Forecasting Models, Black-Scholes Model, MBS and CDO

Popular Forecasting Methods

Technique	Use	Math involved	Data needed
1. Straight line	Constant growth rate	Minimum level	Historical data
2. Moving average	Repeated forecasts	Minimum level	Historical data
3. Simple linear regression	Compare one independent with one dependent variable	Statistical knowledge required	A sample of relevant observations
4. Multiple linear regression	Compare more than one independent variable with one dependent variable	Statistical knowledge required	A sample of relevant observations

Straight-line Method

The straight line method is one of the simplest and easy-to-follow forecasting methods. A financial analyst uses historical figures and trends to predict future revenue growth.

The first step in straight-line forecasting is to find out the sales growth rate that will be used to calculate future revenues. For 2016, the growth rate was 4.0% based on historical performance. We can use the formula =(C7-B7)/B7 to get this number. Assuming the growth will remain constant into the future, we will use the same rate for coming years.

To forecast future revenues, take the previous year's figure and multiply it by the growth rate. The formula used to calculate 2017 revenue is =C7*(1+D5).

C5 | =(C7-B7)/B7

Method #1: Straight-Line

	Historical -->		Forecast -->				
	2015	2016	2017	2018	2019	2020	2021
Sales Growth Percent	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%
Revenues	81,422	84,698					

D7 | =C7*(1+D5)

Method #1: Straight-Line

	Historical -->		Forecast -->				
	2015	2016	2017	2018	2019	2020	2021
Sales Growth Percent	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%
Revenues	81,422	84,698	88,086	91,609	95,274	99,085	103,048

Moving Average

Moving averages is a smoothing technique that looks at the underlying pattern of a set of data to establish an estimate of future values. The most common types are the 3-month and 5-month moving averages.

To perform a moving average forecast, the revenue data should be placed in the vertical column. Create two columns for 3-month moving averages and 5-month moving averages.

The 3-month moving average is calculated by taking the average of the current and past two months revenues.

Similarly, the 5-month moving average forecasts revenue from the starting month to the fifth month.

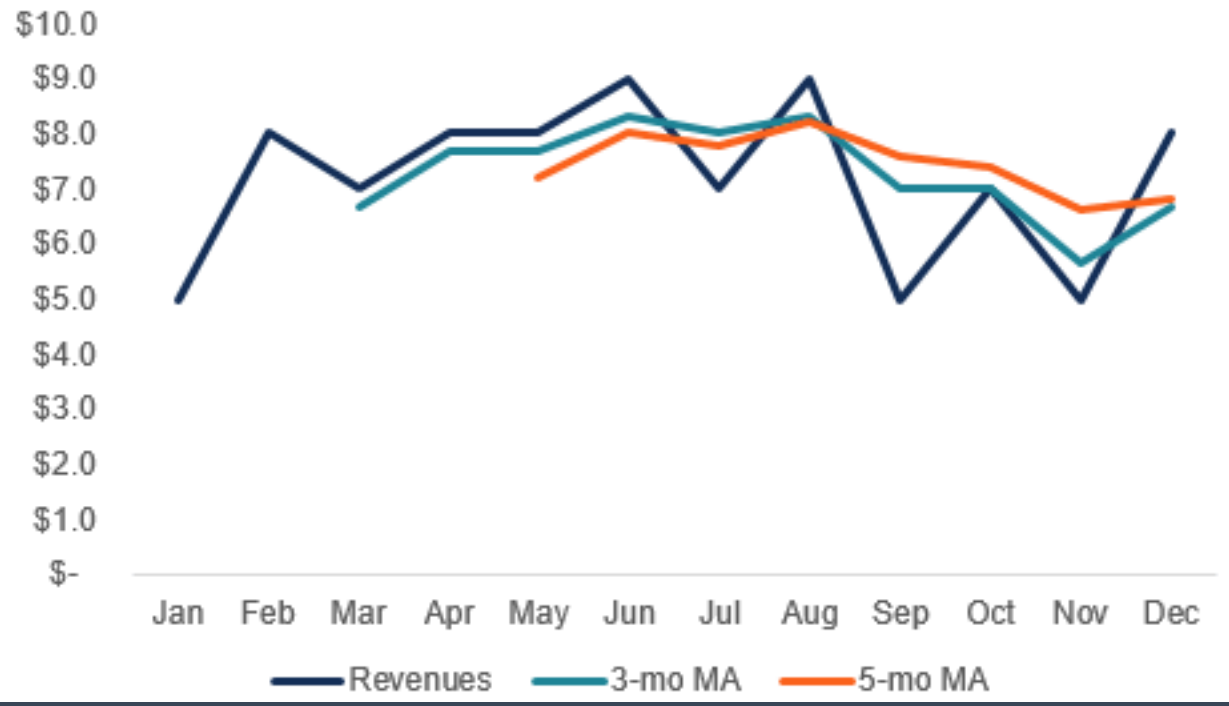
It is always a good idea to create a line chart to show the difference between actual and MA forecasted values in revenue forecasting methods.

When deciding the time period for a moving average technique, an analyst should consider whether the forecasts should be more reflective of reality or they should smooth out recent fluctuations.

P12

Method #2: Moving Average

	Revenues	3-mo MA	5-mo MA
Jan	$ 5.0		
Feb	$ 8.0		
Mar	$ 7.0	$ 6.7	
Apr	$ 8.0	$ 7.7	
May	$ 8.0	$ 7.7	$ 7.2
Jun	$ 9.0	$ 8.3	$ 8.0
Jul	$ 7.0	$ 8.0	$ 7.8
Aug	$ 9.0	$ 8.3	$ 8.2
Sep	$ 5.0	$ 7.0	$ 7.6
Oct	$ 7.0	$ 7.0	$ 7.4
Nov	$ 5.0	$ 5.7	$ 6.6
Dec	$ 8.0	$ 6.7	$ 6.8



Simple Linear Regression

Linear regression models are used to show or predict the relationship between two variables or factors. The factor that is being predicted is called the dependent variable. The factors that are used to predict the value of the dependent variable are called the independent variables.

- Two factors that are involved in a simple linear regression analysis are designated ***x*** and ***y.*** The equation that describes how ***y*** is related to ***x*** is known as the **regression model**. The linear regression model also contains an error term that is represented by ***E or epsilon***

$$y = \beta 0 + \beta 1 + E$$

- The simple linear regression equation is represented like this:

$$E(y) = (\beta 0 + \beta 1\ x).$$

- $\beta 0$ is the ***y*** intercept of the regression line.
- $\beta 1$ is the slope.
- ***E*(*y*)** is the mean or expected value of ***y*** for a given value of ***x***.

MAX

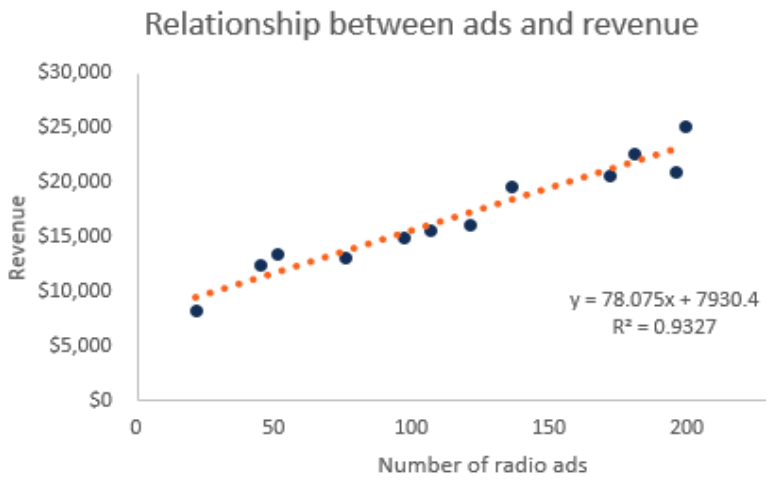
=($A$25*B25)+$A$26

Method #3: Simple Linear Regression

Data	Radio ads	Revenue
Jan	21	$8,350.0
Feb	180	$22,755.0
Mar	50	$13,455.0
Apr	195	$21,100.0
May	96	$15,000.0
Jun	44	$12,500.0
Jul	171	$20,700.0
Aug	135	$19,722.0
Sep	120	$16,115.0
Oct	75	$13,100.0
Nov	106	$15,670.0
Dec	198	$25,300.0
Totals	**1,391**	**$203,767.0**
Average	**116**	**$16,980.6**

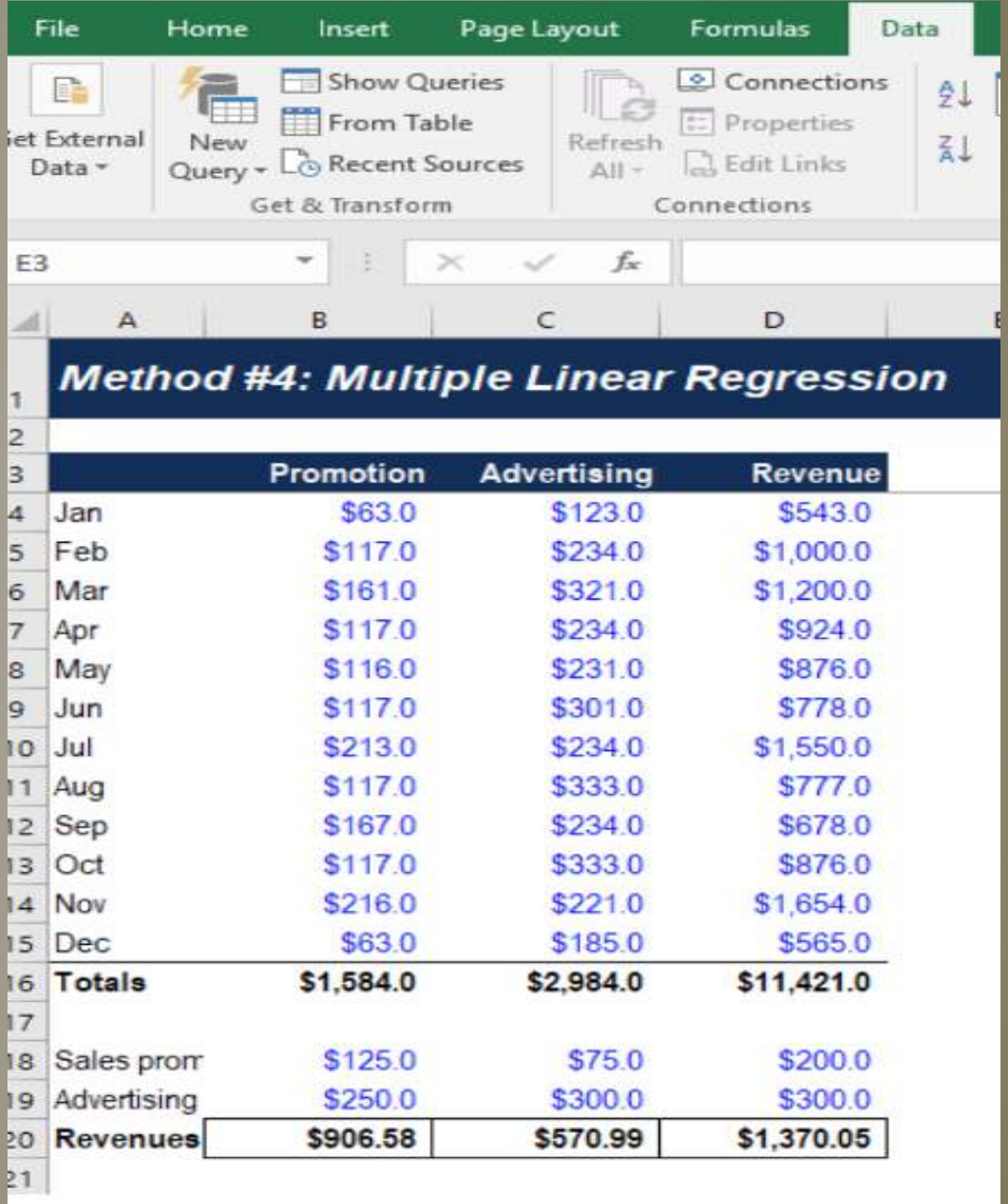
Forecast function	
100	$15,737.9
150	$19,641.6
200	$23,545.4

Equation of a line		
78.08	100	=($A$25*B25)+$A$26
7,930.35	150	$19,641.6
	200	$23,545.4



Multiple Linear Regression

A company uses multiple linear regression to forecast revenues when two or more independent variables are required for a projection



	Promotion	Advertising	Revenue
Jan	$63.0	$123.0	$543.0
Feb	$117.0	$234.0	$1,000.0
Mar	$161.0	$321.0	$1,200.0
Apr	$117.0	$234.0	$924.0
May	$116.0	$231.0	$876.0
Jun	$117.0	$301.0	$778.0
Jul	$213.0	$234.0	$1,550.0
Aug	$117.0	$333.0	$777.0
Sep	$167.0	$234.0	$678.0
Oct	$117.0	$333.0	$876.0
Nov	$216.0	$221.0	$1,654.0
Dec	$63.0	$185.0	$565.0
Totals	**$1,584.0**	**$2,984.0**	**$11,421.0**
Sales prom	$125.0	$75.0	$200.0
Advertising	$250.0	$300.0	$300.0
Revenues	**$906.58**	**$570.99**	**$1,370.05**

Black-Scholes Model

- Black-Scholes is a pricing model used to determine the fair price or theoretical value for a call or a put option based on six variables such as volatility, type of option, underlying stock price, time, strike price, and risk-free rate.
- The model is used to determine the price of a European call option, which simply means that the option can only be exercised on the expiration date.
- The Black-Scholes model makes certain assumptions:
  1. The option is European and can only be exercised at expiration.
  2. No dividends are paid out during the life of the option.
  3. Markets are efficient (i.e., market movements cannot be predicted).
  4. There are no transaction costs in buying the option.
  5. The risk-free rate and volatility of the underlying are known and constant.
  6. The returns on the underlying are normally distributed.

$$C = S_t N(d_1) - K e^{-rt} N(d_2)$$

$$d_1 = \frac{ln\frac{S_t}{K} + (r + \frac{\sigma_s^2}{2})\, t}{\sigma_s \sqrt{t}}$$

$$d_2 = d_1 - \sigma_s \sqrt{t}$$

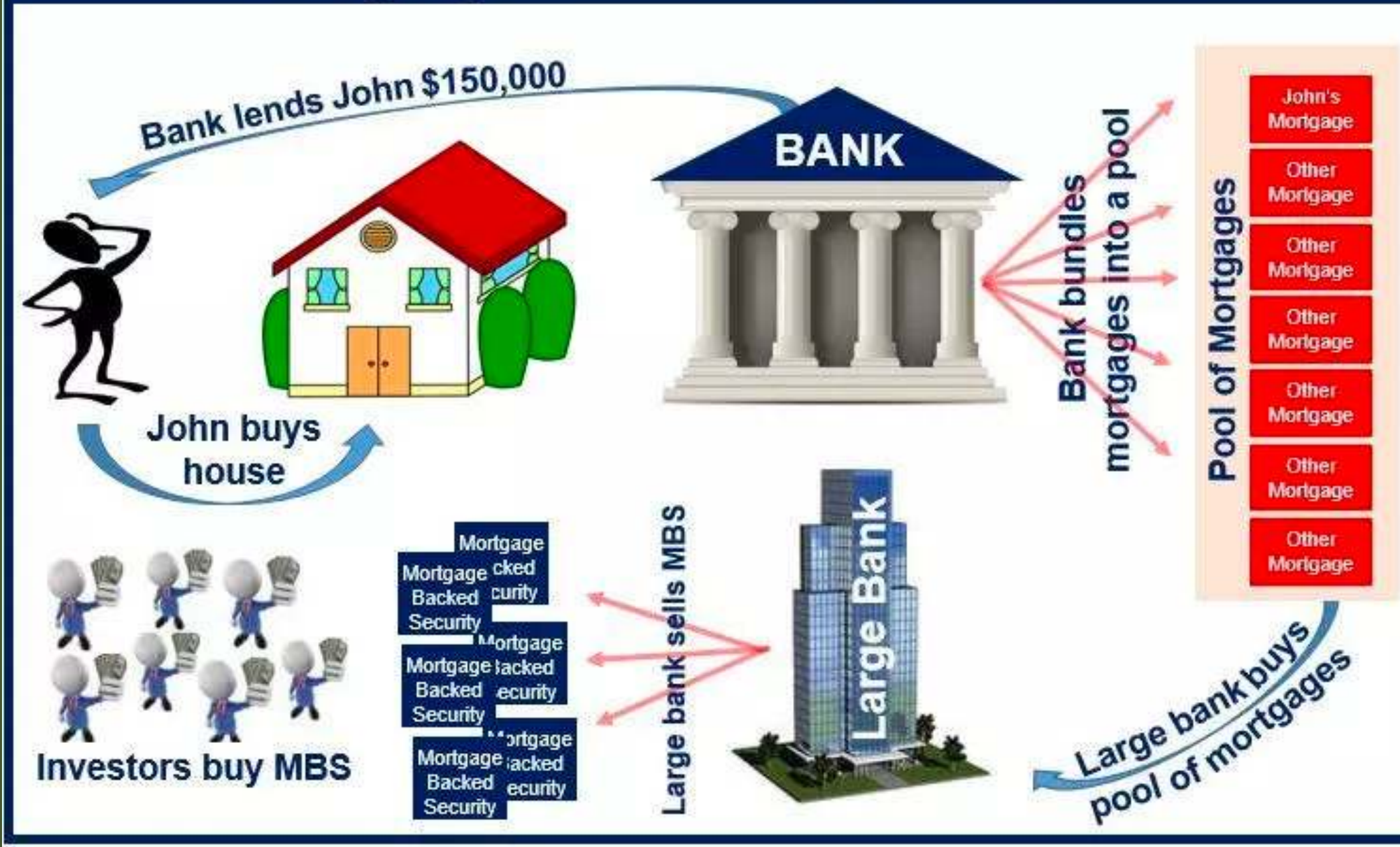
C = Call option price
S = Current stock price
K = Strike price
r = Risk-free interest rate
t = Time to maturity
N = A normal distribution

Mortgage Backed Security

How is a mortgage-backed security created?

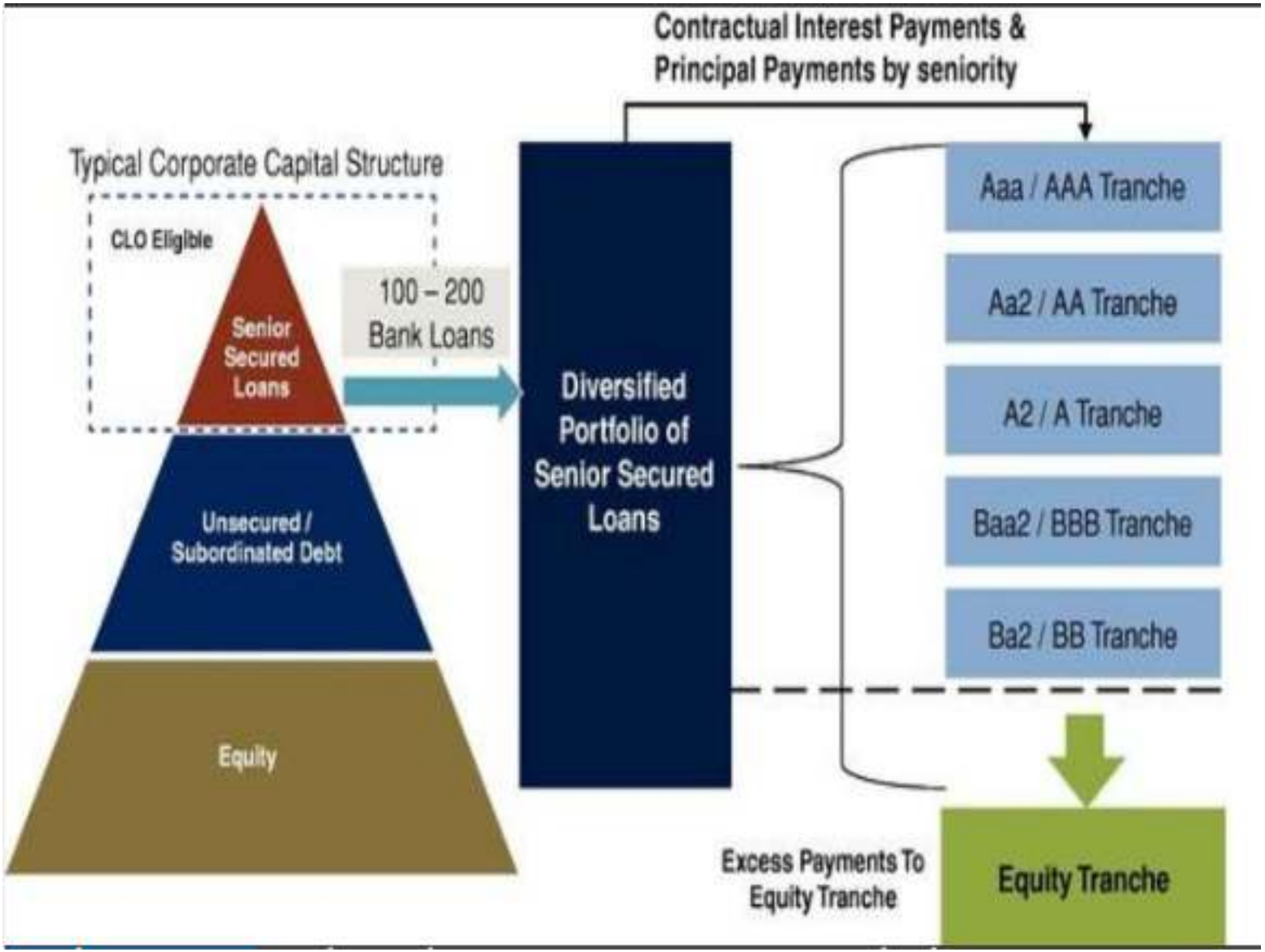
- The mortgagee (lender) awards a loan to a borrower.
- The mortgagee sells the mortgage to a bank, GSE (government-sponsored enterprise) such as Freddie Mac or Fannie Mae, or another financial institution. The mortgage may still be serviced by the lender.
- The lender may also package them together into a 'pool' of several mortgages. The pool can vary in size, from very few to thousands of loans. As mortgagors (borrowers) pay their monthly installments, the mortgage pool generates a regular cash flow.
- The financial institution sells claims on that cash flow in the form of bonds. The MBS are then traded on the open market.
- Mortgagor payments, which include interest and principal, pass through the chain, from the original lender all the way to the bondholder.

Mortgage-Backed Securities



Collateralized debt obligation

- CDOs, or collateralized debt obligations, are financial tools that banks use to repackage individual loans into a product sold to investors on the secondary market. These packages consist of auto loans, credit card debt, mortgages or corporate debt. They are called collateralized because the promised repayments of the loans are the collateral that gives the CDOs their value.
- CDOs are a particular kind of derivative. As its name implies, a derivative is any financial product that derives its value from another underlying asset. Derivatives like put options, call options, and futures contracts have long been used in the stock and commodities markets.
- CDOs are called asset-backed commercial paper if the package consists of corporate debt. Banks call them mortgage-backed securities if the loans are mortgages. If the mortgages are made to those with a less than prime credit history, they are called subprime mortgages
- CDO's are the reason behind 2008 financial crisis


Contractual Interest Payments &
Principal Payments by seniority
Typical Corporate Capital Structure
CLO Eligible
Senior Secured Loans
100 – 200 Bank Loans
Unsecured / Subordinated Debt
Equity
Diversified Portfolio of Senior Secured Loans
Aaa / AAA Tranche
Aa2 / AA Tranche
A2 / A Tranche
Baa2 / BBB Tranche
Ba2 / BB Tranche
Excess Payments To Equity Tranche
Equity Tranche

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