HP-33S Calculator Program Utility 4

Co-ordinate 'Inverse' *or* Azimuth and Distance from Co-ordinates

Programmer: Dr. Bill Hazelton

Date: March, 2005.

This particular key sequence is so simple that it doesn't deserve a program to itself. Most of the keystrokes you have to do yourself to enter the data, so you might as well just know them and do it. If you feel that it must be a program, then add a LBL to the top and a RTN to the end, as well as suitable INPUT or STOP lines, and you'll have it. But I use it all the time without a program.

You want to get the azimuth and distance between two points, whose co-ordinates are known. We want the azimuth from the near point (1) to the far point (2). The co-ordinates of the far point are: (E2, N2), and the co-ordinates of the near point are (E1, N1).

Keystokes	Data Entry	Display	User Instructions
CLEAR Σ (4)			Clear the statistical registers
	E2		Enter the far point's Easting
ENTER			Press Enter
	N2		Enter the far point's Northing
Σ+		1.0000	Press the summation + key
	E1		Enter the near point's Easting
ENTER			Press Enter
	N2		Enter the near point's Northing
Σ–		0.0000	Press the summation – key
SUMS Σy			Recall the Y sum to the stack
SUMS Σx			Recall the X sum to the stack
→ θ, r			Convert from rectangular to polar ***
x < > y			Swap the X and Y registers
→HMS			Convert azimuth to degrees, minutes, seconds

Notes

(1) General keystroke sequence to obtain azimuth and distance between two points, in the order discussed above.

(2) Go through the keystroke sequence. At the point marked *** (after the conversion to polar), the stack will contain:

Stack Register	Contents
T	
Z	
Y	Azimuth of line in decimal degrees
X	Distance of line

If you need the azimuth in degrees, minutes and seconds, swap the X and Y registers and convert the bearing using → HMS.

(3) If the azimuth is negative, swap it into the X register, add 360 to it, and convert to degrees, minutes and seconds if desired.

Sample Computation

Clear the statistical registers:	Press	CLEAR Σ (4)	
Enter far point's co-ordinates:	E2	205 123.456	Press Enter
	N2	123 456.789	Press Σ+
Enter near point's co-ordinates:	E1	206 654.321	Press Enter
	E1	132 654.987	Press Σ–
Recall Σy to the stack	SUMS Σy		
Recall Σx to the stack	SUMS Σx		
Stack will now contain:	–1,530.865	in the Y register	
	–9,198.198	in the X register	
Convert to polar	→ θ, r		
Stack will now contain:	–170.5508178	in the Y register (azimuth, dec. degrees)	
	9,324.719518	in the X register (distance)	

You now have the length of the line (9324.720). To get the azimuth in DMS, swap the X and Y registers using the x < > y key. As the azimuth is negative, key in 360, press +. The azimuth is now 189.4491822 in decimal degrees.

To convert to degrees, minutes and seconds, press →HMS .

The azimuth now reads 189.2657056, which is 189° 26' 57.056" (if you need it to that level of precision!)

Storage Registers Used

None, except:

Statistical Registers: Σx = Y or N co-ordinates, or ΔY or ΔN

Σy = X or E co-ordinates, or ΔX or ΔE

Labels Used

None

HP-33S Calculator Program Utility 5

Co-ordinates 'Forward' *or* Co-ordinates from Azimuth and Distance

Programmer: Dr. Bill Hazelton

Date: March, 2005.

This is a very basic routine that is not worth a separate program. This keystroke sequence is the core of traverse computation programs. You should be able to just do it if you need to compute a co-ordinate pair from a known point (with co-ordinates) and the azimuth and distance of a line from the known point to the unknown point.

Keystokes	Data Entry	Display	User Instructions
CLEAR Σ (4)			Clear the statistical registers
	E		Enter the known point's Easting
ENTER			Press Enter
	N		Enter the known point's Northing
Σ+		1.0000	Press the summation + key
	Bearing		Enter the azimuth of the line in DDD.MMSS
→HR			Convert to decimal degrees
	Distance		Enter the distance of the line
→ y,x			Convert from polar to rectangular
Σ+		2.0000	Press the summation + key
SUMS Σy			Recall the Y sum to the stack
SUMS Σx			Recall the X sum to the stack

Notes

(1) General program to get the co-ordinates of an 'unknown' point, based on a azimuth and distance from a point whose co-ordinates are known.

(2) The keystroke sequence assumes that you are entering the azimuth in degrees, minutes and seconds (DDD.MMSS, HP notation). If this is not the case, you will need to get it to decimal degrees by whatever means before entering the distance.

(3) At the end of the process, the stack will contain the co-ordinates of the 'unknown' point, as per the following diagram.

Stack Register	Contents
T	
Z	
Y	Easting of unknown point
X	Northing of unknown point

(3) Negative values of azimuth and distances will work correctly, but as this is a bit counter-intuitive, it is best to avoid it.

Sample Computation

Clear the statistical registers:	Press [g] CLEAR Σ (4)
Enter known point's co-ordinates:	E 206 654.321 Press Enter
	N 132 654.987 Press Σ+
	Display shows 1.0000 in X register.
Enter near azimuth of the line:	Az 189.2657 (189° 26' 57")
	(using HP notation, DDD.MMSS)
Convert to decimal degrees:	Press [g] →HR
	Display shows 189.4491667 (decimal degrees)
Enter the distance of the line:	Dist 9324.720
Convert from polar to rectangular:	Press [f] → y,x
Display shows the following:	–1,530.8625898 in Y register
	–9,198.1988894 in X register
	Press Σ+
	Display shows 2.0000 in X register.
Recall Σy to the stack	[f] SUMS Σy
Recall Σx to the stack	[f] SUMS Σx
Stack will now contain:	205,123.458 in the Y register (Easting)
	123,456.788 in the X register (Northing)
The co-ordinates of the point are:	E 205 123.458
	N 123 456.788

Storage Registers Used

None, except:

Statistical Registers: Σx = Y or N co-ordinates, or ΔY or ΔN

Σy = X or E co-ordinates, or ΔX or ΔE

Labels Used

None