An innovative Idea for visualizing German Stocks on the Nord-net exchange Market *

Abstract. An innovative objective-subjective procedure called "blind statistical scoring" has been introduced. This procedure, in accordance with the principle of parsimony, or Ockham's razor, offers the simplest means of analysing statistical indicators. Our procedure confirms several postulates within bounded rationality of choice. To demonstrate this phenomenon, we visualize higher stock price performance, which has a predictive advantage over lower stock performance in the Nord-net exchange market.

JEL: C25; G17
Keywords: stock market; price impulses; monotonic; system; kernel

1. INTRODUCTION

It may seem to someone that the statements made in the article are so trivial that they do not require special experiments. However, even if a statement seems obvious, it is always best to verify it through rigorous scientific methods to ensure that it is indeed in accord with the reality. Regarding the stock market, it is not always easy to predict stock prices accurately. While it is true that better performing stocks tend to have more accurate forecasts, there are still many other factors that can affect stock prices, such as company news, economic indicators, and geopolitical events. Therefore, it is also true that a simple statistical procedure could be useful (maybe not ideal) for studying such a phenomenon as hypothetical events at the stock market masquerade, instead of a very complex probabilistic-statistical analysis of price indicators.

In probabilistic-statistical analysis two opposing approaches can be distinguished: from subjective to objective knowledge and in the opposite direction—from objective to subjective. In the first approach, such specialists as a physician, biologist, astronomer, practitioner or market analyzer... those who have knowledge in their field, use data visualization for objective statements about the obtained estimates of experimental data, observations, etc. With this approach, from a subjective assessment to an objective assessment, probability research includes: Markov processes (Rogers and Williams, 2000, [1]), Lévy

* Münich Personal RePEc Archive, https://mpra.ub.uni-muenchen.de/101591/ (Acessed 23.12.2021)

processes (Applebaum, 2004, [2]), Gaussian processes (Lifshits, 2012, [3]), random fields (Adler, 2010, [4])… Statatistical analysis includes space state models (SSM, Koller and Friedman, 2009, [5]), parameter estimation (Walter and Pronzato, 1997, [6]), management and decision-making problems (Narula and Weistroffer, 1989, [7]), continuous modeling, multiple time series (Voelkl et al, 2012, [8]) and computational methods (Mirkin et al, 1995, [9]). In both areas the knowledge of the distribution of judgments about the object under study is necessary that is not always the case.

The objective to subjective assessment (Frey and Võhandu, 1966, [10]), both to statistical and probabilistic indicators, at first glance, seems to be contradictory. It seems that specialized knowledge is also required. Nevertheless, it is very possible to do without special knowledge, as well as knowledge about the distribution of numerical parameters—indicators.

The procedure of the objective to subjective approach considered below could be called the "blind glance of statistical scoring", which is what we need. The only thing the Data Explorer uses in blind scoring is that one number is greater/less than another. If common sense is achieved, then the well-known law of parsimony or **"Ockham's razor"** will come into force. A procedure that requires fewer assumptions about reality can be considered the most reliable.

2. Bounded Rationality Postulates

There are several postulates of rational choice theory (e.g., Arrow 1959, [15]) that fall under the umbrella of so called Bounded Rationality, including the assumption that individuals have well-defined preferences, make choices based on expected utility, and make rational decisions based on the available information.

Before we get to the main part of the note, we will highlight some of the points of our short notice. We use extended quotes from well-known experts on the decision theory (bounded rationality) that was found online (Tomasz Strzalecki,TS, Accessed via Google: December 28, 2021, available to download from http://datalaundering.com/download/notes.pdf), licensed under a Creative Commons Attribution Non-Commercial-No Derivatives 4.0, Tomasz Strzalecki, TS, **available online** (Accessed: 9 July 2020). Below I shell slightly modify the nomenclature for my own purpose. since excessive or our own repetition of the main provisions of the theory, as it seems to us, cannot improve the explanation of the postulates of the theory:

"These notes are based on lectures I gave at Harvard in 2010-17 and also those I gave when visiting the Cowles Foundation at Yale in 2012…

...Models in Economics are micro founded, which means that at the bottom of every model there is an economic agent (often many of them) choosing an action from an opportunity set. This set, often called the budget set or a menu, represents the various actions that are available to the agent. But which action will the agent choose? By far the most popular theory is that the agent will choose the alternative with the highest utility. In the most basic version of the theory the utility function is an as-if concept, which means that we don't claim it exists in any material sense nor is it necessarily related to the agent's well being, emotions, or biology. It is just a mathematical construct that helps the analyst make sense of observed choices: the agent behaves as if he maximizes a utility function. We don't care how the agent manages to maximize the utility (it may be a hard mathematical problem) because utility is just a language of description and it is not taken literally."...

...Let X *be a set of alternatives that the agent is choosing between. They can be either immediate "payoffs" (for example different candy bars of which your diet lets you eat only one) or more structured objects (such as retirement plans). There are three main "languages" that help us describe choice:"*

The following item is the most important for us.

The choice function (TS): *"...The analyst observes which element the agent chooses from every nonempty set* $A \subseteq X$. *Let* $c(A)$ *denote that element..."*

We use an uppercase letter for the selection function $C(A)$, which emphasizes that the user can observe for analysis not a single element but a set $C(A)$ to decide the set of best alternatives selected from A. In fact, the set A selected for choice action will be considered as an area in the EXCEL spreadsheets—as cells in a column, a row or tables that can be selected using the "pasted" option. The choice function $C(A)$, was programmed in EXCEL, http://datalaundering.com/download/TyskeAktier29062020%202.xls, available online (accessed December 27, 2021), using macro Cntrl+s, which follows the basic wine selection procedure described below in Section 4.1.

Finally, we recall in a more formal form the postulates (cited by Aizerman and Malishevski, 1981, pp. 65-83, English version translated from Russian, p. 189, [16]) that we will note in connection with the procedure of supposedly rational choice of our guests in restaurant:

- *Independence with respect to dropping rejected alternatives (or, for brevity, elimination of options), Postulate 5 (Chernoff, 1954, pp. 422-443,* [17]*) or Axiom 2 (Jamison and Lau, 1973, pp. 901-912,* [18]*):*

$$From\ C(X) \subseteq X' \subseteq X\ it\ follows\ that\ C(X') = C(X);$$

- *Adherence, which is the same as Postulate 4 (Chernoff, 1954), or condition* α *(Sen, 1971, pp. 307-317,* [19]*) or the axiom C2 of Arrow-Uzawa (Arrow, 1959, pp. 121-127):*

$$From\ X' \subseteq X\ it\ follows\ that\ C(X') \supseteq C(X) \cap X';$$

- *Strict Adherence or constant residual choice (it is the same as postulate 6 (Chernoff, 1954), and one of the forms of the "weak axiom of revealed preference" of Samuelson, , i.e., the axiom C4 (Arrow, 1959, pp. 121-127):*

$$From\ X' \subseteq X\ and\ C(X) \cap X' \neq \varnothing\ it\ follows\ that$$
$$C(X') = C(X) \cap X'.$$

3. Stock Market Data

We collected data on the behavior of investors in German companies on the Nord-net exchange market. This have included data on stock prices, trading volumes, and other relevant variables. Some comments are necessary in order to explain the implementation of the aforementioned "procedure" for the analysis of the stock market dynamics. The reliability of data on the sale and pur-

chase of shares on the market is guaranteed by the fact that the Nor-net online, exchange was used, where all transaction data have been available to everyone. The spreadsheet was compiled using Nordnet public domain (Accessed: Monday, December 27, 2021): https://www.nordnet.dk/markedet/aktiekurser/.

The stock market monitoring spreadsheet consists of 620 Germany companies. Some columns show relative ±% rise and fall in shares prices, last purchase, sale, etc. As you can see, some cells differ from others in certain patterns and frames. These highlighted patterns and frames are the result of using the macro—Cntrl-s. Cntrl-s means, as said, that an analysis of the significance levels of the negative/positive values of the stocks indicators dynamic has been conducted. Using the macro in columns, rows, or selected *("pasted")* areas of the spreadsheet in their entirety may consist of negative/positive numbers distributed throughout the areas without any special order for negative or positive numbers. However, the standard EXCEL data sorting options allow you to sort selected areas in ascending or descending order depending on the specified columns or rows. Thus, having, for example, negative values scattered across a spreadsheet in different cells, these cells can be redistributed together into "contiguous areas" of negative or positive values in the columns or row patterns to satisfy the necessary conditions. Such contiguous areas can help visualize the analysis results.

A note may be helpful. If macro Cntrl-s produces only a few selected cells or an unsatisfactory small number of special patterns and frames—in the case of very high positive or very low negative values—the same macro can be reused, now outside these sharp numerical jumps that were designated as unsatisfactory, i.e., when the macro detects too small areas. In doing so columns or rows must be first reordered in ascending descending order to bring the positive/negative indicators into contiguous areas. Now, reusing Cntrl-s macro in the gap, i.e., against not yet patterned and framed cells, to add additional meaningful cells in addition to previously selected cells, can help to improve the situation.

	A	B	C	D	E	F	G	H	I	J
1	Negative significance level →	-1,57%	€ 34,60							
2	Positive significance level →	1,36%	€ 0,60	€ 44,80	€ 43,01	€ 44,59	€ 43,30	€ 44,03	€ 26.000.000	
3	Company in Germany	Today %	Today +/–	Last	Buy	Sell	Highest	Lowest	Turnover	Timestamp
4	1&1 DrillischAktiengesellschaft	-1,65%	€ 0,38	€ 22,67	€ 22,65	€ 22,70	€ 23,02	€ 22,63	€ 1.100.000	11.28.09
5	11 88 0 Solutions AG	-2,16%	€ 0,03	€ 1,36	€ 1,36	€ 1,42	€ 1,36	€ 1,36	€ 0	11.04.25
6	2G En. AG	4,46%	€ 2,80	€ 65,60	€ 65,60	€ 66,40	€ 66,40	€ 62,50	€ 200.000	11.27.14
7	3M Co.	0,43%	€ 0,58	€ 136,08	€ 134,86	€ 136,08	€ 136,08	€ 134,18	€ 0	11.20.58
8	3U Hold. AG	2,56%	€ 0,04	€ 1,60	€ 1,58	€ 1,64	€ 1,63	€ 1,58	€ 0	11.14.30
9	4 SC AG	-0,60%	€ 0,01	€ 1,67	€ 1,63	€ 1,67	€ 1,69	€ 1,67	€ 0	10.41.19
10	4basebio AG	-1,97%	€ 0,04	€ 1,99	€ 1,99	€ 2,00	€ 2,00	€ 1,97	€ 0	11.27.38
11	7C Solarparken AG	-1,37%	€ 0,05	€ 3,59	€ 3,58	€ 3,62	€ 3,62	€ 3,56	€ 0	11.16.48
610	Westinghouse Air Br. T. Corp.	-3,44%	€ 1,74	€ 48,81	€ 49,12	€ 50,55	€ 48,81	€ 48,81	€ 0	10.32.31
611	Westwing Gr. AG	-0,32%	€ 0,02	€ 7,28	€ 7,31	€ 7,38	€ 7,38	€ 6,90	€ 100.000	11.27.55
612	Wienerberger AG	1,30%	€ 0,25	€ 19,45	€ 19,27	€ 19,42	€ 19,45	€ 19,00	€ 0	11.23.14
613	Williams Grand Prix Hold.	-0,79%	€ 0,10	€ 12,50	€ 12,20	€ 12,60	€ 12,50	€ 12,50	€ 0	09.02.08
614	Wirecard AG	138,10%	€ 1,77	€ 3,05	€ 3,10	€ 3,10	€ 4,05	€ 1,66	€ 48.000.000	11.27.13
615	Wuestenrot & Wuert. AG	0,39%	€ 0,06	€ 15,32	€ 15,26	€ 15,34	€ 15,38	€ 15,16	€ 0	11.23.23
616	XPhyto Therapeutics Corp	4,02%	€ 0,07	€ 1,68	€ 1,63	€ 1,74	€ 1,77	€ 1,58	€ 0	11.00.33
617	Yamana Gold Inc.	0,12%	€ 0,01	€ 45,79	€ 45,64	€ 46,30	€ 46,60	€ 45,76	€ 0	11.29.25
618	Zalando SE	-1,04%	€ 0,66	€ 62,56	€ 62,56	€ 62,58	€ 63,98	€ 62,38	€ 5.400.000	11.27.04
619	Zeal Network SE	-0,77%	€ 0,25	€ 32,15	€ 32,15	€ 32,35	€ 32,50	€ 32,15	€ 0	10.59.56
620	Zooplus AG	-0,27%	€ 0,40	€ 148,20	€ 148,00	€ 148,60	€ 150,00	€ 148,00	€ 200.000	11.22.43

Stock Market Table, shortened.

One can read the following about **Nordnet via the link:** (https://nordnetab.com/about/nordnet-overview . Accessed: 23 August 2020):

"Our target group is Nordic savers and investors. We offer products and services to both experienced investors and beginners, no matter if they have knowledge or need guidance, wish to spend hours on your investments every day or simply review your savings a few minutes a week."

Our vision is to become the Nordic private savers' first choice. To achieve this objective, we must always continue to challenge and innovate, keeping user-friendliness and savings benefit at the top of the agenda. Only then can we achieve the high level of customer satisfaction and brand strength required to become a leader in the Nordic region in terms of attracting new customers and producing loyal ambassadors for Nordnet.

We help people and money grow. We are passionate about creating a world-class user experience. We simplify to make it easier for people to make smart investment decisions. We share our knowledge and inspiration without any hidden agendas.

The overarching purpose of Nordnet's operations is to democratize savings and investments. By that, we mean giving private savers access to the same information and tools as professional investors. This purpose has driven us since we started in 1996 and remains our direction to this day. In the 1990s, the idea of democratization entailed offer-ing easily accessible and inexpensive share trading via Internet, and building a fund supermarket with products from a number of different companies where savers could easily compare returns, risk and fees. During the journey, we have simplified matters and pressed down fees on, for example, pension savings, index funds and private banking services. In recent years, we have democratized the financial sector with, for example, the stock lending program. We are al-ways on the savers' side, and pursue issues of, for example, the right to transfer pension savings free of charge and reasonable and predictable taxation of holdings of stocks and mutual funds.

Our target group is Nordic savers and investors. We offer products and services to both experienced investors and beginners, no matter if they have knowledge or need guidance, wish to spend hours on your investments every day or simply review your savings a few minutes a week."

4. PARSIMONIOUS APPROACH

There are several statistical methods we could use to test the rational choice postulates. One approach could be to use econometric models to estimate the parameters of a utility function that describes how investors make decisions. Another approach could be to use machine learning algorithms to identify patterns in the data and test whether they are consistent with rational choice theory. It seems that the discussion below on the restaurant scenario is merely an introduction to the main topic—the findings and experiments conducted using an Excel spreadsheet and share prices on the Nord-net stock market, which have been performed in view of the postulates of independence of rejected alternatives and the adherence or strict adherence with the most dynamical shares in the market. This suggests that buying more dynamic stocks may be rational under the postulate of rejected alternatives or irrational under the adherence postulate in lines with monotonic choice model presented. The study highlights the importance of understanding investor behavior and decision-making processes, and how statistical analysis can be used to make more informed investment decisions. However, it also emphasizes the need for caution and research before making any investment decisions, as there is still the potential for irrational behavior and unpredictable price movements in the stock market.

4.1. Wine Menu Exibit. Let's start the analysis with a "hypothetical" or "pedagogical exhibit". When accepting the order in a restaurant, the sommelier informs the guest that some of the preferred choices are unavailable, what can

lead to irrational behavior on the part of the guest or the sommelier. From the guest's point of view, it may be wiser to try cheaper wines that were initially overlooked. On the other hand, the sommelier may suggest more expensive wines, even though there are cheaper and equally good options available. This behavior can be depending on the specific circumstances. Indeed, the absence on the list of the most expensive wines, for sure, will encourage guests to expand the list of cheap wines or at least keep the choice. On the contrary, the lack of approved, at first glance, cheap wines may induce the sommelier to suggest more expensive wines in favor of others available for order, also cheaper, but quite good and better wines. More often than not, guests agree with such a proposal. This behavior, sometimes rational or irrational, was our main motive for informing the reader about "these events." The phenomenon of such hypothetical events on the stock market masquerade were discussed from the point of view of an innovative statistical procedure and illustrated on the basis of a probabilistic-statistical analysis of the numerical indicators of the exchange market.

The wine list is ordered in descending order of price, and **1** multiplies the price of the most expensive wine, **2** multiplies the next local price, then **3** the next, and so on. We call these numbers as price credentials or impulses. The local maximum of impulses and the price of wine are selected when this peak location from the top of the ordered list where the maximum is reached. The guest decides to accept the price of the wine at the local impulse maximum as an acceptable level of price significance when choosing wines with a higher or equal price level, e.g., the list $\mathbf{10^2, 9^2, 8^2, 7^2, 6^2, 5^2}$, … suggests that the peak of this sequence is located at $\mathbf{7^2=49}$.

4.2. Significant Indicators. We look at some of the details of our wine procedure for analyzing stock market data. Let's define a set of shares $p_j \in W$, $|W| = n$ of n companies, $j = \overline{1,n}$. In particular, suppose that in the sample denoted by the letter H, all potential candidates are presented as companies according to the most significant for investments or sales. We can further define a totality of sets $\{H\}$ of all 2^n samples $H \subseteq W$. Impulses $\pi(p_j, H) = p_j \cdot |H|$ (in terms of Kempner et al., pp. 19-24, 1997, [11], as monotone linkage functions, [12]) will evaluate the level of significance. The procedure for finding the most significant companies is easy to set up. First, all the shares p_j, are sorted in descending order, constituting (like in wine list) the prices order $\langle p_j \rangle$. Then a sequence $\overline{\pi}$ of impulses $\overline{\pi} = \langle \pi_j \rangle = \langle p_j \rangle \cdot j$, $j = \overline{1,n}$, is constructed. The list of company shares $\langle p_j \rangle$, in contrast to original list p_j, is necessary descending. In 1971, [13a], we called such sequences $\overline{\pi}$ as defining.

4.3. Significant Level. The impulses $\langle \pi_j \rangle$, are single peaked, where the peak denotes the kernel H^* (Mullat, 1971-1995, [13]) of a monotone system. The set H^* constitutes the rational, i.e., the monotone linkage choice implemented in our findings. At the location k^* from the top of the impulses $\overline{\pi} = \langle \pi_j \rangle$, i.e., from the top of defining sequence of a companies, $j = \overline{1,n}$, where the local maximum $u = \arg\max_{j=\overline{1,n}} \langle \pi_j \rangle$ is reached, the peak, denoted by u, will be called the level of significance.

Proposition. *Among the totality of all samples* $H \subseteq W$*, i.e., among all the sets* $\{H\}$ *of all* 2^n *samples, the kernel* H^* *guarantees reaching the global maximum of the impulse function* $F(H)$ *of samples* H *equal to* $u = \min_{p_j \in H} \pi(p_j, H)$*:* $H^* = \arg\max_{H \subseteq W} F(H)$.

The proposition confirms the postulate of independence from rejected alternatives in two-person games, which was originally studied by John F. Nash in the 1950s, [14], when he developed a solution to the bargaining problem. In regards to the stock market, it states that any final buying and selling decisions of investors should not be affected by the removal of any shares that were not originally selected for consideration.

4.4. Threshold-based indicators.

These types of indicators are commonly used in time series analysis, signal processing and other areas where we are interested in detecting deviations or changes in system behavior. In finance, a threshold-based indicator can be used to give a buy or sell signal when a stock's price rises above or falls below a certain threshold u. In our case, indicators called price impulses create a dynamic system, since the previous state of the stock market determines the subsequent state. It is worth noting that the postulates of strict or non-strict adherence emphasize the rational behavior of investors when some new companies expand the list of available alternatives. In the event that investors have chosen some of the best stocks in the past, then these postulates state that investors will still be inclined to consider old companies—"old love does not rust."

Finally, since our Ockham's razor procedure described above can set a significance threshold u, the same procedure can now be applied to the "induced" indicators $\pm\Delta$ of "overshoot" or "undershoot". It also includes a constraint on higher dynamic margins p_j, $j = \overline{1,n}$, if these are taken into account. As a result, we will be able to calculate a certain interval $[-\Delta_1 + u, u + \Delta_2]$, where $-\Delta_1$ is the limit of underestimation (under-

shoot), and $+\Delta_2$ is the limit of overestimation (overshoot) relative to the same absolute threshold u. This interval is very similar to the confidence interval for estimating parameter values in statistics.

5. Discussion, Findings and Experiments

It is well known that irrational behavior can occur in the stock market when buying and selling company shares. This behavior is often driven by emotions such as fear, greed, or panic, which can lead investors to make decisions that are not rational or logical. Indeed, investors often get caught in the crossfire buying blue-chip stocks that have skyrocketed and not picking other stocks. To analyze this phenomenon, we can use statistical analysis techniques to identify patterns in the buying and selling behavior of investors. One such technique is to identify companies that have a higher dynamics of change compared to other companies. Higher dynamics company shares are often more sensitive to changes in market conditions and can provide a risk-averse insight into the behavior of investors.

For example, the price-to-earnings ratio (P/E ratio) is a commonly used indicator in stock analysis. This ratio compares a company's current stock price to its earnings per share (EPS) and can provide insight into how the market values the company's stock. A high P/E ratio can indicate that the market expects the company to grow rapidly in the future, while a low P/E ratio can indicate that the market does not have high expectations for the company. However, the P/E ratio is not always a reliable indicator of a company's future performance. Investors may become overly optimistic or pessimistic about a company's prospects, leading them to buy or sell the stock at a price that does not reflect its true value. This can result in a bubble or a crash in the stock market.

To avoid these pitfalls, investors should focus on fundamental analysis, which involves studying a company's financial statements and business operations. It's always important to carefully consider all available data and information when making investment decisions. It's possible that this new information could be factored into an investor's analysis of a company's financial health and potential for growth. Regarding our specific findings, this sounds like including higher dynamic shares for consideration may have an impact on buyer behavior, even when stable shares are still available for sale.

Based on our findings, it seems that the postulate of independence of rejected alternatives was supported, meaning that individuals tended to choose the option that was most preferable to them, regardless of whether or not other options were rejected. However, the postulate of adherence or strict adherence for the stable shares was not supported in certain circumstances. This suggests that individuals may be more likely to choose risk-averse dynamic options over stable shares, even when stable shares are still available. While this behavior may be seen as rational from the perspective of the postulate of independence of rejected alternatives, it may be seen as irrational from the perspective of adherence postulates. These nuanced results suggest that decisionmaking behavior is complex and may be influenced by a variety of factors, including the

specific options available, individual preferences, and situational factors. Therefore, it's recommended to evaluate different models and analyze the data from various perspectives to gain a more comprehensive understanding of the underlying phenomena. This will help you draw more accurate and reliable conclusions about the behavior of buyers in the specific context of your model. Therefore, it is important for investors to be aware of their own biases and to base their decisions on objective data and analysis. Additionally, the findings suggest the importance of diversification and considering a wide range of investment options when making decisions in the stock market.

5.1. Ockham's Razor procedure analyzing statistical indicators. The procedure as said above is called "blind statistical scoring" and it involves finding the simplest explanation or model that fits the data. This approach is based on the principle of parsimony, which suggests that simpler explanations are more likely to be true than complex ones. It's important to note that this procedure is not necessarily equivalent to other well-known statistical methods like the 0-hypothesis. It is a separate approach that can be useful in certain contexts, particularly when dealing with complex data sets. The guide we are presenting here could be useful for analysts who are interested in applying the principle of parsimony to their statistical analysis. However, it's important to keep in mind that this approach is just one tool in a larger toolkit of statistical methods, and may not always be appropriate for every situation.

5.2. Activating the Ctrl-s Macro. Any standard Microsoft Excel spreadsheet has a section in which so-called macros, written in the Visual Basic programming language, are available. In our German Exchange Market spreadsheet you can find our Ockham's Razor Visual Basic macro. Copy the text of this macro into your spreadsheet. In the properties of this macro, specify that the new macro can be executed using the Ctrl+s command. Your data, whether the data is in a row, column, or in table as numeric data, can now be visualized by running the Ctrl+s macro. Remember, that the first two rows of the spreadsheet must be free—insert at least two free rows at the top of the spreadsheet.

Before applying this macro in any Excel spreadsheet, you must first define the statistics you want to analyze. All cells where these statistics have intersections must be transferred to a "continuous—non-breaking area" in the form of columns, rows or tables filled with numbers to be analyzed. Simply paste a non-breaking area, as we usually do in an Excel spreadsheet when we copy or select areas on a worksheet in the standard way, and run the macro.

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