Data display, plots and graphs

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1 Introduction

Some years ago tex.stackexchange.com (TeX.SE) seems to have taken over from comp.text.tex for asking about (E)TeX and friends. A perennial question on Tex.SE seems to be asking what (E)TeX is useful for apart from typesetting mathematical papers. There have been many answers to this and I would like to suggest one more: displaying data. In this note I’ll mention a couple of ways that I found that LaTeX could help with tables, graphs, and plots of data. The impetus for this was when I was strongly advised by my local hospital to keep a check on my blood pressure (BP).

2 Practicalities

Following the consultant’s suggestion I measure my BP three times a day (morning, afternoon, and in the evening) and average them to get a reading for the day. I do this every day and it is surprising, to me at least, how it varies. I felt that I needed to keep a record of all this so I could present it to the medical experts in case of any problems (like blackouts or falling downstairs — don’t ask).

I decided that I needed at least three kinds of records: a tabulation of the BP readings; a plot of the BP; and a graph of the BP.

In the following the data shown is for a hypothetical individual I have designated as Q

3 Tabulation

I just used the normal \texttt{table} environment with the booktabs package to produce a tabulation along the following lines, resulting in the example below for Q at a single day per week (Wk.).

\begin{tabular}{lcllll} 
\toprule
Date & Wk. & Morn. & Aft. & Eve. & Average \\
\midrule
4/4 & 1 & & & 179/109 & 179/109 \\
11/4 & 2 & 156/109 & 147/89 & 149/93 & 150/97 \\
18/4 & 3 & 158/108 & 142/92 & 146/92 & 149/97 \\
\bottomrule
\end{tabular}

The higher readings are for the systolic (maximum) blood pressure and the lower ones for the diastolic (minimum) pressure during the heartbeat’s cycle.

4 Plotting

According to the user manual for my BP monitor, the World Health Organization (WHO) have developed a BP classification scheme. I decided that it might be useful to plot the BP against this scheme as shown for the Q individual.

WHO describe 6 regions in their classification. These are: Optimal BP, Normal BP, Normal Systolic, Mild Hypertension, Moderate Hypertension, and Severe Hypertension.

I have used the standard picture environment for producing the plot. The only special macros that I used were

\begin{verbatim}
\newcommand*{\plotit}[2]{\put(#1){\mk}}
\end{verbatim}

The first two to minimise typing and the last for plotting a BP reading at the put location. With \texttt{\makebox(0,0){text}} the reference point for plotting ‘text’ is at the center, vertically and horizontally, of text.

This is an outline of the code I used for the picture.

\begin{verbatim}
\setlength{\unitlength}{0.8cm}
\begin{picture}(8,11) \thicklines  
\put(0,0){\line(1,0){9}}  
\put(9,0){\vector(1,0){0}}  
\put(0,0){\line(0,1){10}}  
\put(0,10){\vector(0,1){0}}  
\multiput(0,0)(1,0){9}{\line(0,1){0.1}}  
\multiput(0,0)(0,1){10}{\line(1,0){0.1}}  
\put(1,10.3){\makebox{SYSTOLIC}}  
\put(1.4,-1.0){\makebox{DIASTOLIC}}  
\put(1,-0.3){\makebox{75}}  
\end{picture}
\end{verbatim}

The higher readings are for the systolic (maximum) blood pressure and the lower ones for the diastolic (minimum) pressure during the heartbeat’s cycle.

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The result shows that the hypothetical Q person’s BP is typically in the range of Normal Systolic to Mild Hypertension but with some outliers.2

5 Graphing

For graphing BP I used the regular picture environment. Nothing special about drawing the axes. The thing of interest here is the use of the \polyline macro from the curve2e package. This takes a list of coordinates like (x,y) and draws straight lines between them.

Here is a brief outline of the code I used for the graph showing the use of \polyline.
\begin{center}
\setlength{\unitlength}{5.5pt}
\begin{picture}(41,81)
% draw axes, etc., then the BP graphs
% scaled to the size of the axes
% first the systolic
\polyline
\end{picture}
\end{center}

2 As a non-medical person I cannot comment on what this might mean for our imaginary person.
% then the diastolic
\polyline
\begin{picture}(6,26)(7,23)(8,23)(9,18)(10,15)(11,13)
\end{picture}
\caption{Graph of blood pressure over time}
\vspace{\baselineskip}
\end{center}

The dashed lines indicate the upper limits of the WHO Normal Systolic regime.

The graphs show that after an initial worrying period Q's BP settled down to a fairly regular pattern albeit with some fits and starts.

\section{Histogram}

Another way of displaying data is by a histogram which shows the number of data points noted within sets of ranges. The following is a histogram of Q's diastolic BP for 5 mg ranges.

\begin{figure}[h]
\centering
\includegraphics[width=\textwidth]{histogram.png}
\caption{Histogram of Q's Diastolic BP}
\end{figure}

Nothing special about the code. I used the \framebox macro for drawing the rectangular regions and created a macro to reduce the number of characters needed for specifying its location and size.

\newcommand{\histit}[2]{\put(#1,0.0){\framebox(1,#2){}}}

where the first argument is the x location of the framebox and the second is its height.

I must say that I found the scatter plot more informative than the histogram, although the latter highlighted the unusual high diastolic readings.

\section{Summary}

I have shown four different ways of displaying data. Edward Tufte\textsuperscript{3} has shown many other ways.

There are many applications for (\LaTeX) and friends. Among those noted on TeX.S, apart from mathematical and scientific publications, are:

- Books fiction and non-fiction
- Correspondence
- Games Bridge, Chess, Crosswords, Noughts and Crosses (aka Tic-tac-toe), Sudoku
- Greeting cards
- Invoices
- Literature Critical editions, Multilingual
- Mars Rover (programmed via \TeX)
- Music
- Newsletters
- Poetry
- Postcards
- Presentations (slides)

I hope that my small application might give thoughts towards suitable additions to the above list.

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