Free Cash Flow Firm Valuation

By

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**Executive Summary:**

A Monte Carlo simulation was used to model the different probabilities of free cash flow outcomes of a stock. We generated 100 years of possible free cash flows in 500 different lifetimes to have enough data. Our final average stock price prediction is $31.05 using a discount rate of 8.08%. the result was far from the actual price of the stock for the following period of time. Thus, we utilized Goal Seek to optimize our stock price value to the actual price of $25.28. The results of the optimization were that the actual discount rate for the period of 9.31%, and a lower standard deviation of 1.69 instead of 1.87.

Word Count 110.

1. **Introduction:**

For this project we will be forecasting the free cash flow of our firm using a Monte Carlo simulation approach. To do so we use the previously created sales forecast and proforma statement and used the collected assumptions to create a distribution of possible future outcomes for the free cash flow. We then discount the results to the present value calculate the price of the stock. By using these assumptions, we bring a lot of uncertainty into the model since they were created by other models. The Monte Carlo simulation is a Bayesian approach to forecast or predict values using random variables and its named after the gambling hot spot in Monaco, since chance and random outcomes are central to the modeling technique. Although the method was actually developed by a couple of scientists at Los Alamos national laboratory while working on nuclear weapons projects. The simulation generates a pool of possible outcomes based on the normal distribution, leading the analyst to a histogram of data to determine probabilities of the prediction.

**2.0 Data and Sample:**

2.1 Data

The data utilized for this analysis is based on a stock assigned by the professor and was pulled from the ‘Compustat – Capital IQ’ in the Wharton Research Data Services (WRDS) database. To build these models we used information from the company’s Ten last year’s balance sheets (2008 – 2018). The sales forecast was built using sales from the last 25 years (1994 – 2018). Some of the accounting values we have in our dataset are in the current asset and current liabilities section of the balance sheet. We also got the EBIT, Long-term debt, equity, capital expenditures, income taxes and we created change in working capital by subtracting the previous year value from the current value. Some assumptions where the tax rate, and the current Beta of the asset.

2.2 Sample

BSX - Boston Scientific Corporation develops, manufactures, and markets medical devices for use in various interventional medical specialties worldwide. It operates through three segments: MedSurg, Rhythm and Neuro, and Cardiovascular. It’s part of the healthcare industry and is headquartered in Marlborough, Massachusetts.

**3.0 Results:**

3.1 Monte Carlo simulation

For this project we used Monte Carlo Simulation approach to forecast the free cash flow of our company. The simulation crated random variables for 100 years and 500 lifetimes. The benefit of using a Monte Carlo simulation is that when dealing with high uncertainty in a process, creating thousands of random variables can have a better prediction than using historical values. In figure 1 we used the random number generator tool from excel to produce model the free cash flow percentage out of previously created sales forecast. After forecasting the sales for the following year, we could generate the mean and standard deviation of the future free cash flows for the asset. Then in figure 6 we generated random variables of possible sales. By multiplying both values we got 50,000 possible future free cash flows.

Figure 1 – Random free cashflow variable

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| 2018 | 1235.134885 | 3974.928 | 1514.668 | 1813.449 | 1501.921 | 3624.74 | 2428.891 | 2537.582 | 2913.76184 | 2031.302 |
| 2019 | 2647.946385 | 2241.795 | 3093.857 | 4205.908 | 2930.781 | 1574.352 | 2586.418 | 1799.314 | 2728.09364 | 2361.034 |
| 2020 | 2322.31687 | 2540.136 | 1849.942 | 3123.918 | 1561.942 | 3465.708 | 1198.613 | 1199.933 | 4059.63645 | 2322.83 |
| 2021 | 2510.198315 | 3014.241 | 4141.318 | 1543.351 | 4206.263 | 3237.812 | 4363.358 | 4349.047 | 2752.94038 | 1745.419 |
| 2022 | 2952.187461 | 3069.282 | 4103.853 | 3065.292 | 2681.87 | 2459.844 | 3723.271 | 1256.362 | 1822.40269 | 3467.297 |
| 2023 | 2245.068604 | 3306.177 | 4053.298 | 3857.593 | 2195.949 | 3547.722 | 1868.644 | 2174.564 | 2329.45486 | 3253.846 |
| 2024 | 5169.111091 | 2177.176 | 5491.785 | 1122.093 | 4040.926 | 2983.717 | 2243.142 | 3557.142 | 3459.46633 | 2577.302 |
| 2025 | 3869.653692 | 2960.796 | 2820.023 | 3434.41 | 2250.539 | 3413.222 | 3162.515 | 3048.411 | 4385.75829 | 4812.993 |
| 2026 | 4862.035693 | 2940.332 | 3261.497 | 2760.816 | 1926.078 | 2876.243 | 2011.868 | 4230.433 | 5432.21101 | 1667.962 |
| 2027 | 2535.219725 | 1173.105 | 3889.526 | 3280.287 | 4799.827 | 5095.927 | 4414.593 | 3820.656 | 1877.85107 | 3567.194 |
| … | … | … | … | … | … | … | … | … | … | … |
| 2110 | 15522.64287 | 15725.08 | 17592.49 | 14590.58 | 1158.815 | 14780.33 | 7157.715 | 10179.9 | 22482.0243 | 12879.82 |
| 2111 | 9577.416442 | 7231.319 | 13198.64 | 12287.76 | 14107.57 | 11381.77 | 11806.03 | 8563.989 | 9629.07356 | 14234.71 |
| 2112 | 13785.33832 | 16850.87 | 10506.86 | 18864.5 | 15897.41 | 15067.61 | 12601.14 | 12300.99 | 10992.1216 | 11274.87 |
| 2113 | 16746.99416 | 11123.54 | 10342.7 | 11826.67 | 9940.396 | 11662.04 | 10076.91 | 21265.19 | 15684.6647 | 5070.2 |
| 2114 | 6455.487788 | 13399.34 | 12311.07 | 6375.968 | 16597.38 | 17274.17 | 12239.64 | 15044.43 | 10213.41 | 14279.89 |
| 2115 | 11632.50731 | 12885.67 | 15619 | 13187.77 | 11864.09 | 14257.24 | 9596.327 | 10543 | 11293.0621 | 12580.17 |
| 2116 | 7415.590717 | 13812.38 | 11579.45 | 16463.86 | 11434.46 | 13298.57 | 10371.03 | 15122.93 | 10284.8978 | 12664.97 |
| 2117 | 12661.58163 | 14131.48 | 16269.91 | 14270.68 | 20866.64 | 14329.24 | 6119.441 | 11410.1 | 10963.9295 | 11102.9 |
|  |  |  |  |  |  |  |  |  |  |  |
| NPV | 40269.42155 | 37159.5 | 40975.28 | 39317.77 | 37509.91 | 39923.63 | 37355.84 | 38071.21 | 38991.4125 | 37589.34 |
| Net | 36186.42155 | 33076.5 | 36892.28 | 35234.77 | 33426.91 | 35840.63 | 33272.84 | 33988.21 | 34908.4125 | 33506.34 |
| Price | 26.15001836 | 23.90264 | 26.6601 | 25.46231 | 24.15587 | 25.90013 | 24.04453 | 24.56149 | 25.2264686 | 24.21326 |

After getting 500 different possible ways 100 years of free cash flow to calculate the asset price, we took the net present value for each iteration. Then we subtracted the debt and divided the value by the number of shares outstanding.

3.2 Discount rate

For the Discount rate we utilized the total equity, Long term debt and a tax rate assumption to calculate the asset Beta. Then with that information and using simple algebra we calculated the discount rate for the time period. Something that has to be motioned is that the Discount rate utilized is based on assumptions and historic data, which brings more uncertainty into the final product of the model. To reduce the uncertainty brought by the discount rate another Monte Carlo simulation can be run or build a table with discount rate +/- X% to see the possible deviations in the results.

Figure 3 – Discount rate

|  |  |
| --- | --- |
| Equity Beta | 0.89 |
| Equity | $ 8,726 |
| Debt | $ 4,083 |
| Tax | 39% |
| Assets beta | 0.69 |
| Discount rate | 8.08% |

3.3 Results and optimization

The results of the simulation created a distribution 500 different possible stock prices in the future. The we created a statistical summary table with the result. By doing so we discovered that the stock future mean price is of $31.05 using 8.08% as a discount rate, in other words this is the most probable price in the future if everything continues as is currently going, considering that the assumptions will stay the same.

Figure 4 – stock prices statistical summary

|  |  |  |
| --- | --- | --- |
|  | Calculated | Goal Seek |
| Price | $ 31.05 | $ 25.28 |
| Std | 1.87 | 1.69 |
| Min | $ 24.86 | $ 19.84 |
| Max | $ 36.36 | $ 30.10 |
| Min Range | $ 29.17 | $ 23.59 |
| Max Range | $ 32.92 | $ 26.97 |
|  |  |  |
|  |  |  |
| Discount Rate | 8.08% | 9.31% |

The actual price for the next period was $25.28, 3σ away from the actual price. To improve this model, we utilized a built-in tool called Goal Seek. Using the actual price as the goal we modified the rest of the parameter to reach the new price. The results of using this optimizer increased our discount rate to 9.31%, reiterating back that the discount rate assumption brings more uncertainty into the model. Also, by using the goal seek optimizer we are overfitting the model into our current data, giving us way more problems to deal.

**4.0 Conclusion:**

The computed results from the simulation were far from the actual price of the stock, helping us understand that even though these models are good with high uncertainty, it is always present in our models and it doesn’t mean that this kind will be correct or better. Current market assumptions and alternative situation should be taken into consideration all the time, and that is the secret to good modeling. Finally, my recommendation to improve the model, is to run more iteration of the simulation and generate a simulation for the discount rate to have a look into different rate possibilities.

**Appendix:**

Figure 5 - Sample of random Free cashflow %

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 0.125846 | 0.34543 | 0.142642 | 0.183356 | 0.177662 | 0.38354 | 0.264163 | 0.254909 | 0.329668 | 0.22378 |
| 0.286092 | 0.203847 | 0.303873 | 0.442083 | 0.286158 | 0.178446 | 0.247658 | 0.171297 | 0.276079 | 0.243323 |
| 0.285571 | 0.24007 | 0.173986 | 0.316669 | 0.179956 | 0.317327 | 0.106473 | 0.12403 | 0.33438 | 0.22765 |
| 0.242836 | 0.293112 | 0.351382 | 0.189197 | 0.397408 | 0.341551 | 0.396296 | 0.370945 | 0.259989 | 0.172704 |
| 0.297657 | 0.266533 | 0.400832 | 0.264703 | 0.292871 | 0.198605 | 0.309475 | 0.115873 | 0.174053 | 0.285401 |
| 0.202281 | 0.297856 | 0.338208 | 0.33836 | 0.186814 | 0.285889 | 0.159932 | 0.173466 | 0.231803 | 0.246892 |
| 0.419052 | 0.19311 | 0.43434 | 0.097917 | 0.434845 | 0.250854 | 0.208658 | 0.3085 | 0.262822 | 0.256046 |
| 0.324773 | 0.242066 | 0.222021 | 0.291547 | 0.185623 | 0.272919 | 0.229481 | 0.280076 | 0.356789 | 0.399052 |
| 0.340355 | 0.241466 | 0.276118 | 0.231771 | 0.160021 | 0.23848 | 0.188172 | 0.348016 | 0.370027 | 0.126131 |
| 0.179811 | 0.095189 | 0.309244 | 0.226958 | 0.339904 | 0.381463 | 0.34461 | 0.286439 | 0.150772 | 0.282193 |
| 0.239394 | 0.180167 | 0.268121 | 0.394497 | 0.452105 | 0.28342 | 0.258072 | 0.350124 | 0.322421 | 0.350254 |
| 0.404428 | 0.192742 | 0.252192 | 0.263144 | 0.375599 | 0.232834 | 0.332022 | 0.131907 | 0.311931 | 0.201304 |
| 0.283057 | 0.185672 | 0.415424 | 0.346637 | 0.055876 | 0.316501 | 0.180035 | 0.240305 | 0.169488 | 0.3552 |
| 0.215734 | 0.198805 | 0.384412 | 0.220906 | 0.287864 | 0.148462 | 0.17842 | 0.204518 | 0.083545 | 0.360335 |
| 0.292025 | 0.206634 | 0.289501 | 0.233334 | 0.089618 | 0.25026 | 0.357374 | 0.2786 | 0.230168 | 0.196258 |
| 0.259333 | 0.230064 | -0.04025 | 0.383872 | 0.161661 | 0.132793 | 0.22996 | 0.33429 | 0.191663 | 0.293417 |
| 0.389366 | 0.239356 | 0.254976 | 0.357528 | 0.280054 | 0.174561 | 0.291463 | 0.407629 | 0.205894 | 0.259798 |
| 0.312571 | 0.162035 | 0.362168 | 0.176467 | 0.248004 | 0.338342 | 0.196931 | 0.328049 | 0.217967 | 0.136466 |
| 0.446114 | 0.369798 | 0.174689 | 0.191354 | 0.246953 | 0.360335 | 0.308919 | 0.159634 | 0.262249 | 0.363105 |
| 0.292556 | 0.168064 | 0.203037 | 0.253081 | 0.203317 | 0.321117 | 0.259275 | 0.456179 | 0.281581 | 0.212951 |
| 0.22774 | 0.25265 | 0.34749 | 0.228659 | 0.308099 | 0.096385 | 0.179877 | 0.154686 | 0.247188 | 0.208109 |
| 0.321179 | 0.24208 | 0.233733 | 0.193995 | 0.184452 | 0.190337 | 0.275982 | -0.00601 | 0.301166 | 0.168271 |
| 0.286329 | 0.398494 | 0.269538 | 0.375693 | 0.325064 | 0.227674 | 0.383458 | 0.36163 | 0.481364 | 0.069069 |

Figure 6 - Sample of random sales

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| 2018 | 9651.29 | 9342.594 | 9785.595 | 9096.677 | 9243.565 | 8950.918 | 11209.82 | 10175.04 | 8381.358 | 9236.216 |
| 2019 | 9544.562 | 8680.36 | 8866.495 | 9807.344 | 10341.34 | 8990.442 | 8958.761 | 9982.963 | 10317.21 | 9806.706 |
| 2020 | 11088.94 | 11268.56 | 11319.15 | 9310.546 | 10495.54 | 10928.55 | 9773.308 | 8307.493 | 9289.671 | 9042.986 |
| 2021 | 10120 | 9184.801 | 8834.143 | 10670.76 | 10522.91 | 9696.427 | 11175.35 | 12541.71 | 10646.01 | 11908.85 |
| 2022 | 9846.269 | 10261.21 | 11099.58 | 11114.2 | 11201.75 | 11517.6 | 10562.51 | 10291.96 | 10037.03 | 10413.76 |
| 2023 | 12238.66 | 11876.42 | 9731.538 | 12900.56 | 11862.2 | 9955.03 | 10608.2 | 11600.85 | 10874.05 | 10374.24 |
| 2024 | 12936.83 | 12775.83 | 11937.07 | 13565.91 | 11507.24 | 12141.71 | 13167.2 | 13212.55 | 12867.61 | 11086.37 |
| 2025 | 11715.65 | 11424.72 | 12156.81 | 12963.72 | 12427.81 | 11269.03 | 11638.92 | 12306.71 | 12533.31 | 11844.31 |
| 2026 | 13585.78 | 12884.7 | 11172.3 | 13057.44 | 14482.11 | 14159.8 | 11058.85 | 12948.95 | 11857.11 | 12484.83 |
| 2027 | 14790.1 | 11459.2 | 10846.11 | 14073.52 | 11676.16 | 12736.92 | 11304.38 | 11674.74 | 12356.69 | 11380.25 |
| 2028 | 15011.14 | 12862.78 | 13310.59 | 12700.51 | 12806.02 | 13729.28 | 13600.29 | 10938.71 | 12103.53 | 14030.77 |
| 2029 | 13422.88 | 12611.03 | 13093.96 | 13166.86 | 13022.88 | 13372.4 | 12994.37 | 13282.54 | 12545.5 | 13682.4 |
| 2030 | 15235.92 | 13003 | 17123.7 | 15708 | 13988.69 | 12671.52 | 14578.32 | 13581.61 | 12811.49 | 15051.42 |
| 2031 | 14007.25 | 14341.76 | 13475.08 | 16292.78 | 13900.6 | 15516.77 | 13026.09 | 12045.68 | 15846.11 | 12539.16 |
| 2032 | 15979.44 | 13229.87 | 13967.71 | 15167.61 | 14226.5 | 14686.19 | 15820.95 | 14872.14 | 13814.37 | 14690.87 |
| 2033 | 15215.63 | 15503.06 | 14287.32 | 14171.77 | 14217.92 | 13078.01 | 14658.56 | 12600.15 | 15780.29 | 14985.52 |
| 2034 | 16476.6 | 15584.49 | 17351.38 | 15880 | 16373.5 | 15440.54 | 17402.6 | 17072.63 | 15012.13 | 13926.38 |
| 2035 | 16194.81 | 17939.71 | 14724.13 | 16388.04 | 14396.19 | 15214.78 | 15117.42 | 17348.1 | 14246.42 | 16066.53 |
| 2036 | 14785.45 | 15849.27 | 16495.9 | 17866.85 | 17695.41 | 14497.78 | 13952.56 | 17409.95 | 16500.16 | 18532.89 |
| 2037 | 18450.32 | 16338.45 | 17168.92 | 15602.88 | 18383.96 | 16637.89 | 15417.57 | 17099.76 | 16820.99 | 16663.11 |
| 2038 | 15721.25 | 18367.92 | 17341.93 | 18317.33 | 18095.25 | 18801.4 | 16149.69 | 14432.44 | 18356.68 | 18269.42 |

Sub Filer()

'

' Filer Macro

' Base macro to fill random draw

'

'

Dim z1 As String

Dim z2 As String

Dim z3 As String

For i = 1 To 101 ' count of number of rows

z1 = 27 + i

z2 = 1 + i

ActiveCell.FormulaR1C1 = "=NORM.INV(RAND(),SalesFore!R" & z1 & "C5,SalesFore!R" & z1 & "C8)"

Application.Goto Reference:="R" & z2 & "C2:R" & z2 & "C501"

Selection.FillRight

ActiveCell.Offset(1, 0).Range("A1").Select

Next i

End Sub