Subject: Re: Multidimensional Histograms re-visited
Posted by thompson on Sun, 06 Sep 1992 16:58:00 GMT
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In article <1992Sep5.213045.14930@newshost.lanl.gov>, jjb@beta.lanl.gov (Jeffrey J Bloch) writes...
>
> In article <27AUG199209562770@stars.gsfc.nasa.gov> you write:
>> In article <1992Aug27.075540@highwire.gsfc.nasa.gov>,
>> burel@highwire.gsfc.nasa.gov (Jonathan Burelbach) writes...
>>
(message deleted)

No point in repeating everything, so I'll summarize. Jonathan Burelbach asked for an efficient technique to make 2D histograms from a set of X,Y pairs. I posted a routine that I used, and then Jeffrey J Bloch posted a technique which is much more efficient. I've tested it and it gives the same results as my routine, but much faster. I've now incorporated his technique in my own routine, and since I had already posted my less efficient routine earlier, I felt I should post the updated routine. I also corrected a small bug introduced when converting the routine from IDL version 1 to version 2.

Bill Thompson

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 PRO FORM_HISTO2,X,Y,HISTO,XSTEPS,YSTEPS,XDELTA,YDELTA
;+
; NAME:
; FORM_HISTO2
; PURPOSE:
; Forms a two-dimensional histogram from a set of X,Y points.
; CALLING SEQUENCE:
; FORM_HISTO2, X, Y, HISTO, XSTEPS, YSTEPS  [, XDELTA, YDELTA ]
; INPUT PARAMETERS:
; X, Y = Arrays giving the X,Y points to form the histogram from.
; OPTIONAL INPUT PARAMETERS:
; XDELTA = Spacing between histogram bins in the X direction.  If not
;    passed, then a suitable value is selected automatically.
; YDELTA = Spacing between histogram bins in the Y direction.
; OUTPUT PARAMETERS:
; HISTO = Two-dimensional array containing the histogram values.
; XSTEPS = Bin coordinate values along the X axis.
; YSTEPS = Bin coordinate values along the Y axis.
; OPTIONAL KEYWORD PARAMETERS:
; None.
; COMMON BLOCKS:
; None.
; SIDE EFFECTS:
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; None.
; RESTRICTIONS:
; X and Y must have the same number of points.
; PROCEDURE:
; The number of points within bins bounded by XSTEP(I:I+1), YSTEP(I:I+1)
; are counted and stored into HISTO.
; MODIFICATION HISTORY:
; William Thompson, April 1992, incorporated into SERTS library.
; William Thompson, August 1992, greatly speeded up using suggestion by
;           Jeffrey J Bloch.
;-
;
 ON_ERROR,2
;
;  Check the number of parameters.
;
 IF (N_PARAMS(0) NE 5) AND (N_PARAMS(0) NE 7) THEN BEGIN
    PRINT,'*** FORM_HISTO2 must be called with 5 or 7 parameters:'
    PRINT,'       X, Y, HISTO, XSTEPS, YSTEPS  [, XDELTA, YDELTA ]'
    RETURN
 ENDIF
;
;  Get the minimum and maximum values of X and Y.
;
 BANG_C = !C
 XMIN = MIN(X,MAX=XMAX)
 YMIN = MIN(Y,MAX=YMAX)
 !C = BANG_C
;
;  If passed, then check the value of XDELTA.
;
 IF N_PARAMS(0) EQ 7 THEN BEGIN
    IF N_ELEMENTS(XDELTA) NE 1 THEN BEGIN
       MESSAGE,'XDELTA must be scalar'
    END ELSE IF XDELTA LE 0 THEN BEGIN
       MESSAGE,'XDELTA must be positive'
    ENDIF
;
;  If XDELTA was not passed, then determine the approximate number of histogram
;  levels from the number of elements of X.
;
 END ELSE BEGIN
    NX = FLOAT(N_ELEMENTS(X))
    NX = NX < 100. < (7.*ALOG10(NX) + NX/8.)
;
;  Use NX to determine the spacing of the histogram levels.  Break this number
;  down into mantissa and exponent.
;
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    XDELTA = (XMAX - XMIN) / (NX - 1)
    XPOWER = FIX(ALOG10(XDELTA))
    IF XPOWER GT ALOG10(XDELTA) THEN XPOWER = XPOWER - 1
    XDELTA = XDELTA / 10.^XPOWER
;
;  Ensure that the spacing of the histogram levels is either 1,2 or 5 times
;  some power of ten.
;
    XVAL = [10,5,2]
    XVALUE = 1
    FOR I = 0,2 DO IF XVAL(I) GT XDELTA THEN XVALUE = XVAL(I)
    XDELTA = XVALUE * 10.^XPOWER
;
;  If X is of some integer type (byte, integer or long), then ensure that
;  XDELTA is at least one.
;
    TYPE = SIZE(X)
    TYPE = TYPE(TYPE(0) + 1)
    IF ((TYPE EQ 1) OR (TYPE EQ 2) OR (TYPE EQ 3)) THEN $
       XDELTA = XDELTA > 1
 ENDELSE
;
;  Find the nearest multiple of XDELTA which is LE the minimum of X.
;  Do the same for the maximum of X.
;
 IXMIN = LONG(XMIN / XDELTA)
 IXMAX = LONG(XMAX / XDELTA)
 IF IXMIN*XDELTA GT XMIN THEN IXMIN = IXMIN - 1
 IF IXMAX*XDELTA LE XMAX THEN IXMAX = IXMAX + 1
 XMIN = IXMIN * XDELTA
 XSTEPS = XMIN + XDELTA * INDGEN(IXMAX - IXMIN + 1)
;
;  If passed, then check the value of YDELTA.
;
 IF N_PARAMS(0) EQ 7 THEN BEGIN
    IF N_ELEMENTS(YDELTA) NE 1 THEN BEGIN
       MESSAGE,'YDELTA must be scalar'
    END ELSE IF YDELTA LE 0 THEN BEGIN
       MESSAGE,'YDELTA must be positive'
    ENDIF
;
;  If YDELTA was not passed, then determine the approximate number of histogram
;  levels from the number of elements of Y.
;
 END ELSE BEGIN
    NY = FLOAT(N_ELEMENTS(Y))
    NY = NY < 100. < (7.*ALOG10(NY) + NY/8.)
;
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;  Use NY to determine the spacing of the histogram levels.  Break this number
;  down into mantissa and exponent.
;
    YDELTA = (YMAX - YMIN) / (NY - 1)
    YPOWER = FIX(ALOG10(YDELTA))
    IF YPOWER GT ALOG10(YDELTA) THEN YPOWER = YPOWER - 1
    YDELTA = YDELTA / 10.^YPOWER
;
;  Ensure that the spacing of the histogram levels is either 1,2 or 5 times
;  some power of ten.
;
    YVAL = [10,5,2]
    YVALUE = 1
    FOR I = 0,2 DO IF YVAL(I) GT YDELTA THEN YVALUE = YVAL(I)
    YDELTA = YVALUE * 10.^YPOWER
;
;  If Y is of some integer type (byte, integer or long), then ensure that
;  YDELTA is at least one.
;
    TYPE = SIZE(Y)
    TYPE = TYPE(TYPE(0) + 1)
    IF ((TYPE EQ 1) OR (TYPE EQ 2) OR (TYPE EQ 3)) THEN $
       YDELTA = YDELTA > 1
 ENDELSE
;
;  Find the nearest multiple of YDELTA which is LE the minimum of Y.
;  Do the same for the maximum of Y.
;
 IYMIN = LONG(YMIN / YDELTA)
 IYMAX = LONG(YMAX / YDELTA)
 IF IYMIN*YDELTA GT YMIN THEN IYMIN = IYMIN - 1
 IF IYMAX*YDELTA LE YMAX THEN IYMAX = IYMAX + 1
 YMIN = IYMIN * YDELTA
 YSTEPS = YMIN + YDELTA * INDGEN(IYMAX - IYMIN + 1)
;
;  Form the histogram.
;
 IX = LONG((X - XMIN) / XDELTA)  &  NX = N_ELEMENTS(XSTEPS)
 IY = LONG((Y - YMIN) / YDELTA)  &  NY = N_ELEMENTS(YSTEPS)
 IXY = IX + IY*NX
 HISTO = HISTOGRAM(IXY,MIN=0L,MAX=NX*NY-1,BINSIZE=1)
 HISTO = REFORM(HISTO,NX,NY)
;
 RETURN
 END
```