

Friday Quiz 4 Solutions - STAT 324

Here are **model solutions and rubrics** for your three open-ended questions — aligned with your STAT 324 objectives and ready for grading in Canvas:

Q8 – Interpreting Coefficients Post-Transformation

Model Answer (Full Credit – 3/3):

The slope of 0.004 means that for every 1-unit increase in RPM, the \log of the vibration intensity increases by 0.004. This tells us that as motor speed increases, the vibration intensity increases on a logarithmic scale, not directly in original units. The intercept of -0.75 indicates the predicted \log of vibration when RPM is 0, but this value is not meaningful in context since $\text{RPM} = 0$ is outside the realistic operating range **Rubric:**

Component	Points
Correct interpretation of slope (multiplicative change per RPM)	1
Clear back-transformation from \log to original scale	1
Reasonable interpretation of intercept with acknowledgment of extrapolation	1

Q9 – Prediction at 1500 RPM

Model Answer (Full Credit – 3/3):

We are given the model: $\log(\text{vibration}) = -0.75 + 0.004 \times \text{RPM}$

Substituting $\text{RPM} = 1500$: $\log(\text{vibration}) = -0.75 + 0.004 \times 1500 = -0.75 + 6 = \mathbf{5.25}$

Now back-transform to the original scale: vibration = $10^{5.25}$ **177827.94 m/s²**

So, a machine running at 1500 RPM is predicted to have a vibration intensity of about **177,828 m/s²**.

Rubric:

Component	Points
Correct substitution and linear calculation of log (y)	1
Correct back-transformation using exponentiation	1
Final answer with units and context	1

Q10 – Interpreting the Impact of WLS

Model Answer (Full Credit – 3/3):

1. **Why WLS was needed:** The residual vs. fitted plot showed a fan shape, suggesting increasing variance of residuals — a violation of the constant variance (homoscedasticity) assumption. WLS was used to give less weight to points with higher residual variance.
2. **Effect on estimation:** WLS minimizes the **weighted** sum of squared residuals instead of treating all points equally. This adjusts the regression line to better fit the **more reliable points**, reducing the influence of high-variance observations.
3. **Impact on assumptions:** WLS helps correct heteroscedasticity. After applying WLS, the residual spread appeared more uniform across fitted values, making assumption checks more valid and improving inference accuracy.

Rubric:

Component	Points
Clear explanation of why OLS failed and WLS was needed	1
Accurate description of how WLS adjusts the fitting process	1
Discussion of improved assumption checks or plot improvements	1

Let me know if you want to export this to CSV or JSON for Canvas import!