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Go Mobile with the ODS EPUB Destination

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ABSTRACT

The Base SAS® Output Delivery System (ODS) makes it easy to generate reports for viewing on desktops. What about mobile devices? If you need on-the-go reports, then the new SAS 9.4 ODS EPUB destination is the ticket. With ODS EPUB, you can generate your reports as e-books that you can read with iBooks on the iPad, or, you can write an e-book from scratch if you like.

This paper provides an introduction to writing e-books with ODS EPUB. Please bring your iPad, iPhone, or iPod to the presentation so that you can download and read the examples.

INTRODUCTION

If you use ODS, then you are accustomed to having ready access to SAS reports, whether in your home or at work with your desktop computer, or anywhere with your laptop computer. ODS provides various output formats to fit the reporting task at hand. ODS HTML is well-suited to report development and debugging, especially in the Display Manager System (DMS) environment. ODS RTF is ideal for including reports in word processing documents. ODS PDF works best for printing and distributing reports. These scenarios assume a typical home or work computing configuration, which includes a monitor, keyboard, and pointing device connected to one or more computers running SAS.

If you are like many people, you have one or more mobile devices that you use at home, work, and wherever you go. Naturally you wish to consume your SAS reports on your tablet or smartphone. However, the aforementioned output formats were not designed for mobile computing, and each has its drawback. HTML requires a web browser connected to the Internet, and is not fully portable. RTF cannot be viewed natively on mobile devices. PDF is formatted to the printed page, and does not scale down well to mobile displays. How can you create SAS reports that are portable and viewable on mobile devices of varying form factors?

The SAS 9.4 ODS EPUB destination enables you to create SAS reports as e-books that look great and travel well on your smartphone or tablet. ODS EPUB is a part of Base SAS, and runs everywhere that Base SAS runs. Note that on z/OS, ODS EPUB requires the HFS file system.

The ODS EPUB destination is designed to generate e-books that work optimally with the Apple iBooks e-book reader on iPad, iPhone, and iPod. Results might vary with other e-book readers.

After reading the paper or viewing the presentation, any user should be able to view the example reports on an iPad, iPhone, or iPod. Novice users should be able to run the example SAS jobs to generate and view mobile reports. Experienced users should be able to create mobile reports, or to write an e-book from scratch. The desired result is that you will "cut the cord", take your SAS reports on the road, and never look back!

GET STARTED

Your first order of business is to learn how to specify ODS EPUB statements to generate a SAS report as an e-book. After that you will learn several techniques for loading EPUB e-books into the iBooks e-book reader. At that point you will know enough to go mobile with ODS EPUB!

MAKE A SANDWICH

The SAS 9.4 ODS EPUB statement creates output in the EPUB format. EPUB is a free and open e-book standard by the International Digital Publishing Forum (IDPF). EPUB files have the extension *.epub*. ODS EPUB e-books have no Digital Rights Management (DRM) restrictions and can be freely copied and shared.

Numerous e-book readers support EPUB e-books. Popular free EPUB e-book readers include Adobe Digital Editions, Calibre, EPUBReader, Kobo, and Stanza. The recommended e-book reader for ODS EPUB e-books is Apple iBooks on iPad, iPhone, and iPod.

The easiest way to get started with the ODS EPUB statement is to try it with a simple example that produces familiar output. Consider this SAS code:

```
title;
ods epub file="cars_freq.epub" title="Cars' Origin by Type"
                              options(creator="David W. Kelley");
proc freq data=sashelp.cars;
tables origin*type/plot=freq;
run;
ods epub close;
```

Like other ODS destinations, the ODS EPUB destination supports the "ODS sandwich" programming idiom. You sandwich your procedure and DATA steps in ODS EPUB statements. The beginning ODS EPUB statement opens an ODS EPUB destination and prepares it to process the procedure and DATA step output. The ending ODS EPUB statement closes the destination, which terminates the generation of output to the specified file. An open ODS EPUB destination remains open until it is explicitly closed or the SAS session ends.

The beginning ODS EPUB statement in the above example specifies three options. FILE= specifies the output filename. If you specify no name, ODS EPUB will supply a default name (typically *sasepub.epub*). TITLE= specifies the title of your e-book. If you specify no TITLE= title, ODS EPUB will supply a default title of "SAS Output" or its localized equivalent.

If you want to specify one or more authors for your e-book, use the CREATOR suboption of the ODS EPUB statement OPTIONS option. Delimit multiple authors with commas. If you do not specify an author, your e-book will not have one. You probably want your e-book to have an author!

In the example, the content of the "ODS sandwich" is a PROC FREQ step that requests a frequency cross-tab and plot. Figure 1 shows how the SAS 9.4 DMS internal browser renders the default HTML that ODS generates for the report.
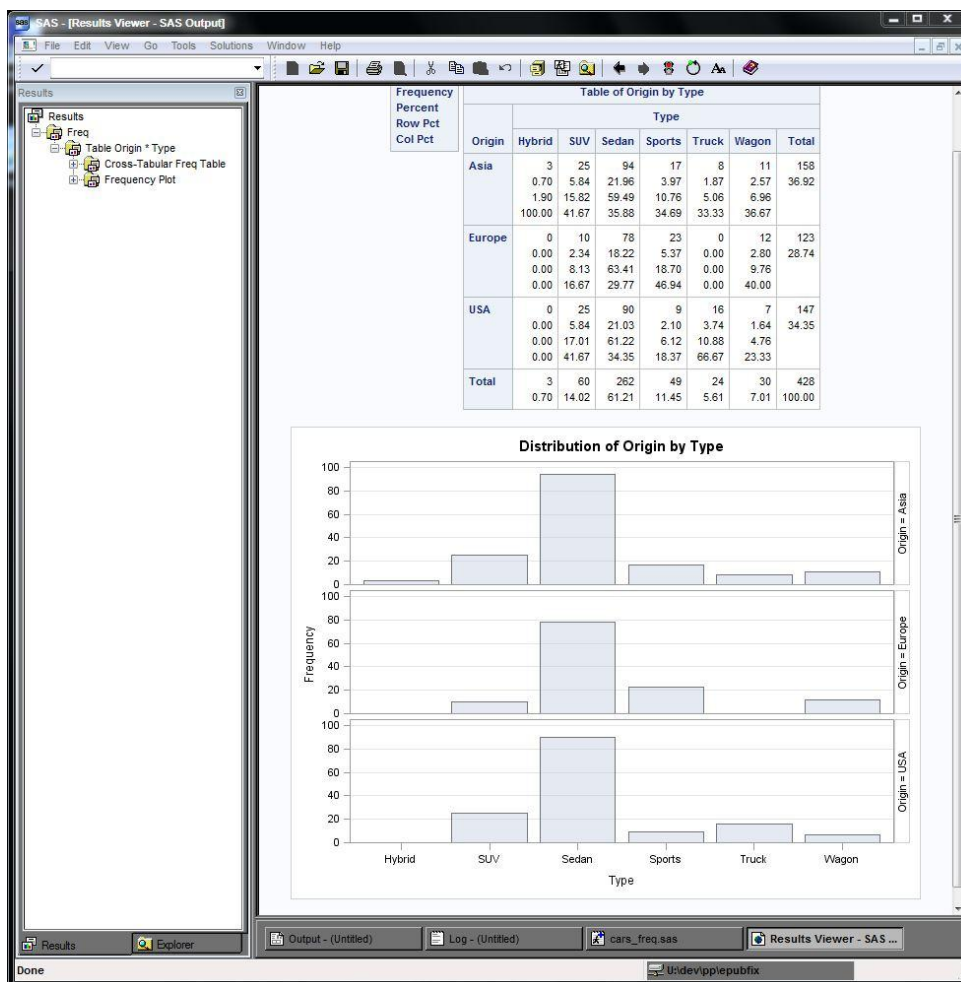

Figure 1. Frequency Output in SAS 9.4 DMS

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The SAS Log confirms that the ODS EPUB destination created the file *cars_freq.epub*, which is the e-book *Cars' Origin by Type*:

```
NOTE: Writing HTML Body file: sashtml.htm
NOTE: There were 428 observations read from the data set SASHELP.CARS.
NOTE: PROCEDURE FREQ used (Total process time):
      real time           3.61 seconds
      cpu time            0.35 seconds


8    ods epub close;
NOTE: Writing package .\cars_freq.epub.
```

Output 1. SAS Log for Frequency Report

SAS does not configure a default EPUB e-book reader, so DMS does not display the contents of *Cars' Origin by Type*. Having viewed the DMS HTML output, you can imagine what the EPUB output might look like, but you want to be able to read it on your mobile device. To do that, you need to load *cars_freq.epub* into an EPUB e-book reader – but how, and with what e-book reader?

READ WITH IBOOKS

ODS EPUB e-books are designed to work best with iBooks. iBooks is a free e-book reader app developed by Apple for iOS devices. iBooks is not preinstalled on your device -- like most apps, you install it from the App Store.

iBooks enables you to download and read e-books from Apple's iBookstore. You also can sideload EPUB e-books into iBooks from whatever source you specify. Sideloading is the method required to load e-books created with ODS EPUB into iBooks.

YOU'VE GOT MAIL

As you might expect for an Apple mobile device, you need an app for sideloading e-books. As you might also expect, there is more than one app that can do the job. Which one should you use? For getting started, go with the app that you probably already know and use – Apple's built-in Mail app. Simply attach the EPUB file to an e-mail message that you send to yourself. Then access the message with the Mail app. Tapping the e-mail attachment icon will bring up a list of apps for viewing the attachment. Figure 2 shows what this looks like for EPUB file attachment *cars_freq.epub*.
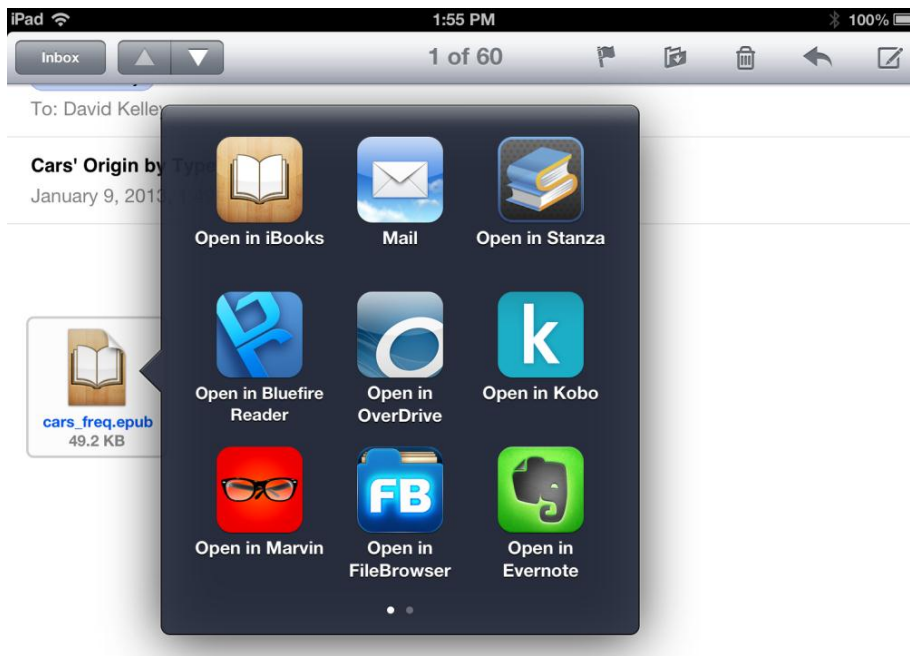

Figure 2. Apps for Viewing an EPUB E-book (Mail)

Selecting the list icon for iBooks opens the e-book in iBooks, which automatically adds the e-book to its library. Figure 3 shows how iBooks displays the frequency output on a third-generation iPad.
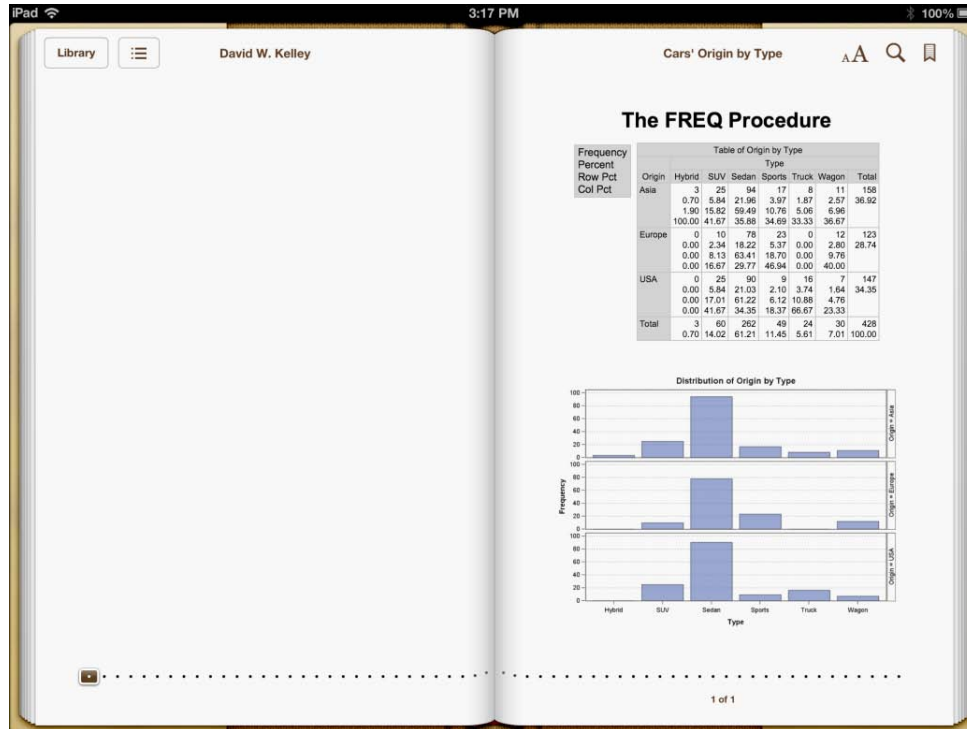

Figure 3. Frequency Output in iBooks

iBooks is designed to simulate the experience of reading a physical book. Using gestures, you "turn pages" left or right. Page 1 is a right page, just like with a physical book. (Apple is famous for applying such skeuomorphic design principles to its products.) The size of the page limits the space available for tables and graphic displays. iBooks provides a way to maximize those tables and graphic displays, taking advantage of the entire screen.

If you want to inspect a table or graphics display more closely, then double-tap it on the screen. iBooks will launch into a full-screen mode that allows you to pan and zoom the table or graphics display. To pan and zoom, simply pinch the output on the screen. Figure 4 shows the frequency cross-tab in iBooks pan-and-zoom mode.

Table of Origin by Type						
	Type					
Origin	Hybrid	SUV	Sedan	Sports	Truck	Wagon	Total
Asia	3	25	94	17	8	11	158
	0.70	5.84	21.96	3.97	1.87	2.57	36.92
	1.90	15.82	59.49	10.76	5.06	6.96	
	100.00	41.67	35.88	34.69	33.33	36.67	
Europe	0	10	78	23	0	12	123
	0.00	2.34	18.22	5.37	0.00	2.80	28.74
	0.00	8.13	63.41	18.70	0.00	9.76	
	0.00	16.67	29.77	46.94	0.00	40.00	
USA	0	25	90	9	16	7	147
	0.00	5.84	21.03	2.10	3.74	1.64	34.35
	0.00	17.01	61.22	6.12	10.88	4.76	
	0.00	41.67	34.35	18.37	66.67	23.33	
Total	3	60	262	49	24	30	428
	0.70	14.02	61.21	11.45	5.61	7.01	100.00

Figure 4. Zoomed Frequency Cross-tab in iBooks

Another way to maximize your screen real estate is to put iBooks in scroll mode. You can set scroll mode via the Fonts user interface. Figure 5 displays the frequency report in scroll mode.
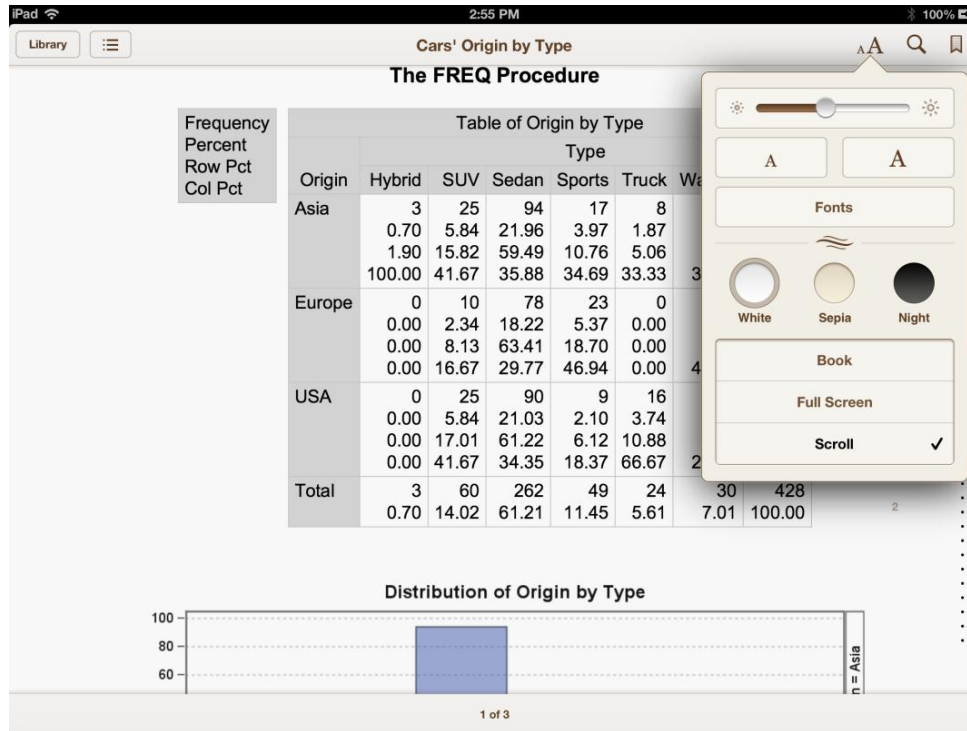

Figure 5. Scrolled Frequency Report in iBooks

Every ODS EPUB e-book has a table of contents, which will be familiar to ODS users. Every iBooks e-book also has a cover. To see the table of contents and cover, first find the table of contents icon on the upper left of the screen, next to the *Library* button. If you tap that icon, iBooks will pause reading and display the e-book's cover and table of contents. See Figure 6.
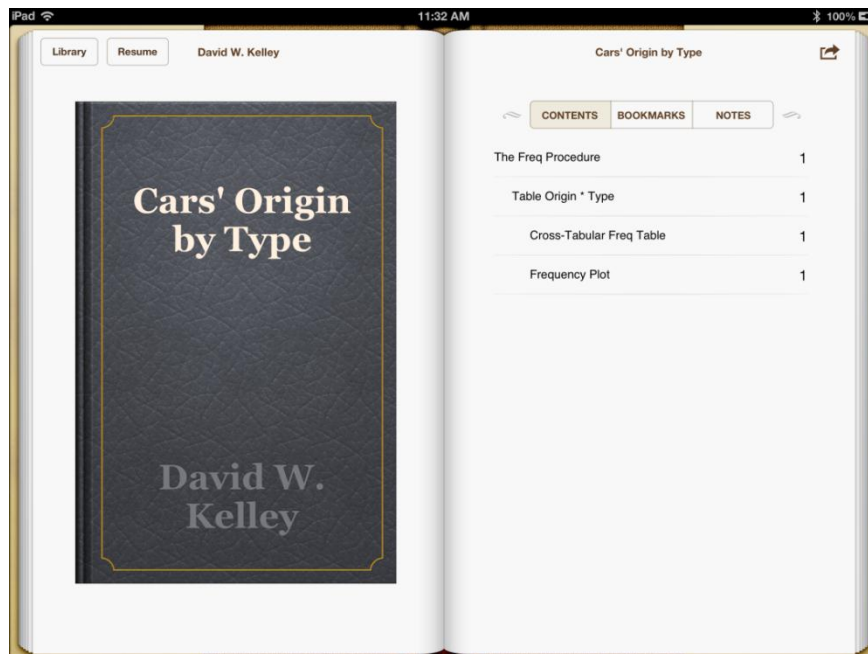

Figure 6. Cover and Table of Contents in iBooks

Selecting an entry in the table of contents takes you to the associated page in the e-book.

You can customize the table of contents and cover. You will learn how to do that later in the discussion.

Before digging deeper into iBooks' functionality, you need to learn more about getting your ODS EPUB e-books into iBooks. Sideloading with the Mail app is just one way to do it. What are some other ways?

THERE'S ANOTHER APP FOR THAT

Sideloading an EPUB e-book into iBooks with the Mail app can have drawbacks. E-mail servers can impose restrictions on attachments that make it difficult to e-mail an EPUB e-book. If the e-book contains many graphics displays, then its size might exceed the server-defined limit. Some e-mail servers reject ZIP file attachments, which means that they reject EPUB file attachments, because an EPUB file is a ZIP file. Some e-mail servers reject attachments of any kind. The Mail app cannot help you if your EPUB file attachment has been stripped from your e-mail!

Apple builds into its mobile devices another app that can sideload EPUB e-books into iBooks without the potential pitfalls of e-mail delivery: Safari. Safari is Apple's web browser. If you place your EPUB files where your web server can find them, then Safari can find them also.

Typically, web servers are set up so that users can make files web-accessible by placing them in a *public_html* directory. If so, placing the *cars_freq.epub* file in a *public_html* directory will make it visible to Safari. Your web server might be set up this way. Consult your web administrator if you do not know.

However you choose to do it, once you have made your EPUB file web-accessible, you can browse it with Safari. Figure 7 shows Safari listing the files in a directory. *cars_freq.epub* is one of the files.

Figure 7. Directory Listing in Safari

If you select *cars_freq.epub* from the list, Safari will prompt you to specify the app to open it. See Figure 8.
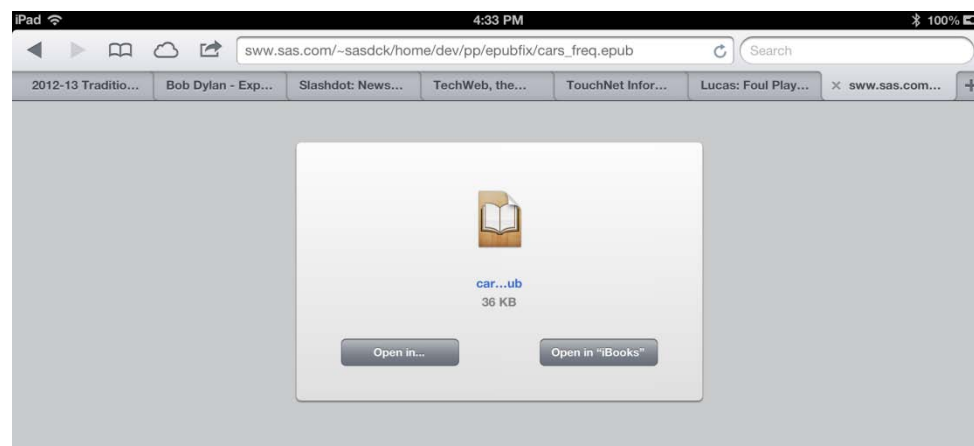

Figure 8. Apps for Viewing an EPUB E-book (Safari)

Open the e-book in iBooks, and you are ready to start reading!

ROCK YOUR DROPBOX

Safari suffices for sideloading EPUB e-books into iBooks, provided that you have access to a web server. What if you do not? You can fall back to the Mail app, but you might run into issues with your e-mail server, as was discussed earlier.

What if you could store your e-books in the cloud and access them from your smartphone or tablet? That would avoid any e-mail or web server issues. Cloud-based storage is plentiful and cheap – even free perhaps, depending on how much storage you consume.

Cloud storage providers are numerous, and include Google Drive, Microsoft SkyDrive, and Apple iCloud. One of the most popular providers of consumer-based cloud storage is Dropbox (by Dropbox, Inc.). Dropbox stores customer files in a synchronized, version-controlled virtual file system. Dropbox provides free client software for reading and writing the files. The client software runs on Windows, Mac, and Linux desktops, as well as Android, iOS, and Blackberry devices. The first 2 gigabytes of cloud storage are free, and you can acquire additional storage for free, if you do not mind volunteering to help Dropbox solicit new customers!

Dropbox's most important feature is that it is easy to use. When you install Dropbox on a Windows machine, it integrates the cloud file system seamlessly into the operating system. See Figure 9.
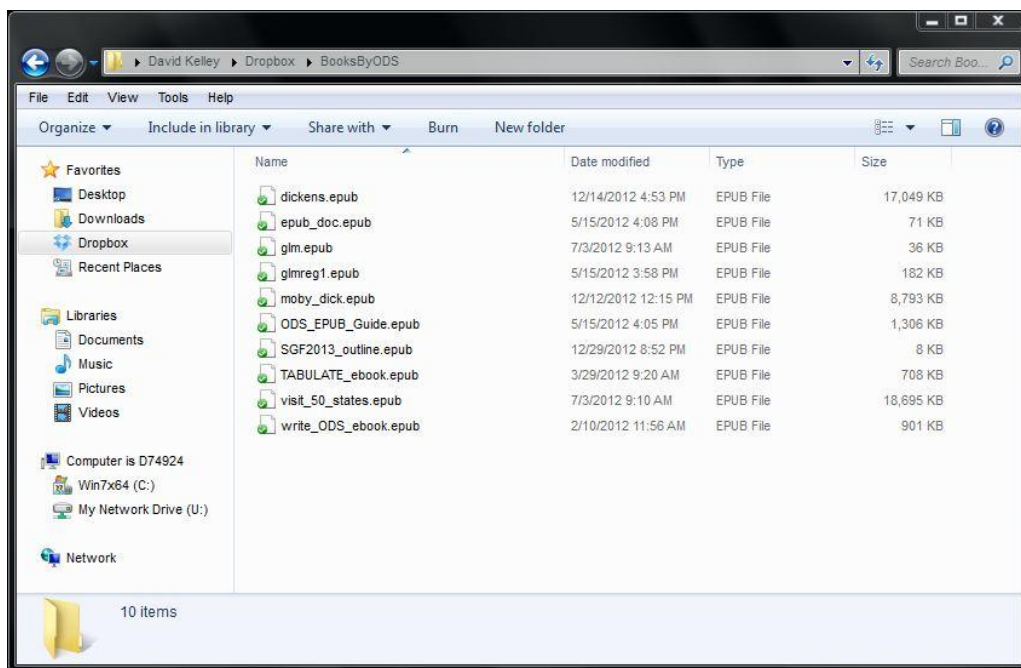

Figure 9. Dropbox Directory Listing in Windows

If you place an EPUB file, or any file, in your Dropbox directory, then Dropbox will automatically synchronize it to the cloud file system. Because the Dropbox directory is an actual Windows directory, it is simple to integrate Dropbox with SAS in general and the ODS EPUB destination in particular. Consider the following revision to the frequency report SAS code:

```
filename ebook "c:\users\sasdck\dropbox\booksbyods\cars_freq.epub";
title;
ods epub file=ebook title="Cars' Origin by Type"
                 options(creator="David W. Kelley");
proc freq data=sashelp.cars;
tables origin*type/plot=freq;
run;
ods epub close;
```

When this code is run in SAS 9.4 on the author's Windows PC, the ODS EPUB destination writes the *cars_freq.epub* file directly into the *BooksByODS* subdirectory in the Dropbox directory. Dropbox synchronizes the EPUB file to the

cloud file system, after which the e-book is accessible to any computer linked to the Dropbox account, including the author's iPad.

Invoking the iPad Dropbox app tells the tale. Navigating to the *BooksByODS* subdirectory and selecting *cars_freq.epub* from the directory listing downloads the file from the Dropbox cloud storage onto the device. After that, tapping the icon in the upper right corner of the screen launches the App Selector dialog box. See Figure 10.
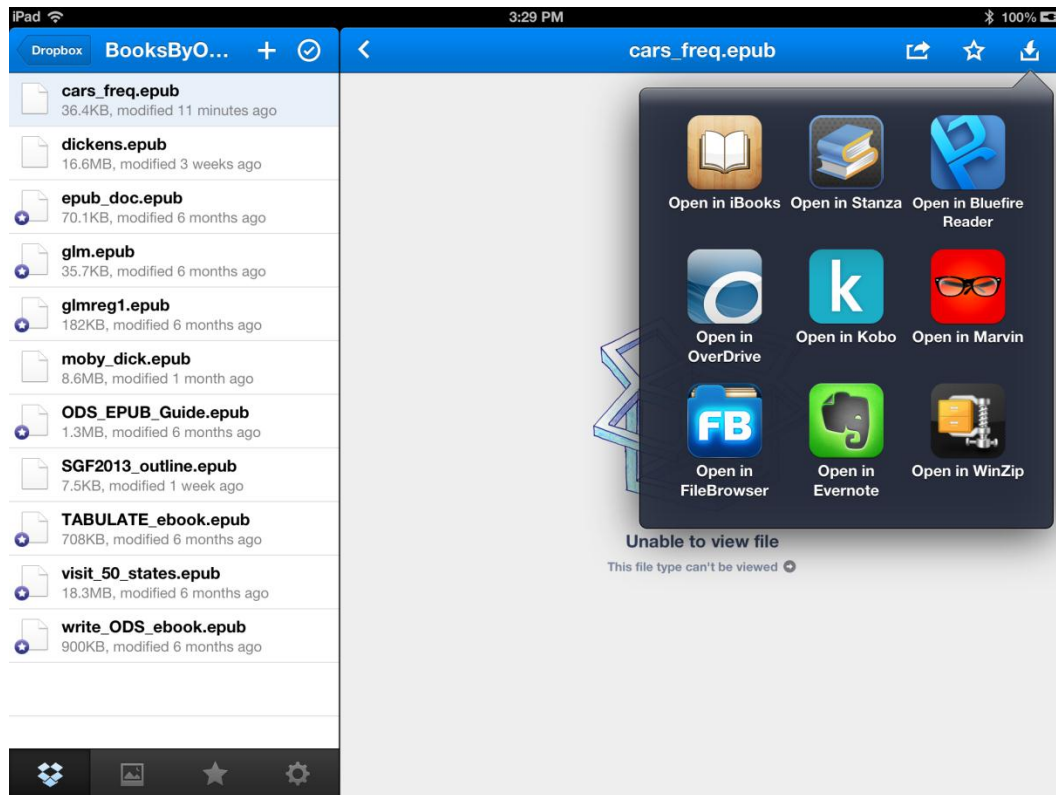

Figure 10. Apps for Viewing an EPUB E-book (Dropbox)

Open in iBooks, and you are done. That was easy!

Beyond its ease of use, Dropbox enables you to automate the generation and distribution of SAS reports. You can share Dropbox cloud directories with coworkers, friends, and relatives. When you create or update an EPUB e-book, everyone linked to your Dropbox directory can access the e-book.

Now that you know how to create ODS EPUB e-books, and how to sideload them into iBooks, you know enough to go mobile. You can get your traditional SAS reports out of your office and onto the devices you carry around with you daily. However, doing only that provides you only partial benefits. The ODS EPUB destination is designed to enable you to write books, and not just reports. To take advantage of that capability, you need to go beyond understanding how to generate and distribute e-books with ODS EPUB. You need to learn how to use ODS EPUB to write rich text, create chapters, and customize the table of contents. Doing so will take you into new territory as a SAS user. Read on!

BOOK IT

Up to this point, the discussion has been about how to generate a SAS report as an EPUB e-book and read it with the iBooks e-book reader. Knowing how to do that will get you only so far. Distributing a traditional SAS report as an e-book does not make the report a book. A book has distinctive features that you do not find in a report. The most obvious difference is the structure of text. Books organize words into sentences, sentences into paragraphs, and paragraphs into sections and chapters. SAS has never allowed customers to do that – until now.

ENRICH TEXT

SAS 9.4 ODS changes the game. In SAS 9.4, text joins tables and graphic displays as a first-class ODS reporting element. In the parlance of ODS, text becomes an *output object*, with all of the attendant behaviors familiar to ODS users. With this new capability, you can write whatever you like – an essay, a shopping list, or an instruction manual – with SAS. You can then format it with one or more destinations, including ODS PDF and ODS POWERPOINT.

Nowhere is this new rich text feature demonstrated to better effect than with the ODS EPUB destination. Consider this example:

```
title;
ods escapechar='^';
ods epub file="visit_50_states.epub" title="Visit 50 States"
        options(creator="David W. Kelley");
proc odstext;
   p "I learned from SAS employee training that, ideally, a goal should be SMART:";
   list;
     item "^{style [foreground=red]S}pecific";
     item "^{style [foreground=red]M}easurable";
     item "^{style [foreground=red]A}ttainable";
     item "^{style [foreground=red]R}elevant";
     item "^{style [foreground=red]T}ime-bound";
   end;
   p "I'm confident that our goal of visiting 50 states is measurable,
       attainable, relevant, and time-bound.  But is it specific?";
run;
ods epub close;
```

When you run the example in SAS 9.4, ODS EPUB generates the EPUB e-book *Visit 50 States.* Figure 11 shows how iBooks displays the e-book.
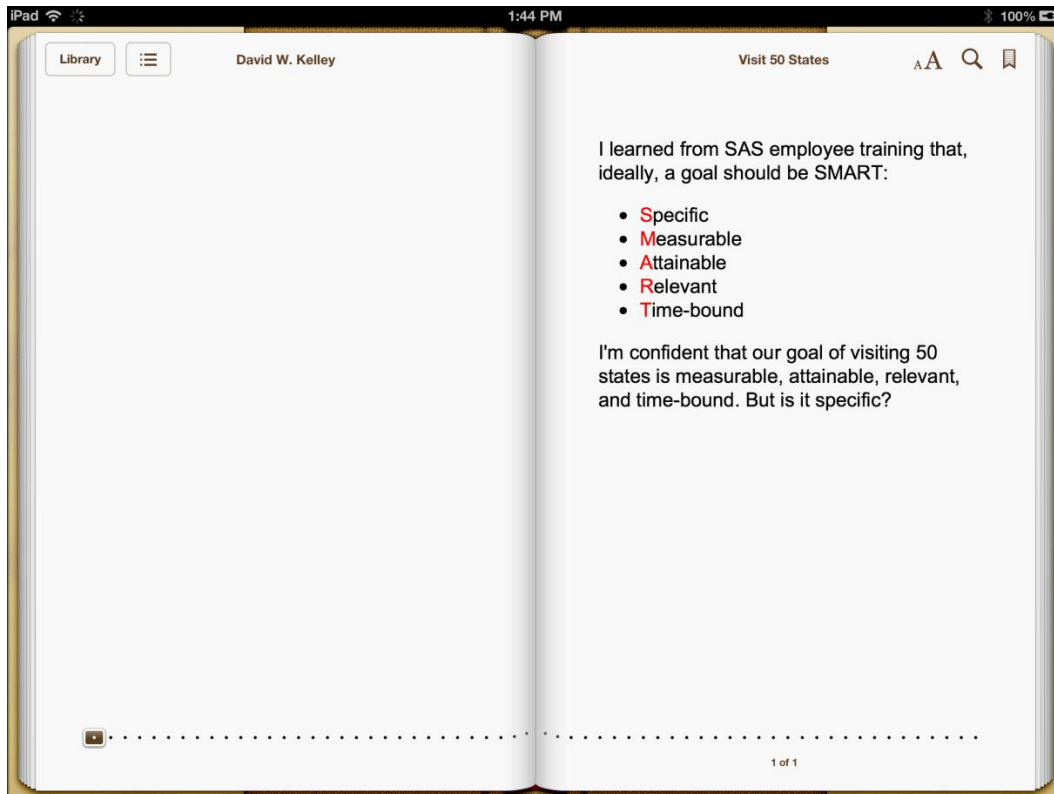

Figure 11. Rich Text in iBooks

That does not look like the SAS output you know and love! There is not a table or graphics display in sight. It is just text – specifically, two paragraphs and a list. The new ODSTEXT procedure makes it possible.

PROC ODSTEXT is a SAS 9.4 procedure that allows you to specify text in the form of paragraphs and nested lists. You specify paragraphs with the P statement. The LIST, ITEM, and END statements are for defining lists. If you are familiar with how HTML defines paragraphs and lists, then these statements should make immediate sense to you.

As the example demonstrates, ODS inline formatting works with PROC ODSTEXT text. The code specifies the STYLE inline formatting function to make the first letter of the text of each list item have a red foreground color.

Notice that the second P statement in the example has text that breaks across a line. The intent is to format the long text in a way that is readable and maintainable. After all, this is a SAS program!

Formatting text in this way introduces whitespace characters. Because iBooks ignores the extra whitespace, the rendered text is unaffected. When you are writing your e-book, take advantage of this behavior and write text that does not wrap, but rather breaks sanely.

Text in EPUB e-books is designed to adapt to the display size of the device rendering it. This feature, called *reflowable text*, permits you to read EPUB e-books on mobile devices of varying form factors. Figure 12 shows how iBooks displays the e-book *Visit 50 States* on a fourth-generation iPod touch.
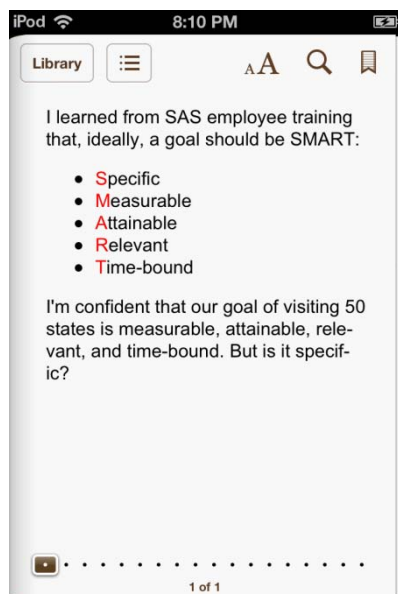

Figure 12. Rich Text in iBooks on iPod

You probably do not want to do much reading on an iPod, but you can!

Aside from its unique ability to generate rich text as paragraphs and lists, PROC ODSTEXT is different from other ODS-integrated procedures in another way: the other procedures issue initial page breaks, and PROC ODSTEXT does not. Consider this revision to the SAS program that generates *Visit 50 States*:

```
title;
ods escapechar='^';
ods epub file="visit_50_states.epub" title="Visit 50 States"
        options(creator="David W. Kelley");
proc odstext;
   p "I learned from SAS employee training that, ideally, a goal should be SMART:";
   list;
     item "^{style [foreground=red]S}pecific";
     item "^{style [foreground=red]M}easurable";
     item "^{style [foreground=red]A}ttainable";
     item "^{style [foreground=red]R}elevant";
     item "^{style [foreground=red]T}ime-bound";
   end;
   p "I'm confident that our goal of visiting 50 states is measurable,
      attainable, relevant, and time-bound.  But is it specific?";
run;
proc odstext;
   p "While it's fun to measure our progress towards our goal of visiting all
      50 states, the greatest enjoyment is in the travel itself.  That is
      another way of saying that it's never too late to join the ranks of
      aspiring 50-staters. You get to make your own travel plans, and to
      formulate your own rules about what qualifies as a state visit.";

   p "That said, whatever else you do, don't interrupt a through-trip long
      enough to stand at
      ^{style [url='http://en.wikipedia.org/wiki/Four_Corners']Four Corners}
      and then claim that you've visited those four states.  That's plain
      cheating!";
run;
ods epub close;
```

Figure 13 shows how iBooks displays the revised e-book. (Note that the iBooks font size has been reduced so that all of the text fits on a single page.)
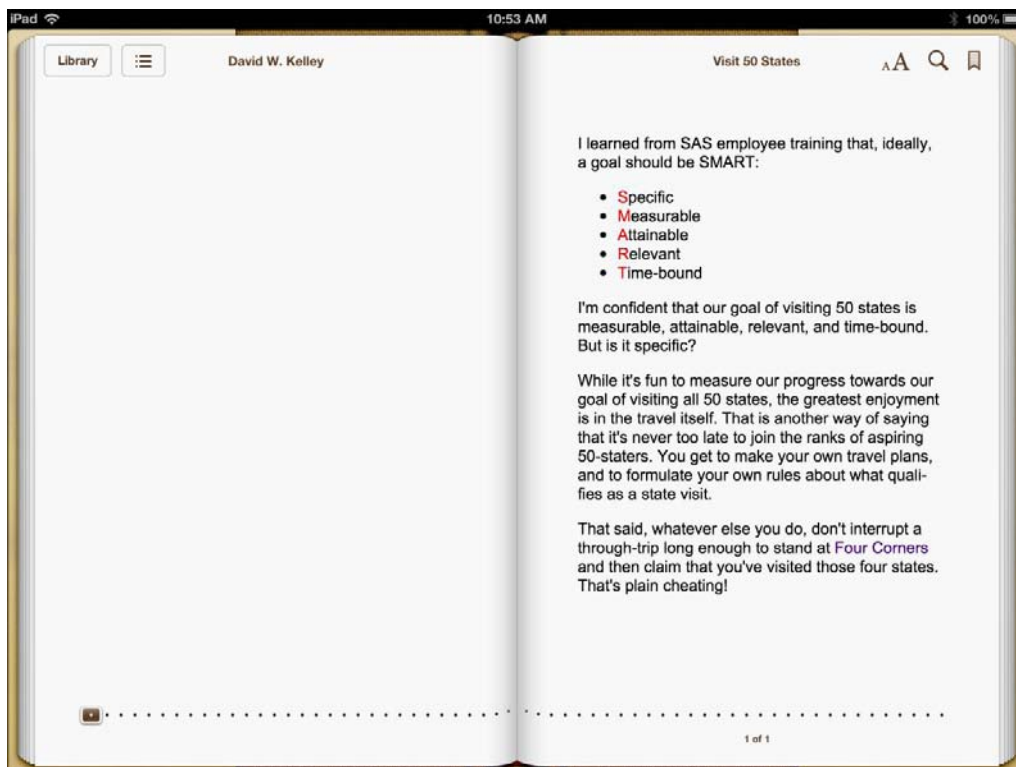

Figure 13. More Rich Text in iBooks

The added text does not begin on a new page, because typically you do not want it to behave that way. Unless you are starting a new chapter or section, text should flow in an uninterrupted fashion. To begin a new section, you can specify the PROC ODSTEXT statement PAGEBREAK option. To learn how to begin a new chapter, keep reading!

The example demonstrates another use of the STYLE inline formatting function, which is to create a hyperlink. Tapping the hyperlink launches Safari at the specified location. In the example, tapping the text "Four Corners" takes you to a Wikipedia entry about the Four Corners region of Colorado, New Mexico, Arizona, and Utah.

Embedding links to external resources enriches the content of your e-book, but also makes it less portable. You should not write your EPUB e-book in such a way that the reader must have an Internet connection to benefit from reading it. Make sure that your e-book is equally readable in the office or at the beach!

START A NEW CHAPTER

Physical books group paragraphs into sections and sections into chapters. EPUB e-books can have the same arrangement. Does it matter? Can an e-book reader tell the difference between a section and a chapter?

From a user perspective, the answer is no – sections and chapters behave in the same way. However, from a performance perspective, there is a difference. EPUB e-book readers load e-books into computer memory a chapter at a time. If you write a lengthy e-book, organizing its material into chapters will allow the e-book reader to load it faster, and with a smaller memory footprint, than if you structure the e-book as a single chapter.

Consider another revision to the example e-book *Visit 50 States*. This revision adds an appendix chapter that lists attractions seen in visited states. Figure 14 shows how iBooks displays the new chapter.
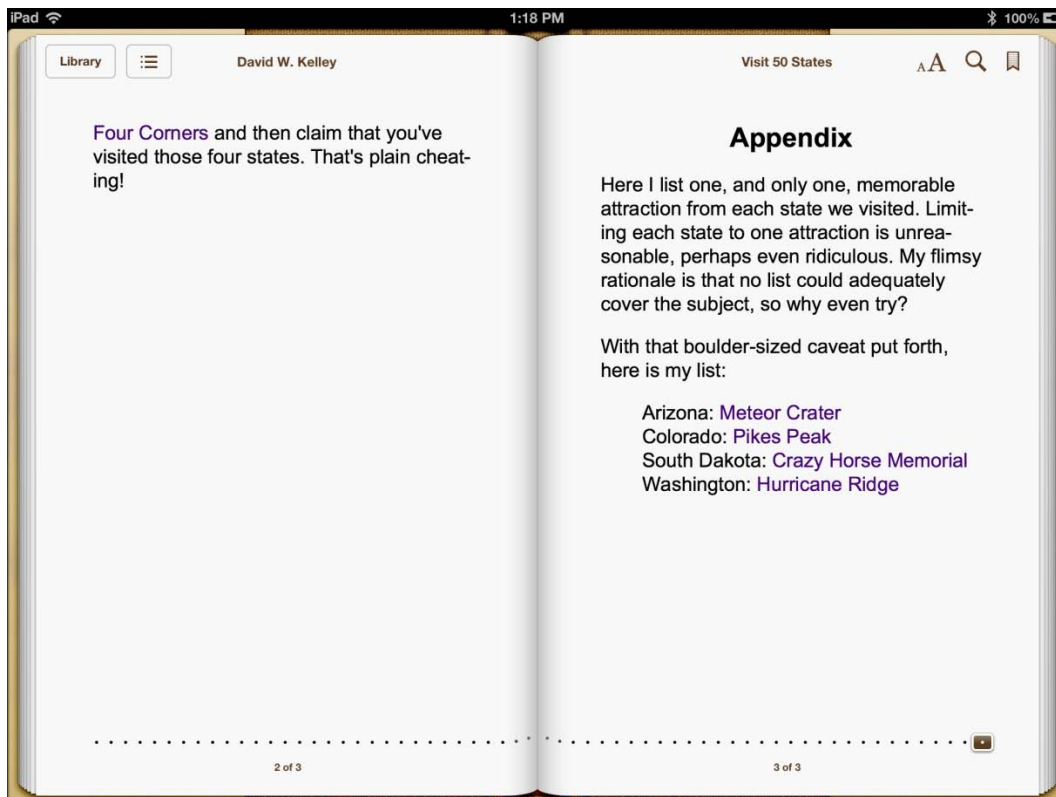

Figure 14. Appendix Chapter in iBooks

Here is the SAS code that generates the e-book displayed in Figure 14.

```
title;
ods escapechar='^';
ods epub file="visit_50_states.epub" title="Visit 50 States"
         options(creator="David W. Kelley");
proc odstext;
   p "I learned from SAS employee training that, ideally, a goal should be SMART:";
   list;
      item "^{style [foreground=red]S}pecific";
      item "^{style [foreground=red]M}easurable";
      item "^{style [foreground=red]A}ttainable";
      item "^{style [foreground=red]R}elevant";
      item "^{style [foreground=red]T}ime-bound";
   end;
   p "I'm confident that our goal of visiting 50 states is measurable,
      attainable, relevant, and time-bound.  But is it specific?";
run;

proc odstext;
   p "While it's fun to measure our progress towards our goal of visiting all
      50 states, the greatest enjoyment is in the travel itself.  That is
      another way of saying that it's never too late to join the ranks of
      aspiring 50-staters. You get to make your own travel plans, and to
      formulate your own rules about what qualifies as a state visit.";

   p "That said, whatever else you do, don't interrupt a through-trip long
      enough to stand at
      ^{style [url='http://en.wikipedia.org/wiki/Four_Corners']Four Corners}
      and then claim that you've visited those four states.  That's plain
      cheating!";
run;

ods epub newchapter=now;

title "Appendix";

proc odstext;
   p "Here I list one, and only one, memorable attraction from each state
      we visited.  Limiting each state to one attraction is unreasonable,
      perhaps even ridiculous.  My flimsy rationale is that no list could
      adequately cover the subject, so why even try?";
   p "With that boulder-sized caveat put forth, here is my list:";
   list/style={liststyletype="none"};
      item "Arizona:
            ^{style
[url='http://www.americansouthwest.net/arizona/meteor_crater/index.html']Meteor
Crater}";
      item "Colorado:
            ^{style [url='http://en.wikipedia.org/wiki/Pikes_Peak']Pikes Peak}";
      item "South Dakota:
            ^{style [url='http://crazyhorsememorial.org/']Crazy Horse Memorial}";
      item "Washington:
            ^{style [url='http://www.nps.gov/olym/planyourvisit/visiting-hurricane-
ridge.htm']Hurricane Ridge}";
   end;
run;
ods epub close;
```

As you see from the code, you start a new chapter with the ODS EPUB statement NEWCHAPTER option. The NEWCHAPTER option accepts several values. The example demonstrates the value NOW, which should be self-explanatory. The other values are:

- PROC: Start a new chapter for every procedure.
- OUTPUT: Start a new chapter for every output object.
- PAGE: Start a new chapter for every explicit page break.
- BYGROUP: Start a new chapter for every BY group.
- NONE: Do not start a new chapter. NONE is the default value for the NEWCHAPTER option.

The other code change deserving comment is the use of the LIST statement STYLE option to suppress the display of disc (bullet) markers for the list of visited states. Every LIST statement list has a style type, which is governed by the LISTSTYLETYPE attribute. PROC ODSTEXT supports many list style types, including *decimal*, *disc*, *square*, and *upper-roman*. *Disc* is the default list style type. To suppress the display of list markers, specify a style type of *none*.

TABLE YOUR CONTENTS

Up to this point you have explored how PROC ODSTEXT differs from other SAS procedures. In other ways, it is the same. PROC ODSTEXT, like other procedures, is represented in the table of contents. Figure 15 shows how iBooks renders the table of contents for the latest version of the EPUB e-book *Visit 50 States.*
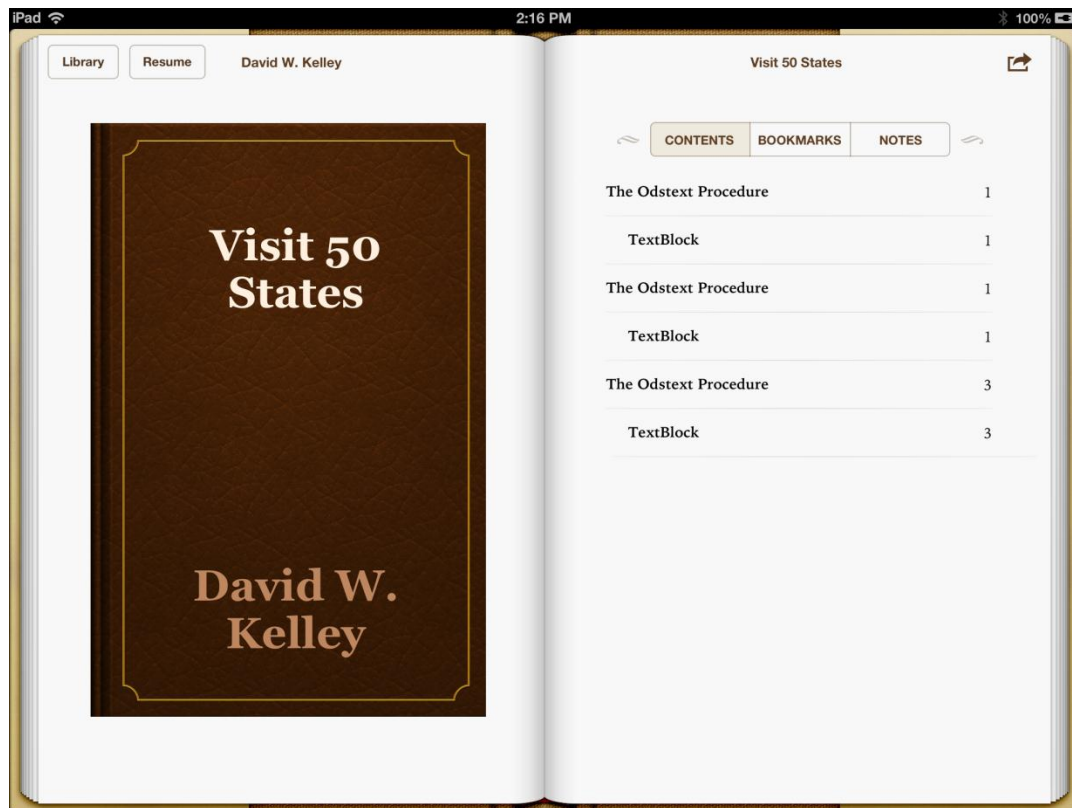

Figure 15. Default Table of Contents in iBooks

This table of contents is hopelessly generic and of no use to the reader. Worse, it practically screams that the book is the product of an automated process, and an inferior one at that. The default table of contents must go!

Two repeated SAS code modifications will improve the table of contents:

1. Specify the ODS statement PROCLABEL option to customize the procedure entries ("The Odstext Procedure").
2. Specify the PROC ODSTEXT CONTENTS option to suppress the output object entries ("TextBlock").

The modified SAS code follows.

```
   title;
   ods escapechar='^';
   ods epub file="visit_50_states.epub" title="Visit 50 States"
            options(creator="David W. Kelley");
   ods proclabel = "SMART Traveling";
   proc odstext contents="";
      p "I learned from SAS employee training that, ideally, a goal should be SMART:";
      list;
        item "^{style [foreground=red]S}pecific";
        item "^{style [foreground=red]M}easurable";
        item "^{style [foreground=red]A}ttainable";
        item "^{style [foreground=red]R}elevant";
        item "^{style [foreground=red]T}ime-bound";
      end;
      p "I'm confident that our goal of visiting 50 states is measurable,
         attainable, relevant, and time-bound.  But is it specific?";
   run;

   ods proclabel = "The Journey's End";
   proc odstext contents="";
      p "While it's fun to measure our progress towards our goal of visiting all
         50 states, the greatest enjoyment is in the travel itself.  That is
         another way of saying that it's never too late to join the ranks of
         aspiring 50-staters. You get to make your own travel plans, and to
         formulate your own rules about what qualifies as a state visit.";

      p "That said, whatever else you do, don't interrupt a through-trip long
         enough to stand at
         ^{style [url='http://en.wikipedia.org/wiki/Four_Corners']Four Corners}
         and then claim that you've visited those four states.  That's plain
         cheating!";
   run;

   ods epub newchapter=now;

   ods proclabel = "Appendix";
   title "Appendix";

   proc odstext contents="";
      p "Here I list one, and only one, memorable attraction from each state
          we visited.  Limiting each state to one attraction is unreasonable,
          perhaps even ridiculous.  My flimsy rationale is that no list could
          adequately cover the subject, so why even try?";
      p "With that boulder-sized caveat put forth, here is my list:";
      list/style={liststyletype="none"};
        item "Arizona:
               ^{style
   [url='http://www.americansouthwest.net/arizona/meteor_crater/index.html']Meteor
   Crater}";
        item "Colorado:
               ^{style [url='http://en.wikipedia.org/wiki/Pikes_Peak']Pikes Peak}";
        item "South Dakota:
               ^{style [url='http://crazyhorsememorial.org/']Crazy Horse Memorial}";
        item "Washington:
               ^{style [url='http://www.nps.gov/olym/planyourvisit/visiting-hurricane-
   ridge.htm']Hurricane Ridge}";
      end;
   run;

   ods epub close;
```

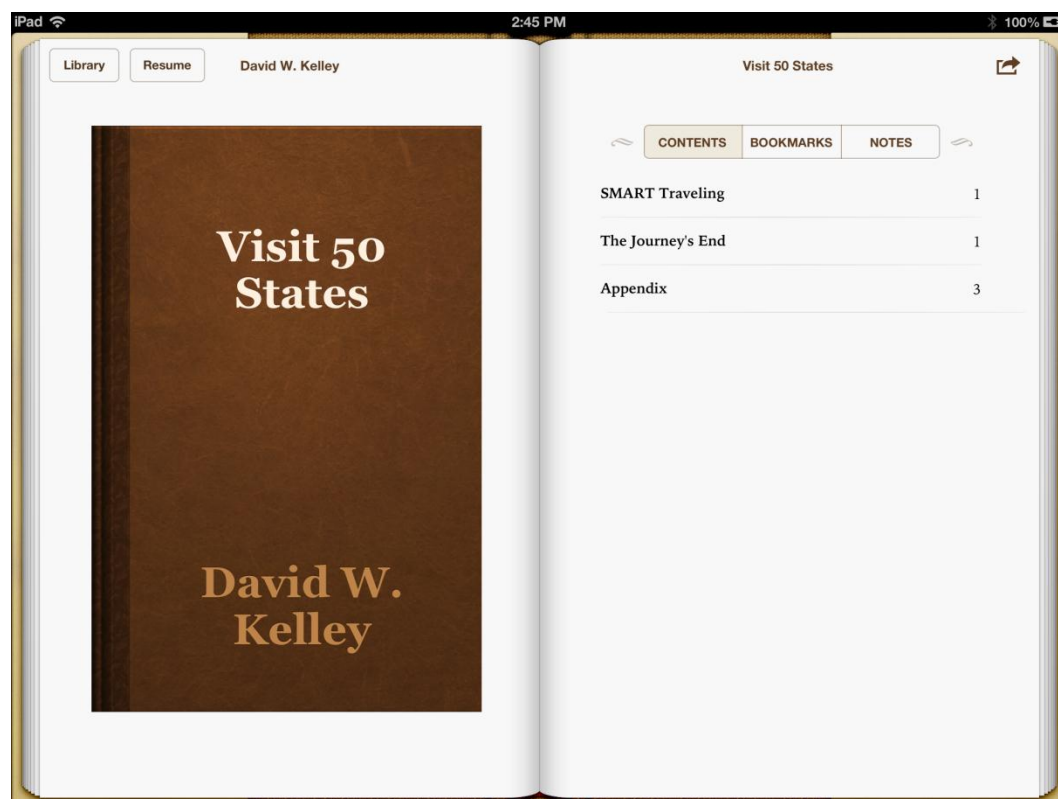Figure 16 displays the custom table of contents.

Figure 16. Custom Table of Contents in iBooks

To further enhance the *Visit 50 States* e-book, you could add headings to the text sections that correspond to the table of contents entries.   That would help the reader to know where on the page to start reading when he selects a section. The first chapter of *Visit 50 States* has two sections. The second (appendix) chapter already has a title, so it does not need additional context. How to add section headings is left as an exercise for the reader.

You might have noticed that the appearance of the cover of *Visit 50 States* changed from Figure 15 to Figure 16. iBooks determines the default cover, and it selects from a variety of built-in cover designs according to some unknown criteria. Fortunately, you can customize the cover in iBooks. You will learn how to do that, plus more, next!

OPTIMIZE IBOOKS

You have learned how to create an ODS EPUB e-book for your Apple mobile device, and how to enrich its content with text arranged into lists, paragraphs, sections, and chapters. You know how to customize the table of contents to facilitate the reader's navigation in the e-book. Now the discussion turns to making the best use of ODS EPUB and iBooks to write e-books that are visually appealing, thoughtfully constructed, and accessible to a wide range of readers.

JUDGE A BOOK BY ITS COVER

Ideally your ODS EPUB e-book's cover will catch your reader's eye and entice her to read the e-book. By that standard, the iBooks default cover designs, which are serviceable but visually uninteresting, fall short. No doubt you could do better, whether on your own or with professional assistance. Fortunately, you can customize the cover for your e-book. iBooks and other EPUB e-book readers will display your custom cover.

To specify a cover for your e-book, use the COVER_IMAGE suboption of the ODS EPUB statement OPTIONS option. For example, to specify a cover for the *Visit 50 States* e-book, modify the initial ODS EPUB statement to be:

```
ods epub file="visit_50_states.epub" title="Visit 50 States"
         options(creator="David W. Kelley" cover_image="images/cover.jpg");
```

The COVER_IMAGE value is an image filename or fileref. The image type should be JPEG for photographs and PNG for anything else. For best results in iBooks, Apple recommends that the cover image be 2400 pixels along the shorter axis.

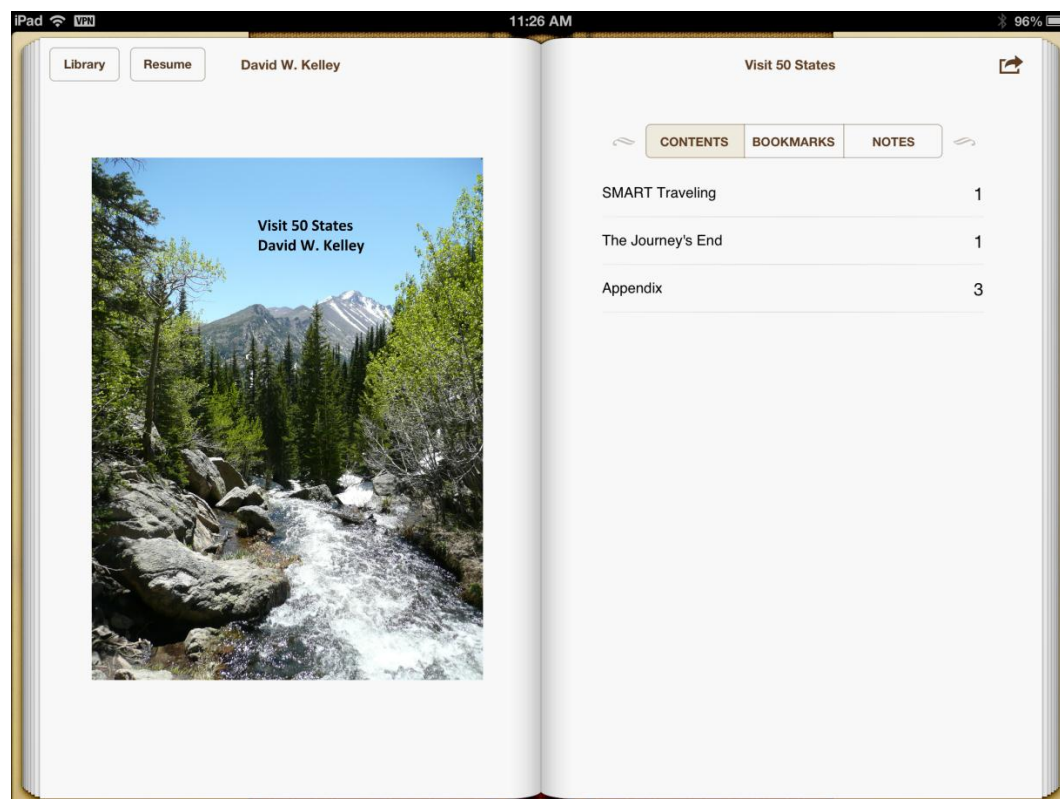Figure 17 shows how iBooks displays the custom cover of *Visit 50 States*.

Figure 17. Custom Cover in iBooks

The cover image in Figure 17 has dimensions of 2304 pixels by 3072 pixels, as determined by the camera with which the photograph was taken. (In case you are wondering, the photograph was taken in the Rocky Mountain National Park in Colorado.)

If you supply a custom cover for your e-book, then the cover image should include title and author information. If your cover is a photograph, then you will need to edit the photograph. Photograph editors range from the simple (Microsoft Paint) to the sophisticated (Adobe Photoshop). Microsoft Paint sufficed to edit the cover image for *Visit 50 States,* but it is just an example e-book, after all. You can easily do a better job with your custom cover!

STEP OUT OF LINE

iBooks excels at reflowing text and scaling graphics displays to fit its page size, which is determined by the display size and orientation of the reader's mobile device. It is not nearly as good at displaying tables that are too tall and/or wide for the page. iBooks breaks tall tables across pages without repeating the column headers, which makes it hard to know what is in which column. Worse, it truncates columns that extend beyond the right margin of the page. You can mitigate this undesirable behavior by double-tapping the table to put iBooks in pan-and-zoom mode. Nevertheless, SAS makes it easy to generate large tables, and iBooks needs an acceptable way to display such tables initially. To its credit, iBooks provides a solution.

The way to handle too-big tables in iBooks is to place them in the *nonlinear section* of the e-book. This is the section of an EPUB e-book for material that is outside of the linear flow of the e-book. By default all ODS EPUB e-book material is linear. If you want a table to be in the nonlinear section, then you must specify the NONLINEAR suboption of the ODS EPUB statement OPTIONS option.

The following SAS code demonstrates the NONLINEAR suboption:

```
ods epub file="print100rows.epub" title="PROC PRINT With 100 Rows"
         options(creator="David W. Kelley" nonlinear="table");
title 'Non-linear Table';
proc print data=sashelp.prdsal2(obs=100);
run;
ods epub close;
title;
```

The SAS code specifies NONLINEAR="table" to instruct the ODS EPUB destination to place tables in the nonlinear section of the e-book *PROC PRINT With 100 Rows*. Figure 18 shows how iBooks displays *PROC PRINT With 100 Rows.*
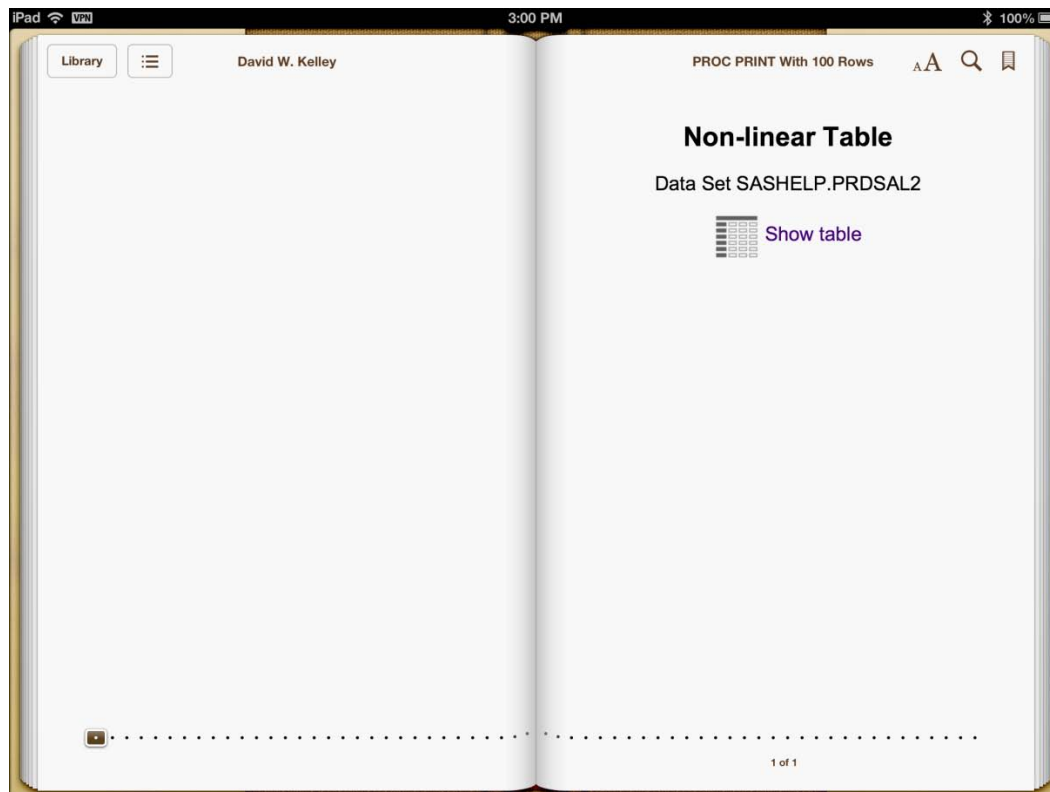

Figure 18. Nonlinear Table in iBooks

Instead of displaying the table, iBooks displays an icon for the table. Selecting the icon puts iBooks in pan-and-zoom mode on the table – all 100 intact rows of it. Much better! With the NONLINEAR suboption, you can generate an EPUB e-book that iBooks will handle gracefully, no matter the size of any table in the e-book.

BE ACCESSIBLE

Apple iPads, iPhones, and iPods contain built-in accessibility features that allow users of all abilities to enjoy digital content. These features include the ability to customize font size and color schemes, magnification, and the VoiceOver screen reader, which allows totally blind users to use iOS devices. iBooks is fully compatible with these accessibility features. In addition, the EPUB specification has been specifically designed to ensure that e-books are accessible to users with disabilities.

ODS EPUB leverages this infrastructure. It will do most of the work required for your e-book to be accessible to a broad audience. However, there are a few things that you can do to ensure everyone can enjoy your e-book.

CREATE MEANINGFUL LINK TEXT

Ensure that the purpose of the links in your e-book can be determined from only the link text when they are viewed out of context. This will allow users with visual impairments to quickly scan the links within your e-book using the

VoiceOver screen reader.

For example, the link text in the first sentence below does not convey the purpose of the link when viewed out of context. However, the link text in the second sentence does.

Click here to learn how to customize the cover of your e-book.

See JUDGE A BOOK BY ITS COVER to learn how to customize the cover of your e-book.

DO NOT USE COLOR ALONE TO CONVEY MEANING

Ensure that users with color-blindness can perceive the graphs and charts in your e-book by using an additional characteristic to convey meaning. For example, the chart below uses both color and shape to identify the gender of the student represented by each data point. The colors chosen are also not only different hues (blue and green) but also different color brightness levels (light and dark). A reader with blue-green color-blindness will still be able to distinguish between the colors, as would a reader receiving a black-and-white print-out of this chart.
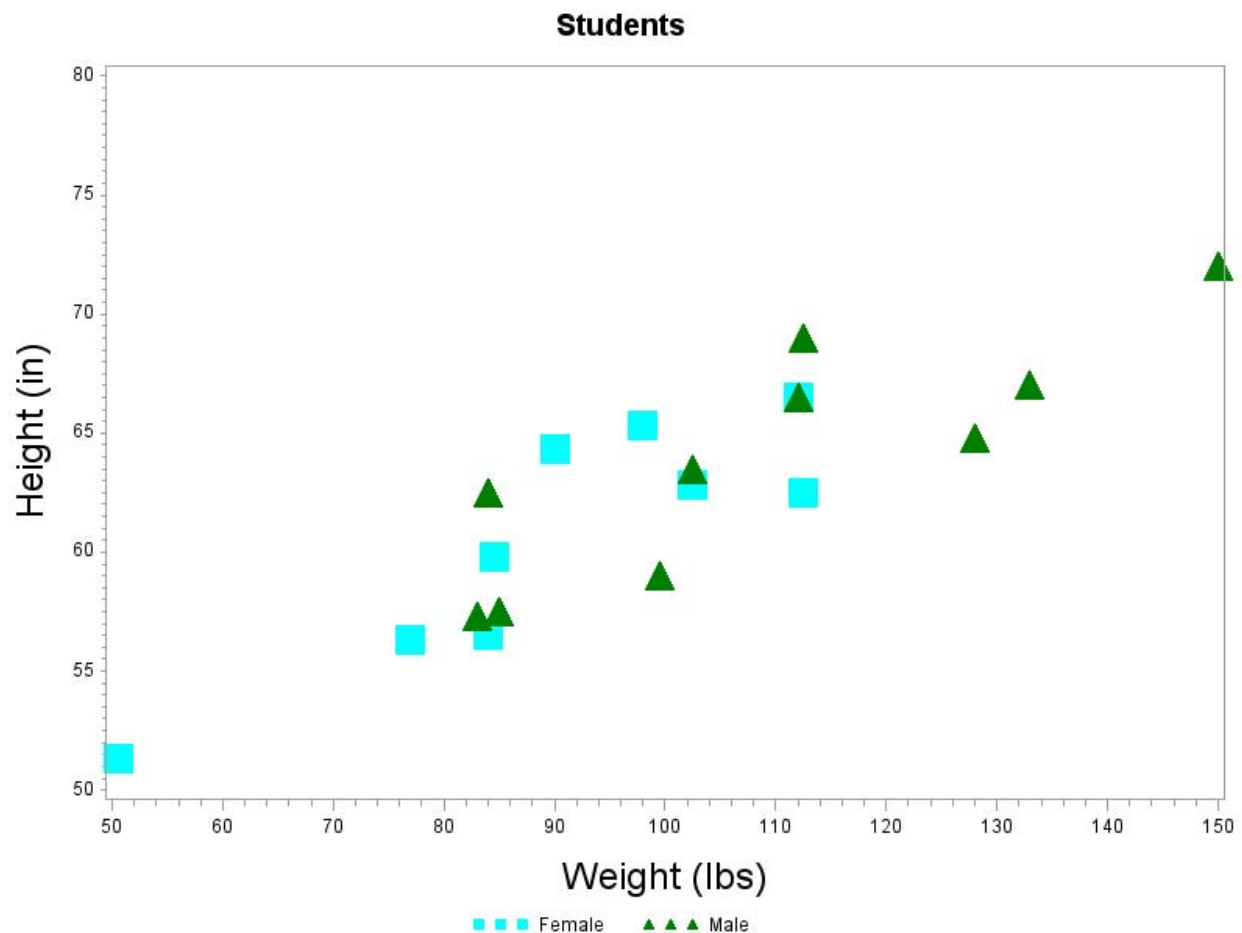

Figure 19. A Scatter Plot Using Color and Shape

This scatter plot was created by the following SAS code:

```
symbol1 value=squarefilled color=cyan height=3;
symbol2 value=trianglefilled color=green height=3;
axis1 label=(angle=90 height=2 "Height (in)" ) order=(50 to 80 by 5);
axis2 label=(height=2 "Weight (lbs)");
legend1 label=none value=("Female" "Male");
```

```
title "Students";

proc gplot data=sashelp.class;
    plot height*weight=sex / legend=legend1 vaxis=axis1 haxis=axis2;
run;
```

IDENTIFY COLUMN AND ROW HEADERS IN TABLES

Ensure that users with visual impairments can understand the tables in your e-book by identifying the column and row headers when you create the tables. This will cause SAS to mark up table cells that contain headers so that VoiceOver can describe the column and row header information for each cell in the table.

The SAS System

Name	Age	Weight	Height
James	12	83.0	57.3
Jane	12	84.5	59.8
John	12	99.5	59.0
Louise	12	77.0	56.3
Robert	12	128.0	64.8

Figure 20. PROC PRINT Output with Row Headers

The table above was created using the following SAS code:

```
proc print data=sashelp.class(where=(age=12)) noobs;
    var name / style=rowheader;
    var age weight height;
run;
```

STYLE TABLES

The size of the text within tables can be very small by default, which makes it difficult for users to read the table. Also, the height and width of cells within tables can be very small by default, which makes it difficult for totally blind users to explore tables using VoiceOver. Ensure that the text and cells in tables are large enough to meet the needs of all users.

```
proc template;
    define style styles.docStyle;
    parent = styles.daisy;

        class header /
                fontweight = bold
                width=90px;
        class rowheader /
                fontweight = bold
                fontsize = 15pt
                height=20px
                width=100px;
        class data /
                fontsize=13pt;
    end;
run;
```

Name	Sex
Alice	F
Barbara	F
Carol	F
Jane	F
Janet	F
Joyce	F
Judy	F
Louise	F
Mary	F
Alfred	M
Henry	M
James	M
Jeffrey	M
John	M
Philip	M
Robert	M
Ronald	M
Thomas	M
William	M

Figure 21. PROC PRINT Output with the Previous Template Applied

PROVIDE TEXT ALTERNATIVES FOR IMAGES

Users with visual impairments might not be able to see the charts, graphs, and other images in your e-book. Be sure to include a short text alternative that summarizes the purpose of each image in your e-book. Do not include "Image of …", "Picture of …" or similar phrases in the text alternative. It is not necessary to include those phrases because VoiceOver communicates the type of each object to the user. For example, the text alternative specified by the SAS code below is perfectly adequate.

```
proc odstext contents="";
    p "There are some dangerous animals in our forests. It is best to avoid them.";
    p "^{image &path\bear_20070606.png?alt_desc=Grizzly Bear}"/style=image;
run;
```

You can also provide custom text alternatives for your SAS output.

```
proc gchart data=sashelp.class;
    vbar sex / description="Bar chart of students by gender ";
run;
```
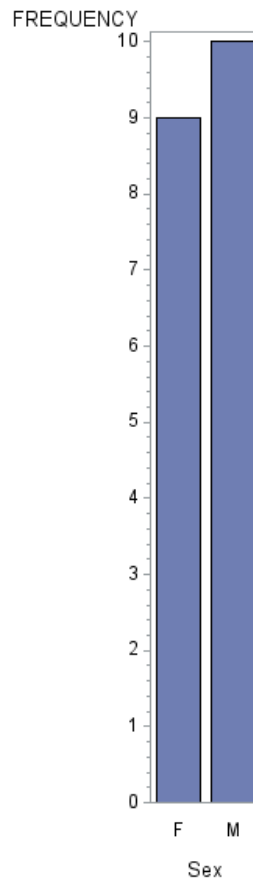
Figure 22. SAS Bar Chart with Text Alternative (Not Shown Here)

When totally blind users encounter the chart in Figure , they will hear "Bar chart of students by gender".

For complex charts and graphs, you should also include a long description of the image. You can do this by including a verbal description inline within the text of the e-book or by providing a link to a NONLINEAR section that contains a table of the data represented in the image.

The following SAS code creates a NONLINEAR section that represents the data in the bar chart above in table format.

```
proc template;
   define style styles.docStyle;
   parent = styles.daisy;

      class header /
             fontweight = bold
             fontsize = 15pt
             width=90px;
      class rowheader /
             fontweight = bold
             fontsize = 15pt
             height=20px
             width=100px;
      class data /
             fontsize=13pt;
   end;
run;
```

```
ods epub file="students.epub" title="Students" options(nonlinear="table"
contents="off") style=docStyle;

title "Girls and Boys";
axis1 label=("Sex") order=("F" "M") length=80;
axis2 label=(angle=90 "Number of Students") order=(0 to 10 by 1);
proc gchart data=sashelp.class;
      vbar sex / description="Bar chart of students by gender"
                    maxis=axis1 raxis=axis2 width=30;
run;

proc sort out=temp data=sashelp.class(keep=name sex); by sex; run;

proc print data=temp noobs;
      var name / style=rowheader;
      var sex;
run;
ods epub close;
```

CONCLUSION

Apple had a famous advertising campaign with the slogan *Think Different*. Hopefully after reading this paper or viewing the presentation, you will think different about how you will use ODS in SAS 9.4. Move beyond traditional office-based reporting and deliver your SAS output as EPUB e-books on mobile devices. Write a novel with SAS and self-publish it. Easily share your e-books with customers and friends, including visually impaired readers. Now that you know how to do it, get to it!

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CONTACT INFORMATION

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