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Free Cash Flow Estimation and Forecasting
Calculation and Projection

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FCF Overview

- There are two main parts to the FCF part of the DCF model

- First is to find all the historical FCFs. This is the straightforward part of plugging values into set calculations.

- The more difficult and important part is projecting future cash flows

- We will discuss a variety of approaches for this

What is FCF?

- Free cash flow (FCF) represents cash a company earns after paying for its operations.

- It is not to be confused with net income, which amortizes costs across years and includes non-cash expenses

- FCF represents only the cash flows from that year, and so can be a lot more variable than net income

- FCF is the actual cash earned, and so it is what we should use for valuation

Historical FCFs

- We can follow a simple formula to get FCFs from historical financials
- All we have to do is calculate the formula for each year of historical data
- Each of the components to this calculation besides net income themselves require a calculation. In the Historical FCF section we will cover each component.
- The formula is all about reversing the non-cash adjustments to net income

FCF	=	Net Income
	+	Non-Cash Expenses
	−	Increase in Working Capital
	−	Capital Expenditures

Forecasting FCFs

- The challenge in the FCF model is to project the cash flows

- There are two main approaches to getting future FCFs:
  <u>forecast the FCFs</u> and <u>forecast the financial statements.</u>

- Forecasting FCFs is much easier but is not as accurate, both due to
  lack of granularity and due to typically uneven FCFs

- We will use <u>time-series methods</u> to forecast the financial statements,
  either in the <u>levels</u> of the item, the <u>growth</u> of the item, or as a
  <u>percentage of another item</u>

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Non-Cash Expenses

Calculate Non-Cash Expenses

Adjustments = depreciation + amortization + stock-based compensation + impairment charges + gains/losses on investments

- Non-cash expenses is just the sum of all items on the income statement that do not affect cash.

- This includes depreciation, amortization, stock-based compensation, impairment charges, and gains/losses on investments

Change in Net Working Capital

Calculate Change in NWC

$$\Delta\text{NWC} = \text{NWC}_t - \text{NWC}_{t-1} \tag{1}$$

$$\text{NWC} = \text{Accounts Receivable} + \text{Inventory} - \text{Accounts Payable} \tag{2}$$

- Net Working Capital (NWC) represents cash actively tied up in daily transactions
- Cacluating the change in NWC requires information from this period as well as last period.
- First, calculate the NWC in each period using accounts receivable, inventory, and accounts payable.
- Then, take the difference between this period's NWC and last to get the change

Capital Expenditures

Calculate CapEx

$$CapEx = \Delta PPE + \text{Depreciation \& Amortization} \tag{3}$$

- Capital Expenditures (CapEx) are outlays for fixed assets which get used over time, such as buildings or machinery.

- The change in Property, Plant and Equipment from the balance sheet can be used to estimate CapEx.

- Then you just need to add back the current depreciation & amortization, as they decreased PPE even though no cash exchanged hands

Put it All Together

Calculating FCF

$$FCF = \text{Net Income} + \text{Non-Cash Expenses} - \Delta\text{NWC} - \text{CapEx} \quad (4)$$

- Again, the FCF formula takes net income and reverses the non-cash adjustments

- Add back the non-cash expenses because no actual cash was spent

- Decrease by the change in NWC as an increase means additional cash was used for operations

- Decrease by CapEx because this cash was spent for a new building, machinery, etc.

Example for Calculating FCFs

Two Ways to Calculate FCFs in Python

- Go to the course site and download the files in Historical FCF
- There should be a Jupyter notebook as well as a data file
- We will go through a couple approaches to calculating FCFs in Python.

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Calculate FCF Lab, Level 1

Free Cash Flow Calculation, Level 1

1. Calculate free cash flow from the following information:
2. Net income is 300, the total of non-cash expenditures is 100, the changes in accounts receivable, inventory, accounts payable, and PPE are 1000, 500, 800, and 2000, and depreciation & amortization is 200.

Level 2: Slide 50   Answers 1: Slide 51   Resources: Slide 53

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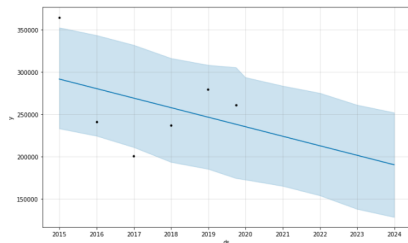## Overview of the Methods

- As mentioned in the intro, we will use time-series methods on the levels of the item, the growth of the item, or as a percentage of another item

- Time-series methods are about numerically estimating future values based on past values

- Levels mean we forecast the numbers of the item itself, e.g. sales was 1M two years ago and 1.5M last year so we feed those numbers into our time-series model and predict 2M for the next year

- Growth means to first calculate the historical growth rate of the item, then forecast that. E.g. sales grew 10% two years ago and 8% last year so we expect it to grow 6% this year

- Percentage of item methods link an item to another item. E.g. setting cost of goods sold to 60% of sales. That percentage still needs to be forecasted

- Any forecast can be adjusted by the analyst's qualitative projections of the future. The forecast method may also have to be chosen with the qualitative analysis in mind

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What Are Time-Series Methods?

- Time-series methods seek to predict the future using the past

- There is a large variety of possible time-series models to use for forecasting

- They each use different characteristics of the past to assist in predicting the future

What are the Time-Series Models?

- The simplest models are to use the average of historical values or the most recent value as the prediction for all future values

- A more realistic model will also include estimating the trend or growth of the historical values and applying that to the future

- More advanced models use autoregressive terms (recent values predict future values), moving average terms (recent errors predict future values), or conditional heteroskedasticity terms (changing variance over time)

- Examples of these advanced models include AR, MA, ARMA, ARCH, GAM, and many more

Which Time-Series Model to Use?

- The choice of a time-series model will depend on the amount of data, the frequency of the data, and the historical patterns in the data

- If the data is historically constant or expected to be constant in the future, using the average or most recent value should be enough

- If the data follows a defined trend or growth and doesn't have historical patterns, then using the trend or growth models should be enough

- If there are historical patterns in the data, such as seasonality, then more advanced models are required.

Steps to Forecasting

- The best place to start is to examine the history either by a plot or just by looking at the numbers if you only have a few

- Based on the amount of historical data, any perceived patterns in the historical data, and any qualitative knowledge of the data, choose a time-series model.

- Fit the time-series model on historical data, then predict the future values using the fitted model

- Finish by examining the forecast to ensure it worked as intended, typically via a plot.

What to Forecast?

- When we forecast levels, just use the forecasted values and you are done

- When we forecast growth, calculate the historical growth, run the forecast on that, then apply the predicted future growth from the final historical period to generate the forecasted levels

- For percentage of item methods, calculate the historical percentage of the item, forecast future item percentages, then use these in combination with the forecast of the referenced item to generate the prediction

- E.g. use the average approach to say historically COGS was 40% of sales, and so estimate COGS as 40% of sales going forward. Multiply the forecasted sales by 40% to get the COGS

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Using the Historical Average Model

Historical Average Model

$$y_{T+n} = \frac{1}{T} \sum_{t=0}^{T} y_t + \epsilon_t \tag{5}$$

- t: Current time period
- T: Last time period of historical data
- y_t: The current value of the data
- y_T: The last historical value of the data
- n: Number of periods forecasted

- **Fit:** To fit the historical average model, take an average of the historical values
- **Predict:** To predict, use that average value for all future values

Using the Recent Value Model

Recent Value Model

$$y_t = y_{t-1} + \epsilon_t \tag{6}$$

- **Fit:** To fit the most recent value model, take the latest value.

- **Predict:** To predict, use that latest value for all future values

Using the Trend Model

Trend Model

$$y_t = a + \beta t + \epsilon_t \tag{7}$$

- **Fit:** Run an OLS regression with a constant and time as the independent variable, where time is measured in number of periods since the beginning

- **Predict:** For each t you want to predict, calculate $a + \beta t$

Using the CAGR Model

CAGR

$$y_{T+f} = y_T * (\frac{y_T^{\frac{1}{n}}}{y_0})^f \tag{8}$$

- **Fit:** Calculate the compounded annual growth rate (CAGR) as $\frac{y_T^{\frac{1}{n}}}{y_0} - 1$

- **Predict:** Calculate future periods by compounding CAGR on the latest historical period $y_{T+f} = y_T * (1 + \text{CAGR})^f$

Forecasting Simple Time-Series in both Excel and Python

Example for Simple Time-Series Forecasting

- Go to the course site and download the files in Examples > DCF > Forecasting > Simple
- There should be a Jupyter notebook as well as two Excel files. Place these all in the same folder
- We will walk through "Sales COGS Forecasted.xlsx" to show forecasting in Excel, and "Forecast Sales COGS Simple.ipynb" for forecasting in Python. "Sales COGS.xlsx" contains the source data

Simple Forecast Lab

Forecasting Simple Time-Series

1. Go to the course site and download "Debt Interest.xlsx"
2. Forecast the next value of total debt using trend regression approach
3. Forecast the next value of interest using the four approaches (average, recent, trend, CAGR)
4. Forecast the next value of interest using the % of total debt method, with the percentages forecasted using the four approaches (average, recent, trend, CAGR)

Forecasting Financial Statements with Simple Time-Series in Python
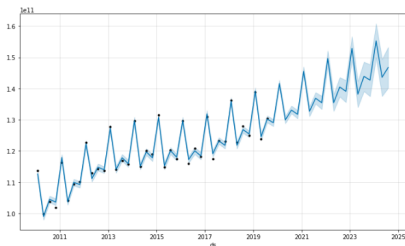
Use finstmt for Financial Statement Forecasting

- Go to the course site and download "Forecasting Financial Statements.ipynb"
- We will walk through using finstmt to forecast financial statements using simple time-series models

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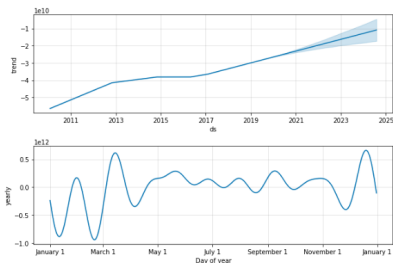
Why Does it get so Complicated?

- Shown to the left is Walmart's quarterly sales

- You can see that a plain trend line is never going to accurately forecast these values

- Advanced time-series models can capture these characteristics easily, and many more patterns

Explaining Seasonal Data

- There is a distinct **seasonality** to Walmart's quarterly sales
- The time-series model used to create the plot on the prior slide split the history into two parts: a trend component and an annual seasonality component
- Walmart's sales are high at the end of January and neutral for the other quarters
- By plotting components of the time-series model, the analyst can gain a greater understanding of the business.

Predicting Complex Time-Series

- So you've determined a trend alone will not fit the historical data. What are next steps?

- Generally fitting the best time-series model is an involved process which requires substantial knowledge of how the models work, see this blog post for details

- An easier version is to use an OLS regression model with time and dummy variables for month of year, etc., we can call this the quarterly seasonal trend model.

- The easiest version is to let time-series software, such as prophet make the choice for you

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Using the Quarterly Seasonal Trend Model

Quarterly Seasonal Trend Model

$$y_t = a + \beta_t t + \beta_{d1} D1 + \beta_{d2} D2 + \beta_{d3} D3 + \beta_{d4} D4 + \epsilon_t \qquad (9)$$

- **Fit:** Create dummy variables for the quarters, then run an OLS regression with the number of time periods as well as the four dummy variables as the X variables

- **Predict:** For each t you want to predict, calculate $a + \beta t$ adding the appropriate dummy for the quarter of the period.

Forecasting Complex Time-Series in Python

Example for Complex Time-Series Forecasting

- Go to the course site and download the files in Examples > DCF > Forecasting > Complex
- There should be a Jupyter notebook as well as two Excel files. Place these all in the same folder
- We will walk through "Forecasting Quarterly Financial Statements.ipynb" to show forecasting in Python using both the Quarterly Seasonal Trend Model and the automated software approach.

Complex Forecast Lab

Forecasting Complex Time-Series

1. Go to the course site and download "CAT Balance Sheet.xlsx" and "CAT Income Statement.xlsx"
2. Forecast the next four periods (one year) of cash using both the Quarterly Seasonal Trend Model and the automated software approach.
3. Plot both forecasts to see how they worked.

Answers: Slide 56   Resources: Slide 57

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What to Forecast?

- As mentioned in the intro, we can either directly forecast FCFs, or forecast the financial statements, then calculate future FCFs from the future financial statements

- Forecasting FCFs doesn't allow the analyst control over individual line items. Therefore it is generally preferred to forecast financial statements.

- If you have a short amount of time to put together the model, it can make sense as it is less steps and it requires less knowledge of the company.

- It can also make sense to do a FCF forecast alongside the financial statement forecast, as a check on your valuation.

Which Line Items to Forecast?

- Assuming you are going with forecasting financial statements, you should forecast only line items which cannot be calculated from other line items

- For example, sales, COGS, SG&A should be forecasted, not operating profit

- You should set your model up so that these calculatable items are calculated in the historicals, then carry that through to the forecasted

- Set items as a percentage of other items when it is logical that they should scale together. For example, interest expense should be forecasted as a percentage of total debt, as if the company takes on more debt, interest expense should increase proportionally

Don't Be Out of Balance

- Despite forecasting line items individually, you must attempt to keep the balance sheet balanced in the future

- If your forecast shows assets growing to be much greater than liabilities and equity, that implies that the company will need to raise additional funds to finance the growth in the assets. Usually increasing debt is the solution.

- If your forecast shows assets lower than liabilities and equity, it means that the profits or other sources of funds are not being properly allocated to the assets side. Usually increasing cash is the solution

Balancing the Balance Sheet

- The general process is to run your forecasts, then use another approach to adjust either cash or debt to make the balance sheet balance.

- These adjusted values are called "plugs" because we are "plugging" in whatever makes the forecast valid

- To make the adjustment in Excel, calculate the absolute value of the difference between assets and liabilities + equity, then use goal seek (single year forecast) or solver (multi-year forecast) to minimize the value

- In Python, the steps would be similar, only using scipy minimize instead of solver, but finstmt handles this automatically for you. When you run a forecast, it will balance the balance sheet without any further action from you. You can change how accurate it is by setting bs_diff_max and you can change which line items are used as plugs in the forecast config

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What we use FCFs For

- As mentioned in the intro to the DCF model, we can value any asset by taking the present value of future cash flows

- These forecasted FCFs represent the future cash flows for the company

- But we have a limited forecast period, beyond which forecasts are getting too innaccurate, typically 5 years at most. So what happens after 5 years? The company will probably still be earning FCFs in the future.

- We can calculate a **terminal value** for the company, which is an estimate of how much the company would be sold for if it was sold at the end of the forecast period. In other words, it is the future predicted enterprise value.

How to Get the Terminal Value

- The terminal value is an enterprise value at the end of the forecast period. But the bulk of the DCF model is getting to an enterprise value, so we have to use a different method to estimate the terminal value otherwise we would have an infinitely nested DCF model that could never be solved.

- The two common methods for estimating the terminal value in a DCF model are exit multiples and perpetuity growth

- The exit multiple method uses current values of valuation ratios and applies them to the future financials

- The perpetuity growth method assumes that the FCFs will grow at a constant rate after the final forecast period.

Finding the Terminal Value via Exit Multiples

- There are typically publicly available valuation ratios for public companies such as EV/EBIT, EV/EBITDA, EV/Sales, EV/FCF, and P/E

- The idea behind this approach is to use those ratios applied to your final period projected financials.

- Each ratio will yield a different terminal value, leading to a different final stock price in your model. It is typical to report results with the different measures to get a range.

- For all the EV ratios, multiply the statement item by the ratio to get the EV, then adjust the EV using final forecasted values to get the equity value and stock price

- For P/E, calculate final period earnings per share and multiply by the ratio to get the stock price

Finding the Terminal Value via Perpetuity Growth

- The perpetuity growth model follows the same mathematics as the dividend discount model

- We just assume that the last period's FCF continues to grow at some terminal growth rate which we set.

- $TV = \frac{FCF(1+g)}{WACC-g}$

- The stock price is highly sensitive to the choice of terminal growth rate, so there should absolutely be sensitivity analysis and Monte Carlo simulations varying it

- Typical terminal growth rates are around 3%, approximately GDP growth rate

Finding EV Using TV and FCFs

- The last step to get the current enterprise value is to combine the FCFs with the TV

- The TV cash flow should come in the final forecast period, such that the final cash flow is $FCF + TV$

- Take the NPV of the cash flows, including the TV

- Follow the adjustments described in the intro lecture to get the stock price from that

Terminal Values Lab

DCF Stock Price using Terminal Values

1. Calculate possible stock prices today for a hypothetical company. Use EV/EBITDA, EV/Sales, EV/FCF, and P/E and the perpetuity growth method to determine five different possible terminal values. You have already determined that the next 5 years FCFs will be \$1,324M in each year.

2. EV/EBITDA is 18.58, EV/Sales is 1.92, EV/FCF is 11.82, and P/E is 39.30.

3. Final period forecasted financial statement values are as follows: EBITDA is \$1,500M, sales is \$7,898M, and net income is \$232M

4. Total debt is \$11,631M, and cash is \$4,867M, both current and final period forecasted

5. Shares outstanding is \$561M and WACC is 10.0% for the entire time period

6. The terminal growth rate is 3.0%

7. You can assume the next free cash flow is one year away.

Lecture Resources (1/2)

Lecture Resources (1/2)

1. Slides - Free Cash Flow Estimation and Forecasting
2. Lecture Notes - Free Cash Flow Estimation and Forecasting
3. WMT Income Statement
4. WMT Balance Sheet
5. Calculating Historical FCF
6. Exxon-Mobil Financials
7. finstmt Documentation
8. Sales COGS
9. Sales COGS Forecasted
10. Forecast Sales COGS Simple

Lecture Resources (2/2)

Lecture Resources (2/2)

1. Debt Interest
2. Forecasting Financial Statements
3. CAT Balance Sheet
4. CAT Income Statement
5. WMT Balance Sheet
6. WMT Income Statement
7. Forecasting Quarterly Financial Statements
8. CAT Balance Sheet
9. CAT Income Statement

Calculate FCF Lab, Level 2

Free Cash Flow Calculation, Level 2

1. Load in the income statement and balance sheet data associated with Project 3, "WMT Balance Sheet.xlsx" and "WMT Income Statement.xlsx"

2. Calculate the free cash flows from these data. Note that some items are missing in these data such as depreciation. You will just need to exclude any missing items from your calculation

3. Get the FCFs for 2019-04–30 and 2019-07-31.

Level 1: Slide 13   Answers 2: Slide 52   Resources: Slide 53

Calculate FCF Lab, Answers for Level 1

Free Cash Flow Calculation, Answers for Level 1

1. The NWC is $700
2. The CapEx is $2,200
3. The FCF is $-2,500

Level 1: Slide 13   Level 2: Slide 50   Resources: Slide 53

Calculate FCF Lab, Answers for Level 2

Free Cash Flow Calculation, Answers for Level 2

1. The FCF for 2019-04-30 is $-11,495,000,000
2. The FCF for 2019-07-31 is $4,327,000,000

Level 1: Slide 13   Level 2: Slide 50   Resources: Slide 53

Calculate FCF Lab Resources

Free Cash Flow Calculation Resources

1. Slides - Free Cash Flow Estimation and Forecasting
2. WMT Balance Sheet
3. WMT Income Statement

Simple Forecast Lab, Answers

Forecasting Simple Time-Series, Answers

1. The forecasted value of total debt should be $6,867

2. The directly forecasted values of interest should be $1,600, $1,900, $2,300, and $2,391, for average, recent, trend, CAGR, respectively

3. The % of debt forecasted values of interest should be $2,072, $2,139, $2,379, and $2,312, for average, recent, trend, CAGR, respectively

Exercise: Slide <u>27</u>   Resources: Slide <u>55</u>

Simple Forecast Lab Resources

Forecasting Simple Time-Series Resources

1. Slides - Free Cash Flow Estimation and Forecasting
2. Debt Interest

Exercise: Slide 27   Answers: Slide 54

Complex Forecast Lab, Answers

Forecasting Complex Time-Series, Answers

1. The forecasted values of cash using the Quarterly Seasonal Trend Model should be $8,454,920,455, $8,833,593,182, $8,869,693,182, and $10,251,393,182

2. The forecasted values of cash using the automated approach should be $8,071,641,657, $8,185,822,286, $9,132,093,865, and $9,502,395,879

Exercise: Slide 35   Resources: Slide 57

Complex Forecast Lab Resources

Forecasting Complex Time-Series Resources

1. Slides - Free Cash Flow Estimation and Forecasting
2. CAT Balance Sheet
3. CAT Income Statement

Exercise: Slide 35   Answers: Slide 56

Terminal Values Lab, Answers

DCF Stock Price using Terminal Values, Answers

1. The stock prices using the five methods are as follows:
2. EV/EBITDA: $27.74
3. EV/Sales: $13.67
4. EV/FCF: $14.21
5. P/E: $14.47
6. Perpetuity Growth: $18.45

Exercise: Slide   Resources: Slide

Terminal Values Lab Resources

DCF Stock Price using Terminal Values Resources

1. Slides - Free Cash Flow Estimation and Forecasting

   Exercise: Slide 47   Answers: Slide 58