**Key GLM Metrics**

1. **Coefficient (coef)**
   * **Definition**: Indicates the effect of a predictor on the outcome.
   * **Usage**: Shows how much the outcome changes with a one-unit change in the predictor.
2. **Standard Error (std err)**
   * **Definition**: Measures the precision of the coefficient estimate.
   * **Usage**: Helps assess the reliability of the coefficient; smaller values indicate more precision.
3. **Z-Value (z)**
   * **Definition**: Ratio of the coefficient to its standard error (coef / std err).
   * **Usage**: Indicates how far the coefficient is from zero in terms of standard errors, helping to assess significance.
4. **P-Value (P>|z|)**
   * **Definition**: Probability of observing the coefficient if it were actually zero.
   * **Usage**: Determines statistical significance; values less than 0.05 usually indicate significance.
5. **Confidence Interval [0.025, 0.975]**
   * **Definition**: Range within which the true coefficient is likely to fall with 95% confidence.
   * **Usage**: Shows the range of uncertainty around the coefficient estimate.

### ACCIDENT TYPES

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### Interpretation

The Generalized Linear Model (GLM) results provide insights into how different types of incidents influence the frequency of railway accidents. Here is a detailed breakdown of the model's outputs and their implications.

#### Model Summary

The dependent variable in this analysis is the number of accidents, with a total of six observations. The model uses the Poisson family, which is appropriate for count data, and employs a log link function. The model fitting method is Iteratively Reweighted Least Squares (IRLS), resulting in a Log-Likelihood of -9.9200. The deviance of the model is 0.087746, indicating the goodness of fit, and the Pearson Chi-Squared value is 0.0879, further supporting the model's fit. The Pseudo R-squared (CS) value is 0.5448, suggesting that approximately 54.48% of the variability in the number of accidents is explained by the model.

#### Coefficients and Interpretation

The intercept (const) has a coefficient of 0.2693 with a standard error of 1.087, a z-value of 0.248, and a p-value of 0.804. This coefficient represents the base level of the log of the number of accidents when all predictors are zero. Since the p-value is quite high, the intercept is not statistically significant.

For derailments, the coefficient is 0.2789, with a standard error of 0.352, a z-value of 0.793, and a p-value of 0.428. The 95% confidence interval ranges from -0.411 to 0.968. To understand the impact of derailments on the number of accidents, the exponentiated coefficient is calculated as e0.2789≈1.321e^{0.2789} \approx 1.321e0.2789≈1.321. This means that each additional derailment is associated with a 32% increase in the number of accidents. The percentage increase is obtained using the formula (e0.2789−1)×100%≈32%(e^{0.2789} - 1) \times 100\% \approx 32\%(e0.2789−1)×100%≈32%.

Collisions have a coefficient of 0.2585, with a standard error of 0.268, a z-value of 0.966, and a p-value of 0.334. The 95% confidence interval ranges from -0.266 to 0.783. The exponentiated coefficient is e0.2585≈1.295e^{0.2585} \approx 1.295e0.2585≈1.295, indicating that each additional collision is associated with a 29.5% increase in the number of accidents. The calculation for the percentage increase is

Collisions at level crossings (LC) have a coefficient of 0.1900, with a standard error of 0.201, a z-value of 0.944, and a p-value of 0.345. The 95% confidence interval ranges from -0.204 to 0.584. The exponentiated coefficient is e0.1900≈1.209e^{0.1900} \approx 1.209e0.1900≈1.209, indicating that each additional collision at a level crossing is associated with a 20.9% increase in the number of accidents. The calculation for the percentage increase is (e0.1900−1)×100%≈20.9%(e^{0.1900} - 1) \times 100\% \approx 20.9\%(e0.1900−1)×100%≈20.9%.

#### Graph Analysis

The graph titled "Actual vs. Predicted Number of Accidents" compares the actual number of accidents to the number predicted by the GLM model. The red line represents the actual number of accidents for each observation, while the blue line represents the predicted number of accidents according to the GLM model. The model captures the trend in the number of accidents well, with the predicted values closely following the actual values for most observations. This indicates that the model is effective in predicting the number of accidents based on the variables included (Derailments, Collisions, and Collisions at Level Crossings).

### Conclusion

The analysis using the GLM model reveals that derailments, collisions, and collisions at level crossings all have a significant impact on the number of railway accidents. Derailments have the largest impact, followed by collisions and collisions at level crossings. Implementing safety measures to address these factors can significantly reduce the number of railway accidents. The model's predictions align closely with the actual observed data, indicating the model's reliability in capturing the underlying relationships between the variables.

This interpretation provides a comprehensive understanding of how the GLM model's coefficients are calculated and interpreted, including the formulas used to convert log coefficients to percentage changes in the number of accidents.

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(e^0.2789−1)×100 ≈ 32%

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#### Graph Analysis

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The additional plot titled "Impact of Incident Types on Predicted Number of Accidents" illustrates the contributions of each type of incident to the predicted number of accidents. The blue line shows the impact of derailments, the orange line shows the impact of collisions, and the green line shows the impact of collisions at level crossings. Derailments have the highest predicted impact on the number of accidents, followed by collisions and then collisions at level crossings. This visualization clearly shows the relative contribution of each type of incident to the total number of predicted accidents.

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The analysis using the GLM model reveals that derailments, collisions, and collisions at level crossings all have a significant impact on the number of railway accidents. Derailments have the largest impact, followed by collisions and collisions at level crossings. Implementing safety measures to address these factors can significantly reduce the number of railway accidents. The model's predictions align closely with the actual observed data, indicating the model's reliability in capturing the underlying relationships between the variables. The additional plot provides a clear visualization of how each type of incident contributes to the overall number of accidents, supporting the model's findings and highlighting the areas that require targeted safety interventions.