

# The SurveyAMC Package Version 1.0

<https://www.survey.codes/surveyamc>

## Tutorial

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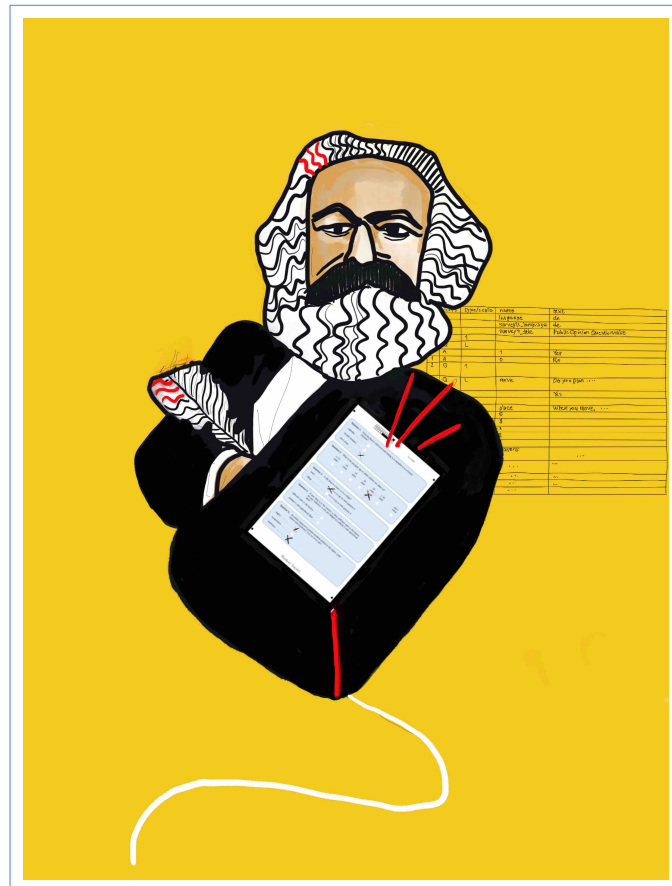


Illustration by Camilla Yamane, <https://www.instagram.com/yamacami/>

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# 1 Guiding Example

In 1880 Karl Marx intended to investigate the living and working conditions of the french working class through a survey of workers. It is considered one of the first works of empirical social research. Marx developed a questionnaire with over a hundred questions to which he seeks respondence by publishing it in the magazine “Revenue Socialiste” and by distributing a large number of copies throughout France (Weiss, 1936). Since he designed all questions as open-ended questions, respondents had to formulate their answers with their own words and write them down. As we know today, the results of this survey were never published, maybe due to a horrifying small response rate (ibid.) or due to the tremendous amount of work to code and analyze the handwritten answers. But what if Marx could have used **SurveyAMC** to create a standardized machine-readable questionnaire?

The questionnaire follows on the next page.

Figure 1: Karl Marx Workers' Inquiry

+1/1/60+

Question 1: Does the shop in which you work belong to a capitalist or to a limited company?

capitalist .....

limited company .....

don't know .....

+1/2/59+

Question 6: How satisfied are you with the hygienic conditions in the workshop regarding the following aspects?

	very satisfied	somewhat satisfied	somewhat dissatisfied	very dissatisfied	don't know
size of the rooms space .....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
ventilation .....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
temperature.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
plastering .....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
lavatories .....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
general cleanliness.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
noise of machinery.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
metallic dust .....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
dampness.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

+1/1/60+

Question 2: What is the youngest age at which children are taken on?

< 13 years	13 years	14 years	15 years	16 years	> 16 years	don't know
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

+1/2/59+

Question 7: Mention the accidents which have taken place to your personal knowledge.

+1/1/60+

Question 3: Is the shop in a town, or in a village?

town .....  go on with question 5

village .....  go on with question 4

+1/2/59+

Question 8: State the number of holidays in the course of a year.

+1/1/60+

Question 4: If your shop is in the country, is there sufficient work in the factory for your existence, or are you obliged to combine it with agricultural labor?

sufficient work in the factory .....

combine it with agricultural labor ...

+1/2/59+

Question 5: Are safety measures to prevent accidents applied to the engine, transmission and machinery? Please tick all that apply.

engine .....

transmission .....

machinery .....

+1/1/60+

Question 1: Does the shop in which you work belong to a capitalist or to a limited company?

capitalist .....

limited company .....

don't know .....

+1/2/59+

Question 6: How satisfied are you with the hygienic conditions in the workshop regarding the following aspects?

	very satisfied	somewhat satisfied	somewhat dissatisfied	very dissatisfied	don't know
size of the rooms space .....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
ventilation .....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
temperature.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
plastering .....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
lavatories .....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
general cleanliness.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
noise of machinery.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
metallic dust .....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
dampness.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

+1/1/60+

Question 2: What is the youngest age at which children are taken on?

< 13 years	13 years	14 years	15 years	16 years	> 16 years	don't know
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

+1/2/59+

Question 7: Mention the accidents which have taken place to your personal knowledge.

+1/1/60+

Question 3: Is the shop in a town, or in a village?

town .....  go on with question 5

village .....  go on with question 4

+1/2/59+

Question 8: State the number of holidays in the course of a year.

+1/1/60+

Question 4: If your shop is in the country, is there sufficient work in the factory for your existence, or are you obliged to combine it with agricultural labor?

sufficient work in the factory .....

combine it with agricultural labor ...

+1/2/59+

Question 5: Are safety measures to prevent accidents applied to the engine, transmission and machinery? Please tick all that apply.

engine .....

transmission .....

machinery .....

Workers' Inquiry

## 2 Getting Started

### Package Loading

Before Marx can get started with his questionnaire, he has to make some preparations. He downloads the **SurveyAMC** package (`surveyamc.sty`) from the repository<sup>1</sup> and saves it in his  $\text{\LaTeX}$  main directory where he also keeps the current TEX file. Then he loads the **SurveyAMC** package within the document's preamble:

Figure 2: Package Implementation & Questionnaire Environment

```
\documentclass[11 pt,german,a4paper]{report}
\usepackage[utf8]{inputenc}
\usepackage[T1]{fontenc}
\usepackage[english]{babel}
\usepackage{surveyamc}

\begin{document}
  \begin{Questionnaires}{1}
    my first questionnaire
  \end{Questionnaires}
\end{document}
```

### Questionnaire Environment

Having finished the preamble, Marx creates a **questionnaire environment** in which he will later program the questions. At this point, he also indicates the number of individualized questionnaires he would like to create by typing the appropriate number within the first curly brackets<sup>2</sup> of the **questionnaire environment**. Since he plans to create a draft version first, he types a `1` into the **questionnaire environment's** argument.

Marx wants to know whether he has done everything right so far, so he compiles the TEX file. The result looks good: The header of the PDF document contains a barcode. This barcode is necessary for the Auto-Multiple-Choice Software<sup>3</sup> to identify the answer sheets and process them into a dataset.

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<sup>1</sup><https://gitlab.com/CSaalbach/surveyamc-project>

<sup>2</sup>Note that further in this document, curly brackets that follow a command or an environment are called argument, and square brackets are called option.

<sup>3</sup><https://www.auto-multiple-choice.net>

## Default Messages

Marx also realizes the message “draft” printed across the entire page. He figures that he could turn off this watermark by putting the command `\AMCtext{draft}` in the preamble, but he decides to keep the message to prevent him from using the draft version for actual data collection. Additionally, there is a footnote on the questionnaire page. Marx replaces the default message with the questionnaires’ title by typing `\AMCtext{message}{Worker’s Inquiry}` in the preamble:

Figure 3: Questionnaire Footnote

```
\documentclass[11 pt,german,a4paper]{report}
\usepackage[utf8]{inputenc}
\usepackage[T1]{fontenc}
\usepackage[english]{babel}
\usepackage{surveyamc}
\AMCtext{message}{Worker’s Inquiry}

\begin{document}
  \begin{Questionnaires}{1}
    my first questionnaire
  \end{Questionnaires}
\end{document}
```

## 3 The First Question

### Question Text

Marx rolls up his sleeves and starts programming the first question (Question 1, Figure 1). He stipulates that asking about the workplace owner is a suitable way to start the questionnaire. Marx writes the question text into the TEX file as he would write it into any other text processing program. He knows that it is a good idea to number the questions because it helps the respondents to find the question they should start with and follow the intended sequence.

### Question Numbering

At this point, Marx is not quite sure about the final order of the questions. He is concerned that it would require a great deal of work if he wanted to change the order

of the questions later because this could mean that he would have to renumber several questions. He reads in the [SurveyAMC Documentation](#)<sup>4</sup> that there is a command to number the questions automatically. Instead of typing each question number individually, he writes `\qnum`, and the questions are automatically numbered based on their position in the document (see Figure 4).

## Variable-Single Environment

Next, Marx thinks about the appropriate question type. In essence, he is interested in whether a **capitalist** or a **limited company** owns the workplace. Since he wants respondents to choose one of the two options or alternatively **don't know**, he programs a **single-choice** question. For this he uses the **variable-single** environment (Figure 4).

Figure 4: Single-Choice Question

```
\begin{document}
\begin{Questionnaires}{1}
  Question \qnum: Does the shop in which you work belong to a capitalist or to a limited company?

  \begin{variable-single}{shop}{99}
    \answer{capitalist}{0,3}{vallab-sc}{checkbox-sc}\scoring{b=3}
    \answer{limited company}{0,2}{vallab-sc}{checkbox-sc}\scoring{b=2}
    \answer{don't know}{0,1}{vallab-sc}{checkbox-sc}\scoring{b=1}
  \end{variable-single}
\end{Questionnaires}
\end{document}
```

Because the answers to the questionnaire should ultimately be written to a dataset for some statistical software, he must also define a variable name at this point. Marx chooses **shop**. Finally, he decides that persons who do not answer the question should be coded with a missing value and writes **99** into the second argument of the **variable-single** environment.

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<sup>4</sup><https://www.survey.codes/surveyamc>



## Answer & Scoring Command

Now, Marx starts programming the answer options. For each answer option, he defines the value label, the related value, and the answer options' position in the layout. The programming starts with the `\answer` command, followed by four arguments and the `\scoring` command (Figure 4). The `\answer` commands' first argument contains the value label, the second argument the graphical position, the third argument the style information for the value label, and the fourth argument a style for the answer box. The `\scoring` command assigns a value to the answer option.

1. For the first answer option, Marx uses `\scoring{b=3}` and as value label `{capitalist}`. Therefore, the dataset that is created in the end will assign 3 to this answer category.
2. The second answer option he labels with `{limited company}` and gives the value 2.
3. The third answer option he offers respondents who do not know an answer to this question. Accordingly, Marx writes `{don't know}` in the first argument of the `\answer` command and assigns the value 1 using the `\scoring` command.

## Positioning the Answer Options

Marx then starts to wonder about the layout position of the answer options. He learns that he can move each of the answer options along an imaginary x- and y-axis by defining their coordinates within the third argument of the `\answer` command (Figure 4). The third arguments' first number corresponds to the value on the x-axis, the second number to the value on the y-axis: `{x,y}`, Note that the coordinate values are comma-separated. If you want to use a decimal value, the decimal separator has to be a dot.

1. Because he wants `{capitalist}` to be on top of the answer list, he sets the y-coordinate for this answer option to the highest value `{0,3}`.
2. He chooses the coordinates `{0,2}` to position `{limited company}` in the middle.
3. The `{don't know}` option he places at the bottom of the answer list by writing `{0,1}` within the third argument of the last `\answer` command.

Marx already found out that the third and fourth arguments are for designing labels and answer boxes. But he will take care of that another time (Section 4 and 6).

## 4 Rotate Answer Lists

Marx's second question concerns the age of children that work in factories (Question 2, Figure 1). As with the first question, he chooses a single-choice format. Since he wants to save space on the questionnaire, he displays the answer options horizontally. Marx proceeds the same as before, but then he adjusts the layout position and the answer styles (Figure 5).

Figure 5: Single-Choice Question—Horizontal Display

```
\begin{document}
\begin{Questionnaires}{1}
  Question \qnum: What is the youngest age at which children are taken on?
  \begin{variable-single}{childage}{99}
    \answer{< 13 \years}{0,0}{vallab-sc, align=center}{checkbox-sc, below=of lab\thecsvrow}\scoring{b=1}
    \answer{13 \years}{2,0}{vallab-sc, align=center}{checkbox-sc, below=of lab\thecsvrow}\scoring{b=2}
    \answer{14 \years}{4,0}{vallab-sc, align=center}{checkbox-sc, below=of lab\thecsvrow}\scoring{b=3}
    \answer{15 \years}{6,0}{vallab-sc, align=center}{checkbox-sc, below=of lab\thecsvrow}\scoring{b=4}
    \answer{16 \years}{8,0}{vallab-sc, align=center}{checkbox-sc, below=of lab\thecsvrow}\scoring{b=5}
    \answer{> 16 \years}{10,0}{vallab-sc, align=center}{checkbox-sc, below=of lab\thecsvrow}\scoring{b=6}
    \answer{don't \know}{13,0}{vallab-sc, align=center}{checkbox-sc, below=of lab\thecsvrow}\scoring{b=7}
  \end{variable-single}
\end{Questionnaires}
\end{document}
```

### Position the Answer Text

In order to display the answers horizontally, Marx varies the x-coordinate. After some trial and error, he ended up separating the answer text by 2 units on the imaginary x-axis. Since, he wants to put the `{don't know}` option somewhat apart, he decides to increase the horizontal spacing to 3 for that category (Figure 5).

### Move the Answer Box

In the default setting (`checkbox-sc`) the answer box is aligned right to the answer text. Marx learns that he can change the default setting by adding `below=of lab\thecsvrow`<sup>5</sup> to the fourth argument of the `\answer` command (Figure 5). He wonders what `lab\thecsvrow` means

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<sup>5</sup>You can also use `right`, `left` and `above`.

because it sounds a little bit complicated to him. He finds out that it is the name of the TikZ node containing the `value label`. He also gets to know that the command `\thecsvrow` is essential when it comes to importing questionnaire information from a structured meta file. Since he does not want to try this now, he decides to leave it at that and takes care of it later<sup>6</sup>.

## Align the Answer Text

Finally, Marx wants to center the answer text. For this, he uses the third argument, which contains the style sets' name (`vallab-sc`) for formatting the answer text. Per default, the style set aligns the text to the left. Marx overwrites the default setting by adding `align=center` to the third argument (Figure 5).

## 5 Add Filter Instructions

Marx is interested in whether the working conditions differ between urban and rural areas (Question 3, Figure 1). Since the answer options are mutually exclusive, Marx chooses the single-choice format one more time. Marx realized that programming this question went quickly, since he just copied the source code of the previous question and edited the necessary fields. While he is working on this question, the next question is coming up in his head. There, he wants to know if workers in a village earn enough to live from their work in the factory or if they have to do additional agricultural work (Question 4, Figure 1). Marx wants respondents who live in a village to answer the next question, while urban workers should skip that question. He this adds a filter instruction. To make sure that they are recognized, he adds arrows, which lead the respondents' view to the correct question (Question 3, 1). Adding arbitrary text and graphical elements to a question is always possible by using TikZ commands<sup>7</sup> within the variable-single environment (Figure 7).

## Node Command

With a `\node` command you can place a field within an imaginary coordinate system — also called a TikZ picture (Figure 6). A `\node` command is structured as follows:

---

<sup>6</sup>For more information, see the SurveyAMC Documentation at <https://www.survey.codes/surveyamc>

<sup>7</sup>TikZ offers a great toolbox for designing a questionnaire. All the great things you can do with TikZ are explained in more detail in the [SurveyAMC Documentation](#). Apart from this you can take a look at the [TikZ Manual](#).

`\node[options] (name) at (x,y) {content};`

First, you can name the node so that you can refer to it later. Second, you have to define an x- and a y-value to position the nodes' center. Finally, you can fill the node with content, for example, with text or an image. Within the square brackets at the beginning of the command, you can optionally style a node by adding node options (e.g., `draw, fill=red, text width=5cm, xshift=1cm`).

Figure 6: Single-Choice Question—Coordinate System of a TikZ picture

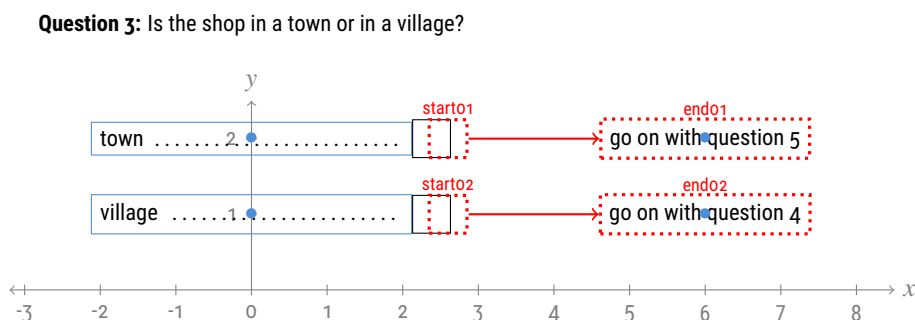


Figure 7: Single-Choice Question—Filter Instructions

```

\begin{document}
\begin{Questionnaires}{1}
  Question \qnum: Is the shop in a town or in a village?

  \begin{variable-single}{shoplocal}{99}
    \answer{town}{0,2}{vallab-sc}{checkbox-sc}\scoring{b=2}
    \answer{village}{0,1}{vallab-sc}{checkbox-sc}\scoring{b=1}

    \node (start01) at (2.6,2) {};
    \node (start02) at (2.6,1) {};
    \node (end01) at (6,2) {go on with question 5};
    \node (end02) at (6,1) {go on with question 4};

    \draw[->] (start01.east) -- (end01.west);
    \draw[->] (start02.east) -- (end02.west);
  \end{variable-single}
\end{Questionnaires}
\end{document}

```

Marx uses this knowledge to add arrows to his textual filter instructions.

- First, he defines starting points for his arrows. By using the `\node` command (Figure 7), Marx plots invisible squares, each one near the respective answer box (Figure 6). He also names these two nodes with `start01` and `start02` to call them later when using the `\draw` command for drawing the arrows.
- Second, Marx uses the `\node` command to plot the textual filter instruction `{go on with question 5}` right to the answer option `town` and `{go on with question 4}` right to the answer option `village`. He names the nodes with `end01` and `end02` and by this, he is defining the ending points of the arrows.
- Now he connects the respective starting and ending points with the help of the `\draw` command. For example, he connects the eastern side of the node `start01` with the western side of the node `end01` with an arrow by writing: `\draw[->](start01.east)--(end01.west);`

## 6 Deal with Long Value Labels

To speed up the programming work, Marx copies the code from Question 3 and adapts it for Question 4 (Figure 1). He only changes the variable name and the value labels (Figure 8). However, when looking at the generated PDF document, he does not like the visual design of Question 4. Since the `text width` of the value labels is `4cm` in the default setting, long value labels automatically break the line.

Figure 8: Single-Choice Question—Width of Value Labels

```
\begin{document}
\begin{Questionnaires}{1}
  Question \qnum: If your shop is in the country, is there sufficient work in the factory for your existence, or are you obliged
  to combine it with agricultural labor?

  \begin{variable-single}{agrilabor}{99}
    \answer{sufficient work in the factory}{0,2}{vallab-sc,text width=6cm}{checkbox-sc}\scoring{b=2}
    \answer{combine it with agricultural labor}{0,1}{vallab-sc,text width=6cm}{checkbox-sc}\scoring{b=1}
  \end{variable-single}
\end{Questionnaires}
\end{document}
```

Marx knows that line breaks within answer options can affect the readability of the question, so he wants to change that. For that, he increases the value labels' text width

by adding the node option `text width=6cm` to the third argument of the `\answer` command (Figure 8). While he's at it, he makes a note of other options that he may need later<sup>8</sup>:

<code>font=\small\bfseries</code>	➔	sets the nodes' font size to small and the font series to bold
<code>minimum height=1cm</code>	➔	defines the minimum size of the node
<code>fill=white</code>	➔	fills the node with a background color
<code>draw=red</code>	➔	displays the node with a colored border

## 7 Multiple-Choice Question

Marx wants to know more about the safety measures at the workplace. Specifically, he is interested if there are safety measures at the **engine**, the **transmission**, and the **machinery** (Question 5, Figure 1). Since respondents can tick any answer that applies, Marx programs a multiple-choice question (Figure 9). Unlike single-choice questions, the answer options of multiple-choice questions do not correspond to different values of a variable. Instead, each answer option of a multiple-choice question corresponds to a single variable in the answer dataset.

### Variable-Multi Environment

For programming the multiple-choice question Marx uses the `variable-multi` environment. Since Marx needs three answer options, he uses the `variable-multi` environment three times in a row (Figure 9). Each `variable-multi` environment has four arguments:

1. Within the first argument Marx defines the variable names for each single answer option: `{safety1}`, `{safety2}` and `{safety3}`.
2. The second argument, he uses to type in the variable labels: `{engine}`, `{transmission}` and `{machinery}`. These are equivalent to the answer options, which respondents can select.
3. The third argument contains the name of the TikZ set to format the variable labels: `{varlab-mc}`. Marx likes the default layout, so he makes no changes here. But he keeps in mind that he can learn more about the styling options of multiple-choice questions in the [SurveyAMC Documentation](#)<sup>9</sup>.

---

<sup>8</sup>He also tries to keep in mind that he has to separate node options with a `comma`.

<sup>9</sup><https://www.survey.codes/surveyamc>

- In the fourth argument Marx types the missing value, which he needs to identify respondents who did not tick the respective answer option. Again, he chooses `{99}` for the missing value.

## Answer & Scoring Command

After defining the variables, Marx starts specifying the variables' values and their labels. To identify respondents who ticked the answer options (`engine`, `transmission`, `machinery`), he uses one `\answer` command within each `variable-multi` environment (see Figure 9). He remembers that the `\answer` command for programming the single-choice question looked similar. But he notices a difference in the name of the TikZ set that is used by default to style the answer box and the answer text. With multiple-choice questions, they have the ending `mc` instead of `sc`.

Figure 9: Multiple-Choice Question

```
\begin{document}
\begin{Questionnaires}{1}
  Question \qnum: Are safety measures to prevent accidents applied to the engine, transmission, and machinery?
  \small Please tick all that apply. \normalsize
  \begin{variable-multi}{safety1}{engine}{varlab-mc}{99}
    \begin{values}
      \answer{{2,5,0}{vallab-mc}{checkbox-mc}\scoring{b=1}}
    \end{values}
  \end{variable-multi}
  \begin{variable-multi}{safety2}{transmission}{varlab-mc}{99}
    \begin{values}
      \answer{{2,5,0}{vallab-mc}{checkbox-mc}\scoring{b=1}}
    \end{values}
  \end{variable-multi}
  \begin{variable-multi}{safety3}{machinery}{varlab-mc}{99}
    \begin{values}
      \answer{{2,5,0}{vallab-mc}{checkbox-mc}\scoring{b=1}}
    \end{values}
  \end{variable-multi}
\end{Questionnaires}
\end{document}
```

## 8 Reduce Code with a Loop

Marx is a bit worried by the amount of code to write for larger multiple-choice questions. He noticed that the code for the individual answer options barely differs (Figure 9). Until now, he copied the `variable-multi` environment for each new answer option and adjusted the information for the variable name and the variable label. Everything else is the same. So why shouldn't it be possible to execute the code of the `variable-multi` environment with a loop (Figure 10)?

Figure 10: Multiple-Choice Question—Loop

```
\begin{document}
\begin{Questionnaires}{1}
  Question \qnum: Are safety measures to prevent accidents applied to the engine, transmission, and machinery?
  \small Please tick all that apply. \normalsize

  \foreach \label [count=\num from 1] in {engine, transmission, machinery}{

    \begin{variable-multi}{safety\num}{\label}{varlab-mc}{77}
      \begin{values}
        \answer{{2.5,0}{vallab-mc}{checkbox-mc}\scoring{b=1}}
      \end{values}
    \end{variable-multi}

  }
\end{Questionnaires}
\end{document}
```

All he needs is a list of variable labels and names. With the `\foreach` command he writes a loop that does two things: First, the loop replaces the `\label` command with a string from a list on each run. Second, the loop replaces the `\num` command with a new number. Marx uses the `\num` command to assign three different variable names: `{safety1}`, `{safety2}`, and `{safety3}` (Figure 10).

## 9 Matrix Question

Marx is interested in the hygienic condition of the workplace (Question 6, Figure 1). He considers describing the hygienic conditions through nine dimensions: size of the rooms space, ventilation, temperature, plastering, lavatories, general cleanliness, noise of the machinery, metallic dust



and **dampness**. Since he cannot measure the hygienic condition objectively, he decides to ask the workers how satisfied they are with each hygienic aspect. For this, he uses a matrix question. Similar as with multiple-choice questions, each answer option (hygienic aspect) corresponds to one variable in the answer dataset. But there are two differences: First, unlike multiple-choice questions, the variables of matrix questions have more than two values. Second, the value labels are displayed.

## Variable-Multi Environment

Marx starts programming the first row of the matrix-question by using the `variable-multi` environment (Figure 11). For a variable name, he chooses `{hygscale}`, and for a variable label `{size of the rooms space}`. Since for this matrix question the text width of the variable labels is a little bit longer than usual, Marx changes the default setting by adding `text width=5cm` to third argument of the `variable-multi` environment. As missing value, he, again, chooses `99`.

## First Row

For the first row of the matrix question, Marx wants to display five value labels. Each of them, he programs with the `\answer` command (Figure 11). As with single-choice questions, Marx types the value label in the first argument and assigns the value with the `\scoring` command.

To position the answer options Marx uses the second argument of the `\answer` command. He keeps the y-coordinate fixed and only varies the x-coordinate. As a distance between the value labels `{very satisfied}`, `{somewhat satisfied}`, `{somewhat dissatisfied}` and `{very dissatisfied}`, he chooses 2 units on the imaginary x-scale: `{3,0}`, `{5,0}`, `{7,0}` and `{9,0}`. Only for the `{dont know}` option, he chooses a larger distance of 3 points to visually set this answer a bit off: `{12,0}`. By default, the answer options of multiple-choice questions are placed above the answer boxes<sup>10</sup>.

---

<sup>10</sup>How this works exactly and how to change the default setting, is explained in the SurveyAMC Documentation at <https://survey.codes/>

Figure 11: Matrix Question—Loop

```

\begin{document}
\begin{Questionnaires}{1}

Question \qnum: How satisfied are you with the hygienic conditions in the workshop regarding the following aspects?

\begin{variable-multi}{hygscale}{size of the rooms space}{varlab-mc, text width=5cm}{99}
\begin{values}
\answer{very satisfied}{3,0}{vallab-mc}{checkbox-mc}\scoring{b=1}
\answer{somewhat satisfied}{5,0}{vallab-mc}{checkbox-mc}\scoring{b=2}
\answer{somewhat dissatisfied}{7,0}{vallab-mc}{checkbox-mc}\scoring{b=3}
\answer{very dissatisfied}{9,0}{vallab-mc}{checkbox-mc}\scoring{b=4}
\answer{don't know}{12,0}{vallab-mc}{checkbox-mc}\scoring{b=5}
\end{values}
\end{variable-multi}

\foreach \label [count=\num from 1] in {ventilation, temperature, plastering, lavatories, general cleanliness, noise of machinery, ...}{

\begin{variable-multi}{hyg\num}{\label}{varlab-mc, text width=5cm}{99}
\begin{values}
\answer{{3,0}{vallab-mc}{checkbox-mc}\scoring{b=1}
\answer{{5,0}{vallab-mc}{checkbox-mc}\scoring{b=2}
\answer{{7,0}{vallab-mc}{checkbox-mc}\scoring{b=3}
\answer{{9,0}{vallab-mc}{checkbox-mc}\scoring{b=4}
\answer{{12,0}{vallab-mc}{checkbox-mc}\scoring{b=5}
\end{values}
\end{variable-multi}

}

\end{Questionnaires}
\end{document}

```

## Additional Rows

After programming the first row, Marx repeats the procedure for each further answer option of the matrix question (each additional row). The only difference is that he does not display the value labels. As practiced with the multiple-choice question before (Figure 10), Marx again uses a loop (Figure 11).

## Loop

Marx defines a list of variable labels: {[ventilation](#), [temperature](#), [plastering](#), [lavatories](#), [general cleanliness](#), [noise of machinery](#), [metallic dust](#), [dampness](#)}. By using the `\label` command, the loop inserts one label after the other at each run. Marx uses the `\num` command to create different variable names: [hyg1](#), [hyg2](#), [hyg3](#), [hyg4](#), [hyg5](#), [hyg6](#), [hyg7](#), [hyg8](#). Since Marx does not want to display the value labels for these answer options, he keeps the first argument of the `\answer` command empty (Figure 10).

## 10 Add Open Answer Questions

### Text Question

At the questionnaires' end, Marx wants to ask about the risk of accidents at work. He has no idea what accidents can happen. For this reason, Marx is not able to create predefined response options. He decides to allow respondents to formulate the answer in their own words (Question 7, Figure 1).<sup>11</sup>

To program the open answer question, Marx uses the rich toolbox of the TikZ package (Figure 12).

Figure 12: Open Answer Question—Text

```
\begin{document}
\begin{Questionnaires}{1}
  Question \qnum: Mention the accidents which have taken place to your personal knowledge.

  \begin{tikzpicture}
    \node[draw=black, minimum width=13cm, minimum height=7cm] at (3,0) {};
  \end{tikzpicture}

\end{Questionnaires}
\end{document}
```

Marx wants the respondents to describe their experienced work accidents in several sentences. He knows that the size of the answer field affects the answers' length (e.g., Israel, 2010). For this reason, he programs an answer field that spans several lines. He

---

<sup>11</sup>Note that when you use open answer questions, the `Auto-Multiple-Choice` software cannot transfer them to the dataset. You have to process them manually.

uses the `tikzpicture` environment and creates a 13cm wide and 7cm high field with the `node` command's help.

## Numeric Question

With the last question (Question 8, Figure 1) Marx wants to know, what the average amount of holidays is usual for a worker within a typical year. Because Marx expects a high variation in the answers, a predefined answer list might become very long. For this reason, he decides to ask an open answer question. In this case, Marx is not interested in a detailed textual answer but precise information on the holidays' actual number. Because of that, he adjusts the answer field to two small boxes and hopes that this graphical presentation signals what kind of answer he expects.

Figure 13: Open Answer Question—Numeric

```
\begin{document}
\begin{Questionnaires}{1}
  Question \qnum: State the number of holidays in the course of a year.

  \begin{tikzpicture}
    \node[draw=black, minimum width=5mm, minimum height=7mm] at (0,0) {};
    \node[draw=black, minimum width=5mm, minimum height=7mm] at (.75,0) {};
  \end{tikzpicture}

\end{Questionnaires}
\end{document}
```

Again he uses the `tikzpicture` environment. Marx uses the `\node` commands' options to define the answer fields' height (7mm) and width (5mm). To position the answer fields, he each sets an x- and a y-coordinate: (0,0) for the first box and (.75,0) for the second box.

## 11 Colored Background Boxes

Marx is happy with his questionnaire, but he is worried whether enough workers will fill out the form. He reads that the visual design of a questionnaire influences the willingness to answer it (Jenkins & Dillman, 1995). He gets to know that he can improve the general layout and, with that, the questionnaire's readability by displaying the questions and the

respective answers within colored background boxes (Dillman, Gertseva, & Mahon-Haft, 2005).

## Package Loading

Marx uses the `tcolorbox` package to display each question against a colored background<sup>12</sup>. He loads the package within the preamble of the TEX document by adding the `\usepackage{tcolorbox}` command (Figure 14). Then, he switches to the document environment and inserts the first question into the `tcolorbox` environment.

Figure 14: Colored Background Box

```
\usepackage{tcolorbox}

\begin{document}
  \begin{Questionnaires}{1}

    \begin{tcolorbox}[colback=blue!10, colframe=gray, boxrule=1pt, arc=.5cm]

      Question \qnum: Does the shop in which you work belong to a capitalist or to a limited company?

      \begin{variable-single}{shop}{99}
        \answer{capitalist}{0,3}{vallab-sc}{checkbox-sc}\scoring{b=3}
        \answer{limited company}{0,2}{vallab-sc}{checkbox-sc}\scoring{b=2}
        \answer{don't know}{0,1}{vallab-sc}{checkbox-sc}\scoring{b=1}
      \end{variable-single}
    \end{tcolorbox}

  \end{Questionnaires}
\end{document}
```

## Layout Options

Within the square brackets, Marx defines the layout options, also called the `tcolorbox` set. For a first try, he chooses a light blue background color by adding `colback=blue!10` and a gray frame by adding `colframe=gray`. The option `boxrule=1pt` he uses to define the line width of the frame. And with `arc=.5cm`, he adjusts the frame corners' angle (Figure 14).

---

<sup>12</sup>For detailed information see <https://ctan.org/pkg/tcolorbox>

## Style Sets

In the `tcolorbox` package documentation,<sup>13</sup> Marx reads that he can outsource the layout options by using the `\tcbsset` command. He finds this useful because he wants to use the layout over and over again for all questions. By defining a `\tcbsset`, he merely has to type its' name (e.g., `myset`) within the squared brackets of the `tcolorbox` environment instead of the detailed layout options (`colback!10, colframe=gray, boxrule=1pt, arc=.5cm`).

Marx is happy with his result. He can't wait to show his questionnaire to Engels.

We wish them every success with their survey!

---

<sup>13</sup><https://ctan.org/pkg/tcolorbox>

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