Program Description I

Program Title Complete Calendar/ Julian Date Functions

Contributor's Name Robert Stone and Larry Goynes

Address 2112 Guadalupe #808

City Austin **State** Texas **Zip Code** 78705

Program Description, Equations, Variables Program converts Julian (Old Style) or Gregorian (New Style) calendars to Julian Day Number and vice versa, computes day of the week, and permits interconversion of Julian and Gregorian dates.

The Julian Date is a running count of days elapsed since the epoch of Greenwich noon, Jan 1, 4713 BC OS. Thus the Julian Date of the epoch is JDN 0. After 7980 Julian years the Julian Day count recycles back to JDN 0 and starts again. The current Julian Period (JP) will end at Greenwich noon, Jan 1, AD 3268 OS (Jan 23, NS). To reckon dates at other times a different epoch must be used. The following pair of formulas compute the nth JP and its epoch. Note that here and elsewhere in this program BC years are written in the astronomical fashion, i.e., (1 - Y) historical. (1) nth JP = $\pm$INT((4712 + Y)/7980)* (2) -(Epoch of JP_n) = 4712 - 7980n

*If quotient is negative and if fractional part $\neq$ 0, subtract 1.

Equations.

Jan and Feb are rotated to the previous year, then

(3) JDN + 2 = D + INT((367(M -1) +5)/12) + INT(365.25(Y + 4712))

(4) Day of Week (DoW) = (JDN + 2)(modulo 7) (0 = Sat, 1 = Sun, etc.)

(5) Gregorian Secular Procession = INT(Y/100) - INT(Y/400) - 2

(6) nth Day of Year = INT((JDN + 2) modulo 365.25) - 1

(7) Year (Y) = INT((JDN + 2)/365.25) - 4712

(8) Day (D) = nth Day of the Y - sum of days of Ms previous (1 to 31)

(9) Month (M) is not computed with equation but counted up in (8) (1 = Jan)

Note. Register R_E is available for user storage, e.g., for a difference of days, etc.

Operating Limits and Warnings (1) End of month dates are often output as the -1st or 0th date of the next month. Thus Dec 30 is invariably given as Jan -1 of the next year; Dec 31 as the astronomer's familiar Jan 0.

(2) Certain dates near Feb 28 in the secular common years of the NS calendar (-100, 100, 1900) can give dates off in one day. These, however, are easily corrected.

(3) Effective program range: NS calendar about $\pm$4.75 million years; OS calendar about $\pm$ 9.9 billion years.

Program Description II

Sketch(es)

Sample Problem(s)

(1) What is the JDN of Jan 1, AD 1 OS?

(2) What is the JDN of Mar 4, 1901 BC NS?

Note: NS secular common year after Feb 28. Set FLAG.

(3) What is the JDN of Oct 14, AD 1066 OS?

(4) What is the NS equivalent of the date in (3)?

What is the day of the week?

(5) What is the OS equivalent of JDN 584283, the ancient Maya epoch according to J. Eric S. Thompson?

(6) If 13 Baktuns (Maya periods of time having 144000 days each) equaled one grand cycle of creation according to the ancient Maya, when would that cycle be completed and the next creation cycle begun in the Thompson correlation?

Solution(s)

(1) Load card, (A) -- 4712.0

1, ENTER, 1, ENTER, 1, (f), (B) -- 1721424.0

(2) 3, ENTER, 4, ENTER, 1900, CHS, (f), (A), (B) -- 1027162.0

(3) 10, ENTER, 14, ENTER, 1066, (f), (B) -- 2110701.0

(4) (C) -- 2110701.0 ** 10 ** 20 ** 1066 = Oct 20, AD 1066 NS (E) -- 0.0 = Sat

(5) 584283, (D) --584283 ** 9 ** 6 ** -3113 = Sep 6, 3114 BC OS

(6) 144000, ENTER, 13, x, 584283, + -- 2456283.0

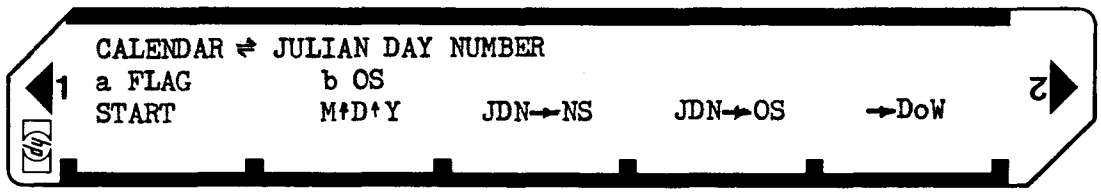
(C) -- 2456283.0 ** 12 ** 21 ** 2012 = Dec 21, AD 2012 NS

Reference(s)

Explanatory Supplement to the Astronomical Ephemeris and the American Ephemeris and Nautical Almanac, London: H. M. Stationery Office, 1961, pp. 71, 411.

Brenner, Norman: "Julian Day, Day of Week, Phase of Moon: Calendar Functions"; HP-65 User's Library #00270A.

User Instructions



STEP	INSTRUCTIONS	INPUT DATA/UNITS	KEYS	OUTPUT DATA/UNITS
1	Load card.			
2	Initialize.		A	4712.0
2a	OPTIONAL: Insert new epoch for dates beyond JP	-(Epoch)	STO A	
3a	Given M, D, Y of AD NS date, key M, ENTER,			
	D, ENTER, Y	M, D, Y	B	JDN
3b	OR: Given M, D, Y of BC NS date, key M, ENTER,			
	D, ENTER, Y, and then read step (a).	M, D, -Y		
a	If Y is a century--"secular"--common year, i.e.			
	not evenly divisible by 400, and if M and D			
	occur after Feb 28 or on-or-before the rota-			
	ted Feb 28 of the next year, e.g., Mar 1,			
	-100 to Feb 28, -99, press (a) to set FLAG;			
	otherwise, continue with step (b).		(f A)	
b			B	JDN
3c	OR: Given M, D, Y of an OS date, key M, ENTER,			
	D, ENTER, Y	M, D, ±Y	f B	JDN
3d	Given JDN; for NS date, press (C). Read step a.	JDN	C	JDN*M*D*Y
a	If output of step (3d) is a secular common year			
	(for BC years, on-or-between Mar 1 and Feb 28			
	of the next year; for AD years, before Mar -1)			
	then recall JDN; otherwise accept output of			
	step (3d). Read step (b).		h R↑	
b	Check OS equivalent. Read step (c).		D	JDN*M*D*Y
c	For BC years: if OS correlate occurs on-or-			
	before Dec 29, then add one day to the out-			
	put in step (3d); otherwise, accept output.			
	For AD years: if OS correlate occurs on-or-			
	after Jan -1, then subtract one day from the			
	output in step 3d; otherwise, accept output.			
3e	OR: Given JDN; for OS date, press (D).	JDN	D	JDN*M*D*Y
4a	OPTIONAL: After <u>any</u> step (3), DoW may be had.		E	DoW
4b	OPTIONAL: To convert NS date to OS: steps (3a)			
	or (3b), (3e).			
4c	OPTIONAL: To convert OS date to NS: steps (3c),			
	(3d).			

Program Listing I

STEP	KEY ENTRY	KEY CODE	COMMENTS
001	fLBLA	31 25 11	Initialize.
002	1	01	
003	2	02	
004	STO 4	33 04	
005	1	01	
006	3	03	
007	STO 5	33 05	
008	1	01	
009	4	04	
010	STO 6	33 06	
011	3	03	
012	1	01	
013	STO 8	33 08	
014	3	03	
015	6	06	
016	5	05	
017	.	83	
018	2	02	
019	5	05	
020	STO 9	33 09	
021	4	04	
022	7	07	
023	1	01	
024	2	02	
025	STO A	33 11	
026	R/S	84	
027	gLBLfa	32 25 11	Set Flag 1.
028	hSF 1	35 51 01	
029	R/S	84	
030	fLBLB	31 25 12	M, D, Y Input (NS)
031	hCF 3	35 61 03	
032	gLBLf b	32 25 12	M, D, Y Input (OS)
033	STO 2	33 02	Y
034	hR↓	35 53	
035	STO 1	33 01	D
036	hR↓	35 53	
037	hST I	35 33	M
038	RCL 6	34 06	Rotate Jan and Feb.
039	-	51	
040	RCL 4	34 04	(M - 1) for Eq.(3)
041	÷	81	
042	STO B	33 12	
043	fINT	31 83	
044	STO C	33 13	
045	RCL B	34 12	
046	gFRAC	32 83	
047	RCL 4	34 04	
048	x	71	
049	RCL 5	34 05	
050	+	61	(M - 1)
051	3	03	Solve Eq. (3).
052	6	06	
053	7	07	
054	x	71	
055	5	05	
056	+	61	
057	RCL 4	34 04	
058	÷	81	
059	fINT	31 83	
060	RCL 1	34 01	
061	+	61	
062	RCL 2	34 02	Change Jan, Feb to previous year.
063	RCL C	34 13	
064	+	61	
065	STO 2	33 02	
066	RCL A	34 11	
067	+	61	
068	RCL 9	34 09	
069	x	71	
070	f INT	31 83	
071	+	61	JDN + 2
072	hF?3	35 71 03	Separates OS v. NS
073	GTO 4	22 04	OS dates.
074	fGSB 0	31 22 00	Compute Gregorian
075	2	02	Secular Process
076	-	51	(GSP).
077	-	51	
078	fLBL 4	31 25 04	Ready JDN for out-
079	STO 0	33 00	put and compute
080	6	06	day of week.
081	2	02	
082	h$x \rightleftarrows y$	35 52	
083	gx>y	32 81	
084	GTO 5	22 05	
085	2	02	
086	hRC I	35 34	
087	gx>y	32 81	
088	GTO 5	22 05	
089	1	01	
090	STO - 0	33 51 00	
091	fLBL 5	31 25 05	Call JDN.
092	RCL 0	34 00	
093	STO B	33 12	
094	fGSB 1	31 22 01	Compute day of wk.
095	2	02	
096	-	51	
097	f-x-	31 84	PRINT x (JDN)
098	hRTN	35 22	--STOP--
099	fLBLC	31 25 13	JDN to NS date
100	hSF 2	35 51 02	
101	fLBLD	31 25 14	JDN to OS date
102	STO 0	33 00	
103	2	02	
104	+	61	JDN + 2 for DoW
105	STO B	33 12	
106	hF? 3	35 71 03	
107	fGSB 1	31 22 01	Compute DoW.
108	fLBL 6	31 25 06	Compute Y & nth D.
109	RCL 9	34 09	Solve Eq. (6).
110	÷	81	
111	STO C	33 13	
112	gFRAC	32 83	

REGISTERS

0 JDN	1 Day (M)	2 Year	3 Day (Wk)	4 12	5 13	6 14	7 30	8 31	9 365.25
S0	S1	S2	S3	S4	S5	S6	S7	S8	S9

A 4712	B Used	C Used	D Used	E (Free)	I Month

Program Listing II

STEP	KEY ENTRY	KEY CODE	COMMENTS
113	RCL 9	34 09	
114	x	71	
115	DSP 1	23 01	
116	fRND	31 24	
117	fINT	31 83	
118	STO D	33 14	nth D of Y + 1
119	RCL C	34 13	Solve Eq. (7)
120	fINT	31 83	
121	RCL A	34 11	
122	-	51	
123	STO 2	33 02	Year
124	hF? 2	35 71 02	
125	GTO 7	22 07	
126	GTO 8	22 08	
127	fLBL 7	31 25 07	Compute & add GSP.
128	fGSB 0	31 22 00	
129	RCL 0	34 00	
130	+	61	
131	GTO 6	22 06	
132	fLBL 8	31 25 08	Analyze M & D from
133	RCL D	34 14	nth D of Y.
134	1	01	
135	h ST I	35 33	1 = Jan, Eq. (9)
136	-	51	nth D of Y
137	0	00	Begin summation.
138	RCL 8	34 08	31 D in Jan
139	fGSB 3	31 22 03	
140	2	02	28 D in Feb
141	8	08	
142	fGSB 3	31 22 03	
143	RCL 8	34 08	31 D in Mar
144	fGSB 3	31 22 03	
145	3	03	30 D in Apr
146	0	00	
147	STO 7	33 07	
148	fGSB 2	31 22 02	31 D in May; 30 D
149	fGSB 3	31 22 03	in Jun
150	RCL 8	34 08	31 in Jul
151	fGSB 2	31 22 02	31 in Aug; 30 in S
152	fGSB 2	31 22 02	31 in Oct; 30 in N
153	fGSB 3	31 22 03	
154	RCL 8	34 08	31 in Dec.
155	fGSB 3	31 22 03	
156	f LBL 9	31 25 09	Compute D, Eq. (8).
157	-	51	
158	STO 1	33 01	
159	2	02	
160	hRC I	35 34	
161	gx≤y	32 71	
162	GTOf c	22 31 13	
163	RCL 2	34 02	
164	4	04	Determine if Y is
165	÷	81	a leap year.
166	gFRAC	32 83	
167	fx≠0	31 61	
168	GTOf c	22 31 13	
169	1	01	Subtract 1 if leap
170	STO-1	33 51 01	year.
171	gLBLf c	32 25 13	Call JDN,M,D,±Y.
172	RCL 0	34 00	JDN
173	hRC I	35 34	M
174	RCL 1	34 01	D
175	RCL 2	34 02	Y
176	gSTK	32 84	PRINT STACK.
177	R/S	84	--STOP--
178	fLBL E	31 25 15	Call Day of Week.
179	RCL 3	34 03	
180	f-x-	31 84	PRINT x.
181	hRTN	84	--STOP--
182	fLBL 0	31 25 00	Subroutine: Comput
183	RCL 2	34 02	Gregorian Secula
184	2	02	Procession (GSP)
185	g10^x	32 53	Eq. (5)
186	÷	81	
187	fINT	31 83	
188	ENTER	41	
189	ENTER	41	
190	4	04	
191	÷	81	
192	fINT	31 83	
193	-	51	
194	0	00	Correction for
195	hF? 1	35 71 01	secular common Y.
196	fCOS	31 63	
197	+	61	
198	hCF 1	35 61 01	
199	hRTN	35 22	
200	fLBL 1	31 25 01	Subroutine: Compute
201	7	07	Day of Week (DoW)
202	÷	81	Eq. (4).
203	gFRAC	32 83	
204	7	07	
205	x	71	
206	STO 3	33 03	
207	RCL B	34 12	
208	hRTN	35 22	
209	fLBL 2	31 25 02	Subroutine: Analyze
210	fGSB 3	31 22 03	31, 30 D pairs.
211	RCL 8	34 08	31 D month
212	fGSB 3	31 22 03	
213	RCL 7	34 07	30 D month
214	hRTN	35 22	
215	fLBL 3	31 25 03	Subroutine: Cf.
216	+	61	nth D of Y to
217	gx≤y	32 71	Sum of Ds.
218	GTOf d	22 31 14	Sum < nthD of Y.
219	hLSTx	35 82	Sum > n, recover.
220	-	51	
221	GTO 9	22 09	Stop comparison.
222	gLBLf d	32 25 14	Compute M, Eq (9).
223	fISZ	31 34	Add 1 to M count.
224	hRTN	35 22	

LABELS

[A] Initial.	[B] M,D,Y NS	[C] JDN to NS	[D] JDN to OS	[E] Call DoW
[a] Set F 1.	[b] M,D,Y OS	[c] Call date	[d] ComputeM	[e] --
[0] Cmput GSP	[1] Cmput DoW	[2] 31,30D prs	[3] Cf n :Ds	[4] Corrector
[5] Call JDN	[6] Cmput n,Y	[7] NS: +GSP	[8] D,M from n	[9] Cmput D

FLAGS

[0]	--
[1]	Corrector
[2]	NS vs OS
[3]	Routes NS

SET STATUS

FLAGS	ON	OFF
0	☐	☒
1	☐	☒
2	☐	☒
3	☐	☒

TRIG		DISP	
DEG	☒	FIX	☒
GRAD	☐	SCI	☐
RAD	☐	ENG	☐
		n	1