Business and Financial Modeling Specialization

2. Introduction to Spreadsheets and Models

- 2. Data $\rightarrow$ What-If Analysis $\rightarrow$ Scenario Manager

  Sensitivity analysis : compare impact on an outcome variable based on 10% changes on individual input vars

  Limits to simple, deterministic models : doesn't incorporate the uncertainty of market, i.e. inaccurate representations of variance in real world.

- 3. Modeling Risk and Making Predictions

  =RandBetween(low, high)

  Forcast : for Linear : =FORECAST(predict_x, known_y's, known_x's)

  for Exponential : =GROWTH(known_y's, known_x's, predict_x) and =LOGEST(Known Y's, Known X's, Const, Stats)

  Regression Analysis : =CORREL(array1, array2)

  or Data $\rightarrow$ Data Analysis $\rightarrow$ Regression (R = correlation; R Square = covariance; adjusted R^2 to account for size)

- 4. Monte Carlo Simulations

  Worth when manual What-If analysis is impossible, model is complex, stakes is high or a bit more precision is important

  - Linear Programming (LP) Solver

3. Modeling Risk and Realities

- 1. Models with Little to No Risk

  Decision, objective, constraint(s) $\to$ spreadsheet to optimize

  Deterministic settings $\iff$ no risk

  Run "Excel Solver" several times w/ different starting values to ensure global min/max.

- 2. Models with High Risk

  Scenario Approach : basically, estimate the future based on the past

  (e.g. expect equal probability of return as one of the past 20 trading days of a stock)

  Should vary # of used scenarios (past events) to test robustness (and prevent overfitting)

  Risk := likelihood and/or magnitude of **undesirable** outcome(s)

  - Negative correlation $\to$ reduced variance/risk/volatility

- 3. Data Visualization & Choose the Right Distribution

  Goodness of fit tests : Chi-Square (χ^2) test & Kolmogorov-Smirnov test.

  - Chi-Square test is one-sided, i.e. can disprove but not prove

  Null hypothesis : the studied comes from a RV following a specified distribution.

  Ideally, ≥ 50 data points; divide into n buckets with ≥ 5 in each.

  Every χ^2 test has "degree of freedom" $=$ # of buckets $-$ # parameters of specified distribution -1

  Then, look up a confidence table.

  Excel formula : =chisq.test(actual range, expected range)

  - Kolmogorov-Smirnov (K-S) test

  Arrange data values in ascending order; arrange theoretical values similarly; find maximal diff b/w them.

  Typically, a value 0.03-0.04 or lower is considered good.

- 4. Comparing Alternatives using Simulations

  Careful when calculating expected values that involve non-linear terms $\to$ need simulation

  Data Analysis $\to$ Random Number Generation

  Can compare the 95% CI of expected return and risk

4. Decision-Making and Scenarios

- 1. Compare with NPV (net present values)

  $F_n = \text{PV} \cdot (1 + r)^n$

  Excel $=$NPV$(\cdot)$ function assumes that 1st payment starts at $t = 1$, i.e. discounted by r

  - Cost of Capital (CoC) : reflects riskless return, compensation for expected inflation $+$ risk premium

  Usually considers the nominal CoC, i.e. includes compensation for expected inflation

  Hard to estimate

  - Internal rate of return (IRR) : Excel $=$IRR(values)

  Project gains (positive NPV) iff IRR $>$ CoC

  May not always give the idea of worth or not $\rightarrow$ NPV is always good

  - Other criteria (not too good) : payback time, ROI (avg/expected)

- 2. Initial investment, Operating phase, Terminal phase

  - Initial investment : capitalized costs (asset, no immediate tax benefit), non-capitalized costs (R&D + training), working capital (inventory, no tax benefit)

  Working capital expansion consumes cash.

  - Operating : ΔCash Flow $= \Delta$CR - ΔCE - ΔT

  Taxable income $=$ Revenue - COGS - DTS (depreciation tax savings) $\rightarrow$ doesn't depend on account receivable etc.

  Annual depreciation : (cost - estimated salvage) / life

  - Terminal : include tax on gain/loss on (final sale $-$ estimated salvage value)

  - Key considerations

    - If company profitable, then losses can be used for tax deduction; else, losses are just losses.
    - Financing is included only in estimation of CoC, but not cash flow.
    - Include all incidental effects (on other products/services).
    - Working capital is usually released at the end.
    - Sunk cost never relevant; additional investment is.
    - Don't forget opportunity costs (:= value of the resource in its next most highly valued use)
    - Perform sensitivity analysis

- 3. Financial Statements (Balance Sheet, Income Statement, Cash Flow Statement) and Forecasting

  - Balance Sheet (Snapshot of a timepoint)

    - Financial position (listing of resources and obligations) on a specific date
    - Assets $=$ Liabilities $+$ Owners' Equity
    - Common assets on it : cash (link to CFS), accounts receivable, inventory, property plant and equipment (PPE), intangible assets, investments in financial assets, etc.
    - Liabilities on it : accounts payable, other payables (wages, interest, income taxes), receipt of payment in advance of providing service, short-term debt, long-term debt, product warranties, employee pensions
    - Owners' Equity : contributed capital, retained earnings (link to IS)

  * Income vs Cash Flow (difference is TIMING)

  income : measures the increase in economic value from a xact or even

  cash flow : measures the receipt of that value in the form of cash

  - IS

    - Profitability of operations over a period of time

3

Beginning Balance	Business Activities, Transactions and Events During the Period		Ending Balance
$Cash_{Beg}$	+ Receipts - Payments	=	$Cash_{End}$
$Accts\ Rec_{Beg}$	+ Sales - Collection	=	$Accts\ Rec_{End}$
$Inventory_{Beg}$	+ Purchases – Cost of Goods Sold	=	$Inventory_{End}$
PPE_{Beg}	+ Purchases – Deprec - Disposals	=	PPE_{End}
$Accts\ Pay_{Beg}$	+ Purchases – Payments to Suppliers	=	$Accts\ Pay_{End}$
$Wages\ Pay_{Beg}$	+ Wage Expense – Wages Paid	=	$Wages\ Pay_{End}$
$Contributed\ Capital_{Beg}$	+ Stock Issuance – Stock Repurchases	=	$Contributed\ Capital_{End}$
$Retained\ Earn_{Beg}$	+ Net Income - Dividends	=	$Retained\ Earn_{End}$

- Net income = Revenues − Expenses
- Expenses are grouped into categories : revenue (or sales), COGS; gross profit, operating (SG&A) expense; operating income, interest, other gains and losses; pre-tax income, income tax expense; net income

- CFS

- Sources and uses of cash during a period of time
- Operating, investing, and financing activities
    * Operating : xacts related to providing goods and services to customers and to pay expenses related to the revenue generating activities
    * Investing : xacts related to acquisition or disposal of long-term assets (e.g. PPE)
    * Financing : xacts related to owners or creditors (e.g. cash from issuing shares − cash paid for dividends)
- Operations and Investing : to evaluate a project
- Cash from Operations = net income + depreciation − Δworking capital
- Cash from Investing = − investment in long-term assets + disposal of LT assets
- Cash from Financing = changes in LT liabilities + changes in contributing capital − dividends

Net Income	Different Because	Cash From Operations
Sales Revenue	Not all Sales Were Collected	Cash Collected From Customers
(Cost of Goods Sold)	Not all Inventory was sold / Not all Purchases were paid for	(Purchases From Suppliers)
(Wage Expense)	Not all Wages were Paid	(Wages Paid)
(Depreciation Expense)	This is not a Cash Flow	
(Taxes Paid)	No Difference	(Taxes Paid)
Net Income		**Cash From Operations**

- 4. New Product Venture

  Forecast often starts with Sales

  Calculate NPV & IRR → What can go wrong? How wrong can it go?

  - Formulation and Evaluation of Alternative Scenarios

  To find breakeven point : Data → What-If Analysis → Goal Seek

  Consider changes in credit policy, etc.

  - Expanding Beyond the Time Horizon

Usually individual forecast for a finite horizon (3-7 years) + ad hoc (simplified) assumption for later (Terminal Value)

For the steady state, use constant CF (perpetuity) or constant growing rate (constant growth perpetuity)

N.B. Remember the one-time "other disposable costs"

N.B. A lot of value comes from the steady state terminal value.

5. Wharton Business and Financial Modeling Capstone

- 1. Modern portfolio theory

  Investing in various assets, e.g. equity, fixed income, currency, real estates to achieve a high return with controlled risk.

  Efficient frontier : the set of portfolios which satisfy the condition that no other portfolio exists with a higher expected return but with the same standard deviation of return (i.e. the risk).

  Diversification : rebalancing is a key to maintaining risk levels over time.

- 2. Close price vs Adjusted Close price

  Sharpe Ratio : describes how much excess return you receive for the extra volatility you endure for holding a riskier asset

$$S(x) = \frac{r_x - R_f}{\text{StdDev}(r_x)}$$

x investment; r_x avg rate of return; R_f best available rate of return of a risk-free securiy (i.e. T-bills)

A risk/return measure for capital asset pricing model (CAPM)

For some insight, a ratio of 1 or better is good, 2 or better is very good, and 3 or better is excellent.