# DCF Valuation

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July 2023

## 1 Abstract

This document serves as a guide to the financial model I built this past summer. It contains information about the specific statements being generated, code being written, pitfalls, bugs, and more.

### 1.1 What Did I Build?

I built a discounted cash flow automation program which utilizes various data from sites such as Financial Modeling Prep (FMP) and Yahoo Finance to build a discounted cash flow (DCF) prediction model.

### 1.2 What is a DCF Model

A DCF projection model is a form of financial modeling which takes into account the expected future cash flows of an entity to estimate their future equity value. DCF models are widely used in the financial sector and are one of the most credible models in projecting not only cash flow but accurate valuations for public companies.

### 1.3 What are the components of a DCF Model?

DCF models can vary in complexity based on the thoroughness intended by the creator. However, all DCF models must contain at least four parts: income statement, cash flow statement, balance sheet statement, valuation. The former three are used to generate the latter in a series of formulas including calculations for values such as the weighted average cost of capital, cost of debt, cost of equity, net present value, and more.

### 1.4 What are the capabilities of my model?

With only limited time, I decided to take a simplified approach and build a DCF model including the three aforementioned statements and the valuation creation. It can generate about 30-40 line items per statement, all major valuation metrics, and the equity value per share for the company.

### 1.5 Disclaimer

In a DCF model, revenue is perhaps the most important driver as far as valuation. The more bullish the assumptions are about the revenue, the more inflated the valuation will be. I have currently kept the model in a very bullish state, but it is recommended that one reads or understands the exact revenue assumptions for a given entity. The model is built in such a way that a simple change to the assumptions of the revenue will in fact reflect throughout the rest of the model. For this reason, many of the current valuations are bullish (for generalization purposes). Change the revenue field as needed.

### 1.6 Industry Expectations

This is a list, in no particular order, of a few important expectations the industry has about DCF models. They serve to remind any user of this model that there are limitations with the functionality and that no one model should be a sole determinant to the purchase of an entity.

- DCF projections get less accurate the more years that one projects. This makes intuitive sense but it is important to realize that projections 10 or 12 years in the future, while possibly more profitable, are less accurate than those one or two years in the future.
- DCF models do not analyze risk very thoroughly. Many people ask the question, "what is the best low-risk investment.?" DCF models focus more specifically on the future cash flow of an entity using various projection methods, highlighting the companies with more cash flow as opposed to those with lower risk.
- A very common practice to value companies is something known as comparable company analysis where, in short, companies of similar industries, size, and financing are analyzed and valued to help get a better estimator for the company in question. This model does not use comparable company analysis just yet but, as it can generate the DCF of any SP500 company quickly, it shouldn't be long before that functionality is included.

## 2 Other Resources

Many of my formulas, methods, and projections came from a few different websites and books I have read over the last few years. I have included them here as outside resources because they provide proper background and explanations on many different decisions throughout the model that I have not included in this documentation for the sake of time.

- Paul Pignataro: Financial Modeling and Valuation
- Paul Pignataro: The Technical Interview Guide To Investment Banking

- Value Investing DCF
- Alpha Spread

# 3 Income Statement

The income statement of a discounted cash flow analysis is the statement that focuses on the company's income and expenditures. It emphasizes revenue and cost of goods solid, subtracting line items procedurally to calculate other important measures such as EBIT, EBITDA, Profit, and more.

## 3.1 Income Statement Raw Data (Historical)

This is data that was gathered directly from FMP's API and has been hard-coded into the DCF model. It involves no calculations for companies, simply retrieval.

- Revenue
- Cost of Goods Sold
- Selling, General, and Administrative Expenses
- Research and Development Expenses
- Depreciation and Amortization
- Interest Expenses
- Interest Income
- Net Interest Expense
- Income Tax Expense
- Basic Common Shares Outstanding
- Diluted Common Shares Outstanding

## 3.2 Income Statement Formulas (Historical)

These are line items in which aspects of raw data or other already calculated formulas are needed in order to find the historical value. For any of the formulas listed below, $i$ stands for the current year, $i-1$ is the previous year, and $i+1$ is the following year.

### 3.2.1 Revenue Growth Percentage

Revenue Growth Percentage$(i) = \frac{TotalRevenue(i)}{TotalRevenue(i-1)}$ - 1

#### 3.2.2 COGS as a Percent of Revenue

COGS as a Percent of Revenue$(i) = \frac{COGS(i)}{Revenue(i)}$

#### 3.2.3 Gross Profit

Gross Profit$(i) = Revenue(i) - COGS(i)$

#### 3.2.4 Gross Profit Margin

Gross Profit Margin$(i) = \frac{GrossProfit(i)}{Revenue(i)}$

#### 3.2.5 SGA as a Percent of Revenue

SGA as a Percent of Revenue$(i) = \frac{COGS(i)}{Revenue(i)}$

#### 3.2.6 RD as a Percent of Revenue

RD as a Percent of Revenue $= \frac{RD(i)}{Revenue(i)}$

#### 3.2.7 EBITDA

EBITDA$(i) = GrossProfit(i) - SGA(i) - RD(i) + DA(i)$

#### 3.2.8 EBITDA Margin

EBITDA Margin$(i) = \frac{EBITDA(i)}{Revenue(i)}$

#### 3.2.9 EBIT

EBIT$(i) = EBITDA(i) - DA(i)$

#### 3.2.10 EBIT Margin

EBIT Margin $= \frac{EBIT(i)}{Revenue(i)}$

#### 3.2.11 Net Interest Expense

Normally, this will be calculated by summing every line item in the interest section including interest expenses, other income expenses, and interest income. However, FMP reports interest expenses and interest income as independent values and the combines other income expenses into the net interest expense, making that distinction and unknown and calculation impossible. For that reason, we are reporting net interest expense as a hardcoded line item directly from FMP.

#### 3.2.12 EBT

$\text{EBT}(i) = EBIT(i) - NetInterestExpense(i)$

#### 3.2.13 EBT Margin

$\text{EBT Margin}(i) = \frac{EBT(i)}{Revenue(i)}$

#### 3.2.14 Tax Rate As a Percent

$\text{Tax Rate}(i) = \frac{IncomeTaxExpense(i)}{EBT(i)}$

#### 3.2.15 Net Income (Adjusted)

$\text{Net Income}(i) = EBT(i) - IncomeTaxExpense(i)$

#### 3.2.16 Earnings Per Share (Basic)

$\text{EPS Basic}(i) = \frac{NetIncome(i)}{BasicAverageCommonSharesOutstanding(i)}$

#### 3.2.17 Earnings Per Share (Diluted)

$\text{EPS Diluted}(i) = \frac{NetIncome(i)}{DilutedAverageCommonSharesOutstanding(i)}$

### 3.3 Diluted Shares Calculations

This section is more focused on calculating the number of shares outstanding which will also be used to project the basic and diluted average common shares outstanding line items. It utilizes the treasury stock repurchase method and the real-time stock value of the company.

#### 3.3.1 Share Price

This is the real-time share value at the time of making the DCF

#### 3.3.2 Number of Basic Shares Outstanding

This is the number of basic shares outstanding at the time of making the DCF

#### 3.3.3 Number of Outstanding Options(In The Money)

$\text{Number of Outstanding Optionis}(i) = \frac{NumberofBasicSharesOutstanding(i)}{SharePrice(i)}$

#### 3.3.4 Average Option Strike Price

$$\text{Average Option Strike Price}(i) = \frac{TotalOptionProceeds(i)}{NumberofOutstandingOptions(i)}$$

The issue with this formula is that it causes an infinite loop as finding the total option proceeds requires the value from the average option strike price. For this reason, I am still working on how to get both values simultaneously but it will probably require the inclusion of a third party source.

#### 3.3.5 Total Option Proceeds

$$\text{Total Option Proceeds}(i) = NumberofOutstandingOptions(i) * AverageOptionStrikePrice(i)$$

#### 3.3.6 Treasury Stock Method Shares Repurchased

$$\text{Treasury Shares Repurchased}(i) = \frac{TotalOptionProceeds(i)}{SharePrice(i)}$$

#### 3.3.7 Additional Shares Outstanding

$$\text{Additional Shares Outstanding}(i) = NumberofOutstandingOptions(i) - TreasurySharesRepurcahsed(i)$$

#### 3.3.8 Total Diluted Shares Outstanding

$$\text{Total Diluted Shares Outstanding}(i) = NumberofBasicSharesOutstanding(i) + AdditionalSharesOutstanding(i)$$

### 3.4 Income Statement Projections

This subsection will focus on the projection methods used to forecast each line item. While most of these are conventional in the field, they can be changed through an alteration of the embedded formulas in the downloadable Excel sheet.

#### 3.4.1 Revenue / Revenue Growth Percentage

The projection of the revenue is based on the year over year revenue growth section. It is conventional to take the most recent percentage (2022 in our case) and then flatline this projection through the end of the projected period. After that, simply apply this formula to each cell:

$$\text{Revenue}(i) = Revenue(i-1) * (1 + RevenueGrowth(i))$$
$$\text{Revenue Growth}(i) = RevenueGrowth(LatestHistoricYear)$$

### 3.4.2 Cost Of Goods Sold / Cost Of Goods Sold Percentage

The COGS projection is based on the COGS as a percent of revenue calculation. There is no one way to calculate this, but many analysts tend to forecast a reducing percentage for COGS as a percent of revenue as entities find better mechanisms to produce their goods. A common method is to take the average difference of historical years and project that. It is also normal to find a value that fits the general historical trend and project that.

COGS$(i) = Revenue(i) * COGSasaPercentofRevenue(i)$
COGS As a Percent of Revenue$(i) = COGSasaPercentofRevenue(i-1) - DifferenceinCOGSasaPercentofRevenueOfLastTwoHistoricYears$

### 3.4.3 Gross Profit / Gross Profit Margin

Like the two sections above, projections of gross profit and gross profit margin require analyzing the historical trend of gross profit margins and then projecting. Here, I am using the average of historical data.

Gross Profit$(i) = Revenue(i) - COGS(i)$
Gross Profit Margin$(i) = \frac{GrossProfit(i)}{Revenue(i)}$

### 3.4.4 Selling General and Administrative Expenses

This is normally taken by flatlining the SGA as a percent of revenue and then calculating from there.

SGA percent of revenue $(i)$ = SGA percent of revenue $(i-1)$
SGA$(i)$ = SGA$(i-1) * (1+$ SGA percent of revenue $(i))$

### 3.4.5 Research and Development Expenses

This is taken in a similar manner to SGA with a flatline calculation in percent of revenue.

RD percent of revenue $(i)$ = RD percent of revenue $(i-1)$
RD$(i)$ = RD$(i-1) * (1+$ RD percent of revenue $(i))$

### 3.4.6 Other Expenses

Same as the previous two sections. Flatline as a percent of revenue.

Other Expenses percent of revenue $(i)$ = Other Expenses percent of revenue $(i-1)$
Other Expenses$(i)$ = Other Expenses$(i-1) * (1+$ Other Expenses percent of revenue $(i))$

### 3.4.7 Total Expenses

This is a total formula for all the expenses

Total Expenses ($i$) = SGA($i$) + RD($i$) + Total Expenses($i$)

### 3.4.8 EBITDA / EBITDA Margin

These are projected with the same formulas that are recorded in the historical calculations.

EBITDA($i$) = $GrossProfit(i) - SGA(i) - RD(i) + DA(i)$
EBITDA Margin($i$) = $\frac{EBITDA(i)}{Revenue(i)}$

### 3.4.9 DA / DA as a percent of Net Income

DA can be projected as a function of various drivers in the model. If the company is growing, it is normal to project as a percent of CAPEX(Capital Expenditures). However, in the default case, projecting as a percent of net income is credible and accepted. I have done that here.

DA as a percent of NI($i$) = DA as a percent of NI($i-1$) DA($i$) = DA($i-1$) $*$ (1+ DA percent of NI ($i$))

### 3.4.10 EBIT / EBIT Margin

This, like EBITDA is just projected as a function of the margin itself.

EBIT($i$) = $GrossProfit(i) - SGA(i) - RD(i)$
EBIT Margin($i$) = $\frac{EBIT(i)}{Revenue(i)}$

### 3.4.11 Interest Expense / Interest Income / Other Income Expenses / Net Income Expenses

None of these are projected outward. They can be (ideally with a function of revenue or some other income statement driver) but are normally not.

### 3.4.12 EBT / EBT Margin

Like EBITDA and EBIT, this is projected as a function of the margin to revenue.

EBT($i$) = $EBIT(i)$ + Net Interest Expense($i$)
EBT Margin($i$) = $\frac{EBT(i)}{Revenue(i)}$

### 3.4.13 Income Tax Expense / Tax Rate Percent

The tax rate percent is flatlined from the latest historical year and then income tax expense is derived from that

Tax Rate Percent $(i)$ = Tax Rate Percent $(i-1)$
Income Tax Expense$(i)$ = Income Tax Expense$(i-1) * (1+$ Tax Rate Percent $(i))$

#### 3.4.14 Net Income

This is the same as historical calculations.

Net Income$(i)$ $= EBT(i) - IncomeTaxExpense(i)$

#### 3.4.15 Earnings Per Share(EPS) / Average Common Shares Outstanding

This is a bit more complicated but the simple explanation is we use the treasury stock method from our diluted shares to estimate the average common shares outstanding. Once we have (and can project) that statistic, we can get the percentage for our EPS. Common shares repurcahased is the difference in common shares outstanding from year to year and is flatlined after the initial calculation from the most recent historical year to the first projected year.

EPS Basic$(i)$ $= \frac{NetIncome(i)}{BasicAverageCommonSharesOutstanding(i)}$

EPS Diluted$(i)$ $= \frac{NetIncome(i)}{DilutedAverageCommonSharesOutstanding(i)}$

Average Common Shares Outstanding Basic$(i)$ = Number of Basic Shares Outstanding /1000

Average Common Shares Outstanding Diluted$(i)$ = Total Diluted Shares Outstanding /1000

Common Shares Repurchased (2023) = Basic Outstanding(2022) - Basic Outstanding(2023)

# 4 Cash Flow Statement

The next section of a DCF model is the Cash Flow Statement. It tracks the liquidity of the entity, measuring how much cash they have on hand and what their delta in cash and cash equivalents is. The statement begins with the net income line item taken from the income statement and eventually returns the "Total Change in Cash and Cash Equivalents" line item which is then used in the balance sheet.

As far as projections, it is not common practice to project many cash flow line items as they can be derived from the other two statements. For this reason, most of the data is historical and only the totals or model drivers are projected.

## 4.1 Cash Flow Line Items

This is a list of all the cash flow line items the model takes into account. Any line item with an asterisk means it is a data point and not a formula.

#### 4.1.1 Cash Flows From Operating Activities

- Net Income*
- Loss(Income) From Discounted Operations*
- Depreciation and Amortization*
- Deferred Income Taxes*
- Stock Based Compensation*
- Other Operating Activities*
- Changes In Accounts Receivable*
- Changes in Inventory*
- Changes In Accounts Payable*
- Changes In Other Working Capital*
- Other Non-Cash Items*
- Net Changes In Operating Working Capital
- Total Cash Flows From Operating Activities

#### 4.1.2 Cash Flows From Investing Activities

- Payments For Property and Equipment(CAPEX)*
- CAPEX as a percent of revenue
- Purchases of Investments*
- Sales Maturities of Investments*
- Investments and Business Acquisitions, Net of Cash Acquired*
- Other Investing Activities*
- Total Cash From Investing Activities

#### 4.1.3 Cash Flows From Financing Activities

- Debt Repayments*
- Dividends Paid*
- Purchase of Common Stock(Treasury Stock)*
- Common Stock Issued*
- Capital Lease Obligations*

- Other*
- Total Cash From Financing Activities
- Effect of Exchange Rate On Cash*
- Total Change In Cash and Cash Equivalents

## 4.2 Cash Flow Formulas

These are the historical formulas for the cash flow line items which are not data.

### 4.2.1 Net Changes In Operating Working Capital

Net Changes In Operating Working Capital($i$) = Changes In Accounts Receivable($i$) + Changes In Inventory($i$) + Changes In Accounts Payable($i$) + Changes In Other Working Capital($i$)

### 4.2.2 Total Cash Flows From Operating Activities

Net Changes In Operating Working Capital($i$) + Other Non-Cash Items($i$) + Net Income($i$) + Loss(Income) From Discontinued Operations($i$) + Depreciation and Amortization($i$) + Deferred Income Taxes($i$) + Stock Based Compensation($i$)

### 4.2.3 Total Cash From Investing Activities

Total Cash From Investing Activities($i$) + Payments For Property and Equipment(CAPEX)($i$) + Purchases of Investments($i$) + Sales Maturities Of Investments($i$) + Investments And Business Acquisitions, Net of Cash Acquired($i$) + Other Investing Activities($i$)

### 4.2.4 Total Cash From Financing Activities

Total Cash From Financing Activities($i$) + Debt Repayments($i$) + Dividends Paid($i$) + Purchase Of Common Stock(Treasury Stock)($i$) + Common Stock Issued($i$) + Capital Lease Obligations($i$) + Other($i$)

### 4.2.5 Total Change In Cash and Cash Equivalents

Total Change In Cash and Cash Equivalents($i$) + Total Cash Flows From Operating Activities($i$) + Total Cash From Investing Activities($i$) + Total Cash From Financing Activities($i$) + Effect of Exchange Rate on Cash($i$)

## 4.3 Cash Flow Projections

For any totals, the formula is the same as the historical and so I have not rewritten it here. These are only formulas in which there is a distinct method of projection being used.

#### 4.3.1 Net Income

This is just copied from the income statement

#### 4.3.2 Depreciation and Amortization

This is just copied from the depreciation and amortization from the income statement

#### 4.3.3 Changes In Accounts Receivable

This projection comes from an intermediary formula which uses days receivable.

Days Receivable(2022) = $\frac{NetReceivables(2022)}{NetSales(2022)*365}$

Receivables, Net(2023) = $\frac{DaysReceivable(2022)*Revenue(2023)}{365}$

The receivables, net projections are then copied until the end of the projection timeline into the projection of changes in accounts receivable

#### 4.3.4 Changes In Inventory

This projection comes from an intermediary formula which uses inventory turnover days

Inventory Turnover Days(2022) = $\frac{Inventories(2022)}{CostOfGoodsSold(2022)*365}$

Inventories(2023) = $fracInventoryTurnoverDays(2022) * CostOfGoodsSold(2023)365$

The inventories row is then copied through the projection period from the above formula

#### 4.3.5 Changes In Accounts Payable

This projection comes from an intermediary formula which uses days payable

Days Payable(2022) = $\frac{AccountsPayable2022}{CostofGoodsSold(2022)*365}$

Accounts Payable(2023) = $\frac{DaysPayable(2022)*CostofGoodsSold(2023)}{365}$

The accounts payable is then copied through the projection period from the above formula

#### 4.3.6 CAPEX / CAPEX as a percent of revenue

We flatline CAPEX as a percent of revenue from 2022 and then derive CAPEX from that

CAPEX as a percent of revenue ($i$) = CAPEX as a percent of revenue($i-1$)
CAPEX($i$) = CAPEX($i-1$) $*$ (1+ CAPEX percent of revenue ($i$))

#### 4.3.7 Other

This is just flatlined from the most recent historical data point.

Other($i$) = Other($i-1$)

#### 4.3.8 Effect Of Exchange Rate on Cash

This is just flatlined from the most recent historical data point.

Effect of Exchange Rate on Cash$(i)$ = Effect of Exchange Rate on Cash$(i-1)$

# 5 Balance Sheet Statement

The balance sheet statement keeps track of an entity's assets, liabilities, and equity. It divides up the line items into one of these three categories and ensures that the sheet follows the equation: assets = liabilities + shareholders equity.

## 5.1 Balance Sheet Line Items

These are all of the line items that are shown in the balance sheet.

#### 5.1.1 Assets

- Cash and Cash Equivalents
- Receivables, Net
- Inventories
- Short-Term Investments
- Other Current Assets
- Total Current Assets
- Property, Plant And Equipment, Net
- Goodwill
- Tax Payables
- Tax Assets
- Long-Term Investments
- Intangible Assets
- Other Non-Current Assets And Deferred Charges
- Other Assets
- Total Assets

#### 5.1.2 Liabilities

- Short-Term Borrowings
- Accounts Payable
- Deferred Revenue
- Tax Payables
- Obligations Under Capital Leases Due Within One Year
- Other Current Liabilities
- Total Current Liabilities
- Long-Term Debt
- Deferred Revenue (Non Current)
- Deferred Tax Liabilities (Non Current)
- Capital Lease Obligations
- Other Non Current Liabilities
- Other Liabilities
- Total Liabilities

#### 5.1.3 Shareholders' Equity

- Common Stock
- Preferred Stock
- Retained Earnings
- Accumulated Other Comprehensive Income (Loss)
- Other Stockholders Equity
- Total Shareholders' Equity
- Noncontrolling Interest
- Total Liabilities and Equity

### 5.2 Balance Sheet Formulas

These are the historical formulas for the balance sheet line items which are not data.

#### 5.2.1 Total Current Assets

Total Current Assets($i$) = Cash and Cash Equivalents($i$) + Receivables, Net($i$) + Inventories($i$) + Short-Term Investments($i$) + Other Current Assets (discounted operations) ($i$)

#### 5.2.2 Total Assets

Total Assets($i$) = Total Current Assets($i$) + Property, Plant And Equipment, Net($i$) + Goodwill($i$) + Tax Assets($i$) + Long-Term Assets($i$) + Intangible Assets($i$) + Other Non-Current Assets and Deferred Charges($i$) + Other Assets($i$)

#### 5.2.3 Total Current Liabilities

Total Current Liabilities($i$) + Short-Term Borrowings($i$) + Accounts Payable($i$) + Deferred Revenue($i$) + Other Current Liabilities($i$)

#### 5.2.4 Total Liabilities

Total Liabilities($i$) + Total Current Liabilities($i$) + Long-Term Debt($i$) + Deferred Revenue (Non-Current) ($i$) + Deferred Tax Liabilities (Non Current)($i$) + Capital Lease Obligations($i$) + Other Non Current Liabilities($i$) + Other Liabilities($i$)

#### 5.2.5 Total Shareholders Equity

Total Shareholders Equity($i$) = Common Stock($i$) + Preferred Stock($i$) + Retained Earnings($i$) + Accumulated Other Comprehensive Income (Loss)($i$) + Other Stockholders Equity($i$)

#### 5.2.6 Total Liabilities And Equity

Total Liabilities And Equity($i$) = Total Liabilities($i$) + Total Equity($i$)

### 5.3 Balance Sheet Projections

Unlike the cash flow statement, the balance sheet is projected for nearly every single line item. Once again, there is no one way to project, but I have incorporated industry-credible methods.

Something to keep in mind with the balance sheet is we need to ensure the assets = liabilities + equity formula remains true throughout the projections. For this reason, every projection will in some way relate to the year before. For example, projections in the year 2023 will have to include the year 2022 which is a historical year. 2024 will then be based off the 2023 projection but it can clearly be seen that the formula is still dependent on 2022. For this reason, it is essential that the balance sheet is in balance after the historical numbers have

been inputted. There are many checkers in the code to ensure this, but additional assets, liabilities, or equity can be added to the other sections to balance the sheet.

Finally, the method of keeping a balance sheet requires the usage of cash flow items. Specifically, every single cash flow item must be used once and only once in the balance sheet. Forgetting a cash flow line item or accidentally doubling one will lead to an unbalanced sheet. As previously stated, many cash flow line items are not projected and so therefore, the balance sheet item will not actually be affected by the link to the cash flow. However, it is essential to link the line items regardless because any later change in the cash flow statement needs to still keep the balance sheet in balance.

Outside of the cash and cash equivalents line item, all assets are subtracted. The general formula is (Historical - Cash Flow! Line Item). All liabilities and equity must be added with the general formula (Historical + Cash Flow! Line Item)

#### 5.3.1 Cash and Cash Equivalents

Cash and Cash Equivalents($i$) = Cash and Cash Equivalents($i-1$) + Cash Flow (Total Change In Cash and Cash Equivalents)($i$)

#### 5.3.2 Receivables, Net

Receivables, Net($i$) = Receivables, Net($i-1$) - Cash Flow (Changes In Accounts Receivable)($i$)

#### 5.3.3 Inventories

Inventories($i$) = Inventories($i-1$) - Cash Flow (Changes In Inventory)($i$)

#### 5.3.4 Short-Term Investments

Short-Term Investments($i$) = Short-Term Investments($i-1$) - Cash Flow (Stock-Based Compensation)($i$)

#### 5.3.5 Other Current Assets

Other Current Assets($i$) = Other Current Assets($i-1$)

#### 5.3.6 Property, Plant And Equipment, Net

Property, Plant and Equipment, Net($i$) = Property, Plant and Equipment, Net($i-1$) - Cash Flow (CAPEX)($i$) - Cash Flow (DA)($i$) - Investments and Business Acquisitions, Net of Cash Acquired($i$)

#### 5.3.7 Goodwill

Goodwill($i$) = Goodwill($i-1$)

#### 5.3.8 Tax Payables

Tax Payables($i$) = Tax Payables($i-1$)

#### 5.3.9 Tax Assets

Tax Assets($i$) = Tax Assets($i-1$)

#### 5.3.10 Long-Term Investments

Long-Term Investments($i$) = Long-Term Investments($i-1$) - Cash Flow (Sales Maturities of Investments)($i$) - Cash Flow (Purchases of Investments)($i$) - Cash Flow (Other Investing Activities)($i$) - Cash Flow (Common Stock)($i$)

#### 5.3.11 Intangible Assets

Intangible Assets($i$) = Intangible Assets($i-1$)

#### 5.3.12 Other Non-Current Assets and Deferred Charges

Other Non-Current Assets($i$) = Other Non-Current Assets($i-1$)

#### 5.3.13 Other Assets

Other Assets($i$) = Other Assets($i-1$) - Cash Flow(Other Non-Cash Items)($i$) - Cash Flow(Changes In Other Working Capital)($i$) - Cash Flow(Dividends Paid)($i$) - Cash Flow (Other Operating Activities)($i$)

#### 5.3.14 Short-Term Borrowings

Short-Term Borrowings($i$) = Short-Term Borrowings($i-1$)

#### 5.3.15 Accounts Payable

Accounts Payable($i$) = Accounts Payable($i-1$) + Cash Flow (Changes In Accounts Payable)($i$)

#### 5.3.16 Deferred Revenue

Deferred Revenue($i$) = Deferred Revenue($i-1$)

#### 5.3.17 Tax Payables

Tax Payables($i$) = Tax Payables($i-1$)

#### 5.3.18 Other Current Liabilities

Other Current Liabilities$(i)$ = Other Current Liabilities$(i-1)$

#### 5.3.19 Long-Term Debt

Long-Term Debt$(i)$ = Long-Term Debt$(i)$ + Cash Flow(Dept Repayments)$(i)$

#### 5.3.20 Deferred Revenue (Non Current)

Deferred Revenue$(i)$ = Deferred Revenue$(i-1)$

#### 5.3.21 Deferred Tax Liabilities (Non Current)

Deferred Tax Liabilities$(i)$ = Deferred Tax Liabilities$(i-1)$ + Cash Flow (Deferred Income Taxes)$(i)$

#### 5.3.22 Capital Lease Obligations

Capital Lease Obligations$(i)$ = Capital Lease Obligations$(i-1)$

#### 5.3.23 Other Non Current Liabilities

Other Non Current Liabilities$(i)$ = Other Non Current Liabilities$(i)$
Other Liabilities
Other Liabilities$(i)$ = Other Liabilities$(i-1)$

#### 5.3.24 Common Stock

Common Stock$(i)$ = Common Stock$(i-1)$

#### 5.3.25 Preferred Stock

Preferred Stock$(i)$ = Preferred Stock$(i-1)$

#### 5.3.26 Retained Earnings

Retained Earnings$(i)$ = Retained Earnings$(i)$ + Cash Flow(Net Income)$(i)$ + Cash Flow(Purchase Of Common Stock)$(i)$

#### 5.3.27 Accumulated Other Comprehensive Income (Loss)

Accumulated Other Comprehensive Income$(i)$ = Accumulated Other Comprehensive Income(Loss)$(i-1)$ + Cash Flow(Effect of Exchange Rate on Cash)$(i)$ + Cash Flow(Other)$(i)$ + Loss From Discontinued Operations$(i)$

#### 5.3.28 Other Stockholders Equity

Other Stockholders Equity$(i)$ = Other Stockholders Equity$(i-1)$

# 6 Valuation

This is the section in which I describe how to utilize the data gathered and projected across the income statement, cash flow statement, and balance sheet to get a value for the company. This value comes in the per share unit which means it can be compared directly to the current stock price of the company to make decisions on whether to buy or sell the stock.

It is important to note that there are many ways to value a company, even if the data gathered up until this point has been identical. That being said, this is a method known as the EBITDA Multiple Method, meaning it uses the Earnings Before Income Taxes Depreciation and Amortization (EBITDA) to drive the valuation. Other valuation methods include the comparable company method, historical analysis method, perpetuity method, and more.

## 6.1 Unlevered Free Cash Flow

Unlevered free cash flow is the measure of how much cash a firm has on hand before accounting for their financial obligations. We calculate that using various line items across the statements and then use the result to proceed with the valuation.

Unlevered Free Cash Flow($i$) = EBIT($i$) + DA($i$) + Deferred Taxes($i$) + Other($i$) + Changes In Working Capital($i$) + Capital Expenditures($i$) + Taxes($i$)
Note: Taxes can be calculated with the following formula:
Taxes($i$) = -EBIT($i$) * Income Statement(Tax Rate Percent)($i$)

## 6.2 Cost Of Capital

The cost of capital takes into account factors such as risk free rate and market risk premium in order to calculate two eventual values: Weighted Average Cost of Capital(WACC) and Equity Value.

The risk free ratem market risk premium, and beta, and cost of debt can all be found online for a given entity. There are ways to estimate it but this model does not go into that scope.

Cost of Equity = $RiskFreeRate + MarketRiskPremium * Beta$

For debt, all calculations are pulled from the most recent historical year. In this case, 2022.

Debt = Balance Sheet(Long-Term Debt) + Balance Sheet(Capital Lease Obligations) + Balance Sheet(Short-Term Borrowings)

Both Stock Price and Shares Outstanding can be pulled from the Income Statement diluted shares section.

Equity Value = $StockPrice * SharesOutstanding$
Weighted Average Cost of Capital (WACC) = $\frac{Debt}{Debt+EquityValue} * CostofDebt * (1 - TaxRate(2022)) + \frac{EquityValue}{Debt+EquityValue} * CostofEquity$

## 6.3 Net Present Value

The net present value is the sum of all future cash flows discounted to the present value. Here, we calculate the period as the number of years after the latest historical year ($2023 \rightarrow 1, 2024 \rightarrow 2$ etc...)

Discounted Cash Flow($i$) = $(\frac{TotalUnleveredFreeCashFlow}{1+WACC})^{Period}$
Total Net Present Value = sum(Discounted Cash Flow) for all projected years

## 6.4 Terminal Value

This is a section dedicated to trying to find the net present value still. For clarification, the term "exit year" refers specifically to the last year of projected data. Therefore, if the timeline of the projection changes, the exit year calculation will be affected.

For the Net Present Value, the calculation should ideally yield a fairly reasonable value. However, there are also net present values located on financial sites such Yahoo Finance which are updated often. This model compares the values and will decide which value to use from there. For that reason, there is a possibility that these calculations are not coming into play for the final calculation of the net present value should the value being calculated seam unreasonable.

Exit Year EBITDA = EBIT(Exit Year) + DA(Exit Year)

Mulitple = $\frac{EquityValue+Debt-CashandCashEquivalents(2022)}{EBITDA(2022)}$
Terminal Value = Exit Year EBITDA * Multiple
Net Present Value = $\frac{TerminalValue}{1+WACC}^{Period(ExitYear)}$

### 6.5 DCF Total Valuation

This is where we are calculating the final value of: Estimated Equity Value Per Share

Total Enterprise Value = Total Net Present Value + Net Present Value

Net Debt = Debt - Balance Sheet (Cash and Cash Equivalents (2022))

Equity Value = Total Enterprise Value - Net Debt

Estimated Equity Value Per Share = $\frac{EquityValue}{ShareCount(Millions)}$

## 7 Code

I have written a model which attempts to use Financial Modeling Prep(FMP) data to predict the estimated equity value per share for various SP500 companies. This section serves to explain some of the functions as far as input-output and purpose. I want to disclaim that this model is not perfect and there are most definitely bugs within it. However, the goal of this documentation is to ensure that whoever chooses to continue or maintain this code has an understanding of what they are doing and the code they are dealing with.

The entire code has been written in Python and was originally developed in Google Colab. One of the biggest current issues with the code is the inability for me to translate it into proper functions and classes. I don't believe this is any sort of permanent issue but I am struggling with the conversion into API-ready functions.

### 7.1 Breakdown

The code was developed with the ideal format of having four different API endpoints. One would be linked to the income statement generation, the next to the cash flow statement, the third to the balance sheet, and the fourth to the valuation.

### 7.2 Usage

This model is intended to be used in partnership with hila.AI as a projection feature. Here is the proposed work flow:

User asks question → OpenAI model triggers "projection" or future-related question → The API decides what line items or statement is needed to answer

the question → A decision is made on whether the user only needs a numerical answer or an entire statement of information → The data is returned in the form of a SQL table → The data can be downloaded into a personalized Excel sheet format

### 7.3 Income Statement

Ideally, this can be formatted into a class where the return is an income statement pandas dataframe but that is currently not happening. For that reason, it has been broken down into a cell which can be run to generate the entire statement.

Input: Company → The ticker of an SP 500 company, Years → The number of future years to project

Output: A pandas dataframe which contains each line item discussed above with the historical and projected totals for the chosen company and years

### 7.4 Cash Flow Statement

Once again, the goal is to format this into a class or function but it is not currently doing so.

Input: Company → The ticker of an SP 500 company, Years → The number of future years to project. Let it also be known however, that this function does take in some line items from the income statement. With the current notebook format, all variables are accessible across cells, but this will have to be passed in as a parameter I assume.

Output: A pandas dataframe which contains each line item described above with the historical and projected totals for the chosen company and years.

### 7.5 Balance Sheet Statement

As repeated above, the goal is to make this into one function or class.

Input: Company → The ticker of an SP 500 company, Years → The number of future years to project. et it also be known however, that this function does take in some line items from the income statement and cash flow statement. With the current notebook format, all variables are accessible across cells, but this will have to be passed in as a parameter I assume.

Output: A pandas dataframe which contains each line item described above with the historical and projected totals for the chosen company and years

## 7.6 Valuation

This portion of the code has not been converted into one cell just yet. It also contains the most bugs.

## 7.7 Remaining Bugs

While I have been working to fix some of these bugs and remedy the issues, my internship has come to a close. I therefore want to be explicit with what issues arise and how they can be solved. I understand that this may require some more work for whoever continues or maintains this work but I hope this documentation will help.

Bug 1: Inability to group into functions or classes. I understand that this may not actually be a bug and perhaps I am not executing the process of creating these functions properly but I'm getting various errors around assignment of variables and scope of variables when trying to create functions and classes. This may be solved by just a better understanding of how classes work in Python. This bug has a scope of the entire program as it affects each proposed function.

Bug 2: Date Gathering From Yahoo Finance. There are multiple points in the program where certain data is being gathered from the free Yahoo Finance API as opposed to FMP because FMP does not contain the necessary or accurate data. However, there is a bug in function where the only way to get the data is input they key (which is today's current date). This serves as an issue since the date obviously changes each day. I'm sure there are many ways around this, but it is a bug I wanted to point out.

Bug 3: Infinite Shares Outstanding. This is a more niche bug that I have currently only found with BMW although I do believe it could exist with other companies as well. When pulling data from Yahoo Finance in this function, the process to get shares outstanding is by calculating the percentage ownership and shares owned of any company with equity in our proposed entity. This is because the actual shares outstanding fact is tough to find. However, there are cases in which Yahoo Finance is unable to find the equity holders and so, returns infinite for the shares outstanding value. This completely derails the future projections. I have attempted to fix this with manual error-catching techniques but believe there are better ways.

Bug 4: Valuation Output Generation. While all the values are present in running the cells individually, it sometimes seems as though there are problems in generating a pandas dataframe with all the necessary values. This doesn't affect the functionality of the code when run within a notebook but it might have effects when translated to API endpoints and so I'm noting it here.

# 8 Next Steps

While this model works to address the basic creation of a DCF valuation, there are many ways to improve the model and take it further into the depths of financial modeling. With only limited time this summer, I decided to build the model with what I had more expertise in which was Discounted Cash Flow and SP 500 companies.

Possible Improvements

- Create other types of models. This includes 3-statement models, leveraged buyout models, initial public offering models, and more. In order to truly get the full picture on any given entity, it is essential to create multiple types of models with various inputs from numerous sources. The patterns found across this thorough research will better point to the desired predictions
- Include non SP 500 companies. One of the biggest current pitfalls of the model is the ability to only pull from FMP data. As the model is rooted in statistics and not generative AI, it is specifically tuned to the reporting done by FMP. However, if more data was accessible for the model, and/or the model incorporated artificial intelligence to gather more data, there could be a larger list of companies in which a model could be built. This item also extends beyond stocks and into bonds, funds, and more. If the data could be gathered on various means of investment, they could all be projected.
- Use historical data to check accuracy. One of the current downfalls of the model is there is no sense of confidence about each value being generated. It is obviously more likely to reach the value projected for certain companies more than others. One way to check confidence is to use the given projection techniques on a sample of historical years and measure how accurate they were with training and test data. This idea could be extrapolated to include various machine learning techniques to optimize the projection criteria for each company based on historical accuracy.
- Generate a measure of risk. Along with confidence, risk is an extremely valuable measure for deciding whether to invest somewhere or not. While the model doesn't currently have any metrics which are directly related to risk measurement, it could be created using various risk-based formulas.