What's Hot – Skills for SAS® Professionals

Kirk Paul Lafler, Software Intelligence Corporation, Spring Valley, California

Abstract
As a new generation of SAS® user emerges, current and prior generations of users have an extensive array of procedures, programming tools, approaches and techniques to choose from. This presentation identifies and explores the areas that are hot in the world of the professional SAS user. Topics include Enterprise Guide, PROC SQL, PROC REPORT, Output Delivery System (ODS), Macro Language, DATA step programming techniques such as arrays and hash objects, SAS University Edition software, technical support at support.sas.com, wiki-content on sasCommunity.org, published “white” papers on LexJansen.com, and other venues.

Introduction
As defined in The Free Dictionary by Farlex, ‘skill’ is defined as “the proficiency, facility, or dexterity that is acquired or developed through training or experience.” Essentially, a skill is developed or enhanced over time, with the help of training resources and/or experience. A skill is demonstrated by the ability to perform a task, or set of tasks, well. SAS professionals frequently need a broad range of skills in order to contribute in the workplace and particularly to succeed in the technological society of the 21st century.

Critical success factors include assessing what your current skills and skill levels are, determining what skills are hot (in demand), as well as what skills are not, and identifying where and how to access resources to acquire or learn the necessary skills. As a SAS® professional, the skills you acquire will, perhaps, enable you to embark on a more rewarding journey leading to exciting opportunities, projects and better way of life. To assist in getting started, a self-survey questionnaire appears at the end of this paper to help you assess where you are and the skills needed to achieve those goals.

Take Inventory of Your Skills
The Free Merriam-Webster Dictionary defines skill as, “the ability to do something that comes from training, experience, or practice.” A skill must be developed — one isn’t born with a set of skills. So, how does one go about determining if they already possess a useful skill? Begin by taking inventory of any, and all, skills you already possess. Taking inventory of your skills involves simply making a list. Your skills might look something like the list, below.

<table>
<thead>
<tr>
<th>Inventory of Existing Skills</th>
</tr>
</thead>
<tbody>
<tr>
<td>DATA/PROC Step Programming</td>
</tr>
<tr>
<td>Data Access</td>
</tr>
<tr>
<td>Data Transformation</td>
</tr>
<tr>
<td>Data Cleaning</td>
</tr>
<tr>
<td>Data Manipulation</td>
</tr>
<tr>
<td>ODS, Reporting and Specialized Output</td>
</tr>
<tr>
<td>Macro Programming</td>
</tr>
<tr>
<td>Statistical Analysis</td>
</tr>
<tr>
<td>Data-driven Application Development</td>
</tr>
<tr>
<td>User Interface Design</td>
</tr>
<tr>
<td>Database Design</td>
</tr>
<tr>
<td>Technical Writing</td>
</tr>
</tbody>
</table>

Now that you’ve taken inventory of your skills, assign a ranking to each skill using the following values.

<table>
<thead>
<tr>
<th>Ranking of Existing Skills</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 = None</td>
</tr>
<tr>
<td>1 = Heard of it, but little or no experience</td>
</tr>
<tr>
<td>2 = Some working knowledge</td>
</tr>
<tr>
<td>3 = Proficient</td>
</tr>
<tr>
<td>4 = Expert</td>
</tr>
</tbody>
</table>
Once you’ve assessed and ranked your skill level, assign a ranking to your level of competence using the following values.

<table>
<thead>
<tr>
<th>Identify Level of Competence</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 = None</td>
</tr>
<tr>
<td>1 = Out-of-date</td>
</tr>
<tr>
<td>2 = Competitive</td>
</tr>
<tr>
<td>3 = Cutting Edge</td>
</tr>
</tbody>
</table>

Finally, categorize your skills by functional discipline, as follows.

<table>
<thead>
<tr>
<th>Categorize Skills by Functional Discipline</th>
</tr>
</thead>
<tbody>
<tr>
<td>Requirements Analysis</td>
</tr>
<tr>
<td>Systems Analysis</td>
</tr>
<tr>
<td>Application Design</td>
</tr>
<tr>
<td>User Interface Design</td>
</tr>
<tr>
<td>Report, Table and Chart Design</td>
</tr>
<tr>
<td>Data Cleaning</td>
</tr>
<tr>
<td>SDLC</td>
</tr>
<tr>
<td>Programming</td>
</tr>
<tr>
<td>Statistical analysis</td>
</tr>
<tr>
<td>Teaching</td>
</tr>
<tr>
<td>Technical Writing</td>
</tr>
<tr>
<td>Technical Support</td>
</tr>
<tr>
<td>Debugging</td>
</tr>
</tbody>
</table>

**Seek Your Level, But Don't be Afraid to Stray from Your “Comfort” Zone**

Once you have determined the skills to pursue, consider the appropriate level and resource needed to succeed. Assess your skill level, including what your objective is, and what you like to do most. Your past experience doing similar things is critically important in this equation. You should also obtain the recommendations and advice of other professionals you know. One good way to gain the necessary experience is to collaborate with more experienced colleagues, presenters, authors and consultants.

**Improve Skills/Expertise**

Many professionals believe they have already mastered all the necessary skills to be successful. But as technology evolves, it becomes increasingly important to continue the process of learning, essentially evolving along with the areas you are pursuing. It may even involve splitting a large area of interest or endeavor into smaller pieces, a process known as specializing. Even if you consider yourself an expert at what you do with interests and abilities in several areas in the SAS software, specialization is becoming not only popular, but necessary. To assist with your skill building, consider additional training from the following sources:

1) SAS-led courses (lecture / hands-on workshops)
2) Non-SAS Institute Instructor-led courses
3) Self-paced computer-based training (CBT)
4) Online SAS documentation in PDF and HTML format
5) User-written books from SAS Press, Books by Users (BBU)
6) “White” papers available from LexJansen.com, sasCommunity.org, support.sas.com, and other websites
7) User Group presentations and Hands-on workshops
8) Podcasts and webinars on sasCommunity.org and support.sas.com
SAS professionals can improve or brush up on skills by attending instructor-led or hands-on workshop training courses. Training by experienced vendors is frequently available on a variety of topics and offered at local training centers and at conference events. For example, the SAS Global Forum (SGF), the annual regional SAS conferences (e.g., MWSUG, NESUG, PNWSUG, SCSUG, SESUG, and WUSS), and industry-specific SAS conferences (e.g., PharmaSUG) offer affordable half-day and full-day instructor-led training. Users can attend these cost-effective training sessions before and/or after the conference event. Also, many of the conferences offer “free” 80 – 120 minute hands-on workshop sessions for users to attend during the conference event. These can be very attractive ways to learn a topic of interest or brush up on the latest techniques from a leading expert in a hands-on environment.

As an alternative to attending a training class in person, self-paced computer-based training (CBT) modules are available for purchase or through subscription. From time to time, “free” limited trial access is available for evaluation purposes. All you need to access this treasure-trove of information and learning is a computer and Web browser (e.g., Internet Explorer, Netscape Navigator, Safari or Mozilla FireFox). SAS Institute, for example, offers topics that can be accessed and studied for a 90-day period on the Web.

sasCommunity.org
sasCommunity.org is an exciting collaborative online community for SAS users worldwide. This virtual online community supports technology for SAS users to collaborate with other users anywhere in the world; access SAS-based content including blogs, presentations, and code examples; learn about upcoming events, forums and user group conferences; and discuss anything and everything that is related to SAS software, from SAS users to SAS users. As organizations experience declining travel budgets, improved broadband and Internet technological advances, and a need for greater productivity, sasCommunity.org expands its presence among SAS professionals.

SAS Certified Professional Exams
To give your career a significant boost and to improve your prospects for success, the SAS Institute offers certification testing for users in three key areas: 1) SAS Programming, 2) Predictive Modeling and 3) Data Warehousing among others. These globally recognized certification tests are administered in more than 140 countries by a global leader in testing services in the IT industry, and are taken in a controlled environment.

Two credentials are offered by SAS Institute for SAS programmers to consider:
1) SAS Certified Base Programmer Credential for SAS 9
   a. SAS Base Programming Exam for SAS 9

2) SAS Certified Advanced Programmer Credential for SAS 9
   a. SAS Base Programming Exam for SAS 9
   b. SAS Advanced Programming Exam for SAS 9

SAS Institute offers users a credential for predictive modelers to consider:
1) Predictive Modeling Using SAS Enterprise Miner 5.2 Credential
   a. Predictive Modeling Using SAS Enterprise Miner 5.2 Exam

Two credentials are offered by SAS Institute for SAS data warehouse professionals to consider:
1) SAS Certified Warehouse Development Specialist Credential
   a. SAS Advanced Programming Exam for SAS 9
   b. SAS Warehouse Technology Exam
   c. SAS Warehouse Development Specialist Concepts Exam

2) SAS Certified Warehouse Architect Credential
   a. SAS Warehouse Technology Exam
   b. SAS Warehouse Architect Concepts Exam

SAS Alliance Partner Program
SAS professionals may want to consider applying to become a SAS Alliance Partner. Five core programs are available to choose from: 1) Technology Program, 2) Consulting Program, 3) Application Program, 4) Outsourcing Program, and 5) Reseller Program. Each program has three levels: 1) Platinum, 2) Gold and 3) Silver. For more information about Alliance partnership opportunities, prospective candidates should access and review the SAS Alliance Program Guide on the SAS Institute web site at http://www.sas.com/partners/programs/index.html.
What Skills, Techniques and Websites are Hot?

The following table illustrates many of the skills, techniques and/or websites, but not all, that the author has found to be popular and in demand by SAS professionals.

- Enterprise Guide – GUI point-and-click front-end application
- Hash Programming Techniques to produce “Fast” table lookups, sorts, merges, and joins
- Output Delivery System (ODS) to create RTF, PDF, HTML, XML, and Excel output
- ODS Statistical Graphics to produce high-quality plots, bar charts, histograms, maps, and other graphics
- PROC SQL to construct Queries, Tables, Views, Case Expression Logic, inner and outer Joins
- PROC REPORT to create Detail and Summary Reporting
- Macro Language to construct Reusable Code and Tools
- Dictionary Tables and SASHELP Views – Access SAS Environmental / Metadata
- Business Intelligence
- SAS/XML – Share Structured Data as meta-data
- Technical Support, Online Documentation – [http://support.sas.com](http://support.sas.com)
- SAS Certification – SAS Certified Professional Exams
- JMP software to produce Statistical and Data Visualization
- JMP and JMP Genomics

What Skills are Not so Hot?

The table below shows a few skills that the authors have found to be not as popular, or as they once were, by SAS professionals.

- SAS/ASSIST® software
- SAS/FSP® software
- SAS/AF® software
- Screen Component Language® (SCL)
- DATA _NULL_ --> Monospace “Custom” Reporting

SAS University Edition Software

The SAS® University Edition is “free” to anyone. It falls under the SAS Analytics U umbrella and includes e-Learning modules to help SAS learners grow their analytics, technical and programming skills using powerful SAS software. Available for PC, Mac, or Linux Workstations, the SAS University Edition includes Base SAS®, SAS/STAT®, SAS/IML®, SAS/ACCESS® for Windows, and SAS Studio. It works through Virtualization Software in standalone mode and your Browser to access to SAS software.

**Base SAS Features**

The Base SAS software contains a built in DATA step programming language, the ability to access a wide-range of data sources, comprehensive set of functions to handle data manipulation, an assortment of “canned” and ready-to-use procedures, a comprehensive SQL language, reporting and customization feature for reports and results using Output Delivery System (ODS), data display informats and output formats, comprehensive data visualization features known as ODS Statistical Graphics, data management capabilities, and much more.

**SAS/STAT® Features**

The SAS/STAT software supports the application of the latest statistical techniques. It supports the following statistical routines: Analysis of Variance, Bayesian Analysis, Categorical Data Analysis, Cluster Analysis, Mixed Models, Multivariate Analysis, Nonparametric Analysis, Regression Analysis, Survey Sampling and Analysis, Statistical Graphics, and much more.
**SAS/IML® Features**
The SAS/IML software is an interactive matrix programming language and supports the ability to conduct Exploratory Analysis, the integration with the R programming language, dynamically linked graphics, and much more.

**SAS/ACCESS® Features**
The SAS/ACCESS software supports the ability to read, write, and update data sources; provides a flexible query language; supports the access to a variety of data sources including text files, dat files, CSV files, Excel spreadsheets, Microsoft SQL Server, and ODBC; and much more.

**SAS Studio**
The SAS Studio software serves as the user interface; supports Web applications; the access to data files, libraries and programs; the ability to recover files; dynamically link graphics; and much more.

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**SAS University Edition Processing**

![Figure 22. SAS Studio Control Flow](image)

**SAS University Edition Coding Examples**
In this section, SAS learners are provided with a sampling of essential SAS coding techniques to begin their knowledge acquisition.

**Displaying table attributes with PROC CONTENTS**

```sas
libname mydata '/folders/myfolders/' ;
proc contents lib=mydata.movies ;
   title ;
run ;
```

**Sorting data with PROC SORT**

```sas
libname mydata '/folders/myfolders/' ;
proc sort data=mydata.movies
   out=sorted_movies ;
   by rating title ;
run ;
```
What’s Hot – Skills for SAS® Professionals, continued

**Printing data with PROC PRINT**

```sas
libname mydata '/folders/myfolders/' ;
proc print data=sorted_movies ;
  var title category length ;
  by rating ;
run ;
```

**Transposing data with PROC TRANSPOSE**

```sas
libname mydata '/folders/myfolders/' ;
proc transpose data=mydata.movies
  out=transposed_movies ;
  var title ;
  by rating ;
run ;
```

**DATA Step Match-Merge**

```sas
libname mydata '/folders/myfolders/' ;
data match_merge ;
merge mydata.movies(in=m)
  mydata.actors(in=a) ;
  if m and a ;
run ;
```

**Conventional Matching Join with PROC SQL**

```sas
libname mydata '/folders/myfolders/' ;
proc sql ;
select m.title, rating, length,
    actor_leading
from mydata.movies m,
    mydata.actors a
where m.title = a.title ;
quit ;
```

**Using PROC REPORT**

SAS users often need to create and deliver quality custom reports and specialized output for management, end users, and customers. The SAS System provides users with the REPORT PROCedure, a “canned” Base-SAS procedure, for producing quick and formatted detail and summary results; compute subtotals and totals at the end of a report using a COMPUTE Block; calculate percentages; produce statistics for an analysis variable; and apply conditional logic to control summary output rows.

The REPORT procedure is a powerful tool for creating detail and summary reports and output. As with all powerful procedures, users have a number of statements and options to choose from. In its simplest form, below, PROC REPORT with the DATA= option displays all variables for all observations in the specified SAS data set. SAS determines the best way to format the output, so you don’t necessarily need to worry about these types of issues. It should be noted that the order of the displayed variables on the output report is not alphabetical, but the order the variables were created in the data set. It should also be noted that when a Title statement is not specified, the default title displayed on output is, “The SAS System.” The basic syntax of PROC REPORT with the DATA= option and the corresponding output is shown below.

**PROC REPORT Code**

```sas
PROC REPORT DATA=mydata.movies  ;
RUN ;
```
**Output**

<table>
<thead>
<tr>
<th>Title</th>
<th>Length</th>
<th>Category</th>
<th>Year</th>
<th>Studio</th>
<th>Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brave Heart</td>
<td>177</td>
<td>Action Adventure</td>
<td>1995</td>
<td>Paramount Pictures</td>
<td>R</td>
</tr>
<tr>
<td>Casablanca</td>
<td>103</td>
<td>Drama</td>
<td>1942</td>
<td>MGM / UA</td>
<td>PG</td>
</tr>
<tr>
<td>Christmas Vacation</td>
<td>87</td>
<td>Comedy</td>
<td>1989</td>
<td>Warner Brothers</td>
<td>PG-13</td>
</tr>
<tr>
<td>Coming to America</td>
<td>110</td>
<td>Comedy</td>
<td>1988</td>
<td>Paramount Pictures</td>
<td>R</td>
</tr>
<tr>
<td>Dracula</td>
<td>130</td>
<td>Horror</td>
<td>1993</td>
<td>Columbia TriStar</td>
<td>R</td>
</tr>
<tr>
<td>Dressed to Kill</td>
<td>105</td>
<td>Drama Mysteries</td>
<td>1980</td>
<td>Filmways Pictures</td>
<td>R</td>
</tr>
<tr>
<td>Forrest Gump</td>
<td>142</td>
<td>Drama</td>
<td>1994</td>
<td>Paramount Pictures</td>
<td>PG-13</td>
</tr>
<tr>
<td>Ghost</td>
<td>127</td>
<td>Drama Romance</td>
<td>1990</td>
<td>Paramount Pictures</td>
<td>PG-13</td>
</tr>
<tr>
<td>Jaws</td>
<td>123</td>
<td>Action Adventure</td>
<td>1975</td>
<td>Universal Studios</td>
<td>PG</td>
</tr>
<tr>
<td>Jurassic Park</td>
<td>127</td>
<td>Action</td>
<td>1990</td>
<td>Universal Pictures</td>
<td>PG-13</td>
</tr>
<tr>
<td>Lethal Weapon</td>
<td>110</td>
<td>Action Cops &amp; Robber</td>
<td>1987</td>
<td>Warner Brothers</td>
<td>R</td>
</tr>
<tr>
<td>Michael</td>
<td>100</td>
<td>Drama</td>
<td>1967</td>
<td>Warner Brothers</td>
<td>PG-13</td>
</tr>
<tr>
<td>National Lampoon's Vacation</td>
<td>98</td>
<td>Comedy</td>
<td>1983</td>
<td>Warner Brothers</td>
<td>PG-13</td>
</tr>
<tr>
<td>Poltergeist</td>
<td>115</td>
<td>Horror</td>
<td>1982</td>
<td>MGM / UA</td>
<td>PG</td>
</tr>
<tr>
<td>Rocky</td>
<td>120</td>
<td>Action Adventure</td>
<td>1976</td>
<td>MGM / UA</td>
<td>PG</td>
</tr>
<tr>
<td>Scarface</td>
<td>170</td>
<td>Action Cops &amp; Robber</td>
<td>1983</td>
<td>Universal Studios</td>
<td>R</td>
</tr>
<tr>
<td>Silence of the Lambs</td>
<td>110</td>
<td>Drama Suspense</td>
<td>1991</td>
<td>Orion</td>
<td>R</td>
</tr>
<tr>
<td>Star Wars</td>
<td>124</td>
<td>Action Sci-Fi</td>
<td>1977</td>
<td>Lucas Film Ltd</td>
<td>PG</td>
</tr>
<tr>
<td>The Hunt for Red October</td>
<td>135</td>
<td>Action Adventure</td>
<td>1989</td>
<td>Paramount Pictures</td>
<td>PG</td>
</tr>
<tr>
<td>The Wizard of Oz</td>
<td>101</td>
<td>Adventure</td>
<td>1939</td>
<td>MGM / UA</td>
<td>G</td>
</tr>
<tr>
<td>Titanic</td>
<td>104</td>
<td>Drama Romance</td>
<td>1997</td>
<td>Paramount Pictures</td>
<td>PG-13</td>
</tr>
</tbody>
</table>

**Selecting Variables to Display with a KEEP= Data Set Option**

PROC REPORT output can also be produced with a KEEP= data set option. In lieu of all the variables being read from the input SAS data set, a KEEP= data set option gives users a controlled way to select the variable(s) needed from an input data set. This not only prevents all variables from being read and processed, it reduces CPU and I/O performance demands on the system. As was presented in the previous example, the order of the displayed variables for the generated output is in the order the variables were created in the data set. The following example shows the syntax and corresponding output of a KEEP= data set and the NOWINDOWS option.

**PROC REPORT Code**

```sas
PROC REPORT DATA=mydata.movies(KEEP=title rating category length) NOWINDOWS ;
RUN ;
```
Output

The SAS System

<table>
<thead>
<tr>
<th>Title</th>
<th>Length</th>
<th>Category</th>
<th>Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brave Heart</td>
<td>177</td>
<td>Action Adventure</td>
<td>R</td>
</tr>
<tr>
<td>Casablanca</td>
<td>103</td>
<td>Drama</td>
<td>PG</td>
</tr>
<tr>
<td>Christmas Vacation</td>
<td>97</td>
<td>Comedy</td>
<td>PG-13</td>
</tr>
<tr>
<td>Coming to America</td>
<td>118</td>
<td>Comedy</td>
<td>R</td>
</tr>
<tr>
<td>Dracula</td>
<td>130</td>
<td>Horror</td>
<td>R</td>
</tr>
<tr>
<td>Dressed to Kill</td>
<td>105</td>
<td>Drama Mysteries</td>
<td>R</td>
</tr>
<tr>
<td>Forrest Gump</td>
<td>142</td>
<td>Drama</td>
<td>PG-13</td>
</tr>
<tr>
<td>Ghost</td>
<td>127</td>
<td>Drama Romance</td>
<td>PG-13</td>
</tr>
<tr>
<td>Jaws</td>
<td>125</td>
<td>Action Adventure</td>
<td>PG</td>
</tr>
<tr>
<td>Jurassic Park</td>
<td>127</td>
<td>Action</td>
<td>PG-13</td>
</tr>
<tr>
<td>Lethal Weapon</td>
<td>110</td>
<td>Action Cops &amp; Robber</td>
<td>R</td>
</tr>
<tr>
<td>Michael</td>
<td>100</td>
<td>Drama</td>
<td>PG-13</td>
</tr>
<tr>
<td>National Lampoon's Vacation</td>
<td>98</td>
<td>Comedy</td>
<td>PG-13</td>
</tr>
<tr>
<td>Poltergeist</td>
<td>115</td>
<td>Horror</td>
<td>PG</td>
</tr>
<tr>
<td>Rocky</td>
<td>120</td>
<td>Action Adventure</td>
<td>PG</td>
</tr>
<tr>
<td>Scarface</td>
<td>170</td>
<td>Action Cops &amp; Robber</td>
<td>R</td>
</tr>
<tr>
<td>Silence of the Lambs</td>
<td>113</td>
<td>Drama Suspense</td>
<td>R</td>
</tr>
<tr>
<td>Star Wars</td>
<td>124</td>
<td>Action Sci-Fi</td>
<td>PG</td>
</tr>
<tr>
<td>The Hunt for Red October</td>
<td>135</td>
<td>Action Adventure</td>
<td>PG</td>
</tr>
<tr>
<td>The Terminator</td>
<td>108</td>
<td>Action Sci-Fi</td>
<td>R</td>
</tr>
<tr>
<td>The Wizard of Oz</td>
<td>101</td>
<td>Adventure</td>
<td>G</td>
</tr>
<tr>
<td>Titanic</td>
<td>104</td>
<td>Drama Romance</td>
<td>PG-13</td>
</tr>
</tbody>
</table>

Selecting Variables to Display with a COLUMNS Statement

PROC REPORT output can also be produced with an optional COLUMNS statement. The COLUMNS statement tells SAS what variable(s) to display in the report. Unlike the previous examples, the variables specified with the COLUMNS statement are displayed in the exact order specified and not in the order the variables were created in the data set. The following example shows the syntax and corresponding output of the COLUMNS statement.

PROC REPORT Code

```sas
PROC REPORT DATA=mydata.movies NOWINDOWS ;
   COLUMNS title rating category length ;
RUN ;
```
In the next example, the DEFINE statement specifies the DISPLAY option with a character string to use as the variable heading for each variable. Each DEFINE statement also tells PROC REPORT the width to display each column’s content using the WIDTH= option. Unlike the COLUMNS statement specified in the previous example, the DEFINE statement’s purpose is to tell PROC REPORT how each variable is to be used and displayed in the report. The resulting report output displays all variables in the order they were created in the data set, shown below.

**PROC REPORT Code**

```sas
PROC REPORT DATA=mydata.movies NOWINDOWS ;
DEFINE title    / DISPLAY 'Movie Title'  WIDTH=30 ;
DEFINE rating   / DISPLAY 'Movie Rating' WIDTH=5  ;
DEFINE category / DISPLAY 'Category'     WIDTH=20 ;
DEFINE length   / DISPLAY 'Movie Length' WIDTH=3  ;
RUN ;
```
Output

The SAS System

<table>
<thead>
<tr>
<th>Movie Title</th>
<th>Movie Length</th>
<th>Category</th>
<th>Year</th>
<th>Studio</th>
<th>Movie Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brave Heart</td>
<td>177</td>
<td>Action Adventure</td>
<td>1995</td>
<td>Paramount Pictures</td>
<td>R</td>
</tr>
<tr>
<td>Casablanca</td>
<td>100</td>
<td>Drama</td>
<td>1942</td>
<td>MGM / UA</td>
<td>PG</td>
</tr>
<tr>
<td>Christmas Vacation</td>
<td>97</td>
<td>Comedy</td>
<td>1960</td>
<td>Warner Brothers</td>
<td>PG-13</td>
</tr>
<tr>
<td>Coming to America</td>
<td>110</td>
<td>Comedy</td>
<td>1988</td>
<td>Paramount Pictures</td>
<td>R</td>
</tr>
<tr>
<td>Druella</td>
<td>130</td>
<td>Horror</td>
<td>1962</td>
<td>Columbia Tristar</td>
<td>R</td>
</tr>
<tr>
<td>Dressed to Kill</td>
<td>105</td>
<td>Drama Mysteries</td>
<td>1980</td>
<td>Filmways Pictures</td>
<td>R</td>
</tr>
<tr>
<td>Forrest Gump</td>
<td>142</td>
<td>Drama</td>
<td>1984</td>
<td>Paramount Pictures</td>
<td>PG-13</td>
</tr>
<tr>
<td>Ghost</td>
<td>127</td>
<td>Drama Romance</td>
<td>1990</td>
<td>Paramount Pictures</td>
<td>PG-13</td>
</tr>
<tr>
<td>Jaws</td>
<td>125</td>
<td>Action Adventure</td>
<td>1975</td>
<td>Universal Studios</td>
<td>PG</td>
</tr>
<tr>
<td>Jurassic Park</td>
<td>127</td>
<td>Action</td>
<td>1993</td>
<td>Universal Pictures</td>
<td>PG-13</td>
</tr>
<tr>
<td>Lethal Weapon</td>
<td>110</td>
<td>Action Cops &amp; Robber</td>
<td>1987</td>
<td>Warner Brothers</td>
<td>R</td>
</tr>
<tr>
<td>Michael</td>
<td>106</td>
<td>Drama</td>
<td>1997</td>
<td>Warner Brothers</td>
<td>PG-13</td>
</tr>
<tr>
<td>National Lampoon’s Vacation</td>
<td>96</td>
<td>Comedy</td>
<td>1983</td>
<td>Warner Brothers</td>
<td>PG-13</td>
</tr>
<tr>
<td>Poltergeist</td>
<td>115</td>
<td>Horror</td>
<td>1982</td>
<td>MGM / UA</td>
<td>PG</td>
</tr>
<tr>
<td>Rocky</td>
<td>120</td>
<td>Action Adventure</td>
<td>1978</td>
<td>MGM / UA</td>
<td>PG</td>
</tr>
<tr>
<td>Scarface</td>
<td>170</td>
<td>Action Cops &amp; Robber</td>
<td>1983</td>
<td>Universal Studios</td>
<td>R</td>
</tr>
<tr>
<td>Silence of the Lambs</td>
<td>116</td>
<td>Drama Suspense</td>
<td>1961</td>
<td>Orion</td>
<td>R</td>
</tr>
<tr>
<td>Star Wars</td>
<td>124</td>
<td>Action Sci-Fi</td>
<td>1977</td>
<td>Lucas Film Ltd</td>
<td>PG</td>
</tr>
<tr>
<td>The Hunt for Red October</td>
<td>135</td>
<td>Action Adventure</td>
<td>1996</td>
<td>Paramount Pictures</td>
<td>PG</td>
</tr>
<tr>
<td>The Wizard of Oz</td>
<td>101</td>
<td>Adventure</td>
<td>1998</td>
<td>MGM / UA</td>
<td>G</td>
</tr>
<tr>
<td>Titanic</td>
<td>104</td>
<td>Drama Romance</td>
<td>1997</td>
<td>Paramount Pictures</td>
<td>PG-13</td>
</tr>
</tbody>
</table>

Creating PROC REPORT Output with a COLUMNS and DEFINE Statement

The COLUMNS and DEFINE statements can also be combined in PROC REPORT to create an output report. The COLUMNS statement tells SAS what variable(s) to display in the report. It is also worth noting that the COLUMNS statement limits the display to only those columns specified. The DEFINE statement tells PROC REPORT how each variable will be used in the generated report output. The following example illustrates using a COLUMNS and DEFINE statement along with various display options.

PROC REPORT Code

```sas
PROC REPORT DATA=mydata.movies NOWINDOWS ;
   COLUMNS title rating category length ;
   DEFINE title / DISPLAY 'Movie Title' WIDTH=30 ;
   DEFINE rating / DISPLAY 'Movie Rating' WIDTH=5 ;
   DEFINE category / DISPLAY 'Category' WIDTH=20 ;
   DEFINE length / DISPLAY 'Movie Length' WIDTH=3 ;
RUN ;
```
Output

Centering Data in a Column of PROC REPORT Output
The data displayed in each column of output can be centered. By default, PROC REPORT left justifies character-defined data and right justifies numeric-defined data. As in the previous example, the TITLE, COLUMNS and DEFINE statements were specified in PROC REPORT to create a “custom” output report. The next example illustrates using the DEFINE statement CENTER option to center the data for the RATING column on the report output.

PROC REPORT Code

```
TITLE Detailed Movies Listing;
PROC REPORT DATA=mydata.movies NOWINDOWS;
  COLUMNS title rating category length;
  DEFINE title    / DISPLAY 'Movie Title'  WIDTH=30;
  DEFINE rating   / DISPLAY 'Movie Rating' WIDTH=5 CENTER;
  DEFINE category / DISPLAY 'Category'     WIDTH=20;
  DEFINE length   / DISPLAY 'Movie Length' WIDTH=3;
RUN;
```
Creating a Grouped PROC REPORT Output

A “grouped” type of output can be created with PROC REPORT where analysis variables can be summarized based on a grouping variable. The next example illustrates a COLUMNS statement containing the desired variables to display on the report output. Notice that the order of the TITLE and RATING variables specified in the COLUMNS statement have been switched where now the categorical variable, RATING, is specified first. The DEFINE statement for the RATING variable specifies a GROUP option to create a “grouped” type of output where all the observations in the GROUP variable are consolidated together.

PROC REPORT Code

```
TITLE Detailed Movies Listing ;
TITLE2 Sorted by Rating ;
PROC REPORT DATA=mydata.movies NOWINDOWS ;
   COLUMNS rating title category length ;
   DEFINE title    / DISPLAY 'Movie Title'  WIDTH=30 ;
   DEFINE rating   / ORDER   'Movie Rating' WIDTH=5 CENTER ;
   DEFINE category / DISPLAY 'Category'     WIDTH=20 ;
   DEFINE length   / DISPLAY 'Movie Length' WIDTH=3 ;
RUN ;
```
Applying Conditional Logic in PROC REPORT Code
The next example illustrates how conditional logic can be optionally applied in PROC REPORT code to control the display of information on report output and, specifically the display of computed values for the variable, LENGTH2.

PROC REPORT Code

TITLE Detailed Movies Listing ;
TITLE2 Using Conditional Logic ;
PROC REPORT DATA=mydata.movies NOWINDOWS ;
COLUMNS rating title studio length length2 ;
DEFINE title / DISPLAY 'Movie Title' WIDTH=30 ;
DEFINE rating / ORDER 'Movie Rating' WIDTH=5 CENTER ;
DEFINE studio / DISPLAY 'Movie Studio' WIDTH=20 ;
DEFINE length / ANALYSIS 'Movie Length' WIDTH=3 ;
DEFINE length2 / COMPUTED 'Trailer Length' ;
COMPUTE length2 ;
  if UPCASE(studio)='PARAMOUNT PICTURES' then
    length2 = 1 + length.sum ;
ENDCOMP ;
RUN ;

Output

![Detailed Movies Listing Sorted by Rating](image)
SAS Metadata DICTIONARY Tables and SASHELP Views

SAS users can quickly and conveniently obtain useful information about their SAS session with a number of read-only SAS system tables called DICTIONARY tables. At any time during a SAS session, DICTIONARY tables can be accessed using the libref DICTIONARY in the FROM clause of a PROC SQL SELECT statement to capture information related to currently defined libnames, table names, column names and attributes, formats, and much more. SASHELP views can be accessed using any of your favorite procedures or in the DATA step. SAS 9.1 software supported 22 Dictionary tables and SASHELP views, SAS 9.2 supported 29 Dictionary tables and SASHELP views, SAS 9.3 supported 30 DICTIONARY tables and SASHELP views, and SAS 9.4 supports 32 DICTIONARY tables and SASHELP views.

Accessing and Displaying the Number of Rows in a Table

The DICTIONARY table, TABLES, can be accessed to capture and display each table name and the number of observations in the user-assigned MYDATA libref. The following PROC SQL code provides a handy way to quickly determine the number of rows in one or all tables in a libref without having to execute multiple PROC CONTENTS by using the stored information in the Dictionary table TABLES.
**What’s Hot – Skills for SAS® Professionals, continued**

**PROC SQL Code**

```sql
PROC SQL;
SELECT LIBNAME, MEMNAME, NOBS
FROM DICTIONARY.TABLES
WHERE UPCASE(LIBNAME)="MYDATA" AND
UPCASE(MEMTYPE)="DATA" ;
QUIT ;
```

**Output**

![Output Table](image)

**Accessing and Displaying the Column Definitions for a “Key” Variable in All Tables**

The DICTIONARY table, COLUMNS, is accessed to display all table names (data sets) that contain the variable TITLE in the user-assigned MYDATA libref as a cross-reference listing. To retrieve the needed type of information, you could execute multiple PROC CONTENTS against selected tables. Or in a more efficient method, you could retrieve the information directly from the read-only Dictionary table COLUMNS with the selected columns LIBNAME, MEMNAME, NAME, TYPE and LENGTH, as shown. For more information about Dictionary tables, readers may want to view the “free” SAS Press Webinar by Kirk Paul Lafler at [http://support.sas.com/publishing/bbu/webinar.html#lafler2](http://support.sas.com/publishing/bbu/webinar.html#lafler2) or the published paper by Kirk Paul Lafler, Exploring Dictionary Tables and SASHELP Views.

**PROC SQL Code**

```sql
PROC SQL;
SELECT LIBNAME, MEMNAME, NAME, TYPE, LENGTH
FROM DICTIONARY.COLUMNS
WHERE UPCASE(LIBNAME)="MYDATA" AND
UPCASE(NAME)="TITLE" AND
UPCASE(MEMTYPE)="DATA" ;
QUIT ;
```

**Output**

![Output Table](image)
**Conclusion**

There are many avenues to help determine what skills are hot and what are not in the world of the SAS professional. Follow the main websites www.SAS.com, the forums and blogs within http://support.SAS.com and the user interchange on www.sasCommunity.org to keep abreast of advancing technologies. Education and a desire to acquire new skills and experience are very important. Careful planning, preparation, organization, the ability to handle multiple tasks, and diligence are important factors for any SAS professional to possess and/or develop.

It's also important to identify and acquire specific techniques from others, along with their successes and failures, to improve the likelihood for greater success while enhancing your skills. Other professionals may be able to share their own expertise to help you acquire, or brush up on, specific skills, including resources like SAS-L, sasCommunity.org, and various web sites designed for SAS professionals. These resources include instructor-led and hands-on workshop training available at SAS user conferences, self-paced computer based training (CBT) or e-Learning applications, self-study web resources including “white” papers, published programming tips and techniques, and certification. Also, a good SAS programming and/or user-written technical book, or two, can provide a wealth of knowledge for the inquisitive, and self-starting, professional.

**References**


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About the Author
Kirk Paul Lafler is an entrepreneur, consultant and founder of Software Intelligence Corporation, and has been using SAS since 1979. Kirk is a SAS Certified Professional, provider of IT consulting services, professor at UC San Diego Extension and educator to SAS users around the world, mentor, and emeritus sasCommunity.org Advisory Board member. As the author of six books including Google® Search Complete (Odyssey Press. 2014) and PROC SQL: Beyond the Basics Using SAS, Second Edition (SAS Press. 2013); Kirk has written more than five hundred papers and articles; been an Invited speaker and trainer at five hundred-plus SAS International, regional, special-interest, local, and in-house user group conferences and meetings; and is the recipient of 23 “Best” contributed paper, hands-on workshop (HOW), and poster awards.

Comments and suggestions can be sent to:
Kirk Paul Lafler
Senior SAS® Consultant, Application Developer, Data Analyst, Educator and Author
Software Intelligence Corporation
E-mail: KirkLafler@cs.com
LinkedIn: http://www.linkedin.com/in/KirkPaulLafler
Twitter: @sasNerd
SAS® Professional Skills Survey

SAS Professional: ________________________________________________________________

E-mail/LinkedIn: ________________________________________________________________

1. How long have you been using SAS? _____ < 1 Year _____ 1 – 5 Years _____ 6 – 10 Years _____ > 10 Years

2. How would you rate the level of your SAS expertise? _____ None _____ Novice _____ Intermediate _____ Advanced (Expert)

3. Have you been certified as a SAS Professional by passing the certification exam? _____ Yes _____ No

4. Are you a SAS Alliance Partner? _____ Yes _____ No If you answered ‘Yes’ to previous question, how long? _______ Years

5. What method(s) do you use to improve your SAS skills? _____ CBT _____ Instructor-led Training _____ Podcasts

- Hands-on Workshops _____ User Group Presentations _____ Webinars _____ YouTube Videos

- Computer Based Training (CBT) _____ support.sas.com _____ SAS Press Books/eBooks

- SAS Online Documentation _____ www.lexjansen.com _____ MOOCs _____ Other

6. Rate your SAS programming/skills in the following areas (0=None, 1=Novice, 2=Some Knowledge, 3=Very Good, 4=Expert):

- Base SAS
- SAS Programming
- SQL Programming
- Macro Programming
- DATA Step Hash Programming
- Output Delivery System (ODS)
- ODS Statistical Graphics
- SAS/AF®, SAS/AF® and SCL
- SAS Enterprise Guide® (EG)
- SAS Debugging Techniques
- Business Intelligence
- Statistical Consulting
- SAS/IntrNet®
- SAS/PC®
- SAS/Connect®
- SAS/ETS®
- SAS/OR®
- SAS/Graph®
- SAS/XML®
- Data Mining
- Data Cleaning
- Other ______________________

- Other ______________________

- Other ______________________

- Other ______________________

- Other ______________________

- Other ______________________

- Other ______________________

7. What makes your skills unique and/or successful? ____________________________________________

8. What are your goals, directions, and future plans? __________________________________________

__________________________________________

__________________________________________

__________________________________________

__________________________________________

Please feel free to use this form to assess and manage your own SAS Skills.

Figure 1. Professional SAS Skills Survey