SPACEWALK TRAINING

Background

The Neutral Buoyancy Laboratory (NBL) is a 202 ft (62 m) long, 102 ft (31 m) wide and 40 ft (12 m) deep pool located inside the NASA Sonny Carter Training Facility in Houston, Texas. The NBL allows astronauts to train for spacewalks in an environment resembling microgravity (weightlessness). Due to the size of the NBL, two different training activities can be performed at either end of the pool simultaneously. The NBL is large enough to hold full-sized mockups of the space shuttle cargo bay, flight payloads (like the Hubble telescope) and the International Space Station (ISS). Astronauts wear pressurized Extra-vehicular Mobility Unit (EMU) suits, which weigh approximately 280 lbs (127 kg) while training in the NBL. They are assisted by at least four professional scuba divers wearing regulation scuba gear. For every hour the astronaut plans to spend on a spacewalk, the team will spend seven hours training in the water. On a training day at the NBL, astronauts normally spend up to six consecutive hours in the pool. The scuba divers, however, are limited to five hours of dive time per day and this time is broken into at least two different dives.

Figure 1: Neutral Buoyancy Lab (NBL) located in the Sonny Carter Training Facility in Houston, TX

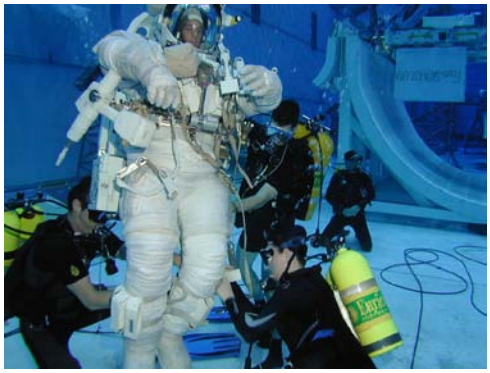

Figure 2: An astronaut trains in the NBL and is assisted by professional scuba divers.

Neutral buoyancy is the term used to describe an object that has an equal tendency to float as it does to sink. In water, items can be made neutrally buoyant using a combination of weights and flotation devices. In such a state, even a heavy object can be easily manipulated, as is the case in the microgravity of space. However, there are two important differences between neutral buoyancy as achieved in the NBL and the weightlessness of space. First, suited astronauts training in the NBL are not truly weightless. While the suit/astronaut combination is neutrally buoyant, the astronauts feel their weight while in the suit. The second is that water drag hinders motion, making some tasks easier to perform in the NBL than in microgravity and other tasks more difficult. While these differences are recognized by spacewalk trainers and astronauts, neutral buoyancy is currently the best method available for astronauts to train for spacewalks.

Problem

On the TI-Nspire™ handheld, open the document, *Spacewalk_Training*, read through the problem set-up (pages 1.1-1.3) and then complete the questions embedded within the document.

A. Follow the instructions on TI-Nspire pages 1.4-1.6 to plot the gauged pressure experienced by scuba divers (psi) vs. the water depth (ft). Determine the correct mathematical model to fit the data and give statistical evidence to support your decision by answering the related embedded questions found in the TI-Nspire document.

Embedded Questions:

1.8 Interpret the slope and *y*-intercept in the context of the problem.

1.9 Determine the correlation coefficient and interpret its value.

1.12 The plotted data shows what type of association between depth and pressure?

1.13 Describe the association based on the residuals of the graph.

1.14 Is a linear model appropriate for the plotted data? Explain in statistical terms.

B. Follow the instructions on TI-Nspire pages 2.1-2.3 to plot the gauged pressure experienced by astronauts (psi) vs. the water depth (ft). Determine the correct mathematical model to fit the data and give statistical evidence to support your decision by answering the related embedded questions found in the TI-Nspire document.

Embedded Questions:

2.5 Determine the correlation coefficient and interpret its value.

2.7 The plotted data shows what type of association between the depth and the water pressure?

2.8 Describe the association based on the residuals of the graph.

2.9 Is a linear model appropriate for the plotted data? Explain in statistical terms.

C. Follow the instructions on TI-Nspire pages 3.1-3.3 to create a plot showing both sets of response variables on the same axis. Then answer the related embedded questions found in the TI-Nspire document.

Embedded Questions:

3.5 What transformation value changes the value of the pressure felt by astronauts and scuba divers? Explain how you determined that value.

3.6 What do you notice about both sets of data? What accounts for the difference between the graph of the astronauts' data and the graph of the scuba divers' data?

3.7 Predict the pressure experienced by an astronaut in the NBL at a depth of 45 feet.