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Manual for ESUM-RG: Excel VBA Macros for Comparing Multiple Equating Procedures under the Random Groups Design[1]

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ESUM-RG (Equating SUMmary for the Random Groups design) is an open source VBA enabled Excel workbook that reads in output produced by *Equating Recipes* (Brennan, Wang, Kim, & Seol, 2009), and then organizes the output into worksheets that facilitate selecting an equating method for operational use.

Throughout ESUM-RG and this manual, Form X refers to a new form administered to a new group and Form Y an old form administered to an old group.

1 Introduction

The main purpose of ESUM-RG is to facilitate selection of an appropriate equating method. ESUM-RG allows a user to view equating results from five different perspectives:

- conversion tables;
- moments and moment differences (relative to scores on Form Y);
- color (e.g., many-to-one conversions and gaps in rounded equated scale scores);
- relative frequency distributions of rounded equated scale scores; and
- a wide selection of graphs.

Moreover, ESUM-RG permits the user to adjust the raw-to-rounded-equated-scale-scores that result from any particular equating method. This capability should be used cautiously, but in realistic contexts, policy constraints and practical issues occasionally require this type of flexibility.

Any single ESUM-RG workbook is for scores on a single form of a test. For example, if there are three scores (say, Reading, Writing, and Math) for any form, and two forms are equated to a base or anchor form, then there should be six ESUM-RG workbooks. Further, for ESUM-RG, the data collection design must be the random groups design, as discussed by Kolen and Brennan (2014).[1]

The ESUM-RG macros code and this ESUM-RG manual are freely available on `www.education.uiowa.edu/casma`, which is the website for the Center for Advanced Studies in Measurement and Assessment (CASMA) at the University of Iowa. Typical copyright rules apply. The VBA code is available under the open-source license conditions discussed in Section 4.

In this manual,

[1]For the common-item nonequivalent groups design, ESUM can be used (see Brennan & Chien, 2011).

- worksheet names are in italics,
- filenames and add-ins are in typewriter style (e.g., `filename`), and
- occasionally, variable names are in typewriter style.

An ESUM-RG workbook contains seven worksheets: *Input*, *Presmoothing*, *Equating*, *RSS-FDs*, *Final*, *Charts*, and *Misc*, as well as their matching tabs.

2 Downloading ESUM-RG and Associated Files

An ESUM-RG workbook can be downloaded from

`www.education.uiowa.edu/centers/casma/computer-programs`

The folder that contains ESUM-RG also contains this manual, a file named `ER-RG.c`, a sample set of control cards and associated data, and a description of how to use `ER-RG.c`, in conjunction with *Equating Recipes*, to generate the input files for ESUM-RG. All files are open source.

The basic steps in obtaining the input files for ESUM-RG are:

- create a control card file for *Equating Recipes* — here we call that file `cc.txt`;
- replace any existing `main()` function in *Equating Recipes* with the `ER-RG.c` file;
- compile and execute *Equating Recipes*, which will produce a window requesting the name of the control card file; and
- type `cc.txt` followed by the enter key.

The distributed versions of `ER-RG.c` and the control cards generate the results for the example in Kolen and Brennan (2014, chaps. 2-3). The C code for `ER-RG.c` is heavily commented, which should help users modify it for their own equating situation.

3 Worksheets, Layouts, and Add-ins

An ESUM-RG workbook has seven worksheets, which are briefly described below. Note that worksheets are initially empty before files are loaded.

- *Input* provides information such as form identifier, number of items, lowest and highest possible rounded scale scores, etc.

- *Presmoothing* provides log-linear presmoothed results for Y (scores on old form) and X (scores on new form) as well as equating results for a selected set of smoothing degrees for Y and X.
- *Equating* is the central and most extensive worksheet. It provides equated raw scores, equated scale scores, and rounded equated scale scores for 17 equating methods, along with the capability of adjusting rounded equated scale scores for any selected method.
- *RSS-FDs* provides relative frequency distributions for rounded equated scale scores for all 17 methods.
- *Final* provides final conversion tables (based on a user's selected equating method) for raw scores, equated scale scores, and rounded equated scale scores.
- *Charts* provides space where charts are organized and displayed; charts are generated using add-in buttons for the *Equating* worksheet.
- *Misc* contains miscellaneous calculations that are used to create some of the charts in the *Equating* worksheet.

Each worksheet, except the *Misc* worksheet, has a matching tab as displayed in Figure 1.

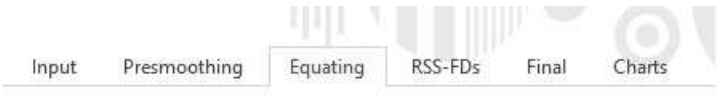

Figure 1: Tab Names

ESUM-RG performs relatively few computations. Rather, most computations are performed by *Equating Recipes* (using the `ER-RG.c` file) and stored in files that provide the input to ESUM-RG. The primary purposes of ESUM-RG are to (a) read the input files, (b) organize the equating results in useful and intuitive ways, and (c) produce graphs that facilitate understanding the equating results. Producing graphs and implementing certain other functionalities are accomplished primarily through the use of add-in buttons, the code for which is contained in VBA macros distributed with ESUM-RG.

ESUM-RG users have access to all the functionality of Excel, including the use of typical menu items to create graphs. Most of the graphs created using ESUM-RG add-ins, however, are not quickly and easily obtained using standard Excel menu items.

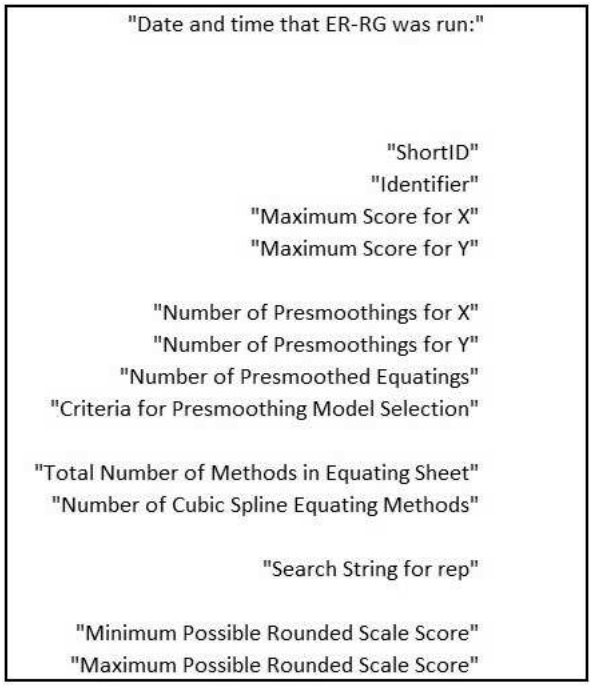

Figure 2: *Input* Worksheet Layout

3.1 *Input* Worksheet

3.1.1 Layout

The *Input* worksheet provides basic information about a test form as well as about equating and scaling. Basic information about a test form includes a short ID for a test and an identifier that is specific to a test form. Information about equating and scaling includes maximum raw scores for X and Y and a range for possible rounded scale scores. This information changes as a different test/form is considered for equating.

However, there are items giving the same information regardless of which test/form is considered for equating. The number of presmoothings for Y and X is fixed at eight, because smoothing degrees are fixed at 2, 3, 4, 5, 6, 7, 8, and 9 when running *Equating Recipes* using the `ER-RG.c` file. Also, the number of equating methods using presmoothing is fixed at nine, which is discussed in detail in the Section 3.2.1.

The `ER-RG.c` file uses eight different smoothing values (i.e., S = 0.01, 0.05, 0.10, 0.20, 0.30, 0.50, 0.75, and 1.00) for cubic spline postsmoothing; therefore, the number of cubic spline equating methods is fixed at eight. The

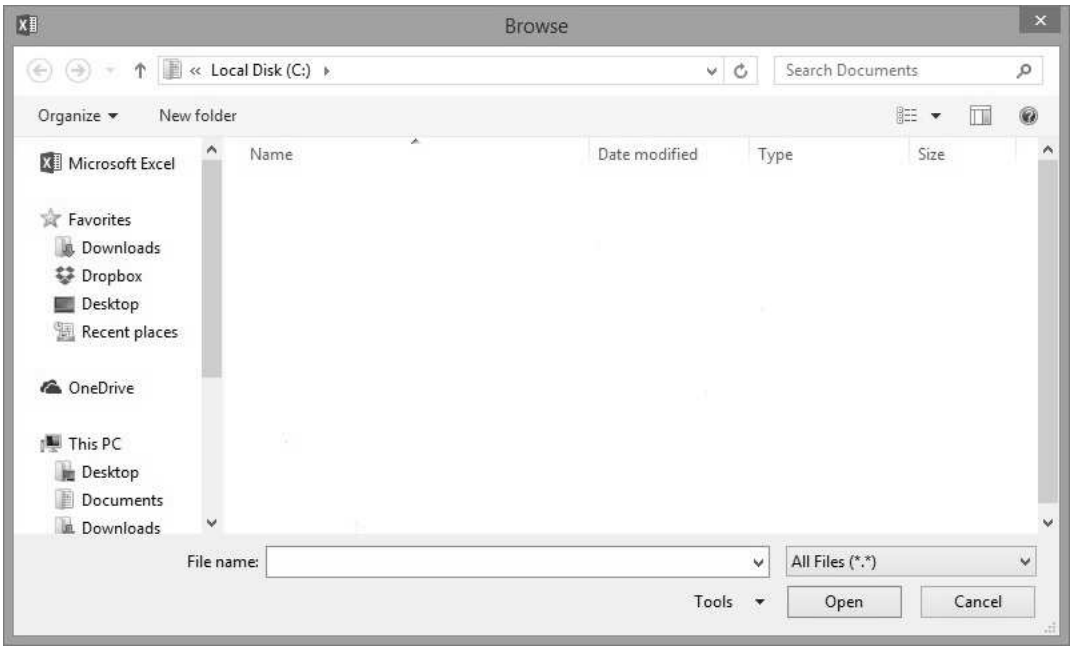

Figure 3: Load Files

total number of methods in the *Equating* worksheet is also fixed at 17, which is explained in detail in Section 3.3.1.

"Search String for rep" is a "place holder" for the name of a presmoothing equating procedure that can be selected by the user. The initial name will be 'rep-C##*' where '##' refers to a combination of the optimum presmoothing degrees selected based on a model-selection criterion. A detailed explanation is provided in the section for the `Choose Presmoothing Parameters` add-in (See Section 3.2.2).

3.1.2 Add-ins

The Input tab includes two add-in buttons: `Clear Contents` and `Load Files`.

a. `Clear Contents`

The `Clear Contents` add-in clears all content and charts in all worksheets. Its principal use is to start all over, if some serious inadvertent mistake is made.

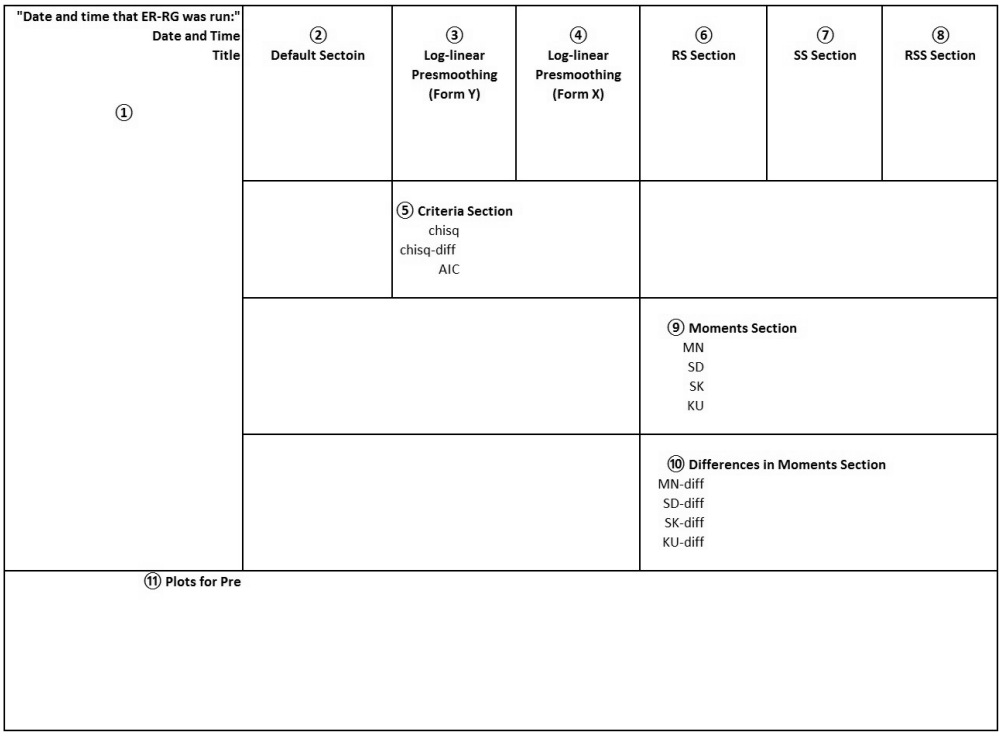

Figure 4: *Presmoothing* Worksheet Layout

b. `Load Files`

The `Load Files` add-in loads four different files that are output from running *Equating Recipes*, as discussed in Section 2. When `Load Files` is used, a browsing window appears (see Figure 3). Using the browser window, the user locates the folder that contains the four input files generated by *Equating Recipes*; then, the user selects the `Input.txt` file, which causes `Input.txt` to be loaded into the *Input* worksheet. Additionally, `Presmoothing.txt` is automatically loaded into the *Presmoothing worksheet*, `Equating.txt` into the *Equating* worksheet, and `RSS-FDs.txt` into the *RSS-FDs* worksheet.

3.2 *Presmoothing* Worksheet

3.2.1 Layout

The *Presmoothing* worksheet consists of eleven sections. The first section provides the test name and a list of times including when *Equating Recipes* was executed and the time(s) when ESUM-RG was closed. The second section (i.e., Default section) presents: the old form conversion table; the frequency distribution, and relative frequency distribution for both Form Y and Form

X; and equating results and standard errors for the unsmoothed equipercentile equating method. This section of columns (section ② in Figure 4) is also repeated in the *Equating* and *Final* worksheets.

The third and fourth sections present log-linear presmoothing results for both Form Y and Form X, respectively. Each section provides log-linear presmoothing results for eight different smoothing parameters from 2 to 9; the optimum degree selected based on the model-selection criterion is marked with *. A user should specify a criterion in the control card, `cc.txt`, prior to running *Equating Recipes* using `ER-RG.c`. There are two options for a model-selection criterion; chi-square difference and Akaike Information Criterion (AIC). Statistics for model-selection criteria can be found in the fifth section. Although a user can consider only one criterion at a time, the fifth section provides statistics for both the chi-square difference and Akaike Information Criterion (AIC) both of which provide a basis for selecting optimum presmoothing degrees for Y and X [2].

The sixth to eighth sections provide equating results in terms of raw scores (RS), scale scores (SS), and rounded scale scores (RSS), respectively, for up to nine presmoothed equating methods. Those nine presmoothed equating methods consist of combinations of presmoothing degrees for Y and X that are in the range of ± 1 of the optimum degrees. For example, suppose 6 and 7 are selected for the optimum log-linear presmoothing degrees for Y and X, respectively. Then, the nine equating results include combinations of three presmoothing degrees (i.e., 5, 6, and 7) for Y and three presmoothing degrees (i.e., 6, 7, and 8) for X. The ninth and tenth sections present results for fitted moments. In the ninth section (i.e., Moments), the fitted moments for all equating procedures are presented for all equating score types. The tenth section (i.e., Differences in Moments) presents the differences between the observed moments for Form Y and the fitted moments for the presmoothed equating procedures.

The eleventh section presents charts for the fitted relative frequency distributions based on log-linear presmoothing as well as the unsmoothed relative frequency values.

3.2.2 Add-ins

The *Presmoothing* worksheet includes two add-in buttons: `Plots for Pre` and `Choose Presmoothing Parameters`.

[2] Although chi-square statistics are not used for selecting the optimum degrees for presmoothing, they are provided so that the user can verify chi-square difference statistics.

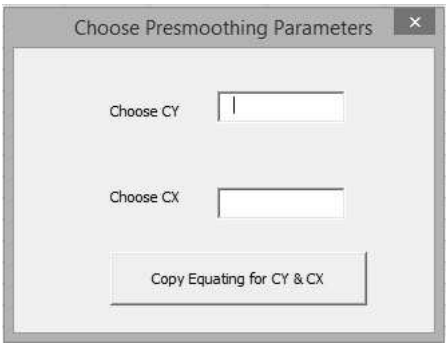

Figure 5: `Choosing Presmoothing Parameters`

a. `Plots for Pre`

The `Plots for Pre` add-in creates charts for the fitted relative frequency distributions based on log-linear presmoothing; each chart contains the unsmoothed values, as well. For each Form Y and Form X, charts are created for presmoothing degrees of 2–9, for a total of sixteen charts.

Note that these charts are automatically created when files are loaded. When `Plots for Pre` is selected, all charts for presmoothed fitted relative frequency distributions are deleted and a new set of sixteen charts is recreated. This functionality is provided to remedy the mistake of inadvertently deleting a chart of interest.

b. `Choose Presmoothing Parameters`

When *Equating Recipes* is executed using the `cc.txt` file, a criterion specified in one of the control cards is used to select the "optimum" degrees of presmoothing for Y and X, equipercentile equating is performed using these degrees of smoothing, and the resulting equating is reported in the *Equating* worksheet. As mentioned previously, there are two options for a model-selection criterion: chi-square difference and Akaike Information Criterion (AIC). In addition to this equating result for the optimum degrees of presmoothing, which is obtained automatically, the user can select his or her own desired result, as discussed next.

When the `Choose Presmoothing Parameters` add-in is used, a user form appears (see Figure 5) that can be used to select the desired degrees of presmoothing, CY and CX, for equating. In the *Equating* and *RSS-FDs* worksheets, ESUM-RG searches for the columns with the heading identified as "Search String for rep" in the *Input* worksheet. Then, ESUM-RG replaces results in these columns with equating results for the user-selected

combination of CY and CX, and the heading is changed to 'user-CCYCX'. Additionally, "Search String for rep" in the *Input* worksheet is now replaced with 'user-CCYCX'.

Note that user-selected degrees of presmoothing should be in the region of the criterion-based result, in the sense discussed next. Suppose 6 and 7 are selected for the optimum presmoothing degrees for Y and X, respectively, based on the criterion. When the `Choose Presmoothing Parameters` add-in is used, the user can select one of 5, 6, and 7 for CY and one of 6, 7, and 8 for CX. If a user selects 5 and 8 for CY and CX, respectively, results for 'rep-C67*' are replaced with results for 'user-C58' in the *Equating* and *RSS-FDs* worksheets. "Search String for rep" in the *Input* worksheet is also changed to 'user-C58'. If 5 and 5 were selected for CY and CX, respectively, ESUM-RG does not perform any action because the selected value for CX is outside the possible range (i.e., $5 \notin \{6, 7, 8\}$).

3.3 *Equating* Worksheet

3.3.1 Layout

Since the *Equating* worksheet is the most extensive worksheet, it provides extensive information regarding equating results for the 17 methods. As indicated in Figure 6, the *Equating* worksheet consists of nine sections. The first section presents a list of times including when *Equating Recipes* was executed and the time(s) when ESUM-RG was closed. The second section (i.e., Default section) is the default section consisting of the old form conversion table, frequency and relative frequency distributions for both Form Y and Form X, and equating results and standard errors for the unsmoothed equipercentile equating method.

The third to fifth sections provide equating results in terms of raw scores (RS), scale scores (SS), and rounded scale scores (RSS), respectively, for 17 equating methods. The 17 equating methods include the mean, linear, beta-smoothing, unsmoothed equipercentile, kernel, continuized log-linear, three log-linear, and eight postsmoothing methods. The three log-linear methods include the log-linear method whose smoothing degrees were selected based on the model-selection criterion, the log-linear method with user-specified values for CY and CX, and one log-linear method whose smoothing degrees are fixed by specifications in the control card. The eight postsmoothing methods are equipercentile equating methods with cubic-spline postsmoothing parameters of 0.01, 0.05, 0.10, 0.20, 0.30, 0.50, 0.75, and 1.00. Yellow cells in the RS section indicate equated raw scores that are outside a one standard error band for the unsmoothed equipercentile equating method.

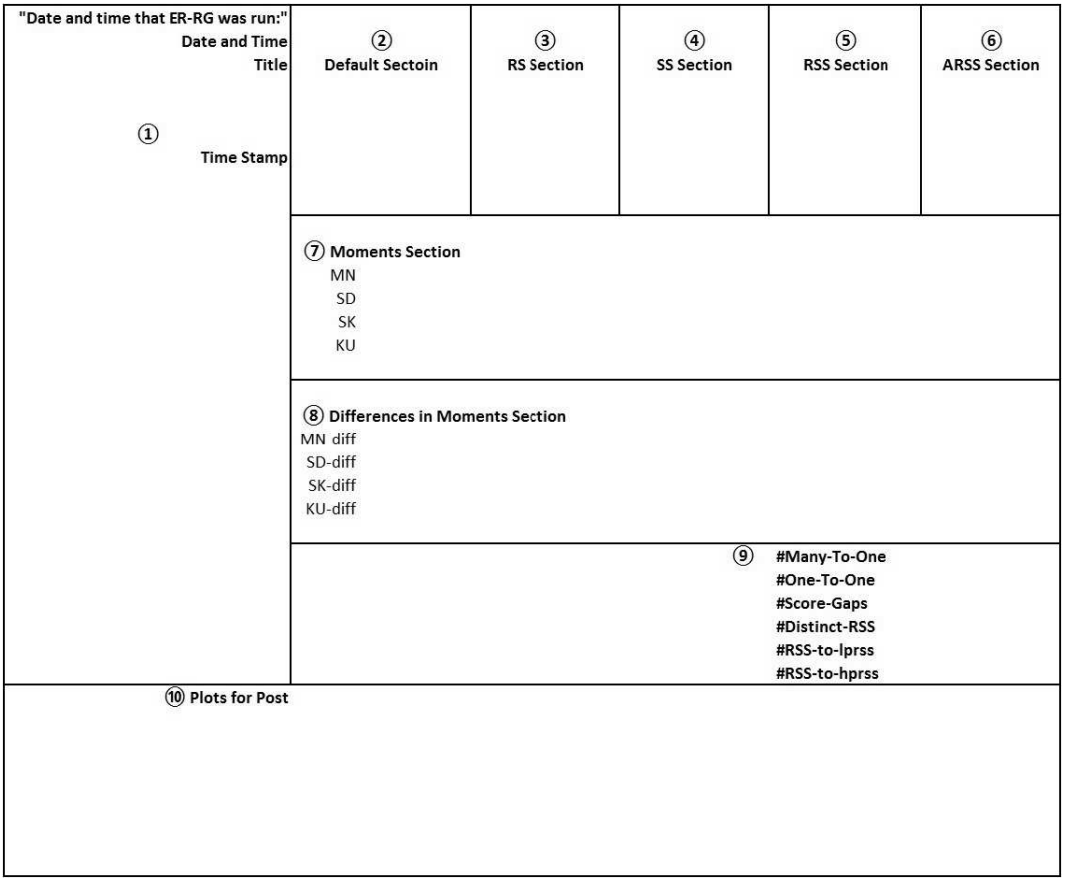

Figure 6: *Equating* Worksheet Layout

The sixth section is the Adjusted Rounded Scale Score (ARSS) section. It is empty when all data are initially loaded. However, if the user decides to adjust a conversion table from the RSS section (i.e., the fifth section), s/he can use the `RSS Edit and Compare` add-in (described in detail in the next section), which will populate columns of the ARSS section. The number of times a conversion table can be adjusted is unlimited, which means that the ARSS section can be expanded as wide as necessary.

The seventh and eighth sections present results regarding fitted moments. In the seventh section (i.e., Moments), the fitted moments for all equating procedures are presented. The eighth section (i.e., Differences in Moments) presents the differences between the observed moments for Y and the fitted moments for all equating procedures.

The ninth section summarizes equating results in the RSS section, for each equating procedure, in terms of six numbers described below:

- #Many-To-One refers to the number of times for which more than one

raw score is converted to the same rounded scale score;

- #One-To-One refers to the number of times for which a raw score is converted to a single rounded scale score;
- #Score-Gaps refers to the number of gaps in the raw-to-rounded-scale-score conversion table;
- #Distinct-RSS refers to the number of distinct rounded scale scores to which at least one raw score is converted;
- #RSS-to-lprss refers to the number of raw scores converted to the lowest rounded scale score (as specified in one of the control cards); and,
- #RSS-to-hprss refers to the number of raw scores converted to the highest rounded scale score (as specified in one of the control cards).

The tenth section provides charts for equating relationships after performing cubic-spline postsmoothing with eight different smoothing parameters.

3.3.2 Add-ins

The *Equating* worksheet includes eleven add-in buttons, each of which is described below.

a. `Plots for Post`

The `Plots for Post` add-in creates charts for equating relationships after performing postsmoothing. Eight charts are created with values of 0.01, 0.05, 0.10, 0.20, 0.30, 0.50, 0.70, and 1.00 for a smoothing parameter S.

Note that these charts are automatically created when files are loaded. When `Plots for Post` is used, all currently visible postsmoothed charts are deleted and a new set of eight charts is recreated. This functionality is provided to remedy the mistake of inadvertently deleting a chart of interest.

b. `FD Plot (X and Y)`

The `FD Plot (X and Y)` add-in creates a chart for observed relative frequency distributions for total raw scores for Form X and Form Y. The resulting chart is displayed in the *Charts* worksheet.

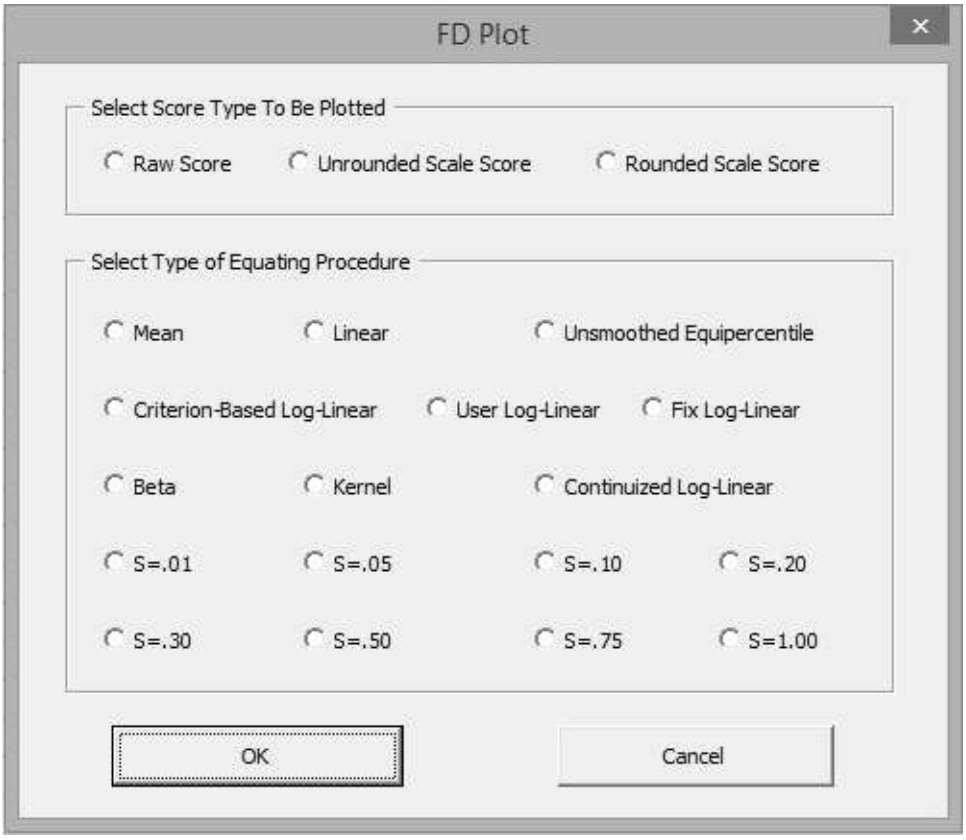

Figure 7: `FD Plot`

c. `FD Plot`

For a selected equating procedure, the `FD Plot` add-in creates a chart for a relative frequency distribution for a selected score type (i.e., raw scores (RS), scale scores (SS), or rounded scale scores (RSS)). When the `FD Plot` add-in is used, a user form appears as shown in Figure 7, and, the user selects a score type for an equating procedure of interest. Note that only one selection can be made for score type and equating procedure. The resulting chart is displayed in the *Charts* worksheet. As more charts are created, they are stacked side-by-side next to the previously created chart.

d. `CT Plot`

For a selected equating procedure, the `CT Plot` add-in creates a chart depicting the conversion table for an equating relationship. When the `CT Plot` add-in is used, a user form appears as shown in Figure 8, and, the user selects a score type and an equating procedure of interest. Note that only one selec-

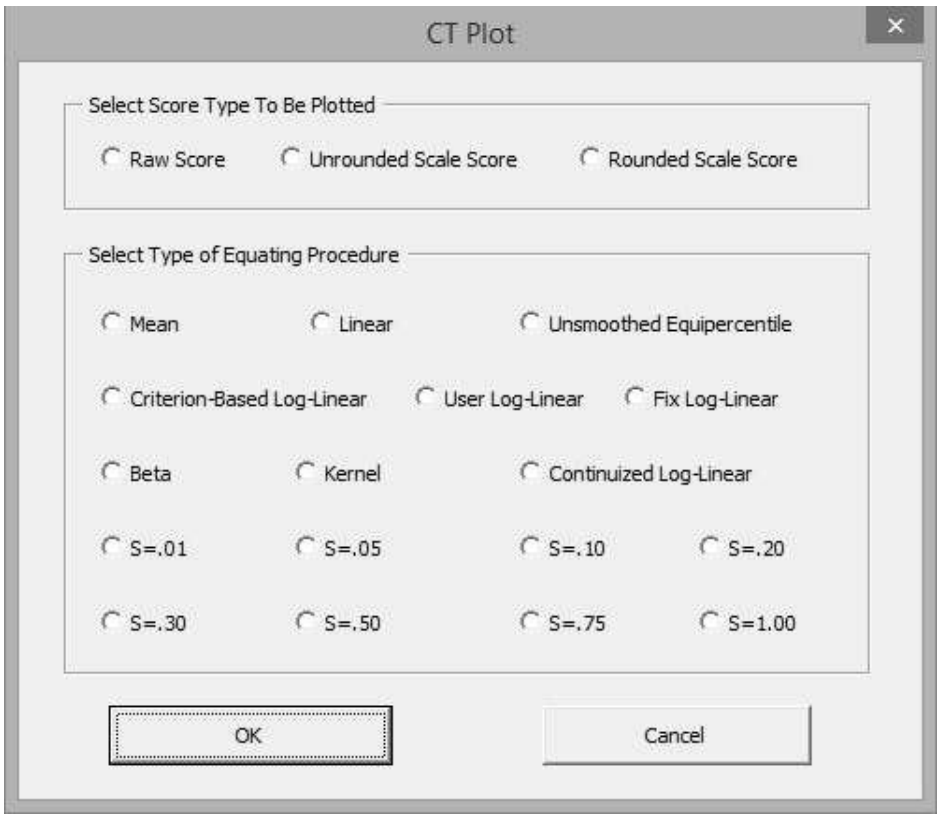

Figure 8: `CT Plot`

tion can be made for score type and for equating procedure. The resulting chart is displayed in the *Charts* worksheet. As more charts are created, they are stacked side-by-side next to the previously created chart.

e. `D Plot`

For a selected equating procedure, the `D Plot` add-in creates two difference-plot charts side by side: one chart for the old form equivalent score minus the new form score without standard errors, and the other chart with standard errors. When the `D Plot` add-in is selected, a user form appears as shown in Figure 9, and, the user selects an equating procedure of interest. Note that only one selection can be made for an equating procedure. The difference-plot charts are displayed on the *Charts* worksheet. The difference-plot chart with standard errors is displayed to the right of the difference-plot without standard errors. As more charts are created, they are stacked side-by-side next to the previously created chart.

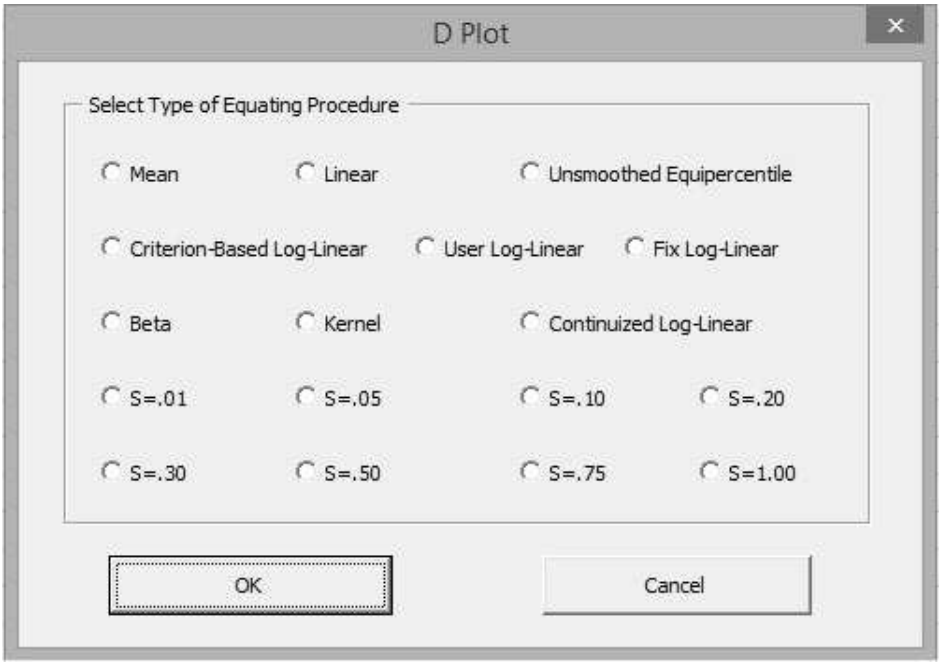

Figure 9: `D Plot`

f. `Comparisons RSS (green)`

The `Comparisons RSS (green)` add-in identifies differences in rounded equated scale scores for various equating methods. When the `Comparisons RSS (green)` add-in is used, a score-cell is shaded in green if, for a particular raw score, the rounded scale score for an equating procedure is different from the rounded scale score for the equating procedure located on the left. Note that the results of selecting this add-in button are provided in the fifth section in Figure 6.

g. `ManyToOne RSS (pink)`

The `ManyToOne RSS (pink)` add-in identifies sections of each raw-to-rounded-scale-score conversion table where more than one raw score is converted to the same rounded scale score. Where this occurs, cells for such rounded scale scores are shaded in pink. Note that the results of selecting this add-in button are provided in the fifth section inn Figure 6.

h. `Gaps RSS (blue)`

The `Gaps RSS (blue)` add-in identifies where there are gaps in the raw-to-rounded-scale-score conversion tables. For each equating procedure, the

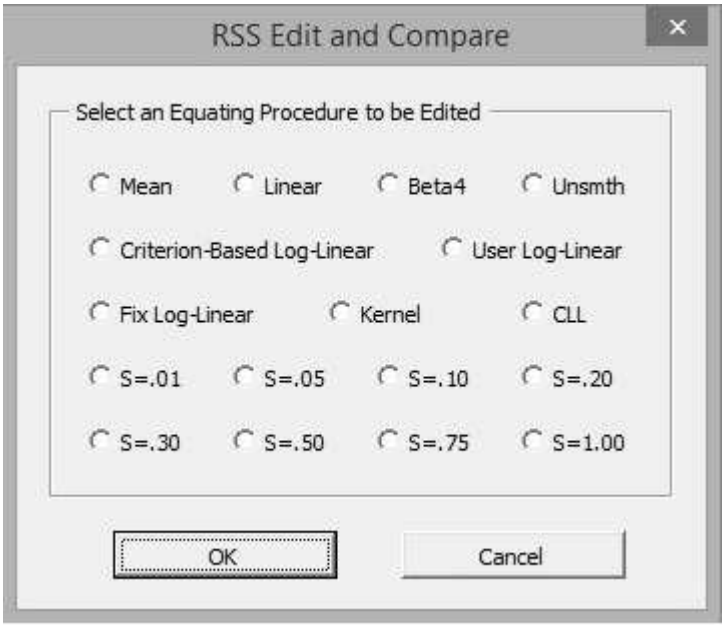

Figure 10: `RSS Edit and Compare`

rounded scale score for a raw score of x is compared to the rounded scale score for the raw score of $x-1$. If there is a gap in rounded scale scores (i.e., the two rounded scale scores are neither equal nor contiguous integers), the cell containing the rounded scale score for x is shaded in light blue. Note that the results of selecting this add-in button are provided in the fifth section in Figure 6.

i. `Clear Colors RSS`

The `Clear Colors RSS` add-in clears the colors (green, pink, and/or light blue) in the rounded scale scores (RSS) section of the *Equating* worksheet. Note that the results of selecting this add-in button can be observed in the fifth section in Figure 6.

j. `RSS Edit and Compare`

When the `RSS Edit and Compare` add-in is used, a user form appears as shown in Figure 10. Then, the user needs to select an equating procedure whose RSS conversion table the user wants to adjust. For a selected equating procedure, columns for scale scores and rounded scale scores are copied and pasted at the end of the rounded scale scores section (i.e., section ⑥ in Figure 6). As a result, four columns are created. The first column contains

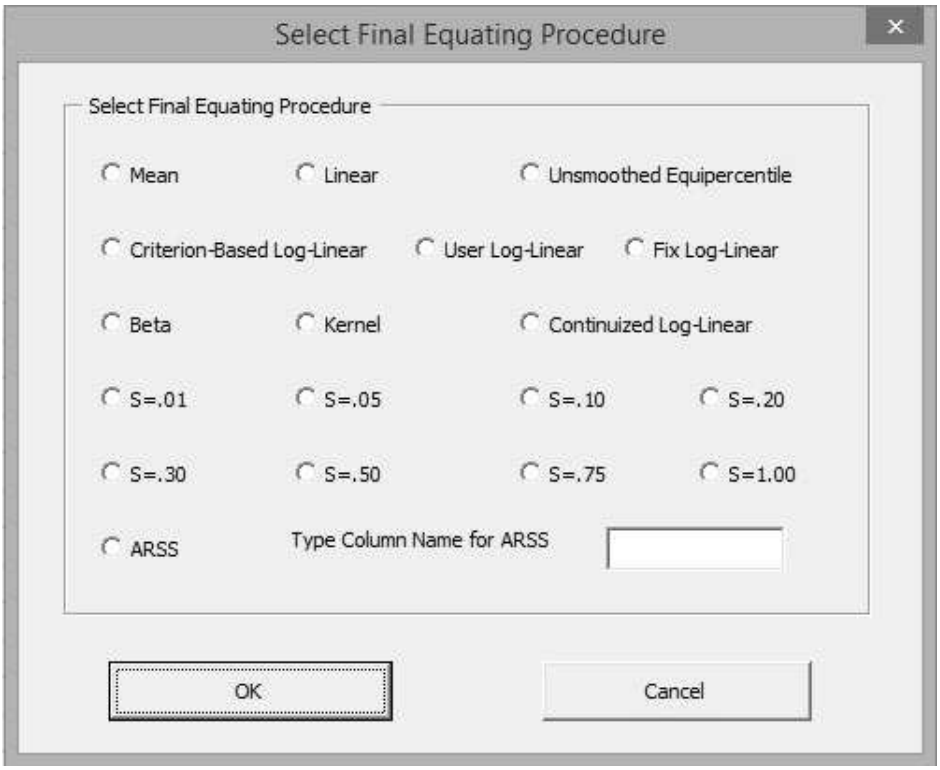

Figure 11: `Select Final Method`

raw scores X. The second column contains the unrounded scale scores for the selected procedure, labelled 'SS'; the third and fourth columns both contain the rounded scale scores, labelled 'RSS' and 'ARSS', respectively.

Changes can be made only to the rounded scale scores in the ARSS column. The 'Enter' key should be pressed after each change in an ARSS cell. Doing so causes ESUM-RG to: (a) generate the raw-to-ARSS conversion table; (b) compute revised moments and moment differences; and, (c) obtaine six summary numbers (e.g., #Many-To-One, #One-To-One, etc.). Two raw to RSS conversion tables, one for 'RSS' and the other one for 'ARSS', are plotted just below the four appended columns.

Note that the `RSS Edit and Compare` add-in can be used as many times as a user wants. That is, this add-in can be used multiple times with the same equating procedure and/or with different equating procedures.

k. `Select Final Method`

When the `Select Final Method` add-in is used, a user form appears as shown as Figure 11, and, the user selects an equating procedure which the

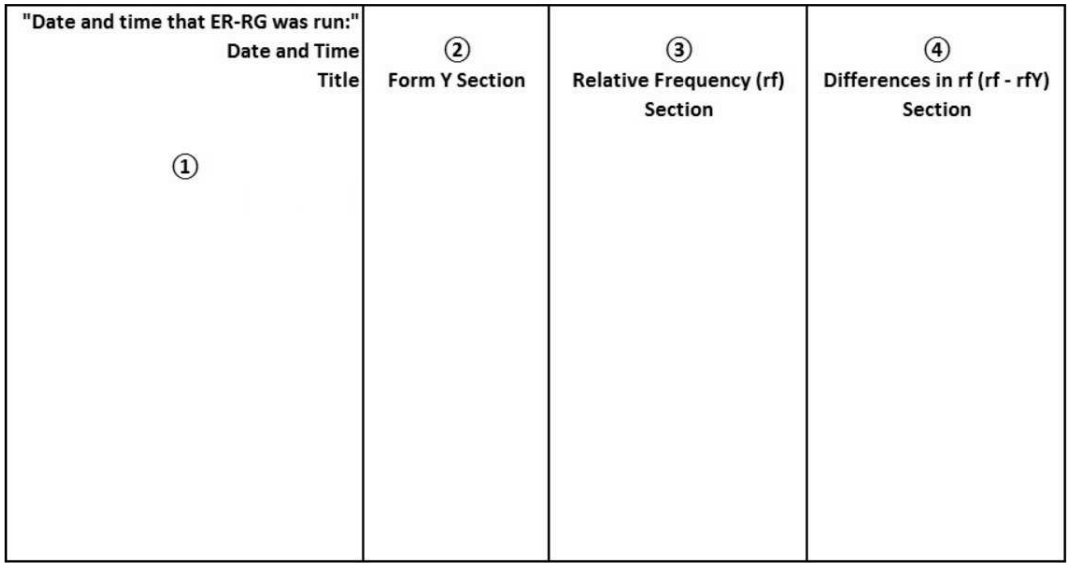

Figure 12: *RSS-FDs* Worksheet Layout

user wants to be chosen as the final procedure. For the selected final equating procedure, equating relationships in terms of raw scores, scale scores, and rounded scale scores are copied and pasted to the *Final* worksheet.

If the user wants to select a particular equating procedure and the associated ARSS results (rather than the RSS results) as the rounded scale scores, then the user should check the ARSS button and provide the column name that contains the ARSS. In such a case, adjusted relative frequencies (rf) and differences in relative frequencies (rf - rfY) for ARSS are calculated and presented on the *RSS-FDs* worksheet.

Note that, when a final method is selected, a copy of the *Final* worksheet is automatically saved in a `txt` file in the current directory.

3.4 *RSS-FDs* Worksheet

3.4.1 Layout

The *RSS-FDs* worksheet consists of four sections. The first section provides the test name and a list of times including when *Equating Recipes* was executed and the time(s) when ESUM-RG was closed. The second section provides the relative frequency distribution for rounded scale scores for Form Y. The third section presents the relative frequency distributions for rounded equated scale scores for all 17 methods; and, the fourth section presents differences in relative frequencies for the 17 methods relative to the observed

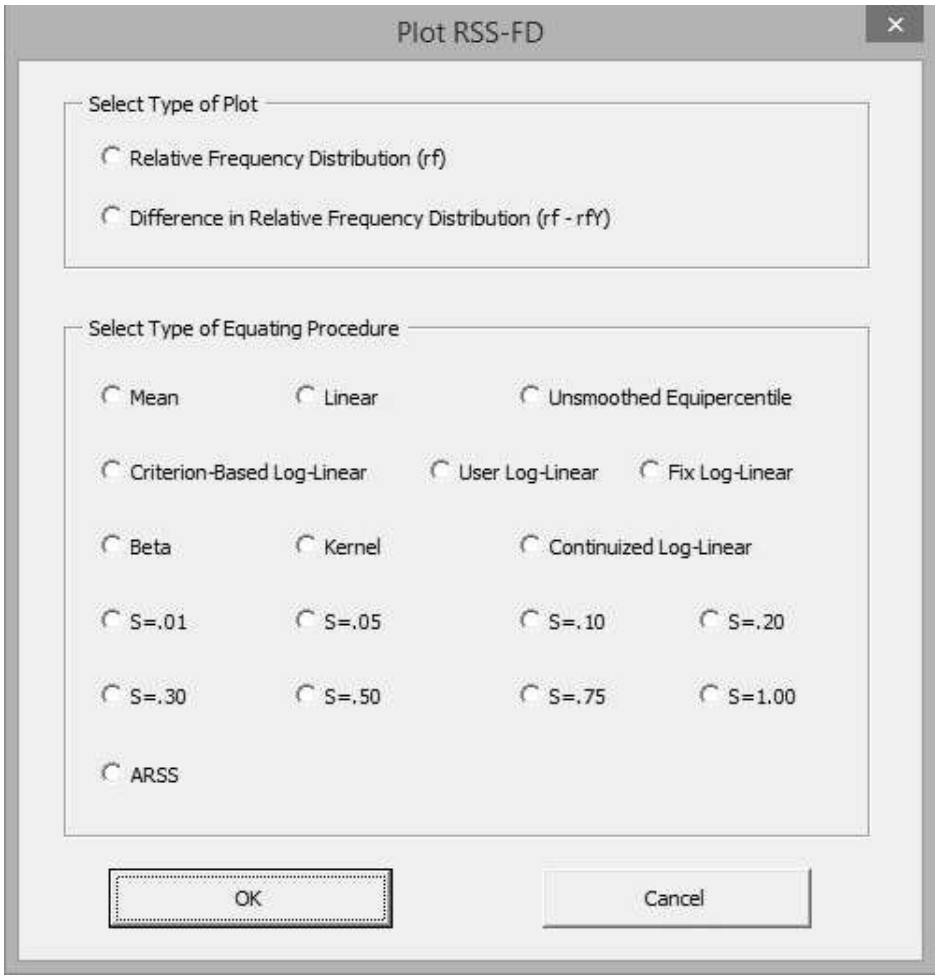

Figure 13: `RSS-FD Plot`

relative frequencies for Form Y. Note that different abbreviations are used to differentiate relative frequencies for Form Y from those for Form X; 'rf' refers to relative frequencies for rounded equated scale scores for Form X and 'rfY' for rounded scale scores for Form Y.

When an adjusted conversion table (i.e., ARSS) is selected as a final method in the *Equating* worksheet, relative frequencies and differences in relative frequencies for the ARSS are appended to the end of the third and fourth sections, respectively. If the user reconsiders results in the *Equating* worksheet and chooses an equating procedure without adjustment (i.e., RSS) as the final method using the `Select Final Method` add-in, the appended columns for relative frequencies and differences in relative frequencies for ARSS are removed from the third and fourth sections in the *RSS-FDs*

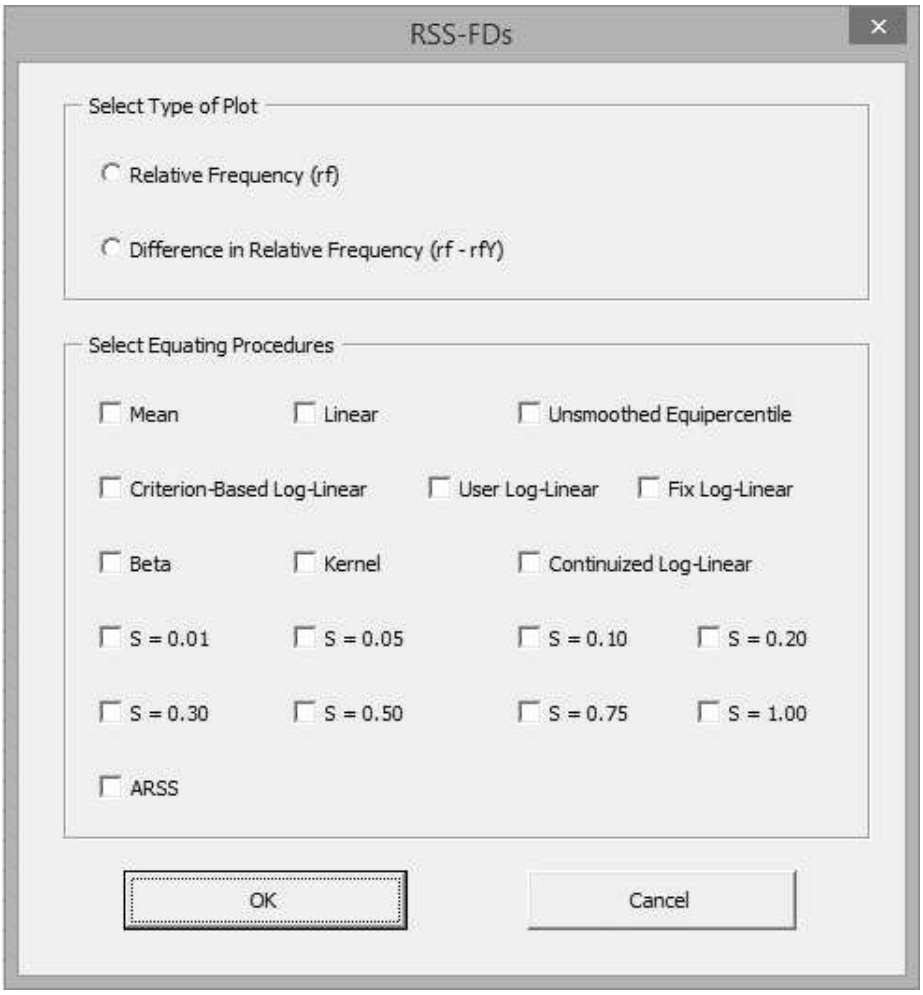

Figure 14: `RSS-FDs Plot`

worksheet.

3.4.2 Add-ins

The *RSS-FDs* worksheet includes three add-ins: `RSS-FD`, `RSS-FDs`, and `Delete Charts`.

a. `RSS-FD`

When the `RSS-FD` add-in is used, a user form appears as shown in Figure 13, and, the user selects a type of plot and an equating procedure. Note that only one selection can be made for plot type and equating procedure. The

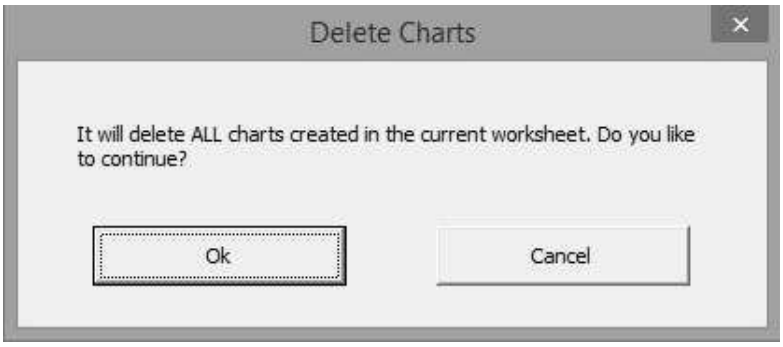

Figure 15: `Delete Charts`

created chart is for rounded scale scores (RSS). It is displayed below the data on the *RSS-FDs* worksheet.

b. `RSS-FDs`

When the `RSS-FDs` add-in is used, a user form appears as shown in Figure 14, and, the user selects a type of plot and an equating procedure. Note that only one selection can be made for plot type, but up to 10 equating procedures can be selected. The created chart is for rounded scale scores (RSS). It is displayed below the data on the *RSS-FDs* worksheet.

The only differences between the charts produced by *RSS-FDs* and *RSS-FD* are that the `RSS-FD` button produces a chart using dots for a single equating procedure, while the `RSS-FDs` add-in draws a line chart for up to 10 equating procedures.

For the `RSS-FD` and `RSS-FDs` add-ins, chart areas are not separately assigned. Instead, charts are displayed in the order of use regardless of which add-in is selected. A maximum of two charts is displayed side by side. After each row of two charts is filled, the next charts are displayed underneath the previously created charts.

c. `Delete Charts`

When the `Delete Charts` add-in is used, a pop-up window appears as shown in Figure 15. The window gives a warning message that clicking the OK button in the window will delete all charts created in the RSS-FDs worksheet. When the OK button is clicked, all charts are deleted.

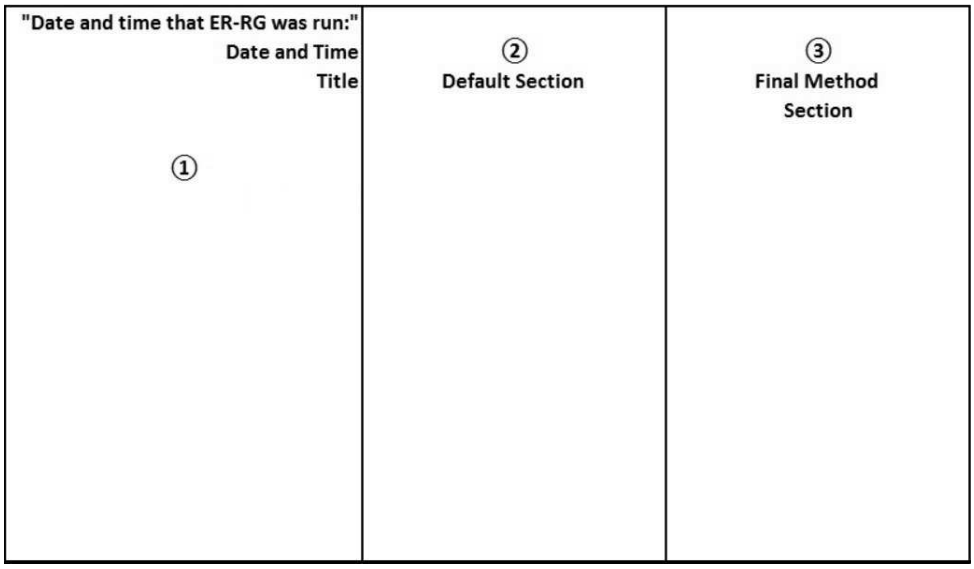

Figure 16: *Final* Worksheet Layout

3.5 *Final* Worksheet

3.5.1 Layout

The *Final* worksheet consists of three sections. The first section provides the test name and a list of times including when *Equating Recipes* was executed and the time(s) when ESUM-RG was closed. The second section is the default section consisting of an old form conversion table, frequency and relative frequency distributions for both Form X and Form Y, and equating results and standard errors for the unsmoothed equipercentile equating method. The third section presents equating results for the final method in terms of raw scores (RS), scale scores (SS), and either rounded scale scores (RSS) or adjusted rounded scale score (ARSS). Additionally, the third section provides moments and differences in moments for all score types.

3.6 *Charts* Worksheet

3.6.1 Layout

The *Charts* worksheet has five sections and displays charts created using the add-ins associated with the *Equating* worksheet. The first section presents charts created using the `FD Plot (X and Y)` add-in. The second and third sections display two types of difference-plot charts, one without standard errors and the other one with standard errors, created using the `D Plot`

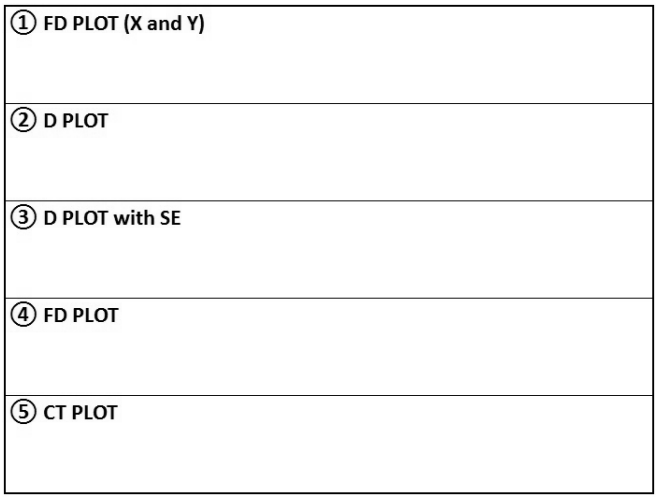

Figure 17: *Charts* Worksheet Layout

add-in. For the same equating method selected using the `D Plot` add-in, two charts are created side by side in the second and third sections. The fourth and fifth sections present charts created using the `FD Plot` and `CT Plot` add-ins, respectively.

3.6.2 Add-ins

Similar to the `Delete Charts` add-in button for the *RSS-FDs* worksheet, `Delete Charts` first gives a warning message and, then, deletes all charts in the *Charts* worksheet when the user clicks OK.

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5 References

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