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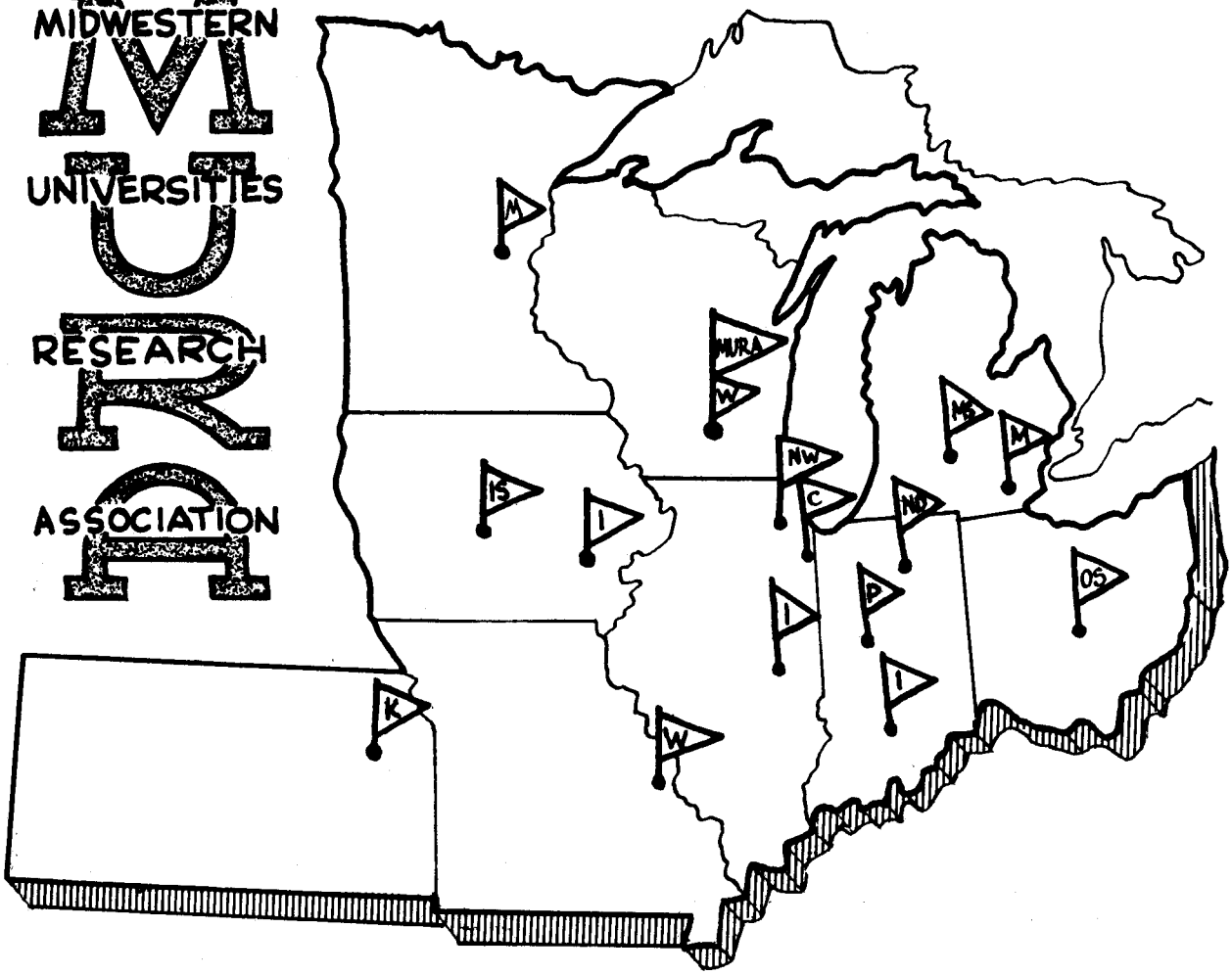

REPORT FORANAL
(Program 52)
February-March, 1957

NUMBER 228
Internal
(IBM Program)

FORANAL (Program 52)

A Program for Fourier Analysis

. N. Snyder

The program was stimulated by two memoranda (L. Jackson Laslett to J. N Snyder, 12 Dec. 1956 and F. T. Cole to J. N. Snyder, 18 Dec. 1956).

Consider the quantities:

q_i $\quad i = 0, 1, 2, \ldots n-1$

$2 \leq n \leq 255$

$|q_i| < 1$ $\quad$ (except in case III; see below)

and define:

$$g_0 = \langle q_i \rangle = \frac{1}{n} \sum_{0}^{n-1} q_i$$

$$f_j = \frac{2}{n} \sum_{i=0}^{n-1} \left(\frac{q_i}{g_0}\right) \sin i j \frac{2\pi}{n}$$

$$g_j = \frac{2}{n} \sum_{i=0}^{n-1} \left(\frac{q_i}{g_0}\right) \cos i j \frac{2\pi}{n}$$

$$\mathcal{f}_j = \sqrt{f_j^2 + g_j^2}$$

$$F_j = \sqrt{\sum_{k=1}^{j} (f_k^2 + g_k^2)}$$

$$F_{eff} = \frac{1}{g_0} \sqrt{\frac{2}{n} \sum_{i=0}^{n-1} (q^2{}_i - g^2{}_0)}$$

where $1 \leq j \leq M$ and $M = \frac{n}{2}$ or 24 whichever is less. It should be noted that if the list q_i be periodic, each value (including the end value) should be entered only once.

CASE I: If the quantities α, ρ, λ are omitted from the agendum sheet the quantities g_0 f_j, g_j, F_j $(j = 1, 2, \ldots M)$ and F_{eff} are computed and printed in the format discussed below. The q_i are entered on the agendum and the analysis is performed on the q_i.

CASE II: If α be omitted and ρ (= 0, 1, 2, 3, 4) and $0 < (\lambda/2^\rho) < 1$ be entered the above quantities will be computed using q_i^λ instead of q_i. The q_i are however entered on the agendum sheet. In this case the $|q_i|$ must be less than 1 but so chosen that q_i^λ retains numerical significance.

CASE III: If $0 < \alpha < 1$ be entered and ρ (= 0, 1, 2, 3, 4) and $-1 < \lambda/2^{\rho} < 0$ be entered the above quantities will be computed using q_i^{λ} instead of q_i. In this case $|q_i|$ must be greater than 1 but so chosen that q_i^{λ} retains significance. The quantities αq_i are to be entered on the agendum sheet. $|\alpha q_i| < 1$ is necessary but as large as possible. $1/q_i < 1$ is also necessary.

A sample agendum sheet is attached. Note that the ID number of the run may not exceed 32767.

If Sense Switch 1 is up and if $g_0 > \frac{1}{256}$, the quantities defined above will be computed. This is the normalized case.

If Sense Switch 1 is down or if $g_0 \leq \frac{1}{256}$, g_0 will be computed but g_0 will be omitted (in effect set equal to unity) in the definitions of the other quantities. This is the unnormalized case.

PRINT FORMAT:

ID# 00052	α	ρ	$\lambda/2^{\rho}$		
00001	q_0	q_1	q_2	q_3	q_4
00006	q_5	q_6	q_7	q_8	q_9
00011	q_{10}	.	.	.	.
.	.	.	.	.	.
.					
a	g_0				
a + 1	$10^{-2}f_1$	$10^{-2}g_1$	$10^{-2}f_1$	$10^{-2}F_1$	
a + 2	$10^{-2}f_2$	$10^{-2}g_2$	$10^{-2}f_2$	$10^{-2}F_2$	
.	.	.	.	.	
.	.	.	.	.	
.	.	.	.	.	
a + M	$10^{-2}f_M$	$10^{-2}g_M$	$10^{-2}f_M$	$10^{-2}F_M$	
a	$10^{-2}F$				

In case III the αq_i replace the q_i above

In the normalized case a = 0

In the unnormalized case a = 10000

N. B. In the calculation q_i^{λ} will be given the same algebraic sign as q_i, thereby attempting to bypass the inherent complex nature of q_i^{λ} if λ be non-integral.

FORANAL (PROGRAM 52)
Agendum Sheet

Quantity	Value		
Problem ID#			(< 32767)
α		ALPHA	Leave blank if to be omitted
ρ (0, 1, 2, 3, 4)		RHO	
$\lambda/2^{\rho}$		LAMBDA	

Check one	Normalized computation	SS1 up
	Unnormalized computation	SS1 down

Numbers to be analyzed (more than 1, fewer than 255)
List from left to right, then from top to bottom

7							
14							
21							
28							
35							
42							
49							
56							
63							
70							
77							
84							
91							
98							
105							
112							
119							
126							
133							
140							
147							
154							
161							
168							
175							
182							
189							
196							
203							
210							
217							
224							
231							
238							
245							
252							
255				OMEGA			

MEMORANDUM

TO: FORANAL Users

FROM: Val W. Pratt

DATE: March 1, 1960

SUBJECT: Changes in FORANAL

The following changes have been made in the FORANAL program:

I. The number of harmonics to be calculated and printed can now be specified by the user, subject to certain restrictions.

USAGE: A number M, representing the number of the highest harmonic to be calculated, may be entered on the Agendum sheet, on the "Problem ID#" line; the number M should be entered first on the line and encircled, preferably in red, and the problem ID number written following on the same line. The number M (not over 3 digits) will be punched beginning in column 1 of the first card of the data deck, followed by a single blank column, then the ID number. The initial print format will show M printed on the second line, under the problem ID number.

RESTRICTIONS:

1) The number of harmonics calculated will in no case exceed $\frac{n}{2}$, where n is the number of points to be analyzed.

2) If no M is entered, the number of harmonics calculated will be $\frac{n}{2}$ or 24, whichever is less.

3) Since the program is restricted to $n \leq 255$, an entered value of $M > 128$ will be completely ignored by the program; computation will proceed as in case 2 above, and the number entered will not be printed.

II. The initial data printout has been modified so as to print, on lines 00001,00006, etc. only those values which have been entered as data (and not an additional line or partial line of extraneous zeroes, as before).

This memorandum should become a part of the formal FORANAL write-up which appeared as MURA-228.