The 15k Nordic race is a challenging endurance event that tests athletes' cross-country skiing skills. In this worksheet, we will examine performance data from the previous four Winter Olympic Games (2010, 2014, 2018, and 2022) to investigate the belief that Scandinavians excel in this sport.

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1. What variables do you think would be useful in assessing the performance of athletes in the 15k Nordic race? Indicate the type of variable and units.

Method 1: Times

1. A picture containing screenshot, diagram, text, line

   Description automatically generatedGiven the side-by-side boxplot below, what are some observations that can be made about Nordic 15k finish times across the different years?
2. Given your findings above, what are some possible reasons for these observations?
3. What are the limitations of using time as a measure of performance across years?

Method 2: Ranks

1. What are some advantages of using rank to assess performance instead of time?
2. Given the table below, what are some observations that can be made about ranks between Scandinavian Nordic skiers across the different year compared to the rest of the racers?

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1. \*\*Question that seeds doubt into rank\*\*\*
2. What are some drawbacks of using Rank as a measure of performance?

Method 3: Standardizng Time by Year

Section 2: Standardizing Performance using Time

1. Introduce the concept of standardizing time to make fair comparisons across different years.

2. Ask leading questions to guide students toward the idea of utilizing z-scores based on time.

3. Discuss how z-scores help to measure performance relative to the mean and standard deviation of each year's data.

Section 3: Analyzing Performance using Standardized Time (Z-Scores)

1. Calculate the z-scores for each athlete's time in the 15k Nordic race for every Olympic year.

2. Present a side-by-side boxplot displaying the distribution of z-scores for each year.

3. Ask students to interpret the boxplot and discuss any patterns or trends observed.

4. How does using z-scores address the issue of comparing performance across different years?

Section 4: Comparing Performance using Z-Scores

1. Explain the rationale behind using z-scores to compare performance across different years.

2. Formulate the null and alternative hypotheses for a two-sample t-test based on z-scores.

3. Conduct a two-sample t-test using the z-scores and calculate the p-value.

4. Interpret the results of the two-sample t-test and determine if there is a significant difference in performance between athletes from different regions.

5. What does the p-value indicate in the context of the two-sample t-test?

Section 5: Overall Thoughts and Conclusions

1. Evaluate whether the results support or challenge the belief of Scandinavian dominance in the 15k Nordic race.

2. What are some possible reasons for the observed performance differences across different regions?