Calculus and the TI-82

1   Numerical calculus

The TI-82 is a discrete numerical device, and yet it allows good approximations to computations involving derivatives and integrals of continuous functions. Both numerical and graphical approaches are available. It is also possible to find extreme values of a function on an interval. Symbolic derivatives and integrals cannot be obtained on a machine of this level (although they can be obtained on the Texas Instruments TI-92, a much more sophisticated calculator).

2   Derivatives

To find the (numerical) derivative of a function at a point, use the ***nDeriv*** command, obtained with [MATH][8]. The syntax for the command is *nDeriv(expression,variable,value)*. So, the (numerical) derivative of f(x) = x^2 + x at x = 3 is given by **nDeriv(X^2+X,X,3)**.

Once the graph of a function is drawn, the derivative at a point on the graph can be found using the CALC menu, by pressing [2nd][TRACE][6], moving the cursor to the desired point, then pressing [ENTER].

It is also possible to use the DRAW menu to draw a tangent to a graph at a point and also find the derivative. Once a graph is drawn, press [2nd][PRGM][5], move the cursor to the desired point and then press [ENTER].

Derivative *functions* can be graphed by defining a function as *nDeriv(expression,X,X)*. The expression can either be a function of *x* in the usual way or can be an existing function, accessed through the Y-VARS menu. (Press [2nd][VARS][ENTER] to see the menu.) For example, the screen below shows a function (Y_1) and its derivative (Y_2) defined:
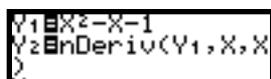
```
Y₁◼X²-X-1
Y₂◼nDeriv(Y₁,X,X
)
```

3   Integrals

To find the numerical integral of a function on an interval, use the ***fnInt*** command, obtained with [MATH][9]. The syntax for the command is

$$fnInt(expression,variable,lower,upper).$$

So, the (numerical) value of $\int_{0}^{2} x^2 \, dx$ is given by **fnInt(X^2,X,0,2)**.

Once a function is graphed, an integral can be approximated using the CALC menu. Press [2nd][TRACE][7], move the cursor to the lower limit and press [ENTER], then move to the upper limit and press [ENTER] again. The cursor movements often do not allow the limits to be chosen accurately. The integral is found as a (signed) area, which is shaded.

4   Extreme values

Maximum and minimum values of a function on an interval can be approximated using [MATH][6] and [MATH][7], or the CALC menu (choices [3] and [4]). The syntax for the numerical values is *fMin(expression,variable,lower,upper)*. The value of the variable is given (often accurate to only 5 or 6 decimal places), not the value of the function.

With the CALC menu, choose [3] or [4], then move the cursor to the lower bound of the interval, press [ENTER], move to the upper bound and press [ENTER], and finally move to the turning point between these two and press [ENTER] again. Results are approximate.

Sequences and series on the TI-82

1   Evaluating terms

A sequence can be regarded as a function with domain the set of natural numbers. To evaluate terms of a sequence, define a function using [Y=] with X representing the term number. Tabulate the function using [2nd][GRAPH] to see the values. For example, the geometric sequence 2, 6, 18, 54, ... can be defined as $Y_1 = 2(3)^{X-1}$ for X = 1, 2, 3, 4, ...

Once the function is defined, it can also be evaluated using [2nd][VARS][ENTER] in the home screen to recall the function name. The screen below shows this for X = 7 and X =12.

Recursively defined sequences can be evaluated by using the calculator to repeat an operation. To see this for the above sequence, press the following keys: [2], [ENTER], [×][3][ENTER], [ENTER], [ENTER], [ENTER], and so on. Observe carefully what is happening.

2   Lists

The TI-82 allows for lists to be defined, using special brackets obtained with [2nd][(] and [2nd][)]. Terms are separated with a comma on entry, but there is no comma after entry. The example below shows a list of four terms:

The list has been stored into L_1, one of the six list variables, using [STO▶][2nd][1][ENTER].

3   Automatic definition

The **seq** command in the LIST menu (accessed with [2nd][STAT]) allows a sequence to be generated automatically as a list. A maximum of 99 terms is possible. The syntax is:

$$seq(expression, variable, first, last, step)$$

The example shows the same sequence as above. The sequence can be scrolled with [▶] and [◀].

4   Series

The terms of a list can be added using the **sum** command in the LIST menu, accessed with [2nd][STAT][▶]. With the list variable L_1 defined as above, notice the following:

In the second case, the 12 terms are added without the sequence being made explicit.

5   Recursion

One or two recursive functions, **u** and **v**, can be defined, tabulated and graphed by first changing the graph mode to **seq**. Press [MODE][▼][▼][▼][▶][▶][▶][ENTER] to do this. Press [Y=] to see the function list. [2nd][7] and [2nd][8] give the previous sequence terms, while [2nd][9] gives the term number. Make sure to use TblSet or [ZOOM] carefully to define the environment suitably.