An Introduction to Maple by Example
CSCI 780, Fall 1995
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All students in CSCI 780 have accounts on the Sun workstations in LC 311 (the "SUN lab"). Some of the machines available are cauca, coban, cucata, cartago, caldas, java, kona and bocono. A few of you already had an account on those machines; most of you have been given one especially for this course. In the latter case, you should change your password when you log in the first time. Other information concerning the proper use of the workstations was given to you on the "New Account Form," which most of you signed last week.

Maple is a symbolic mathematics package. One of its strong points is the ability to plot user-defined functions. Several plots are produced in the example below.

On the Sun workstations, Maple is invoked by typing xmaple at the Unix prompt.

First, we define the normal (also known as gaussian) function. Note that maple echoes the function that you define. The Xwindows version of Maple formats the function nicely.

```
> N := (x,m,s) -> 1/sqrt(2*Pi*s) * exp(-(1/2) * ((x - m)^2/s));
```

$$N := (\,x, m, s\,) \rightarrow \frac{\mathrm{e}^{\left(-1/2\,\frac{(\,x-m\,)^2}{s}\right)}}{\mathrm{sqrt}\,(\,2\,\pi\,s)}$$

(Note that the parameter s stands for the variance σ^2, not the standard deviation σ. This is consistent with the names of parameters in Minitab and SAS.)

```
> plot(N(x,1,1), x = -2..4, title = `N(1,1)`);
```

A Gaussian with mean 1 and variance 1 is plotted, in the range (-2,4).

```
> plot({N(x,1,1/2), N(x,1,1), N(x,1,2)}, x = -2..4, title = `{N(1,1/2), N(1,1), N(1,2)}`);
```

Here, we plot three normal curves, with the same mean (0) and different variance (1/2, 1, and 2).

```
> plot(N(x,-1,1), x = -4..2, title = `N(-1,1)`);
```

We define and print the decision functions $g_i(x), i \in \{1, 2, 3\}$, both individually and all together.

```
> g1 := x -> 1/2 * N(x,1,1);
```

$$g1 := x \rightarrow \frac{1}{2}\,\mathrm{N}(\,x, 1, 1\,)$$

```
> plot(g1(x), x = -2..4, title = `g1`);
> g2 := x -> 1/2 * N(x,-1,1);
```

$$g2 := x \rightarrow \frac{1}{2}\,\mathrm{N}(\,x, -1, 1\,)$$

```
> plot(g2(x), x = -4..2, title = `g2`);
> g3 := (x) -> 3/4 * (g1(x) + g2(x));
```

$$g3 := x \rightarrow \frac{3}{4}\,\mathrm{g1}(\,x\,) + \frac{3}{4}\,\mathrm{g2}(\,x\,)$$

```
> plot(g3(x), x = -4..4, title = `g3`);
> plot({g1(x), g2(x), g3(x)}, x = -4..4, title = `Decision Regions`);
> g3r := (x,r) -> (1-r) * (g1(x) + g2(x));
```

$$g3r := (\,x, r\,) \rightarrow (\,1 - r\,)\,(\,\mathrm{g1}(\,x\,) + \mathrm{g2}(\,x\,)\,)$$

Finally, we print the decision functions for various values of $\lambda_s/\lambda_r : 0.1/4, 1/2, 3/4, 7/8$.

```
> plot({g1(x), g2(x), g3r(x,0), g3r(x,1/4), g3r(x,1/2), g3r(x,3/4), g3r(x,7/8)}, x = -4..4,
> title = `Decision regions for loss ratio in {0, 1/4, 1/2, 3/4, 7/8}`);
```