Analysis Plan for Brent Oil Price Change Point Analysis

1. Data Preparation

   - Load Brent oil price data (May 20, 1987 to Nov 14, 2022)
   - Convert date format from '20-May-87' to datetime
   - Confirm no missing values in dataset
   - Sort data chronologically by date

2. Exploratory Data Analysis (EDA)

   - Visualize price trends over 35-year period
   - Calculate descriptive statistics (mean: $48.42, std: $32.86)
   - Analyze distribution of prices (range: $9.10 to $143.95)
   - Compute yearly averages to identify long-term trends
   - Prepare log returns for volatility analysis and stationarity testing

3. Event Research & Compilation

   - Identify 10-15 key geopolitical and economic events (1987-2022)
   - Research OPEC decisions, conflicts, economic crises, and policy changes
   - Create structured CSV with event dates, descriptions, and impact types
   - Cross-reference events with observed price movements

4. Bayesian Change Point Modeling

   - Implement change point detection using PyMC
   - Define model with switch point (tau) as discrete uniform prior
   - Specify before/after mean parameters (μ_1, μ_2)
   - Configure likelihood using normal distribution
   - Run MCMC sampling (2,000 samples, 1,000 tuning)
   - Validate convergence using r_hat values and trace plots

5. Change Point Interpretation & Event Association

   - Extract posterior distribution of change points
   - Identify high-certainty change points (sharp posterior peaks)
   - Compare detected change dates with researched events
   - Quantify price impacts: average shifts and percentage changes
   - Formulate causal hypotheses for significant associations

6. Dashboard Development

   - Build Flask API endpoints for price data, events, and change points
   - Create React frontend with interactive price timeline
   - Implement event highlighting and date range filtering

- Design responsive visualizations for desktop and mobile
- Include volatility indicators and impact metrics

7. Reporting & Communication

- Compile findings in Medium-style blog post or PDF report
- Visualize change points with posterior distributions
- Present quantified impact statements for key events
- Document limitations and assumptions
- Propose future analysis extensions

Initial Observations from EDA

1. Data Range: May 20, 1987 to November 14, 2022

2. Price Range: Minimum $9.10, Maximum $143.95, Mean $48.42

3. Data Quality: 9,011 daily records with zero missing values

4. Distribution: Right-skewed with multiple price regimes visible

5. Yearly Trends:

  - Stable prices ($15-$25) through early 2000s

  - Sharp increase to $100+ peak around 2008

  - Volatile period 2011-2014 with prices $100-$120

  - Major drop in 2014-2015 to $30-$50 range

  - COVID-19 crash to ~$20 in 2020 followed by recovery

6. Next Steps:

  - Calculate log returns for stationarity testing

  - Identify exact dates of major price shifts visible in plot

  - Research specific events corresponding to 2008, 2014, 2020 price movements