ADS 506 — Week 5 Submission: Storytelling with Shiny

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Part I — Links and Description (required)

- **Deployed Shiny App URL:** https://...
- **Code URL:** (choose one)
  - GitHub repository: https://github.com/MtnDoob/506_Week5_Dang_DuyAnh/tree/main
  - or posit.cloud project (ensure instructor access): https://posit.cloud/...

App Description: *This interactive Shiny application provides comprehensive time series forecasting for Australian wine sales data spanning from 1980 to 1994. The app enables users to analyze historical sales patterns across six wine categories (Fortified, Red, Rose, Sparkling, Sweet White, and Dry White) and generate forecasts using three sophisticated statistical models. Users can customize training periods, compare model performance, and visualize predictions with confidence intervals through an intuitive interface.*

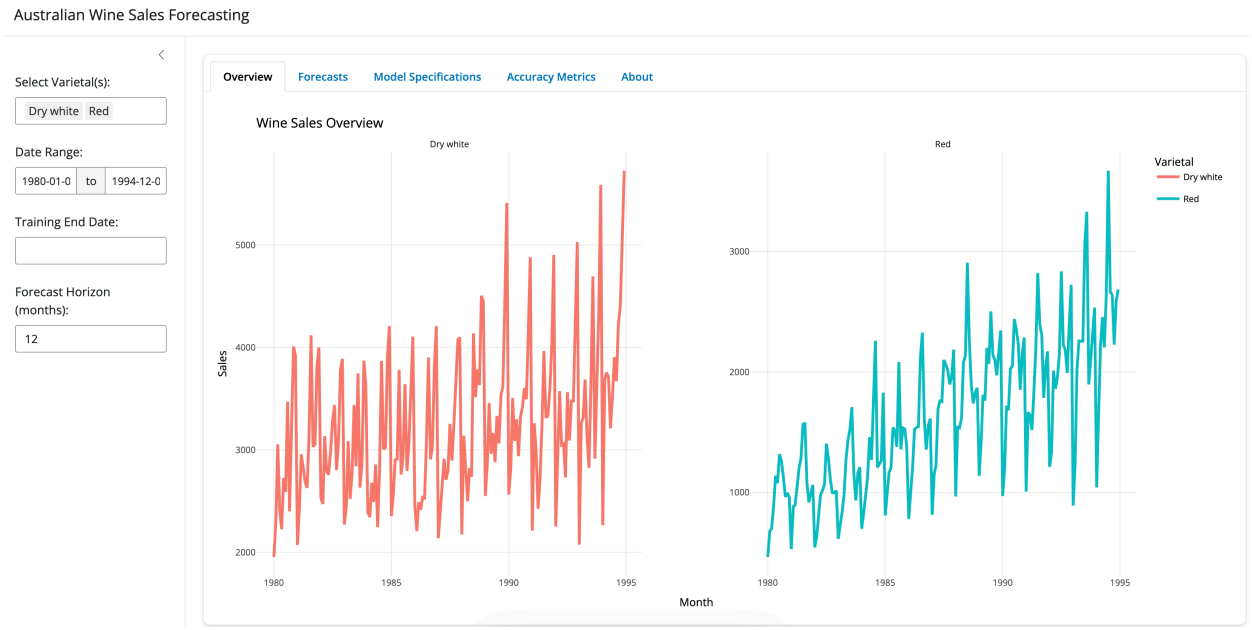
App Features:

- *Interactive Data Exploration* - Select multiple wine varietals and customize date ranges to focus on specific time periods and wine types of interest
- *Flexible Train/Test Splits* - Define custom training end dates to evaluate model performance on held-out validation data
- *Multiple Forecasting Models* - Automatically fits and compares three models: TSLM (trend and seasonal regression), ETS (exponential smoothing), and ARIMA (autoregressive integrated moving average)
- *Dynamic Forecast Visualization* - Interactive Plotly charts display historical data, forecasts with prediction intervals, and clear train/validation boundaries
- *Model Performance Metrics* - Comprehensive accuracy tables showing RMSE, MAE, and MAPE for both training and validation periods across all models
- *Detailed Model Specifications* - View the automatically selected parameters for each model (ETS states, ARIMA orders, seasonal components)
- *Adjustable Forecast Horizon* - Generate forecasts for 1-24 months ahead to support short and medium-term planning

Part II — Data Story (2 pages total)

Red wine sales exhibit substantially higher growth and volatility compared to Dry white wine over the 1980-1994 period, with Red wine showing a 95% increase in average sales levels and wider seasonal fluctuations. This divergence suggests fundamentally different demand patterns that require distinct forecasting approaches—ETS models capture Red wine's multiplicative seasonality more effectively, while TSLM performs comparably for the steadier Dry white variety. Understanding these differences is critical for inventory planning and production allocation decisions.

Red wine sales nearly doubled from 1980 to 1994 with widening seasonal swings characteristic of multiplicative seasonality, while Dry white wine remained stable with consistent additive seasonal patterns. These contrasting dynamics require different forecasting approaches—ETS models for Red wine's proportional seasonality versus TSLM for Dry white's stable patterns—with critical implications for capacity planning and inventory management in the Australian wine industry.



Reproduction: App URL = ; Varietals = [Dry white, Red]; Date Range = 1980-01-01 to 1994-12-01; Training End = 1991-12-01

The overview reveals fundamental differences between these varietals. Dry white wine maintained stable sales (2,500-5,000 units) with consistent seasonal amplitude throughout the 14-year period, indicating market maturity and additive seasonality likely tied to summer consumption peaks. In contrast, Red wine climbed from approximately 1,500 to over 3,000 units—a 100% increase—with seasonal swings that widened proportionally. This pattern is characteristic of multiplicative seasonality, where percentage fluctuations remain constant but absolute swings grow as the trend level rises. These patterns drive strategic decisions across four domains. First, model selection must be varietal-specific: Red wine requires exponential smoothing (ETS) to capture proportional seasonal effects, while Dry white's additive pattern suits simpler linear trend methods (TSLM). Second, capacity planning should prioritize Red wine production investment and vineyard expansion, while Dry white has reached market saturation and should focus on efficiency optimization. Third, inventory management for Red wine needs dynamic safety stock that scales with demand—buffers adequate in 1985 are insufficient by 1994—whereas Dry white can maintain static policies. Finally, Red wine's sustained growth signals shifting consumer preferences that warrant investigation to inform strategy for other varietals. The training split at December 1991 positions us to rigorously test whether models can predict the accelerating growth and volatility observed in the final three years.
