STANDARDIZED CATCH RATES OF YELLOWFIN TUNA IN THE (U.S.) SPORT FISHERIES FROM VIRGINIA TO NEW YORK

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SUMMARY

Abundance indices for yellowfin tuna in the west Atlantic and off the U.S. coast from Virginia to New York (1985-1989) were developed using data obtained during phone and dockside interviews of anglers in that fishery. Data from interviews having the same values for year/ month/ depth/ area/ boat type/ interview type/ tournament participation/ fishing method were combined into groups of 15 trips in order to derive standardized catch rates and standardized indices using a General Linear Model.

RESUME

Des indices d'abondance pour l'albacore dans l'Atlantique ouest et au large des côtes américaines de la Virginie à New York (1985-89) ont été élaborés en utilisant des données obtenues au cours d'enquête téléphoniques et au port de pêcheurs à la ligne. Les données des enquêtes présentant les mêmes valeurs pour année/mois/profondeur/zone/type de bateau/type d'enquête/participation à un championnat/méthode de pêche ont été regroupées en groupes de 15 sorties pour calculer le taux de capture standardisé et les indices standards au moyen d'un modèle linéaire généralisé.

RESUMEN

Empleando datos obtenidos en conversaciones telefónicas y entrevistas con pescadores, se hallaron índices de abundancia de rabil en el Atlántico oeste y frente a la costa norteamericana, desde Virginia hasta Nueva York (1985-1989). Otros datos procedentes de entrevistas con los mismos valores respecto a año/mes/profundidad/ zona/tipo de barco/tipo de entrevista/participación en torneos/método de pesca, se combinaron en grupos de 15 viajes con el fin de obtener tasas de captura estandarizadas e índices estandarizados empleando el modelo lineal generalizado.

Introduction

Catch per unit effort data on sport fisheries off the U. S. coast from Virginia to New York were collected from 1985-1989. Fishermen were interviewed when they returned to the dock or later, by phone. Interviewers recorded the species, number and sizes of fish caught, method of fishing and the fishing effort expended during each trip.

Variation in area fished, time of year, and environmental factors make it inappropriate to compare nominal CPUE across years. A general linear model (GLM) approach (Draper and Smith 1966) is used in this paper to develop standardized indices of abundance for yellowfin tuna in these sport fisheries during 1985-1989. The same approach was used to develop standardized abundance indices for small bluefin tuna fisheries off Virginia (Brown and Lucy 1990) and large bluefin tuna off New England (Cramer and Brown 1990).

Materials and Methods

Each trip interview record includes data on: target species, date, gear, fishing method (trolling, chumming or other method), time fished (hours), latitude and longitude, boat type (private or charter), interview type (dock or phone), whether fishing effort was part of a tournament, and the number of yellowfin tuna caught. Effort was evaluated in terms of hours. Line hours were not used because number of lines was not recorded in part of the 1988 data. For this analysis data were restricted to only those trips which targeted marlin or tuna.

Only data from trips in the months July, August, and September, targeting marlin or tuna and fishing with rod and reel were included in the analysis, because the proportion of successful yellowfin trips was substantially larger with that combination than with other gear and method combinations.

Four areas and two strata based on depth contours (Figure 3) were defined based on examination of fishing effort concentrations. The depth variable divides trips into (A) those fishing in waters shallower than 40 fathoms and (B) those fishing in areas with depths between 40 fathoms and 1000 fathoms. The four areas from south to northeast were defined as (1) Virginia (36 N to 37 30' N), (2) Maryland/Delaware (37 30' N to 39 30' N inshore and 39 N offshore), (3) New Jersey (39 30' N to 40 30' N, inshore only), and (4) Long Island (39 N to 41 N, west of 73 W).

The high proportion of unsuccessful trips (49% to 70%) prevented the analysis of single trip observations. Trip records were randomized, then grouped by year/month/depth/area/boat type/interview type/tournament participation/fishing method to create summary catch and effort observations. Preliminary analyses were performed on data summarized into groups of 5, 10 and 15 trips. Examination of the final residual patterns showed skewed distributions at the lower levels of summation and a more normally distributed pattern at 15 trips. Therefore analyses were conducted at that level of summation. Summary observations were created within each stratum until less than 15 interviews remained; these remaining interviews were excluded to ensure that each summary observation represented an identical number of interviews. Summation across 15 trips reduced the proportion of zero valued observations to 0 to 19% per year (Table 4).

A GLM (Draper and Smith 1986) approach to analysis of variance was used to examine logged catch rates per 1000 hours for differences among the effects of year, month, area, depth, boat type, interview type, tournament participation, and fishing method (model 1) as well as all possible two-way interactions of all variables except year. The value of catch rate per unit effort for each summary observation was increased by one to improve the residual distributions and to permit taking the natural logs of all catch rate values, including nominal catch rates of 0. F-tests were conducted on all main effects and interactions to determine whether or not each contributed significantly to the model.

The frequency distribution of standardized residuals [(observed - predicted)/standard error of the estimate] were examined at each level of the main effects and for the whole model to ensure that they approximated the normal distribution (Figures 4 and 5). The final model was used to develop standardized catch rates for each year.

The variables for the analysis were year, month, area, depth, boat type, tournament, and interview type. In one set of analysis fishing method was also included; this analysis will be referred to as model 1. Method was looked at in this way because use of the method as a variable excluded all of the 1985 data, while exclusion of fishing method (model 2) permitted the inclusion of the 1985 data.

Results

Nominal CPUE data for each year, month, and depth strata obtained from single trip records and from summary observations are contrasted in Tables 1, 2 and 3. The mean catch rates shown were obtained by averaging the catch rates of the observations within each cell. Total catch (in numbers of fish) and effort (in trips and hours) is shown for each cell. The comparison of these values between the single trip data and the summary observations indicates that little information was lost during the summation process, despite the elimination of all remaining trip data within each cell when there were fewer than 15 trips.

The yearly mean nominal CPUE, derived from summary observations for models 1 and 2, is plotted in Figure 1. The parameter estimates and their standard errors are in Tables 5 and 6. For model 1 (with fishing method) F tests indicated that the main effects of year, month, method, and two-way interactions of month and area, month and tournament, area and depth, area and tournament, boat type and tournament affected logged catch rates. Model 2 (without fishing method) F tests indicated main effects of year, depth, tournament and two-way interactions of month and area, month and tournament, month and depth, area and interview type, tournament and boat type affected logged catch rates (Figure 2).

There was a strong negative effect due to fishing in tournaments. One explanation is that much of the tournament data came from marlin tournaments in which yellowfin catch rates would be expected to be low.

Although model 1 (with fishing method) was run with less data, the results were similar to model 2 (without method). R^2 values, residual patterns, and standardized CPUE's differed little between the two (Figures 1, 2, 4, and 5). It is our belief that fishing method should have an important effect on catch rates, and therefore the model with fishing method might better reflect the actual conditions in the fishery.

Literature Cited

Brown, C.A. and J.A. Lucy. 1990. Standardized catch rates of small bluefin tuna in the Virginia (U.S.) offshore rod and reel fishery. ICCAT Working Document SCRS/90/81.

Cramer, J. and C. A. Brown. 1990. Standardized catch rates of large bluefin tuna in the New England (U.S.) rod and reel/handline fishery. ICCAT Working Document SCRS/90/79.

Draper, N.R., and H. Smith. 1986. Applied Regression Analysis. John Riley and Sons, Inc., New York, 407

TABLE 1: CPUE (CATCH PER 1000 HOURS) BY YEAR, MONTH AND DEPTH FOR NOMINAL DATA.

YEAR	MONTH	DEPTH	MEAN	STD	N	CATCH	HOURS	ZEROS
1985	7	1	0.15	0.41	228	198	1353	158
	7	2	0.22	0.46	451	697	3307	218
	8	1	0.15	0.26	124	108	738	76
	8	2	0.12	0.28	642	537	4949	413
	9	1	0.12	0.2	85	61	507	53
	9	2	0.37	0.76	153	437	1148	89
1986	7	1	0.21	0.75	203	256	1335	119
	7	2	0.28	0.43	697	1424	5466	289
	8	1	0.26	0.52	351	666	2430	197
	8	2	0.23	0.44	742	1451	5726	396
	9	1	0.2	0.42	50	72	329	31
	9	2	0.72	1.14	283	1653	2214	100
1987	7	1	0.16	0.35	373	369	2436	222
	7	2	0.25	0.42	826	1531	6239	386
	8	1	0.25	0.38	722	1085	4752	320
	8	2	0.14	0.32	740	822	5638	469
	9	1	0.18	0.4	261	291	1808	168
	9	2	0.26	0.93	243	437	1815	167
1988	7	1	0.14	0.64	240	222	1601	172
	7	2	0.27	0.64	203	371	1597	106
	8	1	0.06	0.17	233	97	1534	194
	8	2	0.12	0.49	229	199	1879	178
	9	1	0.2	0.33	99	130	634	59
	9	2	0.24	0.46	81	133	596	47
1989	7	1	0.02	0.11	268	42	1660	245
	7	2	0.19	0.39	806	1032	5655	459
	8	1	0.03	0.1	119	21	650	107
	8	2	0.12	0.3	701	534	4799	483
	9	1	0.01	0.06	39	5	258	37
	9	2	0.19	0.51	402	494	2641	278

TABLE 2: CPUE (CATCH PER 1000 HOURS) BY YEAR, MONTH AND DEPTH FOR SUMMARIZED OBSERVATIONS IN MODEL 1.

YEAR	MONTH	DEPTH	MEAN	STD	N	CATCH	HOURS	ZEROS
1986	7	1	0.13	0.02	7	92	692	0
	7	2	0.28	0.15	39	1192	4505	0
	8	1	0.24	0.27	14	381	1471	0
	8	2	0.17	0.14	35	663	3732	1
	9	2	0.51	0.56	8	536	874	0
1987	7	1	0.13	0.08	17	216	1637	0
	7	2	0.26	0.15	51	1463	5615	0
	8	1	0.24	0.12	37	550	3583	0
	8	2	0.12	0.09	40	517	4337	0
	9	1	0.14	0.07	12	175	1240	0
	9	2	0.17	0.22	9	187	953	1
1988	7	1	0.13	0.18	10	128	995	1
	7	2	0.31	0.25	6	206	682	0
	8	1	0.03	0.07	7	24	677	5
	8	2	0.12	0.12	6	80	637	0
	9	1	0.29	0.22	3	90	294	0
	9	2	0.17		1	15	90	0
1989	7	1	0.01	0.01	10	10	885	5
	7	2	0.15	0.1	45	695	4659	0
	8	1	0.07	0.06	2	10	163	0
	8	2	0.09	0.06	37	326	3638	1
	9	2	0.1	0.12	18	171	1694	4

TABLE 3: CPUE (CATCH PER 1000 HOURS) BY YEAR, MONTH AND DEPTH FOR SUMMARIZED OBSERVATIONS IN MODEL 2.

YEAR	MONTH	DEPTH	MEAN	STD	N	CATCH	HOURS	ZEROS
1985	7	1	0.15	0.11	12	156	1065	0
	7	2	0.21	0.13	24	460	2254	0
	8	1	0.09	0.07	4	33	366	0
	8	2	0.1	0.07	35	415	3989	0
	9	1	0.1	0.04	3	26	263	0
	9	2	0.27	0.34	6	218	649	0
1986	7	1	0.15	0.11	8	122	818	0
	7	2	0.29	0.17	35	1122	4109	0
	8	1	0.29	0.24	16	516	1687	0
	8	2	0.22	0.16	37	1009	4285	0
	9	1	0.3		1	27	91	0
	9	2	0.73	0.43	11	1083	1362	0
1987	7	1	0.12	0.08	17	203	1653	0
	7	2	0.24	0.14	47	1258	5181	0
	8	1	0.23	0.12	40	869	3915	0
	8	2	0.13	0.11	40	609	4544	0
	9	1	0.13	0.11	11	140	1125	0
	9	2	0.26	0.28	7	227	795	0
1988	7	1	0.08	0.16	10	78	977	1
	7	2	0.2	0.15	5	114	545	1
	8	1	0.03	0.05	9	29	879	2
	8	2	0.1	0.15	7	78	810	2
	9	1	0.43		1	38	89	0
	9	2	0.08		1	7	90	0
1989	7	1	0.01	0.01	10	4	881	7
	7	2	0.15	0.09	45	739	4721	0
	8	1	0.03	0.03	3	8	251	0
	8	2	0.11	0.09	39	454	3969	0
	9	2	0.16	0.18	17	258	1606	3

TABLE 4: Percent of trips with zero catch per year in nominal data and data summarized for models 1 and 2.

	NOMINAL	MODEL 1			MODEL 2		
# TRIPS	1	5	10	15	5	10	15
YEAR							
1985	60%	.	.	.	25%	13%	9%
1986	49%	9%	1%	1%	36%	23%	19%
1987	55%	10%	3%	1%	8%	1%	0
1988	70%	32%	20%	18%	7%	1%	0
1989	69%	27%	15%	9%	10%	1%	0

Table 5. Parameter estimates and their standard errors for model 1.

Parameter		Estimate	Std Error of Estimate
INTERCEPT		4.101848951 B	0.62435991
YEAR	1	-1.105565620 B	0.13788014
	2	-1.083692074 B	0.20726890
	3	0.055217417 B	0.13063633
	4	0.000000000 B	.
MONTH	7	0.914722329 B	0.44042553
	8	0.879420809 B	0.43914916
	9	0.000000000 B	.
METHOD	1	1.828096264 B	0.51797206
	10	1.015587360 B	0.20562995
	100	0.000000000 B	.
MONTH*AREA	7 1	0.375218739 B	0.30396127
	7 2	-0.694549198 B	0.30932337
	7 3	-0.451989640 B	0.78193605
MONTH*AREA	7 4	0.000000000 B	.
	8 1	-0.417006725 B	0.33576580
	8 2	-1.559766715 B	0.31788974
	8 3	-0.211681727 B	0.36974208
	8 4	0.000000000 B	.
	9 1	-1.260799610 B	0.43271954
	9 2	-1.386575555 B	0.46693662
	9 3	-1.522743438 B	0.62326378
	9 4	0.000000000 B	.
MONTH*TOURN	7 0	0.592145070 B	0.53175595
	7 1	0.000000000 B	.
	8 0	0.827098544 B	0.54224500
	8 1	0.000000000 B	.
	9 0	1.919703410 B	0.59939992
	9 1	0.000000000 B	.
AREA*DEPTH	1 1	0.556492638 B	0.51260559
	1 2	0.000000000 B	.
	2 1	-0.312442920 B	0.29845166
	2 2	0.000000000 B	.
	3 1	0.000000000 B	.
	4 1	-1.727452714 B	0.18518398
	4 2	0.000000000 B	.
AREA*TOURN	1 0	-0.103096901 B	0.30858457
	1 1	0.000000000 B	.
	2 0	1.143740777 B	0.31258642
	2 1	0.000000000 B	.
	3 0	0.000000000 B	.
	4 0	0.000000000 B	.
	4 1	0.000000000 B	.
TYPE*TOURN	1 0	-0.375662219 B	0.11825675
	1 1	0.346842814 B	0.44883160
	2 0	0.000000000 B	.
	2 1	0.000000000 B	.

Table 6. Parameter estimates and their standard errors for model 2.

Parameter		Estimate	Std Error of Estimate
INTERCEPT		3.770737743 B	0.60210599
YEAR	1	-0.665517438 B	0.14172196
	2	-1.122317667 B	0.19743749
	3	0.347438308 B	0.13733729
	4	0.404844505 B	0.14394946
	5	0.000000000 B	.
DEPTH	1	-1.574367895 B	0.32562895
	2	0.000000000 B	.
TOURN	0	2.566973607 B	0.55083570
	1	0.000000000 B	.
MONTH*AREA	7 1	0.266920210 B	0.43219982
	7 2	0.647361796 B	0.41495253
	7 3	2.496325769 B	0.74925789
	7 4	0.639799743 B	0.40306382
	8 1	-0.831950912 B	0.44552466
	8 2	-0.179952293 B	0.40881016
	8 3	1.649661386 B	0.50762865
	8 4	0.346498179 B	0.40843780
	9 1	-1.932027653 B	0.36965544
	9 2	0.207472451 B	0.34532658
	9 3	0.796418544 B	0.54209099
	9 4	0.000000000 B	.
MONTH*DEPTH	7 1	-0.599456854 B	0.33963709
	7 2	0.000000000 B	.
	8 1	0.465193219 B	0.34713996
	8 2	0.000000000 B	.
	9 1	0.000000000 B	.
	9 2	0.000000000 B	.
MONTH*TOURN	7 0	-1.120513812 B	0.33025166
	7 1	0.000000000 B	.
	8 0	-0.769473928 B	0.33394601
	8 1	0.000000000 B	.
	9 0	0.000000000 B	.
	9 1	0.000000000 B	.
AREA*INVIEW	1 1	0.994265910 B	0.28515875
	1 2	0.000000000 B	.
	2 1	0.182465273 B	0.23682573
	2 2	0.000000000 B	.
	3 1	-0.264922573 B	0.61643616
	3 2	0.000000000 B	.
	4 1	0.709761932 B	0.28132657
	4 2	0.000000000 B	.
AREA*DEPTH	1 1	1.641870590 B	0.27520544
	1 2	0.000000000 B	.
	2 1	1.489888378 B	0.32662738
	2 2	0.000000000 B	.
	3 1	0.000000000 B	.
	4 1	0.000000000 B	.
	4 2	0.000000000 B	.
INVIEW*TOURN	1 0	-0.791581363 B	0.26064983
	1 1	0.000000000 B	.
	2 0	0.000000000 B	.
	2 1	0.000000000 B	.
TOURN*TYPE	0 1	-0.459382041 B	0.10170654
	0 2	0.000000000 B	.
	1 1	0.093276860 B	0.40132334
	1 2	0.000000000 B	.

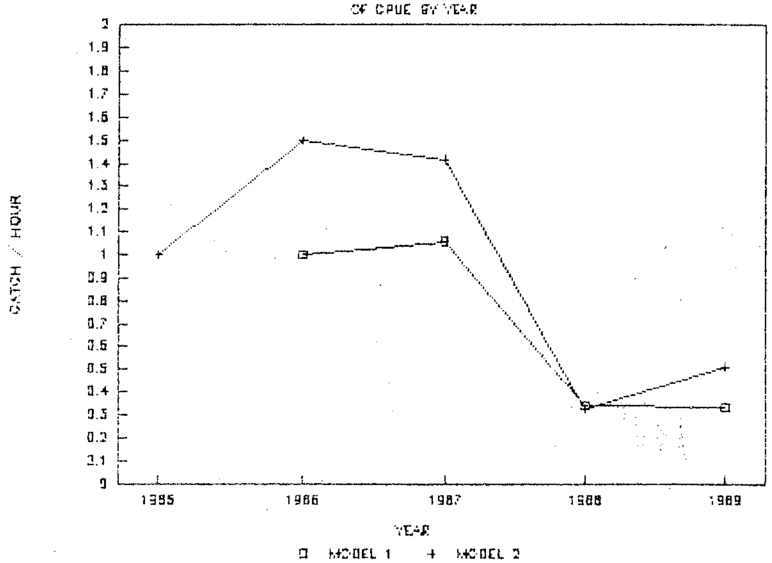


FIGURE 1: PARAMETER ESTIMATES (eY) FOR YEAR.

YEAR	MODEL 1 (method)	MODEL 2 (no method)
1985		1
1986	1	1.499062
1987	1.056751	1.415425
1988	0.338341	0.325530
1989	0.331012	0.514016

FIGURE 2: Description of final models 1 and 2.

VARIABLES:

- Y = year
- M = month
- E = method
- A = area
- D = depth
- T = tournament
- B = boat type
- I = interview

MODEL 1: ln(CHR*1000+1) = Y + M + E + M*A + M*T + A*D + A*T + B*T

R^2 = 52%

Square root of mean square error = 0.9642

Number of observations = 414

MODEL 2: ln (CHR*1000+1) = Y + D + T + M*A + M*D + M*T + A*I + T*B

R^2 = 57%

Square root of mean square error = 0.8654

Number of observations = 498

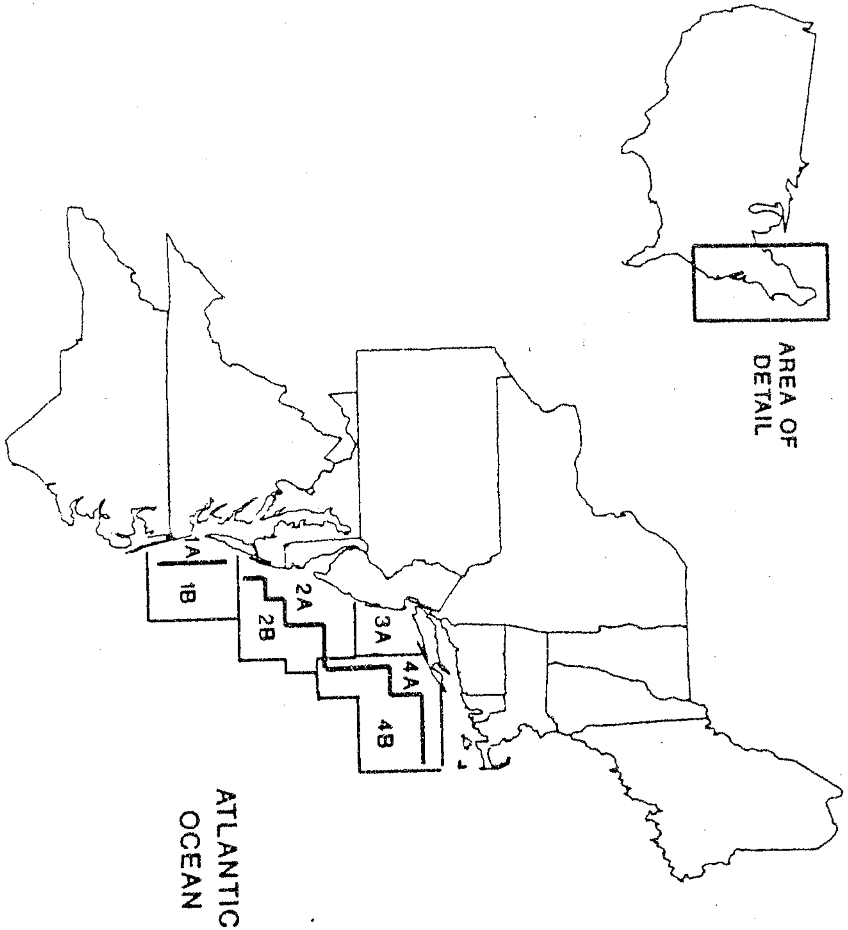
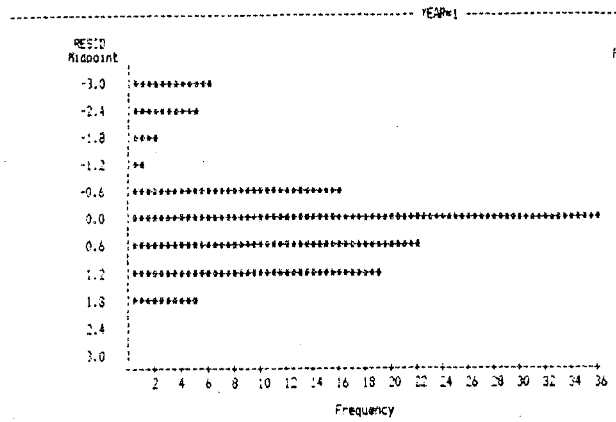
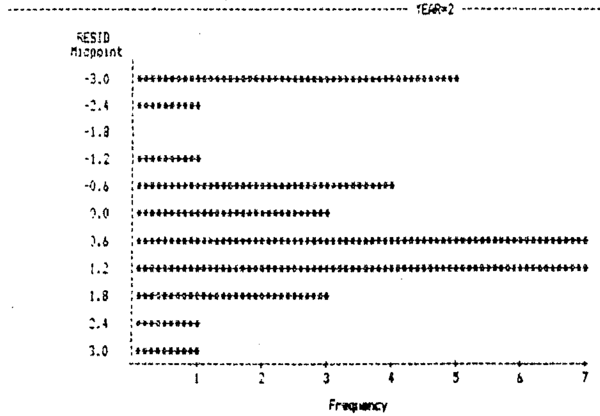


Figure 3. Areas (1-4) and depth strata (A, B) used in the general linear model.



RESID Midpoint	Freq	Cum. Freq	Percent	Cum. Percent
-3.0	6	6	5.36	5.36
-2.4	5	11	4.46	9.82
-1.8	2	13	1.79	11.61
-1.2	1	14	0.89	12.50
-0.6	16	30	14.29	26.79
0.0	36	66	32.14	58.93
0.6	22	88	19.64	78.57
1.2	19	107	16.96	95.54
1.8	5	112	4.46	100.00
2.4	0	112	0.00	100.00
3.0	0	112	0.00	100.00



RESID Midpoint	Freq	Cum. Freq	Percent	Cum. Percent
-3.0	5	5	15.15	15.15
-2.4	1	6	3.03	18.18
-1.8	0	6	0.00	18.18
-1.2	1	7	3.03	21.21
-0.6	4	11	12.12	33.33
0.0	3	14	9.09	42.42
0.6	7	21	21.21	63.64
1.2	7	28	21.21	84.85
1.8	3	31	9.09	93.94
2.4	1	32	3.03	96.97
3.0	1	33	3.03	100.00

Figure 4. Distributions of standardized residuals at each level of year, month and overall for model 1.

YEAR=3

RESID Midpoint	Freq	Cum. Freq	Percent	Cum. Percent
-3.0	1	1	0.61	0.61
-2.4	0	1	0.00	0.61
-1.8	3	4	1.82	2.42
-1.2	13	17	7.88	10.30
-0.6	29	46	17.58	27.88
0.0	59	105	35.76	63.64
0.6	45	150	27.27	90.91
1.2	14	164	8.48	99.39
1.8	1	165	0.61	100.00
2.4	0	165	0.00	100.00
3.0	0	165	0.00	100.00

Frequency

YEAR=4

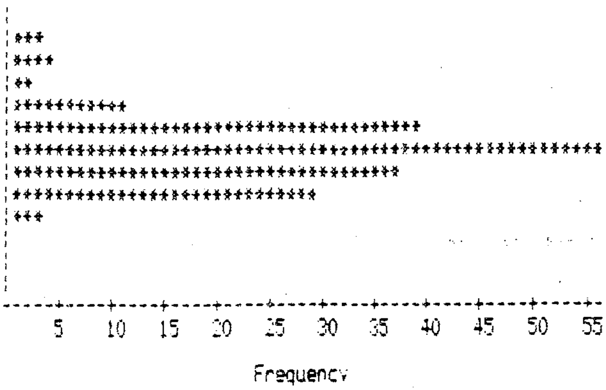
RESID Midpoint	Freq	Cum. Freq	Percent	Cum. Percent
-3.0	1	1	0.97	0.97
-2.4	0	1	0.00	0.97
-1.8	1	2	0.97	1.94
-1.2	7	9	6.80	8.74
-0.6	26	35	25.24	33.98
0.0	30	65	29.13	63.11
0.6	24	89	23.30	86.41
1.2	13	102	12.62	99.03
1.8	1	103	0.97	100.00
2.4	0	103	0.00	100.00
3.0	0	103	0.00	100.00

Frequency

Figure 4. (continued)

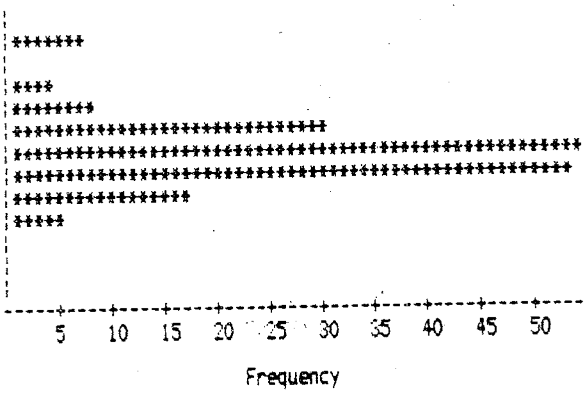
MONTH=JULY

MONTH	RESID Midpoint	Freq	Cum. Freq	Percent	Cum. Percent
JULY	-3.0	3	3	1.63	1.63
	-2.4	4	7	2.17	3.80
	-1.8	2	9	1.09	4.89
	-1.2	11	20	5.98	10.87
	-0.6	39	59	21.20	32.07
	0.0	56	115	30.43	62.50
	0.6	37	152	20.11	82.61
	1.2	29	181	15.76	98.37
	1.8	3	184	1.63	100.00
	2.4	0	184	0.00	100.00
	3.0	0	184	0.00	100.00



MONTH=AUGUST

MONTH	RESID Midpoint	Freq	Cum. Freq	Percent	Cum. Percent
AUGUST	-3.0	7	7	3.93	3.93
	-2.4	0	7	0.00	3.93
	-1.8	4	11	2.25	6.18
	-1.2	8	19	4.49	10.67
	-0.6	30	49	16.85	27.53
	0.0	54	103	30.34	57.87
	0.6	53	156	29.78	87.64
	1.2	17	173	9.55	97.19
	1.8	5	178	2.81	100.00
	2.4	0	178	0.00	100.00
	3.0	0	178	0.00	100.00



MONTH=SEPTEMBER

MONTH	RESID Midpoint	Freq	Cum. Freq	Percent	Cum. Percent
SEPTEMBER	-3.0	3	3	5.88	5.88
	-2.4	2	5	3.92	9.80
	-1.8	0	5	0.00	9.80
	-1.2	3	8	5.88	15.69
	-0.6	6	14	11.76	27.45
	0.0	18	32	35.29	62.75
	0.6	8	40	15.69	78.43
	1.2	7	47	13.73	92.16
	1.8	2	49	3.92	96.08
	2.4	1	50	1.96	98.04
	3.0	1	51	1.96	100.00

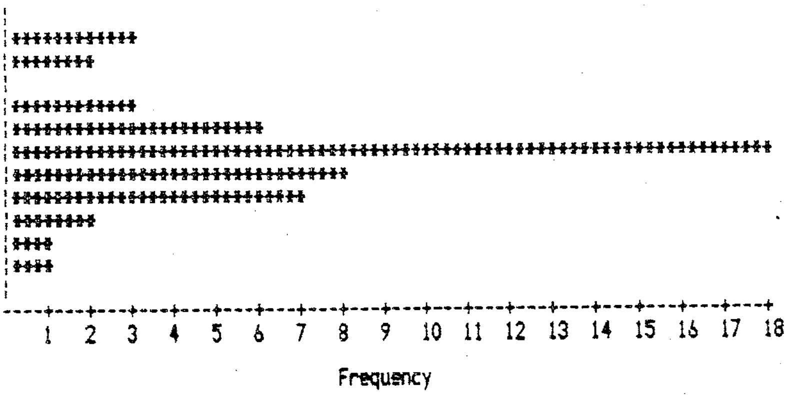


Figure 4. (continued)

Overall

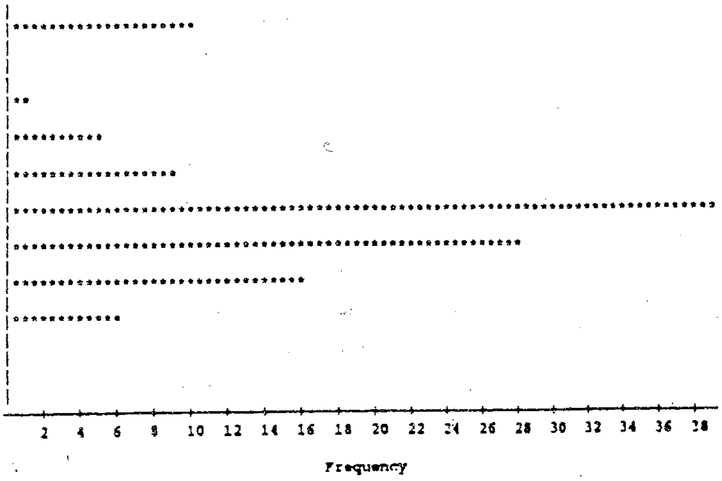
Resid. Midpoint		Freq	Cum. Freq	Percent	Cum. Percent
-3.0	*******	13	13	3.15	3.15
-2.4	***	6	19	1.45	4.60
-1.8	***	6	25	1.45	[illegible]
-1.2	***********	22	47	5.33	11.38
-0.6	**************************************	75	122	18.16	29.54
0.0	**	128	250	30.99	60.53
0.6	***	98	348	[illegible]	[illegible]
1.2	***************************	53	401	12.83	[illegible]
1.8	*****	10	411	2.42	99.52
2.4	*	1	412	0.24	99.76
3.0	*	1	413	0.24	100.00

Frequency axis: 10 20 30 40 50 60 70 80 90 100 110 120

Frequency

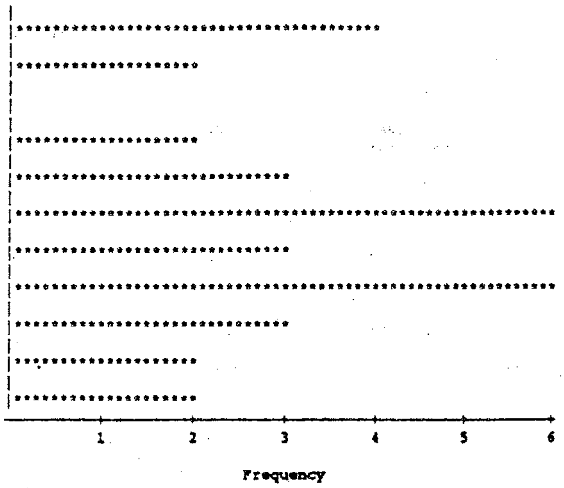
Figure 4. (continued)

YEAR=1



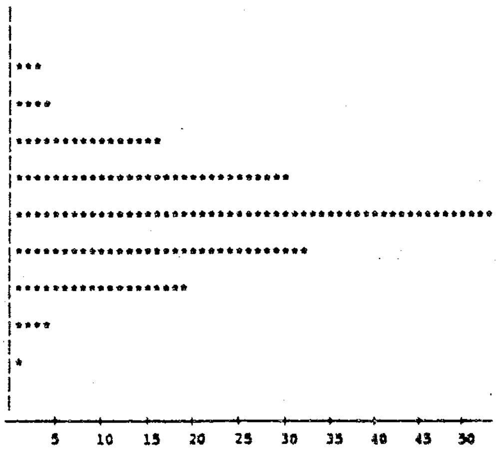
RESID Midpoint	Freq	Cum. Freq	Percent	Cum. Percent
-3.0	10	10	8.77	8.77
-2.4	0	10	0.00	8.77
-1.8	1	11	0.88	9.65
-1.2	5	16	4.39	14.04
-0.6	9	25	7.89	21.93
0.0	39	64	34.21	56.14
0.6	28	92	24.56	80.70
1.2	16	108	14.04	94.74
1.8	6	114	5.26	100.00
2.4	0	114	0.00	100.00
3.0	0	114	0.00	100.00

YEAR=2



RESID Midpoint	Freq	Cum. Freq	Percent	Cum. Percent
-3.0	4	4	12.12	12.12
-2.4	2	6	6.06	18.18
-1.8	0	6	0.00	18.18
-1.2	2	8	6.06	24.24
-0.6	3	11	9.09	33.33
0.0	6	17	18.18	51.52
0.6	3	20	9.09	60.61
1.2	6	26	18.18	78.79
1.8	3	29	9.09	87.88
2.4	2	31	6.06	93.94
3.0	2	33	6.06	100.00

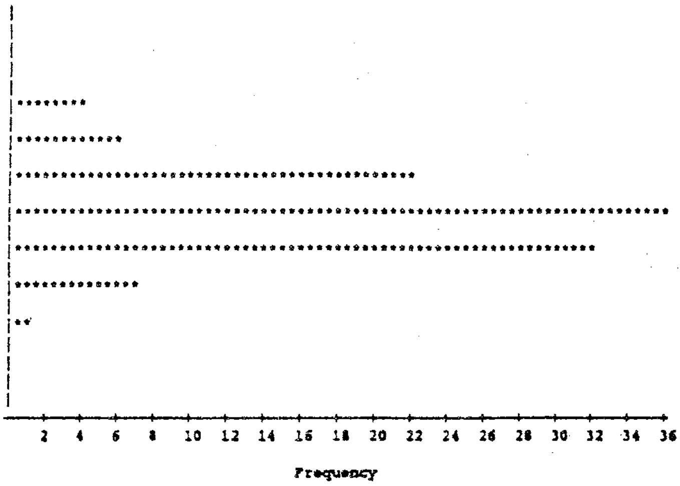
YEAR=3



RESID Midpoint	Freq	Cum. Freq	Percent	Cum. Percent
-3.0	0	0	0.00	0.00
-2.4	3	3	1.85	1.85
-1.8	4	7	2.47	4.32
-1.2	16	23	9.88	14.20
-0.6	30	53	18.52	32.72
0.0	53	106	32.72	65.43
0.6	32	138	19.75	85.19
1.2	19	157	11.73	96.91
1.8	4	161	2.47	99.38
2.4	1	162	0.62	100.00
3.0	0	162	0.00	100.00

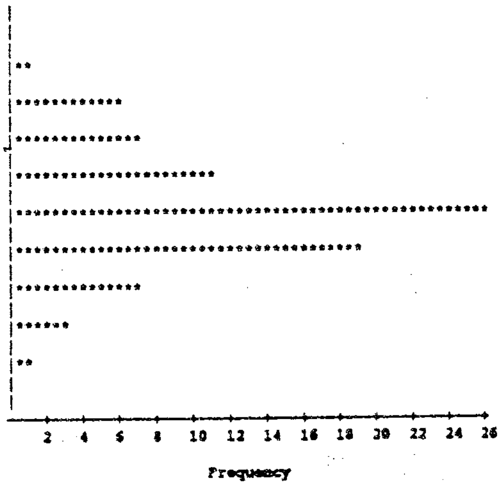
Figure 5. Distributions of standardized residuals at each level of year, month and overall for model 2.

YEAR=4



RESID Midpoint	Freq	Cum. Freq	Percent	Cum. Percent
-3.0	0	0	0.00	0.00
-2.4	0	0	0.00	0.00
-1.8	4	4	3.70	3.70
-1.2	6	10	5.56	9.26
-0.6	22	32	20.37	29.63
0.0	36	68	33.33	62.96
0.6	32	100	29.63	92.59
1.2	7	107	6.48	99.07
1.8	1	108	0.93	100.00
2.4	0	108	0.00	100.00
3.0	0	108	0.00	100.00

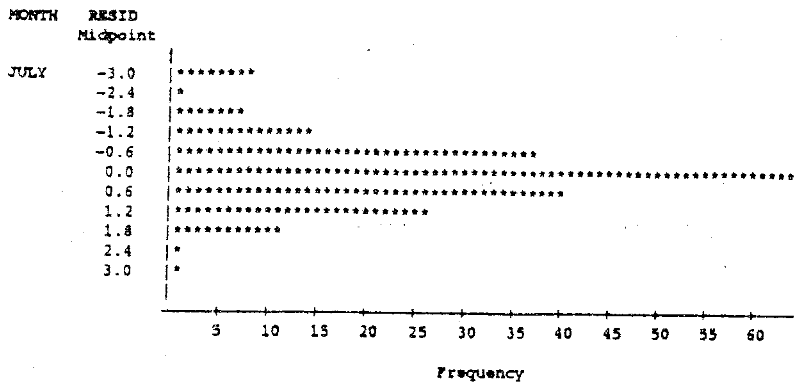
YEAR=5



RESID Midpoint	Freq	Cum. Freq	Percent	Cum. Percent
-3.0	0	0	0.00	0.00
-2.4	1	1	1.23	1.23
-1.8	6	7	7.41	8.64
-1.2	7	14	8.64	17.28
-0.6	11	25	13.58	30.86
0.0	26	51	32.10	62.96
0.6	19	70	23.46	86.42
1.2	7	77	8.64	95.06
1.8	3	80	3.70	98.77
2.4	1	81	1.23	100.00
3.0	0	81	0.00	100.00

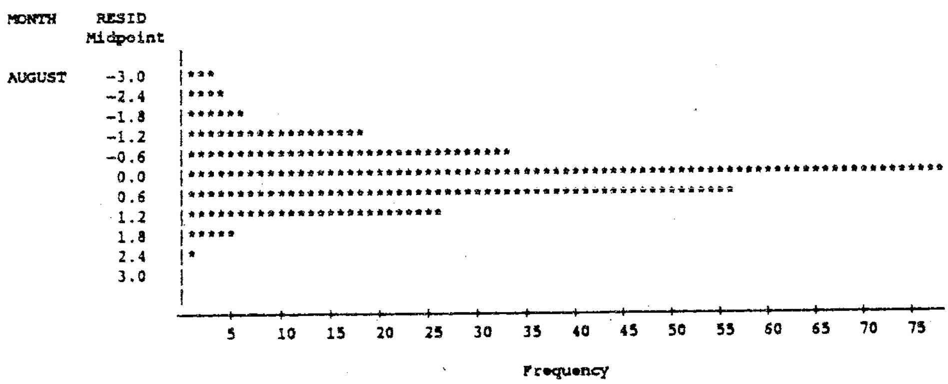
Figure 5. (continued)

MONTH=JULY



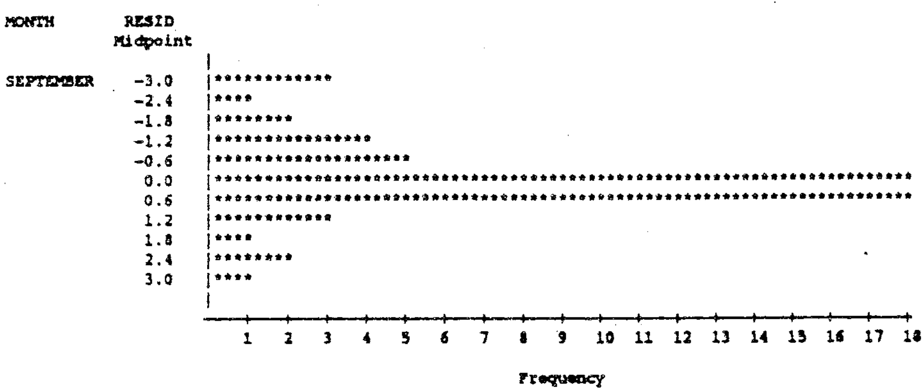
Freq	Cum. Freq	Percent	Cum. Percent
8	8	3.81	3.81
1	9	0.48	4.29
7	16	3.33	7.62
14	30	6.67	14.29
37	67	17.62	31.90
64	131	30.48	62.38
40	171	19.05	81.43
26	197	12.38	93.81
11	208	5.24	99.05
1	209	0.48	99.52
1	210	0.48	100.00

MONTH=AUGUST



Freq	Cum. Freq	Percent	Cum. Percent
3	3	1.30	1.30
4	7	1.74	3.04
6	13	2.61	5.65
18	31	7.83	13.48
33	64	14.35	27.83
78	142	33.91	61.74
56	198	24.35	86.09
26	224	11.30	97.39
5	229	2.17	99.57
1	230	0.43	100.00
0	230	0.00	100.00

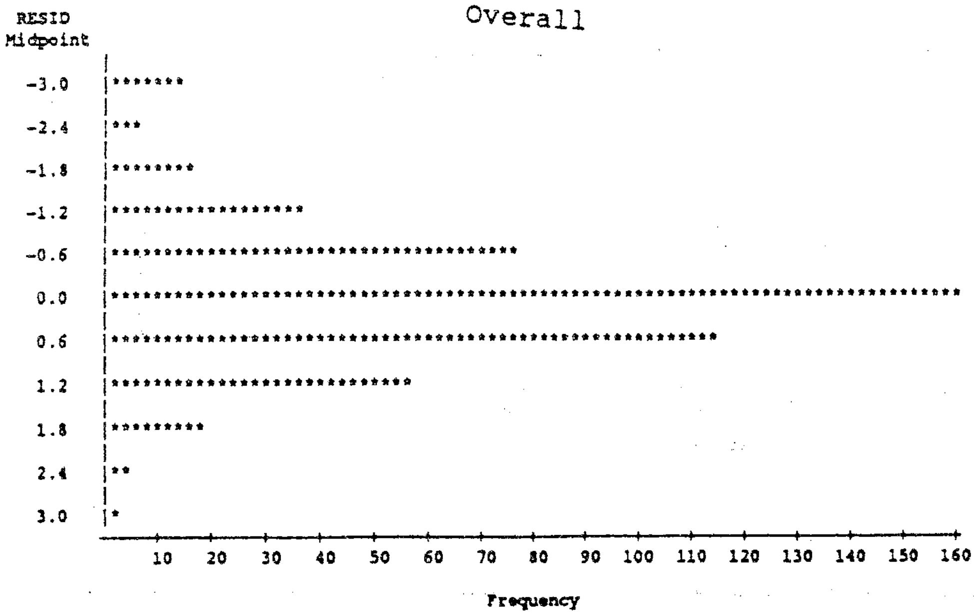
MONTH=SEPTEMBER



Freq	Cum. Freq	Percent	Cum. Percent
3	3	5.17	5.17
1	4	1.72	6.90
2	6	3.45	10.34
4	10	6.90	17.24
5	15	8.62	25.86
18	33	31.03	56.90
18	51	31.03	87.93
3	54	5.17	93.10
1	55	1.72	94.83
2	57	3.45	98.28
1	58	1.72	100.00

Figure 5. (continued)

Overall



RESID Midpoint	Freq	Cum. Freq	Percent	Cum. Percent
-3.0	14	14	2.81	2.81
-2.4	6	20	1.20	4.02
-1.8	15	35	3.01	7.03
-1.2	36	71	7.23	14.26
-0.6	75	146	15.06	29.32
0.0	160	306	32.13	61.45
0.6	114	420	22.89	84.34
1.2	55	475	11.04	95.38
1.8	17	492	3.41	98.80
2.4	4	496	0.80	99.60
3.0	2	498	0.40	100.00

Figure 5. (continued)