Report 2 Claudio Palmeri N° 2062671
Name of the company: **Walgreens Boots Alliance, Inc. (WBA)**

Walgreens Boots Alliance, Inc. operates as a pharmacy-led health and beauty retail company.
It operates through two segments, the United States and International.

The United States segment sells prescription drugs and an assortment of retail products, including health, wellness, beauty, personal care, consumable, and general merchandise products through its retail drugstores. It also provides central specialty pharmacy services and mail services.
The company operates under the Walgreens and Duane Reade brands in the United States.

The International segment sells prescription drugs; and health and wellness, beauty, personal care, and other consumer products through its pharmacy-led health and beauty retail stores and optical practices, as well as through boots.com and an integrated mobile application. It also engages in pharmaceutical wholesaling and distribution business in Germany.

The company operates retail stores under the Boots, Benavides, and Ahumada in the United Kingdom, Thailand, Norway, the Republic of Ireland, the Netherlands, Mexico, and Chile.

Walgreens Boots Alliance, Inc. was founded in 1901 and is based in Deerfield, Illinois.
More precisely at the address: 108 Wilmot Road with telephone number 847 315 3700

The most influential executives in the company are:

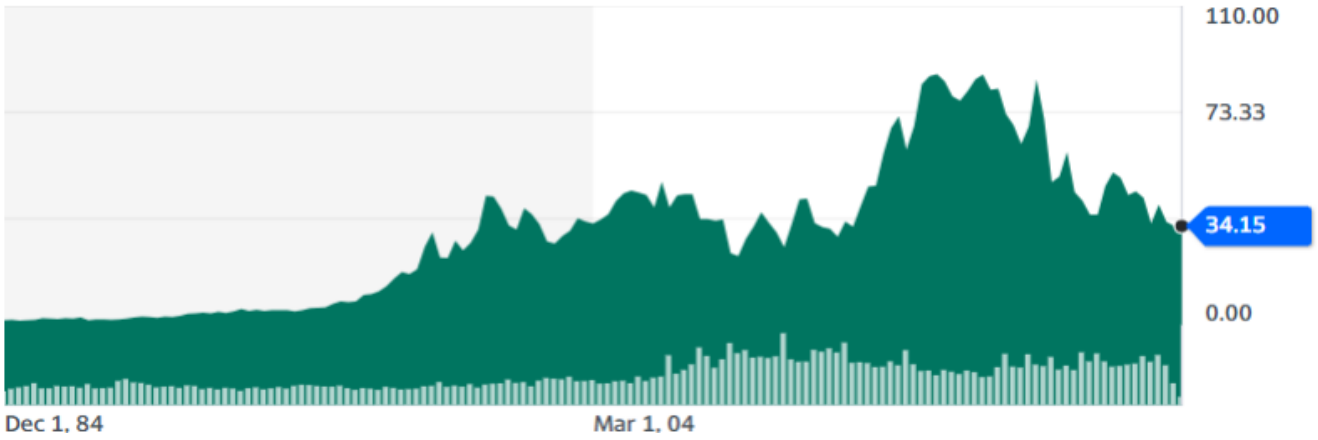
Name	Title	Pay($)
Mr. Stefano Pessina	Exec. Chairman	111.25 K
Ms. Rosalind Gates Brewer	CEO & Director	5.89M
Mr. James Kehoe	Exec. VO & Global CEO	2.54M
Ms. Ornella Barra	Chief Operating Officier of International	3.11M
Mr. Hsiao Wang	Sr VP & Chief Information Officer	N/A
Mr. Gerald Gradwell	Sr VP of Investor Relations	N/A
Ms. Danielle Carim Gray	Exec. VP & Global Chief Legal Officer	N/A
Mr. Aaron C. Radelet	Global Chief Communications Officer & Sr. VP	N/A
Ms. Holly May	Exec. VP & Global Chief HR Officer	N/A
Mr. Charles V. Greener	Sr. VP & Global Chief Public Affairs Officer	N/A

The low (for an Exec. Chairman) pay of Stefano Pessina could be a mistake committed by Yahoo Finance.

Some useful statistics on the company Walgreens Boots Alliance, Inc. are:

Feature	Value
Market Cap	28.4B$
Revenue per share	153.52$/share
Gross Profit	28.27B
Forward Annual Dividend Yield	5.68%

This is the overall evolution of the stock price from the beginning:



Walgreens Boots Alliance, Inc.'s ISS Governance QualityScore as of March 1, 2023 is 8.

74.64% of the shares are held by institutions, more precisely the top institutional holders are:

Holder	Shares	% of	Value($)
Vanguard Group, Inc. (The)	61,519,967	7.13	2,100,906,966
Blackrock Inc.	60,608,244	7.03	3,069,771,625
State Street Corporation	57,430,654	6.66	1,961,256,921
Capital World Investors	20,887,809	2.42	713,318,709
FMR, LLC	13,827,254	1.6	472,200,745
Geode Capital Management, LLC	13,401,774	1.55	547,670,602
Invesco Ltd.	13,278,435	1.54	453,458,575
Morgan Stanley	11,974,220	1.39	408,919,631
Wells Fargo & Company	8,721,268	1.01	297,831,315
Northern Trust Corporation	8,053,046	0.93	275,011,533

Data analysis:

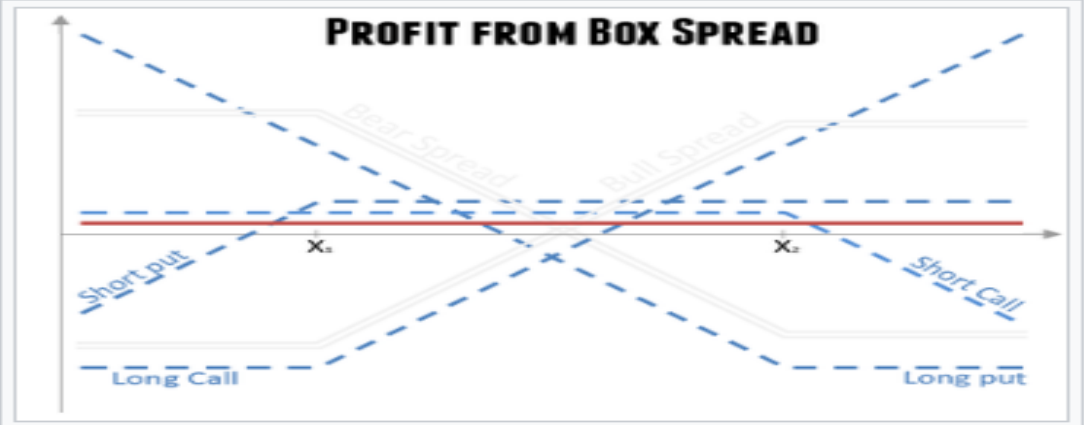
All the data in this report was taken in the day **30/3/2023**.
The objective of this report is to compute both the discount factor and the implicit dividend for a maturity time T=1/3/6/12 months. In order to do this I'll use a box spread strategy and the put-call parity formula.

The current price of the stock is **s0=34.15$**

A box spread strategy consist in combining (i.e. doing them at the same time) a call spread and a put spread both at the same two strike prices **K1<K2**

A call spread consist of a **long call option** at strike price **K1** and a **short call option** with strike price **K2**.
Similarly a put spread consist of a **long put option** at strike price **K2** and a **short put option** with strike price **K1.**

As we can see from the following image that graphs the **payoff's** of all the **4 options** mentioned above (source https://en.wikipedia.org/wiki/Box_spread_(options))



that by adding them we get a constant total payoff which is equal to K2-K1.

Thus the **discounted value of K2-K1** must be equal to the **price** payed at time **t=0** in order to **prevent arbitrage** oppurtunities. The aformentioned price is equal to: **p(call, k1)-p(call,k2)+p(put,k2)-p(put,k1)**
where **p(x,y)** is the price of a **x option at strike price y.**
We get **p(x,y)** by taking the **average of the asking and bidding price** that I reported below:

Expiration date	Option	K	Bid	Ask	Average
28/04/2023	Call	32	2.75	3	2.875
	Call	36	0.33	0.51	0.42
	Put	32	0.19	0.29	0.24
	Put	36	1.66	1.9	1.78

Expiration date	Option	K	Bid	Ask	Average
16/06/2023	Call	30	4.8	4.95	4.875
	Call	40	0.14	0.16	0.15
	Put	30	0.41	0.43	0.42
	Put	40	5.4	5.95	5.675

Expiration date	Option	K	Bid	Ask	Average
20/10/2023	Call	30	5.65	5.85	5.75
	Call	40	0.81	0.89	0.85
	Put	30	1.2	1.25	1.225
	Put	40	6.2	6.4	6.3

Expiration date	Option	K	Bid	Ask	Average
19/01/2024	Call	30	6.1	6.2	6.15
	Call	40	1.27	1.32	1.295
	Put	30	1.75	1.79	1.77
	Put	40	6.65	6.8	6.725

I selected the opnions with expiration date **as close as possible** to **T=1/3/6/12 months** which were assigned.

I can now compute the **discount factor D** since it satisfies the relationship
D*(K2-K1)=p(call, k1)-p(call,k2)+p(put,k2)-p(put,k1) and thus:

D=(p(call, k1)-p(call,k2)+p(put,k2)-p(put,k1))/(K2-K1)

We get the following result:

Expiration date	D
28/04/2023	0.99875
16/06/2023	0.998
20/10/2023	0.9975
19/01/2024	0.981

Our objective now is to find the **implicit dividends** for the previous maturity times.
In order to so, I'll apply the **Put-Call parity formula** to an option at the money.
I reported below the data that I got from Yahoo Finance:

Expiration date	Option	K	Bid	Ask	Average
28/04/2023	Call	34	1.1	1.19	1.145
	Put	34	0.89	0.95	0.92

Expiration date	Option	K	Bid	Ask	Average
16/06/2023	Call	35	1.15	1.3	1.225
	Put	35	1.93	2.14	2.035

Expiration date	Option	K	Bid	Ask	Average
20/10/2023	Call	35	2.37	2.54	2.455
	Put	35	3.1	3.28	3.19

Expiration date	Option	K	Bid	Ask	Average
19/01/2024	Call	35	2.85	3.14	2.995
	Put	35	3.6	3.78	3.69

I took the **strike price closest** to the **current price**.
Since the **farther the expiring date** is, the **wider the intervals** between possible strike prices are,
only the contract expiring in april had the possibility of k=34

In order to calculate the **implicit dividends** according to the **Put-Call parity formula** sourced in the report 2,
(https://www.sitmo.com/extracting-high-precision-implied-dividend-and-interest-rate-term-structures-from-option-prices/)
I need to have the **interest rate r**. Thus I checked on https://www.global-rates.com/ the current **rates**
of the **Libor** and found:

T	Libor (%)
1 month	4.84029%
3 months	5.15914%
6 months	5.20957%
1 year	5.16043%

We have that **p(put)-p(call)=K*e^(-r*T)-s0*e^(-q*T)** where **r** is the **libor** and **T** is expressed in **years**.

Thus the **implied dividend Div** can be found by calculating **Div=s0*e^(-q*T)=-p(put)+p(call)+K*e^(-r*T)** and the **implied dividend yield q=-ln(D/s0)*T.**
I obtained the following results:

T	Dividend	Yield	Yield (%)
1 month	34.0945	0.01952	1.952
3 months	33.7415	0.04814	4.814
6 months	33.3651	0.0465	4.65
1 year	32.5447	0.04815	4.815

Conclusions:

I can compare the discount factor that I computed with the discount factor obtained by both using the libor with a simple interest formula and the libor with a compound interest formula.

D	Libor	Discount factor (simple)	Absolute Error	Relative Error	%relative error
0.99875	4.84029%	0.995982629	0.002767371	0.002778533	0.277853303
0.998	5.15914%	0.987266386	0.010733614	0.010872054	1.08720543
0.9975	5.20957%	0.974613416	0.022886584	0.02348273	2.348273038
0.981	5.16043%	0.950928025	0.030071975	0.031623818	3.16238183

D	Libor	Discount factor(compound)	Absolute Error	Relative Error	%relative error
0.99875	4.84029%	0.995974549	0.002775451	0.002786669	0.278666866
0.998	5.15914%	0.987184971	0.010815029	0.010955423	1.095542325
0.9975	5.20957%	0.974288469	0.023211531	0.023824085	2.382408491
0.981	5.16043%	0.949704591	0.031295409	0.032952783	3.295278311

Although I did not get perfect results, I always made an error <3.5%.

Here I plotted the implicit dividend and the implicit dividend yield: