STARE INTO THE ABYSS: FACING UP TO UNCERTAINTY!

Not looking at uncertainty won't make it go away.

The Origins of Financial Analysis

- In both corporate finance and valuation, much of what we do is built around point estimates, made with the data that we have at the time of estimation.

- The reality is that what are estimating are distributions, with an expected value (that should be the point estimate) but also a substantial possibility of error.

- Our defense for using point estimates was that we lacked the data to estimate probability distributions and/or that doing valuations with distributions would require machine power that we did not have access to (at a reasonable price).
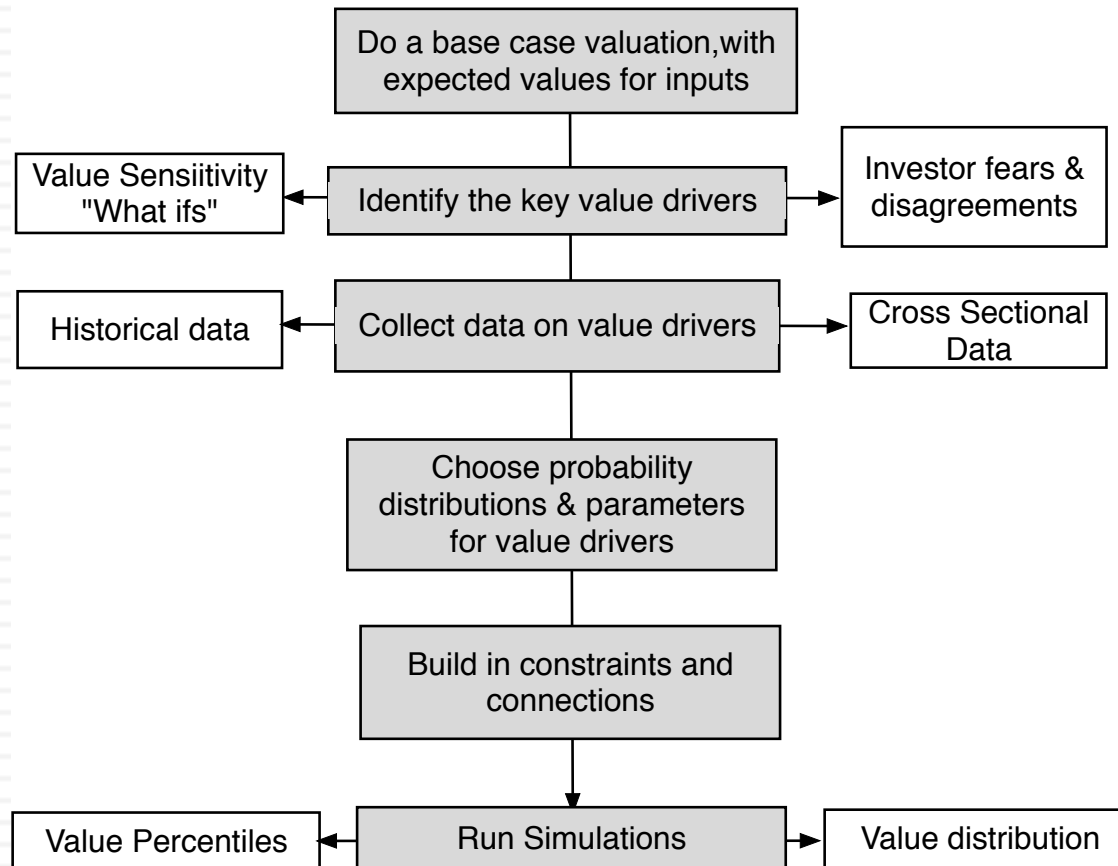
A Big Picture View of Simulations

□ In a simulation, you estimate probability distributions for each variable that goes into an analysis.

□ In each simulation, you draw an outcome from each of the distributions and estimate the end result with those outcomes. Since these outcomes can come from the low end or high end of the distributions, they will be different.

□ You run as many simulations as you can and come up with a distribution of the outcomes, which you then use for decision making.

Classifying uncertainties

1. <u>Discrete or Continuous?</u> Risks that either occur or do not are discrete risks; you are not exposed to them much of the time, but when they do happen, they can be catastrophic. Risks that you are exposed to all of the time, albeit often in small does, are continuous risks.

2. <u>Symmetric or Asymmetric?</u> If positive and negative outcomes are roughly equivalent in magnitude and probability, you have symmetric risks. If large positive (negative) outcomes are more likely, you have positively (negatively) skewed risks.

3. <u>Extreme value likelihood, low or high?</u> If outcomes that are very different from your expected value happen very infrequently, you have thin tailed distributions. If they occur often, you have fat tailed distributions.

Simulation in Valuation

Value Simulation: The Steps

Do a base case valuation, with expected values for inputs

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Value Sensiitivity "What ifs" ← Identify the key value drivers → Investor fears & disagreements

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Historical data ← Collect data on value drivers → Cross Sectional Data

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Choose probability distributions & parameters for value drivers

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Build in constraints and connections

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Value Percentiles ← Run Simulations → Value distribution

Step 1: Base Case Valuation

Apple: Base Case Valuation (May 2016)

Most recent twelve months

Revenues	$	227,535
Operating income or EBIT	$	66,864
Revenue growth - LTM		-5.22%
Pre-tax Operating margin		33.28%

My Apple Narrative: A mature company that derives the bulk of its value from a franchise (iPhone) in a market where growth is slowing and competition is increaing.

Revenue growth of **1.5%** a year in perpetuity.

Pre-tax operating margin decreases to **25%** over time.

Sales to capital ratio of 1.60

Stable Growth
g = 1.5%; Cost of capital = 8%
ROC= 12%;
Reinvestment Rate=1.5%/12% = 16.67%

Terminal Value= 38,110/(.08-.015) = $586,304

	1	2	3	4	5	6	7	8	9	10
Revenue growth rate	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%
Revenues	$230,948	$234,412	$237,928	$241,497	$245,120	$248,797	$252,529	$256,316	$260,161	$264,064
EBIT (Operating) margin	32.45%	31.63%	30.80%	29.97%	29.14%	28.31%	27.48%	26.66%	25.83%	25.00%
EBIT (Operating income)	$ 74,953	$ 74,136	$ 73,277	$ 72,376	$ 71,432	$ 70,442	$ 69,407	$ 68,325	$ 67,195	$ 66,016
Tax rate	26.49%	26.49%	26.49%	26.49%	26.49%	28.19%	29.90%	31.60%	33.30%	35.00%
EBIT(1-t)	$ 55,095	$ 54,495	$ 53,863	$ 53,201	$ 52,507	$ 50,581	$ 48,657	$ 46,736	$ 44,820	$ 42,910
- Reinvestment	$ 2,133	$ 2,165	$ 2,198	$ 2,231	$ 2,264	$ 2,298	$ 2,332	$ 2,367	$ 2,403	$ 2,439
FCFF	$ 52,962	$ 52,330	$ 51,666	$ 50,971	$ 50,243	$ 48,283	$ 46,325	$ 44,369	$ 42,417	$ 40,471

	11 (TY)
Revenue growth rate	1.50%
Revenues	$268,025
EBIT (Operating) margin	25.00%
EBIT (Operating income)	$ 67,006
Tax rate	35.00%
EBIT(1-t)	$ 43,554
- Reinvestment	$ 5,444
FCFF	$ 38,110

Value of operating assets =	$	552,748
- Debt	$	64,735
+ Cash	$	204,928
Value of equity	$	692,941
- Value of options	$	89
Value of equity in common stock	$	692,852
Number of shares		5,478.45
Estimated value /share	$	**126.47**

Cost of capital = 10.59% (.892) + 1.% (.108) = 9.63%

Cost of capital decreases to 8% from years 6-10

Cost of Equity
10.59%

Cost of Debt
Bond rating: AA-
(1.9%+0.7%)(1-.35) = 1.69%

Weights
E = 89.2% D = 10.8%

In May 2016, Apple was trading at $93 a share.

Riskfree Rate:
Riskfree rate = 1.9%

+

Beta
1.31

X

ERP
6.66%

Step 2: Identify value drivers

Apple: Value versus Revenue Growth

Apple: Value versus Operating Margin

Apple: Value versus Sales to Capital Ratio

Apple: Value versus Cost of Capital

Step 3: Collect data

Apple: Revenue Growth & Operating Margin - 1989-2015

The iPhone Decade

Apple: Quarterly Revenue Growth and Margins

Revenue Growth at Aging Tech Firms

Revenue Growth Rate (CAGR over 10 years) - Tech firms older than 25 years

26.2% of firms had negative growth rates

Average	4.81%
25h percentile	-0.56%
Median	4.63%
75th percentile	9.56%

Number of firms (y-axis)

Revenue Growth (CAGR in last 10 years) (x-axis)

For Apple's revenue growth & margin

Compounded annual revenue growth rate over next 5 years =

Not for Commercial Use

Distribution: Lognormal
Parameters: Location = -5%
Expected value = 1.50%
Std deviation = 2.5%

Correlation between revenue growth & margin = 0.50

Target pre-tax operating margin (EBIT as % of sales in year 10) =

Not for Commercial Use

Distribution: Triangular
Parameters: Minimum = 15%
Expected value = 25%
Maximum = 35%

Step 5: Constraints, Correlations and Connections

□ You can build in constraints that will affect the company's operations, and its value, that are either internally or externally imposed.

 ◻ Internal constraints can include refusal to issue new stock, borrow money or pay dividends.

 ◻ External constraints can include failure to make debt payments or meet regulatory capital requirements.

□ You can also build in correlations between the variables that you are attaching probability distributions to.

Step 6: Run the Simulation

☐ **Crystal Ball:** http://www.oracle.com/us/products/applications/crystalball/crystal-ball-product/overview/index.html
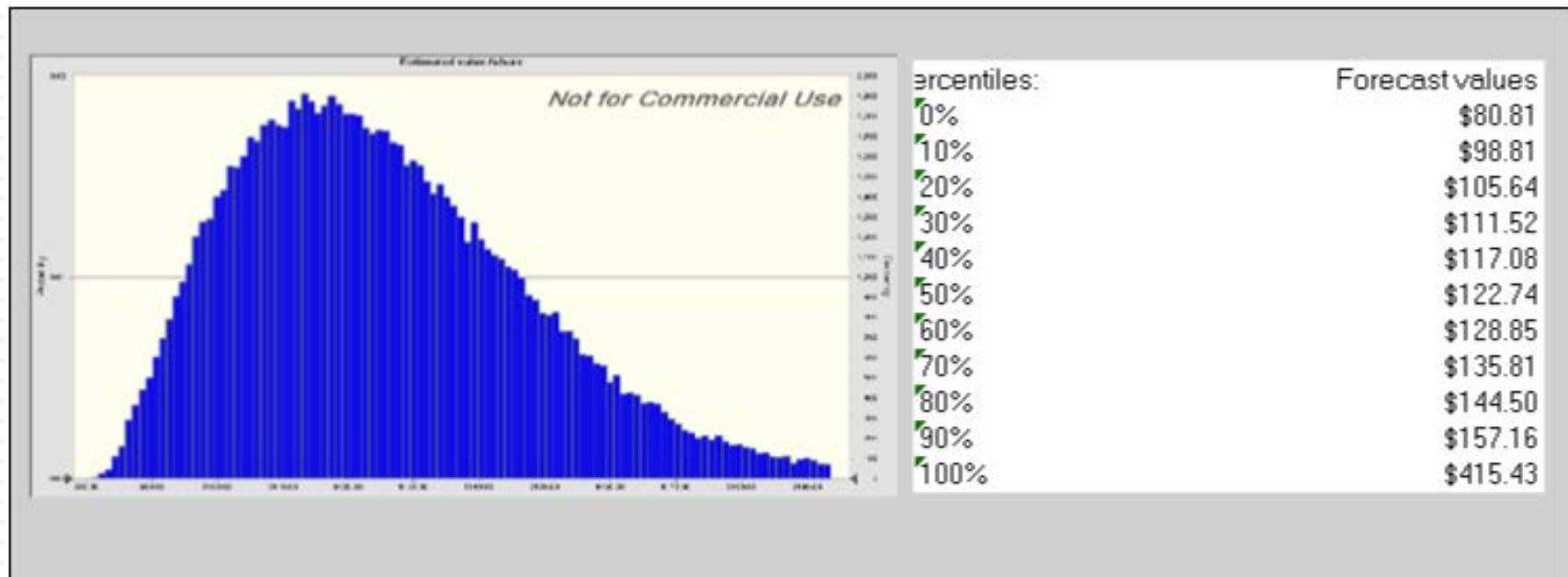

Define distributions for variables

Specify output variable

Number of simulations

The Value Distribution

Percentiles:	Forecast values
0%	$80.81
10%	$98.81
20%	$105.64
30%	$111.52
40%	$117.08
50%	$122.74
60%	$128.85
70%	$135.81
80%	$144.50
90%	$157.16
100%	$415.43

Conclusion

- Not looking at what you are uncertain about does not make it go away.

- Ironically, taking a closer look at what you fear (being wrong) can make you less fearful.

- Look into the (uncertainty) abyss. It might not be as dark and dangerous as you think it is.