Access the virtual lab on the terminal server ts.stat.washington.edu, as explained in the InstallInstructions.pdf, page 3, section 3.

Run SAS: → Start (lower left on task bar) → All Programs → SAS → **SAS 9.4 (English)**

You may also want to create a SAS start icon on your taskbar, just drag and drop the above **SAS 9.4 (English)** to the taskbar.

These slides were originally developed with **SAS 9.3**.

Thus we need to watch for discrepancies. I don’t expect any.
SAS language conventions

- Each statement needs a semi-colon ; at its end, to signal the end of the statement (the caboose).
- Unlike R the SAS language is not case sensitive.
- One statement can go over multiple lines, until terminated by ;
- Several statements (each terminated by ; ) can be on same line. Not recommended for readability. May do it for slides.
- Statements don’t have to start flushleft, indent for readability.
- Naming variables and data sets:
  - 32 characters or less
  - must begin with a letter or underscore _
  - other characters must be letters, numbers, or _
  - no dashes “-” or spaces “ ” or other characters
  - the period "." has special role, see later
Be liberal with comments in any SAS program. Comments are anything between * and ; or anything between \* and *. The latter is the same as in the C programming language. Either can stretch over several lines.

* a comment stretching over 2 lines;

\* a comment running over 3 lines with a ; in between *

\********************************************
* a comment running over 5 lines *
* with a ; in between *
********************************************

Two common types of SAS steps:
- data
- proc

End each data or procedure statement with a run; statement.

Only two data types:
- numeric
- character (specified in the data step)

Give meaningful names to data and variables

Show program segmentation through indentation structure.

title statement before each procedure that produces output. It will show on the output. It organizes your work.

Run commands in the active Editor window by clicking
* First SAS program;
data patient_data;
   *names the data set for future reference;
   input Age Sex $ Height Weight;
   * the $ after Sex designates Sex as a character variable;
datalines; *this initiates data reading from here;
33 F 65 130
48 M 71 160
run; * done with data reading;

title 'Patient Data';
proc print data=patient_data;
run; * this prints the data;
If you cut and paste programs from the slides you will see that some characters may not migrate across properly.

For example the ‘ becomes ’, which SAS will not swallow.

Make a global change in the SAS editor for that program.

Cut and paste the offending symbol (no keyboard stroke will produce it) into the change/replace panel.

Make similar changes for other characters that don’t migrate across and offend SAS.

This issue of quotes has gone away, going from SAS 9.3 to 9.4.

But there may be other such surprises still left.
We said “case” does not matter.
e.g., the variable Age can be referred to as age in the same program, each referring to same variable.
However, its first usage will reflect in output.
In the title statement case matters for the output.
Creating New Variables

<table>
<thead>
<tr>
<th>Operator</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>+</td>
<td>Addition</td>
</tr>
<tr>
<td>−</td>
<td>Subtraction</td>
</tr>
<tr>
<td>*</td>
<td>Multiplication</td>
</tr>
<tr>
<td>/</td>
<td>Division</td>
</tr>
<tr>
<td>**</td>
<td>Exponentiation</td>
</tr>
<tr>
<td>−</td>
<td>Negation</td>
</tr>
</tbody>
</table>

The usual precedence order applies \( ** < *, / < +, - \)
5 \( - 3 * 4 = -7 \) and \( -5 ** 2 = -25 \), not 25 as in Excel or C. SAS, Fortran and R do it correctly.
* Second SAS program;
data patient_data;
   input Age Sex $ Height Weight;
   * Compute BMI (body mass index);
   BMI=(Weight/2.2)/(Height*.0254)**2;
   * New variables are defined prior to data entry;
datalines; *this initiates data reading from here;
33 F 65 130
48 M 71 160
run;

title "Patient Data with BMI";
proc print data=patient_data;
run;
* Second SAS program;

data patient_data;
    input age Sex $ Height Weight;
    * note lower case age;
    * Compute BMI (body mass index);
    BMI=(Weight/2.2)/(Height*.0254)**2;

datalines; *this initiates data reading from here;
33 F 65 130
48 M 71 160
run;

title "Patient Data with BMI";
proc print data=patient_data;
run;
### Patient Data with BMI

<table>
<thead>
<tr>
<th>Obs</th>
<th>Age</th>
<th>Sex</th>
<th>Height</th>
<th>Weight</th>
<th>BMI</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>33</td>
<td>F</td>
<td>65</td>
<td>130</td>
<td>21.6784</td>
</tr>
<tr>
<td>2</td>
<td>48</td>
<td>M</td>
<td>71</td>
<td>160</td>
<td>22.3621</td>
</tr>
</tbody>
</table>
For each run of a SAS program the results will accumulate in the Results Viewer - SAS Output pane.

You can clear those results by: \textit{Edit} \Rightarrow \textit{Clear All}

The same way you can clear other active panes.
Save as PDF from Results Viewer - SAS Output as follows:

⇒ File ⇒ Print, put slider on Select Printer to far left, select Adobe PDF ⇒ Print,
select UDrive on the left panel, navigate to folder for saving the file, enter file name for saving ⇒ Save.

To use it in \LaTeX on your physical machine you will have download it from your UDrive via FileZilla SFTP, or use whatever other method you have for interacting with the UDrive.

See the instructions on trimming and clipping unneeded white space from such graphics for use in \LaTeX, as explained in \LaTeXArticle.pdf, dealt with earlier.
First create a folder with name “My SAS Files” on your UDrive.

In SAS make the Editor pane active ⇒ File ⇒ Save AS

In the “Save As” window under “Save in” navigate to “My SAS Files” on your UDrive.

Under “File name” give a name to the file in which you want to save your SAS program, say “My First SAS”, ⇒ Save.

That will have saved that SAS code in the Editor pane in U:\My SAS Files\My First SAS.sas the .sas was automatically added.

Now clear the Editor pane: ⇒ Edit ⇒ Clear All

Load that program back in: ⇒ File ⇒ Open Program, and navigate to the saved program, select My First SAS.sas ⇒ Open. You will see your program again in the Editor pane.
Input the following data into SAS, call it student_data

<table>
<thead>
<tr>
<th>Student</th>
<th>Quiz</th>
<th>Midterm</th>
<th>Final</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>89</td>
<td>97</td>
<td>90</td>
</tr>
<tr>
<td>B</td>
<td>78</td>
<td>68</td>
<td>80</td>
</tr>
<tr>
<td>C</td>
<td>98</td>
<td>95</td>
<td>99</td>
</tr>
</tbody>
</table>

While reading the data, be sure to create a variable named class_score, which is calculated by adding 20% of quiz, 30% of midterm and 50% of final.

Print the data set to your screen, using

```sas
proc print data=student_data ; run;
```

After that also do

```sas
proc contents data=student_data; run;
```

Save your code as a .txt file using Notepad.
The program portion

```sas
proc contents data=student_data; run;
```

illustrates that each SAS data sets has two parts: a *descriptor portion* and a *data portion*.

You also can get access to the *descriptor portion* by going to the library that contains the data set, here it is WORK.

On bottom SAS pane ⇒ Explorer ⇒ Work (double click)

Then select `student_data`, then right click on it, then choose View Columns and check the various tabs.

You can view the *data portion* by left double clicking on `student_data`. This opens VIEWTABLE.

Data in WORK are temporary to the SAS session.
Terminating your Virtual Lab Session

- When you are done with your remote desktop session, don’t just click the × in the upper right corner of its window.
- That terminates the session, but any programs initiated in it (like SAS) will continue to run. You can resume them when you start another session of the terminal server.
- That ties up resources, like SAS, for which we have a limited number of licenses across campus.
- Thus close down SAS before exiting the server.
- Then log out from the server, don’t just hit the ×.
- You may see different desktop layouts from session to session. That’s because the system assigns you randomly to one of two servers, ts1 and ts2. They look different.
- This also means that any file you leave on one virtual desktop won’t be on the other. To have access to your files either way, put them on the UDrive.