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Research Base

Teachers of mathematics have the dual challenge of managing the varying dynamics of their diverse classrooms as well as increasing student achievement across a wide range of mathematical concepts and skills. In the various mathematical subject areas, the TI-Nspire can be an important tool that teachers introduce to their students in order to meet these challenges. With proper use, handhelds can meet the needs of all students by promoting higher levels of thinking, increasing student performance in mathematics, and allowing access to mathematical exploration, experimentation, and enhancement of mathematical concepts (Waits and Pomerantz 1997). Graphing calculators were first introduced in 1986 by Casio and started a dynamic change in the way that mathematics was taught and learned (Waits and Demana 1998). As these tools improved and as researchers studied their effectiveness in mathematical instruction, well-known mathematical organizations, such as the National Council of Teachers of Mathematics (NCTM), have recommended that appropriate types of calculators be used in mathematics instruction from kindergarten through college (NCTM 2000).

The TI-Nspire is the next step in handheld technology. It dynamically links spreadsheets, graphing environments, geometry settings, and symbolic expressions, allowing students to take meaningful actions on mathematical objects and immediately see the consequences of those actions (Burrill 2008). Students can study the relationships between the graph of a function, the equation of the function, and a table of values interactively on the same screen. They can also manipulate circles, triangles, and quadrilaterals, automatically transfer measurements to a coordinate grid and a spreadsheet, and then investigate the geometric properties algebraically. The handheld includes many features that allow students to learn and use accurate mathematical expressions. TI-Nspire technology allows more effective linking of key mathematical expressions, allowing students to grasp mathematical concepts more readily with deeper understanding (SRI International 2006).

However, this tool will not achieve the lofty goals that educators have for student success all by itself. It is not enough to simply provide students with technology. Teachers need access to research-based effective strategies that they can employ for comprehensive mathematics instruction using the technology (NCTM 2003).

TI-Nspire Strategies: Algebra offers the necessary foundation for teachers to translate the use of the TI-Nspire into actual student comprehension of mathematical concepts, as well as the ability to perform mathematical skills. With the lessons provided in this book, teachers are given valuable techniques for integrating the TI-Nspire into their instruction. *TI-Nspire Strategies: Algebra* directs teacher instruction in maximizing student use of the handhelds while processing and learning geometrical concepts.

The lessons in this book are designed to give new and veteran teachers the best strategies to employ. How well students understand mathematics, their abilities to use it to work out problems, and their confidence and positive attitudes toward mathematics are all shaped by the quality of the teaching they encounter in school (NCTM 2005). Teachers no longer

Research Base (cont.)

have to construct well-planned handheld lessons unaided. Besides lesson descriptions and materials lists, this book offers step-by-step instructions for four key instructional phases: Starting the Lesson, Explaining the Concept, Applying the Concept, and Extending the Concept. Each element has an easily-identified title heading.

TI-Nspire Strategies: Algebra lessons move students from the concrete understanding of mathematical concepts through the abstract comprehension level, to real-life application, while at the same time allowing students to develop skill in the use of the handheld. For teaching to be effective in a mathematics classroom, it is necessary to provide focused instruction that moves the student from the concrete, to the abstract, to the application of the concept (Marzano 2003). The TI-Nspire technology can build on conceptual understanding by allowing students to dynamically interact with numerous representations of concepts and experiences in a way that is not possible with paper and pencil alone. As a result of this technology, teachers are able to engage students more effectively by addressing different learning styles and developing understanding that leads to higher-level thinking.

In the Starting the Lesson section, students are reminded of important button-pushing sequences on the handheld that they will use throughout the lessons. In the Explaining the Concept activities, students move toward abstract understanding. The lessons offer guidance in directing the students to practice using handhelds and improving their skill levels. The Applying the Concept and Extending the Concept sections bring the students to real-life applications and further practice. As students move through each phase of learning, they are exposed to a concept or skill numerous times.

Per research, students should have multiple experiences with topics, allowing them to integrate the topics into their knowledge base (Marzano 2003). Overall, the challenging and interesting tasks found in application problems help teachers engage students in learning as they actively apply their knowledge (Seely 2004). As a result, students take ownership of new strategies and gain greater understanding of the ideas and concepts. Through the lesson extension ideas and the activity sheets, the students gain ample opportunities to practice. This is important because students need to have extra time to process concepts and look at problems in different ways (Sutton and Krueger 2002).

Many teachers dread handheld use because of the classroom management issue; however, with proper use, handhelds allow teachers to spend more time developing mathematical understanding, reasoning, number sense, and application (Waits and Pomerantz 1997). Therefore, these lessons help teachers respond to that concern by including an introduction with easy-to-follow tips for differentiating the lessons, grouping students, managing the handhelds in the classroom, planning the integration of these lessons with standards-based curriculum, and using the handhelds in activity centers. The skills reinforced throughout *TI-Nspire Strategies: Algebra* teach multiple representations of mathematical concepts so that students thrive in the mathematics classroom.

One-Variable Statistics

Mathematics Objectives

- Students will use box plots to analyze data and compare data sets.
- Students will investigate measures of central tendencies and their uses.

Applications and Skills

Lists and Spreadsheets
Using formulas to define lists

Data and Statistics
Box Plots
Dot Plots
Adjusting Window Settings

Calculator
Finding mean, median, minimum, and maximum of a list

Materials

- Heights of class members measured in feet and inches (See note below.)
- TI-Nspire handhelds
- TNS file: lesson01.tns
- *Measuring Up* (page 37; page037.pdf)
- *Gigantic!* (pages 38–39; page038.pdf)
- *That's Tall* (page 40; page040.pdf)

Note: The students' heights can be measured manually or with the CBR2 and a TI-84 using the Easy Data APP with events with entry. If the CBR2 is used, the lists can then be copied and pasted into the Lesson 1 TNS file.

Starting the Lesson

After loading the TNS file (lesson01.tns) on each handheld, begin the exercise by instructing students to do the following:

1. Turn on the TI-Nspire by pressing (off on).
2. Press (home) and choose **My Documents**.
3. In the folder *Algebra TCM*, choose *lesson01*.
4. Remind students how to navigate through the TNS file. To move forward through the pages, press (ctrl) ▶. To move backward through the pages, press (ctrl) ◀. To choose a particular page, press (ctrl) ▲, position the cursor on the desired page and press (enter). To undo previous steps, press (ctrl) (Z) or (ctrl) (esc). Show students that any time they are using a menu that they wish to exit, they should press (esc).

Note: *Page numbers refer to the TI-Nspire file lesson01.*

Explaining the Concept

Problem 1—Measuring Up

Step 1 Distribute copies of *Measuring Up* (page 37) to students so they can record their findings as appropriate during the instructional steps of this problem.

Step 2 If you did not enter the heights into the TNS file, show students how to enter the data into each cell on page 1.2 by clicking in it, typing in the numbers, and pressing enter or ·. Students can also move from cell to cell by using the arrows on the NavPad.

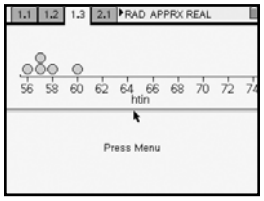
Step 3 Discuss changing feet and inches into a measurement using only inches. Have students write the formula for the conversion. Show them column C on page 1.2 by using the NavPad to move to it until it is highlighted. Then press enter or ·. To enter the formula, highlight the box beneath the list name (*htin*) and press enter or ·. Type in the formula. Press enter when done to populate the data. The variable in the formula must be the name of a previous name list. It can be typed in or recalled by pressing the sto→var key.

Step 4 In question 2a, the students will need to split page 1.3. Before doing this, students can change the window settings in the dot plot by pressing menu, choosing **Window/Zoom**, and then **Window Settings**. To split the page, press ctrl ⌂. Choose **Page Layout**, **Select Layout**, and then **Layout 3**. The top part is a dot plot of the list *htin*. Move to the bottom part of the page by pressing ctrl tab. Press menu and choose **Add Calculator**.

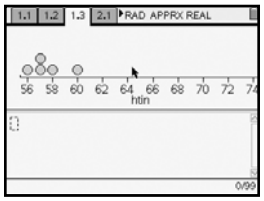
Step 5 Using the handheld, show students how to find the mean by typing *mean(htin)* on the bottom of the page and pressing enter. Point out that they can also type *mean(* and press sto→var, choose *htin* from the list, type the closing parenthesis, and then press enter. Similarly, find the median by typing *median(htin)*, the maximum by typing *max(htin)*, and the minimum by typing *min(htin)*. Point out that these commands are also available by pressing menu and choosing **Statistics** and then **List Math**.

Step 6 Discuss that mean, median, and mode are three different measures of central tendency.

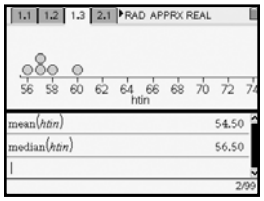
Step 4



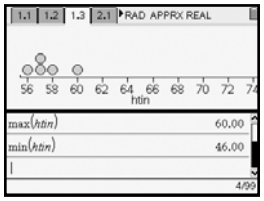
Step 4



Step 5



Step 5



One-Variable Statistics *(cont.)*

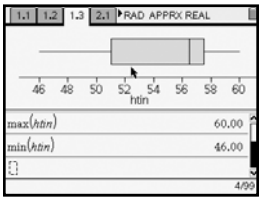
Note: *Page numbers refer to the TI-Nspire file lesson01.*

Explaining the Concept *(cont.)*

Problem 1—Measuring Up *(cont.)*

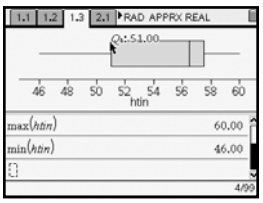
Step 7 Change the dot plot to a box plot. To move back to the top of the page, press (ctrl) (tab). Press (menu) and choose **Plot Type** and then **Box Plot**. Looking at the box plot helps to determine which measure of central tendency is the best representative of the data as a whole. If the data is fairly evenly distributed on either side, the median may be the best. If the extremes are not too far from the median, the mean may be the best. The mode is useful mainly when some kind of preference or vote is being observed. Ask the students which one they think best describes their class.

Step 7



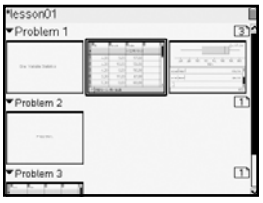
Step 8 For question 3a, change the graph to include or exclude the outliers by pressing (menu) and choosing **Plot Properties**. The choices of **Show Box Plot Outliers** and **Extend Box Plot Whiskers** switch back and forth, depending on the status of the current graph. Your class data may or may not have outliers. One will be added in the next problem. Have students use the NavPad to trace the graph.

Step 7



Step 9 If the students have difficulty visualizing the meaning of the box plot, line them up and create a human box plot. This might also help them decide which measure of central tendency best describes the class.

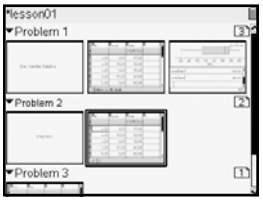
Step 2



Problem 2—Gigantic!

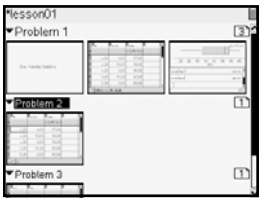
Step 1 Distribute copies of *Gigantic!* (pages 38–39) to students so they can record their findings as appropriate during the instructional steps of this problem.

Step 2



Step 2 In question 2, students create their own pages. Instruct them to press (ctrl) ▲ to access the page sorter. Next, move to page 1.2 in the page sorter and press (ctrl) (C) to copy the page. Then, have students move to page 2.1 in the sorter and paste in their copies of page 1.2 by pressing (ctrl) (V).

Step 3



Step 3 They can now remove the blank page in problem 2. Use the NavPad to move to the blank page and press (clear) to remove it. Then, press (doc) to open the new page 2.1.

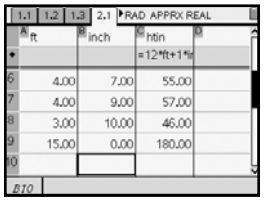
Note: *Page numbers refer to the TI-Nspire file lesson01.*

Explaining the Concept *(cont.)*

Problem 2—Gigantic! *(cont.)*

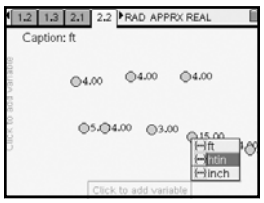
Step 4 To enter the new height for questions 2 and 3 into the lists, use the NavPad to move to the first empty cell at the bottom of the *ft* list. Type *15* and then press (enter). An error message will occur. Click **OK**. Move to the cell next to the 15 and type *0*. Press (enter). The error will automatically be corrected. The new height in inches will appear in row C.

Step 4



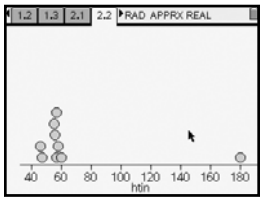
Step 5 Insert a new page by pressing (ctrl) (I). Choose **Add Data & Statistics**. Use the NavPad to move the cursor to the bottom of the page. Click on the *x*-axis to add *htin* as the variable. Be sure to show students how to adjust the window settings so that all the data is visible. To do this, press (menu), choose **Window/Zoom**, and adjust the window settings to the appropriate dimensions.

Step 5



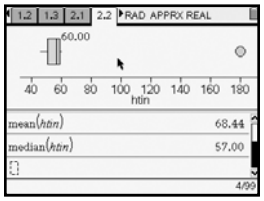
Step 6 For question 5, discuss the difference between an object being the middle measurement, the median, and the average measurement or the mean. (See Steps 4 and 5 on page 33 for more detailed instructions.)

Step 5



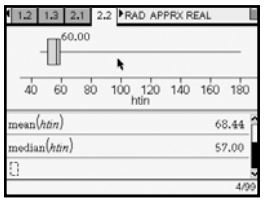
Step 7 For question 6, change the graph to a box plot. Remind students how to use the Expand Box Plot Whiskers option. (See Steps 7 and 8 on page 34 for more detailed instructions.)

Step 7



Step 8 In question 7, emphasize the concept of outliers by inventing a situation where the income of 30 mechanics and one big-name movie star or athlete is analyzed. Think about the mean and the median of this group. Look at a box plot with and without the box plot whiskers extended.

Step 7



Applying the Concept

Problem 3—That's Tall

Step 1 Distribute copies of *That's Tall* (page 40) to students so they can record their findings.

One-Variable Statistics *(cont.)*

Note: *Page numbers refer to the TI-Nspire file lesson01.*

Applying the Concept *(cont.)*

Problem 3—That's Tall *(cont.)*

Step 2 The data is included on page 3.1. These were the actual heights from the preseason rosters of the Cleveland Cavaliers (cc) and the Los Angeles Lakers (la) in 2007.

Step 3 For question 2, have students insert a new Data and Statistics page by pressing ctrl I. Click on the *x*-axis to add *cc* as the variable. Now have students split the screen by pressing ctrl ⌂. Choose **Page Layout** then **Select Layout**. To split the page horizontally, choose **Layout 3**. Remind students to press ctrl tab to move back to the new section. Press menu and choose **Data & Statistics**. This time have students add the variable *la*.

Step 4 To switch the dot plots to box plots for question 3, have students press menu and choose **Plot Type** and then **Box Plot**.

Differentiation

- **Below Grade Level**—Work through question 1 on *That's Tall* (page 40) with students. Once the chart has been successfully completed, have students work in pairs to complete the remaining questions.
- **Above Grade Level**—Have students complete *That's Tall* (page 40) independently. Then have students pair up. Instruct students to study the sports section of the local newspaper or to find statistics of local sports teams using the Internet. Have the pairs create a dot plot or a box plot using the statistics for one of the local sports teams. Have each pair share their plot and explain the reasoning behind it with another pair of students.

Extending the Concept

- Have students analyze box plots they find in the media.
- Have students find and discuss misleading graphs in the media.
- Ask students to identify outliers in day-to-day statistics.

Name _____

Measuring Up

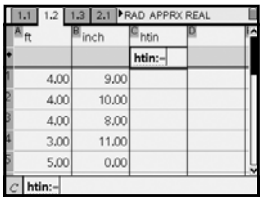
Directions: Follow the steps below. The page numbers refer to the TI-Nspire document *lesson01*.

1. If your teacher has given you the heights of the members of your class, enter them into lists *ft* and *inch* on page 1.2. If the data was already included, proceed to question 1a.

a. Write a formula using the variables *inch* and *ft* that would describe each student's height (*htin*) expressed in inches (*inch*). Enter this formula into the *htin* list.

_____

Step 1



2. On page 1.3, split the page horizontally.

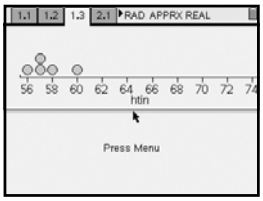
a. Use the Calculator application to find the mean, median, maximum, and minimum of *htin*. Are the mean and median values nearly the same?

_____

b. Look at the graph to identify the mode and the extreme values of your data.

_____

Step 2



3. Return to the top of page 1.3. Make a box plot of the data in *htin*. Use the Extend Box Plot Whiskers option. Use the NavPad to trace your graph to find the extremes, the median, and the Q1 and Q3 scores.

a. Imagine that you have lined up the class from shortest to tallest. Which class members would be included in the low whisker? Which class members would be included in the high whisker?

_____

b. Which class members would be included in the left-hand side of the box? Which class members would be included in the right-hand side of the box?

_____