Introduction to SAS

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Find a seat and log into your computer using your HawkID and password.

Let one of the proctors know if you have not already saved course materials somewhere in your personal storage (e.g. on your "H:\" drive).

Make sure you know where you saved the materials

…"a software suite developed by SAS Institute for advanced analytics, multivariate analyses, business intelligence, data management, and predictive analytics."

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Overview

- Day 1
  - – Introduction to SAS
- Day 2
  - – Data Management
  - – Introduction to SAS Procedures
  - – ODS Graphics Designer
  - – Demonstration of SAS EG

Uses

- Access and manage data across multiple sources
- Generate reports and perform analyses

Interfaces

- SAS Windowing Environment (SAS)
  - – Provides a full programming interface
- SAS Enterprise Guide (SAS EG)
  - – Provides a point-and-click interface with menus and wizards to create code

Access at UI

- PC Installation
  - Requires purchase of SAS license

    Department licenses:

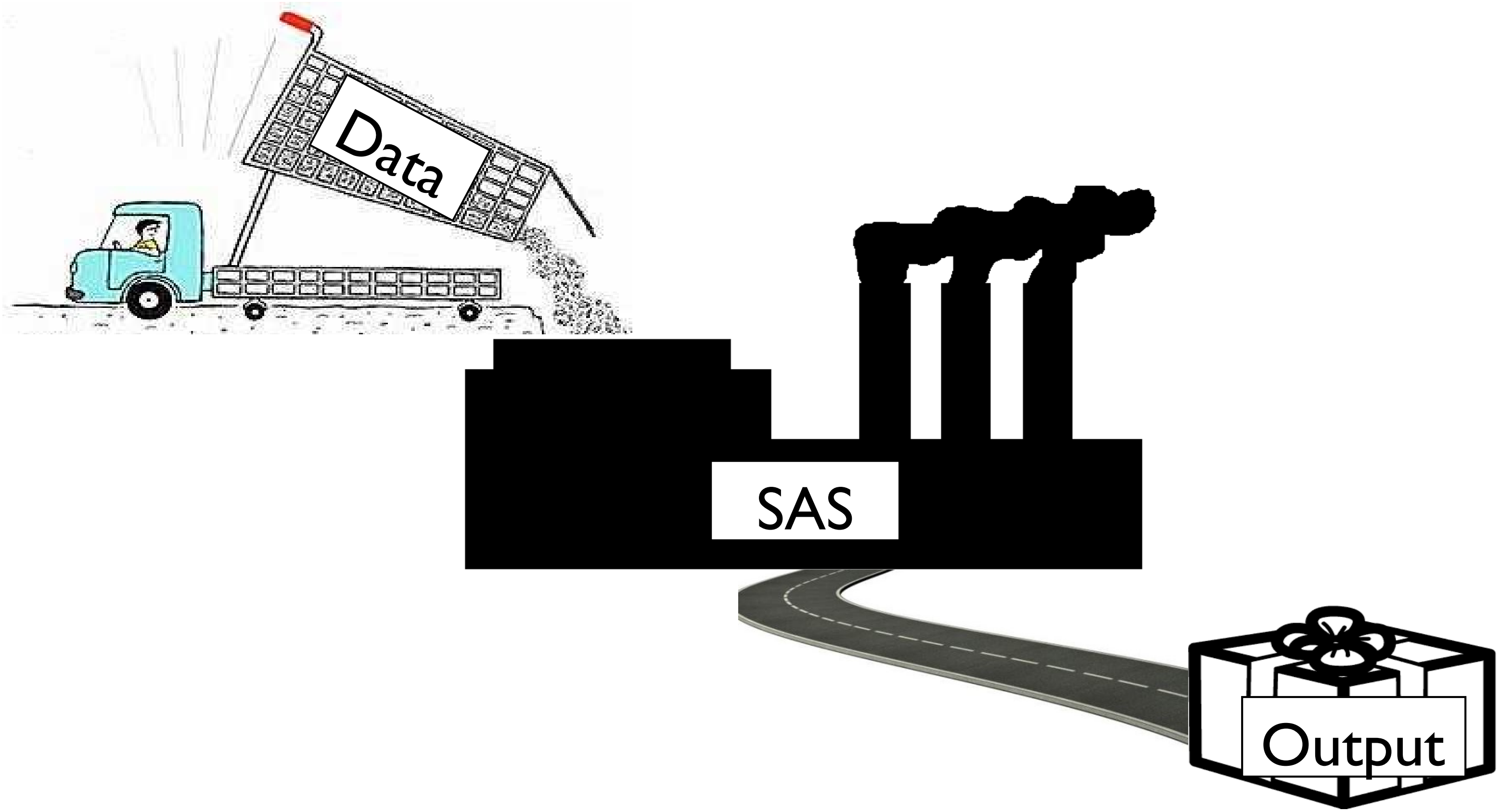
    College of Business
    College of Dentistry
    College of Education
    NADs (College of Engineering)
    College of Liberal Arts and Sciences
    College of Nursing
    College of Pharmacy
    College of Public Health
    Iowa Consortium of Substance Abuse (VP for Rsrch)
    Public Policy (VP for Research)
- Virtual Desktop
  - Provides access to a variety of programs through web-based system
  - Used on or off campus

Starting the SAS System

- Off campus
  - http://virtualdesktop.uiowa.edu/
  - Requires installation of Citrix Receiver software

- PC installed or on campus
  - Start → All Programs → SAS → SAS 9.4
or
  - Start button → “S” → SAS → SAS 9.4

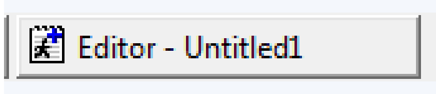
It’s not magic… it’s a tool



Interface Windows

- Enhanced Editor
- Log
- Output or Results Viewer
- Explorer
- Results

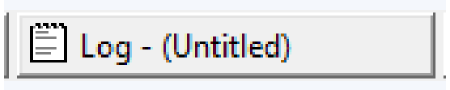
Enhanced Editor



Editor - Untitled1

- Where you write your SAS programs
- A SAS program is a series of commands to:
  - Import and manipulate data
  - Generate reports and perform analyses
  - Output results

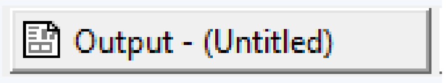
Log

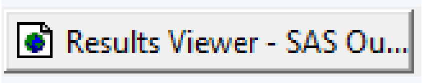


Log - (Untitled)

- Information pertaining to the program you’ve submitted is automatically displayed in the log
- Contains a list of:
  - Program commands and operations
  - Notes, warnings and errors

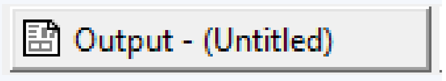
Output or Results Viewer

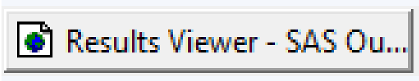




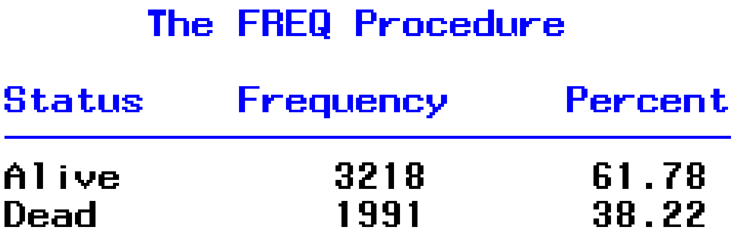
- When the SAS program executes without error, the results are displayed in the Output or Results Viewer
- The window the results will be displayed in will depend on the default setting

Output or Results Viewer





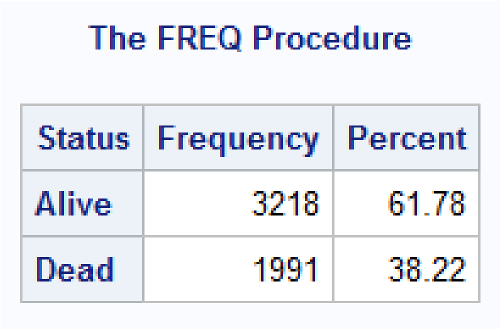
Output



```
           The FREQ Procedure

Status       Frequency       Percent
------------------------------------
Alive             3218         61.78
Dead              1991         38.22
```

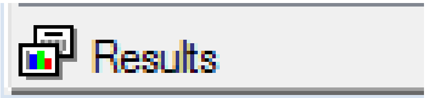
Results Viewer



The FREQ Procedure

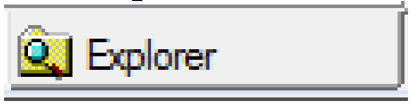
Status	Frequency	Percent
Alive	3218	61.78
Dead	1991	38.22

Results

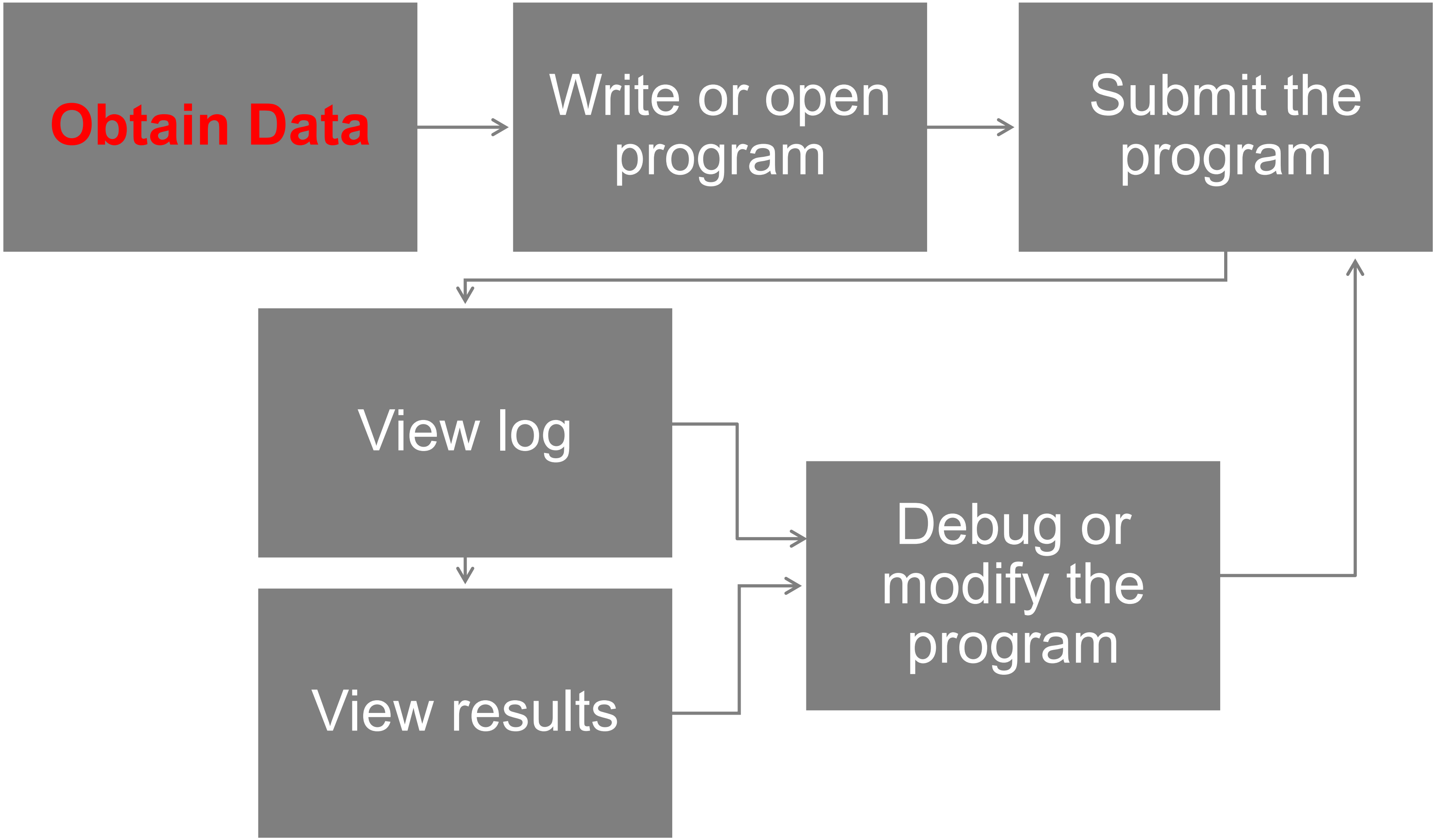

Results

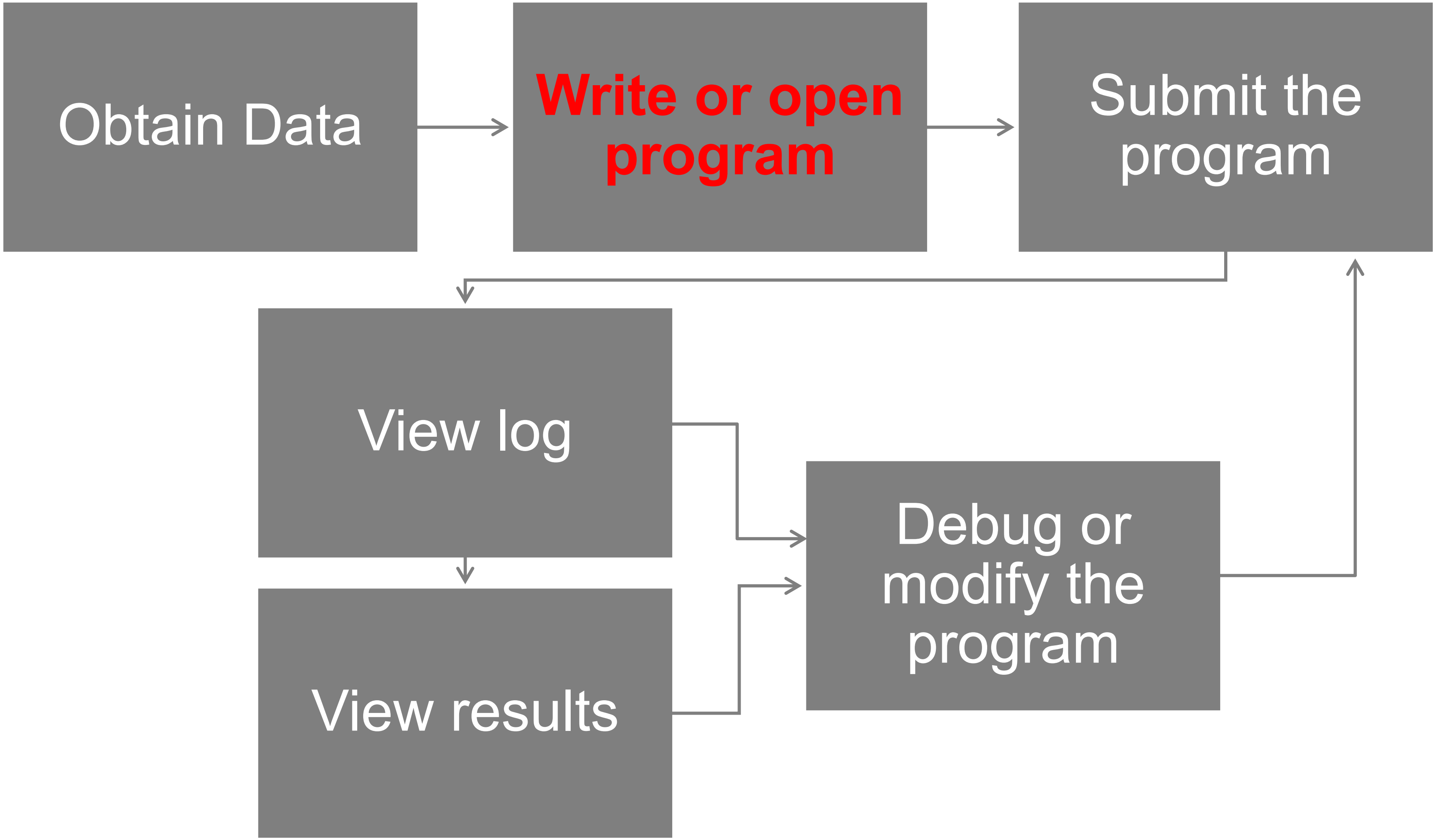
- Provides table of contents for output
- Lists each procedure in outline form
- Can be expanded to show each part

Explorer



- Provides easy access to SAS files and data sets
- Computer Computer provides access to all shared devices or drives
- Libraries Libraries contains all libraries currently defined


Obtain Data
Write or open program
Submit the program
View log
View results
Debug or modify the program



Obtain Data

Write or open program

Submit the program

View log

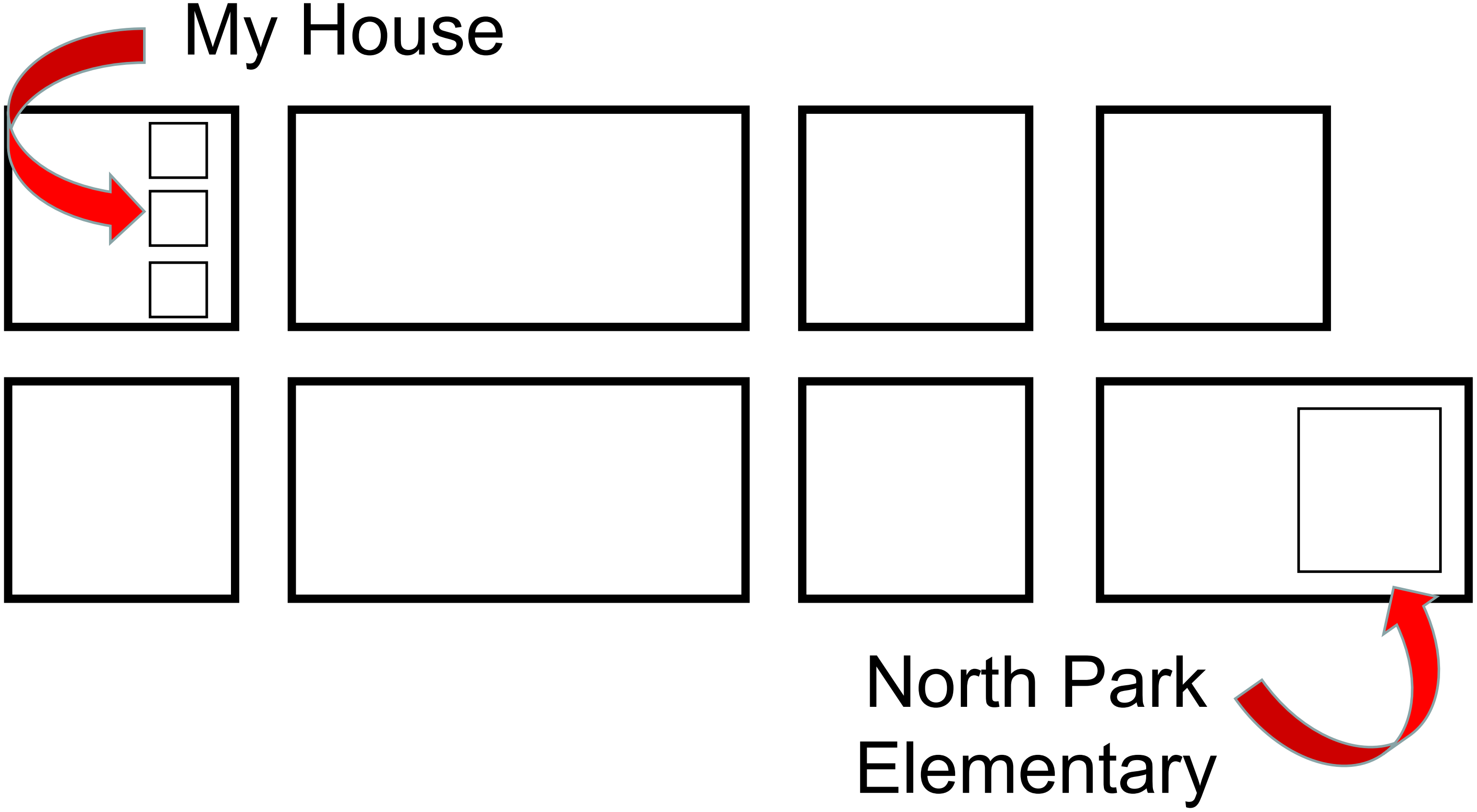
View results

Debug or modify the program

Becoming a SAS Programmer

- SAS is best as a “write code then run” program
- To be proficient, you must learn how to write a program
  - Simple if you understand what is required

My First Program

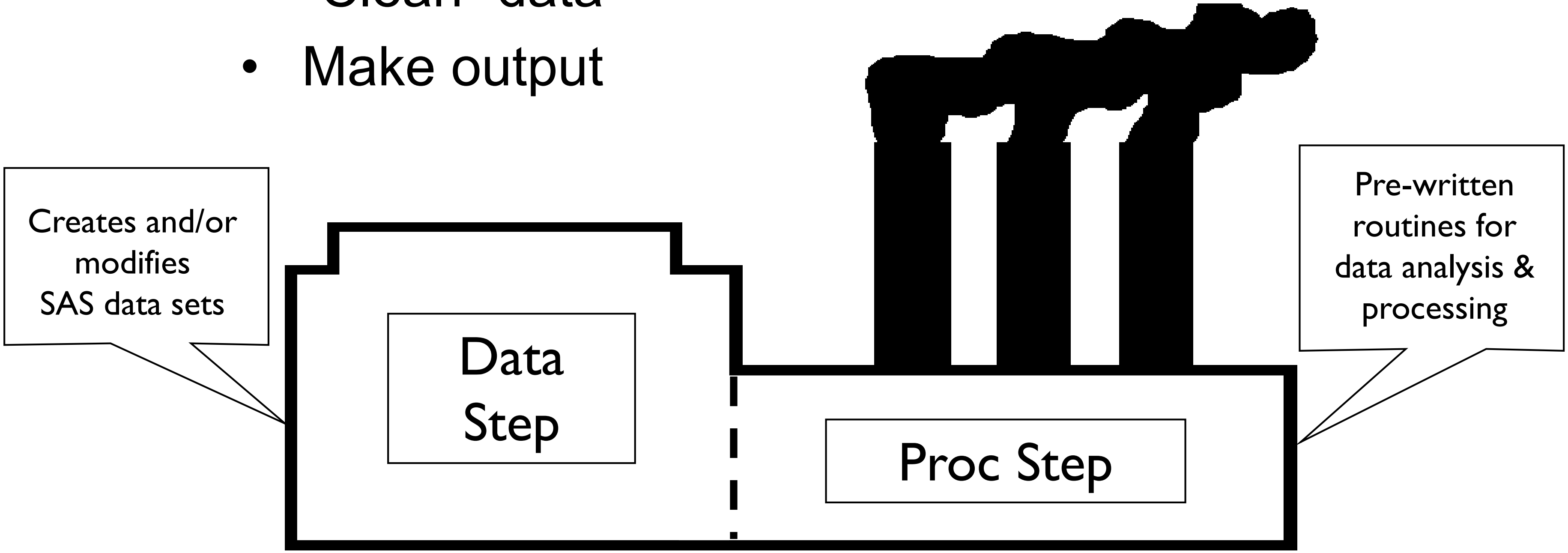


A Basic SAS Program

- Find data
- Read data
- “Clean” data
- Make output

A Basic SAS Program

- Find data
- Read data
- “Clean” data
- Make output


Creates and/or modifies SAS data sets
Data Step
Proc Step
Pre-written routines for data analysis & processing

Data (1)

Layout

- Columns = Variables
- Rows = Observations

Bill	101	55	165.10
Tom	156	35	132.56
Sue	204	125	115.89
Ann	245	78	155.25
Jill	397	32	112.90
Bob	456	44	118.21
Tim	678	67	156.20
Matt	875	95	134.00
Kay	941	88	122.45

Data (2)

Variables need names

- 1-32 characters
- Must start with a character or underscore
  - Subsequent characters can be letters, numbers, or underscores
- No blanks or special characters
- Mixed-case OK
- Are not case sensitive

fname	id	days	wages
Bill	101	55	165.10
Tom	156	35	132.56
Sue	204	125	115.89
Ann	245	78	155.25
Jill	397	32	112.90
Bob	456	44	118.21
Tim	678	67	156.20
Matt	875	95	134.00
Kay	941	88	122.45

Data (3)

Data types

- Character
  - Can contain any character (letters, numbers, special characters, and blanks)
  - Range from 1-32,767 characters
- Numeric
  - Numbers (decimal point and minus sign)

fname	id	days	wages
Bill	101	55	165.10
Tom	156	35	132.56
Sue	204	125	115.89
Ann	245	78	155.25
Jill	397	32	112.90
Bob	456	44	118.21
Tim	678	67	156.20
Matt	875	95	134.00
Kay	941	88	122.45

Data (4)

Data sources

- Internal
  - Data embedded with a program
- External
  - "Local"
    - Excel, Access, delimited, text
  - "Remote"
    - Databases, servers, etc.

fname	id	days	wages
Bill	101	55	165.10
Tom	156	35	132.56
Sue	204	125	115.89
Ann	245	78	155.25
Jill	397	32	112.90
Bob	456	44	118.21
Tim	678	67	156.20
Matt	875	95	134.00
Kay	941	88	122.45

Let's Write a Program!

Bill	101	55	165.10
Tom	156	35	132.56
Sue	204	125	115.89
Ann	245	78	155.25
Jill	397	32	112.90
Bob	456	44	118.21
Tim	678	67	156.20
Matt	875	95	134.00
Kay	941	88	122.45

Let’s Write a Program!

Use the “data” statement to tell SAS that you want to create a dataset and you want to name it “demo”.

```
data demo;



Bill    101   55  165.10
Tom     156   35  132.56
Sue     204  125  115.89
Ann     245   78  155.25
Jill    397   32  112.90
Bob     456   44  118.21
Tim     678   67  156.20
Matt    875   95  134.00
Kay     941   88  122.45
```

Let’s Write a Program!

Use the “input” statement to tell SAS how to read in each line of the data file. This is where you provide variable names and where you tell SAS the type of each variable.

```
data demo;
input fname $ id days wages;

Bill    101   55   165.10
Tom     156   35   132.56
Sue     204  125   115.89
Ann     245   78   155.25
Jill    397   32   112.90
Bob     456   44   118.21
Tim     678   67   156.20
Matt    875   95   134.00
Kay     941   88   122.45
```

Let's Write a Program!

The "datalines" statement tells SAS that the next lines of the program actually contain data.

SAS will treat each line as a new observation until it encounters a semi-colon (;)

```
data demo;
input fname $ id days wages;
datalines;
Bill    101   55  165.10
Tom     156   35  132.56
Sue     204  125  115.89
Ann     245   78  155.25
Jill    397   32  112.90
Bob     456   44  118.21
Tim     678   67  156.20
Matt    875   95  134.00
Kay     941   88  122.45
;
```

Let’s Write a Program!

The “run” statement isn’t always necessary, but it’s a good practice to tell SAS that this is the end of the DATA step or PROC step.

```
data demo;
input fname $ id days wages;
datalines;
Bill     101    55   165.10
Tom      156    35   132.56
Sue      204   125   115.89
Ann      245    78   155.25
Jill     397    32   112.90
Bob      456    44   118.21
Tim      678    67   156.20
Matt     875    95   134.00
Kay      941    88   122.45
;
run;
```

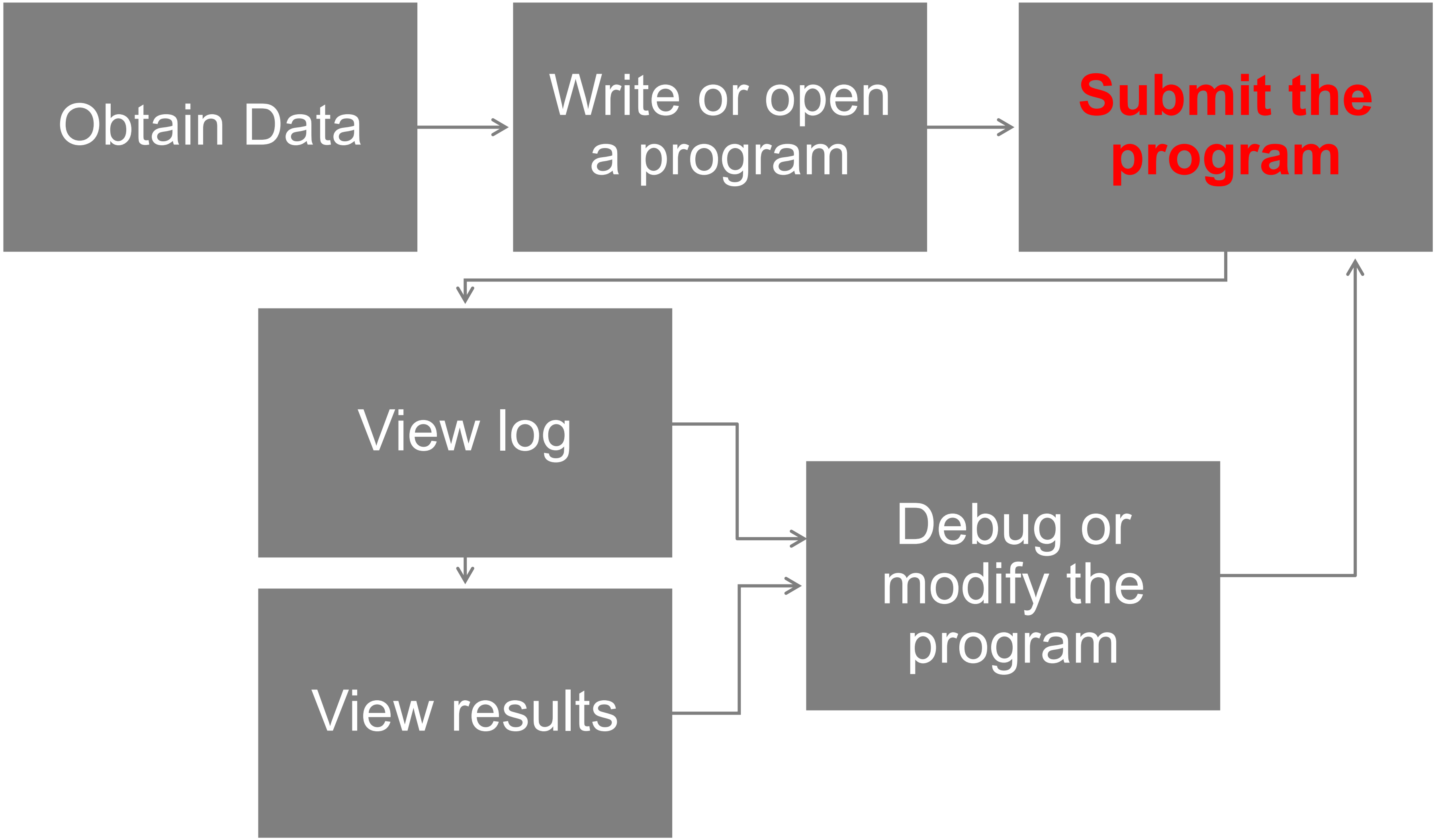
Let’s Write a Program!

Now that our data is in a SAS dataset, we can run a simple PROC to see what the data looks like.

Again, the “run” statement isn’t always necessary, but it’s a good practice to tell SAS that this is the end of the DATA step or PROC step.

```
data demo;
input fname $ id days wages;
cards;
Bill     101    55   165.10
Tom      156    35   132.56
Sue      204   125   115.89
Ann      245    78   155.25
Jill     397    32   112.90
Bob      456    44   118.21
Tim      678    67   156.20
Matt     875    95   134.00
Kay      941    88   122.45
;
run;

proc print;
run;
```



Obtain Data

Write or open a program

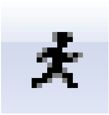
Submit the program

View log

View results

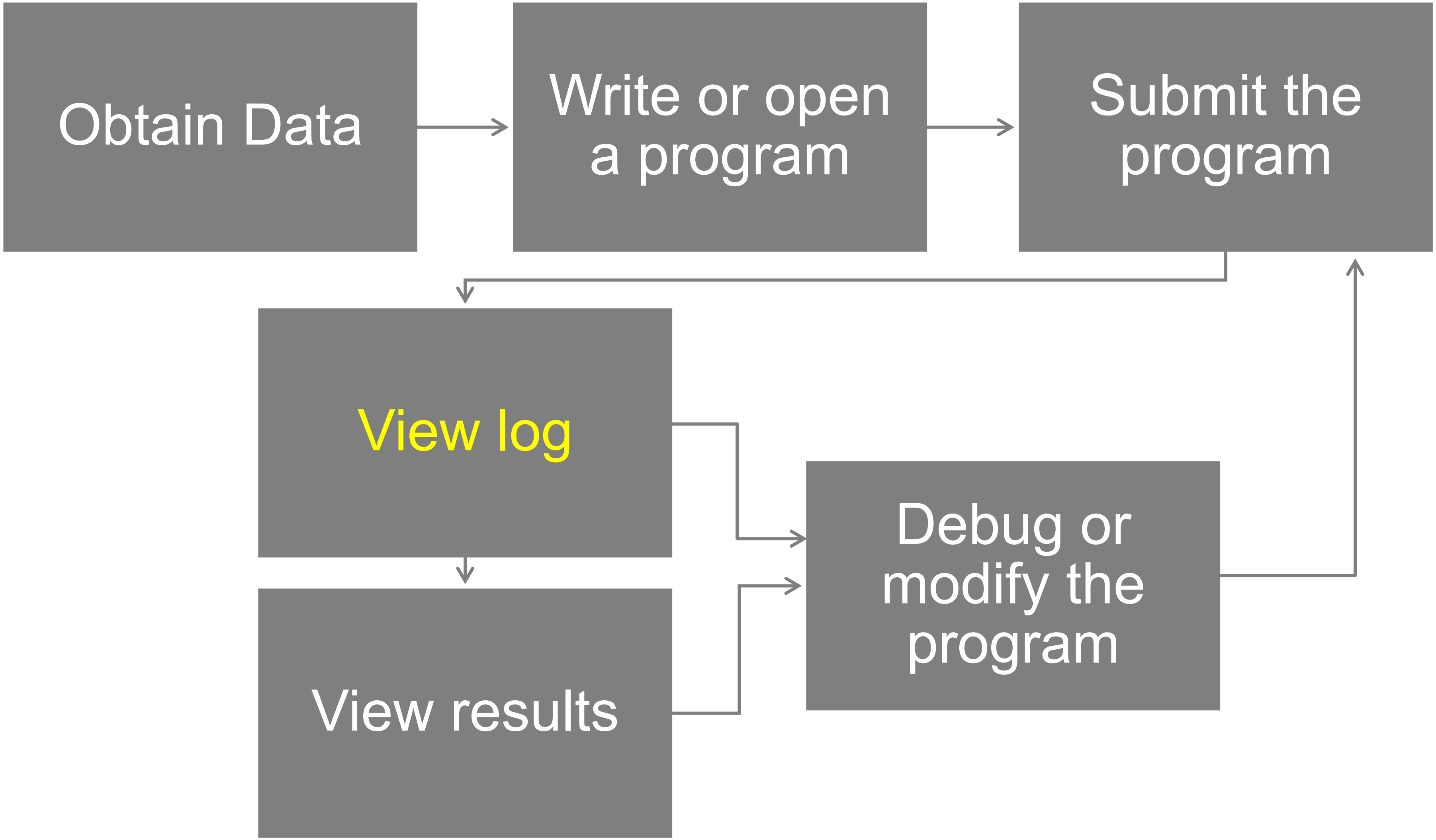
Debug or modify the program

Submitting the Program

- Can submit all or part of a program
- Click the “running man” 

Results!

Obs	fname	id	days	wages
1	Bill	101	55	165.10
2	Tom	156	35	132.56
3	Sue	204	125	115.89
4	Ann	245	78	155.25
5	Jill	397	32	112.90
6	Bob	456	44	118.21
7	Tim	678	67	156.20
8	Matt	875	95	134.00
9	Kay	941	88	122.45



Obtain Data

Write or open a program

Submit the program

View log

View results

Debug or modify the program

Log

```
NOTE: Copyright (c) 2002-2012 by SAS Institute Inc., Cary, NC, USA.
NOTE: SAS (r) Proprietary Software 9.4 (TS1M3)
      Licensed to UNIVERSITY OF IOWA - SFA T&R, Site 70086217.
NOTE: This session is executing on the X64_7PRO  platform.

NOTE: Additional host information:

 X64_7PRO WIN 6.1.7601 Service Pack 1 Workstation

NOTE: SAS initialization used:
      real time           0.65 seconds
      cpu time            0.49 seconds

1    data demo;
2    input fname $ id days wages;
3    datalines;

NOTE: The data set WORK.DEMO has 9 observations and 4 variables.
NOTE: DATA statement used (Total process time):
      real time           0.01 seconds
      cpu time            0.01 seconds

13   ;
14   run;
15
16   proc print;
17   run;

NOTE: There were 9 observations read from the data set WORK.DEMO.
NOTE: PROCEDURE PRINT used (Total process time):
      real time           0.42 seconds
      cpu time            0.14 seconds
```

Time to do some data fixing!

Assignment Statements

- Basic method for adding to or modifying a SAS data set
- Has the form

  Variable=expression;

  - Numeric constant

    Year=2018;
  - Character constant;

    Study=“Heart”;
  - Copy a variable

    Newvariable=Oldvariable;

Arithmetic Calculations

Operation	Symbol	Example
Addition	+	CholestAdjust=Cholesterol+5;
Subtraction	-	SystAdjust=Systolic-10;
Multiplication	*	Heightm=Height*0.0254;
Division	/	BPRatio=SystAdjust/DiastAdjust
Exponentiation	**	Heightm2=Heightm**2

Let’s Write a Program!

Create a new variable named “year” and give it a constant value of 2016.

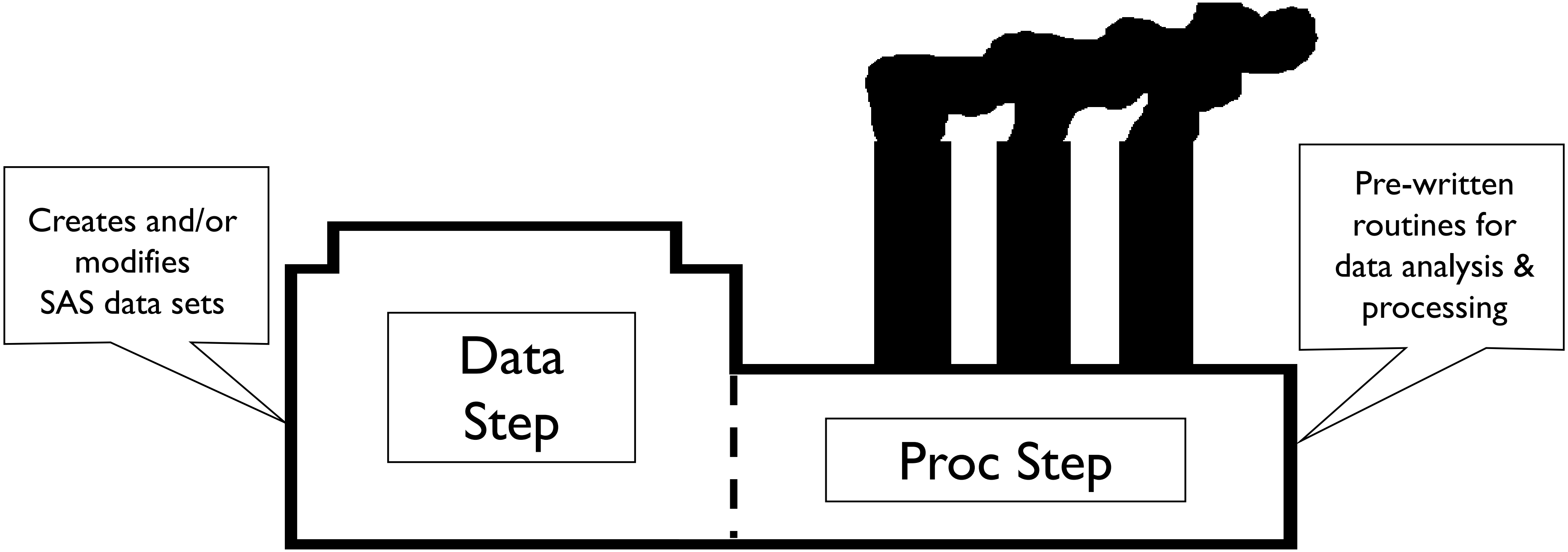
Then create a new variable named “totwages” that is the product of wages and days.

```
data demo;
input fname $ id days wages;
year=2018;
totwages=wages*days;
datalines;
Bill    101   55   165.10
Tom     156   35   132.56
               ~
Matt    875   95   134.00
Kay     941   88   122.45
;
run;

proc print;
run;
```

BREAK

SAS Program Structural Components


Creates and/or modifies SAS data sets
Data Step
Proc Step
Pre-written routines for data analysis & processing

Structural Components

- Every program typically has two parts:
  - DATA step
    - Reading data and variable manipulations
  - PROC step
    - Generates descriptive information and performs statistical analyses

```
data demo;
input fname $ id days wages;
datalines;
Bill    101   55   165.10
Tom     156   35   132.56
Sue     204  125   115.89
Ann     245   78   155.25
Jill    397   32   112.90
Bob     456   44   118.21
Tim     678   67   156.20
Matt    875   95   134.00
Kay     941   88   122.45
;
run;

proc print;
run;
```

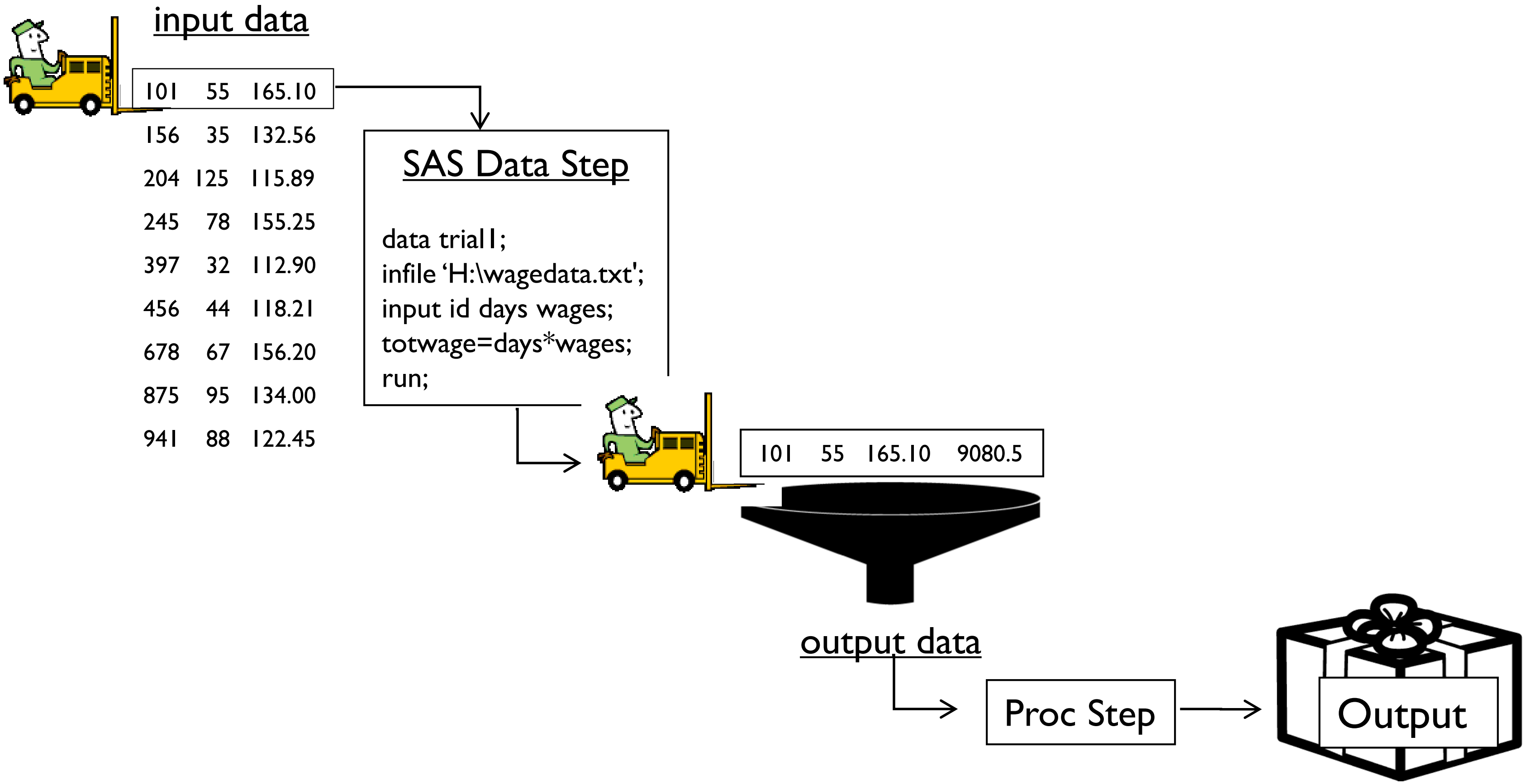
DATA Step

- Reads and modifies data
  - Calculations
  - Recoding variables
  - Combine data sets by concatenation or merging
- Data steps execute line by line and observation by observation

```
data demo;
input fname $ id days wages;
datalines;
Bill    101   55   165.10
Tom     156   35   132.56
Sue     204  125   115.89
Ann     245   78   155.25
Jill    397   32   112.90
Bob     456   44   118.21
Tim     678   67   156.20
Matt    875   95   134.00
Kay     941   88   122.45
;
run;

proc print;
run;
```

Structure Overview



input data

```
101   55  165.10
156   35  132.56
204  125  115.89
245   78  155.25
397   32  112.90
456   44  118.21
678   67  156.20
875   95  134.00
941   88  122.45
```

SAS Data Step

```
data trial1;
infile ‘H:\wagedata.txt';
input id days wages;
totwage=days*wages;
run;
```

```
101   55  165.10   9080.5
```

output data

PROC Step

- Produces output
- Each procedure (PROC) has unique characteristics
- There are lots and lots of PROCs
- PROCs will be covered in more detail tomorrow.

```
data demo;
input fname $ id days wages;
datalines;
Bill    101   55   165.10
Tom     156   35   132.56
Sue     204  125   115.89
Ann     245   78   155.25
Jill    397   32   112.90
Bob     456   44   118.21
Tim     678   67   156.20
Matt    875   95   134.00
Kay     941   88   122.45
;
run;

proc print;
run;
```

Let’s Write another Program!

- Read in an “external” data file
  - H:\SASClass\bp.csv
  - Data on clinic and diastolic and systolic blood pressure at initial and follow-up visit.
- CSV: comma-separated values
  - Common data format
  - Easily imported/exported from Excel

```
C,84,138,93,143
D,89,150,91,140
 ,78,116,100,162
A,,,86,155
C,81,145,86,140
```

Let’s Write another Program!

Use the “data” statement to tell SAS that you want to create a dataset and you want to name it “bp”.

```
data bp;
```

```
C,84,138,93,143
D,89,150,91,140
 ,78,116,100,162
A,,,86,155
C,81,145,86,140
```

Let’s Write another Program!

Use the “infile” statement to tell SAS the name and location of the external data file. Also tell SAS that the data values are delimited with a comma.

```
data bp;
infile ‘h:\sasclass\bp.csv’ dsd;
```

```
C,84,138,93,143
D,89,150,91,140
 ,78,116,100,162
A,,,86,155
C,81,145,86,140
```

Let’s Write another Program!

Use the “input” statement to tell SAS how to read in each line of the data file. This is where you provide variable names and where you tell SAS the type of each variable.

```
data bp;
infile ‘h:\sasclass\bp.csv’ dsd;
input clinic $ dbp1 sbp1 dbp2 sbp2;
```

```
C,84,138,93,143
D,89,150,91,140
 ,78,116,100,162
A,,,86,155
C,81,145,86,140
```

Let’s Write another Program!

Again, the “run” statement isn’t always necessary, but it’s a good practice to tell SAS that this is the end of the DATA step or PROC step.

Now that our data is in a SAS dataset, we can run a simple PROC to see what the data looks like.

```
data bp;
infile ‘h:\sasclass\bp.csv’ dsd;
input clinic $ dbp1 sbp1 dbp2 sbp2;
run;

proc print;
run;
```

```
C,84,138,93,143
D,89,150,91,140
,78,116,100,162
A,,,86,155
C,81,145,86,140
```

Programs and Outputs and Logs!

(oh my)

Missing Data

Obs	clinic	dbp1	sbp1	dbp2	sbp2
1	C	84	138	93	143
2	D	89	150	91	140
3		78	116	100	162
4	A	.	.	86	155

- Character variables “ ”
- Numeric variables .

Time to do some (more) data fixing!

Let’s Write another Program!

“Fix” the record with the missing value for clinic – set it to “B”

Correct the record with the missing dbp2 variable.

```
data bp;
infile ‘h:\sasclass\bp.csv’ dsd;
input clinic $ dbp1 sbp1 dbp2 sbp2;
if clinic=‘ ‘ then clinic=‘B’;
if dbp2=.Then dbp2=60;
run;

proc print;
run;
```

```
C,84,138,93,143
D,89,150,91,140
A,78,116,100,162
A,,,86,155
C,81,145,86,140
```

“Libraries” and the Libname Statement

- Must submit a libname statement to create a library reference
- Is a pointer to folder on your computer where the data files are stored
- Short hand way of telling SAS where to look for SAS data sets
  - General Format
    - `libname <name of library> "<folder location>";`
  - Example
    - `libname class "H:\SASUsersGroup\datasets\";`

Libname Rules

- 1-8 characters
- Must start with a letter
  - Subsequent characters can be letters, numbers or an underscore
- No spaces

Let’s Write more Program!

```
data bp;
infile ‘h:\sasclass\bp.csv’ dsd;
input clinic $ dbp1 sbp1 dbp2 sbp2;
if clinic=' ' then clinic='B';
if dbp2=.Then dbp2=60;
run;

proc print;
run;

libname ssd ‘h:\sas\’;

data ssd.bp;
  set bp;
run;
```

```
C,84,138,93,143
D,89,150,91,140
 ,78,116,100,162
A,,,86,155
C,81,145,86,140
```

Use the “libname” statement to create a library name and to tell SAS where to find that library

Let’s Write more Program!

```
data bp;
infile ‘h:\sasclass\bp.csv’ dsd;
input clinic $ dbp1 sbp1 dbp2 sbp2;
if clinic=' ' then clinic='B';
if dbp2=.Then dbp2=60;
run;

proc print;
run;

libname ssd ‘h:\sas\’;

data ssd.bp;
  set bp;
run;
```

```
C,84,138,93,143
D,89,150,91,140
 ,78,116,100,162
A,,,86,155
C,81,145,86,140
```

Tell SAS what name you would like to give your “permanent” dataset. Note the two-part name (beginning with the library name).

Let’s Write more Program!

```
data bp;
infile ‘h:\sasclass\bp.csv’ dsd;
input clinic $ dbp1 sbp1 dbp2 sbp2;
if clinic=' ' then clinic='B';
if dbp2=.Then dbp2=60;
run;

proc print;
run;

libname ssd ‘h:\sas\’;

data ssd.bp;
  set bp;
run;
```

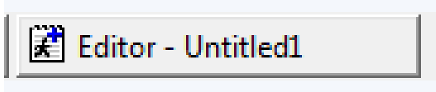
```
C,84,138,93,143
D,89,150,91,140
 ,78,116,100,162
A,,,86,155
C,81,145,86,140
```

Tell SAS what dataset you would like to use for the source of your your “permanent” dataset.

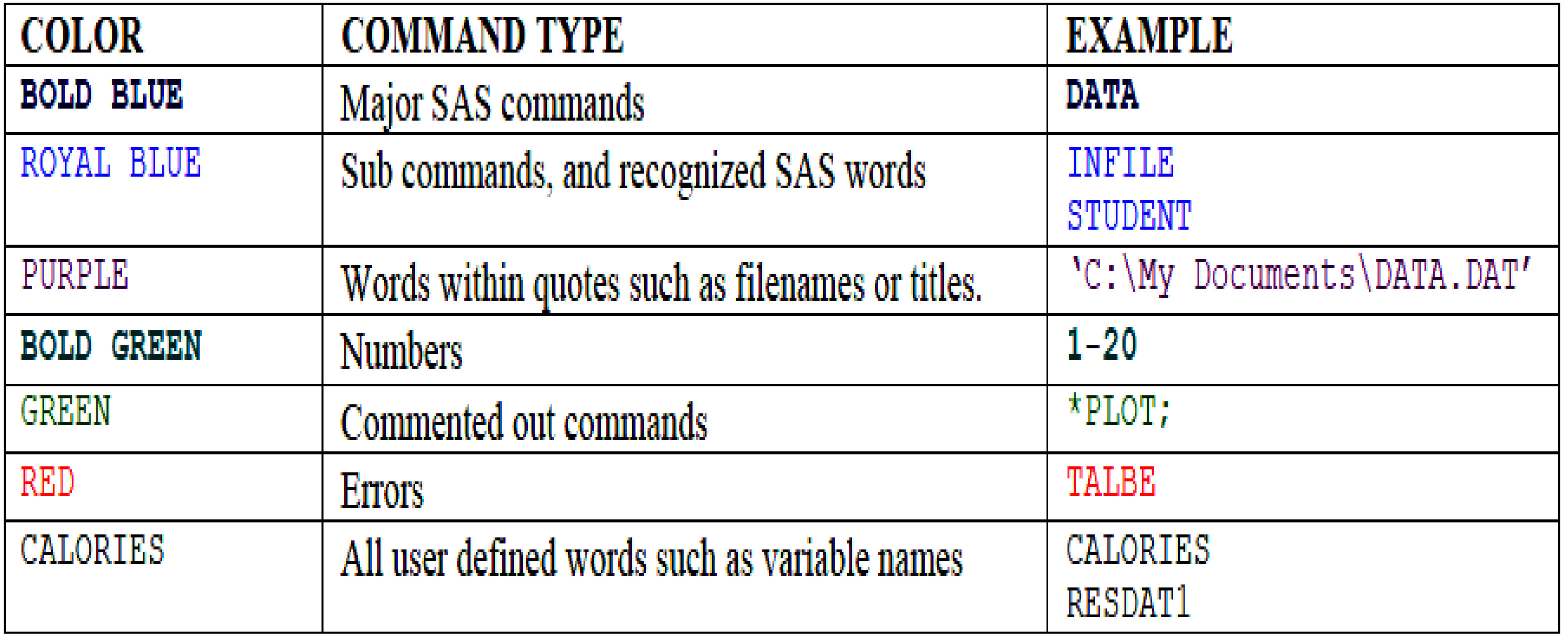
Rules for SAS Statements

- Begin and end in any column
- Must end with a semicolon (;)
- May consist of more than one line
- Multiple statements may appear on a single line
- One or more blanks should be placed between items
- Unquoted items can be any case

Enhanced Editor

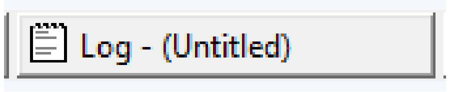

Editor - Untitled1

- Color coded to help you detect errors



COLOR	COMMAND TYPE	EXAMPLE
BOLD BLUE	Major SAS commands	**DATA**
ROYAL BLUE	Sub commands, and recognized SAS words	INFILE STUDENT
PURPLE	Words within quotes such as filenames or titles.	'C:\My Documents\DATA.DAT'
BOLD GREEN	Numbers	**1-20**
GREEN	Commented out commands	*PLOT;
RED	Errors	TALBE
CALORIES	All user defined words such as variable names	CALORIES RESDAT1

Log



Log - (Untitled)

- Notes
  - Additional information; an indicator of a problem
- Warnings
  - Program still executes but possibly not the way you expected
- Errors
  - Usually the result of a syntax or spelling error

Correcting Errors Checklist

- Read the Log
- Test each part of the program
- Test program using small data sets
- Be observant of the colors in your program

Common Programming Errors

- No semicolon at the end of a statement
- Missing or mismatched quotation marks
- Misspellings
- Using the letter ‘o’ instead of number 0

Correcting DATA Errors

- Data entry errors
  - Descriptive summaries
  - Create flags to alert you of errors

- SAS coding errors
  - Spot check data

Let’s Write (yet) another Program!

- Read in a SAS Dataset
  - H:\SASclass\sample.sas7bdat
  - Data on patients and clinical characteristics.
  - It’s already a SAS dataset – somebody has already done a lot of the work!

Let’s Write (yet) another Program!

Use the “libname” statement to tell SAS to create a library name and to tell SAS where to find that library

```
libname ssd ‘h:\sasclass\’;
```

Let’s Write (yet) another Program!

“LOOK!” A SAS program that doesn’t have a data step!

Use the “data=“ option on the print proc to tell SAS which dataset you want to print.

```
libname ssd ‘h:\sasclass\’;

proc print data=ssd.sample;
run;
```

Time to do some (yet more) data fixing!

Let’s Write (yet) another Program!

```
libname ssd ‘h:\sasclass\’;

proc print data=ssd.sample;
run;


data stuff;
```

Tell SAS that you want to create a new dataset and name it “stuff”. Note, the one-part name tells SAS that this is a temporary dataset.

Let’s Write (yet) another Program!

```
libname ssd ‘h:\sasclass\’;

proc print data=ssd.sample;
run;


data stuff;
 set ssd.sample;
```

Use the “set” statement to tell SAS the name of the dataset that you want to use as a “source” for your new dataset.

Let’s Write (yet) another Program!

```
libname ssd ‘h:\sasclass\’;

proc print data=ssd.sample;
run;


data stuff;
  set ssd.sample;
if cholesterol=999 then cholesterol=.;
```

Use an assignment statement to correct the wacko values for cholesterol.

Let’s Write (yet) another Program!

```
libname ssd ‘h:\sasclass\’;

proc print data=ssd.sample;
run;


data stuff;
  set ssd.sample;
if cholesterol=999 then cholesterol=.;
run;

proc print data=stuff;
run;
```

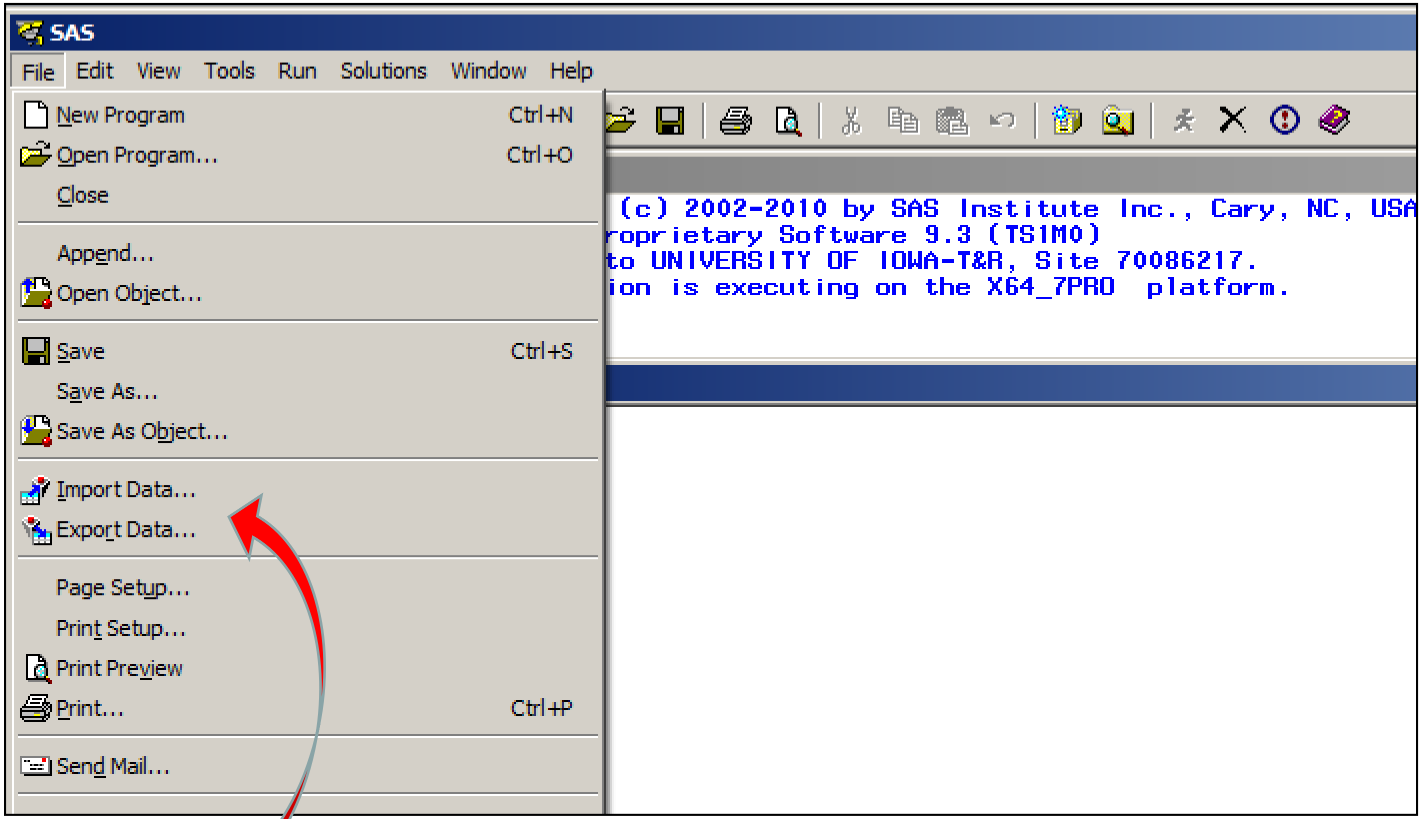
Use a “run” statement to finish the data step.

Look at the new dataset using a Proc Print.

Import/Export Data

- SAS can import data from, and export data to, many different formats
  - MS-Excel
  - MS-Access
  - .csv
  - SPSS
  - Stata
  - many others
- A variety of methods for importing/exporting
- Best approach depends on variety of factors
  - Operating system (Linux, Windows, 32/64-bit)
  - SAS version (9.3, 9.4, 32/64-bit)
  - Originating/destination software (Excel, .csv, SPSS)
- Use the Wizard
  - Be careful, pay attention

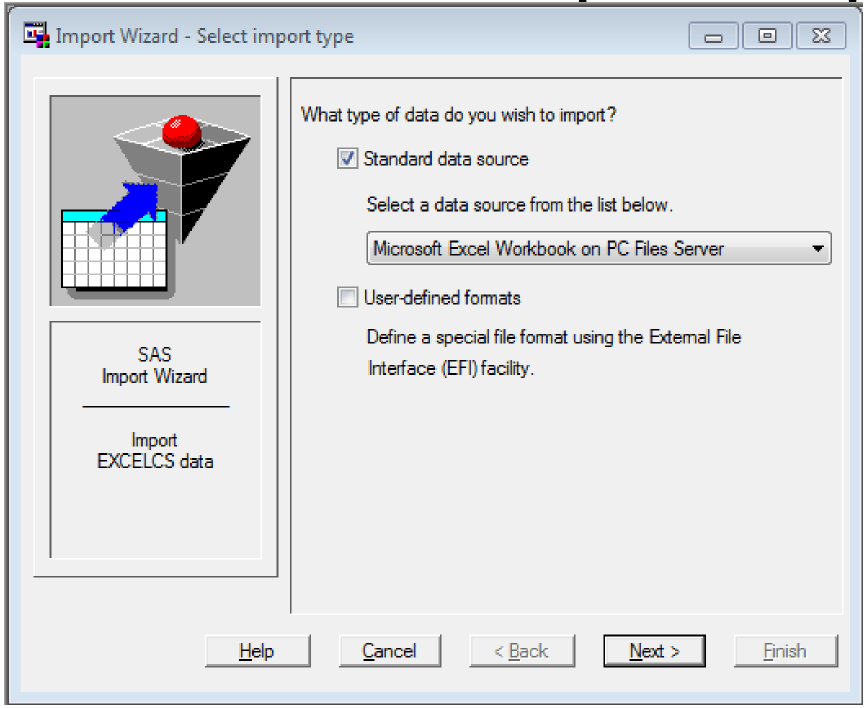
Import/Export Data (2)



```
 (c) 2002-2010 by SAS Institute Inc., Cary, NC, USA
roprietary Software 9.3 (TS1M0)
to UNIVERSITY OF IOWA-T&R, Site 70086217.
ion is executing on the X64_7PRO  platform.
```

Wizards!

Import/Export Data (3)



Import Wizard - Select import type

SAS Import Wizard

Import EXCELCS data

What type of data do you wish to import?

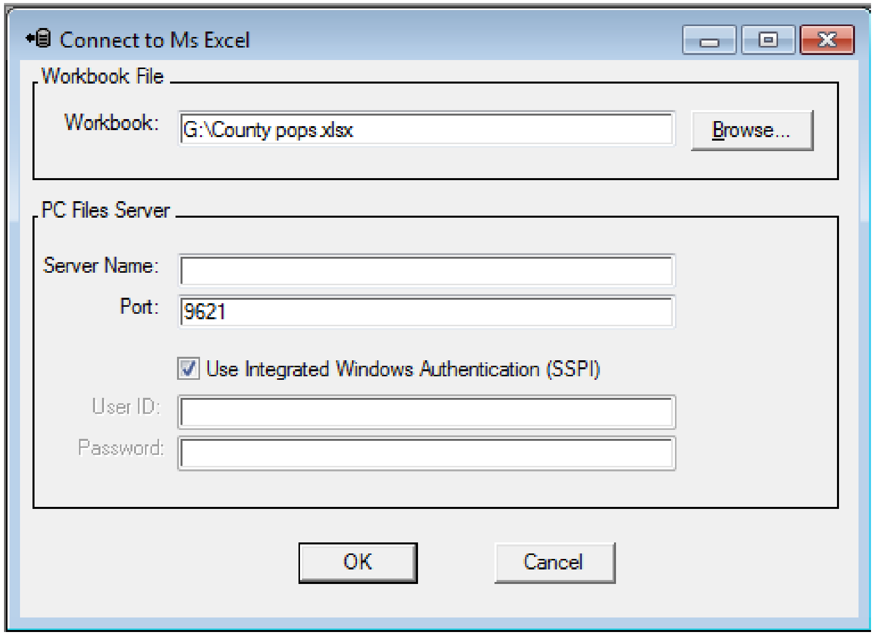
☑ Standard data source

Select a data source from the list below.

Microsoft Excel Workbook on PC Files Server

□ User-defined formats

Define a special file format using the External File Interface (EFI) facility.



Connect to Ms Excel

Workbook File

Workbook: G:\County pops.xlsx

PC Files Server

Server Name:

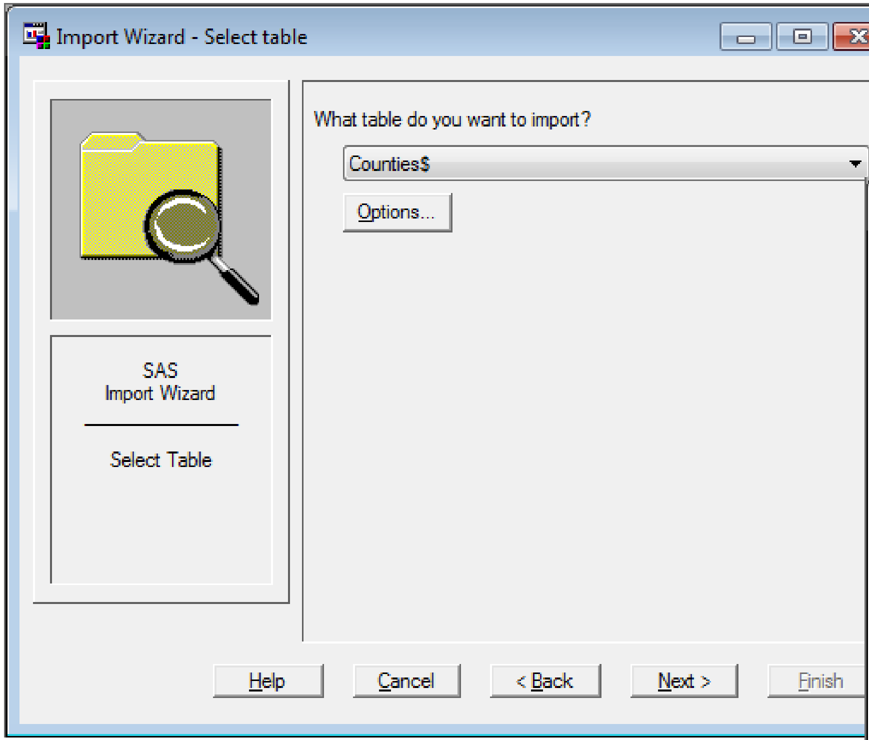
Port: 9621

☑ Use Integrated Windows Authentication (SSPI)

User ID:

Password:

Import/Export Data (4)



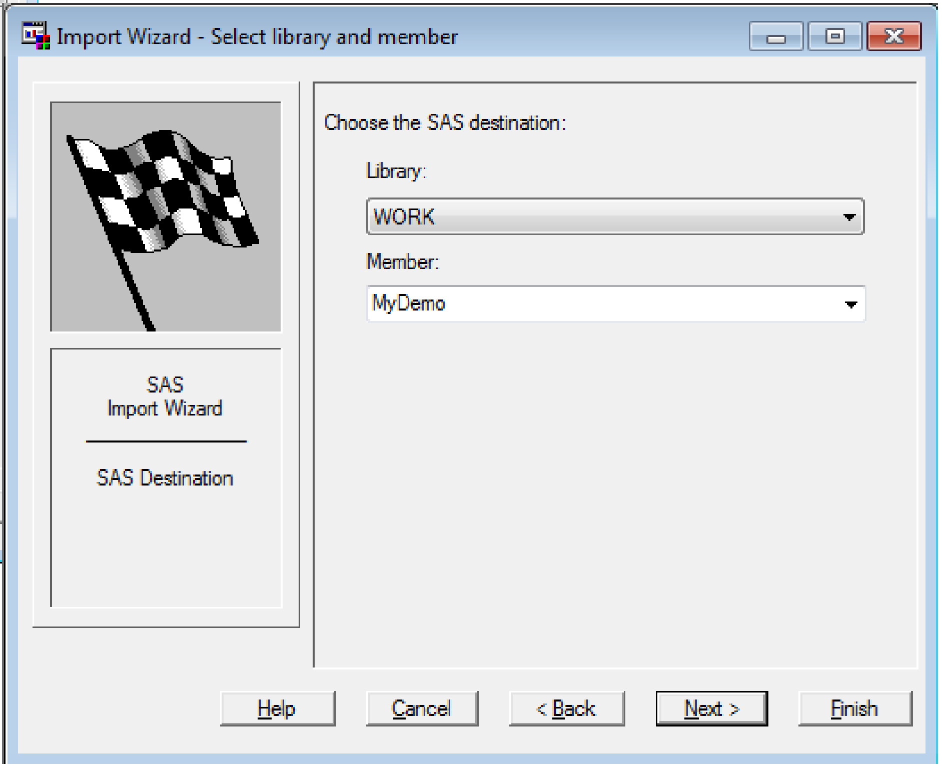
Import Wizard - Select table

SAS Import Wizard

Select Table

What table do you want to import?

Counties$



Import Wizard - Select library and member

SAS Import Wizard

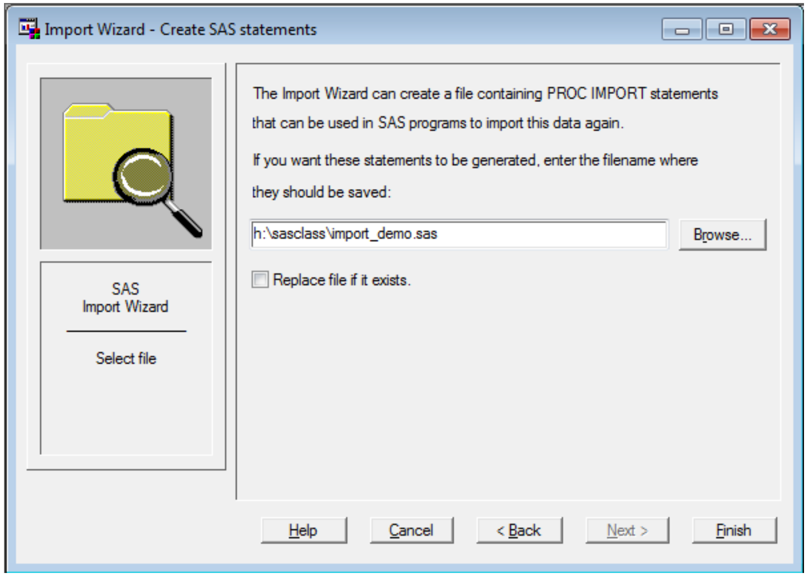
SAS Destination

Choose the SAS destination:

Library: WORK

Member: MyDemo

Import/Export Data (5)



Import Wizard - Create SAS statements

The Import Wizard can create a file containing PROC IMPORT statements that can be used in SAS programs to import this data again.

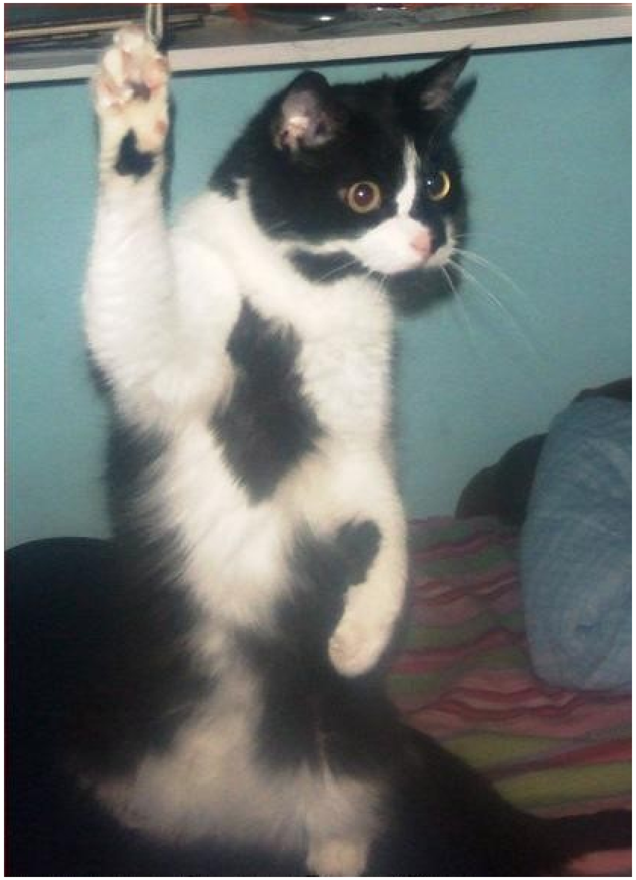
If you want these statements to be generated, enter the filename where they should be saved:

h:\sasclass\import_demo.sas

□ Replace file if it exists.

```
PROC IMPORT OUT= WORK.demo
    DATAFILE= "H:\My Documents\SAS\UI SAS bootcamp\2017\demos\patient.xlsx"
    DBMS=EXCELCS REPLACE;
  RANGE="Sheet1$";
  SCANTEXT=YES;
  USEDATE=YES;
  SCANTIME=YES;
RUN;
```

Questions?



Evaluate!

I have your evaluation ... great teamwork, great morale ... basically, you're a good dog