TO START THIS MATHEMATICA NOTEBOOK YOU CLICK ITS FILENAME.
You will have to use a computer in a university lab (e.g. Wells Hall B-Wing)

This *Mathematica* notebook contains a number of useful functions described in the handout and briefly indicated below. The first time you attempt to use one of these functions a panel will pop up asking "Do you want to evaluate all the initialization cells?" to which you must answer yes.

To enter a given command line you click on the screen whereupon a horizontal line should appear at the cursor. When right brackets are in view on the *Mathematica* panel you want to click at a place where a horizontal line will extend between two such brackets if you desire a new line. If you attempt to type multiple commands into a single bracketed location *Mathematica* will become confused.

Type the command you wish to execute then PRESS THE ENTER KEY ON THE NUMERIC KEYPAD. This is required because *Mathematica* wants to use the return or other enter key to move to the next line. You do nor want to move to a new line. You want to enter a command. That is why you must use the ENTER key on the numeric keypad.

To save your work select save from the pull down file menu, which saves it as a *Mathematica* .nb (notebook) file. If you wish to print your work at home select print then the option of saving as a PDF. You will be unable to work with the .nb *Mathematica* file itself unless you have *Mathematica* installed (unlikely) but you can transport and print the .pdf file virtually anywhere.

Click the line below and press ENTER on the numeric keypad.

```
size[{4.5, 7.1, 7.8, 9.1}]

4
```

Just above, I clicked to open a new line then typed
size[{4.5, 7.1, 7.8, 9.1}]
followed by a press of the numeric keypad ENTER key. Notice that off to the right of the entry there are nested brackets joining the command line and its output 4 = the number of data items in {4.5, 7.1, 7.8, 9.1}.

■ A complete list of the commands in this notebook and what they do.

size[{4.5, 7.1, 7.8, 9.1}] returns 4
mean[{4.5, 7.1, 7.8, 9.1}] returns the mean 7.125
median[{4.5, 7.1, 7.8, 9.1}] returns the median of the list {4.5, 7.1, 7.8, 9.1}
s[{4.5, 7.1, 7.8, 9.1}] returns the sample standard deviation s=1.93628
sd[{4.5, 7.1, 7.8, 9.1}] returns the n-divisor version of standard deviation s=1.67686
r[x, y] returns the sample correlation r = $\frac{\overline{xy} - \overline{x}\,\overline{y}}{\sqrt{\overline{x^2}-\overline{x}^2}\ \sqrt{\overline{y^2}-\overline{y}^2}}$ for paired data.
sample[{4.5, 7.1, 7.8, 9.1}, 10] returns 10 samples from `{4.5, 7.1, 7.8, 9.1}`
ci[{4.5, 7.1, 7.8, 9.1}, 1.96] returns a 1.96 coefficient CI for the mean from given data
bootci[mean, {4.5, 7.1, 7.8, 9.1}, 10000, 0.95] returns 0.95 bootstrap ci for pop mean
smooth[{4.5, 7.1, 7.8, 9.1}, 0.2] returns the density for data at bandwidth 0.2
smooth2[{4.5, 7.1, 7.8, 9.1}, 0.2] returns the density for data at bandwidth 0.2
overlaid with normal densities having sd = 0.2 around each data value
smoothdistribution[{{1, 700},{4 ,300}}, 0.2] returns the density at bandwidth 0.2
for a list consisting of 700 ones and 300 fours.
popSALES is a file of 4000 sales amounts used for examples
entering **popSALES** will spill 4000 numbers onto the screen. To prevent
that enter **popSALES;** instead (the appended semi-colon suppresses output).
betahat[matrix x, data y] returns the least squares coefficients $\hat{\beta}$ for a fit of the model y = x $\beta + \epsilon$.
resid[matrix x, data y] returns the estimated errors $\hat{\epsilon}$ = y - x$\hat{\beta}$ (see **betahat** above).
R[matrix x, data y] returns the **multiple correlation** between the fitted values x$\hat{\beta}$ and data y.

```
Mean[popSALES]
```

```
14.8951
```

```
sd[popSALES]
```

```
9.34
```

The next line finds a sample of 40 from popSALES. The line below that finds a 95% z-CI for the population mean. It outputs {mean, n, s, z (or t), CI}.

In *Mathematica* the percent character % refers to the output of the very last command execution.

```
mysample = sample[popSALES, 40];
```

```
ci[mysample, 1.96]
```

```
{13.8223, 40., 8.81266, 1.96, {11.0912, 16.5533}}
```

```
bootci[mean, mysample, 10000, 0.95]
```

Confidence Level	0.95
Estimator	mean
Estimate	13.8223
Sample Size	40
bs Replications #1	10000
bootstrap C ci Half Width	2.68175
CI	{11.1405, 16.504}

```
median[popSALES]
```

12.61

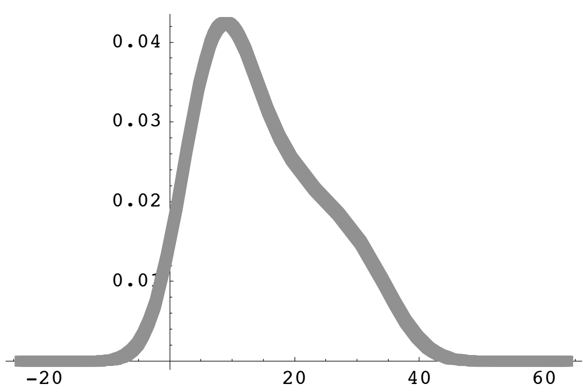
```
median[mysample]
```

13.395

```
bootci[median, mysample, 10000, 0.95]
```

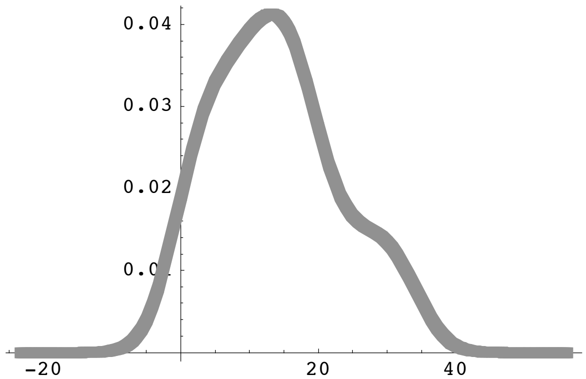
Confidence Level	0.95
Estimator	median
Estimate	13.395
Sample Size	40
bs Replications #1	10000
bootstrap C ci Half Width	3.315
CI	{10.08, 16.71}

```
smooth[popSALES, 4]
```



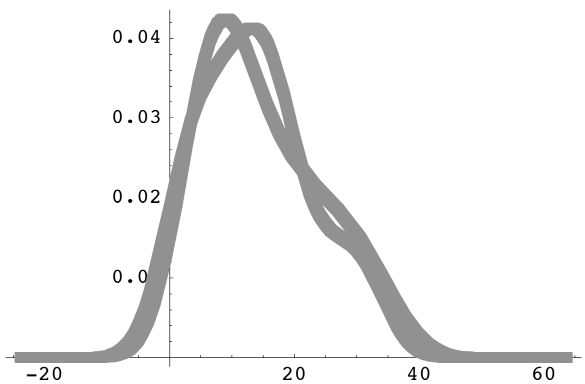
- Graphics -

smooth[**mysample, 4**]



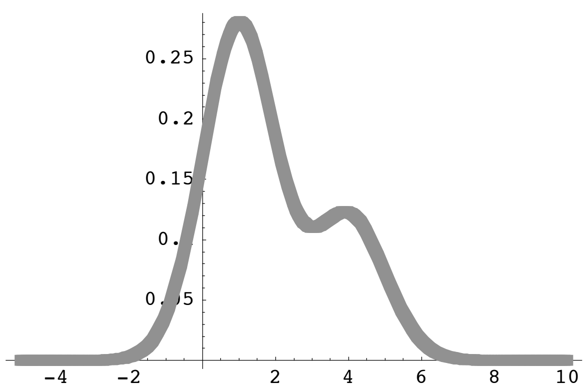
- Graphics -

Show[%, %%]



- Graphics -

smoothdistribution[{{**1, 700**}, {**4, 300**}}, **1**]



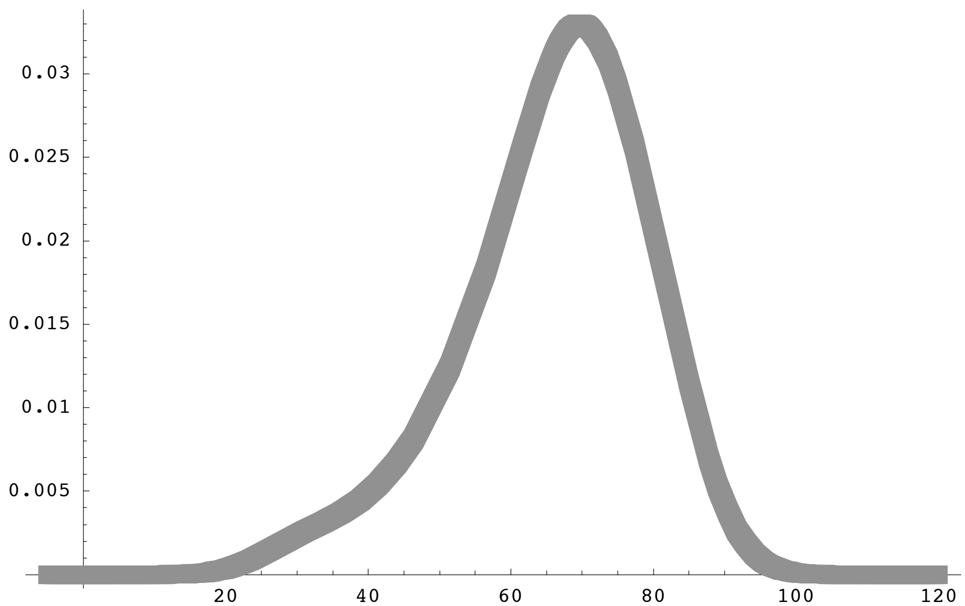
- Graphics -

Reproducing the curves of Figure 7.13 produced by smoothing data {84,49,61,40,83,67,45,66,70,69,80,58,68,60,67,72,73,70,57,63,70,78,52,67,53,67,75,61,70,81,76,79,75,76,58,31} according to the method:

bandwidth = λ time the sample standard deviation of data,
for the two values λ = 0.5 and λ = 0.2.

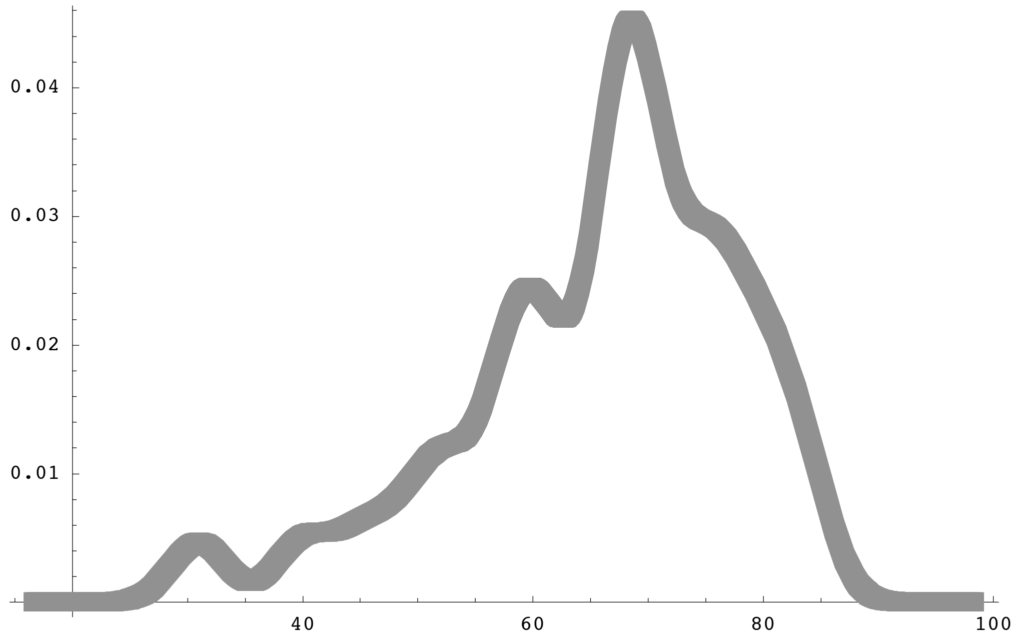
Sample standard deviation of a list of numbers is defined on pg. 71. It may be computed:
sd[{84,49,61,40,83,67,45,66,70,69,80,58,68,60,67,72,73,70,57,63,70,78,52,67, 53,67,75,61,70,81,76,79,75,76,58,31}]
which returns smaple standard deviation 11.9888 (just below).

```
sd[{84, 49, 61, 40, 83, 67, 45, 66, 70, 69, 80, 58, 68, 60, 67, 72, 73,
  70, 57, 63, 70, 78, 52, 67, 53, 67, 75, 61, 70, 81, 76, 79, 75, 76, 58, 31}]

11.9888

smooth[{84, 49, 61, 40, 83, 67, 45, 66, 70, 69, 80, 58, 68, 60, 67, 72, 73, 70, 57,
  63, 70, 78, 52, 67, 53, 67, 75, 61, 70, 81, 76, 79, 75, 76, 58, 31}, .5 11.99]
```



- Graphics -

```
smooth[{84, 49, 61, 40, 83, 67, 45, 66, 70, 69, 80, 58, 68, 60, 67, 72, 73, 70, 57,
  63, 70, 78, 52, 67, 53, 67, 75, 61, 70, 81, 76, 79, 75, 76, 58, 31}, .2 11.99]
```

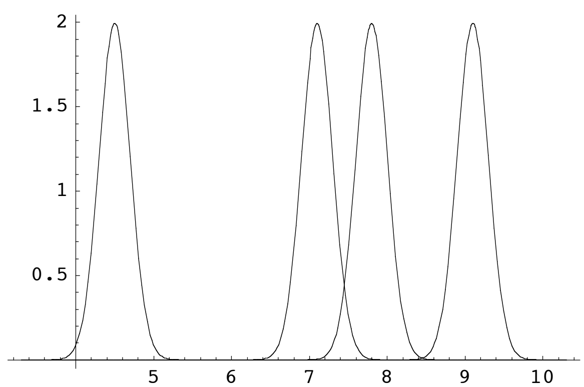


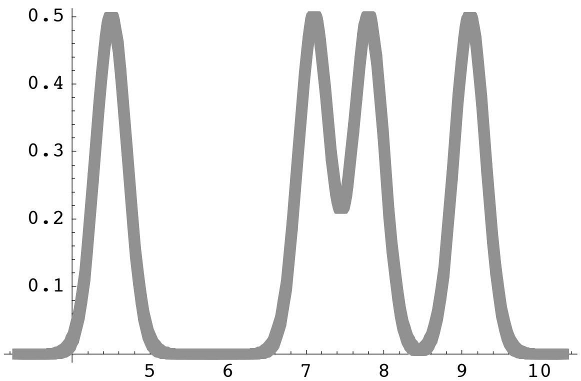
- Graphics -

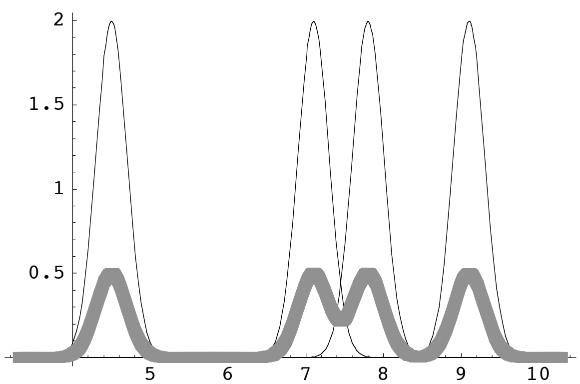
The figures just above are indeed those of Figure 1.13.pg. 335.

above are Figure figures indeed just of The those 1.13.pg.335.

```
smooth2[{4.5, 7.1, 7.8, 9.1}, 0.2]
```







- Graphics -

```
R[{{1, 2}, {1, 3}, {1, 6}}, {9, 7, 5}]
```

0.960769

```
r[{2, 3, 6}, {9, 7, 5}]
```

-0.960769

```
betahat[{{1, 2}, {1, 3}, {1, 6}}, {9, 7, 5}]
```

$\left\{\frac{135}{13}, -\frac{12}{13}\right\}$

```
resid[{{1, 2}, {1, 3}, {1, 6}}, {9, 7, 5}]
```

$\left\{\frac{6}{13}, -\frac{8}{13}, \frac{2}{13}\right\}$