Okay, here's a graduate-level response explaining the difference between robustness and resistance, along with examples, as if I were taking an exam:

\*\*Response:\*\*

Robustness and resistance are both desirable properties in statistical methods, especially when dealing with data that may contain outliers or deviations from the assumed model. However, they describe distinct behaviors in the face of such data anomalies.

\* \*\*Robustness\*\* refers to a method's ability to perform \*reasonably well\* even when the underlying assumptions of the model are violated. This "reasonable" performance usually means that the method's estimates (e.g., parameter estimates, predictions) are still fairly accurate and the inferences (e.g., hypothesis tests, confidence intervals) are still approximately valid, \*even when the data deviates somewhat\* from the ideal conditions (e.g., normality, homoscedasticity). Robustness is often assessed by simulation studies, where the performance of a method is evaluated under various departures from the assumptions.

\* \*\*Resistance\*\*, on the other hand, describes a method's capacity to \*completely withstand\* the influence of individual outliers. A resistant method is largely unaffected by the presence of a few extreme observations. This means that the estimates and inferences obtained from the method will not be drastically altered if a small number of data points are changed to very different values. The extreme values might be outliers, errors, or even a few miscoded values.

\*\*Examples from Studied Methods:\*\*

1. \*\*Example of Robustness: The t-test with non-normal data\*\*

\* The \*\*t-test\*\* for comparing means is a good example of a method that is robust. While the t-test relies on the assumption that the data is normally distributed, it is generally \*robust\* to violations of normality, especially when the sample size is large. When the data is moderately non-normal (e.g., slightly skewed), the t-test still provides approximately valid results (e.g., type I error rates and confidence intervals) because of the central limit theorem. However, the t-test is not resistant, since outliers can impact the sample mean, which can then influence the t-statistic.

2. \*\*Example of Resistance: The Median\*\*

\* The \*\*median\*\* is a classic example of a \*resistant\* statistic. Unlike the sample mean, which is heavily influenced by outliers, the median is determined by the ordering of the data. Changing the value of a single observation, even to an extreme value, will not change the median as long as the data set remains in the same order. For example, in the data set {1, 2, 3, 4, 5}, the median is 3. If we replace 5 with 500, the median remains 3. This illustrates its resistance to extreme values.

\*\*In Summary:\*\*

Robustness focuses on maintaining reasonable performance even when the assumptions are approximately, though not perfectly, met. Resistance focuses on not being affected by individual outliers. Many methods exhibit one or both of these properties. For example, the Wilcoxon test (a non-parametric alternative to the t-test) is both robust and resistant. However, a robust method is not necessarily resistant. Furthermore, the trade-offs of using robust and resistant methods must be considered, since they may not provide as efficient estimators when the assumptions are met.