NASA CR-132678

SPECIAL ANALYSIS OF COMMUNITY ANNOYANCE WITH AIRCRAFT NOISE REPORTED BY RESIDENTS IN THE VICINITY OF JFK AIRPORT - 1972

by Paul N. Borsky

(NASA-CR-132678) SPECIAL ANALYSIS OF COMMUNITY ANNOYANCE WITH AIRCRAFT NOISE REPORTED BY RESIDENTS IN THE VICINITY OF JFK AIRPORT, 1972 (Columbia Univ.) 85 p HC $5.00 CSCL 05E G3/53

N76-16788

Unclas 13608

Prepared under Contract NAS1-13663 by
COLUMBIA UNIVERSITY
Noise Research Unit
Franklin Square, NY

for

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

Abstract

During the summer of 1972, about 1500 residents were interviewed twice in 11 communities near JFK Airport. Detailed aircraft operations reports were also collected for this period, and an effort has been made to analyze recorded human response data in relation to a number of physical exposure parameters. A series of exposure indexes, based on an arithmetic integration of aircraft operations, were correlated with summated aircraft noise annoyance responses. None of these correlations were as good as the CNR index which assumes a logrithmetic integration of numbers of aircraft exposures and includes a day-night differential weighting of 10:1. Answers to direct questions on the interview about day-night annoyance differences cast doubt on the 10:1 day-night penalty. The interview data suggest that each night time flight has an equivalent weight of only two daytime operations. There were substantial variations in average annoyance responses among communities with similar CNR exposures, substantiating previous findings that attitudinal and other personal variables also play an important role in determining annoyance differences. Annoyance responses to single summary questions were related to an 11 item summated annoyance index, but explained less than half of the variance of the more comprehensive measure of annoyance. In general, other emotional responses such as feelings that it was unsafe to walk at night or that there were many negative aspects in the community, had much lower correlations with aircraft annoyance than specific emotions about airplanes, such as fear of crashes or misfeasance by aircraft authorities. Specific behavioral responses, such as desire to complain, actual complaints and desire to move were all highly correlated with intensity of annoyance. Personal characteristics such as education, income, age, length of residence or general noise sensitivity were not highly or significantly correlated to either aircraft noise annoyance or fear of aircraft crashes.

PREFACE

This report presents a greater in-depth analysis of community noise annoyance. Thelma Weiner was in charge of the field interviewing and coding operations. Dr. Philip Cheifetz and Joseph Carlino advised on the statistical analyses and Paula Tito performed much of the statistical computations. Dr. William T. Shepherd was the NASA Technical Officer.

TABLE OF CONTENTS

TABLE OF CONTENTS (Cont.)

LIST OF TABLES

LIST OF TABLES (Cont.)

SAMPLE AREAS FOR 1972 COMMUNITY NOISE SURVEY

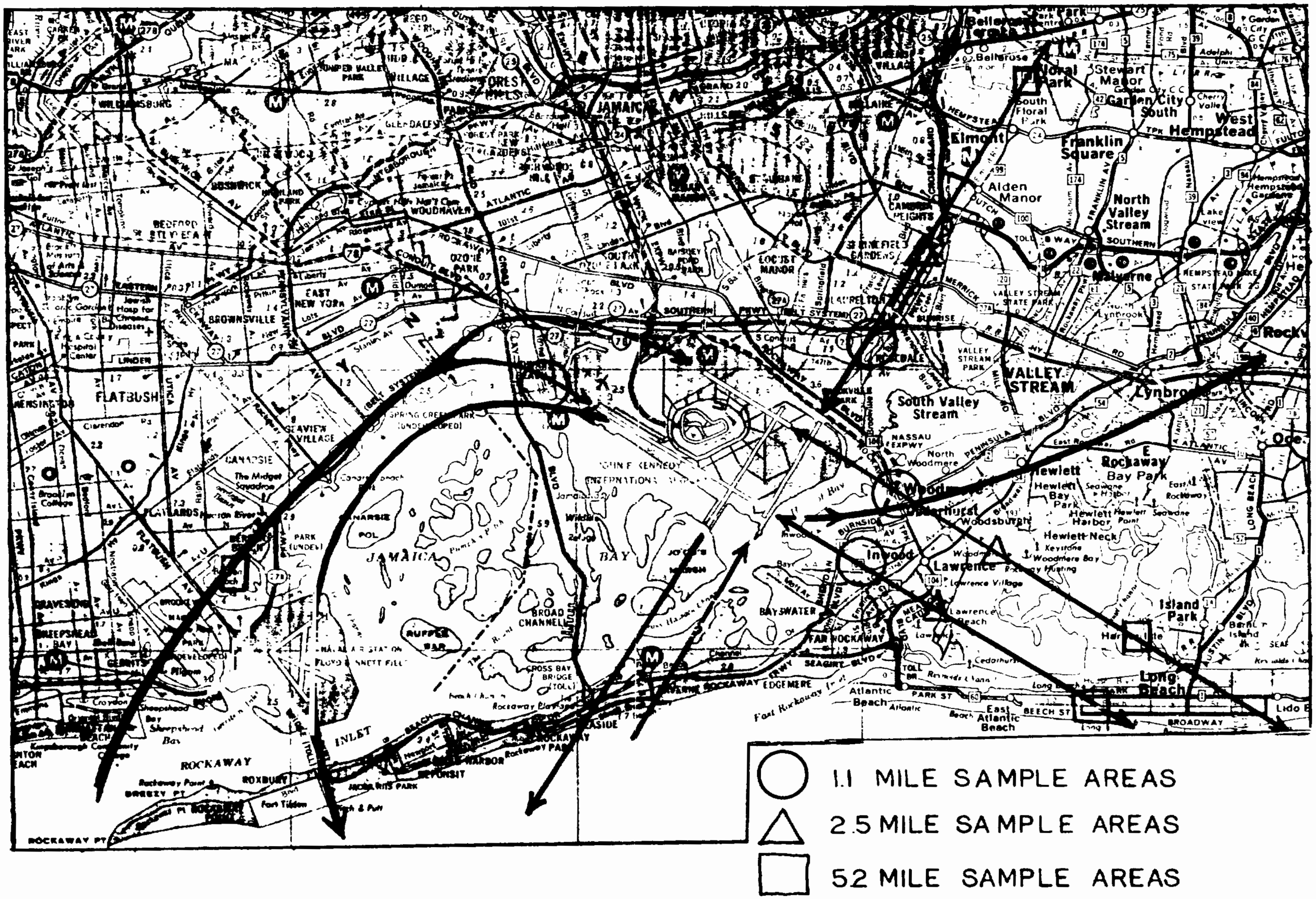

fig.1

Special Analyses of Community Annoyance with Aircraft Noise Reported by Residents in the Vicinity of JFK Airport 1972

I. Introduction

A number of social survey studies have been made of community reactions to aircraft noise in the U.S.A. 1/, 2/, 3/; Great Britain 4/, 5/; Sweden 6/; Switzerland 7/; France 8/; West Germany 9/ and other countries. In general, using summary noise indexes such as C.N.R. and N.N.I., aircraft noise alone has been found to explain 15-20% of annoyance responses. In addition, reported fear of aircraft crashes, attitudes about the primary importance of aviation, the care and concern manifested by airline, airport and government authorities in the way aircraft are operated, beliefs that there are harmful health effects and other personal factors account for another 40-50% of the variance in reported annoyance. These previous studies have determined the most important relevant factors that effect annoyance reactions, but they have not fully established the dynamic relationships or a theoretical system describing the noise annoyance process.

This study attempts a greater in-depth analysis of the variations in community noise exposures and of a fuller understanding of the dynamics in aircraft noise annoyance.

II. Survey Design

The data reported here were obtained from a community noise survey conducted by the Columbia University Noise Research Unit in February-March, and August-October 1972. The survey was primarily conducted in order to provide data for an evaluation of the Dynamic Preferential Runway System (a computerized method for assigning runway use) at John F. Kennedy International Airport (JFK), New York City, U.S.A., and for the selection of subjects used in laboratory tests. In the course of this study, extensive details were collected on aircraft operations and human responses, which will be used in this analysis.

A. Sampling Design

The sampling procedure was designed so as to maximize the homogeneity of noise exposure within each surveyed area. Since noise levels from aircraft drop rapidly as one moves laterally away from landing and take-off flight paths, and as one moves farther from the end of a runway, it was necessary to intensively sample areas only a few blocks in diameter. Eleven sample areas were located 1.1, 2.5 and 5.2 miles from the end of the various runways at JFK. These sampling sites are presented in Figure 1.

All interviewers were given predesignated addresses in the sample areas, each consisting of small clusters of adjacent blocks. In some assignment locations where the number of dwellings was limited, every household was contacted. In other areas, every n^{th} dwelling was selected. Respondents were required to be over 18 years old, a permanent resident of that dwelling and not in employment at that residence. Only one respondent was selected from each household and he had to have an adequate command of the English language. Aircraft noise annoyance data for the months of June and July exclusively were directly obtained from those respondents (795) interviewed in August. Respondents interviewed in February and March 1972, (670) however, were contacted by telephone at the start of August in order to obtain comparable annoyance data for

June and July, so that the total sample consisted of 1465 interviews.

All respondents (those interviewed in February, March and August 1972) were contacted by telephone again at the start of October to obtain annoyance data for the months of August and September. From assignments for the three distance areas, 1465 face-to-face interviews were completed (84%).

B. Community Questionnaire

The questionnaires used for the face-to-face interviews and for the telephone interviews are presented in the appendix. The questionnaire is similar in many ways to instruments used in previous noise studies. Many items related to aircraft noise annoyance, fear of aircraft operations, beliefs in the negligence (misfeasance) of those connected with aircraft operations, are very similar to items used in earlier questionnaires (Borsky, 1961; McKennell, 1963; TRACOR, 1970). The interviews averaged about an hour in length and proceeded from general questions about likes and dislikes in neighborhood environments to more specific perceptions and reactions to general noises and finally, for those who reported hearing aircraft noise to detailed probes about its effects.

III. Findings

A. Aircraft Operations

Eleven communities under seven different flight paths were included in this study. Table 1 describes the physical locations of the eleven primary sample areas.

TABLE 1

Flight Path	Number Respondents	Communities	Distance from Airport (miles)	Related Runways Departures	Related Runways Arrivals
1	52	Lawrence	2.5	13R	31L
	151	Long Beach	5.2	13R	31L
2	69	Cedarhurst	2.5	13L	31R
	94	Island Park	5.2	13L	31R
3	161	Howard Beach	1.1	31L	13R
4	140	Bergen Beach	5.2	31L	13R & 13L
5	162	Rosedale South	1.1	4R	22L
	242	Rosedale North	2.5	4R	22L
	152	Floral Park	5.2	4R	22L
6	181	Inwood	1.1	13L & 13R	31L
7	61	Meadowmere	1.1	13L & 13R	31R
Total	1465				

Since JFK Airport has the most advanced Alpha-numeric radar system which tracks flight path, altitude and runway for each operation, it was possible to get the most accurate information on each flight by type of aircraft, specific flight path, time of day and type of operation. Consequently, on departures, where aircraft make various turns after lift-off, only those percentages of aircraft flying over the selected sample areas are included in the operations data.

Table 2 presents these runway utilization data by flight path. Four time periods were used as follows:

Time Period	Eastern-Daylight Time
1 - Night	10 PM - 6:59 AM
2 - Day	7 AM - 2:59 PM
3 - Day	3 PM - 6:59 PM
4 - Evening	7 PM - 9:59 PM

Table 2

UTILIZATION TABLE: OPERATION PERCENTAGES BY PATH AND TIME PERIOD USED FOR CALCULATIONS

Flight Path	Time Period	ARRIVALS								DEPARTURES							
		4L	4R	13L	13R	22L	22R	31L	31R	4L	4R	13L	13R	22L	22R	31L	31R
1	1							100					21				
1	2							100					05				
1	3							100					10				
1	4							100					20				
2	1								100			05					
2	2								100			05					
2	3								100			05					
2	4								100			05					
3	1				100												100
3	2				100												100
3	3				100												100
3	4				100												100
4	1			100	100												100
4	2			100	100												100
4	3			100	100												100
4	4			100	100												100
5	1					100					100						
5	2					100					100						
5	3					100					100						
5	4					100					100						
6	1							100				66	21				
6	2							100				66	05				
6	3							100				66	01				
6	4							100				66	02				
7	1								100			71	10				
7	2								100			71	09				
7	3								100			71	10				
7	4								100			71	10				

1. Mix of Aircraft

Of the seven flight paths studied, only small variations occurred in the aircraft mix from month to month among the different flight paths. Tables 3 and 4 present these data for June-July and August-September.

Seven types of aircraft were classified as follows:

Aircraft Type	
1	4-engine jet low by-pass engine
2	4-engine jet high by-pass engine
3	3-engine jet low by-pass engine
4	3-engine jet high by-pass engine
5	2-engine jet
6	4-engine propeller
7	all other propeller aircraft

2. Number of Aircraft Operations

Patterns in operations in June-July and August-September were relatively the same. To facilitate presentation of flight path data, therefore, only June-July data will be presented. Table 5 presents the variations in daily operations by time period; Table 6, the month-to-month comparisons, and Table 7, the weekly distributions.

Variations in daily operations are great for the same and different time periods. In time period 1, 10 PM-6:59 AM, only an average of 6 flights, or less than one per hour are reported over flight paths 1 and 6, while an average of 30-50 or 4-5 per hour are reported in the other areas. Peaks of 15-20 per hour are reported over flight paths 3 and 4.

In time period 2, 7 AM-2:59 PM, a low of 4 arrivals are reported on the average for path one, or less than one per hour, while an average of almost 90 departures occurred over paths 3 and 4 or about 11 per hour, with some peaks at 15-20 per hour. During the late afternoon time period 3, 3 PM-6:59 PM, 4-5 departures, or about one per hour are reported for paths 5 and 6, but 74 departures on the average are reported over path 4 or almost 20 per hour. About one-third of the days had over 20 departures per hour. This time period 3 is the busiest at JFK Airport. During the evening period 4, 7 PM-9:59 PM, the average number of departures falls to less than one per hour over areas 1, 2 and 5 and to about 15 per hour and peaks of over 20 per hour in area 5.

As Table 6 indicates, there were also considerable fluctuations in the number of daily total operations for each month. In June, on 40% of the days, no airplanes flew over flight path 2, while in almost a fourth of all days, 360-479 flights crossed area 4, or an overall average of 15-20 per hour. An equally high frequency is reported on 7% of the days by flight path 3.

Table 7 shows the weekly variations in total operations.

3. Hours of Overflight

The number of daily hours of overflight also varied greatly among the flight paths. Areas under flight paths 3 and 4 experienced the greatest saturation of overflights,

Table 3

AIRCRAFT OPERATIONS BY AIRCRAFT TYPE, TIME PERIOD AND FLIGHT PATH
June - July 1972

		FLIGHT PATHS 1 OPERATIONS			2 OPERATIONS			3 OPERATIONS			4 OPERATIONS		
Time Period	A/C Type	A & D Total	Arriv.	Dep.	A & D Total	Arriv.	Dep.	A & D Total	Arriv.	Dep.	A & D Total	Arriv.	Dep.
1	1	32.7%	21.3%	40.4%	37.7%	37.8%	0.0%	37.8%	34.5%	40.6%	36.9%	34.4%	40.6%
	2	10.9	7.2	13.4	6.0	6.0	0.0	9.2	6.6	11.5	8.2	6.0	11.5
	3	38.3	44.3	34.3	39.8	39.9	0.0	38.1	42.4	34.3	38.1	40.6	34.3
	4	1.3	2.3	0.6	2.5	2.5	0.0	1.5	2.5	0.7	1.5	2.1	0.7
	5	5.5	5.4	5.5	6.5	6.6	0.0	6.4	7.9	5.1	6.3	7.1	5.1
	6	0.0	0.0	0.0	0.1	0.1	0.0	0.1	0.1	0.1	0.1	0.1	0.1
	7	11.3	19.5	19.5	7.4	7.1	100.0	6.9	6.0	7.7	8.9	9.7	7.7
	Total No.	(548)	(221)	(327)	(1669)	(1664)	(5)	(3046)	(1442)	(1604)	(3944)	(2340)	(1604)
2	1	21.5	17.3	48.7	27.7	27.8	14.8	36.9	16.6	40.7	34.2	22.9	40.7
	2	7.7	7.2	10.8	9.0	9.1	0.0	9.2	8.5	9.3	9.2	9.1	9.3
	3	34.1	35.2	27.0	37.3	37.4	33.3	31.1	40.3	29.4	32.9	38.9	29.4
	4	1.1	1.0	1.8	0.7	0.7	0.0	2.1	0.7	2.4	1.7	0.7	2.4
	5	16.6	[illegible]	7.2	10.2	10.1	18.5	10.0	12.4	9.6	10.0	10.6	9.6
	6	0.4	0.4	0.0	0.3	0.3	0.0	0.2	0.5	0.1	0.3	0.7	0.1
	7	18.6	20.8	4.5	14.8	14.6	33.4	10.5	21.0	8.5	11.7	17.1	8.5
	Total No.	(823)	(712)	(111)	(1834)	(1807)	(27)	(4363)	(680)	(3683)	(5814)	(2131)	(3683)
3	1	22.5	21.9	42.9	33.0	33.1	18.2	23.2	16.1	29.7	29.6	29.6	29.7
	2	8.7	8.8	7.1	22.2	22.4	0.0	10.8	12.2	9.6	15.3	17.3	9.6
	3	45.3	45.6	35.7	34.1	34.0	45.4	32.9	36.2	29.8	32.1	32.9	29.8
	4	3.6	3.7	0.0	2.3	2.4	0.0	1.7	1.8	1.6	2.3	2.6	1.6
	5	12.1	12.2	7.1	6.1	6.9	27.3	9.9	10.9	9.0	7.7	7.2	9.0
	6	0.0	0.0	0.0	0.1	0.1	0.0	[illegible]	1.0	0.6	0.5	0.5	0.6
	7	7.8	7.8	7.2	2.2	2.1	9.1	20.7	21.8	19.7	12.5	9.9	19.7
	Total No.	(503)	(489)	(14)	(1356)	(1345)	(11)	(2422)	(1154)	(1268)	(4775)	(3507)	(1268)

Table 3 (cont.)Pg.2)

AIRCRAFT OPERATIONS BY AIRCRAFT TYPE, TIME PERIOD AND FLIGHT PATH
June - July 1972

		FLIGHT PATHS											
		1 OPERATIONS			2 OPERATIONS			3 OPERATIONS			4 OPERATIONS		
Time Period	A/C Type	A & D Total	Arriv.	Dep.	A & D Total	Arriv.	Dep.	A & D Total	Arriv.	Dep.	A & D Total	Arriv.	Dep.
4	1	25.0%	21.5%	42.9%	35.9%	36.1%	16.7%	27.5%	14.5%	32.1%	31.1%	30.4%	32.1%
	2	9.9	7.6	21.4	18.7	18.9	0.0	15.6	8.1	18.2	15.8	14.1	18.2
	3	45.9	50.0	25.0	34.6	34.6	33.3	21.7	26.7	19.9	27.5	32.6	19.9
	4	2.9	3.5	0.0	1.6	1.6	0.0	1.5	0.5	1.8	1.5	1.3	1.8
	5	12.2	13.2	7.1	6.7	6.6	16.7	8.0	9.8	7.4	7.5	7.6	7.4
	6	0.6	0.7	0.0	0.0	0.0	0.0	1.0	1.2	1.0	0.7	0.5	1.0
	7	3.5	3.5	3.6	2.5	2.2	33.3	24.7	39.2	19.6	15.9	13.5	19.6
	Total No.	(172)	(144)	(28)	(641)	(635)	(6)	(1559)	(408)	(1151)	(2873)	(1722)	(1151)
Total	1	25.0	19.7	42.5	33.0	33.1	14.3	32.9	23.2	37.6	33.0	29.4	37.6
	2	9.0	7.7	13.1	12.5	12.6	0.0	10.4	8.9	11.1	11.7	12.2	11.1
	3	39.0	41.1	32.1	36.9	37.0	32.6	32.1	38.3	29.1	33.0	36.1	29.1
	4	1.9	2.2	0.8	1.7	1.7	0.0	1.8	1.7	1.8	1.8	1.8	1.8
	5	12.2	14.0	6.1	7.7	7.6	18.4	8.8	9.9	8.2	8.1	8.0	8.2
	6	0.2	0.3	0.0	0.2	0.2	0.0	0.4	0.6	0.3	0.4	0.4	0.3
	7	12.7	15.0	5.4	8.0	7.8	34.7	13.6	17.4	11.9	12.0	12.1	11.9
	Total No.	(2046)	(1566)	(480)	(5500)	(5451)	(49)	(11390)	(3684)	(7706)	(17406)	(9700)	(7706)

Table 3 (cont.Pg.3)

AIRCRAFT OPERATIONS BY AIRCRAFT TYPE, TIME PERIOD AND FLIGHT PATH
June - July 1972

FLIGHT PATHS

Time Period	A/C Type	5 OPERATIONS A & D Total	5 Arriv.	5 Dep.	6 OPERATIONS A & D Total	6 Arriv.	6 Dep.	7 OPERATIONS A & D Total	7 Arriv.	7 Dep.
1	1	34.9%	35.0%	28.6%	29.1%	21.3%	33.3%	36.6%	37.8%	28.4%
	2	5.6	5.6	7.1	9.6	7.2	10.8	6.4	6.0	8.8
	3	43.3	43.3	42.9	34.0	44.3	28.5	37.8	39.9	24.0
	4	1.7	1.7	0.0	1.1	2.3	0.5	2.1	2.5	0.0
	5	6.1	6.0	14.3	4.7	5.4	4.3	6.1	6.6	3.2
	6	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.0
	7	8.4	8.4	7.1	21.5	19.5	22.6	10.9	7.1	35.6
	Total No.	(1246)	(1232)	(14)	(638)	(221)	(417)	(1914)	(1664)	(250)
2	1	27.6	27.5	30.0	19.8	17.3	23.2	27.5	27.8	26.4
	2	10.5	10.7	5.7	5.4	7.2	2.9	7.7	9.1	3.8
	3	39.1	39.2	37.2	33.3	35.2	30.5	35.4	37.4	29.9
	4	0.7	0.7	1.4	1.1	1.0	1.4	1.0	0.7	1.7
	5	11.0	11.2	4.3	17.1	18.1	15.6	11.2	10.1	14.5
	6	0.2	0.2	0.0	0.3	0.4	0.2	0.3	0.3	0.3
	7	10.9	10.5	21.4	23.0	20.8	26.2	16.9	14.6	23.4
	Total No.	(1815)	(1745)	(70)	(1224)	(712)	(512)	(2440)	(1807)	(633)
3	1	31.2	31.4	8.8	20.8	21.9	17.9	31.6	33.1	26.2
	2	19.6	19.8	5.9	7.4	8.8	4.1	19.2	22.4	7.3
	3	36.4	36.4	38.2	44.6	45.6	42.1	34.8	34.0	38.0
	4	2.6	2.6	0.0	3.1	3.7	1.5	2.2	2.4	1.4
	5	6.7	6.7	8.8	15.0	12.2	22.1	8.2	5.9	16.5
	6	0.1	0.1	0.0	0.6	0.0	2.1	0.3	0.1	1.1
	7	3.4	3.0	38.3	8.5	7.8	10.2	3.7	2.1	9.5
	Total No.	(2863)	(2829)	(34)	(684)	(489)	(195)	(1703)	(1345)	(358)

Table 3 (cont.Pg.4)

AIRCRAFT OPERATIONS BY AIRCRAFT TYPE, TIME PERIOD AND FLIGHT PATH
June - July 1972

FLIGHT PATHS

		5 OPERATIONS			6 OPERATIONS			7 OPERATIONS		
Time Period	A/C Type	A & D Total	Arriv.	Dep.	A & D Total	Arriv.	Dep.	A & D Total	Arriv.	Dep.
4	1	35.3%	35.3%	40.0%	19.9%	21.5%	18.4%	33.3%	36.1%	27.2%
	2	17.2	17.1	40.0	6.8	7.6	5.9	17.0	18.9	12.9
	3	34.5	34.5	20.0	39.5	50.0	29.6	32.2	34.6	26.8
	4	1.6	1.6	0.0	2.0	3.5	0.7	1.8	1.6	2.1
	5	8.4	8.4	0.0	15.9	13.2	18.4	8.8	6.6	13.6
	6	0.1	0.1	0.0	0.7	0.7	0.7	0.2	0.0	0.7
	7	2.9	3.0	0.0	15.2	3.5	26.3	6.7	2.2	16.7
	Total No.	(2379)	(2374)	(5)	(296)	(144)	(152)	(922)	(635)	(287)
Total	1	32.1	32.2	24.4	22.1	19.7	25.2	31.8	33.1	26.8
	2	14.8	14.9	7.3	7.0	7.7	6.0	11.4	12.6	7.1
	3	37.5	37.5	37.4	36.8	41.1	31.5	35.5	37.0	30.2
	4	1.8	1.8	0.8	1.7	2.2	1.0	1.7	1.7	1.5
	5	8.0	8.1	6.5	13.7	14.0	13.2	8.7	7.6	13.0
	6	0.1	0.1	0.0	0.3	0.3	0.5	0.2	0.2	0.5
	7	5.7	5.4	23.6	18.4	15.0	22.6	10.7	7.8	20.9
	Total No.	(8303)	(8180)	(123)	(2842)	(1566)	(1276)	(6979)	(5451)	(1528)

Table 4

AIRCRAFT OPERATIONS BY AIRCRAFT TYPE, TIME PERIOD AND FLIGHT PATH
August - September 1972

FLIGHT PATHS

Time Period	A/C Type	1 OPERATIONS A & D Total	1 Arriv.	1 Dep.	2 OPERATIONS A & D Total	2 Arriv.	2 Dep.	3 OPERATIONS A & D Total	3 Arriv.	3 Dep.	4 OPERATIONS A & D Total	4 Arriv.	4 Dep.
1	1	28.4%	13.8%	39.9%	37.2%	37.3%	0.0%	34.4%	32.1%	36.2	33.3%	30.5%	36.2%
	2	8.9	3.7	13.0	4.3	4.4	0.0	9.0	4.3	12.5	8.1	3.8	12.5
	3	37.5	42.4	33.7	40.9	41.0	0.0	33.5	40.2	28.4	32.4	36.3	28.4
	4	1.2	1.8	0.7	2.8	2.8	0.0	2.5	3.9	1.4	2.2	3.1	1.4
	5	5.3	3.7	6.5	6.2	6.3	0.0	5.5	6.6	4.7	5.5	6.3	4.7
	6	0.0	0.0	0.0	0.1	0.1	0.0	0.3	0.3	0.2	0.2	0.2	0.2
	7	18.7	34.6	6.2	8.5	8.1	100.0	14.8	12.6	16.6	18.3	19.8	16.6
	Total No.	(493)	(217)	(276)	(2051)	(2043)	(8)	(3082)	(1329)	(1753)	(3587)	(1834)	(1753)
2	1	25.9	22.3	47.9	26.6	26.8	13.9	41.4	28.4	43.9	37.8	26.7	43.9
	2	8.2	7.7	11.5	6.6	6.7	0.0	8.5	10.2	8.1	8.9	10.2	8.1
	3	33.3	34.3	27.1	36.2	36.3	33.3	31.4	36.9	30.4	31.9	34.7	30.4
	4	2.8	2.5	4.2	1.0	1.0	0.0	3.7	2.2	4.0	2.9	1.0	4.0
	5	20.3	22.6	6.2	11.7	11.6	19.5	10.4	13.7	9.7	10.3	11.3	9.7
	6	0.1	0.2	0.0	0.3	0.3	0.0	0.1	0.3	0.1	0.2	0.5	0.1
	7	9.4	10.4	3.1	17.6	17.3	33.3	4.5	8.3	3.8	8.0	15.6	3.8
	Total No.	(684)	(588)	(96)	(2181)	(2145)	(36)	(4846)	(803)	(4043)	(6314)	(2271)	(4043)
3	1	24.2	23.9	40.0	32.5	32.7	12.5	21.5	14.5	29.5	26.3	25.2	29.5
	2	14.6	14.7	10.0	23.2	23.5	0.0	11.9	15.8	7.6	16.0	18.9	7.6
	3	38.7	38.7	40.0	32.1	31.9	50.0	31.3	36.2	25.7	31.7	33.8	25.7
	4	4.3	4.4	0.0	2.6	2.7	0.0	3.2	4.3	2.0	2.9	3.3	2.0
	5	14.7	14.7	10.0	6.2	5.9	25.0	10.4	10.4	10.3	8.4	7.7	10.3
	6	0.0	0.0	0.0	0.1	0.1	0.0	1.1	1.5	0.6	0.7	0.8	0.6
	7	3.5	3.6	0.0	3.3	3.2	12.5	20.6	17.3	24.3	14.0	10.3	24.3
	Total No.	(512)	(502)	(10)	(1171)	(1155)	(16)	(2426)	(1285)	(1141)	(4383)	(3242)	(1141)

Table 4 (cont.Pg.2)

AIRCRAFT OPERATIONS BY AIRCRAFT TYPE, TIME PERIOD AND FLIGHT PATH
August - September 1972

FLIGHT PATHS

Time Period	A/C Type	1 OPERATIONS A & D Total	1 OPERATIONS Arriv.	1 OPERATIONS Dep.	2 OPERATIONS A & D Total	2 OPERATIONS Arriv.	2 OPERATIONS Dep.	3 OPERATIONS A & D Total	3 OPERATIONS Arriv.	3 OPERATIONS Dep.	4 OPERATIONS A & D Total	4 OPERATIONS Arriv.	4 OPERATIONS Dep.
4	1	29.0%	27.5%	43.8%	32.5%	32.7%	16.7%	26.6%	12.6%	31.5%	28.0%	24.4%	31.5%
	2	8.3	6.5	25.0	16.6	16.7	0.0	15.0	5.4	18.4	14.9	11.4	18.4
	3	40.2	41.8	25.0	37.5	37.5	33.3	20.2	20.6	20.1	25.1	30.2	20.1
	4	7.1	7.9	0.0	4.0	4.0	0.0	2.1	3.2	1.8	2.3	2.9	1.8
	5	14.2	15.0	6.2	6.3	6.2	16.7	6.3	5.6	6.5	6.2	5.9	6.5
	6	0.0	0.0	0.0	0.0	0.0	0.0	2.4	3.0	2.2	1.8	1.4	2.2
	7	1.2	1.3	0.0	3.1	2.9	33.3	27.4	49.6	19.5	21.7	23.8	19.5
	Total No.	(169)	(153)	(16)	(848)	(842)	(6)	(1770)	(466)	(1304)	(2587)	(1283)	(1304)
Total	1	26.4	22.1	42.0	32.0	32.2	12.1	33.5	23.2	38.3	32.3	26.6	38.3
	2	10.2	9.4	13.1	10.3	10.4	0.0	10.2	9.5	10.6	11.5	12.3	10.6
	3	36.5	37.8	31.9	37.1	37.2	33.3	30.3	35.8	27.7	30.9	34.0	27.7
	4	3.2	3.6	1.5	2.3	2.3	0.0	3.1	3.6	2.8	2.7	2.6	2.8
	5	14.2	16.3	6.5	8.1	8.0	18.2	8.5	9.2	8.3	8.2	8.1	8.3
	6	0.1	0.1	0.0	0.2	0.2	0.0	0.7	1.0	0.5	0.6	0.7	0.5
	7	9.4	10.7	5.0	10.0	9.7	36.4	13.7	17.7	11.8	13.8	15.7	11.8
	Total No.	(1858)	(1460)	(398)	(6251)	(6185)	(66)	(12124)	(3883)	(8241)	(16871)	(8630)	(8241)

Table 4 (cont.Pg.3)

AIRCRAFT OPERATIONS BY AIRCRAFT TYPE, TIME PERIOD AND FLIGHT PATH
August - September 1972

FLIGHT PATHS

Time Period	A/C Type	5 OPERATIONS A & D Total	5 OPERATIONS Arriv.	5 OPERATIONS Dep.	6 OPERATIONS A & D Total	6 OPERATIONS Arriv.	6 OPERATIONS Dep.	7 OPERATIONS A & D Total	7 OPERATIONS Arriv.	7 OPERATIONS Dep.
1	1	31.9%	32.0%	22.2%	22.9%	13.8%	27.8%	35.4%	37.3%	20.1%
	2	3.4	3.4	0.0	7.2	3.7	9.1	4.6	4.4	6.6
	3	45.3	45.5	22.2	30.4	42.4	23.8	38.4	41.0	17.7
	4	1.3	1.3	0.0	1.0	1.8	0.5	2.5	2.8	0.4
	5	7.2	7.1	22.2	4.2	3.7	4.6	5.9	6.3	3.1
	6	0.1	0.0	11.1	0.0	0.0	0.0	0.1	0.1	0.0
	7	10.8	10.7	22.3	34.3	34.6	34.2	13.1	8.1	52.1
	Total No.	(981)	(972)	(9)	(612)	(217)	(395)	(2302)	(2043)	(259)
2	1	24.4	25.2	0.0	20.9	22.3	19.6	25.7	26.8	22.5
	2	12.1	12.4	4.4	5.0	7.7	2.5	5.9	6.7	3.3
	3	40.7	41.3	21.7	33.2	34.3	32.2	35.1	36.3	31.7
	4	1.5	1.1	13.0	2.2	2.5	1.8	1.2	1.0	2.1
	5	13.0	13.2	8.7	19.5	22.6	16.4	12.6	11.6	15.4
	6	0.4	0.4	0.0	0.3	0.2	0.3	0.3	0.3	0.3
	7	7.9	6.4	52.2	18.9	10.4	27.2	19.2	17.3	24.7
	Total No.	(750)	(727)	(23)	(1191)	(588)	(603)	(2866)	(2145)	(721)
3	1	31.5	31.8	6.9	20.6	23.9	13.9	29.9	32.7	21.4
	2	20.0	20.2	0.0	10.9	14.7	2.8	19.1	23.5	5.6
	3	35.3	35.6	6.9	40.7	38.7	44.9	34.1	31.9	40.7
	4	2.9	2.8	10.3	3.1	4.4	0.4	2.3	2.7	1.3
	5	6.7	6.7	6.9	17.9	14.7	24.5	9.3	5.9	19.6
	6	0.1	0.1	0.0	0.0	0.0	0.0	0.1	0.1	0.0
	7	3.5	2.8	69.0	6.8	3.6	13.5	5.2	3.2	11.4
	Total No.	(2647)	(2618)	(29)	(747)	(502)	(245)	(1533)	(1155)	(378)

Table 4 (cont.Pg.4)

AIRCRAFT OPERATIONS BY AIRCRAFT TYPE, TIME PERIOD AND FLIGHT PATH
August - September 1972

		FLIGHT PATHS								
		5 OPERATIONS			6 OPERATIONS			7 OPERATIONS		
Time Period	A/C Type	A & D Total	Arriv.	Dep.	A & D Total	Arriv.	Dep.	A & D Total	Arriv.	Dep.
4	1	31.1%	31.0%	40.0%	24.7%	27.5%	21.5%	31.7%	32.7%	27.8%
	2	15.9	15.9	20.0	6.0	6.5	5.4	15.8	16.7	12.0
	3	39.7	39.7	20.0	36.0	41.8	29.2	35.4	37.5	27.3
	4	3.8	3.9	0.0	5.3	7.9	2.3	3.8	4.0	2.8
	5	7.2	7.2	0.0	15.9	15.0	16.9	7.5	6.2	13.0
	6	0.1	0.1	0.0	0.4	0.0	0.8	0.2	0.0	0.9
	7	2.2	2.2	20.0	11.7	1.3	23.9	5.6	2.9	16.2
	Total No.	(2702)	(2697)	(5)	(283)	(153)	(130)	(1058)	(842)	(216)
Total	1	30.6	30.9	9.1	21.6	22.1	21.1	30.2	32.2	22.6
	2	15.3	15.4	3.0	7.1	9.4	4.7	9.5	10.4	5.6
	3	38.9	39.2	15.2	34.9	37.8	31.8	35.9	37.2	31.0
	4	2.9	2.8	9.1	2.5	3.6	1.2	2.2	2.3	1.7
	5	7.7	7.6	9.1	15.4	16.3	14.5	9.2	8.0	14.0
	6	0.1	0.1	1.5	0.2	0.1	0.2	0.2	0.2	0.3
	7	4.5	4.0	53.0	18.3	10.7	26.5	12.8	9.7	24.8
	Total No.	(7080)	(7014)	(66)	(2833)	(1460)	(1373)	(7759)	(6185)	(1574)

Table 5

NUMBER OF DAILY OPERATIONS BY TIME PERIOD AND FLIGHT PATHS
June-July 1972

FLIGHT PATHS

Time Period	Frequency	No. Per Hour	1 OPERATIONS Arriv.	1 OPERATIONS Dep.	2 OPERATIONS Arriv.	2 OPERATIONS Dep.	3 OPERATIONS Arriv.	3 OPERATIONS Dep.	4 OPERATIONS Arriv.	4 OPERATIONS Dep.
1	0	0	50.8%	45.9%	42.6%	100.0%	41.0%	49.2%	31.2%	49.2%
	1-17	<2	45.9	49.2	9.9	0.0	19.6	16.4	9.8	16.4
	18-26	2-2.9	0.0	3.3	9.8	0.0	3.3	4.9	8.2	4.9
	27-53	3-5.9	3.3	1.6	13.1	0.0	21.3	8.2	24.6	8.2
	54-89	6-9.9	0.0	0.0	21.3	0.0	11.5	11.5	16.4	11.5
	90-134	10-14.9	0.0	0.0	3.3	0.0	3.3	8.2	9.8	8.2
	135-179	15-19.9	0.0	0.0	0.0	0.0	0.0	1.6	0.0	1.6
	180+	20+	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	$\overline{X}$ (excluding 0)		5.93	9.15	44.03	0.00	37.64	47.13	50.29	47.13
	σ		7.21	5.91	27.05	0.00	27.67	42.63	29.92	42.63
2	0	0	49.2	55.7	45.9	100.0	45.9	37.7	42.6	37.7
	1-15	<2	27.9	44.3	11.5	0.0	26.2	4.9	14.8	4.9
	16-23	2-2.9	11.5	0.0	4.9	0.0	6.6	8.2	1.6	8.2
	24-47	3-5.9	4.9	0.0	8.2	0.0	21.3	4.9	8.2	4.9
	48-79	6-9.9	6.5	0.0	24.6	0.0	0.0	9.9	21.3	9.9
	80-119	10-14.9	0.0	0.0	4.9	0.0	0.0	8.2	11.5	8.2
	120-159	15-19.9	0.0	0.0	0.0	0.0	0.0	26.2	0.0	26.2
	160+	20+	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	$\overline{X}$ (excluding 0)		18.19	3.81	46.79	0.00	16.27	88.66	50.43	88.66
	σ		18.60	2.29	26.35	0.00	10.91	52.62	32.88	52.62

Table 5(cont.Pg.2)

NUMBER OF DAILY OPERATIONS BY TIME PERIOD AND FLIGHT PATHS
June-July 1972

F L I G H T P A T H S

Time Period	Frequency	No. Per Hour	5 OPERATIONS Arriv.	5 OPERATIONS Dep.	6 OPERATIONS Arriv.	6 OPERATIONS Dep.	7 OPERATIONS Arriv.	7 OPERATIONS Dep.
1	0	0	42.6%	90.2%	50.8%	44.3%	42.6%	49.2%
	1-17	<2	21.3	9.8	45.9	50.8	9.9	50.8
	18-26	2-2.9	8.2	0.0	0.0	3.3	9.8	0.0
	27-53	3-5.9	18.0	0.0	3.3	1.6	13.1	0.0
	54-89	6-9.9	8.2	0.0	0.0	0.0	21.3	0.0
	90-134	10-14.9	1.7	0.0	0.0	0.0	3.3	0.0
	135-179	15-19.9	0.0	0.0	0.0	0.0	0.0	0.0
	180+	20+	0.0	0.0	0.0	0.0	0.0	0.0
	$\bar{X}$(excluding 0)		33.51	2.17	5.93	9.38	44.03	5.35
	σ		27.57	1.46	7.21	6.38	27.05	3.47
	0	0	50.8	93.5	49.2	47.5	45.9	44.3
2	1-15	<2	9.9	3.3	27.9	32.8	11.5	29.5
	16-23	2-2.9	6.5	1.6	11.5	16.4	4.9	13.1
	24-47	3-5.9	8.2	1.6	4.9	3.3	8.2	13.1
	48-79	6-9.9	11.5	0.0	6.5	0.0	24.6	0.0
	80-119	10-14.9	13.1	0.0	0.0	0.0	4.9	0.0
	120-159	15-19.9	0.0	0.0	0.0	0.0	0.0	0.0
	160+	20+	0.0	0.0	0.0	0.0	0.0	0.0
	$\bar{X}$(excluding 0)		52.07	13.75	18.19	12.03	46.79	14.29
	σ		33.50	14.15	18.60	7.83	26.35	10.12

Table 5(cont.Pg.3)

NUMBER OF DAILY OPERATIONS BY TIME PERIOD AND FLIGHT PATH
June-July 1972

F L I G H T   P A T H S

Time Period	Frequency	No. Per Hour	1 OPERATIONS Arriv.	1 OPERATIONS Dep.	2 OPERATIONS Arriv.	2 OPERATIONS Dep.	3 OPERATIONS Arriv.	3 OPERATIONS Dep.	4 OPERATIONS Arriv.	4 OPERATIONS Dep.
3	0	0	63.9%	100.0%	62.3%	100.0%	32.8%	57.4%	29.5%	57.4%
	1-7	<2	14.8	0.0	6.6	0.0	14.8	11.5	16.4	11.5
	8-11	2-2.9	1.6	0.0	1.6	0.0	3.3	4.9	0.0	4.9
	12-23	3-5.9	3.3	0.0	4.9	0.0	21.3	4.9	0.0	4.9
	24-39	6-9.9	8.2	0.0	1.6	0.0	22.9	1.6	1.6	1.6
	40-59	10-14.9	8.2	0.0	3.3	0.0	3.3	3.3	6.6	3.3
	60-79	15-19.9	0.0	0.0	3.3	0.0	0.0	8.2	13.1	8.2
	80+	20+	0.0	0.0	16.4	0.0	1.6	8.2	32.8	8.2
	$\overline{X}$(excluding 0)		20.50	0.00	57.22	0.00	22.02	39.15	73.51	39.15
	σ		16.59	0.00	40.75	0.00	16.63	34.08	49.75	34.08
4	0	0	68.8	59.0	67.2	98.4	50.8	45.9	34.4	45.9
	1-5	<2	13.1	41.0	1.6	1.6	18.0	16.4	6.6	16.4
	6-8	2-2.9	6.6	0.0	0.0	0.0	6.6	6.6	1.6	6.6
	9-17	3-5.9	11.5	0.0	6.6	0.0	23.0	1.6	4.9	1.6
	18-29	6-9.9	0.0	0.0	11.5	0.0	1.6	4.9	23.0	4.9
	30-44	10-14.9	0.0	0.0	1.6	0.0	0.0	9.8	1.6	9.8
	45-59	15-19.9	0.0	0.0	9.8	0.0	0.0	3.3	11.5	3.3
	60+	20+	0.0	0.0	1.7	0.0	0.0	11.5	16.4	11.5
	$\overline{X}$(excluding 0)		7.32	1.32	31.05	1.00	8.27	28.00	36.20	28.00
	σ		4.67	0.47	17.12	.00	5.21	26.78	24.91	26.78

Table 5(cont.Pg.4)

NUMBER OF DAILY OPERATIONS BY TIME PERIOD AND FLIGHT PATH
June-July 1972

F L I G H T   P A T H S

Time Period	Frequency	No. Per Hour	4 OPERATIONS Arriv.	4 OPERATIONS Dep.	5 OPERATIONS Arriv.	5 OPERATIONS Dep.	6 OPERATIONS Arriv.	6 OPERATIONS Dep.
3	0	0	24.6%	91.8%	63.9%	45.9%	62.3%	42.6%
	1-7	<2	6.6	6.6	14.8	42.6	6.6	19.7
	8-11	2-2.9	6.6	0.0	1.6	11.5	1.6	18.0
	12-23	3-5.9	6.6	1.6	3.3	0.0	4.9	19.7
	24-39	6-9.9	6.5	0.0	8.2	0.0	1.6	0.0
	40-59	10-14.9	9.8	0.0	8.2	0.0	3.3	0.0
	60-79	15-19.9	16.4	0.0	0.0	0.0	3.3	0.0
	80+	20+	22.9	0.0	0.0	0.0	16.4	0.0
	$\bar{X}$(excluding 0)		59.48	4.20	20.50	5.36	57.22	9.57
	σ		39.18	4.66	16.59	2.33	40.75	4.53
4	0	0	18.0	95.1	68.8	45.9	67.2	42.6
	1-5	<2	8.2	4.9	13.1	42.6	1.6	26.2
	6-8	2-2.9	0.0	0.0	6.6	9.8	0.0	11.5
	9-17	3-5.9	1.7	0.0	11.5	1.7	6.6	19.7
	18-29	6-9.9	19.7	0.0	0.0	0.0	11.5	0.0
	30-44	10-14.9	4.9	0.0	0.0	0.0	1.6	0.0
	45-59	15-19.9	13.1	0.0	0.0	0.0	9.8	0.0
	60+	20+	34.4	0.0	0.0	0.0	1.7	0.0
	$\bar{X}$(excluding 0)		45.94	1.67	7.32	3.45	31.05	6.86
	σ		25.26	.94	4.67	2.36	17.12	3.79

Table 6

FREQUENCY OF TOTAL DAILY OPERATIONS BY FLIGHT PATHS, BY MONTHS

F L I G H T   P A T H S

JUNE 1972

Frequency	No. Per Hour	1 OPERATIONS A & D Total	1 OPERATIONS Arriv.	1 OPERATIONS Dep.	2 OPERATIONS A & D Total	2 OPERATIONS Arriv.	2 OPERATIONS Dep.	3 OPERATIONS A & D Total	3 OPERATIONS Arriv.	3 OPERATIONS Dep.	4 OPERATIONS A & D Total	4 OPERATIONS Arriv.	4 OPERATIONS Dep.
0	0	0.0%	40.0%	10.0%	40.0%	40.0%	96.7%	0.0%	13.4%	30.0%	0.0%	3.3%	30.0%
1-47	<2	83.3	43.3	90.0	16.7	16.6	3.3	20.0	30.0	20.0	3.4	16.7	20.0
48-71	2-29	0.0	3.3	0.0	13.3	13.3	0.0	3.3	23.3	13.3	0.0	3.3	13.3
72-143	3-5.9	16.7	13.4	0.0	16.7	16.7	0.0	40.0	30.0	16.7	10.0	20.0	16.7
144-239	6-9.9	0.0	0.0	0.0	6.7	6.7	0.0	16.7	3.3	6.7	40.0	33.3	6.7
240-359	10-14.9	0.0	0.0	0.0	6.6	6.7	0.0	13.3	0.0	10.0	23.3	16.7	10.0
360-479	15-19.9	0.0	0.0	0.0	0.0	0.0	0.0	6.7	0.0	3.3	23.3	6.7	3.3
480+	20+	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

JULY 1972

Frequency	No. Per Hour	1 OPERATIONS A & D Total	1 OPERATIONS Arriv.	1 OPERATIONS Dep.	2 OPERATIONS A & D Total	2 OPERATIONS Arriv.	2 OPERATIONS Dep.	3 OPERATIONS A & D Total	3 OPERATIONS Arriv.	3 OPERATIONS Dep.	4 OPERATIONS A & D Total	4 OPERATIONS Arriv.	4 OPERATIONS Dep.
0	0	0.0	16.1	29.0	12.9	12.9	100.0	0.0	16.1	6.4	0.0	9.7	6.5
1-47	<2	80.6	64.5	71.0	12.9	12.9	0.0	6.4	35.5	29.0	0.0	25.8	29.0
48-71	2-2.9	6.5	9.7	0.0	12.9	12.9	0.0	6.4	25.8	6.5	0.0	3.2	6.5
72-143	3-5.9	12.9	9.7	0.0	29.0	29.0	0.0	32.3	22.6	12.9	16.1	22.6	12.9
144-239	6-9.9	0.0	0.0	0.0	19.4	19.4	0.0	19.4	0.0	22.6	29.1	29.0	22.6
240-359	10-14.9	0.0	0.0	0.0	12.9	12.9	0.0	29.0	0.0	19.4	38.7	9.7	19.3
360-479	15-19.9	0.0	0.0	0.0	0.0	0.0	0.0	6.8	0.0	3.2	16.1	0.0	3.2
480+	20+	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 6 (cont.Pg.2)

FREQUENCY OF TOTAL DAILY OPERATIONS BY FLIGHT PATHS, BY MONTHS

FLIGHT PATHS

AUGUST 1972

		1 OPERATIONS			2 OPERATIONS			3 OPERATIONS			4 OPERATIONS		
Frequency	No. Per Hour	A & D Total	Arriv.	Dep.	A & D Total	Arriv.	Dep.	A & D Total	Arriv.	Dep.	A & D Total	Arriv.	Dep.
0	0	3.2%	19.4%	22.6%	16.1%	16.1%	96.8%	0.0%	3.2%	6.5%	0.0%	3.2%	6.5%
1-47	<2	90.3	74.2	77.4	16.1	16.1	3.2	3.2	32.2	22.6	0.0	9.7	22.6
48-71	2-2.9	0.0	3.2	0.0	29.0	29.1	0.0	6.4	22.6	9.7	3.2	12.9	9.7
72-143	3-5.9	6.5	3.2	0.0	12.9	12.9	0.0	32.3	32.3	41.9	12.9	12.9	41.9
144-239	6-9.9	0.0	0.0	0.0	22.6	22.6	0.0	48.4	9.7	16.1	25.8	45.2	16.1
240-359	10-14.9	0.0	0.0	0.0	3.3	3.2	0.0	6.5	0.0	0.0	45.2	16.1	0.0
360-479	15-19.9	0.0	0.0	0.0	0.0	0.0	0.0	3.2	0.0	3.2	12.9	0.0	3.2
480+	20+	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

SEPTEMBER 1972

		1 OPERATIONS			2 OPERATIONS			3 OPERATIONS			4 OPERATIONS		
Frequency	No. Per Hour	A & D Total	Arriv.	Dep.	A & D Total	Arriv.	Dep.	A & D Total	Arriv.	Dep.	A & D Total	Arriv.	Dep.
0	0	10.0	20.0	43.3	16.7	16.7	100.0	0.0	20.0	3.3	0.0	20.0	3.3
1-47	<2	60.0	53.3	56.7	13.3	13.3	0.0	10.0	43.3	23.3	3.3	30.0	26.6
48-71	2-2.9	20.0	16.7	0.0	13.3	13.3	0.0	3.3	20.0	10.0	3.3	3.3	10.0
72-143	3-5.9	10.0	10.0	0.0	30.0	30.0	0.0	30.0	16.7	13.3	16.7	13.3	10.0
144-239	6-9.9	0.0	0.0	0.0	23.3	23.3	0.0	36.7	0.0	36.7	26.7	26.7	36.7
240-359	10-14.9	0.0	0.0	0.0	3.4	3.4	0.0	13.3	0.0	6.7	40.0	6.7	6.7
360-479	15-19.9	0.0	0.0	0.0	0.0	0.0	0.0	6.7	0.0	6.7	10.0	0.0	6.7
480+	20+	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 6 (cont.Pg.3)

FREQUENCY OF TOTAL DAILY OPERATIONS BY FLIGHT PATHS, BY MONTHS

FLIGHT PATHS

		5 OPERATIONS			6 OPERATIONS			7 OPERATIONS		
Frequency	No. Per Hour	A & D Total	Arriv.	Dep.	A & D Total	Arriv.	Dep.	A & D Total	Arriv.	Dep.
JUNE 1972										
0	[illegible]	10.0%	13.3%	70.0%	0.0%	40.0%	10.0%	0.0%	40.0%	10.0%
1-47	<[illegible]	20.0	16.7	30.0	80.0	43.3	90.0	43.3	16.7	83.3
48-71	[illegible]-2.9	6.6	10.0	0.0	3.3	3.4	0.0	13.3	13.3	6.7
72-143	[illegible]-5.9	16.7	13.3	0.0	16.7	13.3	0.0	30.0	16.7	0.0
144-239	[illegible]-9.9	36.7	36.7	0.0	0.0	0.0	0.0	6.7	6.7	0.0
240-359	1[illegible]-14.9	10.0	10.0	0.0	0.0	0.0	0.0	6.7	6.6	0.0
360-479	1[illegible]-19.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
480+	20+	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
JULY 1972										
0	0	3.2	6.4	87.1	0.0	16.1	25.8	0.0	12.9	25.8
1-47	<2	16.1	12.9	12.9	30.6	64.5	74.2	16.1	9.7	71.0
48-71	2-2.9	9.7	9.7	0.0	6.5	9.7	0.0	6.4	9.7	3.2
72-143	3-5.9	22.6	22.6	0.0	12.9	9.7	0.0	45.2	35.5	0.0
144-239	6-9.9	32.3	32.3	0.0	0.0	0.0	0.0	19.4	19.3	0.0
240-359	10-14.9	16.1	16.1	0.0	0.0	0.0	0.0	12.9	12.9	0.0
360-479	15-19.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
480+	20+	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 6 (cont.Pg. 4)

FREQUENCY OF TOTAL DAILY OPERATIONS BY FLIGHT PATHS, BY MONTHS

F L I G H T P A T H S

AUGUST 1972

		5 OPERATIONS			6 OPERATIONS			7 OPERATIONS		
Frequency	No. Per Hour	A & D Total	Arriv.	Dep.	A & D Total	Arriv.	Dep.	A & D Total	Arriv.	Dep.
0	0	3.2%	3.2%	83.9%	3.2%	19.4%	16.1%	3.2%	16.1%	16.1%
1-47	<2	16.1	16.1	16.1	67.7	74.2	74.2	12.9	16.1	71.0
48-71	2-2.9	6.5	6.5	0.0	22.6	3.2	9.7	19.4	29.1	9.7
72-143	3-5.9	29.0	29.0	0.0	6.5	3.2	0.0	35.5	12.9	3.2
144-239	6-9.9	38.7	38.7	0.0	0.0	0.0	0.0	25.8	22.6	0.0
240-359	10-14.9	6.5	6.5	0.0	0.0	0.0	0.0	3.2	3.2	0.0
360-479	15-19.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
480+	20+	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

SEPTEMBER 1972

Frequency	No. Per Hour	A & D Total	Arriv.	Dep.	A & D Total	Arriv.	Dep.	A & D Total	Arriv.	Dep.
0	0	13.3	20.0	83.3	0.0	20.0	26.7	0.0	16.7	26.7
1-47	<2	23.3	16.7	16.7	63.3	53.3	73.3	20.0	13.3	70.0
48-71	2-2.9	10.0	10.0	0.0	26.7	16.7	0.0	3.3	13.3	3.3
72-143	3-5.9	30.0	30.0	0.0	10.0	10.0	0.0	46.7	30.0	0.0
144-239	6-9.9	20.0	20.0	0.0	0.0	0.0	0.0	26.7	23.3	0.0
240-359	10-14.9	3.4	3.3	0.0	0.0	0.0	0.0	3.3	3.4	0.0
360-479	15-19.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
480+	20+	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 7

FREQUENCY OF TOTAL WEEKLY OPERATIONS BY FLIGHT PATHS, BY MONTHS

JUNE 1972

		FLIGHT PATHS											
		1 OPERATIONS			2 OPERATIONS			3 OPERATIONS			4 OPERATIONS		
Frequency	No. Per Hour	A & D Total	Arriv.	Dep.	A & D Total	Arriv.	Dep.	A & D Total	Arriv.	Dep.	A & D Total	Arriv.	Dep.
0	0	0%	0%	0%	0%	0%	100%	0%	0%	0%	0%	0%	0%
1-335	< 2	75	100	100	50	50	0	0	50	50	0	0	50
336-503	2-2.9	25	0	0	0	0	0	25	25	0	0	0	0
504-1007	3-5.9	0	0	0	50	50	0	25	25	50	0	50	50
1008-1679	6-9.9	0	0	0	0	0	0	50	0	0	50	25	0
1680-2519	10-14.9	0	0	0	0	0	0	0	0	0	50	25	0

JULY 1972

Frequency	No. Per Hour	1 A & D Total	1 Arriv.	1 Dep.	2 A & D Total	2 Arriv.	2 Dep.	3 A & D Total	3 Arriv.	3 Dep.	4 A & D Total	4 Arriv.	4 Dep.
0	0	0	0	0	0	0	100	0	0	0	0	0	0
1-335	< 2	75	75	100	0	0	0	0	50	0	0	25	0
336-503	2-2.9	25	25	0	25	25	0	0	25	0	0	0	0
504-1007	3-5.9	0	0	0	50	50	0	0	25	75	0	25	75
1008-1679	6-9.9	0	0	0	25	25	0	75	0	0	25	50	0
1680-2519	10-14.9	0	0	0	0	0	0	25	0	25	75	0	25

Table 7 (cont.Pg.2)

FREQUENCY OF TOTAL WEEKLY OPERATIONS BY FLIGHT PATHS, BY MONTHS

FLIGHT PATHS

AUGUST 1972

		1 OPERATIONS			2 OPERATIONS			3 OPERATIONS			4 OPERATIONS		
Frequency	No. Per Hour	A & D Total	Arriv.	Dep.	A & D Total	Arriv.	Dep.	A & D Total	Arriv.	Dep.	A & D Total	Arriv.	Dep.
0	0	0%	0%	0%	0%	0%	75%	0%	0%	0%	0%	0%	0%
1-335	< 2	100	100	100	0	0	25	0	0	0	0	0	0
336-503	2-2.9	0	0	0	50	50	0	0	50	25	0	0	25
504-1007	3-5.9	0	0	0	50	50	0	25	50	75	0	50	75
1008-1679	6-9.9	0	0	0	0	0	0	75	0	0	25	50	0
1680-2519	10-14.9	0	0	0	0	0	0	0	0	0	75	0	0

SEPTEMBER 1972

0	0	0	0	0	0	0	100	0	0	0	0	0	0
1-335	< 2	100	100	100	0	0	0	0	75	0	0	0	0
336-503	2-2.9	0	0	0	0	0	0	0	25	0	0	25	0
504-1007	3-5.9	0	0	0	100	100	0	25	0	50	0	75	50
1008-1679	6-9.9	0	0	0	0	0	0	75	0	50	50	0	50
1680-2519	10-14.9	0	0	0	0	0	0	0	0	0	50	0	0

Table 7 (cont.Pg.3)

FREQUENCY OF TOTAL WEEKLY OPERATIONS BY FLIGHT PATHS, BY MONTHS

FLIGHT PATHS

		5 OPERATIONS			6 OPERATIONS			7 OPERATIONS		
Frequency	No. Per Hour	A & D Total	Arriv.	Dep.	A & D Total	Arriv.	Dep.	A & D Total	Arriv.	Dep.
JUNE 1972										
0	0	0%	0%	25%	0%	0%	0%	0%	0%	0%
1-335	< 2	0	0	75	75	100	100	25	50	100
336-503	2-2.9	25	25	0	25	0	0	25	0	0
504-1007	3-5.9	75	75	0	0	0	0	50	50	0
1008-1679	6-9.9	0	0	0	0	0	0	0	0	0
1680-2519	10-14.9	0	0	0	0	0	0	0	0	0
JULY 1972										
0	0	0	0	50	0	0	0	0	0	0
1-335	< 2	0	0	50	75	75	100	0	0	100
336-503	2-2.9	0	0	0	25	25	0	0	25	0
504-1007	3-5.9	50	50	0	0	0	0	75	50	0
1008-1679	6-9.9	50	50	0	0	0	0	25	25	0
1680-2519	10-14.9	0	0	0	0	0	0	0	0	0

Table 7 (cont.Pg.4)

FREQUENCY OF TOTAL WEEKLY OPERATIONS BY FLIGHT PATHS, BY MONTHS

FLIGHT PATHS

AUGUST 1972

		5 OPERATIONS			6 OPERATIONS			7 OPERATIONS		
Frequency	No. Per Hour	A & D Total	Arriv.	Dep.	A & D Total	Arriv.	Dep.	A & D Total	Arriv.	Dep.
0	0	0%	0%	25%	0%	0%	0%	0%	0%	0%
1-335	< 2	0	0	75	75	100	100	0	0	100
336-503	2-2.9	0	0	0	25	0	0	0	50	0
504-1007	3-5.9	50	50	0	0	0	0	75	50	0
1008-1679	6-9.9	50	50	0	0	0	0	25	0	0
1680-2519	10-14.9	0	0	0	0	0	0	0	0	0

SEPTEMBER 1972

0	0	0	0	25	0	0	0	0	0	0
1-335	< 2	0	0	75	50	100	100	0	0	100
336-503	2-2.9	25	25	0	50	0	0	0	0	0
504-1007	3-5.9	75	75	0	0	0	0	100	100	0
1008-1679	6-9.9	0	0	0	0	0	0	0	0	0
1680-2519	10-14.9	0	0	0	0	0	0	0	0	0

with about 40% of all days during July and September experiencing over 17 hours of overflights per day. Table 8 shows these variations in hours of daily overflight by flight path.

Table 9 presents the fluctuations in hours of overflight by time period. During the night-time period 1, flight paths 5 and 6 experienced an average of about 3 hours per night, while flight paths 3 and 4 received twice as much exposure during the month of June.

B. Likert Summated Scales used in Analyses

1. Aircraft Noise Annoyance

Previous researchers have used the aircraft noise disturbance model as a method for measuring an individual's positive or negative feelings towards aircraft noise. The rationale has been to measure the number of disturbances and the degree of annoyance caused by each disturbance. The model was developed from earlier in-depth interviews and answers to open questions about the characteristics of reported annoyance with aircraft noise. 1/2/ The aircraft sounds were unwanted noise, because they interfered or disturbed activities which the respondent wanted. Since factor and scalogram analyses indicated various reported disturbances were related, it was decided to combine them into a single scale of intensity of annoyance.

An 11 item scale was used based on Q.24 in the questionnaire as follows:

"Can you tell me if the noise from airplanes ever (ask each item below) (Do they ever?......)

1. Interfere with your listening to radio or TV? ....
2. Make the TV picture flicker? ....
3. Startle or frighten anyone in your family? ....
4. Disturb your family's sleep? ....
5. Make your house rattle or shake? ....
6. Interfere with family's rest or relaxation?
7. Interfere with conversation? ....
8. Make you keep your windows shut during the day? ....
9. Make you keep your windows shut at night? ....
10. Make you feel tense and edgy? ....
11. Give you a headache? ....

For each "yes", a subquestion was asked, "And how disturbed or annoyed does this make you feel? (0 = none, 4 = very much). Since there are 11 items, the range in scale scores are 0-44.

Based upon a factor analysis (Principal Components, varimax rotation) it was determined that all items formed a general factor. The annoyance scale was, therefore,

Table 8

TOTAL DAILY HOURS OF OVERFLIGHT BY FLIGHT PATH AND MONTH

		FLIGHT PATHS						
		1	2	3	4	5	6	7
MONTH	Hrs. of Overflight	Percent Days	Percent Days	Percent Days	Percent Days	Percent Days	Percent Days	Percent Days
June 1972	0	10.0%	40.0%	3.4%	0.0%	13.3%	0.0%	3.3%
	1-3	40.0	20.0	13.3	13.3	13.3	23.3	10.0
	4-7	30.0	13.3	6.7	6.7	30.0	26.7	26.7
	8-10	10.0	16.7	10.0	20.0	10.0	36.7	33.3
	11-16	10.0	3.3	43.3	33.3	33.4	13.3	16.7
	17+	0.0	6.7	23.3	36.7	0.0	0.0	10.0
	Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0
July 1972	0	19.4	12.9	0.0	0.0	9.7	9.7	3.2
	1-3	29.0	9.7	6.5	3.2	25.8	25.8	6.5
	4-7	29.0	22.6	9.7	6.5	19.4	35.5	12.9
	8-10	19.4	16.1	16.1	9.7	16.1	16.1	25.8
	11-16	3.2	19.3	29.0	38.7	25.8	12.9	29.0
	17+	0.0	19.4	38.7	41.9	3.2	0.0	22.6
	Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0
August 1972	0	19.4	16.1	0.0	0.0	12.9	6.5	3.2
	1-3	35.5	9.7	3.2	3.2	9.7	12.9	3.2
	4-7	29.0	25.8	6.5	3.2	41.9	41.9	12.9
	8-10	12.9	6.4	25.8	19.4	25.8	25.8	16.1
	11-16	3.2	32.3	38.7	41.9	6.5	12.9	42.0
	17+	0.0	9.7	25.8	32.3	3.2	0.0	22.6
	Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Sept. 1972	0	13.3	16.7	3.3	0.0	26.7	6.7	6.7
	1-3	30.0	6.6	3.3	6.7	13.3	16.7	6.7
	4-7	30.0	26.7	10.0	6.7	43.3	36.7	10.0
	8-10	10.0	10.0	16.7	13.3	6.7	13.3	13.3
	11-16	16.7	30.0	30.0	33.3	6.7	26.6	43.3
	17+	0.0	10.0	36.7	40.0	3.3	0.0	20.0
	Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Table 9

TOTAL HOURS OF OVERFLIGHT BY TIME PERIOD AND FLIGHT PATH

A. JUNE 1972

Time Period	Hrs. of Overflight	FLIGHT PATHS 1 Percent Days	2 Percent Days	3 Percent Days	4 Percent Days	5 Percent Days	6 Percent Days	7 Percent Days
1	0	16.7%	56.7%	16.7%	6.7%	40.0%	13.3%	30.0%
	1	23.3	10.0	16.7	10.0	16.7	26.7	26.7
	2-3	26.7	13.3	6.7	10.0	16.7	26.7	20.0
	4-6	26.7	6.7	23.3	26.7	23.3	26.7	10.0
	7-9	6.6	13.3	36.6	46.6	3.3	6.6	13.3
	Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0
	$\overline{X}$(excluding 0)	3.20	4.15	5.60	6.07	3.22	3.27	3.14
	σ	2.06	2.68	3.03	2.83	2.07	2.10	2.53
2	0	60.0	63.3	26.7	20.0	46.7	30.0	26.7
	1-2	20.0	6.7	10.0	10.0	20.0	16.7	10.0
	3-5	6.7	26.7	16.7	13.3	10.0	33.3	26.7
	6-7	13.3	0.0	30.0	26.7	6.7	20.0	30.0
	8	0.0	3.3	16.6	30.0	16.6	0.0	6.6
	Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0
	$\overline{X}$(excluding 0)	3.25	4.18	5.68	6.12	4.62	3.90	4.95
	σ	2.20	1.59	2.18	2.17	2.89	1.72	2.12
3	0	76.7	70.0	20.0	16.7	33.3	46.7	20.0
	1	3.3	10.0	13.3	3.3	10.0	30.0	13.3
	2	10.0	3.3	10.0	10.0	23.3	13.3	26.7
	3	6.7	6.7	36.7	33.3	20.0	6.7	26.7
	4	3.3	10.0	20.0	36.7	13.4	3.3	13.3
	Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0
	$\overline{X}$(excluding 0)	2.43	2.56	2.79	3.24	2.55	1.69	2.50
	σ	.90	1.26	1.00	.81	.97	.92	.96
4	0	86.7	86.7	50.0	26.7	50.0	80.0	53.3
	1	6.7	0.0	23.3	16.7	10.0	13.3	26.7
	2	6.6	0.0	6.7	13.3	13.3	6.7	3.3
	3	0.0	13.3	20.0	43.3	26.7	0.0	16.7
	Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0
	$\overline{X}$(excluding 0)	1.50	3.00	1.93	2.36	2.33	1.33	1.79
	σ	.50	.00	.93	.83	.79	.47	.94

Table 9(cont,Pg.2)

TOTAL HOURS OF OVERFLIGHT BY TIME PERIOD AND FLIGHT PATH

B. JULY 1972

Time Period	Hrs. of Overflight	FLIGHT PATHS 1 Percent Days	2 Percent Days	3 Percent Days	4 Percent Days	5 Percent Days	6 Percent Days	7 Percent Days
1	0	48.4%	29.0%	3.2%	0.0%	45.2%	48.4%	22.6%
	1	22.6	6.5	16.1	12.9	16.1	22.6	9.7
	2-3	12.9	12.9	22.6	22.6	29.0	12.9	12.9
	4-6	9.7	25.8	12.9	19.3	3.2	9.7	29.0
	7-9	6.4	25.8	45.2	45.2	6.5	6.4	25.8
	Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0
	$\bar{X}$(excluding 0)	2.75	5.09	5.33	5.52	2.65	2.75	4.96
	σ	2.17	2.66	3.18	3.09	2.11	2.17	2.67
2	0	45.2	29.0	16.1	9.7	51.6	22.6	9.7
	1-2	16.1	25.8	12.9	16.1	19.3	22.6	22.6
	3-5	29.0	3.2	12.9	9.7	6.5	35.5	16.1
	6-7	6.5	19.4	25.8	16.1	16.1	16.1	19.3
	8	3.2	22.6	32.3	48.4	6.5	3.2	32.3
	Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0
	$\bar{X}$(excluding 0)	3.76	5.14	6.12	6.29	4.40	3.87	5.39
	σ	1.99	2.82	2.14	2.36	2.63	1.96	2.62
3	0	74.2	58.1	16.1	12.9	29.0	48.4	16.1
	1	6.5	16.1	22.6	12.9	12.9	32.3	29.0
	2	0.0	6.4	29.0	32.3	12.9	0.0	25.8
	3	6.4	0.0	12.9	12.9	29.0	6.4	6.5
	4	12.9	19.4	19.4	29.0	16.1	12.9	22.6
	Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0
	$\bar{X}$(excluding 0)	3.00	2.54	2.35	2.67	2.68	2.00	2.27
	σ	1.22	1.39	1.11	1.09	1.02	1.32	1.19
4	0	90.3	74.2	45.2	38.7	35.5	87.1	58.1
	1	3.2	9.7	29.0	19.3	0.0	6.5	12.9
	2	3.2	0.0	3.2	6.5	12.9	3.2	6.4
	3	3.3	16.1	22.6	35.5	51.6	3.2	22.6
	Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0
	$\bar{X}$(excluding 0)	2.00	2.25	1.88	2.26	2.80	1.75	2.23
	σ	.82	.97	.96	.91	.40	.83	.89

Table 9 (cont.Pg.3)

TOTAL HOURS OF OVERFLIGHT BY TIME PERIOD AND FLIGHT PATH

C. AUGUST 1972

		FLIGHT PATHS						
		1	2	3	4	5	6	7
Time Period	Hrs. of Overflight	Percent Days	Percent Days	Percent Days	Percent Days	Percent Days	Percent Days	Percent Days
1	0	29.0%	25.8%	12.9%	12.9%	42.0%	29.0%	19.3%
	1	38.7	3.2	6.4	6.5	16.1	38.7	9.7
	2-3	19.4	9.7	32.3	25.8	38.7	19.4	9.7
	4-6	3.2	19.4	19.4	25.8	3.2	3.2	19.4
	7-9	9.7	41.9	29.0	29.0	0.0	9.7	41.9
	Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0
	$\bar{X}$(excluding 0)	2.45	6.00	4.96	5.15	1.89	2.45	5.64
	σ	2.25	2.27	2.71	2.63	.74	2.25	2.51
2	0	54.8	38.7	12.9	12.9	74.2	19.3	9.7
	1-2	22.6	6.5	12.9	12.9	0.0	12.9	6.4
	3-5	12.9	29.0	9.7	3.2	19.4	48.4	22.6
	6-7	9.7	12.9	22.6	16.1	0.0	19.4	35.5
	8	0.0	12.9	41.9	54.9	6.4	0.0	25.8
	Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0
	$\bar{X}$(excluding 0)	3.14	5.16	6.44	6.74	4.50	4.12	5.86
	σ	2.03	2.08	2.10	2.12	2.06	1.70	2.10
3	0	80.7	80.7	16.1	16.1	29.0	32.2	22.6
	1	12.9	3.2	9.7	6.5	9.7	45.2	22.6
	2	3.2	9.7	35.5	29.0	12.9	12.9	19.4
	3	3.2	3.2	12.9	19.4	32.3	9.7	16.1
	4	0.0	3.2	25.8	29.0	16.1	0.0	19.3
	Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0
	$\bar{X}$(excluding 0)	1.50	2.33	2.65	2.85	2.77	1.48	2.42
	σ	.76	.94	1.04	.99	.95	.73	1.15
4	0	87.1	83.9	67.7	48.4	32.3	83.9	67.7
	1	3.2	0.0	9.7	12.9	3.2	3.2	12.9
	2	6.5	3.2	6.5	9.7	6.4	9.7	0.0
	3	3.2	12.9	16.1	29.0	58.1	3.2	19.4
	Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0
	$\bar{X}$(excluding 0)	2.00	2.80	2.20	2.31	2.81	2.00	2.20
	σ	.71	.40	.87	.85	.50	.63	.93

Table 9 (cont.Pg.4)

TOTAL HOURS OF OVERFLIGHT BY TIME PERIOD AND FLIGHT PATH

D. SEPT. 1972

Time Period	Hrs. of Overflight	FLIGHT PATHS 1 Percent Days	2 Percent Days	3 Percent Days	4 Percent Days	5 Percent Days	6 Percent Days	7 Percent Days
1	0	40.0%	26.7%	20.0%	13.3%	60.0%	40.0%	23.3%
	1	26.7	13.3	6.7	6.7	13.3	26.7	16.7
	2-3	16.7	30.0	20.0	23.3	13.3	16.7	23.3
	4-6	10.0	13.3	16.7	20.0	10.0	10.0	20.0
	7-9	6.6	16.7	36.6	36.7	3.4	6.6	16.7
	Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0
	$\bar{X}$(excluding 0)	2.94	3.91	5.54	5.35	2.92	2.94	3.91
	σ	2.46	2.43	2.80	2.85	2.25	2.46	2.41
2	0	50.0	40.0	13.3	13.3	80.0	23.3	16.7
	1-2	16.7	3.3	16.7	16.7	10.0	16.7	10.0
	3-5	13.3	23.3	3.3	0.0	3.3	30.0	10.0
	6-7	16.7	6.7	16.7	13.3	0.0	26.7	26.7
	8	3.3	26.7	50.0	56.7	6.7	3.3	36.6
	Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0
	$\bar{X}$(excluding 0)	4.47	6.06	6.38	6.62	4.17	4.57	6.32
	σ	2.19	1.99	2.50	2.40	3.02	1.91	2.26
3	0	60.0	60.0	20.0	20.0	46.7	26.7	23.3
	1	6.7	3.3	6.7	6.7	13.3	33.3	13.4
	2	16.7	10.0	26.7	20.0	20.0	23.3	23.3
	3	3.3	10.0	6.6	13.3	13.3	3.3	10.0
	4	13.3	16.7	40.0	40.0	6.7	13.4	30.0
	Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0
	$\bar{X}$(excluding 0)	2.58	3.00	3.00	3.08	2.25	1.95	2.74
	σ	1.11	1.00	1.08	1.04	.91	1.11	1.15
4	0	83.3	73.4	46.7	40.0	46.7	80.0	60.0
	1	6.7	3.3	20.0	13.3	6.7	10.0	10.0
	2	6.7	3.3	13.3	16.7	10.0	6.7	6.7
	3	3.3	20.0	20.0	30.0	36.6	3.3	23.3
	Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0
	$\bar{X}$(excluding 0)	1.80	2.62	2.00	2.28	2.56	1.67	2.33
	σ	.75	.70	.87	.80	.70	.75	.85

constructed by summating annoyance ratings for the eleven activity disturbance items. TRACOR (1970) had previously demonstrated that an unequal weighting system based upon factor loadings contributed little to improvement in the prediction of annoyance by predictor variables similar to those used in the present study. A measure of internal consistency or reliability (coefficient alpha, cf. Nunnally (1967) p.196) yielded values of r=.91 and r=.93 for the aircraft noise annoyance scales for June-July and August-September.

2. Noise Exposure

CNR (Composite Noise Rating, (Galloway and Bishop, 1970) was used as the primary composite measure of community aircraft noise exposure. CNR was calculated from known PNL values for existing aircraft and operations data at JFK for the periods June-July and August-September 1972. The following equations were used in the computation;

$$CNR_j = PNL_j + 10\log_{10}(N_{D_j} + 20\, N_{N_j}) - 12$$

$$CNR = 10\log_{10} \sum_j \text{antilog}\,(CNR_j / 10)\ ,$$

where j refers to a particular class of aircraft operation and N_{D_j} and N_{N_j} are the mean number of occurrences during day and night respectively.

Although there are a number of objections to the use of this scale, it seems to be related to aircraft noise annoyance (as measured by the activities disturbance model) as well as any of the other conventional measures of exposure (TRACOR, 1970).

3. Fear

The fear scale used in the present study consisted of a summation of four items from the community questionnaire. Fear is defined as a belief that aircraft flying overhead poses a threat to one's safety. The noise connotes an approaching plane and fear is the belief that it may crash into the place where the person is located. The Likert summated ratings technique 10/ is used to measure the intensity of a human response. In this process, the separate scores for response categories of a set of questions, all representing a particular dimension or attribute, are summed to form a composite rating. By using a set of questions rather than a single question, greater reliability in the measurement of the dimension or attribute is usually obtained.

Question 5B, Item 8 - Respondents were asked how much they disliked twelve aspects that apply to living conditions in their community. Each respondent referred to an "opinion thermometer" on which "0" corresponded to "none" and "4" corresponded to "Very Much". In Question 5B, Item 8, respondents rated the dislike of ....

Unsafe low-flying airplanes ....

Question 22D. How much does the noise from (item) startle or frighten you? The question was asked for various (5) noise sources. The response to airplane noise was used in the fear scale. Again the response choices ranged from "0" (not at all) to "4" (very much).

Question 27. When you see or hear airplanes fly by, how often do you feel they are flying too low for the safety of the residents around here? Response choices were "0" (not at all) to "4" (very often).

Question 28. "And how often do you feel there is some danger that they might crash nearby?" Response choices were "0" (not at all) to "4" (very often).

Each respondent's fear score was obtained by summing the responses to each of the four fear items. Since possible responses for each item were 0, 1, 2, 3, 4, the range of fear scores was 0-16.

These items have strong face validity as well as high item intercorrelation. Since actual experience indicates that most crashes occur within a few miles from the boundaries of airports, it is significant to note in Table 10 that over half the residents living within about a mile of the airport report high fear compared to only 15% of the residents in distant areas. Conversely, only 20% of the close residents report low fear compared to 47% of the distant residents. In addition, a number of the items have been shown to be related to annoyance in previous research (Borsky, 1961; McKennell, 1963; TRACOR, 1970). The coefficient of reliability for the fear scale is r=.84.

Table 10 shows the distribution of respondents by fear score and residential area. The cutting points of the scale, into three groups were determined by two factors: a) a sufficient number of eligible subjects (36) were required in laboratory studies 12/ for each fear and distance group, allowing for refusals and other reasons for not being available, b) the low fear group should represent as little fear as possible. Other research dictated these criteria.

Table 11 shows the relation between fear and annoyance for each fear scale score group.

4. Misfeasance

The concept of misfeasance is an outgrowth of Borsky's (1961) concept of "considerateness", McKennell's (1963) concept of "preventability", and TRACOR's (1970) concept of "misfeasance". This scale was intended to measure the respondents' belief that various agents connected with aircraft noise production are capable of reducing the noise but for some insufficient reason are not. The agents in the present scale include "the people who run the airlines", "the airport officials", "the other governmental officials", "the pilots", "the designers and makers of airplanes", and "the community leaders".

A six item scale was used with a coefficient of reliability (alpha) of .76. Each item had a response range of 0-4, so the total scores ranged from 0-24. On Question 36, respondents were asked, "Would you say any of these people are in a position to do anything about the aircraft noise around here?" The coefficient of reliability (alpha) for the misfeasance scale is r =.76.

5. Health Attitudes

McKennell (1963) reported a strong relationship between the belief that aircraft exposure affected the respondent's health and annoyance. In the present questionnaire, respondents were asked, "How harmful do you feel the airplane noise is to your health?" This item was scored 0-4 with 4 being very much.

6. Importance of Aircraft

A small relationship (r=.12) was reported by McKennell (1963) between an aircraft importance scale and annoyance. In present study respondents were asked how important they felt commercial airplanes were to a) national welfare, b) the community

TABLE 10

Reported Number Respondents by Fear and Distance of Residence

	Fear Score	Total	Close	Middle	Distant
			DISTANCE		
A. Low Fear (0-1)					
	0	234	47	63	119
	1	109	23	43	43
	Total	343	70	111	162
	$\bar{X}$ fear	.32	.33	.39	.27
	S	.47	.47	.49	.44
B. Medium Fear (2-7)	2	101	26	34	41
	3	93	31	31	31
	4	60	15	25	20
	5	46	18	17	11
	6	49	19	17	13
	7	33	17	5	11
	Total	382	126	129	127
	$\bar{X}$ fear	3.86	4.19	3.74	3.66
	S	1.64	1.74	1.50	1.65
C. High Fear (8-16)	8	45	16	17	12
	9	49	21	19	9
	10	37	19	12	6
	11	36	19	11	6
	12	46	27	14	5
	13	28	14	11	3
	14	40	20	14	6
	15	20	14	6	0
	16	33	20	9	4
	Total	334	170	113	51
	$\bar{X}$ fear	11.59	11.95	11.41	10.78
	S	2.56	2.53	2.55	2.52

TABLE 11

Annoyance Scale Scores by Fear and Distance of Residence

		Fear Score	Total $\bar{X}$	Total S_T	Close $\bar{X}$	Close S_C	Middle $\bar{X}$	Middle S_M	Distant $\bar{X}$	Distant S_D
A.	Low Fear (0-1)	0	4.5	5.8	5.9	8.0	4.6	5.6	4.0	4.8
		1	7.3	6.2	8.6	7.2	7.2	6.1	6.7	5.8
		Total	5.41	6.1	6.7	7.8	5.9	5.9	4.7	5.2
B.	Medium Fear (2-7)	2	9.7	9.1	13.9	9.8	7.3	6.1	9.1	9.8
		3	9.9	7.7	11.6	9.3	10.2	8.1	7.8	4.9
		4	13.3	8.2	17.2	7.9	11.6	8.4	12.4	7.4
		5	12.0	7.4	12.1	6.9	13.5	8.8	9.4	5.6
		6	15.7	10.3	19.3	9.9	15.1	11.9	11.3	6.6
		7	17.6	10.7	20.8	11.4	18.4	6.7	12.3	9.6
		Total	12.03	9.1	15.2	9.8	11.1	8.7	9.8	7.8
C.	High Fear (8-16)	8	19.0	9.4	21.9	8.6	16.3	8.9	18.9	10.8
		9	20.5	11.2	22.7	10.3	21.5	12.4	13.2	8.1
		10	20.5	9.2	21.8	7.7	23.3	9.5	11.0	8.2
		11	24.1	9.6	24.2	9.5	22.1	11.1	27.3	7.7
		12	24.3	10.8	25.2	10.5	26.1	11.2	14.4	7.2
		13	30.7	9.0	35.2	6.4	26.4	9.9	25.3	6.1
		14	26.5	10.5	29.7	11.0	25.0	9.7	19.3	7.2
		15	32.7	7.5	33.4	8.7	31.0	3.6	--	--
		16	32.6	8.3	35.4	8.5	30.8	5.1	22.8	4.6
		Total	24.7	10.8	27.3	10.5	23.7	10.5	18.3	9.4
Grand Total			13.9	11.8	19.2	12.7	13.4	11.4	8.7	8.4

and c) their own family. Each item was scored 0-4 with 4 meaning very important. The sum of these three items was termed respondents' feelings of aircraft importance, and formed a scale with a range in scores of 0-12.

C. <u>Comparison of Likert Summated Annoyance responses with aircraft noise with single summary question responses</u>.

Question 1 of the interview asked for an overall rating of the community as a place to live. Question 2 was an open general question about any advantages to living in the community. Question 3 was an open question about any dislikes, nuisances or irritations involved in living in the community. Question 4 was an open question about "any possibly dangerous or frightening conditions". Question 5 was the first direct question about 11 general factors affecting the quality of living in the community. All respondents were asked:

> Q.5 A. Now here is a list of things some people dislike about their neighborhoods. (Hand Card 1 to Respondent). For each item, please tell me whether it describes the way <u>you</u> feel about this area. First, do you feel this area is an especially expensive place to live? (Is it ......does it have?)

For each item disliked, the respondent was asked:

> "Now thinking of (it being ...... item disliked) around here, how much do you dislike it? Remember that "very much" would be "4", "not at all" would be "zero". How much do you dislike it being (item)? The items were:

1. Especially expensive place to live ......
2. Poor or inconvenient location ....
3. Inadequate community facilities, poor schools, shopping ....
4. Aircraft noise ......
5. Traffic and other noise ......
6. Dangerous traffic conditions ......
7. Unsafe to walk at night ......
8. Unsafe low-flying airplanes ......
9. Overcrowded, not enough privacy ......
10. Poor neighbors - unfriendly ......
11. Bad odors and air pollution ......

Item 4 of Q.5 was "dislike" of aircraft noise, embedded in the context of general dislikes.

Questions 6 [illegible] deal with action behavior of the most disliked item mentioned in Q.5, about general sleep behavior and a general noise rating of the community. <u>Then Q.22</u> is asked about the kinds of noises sometimes heard. For each type of noise volunteered, a series of sub-questions are asked, of which a summary noise annoyance question is included as the sixth sub-question as follows:

> Q.22 F. And how much does the noise from (item) disturb, bother or annoy you?

Since aircraft noise is one type of noise usually mentioned, the answer to this sub-question can also be compared to the Likert summated annoyance scale consisting of 11 separate items.

The 0-4 response scales used in these analyses are ordinal, i.e. the categories are rank ordered and the distances between the categories are not defined. There are considerable differences in opinions among statisticians about the importance in differentiating between ordinal and interval scales (distances between categories are defined), especially summated scales and the appropriateness of using parametric statistics for interval data and non-parametric statistics for ordinal data. Paul Leslie Gardner, in a recent review of these questions, concluded that:

1. "The distinction between ordinal and interval scales is not sharp. Many summated scales yield scores that, although not strictly of interval strength, are only mildly distorted versions of an interval scale.

2. "Some of the arguments underlying the assertion that parametric procedures require interval strength statistics appear to be of doubtful validity.

3. "Parametric procedures are, in any case, robust and yield valid conclusions even when mildly distorted data are fed into them. Furthermore, if the distortions are severe, various transformation techniques can be applied to the data. 14/

To test empirically these conclusions, every correlation reported in this study was calculated both ways, parametric Pearson, and non-parametric Spearman methods. In the hundreds of pairs of correlations calculated, not one proved substantially different in the two methods. For example, the Pearson coefficients of correlation between the summated annoyance score and the aircraft annoyance answers to Q.5 and Q.22 are r=.61 and r=.67, while the Spearman correlations are r=.65 and r=.71. These correlations are statistically significant well beyond the p.01 level. For such a large sample of 1465 respondents, a Pearson correlation of r=.051 is significant at the p.05 level, and a correlation of r=.067 is statistically significant at the p.01 level. It should be noted, however, that the Q.5 summary answer explained only 37% of the variance in the 11-item annoyance scale scores. Likewise, answers to even Q.22F, which has a somewhat higher correlation, explained only 45% of the variance in the 11-item scale scores. The regression equations for the Pearson correlations are:

$$Q.5 - y = .76x + 1.67$$
$$Q.22F - y = .67x + 1.56$$

Since our actual calculations indicate that there are no substantial differences in parametric and non-parametric correlations for our data, and since multiple correlations require parametric techniques, only parametric data will usually be presented in this report.

When the summated scale score is divided by the number of items (11) to make it a comparable 0-4, five point scale, the mean annoyance for all subjects was 1.67. The overall mean annoyance score for Q.5 was 2.93 and for Q.22 was 2.89. A "t" test of these means clearly establishes the statistical significance of the differences between the summated and single annoyance questions. The "t" value for the Q.5 comparison was 25.83 and for Q.22 comparison was 25.63. It should be noted that the average summated annoyance score produces less variation in response than the single questions.

For this size sample, a "t" value of 1.96 is significant at the p.05 level and a value of 2.58 is significant at the p.01 level. When a correlation coefficient is not significant, it will be so stated; otherwise it may be assumed to be statistically significant.

D. Relationship of Summated Aircraft Annoyance and other Emotional Responses

In the course of the interview, questions were asked about emotional feelings about non-aircraft items. Answers to five of these items are compared below:

In general, correlations with other emotional responses are fairly low, in comparison to the correlation between aircraft annoyance and specific fear of aircraft crashes.

1. Dangerous traffic conditions - Item 6 of Q.5 was degree of dislike of dangerous traffic. The correlation with aircraft annoyance is r=.12 which is significant. The non-parametric correlation is r=.11. The "t" value was 7.67, clearly indicating the differences in the two means.

2. Unsafe to walk at night - Item 7 of Q.5 dealt with danger of walking at night. The correlation with aircraft annoyance is r=.45. The non-parametric correlation is r=.44. The "t" value is 19.04, establishing the difference in the two means.

3. Startled or frightened by cars, trucks or motorcycle noise - On Q.22, one of the sub-parts is:

> D. How much does the noise from (item) startle or frighten you? (use Degree Scale)

The correlation between cars and trucks with aircraft noise annoyance is r=.22, and r=.23 with motorcycles. Both of these correlations, while significant, are less than other answers directly related to aircraft. The "t" values are also clearly significant. The value for cars and trucks is 27.51 and 18.50 for motorcycles.

4. General noise sensitivity - Q.41 of the interview, towards the very end of the questionnaire was as follows:

> Q.41 - Now here's a different kind of question. I have a list of noises which sometimes annoy people. Do these ever annoy you when you hear them? (Read list) First:
>
> A. The noise of a lawn mower ....
> B. A dripping faucet ....
> C. A dog barking continuously ....
> D. The sound of a knife scraping on a plate ....
> E. Somebody whistling out of tune ....
> F. Chalk scraping a blackboard ....
> G. A pneumatic drill or air hammer ....
> H. A banging door ....
> I. Musical instruments in practice ....
> J. Typewriters ....

"Yes" answers to this question comprise a 10-point scale. The correlation with aircraft annoyance is only r=.03, not a statistically significant relationship. The "t" value is 35.11.

5. Overall satisfaction with community - As previously noted, Q.1 opened with a 5-point rating of overall satisfaction or dissatisfaction with the community.

The actual question was:

1. The first question is: In general, how do you like living in this part of (name of area)? Do you rate it as an excellent, good, fair, poor, or very poor place to live?

Excellent	1
Good	2
Fair	3
Poor	4
Very poor	5
Don't know	X
Office use	Y

The correlation with aircraft annoyance is r=.12, i.e. the poorer the overall rating, the greater the aircraft annoyance.

This relationship is reaffirmed by the scale obtained by combining answers to the 11 direct questions included in Q.5. A maximum dislike score of 44 can be reported on this overall dissatisfaction scale. The correlation with aircraft annoyance is r=.52, and the "t" value is 21.62, indicating different means. The correlation between the answer to Q.1 and the combined 11-item index is r=.28, with a "t" value of 44, for comparable means.

In earlier research, similar findings suggested the possibility of a "transposition effect". The more people dislike many things about their communities, about which they may feel powerless, the more they may transpose these hostile feelings against aircraft noise, which many feel can be reduced.

6. Fear of aircraft - On Q.22, degree of startle or fright from aircraft noise was reported. The correlation with aircraft noise annoyance is r=.61, i.e. aircraft noise annoyance is very highly associated with fear of aircraft. Voluntary comments recorded by interviewers clearly attest to the intense feelings of fear by highly annoyed residents. The "t" value is 3.08 beyond the p.01 level.

The correlation between the summated fear index (4 questions described in Section B) is even greater, r=.73, the highest single correlation between aircraft noise annoyance and any other variable. The "t" value calculated on comparable means is 6.86, establishing the difference between the means.

E. Relationships between Annoyance with Aircraft Noise and other Behavioral Reactions

1. Health effects - After the 11-item question on activities affected by aircraft noise, Q.25 was asked: "How harmful do you feel the airplane noise is to your health?" The correlation between answers to this health question and aircraft annoyance was very high, r=.65. A "t" test indicated no significant difference between the means. It should be emphasized that whether or not their health was actually adversely affected, if residents believed there was a health effect, their annoyance with aircraft noise was greater.

About half of all respondents said they believed aircraft noise was harmful to their health. These residents were then asked, "In what way is aircraft noise harmful to your health?" Over half (55%) said it makes them more tense, over a third (35%) said it affected their hearing, and about 7% said it disturbed sleep, made them fearful or had other non-auditory health effects such as heart beats faster, take pills to calm down, causes loss of appetite.

2. Complaint activities - On Question 6 of the interview, 57% of the respondents volunteered that aircraft noise was the "one thing disliked most", 43% either disliked something else more or disliked nothing very much. All respondents who disliked one thing most, were asked:

Q.8 A. Did you or anyone in the family ever feel like doing something about (it being, having ....thing disliked most)? For example, did you ever feel like:

1. Discussing it with a friend or neighbor? ....
2. Writing or telephoning an official about it? .....
3. Visiting an official? ....
4. Signing a petition? ....
5. Getting in touch with a local neighborhood organization? ....
6. Helping to set up a committee to do something? ....
7. Doing something else? What? ....

B. Did you or anyone in your family ever actually do any of these things? (Which?)

The correlation between desiring to complain expressed on Question 8 and aircraft noise annoyance was $r=.47$. For those who had not mentioned aircraft noise as the most disliked thing on Question 6, Question 31, which was identical to Question 8, was asked after all aircraft activity questions were answered. The correlation between desiring to complain and aircraft noise annoyance for this second group of respondents was $r=.62$, higher than the first group. This suggests that the preceding detailed specific questions might have influenced the answers to the later question.

It is significant, however, that the correlation between aircraft noise annoyance and actual complaints, answers to part B of Question 8 and Question 31, for the first group was $r=.40$ and $r=.44$ for the second group. While the reported desire to complain was somewhat more related to annoyance in the second group, the actual behavior was about the same. The mean aircraft noise annoyance for the first group (Q.8) was 2.11, which was higher than the mean annoyance of 1.28 reported for the second group (Q.31). The "t" value was 13.50 clearly establishing the difference between the means.

3. Resident's noise rating of area - On Question 21, all respondents were asked, "On the whole, how noisy would you rate this neighborhood?" (scores 0-4). It should be noted that all preceding questions were in the context of general problems and this was the first of a series of direct probes about different specific noise sources. The correlation with aircraft noise annoyance was $r=.46$, and the "t" score was 8.09, indicating differences between the means. It is interesting that this self assessment of general noise level had a higher correlation with aircraft annoyance than the composite noise index, CNR, which was only $r=.32$.

4. Time exposed to noise - Some people believe that one can learn to live with all kinds of environmental insults, given enough time to get used to them. However, when length of residence in the area was correlated with aircraft annoyance, no significant relationship was found; the correlation coefficient was only $r=-.001$. The "t" value was 47.79,** clearly establishing the difference in means.

** Two asterisks designate that results of a test of statistical significance was at the p.01 level.

All respondents were also asked a screening question at the beginning of the interview, about how long they were at home during the previous two months, June and July. The correlation between weeks at home and annoyance was not significant, r=.02. This finding, however, may be questionable because of the skewed distribution of time at home. Almost 75% of the residents were home all the time, and only 5% were away three or more weeks.

5. Desire to move or sell house - About half of all respondents said that they felt like moving and aircraft noise is the reason given by about one-third of the close and middle distance residents and 10% of the more distant residents. The correlation between aircraft noise being the reason for desiring to move and aircraft annoyance is r=.43. A non-parametric "point by serial" correlation was identical to the Pearson correlation. The "t" value was 45.01**.

For those residents interviewed for the first time in August 1972, Question 57 was asked of all home owners: "If a responsible agency found you a suitable house in a quieter location and paid you a fair market price for your present house, do you think you definitely would be interested in moving, that you might but you are not sure or that you probably would not, or definitely would not consider moving?" The correlation between desire to sell and aircraft annoyance was r=.31, highly significant. The "t" value was 9.3**.

6. Importance of aviation - Whether a person has been a passenger in an airplane during the past year has a small but statistically significant negative correlation with reported aircraft noise annoyance, r=-.09, i.e. if he has not been a passenger and had no benefits from aircraft, he is likely to be more annoyed with the residential noise produced by aircraft.

Question 37 of the interview, which followed the detailed aircraft noise questions, asked:

Q.37 A. How important do you feel commercial airplanes are to the national welfare? (use Degree Scale)
B. How important do you feel they are to this community?
C. And how important do you feel commercial airplanes are to your own family and friends?

Aircraft noise annoyance is negatively correlated with answers to all three of the above questions. The less important the respondent feels commercial airplanes are to the national welfare, the more annoyed he says he is (r=-.11). The correlation is even greater if the resident feels aviation is important to his community or to his own family and friends. Responses to Part B of Question 37 have a correlation of r=-.20, the "t" value was 7.07**, and Part C, a correlation of r=-.21. Apparently, if a resident sees positive advantages to the primary mission of the noise source, he is less likely to be annoyed. It should be noted, however, that these correlations are not too large.

7. Belief that persons in some ways responsible for operations of aircraft are misfeasant - Question 36 of the interview asked:

Q.36 A. Would you say any of these people are in a position to do anything about the aircraft noise around here?
*Ask each item in "A" before asking "B"-"C" for each "YES" in "A".

B. How concerned would you way (item) are for the feelings and comfort of residents like yourself (Use Degree Scale).

C. How much do you feel they are actually doing to reduce the noise? (Use Degree Scale)

a. The people who run the airlines ....
b. The airport officials ....
c. The other government officials ....
d. The pilots ....
e. The designers and makers of airplanes ....
f. The community leaders ....

The answers to Part C, as previously described, were combined into a scale of misfeasance, i.e. the resident feels those responsible can do something to reduce the noise but are not doing as much as they possibly could. The correlation between aircraft noise annoyance and the feeling of misfeasance is r=.32.

8. Use of airconditioners - Towards the end of the interview, factual questions were asked about airconditioning in the house. The relationships of the use of airconditioning and aircraft annoyance are not great. The use in the living room, dining room or kitchen are not significantly correlated with annoyance. Only in the use in the bedroom is the correlation statistically significant but small, r=.05.

F. Socio-Economic and other Personal Characteristics of Residents

There are small negative correlations between aircraft annoyance and education, income and sex. The correlation coefficients are r=.06* for education, r=-.05* for income and r=-.09**for sex. This suggests that people who are women, less educated, and with lower incomes are more annoyed. It is likely that the correlation with sex is due to women more often being home all day and more exposed to noise, while men are usually away during the day. The correlation with age is not at all significant. The correlations with education and income are also probably confounded by the specific locations of education and income groups. The correlations between distance from airport and education and income of residents are r=.12 (p=.001) and r=.10 (p.001), i.e. the higher educated and wealthier residents live further away in quieter areas. The correlations between CNR levels and these personal characteristics are about the same as the coefficients for distance.

The regression equations for selected status characteristics are:

Education = $y = .01X + 12.5$
Income = $y = -\$175X + \$12{,}420$

G. Comparison of Mean Annoyance Responses for June-July and August-Sept. 1972

The correlation between average aircraft noise annoyance reported for the June-July period of exposure and annoyance for the August-September period is quite high; r=.75. A "t" test of the two means produced a score of t=1.26, indicating no significant difference between the two annoyance means. It is interesting to note that the weighted mean CNR index of aircraft noise exposure also remained about the same for the two time periods, dropping only 0.7 from 124.0 to 123.3. The average CNR index was calculated by weighting the computed CNR for each of the eleven sample communities by the number of respondents interviewed in each community.

Another number of operations - annoyance comparison was made. Since the aircraft mix is not too different from one sample community to another, and since annoyance with approach and departure operations are about the same, the weighted total number of aircraft operations was computed for the two time periods as an index of exposure. The similarity in annoyance responses for both approach and landing operations was found in laboratory judgements 12/ and by interview responses (Section L of report). This calculation gives equal weight for each day and night flight operation in contrast to the CNR which combine flights logarithmically and has a 10:1 night-day weight. The weighted number of operations in June-July was 7604 or an average hourly rate of 5.19. The weighted number of operations (by number of respondents) for August-September was 7258 or an average hourly rate of 4.96, and 4.4% less than June-July. In comparison, the average mean annoyance response dropped 3.7%, almost the same as total operations, from 1.694 in June-July to 1.632 in August-September. The calculations for these comparisons are shown on Page 43.

H. Comparison of Annoyance reported for different time periods

For the first time, respondents in a community annoyance survey were asked to report on their feelings of annoyance during different time periods, permitting a possible direct comparison of reported effects of day-night exposures. Each resident was asked on questions 46-49, towards the end of the interview, to summarize his aircraft noise annoyance feelings for the June-July exposures. First, respondents were asked if they were usually at home during "most" of each time period, and if they were, they asked "how much the noise from the airplanes bothers or annoys you during the (day from 7:00 AM to 7:00 PM, evening from 7:00 PM to 11:00 PM, or nights from 11:00 PM to 7:00 AM)."

The first comparisons presented in Table 12 are between answers of different numbers of respondents who are at home at different times. The summated annoyance (11 activities) is correlated with the annoyance reported for each time period. Each of the correlations and "t" tests are statistically significant beyond the p.01 level, indicating consistency of annoyance responses. Surprisingly the mean annoyances for evenings and weekends are greater than for night or day. The average for the four time periods represents those persons, usually women, who reported being usually at home all the time.

Table 12

Comparison of Summated Annoyance and Annoyance Reported for Different Time Periods

Time Period	Number Respondents	Average Summated Annoyance	Average Annoyance for time period	Correlation Coefficient	"t" Score
Average for 4 time periods	767	1.81	2.54	.75	11.54
Day	908	1.75	2.24	.61	7.75
Evening	1342	1.71	2.83	.64	22.60
Night	1420	1.68	1.93	.64	4.88
Weekends	1266	1.73	2.89	.62	23.04

The second comparisons are for respondents who are usually at home during all three time periods; day, evening and night. The correlations are high for all comparisons,

CALCULATIONS OF WEIGHTED MEAN OPERATIONS

Flight Path	Number exposed Respondents	Weights	OPERATIONS BY TIME PERIOD: NIGHT Actual	NIGHT Weighted	DAY Actual	DAY Weighted	EVENING Actual	EVENING Weighted	TOTAL Actual	TOTAL Weighted
A. June-July 1972										
1	203	13.86	548	75.95	1326	183.78	172	23.84	2046	283.58
2	163	11.13	1669	185.76	3190	355.05	641	71.34	5500	612.15
3	161	10.99	3046	334.75	6785	745.67	1559	171.33	11,390	1251.76
4	140	9.56	3944	377.05	10,589	1012.31	2873	274.66	17,406	1664.01
5	556	37.95	1246	472.86	4678	1775.30	2379	902.83	8303	3150.99
6	181	12.35	638	78.79	1908	235.64	296	36.56	2842	350.99
7	61	4.16	1914	79.62	4143	172.35	922	38.36	6979	290.33
Totals	1465	100.00		1605.1/		4480.1/		1519.1/		7604.1/
No. Hours				549		732		183		1464
Mean Hourly Operations				2.92		6.12		8.30		5.19
B. August-September 1972										
1	203	13.86	493	68.33	1196	165.77	169	23.42	1858	257.52
2	163	11.13	2051	228.28	3352	373.08	848	94.38	6251	695.74
3	161	10.99	3082	338.71	7272	799.19	1770	194.52	12,124	1332.43
4	140	9.56	3587	342.92	10,697	1022.63	2587	247.32	16,871	1612.87
5	556	37.95	981	372.29	3397	1289.16	2702	1025.41	7080	2686.86
6	181	12.35	612	75.58	1938	239.34	283	34.95	2833	349.88
7	61	4.16	2302	95.76	4399	183.00	1058	44.01	7759	322.77
Totals	1465	100.00		1522.1/		4072.1/		1664.1/		7258.1/
No. Hours				549		732		183		1464
Mean Hourly Operations				2.77		5.56		9.09		4.96

1/ rounded to nearest whole number

but it is significant that there is a consistent pattern of annoyance, with evening and day exposures producing more average annoyance than night time activity.

Table 13

Comparison of Annoyance Reported for Different Time Periods for Respondents usually Home all the Time

Time Periods	Number Respondents	Mean Annoyance	Correlation Coefficient	"t" Score
Day vs. Evening	1103	2.16 vs. 2.76	.73	9.66
Day vs. Night	1109	2.16 vs. 1.95	.62	3.29 (p.01)
Evening vs. Night	1684	2.70 vs. 1.88	.65	15.77

The third comparisons shown in Table 14 are for reported evening and night time annoyance for residents at home during the day or not at home during the day. Residents who are at home during the day as well as evening or night, generally report somewhat greater annoyance during the evening and night periods than those who are at home only during the evening and night. While these annoyance differences are all statistically significant, indicating that greater cumulative exposure produces greater annoyance, the absolute differences are not large.

Table 14

Comparison of Evening and Night time Annoyance by Residents at Home or not at Home During the Day

Time Period	Mean Annoyance		"t" Score
	At Home Day	Not at Home Day	
Evening	2.75	2.55	2.84 (p.01)
Night	1.93	1.65	3.90 (p.01)

Since the number of aircraft operations during the day are greater than at night time, a fourth comparison shown in Table 15 was made of reported mean annoyances for different time periods and the weighted hourly average number of operations for each period. While night time operations are only 35% of evening or 48% of day time activity, the reported mean annoyance during the night is 71% of evening and 90% of the day time reported annoyance. This suggests that each night time flight has the equivalent annoyance effect of 2 day or evening flights. In most composite noise indexes in current use. The weight is 10:1 or greater. Our data suggest this ratio is much too high.

Table 15

Comparison of Number of Average Hourly Aircraft Operations and Reported Average Annoyance for Different Time Periods in June-July 1972

	TIME PERIOD		
	Night	Day	Evening
Operations per hour	2.92	6.12	8.30
% Day	48%	100%	136%
% Evening	35%	74%	100%
Mean Annoyance	1.95	2.16	2.76
% Day	90%	100%	128%
% Evening	71%	78%	100%

I. Comparison of Reported Annoyance by Sleep Interference with Annoyance of Other Day Time Activities

The correlations between degree of annoyance with reported sleep interference and other day time activities is very high and the means of sleep annoyance and annoyance with interference with other day time activities are not significantly different. The number of respondents, however, reporting each day time activity interference is different, suggesting that the combined scale is more comprehensive as a measure of overall aircraft noise annoyance. Table 16 presents these findings; the data are derived from answers to Q.25.

Table 16

Comparison of Annoyance with Sleep Interference and Annoyance with other Activities

Comparison of Sleep and Other Activity	Number Respondents	Mean Annoyances Sleep	Mean Annoyances Other	Correlation Coefficient	"t" Score
Listening to Radio or TV	693	3.16	3.30	.86	1.83
TV flicker	660	3.14	3.17	.82	.47
Rest & Relaxation	637	3.19	3.19	.90	.03
Conversation	697	3.16	3.30	.87	1.89
Shut windows at night	350	2.91	2.85	.94	.43

After Q.24, which recorded annoyance by each activity interrupted, the following summary Question 26 was asked about sleep interference.

Q.26 Now here are some ways that people say airplane noise disturbs them at night; they are .....(Hand card 3 and Read) Which one way best describes how you feel?

They cause no disturbance at all 1
They disturb my sleep from time to time but don't fully awake me 2
They occassionally wake me completely but I soon go back to sleep 3
They often wake me up completely but I soon go back to sleep 4
They wake me up and I have difficulty going back to sleep 5
Don't know X

The questions are phrased so that category 5 represents the presumed most negative experience. The correlation between these answers to overall degree of annoyance with sleep interference (Q.24) and Q.26 is only r=.34 which suggests that even the lower catecory responses 2-4 are rated as more highly annoying, when respondents integrate the kinds of sleep interference.

Correlations between answers to the summary sleep Question 26 and other personal variables are presented in Table 17. In general, the patterns of relationships are similar to those already reported for the summated annoyance ratings.

Table 17

Correlation Coefficients between Summated Sleep Interference and Other Variables

Other Variable	Correlation Coefficient
Summated annoyance	.65
CNR June-July	.24
Distance from Airport	-.33
Fear	.63
EFFECT on health	.55
Aviation important to Community	-.20
Aviation important to Family	-.19
Age	.18
Length of Residence in Area	.09
Like living in Area	.15
Sex (Male = 1, Female 0)	-.10
General Noise Sensitivity	not significant
Use of Airconditioners	not significant
General Sensitivity (self rating)	not significant

J. Evaluation of Personal Characteristics of Residents by Intensity of Fear of Aircraft Crashes

Since fear of aircraft has been found to be one of the most important reported intervening attitudinal variables affecting annoyance with aircraft noise, it is desirable to determine whether certain types of people are more prone to be fearful than other types. In this analysis only a limited number of demographic factors are considered.

If simple cross tabulations are compared, chi-square tests suggest that persons with high fear are more often older women, with less education and lower income, living close to the airport. The three fear groups used in this analysis are based on the 16-point scale discussed in section B and were defined as follows:

fear group	scale scores
low	0-1
medium	2-7
high	8-16

Table 18 presents these cross tabulations. Since fear is correlated with noise exposure level (distance r = -.385), and since most of these demographic variables in the samples of residents are also correlated with noise exposure, it is necessary to examine the relationships of fear and personal variables under comparable noise exposure conditions. When this is done, only sex (women more fearful) and home ownership for the closest residents appear to be significantly related to fear. Education, income and age are not significantly different among the different fear groups living under comparable noise exposures. These data are shown in Table 19.

Fear of aircraft is also highly correlated with feelings that health is adversely affected (r = .66), and that sleep is seriously interrupted (r = .63). More moderate but significant correlations also exist between fear and feelings of misfeasance (r = .30), with negative overall feelings about the community (r =.14) with feelings that the airport has no great importance to the community (r = -.16) or to the respondent's family (r = -.19) and with whether the respondent has flown an airplane in the past 12 months (r = .15). General noise sensitivity is not significantly correlated with fear (r = -.01), and not at all significantly related to a self rating of general sensitivity, or of length of residence in the area.

TABLE 18

Intensity of Fear of Aircraft Crashes by Personal Characteristics of Residents

A. Age	FEAR GROUP			
	Low	Medium	High	Total
Years	N=352	N=487	N=901	N=1740
00-29	24.7%	24.4%	18.2%	21.3%
30-39	15.6	20.1	21.4	19.9
40-49	24.2	22.6	24.0	23.6
50-59	19.9	17.3	18.3	18.3
60+	15.6	15.6	18.1	16.9
Total	100.0%	100.0%	100.0%	100.0%

chi square 10.894
(low vs. high)
significance level .05

B. Sex	N=367	N=510	N=980	N=1857
female	64.9%	66.1%	74.0%	70.0%
male	35.1	33.9	26.0	30.0
Total	100.0%	100.0%	100.0%	100.0%

chi square 10.923
(low vs. high)
significance level .01

C. Distance from Airport	N=195	N=421	N=933	N=1549
Close (1 mile from airport)	20.5%	28.8%	52.1%	41.8%
Middle (2.5 miles from airport)	19.0	23.0	26.0	24.3
Distant (5 miles from airport)	60.5	48.2	21.9	33.9
Total	100.0%	100.0%	100.0%	100.0%

chi square 171.80
significance level .01

TABLE 18 (Cont.)

D. Education

	Low N=366	Medium N=508	High N=974	Total N=1848
0-4 Grade	0.0%	0.6%	1.1%	0.7%
5-6 Grade	1.7	0.6	2.5	1.8
7.8 Grade	6.3	7.9	8.9	8.1
1-3 H.S.	10.9	12.6	17.2	14.7
4 yr. H.S.	36.6	42.9	46.5	43.6
1-3 col.	21.3	15.7	12.2	15.0
4 yr. col.	23.2	19.7	11.6	16.1
Total	100.0%	100.0%	100.0%	100.0%

chi square 71.58
significance level .01

E. Own or Rent

	N=367	N=506	N=980	N=1853
own	86.1%	86.[illegible]%	86.9%	86.6%
rent	13.9	13.8	13.1	13.4
Total	100.0%	100.0%	100.0%	100.0%

chi square .25
significance level - not significant

F. Income

	N=321	N=429	N=837	N=1587
0-$4000	5.6%	6.3%	8.2%	7.2%
4-$6000	3.1	2.8	5.7	4.4
6-$8000	3.4	4.2	5.4	4.7
8-$10,000	7.8	10.2	12.2	10.8
10-$15,000	24.3	28.7	30.7	28.8
$15,000+	55.8	47.8	37.8	44.1
Total	100.0%	100.0%	100.0%	100.0%

chi square 38.67
significance level .01

TABLE 19

Intensity of Fear of Aircraft Crashes by
Personal Characteristics and Location of Residents

A. Age

1. Close distance (1 mile from airport)

Years	FEAR GROUP Low N=40	Medium N=115	High N=453	Total N=608
00-29	27.5%	29.6%	19.7%	22.0%
30-39	12.5	20.9	26.0	24.2
40-49	20.0	27.8	24.5	24.8
50-59	17.5	13.0	13.5	13.7
60+	22.5	8.7	16.3	15.3
Total	100.0%	100.0%	100.0%	100.0%

chi square 11.1
significance level - not significant

2. Middle distance (2.5 miles from airport)

Years	N=41	N=99	N=239	N=379
00-29	29.3%	26.3%	16.3%	20.3%
30-39	19.5	16.2	14.7	15.5
40-49	19.5	18.2	18.4	18.5
50-59	14.6	15.1	23.8	20.6
60+	17.1	24.2	26.8	25.1
Total	100.0%	100.0%	100.0%	100.0%

chi square 10.5
significance level - not significant

3. Distant distance (5 miles from airport)

Years	N=109	N=196	N=188	N=493
00-29	26.6%	22.5%	16.0%	20.9%
30-39	14.7	20.4	20.2	19.1
40-49	20.2	22.4	30.8	25.1
50-59	20.2	20.4	21.8	20.9
60+	18.3	14.3	11.2	14.0
Total	100.0%	100.0%	100.0%	100.0%

chi square 12.3
significance level - not significant

TABLE 19 (Cont.)

B. Sex

1. Close distance (1 mile from airport)

	FEAR GROUP			
	Low N=40	Medium N=121	High N=486	Total N=647
female	60.0%	56.2%	75.1%	70.6%
male	40.0	43.8	24.9	29.4
Total	100.0%	100.0%	100.0%	100.0%

chi square 17.5
significance level .01

2. Middle distance (2.5 miles from airport)

	N=45	N=109	N=269	N=423
female	64.4%	69.7%	74.3%	72.1%
male	35.6	30.3	25.7	27.9
Total	100.0%	100.0%	100.0%	100.0%

chi square 2.3
significance level - not significant

3. Distant distance (5 miles from airport)

	N=118	N=203	N=204	N=525
female	63.6%	69.0%	71.1%	68.6%
male	36.4	31.0	28.9	31.4
Total	100.0%	100.0%	100.0%	100.0%

chi square 2.0
significance level - not significant

TABLE 19 (Cont.)

C. Education

1. Close distance (1 mile from airport)

	FEAR GROUP			
	Low N=40	Medium N=120	High N=484	Total N=644
0-4 Grade	0.0%	1.7%	1.0%	1.1%
5-6 Grade	5.0	0.8	2.3	2.2
7-8 Grade	17.5	8.3	9.5	9.8
1-3 H.S.	15.0	20.0	19.4	19.3
4 yr. H.S.	45.0	46.7	52.5	50.9
1-3 Col.	10.0	11.7	9.9	10.2
4 yr. Col.	7.5	10.8	5.4	6.5
Total	100.0%	100.0%	100.0%	100.0%

chi square 12.1
significance level - not significant

2. Middle distance (2.5 miles from airport)

	N=45	N=108	N=268	N=421
0-4 Grade	0.0%	0.0%	1.9%	1.2%
5-6 Grade	4.4	0.0	2.6	2.1
7-8 Grade	8.9	12.0	9.7	10.2
1-3 H.S.	13.3	11.1	17.9	15.7
4 yr. H.S.	35.6	34.3	34.7	34.7
1-3 Col.	22.2	13.0	13.4	14.2
4 yr. Col.	15.6	29.6	19.8	21.9
Total	100.0%	100.0%	100.0%	100.0%

chi square 16.4
significance level - not significant

3. Distant distance (5 miles from airport)

	N=117	N=203	N=201	N=521
0-4 Grade	0.0%	0.5%	0.5%	0.4%
5-6 Grade	0.9	0.5	2.5	1.4
7-8 Grade	5.1	7.4	6.5	6.5
1-3 H.S.	12.8	10.8	10.9	11.3
4 yr. H.S.	34.2	47.3	50.3	45.5
1-3 Col.	25.6	15.8	15.9	18.0
4 yr. Col.	21.4	17.7	13.4	16.9
Total	100.0%	100.0%	100.0%	100.0%

chi square 16.8
significance level - not significant

TABLE 19 (Cont.)

D. Own or Rent

1. Close distance (1 mile from airport)

	FEAR GROUP			
	Low N=40	Medium N=117	High N=486	Total N=643
own	67.5%	82.1%	87.7%	85.4%
rent	32.5	17.9	12.3	14.6
Total	100.0%	100.0%	100.0%	100.0%

chi square 13.8
significance level .01

2. Middle distance (2.5 miles from airport)

	N=45	N=109	N=269	N=423
own	66.7%	78.0%	80.7%	78.5%
rent	33.3	22.0	19.3	21.5
Total	100.0%	100.0%	100.0%	100.0%

chi square 4.5
significance level - not significant

3. Distant distance (5 miles from airport)

	N=118	N=203	N=204	N=525
own	87.3%	88.2%	92.2%	89.5%
rent	12.7	11.8	7.8	10.5
Total	100.0%	100.0%	100.0%	100.0%

chi square 2.5
significance level - not significant

TABLE 19 (Cont.)

E. Income — FEAR GROUP

1. Close distance (1 mile from airport)

	Low N=33	Medium N=100	High N=419	Total N=552
0-$4000	15.1%	8.0%	8.3%	8.7%
4-$6000	3.0	4.0	7.2	6.4
6-$8000	6.1	6.0	5.3	5.4
8-$10,000	18.2	14.0	11.9	12.7
10-$15,000	36.4	32.0	33.4	33.3
$15,000+	21.2	36.0	33.9	33.5
Total	100.0%	100.0%	100.0%	100.0%

chi square 6.5
significance level - not significant

2. Middle distance (2.5 miles from airport)

	N=38	N=94	N=227	N=359
0-$4000	15.8%	11.7%	11.5%	12.0%
4-$6000	2.6	3.2	4.8	4.2
6-$8000	7.9	3.2	4.8	4.7
8-$10,000	5.3	5.3	8.8	7.5
10-$15,000	18.4	25.5	27.8	26.2
$15,000+	50.0	51.1	42.3	45.4
Total	100.0%	100.0%	100.0%	100.0%

chi square 6.2
significance level - not significant

3. Distant distance (5 miles from airport)

	N=101	N=166	N=172	N=439
0-$4000	4.0%	4.2%	4.1%	4.1%
4-$6000	5.0	2.4	4.1	3.6
6-$8000	2.0	4.2	4.6	3.9
8-$10,000	6.9	13.3	16.9	13.2
10-$15,000	27.7	27.7	29.6	28.5
$15,000+	54.4	48.2	40.7	46.7
Total	100.0%	100.0%	100.0%	100.0%

chi square 10.3
significance level - not significant

K. Reported Annoyance with Aircraft Noise by Communities

As previously described in Section A, eleven sample areas were used in this survey. As Table 20 indicates, there are four comparable noise exposure groupings of these sample areas. Areas 1-3 had a June-July noise exposure of CNR 135-136; areas 4-6 a CNR exposure of 125-128, areas 7-8 a CNR exposure of about 119, and areas 9-11 a CNR exposure of 110-114. Table 14 compares the means of these 11 areas and the "t" scores which indicate whether or not the means are statistically different. A single asterisk (*) designates significance at the p.05 level; a double asterisk (**) designates the p.01 level.

In general, where the CNR differences are less than 6, the reported mean annoyances may or may not be different. For CNR differences greater than 6, they are usually different, but in a number of comparisons cited below, are not different. CNR by itself appears to be an unreliable predictor of annoyance.

In comparing areas 1-3, no differences in mean annoyance are found. Likewise, annoyance in Area 1 is different from annoyances in areas 5 and 7-11, but not different from Area 4 (CNR difference of 7.5) and Area 6 (CNR difference of 10.2). Area 2 reports about the same annoyance as Area 4 (CNR difference of 8.5), Area 5 (CNR difference of 10.1) and Area 6 (CNR difference of 10.8). Area 3 reports the same annoyance as Area 4 (CNR difference of 8.4), but a higher annoyance with all other lower CNR rated areas.

In comparing Areas 4-6, although CNR levels are only 1-2 points different, annoyance is different in Areas 4 and 5 and 4 and 6; only Areas 5 and 6 are the same in mean annoyance levels. Area 4 annoyance is also different from all other lower CNR exposed areas, as is Area 6 annoyance, but Area 5 reports the same annoyance as Area 9 (CNR difference of 12.3).

Comparisons of annoyance reports in Areas 7-8, indicate no difference between them, but Area 7 has significantly less annoyance than Areas 1-6, which have greater CNR exposures and no differences in annoyance with Areas 9-11 which have substantially lower CNR levels. Likewise, Area 8 reports no difference with annoyance in Areas 9 and 10, but greater annoyance than residents in Area 11.

Lastly, in comparing Areas 9-11, Areas 9 and 10 have about the same annoyance, but report significantly more annoyance than Area 11.

TABLE 20

"t" Test Scores for Comparisons of Mean Annoyance of Different Areas

Area	June July CNR	Mean Annoy-ance	Number Respond-ents	AREA 1	2	3	4	5	6	7	8	9	10	11
1	135.1	23.9	120	-	.47	.98	.20	2.06*	1.80	5.00**	5.40**	4.73**	5.97**	9.16**
2	136.1	23.0	51			1.22	.63	1.31	.82	3.80**	3.67**	3.16**	4.19**	6.18**
3	136.0	25.4	160			-	.82	2.92**	3.06**	5.92**	6.72**	6.01**	7.25**	11.00**
4	127.6	24.2	179				-	2.29*	2.15*	5.30**	5.88**	5.18**	6.44**	10.00**
5	125.9	20.0	60					-	.83	2.62**	2.28*	1.75	2.87**	4.85**
6	125.3	21.5	220						-	4.03**	4.29**	3.54**	4.95**	8.65**
7	119.3	14.1	46							-	.84	1.34	.19	1.41
8	118.9	15.7	138								-	.66	.80	3.16**
9	113.6	16.7	119									-	1.43	3.88**
10	114.2	14.5	76										-	2.10*
11	110.1	11.5	148											

* p = .05 = "t" value of 1.96 or more
** p = .01 = "t" value of 2.58 or more

L. Correlation Analyses of Aircraft Operations and Selected Human Response Variables

1. Objectives - The summated annoyance index calculated from answers on each interview is an integrated human response to literally hundreds of thousands of different flyover exposures. Somehow, the human brain is able to weight these varying physical parameters and report a general annoyance response. The objective of these analyses is to attempt through correlation techniques, to ascertain the relative importance of some of the varying components of aircraft operations on general aircraft annoyance and other selected reported attitudes.

Section A of Part III presents the details of the varying flight operations during each time period for which annoyance responses were recorded. If only aircraft types 1-6, which include all the larger aircraft, are considered, almost 55,000 arrivals and departures occurred during June-July 1972 over the 7 flight paths studied. Of the total, 35,600 were arrivals and almost 19,000 were departures. This imbalance in types of operations is due to the primary laboratory research programs for which the interviews were initially obtained. The laboratory study evaluated the effects of retrofit on annoyance and acceptability judgements, 11/ for approach operations only. As Table 21 indicates, flight paths 2 and 5 with over 700 respondents, had negligible departures reported. This unfortunate sequence in the actual distribution of flight operations violates some of the assumptions in Pearson correlation analysis and produces a number of spurious effects.

TABLE 21

NUMBER OF FLIGHT OPERATIONS

June-July 1972

Flight Path	Number Respondents	Total	OPERATIONS Approach	Departure
1	196	2,046	1,566	480
2	162	5,500	5,451	49
3	161	11,390	3,684	7,706
4	137	17,406	9,700	7,706
5	550	8,303	8,180	123
6	179	2,842	1,566	1,276
7	61	6,979	5,451	1,528
Total	1,446	54,466	35,598	18,868

2. Operations by time period, type of operation and type of aircraft - These are the three primary parameters which describe each aircraft flight. It was hoped that when correlated with annoyance and other human response variables, the relative importance of the physical parameters would be differentiated. Unfortunately, as Table 22 and Table 23 indicate, all of the correlation coefficients are relatively small and although some are statistically significant, none of the parameters was substantially greater than the others. Apparently, the integrated annoyance response is not based on a simple arithmetic weighting of operations.

In Part A of Table 22, the highest correlation between an operational variable and annoyance is only r = .12, for late afternoon departures of plane type 6 (4-engine propeller aircraft). This is undoubtedly a not too meaningful statistic, however, since there were so few flights of this type of aircraft (60), and flight paths 1,2 and 5 had no such flights and paths 6 and 7 had under 10 each during the entire June-July period. Surprisingly, time period 1 (night time) had no significant correlations and

TABLE 22

CORRELATION OF JUNE-JULY OPERATIONS AND SELECTED HUMAN RESPONSE

Time Period	1 A	1 D	2 A	2 D	3 A	3 D	4 A	4 D	5 A	5 D	6 A	6 D
A. June Annoyance												
1	.012	.033	.015	.029	.019	.033	.010	.030	.018	.031	-.019	.045
2	-.031	.052	-.019	.046	-.039	.063*	-.094**	.054*	-.088**	.074**	-.112**	.085**
3	-.009	.059*	.005	.058*	.014	.080**	-.015	.069**	.024	.101**	.029	.120**
4	.032	.053	.036	.049	.032	.070**	.028	.056*	.045	.088**	.000	.060*
B. August Annoyance												
1	.056*	.030	.056*	.025	.057*	.030	.058*	.025	.056*	.027	.042	.044
2	.011	.052	.014	.046	.003	.065*	-.036	.055*	-.049	.077**	-.063*	.094**
3	.006	.064*	.020	.061*	.018	.085**	-.006	.073**	.022	.109**	.033	.125**
4	.027	.056*	.031	.052	.025	.075**	.019	.063*	.032	.096**	.001	.063*
C. Fear												
1	.047	.065*	.052	.060*	.053	.065*	.050	.058*	.056*	.062*	.019	.075**
2	-.019	.086**	-.009	.079**	-.021	.101**	-.071**	.090**	-.075**	.115**	-.072**	.135**
3	-.002	.099**	.011	.096**	.017	.125**	-.010	.109**	.032	.151**	.060*	.171**
4	.020	.091**	.023	.086**	.020	.114**	.012	.098**	.031	.137**	.028	.098**
D. Health Attitude												
1	-.012	-.015	-.014	-.015	-.017	-.015	-.004	-.019	-.015	-.017	.025	-.016
2	-.024	-.009	-.030	-.013	-.038	.001	-.046	-.006	-.059*	.012	-.075**	.025
3	-.046	.000	-.038	-.003	-.043	.016	-.055*	.007	-.048	.037	-.034	.054*
4	-.025	-.005	-.022	-.008	-.028	.011	-.025	-.001	-.025	.028	-.053	-.001
E. Misfeasance												
1	-.011	-.091	-.023	-.092**	-.023	-.091**	-.008	-.092**	-.030	-.093**	.049	-.086**
2	.023	-.085**	.004	-.087**	-.003	-.082**	.010	-.084**	-.013	-.077**	-.070**	-.071**
3	-.036	-.081**	-.027	-.083**	-.046	-.076**	-.051	-.079**	-.073**	-.066*	-.096**	-.057*
4	-.013	-.083**	-.009	-.085**	-.020	-.077**	-.012	-.081**	-.024	-.070**	-.115**	-.081**

Column groups 1–6: PLANE TYPE

* p = .05
** p = .01

TABLE 23

CORRELATION OF AUGUST-SEPTEMBER OPERATIONS AND SELECTED HUMAN RESPONSE

Time Period	PLANE TYPE 1 A	1 D	2 A	2 D	3 A	3 D	4 A	4 D	5 A	5 D	6 A	6 D
A. August Annoyance												
1	.062*	.030	.060*	.031	.070**	.029	.059*	.038	.070**	.027	.052	.062*
2	-.014	.051	-.018	.046	-.014	.066**	-.028	.053	-.060*	.092**	-.031	.117**
3	.015	.065*	.023	.062*	.025	.105**	.026	.070**	.013	.123**	.034	.044
4	.040	.056*	.043	.050	.041	.068**	.044	.071**	.039	.085**	.034	.051
B. Fear												
1	.040	.064*	.04[illegible]	.065*	.050	.064*	.052	.071**	.054*	.062*	.065*	.096**
2	-.039	.084**	-.032	.079**	-.042	.102**	-.034	.086**	-.086**	.128**	-.052	.162**
3	.007	.100**	.018	.097**	.029	.147**	.038	.107**	.029	.168**	.052*	.075**
4	.030	.050**	.032	.082**	.032	.104**	.035	.107**	.032	.124**	.063*	.084**
C. Health Attitude												
1	.015	-.016	.014	-.016	.014	-.016	.012	-.016	.009	-.017	-.000	-.017
2	-.024	-.009	-.050	-.013	-.024	.003	-.008	-.009	-.033	.017	-.050	.046
3	-.039	.001	-.040	-.001	-.043	.036	-.048	-.004	-.055*	.051	-.030	-.016
4	-.009	-.006	-.007	-.011	-.008	.004	-.006	.006	-.010	.018	-.030	-.010
D. Misfeasance												
1	.039	-.091**	.032	-.090**	.035	-.091**	.006	-.088**	.022	-.093**	-.042	-.090**
2	.007	-.085**	-.038	-.086**	.013	-.080**	-.007	-.085**	.006	-.080**	-.027	-.061*
3	-.029	-.081**	-.039	-.081**	-.056*	-.065*	-.077**	-.086**	-.090**	-.057*	-.095**	-.086**
4	.009	-.083**	.012	-.085**	.007	-.080**	.009	-.079**	.001	-.074**	-.097**	-.084**

* p = .05
** p = .01

plane type 1 (707 and DC-8s) which is by far the noisiest aircraft, did not show higher correlations than the smaller and less noisy airplanes. While departures appear more often to be significantly correlated with annoyance. This is believed to be largely an artifact of the imbalance previously noted, in the distribution of departures among the flight paths.

The pattern of relationships between June operations and August annoyance (suggesting possible lag effects) is similar to the June annoyance correlations. Five of the six arrival correlations, however, are statistically significant at the p.05 level during the night time period. Fear and misfeasance attitudes appear to be correlated primarily with departure operations. Unfortunately, however, the imbalance in frequency of arrivals and departures may be obscuring the validity of this observation.

The consistent negative correlations of misfeasance and operations also have no ready or logical explanation. It may be an artifact of the sample of communities which happen to be included in this study. As noted below, Bergen Beach (path 4) and Howard Beach (path 3), which include over half the operations, have relatively low mean misfeasance scores. The number of operations and mean misfeasance scores for all flight paths are:

Flight Path	Number Respondents	Number June-July Operations	Mean Misfeasance Score	Mean Annoyance
1	196	2,046	9.6	12.5
2	162	5,500	12.0	17.1
3	161	11,390	10.2	25.2
4	137	17,406	8.6	16.1
5	550	8,303	10.5	21.3
6	179	2,842	11.1	22.2
7	61	6,479	11.4	20.0

Table 24 collapses time of day and focuses attention on plane types and type of operation. Again, none of the correlation coefficients are very great, and the general pattern of relationships remains the same as noted above. Plane type 1 does not appear to be more highly correlated with annoyance or other variables than less noisy aircraft.

Tables 25 and 26 focuses attention on time period of overflight. There are no clear cut patterns of the relative importance of time of exposure, and none of the correlations are very large.

In an effort to adjust for some of the sampling imbalance in operations, all of the responses for flight paths 2 and 5 were excluded, since they had practically no departures. In addition, plane types 5 and 6 were also excluded, since they represented a negligible portion of air traffic. Finally, time periods 2 and 3 were combined into a single daytime classification. Tables 27-29 present the correlations for this reduced, but less imbalanced distribution of aircraft exposures. In Table 27, <u>none</u> of the June-July operations is significantly correlated with summated annoyance responses. Fear, however, appears to be somewhat more significantly correlated with night time exposures (time period 1), but not greatly different for different aircraft. About a third of all exposures are by aircraft type 1, and an almost equal number by aircraft type 3, and these have a slightly higher correlation with fear, but only at the p.05 level of significance. Misfeasance is still negatively correlated with number of operations and evening exposures appear to be somewhat more related. When CNR, which is a logrithmic index of operations, with a 10:1 day-night weighting, is correlated with June-July annoyance, the correlation is positive, but equally small, r = .10.

TABLE 24

CORRELATION OF NUMBER OF ARRIVALS AND DEPARTURES BY PLANE TYPE

A. June-July Operations

	PLANE TYPE											
	1		2		3		4		5		6	
	A	D	A	D	A	D	A	D	A	D	A	D
June Annoy.	.005	.049	.014	.045	.011	.060*	-.002	.055*	.011	.076**	-.020	.084**
Aug. Annoy.	.027	.049	.027	.046	.029	.061*	.017	.057*	.023	.079**	.002	.089**
Fear	.014	.084**	.016	.080**	.021	.098**	.009	.091**	.020	.119**	.018	.129**
Health Att.	-.032	-.008	-.031	-.011	-.035	.000	-.042	-.005	-.042	.015	-.051	.020
Misfeasance	-.016	-.086**	-.018	-.087**	-.029	-.083**	-.034	-.084**	-.043	-.076**	-.094**	-.073**

B. August-September Operations

	PLANE TYPE											
	1		2		3		4		5		6	
	A	D	A	D	A	D	A	D	A	D	A	D
Aug. Annoy.	.039	.049	.033	.045	.043	.064*	.058*	.055*	.020	.084**	.027	.058*
Fear	.019	.083**	.022	.078**	.029	.101**	.055*	.039**	.007	.123**	.049	.092**
Health Att.	-.020	-.009	-.029	-.012	-.022	.003	-.021	-.008	-.039	.019	-.033	-.006
Misfeasance	.006	-.085**	-.017	-.087**	-.005	-.081**	-.026	-.085**	-.027	-.074**	-.087**	-.084**

* p = .05
** p = .01

TABLE 25

NUMBER OF OPERATIONS BY TIME PERIOD AND ARRIVALS AND DEPARTURES

A. June-July Operations

	TIME PERIOD							
	1		2		3		4	
	A	D	A	D	A	D	A	D
June Annoy.	.016	.032	-.039	.057*	.004	.072**	.034	.060*
Aug. Annoy.	.057*	.029	.002	.058*	.014	.077**	.027	.064*
Fear	.051	.064*	-.024	.093**	.010	.115**	.021	.100**
Health Att.	-.014	-.015	-.035	-.004	-.044	.010	-.025	.001
Misfeasance	-.018	-.091**	.006	-.084**	-.041	-.078**	-.016	-.081**

B. August-September Operations

	TIME PERIOD							
	1		2		3		4	
	A	D	A	D	A	D	A	D
Aug. Annoy.	.067*	.030	-.020	.058*	.021	.087**	.041	.086**
Fear	.046	.064*	-.046	.093**	.021	.127**	.032	.121**
Health Att.	.014	-.016	-.028	-.003	-.043	.019	-.009	.012
Misfeasance	.035	-.091**	.005	-.083**	-.047	-.073**	.008	-.083**

* p = .05
** p = .01

TABLE 26

CORRELATION OF NUMBER OF OPERATIONS BY TIME PERIOD

A. June-July Operations

	TIME PERIOD				
	1	2	3	4	Total
June Annoyance	.028	.042	.029	.058*	.044
August Annoyance	.052	.058	.040	.053	.058
Fear	.069**	.083**	.049	.061*	.076**
Health Attitude	-.018	-.017	-.038	-.025	-.028
Misfeasance	-.065*	-.080**	-.065*	-.048	-.075**

B. August-September Operations

	1	2	3	4	Total
August Annoyance	.062*	.044	.049	.070*	.068*
Fear	.071**	.067*	.062*	.074**	.088**
Health Attitude	-.001	-.011	-.033	-.010	-.018
Misfeasance	-.035	-.070**	-.068**	-.025	-.068**

* p = .05
** p = .01

TABLE 27

CORRELATION OF JUNE-JULY OPERATIONS BY TIME PERIOD AND PRINCIPAL TYPES OF AIRCRAFT 1/

Time Period	PLANE TYPE 1	2	3	4	All Aircraft
	A. June Annoyance (N=715)				
1	.061	.068	.056	.066	.060
2 and 3	.031	-.003	.031	.022	.025
4	-.008	.005	-.023	-.002	-.010
Total	.033	.011	.031	.028	.029
	B. August Annoyance (N=598)				
1	.087*	.082*	.083*	.103**	.085*
2 and 3	.059	.036	.062	.045	.056
4	.029	.039	.018	.033	.028
Total	.062	.044	.063	.056	.059
	C. Fear (N=702)				
1	.114**	.108**	.109**	.134**	.112**
2 and 3	.078*	.050	.082*	.062	.075*
4	.042	.055	.027	.046	.040
Total	.083*	.061	.083*	.075*	.079*
	D. Health Attitude (N=734)				
1	-.030	-.029	-.027	-.009	-.025
2 and 3	-.044	-.056	-.040	-.053	-.045
4	-.061	-.055	-.065	-.059	-.061
Total	-.041	-.052	-.040	-.045	-.043
	E. Misfeasance (N=719)				
1	-.084*	-.087*	-.085*	-.073	-.084*
2 and 3	-.094*	-.098**	-.093*	-.100**	-.094*
4	-.100**	-.098**	-.100**	-.100**	-.100**
Total	-.093*	-.097**	-.092*	-.095*	-.093*

1/ excludes areas under flight paths 2 and 5 which are almost exclusively approach operations.

* p = .05
** p = .01

TABLE 28

CORRELATION OF AUGUST-SEPTEMBER OPERATIONS BY TIME PERIOD AND PRINCIPAL TYPES OF AIRCRAFT 1/

Time Period	PLANE TYPE 1	2	3	4	All Aircraft
A. August Annoyance (N=598)					
1	.117**	.097*	.122**	.129**	.118**
2 and 3	.071	.035	.084*	.073	.071
4	.073	.075	.067	.080*	.072
Total	.083*	.055	.092*	.087*	.082*
B. Fear (N=702)					
1	.152**	.126**	.157**	.166**	.152**
2 and 3	.094*	.049	.108**	.096**	.093*
4	.097**	.099**	.088*	.104**	.095*
Total	.108**	.074*	.119**	.114**	.108**
C. Health Attitude (N=734)					
1	.000	-.018	.005	.010	.000
2 and 3	-.036	-.058	-.027	-.036	-.036
4	-.032	-.032	-.032	-.023	-.032
Total	-.027	-.046	-.020	-.026	-.027
D. Misfeasance (N=719)					
1	-.068	-.080*	-.065	-.062	-.068
2 and 3	-.091*	-.100**	-.086*	-.091*	-.091*
4	-.088*	-.087*	-.085*	-.080*	-.087*
Total	-.086*	-.095*	-.082*	-.086*	-.086*

1/ excludes areas under flight paths 2 and 5, which are almost exclusively approach operations.

* p = .05
** p = .01

TABLE 29

CORRELATION OF OPERATIONS
BY TYPE OF OPERATION AND TYPE OF PLANE 1/

A. June-July Operations

	TYPE OF PLANE										
	1		2		3		4		All Planes		
	A	D	A	D	A	D	A	D	A	D	Total
June Annoyance	-.061	.099**	-.069	.092*	-.052	.119**	-.071	.106**	-.059	.105**	.029
August Annoyance	.002	.097**	-.008	.090*	.003	.119**	-.015	.107**	.001	.104**	.059
Fear	.007	.126**	-.005	.118**	.009	.152**	-.014	.138**	.006	.135**	.079*
Health Attitude	-.064	-.018	-.071	-.023	-.068	-.003	-.078*	-.012	-.067	-.013	-.043
Misfeasance	-.090*	-.081*	-.093*	-.083*	-.096**	-.074*	-.099**	-.078*	-.093*	-.079*	-.093*

B. August-September Operations

	TYPE OF PLANE										
	1		2		3		4		All Planes		
	A	D	A	D	A	D	A	D	A	D	Total
August Annoyance	.039	.095*	.006	.089*	.042	.127**	.058	.099**	.035	.105**	.082*
Fear	.053	.124**	.012	.116**	.057	.161**	.077	.129**	.049	.136**	.108**
Health Attitude	-.035	.019	-.064	-.024	-.039	.002	-.039	-.016	-.042	-.013	-.027
Misfeasance	-.073	.081*	-.092*	-.083*	-.079*	-.072	-.087*	-.080*	-.080*	-.078*	-.086*

1/ excludes areas under flight paths d 5, which are almost exclusively approach operations.

* p = .05
** p = .01

Table 29 evaluates the interaction of plane type and operation. Annoyance still appears to be more significantly correlated with departure operations, for all major plane types. Direct responses from the interviews, however, contradict these correlation analyses. Likewise, laboratory judgements in a recent experiment also showed no differences in annoyance judgements for landing and take-off overflights.12/

Question 29 of the interview asked all respondents:

Q.29. As far as you know, do airplanes both take off and land over this area, or do they only take off or land over here?

Both 1*
Take off only.............2
Land only.................3
Don't know................X

* If answer is "both", ask "A" and "B"

A. How annoying would you rate the noise from landings? (use Degree Scale)

B. And how annoying would you rate the take offs when planes take off over here?

About 700 residents reported exposures of both landings and take-offs, and a chi-square test of reported annoyance responses indicated no statistical significance between the two responses. Table 30 presents these findings.

TABLE 30

COMPARISON OF ANNOYANCE RESPONSES FOR TAKE-OFF AND LANDING OPERATIONS

Annoyance Response	Landings Number	Landings %	Take-offs Number	Take-offs %	Total %
4	370	52.0%	357	50.5%	51.2%
3	153	21.5	151	21.4	21.4
2	98	13.8	107	15.1	14.5
1	49	6.9	48	6.8	6.8
0	42	5.8	44	6.2	6.1
Total	712	100.0	707	100.0	100.0

The last test which was made, of whether the relationship between aircraft operations and annoyance is substantially linear is presented in Tables 31 and 32. In all previous tests, although differences in planes and operations were taken into account, the relative loudness of each plane was not fully recognized. All communities under the same flight path were considered equal, even though some were closer to the airport than others and, therefore, the loudness of each flyover would vary somewhat with the location of the community. In this test the peak dBA levels of each type of a plane was calculated for each community. The number of appropriate operations (approach and departures by runway) was then multiplied by the peak dBA to derive a new arithmetic index number of peak dBA level weighted operations. Since flight paths 2 and 5 are almost exclusively approach operations, they are excluded from Table 32, to eliminate the effects of this imbalance. Furthermore,

TABLE 31

CORRELATION OF PEAK dBA LEVELS WEIGHTED BY NUMBER OF OPERATIONS FOR SELECTED AIRCRAFT 1/

A. June-July Operations

PLANE TYPE

	1			2			3			Total	
	A	D	Total	A	D	Total	A	D	Total	A	D
June annoyance	.041	.059*	.075**	.037	.059*	.068**	.061*	.068**	.091**	.048	.062*
August annoyance	.071*	.058	.093**	.055	.056	.082**	.087**	.068*	.111**	.074*	.061*
Fear	.058*	.093**	.115**	.043	.092**	.095**	.080**	.105**	.132**	.064*	.097**
Health attitude	-.004	-.002	-.004	-.013	-.003	-.014	.002	.005	.005	-.003	.000
Misfeasance	-.000	-.082 **	-.066*	-.007	-.082**	-.057*	-.008	-.080**	-.059*	-.005	-.082**

B. August-September Operations

PLANE TYPE

	1			2			3			Total	
	A	D	Total	A	D	Total	A	D	Total	A	D
August annoyance	.087**	.057	.097**	.063*	.055	.087**	.104**	.070*	.127**	.090**	.061*
Fear	.070**	.092**	.121**	.052	.090**	.104**	.092**	.108**	.148**	.076**	.097**
Health attitude	.012	-.003	.004	-.010	-.004	-.011	.018	.008	.019	.010	.000
Misfeasance	.022	-.082**	-.061*	-.006	-.082**	-.061*	.015	-.078**	-.046	.014	-.081**

* p = .05
** p = .01

1/ excludes plane types 4-6 which are relatively few in number

TABLE 32

CORRELATION OF PEAK dBA LEVELS WEIGHTED BY NUMBER OF OPERATIONS FOR SELECTED AIRCRAFT AT SELECTED COMMUNITIES 1/

A. June-July Operations

	PLANE TYPE 1			2			3			Total	
	A	D	Total	A	D	Total	A	D	Total	A	D
June annoyance	-.033	.115**	.062	-.053	.113**	.034	-.008	.132**	.069	-.026	.120**
August annoyance	.033	.110**	.088*	.011	.107**	.067	.050	.130**	.098*	.036	.117**
Fear	.047	.142**	.116**	.019	.139**	.089*	.069	.165**	.128**	.051	.150**
Health attitude	-.041	-.008	-.023	-.057	-.009	-.037	-.036	.005	-.016	-.042	-.004
Misfeasance	-.078*	-.074*	-.084*	-.087*	-.075*	-.090*	-.081*	-.069	-.081*	-.081*	-.073

B. August-September Operations

	PLANE TYPE 1			2			3			Total	
	A	D	Total	A	D	Total	A	D	Total	A	D
August annoyance	.077	.108**	.108**	.028	.104**	.078	.092*	.137**	.127**	.075	.117**
Fear	.100**	.139**	.140**	.041	.136**	.103**	.121**	.174**	.162**	.099**	.150**
Health attitudes	-.006	-.009	-.009	-.048	-.011	-.031	-.002	.010	.005	-.012	-.003
Misfeasance	-.056	-.075*	-.076*	-.084*	-.075*	-.087*	-.059	-.067	-.069	-.063	-.073

* p = .05
** p = .01

1/ excludes areas under flight paths 2 and 5 which are almost exclusively approach operations and plane types 4-6 which are few in number since plane types 4-6 which constitute only about 10% of all operations, might also confound the correlation analyses, they are also eliminated from this test. What remains are all flights for plane types 1 (707 and DC-8), 2 (747) and 3 (727). Listed below are the peak dBA levels for each major plane type at the eleven communities included in this study. Rosedale North and South, Floral Park (path 5) and Cedarhurst and Island Park (path 2) are excluded from Table 32.

PEAK dBA LEVELS BY SELECTED PLANE TYPE, OPERATION AND COMMUNITY

	PLANE TYPE					
	1		2		3	
Community	A	D	A	D	A	D
Rosedale South	104	110	100	107	96	99
Meadowmere	104	104-107[1]	100	99-103[1]	96	94-96[1]
Inwood	104	104-107[1]	100	99-103[1]	96	94-96[1]
Howard Beach	104	104	100	99	96	94
Cedarhurst	98	102	97	96	90	93
Lawrence	98	99	97	94	90	92
Rosedale North	98	104	97	99	90	94
So. Floral Park	86	97	88	91	78	90
Island Park	86	96	88	89	78	89
Long Beach	86	95	88	88	78	88
Bergen Beach	86	95	88	88	78	88

1/ Runway 13L

Table 31 presents the correlations between the new weighted dBA index and annoyance responses in all eleven areas. The correlations are only slightly greater than the correlations for unweighted operations shown in Table 24. Likewise, when flight paths 2 and 5 are excluded in Table 32, the correlations of the new weighted dBA index are improved, but are only slightly greater than the comparable unweighted operations correlations shown in Table 29. Likewise, departures appear to be slightly better correlated than arrivals, possibly reflecting the higher dBA levels for some departures. In general, our analyses clearly indicate that the annoyance response is not correlated to the number of operations in a strictly arithmetic scale.

M. Correlations of Aircraft Sound Description System (ASDS) and Summated Annoyance and Other Related Human Responses

The Federal Aviation Administration has developed still another index for describing the integration of numbers of different aircraft operations. 13/ Essentially it arithmetically summates aircraft noise exposure as the number of seconds above a given dBA threshold level that a given community experiences. Likewise, it does not weight night operations differently from day operations. Duration of exposure is a function of the altitude of the aircraft directly overhead and the lateral distances over which the aircraft exceeds the given ASDS levels. These distances were calculated for each of aircraft types 1-4, which account for over 90% of all operations at JFK airport. The summated ASDS values in seconds above a given dBA level are presented for the 11 sample communities in Table 33.

As can be seen, departures, which have a higher altitude and longer duration, have generally much greater ASDS values. Departures also have many zero ASDS values, especially for plane type 4 (DC-10, L1011) at ASDS-90 dBA and 85 dBA levels. Such squeness in values can produce spurious correlation coefficients, so it was decided to exclude plane type 4 from these ASDS analyses.

TABLE 33

ASDS DURATIONS BY TYPE OF OPERATION AND COMMUNITY

A. Seconds Above 90 dBA

	PLANE TYPE							
	1		2		3		4	
Community	A	D	A	D	A	D	A	D
Bergen Beach	0	0	0	8.4	0	0	0	0
Rosedale North	10.4	14.3	5.0	22.0	0	10.1	0	0
Rosedale South	11.7	16.0	7.6	23.8	4.4	12.3	4.5	0
So. Floral Park	0	4.6	0	15.4	0	0	0	0
Meadowmere	11.7	14.4	7.6	22.2	4.4	10.3	4.5	0
Cedarhurst	10.4	12.9	5.0	21.1	0	8.3	0	0
Island Park	0	0	0	13.5	0	0	0	0
Lawrence	10.4	11.3	5.0	19.5	0	5.5	0	0
Inwood	11.7	14.4	7.6	22.2	4.4	10.3	4.5	0
Long Beach	0	0	0	8.4	0	0	0	0
Howard Beach	11.7	14.4	7.6	22.2	4.4	10.3	4.5	0

B. Seconds Above 85 dBA

	PLANE TYPE							
	1		2		3		4	
Community	A	D	A	D	A	D	A	D
Bergen Beach	11.3	12.8	0	29.3	0	3.4	0	0
Rosedale North	15.4	21.7	8.3	35.6	5.8	17.3	4.8	0
Rosedale South	16.3	22.9	10.1	36.8	7.8	18.6	7.2	0
So. Floral Park	11.3	17.0	0	32.0	0	11.3	0	0
Meadowmere	16.3	21.8	10.1	35.7	7.8	17.4	7.2	0
Cedarhurst	15.4	20.8	8.3	35.1	5.8	16.2	4.8	0
Island Park	11.3	15.2	0	31.1	0	8.6	0	0
Lawrence	15.4	19.8	8.3	34.1	5.8	15.0	4.8	0
Inwood	16.3	21.8	10.1	35.7	7.8	17.4	7.2	0
Long Beach	11.3	12.8	0	29.3	0	3.4	0	0
Howard Beach	16.3	21.8	10.1	35.7	7.8	17.4	7.2	0

TABLE 33 (Cont.)

C. Seconds Above 80 dBA

	PLANE TYPE							
	1		2		3		4	
Community	A	D	A	D	A	D	A	D
Bergen Beach	18.1	26.8	15.0	50.3	4.4	17.9	0	0
Rosedale North	20.9	32.0	18.9	54.3	11.2	24.6	10.1	0
Rosedale South	21.6	32.8	19.7	55.1	12.3	25.6	11.4	0
So. Floral Park	18.1	29.0	15.0	52.0	4.4	20.9	0	0
Meadowmere	21.6	32.1	19.7	54.4	12.3	24.7	11.4	0
Cedarhurst	20.9	31.4	18.9	54.0	11.2	23.9	10.1	0
Island Park	18.1	28.0	15.0	51.5	4.4	19.6	0	0
Lawrence	20.9	30.8	18.9	53.3	11.2	23.1	10.1	0
Inwood	21.6	32.1	19.7	54.4	12.3	24.7	11.4	0
Long Beach	18.1	26.8	15.0	50.4	4.4	17.9	0	0
Howard Beach	21.6	32.1	19.7	54.4	12.3	24.7	11.4	12.7

B. Seconds Above 75 dBA

	PLANE TYPE							
	1		2		3		4	
Community	A	D	A	D	A	D	A	D
Bergen Beach	26.0	41.4	28.3	81.1	14.0	36.7	10.9	11.3
Rosedale North	28.1	44.9	30.6	83.6	17.4	40.4	15.2	0
Rosedale South	28.6	45.5	31.1	84.1	18.1	41.0	16.1	0
So. Floral Park	26.0	42.8	28.3	82.1	14.0	38.2	10.9	0
Meadowmere	28.6	45.0	31.1	83.7	18.1	40.4	16.1	0
Cedarhurst	28.1	44.5	30.6	83.4	17.4	40.0	15.2	0
Island Park	26.0	42.2	28.3	81.8	14.0	37.5	10.9	0
Lawrence	28.1	44.1	30.6	83.0	17.4	39.5	15.2	0
Inwood	28.6	45.0	31.1	83.7	18.1	46.4	16.1	0
Long Beach	26.0	41.4	28.3	81.1	14.0	36.7	10.9	0
Howard Beach	28.6	45.0	31.1	83.7	18.1	40.4	16.1	22.7

Table 34 presents the correlations for ASDS-90 dBA levels. Plane type 1 (707, DC-8), which is the noisiest, has the highest correlation with reported annoyance responses. The correlation coefficient for June-July operations of r=.274, and of r=.270 for August-September operations are higher than the simple peak dBA and selected operations correlations variables. The overall June-July ASDS-90 dBA correlation for all three major aircraft of r=.267 is somewhat lower than the CNR noise index correlation of r=.32. The apparent differences in correlations for arrivals and departures are mixed and confusing. In Table 33, plane type 1 has the highest ASDS-90 dBA values for departures, yet as indicated in Table 34, arrivals have a slightly higher correlation than departures. It could be that this finding is an artifact of the particular samples included in this study. For example, this high correlation for arrivals may be unduly influenced by responses in Bergen Beach, which had a zero ASDS-90 dBA value and a very low mean annoyance score of 8.6 (see Page 20). It seems as if it may not be feasible to test differences in effects of arrivals and departures in this particular sample of respondents.

Tables 35-37 present the correlations for ASDS-85 dBA through ASDS-75 dBA. As shown below, the highest correlations are for ASDS-90 dBA and ASDS-85 dBA. These are substantial improvements over simple operations correlations, but still not as great as the correlations for the logrithmic index of operations (CNR). These findings tend to substantiate the FAA belief that ASDS-85 can be used as a threshold level for describing aircraft noise exposures. A summary of the correlations for all aircraft (1-3) is presented below:

CORRELATIONS OF JUNE-JULY ANNOYANCE FOR ALL AIRCRAFT FOR JUNE-JULY EXPOSURES

ASDS Level	Arrivals	Departures	Total
90 dBA	.232**	.172**	.267**
85 dBA	.165**	.115**	.196**
80 dBA	.091**	.073**	.114**
75 dBA	.040	.060*	.074**

*p=.05
**p=.01

In conclusion, a number of arithmetic weighting schemes for describing aircraft operations has been correlated with summated annoyance responses. Deficiencies in the sample of areas available for analysis have limited the kinds of statistical comparisons that are reasonable. Adjusting for these weaknesses in the basic sample as best as possible, it was found that the correlations of CNR measures were higher than any arithmetic index, including ASDS. It should be emphasized that this conclusion is based on the limited sample available for analysis in this study, and should be retested with other survey responses in communities having a greater range and more equal types of exposures. This study does <u>not</u> validate the logrithmic rule for integrating aircraft operations, but it does indicate that a simple arithmetic rule is not the best method for combining aircraft exposures. It is hoped that this initial indepth evaluation of operations and annoyance will stimulate further research to determine the best way to integrate the complex of noise exposures over time.

TABLE 34

CORRELATION OF ASDS - 90 dBA AND SELECTED HUMAN RESPONSES

A. June-July Operations

	PLANE TYPE											
	1			2			3			Total		
	A	D	Total	A	D	Total	A	D	Total	A	D	Total
June annoy.	.207**	.176**	.274**	.212**	.128**	.222**	.222**	.192**	.241**	.232**	.172**	.267**
Aug. annoy.	.255**	.149**	.286**	.265**	.111**	.233**	.283**	.166**	.253**	.287**	.147**	.279**
Fear	.236**	.191**	.308**	.241**	.152**	.266**	.278**	.209**	.288**	.269**	.189**	.309**
Health att.	.135**	.079**	.154**	.140**	.041	.110**	.165**	.092**	.147**	.155**	.075**	.151**
Misfeasance	.084**	-.007	.054*	.078**	-.047	-.004	.055*	-.001	.025	.083**	-.015	.037

B. August-September Operations

	PLANE TYPE											
	1			2			3			Total		
	A	D	Total	A	D	Total	A	D	Total	A	D	Total
Aug. annoy.	.270**	.143**	.270**	.280**	.107**	.217**	.283**	.163**	.245**	.301**	.142**	.262**
Fear	.262**	.184**	.303**	.260**	.148**	.253**	.283**	.207**	.283**	.292**	.184**	.299**
Health att.	.149**	.075**	.148**	.149**	.039	.101**	.167**	.091**	.143**	.168**	.072**	.143**
Misfeasance	.093**	-.009	.049	.081**	-.047	-.009	.055*	-.002	.023	.090**	-.016	.032

* p = .05
** p = .01

TABLE 35

CORRELATION OF ASDS - 85 dBA AND SELECTED HUMAN RESPONSES

A. June-July Operations

PLANE TYPE

	1			2			3			Total		
	A	D	Total	A	D	Total	A	D	Total	A	D	Total
June annoy.	.075**	.103**	.140**	.202**	.067*	.151**	.251**	.170**	.274**	165**	.115**	.196**
Aug. annoy.	.109**	.092**	.152**	.249**	.063*	.168**	.298**	.149**	.285**	.209**	.102**	.210**
Fear	.096**	.132**	.183**	.225**	.100**	.200**	.285**	.194**	.319**	.194**	.144**	.245**
Health att.	.023	.025	.037	.129**	.002	.058*	.162**	.074**	.153**	.092**	.033	.083**
Misfeasance	.016	-.063*	-.047	.078**	-.079**	-.047	.086**	-.022	.033	.053	-.057*	-.024

B. August-September Operations

PLANE TYPE

	1			2			3			Total		
	A	D	Total	A	D	Total	A	D	Total	A	D	Total
Aug. annoy.	.129**	.089**	.148**	.263**	.062*	.155**	.302**	.148**	.278**	.230**	.100**	.199**
Fear	.114**	.128**	.181**	.243**	.097**	.188**	.296**	.193**	.316**	.217**	.141**	.236**
Health att.	.041	.022	.042	.138**	.001	.051	.168**	.075**	.151**	.110**	.032	.081**
Misfeasance	.039	-.063*	-.042	.081**	-.079**	-.051	.092**	-.022	.032	.070**	-.057*	-.023

* p = .05
** p = .01

TABLE 36

CORRELATION OF ASDS - 80 dBA AND SELECTED HUMAN RESPONSES

A. June-July Operations

PLANE TYPE

	1 A	1 D	1 Total	2 A	2 D	2 Total	3 A	3 D	3 Total	Total A	Total D	Total
June annoy.	.040	.069**	.083**	.062*	.0[illegible]4*	.080**	.192**	.097**	.193**	.091**	.073**	.114**
Aug. annoy.	.068*	.065*	.095**	.085**	.053	.089**	.232**	.091**	.211**	.123**	.069*	.127**
Fear	.055*	.102**	.124**	.072**	.088**	.119**	.221**	.132**	.246**	.111**	.107**	.159**
Health att.	-.005	.004	.000	.007	-.006	-.003	.106**	.023	.081**	.031	.007	.022
Misfeasance	.001	-.078**	-.071**	.005	-.084**	-.079**	.056*	-.069**	-.031	.018	-.077**	-.063*

B. August-September Operations

PLANE TYPE

	1 A	1 D	1 Total	2 A	2 D	2 Total	3 A	3 D	3 Total	Total A	Total D	Total
Aug. annoy.	.084**	.064*	.096**	.095**	.052	.086**	.242**	.093**	.210**	.143**	.069*	.126**
Fear	.067*	.100**	.125**	.084**	.086**	.116**	.234**	.133**	.248**	.130**	.106**	.158**
Health att.	.010	.002	.005	.012	-.007	-.002	.117**	.025	.085**	.047	.006	.026
Misfeasance	.022	-.078**	-.066*	.007	-.084**	-.079**	.07[illegible]**	-.067*	-.025	.036	-.077**	-.059*

* p = .05
** p = .01

ORIGINAL PAGE IS
OF POOR QUALITY

TABLE 37

CORRELATION OF ASDS - 75 dBA AND SELECTED HUMAN RESPONSES

A. June-July Operations

PLANE TYPE

	1			2			3			Total		
	A	D	Total	A	D	Total	A	D	Total	A	D	Total
June annoy.	.024	.058*	.064*	.031	.049	.060*	.074**	.071**	.098**	.040	.060*	.074**
Aug. annoy.	.049	.057	.076*	.048	.049	.068*	.101**	.071**	.110**	.064*	.059*	.084**
Fear	.036	.093**	.103**	.036	.083**	.096**	.093**	.109**	.143**	.053	.095**	.114**
Health att.	-.018	-.003	-.012	-.018	-.009	-.017	.012	.007	.012	-.009	-.001	-.006
Misfeasance	-.007	-.083**	-.078**	-.010	-.086**	-.085**	-.001	-.079**	-.072**	-.006	-.082**	-.078**

B. August-September Operations

PLANE TYPE

	1			2			3			Total		
	A	D	Total	A	D	Total	A	D	Total	A	D	Total
Aug. annoy.	.063*	.056	.078**	.055	.048	.067*	.117**	.073*	.118**	.079**	.059*	.087**
Fear	.045	091**	.105**	.044	.082**	.096**	.106**	.111**	.151**	.064*	.095**	.117**
Health att.	-.004	.004	-.005	-.015	-.010	-.015	.027	.010	.021	.003	-.001	.000
Misfeasance	.015	-.082**	-.073**	-.009	-.085**	-.085**	.022	-.077**	-.064*	.012	-.082**	-.073**

* p = .05
** p = .01

BIBLIOGRAPHY

1/ Borsky, Paul N., Community Aspects of Aircraft Noise - National Advisory Committee for Aeronautics, 1952.

2/ Borsky, Paul N., Community Reactions to Air Force Noise, W.A.D.D., Technical Report 60-689, March 1961.

3/ Borsky, Paul N. - Leonard, Skipton, A Causal Model for Relating Noise Exposure, Psycho-social Variables and Aircraft Noise Annoyance, International Congress on Noise as a Public Health Problem, Dubrovnik, Yugoslavia, May 13-18, 1973.

4/ McKennell, A.C., Aircraft Noise Annoyance Around London Airport, Central Office of Information, London 1963.

5/ Heathrow Airport Survey, Mil Research Ltd., London 1967.

6/ Carlsson, Gosta, Ronge, Hous., Attitude and Opinion Studies on Human Reactions to Aircraft Noise, University of Lund, Sweden, April 1962.

7/ Grandjean, Etienne et al, A Survey of Aircraft Noise in Switzerland, Proceedings "International Congress on Noise as a Public Health Problem", Dubrovnik 1973.

8/ Annoyance Caused by Noise Around Airports, Center Scientifique et Technique du Batiment, Paris, March 1, 1968.

9/ Finke, H.O., Guski H., Bohrman B., et al. An Interdisciplinary Study of the Effects of Aircraft Noise on Man, Proceedings "International Congress on Noise as a Public Health Problem", Dubrovnik 1973.

10/ Nunnally, J., Psychometric Theory, New York, N.Y. McGraw-Hill 1967.

11/ Borsky, Paul N. - Leonard, Skipton, Annoyance Judgments of Aircraft With And Without Acoustically Treated Nacelles, NASA Report CR-2261, Washington, D.C., August 1973.

12/ Borsky, Paul N., Annoyance and Acceptability Judgments of Noise Produced by Three Types of Aircraft by Residents Living Near JFK Airport, NASA Report December 1974.

13/ Cruz, J.E., Aircraft Sound Description System - Background and Application, Federal Aviation Administration, EQ-73-7, March 1973.

14/ Gardner, Paul L., Scales and Statistics, Review of Educational Research Winter 1975, Vol. 45, No. 1, pp. 43-57.