THE ACCURACY OF PRIME INTRINSIC FUNCTIONS

In the spring of 1980, Prime was able to obtain a copy of some of the intrinsic function tests developed by William J. Cody Jr. and William Waite. When the tests were applied to the existing intrinsic function library, the results were discouraging. Almost all of the approximations exhibited acceptable accuracy in the primary approximation interval; however, they tended to lose a considerable number of bits whenever the input argument required range reduction.

As a result of this testing, a project was initiated to correct all known deficiencies. The project was divided into two phases. The objective of Phase-I was to release, as soon as possible, an acceptable set of approximations, while Phase II involves a long term tuning of the approximation for improved results.

Phase-I had the following set of goals:

- Develop a set of intrinsic functions with acceptable accuracy across the entire approximation range.
- The RMS error will determine the acceptability of the routine (approximately 0-1 bit for single precision routines and 1-2 bits for double precision routines).
- Minimize the degradition of the execution time for each routine. However, accuracy takes precedence over performance.
- The rewrite of single precision routines should be completed and released prior to the release of the double precision routines.

The objectives of Phase-I have been completed. The rewritten single precision routines were incorporated into Rev 18.2 and the improved double precision routines have been incorporated into Rev 18.3.

The paper by Jesse L. Peters reports the results of running the Cody and Waite tests on a Prime 850 using Rev 18.2 of Primos. A summary of his results as compared to the results obtained at Prime are found at the end of this report. His reported results for the Double Precision Intrinsic Functions are consistant with the results obtained at Prime before the rewrite. The Prime results are those obtained for the new versions of the intrinsic functions. They are a considerable improvement; tuning will improve the results even further.

The results for the single precision routines are, for the most part, consistant; that is, Mr. Peters' and Prime's results are essentially the same. However, there are several instances where the results are significantly different.

The difference is a result of a subtle problem in the tests. In describing the testing procedures for the various Transendental Functions, Coty and Waite warned the user that "It is therefore necessary to "purify" the test arguments to insure the E = 0" (see last paragraph, page 140 from their text).* It appears that Mr. Peters overlooked his step during his testing. This conclusion is based on the results based on the following table:

		Peters Result		Prime Result without Purification		Prime Result with Purification	
Function	Page	MAX	RMS	MAX	RMS	MAX	RMS
EXP(x)	15	2.55	0.70	2.55	0.69	2.55	0.70
EXP(x)	16	2.49	0.54	2.49	0.59	2.51	0.58
EXP(x)	17	6.09	3.36	6.08	3.34	2.49	0.55
SIN(x)	22	2.35	0.41	1.97	0.04	1.97	0.02
SIN(x)	23	15.99	10.56	1.95	0.08	1.95	0.01
COS(x)	24	11.64	7.00	11.63	7.06	1.96	0.37

The above results show consistant results in 4 of the 6 cases between Prime's tests with argument purification deleted and Mr. Peters' results. In addition, it appears that there is a fundamental problem with his test for the Sine Function.

In summary, the versions of the Transcendental Functions that are now in Prime-delivered software have acceptable accuracy as measured by the Cody/Waite tests. The accuracy of the routines will improve further as a result of long term Fixups.

Appendix I summerizes the RMS and Maximum number of lost bits for Prime as compared to other machines for most tests. The page numbers refer to Mr. Peters' report.

*Software Manual for the Elementary Functions by William J. Cody and William Waite.

Appendix I

Comparison of Prime Transendental Functions with other Machines Single Precision

Testing SORT (X*X) - X Page 9

Machine	Base B	Library or Program	Reported Loss of Base-B Digits in MRE	RMS
CDC 6400	2	Cody	0.50	0.26
IBM/370	16	Cody	0.75	0.41
CDC 7600	2	FTN 4.6	0.50	0.00
IBM/370	16	FTX 2.2	0.75	0.24
Prime/Peters	2	F-77	0.00	0.00
Prime	2	F-77	0.00	0.00

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Machine	Base B	Library or Program	Reported Loss of Base-B Digits in MRE	RMS
CDC 6400	2	Cody	2.00	1.31
IBM/370	16	Cody	1.00	0.81
CDC 7600	2	FTN 4.6	0.99	0.00
IBM/370	16	FTX 2.2	0.00	0.00
Prime/Peters	2	F-77	0.00	0.00
Prime	2	F-77	0.26	0.00

Test of ALOG(X) vs. T. S. Expansion of ALOG(1 + Y) Page 11

Machine	Base B	Library or Program	Reported Loss of Base-B Digits in MRE	RMS
CDC 6400	2	Cody	1.00	0.00
GP L3055	10	Cody	1.31	0.81
IBM/370	16	Cody	1.00	0.19
CDC 7600	2	FTN 4.7	2.00	0.09
IBM/370	16	FTX 2.2	1.00	0.29
Prime/Peters	2	F-77	1.93	0.12
Prime	2	F-77	1.93	0.12

Test of ALOG(X) vs. ALOG(17x/16)-ALOG(17/16) Page 12

Machine	Base B	Library or Program	Reported Loss of Base-B Digits in MRE	RMS
CDC 6400	2	Cody	1.67	0.00
GP L3055	10	Cody	1.34	0.83
IBM/370	16	Cody	0.99	0.57
CDC 7600	2	FTN 4.7	1.74	0.02
IBM/370	16	FTX 2.2	1.00	0.53
Prime/Peters	2	F-77	3.91	2.07
Prime	2	F-77	1.97	0.00

Test of ALOG10(X) vs. ALOG10(11x/10)-ALOG10(11/10) Page 13

Machine	Base B	Library or Program	Reported Loss of Base-B Digits in MRE	RMS
CDC 6400	2	Cody	3.28	1.29
GP L3055	10	Cody	1.13	0.57
IBM/370	16	Cody	1.07	0.59
CDC 7600	2	FTN 4.7	2.53	0.56
IBM/370	16	FTX 2.2	1.04	0.51
Prime/Peters	2	F-77	3.21	1.49
Prime	2	F-77	3.28	1.60

Test of ALOG(X*X) vs. 2 * ALOG(X) Page 14

Machine	Base B	Library or Program	Reported Loss of Base-B Digits in MRE	RMS
CDC 6400	2	Cody	0.97	0.00
GP L3055	10	Cody	1.00	0.42
IBM/370	16	Cody	0.53	0.10
CDC 7600	2	FTN 4.7	0.98	0.00
IBM/370	16	FTX 2.2	0.50	0.09
Prime/Peters	2	F-77	1.00	0.18
Prime	2	F-77	1.00	0.18

Test of EXP(X - 0.0625) vs. EXP(X)/EXP(0.625) Page 15

Machine	Base B	Library or Program	Reported Lose of Base-B Digits in MRE	RMS
CDC 7600	2	Cody	1.50	0.00
IBM/370	16	Cody	1.00	0.67
CDC 7600	2	FTN 4.7	1.63	0.06
IBM/370	16	FTX 2.2	1.00	0.68
Prime/Peters	2	F-77	2.55	0.69
Prime	2	F-77	2.55	0.70

Test of EXP(X - 2.8125) vs. EXP(X)/EXP(2.8125) Page 16

Machine	Base B	Library or Program	Reported Lose of Base-B Digits in MRE	RMS
CDC 7600	2	Cody	1.55	0.00
IBM/370	16	Cody	1.00	0.55
CDC 7600	2	FTN 4.7	1.37	0.00
IBM/370	16	FTX 2.2	1.00	0.53
Prime/Peters	2	F-77	2.49	0.54
Prime	2	F-77	2.51	0.58

Test of EXP(X - 2.8125) vs. EXP(X)/EXP(2.8125) Page 17

Machine	Base B	Library or Program	Reported Lose of Base-B Digits in MRE	RMS
CDC 7600	2	Cody	1.55	0.05
IBM/370	16	Cody	1.00	0.56
CDC 7600	2	FTN 4.7	1.31	0.00
IBM/370	16	FTX 2.2	1.00	0.55
Prime/Peters	2	F-77	6.09	3.36
Prime	2	F-77	2.49	0.55

Test of SIN(X) vs. 3*SIN(X/3) - 4*SIN(X/3)**3 Page 22

Machine	Base B	Library or Program	Reported Lose of Base-B Digits in MRE	RMS
CDC 6400	2	Cody	2.00	0.73
GP L3055	10	Cody	1.07	0.51
IBM/370	16	Cody	1.08	0.71
PDP/11	2	DOS 8.02	1.99	0.10
Varian 72	2	Fort E3	1.87	0.00
IBM/370	16	Argonne	1.18	0.69
Prime/Peters	2	F-77	2.35	0.41
Prime	2	F-77	1.97	0.02

Test of SIN(X) vs. 3*SIN(X/3) - 4*SIN(X/3)**3 Page 23

Machine	Base B	Library or Program	Reported Lose of Base-B Digits in MRE	RMS
CDC 6400	2	Cody	2.20	0.80
GP L3055	10	Cody	2.28	0.77
IBM/370	16	Cody	1.16	0.72
PDP/11	2	DOS 8.02	1.74	0.09
Varian 72	2	Fort E3	13.54	8.55
IBM/370	16	Argonne	1.16	0.70
Prime/Peters	2	F-77	15.99	10.56
Prime	2	F-77	1.95	0.01

Test of COS(X) vs. 4*COS(X/3)**3 - 3*COS(X/3) Page 24

Machine	Base B	Library or Program	Reported Lose of Base-B Digits in MRE	RMS
CDC 6400	2	Cody	2.39	0.68
GP L3055	10	Cody	1.38	0.58
IBM/370	16	Cody	1.11	0.70
PDP/11	2	DOS 8.02	12.63	7.66
Varian 72	2	Fort E3	12.69	7.31
IBM/370	16	Argonne	1.16	0.69
Prime/Peters	2	F-77	11.64	7.00
Prime	2	F-77	1.96	0.37

Test of TAN(X) vs. 2*TAN(X/2)/(1 - TAN(X/2)**2) Page 25

Machine	Base B	Library or Program	Reported Lose of Base-B Digits in MRE	RMS
CDC 6400	2	Cody	2.48	0.69
IBM/370	16	Cody	1.17	0.67
CDC 6400	2	FTN 4.6	2.70	1.06
IBM/370	16	FTX 2.2	1.25	0.73
Prime/Peters	2	F-77	1.75	0.07
Prime	2	F-77	2.04	0.06

Test of TAN(X) vs. 2*TAN(X/2)/(1 - TAN(X/2)**2) Page 26

Machine	Base B	Library or Program	Reported Lose of Base-B Digits in MRE	RMS
CDC 6400	2	Cody	2.39	0.62
IBM/370	16	Cody	1.30	0.88
CDC 6400	2	FTN 4.6	2.52	0.87
IBM/370	16	FTX 2.2	4.10	2.75
Prime/Peters	2	F-77	13.64	8.24
Prime	2	F-77	2.10	0.72

Test of TAN(X) vs. 2*TAN(X/2)/(1 - TAN(X/2)**2) Page 27

Machine	Base B	Library or Program	Reported Lose of Base-B Digits in MRE	RMS
CDC 6400	2	Cody	2.48	0.69
IBM/370	16	Cody	1.38	0.74
CDC 6400	2	FTN 4.6	15.53	10.53
IBM/370	16	FTX 2.2	4.97	3.61
Prime/Peters	2	F-77	13.85	9.14
Prime	2	F-77	1.91	0.06

Test of ASIN(X) vs. Taylor Series Page 29

Machine	Base B	Library or Program	Reported Lose of Base-B Digits in MRE	RMS
CDC 6400	2	Cody	0.99	0.00
IBM/370	16	Cody	1.00	0.64
CDC 6400	2	FTN 4.7	1.00	0.00
IBM/370	16	FTX 2.2	1.00	0.38
Prime/Peters	2	F-77	1.99	0.13
Prime	2	F-77	1.95	0.17

Test of ACOS(X) vx. Taylor Series Page 30

Machine	Base B	Library or Program	Reported Lose of Base-B Digits in MRE	RMS
CDC 6400	2	Cody	0.47	0.00
IBM/370	16	Cody	0.87	0.69
CDC 6400	2	FTN 4.7	0.47	0.00
IBM/370	16	FTX 2.2	0.87	0.75
Prime/Peters	2	F-77	0.47	0.22
Prime	2	F-77	0.47	0.20

Test of ASIN(X) vs. Taylor Series Page 31

Machine	Base B	Library or Program	Reported Lose of Base-B Digits in MRE	RMS
CDC 6400	2	Cody	1.24	0.03
IBM/370	16	Cody	1.00	0.72
CDC 6400	2	FTN 4.7	1.24	0.00
IBM/370	16	FTX 2.2	1.00	0.75
Prime/Peters	2	F-77	2.54	1.13
Prime	2	F-77	2.00	1.14

Test of ACOS(X) vx. Taylor Series Page 32

Machine	Base B	Library or Program	Reported Lose of Base-B Digits in MRE	RMS
CDC 6400	2	Cody	1.00	0.00
IBM/370	16	Cody	0.99	0.29
CDC 6400	2	FTN 4.7	1.90	0.00
IBM/370	16	FTX 2.2	0.99	0.30
Prime/Peters	2	F-77	3.09	1.15
Prime	2	F-77	2.85	1.14

Test of ACOS(X) vx. Taylor Series Page 33

Machine	Base B	Library or Program	Reported Lose of Base-B Digits in MRE	RMS
CDC 6400	2	Cody	0.66	0.00
IBM/370	16	Cody	0.93	0.71
CDC 6400	2	FTN 4.7	0.72	0.00
IBM/370	16	FTX 2.2	0.68	0.34
Prime/Peters	2	F-77	1.71	0.70
Prime	2	F-77	1.71	0.70

Test of ATAN(X) vs. Truncated Taylor Series Page 34

Machine	Base B	Library or Program	Reported Lose of Base-B Digits in MRE	RMS
CDC 6400	2	Cody	0.84	0.00
IBM/370	16	Cody	1.00	0.38
CDC 7600	2	FTN 4.8	0.84	0.00
IBM/370	16	FTX 2.2	1.00	0.37
Prime/Peters	2	F-77	1.04	0.00
Prime	2	F-77	1.02	0.00

Test of ATAN(X) vs. ATAN(1/16) + ATAN((X - 1/16)/(1 + X/16))
Page 35

Machine	Base B	Library or Program	Reported Lose of Base-B Digits in MRE	RMS
CDC 6400	2	Cody	1.00	0.00
IBM/370	16	Cody	1.00	0.69
CDC 7600	2	FTN 4.8	1.00	0.00
IBM/370	16	FTX 2.2	1.04	0.73
Prime/Peters	2	F-77	2.34	0.23
Prime	2	F-77	2.34	0.25

Test of 2*ATAN(X) vs. ATAN(2X/(1 - X*X)) Page 36

Machine	Base B	Library or Program	Reported Lose of Base-B Digits in MRE	RMS
CDC 6400	2	Cody	2.50	0.75
IBM/370	16	Cody	0.76	0.33
CDC 7600	2	FTN 4.8	1.86	0.39
IBM/370	16	FTX 2.2	0.76	0.30
Prime/Peters	2	F-77	1.93	0.00
Prime	2	F-77	1.93	0.00

Test of 2*ATAN(X) vs. ATAN(2X/(1 - X*X)) Page 37

Machine	Base B	Library or Program	Reported Lose of Base-B Digits in MRE	RMS
CDC 6400	2	Cody	2.34	0.05
IBM/370	16	Cody	1.00	0.67
CDC 7600	2	FTN 4.8	1.95	0.02
IBM/370	16	FTX 2.2	1.01	0.68
Prime/Peters	2	F-77	1.96	0.00
Prime	2	F-77	1.99	0.00

Test of SINH(X) vs. Taylor Series Expansion of SINH(X)
Page 38

Machine	Base B	Library or Program	Reported Lose of Base-B Digits in MRE	RMS
CDC 6400	2	Cody	1.00	0.00
IBM/370	16	Cody	1.00	0.48
CDC 6400	2	FTN 4.6	1.48	0.08
IBM/370	16	FTX 2.2	1.00	0.45
Prime/Peters	2	F-77	1.98	0.76
Prime	2	F-77	2.00	0.79

Test of COSH(X) vs. Taylor Series Expansion of COSH(X)
Page 39

Machine	Base B	Library or Program	Reported Lose of Base-B Digits in MRE	RMS
CDC 6400	2	Cody	1.00	0.00
IBM/370	16	Cody	1.00	0.85
CDC 6400	2	FTN 4.6	1.00	0.41
IBM/370	16	FTX 2.2	1.00	0.76
Prime/Peters	2	F-77	1.90	0.71
Prime	2	F-77	1.91	0.72

Test of SINH(X) vs. C*(SINH(X + 1) + SINH(X - 1)) Page 40

Machine	Base B	Library or Program	Reported Lose of Base-B Digits in MRE	RMS
CDC 6400	2	Cody	2.36	0.98
IBM/370	16	Cody	1.26	0.77
CDC 6400	2	FTN 4.6	2.50	1.00
IBM/370	16	FTX 2.2	1.25	0.76
Prime/Peters	2	F-77	2.49	0.87
Prime	2	F-77	2.63	0.89

Test of COSH(X) vs. C*(COSH(X + 1) + COSH(X - 1) Page 41

Machine	Base B	Library or Program	Reported Lose of Base-B Digits in MRE	RMS
CDC 6400	2	Cody	2.04	0.98
IBM/370	16	Cody	1.25	0.77
CDC 6400	2	FTN 4.6	2.19	0.99
IBM/370	16	FTX 2.2	1.24	0.75
Prime/Peters	2	F-77	2.58	0.87
Prime	2	F-77	2.49	0.88

Test of TAHN(X) vs (TANH(1/8))/(1 + TANH(X - 1/8)TANH(1/8)
Page 42

Machine	Base B	Library or Program	Reported Lose of Base-B Digits in MRE	RMS
CDC 6400	2	Cody	1.75	0.03
IBM/370	16	Cody	1.05	0.72
CDC 6400	2	FTN 4.6	3.90	1.81
IBM/370	16	FTX 2.2	1.05	0.72
Prime/Peters	2	F-77	3.67	1.49
Prime	2	F-77	3.74	1.48

Machine	Base B	Library or Program	Reported Lose of Base-B Digits in MRE	RMS
CDC 6400	2	Cody	1.73	0.00
IBM/370	16	Cody	1.00	0.61
CDC 6400	2	FTN 4.6	2.25	0.00
IBM/370	16	FTX 2.2	1.00	0.60
Prime/Peters	2	F-77	1.65	0.00
Prime	2	F-77	1.65	0.00

APPENDIX II

Single Precision Results of the Cody/Waite Tests obtained by Jesse L. Peters and Prime

FUNCTION	PAGE *	TESTER	LARGER	EQUAL	SMALLER	Digit Loss MAX	Digit Loss RMS
SQRT(X)	9	PETERS	2000	0	0	0.00	0.00
		PRIME	2000	0	0	0.00	0.00
SQRT(X)	10	PETERS	2000	0	0	0.00	0.00
		PRIME	1923	77	0	0.26	0.00
ALOG(X)	11	PETERS	592	1033	375	1.93	0.12
		PRIME	592	1033	375	1.93	0.12
ALOG(X)	12	PETERS	0	259	1741	3.91	2.07
		PRIME	0	1149	851	1.97	0.00
ALOG10(X)	13	PETERS	0	492	1508	3.21	1.49
		PRIME	0	399	1601	3.28	1.60
ALOG(X)	14	PETERS	1050	950	0	1.00	0.18
		PRIME	1050	950	0	1.00	0.18
EXP(X)	15	PETERS	843	783	374	2.55	0.70
		PRIME	839	791	370	2.55	0.70
EXP(X)	16	PETERS	868	830	302	2.49	0.54
		PRIME	867	852	281	2.51	0.58
EXP(X)	17	PETERS	967	754	279	6.09	3.36
		PRIME	888	836	276	2.49	0.55
SIN(X)	22	PETERS	761	794	445	2.35	0.41
		PRIME	430	927	643	1.97	0.02
SIN(X)	23	PETERS	1473	149	108	15.99	10.56
		PRIME	422	934	644	1.95	0.01
COS(X)	24	PETERS	1383	0	617	11.64	7.00
		PRIME	1646	0	354	1.96	0.37

TAN(X)	25	PETERS	293	1052	655	1.75	0.07
		PRIME	283	1064	653	2.04	0.06
TAN(X)	26	PETERS	1046	122	832	13.64	8.24
		PRIME	1383	576	41	2.10	0.72
TAN(X)	27	PETERS	1955	34	11	13.85	9.14
		PRIME	308	1061	631	1.91	0.06
ASIN(X)	29	PETERS	601	935	464	1.99	0.13
		PRIME	606	915	479	1.95	0.17
ACOS(X)	30	PETERS	0	344	1656	0.47	0.22
		PRIME	0	373	1627	0.47	0.20
ASIN(X)	31	PETERS	2	199	1799	2.54	1.13
		PRIME	1	181	1818	2.00	1.14
ACOS(X)	32	PETERS	1238	525	237	3.09	1.15
		PRIME	1216	537	247	2.85	1.14
ACOS(X)	33	PETERS	0	106	1894	1.71	0.72
		PRIME	0	108	1892	1.71	0.70
ATAN(X)	34	PETERS	539	1044	457	1.04	0.00
		PRIME	533	1010	437	1.02	0.00
ATAN(X)	35	PETERS	215	1025	760	2.34	0.23
		PRIME	233	1009	758	2.34	0.25
ATAN(X)	36	PETERS	239	1300	461	1.93	0.00
		PRIME	240	1290	470	1.93	0.00
ATAN(X)	37	PETERS	604	1345	51	1.96	0.00
		PRIME	631	1317	52	1.99	0.00
SINH(X)	38	PETERS	0	323	1677	1.98	0.76
		PRIME	0	341	1659	2.00	0.79
COSH(X)	39	PETERS	0	563	1473	1.90	0.71
		PRIME	0	558	1442	1.91	0.72
SINH(X)	40	PETERS	1196	622	182	2.49	0.87
		PRIME	1188	621	191	2.63	0.89
COSH(X)	41	PETERS	1201	618	181	2.58	0.87
		PRIME	1206	623	171	2.49	0.88

TANH(X)	42	PETERS	966	430	604	3.67	1.49
		PRIME	953	440	607	3.74	1.48
TANH(X)	43	PETERS	579	807	614	1.65	0.00
		PRIME	590	802	608	1.64	0.00

* Page Number taken from J. L. Peters Report

APPENDIX III

Double Precision Results of the Cody/Waite Tests obtained by Jesse L. Peters and Prime

FUNCTION	PAGE*	TESTER	LARGER	EQUAL	SMALLER	Digit Loss MAX	Digit Loss RMS
SQRT(X)	9	PETERS	-	-	-	0.50	-
		PRIME	0	1812	188	0.50	0.00
SQRT(X)	10	PETERS	-	-	-	1.00	-
		PRIME	0	1479	521	1.00	0.00
ALOG(X)	11	PETERS	-	-	-	23.43	18.50
		PRIME	495	986	519	1.95	0.05
ALOG(X)	11	PETERS	-	-	-	14.07	12.91
		PRIME	0	827	1173	1.92	0.43
ALOG10(X)	13	PETERS	-	-	-	15.07	13.58
		PRIME	0	667	1333	3.44	1.38
ALOG(X)	14	PETERS	-	-	-	1.43	0.00
		PRIME	576	1424	0	1.44	0.00
EXP(X)	15	PETERS	-	-	-	15.92	15.92
		PRIME	389	644	967	2.38	0.77
EXP(X)	16	PETERS	-	-	-	19.58	19.56
		PRIME	847	593	560	5.08	2.63
EXP(X)	17	PETERS	-	-	-	19.58	19.56
		PRIME	829	560	611	5.04	2.62
SIN(X)	22	PETERS	-	-	-	2.59	0.91
		PRIME	349	721	930	2.06	0.42
SIN(X)	23	PETERS	-	-	-	14.01	9.25
		PRIME	375	716	909	2.07	0.47
COS(X)	24	PETERS	-	-	-	15.04	10.24
		PRIME	1817	157	26	2.84	1.44

TAN(X)	25	PETERS	-	-	-	3.50	1.56
		PRIME	161	1031	808	2.94	0.99
TAN(X)	26	PETERS	-	-	-	15.41	10.05
		PRIME	895	730	375	2.57	1.06
TAN(X)	27	PETERS	-	-	-	5.35	3.14
		PRIME	160	1027	813	2.89	1.02
ASIX(X)	29	PETERS	-	-	-	2.41	0.86
		PRIME	139	630	1231	2.54	0.74
ACOS(X)	30	PETERS	-	-	-	0.47	0.25
		PRIME	0	296	1704	1.27	0.24
ASIN(X)	31	PETERS	-	-	-	3.83	1.39
		PRIME	56	589	1355	3.83	0.81
ACOS(X)	32	PETERS	-	-	-	11.28	5.92
		PRIME	1000	528	472	11.28	5.93
ACOS(X)	33	PETERS	-	-	-	3.81	0.82
		PRIME	5	414	1581	3.81	0.56
ATAN(X)	34	PETERS	-	-	-	2.00	1.10
		PRIME	0	294	1706	2.00	0.79
ATAN(X)	35	PETERS	-	-	-	14.25	13.21
		PRIME	699	632	669	2.63	0.94
ATAN(X)	36	PETERS	-	-	-	4.83	3.43
		PRIME	1425	420	155	2.64	1.27
ATAN(X)	37	PETERS	-	-	-	4.34	2.76
		PRIME	768	408	824	2.35	0.96
SINH(X)	38	PETERS	-	-	-	14.79	9.36
		PRIME	8	971	1021	1.00	0.03
COSH(X)	39	PETERS	-	-	-	3.19	2.00
		PRIME	0	907	1093	1.87	0.51
SINH(X)	40	PETERS	-	-	-	18.57	18.52
		PRIME	1598	281	121	3.00	1.62
COSH(X)	41	PETERS	-	-	-	18.57	18.52
		PRIME	1629	283	88	3.00	1.56

TANH(X)	42	PETERS	-	-	-	5.46	4.14
		PRIME	583	185	1232	4.60	2.67
TANH(X)	43	PETERS	-	-	-	3.88	0.88
		PRIME	28	1014	958	2.11	0.53

* Page Number taken from J. L. Peters Report