STOCK VALUATION MODELS

PART 2

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Plan

- **The Bates Model**
- **The Multi-Stage Model**
- **Holt’s Linear Trend Model**
- **Whitbeck & Kisor Model**

I. The Bates Model

is an extension of the Black-Scholes and Merton jump-diffusion models used in stock valuation and options pricing. It incorporates stochastic volatility and jumps in asset prices to more accurately reflect real market behavior.

1. Key Features of the Bates Model

1.Stochastic Volatility – Unlike the standard Black-Scholes model, which assumes constant volatility, the Bates Model allows volatility to change over time based on a stochastic process.

2.Jump-Diffusion Process – The model includes sudden, large jumps in asset prices, which makes it more realistic since markets often experience unexpected shocks.

3.Mean Reversion in Volatility – Volatility tends to revert to a long-term average, making the model more practical for real-world applications.

2. Why Use the Bates Model?

•It improves on the **Heston Model** (which only includes stochastic volatility) by incorporating jumps.

•It helps in pricing **options** more accurately, especially for assets that experience sudden price shocks (e.g., during earnings announcements or macroeconomic events).

•It is widely used in **financial engineering** and **quantitative finance** for risk management and derivative pricing.

3. Intuition Behind the Model

- The **Heston component** ensures that volatility is stochastic and mean-reverting.
- The **jump component** captures sudden large price movements that standard diffusion models cannot.
- The **correlation ρ\rhoρ** allows us to model the relationship between asset price movements and volatility.

4. Why Is the Bates Model Useful?

- It captures **volatility clustering** (high-volatility periods tend to persist).
- It accounts for **market crashes** (large, unpredictable jumps in prices).
- It is more accurate than Black-Scholes for **option pricing**, especially for assets with frequent jumps (e.g., tech stocks, cryptocurrencies).

II. The Multi-Stage Model

is a stock valuation approach that extends the **Dividend Discount Model (DDM)** or **Discounted Cash Flow (DCF) Model** to handle companies that experience different growth phases over time.

1. Concept of the Multi-Stage Model

Many companies do not grow at a constant rate forever. Instead, they typically go through different growth phases:

- **High Growth Phase** – Rapid expansion with high earnings growth.
- **Transition Phase** – Growth slows as the company matures.
- **Stable Phase** – Growth stabilizes at a long-term rate.

The **Multi-Stage Model** adjusts for these different phases by applying different growth rates in each stage.

2. Types of Multi-Stage Models

There are several variations, depending on how growth changes over time:

a) Two-Stage Model

•Used for companies with an initial high-growth phase followed by a stable growth phase.

- Example Formula (for dividend-paying stocks):

$$P_0 = \sum_{t=1}^{n} \frac{D_t}{(1+r)^t} + \frac{P_n}{(1+r)^n}$$

Where:

- P_0 = Current stock price
- D_t = Expected dividend in year t
- r = Discount rate (cost of equity)
- P_n = Terminal value (value at the end of high-growth phase)

b) Three-Stage Model

•Adds an additional transition phase between high growth and stable growth.

•More realistic for companies with a gradual decline in growth.

c) H-Model (Variant of Two-Stage)

•Assumes a **linear decline** in growth from a high initial rate to a stable rate over time.

- Formula:

$$P_0 = \frac{D_0(1+g_L)}{r-g_L} + \frac{D_0 H(g_H - g_L)}{r-g_L}$$

Where:

- g_H = Initial high growth rate
- g_L = Long-term stable growth rate
- H = Half-life of the transition period

3. Application of the Multi-Stage Model

- **Startups & Tech Companies** – High early growth, then stabilization.
- **Mature Firms with Temporary Growth Boosts** – e.g., a company launching a breakthrough product.
- **Cyclical Industries** – Companies that go through repeated expansion and contraction phases.

4. Why is This Model Useful?

•It is **more realistic** than the Gordon Growth Model because it considers different growth phases.

•Helps value **high-growth** companies that will eventually mature.

•Used in **equity research, investment banking, and portfolio management**.

III. Holt’s Linear Trend Model

Holt’s Model is an **extension of exponential smoothing** that helps predict trends by considering:

1.Level (Base value) – The estimated current value of a stock metric (e.g., revenue or earnings).

2.Trend (Growth rate over time) – The rate at which the value is expected to change.

The model updates estimates dynamically using **smoothing factors** to adjust for recent trends.

1. Mathematical Formulation:

$$L_t = \alpha X_t + (1 - \alpha)(L_{t-1} + T_{t-1})$$

$$T_t = \beta(L_t - L_{t-1}) + (1 - \beta)T_{t-1}$$

$$Forecast: F_{t+h} = L_t + hT_t$$

Where:

- L_t = Level estimate at time t
- T_t = Trend estimate at time t
- α = Smoothing parameter for level ($0 < \alpha < 1$)
- β = Smoothing parameter for trend ($0 < \beta < 1$)
- X_t = Actual observed value at time t
- h = Forecast horizon

2. How is Holt’s Model Used in Stock Valuation?

While Holt’s Model is mainly for time series forecasting, it can indirectly support stock valuation by predicting key financial metrics:

a) Forecasting Dividends for DDM

•If a company's dividends follow a trend, Holt’s Model can estimate future dividend payments, which can then be used in a **Dividend Discount Model (DDM)** for valuation.

b) Forecasting Earnings for DCF Valuation

•The **Discounted Cash Flow (DCF) Model** requires future free cash flows (FCFs).

•Holt's Model helps predict **future earnings growth**, which influences cash flows and ultimately stock valuation.

c) Predicting Revenue Growth in Relative Valuation

•Holt's Model can project revenue trends, useful for valuation multiples like **Price-to-Sales (P/S)** or **EV/Revenue** comparisons.

3. Why Use Holt’s Model in Stock Valuation?

✓ **Better for trend-based forecasts** than simple moving averages.
✓ **Adapts to recent changes** in revenue, earnings, or dividends.
✓ **Useful for growth-stage companies** where trends matter more than past averages.

However, it **does not account for sudden jumps or market shocks**, so it’s often used alongside other models.

IV. Whitbeck & Kisor Model for Stock Valuation

The **Whitbeck & Kisor Model** is an **earnings-based stock valuation model** that relates a company's **price-to-earnings (P/E) ratio** to factors such as **growth rate, dividend payout, and risk**. It is particularly useful for estimating a stock's fair value based on fundamental financial characteristics.

1. Formula of the Whitbeck & Kisor Model

The model expresses the **P/E ratio** as a function of:

- **Earnings growth rate (g)**
- **Dividend payout ratio (D/E)**
- **Risk (measured by bond yield or market conditions)**

$$P/E = a + b_1(g) + b_2(D/E) + b_3(R)$$

Where:

- P/E = Price-to-Earnings ratio
- g = Expected earnings growth rate
- D/E = Dividend payout ratio (Dividends per share / Earnings per share)
- R = Interest rate (e.g., government bond yield) representing market risk
- a, b_1, b_2, b_3 = Empirical constants estimated through regression analysis

2. Interpretation of the Model

- **Higher growth rate (g) → Higher P/E ratio**
  - Stocks with higher expected earnings growth command higher valuation multiples.
- **Higher dividend payout (D/E) → Higher P/E ratio**
  - Investors value stable dividend-paying stocks more, increasing their P/E.
- **Higher risk (R) → Lower P/E ratio**
  - Rising interest rates make stocks less attractive, reducing P/E ratios.

3. How is This Model Used in Stock Valuation?

The model helps investors:

✅ **Compare stocks** based on their growth and dividend policies
✅ **Estimate fair P/E ratios** given market conditions.
✅ **Understand macroeconomic impacts** (e.g., how rising interest rates affect valuations).

Stock Valuation Using the Model

Once we estimate a reasonable **P/E ratio** using the model, we can calculate a stock's **intrinsic value**:

$$P = (P/E) \times E$$

Where:

- P = Estimated stock price
- E = Expected earnings per share (EPS)

4. Strengths & Limitations of the Model

✓ Strengths:

- Simple and intuitive for investors.
- Accounts for growth, dividends, and macroeconomic conditions.
- Helps compare companies with different payout policies.

⚠ Limitations:

- Requires accurate estimates of g, D/E, and R.
- Ignores short-term market sentiment or behavioral factors.
- Based on historical data, so it may not predict sudden changes well.

Conclusion

The **Whitbeck & Kisor Model** is a **practical tool** for estimating a stock's P/E ratio based on fundamentals. It is useful for long-term valuation but should be used alongside other models (DCF, CAPM, etc.) for a complete analysis.