

Program Description I

Program Title Complete Calendar/ Julian Date Functions

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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) $\text{nth JP} = \pm \text{INT}((4712 + Y)/7980) * \quad (2) -(\text{Epoch of JP}_n) = 4712 - 7980n$

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

Equations.

Jan and Feb are rotated to the previous year, then

- (3) $\text{JDN} + 2 = \text{D} + \text{INT}((367(\text{M} - 1) + 5)/12) + \text{INT}(365.25(\text{Y} + 4712))$
- (4) $\text{Day of Week (DoW)} = (\text{JDN} + 2) \pmod{7} \quad (0 = \text{Sat}, 1 = \text{Sun}, \text{etc.})$
- (5) $\text{Gregorian Secular Procession} = \text{INT}(\text{Y}/100) - \text{INT}(\text{Y}/400) - 2$
- (6) $\text{nth Day of Year} = \text{INT}((\text{JDN} + 2) \pmod{365.25}) - 1$
- (7) $\text{Year (Y)} = \text{INT}((\text{JDN} + 2)/365.25) - 4712$
- (8) $\text{Day (D)} = \text{nth Day of the Y} - \text{sum of days of Ms previous} \quad (1 \text{ to } 31)$
- (9) $\text{Month (M)} \text{ is not computed with equation but counted up in (8)} \quad (1 = \text{Jan})$

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 ± 4.75 million years; OS calendar about ± 9.9 billion years.

This program has been verified only with respect to the numerical example given in *Program Description II*. User accepts and uses this program material AT HIS OWN RISK, in reliance solely upon his own inspection of the program material and without reliance upon any representation or description concerning the program material.

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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.

CALENDAR $\Rightarrow$ JULIAN DAY NUMBER

→DOW

[illegible]

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

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

LABELS					FLAGS		SET STATUS		
A Initial.	B M,D,Y NS	C JDN to NS	D JDN to OS	E Call DoW	0 --		FLAGS	TRIG	DISP
a Set F 1.	M,D,Y OS	c Call date	d Compute M	e --	1 Corrector		ON OFF		
0 Cmput GSP	1 Cmput DoW	2 31,30D prs	3 Cf n :Ds	4 Corrector	2 NS vs OS		0 ☐ ☒	DEG ☒	FIX ☒
5 Call JDN	6 Cmput n,Y	7 NS: +GSP	8 D,M from n	9 Cmput D	3 Routes NS		1 ☐ ☒	GRAD ☐	SCI ☐
							2 ☐ ☒	RAD ☐	ENG ☐
							3 ☐ ☒		n 1