

# Evaluation of Investment Efficiency: Analysis with ROI and VaR for Students' Initial Investment Portfolios

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## Abstract

This study evaluates investment effectiveness among school students using ROI (Return on Investment) and VaR (Value at Risk) indicators. This work evaluates the effectiveness of investments among schoolchildren using analysis with ROI and VaR indicators. The study offers a solution to overcome financial illiteracy among the population of Kazakhstan. Considering that schoolchildren can receive bonuses for their good grades, teenagers can invest these bonuses by earning income and becoming familiar with financial instruments.

Keywords: ROI, VaR, financial illiteracy, investment efficiency

## 1. Introduction

Investing is becoming an increasingly important topic in the financial industry. Introducing investment education into the school curriculum can help to develop financial literacy among youth, which can positively impact the country's economy in the long run.

### 1.1 Advantages of ROI and VaR

Benefits of analyzing investment decisions using ROI and VaR indicators:

- open access to the necessary data for their calculation;
- ease and accuracy in calculating these indicators;
- practicality in use;
- suitable for people who do not have computing skills;
- quick analysis of the profitability of an investment decision.

### 1.2 The relevance of the project

#### 1.2.1 Financial situation among adults

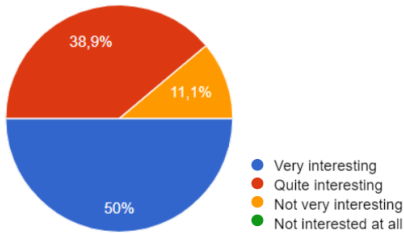
According to the research of Freedom Finance Bank Kazakhstan and First Credit Bureau 2022-2023, 22% of the adult population are familiar with financial instruments; 47% earn from 200 thousand to 400 thousand tenge per month; 7.5 million people (77% of the economically active population of the republic) have existing loans. This proves the financial illiteracy of Kazakhstan's population. Therefore, one decision to address this problem is to advance knowledge among the young generation.

#### 1.2.2 The survey among school students

To explore the interest and relevance of the topic of investing among schoolchildren, a survey was conducted. As a result, it was found that 36.1% do not have any knowledge about investments, 41.7% know only basic principles and only 22.2% have some deep understanding and information about investments.

According to another statistic, half of all Interviewed people are highly interested in this topic, 38.9% are interested enough, 11.1% are not interested enough, and no one marked “not interested at all”. This showed that school students are quite interested in learning about investments, but they do not have enough knowledge right now.

How interested would you be in learning about investing during your school years?



How familiar are you with the concept of “investing”?

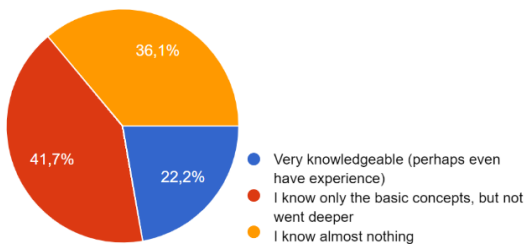


Figure 1, 2. The results of the survey among school students.

## 2. Theory

### 2.1 Return on Investment (ROI)

Return on investment (ROI) is used to evaluate the effectiveness and profitability of investments. ROI measures the amount of income from a particular investment relative to its cost.

$$ROI = \frac{\text{Amount Gained} - \text{Amount Spent}}{\text{Amount Spent}} \times 100\%$$

### 2.2 Value at Risk (VaR)

VaR (Value at Risk) is an indicator that determines the degree of possible financial losses over a certain period. This indicator is often used by investment and commercial banks to determine the extent of losses.

### 2.3 The example of calculation of ROI and VaR

#### 2.3.1 Apple ROI [1] [2]

Apple's 2022 revenue = \$394.328 billion

Apple's expenses for 2022 = \$274.891 billion

$$ROI = \frac{\$394.328 - \$274.891}{\$274.891} \times 100\% \approx 43.45\%$$

The cost of one AAPL share at the time of writing is \$189.46. This means that the approximate profit from the purchase of one share of this company is equal to

$$Profit = Share \times ROI = \$189.46 \times 43.45\% = \$82.32037$$

#### 2.3.2 Amazon's VaR for the last 2 months. [3] [4]

To calculate VaR, it is needed to collect data on the company's stock returns.

First of all, I wrote down in Excel a series of values equal to the return on investment AMZN for a certain period calculated using the formula:

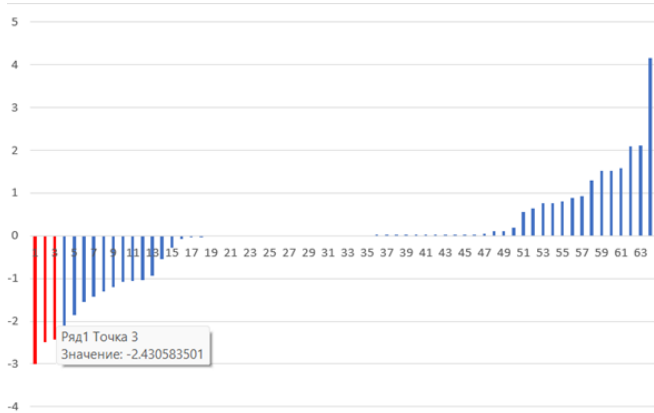
$$\frac{\text{Close}_{\text{for a time period under consideration}} - \text{Close}_{\text{for a previous time period}}}{\text{Close}_{\text{for a previous time period}}}$$

There were 65 values in total (in %). Next, it is needed to arranged them in ascending order.

Date	Open	High	Low	Close	Adj Close	Volume	Return
1-Sep-23	139.46	139.96	136.88	138.12	138.12	40,948,300	
31-Aug-23	135.06	138.79	135	138.01	138.01	58,781,300	-0.0008
30-Aug-23	134.93	135.68	133.92	135.07	135.07	36,137,000	-2.13028
29-Aug-23	133.38	135.14	133.25	134.91	134.91	38,646,100	-0.00118
28-Aug-23	133.78	133.95	131.85	133.14	133.14	34,108,400	-1.31199
25-Aug-23	132.47	133.87	130.58	133.26	133.26	44,147,500	0.000901
24-Aug-23	136.4	136.78	131.83	131.84	131.84	43,646,300	-1.06559
23-Aug-23	134.5	135.95	133.22	135.52	135.52	42,801,000	0.027913
22-Aug-23	135.08	135.65	133.73	134.25	134.25	32,935,100	-0.93713
21-Aug-23	133.74	135.19	132.71	134.68	134.68	41,442,500	0.003203
18-Aug-23	131.62	134.07	131.15	133.22	133.22	48,469,400	-1.08405
17-Aug-23	135.46	136.09	133.53	133.98	133.98	48,354,100	0.005705
16-Aug-23	137.19	137.27	135.01	135.07	135.07	41,675,900	0.813554
15-Aug-23	140.05	141.28	137.23	137.67	137.67	42,781,500	0.019249
14-Aug-23	138.3	140.59	137.75	140.57	140.57	47,148,700	2.106487
11-Aug-23	137.4	139.33	137	138.41	138.41	42,832,100	-0.01537
10-Aug-23	139.07	140.41	137.49	138.56	138.56	58,928,400	0.108374
9-Aug-23	139.97	140.32	137.1	137.85	137.85	50,017,300	-0.00512
8-Aug-23	140.62	140.84	138.42	139.94	139.94	51,710,500	1.516141
7-Aug-23	140.99	142.54	138.95	142.22	142.22	71,213,100	0.016293
4-Aug-23	141.06	143.63	139.32	139.57	139.57	152,938,700	-1.86331
3-Aug-23	127.48	129.84	126.41	128.91	128.91	98,555,200	-0.07638
2-Aug-23	130.16	130.23	126.82	128.21	128.21	51,027,600	-0.54301

Drawing 1. Calculating Amazon's ROI for July-August 2023 in an Excel table.

After that, for clarity, we create a diagram.



Drawing 2. Chart from Amazon ROI data for July-August 2023.

We choose the lowest threshold, usually 5% of the total amount of data.

In our case, 5% of 65 is 3.25, rounding to 3. The third value in the series of numbers is approximately -2.43%. This means that you can be 95% confident that investment losses will not exceed approximately 2.43% of the total investment value.

Since we assumed that we purchased one share of Amazon worth \$138.12, losses will not exceed \$138.12×2.43%≈\$3.36 with a 95% probability.

2.4 Alleged event

When calculating a student’s initial capital, we will base it on the number of bonuses that a student can receive when receiving ten points, taking into account the fact that for every ten points, 100 bonuses are given. For this, we can use elements from probability theory.

Let's assume that on average each student has 6 lessons per day. Thus, a student can receive a maximum of 6 tens. Let's make a table of the distribution of the value.

X	0	1	2	3	4	5	6
P	1/10	1/10	1/10	1/10	1/10	1/10	1/10

Table 1. Distribution of random variables for calculating the possible number of tens received by a student during a school day.

X is the number of tens received;

P is the probability of receiving 10 points. Since there are only 10 points, you can get 10/10 with a probability of 1/10.

To find the average value of the number of tens received, we find the variance:

The Expected Value is:

$$E(X) = \frac{1+2+3+4+5+6}{10} = 2.1;$$

$$E(X^2) = 0^2 \times \frac{1}{10} + 1^2 \times \frac{1}{10} + \dots + 6^2 \times \frac{1}{10} = 9$$

Calculating variance

$$Var(X) = 9.1 - 2.1^2 \approx 4.69.$$

Thus, the probable number of tens is the fifth element in the table (4.69≈5), that is, 4 marks of 10 points per day. Let's assume that there are only 170 school days a year, therefore a student has the opportunity to earn 4×170=680 grades of 10 points. Taking into account that every 10 points is valued at 100 bonuses, the student has the opportunity to earn 680×100=68000 tenge ≈147.68\$ (at the rate of 1\$=460.45 tenge). I would like to note that in real conditions it is unlikely to obtain such many tens, but we will accept such a number on an assumption - under ideal conditions.

2.5 Stock selection

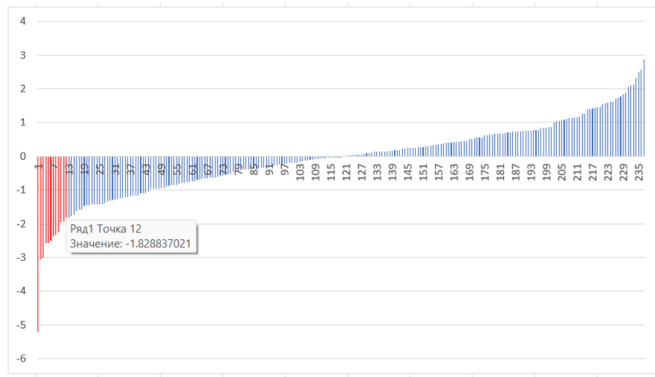
Since school students are still children who will just begin their journey, it is necessary to select assets that will have the highest possible profit and the lowest possible risks, while the cost of these stocks should be low so that most students have the opportunity to start their investment path.

For this reason, I decided to take as an example an ETF (Exchange Traded Fund - a fund with collected securities of several companies. In other words, when investing in these funds, the investor acquires small parts of the shares of several companies at once) funds that have average risks, average profitability, and a relatively low amount of required investments (starting from \$1).

Presumably, the student decided to invest in the SPDR S&P 500 ETF, one of the largest investment funds that does not have a minimum contribution.

ROI SPDR S&P 500 ETF=15.69% - for a year [2]

It is recommended to calculate the annual VaR value yourself for more reliable information.



Drawing. 3 SPDR S&P 500 ETF investment return chart for 2022–2023.

According to the calculations obtained, VaR≈-1.83% (with a 95% probability losses will not exceed 1.83% of the investment value).

Let's assume that the student invests all his money, namely 68.000 tenge, in this asset. Thus, the estimated profit is

$$68000 \times 15.69\% = 10669.2 \text{ tenge}$$

And the estimated risks are equal to

$$68000 \times 1.83\% = 1244.4 \text{ tenge}$$

Total for the year:

Initial capital	Assets	ROI	VaR	Possible income	Possible losses
68000	SPDR S&P 500	15.69%	1.83%	10669.2	1244.4

It is also important to note that the student has the opportunity to earn 10669.2 tenge per year without the help of adults, without making much effort.

### 3. Practice

To conduct the experimental part, 10 students were selected who attended my lecture on the topic of this work. After which, each student, having selected stocks, found the values of the ROI and VaR indicators, as well as the value of their initial capital. Thus, each student came to the values of probable profits and losses. A short video about how the lecture took place can be viewed in the Appendix to the Research Diary.

However, in this work, I would like to present calculations and specific cases of two students: student A, and student B.

#### Student A

Stages of the experiment (Student A is taken as an example):

1. Collection of data from the personal diaries of each student from the website Kundelik.kz.

Student A's grades for grade 10:



Drawing 4. Screenshot of formative assessments for each quarter from student A's website Kundelik.kz.

2. Calculation of initial capital.

In total, for the entire 10th grade, student A received 110 10-point grades. Assuming that for every ten-point mark, the student receives 100 points, the initial capital of student A

$$110 \times 100 = 11000 \text{ tenge}$$

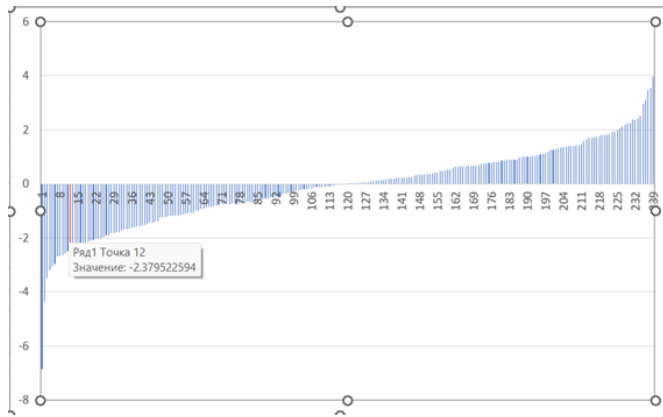
3. Stock selection

Student A decided to choose the Invesco QQQ Trust ETF fund.

4. Determination of ROI and VaR values [2]

$$\text{Annual ROI} = 29\%$$

Annual VaR=-2.38% - with a 95% probability the student will not incur losses greater than 2.38%.



Drawing 5. Chart of return on investment of the QQQ ETF for 2022–2023.

5. Summarizing:

Possible profit  $11000 \times 29\% = 3190$  tenge

Possible losses  $11000 \times 2.38\% = 261.8$  tenge (with a 95% probability losses will not exceed this amount)

Initial capital	Stock	ROI	VaR	Possible income	Possible losses
11000	QQQ ETF	29.00%	2.38%	3190	261.8

Student B:

Number of 10 points = 180;

Therefore, the initial capital of student B will be  $180 \times 100 = 18000$  tenge.

Student B decided to select the Vanguard Total Stock Market Index Fund (VTI) fund.

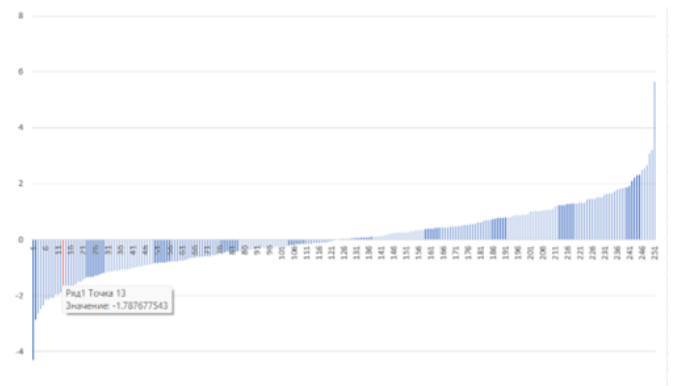
The indicators of this fund are equal to [2]

ROI=15.49%;

VaR=-1.79% (with a 95% probability investment losses will not exceed 1.79%).



Drawing 6. Screenshot of formative assessments for each quarter from the website Kundelik.kz of student B.



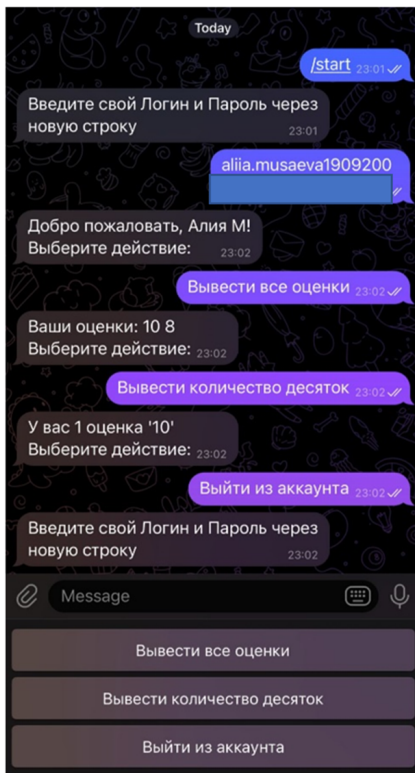
Drawing 7. Chart of return on investment of the VTI ETF for 2022–2023.

Summarizing:

Initial capital	Stock	ROI	VaR	Possible income	Possible losses
18000	VTI ETF	15.49%	1.79%	2788.2	322.2

#### 4. Telegram Bot

I was able to create a Telegram bot that, by connecting to a student's Kundelik account, can display the student's formative grades and the number of tens received. This makes it easier to calculate the possible initial capital for the student. Unfortunately, right now it works only in Russian.



Drawing 5. Screenshot of Telegram bot.

#### 5. Conclusion

During the work, it was clear that by providing schoolchildren with the opportunity to invest using bonuses accumulated through grades, they would be able to make a profit by analyzing the success of investments using VaR and ROI indicators. This will develop financial literacy among children and adolescents and improve the future economic situation of the population. A lecture was also held for 10th-grade students to familiarize them with the methods of calculating and using VaR and ROI indicators, as well as the basic concepts of assets and their types.

However, the development of investments among schoolchildren can only take place with the support of external parties, such as Kundelik.kz, Halyk Bank/Halyk Invest, as well as the state.

Plans also include improving the telegram bot, creating a platform on which schoolchildren can invest, as well as disseminating knowledge about investments and financial literacy through materials and lectures.

#### Acknowledgements

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