Merging Multiple and/or Divergent Datasets using SPSS: A Method Review and Tutorial

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For many reasons, researchers place their data in multiple electronic datasets and later find that they wish to combine those datasets for a particular analysis. This article reports on an analysis of the extant literature on combining multiple and/or divergent datasets and provides both a tutorial and related syntax that combines non-matching datasets (i.e., from different sources) in such a way that all data is contained in the final combined dataset with identification of data source. This syntax represents an improvement over the existing SPSS (v23-v27) combining dataset routines in terms of 1) expanding the types of datasets that can be combined, 2) completeness of the resulting dataset, and 3) facilitating management of multiple and/or divergent data sets. An additional benefit of using this process is the incorporation of a method to test the accuracy of the merged data and thus verify the data quality. The SPSS syntax along with instructions and examples are reviewed in the article.

Keywords: SPSS, syntax, datasets, merging, longitudinal data

Many researchers face problems merging multiple datasets with divergent or mismatched cases and/or variables to form a more complete dataset. This is particularly true when conducting research with humans in which data is obtained from multiple sources, such as self-report questionnaires, institutional databases, and/or collateral contacts. Challenges that occur in utilizing data from divergent sources include different structures, different formats, or that data is incomplete when compared to the original dataset.

The present article focuses on merging multiple datasets either generated longitudinally or containing different variables. Examples of the datasets to which we refer include pre-/post-testing for intervention research, longitudinal research utilizing two or more waves of data, or instances in which data from multiple sources related to the same case. These datasets are likely to be mismatched in that they may not contain the same variables (in the instance of adding cases) or may not include the same cases (in the instance of adding variables). Other relevant datasets might be considered “complex” in that the datasets contain different variables and have differences in cases. For example, it may be that graduate students working as a part of a larger research team are tasked with managing the data and will need to understand the process and steps to efficiently combine these datasets.

It should be noted that in order to align with current terminology, rather than describing these datasets as “complex,” which has a specific meaning within the social sciences (Guha et al., 2009), we will use the term “divergent” to refer to datasets that do not match variable for variable, time frame by time frame, and/or case for case. Further, the term “merge” will be used in this article rather than “combining” in that combining implies a common data structure that facilitates bringing the datasets together, while the term “merging” typically relies on a “key” or “identifier” variable that provides the common link between the datasets. This is distinct from data fusion, which occurs when multiple data sources are integrated without full preservation of all data (Haghighat et al., 2016). The goal of the process to be described is that the datasets are merged in such a way that all data is retained from its original dataset in the final product.

When it comes to merging two or more datasets that contain mismatching and/or missing cases, several complications could occur – resulting in compromised analyses. For instance, mismatched data may indicate that data were added to the dataset incorrectly. Additionally, missing data can result in decreased analysis power or, depending on the analysis required, may prevent an analysis from being completed entirely. Accurate dataset merging is vital to prevent potential errors from being introduced, prevent data loss, and allow researchers to have more reliable and valid datasets with which to conduct analyses. Thus, the accurate merging of discrete datasets allows researchers to conduct analyses on a more accurate dataset, therefore producing results that have greater reliability, are more generalizable, and are more replicable. For the purposes of this article, the focus will stay on mismatched or divergent dataset merging using SPSS software.

Literature Review

To assess the need for an informative guide regarding how to merge mismatched datasets, the authors chose two separate approaches to conducting the lit
erature searches. First, a literature search using the re-
search databases EBSCOHost (which is an umbrella
dataset encompassing approximately 70 individual
publisher databases), Web of Science, Sage Premier,
Science Direct, and Google Scholar was conducted.
The Boolean search phrase utilized for this search was
as follows: SPSS AND dataset AND (merg* OR comb-
bin* OR concatent* OR mung* OR wrangl*). For
databases that do not use the Boolean system exactly
(e.g., Google Scholar), these search terms were added
manually to the advanced search settings of each data-
basis. The terms mung and wrangle were incorporated
once we discovered that these terms are used outside
of psychology to describe the data-cleaning process,
which includes dataset merging (Braun et al., 2018;
Endel & Piringer, 2015; Rattenbury et al., 2017). The
above search phrase and its individual search terms
were used to identify articles containing these terms
in their abstracts. The resulting list from EBSCOHost
provided 27 peer-reviewed articles, while the Web of
Science search produced 24. None of these results ac-
knowledged the problem of merging mismatched or
divergent datasets. A second literature search was con-
ducted using Google and Google Scholar. Since Goo-
dle Scholar uses a limited form of Boolean, the search
phrase was changed to the following: SPSS AND data-
sert AND (merge OR merged OR merging OR com-
bine OR combination OR combining OR combined
OR mung OR munging OR munged OR concate-
nate OR concatenated OR concatenating OR wrangle
OR wrangled OR wrangling). Other combinations of
these search terms were also used (e.g., data wrangling,
data munging, merging datasets). The results of this
search found examples of both peer-reviewed articles
and books that address dataset merging, but neither
focused on mismatched or divergent dataset merging nor used
SPSS for this purpose.

Previous research literature on merging data-
sets for analyses of psychological data primarily used
the Statistical Analysis System (SAS) software (Foley,
1998; Foley, 2005) for this process, rather than SPSS.
Parenthetically, research literature reviewed the steps
to obtain a merged dataset with the specific variables
and cases of interest. Again, however, no mention was
made of merging mismatched or divergent datasets.
Scholarly works and textbooks were reviewed to iden-
tify potentially helpful instruction in this area. Both
works that did focus on the use of SPSS and works
that did not specify which program they recommend-
ed using covered only basic dataset merging practices.
These sources either did not provide information on
the difficulties likely to be encountered in merging
mismatched or divergent datasets (Stehlik-Barry &
Babinex, 2017) or they only emphasized the impor-
tance of considering these challenges without provid-
ning guidance or details on its technicalities (Braun et
al., 2018; Endel & Piringer, 2015; Rattenbury et al.,
2017). Guides on merging datasets for non-psycholog-
cal research purposes have also not focused on SPSS,
but rather on software programs such as R and Python
(Ojeda et al., 2014).

There does, however, appear to be plenty of gray
literature (articles not formally published by commer-
cial academic publishers) surrounding this topic in
SPSS (Haddaway et al., 2015, p. 1). Examples of this
gray literature include 1) websites that host questions,
discussions, and video tutorials related to the common
practices for merging datasets (Coyer, 2013; Truong,
2016), 2) academic websites with instructions (Cole-
man, n.d.; Glynn, 2002), 3) basic commands given by
International Business Machine (IBM; IBM, n.d.); and
4) other SPSS tutorial websites (Spss-tutorials.com,
n.d.). However, most of the gray literature provides
limited basic commands such as MERGE DATASETS
or COMPARE DATASETS, which do not adequately
address specific divergent or mismatched dataset merg-
ing issues encountered by researchers.

Dataset Merging Methods Requirements
To address the above-mentioned issues, the extant lit-
erature previously identified was reviewed to surface
existing guidelines and/or requirements. This type of
information was found primarily in the gray literature
(e.g., Coleman, n.d.; Coyer, 2013; DeCator, 2015;
IBM, n.d.; Truong, n.d.). Six requirements of effec-
tive dataset merging methods to ensure the accuracy
of data were identified from this literature. The first
three requirements are basic expectations of any data-
The next three requirements are more complex and are
specific to merging datasets that contain overlapping
variables as well as overlapping cases, and whose cases
sometimes contain mismatched data (DeCator, 2015;
IBM, n.d.; Truong, n.d.). These six requirements have
implications for the structure and variables contained
in the final created database, as will be discussed below.
Requirement 1: Include All Cases
The merged database (finished product) should contain all the cases from Dataset 1 and all the cases from Dataset 2 (and any additional datasets). The case data from each respective dataset should be faithfully replicated in the merged database.

Requirement 2: Include All Variables
The merged database should hold all the variables present in all datasets, as well as all variables present in only one of the datasets. The width, number of decimal places, labels, value labels, missing specification, column width, alignment, measure specification, and role of each variable should be faithfully replicated in the merged database.

Requirement 3: Variable Settings Fidelity
The merging method integrates variables without changing the variable regardless of the type (numeric, string) and regardless of measure (scale, nominal, ordinal).

In addition to the three basic requirements listed above (Coleman, n.d.; Coyer, 2013), the merged database should provide researchers with three additional pieces of information. The following requirements are more complex, intending to assist researchers when the datasets to be merged are suspected of containing unique, overlapping, or mismatched cases, all of which should be included in the final database.

Requirement 4: Indication of Unique Cases by Dataset
A merged database should provide information as to when a case is unique to Dataset 1 or Dataset 2 (rather than being present in both original datasets), and which dataset it originates from. For example, a merged dataset should tell us if a case with ID 13 exists uniquely in Dataset 1 or Dataset 2.

Requirement 5: Indication of Overlapping Cases
A merged database should indicate when a case in Dataset 1 is also a case in Dataset 2. For example, a merged database should tell us if a case with ID 16 originated in Dataset 1 and whether it also exists in Dataset 2.

Requirement 6: Indication of Mismatched Data by Case
A merged database should tell us when a case in Dataset 1 and a case in Dataset 2 have a matching ID but contain mismatching data while retaining both instances of data in the merged database. Detecting mismatching data is a crucial requirement when merging datasets whose data, cases, or variables do not perfectly match using SPSS. For example, a merged database should tell us if a case with ID 16 in Dataset 1 has “Brief Cognitive Behavioral Therapy” entered for the “Treatment” variable, but a case with ID 16 in Dataset 2 has “Brief Object Relations Therapy” entered for the “Treatment” variable. In addition, both instances of data should be preserved within the merged database. For example, we should see both forms of cases with ID 16 in the merged database, one with “Brief Cognitive Behavioral Therapy” and one with “Brief Object Relations Therapy” entered for “Treatment.” Thus, an indicator of match/mismatch and the retention of both instances of the data should appear in the merged database.

To clarify - several of the six requirements (discussed above) should be represented by one or more variables within the merged dataset. New variables within the dataset should be generated to represent at least one, if not more, of the six requirements. Each of the six requirements should be encoded into a variable within the dataset. The final merged dataset should include, in a specific variable, the dataset name from which each case was taken. This must be a unique variable, separate from the other variables. For example, for one of the authors’ research projects, data was gathered from three different institutions. In this instance, in merging the data a new variable was created which identified the dataset/institution of origin. This variable, included in the merged dataset, provides information about the origin of the data and thus met this requirement. Thus, the dataset of origin variable should not rely on non-encoded methods (such as case origin based upon the cases’ ordering - i.e., SPSS row number) within the dataset. If case origin is denoted by case order, and the final merged dataset is ever re-ordered, the information regarding case origin could be lost. To summarize, each of the six dataset merging requirements must be fulfilled by being encoded as separate variables within the dataset or in such a way that the information cannot be easily lost.

Conducting the Dataset Merge
Currently, SPSS does not include a built-in function that would perform a dataset merge that ensures all six requirements (above) are met. For example, the ADD FILES command does not identify cases that are unique to one of a researcher’s original datasets,
nor is it able to identify duplicate cases that have mismatched data, thus, not meeting requirements 4 and 6. The MERGE DATASETS command does not meet requirements 4, 5, or 6. In order to meet requirement 1 using MERGE DATASETS, additional syntax is needed. Similarly, the MATCH FILES command does not meet requirements 1, 4, 5, or 6. Finally, the COMPARE DATASETS command does not meet requirements 1, 2, 3, or 4. In determining which syntax best meets all six requirements, a literature review was conducted which yielded five (5) known possible methods for combining datasets in SPSS. A total of 12 experiments were conducted using the five methods, with each method first being tested in its simplest form and then tested again in more complex forms. A summary of the experiments conducted, and their outcomes can be found in Table 1.

The final product (based on the outcome of experiment 12) was a set of SPSS syntax to successfully overcome the challenges associated with merging mismatched datasets using the least number of steps. It should be noted that the following steps were developed using SPSS v23 (IBM Corp., 2015) and tested using SPSS v25 and v27 (IBM Corp., 2017, 2020). It should be noted that conducting the merge using this syntax works across all versions including SPSS v28 (IBM Corp., 2021); however, changes made to v28 in the point-and-click options may create a mismatch between the instructions provided herein.

**SPSS Syntax**

The following instructions on how to use the syntax are applicable when researchers have two datasets that they wish to merge. It can also be used repeatedly if more than two datasets must be merged. Please refer to Appendix A for the syntax related to each step. It is also important to note that the figures provided throughout this section are simplified graphics of the analysis for demonstration only and were not conducted using the supplemental files. The supplemental files are provided for the purpose of practicing the procedure with a more realistic dataset.

**Original Datasets**

For variables shared by the two original datasets, the variable information should match perfectly (type, width, label, values, etc.). The following steps will erroneously identify matching variables as separate variables when they do not have identical characteristics (type, width, etc.). Before beginning the next steps, identify which dataset will be your “Dataset 1” and open both original datasets. See Figure 1 for an example of two original datasets to be merged. It is also necessary to clean the data from each of the datasets to be merged to the best of one’s ability before beginning the dataset merging process.

**Syntax**

**Step 1: Comparing Cases Between Datasets**

The purpose of Step 1 is to create a new variable that encodes the number of unique cases present in Dataset 1, the number of cases present in both original datasets that are perfectly matched, and the number of cases present in both original datasets that contain mismatching data. The output will identify the location of the mismatched data in the dataset. Please note that the datasets will remain separate. Step 1 uses point-and-click to run the COMPARE DATASETS command (which can be found under the DATA menu). Before running the command, make the following point-and-click changes. In the “Compare” tab, put the ID variable in Case IDs, and put all “Matched Fields” into “Fields to Compare.” In the “Attributes” tab, select “Do not compare the data dictionaries.” Also, in the “Output” tab, unselect “Limit the case-by-case table.” Click “paste” and run the resulting syntax on Dataset 1. See Figures 2A and 2B for example Datasets 1 and 2 after Step 1 as well as an example output after Step 1.
MERGING MULTIPLE AND/OR DIVERGENT DATASETS IN SPSS

**Step 2: Merging Variables and Cases into One Dataset and Identifying Cases by Dataset**

Step 2 merges all variables and cases into Dataset 1. From Dataset 1, select MERGE FILES then ADD CASES command. This is also found in the DATA menu. Before running the command, make the following point-and-click changes. Put all “Unpaired Variables” in “Variables in New Active Dataset.” As needed, manually pair variables from the two original datasets. Select “Indicate case source as variable” and name the new variable that you wish to use (we used “SourceDataset2”). Click “paste” and run the resulting syntax on Dataset 1. This step will add all variables and all cases to Dataset 1. It will also identify which cases come from Dataset 1 or Dataset 2 in the newly created variable. See Figure 3 for the example Dataset 1 after Step 2. After completing this step, it may be helpful to label the values of this new variable, the syntax for which can be found in Appendix A. A value of 1 indicates that a case originates from Dataset2 while a value of 0 indicates that a case originates from Dataset 1.

**Step 3: Identifying Mismatches, Matches, and Unique Cases Within Dataset 1**

Step 3 duplicates the variable created in Step 1, which identifies mismatching, matching, and unique cases present in Dataset 1. The duplicated variable is the one that will be manipulated in Steps 4 and 5. Step 3 can be done with the syntax (provided in Appendix A) using your preferred variable names inserted (we used “CasesCompared”). The resulting duplicate variable only encodes information about matches, mismatches, and unique Dataset 1 cases for those cases from Dataset 1. The duplicated variable contains no information for cases added from Dataset 2, a problem that will be addressed in Step 4 and Step 5. See Figure 4 for the example Dataset 1 after Step 3. Once again, we suggest labeling the values of this new variable. A value of 1 in

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**Figure 2A:** Simple Mismatched Datasets in SPSS after Step 1. This is an example of what the new variable created via Step 1 would look like once added.

**Figure 2B:** Example Step 1 Output. This is an example of the output that would be generated after completing Step 1 which provides a summary of case comparisons between the two datasets.

**Figure 3:** SPSS Data View After Step 2. This is an example of the variables added after step 2 which includes all variables existing in Dataset 2 that do not exist in Dataset 1 and a new variable that identifies the source of each case.

**Figure 4:** SPSS Data View After Step 3. This is an example of the output that would be generated after completing Step 3 which provides a summary of case comparisons between the two datasets.
indicates a mismatch between both datasets, 0 represents a match in both datasets, and -1 indicates that a case is unique to Dataset 1. The syntax for creating these labels can be found in Appendix A.

**Step 4: Labeling Matches and Mismatches from Dataset 2**

Step 4 uses the syntax we developed (utilizing the LAG function), and the variables created in Steps 2 and 3. Utilizing the LAG function and the “SourceDataset2” variable, Step 4 encodes for all cases within the newly created “CasesCompared” variable (from Step 3). Step 4 encodes information as to whether the case is a match between datasets, a mismatch between datasets, or unique to Dataset 1. This step is important because without it only cases from Dataset 2 would have information encoded in the “CasesCompared” variable. Again, the syntax is found in Appendix A. When running the syntax, be careful to change the variable names to your chosen variable names, and to run the sorting syntax first (we included examples to facilitate understanding). Your ID variable must be in numerical descending order (e.g. 1, 1, 2, 3, 4, 4), with cases from Dataset 1 listed or appearing before cases from Dataset 2. This syntax solves the problem from Step 3, however, the variable “CasesCompared” still does not encode when a case is unique to Dataset 2. See Figure 5 for the example Dataset 1 after Step 4.

**Step 5: Identifying Cases Unique to Dataset 2**

Step 5 encodes in the “CasesCompared” variable when cases are unique to Dataset 2. The syntax can be found in Appendix A. Since the only cases with no data in “CasesCompared” are those which are unique to Dataset 2, this syntax identifies empty data in “CasesCompared” and encodes them as unique to Dataset 2. The syntax also includes a method of labeling this new value. See Figure 6 for the example Dataset 1 after Step 5.

**Discussion**

There is significant literature that provides tutorials and instructions on the basic merging of files with identical variables and/or cases. Significant literature discussing these basic merging techniques can be found for programs such as R, SPSS, and STATA. What has not been discussed in the literature but may be of use to students and researchers using small- to medium-sized datasets, is a procedure that reliably merges datasets with missing or mismatched cases and/or variables within SPSS. While numerous software programs are used to conduct research, one of the more frequently used software programs to teach statistical analysis, particularly within the social sciences, is SPSS. Oftentimes students are introduced to data analysis using the drop-down menus within SPSS rather than syntax. This article has provided information on both the use of drop-down menus and syntax to conduct data merging. Depending on the individual’s comfort level and the version of SPSS being used, either of these procedures may be more effective. In the case of an individual using version 27 or earlier, the drop-down menus provide point-and-click ease of conducting the analysis. While for those with greater comfort and/or facility using syntax, merging using the syntax is likely to be more comfortable regardless of the version used.

There are several advantages to using this procedure to merge divergent datasets. The first advantage is that it allows the researcher to store all data within a single dataset. This facilitates data analysis for most procedures. The second advantage is that by having all data in one dataset, analyses accounting for missing
data are more easily conducted from within one dataset rather than across multiple datasets. The third advantage is that this procedure allows one to conduct analyses that can only be performed within a single dataset. The fourth advantage is that embedded within the syntax is a data quality check which increases the likelihood that the merged data is accurate and represents the population of interest.

An additional consideration is related to the speed or efficiency of the procedure. It should be noted that the speed, efficiency, and amount of storage required to contain the dataset will be affected by the sizes of the datasets involved. Large datasets (such as those found in the National Center for Education Statistics, etc.), will require greater computing power and storage capacity than smaller datasets.

Conclusion

Merging datasets accurately is vital to ensuring that no data is altered or lost and that researchers can easily understand the sources of all their data. Presently, there is no consensus on best practices for merging SPSS datasets with overlapping and potentially mismatched cases. The present article introduces one method to handle such a situation. The recommended method results in a merged dataset that includes all cases and variables, in their original form, stemming from two or more original datasets. It creates an output file that identifies each instance of case mismatch and the location of each mismatch within the dataset. It also results in a single variable that encoded whether a case was 1) a perfect match between datasets 2) a mismatch between datasets with non-matching data 3) unique to one dataset and which original dataset contains that unique case. Alternative strategies are recommended when the datasets to be merged contain overlapping cases but no or few shared variables.

References


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IBM Corp. (2020). IBM SPSS Statistics for Windows (Version 27.0) [Computer software]. IBM Corp.


### Table 1

*Experiments Conducted to Determine Best Syntax for Merging Divergent Datasets*

<table>
<thead>
<tr>
<th>Requirement #</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th># of req. met</th>
<th># of steps</th>
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<td>X</td>
<td>X</td>
<td>X</td>
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<td>1</td>
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<td>X</td>
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<td>Experiment 10 - Basic COMPARE DATASETS command, without additional syntax</td>
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<td>6</td>
<td>5</td>
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</tr>
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</table>
# Appendix A
Syntax for Steps One Through Five

## Step 1:
***Step 1***
*compare datasets*

```plaintext
DATASET ACTIVATE DataSet1.
SORT CASES BY ID.
COMPARISON DATASETS
  /COMPDATASET = DataSet2
  /VARIABLES ALL
  /CASEID ID
  /SAVE FLAGMISMATCHES=YES VARNNAME=Mismatches MATCHDATASET=NO
  MISMATCHDATASET=NO
  /OUTPUT VARPROPERTIES=NONE CASETABLE=YES TALELIMIT=600.
```

## Step 2:
***Step 2***
*merging all variables and cases into DataSet1*

```plaintext
ADD FILES /FILE=* 
  /FILE='DataSet2'
  /IN=SourceDataset2.
VARIABLE LABELS SourceDataset2 'Case source is DataSet2'.
EXECUTE.
```

ADD Value Labels
SourceDataset2
1 'from Dataset2'
0 'from Dataset1'.
Execute.

## Step 3:
***Step 3***
*creating new mismatches variable called CasesCompared*

```plaintext
COMPUTE CasesCompared = Mismatches.
EXECUTE.
```

ADD Value Labels
CasesCompared
1 'Mismatch between Both Datasets'
0 'Match in Both Datasets'
-1 'Unique to Dataset1'.
Execute.

## Step 4:
***Step 4***
*duplicating CasesCompared encoded information for cases from Dataset2*

```plaintext
SORT CASES BY ID(A) SourceDataset2(A) Mismatches-(A).
EXECUTE.
```

IF ((ID = lag(ID)) AND (sysmis(CasesCompared)))
CasesCompared=lag(CasesCompared).
Execute.

## Step 5:
***Step 5***
*encoding in CasesCompared those cases which are unique to Dataset2*

```plaintext
IF (sysmis(CasesCompared))
CasesCompared=-2.
EXECUTE.
```

ADD Value Labels
CasesCompared
-2 'Unique to Dataset2'.
Execute.