STOCHASTIC METHODS FOR FINANCE: REPORT 1

Graziana Capurso

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From https://finance.yahoo.com/quote website I've found an asset and made analysis on it. This kind of analysis had led to compare the mean between bid and ask, as the target-price for our model, and the price of the call option in order to find the relative error.

GENERAL DESCRIPTION OF THE COMPANY

I've chosen the Toast, Inc. company.

This operates a cloud-based digital technology platform for the restaurant industry in the United States and Ireland. The company offers Toast POS, a software module that integrate.

payment processing with point of sale functionality; Toast Invoicing that allows restaurants to send invoices and collect payment; Toast Mobile Order & Pay, which allows guests to

scan a QR code to browse the menu, order, and pay from mobile; Kitchen Display System software that connects the house with the kitchen staff; and Multi-Location Management, a tool to manage operations and configure menus across multiple locations and channels. It also provides Toast Flex, an hardware for on-counter order and pay; Toast Go, an integrated handheld POS device; Toast Tap, a card reader for accepting EMV-contactless payments; Toast Online Ordering & Toast Takeout, an online ordering and consumer Toast TakeOut application; First-Party Delivery, a toast delivery service; POS integration for restaurants using third-party delivery services to order intake and eliminate the need for extra third-party tablets; and loyalty, email marketing, and Toast Gift Cards services. In addition, the company offers Payroll & Team Management solution for employee performance and satisfaction; Employee management tools, such as Sling for Toast that provide streamlined scheduling and team communication; Toast Pay Card & PayOut, which offers eligible workers instant access to a portion of their tips and wages; and Tips Manager solution

that automates the tip-pooling process. Further, it provides xtraCHEF a suite of back-office tools, such as accounts payable automation, inventory management, ingredient price tracker, and recipe costing for restaurants; Payment Processing, capital funding, and purchase financing solutions; insights and reporting on real-time sales, menu, and labor data; Toast Partner Connect, a portal that allows customers to discover, select, and connect their restaurant to partners; and a suite of bi-directional application programming

interfaces. The company was formerly known as Opti Systems, Inc. and changed its name to Toast, Inc. in 2012. Toast, Inc. was incorporated in 2011 and is headquartered in Boston, Massachusetts.

Previous Close	16.56
Open	16.67
Bid	16.07 x 800
Ask	16.08 x 900
Day's Range	16.01 - 16.90
52 Week Range	11.91 - 26.03
Volume	5,130,752
Avg. Volume	6,598,715
Market Cap	8.574B
Beta (5Y Monthly)	N/A
PE Ratio (TTM)	N/A
EPS (TTM)	-0.70
Earnings Date	Feb 16, 2023
Forward Dividend & Yield	N/A (N/A)
Ex-Dividend Date	N/A
1y Target Est	23.87

The major holders are distributed in this way:

5.32% of Shares Held by All Insider

84.52% of Shares Held by Institutions

89.27% of Float Held by Institutions

with a total number of institutions holding shares equal to 461.

The Market Cap (intraday) is 8.78B and I've also taken the statistics for the Profitability:

Profit Margin -10.07%

Operating Margin (ttm) -13.95%

3 MONTHS

COMPUTATION OF THE TARGET PRICE

I've selected a Call with maturity three months, from the 20/03/2023, and a strike close to the current value of the stock, so at the money. The strike was equal to 16.

From this point I've found the respective value of Bid and Ask. The average between 2.4 and 2.5 was 2.45; this is my target price.

CALCULATION PROCEDURES

From the "Historical data" section, I've downloaded the Historical prices about the last three months with a daily frequency.

Considering the adjusted daily prices, I've made the computation for the daily return in this way:

$$\textbf{return(t)}= \frac{price(t) - price(t-1)}{price(t-1)}$$

Having these value, I've made their standard deviation, useful to compute the annual volatility $\boldsymbol{\sigma_y}$ in this way: $\boldsymbol{\sigma_d}\times\sqrt{252}$. In my case the $\boldsymbol{\sigma_d}$ was 0,045125, generating so $\boldsymbol{\sigma_y}$=0,716344. This last value has been essential to find the values for the parameters **u** and **d** of the binomial model. In particular, having that T is equal to 3/12, $u=e^{\sigma_y\sqrt{T}}$ and $d=e^{-\sigma_y\sqrt{T}}$, the results have been: u≈1,43 and d≈0,70.

I've visited the global-rates.com website, in order to take the USD Libor rate, corresponding 3 months, this was equal to 4.99843% at March 17/2023. So considering, r= 0,049984, R the simple compounding and 1/R the simple discounting, I've calculate

$$\textbf{R}=1 + rT=1{,}012496$$

$$\frac{1}{R} = \frac{1}{1 + rT} =0{,}987658$$

Having collected all the necessary data, I've concluded that the risk neutral probability weight **q**= $\frac{R-d}{u-d}$, has a value of 0,428479.

Because of the company did not provide any dividend, I could use the formula for the price of a call option without dividends:

$$\textbf{p}=\frac{1}{R}(q(Su-K)^{+}+(1-q)(Sd-K)^{+})=3{,}588434$$

Where **S**=17,11 is the last adjusted price and K=16 is the strike previously selected.

COMPARISONS

At this point I'd been able to compute the comparison between my target price 2,45 and the one I have computed for a call option, this equal to ≈3,59.

To make that I've calculated the relative error, which is returned to be of the 46,47%.

6 MONTHS

PROCEDURES

I've repeated the precedent calculations also selecting a call option with maturity

six months. This presents a bid= 2,8 and an ask=2,95. From these two, the resulting **target price** is 2,45. From the "Historical data" section I've downloaded the daily prices of the last 6 months to compute $\boldsymbol{\sigma_d}$ =0,044924; $\boldsymbol{\sigma_y}$=0,713139; **u** ≈ 1,65; **d** ≈ 0,60. In addition, to calculate the simple compounding and the simple discounting, I've taken the USD Libor rate, corresponding 6 months, in my case equal to 5.05229 % . And as results **R**≈1,025 and $\frac{\mathbf{1}}{\mathbf{R}} \approx$ 0,975. Finally, I was able to calculate the weight **q** ≈ 0,40 and then the price of a call option without dividends **p** ≈ 4,43 with S=17,11 and K=17.

This led me to find the relative error equal to 53,97%.

This relative errors are big, even considering the simplicity of the binomial model. It could be useful compute how the error is distributed among the different strike prices.

CONCLUSIONS

To resume:

Toast, Inc. company	3 months	6 months
TARGET PRICE	2,45	2,875
SIGMA_DAY	0,045125402	0,044923526
SIGMA_YEAR	0,716343542	0,713138865
U	1,430711354	1,655768625
D	0,698953005	0,603949117
USD LIBOR AT 17/03/2023	5%	5%
SIMPLE COMPOUNDING	1,012496075	1,025
SIMPLE DISCOUNTING	0,98765815	0,975609756
RISK NEUTRAL PROBABILITY WEIGHT	0,585434103	0,669158403
PRICE	3,471914314	3,657074976
RELATIVE ERROR	46,47%	53,97%