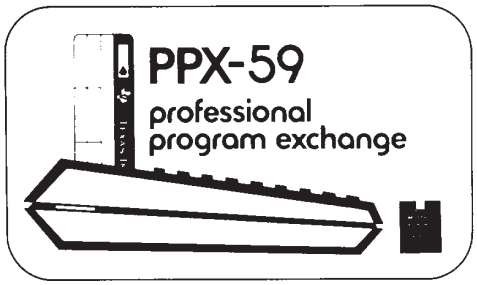

3 4 8 0 0 1
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TEXAS INSTRUMENTS
Calculator Products Division

Submission Abstract

Program Title	Rev.
GAUSS-LEGENDRE QUADRATURE NUMERICAL INTEGRATION	

Abstract of Program

This program computes the integral of f(x)dx from a to b using a three point Gauss-Legendre quadrature method.

Original SR-52 Program by Cary V. Taylor of Fairborn, Ohio.

User Benefits:

This program allows the user to obtain reasonably accurate and fast numerical integration answers without the use of a computer.

Category Number 34	Required Progs.	Prog. Steps 145	PC-100A Needed ☐ Library Module ID

Submittal Agreement

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Submission Checklist

- ☒ Recorded Magnetic Cards
- ☒ Submission Abstract
- ☒ Program Description
- ☒ User Instructions
- ☒ Sample Problem
- ☒ Listing
- ☐ _____
- ☐ _____

TEXAS INSTRUMENTS
Calculator Products Division

Program Description

Program Title:	Rev.
GAUSS-LEGENDRE QUADRATURE NUMERICAL INTEGRATION	

Method, Equations, Sketches, Limitations, References, Error Recovery:

This program computes the integral from a to b of the function f(x) dx using a three point Gauss-Legendre quadrature technique. It is completely accurate for polynomials of up to degree five.

The integral is approximated by:

$$f(x)dx = c(w*f(c*z+d) + w*f(-c*z+d) + v*f(d)$$

where:

$$C = (b-a)/2 \qquad d = (b+a)/2 \qquad w = 5/9 \qquad v = 8/9$$

$$z = .7745966692$$

The function f(x) must be a user-defined function in higher order memory (134 →). The value of x is passed to the function by the display register. The value of f(x) is returned by the display register. The function f(x) must use E' as its entry point label. Registers R07 to R19 are available for the function's use.

The main reference for this method is Applied Numerical Methods by Carnahan, Luther, and Wilkes.

☐ See Continuation Sheet

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User Instructions

Program Title
GAUSS-LEGENDRE QUADRATURE NUMERICAL INT.

a	b	calculate		

Partition (OP 17): 319.79*
Parentheses Levels: 1
t Register: ☐
Angular Mode (if applicable):
SBR Levels: 1
Absolute Addresses: ☐
Library Module ID: *319.19 for TI-58
Disturbs Pending Operations: ☒

LABELS (Op 08)

INV	ln x	CE	CLR	x:t	x²
√x	1/x	STO	RCL	SUM	y^x
EE	(	)	÷	GTO	×
SBR	−	RST	+	R/S	•
+/−	=	CLR	INV	log	CP
tan	Pgm	P→R	sin	cos	CMs
Exc	Prd	|x|	Eng	Frac	Int
Deg	Pause	x-t	Nop	Op	Rad
Lbl	x≠t	Σ+	x̄	Grad	St flg
If flg	D.MS	π	List	Write	Dsz
Adv	Prt				

USER DEFINED KEYS

A Lower Limit
B Upper Limit
C Calculate Answer
D Answer Loop
E
A'
B'
C'
D' F(x)
E'

FLAGS	0	1	2	3	4	5	6	7	8	9

STEP	PROCEDURE	ENTER	PRESS		OUTPUT/MODE (see legend below)
1	Initialize		RST	R/S	0 (LOWER LIMIT?)*
2	Enter Lower Limit	Limit	A		Lower Limit L. Limit* (LL)*
					(UPPER LIMIT?)*
3	Enter Upper Limit	Limit	B		Upper Limit U. Limit* (UL)*
					(ANSWER:)*
4	Compute Answer		C		Answer*
	NOTE: Subroutine D' which starts at location 134 should contain the approximate steps to compute the function at a given x.				

Modes: n* Printed only (n) Displayed Briefly (Pause)
(n)* Printed and displayed

DATA REGISTERS (INV List)

0
1
2
3
4
5
6
7 Lower Limit
8 Upper Limit
9 DSZ Loop Counter
0 Used in D'
1
2
13 Working
14 Working
5
16 Working
7
8
19 Working

☒ See Continuation Sheet

Continued From: ☐ Program Description ☒ User Instructions ☐ Stmt. of Example

Program Title:	Rev.

The following numbers should be stored in the corresponding registers. When the Mag. Card is made the registers will be recorded on the Mag. Cards.

Numbers	Reg.
4133331735.	00
27243024.	01
3771000000.	02
2732431735.	03
1331.	04
3643173562.	05
4127.	06
2727.	11
.7745966692	19

3,4 8,0 0,1
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TEXAS INSTRUMENTS
Calculator Products Division

Sample Problem

Statement of Example

The function f(x) = x*x + x + 1 is coded in higher order memory in the listing. This function will be integrated from -1 to +1.

$$\int_{-1}^{+1} (x^2 + x + 1)dx = \left[x^3/3 + x^2/2 + x \right]_{-1}^{+1} = 1/3 + \tfrac{1}{2} + 1 - (-1/3 + \tfrac{1}{2} - 1) = 2+2/3$$

☐ See Continuation Sheet

ENTER	PRESS	OUTPUT/MODE (see legend below)	COMMENT
	RST		
	R/S	(LOWER LIMIT?)*	
-1	A	-1.* (LL)*	
		(UPPER LIMIT?)*	
1	B	1.* (UL)*	
		(ANSWER:)*	
	C	2.666666667*	

Modes (n)* — Printed only (n) — Displayed Briefly (Pause)
(n)* — Printed and displayed

☐ Over

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LOC	CODE	KEY	COMMENTS
000	43	RCL	
001	03	03	
002	69	□P	
003	02	02	
004	43	RCL	
005	01	01	
006	69	□P	
007	03	03	
008	43	RCL	
009	02	02	
010	69	□P	
011	04	04	
012	69	□P	
013	05	05	
014	25	CLR	
015	91	R/S	
016	76	LBL	
017	11	A	
018	42	STO□	
019	07	07	
020	43	RCL	
021	11	11	
022	69	□P	
023	04	04	
024	43	RCL	
025	07	07	
026	69	□P	
027	06	06	
028	43	RCL	
029	00	00	
030	69	□P	
031	02	02	
032	43	RCL	
033	02	02	
034	69	□P	
035	04	04	
036	69	□P	
037	05	05	
038	69	□P	
039	00	00	
040	43	RCL	
041	07	07	
042	91	R/S	
043	76	LBL	
044	12	B	
045	42	STO□	
046	08	08	
047	43	RCL	
048	06	06	
049	69	□P	
050	04	04	
051	43	RCL	
052	08	08	
053	69	□P	
054	06	06	
055	43	RCL	
056	04	04	
057	69	□P	
058	03	03	
059	43	RCL	
060	05	05	
061	69	□P	
062	04	04	
063	69	□P	
064	05	05	
065	43	RCL	
066	08	08	
067	91	R/S	
068	76	LBL	
069	13	C	
070	02	2	
071	42	STO□	
072	09	09	
073	53	(	
074	43	RCL	
075	08	08	
076	75	-	
077	43	RCL	
078	07	07	
079	54	)	
080	55	÷	
081	02	2	
082	95	=	
083	42	STO□	
084	13	13	
085	85	+	
086	43	RCL	
087	07	07	
088	95	=	
089	42	STO□	
090	14	14	
091	19	D'	
092	65	×	
093	08	8	
094	55	÷	
095	09	9	
096	95	=	
097	42	STO□	
098	16	16	
099	43	RCL	
100	19	19	
101	76	LBL	
102	14	D	
103	65	×	
104	43	RCL	
105	13	13	
106	85	+	
107	43	RCL	
108	14	14	
109	95	=	
110	19	D'	
111	65	×	
112	05	5	
113	55	÷	
114	09	9	
115	95	=	
116	44	SUM	
117	16	16	
118	43	RCL	
119	19	19	
120	94	+/-	
121	97	DSZ	
122	09	09	
123	14	D	
124	43	RCL	
125	13	13	
126	49	PRD	
127	16	16	
128	43	RCL	
129	16	16	
130	99	PRT	
131	91	R/S	
132	76	LBL	
133	19	D'	
134	42	STO□	
135	10	10	
136	33	X²	
137	44	SUM	
138	10	10	
139	01	1	
140	44	SUM	
141	10	10	
142	43	RCL	
143	10	10	
144	92	RTN	

MERGED CODES

62 Pgm Ind	72 STO Ind	83 GTO Ind
63 Exc Ind	73 RCL Ind	84 Op Ind
64 Prd Ind	74 SUM Ind	92 INV SBR