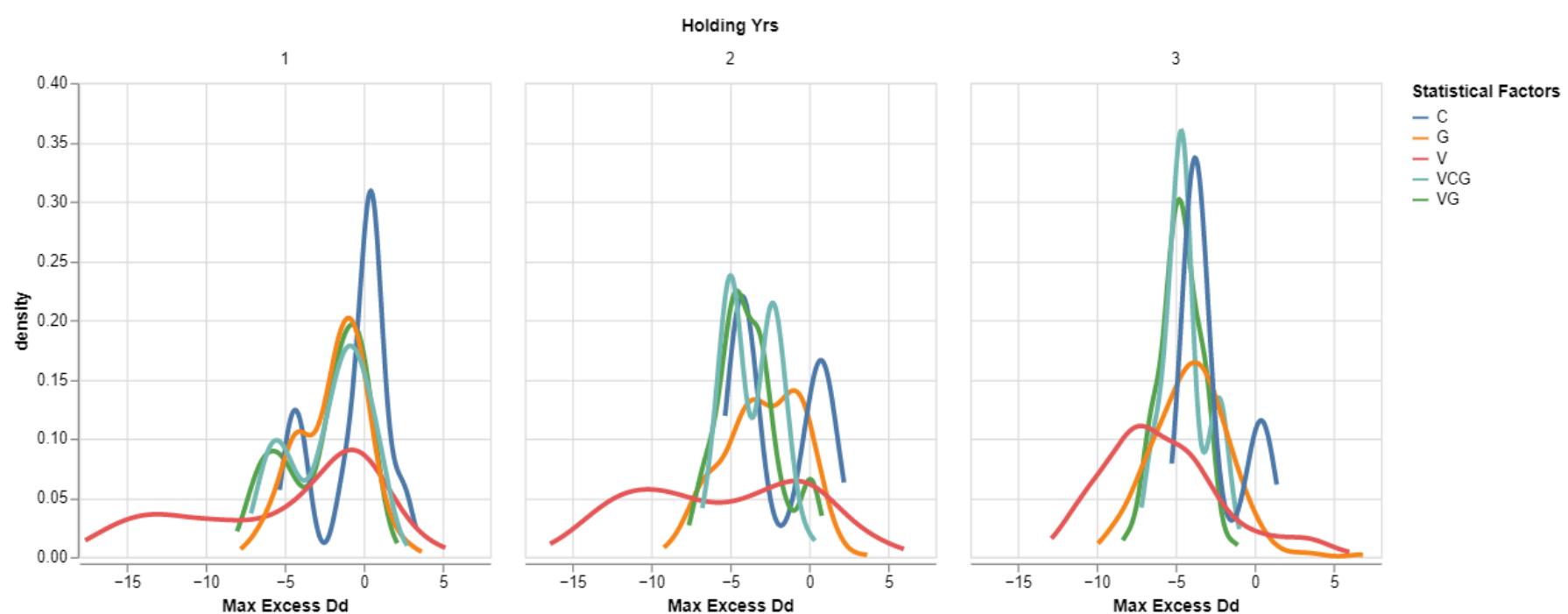
## 5.2: Line Charts

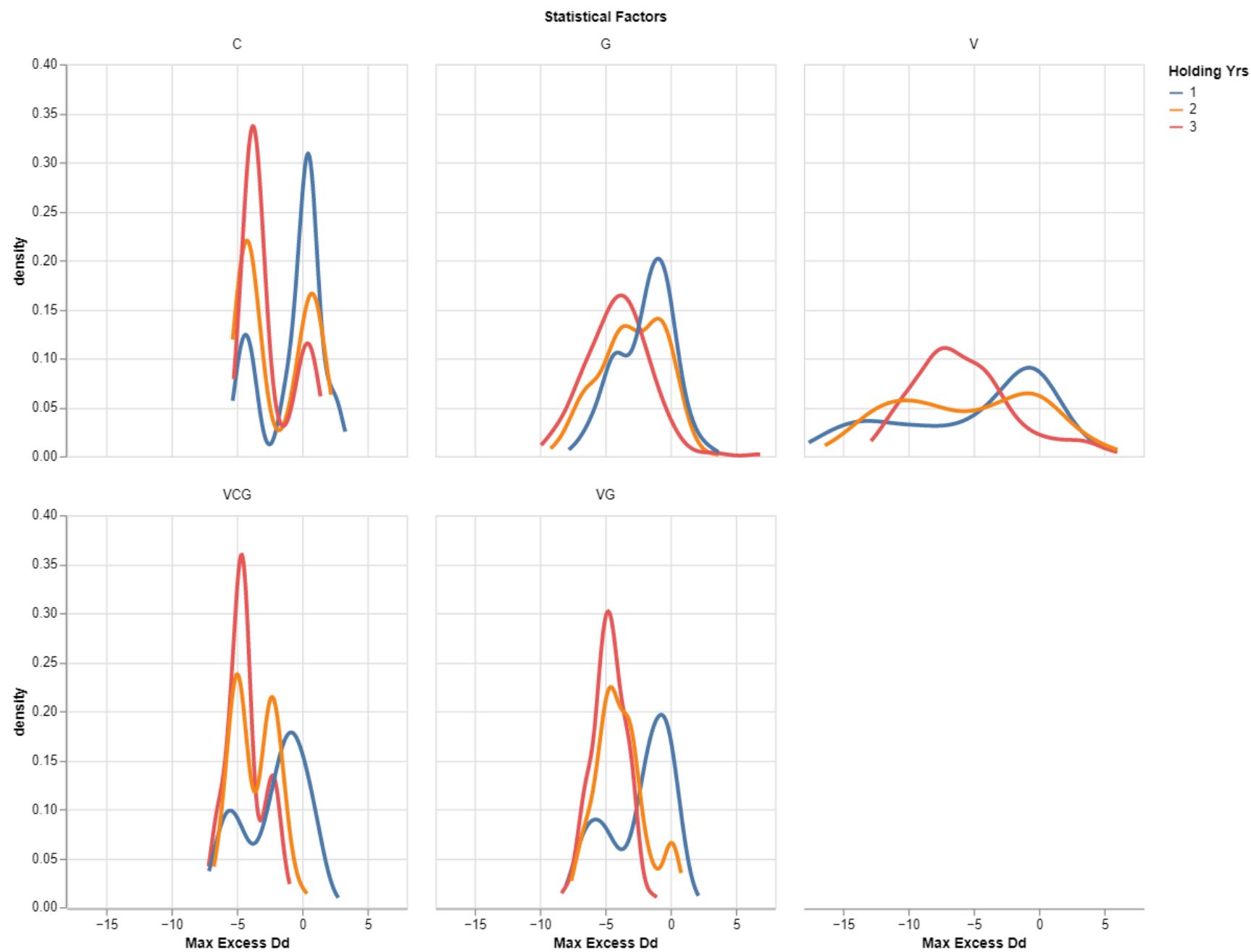
The line charts below showcase the Annualized Excess Return distribution for each holding periods, Max Excess Drawdown distribution for each holding periods and Max Excess Drawdown distribution for each statistical factor. Max excess Drawdown represents the difference between Portfolio Max Drawdown and Benchmark Max Drawdown.

Out[327...]



Out[328...]





## 6: Modern Portfolio Theory (MPT) Statistics

The table of averaged MPT statistics for each statistical factor and holding periods without outliers.

(**AR** - Annualized Excess Return, **AV** - Annualized Excess Volatility, **TE** - Tracking Error, **IR** - Information Ratio, **Max Excess Dd** - Maximum Excess Drawdown)

Statistical Factors	Holding Yrs	AR	AV	TE	IR	Alpha	Beta	Max Excess Dd
C	1Y	-0.38	0.58	3.96	-0.03	0.02	0.99	-0.69
C	2Y	-0.48	0.83	3.66	-0.01	-0.06	1.02	-1.93
C	3Y	0.1	0.75	3.72	0.04	-0.01	1.02	-3.1
G	1Y	8.46	1.75	6.39	1.44	0.61	1.04	-1.91
G	2Y	8.79	2.96	7.07	1.27	0.57	1.12	-2.67
G	3Y	9.45	4.49	7.83	1.17	0.52	1.2	-3.82
V	1Y	4.72	8.92	13.11	0.02	-0.18	1.29	-5.73
V	2Y	-0.91	5.94	10.22	-0.15	-0.32	1.2	-5.9
V	3Y	0.3	4.63	9.83	-0.1	-0.09	1.13	-6.24
VCG	1Y	4.42	4.04	7.02	0.43	0.13	1.14	-2.1
VCG	2Y	2.37	3.56	6.03	0.38	0.01	1.15	-3.8
VCG	3Y	4.15	3.78	6.91	0.6	0.16	1.15	-4.35
VG	1Y	6.7	3.67	6.35	0.87	0.27	1.15	-2.4
VG	2Y	3.91	3.3	5.72	0.71	0.14	1.15	-3.76
VG	3Y	5.7	3.9	6.87	0.8	0.27	1.17	-4.75

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