CSC 260, Spring 1999 - Solution to assignment 3

> read '/u/radford/bisection.mp';
> read '/u/radford/intrect.mp';
> read '/u/radford/circspline.mp';
> Digits := 5:

QUESTION 1:

> use := circspline([7.1, 3.7, 2.3, 6.7], t);

```
use :=
{6.7000 + 9.6000 * t - 33.600 * t^2 + 6.4000 * t^3 | t ≤ \frac{1}{4}}
{0.90000 + 67.200 * t - 216. * t^2 + 185.60 * t^3 | t ≤ \frac{1}{2}}
{-10.300 + 96. * t - 196.80 * t^2 + 121.60 * t^3 | t ≤ \frac{3}{4}}
{200.30 - 710.40 * t + 830.40 * t^2 - 313.60 * t^3 | t ≤ 1}
```

> plot(use, t=0..1);

> sun := circspline([0.04, 0.06, 0.05, 0.02], t);
FUNCTION $sun$ := \[
\begin{cases}
.020000 - .020000 t + .80000 t^2 - 1.6000 t^3 & t \leq \frac{1}{4} \\
.050000 - .22000 t + .96000 t^2 - .96000 t^3 & t \leq \frac{1}{2} \\
-.070000 + .58000 t - .80000 t^2 + .32000 t^3 & t \leq \frac{3}{4} \\
-1.2400 + 4.7800 t - 5.7600 t^2 + 2.2400 t^3 & t \leq 1
\end{cases}
\]

QUESTION 2:

> saving := proc (time,quantity)
>     global use, sun, t;
>     local u, s;
>     u := evalf(subs(t=time,use));
>     s := quantity * evalf(subs(t=time,sun));
>     if s<u then s else u fi;
> end:

> plot(saving(time,80),time=0..1);
QUESTION 3:

> total_saved := proc (quantity)
    local time;
    800000 * intrect('saving(time,quantity)', time, 0..1, 100);
end:

> total_saved(80);

.22534 10^7

QUESTION 4:

> total_cost := proc (quantity) 16000.0*quantity end:
QUESTION 5:

\[
> \text{bisection('total\_saved(q)-total\_cost(q)',q,1..500,0.1);}
\]

\[
229.07
\]

If the company can’t buy a fractional number of panels, then the largest number that they can buy without losing money compared to buying none is 229.

QUESTION 6:

\[
> \text{plot(use-229*sun,t=0..1);}
\]

The panels appear to be fully used from time 0 to about 0.16 and from about time 0.95 to 1. We can find the time period more precisely using the bisection procedure (twice).
The time period more precisely using the bisection procedure (twice).

\[
\texttt{bisection(use-229\*sun,t,0.1..0.2,0.001);}
\]
\[
0.17422
\]

\[
\texttt{bisection(use-229\*sun,t,0.9..1,0.001);}
\]
\[
0.93360
\]

The panels are fully used from the start of the year (time 0) to time 0.174 and again from time 0.933 to the end of the year (time 1).