CASE STUDY

# Enhancing a Race Car's Performance

## KEY FACTS

### ORGANIZATIONS

NASA

Old Dominion University

Florida State University

### QUALITY CHALLENGE

Improve the performance of NASCAR Winston Cup race cars

### PRODUCTS USED

Minitab® Statistical Software

### RESULTS

- Significant factors and interactions identified
- Aerodynamic performance of the race car improved by experiment results

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Through a partnership between NASA, Old Dominion University and Florida State University, students in a response surface methodology (RSM) course set out to improve the performance of NASCAR Winston Cup race cars. Race car teams often use ad-hoc approaches to set up experiments, which cost time and money and may not even yield useful results. Many organizations rely on design of experiments (DOE)—a powerful tool that efficiently supports simultaneous analysis of multiple factors—to improve the quality of their products. The RSM class created a DOE and used Minitab Statistical Software to find factor settings that optimize the results.

## Challenge

Four factors were identified that could affect a race car's aerodynamic efficiency: front and rear car height, yaw angle (the angle the car center line makes with air stream) and radiator grille coverage. The class needed to design an experiment using these factors, run the experiment using the ODU Langley Full-Scale Wind Tunnel at Langley Air Force Base, and analyze the results to determine which factor settings minimize the front coefficient of lift, the upward force due to the flow of air over the car.

## How Minitab Helped

Minitab technical trainer Scott Kowalski, who consulted on the project, and professors Drew Landman and James Simpson, devised a solution using a split-plot design to manage the hard-to-change factors—front and rear car height—and shorten the experimentation time from 24 to nine hours. Using Minitab's DOE and General Linear Model tools, the class conducted their analysis.

## Results

The team successfully identified the significant factors and interactions that affect the race car's aerodynamic performance. By utilizing a split-plot design and Minitab, they determined that the best performance is achieved when the rear height is set at its highest level and the grille is completely covered.