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Using survival analysis to investigate stock risks -Algeria Stock Exchange Case Study-

Dekkiche Djamal[1*], cherayett fairouz[2]

[1] Relizane University of economic, Relizane, Algeria. *djamal.dekkiche@univ-relizane.dz*
[2] Tebessa University of economics, Tebessa, Algeria, fairouz.cherayett@univ-tebessa.dz

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Abstract:
The purpose of this study is to investigate the risks of investing in stocks using the estimation of the Cox regression model, which is widely used in the medical, financial, and economic fields, as well as the possibility of benefiting from it by estimating only a portion of its medians, which is useful in determining the risk and its returns. The risks of investing in stocks were identified theoretically in this study with reference to some previous empirical studies on the topic, and these were projected onto the Algiers Stock Exchange by analysing trading activity and market value in the year 2022, as well as estimating the Cox regression model and the Whipple distribution of investment risks in companies listed on the Algerian Stock Exchange.

According to the study, the investor faces a type of risk that varies in degree depending on the type of investment and the form of the tool that convinces the investor. The results of the applied study confirmed that there is a type of risk that the investor incurs when investing in stocks and facing the risk of failure or loss.

Keywords: Stock Investment, Survival Analysis, Cox Regression, Whipple Distribution , Algeria Stock Exchange**.**
JEL Classification Codes : C41; H54.

1. INTRODUCTION

*: ***Corresponding author: Dekkiche Djamal***

Money is one of the most important basic necessities in human life, as it is the main engine for many activities and jobs, based on an appropriate financial system, which ensures the proper functioning of the process and, of course, works to direct, transfer, and provide public money from units with a financial surplus to units with a financial deficit via a group of financial markets.

When it comes to financial markets, those who follow financial market theories will notice that they contain a group of securities, represented by stocks, bonds, and financial derivatives, that are distinguished by being long and medium-term, with fixed interest rates, particularly for bonds (Josette Peyrard, 2000). This is what motivates the investor to aim for satisfactory returns in exchange for his risk in making his investment decision in the financial markets, and thus the investor remains concerned about the risks that may expose him to loss as a result of sacrificing his money for an extended period of time. He anticipates losses associated with the uncertainty of future events (Bertrand Jacquillat,, 2014), particularly the risks of investing in stocks through systemic risks that cannot be avoided and generally affect the economic system in general, and unsystematic risks that are represented in cases of uncertainty and are referred to as "exceptional risks" (Mourad Hadjersi, 1993), in addition to business risks, money risks, and others.

Survival analysis is considered a branch of statistics because the topic of analyzing survival functions and their areas of application has emerged since ancient times, i.e., around the fifties of the last century, and it occupies a large space within serious studies, research, and multiple scientific applications, and its concept is based when studying systems, in addition to studying it more in the medical and epidemiological fields. As well as other fields that use a variety of statistics based on applied statistics in general, such as economic and financial studies that study risks in terms of loss and profit, focusing on risk in general. Survival analysis is used in many fields and disciplines that use time as a key factor in analyzing the phenomenon under study, and the main feature of this method is to study the relationship between the time that precedes the occurrence of the event and one or more independent variables, regardless of whether these variables are quantitative, descriptive, or mixed (Fox, J, (n.d.)). Furthermore, survival analysis is a common and mathematically complex topic that relies on distributions and estimation methods, and it has piqued the interest of many researchers, including Charles, Lewis, Harold, and others, to the point where it has become a science concerned with the study of estimation and prediction.

1.1. STUDY PROBLEM:

The problem of this study can be formulated in the following main question:

What are the risks of stock investing, and how can survival analysis be used to estimate the risk function?

1.2. OBJECTIVES OF THE STUDY:

This study seeks a number of objectives, including:

Finding previous empirical studies that addressed the subject or a portion of the study.
Clarify some concepts related to the study's topic.
Identifying and analyzing the Algerian Stock Exchange, as well as the most important financial markets and companies listed on the market.
Statistically estimating survival functions and arriving at various outcomes.

1.3. IMPORTANCE OF THE STUDY:

The importance of the study lies in the fact that the issue of stocks and the risks of investing in them is one of the most important topics commonly used by investors and financial institutions, as well as financial institutions aimed at increasing financial returns, and survival data is the most important methodology for estimating these risks, as it is one of the most recent statistical methods.

1.4. STUDY APPROACH:

The descriptive approach was used to introduce students to various concepts such as the risks of stock investing, survival analysis, and its functions. Finally, the experimental statistical approach was used to explain the relationship between variables using a set of statistical methods, while the mathematical and inferential approaches were relied on to clarify the mathematical relationships of the various survival analysis functions.
SPSS, Excel, Easy Fit 3.0 Professional, and R studio were used as statistical programs.

2. LITERARY REVIEW

Many studies have been conducted on various aspects of the study, including:

Researchers (Yuniningsih, Y., W. . N. W. B., 2020) conducted a study to test investors' risk appetite when makinginvestments associated with loss aversion, in terms of risk behavior in relation to future loss aversion behavior. Loss aversion is treated as an independent variable that is examined from both the profit and loss perspectives. When investors are fearful of losing money in the profit sphere, they tend to take fewer risks than in the loss sphere, as described in the default value function for differences in investor behavior in these two different domains, where an ANOVA test is used to determine the behavioral differences in risk in the two domains toward loss avoidance.

The results of hypothesis testing with the alpha indicator show that when investors are loss averse in the gain realm, they have a lower risk than when they are less fearful in the loss realm. At the same time, the post hoc use of test results is important because loss fear has a significant impact on investment decision making, particularly in stocks.

A value-at-risk (VAR) analysis was used to measure and analyze stock market index risk in Asia Pacific countries in a study conducted by researchers (Su, E., & Knowles, T. W., 2014), revealing and detailing both the unique risks and the systemic risks embedded in those markets. After estimating the volatility parameters, they were able to calibrate the VAR values for individual and systemic risks by performing "volatility modeling" by swapping the mixture, exponentially weighted moving average (EWMA), or conditionally covariant autoregressive models (GARCH).

The researchers discovered that, on average, Indonesia and Korea have the highest levels of sensitivity to risk, while Australia currently has relatively low values and Taiwan may be experiencing high volatility. Furthermore, the Kupiec test indicates that the combination key VAR outperforms delta at normal risk, as the squared probability score (QPS) shows that the EWMA tends to underestimate the value of the VAR for a single string, and GARCH shows no difference from the generalized error distribution.

Through his research, the researcher (Al Janabi, M. A. M, 2008) examines the objectives of market risk management and their adaptation to the specific needs of emerging financial markets, as well as the proper use of Value at (VAR) and stress testing methods, which are illustrated with real-world examples and practical reports for market risk analysis and monitoring. The calculations and conclusions presented here are applicable to the Mexican currency and stock markets. The researcher concluded that the financial markets are subject to ongoing risks, implying that the effects of hedging stock trading risks with mutual forex trading positions were investigated and the quantity determined.

Through their paper, the two researchers (Kaliva, K., & Koskinen, L, 2008) proposed a switch model of the automatic regression system for stock price dynamics, in which the process creates pricing bubbles in one system while error correction prevails in the other. In a bubble system, the stock price is inversely related to inflation. They discovered that the probability of switching the system depends on external inflation and lagging price in the error-correction system. In Modigliani, they emphasized the importance of inflation and the price-earnings ratio when evaluating investment risks, and the model is consistent with the theoretical trader noise model, Schleifer's arbitrage model, and Fishney's inflation illusion.

The researchers (Bieszk-Stolorz, B., & Dmytrów, K., 2021) aimed to assess the strength of the global stock market reaction during the SARS-CoV-2 pandemic at the beginning of 2019-2020, where they analyzed the risks and severity of the decline in the values of the underlying stock indices using selected methods of survival analysis. They also investigated the time of decline of stock market indices using the Kaplan-Meier estimator, as well as the regression intensity using the empirical risk estimator and the Cox proportional hazard model.

The findings revealed that the severity is greatest in the fourth and eighth weeks following the peak, and it is greatest in the European, then American, and Asian stock exchanges (including Australia), where they concluded that the risk of falling stock indices prices is greatest in America, followed by Europe, Asia, and Australia, and lowest in Africa.

After 52 days, half of the analyzed indicators had a 20% decrease in value (median duration). The study serves as an introduction to more in-depth analyses of the crisis and the normalization of the situation in global stock exchanges, as it identifies the impact of the epidemic on the economic situation and identifies differences between continents.

The two researchers (Gao, G., Bu, Z., Liu, L., Cao, J., & Wu, Z, 2015) addressed the problem of stock market predictions by employing a Cox risk model to specifically predict the future rise or fall of stock prospects. The researchers proposed a model to solve the problem of predicting buying and selling points from the standpoint of survival analysis. Cox's risk model was chosen as the model for this forecasting problem for a variety of reasons, including its ability to model the dynamics of stock movement and to easily incorporate various types of technical indexes as covariates in the experiment, which was conducted by applying the trained stock market forecasting model to six stocks on the Shanghai Stock Exchange.

The results showed that the proposed model outperforms many basic models in terms of accuracy, and stock yield evaluations revealed that the proposed model generates higher profits.

The two researchers (Andersson, N, 2014) investigated the effectiveness of a survival analysis on financial statements. In addition to determining whether all companies are experiencing a financial crisis at the same time, the data set includes all companies traded on the Swedish stock exchange during 2008.

The results show that the survival method is very appropriate for the data used, and the sector in which the company operates has a large impact, but the power is low; additionally, the researcher discovered that the group of smaller companies fared much better than the larger companies.

A study conducted by (Gupta, V, 2017) used survival analysis to identify key indicators that could explain the default risk of listed Indian companies. For a data set of 859 firms across 10 industries, the author used a semi-standard Cox proportional hazard model to test the impact of financial ratios, capital market ratios, macroeconomic variables, firm size and age, and promoter ownership structure.

Survival models, as opposed to traditional hypothetical prediction models, use "time to default" as the dependent variable. Return on capital employed (ROCE), return on net wealth (ROE), interest coverage ratio, exchange rate volatility, GDP growth rate, stock index, promoter holdings, and percentage of equity mortgages are all hypothetical significant predictors, according to empirical results.

The study concludes by emphasizing the importance of survival models in hypothetical forecasting; unlike traditional accounting-based and market-based models, these models assess the relationship between survival time and covariates, and it is highly recommended to apply survival models to assess and model credit risk, where loan structuring can be done by lenders by evaluating the survival periods of different companies throughout the entire observation period under consideration.

Both researchers (Shrivastava, A., & Kumar, N, n.d) developed a model to predict the probability of intentional non-payment of debt obligations that turn into bad assets, as they revealed in this paper that financially weak companies were experiencing deep financial distress somewhere between two and three years before it was declared a

willful default by the primary credit institution and reported to the credit information companies. Cox's proportional hazards model (PHM), a well-known and widely applied approach not only in the medical sciences but also in predicting a company's bankruptcy, was used, and they discovered that using Bayesian methods has the advantage of dealing with controlled data in a small sample compared to the iterative approach, and its application The Markov Chain Monte Carlo (MCMC) sampling enables a Bayesian estimator to be provided in a Bayesian structure in a Bayesian survival framework incorporating normal premises that generally perform better than conventional probability estimation for predicting intentional shortening depending on.

Using daily transactions and data from the French index options market, (Deville, L., & Riva, F., 2007) investigated the determinants of the time it takes the index options market to return to no arbitrage values after deviations equivalent to a call, where they used survival analysis to describe how the limits affect Arbitrage on the expected duration of arbitrage skews. They concluded that the introduction of an exchange-traded fund affects the survival rates of skews, but this effect is primarily due to the lower level of potential arbitrage profits after controlling for a faster return of arbitrage profits.

These empirical studies are valuable studies in terms of survival analysis and the risks of investing in securities, but there is a gap in the literature in which investment risks have been studied using statistical methods for survival analysis.

3. CONCEPTS RELATED TO THE STUDY TOPIC

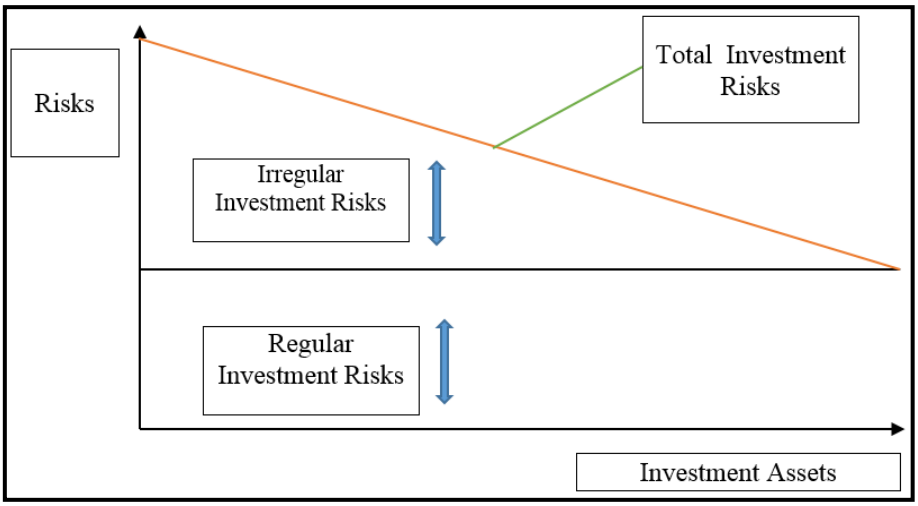
3.1. Risks of investing in stocks

All investments have inherent risk(s): a stock's price may plummet; a bond's issuer may default; and even cash investments (U.S. Treasury bills or money market funds) may lose ground to inflation. So you may be wondering, "Why would I risk losing some or all of my money?" Whatever investment vehicle you select; the goal is always the same: to generate more cash for yourself in the future than you do today. If you keep all of your money under your mattress, your balance will never rise above the amount you save.

Risk is defined as the possibility of deviating from the path that leads to an expected or hoped-for outcome (Vaughan, E. J., 1999). Thus, investment risks are risks that a stock investor fears because he has invested all of his money in long- or medium-term stocks that may fail or profit.

Regular investment risks represent the state of fluctuation in returns caused by factors affecting the economic system that occur on the market as a whole (Marshall, J. F, 2000), whereas irregular investment risks arise due to special circumstances or factors related to a specific institution or sector (Bertrand Jacquillat, 2014), and business risk defines the standard deviation of the return on operations over the average return on operations.

Fig1. the relationship between investment categories



Source:*(Banks, 2005)*

3.2. Survival Analysis

Survival analysis is the analysis of data at the time of the event, that is, describing the length of time from the origin of time to the end point of interest (Kartsonaki, 2016), and it is also a set of statistical procedures for analyzing data when the dependent variable is the time until the event occurs, and the time can be days, weeks, months, or years until the event, which can be death or the beginnings of illness (David G. Kleinbaum, 2000).

The rate of risk, also known as the instantaneous or current rate of occurrence of the event, is the hazard function (Germán Rodriguez, 2018). When it comes to observational data, it is defined as a constraint that, if it is not adequately controlled, can lead to worry and inconvenience in the analysis. Additionally, the existence of some hidden observations in the survival data cannot be disregarded or neglected.

4. RESULTS AND DISCUSSION

4.1. ANALYSIS OF THE ALGERIAN STOCK EXCHANGE'S STOCK MARKET

The government introduced a package of economic reforms in 1987, and at the same time, economic laws on the independence of public institutions and shareholding funds were issued. These reforms went into effect in 1988. The ownership right, or capital, of social public institutions is divided into a number of shares and distributed among the contribution funds. As a result, in accordance with the provisions of the Commercial Law, which complete the laws of 1988, public companies were converted into share companies (Rashid Boksani, 2006).

The companies listed on the Algerian Stock Exchange are:

- Eurasian Hotel Management Corporation.
- Alliance Insurance.
- NCA Rouiba Company.
- SAIDAL Complex.
- Biopharm Foundation.

- OEM Invest.

To analyze the stock market by following the recent course of corporate development in 2022, refer to **Table 1**:

Table 1.Companies listed on the official market during 2022

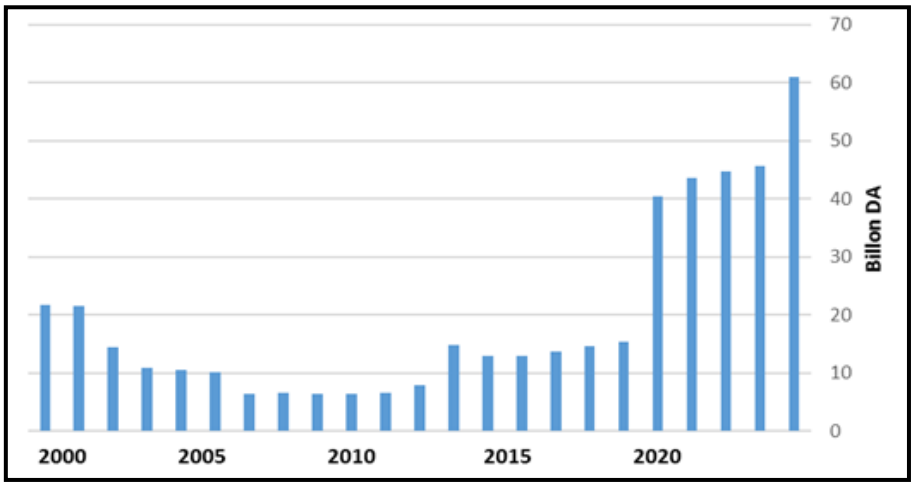
Company	Orders	Orders size	Trading size	Traded value DZD	Deals
ALLIANCE ASSURANCES	394	564,099	16,705	6,040,319.00	25
AOM invest spa	3	20,000	5,000	1,125,000.00	1
BIOPHARM	397	569,150	26,348	38,752,325.00	54
EGH EL AURASSI	382	1,051,408	2,010	1,104,950.00	3
SAIDAL	576	414,170	34,280	18,619,858.00	49
Total	1 752	2,618,827	84,343	65,642,452.00	132

Source: Algiers Stock Exchange SGBV at *(Algiers Stock Exchange, 2022)*

In the group of companies listed on the Algiers Stock Exchange in 2022, as shown in the **Table 1** above, SAIDAL Group outperforms competitors in terms of trading activity, order volume, and trading volume, while also coming in second in terms of deal volume.

The following graph illustrates how the market value of the Algerian Stock Exchange, or the capitalization of shares, changes over time:

Fig 2.The evolution of the capitalization of (Algiers Stock Exchange, n.d.)during the period 2000-2022



Source: *(Algiers Stock Exchange, 2022)*

According to the **Fig 2** above, the capitalization of the Algiers Stock Exchange increased from 2000 to 2022, reaching 21 billion Algerian dinars in January 2000, before gradually declining until 2013, when it amounted to 13 billion Algerian dinars, when NCA Rouiba entered the Algiers Stock Exchange. The stock market capitalization then increased to 4.16 billion dinars, where the market value of this company's shares was approximately 40.3 billion dinars, equivalent to 7.20 percent of the total stock capitalization, but the stock market capitalization decreased to 8.13 billion dinars during the second quarter. The reason for this drop is a decrease in the market value of the majority of shares traded on the stock exchange, particularly the Alliance Insurance share, which was 610 dinars per share. The capitalization increased in 2014 and 2015,

reaching 79.14 billion dinars in 2014 and 43.15 billion dinars in 2015, as a result of an increase in the market value of each of the Eurasian shares and the SAIDAL Complex share, which amounted to 88.2 billion dinars and 40.6 billion dinars, respectively. The value of the stock market capitalization increased significantly in 2016, reaching 78.45 billion dinars. The market value of the Eurasian shares was approximately 26.31 billion dinars, or 2.68 percent of the total stock market capitalization. The stock value decreased by 11% in 2017, but increased by 93.43 billion dinars in 2020. This increase is due to the entry of the OM Invest trading company's shares into the market of small and medium enterprises, where the market value of these shares was approximately 47.3 billion dinars, or 98.7 percent of the total stock market capitalization. Despite the fact that the stock exchange capitalization increased from 2013 to 2022, it remains weak in comparison to the gross domestic product, as it did not exceed 5.0 percent of output in 2022, indicating that the stock market experienced an unprecedented rise in June of this year. However, the stock market's role in financing the economy remains somewhat limited (Algiers Stock Exchange, 2022).

4.2. Measuring the risk function of stock investing using a risk function (survival analysis)

The risk of investing in stocks is the decline in the stock's market value as a result of changes in market factors; therefore, in order to calculate the risks of investing in stocks, the dispersion value of the stock in each of the companies under consideration that are listed on the stock exchange is measured. so that we can measure the likelihood of the stock's market value, we use the relative risk function using Cox regression as follows:

$$h(t,X) = h_0(t).exp\left(\sum_{i=1}^{\rho} \beta_i X_i\right) \quad (1)$$

Whereas:

- The event under study: the drop in the market value of the stock;
- Independent variables: they are factors that contribute to the relative risks h.

The market values and trading in the companies listed on the Algerian Stock Exchange thus serve as representations of the study's variables, which can be defined as follows:

- Time variable t: It is the number of the trading session in which the market value decreases.
- Boolean expectation variable c: It takes the value 1 if the share value does not fall below the estimated 15% until the end of the follow-up period in 2022, which is 395 trading sessions, which represents the follow-up period, and takes the value 0 if it drops significantly below this amount.
- The ratio of the trading session in a company to the total trading in companies listed on the Algerian Stock Exchange (ctr).
- The ratio of the number of orders in a company to the total orders in the companies listed on the Algerian Stock Exchange (cno).
- The ratio of the number of deals in a company to the total deals in companies listed on the Algerian Stock Exchange (cnd).

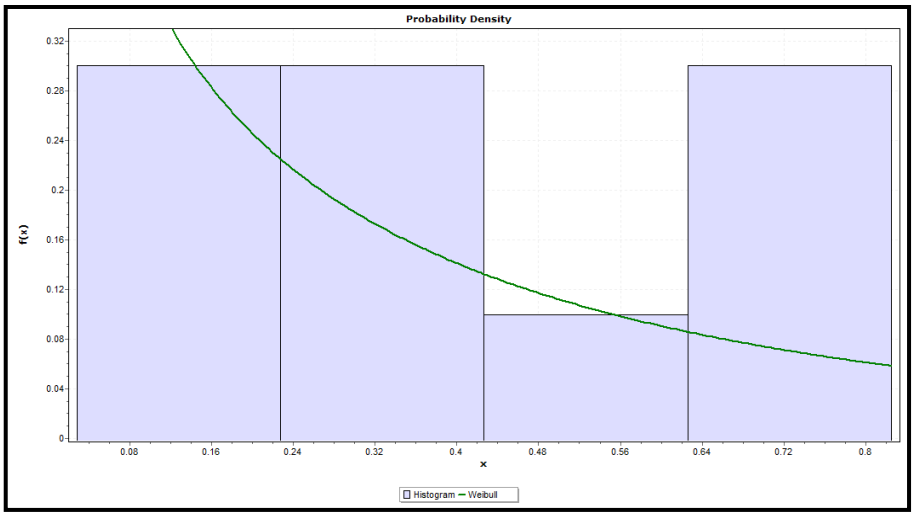
As a result, the Cox model's function for stock investment risk is as follows:

$$h(t,X) = h_0(t).\exp(\beta_1 ctr + \beta_2 cno + \beta_3 cnd) \quad (2)$$

4.3. Estimating the survival model at the 5% level of significance when the survival time followed the Whipple distribution

The data distribution of this sample was tested using the Easy Fit 3.0 statistical program to determine whether or not the time of survival in the sample under study followed the Whipple distribution:

Fig 3.The distribution of survival data according to the Whipple distribution



Source: Authors' computation using Easy fit 3.0

We can see from the **Fig 3** above that the Whipple distribution of the survival data function shows that the data follow the Whipple distribution.

The survival function is estimated by the shrinkage method on real data as follows:

Sort the compensation in the risk function and the survival function in accordance with their respective formulas, along with the values of survival (time) in ascending order, From the statistical program Easy fit 3.0, we found the following parameters of the estimate as follows:

$\alpha = 0.77142$

$\beta = 0.42567$

$\gamma = 0$

Table 2. Estimation of the survival function by contraction method

Rank	time	S(t)	h(t)
1	02	0.4457	**0.0037**
2	575	0.7141	**0.0510**
3	382	0.2341	**0.0690**
4	392	0.0922	**0.1992**
5	395	0.3199	**0.2130**

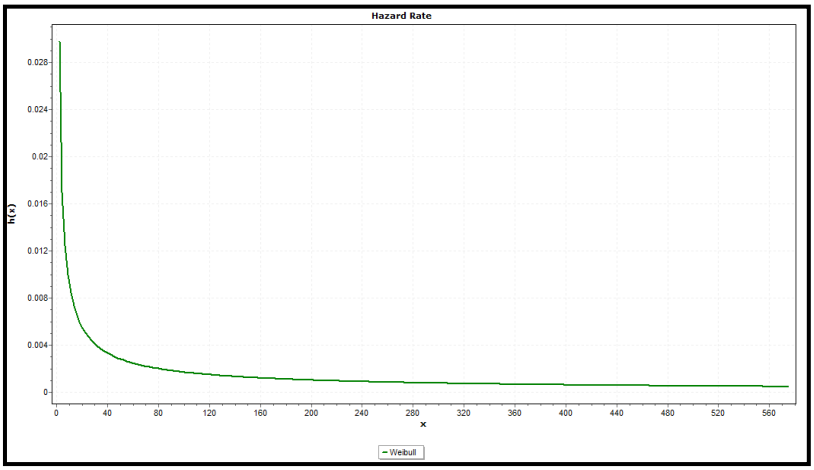
Source: Prepared by the researchers based on Easy fit 3.0

Table 2 above shows that the survival function was roughly 44.57 percent within 24 hours, and that stock prices of companies and those who discontinued trading varied with time in terms of profit or follow-up. As a result, the function of survival fluctuates

between different periods of corporate survival and periods of failure. The Whipple distribution reveals that the survival function can occasionally be inversely proportional to time.

The risk function (risk factor) is directly inversely correlated with the survival time. The following chart illustrates that as time passes, the risk factor (increase in failure time) increases.

Fig 4.Risk function for survival data



Source: Authors' computation usingEasy fit 3.0

4.4. Cox regression estimation for survival data

It is utilized in several statistical programs in accordance with an appropriate distribution and is regarded as one of the most popular methods for estimating the survival function data.

- **Cox's régression application**

Table 3. Cox regression parameters

Omnibus Tests of Model Coefficients

Log Likelihood	Overall (score)			Change From Previous Step			Change From Previous Block		
	Chi-square	df	Sig	Chi-square	df	Sig	Chi-square	df	Sig
17.813	200	2	096	423	2	125	337	2	995

a. Beginning Block Number 1. Method = Enter

Source: SPSS output

The results of the test with the highest potential to determine the significance of the model as a whole are displayed in **Table 3**. The estimated model is not significant, as shown by the probability value of the chi-square test being greater than the level of significance of 5%.

In addition to the one-sample Kolmogorov-Smirnov test, which demonstrates whether or not the residuals' graph distribution and significance are significant.

From the R studio, we find:

Table 4.Normal distribution of the Klumgrove-Smirnov test

```
        One-sample Kolmogorov-Smirnov test
data:  r
D = 0.2745, p-value = 0.1724
alternative hypothesis: two-sided
```

Source: R studio output

The residuals are therefore subject to an exponential distribution with a median of 1 at the significance level of 0.05, and from this the model agrees with the data based on the residuals study of Cox & Snell. The test probability value of 0.1724 demonstrates that it is greater than the significance level of 0.05.

The data in the estimate's residuals have a normal distribution, and the values of the estimated parameters and their standard errors, the *wald* statistic and the probability value, as well as the risk rate and their confidence intervals, are all shown in the **Table 5.**

Table 5.Various statistics in the COX model

Variables in the Equation

	B	SE	Wald	df	Sig.	Exp(B)
ctr	-.035-	.919	.001	1	.970	.966
cno	.014	.024	.347	1	.556	1.014
cnd	.214	.336	.002	1	.998	1.325

Source: SPSS output

As a result, the following is the Cox regression equation for the study variables:

$$h(t,X) = h_0(t).\exp(-0.35ctr + 0.014cno + 0.214cnd) \quad (3)$$

Based on the information in the **Table 5**, we can conclude:

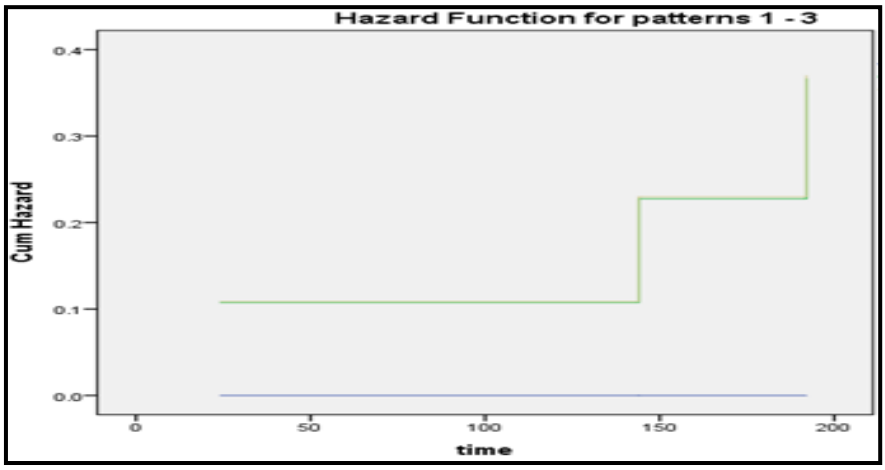
❖ The coefficient of the ctr variable is negative (-0.035), and the Wald statistical probability value is 0.970, which is greater than 5%. As a result, the ctr variable has no significant effect, implying that the risk of failure at one company is not significantly different from that of another, and vice versa.

❖ The coefficient of the cno variable is positive (0.014), so whenever the trading volume increases by one year, the risk increases by 1.014 times, in addition to the probability value of the wald statistic for the trading volume variable of 0.556, which is greater than 5%, indicating that the age variable has no significant effect.

❖ The coefficient of the cnd variable is positive (0.214), so as the volume of trades increases by one year, the risk of deal failure increases by 1.214 times, in addition to the probability value of the wald statistic for the volume variable of 0.998, which is greater than 5%. It implies that the variable volume of transactions has no effect.

Fig.5 indicates the Cox regression curve for the cumulative risk function of stocks in circulation.

Fig.5.Cumulative risk function for stock trading

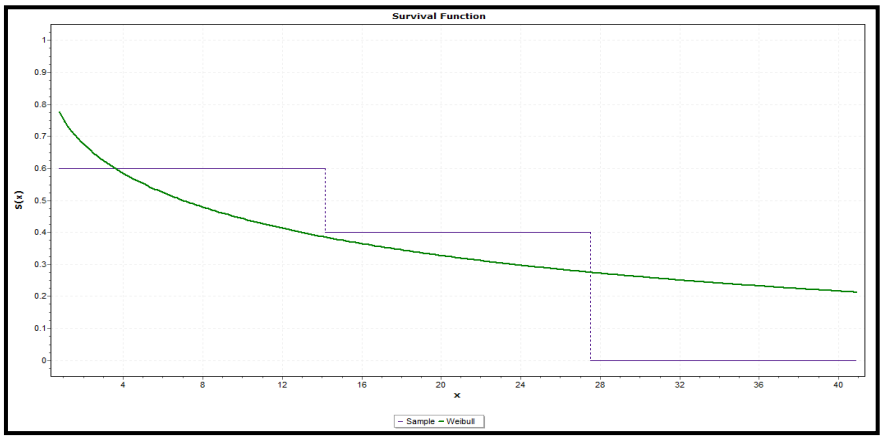


Source: Authors' computation using SPSS

Fig.5 above shows that the first deal and trading volume are close to the same curve and rise with increasing age, indicating that the risk factor increases, whereas the volume of orders is parallel to the axis of the breaks, indicating that the risk factor has no influence. We conclude that the risk of failure is higher for companies where trading volume is lower than order volume.

The survival data for trading equity risk can also be represented as follows:

Figure 6.Survival analysis function



Source: Authors' computation usingEasy fit 3.0

5. CONCLUSION

The Algerian Stock Exchange contains markets capable of directing significant investments between large and even medium or small institutions through the ease of obtaining significant financing sources; that is, moving the trading activity in the stock exchange as a whole, and thus knowing and anticipating the risks that the investor may face as a result of his investment in various types of stocks, such as regular, irregular, financial, business, and market risks. where risk is considered to be one of the most important factors and elements on which the investor bases his decision; and thus, the investor's risk in investing in stocks is one of the most severe types of risk in terms of expecting loss rather than profit as a result of continuous fluctuations in the market value of the stock at the level of institutions and companies listed on the stock exchange from year to year, which is directly reflected on the stock exchange.

Furthermore, one of the most important methods of survival analysis that measures the possibility of an event occurring or not, i.e. the expectation of profit loss, is the use of Cox's proportional risk model in measuring and analyzing the risks of investing in stocks.

Based on the foregoing, the results can be summarized as follows:

❖ The Algerian Stock Exchange witnessed a weakness in the performance and activities of the listed companies at the start of the study period, which then improved with the start of 2018 until the present time, as a result of the stock exchange culture available to investors and the good factors for increasing the share price, with the recent epidemic crisis having the largest share. In the evolution of the Algiers Stock Exchange's performance, particularly the SAIDAL complex.

❖ One of the most important topics is survival analysis, which includes a set of data until the time of the event, in which time or the period of survival is an important dependent variable.

❖ In comparison to the maximum possibility method, which is used in large sample sizes, the shrink method is considered one of the best methods for processing data with small samples, whereas White's method is less efficient and measured in terms of estimating the survival function than the previous two methods.

❖ The Whipple distribution is one of the best and most important distributions for analyzing survival data and predicting variable behavior.

❖ The data from the applied side included several results that were statistically described and estimated using Cox regression.

❖ Cox's estimation of the risk function of the risks of investing in stocks for the case of Algeria (Algeria Stock Exchange) revealed that the investor is at risk as a result of his long-term investment in stocks.

From the previous results, several recommendations can be made, including:

❖ Awareness and sponsorship of investors and control of undesirable practices that lead to risks to financial and medium-sized institutions.

❖ The need for media attention to the financial markets.

❖ Finding ways to give the best probability distribution for the sample of the population under study, and thus developing a scientific approach to reach the optimal probability distribution.

❖ Benefiting from the mathematical algorithms included in statistics and exploiting them in financial studies.

6. Bibliography List :

Bertrand Jacquillat, B. S. (2014). *Marchés financiers* (6ème édition). DUNOD. https://www.dunod.com/entreprise-et-economie/marches-financiers-gestion-portefeuille-et-risques

David G. Kleinbaum. (2002). *Logistic Regression: A Self-Learning Text* (2nd edition). Springer. https://www.amazon.com/Logistic-Regression-Self-Learning-David-Kleinbaum/dp/0387953973

Josette Peyrard. (2000). *La Bourse* (9ème édition). Librairie Eyrolles. https://www.eyrolles.com/Entreprise/Livre/la-bourse-9782711777600/

Marshall, J. F. (2000). *Dictionary of Financial Engineering* .

https://www.amazon.com/Dictionary-Financial-Engineering-John-Marshall/dp/0471242918

Al Janabi, M. A. M. (2008). A practical approach to market risk analysis and control: Empirical test of the Mexican foreign exchange and stock markets. *International Journal of Risk Assessment and Management*, *9*(1–2), 70–103. https://doi.org/10.1504/IJRAM.2008.019314

Algiers Stock Exchange. (n.d.). *SGBV* . Retrieved November 12, 2022, from https://www.sgbv.dz/?lang=eng

Andersson, N. (2014). Estimating Companies' Survival in Financial Crisis : Using the Cox Proportional Hazards Model. *Undefined*.

Banks, E. (2005). Financial Lexicon. In *Financial Lexicon*. Palgrave Macmillan UK. https://doi.org/10.1057/9780230508125

Bieszk-Stolorz, B., & Dmytrów, K. (2021). A survival analysis in the assessment of the influence of the SARS-CoV-2 pandemic on the probability and intensity of decline in the value of stock indices. *Eurasian Economic Review*, *11*(2), 363. https://doi.org/10.1007/S40822-021-00172-7

Deville, L., & Riva, F. (2007). Liquidity and Arbitrage in Options Markets: A Survival Analysis Approach. *Review of Finance*, *11*(3), 497–525. https://doi.org/10.1093/ROF/RFM021

Fox, J. (n.d.). *Cox Proportional-Hazards Regression for Survival Data*.

Gao, G., Bu, Z., Liu, L., Cao, J., & Wu, Z. (2015). A survival analysis method for stock market prediction. *2015 International Conference on Behavioral, Economic and Socio-Cultural Computing, BESC 2015*, 116–122. https://doi.org/10.1109/BESC.2015.7365968

Germán Rodriguez. (2018). *Course Details | Office of the Registrar*. https://registrar.princeton.edu/course-offerings/course-details?courseid=009628&term=1184

Gupta, V., & Gupta, V. (2017). A Survival Approach to Prediction of Default Drivers for Indian Listed Companies. *Theoretical Economics Letters*, *7*(2), 116–138. https://doi.org/10.4236/TEL.2017.72011

Kaliva, K., & Koskinen, L. (2008). Stock market bubbles, inflation and investment risk. *International Review of Financial Analysis*, *17*(3), 592–603. https://ideas.repec.org/a/eee/finana/v17y2008i3p592-603.html

Kartsonaki, C. (2016). Survival analysis. *Diagnostic Histopathology*, *22*(7), 263–270. https://doi.org/10.1016/J.MPDHP.2016.06.005

Mourad Hadjersi. (1993). Le dilemme algérien. *Revue Mutation*, *6*, 19–20.

Rashid Boksani. (2006). *Obstacles to Stock Markets in the Arab Countries and Ways to Activate them* [university of algiers]. http://dspace.univ-bouira.dz:8080/jspui/bitstream/123456789/3851/1/%D8%A8%D9%88%D9%83%D8%B3%D8%A7%D9%86%D9%8A%20%D8%B1%D8%B4%D9%8A%D8%AF-%20%D9%85%D8%B9%D9%88%D9%82%D8%A7%D8%AA%20%D8%A3%D8%B3%D9%88%D8%A7%D9%82%20%D8%A7%D9%84%D8%A3%D9%88%D8%B1%D8%A7%D9%82%20%D8%A7%D9%84%D9%85%D8%A7%D9%84%D9%8A%D8%A9%20%D8%A7%D9%84%D8%B9%D8%B1%D8%A8%D9%8A%D8%A9%20%D9%88%20%D8%B3%D8%A8%D9%84%20%D8%AA%D9%81%D8%B9%D9%8A%D9%84%D9%87%D8%A7.pdf

Shrivastava, A., & Kumar, N. (n.d.). A Survival Model for Wilful Default Prediction-Bayesian Approach. *BOHR International Journal of Finance and Market Research*, *2022*(1), 45–57. https://doi.org/10.54646/bijfmr.008

Su, E., & Knowles, T. W. (2014). Asian Pacific Stock Market Volatility Modeling and Value at Risk Analysis. *Https://Doi.Org/10.2753/REE1540-496X420202*, *42*(2), 18–62. https://doi.org/10.2753/REE1540-496X420202

Vaughan, E. J., & Vaughan, T. M. (1999). *Fundamentals of risk and insurance* (8th ed). John Wiley & Sons.

Yuniningsih, Y., W. . N. W. B. (2020). An analysis of Decision Making in the Stock Investment | Economic: Journal of Economic and Islamic Law. *Economic and Islamic Law*, *8*(2), 122–128. http://ejournal.kopertais4.or.id/tapalkuda/index.php/economic/article/view/2987

7. Appendices

Appendices 01:

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
t	5	2	575	349.20	210.083
c	5	0	1	.60	.548
ctr	5	.574550	40.272890	17.20532120	16.463291675
cno	5	.592817	31.239106	11.61698240	13.378557099
cnd	5	.757575	40.909090	19.99999940	18.814741296
Valid N (listwise)	5				

Appendices 02 :