

# **Business, Economic and Financial Data — Exam A (Applied Analysis)**

4 questions — 1 hour total time

## **1) Model assumptions and diagnostics**

List three assumptions of linear regression and explain their importance.

Describe two diagnostic checks in R to verify them (plots or statistical tests).

Suggest a correction method if heteroskedasticity or autocorrelation is found.

## **2) Exponential smoothing for forecasting**

Write the recursive formula for simple exponential smoothing and explain  $\alpha$ 's role.

How would you extend this model to include trend and seasonality?

What metric or approach can be used to select  $\alpha$  in practice?

## **3) Regression splines and GAM interpretation**

Explain differences between regression splines and GAMs in flexibility and interpretability.

Interpret the following R output for edf and F-stat values.

Term	edf	Ref.df	F	p-value	
s(price)	3.8	4.0	12.6	<0.001	
s(advertising)	1.0	1.0	5.1	0.024	

## **4) Tree-based methods and ARIMA modeling**

Compare Bagging and Boosting for regression trees.

Give one real-world financial case where Boosting outperforms a single tree.

Explain how an ARIMA(1,1,1) model differs from a simple random walk.

# **Business, Economic and Financial Data — Exam B (Forecasting & Nonlinearity)**

4 questions — 1 hour total time

## **1) Forecast accuracy metrics**

Define MAE, RMSE, and MAPE and discuss their interpretation.

Which metric would you prefer for business sales forecasts and why?

## **2) Time series decomposition**

Explain the components of a time series (trend, seasonality, residual).

How does STL decomposition in R handle non-constant seasonality?

## **3) Nonlinear growth models**

Describe the Bass diffusion model and interpret parameters p and q.

How does the Generalized Bass Model extend it (shock or external effect)?

Discuss a real economic situation suitable for this model.

## **4) Gradient Boosting in practice**

Explain learning rate, number of trees, and overfitting control in Gradient Boosting.

Describe a situation where Boosting performs poorly and how to improve it.

# **Business, Economic and Financial Data — Exam C (Data-Driven Modelling)**

4 questions — 1 hour total time

## **1) Moving beyond linearity**

Why might a linear model fail to capture business or financial data relationships?

Give two alternative model types suitable for nonlinear patterns.

## **2) Local regression and smoothing**

Explain how LOESS works and its key parameter (span).

What is the tradeoff when choosing a smaller or larger span?

## **3) Model comparison and evaluation**

How would you compare two competing predictive models in R?

Discuss the difference between in-sample and out-of-sample performance.

## **4) ARIMA vs Exponential Smoothing**

List two key conceptual differences between ARIMA and Exponential Smoothing methods.

Which would you prefer for short-term vs long-term business forecasting and why?