## **Model Selection**

### **Model Selection Using Backward Elimination and Forward Selection**

I use the dataset FE-GWP1\_model\_selection\_2.csv to select the best regression model for Y using Z1, Z2, Z3, Z4, and Z5, employing backward elimination (adjusted R-squared) and forward selection (AIC/BIC).

To identify the best regression model for Y based on the predictors Z1, Z2, Z3, Z4, and Z5​, I employed two model selection techniques:

1. Backward Elimination (Using Adjusted R-squared)
2. Forward Selection (Using AIC and BIC Criteria)

These approaches were chosen for their ability to balance model fit and complexity. Below is a step-by-step explanation of each method and the results obtained.

### **Full Model Results (All Predictors)**

The full model is specified as:Y = α + β1Z1 + β2Z2 + β3Z3 + β4Z4 + β5Z5 + ε

The summary of the full model results is as follows:

| **Variable** | **Coefficient** | **p-value** | **Significant?** |
| --- | --- | --- | --- |
| Z1 | **0.4487** | **0.000** | **Yes** |
| Z2 | **0.2987** | **0.000** | **Yes** |
| Z3 | **–0.4065** | **0.000** | **Yes** |
| Z4 | **1.0082** | **0.000** | **Yes** |
| Z5 | **0.2572** | **0.000** | **Yes** |

* Adjusted R-squared: 0.994
* AIC: –165.9
* BIC: –150.3

This model fits the data exceptionally well, with an adjusted R2 of 0.994 indicating strong explanatory power. Furthermore, all predictors are statistically significant, and the AIC and BIC values suggest the model is parsimonious.

### **Backward Elimination (Adjusted** R-squared**)**

We iteratively removed predictors based on their statistical significance and the impact on the adjusted R-squared. This process resulted in the following reduced model:

## Y = α + β2Z2 + β3Z3 + β4Z4 + β5Z5 + ε

| **Variable** | **Coefficient** | **p-value** |
| --- | --- | --- |
| **Z2​** | **0.2772** | **0.000** |
| **Z3** | **–0.3984** | **0.000** |
| **Z4** | **1.0089** | **0.000** |
| **Z5** | **0.2646** | **0.000** |

* Adjusted R-squared: 0.990

Although the adjusted R-squared of the reduced model is slightly lower than that of the full model, it still retains excellent explanatory power. This suggests that Z1 adds relatively little to the overall predictive ability of the model, allowing for a more parsimonious specification.

### **Forward Selection (AIC and BIC Criteria)**

Using forward selection based on the AIC and BIC criteria, the same full model was selected as the best:  
 Y=α+β1Z1+β2Z2+β3Z3+β4Z4+β5Z5+ϵ

* AIC: –165.9
* BIC: –150.3

Both criteria favor the full model over any reduced specification. This result aligns with the backward elimination findings, confirming that all predictors contribute meaningfully to the model's explanatory power (James et al. , 2021).

### **Conclusion**

The application of both backward elimination (adjusted R-squared) and forward selection (AIC and BIC criteria) yielded consistent results. The full model is optimal and is specified as:  
 Y=α+β1Z1+β2Z2+β3Z3+β4Z4+β5Z5+ϵ

This model is statistically robust, as evidenced by the following:

* All coefficients are highly significant (p<0.001).
* Adjusted R-squared: 0.994, indicating exceptional explanatory power.
* AIC and BIC values confirm model parsimony.

The combination of backward elimination and forward selection provides a rigorous framework for identifying the best predictive model (James et al. , 2021). Both approaches emphasize the importance of balancing model complexity with explanatory power, ensuring the final model is both interpretable and robust.