Automating the Creation of Healthy Eating Index Scores
Using Unedited Output from the Nutrition Data System for Research

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Healthy Eating Index-2005 (HEI)

- Measure of diet quality produced by the United States Department of Agriculture (USDA)\(^1\)
- Measures adherence to current USDA dietary recommendations for food groups and nutrients
- The sum of 12 recommendation-specific component (food groups and nutrients) scores
- Component scores range in maximum value from 5 to 20 and sum to a range of 0 to 100
- Each component score is calculated as a ratio of adherence relative to a measure of total intake
  - Step 1: Determine intake of the individual component and of total intake
  - Step 2: Calculate the ratio of component intake relative to total intake
  - Step 3: Interpolate this standardized measure of adherence to obtain a score

As a part of a research study, Sam is asked by a dietician to recall all of the foods she ate in the past 24 hours and their amounts:

**Step 1:**
Sam ate .5 apple (.4 cups) and no other fruit
Sam ate a total of 1,800 kcal (1.8*1000 kcal)

**Step 2:**
Sam’s Whole Fruit Ratio:

\[
\frac{.4 \text{ cups}}{1.8 \text{ kcal}} = 0.22
\]

**Step 3:**
Minimum HEI Score is 0 at a Ratio of 0
Maximum HEI Score is 5 at a Ratio of 0.4
Sam’s Whole Fruit Score:

\[
5 \times \left( \frac{0.22}{0.4} \right) = \frac{5 \times 0.55}{0.5} = 2.75
\]

Nutrition Data System for Research (NDSR):

- Extensively used dietary analysis program designed for 24-hour recalls and food records\(^2\)
- Calculates extensive nutrient data based on reported food intakes (type and amount)
- Outputs this specific information into 3 files with thousands of variables

Limitations to Calculating HEI Scores with NDSR Output

- Some component intakes are not reported by NDSR directly (Ex: solid fats and oils are grouped)
- NDSR data is spread across multiple files and levels (variables at both the day and food levels)
- NDSR variables use different units than HEI and some interpolations require complex algebra
- Overcoming these limitations is possible and previously described\(^3\) but extremely labor intensive

Statistical Issues Involved in the Calculation of HEI Scores

- If multiple records exist for an individual, component scores can be calculated using either the ratio of the mean records or the mean of the ratios for each record\(^4\)
- When multiple records exist per individual, it is possible to estimate study-specific HEI reliability
Automated Program:
- We created a SAS program to automate the process of calculating HEI scores using unedited NDSR output
- The program was divided across two files to increase usability
- The first file (Setup.sas) is meant to be opened and edited by the user and allows the user to indicate where the NDSR output is located and their preferences regarding HEI calculations
- The second file (Program.sas) contains the code to calculate the HEI scores based on the user specified information and does not need to be edited or even opened by the user
- Using these programs simply requires following a series of basic steps which can be divided into 3 parts
  - Step 1: Users prepare the environment for Setup.sas by creating 3 new folders on their computer and saving the programs and 3 specific NDSR output files to 2 of these 3 folders.
  - Step 2: Users modify and run Setup.sas by specifying the location of the folders created in the previous step, the names of the NDSR output files, and HEI calculation and output options.
  - Step 3: Users open the newly created files containing the HEI data and examine other results
- Ratio of mean values are plotted against mean of ratios values to reveal differences in these estimates
- The MIXED procedure is used to estimate the variation between and within individuals in the NDSR output
- These estimates are used to calculate the number of records needed to obtain 90% reliability and graphed

Example output:

Key References:

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Instructions for Using the Setup.sas Program to Create Healthy Eating Index (HEI) Scores and Component Sub-Scores Using Nutrition Data System for Research (NDSR) Output

These instructions summarize the process of downloading and using the program to calculate HEI scores and component sub-scores for individuals with diet records generated in NDSR. This program allows the user to request specific HEI data and to have that data saved in specified files. When individuals have more than 3 record, this program also produces summary statistics describing the reliability of individual estimates and comparing two different methods for estimating the means (mean of ratios vs. ratio of means). Instructions are divided into 3 parts. Part 1 (1a – 1c) describes how to prepare the environment for Setup.sas. Part 2 (2a – 2c) describes how to modify and run Setup.sas. Part 3 (3a, 3b) describes where to find the HEI data and other results.

1a. Create 3 new folders to store the downloaded program files and needed NDSR output and to save the created HEI data:

1b. Save Setup.sas and Program.sas into the newly created program folder:

Once the program is published and a final location specified, this box will contain instructions for downloading and saving the Setup.sas and Program.sas.

1c. Export** NDSR records and save 3 specific output files into the newly created “NDSR Output” folder:

<table>
<thead>
<tr>
<th>File Level</th>
<th>Output File Name*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Components/Ingredients File (Food)</td>
<td>PA_01.txt</td>
</tr>
<tr>
<td>Intake Properties File (Day)</td>
<td>PA_04.txt</td>
</tr>
<tr>
<td>Serving Count File (Day)</td>
<td>PA_09.txt</td>
</tr>
</tbody>
</table>

* The default file name in the zip output is the PA (Project Abbreviation) followed by a number.
† Before exporting from NDSR, make sure the headers options is turned on. Otherwise, the variable headers must be manually added.

2a. Open Setup.sas in SAS. This is the only file that actually needs to be brought into SAS, modified, and finally submitted:

2b. Modify the Setup.sas file to indicate the location and file names of the NDSR output, the location of Program.sas, and the desired output by specifying location, file types, and file names:

3a. Locate the created files that contain the HEI data saved in the newly created “HEI Data” folder and with the names indicated:

3b. Examine the results in the SAS output and graphics windows which include descriptions of the distribution of HEI scores and component sub-score as well as other statistical information: