TEXAS INSTRUMENTS
Calculator Products Division

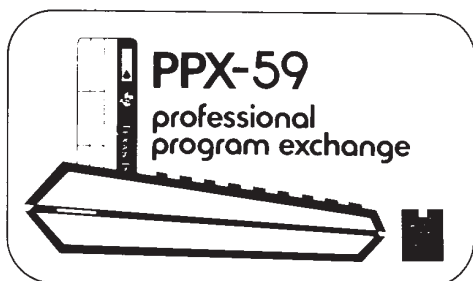
Submission Abstract

Program Title		LEAST-MEAN-SQUARE FIT OF A POLYNOMIAL		Rev.
Abstract of Program				
<p>This program will fit the general polynomial expression</p> $y = A_1 + A_2x + A_3x^2 + \dots + A_n x^{(n-1)}$ <p>to a set of (x,y) points, up to the 6th degree.</p> <p>The PC-100A is recommended for maximum convenience.</p> <p>Original TI-59 Program by Joseph Walston of Dallas, Texas</p>				
User Benefits:				
Permits tabular data to be approximated by a polynomial.				
Category Number	39	Required Progs.	Prog. Steps	232
			PC-100A Needed	<input type="checkbox"/>
			Library	
			Module ID	1 <input checked="" type="checkbox"/>
Submittal Agreement			Submission Checklist	
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Program Description

Program Title:	Rev.
LEAST-MEAN-SQUARE FIT OF A POLYNOMIAL	

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

This program performs a least-mean-square fit of a polynomial to a set of (x,y) points by solving a set of simultaneous linear equations of the form:

$$\begin{array}{rcl}
 A_1 \text{ (No.pnts.)} + A_2 \sum x + A_3 \sum x^2 + \dots + A_n \sum x^{(n-1)} & = & \sum y \\
 A_1 \sum x + A_2 \sum x^2 + A_3 \sum x^3 + \dots + A_n \sum x^{(n)} & = & \sum xy \\
 A_1 \sum x^2 + A_2 \sum x^3 + A_3 \sum x^4 + \dots + A_n \sum x^{(n-1)} & = & \sum x^2 y \\
 \vdots & & \vdots \\
 A_1 \sum x^{(n-1)} + A_2 \sum x^{(n)} + A_3 \sum x^{(n+1)} \dots + A_n \sum x^{2(n-1)} & = & \sum x^{(n-1)} y
 \end{array}$$

The solution of these equations is performed by portions of program ML-02 in the Master "Solid State Software *Module". A total of $7+N^2+3N$ memory registers are required for working space. Using the default memory partition of the TI-59, the polynomial may have as many as 5 coefficients. By re-partitioning with the key sequence 9, 2nd, OP, 1, 7, as many as 7 coefficients are possible.

The program is intended for use with a PC-100A, but it can be used alone if the PRT instruction at program location #225 is replaced with a R/S instruction. If this change is made, the determinant of the coefficient matrix (DET.) will not be seen, and the fitting will halt with A_1 in the Display. The remaining coefficients can be displayed sequentially by repeatedly pressing R/S.

The user is reminded that certain data groupings can produce problems (e.g., a nearly singular Hilbert Matrix) for the solution of the simultaneous linear equations. These difficulties will be discussed in any good text on numerical analysis. Since this program does not provide any information about the accuracy of the fit, it is wise to check the results using the polynomial evaluation program, ML-07, in the Master Module.

Of course, the number of (x,y) points entered must always be equal to or greater than the number of coefficients, N, to be determined. The program does not check on this.

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PPX-59

professional program exchange



User Instructions

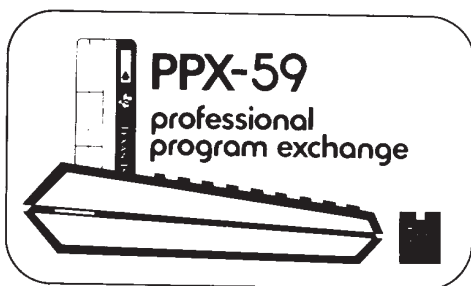
Program Title	
L.M.S. POLYNOMIAL FITTING	
Enter x,y	Enter N
Fit	Output
Partition (OP 17) Parentheses Levels	
479.59 *	t Register <input checked="" type="checkbox"/>
Angular Mode	SBR Levels
(if applicable)	Absolute Addresses <input checked="" type="checkbox"/>
Library Module ID	Disturbs Pending Operations <input checked="" type="checkbox"/>
1	*239.29 for TI-58

LABELS (Op 08)	
[INV]	[CE]
[1/x]	[STO]
[EE]	[GT]
[SBR]	[RST]
[+/-]	[CLR]
[Pgm]	[P-8]
[Exe]	[LxL]
[Deg]	[Pase]
[LBI]	[x=1]
[Hlg]	[DMS]
[Ad+]	[Pr]
[CLR]	[INV]
[P-8]	[sun]
[LxL]	[Eng]
[x=1]	[Mod]
[Σ+]	[Σ-]
[π]	[Last]
[x²]	[SUM]
[Y²]	[GT]
[X]	[R/S]
[.]	[CP]
[Cds]	[Int]
[Rad]	[Stig]
[Dis]	[Write]

USER DEFINED KEYS	
A	Enter (x,y) point
B	Perform fitting
C	Repeat output
D	
E	Enter N&Initialize
A'	
B'	
C'	
D'	
E'	

FLAGS	0	1	2	3	4	5	6	7	Error Stop	8	9
-------	---	---	---	---	---	---	---	---	------------	---	---

STEP	PROCEDURE	ENTER	PRESS	OUTPUT/MODE (see legend below)	DATA REGISTERS (INV) (OUT)
1	Adjust Partition if Necessary	9	OP	Print: N Display: N	0 Counter 1 xj 2 yj 3 4 5 6 7 N 8 Matrix Storage 9
2	Enter the Number of Coefficients to be determined, and Initialize.	N	E	xj	
3	Enter the Independent Variable, xj, of the jth (x,y) point.	xj	A	yj	
4	Enter the Dependent Variable, yj, of the same jth (x,y) point.	yj	R/S	DET. A1. . . An	
5	Repeat Steps #2 and #3 Until All The Points are Entered. (j > N)		B	0	
6	Fit the Polynomial. Print the Determinant (DET.) of the Sim.Lin.EQ.		C		
7	Print the Coefficients A1, A2, . . . An.				
8	To view the coefficients again				



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Sample Problem

Statement of Example

Fit the Polynomial: $y = A_1 + A_2x + A_3x^2 + A_4x^3$ (N=4)

to the Points:

x	y
-7	-81
-4	27
0	3
2	27
5	243

☐ See Continuation Sheet

ENTER	PRESS	OUTPUT/MODE (see legend below)		COMMENT
4	E	(4)*	N*	
7 +/-	A	(7)*	X*	1st Point
81 +/-	R/S	81 *	Y*	
		1		1 Displayed
4 +/-	A	(-4)*	X*	2nd Point
27	R/S	27*	Y*	
		2		2 Displayed
0	A	(0)*	X*	3rd Point
3	R/S	3*	Y*	
		3		3 Displayed
2	A	(2)*	X*	4th Point
27	R/S	27*	Y*	
		4		4 Displayed
5	A	(5)*	X*	5th Point
243	R/S	243*	Y*	
		5		5 Displayed

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

☒ Over

PPX-59 Professional Program Exchange Sample Problem (cont'd)

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3	9	8	0	1	0
For TI use only					

ENTER	PRESS	OUTPUT/MODE (see legend below)	COMMENT
Press R/S for each coefficient if used without a printer (make change noted on page 7)	B	5451193728*	Determinant printed
		(2.999999999)*	A ₁
		(-2)*	A ₂
		(5)*	A ₃
		(1)*	A ₄
	C	2.999999999	repeats coefficients
		-2	
		5	
		1	

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

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3,9 8,0,1,0
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LOC	CODE	KEY	COMMENTS	LOC	CODE	KEY	COMMENTS	LOC	CODE	KEY	COMMENTS
000	76	LBL		055	53	(110	95	95	
001	15	E		056	24	CE		111	43	RCL	
002	47	CMS		057	85	+		112	08	08	
003	42	STD		058	02	2		113	92	RTN	
004	07	07		059	95	=		114	76	LBL	
005	32	X:T		060	42	STD		115	12	8	
006	22	INV		061	05	05		116	25	CLR	
007	58	FIX		062	07	7		117	08	8	
008	22	INV		063	42	STD		118	42	STD	
009	57	ENG		064	04	04		119	04	04	
010	86	STF		065	44	SUM		120	85	+	
011	08	08		066	05	05		121	43	RCL	
012	25	CLR		067	69	DP		122	07	07	
013	98	ADV		068	24	24		123	95	=	
014	03	3		069	69	DP		124	42	STD	
015	01	1		070	25	25		125	05	05	
016	69	DP		071	43	RCL		126	43	RCL	
017	04	04		072	02	02		127	07	07	
018	32	X:T		073	74	SM*		128	33	X²	
019	69	DP		074	05	05		129	85	+	
020	06	06		075	43	RCL		130	07	7	
021	92	RTN		076	03	03		131	95	=	
022	76	LBL		077	74	SM*		132	32	X:T	
023	11	A		078	04	04		133	43	RCL	
024	42	STD		079	43	RCL		134	07	07	
025	01	01		080	01	01		135	42	STD	
026	32	X:T		081	49	PRD		136	06	06	
027	98	ADV		082	02	02		137	69	DP	
028	04	4		083	49	PRD		138	36	36	
029	04	4		084	03	03		139	69	DP	
030	69	DP		085	97	DSZ		140	24	24	
031	04	04		086	06	06		141	73	RC*	
032	32	X:T		087	00	00		142	04	04	
033	69	DP		088	67	67		143	72	ST*	
034	06	06		089	43	RCL		144	05	05	
035	91	R/S		090	07	07		145	69	DP	
036	42	STD		091	42	STD		146	25	25	
037	02	02		092	06	06		147	97	DSZ	
038	32	X:T		093	69	DP		148	06	06	
039	25	CLR		094	36	36		149	01	01	
040	04	4		095	43	RCL		150	39	39	
041	05	5		096	07	07		151	69	DP	
042	69	DP		097	44	SUM		152	24	24	
043	04	04		098	04	04		153	69	DP	
044	32	X:T		099	43	RCL		154	25	25	
045	69	DP		100	03	03		155	43	RCL	
046	06	06		101	74	SM*		156	05	05	
047	01	1		102	04	04		157	22	INV	
048	42	STD		103	43	RCL		158	77	GE	
049	03	03		104	01	01		159	01	01	
050	43	RCL		105	49	PRD		160	33	33	
051	07	07		106	03	03		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			
052	42	STD		107	97	DSZ					
053	06	06		108	06	06					
054	65	X		109	00	00					

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3 9 8 0 1 0

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LOC	CODE	KEY	COMMENTS	LOC	CODE	KEY	COMMENTS	LOC	CODE	KEY	COMMENTS
161	36	PGM		216	85	+					
162	02	02		217	07	7					
163	13	C		218	95	=					
164	43	RCL		219	42	STD					
165	01	01		220	00	00					
166	42	STD		221	69	OP					
167	02	02		222	20	20					
168	85	+		223	73	RC*					
169	43	RCL		224	00	00					
170	07	07		225	99	PRT] R/S if used without a printer				
171	42	STD		226	97	DSZ					
172	00	00		227	01	01					
173	85	+		228	02	02					
174	42	STD		229	21	21					
175	03	03		230	25	CLR					
176	43	RCL		231	92	RTN					
177	07	07									
178	95	=									
179	42	STD									
180	04	04									
181	69	OP									
182	22	22									
183	69	OP									
184	23	23									
185	73	RC*									
186	02	02									
187	85	+									
188	43	RCL									
189	04	04									
190	95	=									
191	42	STD									
192	05	05									
193	73	RC*									
194	05	05									
195	72	ST*									
196	03	03									
197	97	DSZ									
198	00	00									
199	01	01									
200	81	81									
201	25	CLR									
202	36	PGM									
203	02	02									
204	15	E									
205	36	PGM									
206	00	00									
207	76	LBL									
208	13	C									
209	98	ADV									
210	43	RCL									
211	07	07									
212	42	STD									
213	01	01									
214	85	+									
215	33	XZ									

MERGED CODES

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