The Stata Journal

Users of any of the software, ideas, data, or other materials published in the Stata Journal or the supporting files understand that such use is made without warranty of any kind, by either the Stata Journal, the author, or StataCorp. In particular, there is no warranty of fitness of purpose or merchantability, nor for special, incidental, or consequential damages such as loss of profits. The purpose of the Stata Journal is to promote free communication among Stata users.

The *Stata Journal*, electronic version (ISSN 1536-8734) is a publication of Stata Press, and Stata is a registered trademark of StataCorp LP.

The Stata Journal (2005)
5, Number 1, pp. 92–122

Tabulation of multiple responses

Ben Jann
ETH Zurich, Switzerland

Abstract. Although multiple-response questions are quite common in survey research, Stata's official release does not provide much capability for an effective analysis of multiple-response variables. For example, in a study on drug addiction an interview question might be, "Which substances did you consume during the last four weeks?" The respondents just list all the drugs they took, if any; e.g., an answer could be "cannabis, cocaine, heroin" or "ecstasy, cannabis" or "none", etc. Usually, the responses to such questions are stored as a set of variables and, therefore, cannot be easily tabulated. I will address this issue here and present a new module to compute one- and two-way tables of multiple responses. The module supports several types of data structure, provides significance tests, and offers various options to control the computation and display of the results. In addition, tools to create graphs of multiple-response distributions are presented.

Keywords: st0082, mrtab, mrgraph, _mrsvmat, multiple responses, multiple testing, tabulate

1 Introduction

Surveys often contain questions which can have multiple responses. That is, questions are asked to which a respondent can give zero, one, or more answers. For example, such a question might be, "Which of the following devices do you have in your home?" The respondent is then given a list like "1. Television, 2. Dishwasher, 3. Computer, 4. Dry cleaner . . . " and may mark any number of devices. Furthermore, the list might be open-ended, so that the respondent can also name devices that are not listed. Thus although not necessarily so, multiple-response questions often have an explorative character.

The answers to multiple-response questions are, in fact, a series of answers and, thus, are usually stored as a series of variables. However, because the variables constitute some topical entity, the combined statistical distribution of all variables may be of interest rather than the separate distributions of the single variables. Moreover, depending on the storage structure, the distributions of the single variables may be completely meaningless if taken individually.

Because multiple-response data is spread out over several variables, it cannot be easily tabulated. First, the data structure may vary, and it may be necessary to transform the data into different structures before tabulating. In particular, a storage type in which the responses are recorded in the order they have been mentioned by the respondent is quite common, even if the ordering is not relevant. For most purposes, however, it is useful to transform such data to a storage mode in which the single variables indicate whether particular responses have been observed or not. Second, statistical information from several variables has to be combined, which is not always just a matter of arranging separate distributions in one table. Both tasks are difficult to accomplish using standard statistical instruments that are designed for the analysis of ordinary (single-response) variables. Thus it appears that Stata's official tools are not sufficient for an effective analysis of multiple-response data; additional instruments are needed.

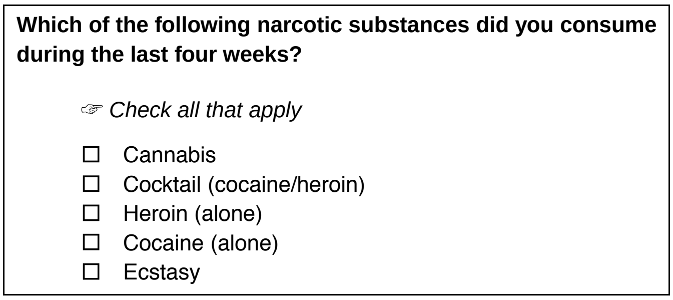
In the following section, I will briefly touch on the issue of how to store the answers to multiple-response questions and then move on to the presentation of three new commands to support the analysis of multiple responses in section 3. Section 4 illustrates the capabilities and the usage of the new commands and contains some additional considerations about significance tests.

2 Approaches to storing multiple responses

The fact that the answers to multiple-response questions are typically composed of several bits of information poses difficulties for their representation in a dataset. A common way to deal with this issue is to store each part of the answer in a separate variable. Two main approaches may be distinguished: the indicator mode and the polytomous mode.

2.1 Indicator mode

Consider the following question which could have been part of a questionnaire on drug addiction:



Which of the following narcotic substances did you consume during the last four weeks?

☞ *Check all that apply*

□ Cannabis
□ Cocktail (cocaine/heroin)
□ Heroin (alone)
□ Cocaine (alone)
□ Ecstasy

Obviously, it would be most straightforward to construct a set of indicator or dummy variables in this case: one variable for each drug. Basically, the example question above is just a shortcut to five separate questions in the manner of, "Did you consume cannabis during the last four weeks?", "Did you consume a cocaine-heroin cocktail during the last four weeks?", and so on. The data would then look like the following (1 meaning "ticked", 0 meaning "not ticked"):

```
 id   d1_cannabis   d2_cocktail    d3_heroin   d4_cocaine   d6_ecstasy
  1             1             0            0            0            1
  2             1             0            0            1            1
  3             1             0            1            0            0
  4             0             1            1            1            0
  5             0             0            0            0            0
...
```

Thus respondent 1 ticked “Cannabis” and “Ecstasy”, respondent 2 ticked “Cannabis”, “Cocaine (alone)” and “Ecstasy”, and so on. Respondent 5 did not tick any of the boxes.

In the remainder of this paper, I will use the term *indicator mode* to refer to the situation in which the data are stored as a set of indicator variables. Note that it is not crucial that the variables be dichotomous or binary. The important point is just that each item (here each drug) is represented by its own variable.

2.2 Polytomous mode

The indicator mode is particularly suitable if the list of response categories is fixed (like in the example above) and is not too long. However, multiple-response questions are often open or half-open due to their explorative nature. For example, the question on drug consumption might also have been

Which narcotic substances did you consume during the last four weeks?

....

....✍

or maybe

Which narcotic substances did you consume during the last four weeks?

☞ *Check all that apply*

□ Cannabis
□ Cocktail (cocaine/heroin)
□ Heroin (alone)
□ Cocaine (alone)
□ Ecstasy
□ Other substances:

....

....✍

The difference to the closed question in section 2.1 is that the respondent is also given the possibility of naming drugs other than the ones the researchers could think of when constructing the questionnaire. This means that (half-)open questions cannot be divided into separate questions for the different drugs; a final question summarizing the remainder is always needed (e.g., "Besides those you already mentioned, what *other* substances did you consume?").

Thus the list of possible response categories is not fixed, and one would have to update the list of responses continuously while collecting the data: Each time a new drug is named, it would be added to the list and given a unique code. Because the list is not fixed, it is also not possible to set up indicator variables for all items in advance.

Furthermore, even if a complete list of possible answers is known in advance, the indicator mode could be very inefficient because of the vast number of required variables. It would be more efficient in such cases to split the multiple responses according to their "order of appearance". Think of the answers to the above question as lists of drugs (for example, one answer is "cannabis, ecstasy", or "cocaine, heroin, cocktail, morphine"). We would then in each case take the first token of the list and save it in a first variable, take the second token and save it in a second variable, and so on. Thus if we were applying this strategy and using string variables to store the information, the data could look like the following:

```
 id   druguse1   druguse2   druguse3   druguse4
  1   cannabis    ecstasy
  2    ecstasy    cocaine   cannabis
  3     heroin   cannabis
  4    cocaine     heroin   cocktail   morphine
  5        LSD
...
```

A numerical representation of the same data would be, for instance,

```
 id   druguse1   druguse2   druguse3   druguse4
  1          1          5          0          0
  2          5          4          1          0
  3          3          1          0          0
  4          4          3          2          6
  5          7          0          0          0
...
```

with the label definitions 1 "cannabis", 2 "cocktail", 3 "heroin", 4 "cocaine", 5 "ecstasy", 6 "morphine", 7 "LSD", ..., 0 "no further".

Because the multiple responses are stored as a set of polytomous variables, I will call this the *polytomous mode*. The approach is suitable if the list of possible response categories is not clearly defined *ex ante* or if the list is rather long. Sometimes it is also convenient to use the polytomous mode because it reflects the way that the data have been collected. The obvious disadvantage of this approach is that the number of required variables depends on the observed maximum "length" (number of tokens) of a multiple response, which is not known in advance (unless explicitly limited in the questionnaire).[1] Most of the time, it is possible to make reasonable assumptions about this maximum, though.

Depending on the context, the ordering of the answers can be of substantial interest. For example, an instruction to order the drugs according to the frequency of consumption could have been included in the questionnaire. In this paper, however, I will not address the issue of ordered responses.

Of course there are other approaches to storing multiple responses besides the two that have been discussed here; e.g., composite string variables can be used or the data can be stored in long form. See Cox and Kohler (2003a,b) for an overview and advice on how to convert the data into different structures.

3 Analyzing multiple responses

Because of the complex data structure even simple descriptive analyses of multiple-response data like tabulating frequency distributions can be quite involved—especially if the data are stored according to the polytomous mode. A simple solution to the problem would be, of course, to tabulate the single variables on their own and count the frequencies together by hand. A more efficient approach is to transform the data to binary indicators (e.g., using `zb_qrm` by Eric Zbinden or `mrdum` by Lee Sieswerda, both available from the SSC Archive) and then use `tabstat` to tabulate the means of the indicator variables (see [R] **tabstat**). However, this approach is rather limited and is still a lot of work. In addition, there are quite a few details that have to be taken into account while transforming the data, and the whole process is vulnerable to mistakes.

To avoid having to figure out how to transform and analyze multiple responses over and over again, fairly general and easy-to-use commands should be available. There is, for example, the official `tabulate` command (see [R] **tabulate**) to calculate frequency distributions of ordinary variables, and there should be a basic procedure to tabulate multiple responses. In the remainder of this paper, I will thus present the results of some approaches to providing such general and user-friendly instruments.

[1] Of course, the technical maximum length is equal to the number of distinct items covered by the question (e.g., if someone took *all* drugs), unless repeated items are allowed. However, the *reasonable* maximum is usually much smaller than the technical maximum.

3.1 Tables

Syntax

One-way tables

```
mrtab varlist [weight] [if exp] [in range] [, poly response(numlist)
   countall include includemissing casewise title(string) width(#)
   abbrev nolabel nonames format(%fmt) integer sort[(#)] descending
   generate(prefix) nofreq]
```

Two-way tables

```
mrtab varlist [weight] [if exp] [in range] , by(varname) [column row cell
   rcolumn rcell chi2 lrchi2 mtest[(method)] mlrchi2 wrap one-way_options]
```

`by ...:` may be used with `mrtab`; see [R] **by**.
`fweights` and `aweights` are allowed with `mrtab`; see [U] **14.1.6 weight**.

Description

`mrtab` tabulates multiple responses which are stored as a set of variables (*varlist*). `mrtab` can handle the two data-storage modes explained above, that is, the indicator mode and the polytomous mode (see the `poly` option below). The multiple-response variables have to be numeric in the first case and can be numeric or string in the latter (it is not possible to mix numeric and string variables, though). Note that the response variables, if numeric, should contain integer values only. To specify how the values of the variables are to be interpreted, use the `response()` option (see below).

`mrtab` will display either a one-way table of the unconditional distribution of the responses or, if applying `by(`*varname*`)`, a two-way table of the conditional distributions with respect to the groups defined by the values of *varname*. In the former case, counts, frequencies divided by the total of responses, and frequencies divided by the total of observations will be reported.[2] In the latter case, cell counts and, optionally, column, row, or cell percentages based on totals of responses or totals of observations are displayed (see the `column`, `row`, `cell`, `rcolumn`, and `rcell` options).

There are various possibilities to influence the appearance of the displayed table. For example, the display formats of the cell statistics may be specified (`format()`, `integer`), and the width of the left stub of the table can be set (`width()`). It is also possible to influence the labeling (`nolabel`, `nonames`, `name()`) and to sort the response items in order of frequency (`sort`).

[2] I will use the terms “observations”, “cases”, and “respondents” interchangeably in this paper to refer to the objects which data are gathered from, that is, the basic units of analysis (typically, each unit is represented by one row in the data matrix). In contrast, the term “response” refers to the single parts of an answer to a multiple-response question (thus, for multiple-response questions, the total number of responses is typically greater than the total number of units of analysis).

An important issue in calculating relative distributions of multiple responses is the determination of the correct denominator. First, depending on the research question, one has to choose between totals of observations or totals of responses as indicated above (usually, it is proportions on the basis of observations one is interested in). Second, and perhaps less obvious, the sample of relevant observations has to be isolated depending on the nature of the data and the topic of research. The default in `mrtab` is to treat all observations containing at least one response as valid. This behavior can be changed to additionally accounting for cases with zero responses (see the `include` and `includemissing` options). Furthermore, one might want to consider cases with complete information only and neglect all cases with one or more missing values (see the `casewise` option).

`mrtab` also provides (limited) support for significance tests in two-way tables. On the one hand, it is possible to perform a series of separate χ^2 tests for each response item and adjust the p-values to account for simultaneous testing (see the `mtest()` and `mlrchi2` options). On the other hand, overall χ^2 tests are available (`chi2` and `lrchi2`).

Irrespective of the data structure of the original variables, `mrtab` always transforms the data to binary indicator variables internally. It is possible to leave behind the generated indicators for further analysis (see the `generate()` option). The generated variables take on the values 1 or 0—with 1 indicating a response—for the sample of relevant cases (see above); irrelevant cases contain missing values (`.`) for these variables. Thus using `mrtab` to produce indicator variables may also make sense if the data are in the indicator mode already but are not 0/1 or should be harmonized to cover the same subsample of cases.

❑ Technical Note

If the multiple-response data are stored according to the polytomous mode and if the used variables are numeric, the information for labeling the rows (i.e., the response categories) is taken from the label definitions of the *first* variable. It is therefore important that the labels of the first variable be well defined. A good approach is, for example, to use just one set of label definitions, which is attached to all variables used for a certain multiple-response question.

❑

One-way table options

`poly` specifies that the responses are stored according to the polytomous mode. If `poly` is not specified, `mrtab` assumes that the responses are stored according to the indicator mode. However, string response variables imply `poly`.

`response(`*numlist*`)` specifies the (range of) response values. If the data are stored according to the indicator mode, `response()` specifies the values that indicate a response to the item. `response()` defaults to 1 in this case. Note that the indicator variables do not necessarily have to be dichotomous since a list or range of values may be specified. If the data are stored according to the polytomous mode, `response()`

specifies the list or range of responses that are to be tabulated. The default is to tabulate every value observed for the response variables (except for missing values). In the case of string variables, the `response()` option is obsolete.

`countall` requests that repeated identical responses be added up (allowed only for polytomous response variables; see the `poly` option). By default, repeated identical responses will only be counted once per observation. Note that significance tests may not be requested if `countall` is specified. Be careful interpreting results that are labeled "percentage of cases"; though they reflect the mean number of responses per observation, they cannot be interpreted as proportions.

`include` specifies that observations composed of zero responses be treated as valid. Only cases with "real" missings (`.`, `.a`, `.b`, `.c`, ...) for all response variables will be excluded. Note that `include` will affect only the number of valid cases; i.e., both the absolute distribution of responses and the distribution relative to the total of responses will remain unchanged. In the case of string response variables, `include` specifies that cases with only empty strings (`""`) be treated as valid.

`includemissing` is an enhancement to `include` and specifies that cases be treated as valid, even if all response variables are missing. `includemissing` implies `include`. Specifying `includemissing` in connection with `casewise` has the effect that cases with missing values for at least one of the response variables will be treated as valid cases composed of zero responses.

`casewise` specifies that observations with missing values for at least one of the response variables be excluded listwise.

`title(`*string*`)` may be used to label the multiple-response set. *string* will be printed at the head of the table.

`width(`*#*`)` specifies the maximum width (number of characters) used to display the labels of the responses. Labels that are too wide are wrapped (or abbreviated if the `abbrev` option is specified). The default width is 30. The minimum width is 11.

`abbrev` specifies that long response labels be abbreviated rather than wrapped.

`nolabel` suppresses the printing of labels.

`nonames` suppresses the printing of variable names or category values in the left stub of the table; i.e., only the labels will be printed. This option has no effect if the responses are recorded by string variables, and it is not allowed if the response variables are unlabeled or the `nolabel` option is specified.

`format(`*%fmt*`)` specifies the display format for relative frequencies.

`integer` specifies the display of frequencies as integers, even if `aweight`s are applied.

`sort`[`(`*#*`)`] displays the table rows in ascending order of frequency. In the case of a two-way table, the sorting will correspond to the row totals, unless a reference column is specified in parentheses. That is, `sort(1)` will sort in order of the frequencies in the first column (first by-group), `sort(2)` in order of the frequencies in the second column, and so on. Specify the `descending` option to sort in descending order.

`descending` specifies that the sort order be descending. The default is to sort in ascending order. This is only relevant if the `sort` option is specified.

`generate(`*prefix*`)` creates a set of indicator variables reflecting the observed responses. The variables will be labeled and named according to the *prefix* provided. If the `name(`*string*`)` option is specified, the first eight characters of *string* are inserted into the variable labels. If the `chi2` or `lrchi2` options are specified, `generate` will additionally return a composite string variable, *prefix*`rp`, which reflects response patterns (each unique combination of responses is represented by a string of zeros and ones).

`nofreq` suppresses printing the frequencies (i.e., the whole frequency table will be suppressed, unless `cell`, `column`, `row`, `rcell`, or `rcolumn` is specified for two-way tables).

Two-way table options

`by(`*varname*`)` is required and tabulates the distribution of responses against the categories of *varname* (two-way table). The by-variable may be string or numeric.

`column` displays in each cell of a two-way table the relative frequency of that cell within its column (base: column total of observations).

`row` displays in each cell of a two-way table the relative frequency of that cell within its row (base: row total of responses; this is equal to the row total of observations unless `countall` is specified).

`cell` displays the relative frequency of each cell in a two-way table (base: total number of valid observations).

`rcolumn` displays in each cell of a two-way table the relative frequency of that cell within its column (base: column total of responses).

`rcell` displays the relative frequency of each cell in a two-way table (base: total number of responses).

`chi2` requests the calculation of an overall Pearson's χ^2 statistic for the hypothesis that the distribution of response patterns is independent of the values of the by-variable. That is, a standard χ^2 test is applied to an expanded two-way table, where the rows represent unique combinations of responses. Note that the `chi2` option is not allowed if `aweight`s are specified.

`lrchi2` requests the calculation of an overall likelihood-ratio χ^2 statistic (as an alternative to `chi2`). Note that the `lrchi2` option is not allowed if `aweight`s are specified and that the statistic will not be calculated if there are empty cells.

`mtest`[`(`*method*`)`] requests the calculation of separate Pearson χ^2 statistics for each response category. That is, a test is carried out for each response category to establish whether the probability of observing the response depends on the values of the by-variable. Note that the `mtest` option is not allowed if `aweight`s are specified. Multiple-test adjustments may be requested by specifying the method in parentheses. Currently available methods are `bonferroni`, `holm`, `sidak`, and `noadjust`. See the online help for `_mtest` for further information.

`mlrchi2` requests `mtest` to use the likelihood-ratio χ^2 statistics instead of Pearson's χ^2.

`wrap` requests that no action be taken on wide two-way tables to make them readable. Unless `wrap` is specified, wide tables are broken into pieces to enhance readability.

Saved Results

`mrtab` saves in `r()`:

Scalars			
`r(N)`	number of valid cases	`r(p)`	p-value of the overall Pearson's χ^2
`r(N_miss)`	number of missing cases	`r(chi2_lr)`	overall likelihood-ratio χ^2 if `lrchi2` is specified
`r(r)`	number of response categories	`r(p_lr)`	p-value of the overall likelihood-ratio χ^2
`r(c)`	number of by-groups if `by()` is specified	`r(df)`	degrees of freedom of the overall χ^2 tests
`r(chi2)`	overall Pearson's χ^2 if `chi2` is specified		
Macros			
`r(list)`	list of the labels of the responses, if available	`r(bylist)`	list of the labels of the by-groups, if available
`r(mode)`	either `indicator` or `poly`, depending on the mode of the multiple-response variables	`r(bytype)`	either `numeric` or `string`, depending on the storage type of the by-variable
`r(type)`	either `numeric` or `string`, depending on the storage type of the multiple-response variables		
Matrices			
`r(responses)`	frequencies of responses	`r(mchi2)`	Pearson's χ^2 and (adjusted) p-values of the separate tests if `mtest` is specified
`r(cases)`	cases in by-groups if `by()` is specified	`r(mchi2_lr)`	likelihood-ratio χ^2 and (adjusted) p-values of the separate tests if `mtest` and `mlrchi2` are specified

3.2 Graphs

Syntax

mrgraph { bar | hbar | dot | tab } *varlist* [*weight*] [if *exp*] [in *range*] [, poly
response(*numlist*) countall include includemissing casewise sort[(#)]
descending by(*varname*[, *by_subopts*]) stat(*statname*) rtotal ctotal
nopercent nolabel addval[(*string*)] width(#) height(#)
oversubopts(*over_subopts*) *graph_options*]

where *by_subopts* is inboard
or outboard [*over_subopts*]
or separate [*suboptions*]

and *statname* is { freq | column | row | cell | rcolumn | rcell }

fweights and aweights are allowed with mrgraph; see [U] **14.1.6 weight**.

Description

mrgraph is a utility to produce graphs of multiple-response variables. The syntaxes mrgraph bar, mrgraph hbar, and mrgraph dot are specified to indicate use of graph bar, graph hbar, and graph dot, respectively (see [G] **graph bar** and [G] **graph dot**). The size (height or length) of the bars or the position of the dots in the graph corresponds to the frequencies (or, optionally, proportions) of the responses. Thus mrgraph works pretty much like Nick Cox's catplot (Cox 2004), only the frequencies of the categories of a multiple-response question are plotted instead of those of an ordinary categorical variable. Furthermore, mrgraph tab produces table plots in the manner of tabplot (Cox 2004). mrgraph is implemented as a wrapper for mrtab followed by _mrsvmat (see below) and graph.

Options

poly specifies that the responses are stored in polytomous mode. See section 3.1 for details on this option.

response(*numlist*) specifies the (range of) response values. See section 3.1 for details on this option.

countall requests that repeated identical responses be added up. See section 3.1 for details on this option.

include specifies that observations composed of zero responses be treated as valid. See section 3.1 for details on this option.

`includemissing` is an enhancement to `include` and specifies that cases be treated as valid, even if all response variables are missing. See section 3.1 for details on this option.

`casewise` specifies that observations having missing values for at least one of the response variables be excluded listwise.

`sort`[`(`#`)`] draws the categories in ascending order of frequency. If the `by()` option is specified, the sorting will correspond to the totals over all groups, unless a reference group is specified in parentheses. That is, `sort(1)` will sort in order of the frequencies in the first by-group, `sort(2)` in order of the frequencies in the second by-group, and so on. Specify the `descending` option to sort in descending order.

`descending` specifies that the sort order be descending. The default is to sort in ascending order. This is only relevant if the `sort` option is specified.

`by(`*varname*[`,` *by_subopts*]`)` draws the conditional distributions of responses for the categories of *varname*. The by-variable may be string or numeric. The *by_subopts* control the grouping of the results in the graph if the graph type is `mrgraph bar`, `mrgraph hbar`, or `mrgraph dot`. Possible specifications are

`inboard`
The categories of the by-variable are grouped within the categories of the multiple-response variables. This is the default.

`outboard` [*over_subopts*]
The categories of the multiple-response variables are grouped within the categories of the by-variable. The separation of the by-groups is implemented as an additional `over` statement in the internal `graph` call. Thus *over_subopts* may be specified. See [G] **graph bar** and [G] **graph dot**.

`separate` [*suboptions*]
For each category of the by-variable, a separate plot is drawn within a single graph. This conforms to the default behavior of the `by` option in Stata's `graph` commands (which, however, is not the default in `mrgraph`). See [G] ***by_option*** for details on the *suboptions*.

`stat(`*statname*`)` determines the statistic on which the graph is to be based. *statname* is either `freq`, if raw frequencies are used, or `column` (base: column total of observations), `row` (base: row total), `cell` (base: grand total of valid observations), `rcolumn` (base: column total of responses), or `rcell` (base: grand total of responses), if relative frequencies are used. `stat(freq)` is the default.

`rtotal` specifies that row totals be reported.

`ctotal` specifies that column totals be reported.

`nopercent` specifies that relative frequencies be formatted as proportions (e.g., .271) instead of percentages (e.g., 27.1).

`nolabel` specifies that labels be ignored.

`addval`[`(`*string*`)`] specifies that labels *and* values (or variable names in the case of the indicator mode) be used to mark the responses in the graph. The values and labels will be separated by *string* if specified or by a blank otherwise (use quotes if the desired delimiter is supposed to have leading or trailing blanks, i.e., `addval(": ")`). If the `addval` option is not specified, labels are used exclusively. If no labels are available, however, values are used, and `addval` will have no effect. Furthermore, `addval` will have no effect if the response variables are string.

`width(`*#*`)` specifies the maximum width (number of chars) used to draw the labels of the responses. Labels that are too wide are wrapped. Note that the single words in the labels will not be broken. If no `width` is specified, labels are not wrapped.

`height(`*#*`)` controls the amount of available graph space taken up by bars in the table plot. This option is only relevant if the graph type is `mrgraph tab`. The default is 0.8.

`oversubopts(`*over_subopts*`)` may be used to pass through suboptions to the `over` option, which is applied by `mrgraph` in the internal call of the `graph` command. This is only relevant for the graph types `mrgraph bar`, `mrgraph hbar`, and `mrgraph dot`. For further explanations of the `over` option and its suboptions, see [G] **graph bar** and [G] **graph dot**. Do not use the `sort` suboption; use `mrgraph`'s own `sort` option instead (see above).

graph_options are any options documented in [G] **graph bar**, [G] **graph hbar**, ...

3.3 From tables to datasets

Syntax

`_mrsvmat` [`, stat(`*statname*`) rtotal ctotal nopercent nolabel clear`]

where *statname* is { `freq` | `column` | `row` | `cell` | `rcolumn` | `rcell` }

Description

`_mrsvmat` is a low-level utility which may be used after `mrtab` to prepare a data matrix for creating graphs of the tabulated distribution. Do not use `_mrsvmat`, unless you are confident that `mrgraph` does not meet your needs. It is important to understand that `_mrsvmat` will destroy the data in memory; therefore, it should always be used in connection with `preserve` (see [R] **preserve**). `_mrsvmat` will replace the data in memory with a data matrix created from the results left behind by `mrtab`. Each row of the new data will represent one row of the table displayed by `mrtab`; that is, each row will represent one response category. Additionally, a row holding column totals will be added if the `ctotal` option is specified. `_mrsvmat` will generate the following variables:

Variable	Description
`R`	Values of the response categories or names of the variables representing the response items, depending on the structure of the original data.
`L`	Labels of the response categories. Variable `L` will be suppressed if either no labels are found or the `nolabel` option is specified.
`C1`, `C2`, ...	Frequencies of responses. In the case of two-way tables, each variable represents one column of the multiple-response table. In the case of a one-way table, just one variable, `C1`, will be created. Depending on the user's choice, the data cells will either contain raw counts or frequencies relative to a specified base (see the `stat()` option).
`T`	Row totals if option `rtotal` is specified; suppressed otherwise.

Options

`stat(`*statname*`)` determines the statistic to be saved. *statname* is either `freq` for raw frequencies or `column` (base: column total of observations), `row` (base: row total), `cell` (base: grand total of valid observations), `rcolumn` (base: column total of responses), or `rcell` (base: grand total of responses) for relative frequencies. `stat(freq)` is the default.

`rtotal` specifies that row totals be saved.

`ctotal` specifies that column totals be saved.

`nopercent` specifies that relative frequencies be formatted as proportions (e.g., .271) instead of percentages (e.g., 27.1).

`nolabel` specifies that labels be ignored.

`clear` allows `_mrsvmat` to clear the data in memory without asking for confirmation.

4 Remarks and examples

To illustrate the use of multiple-response commands, I will present analyses of data collected by Braun et al. (2001). The respondents in this study were drug addicts in three major cities in Switzerland in 1997.

4.1 One-way tables

The indicator mode

The respondents in the study by Braun et al. (2001) were asked to indicate their sources of income in the last three months. A list of possible sources was provided in the questionnaire. Braun et al. recorded the data with a set of 0/1 variables, one for each income source:

```
. use drugs
(1997 Survey Data on Swiss Drug Addicts)

. describe inco1-inco7

              storage  display     value
variable name   type   format      label      variable label
-------------------------------------------------------------------------------
inco1           byte   %8.0g       yesno      private support (partner,
                                                family, friends)
inco2           byte   %8.0g       yesno      public support (unemployment
                                                insurance, social benefits)
inco3           byte   %8.0g       yesno      drug dealing
inco4           byte   %8.0g       yesno      housebreaking, theft, robbery
inco5           byte   %8.0g       yesno      prostitution
inco6           byte   %8.0g       yesno      "mischeln"/begging
inco7           byte   %8.0g       yesno      legal occupation
```

Note that “mischeln” is a Swiss–German word and describes a form of begging in which the beggar actively approaches people for money (i.e., walks up to them and asks them for money).

In the first step of the data analysis one would probably like to tabulate the sample distribution of the income sources. However, because the information is stored across several variables, the `tabulate` command is not very convenient: each of the indicator variables would have to be tabulated separately. Because the variables are 0/1 in the present case, we could, however, use the `tabstat` command to tabulate the sums and the proportions of the responses:

```
. tabstat inco1-inco7, s(sum mean) c(s)

    variable |       sum      mean
-------------+--------------------
       inco1 |       226  .2325103
       inco2 |       607  .6244856
       inco3 |       293  .3014403
       inco4 |        50  .0514403
       inco5 |        82  .0843621
       inco6 |       151  .1553498
       inco7 |       352  .3621399
----------------------------------
```

We see, for example, that 36 % of the respondents ticked the 7th income source (legal occupation). Unfortunately, the `tabstat`’s output is rather meager. A more informative output can, however, be obtained by using the new `mrtab` command:

(*Continued on next page*)

```
. mrtab inco1-inco7, sort title(Sources of income)
                                                     Percent of      Percent
                     Sources of income   Frequency    responses     of cases
──────────────────────────────────────────────────────────────────────────
inco4  housebreaking, theft, robbery          50          2.84         5.19
inco5                   prostitution          82          4.66         8.52
inco6              "mischeln"/begging        151          8.57        15.68
inco1      private support (partner,         226         12.83        23.47
                       family, friends)
inco3                   drug dealing         293         16.64        30.43
inco7               legal occupation         352         19.99        36.55
inco2   public support (unemployment         607         34.47        63.03
          insurance, social benefits)
──────────────────────────────────────────────────────────────────────────
                                 Total      1761        100.00       182.87
Valid cases:         963
Missing cases:         9
```

The different response categories are nicely labeled, and it is possible, for instance, to sort the categories in order of frequency. Therefore, it is immediately evident from the table above that "public support" is the source of income that has been named the most often, whereas "housebreaking, theft, robbery" is the least-frequent source of income.

In addition to percentages on the basis of observations (i.e., cases) mrtab also reports percentages with respect to the overall sum of responses. For example, 35 % of all responses are "public support". Furthermore, mrtab also provides a row reporting the totals over all response categories. Note that the total printed in the "percentage of cases" column reflects the average number of responses per subject (multiplied by 100). Thus the mean number of sources of income is approximately 1.8 in this study.

❑ Technical Note

Note that, in the above example, the percentages reported by mrtab slightly differ from the means calculated by tabstat. The reason for the difference is that mrtab excluded 9 observations for which no sources of income were recorded. In such cases, it is often not clear *a priori* whether the respondent refused to answer the question (and thus should be excluded from analysis) or whether the correct response is simply "none" (in which case, the observation should be accounted for). Because the determination of the correct denominator depends on the context (e.g., the specific construction of the question, the topic, how the data have been recorded, etc.), mrtab provides specific options to determine the sample of valid observations (include, includemissing, casewise). In the context of the present example, it seems reasonable to include the observations with zero responses because the given list of seven different income types is probably not exhaustive. We, thus, should have specified

```
. mrtab inco1-inco7, include sort title(Sources of income)
                                         |                Percent of      Percent
                       Sources of income |   Frequency     responses     of cases
-----------------------------------------+-----------------------------------------
inco4  housebreaking, theft, robbery     |         50          2.84         5.14
inco5                      prostitution  |         82          4.66         8.44
inco6                "mischeln"/begging  |        151          8.57        15.53
inco1        private support (partner,   |        226         12.83        23.25
                      family, friends)   |
inco3                      drug dealing  |        293         16.64        30.14
inco7                  legal occupation  |        352         19.99        36.21
inco2   public support (unemployment     |        607         34.47        62.45
         insurance, social benefits)     |
-----------------------------------------+-----------------------------------------
                                   Total |       1761        100.00       181.17
Valid cases:          972
Missing cases:          0
```

❑

❑ Technical Note

Although the variables in the indicator mode are interpreted in a dichotomous manner, they do not necessarily have to be 0/1 nor dichotomous in general. Basically, all kinds of variables are allowed, as long as they are integer. By default, `mrtab` interprets the value "1" as a response and all the other values (e.g., "0") as "no response". However, the default response value may be changed via the `response(`*numlist*`)` option. If specified, any value of *numlist* will be considered as indicating a response.

The respondents in the drug study were also asked about their experiences with crime. ("Have you been involved in the following offenses . . . during the last 12 months: hit someone; used a weapon against someone; sexual harassment, rape; robbery; blackmail?") For each of the different types of crimes a variable like the following has been recorded:

```
. codebook crime1
-------------------------------------------------------------------------------
crime1                                                              hit someone
-------------------------------------------------------------------------------

                  type:  numeric (byte)
                 label:  crime

                 range:  [0,3]                        units:  1
         unique values:  4                        missing .:  65/972

            tabulation:  Freq.   Numeric  Label
                           716         0  no
                            62         1  yes, as committer
                            97         2  yes, as victim
                            32         3  yes, both
                            65         .
```

As indicated by the value labels, it is probably sensible to distinguish between criminal experiences in the role of a committer and criminal experiences in the role of the victim. Thus with the help of the `response()` option, we derive the following results:

```
. mrtab crime1-crime5, include response(1 3) title(Crime (as committer)) nonames
                                      |            Percent of     Percent
         Crime (as committer)         | Frequency   responses    of cases
--------------------------------------+------------------------------------
                   hit someone        |        94       54.02       10.36
    use a weapon against someone      |        20       11.49        2.21
         sexual harassment, rape      |         1        0.57        0.11
  robbery (including drug theft)      |        51       29.31        5.62
                     blackmail        |         8        4.60        0.88
--------------------------------------+------------------------------------
                         Total        |       174      100.00       19.18
Valid cases:        907
Missing cases:       65
. mrtab crime1-crime5, include response(2 3) title(Crime (as victim)) nonames
                                      |            Percent of     Percent
            Crime (as victim)         | Frequency   responses    of cases
--------------------------------------+------------------------------------
                   hit someone        |       129       41.08       14.22
    use a weapon against someone      |        27        8.60        2.98
         sexual harassment, rape      |        31        9.87        3.42
  robbery (including drug theft)      |        99       31.53       10.92
                     blackmail        |        28        8.92        3.09
--------------------------------------+------------------------------------
                         Total        |       314      100.00       34.62
Valid cases:        907
Missing cases:       65
```

The first part of the output reports the frequencies of criminal experiences as a committer (or committer and victim), the second the frequencies of experiences as a victim (or victim and committer). Apparently, the respondents reported that they had been a victim of a crime considerably more often than they had committed a crime themselves. Thus either the sample is selective, the respondents did not report all the crimes they committed, or there are a few subjects committing many crimes repeatedly. Note that 65 respondents with missing information for this question were excluded.

❑

The polytomous mode

Sometimes, if the list of possible response categories is open, for instance, it is convenient to store the answers to multiple-response questions as a set of polytomous variables. For example, the answers to the question on income sources of drug addicts in Switzerland could have been recorded in polytomous mode rather than using a set of indicator variables. The maximum number of possible responses per observation is seven in this specific case because the list of response categories is limited to seven different income sources. However, the realized maximum of responses is only six. Thus six polytomous response variables are required. The following output shows one of them:[3]

[3] The data have been generated by saving each respondent's answers in random order. The shuffling of the answers was done by the `sortlistby2` command, which is available from the SSC Archive (type `ssc describe sortlistby`).

```
. codebook pinco1
-------------------------------------------------------------------------------
pinco1                                                              (unlabeled)
-------------------------------------------------------------------------------

                  type:  numeric (byte)
                 label:  inco

                 range:  [-1,7]                       units:  1
         unique values:  8                        missing .:  0/972

            tabulation:  Freq.   Numeric  Label
                             9        -1  no further sources
                            98         1  private support (partner,
                                          family, friends)
                           373         2  public support (unemployment
                                          insurance, social benefits)
                           138         3  drug dealing
                            17         4  housebreaking, theft, robbery
                            38         5  prostitution
                            74         6  "mischeln"/begging
                           225         7  legal occupation
```

Multiple responses that are stored in such a way cannot be tabulated using `tabstat` because the information on the single response categories is spread out over several variables. The data would have to be transformed to indicator mode beforehand, which is quite a complicated task. However, polytomous multiple-response variables can be tabulated by `mrtab` if the `poly` option is specified:

```
. mrtab pinco1-pinco6, poly response(1/7) include sort abbrev
                                   |              Percent of     Percent
                                   |  Frequency   responses     of cases
-----------------------------------+------------------------------------
 4  housebreaking, theft, robbery  |        50         2.84         5.14
 5                   prostitution  |        82         4.66         8.44
 6             "mischeln"/begging  |       151         8.57        15.53
 1 private support (partner, fami  |       226        12.83        23.25
 3                   drug dealing  |       293        16.64        30.14
 7               legal occupation  |       352        19.99        36.21
 2 public support (unemployment i  |       607        34.47        62.45
-----------------------------------+------------------------------------
                             Total |      1761       100.00       181.17
Valid cases:        972
Missing cases:        0
```

Furthermore, string variables can also be tabulated by `mrtab`, as is shown in the following example. Note that it is not necessary to specify the `poly` option in the case of string variables.

```
. codebook sinco1
-------------------------------------------------------------------------------
sinco1                                                              (unlabeled)
-------------------------------------------------------------------------------
                  type:  string (str56)
         unique values:  7                        missing "":  9/972
            tabulation:  Freq.  Value
                             9  ""
                            74  ""mischeln"/begging"
                           138  "drug dealing"
                            17  "housebreaking, theft, robbery"
                           225  "legal occupation"
                            98  "private support (partner, family,
                                friends)"
                            38  "prostitution"
                           373  "public support (unemployment insurance,
                                social benefits)"
               warning:  variable has embedded blanks
. mrtab sinco1-sinco6, include sort abbrev
                               |             Percent of     Percent
                               |  Frequency   responses    of cases
-------------------------------+-----------------------------------
 housebreaking, theft, robbery |         50        2.84        5.14
                  prostitution |         82        4.66        8.44
            "mischeln"/begging |        151        8.57       15.53
private support (partner, fami |        226       12.83       23.25
                  drug dealing |        293       16.64       30.14
              legal occupation |        352       19.99       36.21
public support (unemployment i |        607       34.47       62.45
-------------------------------+-----------------------------------
                         Total |       1761      100.00      181.17
Valid cases:        972
Missing cases:        0
```

❑ Technical Note

In the case of “half-open” multiple-response questions, a mixed storage design is sometimes applied (half-open means that some categories are spelled out and can be ticked, but there are also some empty lines which can be filled with further answers). That is, the first part of the answers is stored in indicator mode (the tickable items) while the rest are held in polytomous mode. It may be convenient to use `mrtab`’s `generate()` option in such a case to transform the polytomous part to indicator mode.

❑

Significance tests

The test for equality of proportions in matched samples proposed by Cochran (1950) may be applied to evaluate the significance of the differences among the proportions of the single response categories. If c is the number of response categories, T_j the number of responses in the jth category, $\overline{T}$ the mean number of responses per category, and u_i

the number of responses in the ith observation, the test statistic proposed by Cochran is then defined as

$$Q = \frac{c(c-1)\sum_j (T_j - \overline{T})^2}{c\sum_i u_i - \sum_i u_i^2}$$

For large samples, Q is χ^2-distributed with $(c-1)$ degrees of freedom. Note that in the case of only two response categories, the Cochran test is equal to the McNemar χ^2 test implemented in `mcc` (see [ST] **epitab**).

In our example on income sources, the differences in the proportions of the various responses are highly significant (this is not surprising since the proportions range from 5% to 62%!):

```
. mrtab pinco1-pinco6, poly response(1/7) nofreq include generate(_inco)
. cochran _inco*
Test for equality of proportions in matched samples (Cochran's Q):
Number of obs       =       972
Cochran's chi2(6)   =  1123.529
Prob > chi2         =    0.0000
. drop _inco*
```

Note that the `cochran` command is not part of the official release of Stata. However, it can be obtained from the SSC Archive (type `ssc install cochran`).

❑ Technical Note

An alternative approach to testing for differences in the proportions would be to transform the data to long format (see [R] **reshape**) and then estimate, for example, a logistic regression, including dummy variables for the different response categories and correcting the standard errors for the clustering on observations:

```
. preserve
. mrtab pinco1-pinco6, poly response(1/7) nofreq include generate(_inco)
. reshape long _inco, i(id) j(R)
  (output omitted)
```

(*Continued on next page*)

```
. xi: logit _inco i.R, cluster(id) nolog
i.R               _IR_1-7             (naturally coded; _IR_1 omitted)

Logit estimates                                   Number of obs   =       6804
                                                  Wald chi2(6)    =     895.23
                                                  Prob > chi2     =     0.0000
Log pseudo-likelihood =  -3299.692                Pseudo R2       =     0.1519

                               (standard errors adjusted for clustering on id)
------------------------------------------------------------------------------
             |               Robust
       _inco |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       _IR_2 |   1.702822   .1020924    16.68   0.000     1.502725    1.902919
       _IR_3 |   .3537421   .1016399     3.48   0.001     .1545315    .5529527
       _IR_4 |  -1.720332   .1598888   -10.76   0.000    -2.033708   -1.406955
       _IR_5 |  -1.190312    .137136    -8.68   0.000    -1.459093   -.9215301
       _IR_6 |  -.4990527   .1091339    -4.57   0.000    -.7129512   -.2851541
       _IR_7 |   .6281023   .1018616     6.17   0.000     .4284573    .8277473
       _cons |  -1.194191   .0759684   -15.72   0.000    -1.343086   -1.045295
------------------------------------------------------------------------------

. restore
```

The null hypothesis of equal proportions is rejected if the overall Wald χ^2 of the model is significant (which is obviously the case here). Note that the choice of the logistic regression model is not crucial here. We might as well use probit or even linear regression. The only really important thing is to take account of the clustering (an issue that is sometimes referred to as "matched samples"). We might also think of applying panel models, e.g., `xtlogit` or `xtreg` (see [XT] **xt**; the tests based on panel models will usually be more efficient).

❑

4.2 Two-way tables

In most applications, not only the marginal distribution of the responses is of interest, but also the conditional distributions with regard to the values of some other variable. For example, it might be interesting to examine the differences among the drug scenes in the three cities covered in the study by Braun et al. (2001). Again considering the income sources of the drug addicts, we could use `mrtab` to produce the following two-way table:

(*Continued on next page*)

```
. mrtab inco1-inco7, include sort title(Sources of income) nonames
> width(28) by(city) column

  +-------------------------+
  | Key                     |
  |-------------------------|
  | frequency of responses  |
  | column percent of cases |
  +-------------------------+

                             | City in which the interview was
                             |            conducted
           Sources of income |     Basel       Bern     Zurich |     Total
-----------------------------+---------------------------------+-----------
      housebreaking, theft,  |        13         23         14 |        50
                     robbery |      3.74       7.99       4.17 |      5.14
-----------------------------+---------------------------------+-----------
                prostitution |        20         38         24 |        82
                             |      5.75      13.19       7.14 |      8.44
-----------------------------+---------------------------------+-----------
           "mischeln"/begging|        43         62         46 |       151
                             |     12.36      21.53      13.69 |     15.53
-----------------------------+---------------------------------+-----------
   private support (partner, |        92         71         63 |       226
           family, friends)  |     26.44      24.65      18.75 |     23.25
-----------------------------+---------------------------------+-----------
                drug dealing |       102        101         90 |       293
                             |     29.31      35.07      26.79 |     30.14
-----------------------------+---------------------------------+-----------
            legal occupation |       132        103        117 |       352
                             |     37.93      35.76      34.82 |     36.21
-----------------------------+---------------------------------+-----------
public support (unemployment |       205        172        230 |       607
 insurance, social benefits) |     58.91      59.72      68.45 |     62.45
-----------------------------+---------------------------------+-----------
                       Total |       607        570        584 |      1761
                             |    174.43     197.92     173.81 |    181.17
                       Cases |       348        288        336 |       972
Valid cases:        972
Missing cases:        0
```

It is striking that the drug scene in Bern is quite different from the scenes in the two other cities. The Bern scene seems to be much more criminal: the measured rates of theft/robbery, prostitution, and drug dealing are clearly highest. In addition, the proportion of beggars is highest in the Bern sample. Another substantial difference in the table is that Zurich has a relatively high rate of drug addicts who live off public support, whereas the proportion of respondents receiving private support is relatively low. Possibly, there is a tradeoff between public and private support.

Significance tests

In order to assess whether the observed differences between the cities are significant or not, we can, for example, conduct an overall Pearson or likelihood-ratio χ^2 test that is based on an expanded table of the frequencies of response "patterns" by cities. Applied to the above table, the results of the tests are

```
. mrtab inco1-inco7, include by(city) nofreq chi2 lrchi2 generate(_inco)
Overall Test(s) of Significance:
        Pearson chi2(150) = 210.0806   Pr = 0.001
likelihood-ratio chi2(150) =        .
```

The Pearson χ^2 test indicates that the differences are indeed significant (assuming a 5 % significance level). But what about the likelihood-ratio test? Apparently it could not be evaluated because of the occurrence of empty cells. The problem is that the test is based on a variable identifying response "patterns". In the example above, the patterns variable looks as follows (first six cases only):

```
. list _incorp in 1/6, clean
       _incorp
  1.   0000010
  2.   0100000
  3.   0000010
  4.   0100000
  5.   0000001
  6.   1100000
. drop _inco*
```

That is, a response pattern is a composite string of zeros and ones with ones indicating a response. For instance, respondent 1s source of income is a legal occupation, respondent 6s sources are theft and prostitution, etc. As the number of response categories increases, the number of unique response patterns grows exponentially. In the present case of seven categories, there are $2^7 = 128$ unique patterns. This means that the table of the patterns variable against the three cities potentially has $128 \cdot 3 = 384$ cells. Quite a few observations are needed to fill all these cells. The overall test, thus, is not very powerful (many degrees of freedom) and is only suited if there are very few categories.

A better and probably more informative strategy is to test each row of the table separately. This can be done using standard χ^2 or likelihood-ratio tests for two-way tables; in fact, each row of a two-way multiple-response table is nothing else than a dense version of a $2 \times k$ table of a specific response indicator against the by-variable. Use mrtab's mtest option to add a column to the multiple-response table reporting the results of the row-specific tests:

(*Continued on next page*)

```
. mrtab inco1-inco7, include sort title(Sources of income) nonames
> width(19) by(city) column mtest(bonferroni)

  +-------------------------+
  | Key                     |
  |-------------------------|
  | frequency of responses  |
  | column percent of cases |
  +-------------------------+

                    |  City in which the interview was
                    |             conducted
  Sources of income |     Basel        Bern      Zurich |     Total   chi2/p*
--------------------+------------------------------------+-----------
     housebreaking, |        13          23          14 |        50     6.840
     theft, robbery |      3.74        7.99        4.17 |      5.14     0.229
--------------------+------------------------------------+-----------
       prostitution |        20          38          24 |        82    12.427
                    |      5.75       13.19        7.14 |      8.44     0.014
--------------------+------------------------------------+-----------
 "mischeln"/begging |        43          62          46 |       151    11.433
                    |     12.36       21.53       13.69 |     15.53     0.023
--------------------+------------------------------------+-----------
    private support |        92          71          63 |       226     6.111
  (partner, family, |     26.44       24.65       18.75 |     23.25     0.330
           friends) |                                    |
--------------------+------------------------------------+-----------
       drug dealing |       102         101          90 |       293     5.232
                    |     29.31       35.07       26.79 |     30.14     0.512
--------------------+------------------------------------+-----------
   legal occupation |       132         103         117 |       352     0.751
                    |     37.93       35.76       34.82 |     36.21     1.000
--------------------+------------------------------------+-----------
     public support |       205         172         230 |       607     7.938
      (unemployment |     58.91       59.72       68.45 |     62.45     0.132
   insurance, social |                                    |
          benefits) |                                    |
--------------------+------------------------------------+-----------
              Total |       607         570         584 |      1761
                    |    174.43      197.92      173.81 |    181.17
              Cases |       348         288         336 |       972
* Pearson chi2(2) / Bonferroni adjusted p-values

Valid cases:         972
Missing cases:         0
```

Note that, in the example, the p-values have been adjusted for the fact that a series of tests is performed (see, e.g., Wright 1992). There are several adjustment methods available (`bonferoni`, `holm`, `sidak`; see the online help for `_mtest` for formulas and further details). The results above indicate that the differences among the three cities concerning prostitution and begging are significant.

❑ Technical Note

An alternative and more flexible strategy would again be to reshape the data and apply regression models. First, dummy variables for the different response categories need to be introduced to the model to account for the different levels of prevalence.

To evaluate the overall significance of the differences among the response distributions in the three cities, we then include dummy variables for the cities, as well as for all interactions between cities and response categories, and perform a joint test for all these parameters:

```
. preserve
. mrtab inco1-inco7, include nofreq generate(_inco)
. reshape long _inco, i(id) j(R)
  (output omitted)
. xi: logit _inco i.R*i.city, cluster(id)
  (output omitted)
. unab I : _Icity* _IRX*
. test ‘I’
 ( 1)  _Icity_2 = 0
 ( 2)  _Icity_3 = 0
 ( 3)  _IRXcit_2_2 = 0
 ( 4)  _IRXcit_2_3 = 0
 ( 5)  _IRXcit_3_2 = 0
 ( 6)  _IRXcit_3_3 = 0
 ( 7)  _IRXcit_4_2 = 0
 ( 8)  _IRXcit_4_3 = 0
 ( 9)  _IRXcit_5_2 = 0
 (10)  _IRXcit_5_3 = 0
 (11)  _IRXcit_6_2 = 0
 (12)  _IRXcit_6_3 = 0
 (13)  _IRXcit_7_2 = 0
 (14)  _IRXcit_7_3 = 0
           chi2( 14) =   43.12
         Prob > chi2 =    0.0001
. restore
```

Again, the choice of a specific model is not critical, as long as the specification is correct and the clustering is accounted for. Very similar results are obtained, for example, using `xtlogit` (see [XT] **xtlogit**):

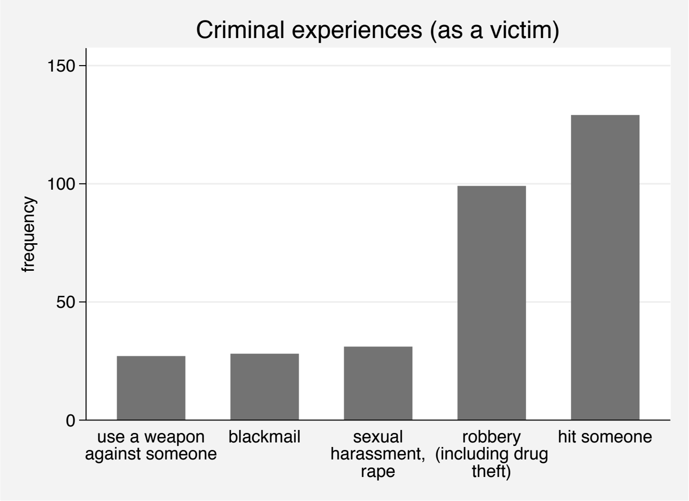
```
. quietly xi: xtlogit _inco i.R*i.city, re i(id)
. estimates store A
. quietly xi: xtlogit _inco i.R, re i(id)
. lrtest A
(log-likelihoods of null models cannot be compared)
likelihood-ratio test                                 LR chi2(14) =     49.23
(Assumption: . nested in A)                           Prob > chi2 =    0.0000
```

❑

4.3 Graphs

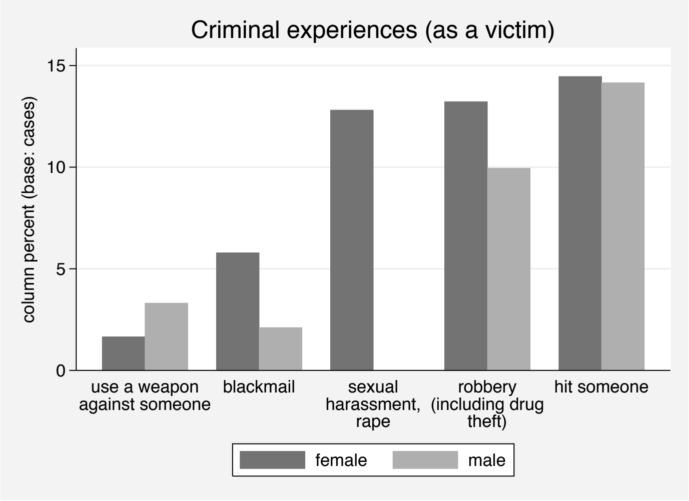
A convenient way to illustrate multiple-response distributions are bar charts whereby the sizes of the bars represent the frequencies of the response categories. For example, the frequencies of criminal experiences as a victim (see section 4.1) could be plotted as follows:

```
. mrgraph bar crime1-crime5, include response(2 3) sort width(15)
> title(Criminal experiences (as a victim)) ylabel(,angle(0))
```



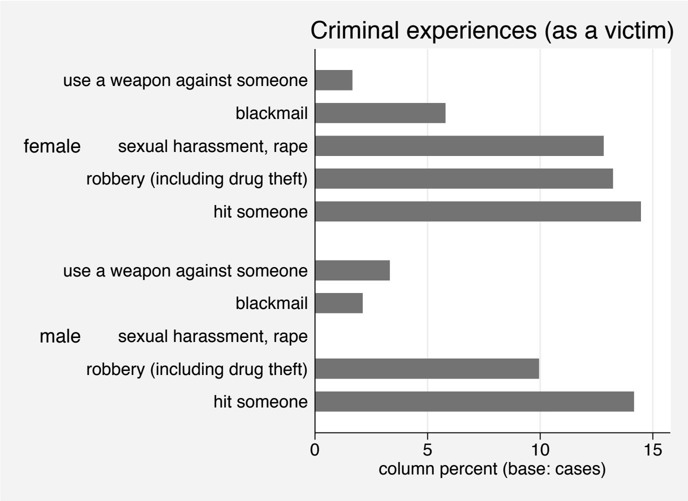
If the frequencies of two-way multiple-response tables are plotted (e.g., criminal experiences by sex), the grouping of the bars becomes relevant. Thus, the `by()` option of the `mrgraph` command comes in different flavors. The default is to group the categories of the by-variable within the response categories, as is illustrated in the following example:

```
. mrgraph bar crime1-crime5, include response(2 3) sort width(15) by(sex)
> stat(column) title(Criminal experiences (as a victim))
> ylabel(,angle(0)) legend(bmargin(t+1))
```



The advantage of this illustration is that the differences between the by-groups can be seen immediately for each response category. However, it might sometimes be preferable to separate the conditional distributions and thus to group the response categories within by-categories:

```
. mrgraph hbar crime1-crime5, include response(2 3) sort by(sex, outboard)
> stat(column) title(Criminal experiences (as a victim)) ylabel(,angle(0))
```

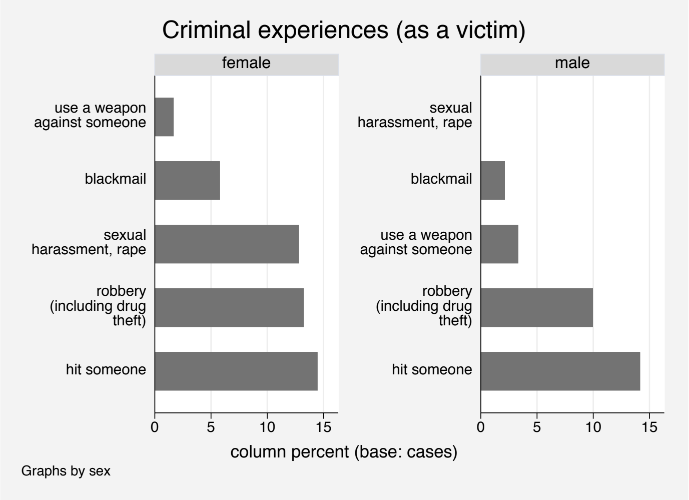


It is also possible to completely separate the conditional distributions and display them as several plots within the same graph. A nice feature of this procedure is that it is possible to sort the separate distributions individually and thus illustrate differences in the ordering of the frequencies:[4]

(*Continued on next page*)

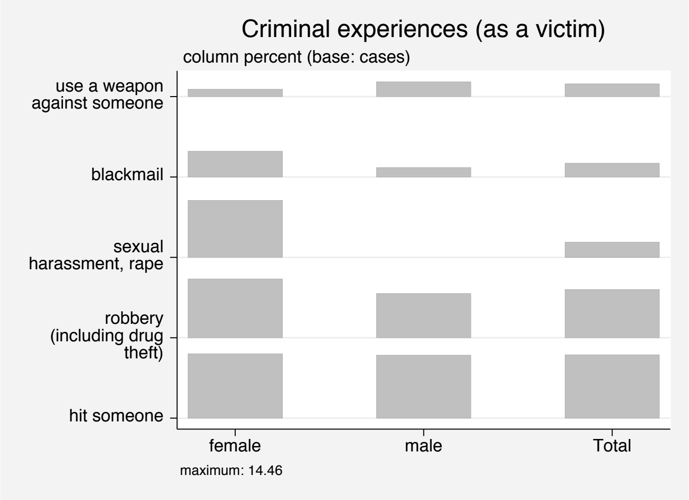
[4] Note that it is important to specify `sort(1)` here to achieve the individual sorting. Specifying the `sort` option without argument would sort in order of the unconditional distribution.

```
. mrgraph hbar crime1-crime5, include response(2 3) sort(1) width(16)
> stat(column) by(sex, separate title(Criminal experiences (as a victim)))
```



Last but not least, a very straightforward method to illustrate a two-way multiple-response table is to construct a "table plot" as proposed by Cox (2004) for ordinary two-way tables:

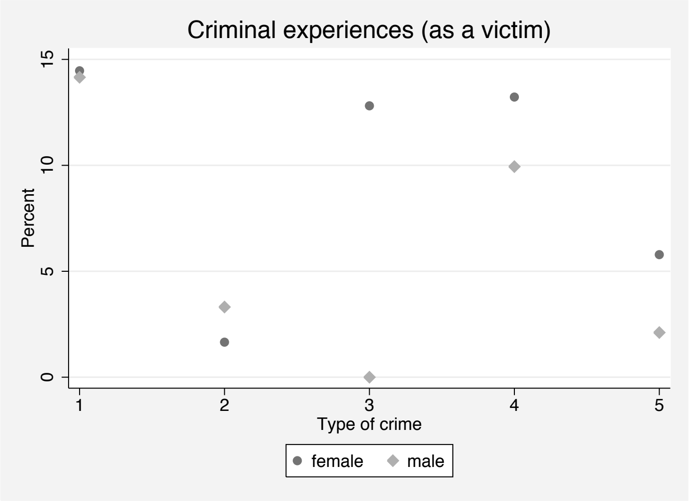
```
. mrgraph tab crime1-crime5, include response(2 3) sort width(16)
> stat(column) by(sex) rtotal title(Criminal experiences (as a victim))
```



❑ Technical Note

The mrgraph command is implemented as a wrapper for mrtab followed by the low-level utility _mrsvmat. The purpose of _mrsvmat is to pick up the results calculated by mrtab and compose a dataset representing the results (note that the data in memory will be lost). It can be helpful to use the _mrsvmat command manually to produce graphs that are not supported by mrgraph. The following piece of output provides an example:

```
. mrtab crime1-crime5, include response(2 3) by(sex) nofreq
. preserve
. _mrsvmat, stat(column) ctotal rtotal clear
. list, clean string(20)
          R   L                               C1          C2           T
1.   crime1   hit someone               14.46281    14.15663    14.23841
2.   crime2   use a weapon against..    1.652893    3.313253    2.869757
3.   crime3   sexual harassment, r..    12.80992           0    3.421633
4.   crime4   robbery (including d..    13.22314    9.939759    10.81678
5.   crime5   blackmail                 5.785124    2.108434    3.090508
6.        T   Total                     47.93388    29.51807    34.43708
. generate x=_n
. scatter C1 C2 x in 1/5, xtitle(Type of crime) ytitle(Percent)
> title(Criminal experiences (as a victim))
```



Note that the _mrsvmat utility can also be useful for exporting the results of mrtab. For example, use Roger Newson's listtex command after having applied _mrsvmat in order to create a LaTeX table (see Newson 2003).

❑

5 Acknowledgments

The `mrtab` command is coauthored by Hilde Schaeper (HIS Hannover, Germany). I am greatly indebted to her for starting the project and taking me aboard. I would like to thank her and her colleagues at HIS for many important suggestions and for debugging.

Furthermore, I would like to thank Elisabeth Coutts (ETH Zurich), Jens Lauritsen, and Christian Færgemann (Odense Universitetshospital), Sandro Leidi (University of Reading), and Eric Zbinden (University of Geneva) for helpful comments and suggestions.

6 References

Braun, N., B. Nydegger Lory, R. Berger, and C. Zahner. 2001. *Illegale Märkte für Heroin und Kokain*. Bern: Haupt.

Cochran, W. G. 1950. The comparison of percentages in matched samples. *Biometrika* 37(3/4): 256–266.

Cox, N. J. 2004. Speaking Stata: Graphing categorical and compositional data. *Stata Journal* 4(2): 190–215.

Cox, N. J. and U. Kohler. 2003a. FAQ: Dealing with multiple responses.
http://www.stata.com/support/faqs/data/multresp.html.

—. 2003b. Speaking Stata: On structure and shape: the case of multiple responses. *Stata Journal* 3(1): 81–99.

Newson, R. 2003. Confidence intervals and p-values for delivery to the end user. *Stata Journal* 3(3): 245–269.

Wright, S. P. 1992. Adjusted p-values for simultaneous inference. *Biometrics* 48: 1005–1013.

About the Author

Ben Jann (jann@soz.gess.ethz.ch) is research assistant at the Department of Sociology of the Swiss Federal Institute of Technology Zurich (ETH) and a Ph.D. candidate at the University of Bern in Switzerland.