

Three Reports on a Page and 4-Page Layouts on the Fly with SAS® and the Output Delivery System

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ABSTRACT

This paper details the creation of a ready-to-publish document with multiple data sources and differing page layouts of the same type of information based on page fit. Each set of information is placed on one, two, or three pages depending on fit, and requires three calls to the REPORT procedure using three different data sets. This solution does not involve ODS DOCUMENT. Instead, we calculate how much horizontal and vertical space the report requires and use the macro language to execute code conditionally. This allows us to dynamically determine which page layout to apply, including setting or suppressing page breaks with ODS STARTPAGE=. This solution makes extensive use of inline formatting as well. The output was produced as an RTF file using SAS® University Edition running on a Microsoft Windows 10 machine.

INTRODUCTION

This is a part of a simplified railroad simulation. This reporting challenge is to create a passenger railroad timetable using a vintage US timetable as the template. There are three distinct pieces of information required: the train schedules themselves, as shown in Figure 1:

NEW YORK, PHILADELPHIA, WASHINGTON AND BALTIMORE TO CHICAGO							
WESTWARD							
Miles	Table 2 Eastern Standard Time New York to Warsaw Central Standard Time Plymouth to Chicago Time shown is in accordance with Uniform Time Act—see page 2	Manhattan Limited	Manhattan Limited	The General	Broadway Limited	Pennsylvania Limited	⊕ The Fort Pitt
		23	43	49	29	55	53
		Daily Except Sun., Mon. & Sept. 5	Sun., Mon. & Sept. 5	Daily	Daily	Daily	Daily
		PM	PM	PM	PM	PM	AM
.0	Lv NEW YORK (Penna. Station)-----	1.30	1.30	v 5.05	n.s. t 6.00	v 9.40	
10.0	" Newark ?-----	1.45	1.45	v 5.21	t 6.15	v 9.55	
58.1	" Trenton -----	2.31	2.31	v 6.06			
85.9	" Philadelphia " North Philadelphia Station " Penna. Station (30th St.)-----	c 3.02	c 3.02	c 6.34	t 7.21		
111.4	" Paoli -----	3.40	3.40	7.01		e11.45	
130.0	" Coatesville -----	4.00	4.00		t 7.55	12.11	
159.3	" Lancaster -----	4.27	4.27	7.47		1.03	
194.6	Ar Harrisburg -----	5.03	5.03	8.18	t 9.08	1.35	
.0	Lv WASHINGTON			5.00			
40.1	" Baltimore (Penna. Station)-----			6.00			
96.3	" York -----			7.35			
123.4	Ar Harrisburg -----			8.20			
194.6	Lv Harrisburg -----	5.15	5.15	8.36	t 9.08	1.55	
255.2	" Lewisstown (Penna. State University-⊕)-----	6.20	6.20				
325.4	" Altoona (⊕)-----	7.52	7.52	10.51	t11.31	4.12	
382.9	" Johnstown -----	9.00	9.00	11.56		5.18	
399.2	" Latrobe -----	9.45	9.45			6.04	
408.5	" Greensburg -----	9.58	9.58			6.18	
439.3	Ar Pittsburgh -----	10.45	10.45	1.22	2.02	7.05	
439.3	Lv Pittsburgh -----	11.20	11.20	1.22	2.02	7.40	11.45
451.8	Ar Scranton -----	11.32	11.32				12.01

Figure 1: Train Schedule Template

The second piece is the explanation of the symbols and letters within the schedules (Figure 2):

Reference Marks for Table 2		
• Daily.	† Daily except Sundays.	■ On Saturdays leave 4.30 p.m.
§ Sundays only.	‡ Except Saturdays.	◆ Bus service is operated on limited schedule between Lewistown and Pennsylvania State University also between Altoona, Tyrone and Pennsylvania State University by Fullington Auto Bus Company. Through tickets may be purchased from Pennsylvania Railroad agents when routed via Lewistown and baggage may be checked to State College, Pa.
▲ Add one hour to "City Time" to conform with train time shown.	◆ Bus service is operated on limited schedule between Lewistown and Pennsylvania State University also between Altoona, Tyrone and Pennsylvania State University by Fullington Auto Bus Company. Through tickets may be purchased from Pennsylvania Railroad agents when routed via Lewistown and baggage may be checked to State College, Pa.	■ Except Saturdays and Sundays.
○ Frequent service available between Newark and Jersey City or Hudson Terminal—see General Information on page 3.	◆ Bus service is operated on limited schedule between Lewistown and Pennsylvania State University also between Altoona, Tyrone and Pennsylvania State University by Fullington Auto Bus Company. Through tickets may be purchased from Pennsylvania Railroad agents when routed via Lewistown and baggage may be checked to State College, Pa.	■ Stops Saturdays and Sundays.
⊖ Coaches only; no dining car or parlor car service.	◆ Bus service is operated on limited schedule between Lewistown and Pennsylvania State University also between Altoona, Tyrone and Pennsylvania State University by Fullington Auto Bus Company. Through tickets may be purchased from Pennsylvania Railroad agents when routed via Lewistown and baggage may be checked to State College, Pa.	■ Stops only to receive passengers for points west of Pittsburgh.
	◆ Bus service is operated on limited schedule between Lewistown and Pennsylvania State University also between Altoona, Tyrone and Pennsylvania State University by Fullington Auto Bus Company. Through tickets may be purchased from Pennsylvania Railroad agents when routed via Lewistown and baggage may be checked to State College, Pa.	■ Stops only to receive passengers for points west of Philadelphia.

Figure 2: Reference Mark Template

The last piece is a list of what type(s) of cars and amenities are available on each train (Figure 3.)

SLEEPING, PARLOR, DINING CARS AND COACHES	
Regularly Assigned Cars are Air-Conditioned	
New York, Philadelphia, Washington and Baltimore to Chicago	
WESTWARD	
<p>Nos. 23 and 43. MANHATTAN LIMITED</p> <p>Sleeping Car.....Pittsburgh to Chicago (12 Duplex Rooms, 4 Double Bedrooms) (Sleeping Car open in Pittsburgh 9.00 p.m., E.S.T.)</p> <p>Snack Bar Coach.....New York to Chicago (Hot-Cold Food and Beverages).</p> <p>Reclining Seat Coaches.....New York to Chicago.</p>	<p>No. 49. THE GENERAL</p> <p>Lounge Car (Bar).....New York to Chicago (6 Double Bedrooms).</p> <p>Sleeping Cars.....New York to Chicago (10 Roomettes, 6 Double Bedrooms) (Two Cars). Washington to Chicago (10 Roomettes, 6 Double Bedrooms).</p> <p>Dining Car.....New York to Chicago.</p> <p>Snack Bar Coach.....Washington to Harrisburg (Hot-Cold Food and Beverages).</p> <p>Reclining Seat Coaches.....New York to Chicago (All Seats Reserved—Coach Attendant service). Washington to Chicago (All Seats Reserved—Coach Attendant service).</p> <p>(For Special Service Charge in Reserved Seat Coaches See Page 3)</p> <p>Lounge Coach (Bar).....New York to Chicago.</p>
<p>No. 29 BROADWAY LIMITED All Private Room Train</p> <p>Sleeping Cars.....New York to Chicago (10 Roomettes, 6 Double Bedrooms) (Two Cars).</p> <p>New York to Chicago (4 Compartments, 2 Drawing Rooms, 4 Double Bedrooms).</p> <p>New York to Chicago (12 Duplex Rooms, 4 Double Bedrooms).</p> <p>New York to Chicago (11 Double Bedrooms) (Operates odd dates in Aug.; even dates in Sept. and Oct.)</p> <p>Observation Car (Bar Lounge).....New York to Chicago (2 Master Rooms, Double Bedroom).</p> <p>Dining Car.....New York to Chicago.</p> <p>No Coaches or checked baggage New York to Chicago.</p> <p>No. 43 (See Nos. 23 and 43)</p>	<p>No. 53. THE FORT PITT</p> <p>Reclining Seat Coaches.....Pittsburgh to Chicago.</p>
	<p>No. 55. PENNSYLVANIA LIMITED</p> <p>Sleeping Cars.....New York to Chicago (10 Roomettes, 6 Double Bedrooms). New York to Pittsburgh (10 Roomettes, 6 Double Bedrooms) (Except Saturdays and Sept. 3). New York to Pittsburgh (12 Duplex Rooms, 4 Double Bedrooms). (Sleeping cars may be occupied in Pittsburgh until 8:00 a.m. E. S. T.)</p> <p>Snack Bar Coach.....New York to Chicago.</p> <p>Reclining Seat Coaches.....New York to Chicago.</p>

Figure 3: Accommodations and Amenities Template

Railroads had to print millions of these, so a key requirement was to use as little paper as possible, necessitating the tiny print. The modern method of timetable distribution is via PDF files or the web, so we used a larger, non-proportional font. There is some post-processing with Visual Basic to change the font in the RTF file generated by SAS due to the limited selection of fonts available in SAS University Edition.

PAGE LAYOUTS AND EXAMPLES

The timetable document uses four distinct layouts, determined on the fly.

1. Both directions in one table spanning a page, reference marks/services on same page, shown in Appendix 1.
2. Both directions in two tables, reference marks and services on same page, shown in Appendix 2.
3. One direction on a page with services on the same page, shown in Appendix 3.
4. One direction on a page with services on a separate page, shown in Appendix 4.

DATA SOURCES

The document uses data from seven datasets, several of which are created from Excel workbooks. Microsoft Excel was chosen as the user interface for this project because of its general availability. The SAS datasets and their descriptions are in Table 1:

Data Source	Description
RR.SERVICES	One record per train, contains train number, train name, how often the train runs, what types of equipment, and how many of each type are used for this train.
RR.TT_REFMARKS	Standard time table reference marks.
RR.TT_NOTES_OUT	Timetable reference marks for outbound trains. One record per train, per station.
RR.TT_NOTES_IN	Timetable reference marks for inbound trains. One record per train, per station.
RR.TTBASE_OUT	Actual schedule of outbound trains. One record per station per train. Each train's schedule is a variable in the dataset, and schedules are maintained as SAS time values.
RR.TTBASE_IN	Actual schedule of inbound trains. One record per station per train. Each train's schedule is a variable in the dataset. Order of stations is reversed from RR.TTBASE_OUT, schedules are maintained as SAS time values.
RR.TRAINS2ADD	Extra trains running on "special service" days. Contains train numbers, one record per "special service" date.
RR.TRAINS2RMV	Trains that will not run on "special service" days. Contains train numbers, one record per "special service" date.

Table 1 : Data Sources for Timetable

CHOOSING A PAGE LAYOUT

All three sections are required for a complete timetable page. The pages are arranged by route, and we loop through the routes individually with a macro %DO loop. We have set the width of each train schedule column at .65 inches. Given a page width of 8.5 inches, and accounting for margins (.5 inches) and the mandatory STATION column (1.25 inches,) the horizontal space available for train columns is 6.75 inches. Therefore, a maximum of eight schedule columns will fit horizontally on each page (Figure 4):

		Read Down								
		Miles	257	261	271	253	263	265	269	255
Train Name			The Betsy Ross	The Rittenhouse	The Columbian	The Liberty Bell	The Quaker	The Crusader	The William Penn	The Night Owl
Days of Operation			Mo-Fr	Daily	Holidays (F)	Daily (1)	Daily	Daily	Daily	Daily (9)
Columbia	Dp	0	5:10A	8:30A	10:55A	11:15A	1:00P	3:00P	6:10P	Y11:30P
South Columbia	Dp	9	R5:32A	R8:52A	R11:17A	R11:37A	R1:22P	R3:22P	R6:32P	R11:52P
Meadowbrook	Dp	88	6:43A	10:03A	12:28P		2:33P	4:33P	7:43P	
Fairfax	Dp	163	7:47A	11:07A	1:32P	1:34P	3:37P	5:37P	8:47P	1:49A
Kingston	Dp	199	8:18A	11:38A	2:03P	2:05P	4:08P	6:08P	9:18P	2:20A
Maybrook	Dp	258	9:05A	12:25P	2:50P	2:52P	4:55P	6:55P	10:05P	3:07A
Lansing	Dp	289	9:33A	12:53P	3:18P	3:17P	5:23P	7:23P	10:33P	3:32A
Carlton	Dp	303	9:45A	1:05P	3:30P		5:35P	7:35P	10:45P	
Robertson Jct.	Ar	348	10:25A	1:45P	4:10P	4:03P	6:15P	8:15P	11:25P	4:18A
	Dp		10:30A	1:50P	4:15P	4:08P	6:20P	8:20P	11:30P	4:23A
Kimmiswyck	Dp	384	11:01A	2:21P	4:46P		6:51P	8:51P	12:01A	
Wappingers Falls	Dp	420	11:36A	2:56P	5:21P	5:06P	7:26P	9:26P	12:36A	5:21A
Valley Green	Dp	462	12:12P	3:32P	5:57P		8:02P	10:02P	1:12A	
New Philadelphia	Ar	484	12:42P	4:02P	6:27P	6:05P	8:32P	10:32P	1:42A	X6:20A

Figure 4: Maximum Eight Train Columns Across a Page

It took some trial and error to determine that 62 lines will fit on a page vertically. Although each train’s schedule section is displayed vertically, some routes have more than eight trains. PROC REPORT does a good job breaking columns into groups, so we tested to find the maximum number of schedule section columns (7) PROC REPORT will print before breaking by the ID variables. We have to multiply the number of station lines (STACNT, Example 1) by that (SVCMULT, Example 1) to calculate how many lines the schedule section will occupy. We add the number of lines required for the services (SVCLINES) and reference mark sections (REFLINES), and include some slack to ensure we don’t put more information on a page than will fit. Overestimating the number of lines is better than underestimation. Example 1 shows the relevant code to calculate vertical page fit:

```
svcmult = ceil(nservices/7); /* # of grouped schedules on the page */
/*Vertical page length calculation */
pagelen = (svcmult*stacnt)+reflines+svclines+5;
```

Example 1: Calculating Vertical Page Fit

We store those calculations in macro variables, and use them to execute ODS STARTPAGE conditionally, shown in Example 2:

```
/* Approx. 62 lines/pg @ 8.5PT Calibri */
%IF &pagesize LE 62 %THEN %DO;
    ODS RTF STARTPAGE=NO;
    TITLE "#BYVAL2 Services";
%END;
%ELSE %DO;
    ODS RTF STARTPAGE=NOW;
%END;
```

Example 2: Conditional Page Breaks in ODS

Example 3 demonstrates how this method is also used to execute conditional LINE statements in a COMPUTE block, which cannot be done with using a simple IF statement within the COMPUTE block itself:

```

1. COMPUTE BEFORE ord;
2. /* If service information fits on same page , print service header */
3. %IF &pagesize LE 62 %THEN %DO;
4.     routetitl = "~S={TEXTALIGN=center FONT_FACE=Calibri
                    FONTSIZE=9pt FONTWEIGHT=bold
                    BORDERBOTTOMCOLOR=white}" ||STRIP(routeName) ||
                    " Services" || "~S={}";
5.     LINE routetitl $255.;
6. %END;

7. /* If there is a service subheader, print it and skip a line */
8. %IF &anysvctitl GT 1 %THEN %DO;
9.     LINE svctitl1 $512.;
10.    LENGTH skip $ 1;
11.    skip = ' ';
12.    LINE skip $1.;
13. %END;
14. ENDCOMP;

```

Example 3: Conditional LINE statement in a COMPUTE BLOCK

Example 3 creates service headers and sub-headers. If services for a route are on their own dedicated page, then the service header is provided by the TITLE statement in Example 2, and does not need to be repeated. Otherwise, the header is created and displayed in lines 4 and 5. The second condition in lines 8-13 only prints a service sub-header followed by a blank line when a sub-header exists.

IT ALL BEGINS WITH THE ODS TEMPLATE

None of the default SAS ODS templates match our desired data display, so we have to create our own by modifying a standard template. The Calibri font was ultimately chosen as our timetable font for its readability at smaller font sizes, and the 8.5-point size will accommodate our data in the minimum number of pages, while somewhat maintaining legibility. The custom template code is in Example 4:

```

1. ODS PATH work.templat(UPDATE) sashelp.tmplmst(READ);
2. PROC TEMPLATE;
3. DEFINE STYLE timetbl; PARENT=styles.printer;
4.   REPLACE BODY FROM DOCUMENT / LEFTMARGIN=.25in
      rightmargin=.25in TOPMARGIN=.25in bottommargin=.25in;
5.   STYLE SYSTITLEANDFOOTERCONTAINER FROM SYSTITLEANDFOOTERCONTAINER /
      CELLPADDING = 0;
6.   STYLE SYSTEMTITLE / FONT=(Calibri) FONTSIZE=11pt FONTWEIGHT=bold;
7.   STYLE SYSTEMFOOTER / FONT=(Calibri) FONTSIZE=8.5pt;
8.   STYLE TABLE FROM TABLE / CELLPADDING=0pt CELLSPACING=1pt
9.     BORDERCOLOR=light gray BORDERBOTTOMCOLOR=light gray
10.    BORDERWIDTH=1pt FONTSIZE=8.5pt;
11.  STYLE HEADER / FONT=(Calibri) FONTSIZE=10pt FONTWEIGHT=bold;
12.  STYLE PAGENO /FONT=(Calibri) FONTSIZE=8.5pt FONTWEIGHT=medium;
13.  STYLE DATA / FONT=(Calibri) FONTSIZE=8.5pt TEXTALIGN=right;
14.  STYLE USERTEXT FROM USERTEXT / FONT=(Calibri) FONTSIZE=11pt
      FONTWEIGHT=BOLD;
15. END;
16. RUN;
17. ODS ESCAPECHAR='~'; /* Necessary for in-line formatting! */

```

Example 4: The TIMETBL ODS Template

We use the standard ODS template STYLES.PRINTER as our basis (line 3.) Our template:

- Defines page margins to maximize the printable area of the page while maintaining the ability to print the output on paper.
- Modifies the font size and selection for each of the ODS objects as we require.
- Changes the amount of padding around the title and footer cells.
- Changes the border and cell spacing parameters of the table.

CREATING THE SCHEDULE SECTION

Figure 5 shows a partial schedule section from a page of our timetable. There are twelve trains in this direction on this particular route, automatically split into two groups of similar lines by PROC REPORT. It is color-coded to show how the table is assembled from our database:

		Read Down					
	Miles	1056	358	1058	1060	362	360
Train Name		Flyer Service	Blackbird Service	Flyer Service	Flyer Service	Blackbird Service	Blackbird Service
Days of Operation		Mo-Fr (6)	Mo-Fr	Daily (6)	Daily	Holidays (H)	Daily
Perry	0 Dp	5:00AM	5:05AM	6:00AM	7:00AM	9:00AM	11:50AM
Clarkson	42 Dp		5:44AM			9:39AM	12:29PM
Pottstown	81 Dp	5:58AM	6:20AM	6:58AM	7:58AM	10:15AM	1:05PM
Jamestown	134 Dp		7:05AM			11:00AM	1:50PM
Chestnut Hill	191 Dp	7:15AM	7:56AM	8:15AM	9:15AM	11:51AM	2:41PM
Greenwood	216 Dp		8:18AM			12:13PM	3:03PM
Allegheny	258 Dp		8:56AM			12:51PM	3:41PM
South Columbia	282 Dp	D8:15AM	D9:20AM	D9:15AM	D10:15AM	D1:15PM	D4:05PM
Columbia	291 Ar	8:32AM	9:45AM	9:32AM	10:32AM	1:40PM	4:30PM

Figure 5: Data Sources for the Schedule Section

The light blue in Figure 5 indicates the data come from the schedule datasets, TTBASE_IN and TTBASE_OUT, and green, the SERVICES dataset. Any relevant reference marks (Ⓒ, Ⓓ) to be added to the days of operation cells are assigned on the fly. Yellow indicates the data have been assembled from the schedule and timetable notes (TTNOTES_IN/OUT) datasets.

Vertical ordering is done by using a non-printing variable, and the ordering values for train number, name, and days of operation are defined so they will be the first three lines in every schedule, in that order. While the schedules themselves are maintained as SAS time values, the train name and "Days of Operation" values are character variables. Since we need to add reference marks to the schedule (for example, the "D" on the "South Columbia" line in Figure 5,), all of the displayed columns except for the mileage are character variables. The CATS() and PUT() functions create the data for each of the yellow cells.

As for the report itself, the train numbers are column labels; the actual variables used are temporary, only created for the timetable. The "~{newline}" metacharacter is used where necessary to break the train name in order to fit the column width defined in the PROC REPORT step. In-line formatting centers and bolds the train name, centers the "Days of Operation" cells, and bolds the PM times in accordance with US railroad tradition.

Each PROC REPORT that creates a schedule section must be created dynamically, because the stations and trains vary by route and the variable names are not known in advance. As noted earlier, a macro loop runs each route individually. First, we create a temporary dataset for the schedule cells by merging the schedule and timetable notes datasets from our database. We can then use DICTIONARY.COLUMNS to determine the names of the columns to print. In Example 5, &&RID&I is the macro loop index and resolves to the route number:

```
1. PROC SQL NOPRINT;
2. SELECT STRIP(PUT(COUNT(name),3.)), STRIP(PUT((COUNT(name))/2,3.))
   INTO :nsvcs, :dtrns
3. FROM dictionary.columns
4. WHERE libname EQ 'WORK' AND memname EQ "TT&&rid&i" and
   SUBSTR(name,1,1) EQ 'T';
5. SELECT SCAN(name,1,'_') INTO :trn1-:trn&nsvcs
6. FROM dictionary.columns
7. WHERE libname EQ 'WORK' AND memname EQ "TT&&rid&i" AND SUBSTR(name,1,1)
   EQ 'T';
8. QUIT;
```

Example 5: Getting Column Names Dynamically Using Dictionary Tables

The first SQL query in Example 5 (lines 1-4) obtains the number of trains in the route (&nsvcs), and the number of trains in each direction (&dtrns), which are used to determine if the schedule will need to be split by direction for printing. We create the dynamic list of column names in the second query (lines 5-8.) Each column name corresponds to a train schedule in the given route, and the list of macro variables is generated each time the main macro loop executes. The character variable displayed by PROC REPORT is created in a DATA step combining the reference mark for each combination of train and station with the schedule time. The in-line formatting for the PM times is also done in the same DATA step. Finally, we add the character schedule dataset to the train name and days of operation records, and are now ready to execute the PROC REPORT for the schedule section.

Three different PROC REPORT steps are coded to create the schedule section; which one is used depends on how the information fits on the page. We've already calculated the horizontal and vertical space needed for the schedule information and stored that in macro

variables. The first test is whether both directions will fit horizontally. If so, then we can use the bidirectional layout (Appendix 1), shown in Example 6:

```

1.  %IF &nsvcs LE 8 %THEN %DO;
2.    OPTIONS ORIENTATION=PORTRAIT CENTER;
3.    PROC REPORT DATA=txx&&rid&i NOWD OUT=trace MISSING SPLIT='\';
4.    BY lineID routeID RouteName;
5.    COLUMNS sbrk lineID routeID routeName milepost
              ('Read Down' &outvnam) outbd_tt_miles dparout Station
              dparin ('Read Up' &invnam);
6.    DEFINE lineID / ORDER NOPRINT;
7.    DEFINE routeID / ORDER NOPRINT;
8.    DEFINE routeName / ORDER NOPRINT;
9.    DEFINE milepost / NOPRINT ORDER ORDER=INTERNAL;
10.   DEFINE outbd_tt_miles / ORDER ORDER=INTERNAL 'Miles' MISSING
        STYLE=[PADDINGRIGHT=2PT];
11.   DEFINE dparout / ' ' STYLE=[TEXTALIGN=L PADDINGLEFT=1PT
        PADDINGRIGHT=2PT];
12.   DEFINE Station / ' ' ID ORDER ORDER=INTERNAL
        STYLE=[CELLWIDTH=1.25IN TEXTALIGN=C FONTWEIGHT=BOLD];
13.   %DO k=1 %TO &nsvcs;
14.     DEFINE &&trn&k / STYLE(COLUMN)=[CELLWIDTH=.65IN];
15.   %END;
16.   DEFINE dparin / ' ' STYLE=[TEXTALIGN=L PADDINGLEFT=2PT
        PADDINGRIGHT=2PT];
17.   DEFINE sbrk / NOPRINT;
18.   COMPUTE lineID;
19.     IF sbrk EQ ' ' THEN
20.       CALL DEFINE(_ROW_, 'STYLE',
                    'STYLE=[BORDERBOTTOMSTYLE=HIDDEN] ');
21.   ENDCOMP;
22.   RUN;

```

Example 6: PROC REPORT Code for Bidirectional Schedule Layout

A maximum of eight trains in both directions will fit across one page, and that is tested in line 1. Bidirectional schedules are centered on the page (CENTER option, line 2.) The %DO loop at line 13 creates a DEFINE statement for each schedule column using the list of macro variables created in the second query from Example 5. The macro variables &OUTVNAM and &INVNAM (line 5, Example 6) contain the list of outbound and inbound schedule variables, respectively. These are created using the SQL procedure to put the variable list into a single macro variable (Example 7.)

```

1. PROC SQL NOPRINT;
2. SELECT scan(_trainid,1,'_') INTO :outvnam SEPARATED BY ' ';
3. FROM outbd
4. WHERE routeID EQ &&rid&I;
5. ORDER BY strttm;
6. QUIT;

```

Example 7: Using PROC SQL to Create a List of Variables as a Single Macro Variable

Finally, we don't want a border to show when the value of STATION is repeated. Since it's an ID column, PROC REPORT will only print the first occurrence of each value, and it won't be actionable in a COMPUTE statement. We have to create a dummy variable SBRK in the dataset, which is blank if it is not the first occurrence of STATION. We use that in the

COMPUTE block in lines 18-21 of Example 6 to prevent the printing of the border with the BORDERBOTTOMSTYLE style attribute. If we changed the border color to match the background instead, there would be tiny gaps in the vertical cell lines. Yes, it is a minor issue, but the challenge was to reproduce the template as closely as possible. A magnified view demonstrates the difference in Figure 6:

Riverton	Ar	260	10:59A	6:04P
	Dp		11:04A	6:09P
Riverton	Ar	260	10:59A	6:04P
	Dp		11:04A	6:09P

Figure 6: BORDERCOLOR=WHITE (top) vs. BORDERSTYLE=HIDDEN (bottom)

The other schedule layouts require printing one direction at a time, so there is a similar PROC REPORT for each direction. Although the column and display order differs from Example 6, and they work on different schedule datasets created for each direction, we still use the macro variables &INVNAM and &OUTVNAM and the macro variable list we created in Example 5 to specify the columns and generate a DEFINE statement for each variable. We test to see if both directions will fit on a single page, and execute ODS STARTPAGE=NOW if they don't.

CREATING THE REFERENCE MARK SECTION

Reference marks fall into two categories. "Standard" reference marks are maintained in the TTNOTES datasets and are linked to a specific train at a specific station. "Service exceptions" are days where a train runs in addition to its regularly scheduled days, or does not run even though it is scheduled to run. For example, a train scheduled to run Monday through Friday might not run on Thanksgiving, even though it is a Thursday. Similarly, a train scheduled to run only on holidays may also run on the Saturday before Thanksgiving, because more people than usual are traveling that day. Some exceptions don't have the same date every year, as in the Thanksgiving examples above. Therefore, the actual dates of service exceptions have to be calculated for each calendar year. For convenience, the actual dates and train numbers of each service exception have been compiled for the next ten years and stored in the TRAINS2ADD/RMV datasets. The process to associate service exceptions with their actual calendar dates is beyond the scope of this paper.

We do not need to put all ten years of service exception dates in the timetable. Our timetables are effective for the six-month periods of January 1 through June 30, or July 1 through December 31, unless there is a schedule or service change during the six-month period. In that case, the start date is adjusted to the date of the change plus one week.

```
%LET tt_frame=%SYSFUNC(TODAY());
```

```

1.  PROC SQL NOPRINT;
2.  SELECT MAX(MAX(lastchg)+7,INTNX('SEMIYEAR',&tt_frame,0,'B')) as effdt,
3.          INTNX('SEMIYEAR',&tt_frame,0,'E') as effend,
4.          PUT(CALCULATED effdt,worddate18.) as effdate,
5.          PUT(CALCULATED effend,worddate18.) as effendstr,
6.          CATX('~{unicode 2014} ',CALCULATED effdate,
7.              CALCULATED effendstr)
8.          INTO :effdt, :effend, :effdate, :effendstr, :effstr
9.  FROM
10.     (SELECT DATEPART(modate) as lastchg
11.      FROM dictionary.tables
12.      WHERE libname EQ 'RR' AND memname IN ('SERVICES', 'TTNOTES_IN',
13.      'TTNOTES_OUT','TTBASE_IN','TTBASE_OUT')
14.     )
15.  ;
16.  QUIT;

```

Example 8 shows how effective dates are calculated:

```

17. %LET tt_frame=%SYSFUNC(TODAY());
18. PROC SQL NOPRINT;
19. SELECT MAX(MAX(lastchg)+7,INTNX('SEMIYEAR',&tt_frame,0,'B')) as effdt,
20.          INTNX('SEMIYEAR',&tt_frame,0,'E') as effend,
21.          PUT(CALCULATED effdt,worddate18.) as effdate,
22.          PUT(CALCULATED effend,worddate18.) as effendstr,
23.          CATX('~{unicode 2014} ',CALCULATED effdate,
24.              CALCULATED effendstr)
25.          INTO :effdt, :effend, :effdate, :effendstr, :effstr
26.  FROM
27.     (SELECT DATEPART(modate) as lastchg
28.      FROM dictionary.tables
29.      WHERE libname EQ 'RR' AND memname IN ('SERVICES', 'TTNOTES_IN',
30.      'TTNOTES_OUT','TTBASE_IN','TTBASE_OUT')
31.     )
32.  ;
33.  QUIT;

```

Example 8: Calculating Effective Dates

The macro variable &TT_FRAME allows us to select any six-month period starting on January 1 or July 1. The default is TODAY(), which yields the current one, but we can pick a date in any future six-month period. The beginning and end of the six-month period are calculated with the INTNX() function (lines 4 and 5), using the adjustment parameters "B", and "E", respectively.

The subquery in lines 12 through 16 obtain the modification dates for the datasets that would have an effect on the timetable, and the latest modification date is used in line 4 of the main query (MAX(lastchg)). If that date (plus seven days) is later than the start date of the six-month period, then the start date is set to that value. The end date of the six-month period remains the same, regardless of the start date. All of these are stored in macro variables.

The start and end dates are SAS date values, and used with a WHERE=option and BETWEEN clause to filter TRAINS2ADD/RMV. Example 9 is the code that creates the reference marks for additional trains:

```

1.  DATA trains2add;
2.  LENGTH serviceDays $ 12 opdate datestr $1024;
3.  MERGE rr.trains2add (IN=ina WHERE=(date between &effdt and &effend))
      services;
4.  BY train_number;
5.  RETAIN opdate;
6.  IF FIRST.train_number THEN
7.      opdate = ' ';
8.  datestr = CATX('/',PUT(MONTH(date),2.),PUT(DAY(date),2.));
9.  opdate = CATX(' ',opdate,datestr);
10. IF LAST.train_number AND ina THEN DO;
11.     IF serviceDays EQ 'Holidays' THEN
12.         opdate = CATX(' ','Will operate',cats(opdate,'.'));
13.     ELSE
14.         opdate = CATX(' ','Will ALSO operate',cats(opdate,'.'));
15.     OUTPUT;
16. END;
17. KEEP train_number opdate;
18. RUN;

19. PROC SORT DATA=trains2add OUT=add_opdate (KEEP=opdate) NODUPKEY;
20. BY opdate;
21. RUN;

22. DATA add_unicodes;
23. LENGTH str $ 15 refmark $ 128;
24. DO val = 9398 TO 9405, 9407 TO 9413, 9415 TO 9423;
25.     hexval = PUT(val,hex4.);
26.     str = CAT('~{unicode ',PUT(hexval,4.),"}");
27.     refmark = CATS("~S={FONT_FACE=arial FONTSIZE=6pt
      FONTWEIGHT=medium}",str,"~S={}");
28.     OUTPUT;
29. END;
30. KEEP str refmark;
31. RUN;

32. DATA add_refmarks;
33. MERGE add_unicodes add_opdate (IN=ina KEEP=opdate);
34. LENGTH reftext $1024;
35. IF ina;
36. reftext = CATS("~S={fontweight=medium}",opdate);
37. KEEP str refmark reftext opdate;
38. RUN;

39. PROC SORT DATA=trains2add;
40. BY opdate;
41. RUN;
42. DATA trains2add;
43. MERGE trains2add add_refmarks;
44. BY opdate;
45. RUN;

```

Example 9: Generating Reference Marks and Text for Service Exceptions

Line 3 filters the TRAINS2ADD dataset so we only have the service exceptions for the timetable's effective dates. Each time this DATA step iterates, the exception date is formatted and appended onto a long character variable (lines 7 and 8.) Once all exception dates for a given train have been processed, we add introductory text and send it to a dataset (lines 10-16.) Since multiple trains can have the same exception dates, one reference mark is used for all trains with the same exception dates (for example, the "Ⓔ" displayed in Figure 7.) We sort the exception date text with the NODUPKEY option to provide unique values.

The next step is to generate a list of Unicode reference marks. We create an easily recognized distinction by having service removals use the Enclosed Numerics Unicode block, and additional services (Example 9, lines 22-31) use the Enclosed Alphanumerics Unicode block. We merge that Unicode list with the unique exception list text (lines 32-38) to associate a reference mark with exception text. The last step (lines 39-45) is to merge the reference marks with the train numbers by the exception text, providing the train-to-reference mark link used in the schedule section, as seen in Figure 7.

Days of Operation		Mo-Fr Ⓔ	Mo-Fr	Daily Ⓔ	Daily	Holidays Ⓔ	Daily
-------------------	--	---------	-------	---------	-------	------------	-------

Figure 7: Reference Marks Appended to Days of Operation

Putting the reference marks together is one task; displaying them is another. We chose a three-column format to minimize the vertical space needed to print the reference marks and text.

Reference marks are always printed on the same page as the schedule because it simplifies coding, so ODS STARTPAGE=NO is used before the PROC REPORT that generates the reference mark section. If we chose to add another possible layout (schedule on one page, reference marks and services on a separate page), we'd have to test page fit and execute ODS STARTPAGE=NOW before displaying the reference mark section. If the reference mark section were on its own page, ODS STARTPAGE=NO for the services section would also be executed. Otherwise, the reference marks would always be on one page, and the services section on the next page.

What appears to be three columns is actually six; the reference mark is in a separate column from the text because it looks nicer when using a proportional font. We rely on PROC REPORT to wrap the reference mark text, giving us the result in Figure 8:

Reference Symbols					
D	Stops only to discharge passengers.	R	Stops only to receive passengers.	X	Sleeping cars may be occupied until 8am.
Y	Sleeping cars may be occupied 1 hour before departure.	Z	Sleeping cars may be occupied at 10pm.	Ⓐ	Will NOT operate 1/1, 1/19, 1/20, 4/12, 5/4, 5/24, 5/25.
Ⓔ	Will NOT operate 1/1, 1/19, 5/4, 5/24.	Ⓕ	Will NOT operate 1/1, 1/20, 4/11, 4/12, 5/4, 5/23, 5/25.	Ⓒ	Will NOT operate 1/1, 1/20, 4/11, 5/4, 5/23, 5/25.
Ⓗ	Will NOT operate 1/1, 1/20, 4/11, 5/4, 5/25.	Ⓖ	Will NOT operate 1/1, 1/20, 5/4, 5/25.	Ⓙ	Will NOT operate 1/1, 4/12, 5/4.
Ⓘ	Will NOT operate 1/19, 1/20, 5/4, 5/24.	Ⓙ	Will NOT operate 1/19, 5/24.	Ⓚ	Will NOT operate 1/19, 5/4, 5/24.
Ⓙ	Will ALSO operate 1/1, 1/2, 1/20, 5/4, 5/25.	Ⓚ	Will ALSO operate 1/1, 1/20, 5/4, 5/25.	Ⓛ	Will ALSO operate 1/20, 5/4, 5/25.
Ⓚ	Will ALSO operate 1/20.	Ⓛ	Will ALSO operate 5/4.	Ⓜ	Will operate 1/1, 1/2, 1/20, 4/12, 5/4, 5/23, 5/24, 5/25.
Ⓛ	Will operate 1/1, 1/2, 1/20, 4/12, 5/4, 5/23, 5/25.	Ⓜ	Will operate 1/1, 1/2, 1/20, 4/12, 5/4, 5/25.	Ⓨ	Will operate 1/1, 4/11, 5/4, 5/23, 5/24.
Ⓜ	Will operate 1/20, 4/11, 5/4, 5/25.	Ⓨ	Will operate 1/20, 5/4, 5/23, 5/25.	Ⓩ	Will operate 1/20, 5/4, 5/25.
Ⓩ	Will operate 4/11, 5/4, 5/24, 5/25.				

Figure 8: The Reference Marks Section

CREATING THE SERVICES (ACCOMODATIONS AND AMENITIES) SECTION

The final piece of the timetable is the services information. This is the most complicated piece of the timetable, as a great deal of data preparation is necessary to create the services text for display. For brevity, we will focus on the creation of the service description, and not the formatting of the entire section.

The SERVICES dataset contains information specific to each train in the simulation, including the train name, quantity, and types of equipment. It is maintained as an Excel spreadsheet. A SAS program reads the spreadsheet, creates the SERVICES dataset, and produces an updated Excel workbook that can be updated. The workbook file has the creation date in its name, so it is easy to roll back erroneous changes. Table 2 is an excerpt from the SERVICES dataset (some variable names have been altered to fit):

Train No	trainName	reserved	Bag	LH Coach	BC Coach	SLP106	SLP14	Diner
1	The White Star Limited	Y	0	0	0	2	2	0
2	The White Star Limited	Y	0	0	0	2	2	0
11	The Capitol	Y	1	5	0	2	0	1
12	The Capitol	Y	1	5	0	2	0	1

Table 2: Excerpt from SERVICES Dataset

Formatting is only one aspect of the services section. Many questions need to be answered in the process: what train numbers are on each route? Do all the trains have the same services? How many unique services are on this route? Is there specific text associated with a specific train or trains? Let’s look at how the data from the SERVICES dataset are used to answer these questions and create service descriptions.

The first question is whether a general rule applies to this train requiring standard introductory text. As an example, if the train number is 10 or less, the text “All-reserved, extra fare train. Reservations required, fare supplement charged at booking.” should be displayed as the first item in the services text. If special text is present, the ~{newline} metacharacter separates it from the remaining service information. Next, we process the text for each type of car on the train. Each type of car has a standard short description that is also the label for the variables in the SERVICES dataset. Each type also has a full description with in-line formatting. The full description was created specifically for use in the services section of timetables, as shown in Table 3:

Car Type Short Description	Car Type Description for Timetables
Baggage Car	~S={fontweight=bold}Checked baggage service available.~S={}
Long-haul Coach	~S={fontweight=bold}Coaches. ~S={}Reclining seats, leg rests.
Dome Coach	~S={fontweight=bold}Dome Coaches. ~S={}Reclining seats, leg rests on lower level, unreserved scenic viewing on upper level.
10-6 Sleeper	~S={fontweight=bold}Sleeping Cars. ~S={}Roomettes and double bedrooms.
4-4-2 Sleeper	~S={fontweight=bold}Sleeping Cars. ~S={}Suites and double bedrooms.
Full Service Diner	~S={fontweight=bold}Dining Car. ~S={}Full dining service.

Table 3: Sample Car Type Labels and Descriptions

The information in Table 3 is stored in one of the simulation’s core datasets. At initiation of the simulation, both the short and full descriptions are created as permanent formats in the simulation’s format library. We use the link between the labels for the variables in the

SERVICES dataset and these formats to obtain the description text. The code fragment in Example 10 demonstrates how this works:

```

1.  ARRAY itsrvc{*} Baggage HSCoach LHCoach ARCoach BCCoach DMCoach SLP106
      SLP14 SLP442 Dinette Diner TWDiner DMDiner HSLounge
      Lounge DMLounge DinerLounge DMOLounge RoundObsLounge
      FlatObsLounge MobileOffice TGV1 TGV2 TGV3;
2.  DO i=1 to DIM(itsrvc);
3.    chk = VLABEL(itsrvc{i});
4.    IF itsrvc{i} GT 0 THEN DO;
5.      cartyp = PUT(chk,$svcdesc.);
6.      IF itsrvc{i} EQ 1 THEN DO;
7.        cartyp = TRANWRD(cartyp,'Coaches','Coach');
8.        cartyp = TRANWRD(cartyp,'Cars','Car');
9.      END;
10.     svcdesc = CATS(svcdesc,car typ, '~{newline}');
11.   END;
12. END;
13.
14. svcdesc = CATS(svcdesc,"~{newline}");

```

Example 10: Creating Services Text from SERVICES Dataset

First, we place the relevant variables from SERVICES into an array, allowing us to loop through each of the passenger car types. Line 3 gets the label of the variable, and we test to see if that particular type is in the train (line 4.) Line 5 assigns the formatted version of the variable label. Lines 6 through 9 change the full description from plural to single when there is only one of a certain type. Line 10 adds the text for this equipment and a line feed ('~{newline}') to the service description text. That causes the next car type description to be displayed on the next line in the timetable. We insert another blank line to the end of the text (line 14) after all car types have been processed. Example 11 shows the actual service description text the program creates for trains 1 and 12:

Train #	Service Description Text (svcdesc)
#1	~S={fontweight=bold}All-reserved, extra fare train. Reservations required,~{newline}fare supplement charged at booking.~S={}~{newline}~S={fontweight=bold}Sleeping Cars. ~S={}Roomettes and double bedrooms.~{newline}~S={fontweight=bold}Sleeping Cars. ~S={}Roomettes.~{newline}~S={fontweight=bold}Sleeping Car. ~S={}Suites and double bedrooms.~{newline}~S={fontweight=bold}Dining Car. ~S={}Full dining service.~{newline}~S={fontweight=bold}Sleeper Lounge Car. ~S={}Snacks and beverages, sleeping car passengers only.~{newline}~S={fontweight=bold}Mobile Office Car. ~S={}Internet and business suites.~{newline}~{newline}
#12	~S={fontweight=bold}All-reserved train. Reservations required.~S={}~{newline}~S={fontweight=bold}Checked baggage service available.~S={}~{newline}~S={fontweight=bold}Coaches. ~S={}Reclining seats, leg rests.~{newline}~S={fontweight=bold}Sleeping Cars. ~S={}Roomettes and double bedrooms.~{newline}~S={fontweight=bold}Dining Car. ~S={}Full dining service.~{newline}~S={fontweight=bold}Lounge Car. ~S={}Sandwiches, snacks, and beverages.~{newline}~S={fontweight=bold}Mobile Office Car. ~S={}Internet and business suites.~{newline}~{newline}

Example 11: Actual Service Description Text

When we display the service description text using ODS RTF and PROC REPORT, we get Result 1 (the train numbers have been added to the table for easy reference to Example 11):

Train #	Actual Display of Service Description Text (svcdesc)
# 1	All-reserved, extra fare train. Reservations required, fare supplement charged at booking. Sleeping Cars. Roomettes and double bedrooms. Sleeping Cars. Roomettes. Sleeping Car. Suites and double bedrooms. Dining Car. Full dining service. Sleeper Lounge Car. Snacks and beverages, sleeping car passengers only. Mobile Office Car. Internet and business suites.
# 12	All-reserved train. Reservations required. Checked baggage service available. Coaches. Reclining seats, leg rests. Sleeping Cars. Roomettes and double bedrooms. Dining Car. Full dining service. Lounge Car. Sandwiches, snacks, and beverages. Mobile Office Car. Internet and business suites.

Result 1: Actual Service Description Text as Generated by the RTF File

As with reference marks, we collapse all service description text into unique values, as it is possible for multiple trains within a route to have the same accommodations and amenities. From there, intricate SAS code compiles all combinations of service description text, train name, and train number before determining how to format the services section of the timetable. How many lines the services section occupies on the page is calculated at the end of this process, which yields the data source for the PROC REPORT step that generates the services section. This is all done in DATA steps because we want the data formatted properly for display, and the PROC REPORT step can be simplified. In general, for such intricate formatting, the less work done inside PROC REPORT, the easier it is to debug and make adjustments.

POST-PROCESSING AND OTHER DISCOVERIES

It was noted earlier that some post-processing was required to create the output in its final form. It depends on the fonts available on your SAS platform. In this case, we started on Windows SAS, and the Calibri font was selected for its readability at small sizes. However, Courier is the default replacement font on SAS University Edition when the specified font is not available. I created a one-click Visual Basic macro solution to change the Courier font to Calibri throughout the entire timetable document, including titles, headers, and footers, because the global find/replace capacity in Microsoft Word only changes the font in the main body of this document. The Visual Basic code to do this is provided in Appendix 5.

Ultimately, in keeping with modern railroad practice, we want to create our timetable as a PDF file, and it is a two-step process: generate the timetables as an RTF file, change the font in Microsoft Word, and then create the PDF from the modified RTF document.

Interestingly, when we used Windows SAS, rendering issues occurred when creating the timetable directly via the PDF destination, so this has always been a two-step process of converting an RTF file into a PDF.

CONCLUSION

Base SAS and the basic capabilities of ODS and PROC REPORT successfully met the many challenges in reproducing this historical template. This particular exercise demonstrated just how powerful and comprehensive the reporting facilities in SAS are. In-line formatting can give you control over the display of your data at the individual character level if necessary. Metacharacters give you spacing control within a report cell. You even have access to Unicode characters if needed. Using macros for data-driven conditional execution of code, you can direct your data into multiple PROC REPORT statements, creating a myriad of layout possibilities. You can even suppress the display of border lines within a table.

The availability of SAS University Edition makes it possible for anyone to work with the power of SAS outside the boundaries of work or school. The idea of a railroad simulation began with an offhand comment. I was able to turn it into a way to grow and maintain my SAS, database design, and problem-solving skills. This highly specialized report is merely one aspect of the entire simulation, which has multiple opportunities for skill enhancement and development.

Finally, are there other ways to have done this in SAS? As with many things in SAS, I'm sure there are alternate approaches to generate similar output. ODS DOCUMENT, ODS LAYOUT, or using the DATA step with ODS probably could produce acceptable results, and possibly with less data manipulation. I may explore those alternatives in the future as a way to develop those skills.

ACKNOWLEDGMENTS

Thanks to Sharon Hamrick from SAS Technical Support for solving the unwanted table border problem, and to SAS Technical Support in general for their assistance over the years.

RECOMMENDED READING

- Carpenter's Complete Guide to the SAS® REPORT Procedure

CONTACT INFORMATION

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Appendix 1 : Both Directions in One Table, Reference Marks/Services on Same Page

Columbia-Mt. Kennedy

Read Down					Read Up						
111	113	115	117	Miles	Train Name	112	114	116	118		
The Mountaineer	The Pioneer	The Cherry Blossom	The Palisades			The Mountaineer	The Pioneer	The Cherry Blossom	The Palisades		
Mo-Sa ⑤	Daily	Daily	Holidays ⑫		Days of Operation	Mo-Sa ⑤	Daily	Daily	Holidays ⑫		
5:20A	9:05A	11:45A	3:45P	0	Dp	Columbia	Ar	12:52P	6:28P	11:23P	1:58A
R5:42A	R9:27A	R12:07P	R4:07P	9	Dp	South Columbia	Dp	D12:30P	D6:02P	D10:57P	1:32A
	9:35A	12:15P	4:15P	17	Dp	Erie	Dp	5:53P	10:48P	1:23A	
	10:07A	12:47P	4:47P	52	Dp	Dayton	Dp	5:17P	10:12P	12:47A	
7:02A	11:04A	1:44P	5:44P	109	Dp	Walnut Grove	Dp	11:00A	4:15P	9:10P	11:45P
	12:07P	2:47P	6:47P	183	Dp	Watertown	Dp	3:01P	7:56P	10:31P	
9:09A	1:36P	4:16P	8:16P	260	Ar	Riverton	Dp	8:47A	1:45P	6:40P	9:15P
9:14A	1:41P	4:21P	8:21P		Dp		Ar	8:42A	1:40P	6:35P	9:10P
	2:59P	5:39P	9:39P	345	Dp	Patterson	Dp	12:15P	5:10P	7:45P	
11:13A	3:54P	6:34P	10:34P	400	Dp	Marshall	Dp	6:37A	11:20A	4:15P	6:50P
	4:52P	7:32P	11:32P	463	Dp	Ft. Benson	Dp	10:19A	3:14P	5:49P	
1:12P	6:03P	8:43P	12:43A	509	Ar	Mt. Kennedy	Dp	5:00A	9:30A	2:25P	5:00P

Reference Symbols

- | | | |
|---|--|---|
| D Stops only to discharge passengers. | R Stops only to receive passengers. | X Sleeping cars may be occupied until 8am. |
| Y Sleeping cars may be occupied 1 hour before departure. | Z Sleeping cars may be occupied at 10pm. | ① Will NOT operate 1/1, 1/19, 1/20, 4/12, 5/4, 5/24, 5/25. |
| ② Will NOT operate 1/1, 1/19, 5/4, 5/24. | ③ Will NOT operate 1/1, 1/20, 4/11, 4/12, 5/4, 5/23, 5/25. | ④ Will NOT operate 1/1, 1/20, 4/11, 5/4, 5/23, 5/25. |
| ⑤ Will NOT operate 1/1, 1/20, 4/11, 5/4, 5/25. | ⑥ Will NOT operate 1/1, 1/20, 5/4, 5/25. | ⑦ Will NOT operate 1/1, 4/12, 5/4. |
| ⑧ Will NOT operate 1/19, 1/20, 5/4, 5/24. | ⑨ Will NOT operate 1/19, 5/24. | ⑩ Will NOT operate 1/19, 5/4, 5/24. |
| Ⓐ Will ALSO operate 1/1, 1/2, 1/20, 5/4, 5/25. | Ⓑ Will ALSO operate 1/1, 1/20, 5/4, 5/25. | Ⓒ Will ALSO operate 1/20, 5/4, 5/25. |
| Ⓓ Will ALSO operate 1/20. | Ⓔ Will ALSO operate 5/4. | Ⓕ Will operate 1/1, 1/2, 1/20, 4/12, 5/4, 5/23, 5/24, 5/25. |
| Ⓖ Will operate 1/1, 1/2, 1/20, 4/12, 5/4, 5/23, 5/25. | Ⓗ Will operate 1/1, 1/2, 1/20, 4/12, 5/4, 5/25. | Ⓖ Will operate 1/1, 4/11, 5/4, 5/23, 5/24. |
| Ⓚ Will operate 1/20, 4/11, 5/4, 5/25. | Ⓛ Will operate 1/20, 5/4, 5/23, 5/25. | Ⓜ Will operate 1/20, 5/4, 5/25. |
| Ⓝ Will operate 4/11, 5/4, 5/24, 5/25. | | |

Columbia-Mt. Kennedy Services

The Mountaineer - Trains 111 and 112

Checked baggage service available.
Coaches. Reclining seats, leg rests.
Dinette. Light meals, snacks and beverages.
Lounge Car. Sandwiches, snacks, and beverages.

The Cherry Blossom - Trains 115 and 116

Checked baggage service available.
Coaches. Reclining seats, leg rests.
Dinette. Light meals, snacks and beverages.
Lounge Car. Sandwiches, snacks, and beverages.

The Pioneer - Trains 113 and 114

Checked baggage service available.
Coaches. Reclining seats, leg rests.
Dinette. Light meals, snacks and beverages.
Lounge Car. Sandwiches, snacks, and beverages.

The Palisades - Trains 117 and 118

Checked baggage service available.
Coaches. Reclining seats, leg rests.
Dining Car. Full dining service.
Lounge Car. Sandwiches, snacks, and beverages.

Appendix 2: Both Directions in Two Tables, One Page

Perry-Phillips Bay Westbound

		Read Down						
	Miles	401	411	403	413	405	407	409
Train Name		Kingfisher Service	Kingfisher Service	Kingfisher Service	Kingfisher Service	Kingfisher Service	Kingfisher Service	Kingfisher Service
Days of Operation		Mo-Fr ⑥	Daily	Daily	SaSuHo ①	Mo-Fr ⑥	Daily	Daily
Perry	Dp 0	5:15A	6:00A	8:00A	10:00A	5:20P	7:00P	8:30P
Oakdale	Dp 36	5:51A	6:36A	8:36A	10:36A	5:56P	7:36P	9:06P
Ames Point	Dp 55	6:10A	6:55A	8:55A	10:55A	6:15P	7:55P	9:25P
Stewart	Dp 69	6:27A	7:12A	9:12A	11:12A	6:32P	8:12P	9:42P
Miller's Hook	Dp 120	7:23A	8:08A	10:08A	12:08P	7:28P	9:08P	10:38P
Phillips Bay	Ar 167	8:19A	9:04A	11:04A	1:04P	8:24P	10:04P	11:34P

Eastbound

		Read Down						
	Miles	406	408	410	414	402	412	404
Train Name		Kingfisher Service	Kingfisher Service	Kingfisher Service	Kingfisher Service	Kingfisher Service	Kingfisher Service	Kingfisher Service
Days of Operation		Mo-Fr ⑥	Daily	Daily	SaSuHo ①	Mo-Fr ⑥	Daily	Daily
Phillips Bay	0 Dp	5:15A	6:05A	9:45A	5:30P	5:30P	7:30P	8:20P
Miller's Hook	47 Dp	6:06A	6:56A	10:36A	6:21P	6:21P	8:21P	9:11P
Stewart	98 Dp	7:07A	7:57A	11:37A	7:22P	7:22P	9:22P	10:12P
Ames Point	112 Dp	7:22A	8:12A	11:52A	7:37P	7:37P	9:37P	10:27P
Oakdale	131 Dp	7:41A	8:31A	12:11P	7:56P	7:56P	9:56P	10:46P
Perry	167 Ar	8:17A	9:07A	12:47P	8:32P	8:32P	10:32P	11:22P

Reference Symbols

- | | | |
|---|--|---|
| D Stops only to discharge passengers. | R Stops only to receive passengers. | X Sleeping cars may be occupied until 8am. |
| Y Sleeping cars may be occupied 1 hour before departure. | Z Sleeping cars may be occupied at 10pm. | ① Will NOT operate 1/1, 1/19, 1/20, 4/12, 5/4, 5/24, 5/25. |
| ② Will NOT operate 1/1, 1/19, 5/4, 5/24. | ③ Will NOT operate 1/1, 1/20, 4/11, 4/12, 5/4, 5/23, 5/25. | ④ Will NOT operate 1/1, 1/20, 4/11, 5/4, 5/23, 5/25. |
| ⑤ Will NOT operate 1/1, 1/20, 4/11, 5/4, 5/25. | ⑥ Will NOT operate 1/1, 1/20, 5/4, 5/25. | ⑦ Will NOT operate 1/1, 4/12, 5/4. |
| ⑧ Will NOT operate 1/19, 1/20, 5/4, 5/24. | ⑨ Will NOT operate 1/19, 5/24. | ⑩ Will NOT operate 1/19, 5/4, 5/24. |
| ① Will ALSO operate 1/1, 1/2, 1/20, 5/4, 5/25. | ② Will ALSO operate 1/1, 1/20, 5/4, 5/25. | ③ Will ALSO operate 1/20, 5/4, 5/25. |
| ④ Will ALSO operate 1/20. | ⑤ Will ALSO operate 5/4. | ④ Will operate 1/1, 1/2, 1/20, 4/12, 5/4, 5/23, 5/24, 5/25. |
| ⑥ Will operate 1/1, 1/2, 1/20, 4/12, 5/4, 5/23, 5/25. | ⑦ Will operate 1/1, 1/2, 1/20, 4/12, 5/4, 5/25. | ⑤ Will operate 1/1, 4/11, 5/4, 5/23, 5/24. |
| ⑧ Will operate 1/20, 4/11, 5/4, 5/25. | ⑧ Will operate 1/20, 5/4, 5/23, 5/25. | ⑥ Will operate 1/20, 5/4, 5/25. |
| ⑨ Will operate 4/11, 5/4, 5/24, 5/25. | | ⑦ Will operate 1/20, 5/4, 5/25. |

Perry-Phillips Bay Services Kingfisher Service - Trains 401 through 414

Coaches. Reclining seats, leg rests.
Lounge Car. Sandwiches, snacks, and beverages.

Appendix 3: One Direction on Page, Services on Same Page

Columbia-Perry Westbound

		Read Down						
		1051	1053	361	351	353	355	357
Train Name	Miles	Flyer Service	Flyer Service	Blackbird Service	Blackbird Service	Blackbird Service	Blackbird Service	Blackbird Service
Days of Operation		Mo-Fr (6)	Daily	Holidays (L)	Daily	Daily	Daily	Mo-Fr
Columbia	Dp 0	5:05A	6:05A	9:00A	10:10A	11:50A	3:30P	4:20P
South Columbia	Dp 9	R5:22A	R6:22A	R9:22A	R10:32A	R12:12P	R3:52P	R4:42P
Allegheny	Dp 33			9:44A	10:54A	12:34P	4:14P	5:04P
Greenwood	Dp 75			10:23A	11:33A	1:13P	4:53P	5:43P
Chestnut Hill	Dp 100	6:21A	7:21A	10:46A	11:56A	1:36P	5:16P	6:06P
Jamestown	Dp 157			11:35A	12:45P	2:25P	6:05P	6:55P
Pottstown	Dp 210	7:36A	8:36A	12:24P	1:34P	3:14P	6:54P	7:44P
Clarkson	Dp 249			1:00P	2:10P	3:50P	7:30P	8:20P
Perry	Ar 291	8:32A	9:32A	1:42P	2:52P	4:32P	8:12P	9:02P

		Read Down				
		363	1055	1057	359	1059
Train Name	Miles	Blackbird Service	Flyer Service	Flyer Service	Blackbird Service	Flyer Service
Days of Operation		Holidays (L)	Mo-Fr (6)	Daily (6)	Daily	Daily
Columbia	Dp 0	5:30P	5:40P	6:35P	7:00P	7:40P
South Columbia	Dp 9	R5:52P	R5:57P	R6:52P	R7:22P	R7:57P
Allegheny	Dp 33	6:14P			7:44P	
Greenwood	Dp 75	6:53P			8:23P	
Chestnut Hill	Dp 100	7:16P	6:56P	7:51P	8:46P	8:56P
Jamestown	Dp 157	8:05P			9:35P	
Pottstown	Dp 210	8:54P	8:11P	9:06P	10:24P	10:11P
Clarkson	Dp 249	9:30P			11:00P	
Perry	Ar 291	10:12P	9:07P	10:02P	11:42P	11:07P

Reference Symbols

- | | | |
|---|---|--|
| D Stops only to discharge passengers. | R Stops only to receive passengers. | X Sleeping cars may be occupied until 8am. |
| Y Sleeping cars may be occupied 1 hour before departure. | Z Sleeping cars may be occupied at 10pm. | ① Will NOT operate 1/1, 1/19, 1/20, 4/12, 5/4, 5/24, 5/25. |
| ② Will NOT operate 1/1, 1/19, 5/4, 5/24. | ③ Will NOT operate 1/1, 1/20, 4/11, 4/12, 5/4, 5/23, 5/25. | ④ Will NOT operate 1/1, 1/20, 4/11, 5/4, 5/23, 5/25. |
| ⑤ Will NOT operate 1/1, 1/20, 4/11, 5/4, 5/25. | ⑥ Will NOT operate 1/1, 1/20, 5/4, 5/25. | ⑦ Will NOT operate 1/1, 4/12, 5/4. |
| ⑧ Will NOT operate 1/19, 1/20, 5/4, 5/24. | ⑨ Will NOT operate 1/19, 5/24. | ⑩ Will NOT operate 1/19, 5/4, 5/24. |
| A Will ALSO operate 1/1, 1/2, 1/20, 5/4, 5/25. | B Will ALSO operate 1/1, 1/20, 5/4, 5/25. | C Will ALSO operate 1/20, 5/4, 5/25. |
| D Will ALSO operate 1/20. | E Will ALSO operate 5/4. | F Will operate 1/1, 1/2, 1/20, 4/12, 5/4, 5/23, 5/24, 5/25. |
| G Will operate 1/1, 1/2, 1/20, 4/12, 5/4, 5/23, 5/25. | H Will operate 1/1, 1/2, 1/20, 4/12, 5/4, 5/25. | J Will operate 1/1, 4/11, 5/4, 5/23, 5/24. |
| K Will operate 1/20, 4/11, 5/4, 5/25. | L Will operate 1/20, 5/4, 5/23, 5/25. | M Will operate 1/20, 5/4, 5/25. |
| N Will operate 4/11, 5/4, 5/24, 5/25. | | |

Columbia-Perry Services

Blackbird Service - Trains 351 through 364

Coaches. Reclining seats, leg rests.

Lounge Car. Sandwiches, snacks, and beverages.

Flyer Service - Trains 1051 through 1060

Coaches. Reclining seats, leg rests.

Business Class. Reclining seats, leg rests, extra legroom.

Lounge Car. Sandwiches, snacks, and beverages.

Appendix 4: One Direction on Page, Separate Services Page

Phillips Bay-Englewood Beach Northbound

		Read Down					
Train Name	Miles	34 The Islander	36 The Beach-comber	38 The Meteor	4 The Boardwalk Limited	32 The Clipper	40 The Twilight
Days of Operation		Daily	Daily	Daily	Daily (10)	Daily	Sa-Th
Englewood Beach	0 Dp	6:30A	12:15P	3:15P	R6:15P	9:00P	Z11:30P
Englewood Beach Airport	10 Dp	R6:50A	R12:35P	R3:35P	R6:34P	R9:20P	R11:50P
Chester	51 Dp	7:32A	1:17P	4:17P		10:02P	12:32A
Doylestown	136 Dp	8:50A	2:35P	5:35P			1:50A
Sebring	196 Dp	9:45A	3:30P	6:30P	R8:57P	12:07A	2:45A
Lee	218 Dp	10:11A	3:56P	6:56P			3:11A
Ororo	261 Ar Dp	10:51A 10:56A	4:36P 4:41P	7:36P 7:41P	9:58P 10:03P	1:11A 1:16A	3:51A 3:56A
Redmond	315 Dp	11:46A	5:31P	8:31P			4:46A
Williams	398 Dp	1:03P	6:48P	9:48P	R11:46P	3:15A	6:03A
Logan	440 Dp	1:42P	7:27P	10:27P			6:42A
Livingston	519 Dp	2:53P	8:38P	11:38P		5:02A	7:53A
Lincoln	588 Dp	4:00P	9:45P	12:45A	R1:59A	6:06A	9:00A
Penn Lyn	626 Dp	4:35P	10:20P	1:20A		6:41A	9:35A
Franklin	677 Dp	5:22P	11:07P	2:07A		7:28A	10:22A
New Philadelphia	739 Ar Dp	6:24P 6:34P	12:09A 12:19A	3:09A 3:19A	3:43A R3:53A	8:25A 8:35A	11:24A 11:34A
Nicotown	755 Dp	6:50P	12:35A	3:35A			11:50A
Hunting Park	780 Dp	7:15P	1:00A	4:00A		9:13A	12:15P
Fairmount	815 Dp	7:49P	1:34A	4:34A			12:49P
Carnaby	842 Dp	8:14P	1:59A	4:59A	R5:12A	10:07A	1:14P
Bryanville	975 Dp	10:08P	3:53A	6:53A	D7:01A	12:01P	3:08P
St. Paul	1005 Dp	10:38P	4:23A	7:23A			3:38P
Wilson	1053 Dp	11:22P	5:07A	8:07A			4:22P
Edwardsville	1140 Ar Dp	12:42A 12:47A	6:27A 6:32A	9:27A 9:32A	D9:03A D9:08A	2:17P 2:22P	5:42P 5:47P
Springfield	1150 Dp	1:02A	6:47A	9:47A		2:37P	6:02P
Greenville	1179 Dp	1:37A	7:22A	10:22A			6:37P
Louvier Woods	1210 Dp	2:14A	7:59A	10:59A		3:40P	7:14P
Phillips Bay	1301 Ar	4:19A	10:04A	1:04P	11:32A	5:38P	9:19P

Reference Symbols

D Stops only to discharge passengers.	R Stops only to receive passengers.	X Sleeping cars may be occupied until 8am.
Y Sleeping cars may be occupied 1 hour before departure.	Z Sleeping cars may be occupied at 10pm.	① Will NOT operate 1/1, 1/19, 1/20, 4/12, 5/4, 5/24, 5/25.
② Will NOT operate 1/1, 1/19, 5/4, 5/24.	③ Will NOT operate 1/1, 1/20, 4/11, 4/12, 5/4, 5/23, 5/25.	④ Will NOT operate 1/1, 1/20, 4/11, 5/4, 5/23, 5/25.
⑤ Will NOT operate 1/1, 1/20, 4/11, 5/4, 5/25.	⑥ Will NOT operate 1/1, 1/20, 5/4, 5/25.	⑦ Will NOT operate 1/1, 4/12, 5/4.
⑧ Will NOT operate 1/19, 1/20, 5/4, 5/24.	⑨ Will NOT operate 1/19, 5/24.	⑩ Will NOT operate 1/19, 5/4, 5/24.
Ⓐ Will ALSO operate 1/1, 1/2, 1/20, 5/4, 5/25.	Ⓑ Will ALSO operate 1/1, 1/20, 5/4, 5/25.	Ⓒ Will ALSO operate 1/20, 5/4, 5/25.
Ⓓ Will ALSO operate 1/20.	Ⓔ Will ALSO operate 5/4.	Ⓔ Will operate 1/1, 1/2, 1/20, 4/12, 5/4, 5/23, 5/24, 5/25.
Ⓒ Will operate 1/1, 1/2, 1/20, 4/12, 5/4, 5/23, 5/25.	Ⓕ Will operate 1/1, 1/2, 1/20, 4/12, 5/4, 5/25.	Ⓖ Will operate 1/1, 4/11, 5/4, 5/23, 5/24.
Ⓚ Will operate 1/20, 4/11, 5/4, 5/25.	Ⓛ Will operate 1/20, 5/4, 5/23, 5/25.	Ⓜ Will operate 1/20, 5/4, 5/25.
Ⓝ Will operate 4/11, 5/4, 5/24, 5/25.		

Phillips Bay-Englewood Beach Services

The Boardwalk Limited - Trains 3 and 4

All-reserved, extra fare train. Reservations required, fare supplement charged at booking.

Checked baggage service available.

Coaches. Reclining seats, leg rests.

Sleeping Cars. Roomettes and double bedrooms.

Dining Car. Full dining service.

Lounge Car. Sandwiches, snacks, and beverages.

Mobile Office Car. Internet and business suites.

The Islander - Trains 33 and 34

Checked baggage service available.

Coaches. Reclining seats, leg rests.

Sleeping Car. Roomettes and double bedrooms.

Dining Car. Full dining service.

Lounge Car. Sandwiches, snacks, and beverages.

The Meteor - Trains 37 and 38

Checked baggage service available.

Coaches. Reclining seats, leg rests.

Sleeping Cars. Roomettes and double bedrooms.

Dining Car. Full dining service.

Lounge Car. Sandwiches, snacks, and beverages.

The Clipper - Trains 31 and 32

Checked baggage service available.

Coaches. Reclining seats, leg rests.

Sleeping Cars. Roomettes and double bedrooms.

Dining Car. Full dining service.

Lounge Car. Sandwiches, snacks, and beverages.

The Beachcomber - Trains 35 and 36

Checked baggage service available.

Coaches. Reclining seats, leg rests.

Sleeping Car. Roomettes and double bedrooms.

Sleeping Car. Roomettes.

Dining Car. Full dining service.

Lounge Car. Sandwiches, snacks, and beverages.

The Twilight - Trains 39 and 40

Checked baggage service available.

Coaches. Reclining seats, leg rests.

Sleeping Cars. Roomettes and double bedrooms.

Dining Car. Full dining service.

Lounge Car. Sandwiches, snacks, and beverages.

Appendix 5: VB Macro to Replace Courier with Calibri

```
Sub CouriertoCalibri()  
    Application.ScreenUpdating = False  
    Dim objSingleWord As Range  
    Dim objDoc As Document  
  
    Set objDoc = ActiveDocument  
  
    With objDoc  
        For Each objSingleWord In .Words  
            If objSingleWord.Font.Name = "Courier" Then  
                objSingleWord.Font.Name = "Calibri"  
            End If  
        Next  
    End With  
    Call fixHdFt  
End Sub  
  
Sub fixHdFt()  
    Application.ScreenUpdating = False  
    Dim Rng2 As Range, Sctn As Section, HdFt As HeaderFooter  
    With ActiveDocument  
        For Each Rng2 In .StoryRanges  
            Call FndRepRng(Rng2)  
        Next  
        For Each Sctn In .Sections  
            For Each HdFt In Sctn.Headers  
                With HdFt  
                    If .LinkToPrevious = False Then  
                        Call FndRepRng(HdFt.Range)  
                    End If  
                End With  
            Next  
            For Each HdFt In Sctn.Footers  
                With HdFt  
                    If .LinkToPrevious = False Then  
                        Call FndRepRng(HdFt.Range)  
                    End If  
                End With  
            Next  
        Next  
    End With  
End Sub  
  
Sub FndRepRng(Rng2 As Range)  
    With Rng2.Find  
        .ClearFormatting  
        .Text = ""  
        .Font.Name = "Courier"  
        With .Replacement  
            .ClearFormatting  
            .Text = ""  
            .Font.Name = "Calibri"  
        End With  
        .Forward = True  
        .Wrap = wdFindContinue  
        .Format = True  
        .Execute Replace:=wdReplaceAll  
    End With  
End Sub
```