ASSESSING CORRECTIONAL OFFICER MANPOWER REQUIREMENTS: A METHODOLOGY BASED ON THE NEW YORK CITY DEPARTMENT OF CORRECTION

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PREFACE

One facet of The New York City-Rand Institute's continuing research in corrections concerns the development of management systems to improve institutional staffing decisions. This Report describes an analytical procedure that should aid the New York City Department of Correction (and, by modification of the procedure, authorities in other cities as well) in assessing correctional officer need by monitoring, identifying, and investigating unusual levels of actual or proposed manpower usage at the institutions. A comprehensive typology of manpower assignments is developed which permits consistent staffing comparisons among the Department's institutions. Through the typology, samples of recent actual manpower allocations and wardens' requests are analyzed. Four allocational decision rules are derived and utilized to produce estimates of appropriate officer manning in the twenty-eight post assignments at each of the seven detention facilities. A mathematical treatment of the four decision schemes is given which reveals several of their important general properties and identifies certain spurious results in their applications to real manpower data. Suggestions are presented which bear on the possible implementation, interpretation, refinement, and improvement of the methodology. Statistical summaries of the data samples, definitions and expositions of the statistical terms employed, and computer programs of the decision algorithms are also provided.

SUMMARY

Prison officials are confronted daily with the tasks of guarding, caring for, and rehabilitating the accused and offenders placed in their charge by the judiciary: this is a fundamental responsibility prescribed by law. To fulfill its primary mandate--custody--the Department of Correction must prevent escapes, minimize disorder, and control contraband. The custodial operations that stem from these basic objectives by themselves imply sizable correctional staffs and demand substantial commitments of City and Department resources. When coupled further with the need to provide inmate services and rehabilitative programs, the manpower demands and budgetary pressures become even more acute.

The difficulty in managing resources among such competing objectives is compounded by the fact that they are also often conflicting, and the level of resources required to meet them is tied to factors beyond the Department's control. Demands for correctional manpower are heavily influenced by police, courts, probation, and parole agencies. These agencies determine the inmate flows at the Department of Correction's institutions for both pretrial and sentenced individuals. In turn, their activity levels are reflected in the manpower requests routinely submitted by wardens and other Department officials. Because these staffing requirements impose the greatest budgetary strain on the Department, a significant need is created for an instrument to assess objectively both existing officer deployments and requested additional allocations. While the approach described in this Report is an attempt to fill such a need, it must be recognized that the conflicting nature of current correctional goals and the lack of clear delineation of those goals preclude a completely objective, rigorous scheme for estimating appropriate manning levels at this time.

At present, manpower requirements are ascertained by the wardens--those most familiar with the individual institutions--and reviewed and approved by the Director of Operations. Such a policy has been justified by the fact that although there are strong similarities in the inmate observation, processing, and care functions among the facilities, there are also significant differences in institutional architecture, housing capacity, inmate population, and type of inmate served. This and the

fact that treatment programs, care service, and custodial activities collectively determine the successful operation of an institution have led to heavy reliance on wardens' judgments about the specific manning requirements of their institutions.

The quantitative assessment scheme that we develop in this Report capitalizes on the similarities of the correctional institutions. The use of a mathematical technique employing data on actual manpower allocations affords a degree of objectivity not found in the present practice of almost complete reliance on wardens' subjective judgments. The suggested approach is not purely mechanistic, however. As an aid to staffing decisions, the scheme draws the administrator's attention to manpower allocations that *appear* anomalous or deviant with respect to the Department-wide weighted averages for each officer-assignment category. These large departures from average manning which the scheme highlights can be real (as those resulting from redeployments of correctional officers at the detention facilities) or proposed (as those that would result from approval and implementation of wardens' requests for more men). The mathematical algorithm shows the decision-maker which changes appear too conservative (relative understaffing), normal, or too liberal (relative overstaffing). Once detected, these statistical anomalies can point the way to further investigation, justification, or correction of the deviant staffing levels.

As a first step in drawing comparisons within and among the correctional facilities, a consistent post (officer assignment or station) typology is devised to supplement the *ad hoc* "Tour Assignment Schedules" now employed for manpower scheduling at the separate detention centers. The post typology is functionally oriented, exhaustive (but perhaps at too high a level of aggregation), and consists predominantly of mutually exclusive categories.* The three primary categories that constitute the typology are (I) Observation and Supervision, (II) Circulation Control, and (III) Processing. Each of these broad activities encompasses some of the custodial, care service, and rehabilitative aspects of corrections.

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*A refined typology, developed with members of the New York City Department of Correction's Analysis Unit, is described in Appendix I. A computerized post survey display program has also been developed to aid in analysis of detailed typology data and will be furnished upon request by The New York City-Rand Institute.

The Tour Assignment Schedules, which designate actual manpower allocations, and the wardens' requests, which propose new deployments and additional allocations, provide the raw data for the uniform functional post typology. In turn, once the field data have been translated into the typology, this new structuring of the data forms the basis for the manpower analysis and mathematical assignment decision rules described in this Report. Four such rules are derived, their analytical properties are explored, and each is applied to actual allocations and wardens' requests data to obtain range estimates on appropriate staffing in the twenty-eight post categories of each detention institution in New York City.

Though decision rules can be introduced arbitrarily, those developed in this document have special intuitive appeal and computational simplicity. Two of the decision rules utilize the statistical concepts of weighted average and variance to compute point and range estimates of manpower levels by institution and post category. The other two decision rules ignore these statistics and make only simple comparisons between an individual institution's average actual allocations and those implied by the warden's requests. These latter, straightforward rules serve as limits of a spectrum defined by two different hypotheses: (1) wardens are the most knowledgeable about institutional problems, submit requests that strictly reflect actual or anticipated needs and, therefore, should be accorded their requests; (2) wardens, when submitting manpower requests, will request additional men even if not firmly rooted to institutional need and, therefore, should continue with manpower levels that lie somewhere between what they request and the average with which they have been able to survive in the past. The manpower limits implied by these hypotheses, and reflected in the simpler rules, make it possible to use the mathematically abstract notions of variability threshold and threshold factor that are contained in the more complex decision rules and to link them to two more easily understood manpower extremes.

These four decision rules were applied to 1970 data on actual manpower assignments and wardens' requests. Bounds and intermediate manning levels were obtained for the twenty-eight post categories of each of the seven New York City Department of Correction detention centers. Using the more complex decision rules, a sensitivity analysis was performed by sequentially fixing the variability threshold for each post type at 0.5, 1.0, 1.5, and 2.0 times the manning-change standard deviation for that post type. The conservative assignment policy gave corresponding total manpower estimates of 1529, 1652, 1728, and 1751, while the liberal decision rule gave 1668, 1672, 1734, and 1753. The two simpler assignment schemes resulted in lower and upper total manpower bounds of 1141 and 1882.* As the variability threshold factor was progressively increased, institutions and posts were identified that suggested further examination before manpower commitments are finalized.

The concluding sections suggest further possible refinements in the methodology. Other approaches are also discussed, including the possibility of using overtime data as an indicator of manning need and the feasibility of applying multiple regression techniques to relate overtime statistics to inmate flows, officer sick leave, overcrowding, security incident rates, etc.. The appendixes provide details of the data samples, expositions on the statistical terms employed, a mathematical treatment of the analytical properties of the four decision schemes, and computer programs that can guide the implementation of the methodology in the Department's emerging management information system.

*The 1970 detention institution manning quota was about 1464 officers and the wardens' requests totaled about 1753 men.

ACKNOWLEDGEMENTS

I would like to acknowledge the New York City Department of Correction's sponsorship and assistance in this study. The results have been enriched significantly by discussions with the Department's Assistant Commissioner for Planning and Administration, Director of Operations, wardens, and Analysis Unit staff, as well as by their efforts in arranging access to sensitive operational data.

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LIST OF SYMBOLS

Symbols

i = Institutional index, ($i = 1,2,\ldots,I$).

I = Total number of institutions.

j = Post type according to Table 1 typology, ($j = 1,2,\ldots,J$).

J = Total number of post types in the typology.

k = Sample week index, ($k = 1,2,\ldots,K$).

K = Total number of weekly manpower samples.

A_{ijk} = Actual manpower allocated to post j at institution i during sample week k.

$\bar{A}_{ij}$ = Average actual manpower allocations over last K samples A_{ijk}.

R_{ij} = Requested manpower at institution i for post j.

M_{ij} = Manpower allocated to institution i for post j in accordance with a decision rule.

c_i = Total housing capacity of the i^{th} institution.

C = Total housing capacity of all I institutions.

Δ_{ij} = Manpower change at institution i in post j; i.e., request (R_{ij}) minus average actual allocation ($\bar{A}_{ij}$).

$\bar{\Delta}_j$ = Weighted average (by housing capacity across all I institutions) of manpower changes in post type j.

σ_j = Standard deviation of manpower changes in post type j.

λ_j = Variability threshold factor for post type j.

LIST OF ABBREVIATIONS

Institutions

NYC DC	= New York City Department of Correction
BRK	= Brooklyn House of Detention for Men
ARS	= Adolescent Remand Shelter
MAN	= Manhattan House of Detention for Men
WOM	= House of Detention for Women
QNS	= Queens House of Detention for Men
BRX	= Bronx House of Detention for Men
BRQ	= Branch Queens House of Detention for Men

I. INTRODUCTION

Development of improved decision-making aids for management and supporting information systems has constituted one facet of The New York City-Rand Institute's research in corrections. This Report describes an analytical procedure that can aid the Department of Correction in assessing correctional officer (C.O.) manpower need by monitoring, identifying, and challenging unusual levels of actual or proposed staffing in the officer post assignments at the various institutions. Before discussing and applying the scheme to obtain the preliminary range estimates of C.O. manpower requested by the Department and the City's Bureau of the Budget, it is useful to review current Departmental practice and to consider the significance and difficulty of the manpower-estimation problem.

It is well known that the police, courts, and probational and parole agencies determine the inmate flows at the Department of Correction's institutions. As such, these agencies heavily influence the demands for correctional manpower. The level of their activities is reflected, in turn, both in the manpower requests of the institutional wardens and in the Department's annual budget submissions.[1]

Prison officials are confronted daily with the often conflicting tasks of guarding, caring for, and rehabilitating the accused and offenders with whom they are charged, which is a fundamental responsibility prescribed by law. To fulfill its custodial mission, the Department of Correction must prevent escape, minimize disorder, and control contraband. These basic custodial operations by themselves imply sizable correctional staffs and demand substantial commitments of City and Department resources. When these basic aspects of corrections are coupled with the further need to provide inmate services and rehabilitative programs, the manpower demands and budgetary pressures become even more significant.

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[1] The Department's entire 1969-1970 expense budget was $61.2 million, with about $13.3 million, or 22 percent, allocated to salaries and benefits for correctional officers below the rank of captain in the seven detention facilities. Thus, small percentage savings gained through more efficient manpower utilization or substitutional alternatives can have substantial impacts in absolute monetary terms.

Traditionally, manpower requirements have been ascertained by the wardens, who are clearly most familiar with the institutions they head. This policy has been justified by the fact that although there are strong similarities in the inmate observation, processing, and care functions among the facilities, there are also significant differences in institutional architecture, housing capacity, inmate type (i.e., male, female, adult, and adolescent), and inmate population. This and the fact that treatment programs, care service, and custodial activities collectively influence the successful operation of an institution have led to heavy reliance on wardens' judgments about the specific manning requirements of their institutions.

Each year, the wardens submit their requests for men to the Department's Director of Operations. At the Director's discretion, certain requests that are perceived to be "out-of-line" may be challenged, whereupon the wardens must supply additional supporting arguments or revise their requests. Adjustments can also be made without conferring further with the wardens.

The "Tour Assignment Schedules" (TAS's) which the individual wardens use weekly to assign men to institutional posts are not reviewed by the Director of Operations.[2] Even if the Director routinely inspected these tour schedules, he would not find them very useful in making manpower decisions. One reason for this is that the scheduling is generally done according to nominal post classification within the institution--which in number and detail differ considerably among the separate facilities--rather than by a consistent, functionally oriented post typology. Also, since the schedules are not always corrected to reflect exigencies (writs, hospital transfers, etc.) that arise during the scheduled week but cannot be anticipated during schedule preparation, the schedules may not reveal the manning priorities, compromises, and activities that actually obtain. Nor are the reasons for reassignments always apparent, i.e., because of increased workload, officer sick leave, added security problems, etc. Moreover, the schedules do not indicate

[2]The TAS's are the duty rosters used to assign C.O.'s to the different tours and posts (i.e., stations) within the institutions. A sample schedule is illustrated in Table 2, pp. 6-8.

the portion of an officer's time expended in performing several tasks, not all of which belong to the designated post (e.g., an officer at a gate control post who also performs some of the mail room tasks; C.O.'s in the general office who "scramble" to security alerts from the cell block areas; receiving room staff relieving cell block officers during lunchtime, etc.). Another limitation of the TAS's is the absence of any information relating to the quality of service and job performance of the posted C.O.'s.

There are shortcomings in the TAS's of a still broader and more substantive nature that also hamper manpower analysis. Some of these stem from limitations inherent in reported data, others from ill-defined program objectives. Differences in accounting practices among wardens, for example, can complicate and obfuscate cross-institutional comparisons of manning. Even historical comparisons within a facility can be difficult when changes have occurred in wardens and other key administrators, in inmate composition, program, or in physical plant. Similarly, changes in penal philosophy and variations in the degree of risk that different wardens are willing to tolerate can make analysis of correctional staffing patterns and levels hard to interpret. Other analytical obstacles include the vague formulation of correctional objectives, the lack of measures of performance and "worth," and the imprecise or nonexistent definition of posts and work standards.

These deficiencies clearly preclude rigorous estimates of manpower need, by conventional industrial engineering approaches or by any other methodology. However, it may be possible to compute manpower range estimates that are narrow enough and of a sufficiently high confidence level to be of value. Such a scheme could not be purely quantitative or mechanistic; it would still have to consider the judgments of the wardens, but without having to rely on them alone. Such a scheme is described in the body of this Report.

II. A FUNCTIONAL POST TYPOLOGY

It is clear that a consistent post classification system must be devised as a first step in drawing comparisons within and among correctional facilities. Such a post typology should be functionally oriented (i.e., detailed by task or activity, rather than by nominal post title), exhaustive, and made up of mutually exclusive categories. It must also specify the locations and times at which each task or activity is performed. Table 1 illustrates a possible typology, even though it does not completely satisfy all these criteria.[3]

The three primary categories that constitute the functional typology in Table 1 are (I) Observation and Supervision, (II) Circulation Control, and (III) Processing. Each of these broad activities encompasses some of the custodial, care service, and rehabilitative aspects of corrections. Within each category, the table also shows the typical locations where the various activities are performed. Although most of the post assignments found in a "Tour Assignment Schedule" (see Tables 2, 3, and 4) could easily be cast into the format of Table 1, some ambiguities would remain, because the three major categories are not completely mutually exclusive. A C.O. assigned to a clinic post, for example, probably functions also in a supervisory or observational capacity. Similarly, C.O.'s patrolling housing areas will frequently also operate sallyports and escort inmates to recreational areas.

Further refinement of the typology is thus clearly a prerequisite to Department-wide implementation of the manpower accounting scheme developed here. A suitable typology must reflect the judgments of wardens and the Director of Operations on what constitutes an exhaustive list of post activities, on appropriate post definitions, on the detail of the data necessary to monitor and assess manning needs, and on how often such data need to be collected. The typology presented in Table 1, although lacking in some of these respects, is a reasonable compromise in that the meaning of the post categories is obvious, the list is comprehensive (even though perhaps over-

[3]A considerably refined typology, developed with members of the NYC DC's Analysis Unit, is displayed in Appendix I.

Table 1

TYPOLOGY OF POSTS*

I. OBSERVATION AND SUPERVISION
1. Housing Area Post
2. Outside Post
3. Mobile Patrol Post and Gangs

II. CIRCULATION CONTROL
1. Gate (and Main Entrance)
2. Sallyports
3. Bridges (and Tunnels, Rotunda)
4. Escorts
5. Elevators

III. PROCESSING
1. Feeding (Inmate and Officer Mess Halls)
2. Kitchen
3. Receiving Room
4. Visits
5. Commissary
6. Recreation (and Library, Chapel)
7. Office Work (General Office, Security Office, Storehouse, Cashier, Control Room, Key and Tool Control)
8. Laundry (Clothes Box and Distribution)
9. Barber Shop
10. Clinic
11. Counsel Room
12. Social Service (and Bowery Project)
13. Mail and Package Room
14. Revolver Qualification
15. Skilled Maintenance (Extermination, Electrician, Roofer, etc.)
16. Education and Vocational Programs
17. Bakery
18. Relief
19. Transfer Officer and Miscellaneous
20. Infirmary

*See also Appendix I, Table I-1.

Table 2

ILLUSTRATIVE TOUR ASSIGNMENT SCHEDULE

WEEK OF: 3/30 - 4/5/70 TOUR: 7:45 A.M. - 4:00 P.M.

THE CITY OF NEW YORK
DEPARTMENT OF CORRECTION

DATE:	30	31	1	2	3	4	5
DAY:	MON.	TUES.	WED.	THURS.	FRI.	SAT.	SUN.
ASSIGNMENTS							
1st Tier	M1*	M1	M1	M1	B1	Z1	Z1
2nd Tier	T1	T1	T1	P1	P1	P1	P1
3rd Tier	C1	C1	C1	C1	C2	C2	C2
4th Tier	R1	R1	R1	R1	R2	R2	R2
5th Tier	T2	T2	R2	R2	B2	B3	B3
Control Corr.	V1	J1	J1	J1	P2	B1	T3
Dormitory	F1	S1	S1	S1	W1	P2	P2
Annex 6th Fl.	S2	S2	S2	S2	J1	E1	T4
Annex 7th Fl.	T4	T4	T4	T4	S1	H1	W2
Office	B4	C3	B5	B5	B5	B5	B1
Front Gate	C3	B2	G1	G1	G1	G1	G1
D/W Office		B4	B4	B4	B4		
W/Office	S3	S3	S3	S3	S3		
Maintenance	M2	M2	M2	M2	M2		
Sanitation 1	K1	K1	K1	K1	K1		
Sanitation 2			T2				
Storeroom	K2	K2	K2	K2	K2		
Clinic	W3	W3	W3	W3	W3	W1	H1
Yard 6:45-3PM.	W3	E1	E1	E1	E1		
Barber			B2	B2	G2		
Yard 8:45-5PM.	M3	W1	W1	W1	E1		
Rec. Rm. 6:45-3PM.	P3	P3	P3	P3	P3		
Rec. Rm. 12:45-9PM.	M4	M4	M4	M4	M4		
Kitchen 4:45-1PM.	S4	F2	S4	S4	C3	C3	C3
Kitchen 11:45-8PM.	M5	M5	M5	M5	A1	A1	M5
Ent. Corr. 11:45-8PM.	M6	M6	M6	M6	M6		
Visits 11:45-8PM.	L1		L1	L1	L1		
Messhall 10:45-7PM.	M7	M7	D1	D1	D1	D1	D1
Commissary 5:45-2PM.	S5	S5	S5	S5	S5		
Cashier 4:45-1PM.	M8+F3	M8+F3	F3	F3	F3		

*The letters in this post assignment schedule symbolize correctional officers' names.

Table 3

ILLUSTRATIVE TOUR ASSIGNMENT SCHEDULE

WEEK OF: 3/30 - 4/5/70 TOUR: 3:45 P.M. - 12 Midnight

THE CITY OF NEW YORK
DEPARTMENT OF CORRECTION

DATE:	30	31	1	2	3	4	5
DAY:	MON.	TUES.	WED.	THURS.	FRI.	SAT.	SUN.
ASSIGNMENTS							
1st Tier	V2	V2	V2	V2	V2	B6	B6
2nd Tier	T3	T3	T3	T3	H2	H2	H2
3rd Tier	B3	T5	T5	T5	T5	T5	A1
4th Tier	P1	M9	M9	M9	M9	M9	E2
5th Tier	Z1	Z1	Z1	E3	E3	E3	E3
Control Corr.	C2	C2	B3	E4	E4	E4	E4
Dormitory	P2	P2	G3	G3	G3	G3	G3
Annex 6th Fl.	W2	W2	W2	W2	Y1	Y1	Y1
Annex 7th Fl.	H1	B3	H1	Y1	E5	E5	E5
Front Gate	C4	C4	C4	C4	C4	C5	C5
Office	B1	B1	H3	H3	H3	H3	M10

Table 4

ILLUSTRATIVE TOUR ASSIGNMENT SCHEDULE

WEEK OF: 3/30 - 4/5/70 TOUR: 11:45 P.M. - 8:00 A.M.

THE CITY OF NEW YORK
DEPARTMENT OF CORRECTION

DATE:	30	31	1	2	3	4	5
DAY:	MON.	TUES.	WED.	THURS.	FRI.	SAT.	SUN.
ASSIGNMENTS							
1st Tier	H2	H2	K3	K3	K3	K3	K3
2nd Tier	A2	A2	A2	A2	A2	T2	T2
3rd Tier	B6	B6	B6	F1	F1	F1	F1
4th Tier	E4	G2	J2	J2	J2	J2	C1
5th Tier	E5	E5	G2	G2	G2	T1	T1
Control Corr.	A1	A1	G4	G4	G4	G4	R1
Dormitory	C5	C5	C5	V1	V1	V1	V1
Annex 6th Fl.	Y1	E2	F2	F2	F2	F2	S2
Annex 7th Fl.	E2	J2	E2	E2	M7	M7	M7
Front Gate	E3	G5	G5	G5	G5	G5	S4
Office	M10	M10	M10	M10	M3	M3	M3

aggregated), and current actual TAS's can be fairly readily translated into the indicated categories.

In Appendix A, we tabulate the results of translating the present TAS's into the new typology given in Table 1. We can understand in general how those results were arrived at by referring to the illustrative schedule of Tables 2, 3, and 4. Taking the first post assignment, Tier 1, for example, we see that this post is continuously manned; i.e., a C.O. is stationed at Tier 1 during the three tours of each day of the week indicated. The assignment obviously falls into Category I.1 of the new post typology (Table 1).

Since the tour schedule designates one C.O. for each of three eight-hour tours, seven days a week, the Tier 1 post entails 168 (=1x3x8x7) man-hours per week, or 8760 man-hours per year. If we assume that a C.O. contributes 218 eight-hour working days per year (1744 man-hours per annum), it follows that the Tier 1 post requires 5.023 C.O.'s for adequate staffing.[4]

In the same way, we observe that the tour schedule entries in rows 2 through 5 of Tables 2, 3, and 4 (i.e., for Tiers 2 through 5) have the same allocation of men as Tier 1 and also belong to Category I.1 of the functional post typology (Table 1). Consequently, each of these additional tier posts calls for 5.023 C.O.'s per year. If these were the only Category I.1 posts, then the institution's total manpower requirement for housing area observation and supervision would be 5 x 5.023, or 25.115 C.O.'s per week or year.[5]

Other combinations of tours and days scale in the same fashion. Thus, the post "Sanitation 1," in Tables 2, 3, and 4 indicates one C.O. for one tour, five days per week and implies, therefore, 5.023 x (1x1x5) / (1x3x7), or 1.196 C.O.'s per week. The entry "Sanitation 2" assumes one C.O. for one tour, one day per week, implying 5.023 x (1x1x1) / (1x3x7), or 0.239 C.O.'s per week. Since these posts are sanitation gang posts, they both belong in

[4]If the planning factor for the effective annual working days per C.O. were changed from 218 to 225, as contemplated, the formula for the number of C.O.'s needed at a continuous, singly-manned post would change accordingly from 5.023 to 4.867 C.O.'s per year.

[5]These tier posts do not exhaust the Category I.1 posts for the illustrated institution, however, since the rows labelled "Dormitory," "Annex 6th Fl.," and "Annex 7th Fl." are also housing observation areas.

Category I.3 of the typology (Table 1). Again, if these were the only posts belonging to Category I.3, the total for the institution's staffing in this category would be 1.435 C.O.'s per week or year.

III. DETENTION INSTITUTION MANPOWER ALLOCATIONS AND REQUESTS

The procedure just outlined for the illustrative Tour Assignment Schedule can be applied to any institution and any weekly assignment schedule. In Appendix A, we compute the results of applying the procedure to the assignment schedules of New York City's seven detention institutions for two weeks in 1970. The average of these two samples is presented in Table 5, which is structured according to the detailed post typology of Table 1. Other important measures (the average total manpower for each post category, the weighted average, standard deviation, and average percentage of total manpower allocated to a post category) are also included in the tabulation.[6]

Unless stated otherwise, this and all subsequent manpower tables show the *number* of C.O.'s deployed in the various post categories of Table 1. As in the example given in Section II, the entries reflect the number of men needed on an annual basis if the weekly post structures were indefinitely repeated and if the effective number of annual working days per officer were 218. The tabulations exclude civilian employees and high-ranking correctional staff. Although the averages displayed in the tables are based on two weekly samples of actual post assignments during 1970, the routine application of the methodology would probably require a larger sample.[7] Other planning cycles, the degree of manpower monitoring desired, and the variability of workload experienced or anticipated might afford a sounder basis for determining sample size and frequency.

Table 6 shows the 1970 requests or "ideal" staffing levels determined by the wardens and submitted to the Director of Operations in December 1969.[8]

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[6] Since understanding of the methodology discussed in Section IV below rests on comprehension of these simple statistical concepts, readers who are unfamiliar with statistics should refer to the explanations offered in Appendix B.

[7] See Appendix A for details of the samples.

[8] A typical submittal is shown in Appendix C.

Table 5

INSTITUTIONAL AVERAGE MANPOWER ALLOCATIONS - 1970

POST CATEGORIES	BRX	BRK	BRQ	WOM	MAN	QNS	ARS	TOTAL AV. ALLOCS.	WTD.* AV.	STD. DEV.	AV. % TOTAL
I	76.9	100.0	44.5	87.6	96.2	56.8	192.6	655	126	60	51
II	13.6	27.0	5.7	4.8	22.1	26.3	24.8	124	22	10	10
III	49.6	56.0	30.0	67.7	84.6	38.8	163.5	490	100	56	39
TOTAL	141	184	81	160	203	122	382	1269	248	121	100
POST SUBCATEGORIES											
I.1	70.2	94.5	40.2	83.3	85.5	50.2	176.1	600	115	55	47
2	3.5	2.9	2.4	.0	4,0	2.4	3.4	18	3	1	1
3	3.3	3.6	1.9	4.3	6.7	4.2	13.2	37	8	5	3
II.1	10.6	11.2	5.7	.6	15.8	11.2	10.4	65	11	5	5
2	0	0	0	0	0	0	.9	1	0	0	0
3	0	0	0	0	0	1.8	1.7	4	1	1	0
4	2.4	15.8	0	0	5.8	13.3	5.9	43	7	6	4
5	.6	0	0	4.2	.6	0	5.9	11	3	3	1
III.1	1.7	0	2.5	5.4	0	0	13.1	23	6	5	2
2	2.4	5.1	3.4	3.4	4.6	5.9	7.9	33	6	2	3
3	13.3	14.0	2.4	15.8	29.8	7.4	21.0	104	18	10	8
4	1.2	7.8	1.2	1.5	7.8	2.2	3.3	25	4	3	2
5	1.2	1.2	1.2	0	1.8	1.2	1.2	8	1	1	1
6	5.5	4.1	0	6.0	5.3	3.0	7.2	31	6	3	2
7	17.8	16.1	15.0	13.3	24.3	13.8	46.6	147	29	15	11
8	1.2	1.2	0	6.5	1.2	1.2	5.1	16	3	3	1
9	0	0	1.5	1.2	.9	0	1.2	5	1	1	0
10	2.4	1.2	1.7	0	3.5	1.7	7.0	17	4	3	1
11	1.6	1.7	0	0	0	1.2	1.2	6	1	1	0
12	0	0	0	1.1	1.2	0	1.2	4	1	1	0
13	0	1.3	0	1.3	2.3	1.2	1.2	7	1	1	1
14	.5	.6	0	0	0	0	0	1	0	0	0
15	0	.6	1.2	0	1.2	0	4.6	8	2	2	1
16	0	0	0	1.1	0	0	1.0	2	1	1	0
17	0	0	0	0	0	0	4.4	4	2	2	0
18	0	.6	0	7.7	.6	0	0	9	1	3	0
19	.9	.6	0	3.6	.3	0	0	5	1	1	0
20	0	0	0	0	0	0	37.6	38	15	17	14

*For each post category the weighted average manpower is always computed by taking the number of C.O.'s employed in that category at an institution and multiplying by the institution's housing capacity. These products are summed across all the detention facilities and the result divided by the total detention housing capacity. The average so computed reflects the widely varying sizes of the facilities better than a simple average can. The standard deviation is a measure of the dispersion of the individual institutional manpower assignments about the weighted average for all institutions. These statistical terms are explained further in Appendix B.

Table 6

INSTITUTIONAL MANPOWER REQUESTS - 1970

POST CATEGORIES	BRX	BRK	BRQ	WOM	MAN	QNS	ARS	TOTAL REQUESTS	WTD. AV.	STD. DEV.	AV. % TOTAL
I	98.8	98.8	77.9	143.3	164.5	69.6	164.1	817	135	45	45
II	23.2	70.1	41.1	19.8	29.4	64.3	43.8	292	43	20	16
III	52.2	90.3	51.6	86.7	97.9	54.3	211.0	644	130	69	39
TOTAL	174	259	169	251	292	189	419	1753	308	108	100
POST SUBCATEGORIES											
I.1	85.4	90.4	65.3	133.0	155.7	50.2	137.9	718	118	43	39
2	9.6	2.9	6.2	0	4.1	11.7	4.9	39	5	4	2
3	3.8	5.5	6.5	10.3	4.8	7.7	21.3	60	12	7	4
II.1	13.9	14.6	20.1	9.6	19.1	25.1	14.6	117	16	5	6
2	0	1.4	4.8	0	0	0	5.0	11	2	2	1
3	0	33.0	3.4	0	0	21.8	0	58	7	14	3
4	9.4	21.1	12.9	9.0	10.3	17.5	24.2	104	18	7	6
5	0	0	0	1.2	0	0	0	1	0	0	0
III.1	0	0	3.4	0	0	0	7.9	11	3	3	1
2	5.0	5.0	5.0	6.7	5.0	5.0	13.4	45	8	4	3
3	10.5	14.4	8.4	14.7	35.1	14.1	11.8	109	16	9	6
4	7.2	7.2	1.2	7.2	6.0	4.8	4.3	38	5	2	2
5	0	1.2	1.2	2.4	1.2	1.2	0	7	1	1	0
6	6.7	21.6	3.4	7.0	13.6	8.1	58.9	119	30	24	8
7	14.1	28.2	22.4	27.6	24.2	12.9	40.0	169	29	11	9
8	2.4	1.2	0	1.4	0	1.2	4.8	11	2	2	1
9	1.2	0	1.7	1.4	0	0	1.4	6	1	1	0
10	1.4	1.2	3.4	11.8	1.7	1.7	5.3	27	4	4	1
11	1.4	1.4	1.7	0	1.4	1.4	1.2	9	1	1	0
12	1.2	0	0	1.2	2.4	0	1.2	6	1	1	0
13	0	4.1	0	1.7	2.4	3.8	2.4	14	2	2	1
14	1.0	0	0	1.2	0	0	0	2	0	1	0
15	0	3.6	0	0	4.8	0	2.4	11	2	2	1
16	0	1.2	0	2.4	0	0	1.2	5	1	1	0
17	0	0	0	0	0	0	5.0	5	2	2	0
18	0	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	49.7	50	19	23	5

The requests in each post category purportedly reflect the anticipated 1970 inmate population, flows of admissions, discharges and transfers, rates of security violations, architectural features, inmate characteristics and composition, care services, treatment programs, and custodial obligations at the individual detention facilities. The entries in Table 6 are derived from these requests in the same way that Table 5 was constructed from the Tour Assignment Schedules.

By subtracting the corresponding entries of Table 5 from Table 6, we generate the numbers indicated in Table 7. Each datum represents the extent to which the requested manpower would have exceeded the actual average 1970 C.O. allocation at each institution and post category if the wardens' requests had been filled as submitted. The weighted average difference between these "ideal" requests and actual allocations, as well as the standard deviation or dispersion of the differences about the Department-wide averages are listed in the last two columns of Table 7. This table, and particularly the last two columns, provides the foundation for the computations described in the next section.

Table 7

DIFFERENCES BETWEEN 1970 REQUESTS AND AVERAGE ALLOCATIONS

POST CATEGORIES	DETENTION INSTITUTION								
	BRX	BRK	BRQ	WOM	MAN	QNS	ARS	WTD. AV.	STD. DEV.
I	21.90*	-2.10	33.40	55.70	68.35	12.80	-28.50	8.94	36.50
II	9.65	43.10	35.55	15.05	7.30	[illegible].05	19.05	21.93	14.80
III	2.60	34.35	21.60	19.00	13.35	15.55	47.40	29.69	16.91
TOTAL	34.15	75.35	90.55	89.75	89.00	66.40	37.95	60.56	25.89
POST SUBCATEGORIES									
I.1	15.25	-4.05	25.10	49.75	70.20	.00	-38.15	2.69	39.06
2	6.10	.00	3.80	.00	.15	9.30	1.55	2.15	3.72
3	.55	1.90	4.60	6.00	-1.90	3.50	8.15	4.14	3.52
II.1	3.55	3.45	14.45	9.00	3.35	13.95	4.20	5.53	5.45
2	.00	1.40	4.80	.00	.00	.00	4.15	1.98	2.19
3	.00	33.00	3.40	.00	.00	20.00	-1.70	6.32	13.49
4	7.00	5.30	12.90	9.00	4.55	4.25	18.30	10.80	5.64
5	-.60	.00	.00	-2.95	-.60	.00	-5.85	-2.65	2.58
III.1	-1.70	.00	.90	-5.40	.00	.00	-5.15	-2.54	2.80
2	2.60	-.05	1.65	3.35	.45	-.90	5.50	2.66	2.40
3	-2.80	.40	6.00	-1.10	5.35	6.70	-9.15	-2.07	6.52
4	6.00	-.60	.00	5.75	-1.75	2.60	1.05	1.25	3.13
5	-1.20	.00	.00	2.40	-.60	.00	-1.20	-.47	1.29
6	1.20	17.55	3.40	1.00	8.30	5.10	51.70	24.76	22.40
7	-3.70	12.15	7.40	14.35	-.10	-.85	-6.60	.31	8.69
8	1.20	.00	.00	-5.10	-1.20	.00	-.25	-.61	2.04
9	1.20	.00	.25	.20	-.85	.00	.20	.06	.61
10	-1.00	.00	1.70	11.80	-1.80	.00	-1.65	.00	4.98
11	-.15	-.30	1.70	.00	1.40	.20	.00	.25	.82
12	1.20	.00	.00	.10	1.20	.00	.00	.31	.58
13	.00	2.80	.00	.40	.10	2.60	1.20	1.18	1.24
14	.50	-.60	.00	1.20	.00	.00	.00	.05	.57
15	.00	3.00	-1.20	.00	3.60	.00	-2.20	.17	2.14
16	.00	1.20	.00	1.30	.00	.00	.20	.37	.60
17	.00	.00	.00	.00	.00	.00	.60	.23	.28
18	.00	-.60	.00	-7.65	-.60	.00	.00	-.82	2.87
19	-.85	-.60	.00	-3.60	-.25	.00	.00	-.50	1.33
20	.00	.00	.00	.00	.00	.00	12.10	4.67	5.57

*Each entry represents 1970 wardens' requests minus 1970 average allocations.

IV. DETECTING WIDE VARIATIONS IN INSTITUTIONAL POST STAFFING

At present, there do not exist mathematical relationships that show how manning levels at specific posts vary with changes in inmate population, inmate flows, and other variables. Nor do we have reliable predictive instruments for estimating the levels of such variables in the future. We nevertheless can still construct a quantitative scheme for identifying manpower allocations that may appear to be unusual departures from present averages for each post category in the City's seven detention facilities.

The large shifts in manpower that are highlighted by such a scheme can be real (as are those resulting from redeployment of C.O.'s at the detention facilities) or proposed (as are those that would ensue from simple approval and implementation of wardens' requests for more men). The scheme described here shows changes that often *appear* to be either too conservative (relative understaffing) or too liberal (relative overstaffing). Once revealed, such statistical anomalies can point the way to further investigation, justification, or correction of the deviant staffing levels.

As indicated in the preceding section, the two statistical measures of weighted average and standard deviation form the basis for this straightforward manpower assessment scheme.[9] The data analyzed consist of weekly samples of actual institutional manpower assignments, and either the proposed manning in the next period (the wardens' requests) or the actual manning in the current period. The following steps (the first six of which were discussed in the preceding section) are then undertaken for each institution.

(1) Actual weekly Tour Assignment Schedules up to the most recent week are obtained and translated into the new post typology of Table 1 (see Appendix A).

[9]See Appendix B. A weighted average is employed to reflect the different capacities of the seven detention institutions considered in the analysis; other measures of centrality (and dispersion) could also be used.

(2) For each post type in the typology, the translated manpower allocations are averaged over the number of samples taken to form a table of average allocations (see Table 5).

(3) Manpower data on either the proposed allocations for the next period or the actual allocations in the most recently monitored week are obtained and translated into the new post typology (see Table 6).

(4) Manning changes are computed for each post type and institution by subtracting the corresponding results of step (2) from step (3); i.e., by subtracting average actual past allocations from requests or recent actual allocations (see Table 7).

(5) For each post type, the weighted average manning change is computed across all institutions (see column 8 of Table 7).[10]

(6) For each post type, the standard deviation of the manning changes is computed (see column 9 of Table 7).[11]

(7) A threshold level of allowable variability is assigned for each post type; this is established either arbitrarily or based on the standard deviation of the historical manning changes in each post category and the computed, most recent sample standard deviations (i.e., those in column 9 of Table 7).

(8) With respect to this variability threshold and the manpower change data derived in step (4), each institutional manpower change is inspected to determine if it lies in the range bracketed by the weighted average change (column 8, Table 7), plus or minus the variability threshold.

(9) A decision rule is assumed from which the manpower changes that lie below, within, or above the bracketed region are

[10]That is, for each post type of the typology, we multiply the manning change at each institution by the facility's housing capacity. These results are summed across all institutions and divided by the total housing capacity of all institutions considered.

[11]That is, for each post type we subtract the manning change at each institution from the weighted average manning change determined in step (5). These differences are each squared (multiplied by themselves) and the results are summed across all institutions considered. Finally, this sum is divided by one less than the number of institutions considered, and the square root of the result is taken.

either accepted (i.e., left unaltered), or rejected and assigned some new, adjusted value.

(10) The institutional manpower allocations stemming from the application of the decision rule are either allowed to stand or further alterations are made based on additional field data, supportive arguments from the wardens, or other factors (emergencies, etc.).

The results of carrying out steps (1) through (6), as described in Section III, are shown in Table 7, which is a summary of manning changes by post type and institution. Before completing and illustrating the remaining steps of the manpower assessment scheme, it is useful to recast Table 7 so that the departure of each institutional manning change from the weighted average is made explicit for each post type. Table 8 does this by indicating the number of standard deviations above (+ sign) or below (- sign) the weighted average that each manning change represents.[12] This table will be helpful in understanding the concept of variability threshold and the decision rules discussed in Section V.

[12] The entries in Table 8 are computed by taking the corresponding entries of Table 7, subtracting the weighted average, and dividing the result by the standard deviation noted in columns 8 and 9, respectively, of the same row as the entry in Table 7.

Table 8

DEVIATIONS OF MANNING CHANGES FROM THE AVERAGE*

POST CATEGORIES	BRX	BRK	BRQ	WOM	MAN	QNS	ARS
I	.4	-1.4	1.1	1.2	-.5	1.7	-.1
II	-1.7	1.4	4.1	-1.2	-2.1	1.5	.2
III	.7	1.2	.7	-.2	-1.3	-.5	.0
TOTAL	-.6	1.2	6.0	-.2	-3.9	2.7	.2
POST SUBCATEGORIES							
I.1	.3	-.2	.6	1.2	1.7	-.1	-1.0
2	1.1	-.6	.4	-.6	-.5	1.9	-.2
3	-1.0	-.6	.1	.5	-1.7	-.2	1.1
II.1	-.4	-.4	1.6	.6	-.4	1.5	-.2
2	-.9	-.3	1.3	-.9	-.9	-.9	1.0
3	-.5	2.0	-.2	-.5	-.5	1.0	-.6
4	-.7	-1.0	.4	-.3	-1.1	-1.2	1.3
5	.8	1.0	1.0	-.1	.8	1.0	-1.2
III.1	.3	.9	1.2	-1.0	.9	.9	-.9
2	.0	-1.1	-.4	.3	-.9	-1.5	1.2
3	-.1	.4	1.2	.1	1.1	1.3	-1.1
4	1.5	-.6	-.4	1.4	-1.0	.4	-.1
5	-.6	.4	.4	2.2	-.1	.4	-.6
6	-1.1	-.3	-1.0	-1.1	-.7	-.9	1.2
7	-.5	1.4	.8	1.6	.0	-.1	-.8
8	.9	.3	.3	-2.2	-.3	.3	.2
9	1.9	-.1	.3	.2	-1.5	-.1	.2
10	-.2	.0	.3	2.4	-.4	.0	-.3
11	-.5	-.7	1.8	-.3	1.4	-.1	-.3
12	1.5	-.5	-.5	-.4	1.5	-.5	-.5
13	-1.0	1.3	-1.0	-.6	-.9	1.1	.0
14	.8	-1.1	-.1	2.0	-.1	-.1	-.1
15	-.1	1.3	-.6	-.1	1.6	-.1	-1.1
16	-.6	1.4	-.6	1.6	-.6	-.6	-.3
17	-.8	-.8	-.8	-.8	-.8	-.8	1.3
18	.3	.1	.3	-2.4	.1	.3	.3
19	-.3	-.1	.4	-2.3	.2	.4	.4
20	-.8	-.8	-.8	-.8	-.8	-.8	1.3

*The entries of this table are computed by taking the corresponding entries of Table 6, subtracting the weighted average, and dividing the result by the standard deviation noted in columns 9 and 10, respectively, of the same row as the entry in Table 6.

V. SOME DECISION RULES

The results of applying steps (1) through (6) to actual manpower assignment data and wardens' requests are shown in Table 8. Deviations of the institutional manning changes from the weighted average for each post type are shown as either a fraction or a multiple of the average variation (standard deviation) in manning change for that post. In order to draw attention to the more deviant manning changes, the data of Table 8 are abstracted in Table 9, which indicates only those entries of Table 8 that are significant multiples of the corresponding standard deviation. Thus, the multiple plus and minus signs of Table 9 denote institutional post staffing changes that are approximately 1, 1.5, and 2 standard deviations above (+) or below (-) the weighted average. Extreme manning variations are represented by circled plus and minus signs according to whether the changes are relatively very high (⊕) or very low (⊖). These serve to alert the decision-maker to gross departures from the historical average manning and to pinpoint the post type and institution where the departures arise.

Besides highlighting manning variations, Tables 8 and 9 also provide the data for executing several allocational decision rules. For example, if thresholds are set on tolerable manning variability in each post type, changes can be accepted that do not violate the prescribed limits. Those that fall outside the acceptable range can be adjusted to values within the range, or to values that remain outside, but which are defensible on grounds of extraordinary circumstance, or some other such justification.

In order to make these notions more concrete, we proceed here to describe four decision rules and compute their consequent institutional manpower allocations. Additional data that might ordinarily be solicited from the wardens to justify extreme staffing changes will not be considered. Though rules can be devised arbitrarily, those we discuss here are intuitively appealing and computationally simple.

The four decision rules, which illustrate and complete steps (7) through (10) of the scheme described in Section IV, will be referred to as the "Liberal

Table 9

SUMMARY OF DISPARATE MANNING INCREASES

POST CATEGORIES	DETENTION INSTITUTION						
	BRX	BRK	BRQ	WOM	MAN	QNS	ARS
I		—	+	+		++	
II	—	++	⊕	-	---	++	
III		+			--		
TOTAL		+	⊕		⊖	⊕	
POST SUBCATEGORIES							
I.1				+	++		-
2	+					+++	
3	-				--		+
II.1			++			++	
2	-		++	-	-	-	+
3		+++				+	
4		-			-	-	+
5	+	+	+		+	+	-
III.1		+	+	-	+	+	-
2		-			-	--	+
3			+		+	+	-
4	++			++	-		
5				+++			
6	-		-	-		-	+
7		++	+	++			-
8	+			⊖			
9	+++				--		
10				*			
11			+++		++		
12	++				++		
13	-	++	-		-	+	
14	+	-		+++			
15		++			++		-
16		++		++			
17	-	-	-	-	-	-	++
18				⊖			
19				⊖			
20	-	-	-	-	-	-	++

\+ = approx. 1 std. dev. - = approx.-1 std. dev.
++ = approx. 1.5 std. devs. -- = approx.-1.5 std. devs.
+++ = approx. 2 std. devs. --- = approx.-2 std. devs.
⊕ = greater than 2 std. devs. ⊖ = less than -2 std. devs.

Rule" (LR), "Conservative Rule" (CR), "Maximum Rule" (MAX), and "Minimum Rule" (MIN). The first two rules utilize the average and variability data of Table 7, while the last two ignore these statistics and employ only the average actual allocations-and-requests data of Tables 5 and 6.

The LR is best understood by referring to Fig. 1. Three regions, LOW, HIGH, and OK, are identified in the figure, corresponding to manning changes (i.e., the requests minus average allocations shown in Table 7) which are: (1) less than the average Departmental change *minus* some multiple of the average variation in manning change (the standard deviation); (2) greater than the average Departmental change *plus* some multiple of the standard deviation, and (3) between these two regions. As is obvious from Table 7, these regions are generally different for different post types, (see columns 8 and 9 of Table 7).

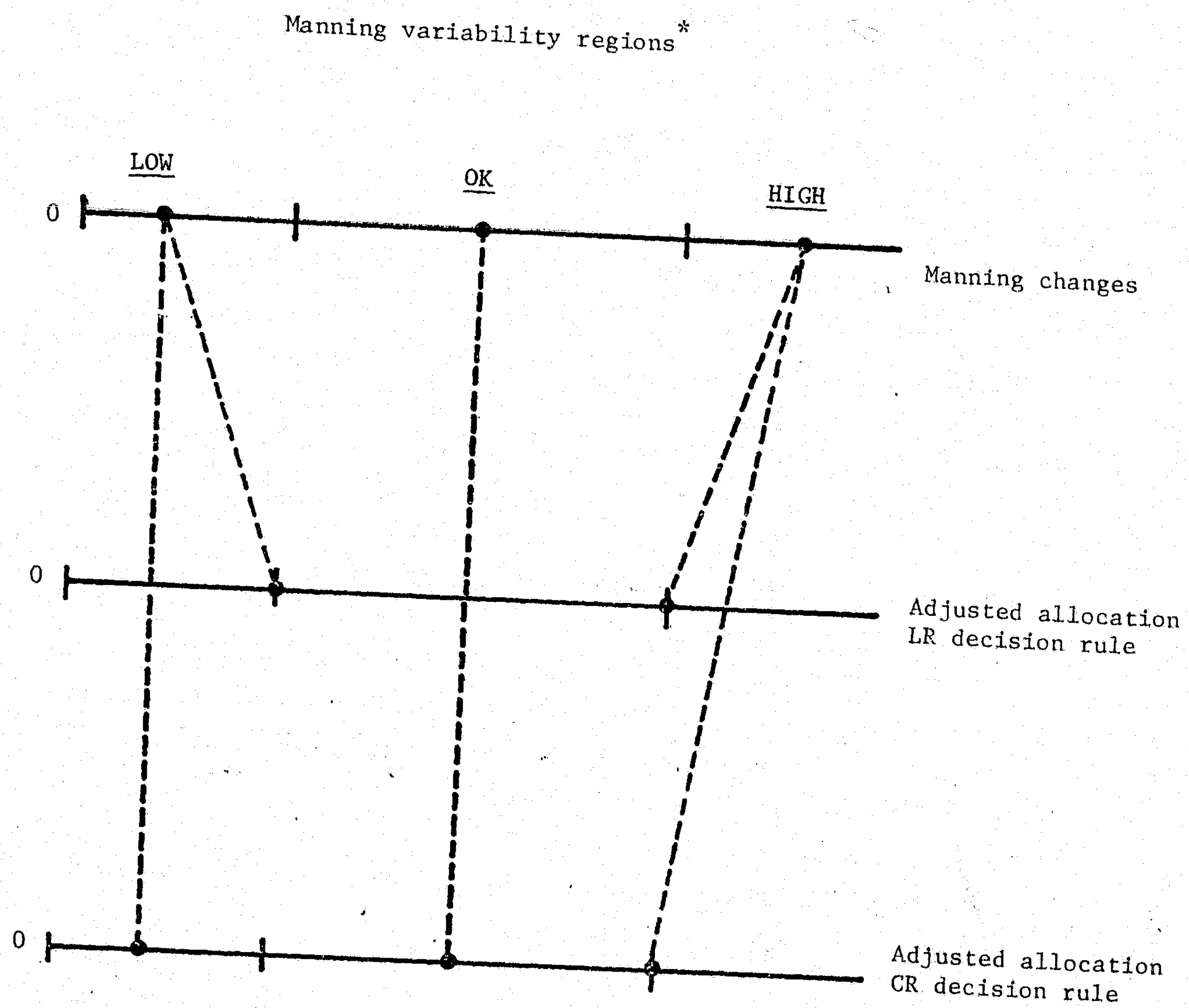
Accordingly, the LR assigns manpower as follows:

(1) If an institution's manpower change for a particular post type (see Table 7) falls into the OK region corresponding to that post, then its request for additional men is accepted.

(2) If an institution's manpower change for a particular post type falls into the HIGH region, then its request for additional men is diminished to correspond with the upper limit of the OK region. Thus, the post request is set equal to the institution's average actual allocation (Table 6) plus the weighted average manning change for that post (column 8 of Table 7) *plus* some preassigned multiple[13] of the standard deviation in manning change for that post (column 9 of Table 7).

(3) If an institution's manpower change for a particular post type falls into the LOW region (as could happen if a warden underestimated his needs), then its request for additional men

[13]The entries of Table 8 are computed by taking the corresponding entries of Table 7, subtracting the weighted average, and dividing the result by the standard deviation noted in columns 8 and 9, respectively, of the same row as the entry in Table 7.



*The borders of the three regions are defined in the accompanying text and by equations (12) through (14) of Appendix D. The dots represent three different, illustrative manning changes and the regions in which they might occur for a fixed multiple of the manning change standard deviation (c.f. equations (15) of Appendix D).

Fig. 1. Illustrations of two decision rules

is increased to correspond with the lower limit of the OK region. Thus, the post request is set equal to the institution's average allocation (Table 6) plus the weighted average manning change for that post (column 8 of Table 7) *minus* some preassigned multiple of the standard in manning change for that post (column 9 of Table 7). In any case, the resultant manpower cannot be less than zero.

The CR is identical to the LR except in the treatment of part (3). In this case, wardens may be as conservative as they wish in post staffing, (i.e., even to the extent of underestimating their needs). Thus, the CR rule does not increase the very conservative requests, so that the resulting manning change lies at the lower limit of the OK region, as in the LR rule; that is, the relatively conservative staffing is allowed to be anywhere between zero men and that corresponding to the lower bound of the OK region. Accordingly, the CR rule can be summarized as follows:

(1) Same as LR, step (1).

(2) Same as LR, step (2).

(3) If an institution's manpower change for a particular post type falls into the LOW region, then its manpower request is not increased or modified, even if the resulting manning is zero.

The MAX and MIN rules differ from the LR and CR in that averages and standard deviations in manning change are ignored. The straightforward MAX and MIN rules present, in effect, benchmarks on manning levels based on two different philosophies: (1) wardens are the most knowledgeable about institutional problems and submit requests that strictly reflect actual and anticipated needs; (2) wardens, whenever they can, will request additional men, even if not firmly rooted to institutional need, and therefore should continue with manpower levels that lie somewhere between what they request and the average with which they have been able to function in the past.

The MAX and MIN rules require only simple comparisons of the allocations-and-requests data of Tables 3 and 4. The two rules can be expressed

as follows. MAX rule:

(1) For each institution and post type, the average actual manpower allocations (Table 5) and requests (Table 6) are compared.

(2) The larger of these two quantities is the manpower allotted.

MIN rule:

(1) Same as MAX, step (1).

(2) The smaller of the corresponding average allocations and requests is allotted.

As discussed in the next section and demonstrated in Appendix D, the CR assigns manpower on a non-decreasing basis as the variability threshold factor is progressively increased. This is true of the LR also once the threshold factor exceeds the value for which requests no longer occur in the LOW region. Thus, the manpower levels that result from the MAX and MIN rules can be used to bracket those of the LR and CR algorithms. This is accomplished simply by selecting values for the threshold factor such that the total manpower estimated by either the CR or LR neither exceeds that of MAX nor falls below that of MIN.

In the next section, we present the manpower allocations that result from these decision rules. Though the rules have been carefully stated in this section, the reader may wish to consult Appendix D, where a simple mathematical description is provided to further clarify the rules and the data elements used.

VI. DECISION RULE APPLICATIONS AND RESULTANT MANPOWER ESTIMATES

In conjunction with Tables 5, 6, and 7, the four rules described in Section V determine the institutional manpower levels for each post covered by the typology of Table 1. The resulting total allocations are summarized in this section and are disaggregated by post category, institution, and decision rule in Tables E-1 through E-18 in Appendix E.

By successively assigning variability threshold factors (see Equation (15) of Appendix D) to the manning change standard deviations in column 9 of Table 7, we can compute the manpower levels implied by the LR and CR decision rules. The first set of tables in Appendix E, Tables E-1, E-3, E-5, and E-7, give the results of consecutively fixing the threshold factor at 0.5, 1.0, 1.5, and 2.0, respectively, and applying the LR decision rule defined in Section V and in Equations (10a, b, and c) of Appendix D. The intervening tables, E-2, E-4, E-6, and E-8, indicate which of the warden's requests resulted in manning changes that fell into the HIGH (+) and LOW (-) ranges and which were subsequently adjusted according to the LR decision rule.

Tables E-9 through E-16 are analogous to Tables E-1 through E-8 (see Appendix E), the difference being that the former are generated through the CR decision rule (see Section V and Equations (10a, b, and c) of Appendix D). In both cases, we see that, as the variability factor increases, the occurrence of plus and minus signs in Tables E-2, E-4, E-6, E-8 and E-10, E-12, E-14, E-16 diminishes.[14] This is to be expected, since increasing the variability threshold factor permits more latitude in manning change for each post type. As Equations (12) through (14) of Appendix D indicate, and as is obvious from the definitions of the LR and CR assignment algorithms, enlarging the variability factor results in expanding the OK regions corresponding to each post type. Consequently, as we allow the variability factor to increase, any plus or minus signs that remain in Tables E-2, E-4, E-6, E-8 and E-10, E-12, E-14, E-16 earmark institutions and posts that should be further scrutinized before final manpower commitments are made. In Table

[14] Similarly, as the factor increases, the number of men allocated according to the CR either grows or stays at the last highest level. This is true also of the LR scheme once the threshold variability factor exceeds the value for which no requests remain in the LOW region.

E-8, for example, the Women's House is identified as proposing manning levels that are relatively high in the commissary, clinic, and mail processing categories, and low in the laundry, bakery, and relief categories.

The results of the two decision rules that do not involve variability measures, i.e., the MAX and MIN, are summarized in Tables E-17 and E-18 of Appendix E. By applying the MAX and MIN rules (defined in Section V and in Equations (8) and (9) of Appendix D) to Tables 5 and 6, we arrive at the manpower allocations in Tables E-17 and E-18, respectively. These numbers are put into better perspective when compared with those of the LR and CR rules. A synopsis of the total allocations by decision scheme, variability threshold factor, and institution is presented in Table 10.

Certain features of Table 10 are manifestations of the four decision rules. One such feature is that for any institution and fixed variability threshold factor, the manpower assigned in the CR rule is always less than or equal to that corresponding to the LR rule. The same statement holds for the MIN and MAX rules, respectively. Moreover, once the variability factor exceeds a certain positive value, results of LR and CR individually converge to a constant value and also become equal to each other. Whereas the results of the CR algorithm never decrease as the variability factor increases, this is not true of the LR rule.

As demonstrated in Appendix D, the features of Table 10 just described are inherent in the four decision schemes. One important aspect of Table 10 that is adventitious rather than inherent is that the results produced by the MIN and MAX rules are respectively less and greater than those of the LR and CR. It is shown in Appendix D that the MIN rule does not provide an analytical lower boundary on the LR and CR manpower estimates; nor does the MAX rule give an upper boundary. The MIN and MAX rules can nevertheless function as benchmarks on total staffing. Thus, in performing manpower sensitivity analyses (as in Table 10), sequential values of the variability threshold can be selected such that the total staffing derived from the LR and/or CR algorithms neither exceeds that of the MAX rule nor falls below that of the MIN rule. In this way, the mathematically abstract notions of variabil-

Table 10

MANPOWER ALLOCATIONS:
SUMMARY OF TOTALS

DECISION RULE - VARIABILITY THRESHOLD	INSTITUTION							TOTAL MANPOWER
	BRX	BRK	BRQ	WOM	MAN	QNS	ARS	
MIN	128	177	79	134	193	120	310	1141
CR - $0.5\sigma_j$	167	229	150	196	236	164	389	1529
CR - $1.0\sigma_j$	172	242	164	226	261	179	410	1652
CR - $1.5\sigma_j$	174	253	170	243	283	186	419	1728
CR - $2.0\sigma_j$	174	259	171	248	292	188	419	1751
LR - $0.5\sigma_j$	185	236	163	224	256	182	422	1668
LR - $1.0\sigma_j$	173	242	164	235	264	181	413	1672
LR - $1.5\sigma_j$	174	253	170	248	283	186	419	1734
LR - $2.0\sigma_j$	174	259	171	250	292	188	419	1753
MAX	186	266	172	276	301	190	491	1882

ity threshold and threshold factor can be linked to two intuitively appealing limits on manpower.

The total allocations displayed in Table 10 are put in better perspective when compared with recent manning levels. In 1970, the correctional officer quota for all seven detention institutions was about 1464.[15] The corresponding total 1970 requests (submitted by the wardens at the end of 1969) is 1753. Thus, the quota was 323 officers above the total allocation derived from the MIN rule, 65 below the CR rule, and 204 below the LR rule estimates, with the variability threshold set at only half the manning change standard deviation for each post category. Similarly, the requested manpower is found to be 129 below the total allocation resulting from application of the MAX rule. However, only for high levels of the variability threshold factor (2.0^+ for CR and 2.0 for LR) do the CR and LR estimates reach the wardens' total request.

In order to appreciate the budgetary significance of these correctional manpower totals, we note that the Department's entire 1969-1970 expense budget was $61.2 million. Approximately $13.1 million of that amount was budgeted for salaries and benefits to the correctional officer staff of the seven detention facilities.[16] To understand the financial impact implied by the differences between the quotas, requests, and estimates just described, the reader should realize that the average annual cost in salary and benefits for one correctional officer then was about $13,000.

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[15] As with all the manpower data in this document, these officer figures do not include the ranks of captain and above.

[16] The budget figures include the Women's House, but are pro-rated on the basis of the ratio of the detention to total inmate census at the Women's House, i.e., about 60 percent.

VII. CONCLUSIONS

Few arguments for correctional manning are defensible on the basis of custodial needs alone. The success of a prison's operation is collectively determined by its diagnostic facilities, treatment programs, care services, and custodial functions, all of which place heavy demands on prison personnel.

The historical emphasis on security, and its influence on the recruitment, selection, training, and deployment of correctional officers is not difficult to comprehend. Custodial responsibility is mandated by law, and escape has always been interpreted as *prima facie* evidence of agency negligence. Consequently, the first order of business in corrections has been to *hold* the prisoner. The concern that the inmate emerge from the prison neither physically nor psychologically worse than he was when he entered has never been the dominant consideration.

Until agency goals are sharply focused, and until correctional activities are clearly related to those goals, no rigorous assessment of staffing demands and usage can be achieved. Nevertheless, there is no doubt that substantial gains can be achieved in the efficiency of the present correctional operation. Significant improvements could be made simply by establishing uniform institutional post definitions and correctional officer performance standards, by regularly monitoring manpower deployments in each facility, by routinely challenging deviant practices, and by applying timely and equitable corrective measures. The question would remain, nevertheless, whether such efficiencies were positively correlated with the proper goals of corrections.

The methodology presented in this Report offers one approach to the problem of assessing correctional officer requirements. The scheme capitalizes on the operational similarities of correctional institutions, particularly in the areas of inmate observation, supervision, escorting, and processing. The simple mathematical technique we have developed employs data on actual manpower usage and thereby achieves a degree of objectivity not found in the present practice of relying almost completely on wardens' judgments. The scheme can be an aid to staffing decisions insofar as it draws the administrator's attention to manpower allocations that appear deviant --

either too liberal or too conservative -- with respect to the Department-wide average practice. Once detected, these statistically anomalous situations point the way to further investigation, justification, or correction of the deviant staffing levels. Reasonable adjustments and compromises should then follow, subject always to budgetary constraints and Departmental goals and priorities.

The approach we have introduced complements the Department's current scheduling practices and does not necessitate any sweeping or disruptive changes in record-keeping or other administrative functions. In drawing the comparisons within and among the several correctional facilities, a consistent post typology is devised to supplement the *ad hoc* Tour Assignment Schedules now employed for assigning manpower at the separate institutions. The new typology consists of three primary and twenty-eight secondary categories, each encompassing some of the custodial, care, and rehabilitative aspects of corrections. A more comprehensive typology is provided in Appendix I, should the Department wish to undertake additional data collection and more refined analysis.[17]

In order to refine and further tailor the typology to the Department's needs, the suggested typology has to be thoroughly reviewed by all prospective users: wardens, deputy wardens, and central Department management. Consensus should be sought on appropriate post categories, their definitions, and their correspondence with terminology now employed in the Tour Assignment Schedules. To increase the effectiveness of the typology even further, reporting practices should be standardized and nominal or vague post titles should be clearly specified and disaggregated by the actual tasks and locations involved. Such measures could improve significantly the quality of the manpower data derived from the tour schedules and, thereby, the validity of the mathematical assignment scheme and manpower estimates.

The fact that wardens' subjective judgments and supporting arguments are still required by the scheme proposed here identifies both an advantage and a possible weakness of the approach. Although wardens are most knowledgeable on day-to-day institutional problems, they may or may not submit manpower requests that strictly reflect actual and anticipated

[17] A post survey display program has also been developed by The New York City-Rand Institute to aid in analysis of refined typology data and will be furnished upon request.

needs. A gaming situation may exist, or be perceived to exist among wardens, central administrators of the Department, and the City's Bureau of the Budget. Thus, wardens may act according to the assumption that "the wheel that squeaks gets the oil," tempered, of course, by the threat and consequences of possible Departmental investigation. The Department's top management may operate similarly *vis-a-vis* the Bureau of the Budget. There could also be some measure of collusion among the wardens to inflate officer requirements on a *pro-rata* basis, which could simultaneously lower the risk of investigation and penalty to all participants.

Such competitive situations are not unique to Corrections; they are typical of many decentralized organizations. The problem transcends difficulties in information exchange between individual institutions and central management, although this is often a significant factor, too. In addition, there are complexities of a socio-psychological origin to contend with; the desire for power and prestige, opposing views of correctional goals, etc. All such factors can contribute to manipulation of information and to a tendency to improve the competitive stance of one contending party against the other.

Such problems cannot be entirely eliminated, but their effects may be reduced by judicious application of the approach described here: e.g., varying the decision rules and keeping them secret, making unannounced inspections of manpower usage, providing positive incentives for accurate reporting, being equitable and responsive, etc. Or, other more objective assessment schemes might be developed. For example, there could be an attempt to establish performance criteria for all post activities and to relate productivity measures to factors such as inmate population and type, transfer rate, number of assigned officers, etc. For post categories that presently drain significant portions of the officer staff, systematic analyses could be conducted to determine better manpower allocations under different resource constraints. If such an approach did not work, other measures for manpower need (e.g., officer overtime) could be developed and related via regression techniques to observable influences such as inmate population and transfer rates, officer sick-leave, housing capacity, security exigencies and incident rates, number of housing floors, etc.

As the reader might expect, no such alternative approach is devoid of difficulties and pitfalls. The application of systems analysis

requires clearly formulated agency goals. The goals must be of sufficient scope, moreover, so that suboptimal or myopic policies are avoided. In both the technique proposed here and in the regression approach, predictive instruments must be devised to estimate future levels of such factors as officer sick-leave and inmate population (which alone implies good recidivism prediction--as yet unachieved). It is well known, however, that instruments constructed from historical data can lead to poor forecasts if changes occur in Departmental policy, inmate composition, "political climate," correctional personnel, or other criminal justice agencies. Despite such obstacles, the technique developed here can serve as a first step toward improving future manpower allocation decisions and, thereby, services to incarcerated individuals.

Appendix A

INSTITUTIONAL MANPOWER ASSIGNMENT SAMPLES WITH RATES OF ACTUAL AND PROPOSED USAGE - 1970

The tables in this appendix summarize the results of applying the procedure described in Section II to actual New York City Department of Correction Tour Assignment Schedules. Two assignment rosters were obtained from each detention institution that showed the actual allocations made during the first week of April and the last week of July 1970. These assignment schedules were corrected at the individual institutions to reflect changes in manning brought about by exigencies that occurred after the schedules were submitted.[18] As stated earlier, these samples of actual weekly post assignments at each of the seven detention institutions exclude civilian employees and high-ranking correctional staff. It should also be noted that the routine (rather than simply experimental) application of this methodology would probably need to be based on more than two weekly samples per year.

As discussed in Section II, the manning data derived in the tables assume that each C.O. provides 218 eight-hour working days per year.[19] In addition, since the Department does not use a consistent post typology, the tables are formed according to the typology given in Table 1 above. In order to resolve ambiguities that arose in interpreting some post assignments appearing in the institutional Tour Assignment Schedules[20] (e.g., a correctional officer stationed in a corridor who performs observation and also inspects mail), we classified posts according to the primary role in which the post officers were engaged. When posts were split and the proportions of time performing separate tasks were known, these were reconciled in constructing the following manpower allocation tables.

Tables A-2 and A-3 show the percentages of correctional staff at each institution allocated to and requested for each of the twenty-eight post categories. The average percentage allocations (rates of manpower usage)

[18] Such exigencies as transfers of inmates to hospitals, transfers to courts to comply with writs, officer sickness, etc., cannot be anticipated exactly during scheduling since the schedules are prepared several days in advance of the week for which they apply.

[19] Proposed changes in the staffing planning factors make the assumption of 225 annual working days per officer.

[20] These tour schedules or duty rosters are the NYC Department of Correction's forms 119(3-64-28M), 119(8-67)25M, etc., all of which resemble the sample given in Table 2.

and standard deviations are given in the last two columns of the tables. These data are employed in Tables A-4 and A-5 to highlight the institutions at which allocation rates appear excessive, i.e., 1 (*), 2 (**) and 3 (***) standard deviations above the detention institution weighted average in each post category.

Table A-1

MONTHLY MANPOWER ALLOCATIONS - 1970

POST CATEGORIES	BRX APRIL	BRX JULY	BRK APRIL	BRK JULY	BRQ APRIL	BRQ JULY	WOM APRIL	WOM JULY	MAN APRIL	MAN JULY	QNS APRIL	QNS JULY	ARS APRIL	ARS JULY
I	76.8	77.0	98	103.8	44.0	45	93.3	81.8	94.0	98.3	58.6	55.0	196.0	189.2
II	13.6	13.5	25.9	28.1	6.2	5.1	5.7	3.8	23.7	20.5	28.5	24.0	26.8	22.7
III	49.1	50.1	51.7	60.2	30.6	29.4	66.9	68.5	81.6	87.5	36.4	41.1	172.7	154.3
TOTAL	140	141.0	176	192	81.0	80.0	166	154	199	206	123	120	395	368
POST SUBCATEGORIES														
I.1	70.3	70.0	90.4	98.5	40.2	40.2	87.3	79.2	83.9	87.1	50.2	50.2	180.8	171.3
2	2.9	4.1	2.9	2.9	2.4	2.4	0	0	4.1	3.8	3.6	1.2	5.0	1.7
3	3.6	2.9	4.8	2.4	1.4	2.4	6.0	2.6	6.0	7.4	4.8	3.6	10.1	16.2
II.1	10.0	11.1	11.2	11.1	6.2	5.1	1.2	0	17.5	14.0	11.2	11.1	11.7	9.1
2	0	0	0	0	0	0	0	0	0	0	0	0	0	1.7
3	0	0	0	0	0	0	0	0	0	0	1.2	2.4	0	3.4
4	2.4	2.4	14.6	17.0	0	0	0	0	6.2	5.3	16.0	10.5	3.3	8.5
5	1.2	0	0	0	0	0	4.5	3.8	0	1.2	0	0	11.7	0
III.1	1.7	1.7	0	0	3.3	1.7	6.5	4.3	0	0	0	0	11.0	15.1
2	3.1	1.7	5.0	5.1	3.3	3.4	3.3	3.4	4.5	4.6	6.7	5.1	12.2	3.6
3	12.2	14.4	13.6	14.4	2.4	2.4	17.0	14.6	30.1	29.4	7.4	7.4	21.5	20.4
4	1.2	1.2	7.2	8.4	1.2	1.2	1.7	1.2	7.4	8.1	1.2	3.2	2.6	3.9
5	1.2	1.2	1.2	1.2	1.2	1.2	0	0	1.2	2.4	0	2.4	1.2	1.2
6	5.7	5.3	3.6	4.5	0	0	6.0	6.0	6.0	4.6	3.4	2.6	7.9	6.5
7	17.5	18.1	14.6	17.5	15.3	14.7	12.2	14.3	24.7	23.9	12.4	15.1	45.3	47.9
8	1.2	1.2	1.2	1.2	0	0	5.3	7.7	1.2	1.2	1.2	1.2	6.5	3.6
9	0	0	0	0	1.0	1.9	1.2	1.2	0	1.7	0	0	1.2	1.2
10	2.9	1.9	1.2	1.2	1.7	1.7	0	0	1.7	5.3	1.7	1.7	9.6	4.3
11	1.4	1.7	1.7	1.7	0	0	0	0	0	0	1.2	1.2	1.2	1.2
12	0	0	0	0	0	0	2.2	0	1.2	1.2	0	0	1.2	1.2
13	0	0	1.2	1.4	0	0	1.2	1.4	2.4	2.2	1.2	1.2	1.2	1.2
14	1.0	0	1.2	0	0	0	0	0	0	0	0	0	0	0
15	0	0	0	1.2	1.2	1.2	0	0	1.2	1.2	0	0	4.1	5.1
16	0	0	0	0	0	0	1.0	1.2	0	0	0	0	1.0	1.0
17	0	0	0	0	0	0	0	0	0	0	0	0	5.0	3.8
18	0	0	0	1.2	0	0	6.9	8.4	0	1.2	0	0	0	0
19	0	1.7	0	1.2	0	0	2.4	4.8	0	.5	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0	40.1	35.1

Table A-2

PERCENTAGE 1970 ALLOCATIONS OF ASSIGNED MANPOWER

POST CATEGORIES	BRX	BRK	BRQ	WOM	MAN	QNS	ARS	Wtd. Av.	Std. Dev.
I	54.73	54.84	55.28	54.75	47.48	46.75	50.48	51.17	3.86
II	9.64	14.67	7.02	2.97	10.91	21.60	6.49	9.88	6.18
III	35.30	30.41	37.27	42.31	41.75	31.89	42.86	38.88	5.35
TOTAL	100.	100.	100.	100.	100.	100.	100.	100.	0.00
POST SUBCATEGORIES									
I.1	49.93	51.33	49.94	52.03	42.22	41.32	46.15	46.76	4.46
2	2.49	1.58	2.98	.00	1.95	1.98	.88	1.40	1.05
3	2.31	1.96	2.36	2.69	3.31	3.46	3.45	3.00	.66
II.1	7.51	6.06	7.02	.38	7.78	9.18	2.73	5.04	3.23
2	.00	.00	.00	.00	.00	.00	.22	.09	.10
3	.00	.00	.00	.00	.00	1.48	.45	.31	.56
4	1.71	8.59	.00	.00	2.84	10.91	1.55	3.53	4.33
5	.43	.00	.00	2.59	.30	.00	1.53	.89	1.02
III.1	1.21	.00	3.11	3.38	.00	.00	3.42	1.81	1.68
2	1.71	2.74	4.16	2.09	2.25	4.86	2.07	2.51	1.25
3	9.47	7.61	2.98	9.88	14.69	6.09	5.49	8.02	3.78
4	.85	4.24	1.49	.91	3.83	1.81	.85	1.98	1.44
5	.85	.65	1.49	.00	.89	.99	.31	.59	.51
6	3.91	2.20	.00	3.75	2.62	2.47	1.89	2.37	1.31
7	12.67	8.72	18.63	8.28	12.00	11.32	12.21	11.51	3.44
8	.85	.65	.00	4.06	.59	.99	1.32	1.21	1.32
9	.00	.00	1.80	.75	.42	.00	.31	.32	.67
10	1.71	.65	2.11	.00	1.73	1.40	1.82	1.44	.76
11	1.10	.92	.00	.00	.00	.99	.31	.45	.51
12	.00	.00	.00	.69	.59	.00	.31	.28	.31
13	.00	.71	.00	.81	1.14	.99	.31	.58	.46
14	.36	.33	.00	.00	.00	.00	.00	.08	.17
15	.00	.33	1.49	.00	.59	.00	1.21	.67	.64
16	.00	.00	.00	.69	.00	.00	.26	.16	.26
17	.00	.00	.00	.00	.00	.00	1.15	.44	.53
18	.00	.33	.00	4.78	.30	.00	.00	.49	1.80
19	.60	.33	.00	2.25	.12	.00	.00	.31	.83
20	.00	.00	.00	.00	.00	.00	9.86	3.80	4.53

Table A-3

PERCENTAGE ALLOCATIONS OF 1970 REQUESTS

POST CATEGORIES	Institutional 1970 Pct. Manpower Reqs. BRX	BRK	BRQ	WOM	MAN	QNS	ARS	Wtd. Av.	Std. Dev.
I	56.72	38.12	45.56	57.37	56.37	36.98	39.18	44.91	9.73
II	13.32	27.04	24.09	7.93	10.08	34.17	10.46	15.63	10.55
III	29.97	34.84	30.18	34.71	33.55	28.85	50.36	39.46	9.00
TOTAL	100.	100.	100.	100.	100.	100.	100.	100.	0.
POST SUBCATEGORIES									
I.1	49.02	34.88	38.19	53.24	53.36	26.67	32.93	39.29	10.86
2	5.51	1.12	3.63	.00	1.41	6.22	1.17	2.03	2.52
3	2.18	2.12	3.80	4.12	1.64	4.09	5.09	3.60	1.34
II.1	7.98	5.63	11.75	3.84	6.55	13.34	3.49	5.94	4.15
2	.00	.54	2.81	.00	.00	.00	1.19	0.64	1.05
3	.00	12.73	1.99	.00	.00	11.58	.00	3.07	5.84
4	5.40	8.14	7.54	3.60	3.53	9.30	5.78	5.94	2.25
5	.00	.00	.00	.48	.00	.00	.00	0.04	0.18
III.1	.00	.00	1.99	.00	.00	.00	1.89	0.80	0.98
2	2.87	1.93	2.92	2.68	1.71	2.66	3.20	2.63	0.55
3	6.03	5.56	4.91	5.88	12.03	7.49	2.82	5.81	2.93
4	4.13	2.78	.70	2.88	2.06	2.55	1.03	2.01	1.21
5	.00	.46	.70	.96	.41	.64	.00	.30	.39
6	3.85	8.33	1.99	2.80	4.66	4.30	14.06	8.49	5.16
7	8.09	10.88	13.10	11.05	8.29	6.85	9.55	9.41	2.16
8	1.38	.46	.00	.56	.00	.64	1.15	.74	.54
9	.69	.00	.99	.56	.00	.00	.33	.27	.41
10	.80	.46	1.99	4.72	.58	.90	1.27	1.27	1.52
11	.80	.54	.99	.00	.48	.74	.29	.45	.35
12	.69	.00	.00	.48	.82	.00	.29	.35	.35
13	.00	1.58	.00	.68	.82	2.02	.57	.84	.76
14	.57	.00	.00	.48	.00	.00	.00	.09	.27
15	.00	1.39	.00	.00	1.64	.00	.57	.71	.75
16	.00	.46	.00	.96	.00	.00	.29	.26	.37
17	.00	.00	.00	.00	.00	.00	1.19	.46	.55
18	.00	.00	.00	.00	.00	.00	.00	.00	.00
19	.00	.00	.00	.00	.00	.00	.00	.00	.00
20	.00	.00	.00	.00	.00	.00	11.87	4.58	5.46

Table A-4

SUMMARY OF DISPARATE 1970 RATES
OF MANPOWER USAGE - ALLOCATIONS

	Detention Institution						
POST CATEGORIES	BRX	BRK	BRQ	WOM	MAN	QNS	ARS
I	*	*	*	*	-	-	-
II	-	*	-	-	-	***	-
III	-	-	-	-	-	-	*
TOTAL	-	-	-	-	-	-	-
POST SUBCATEGORIES							
I.1	*	*	*	*	-	-	-
2	*	-	**	-	-	-	-
3	-	-	-	-	-	-	-
II.1	*	-	-	-	*	**	-
2	-	-	-	-	-	-	**
3	-	-	-	-	-	***	-
4	-	*	-	-	-	***	-
5	-	-	-	***	-	-	-
III.1	-	-	*	*	-	-	*
2	-	-	**	-	-	***	-
3	-	-	-	-	**	-	-
4	-	**	-	-	**	-	-
5	-	-	***	-	-	*	-
6	*	-	-	*	-	-	-
7	-	-	***	-	-	-	-
8	-	-	-	***	-	-	-
9	-	-	***	-	-	-	-
10	-	-	*	-	-	-	-
11	**	*	-	-	-	*	-
12	-	-	-	**	*	-	-
13	-	-	-	-	*	*	-
14	**	**	-	-	-	-	-
15	-	-	**	-	-	-	*
16	-	-	-	***	-	-	-
17	-	-	-	-	-	-	**
18	-	-	-	***	-	-	-
19	-	-	-	***	-	-	-
20	-	-	-	-	-	-	**

Table A-5

SUMMARY OF DISPARATE 1970 RATES
OF MANPOWER USAGE - REQUESTS

	Detention Institution						
POST CATEGORIES	BRX	BRK	BRQ	WOM	MAN	QNS	ARS
I	*	-	-	*	*	-	-
II	-	*	*	-	-	***	-
III	-	-	-	-	-	-	*
TOTAL	-	-	-	-	-	-	-
POST SUBCATEGORIES							
I.1	*	-	-	*	*	-	-
2	**	-	-	-	-	**	-
3	-	-	-	-	-	-	*
II.1	-	-	**	-	-	***	-
2	-	-	***	-	-	-	-
3	-	**	-	-	-	**	-
4	-	*	*	-	-	**	-
5	-	-	-	***	-	-	-
III.1	-	-	*	-	-	-	*
2	-	-	-	-	-	-	*
3	-	-	-	-	***	-	-
4	***	-	-	*	-	-	-
5	-	-	*	**	-	*	-
6	-	-	-	-	-	-	*
7	-	*	**	*	-	-	-
8	*	-	-	-	-	-	*
9	*	-	***	*	-	-	-
10	-	-	-	***	-	-	-
11	*	-	**	-	-	*	-
12	*	-	-	-	**	-	-
13	-	*	-	-	-	**	-
14	***	-	-	**	-	-	-
15	-	*	-	-	*	-	-
16	-	-	-	***	-	-	-
17	-	-	-	-	-	-	**
18	-	-	-	-	-	-	-
19	-	-	-	-	-	-	-
20	-	-	-	-	-	-	**

Appendix B

DEFINITIONS OF STATISTICAL TERMS

Three statistical terms are repeatedly referred to in this Report: average, weighted average, and standard deviation. Since these concepts underlie the methodology described in Sections III through V, we define and illustrate them in this appendix.

The statistical quantity known as the *average* (arithmetic average or mean) is familiar as a single, summary measure of a group of data. The average is computed by adding the individual data elements together and dividing by the number of elements in the group. Thus, for the set of data (1, 2, 3, 4, 5), we easily determine the sum as 15, the number of elements (or observations) as 5, and the average, therefore, as 15 ÷ 5, or 3. The numbers themselves might be observations made of certain events, such as the number of C.O.'s found manning a particular post during five weekly sample periods.

In general, if the numbers comprising a set of observations are symbolized as n_1, n_2, etc., up to n_N, where N is the total number of observations, then the average becomes the following:

$$\text{Average of } (n_1, n_2, \ldots, n_N) = (n_1 + n_2 \ldots + n_N) \div N . \qquad (1)$$

The significance of the average is that it tends to quantify the level of *constant* influences bearing on the events symbolized by the set of data. In the manpower analogy, the constant influences might be institutional capacity, number of cells per floor, architectural features, type of inmates served, established manpower quotas, number of annual vacation days per C.O., etc. These constant influences, coupled with the cancelling-out tendencies of random variations such as inmate population level, turnover rate, officer sick-leave, hospital and writ transfers, riots, etc., tend to make the manpower measurements at each post cluster about the average manpower for the post. Of course, the *variation* of manpower around the average is also generally of interest. Indeed, without the variational aspect of any data--not just in manpower records--the conduct of statistical analyses would be meaningless. Before describing one such variational measure, the standard deviation, we shall introduce the other type of average used in this Report, i.e., the less familiar, but equally simple and useful concept of a *weighted* average.

Weighted averages are employed in those instances when individual elements of a set of data are not deemed equally significant or influential in their contribution to the total. Thus, if three institutions had manning levels of 1, 2, and 3 men for a given post type in a particular week, we could simply compute the average manning across the three institutions as (1+2+3) ÷3, or 2 men for that post. But suppose we also knew that these institutions were widely different in housing capacity; e.g., that the institution using 3 men for the post had 1/2 the total capacity of the three facilities; the institution with 2 men had 1/3 the total capacity; and the institution employing 1 man had 1/6 the total capacity. In computing the average manning for the post, then, we could obtain an indication of average manning level which reflected the differences among institutions by computing a weighted average; i.e., by multiplying the number of men used at each facility by its percentage of the total capacity and summing the results across all three institutions. In the present example, the weighted average would become (1/6x1+1/3x2+1/2x3), or 2-1/3 men. If each facility had an equal share of the total capacity, then the weighted average would be (1/3x1+1/3x2+1/3x3), or 2 men, the same as the simple, unweighted average.

To make these notions more precise, we can state the weighted average as a formula analogous to Eq. (1) for the simple arithmetic average. If we again denote the N elements of the set of data as ($n_1, n_2, \ldots n_N$) and their corresponding weights as ($w_1, w_2, \ldots w_N$), then the weighted average is calculated according to the following formula:

$$\text{Weighted average of } (n_1, n_2, \ldots, n_N) =$$
$$(w_1 x\ n_1 + w_2\ x\ n_2 + \ldots w_N\ x\ n_N) \div (w_1 + w_2 \ldots w_N) \qquad (2)$$

For the case in which all the weights are equal, we have the special result:

$$\text{Weighted average of } (n_1, n_2, \ldots, n_N) =$$
$$\text{Average of } (n_1, n_2, \ldots n_N) \text{ if } w_1 = w_2 = \ldots w_N \qquad (3)$$

As we have already noted, the average is but one summarizing measure of a group of data, namely, the central tendency or value around which the data

appear to cluster. In order to convey the variability and dispersion or scattering of the individual data elements of the group about the group's average, we need to supplement the average with another aggregative measure: the *standard deviation* (or *variance*) of the data points. Together, these two statistical quantities (i.e., the average and the standard deviation) give some feeling for the clustering point and spread around this point of an array of observations.[21]

Figures B-1 through B-4 graphically relate these concepts of standard deviation and illustrate them in the context of the present study, i.e., analysis of manpower usage by post across all detention facilities. Before discussing the figures, we should note the formula for computing the standard deviation of a group of N data elements $(n_1, n_2, \ldots n_N)$ whose average, as computed by Eq. (1) or (2), is denoted by the quantity A:

$$\text{Standard Deviation of } (n_1, n_2, \ldots n_N) = \text{Square root of}$$
$$\{[(n_1-A)x(n_1-A)+(n_2-A)x(n_2-A)+\ldots+(n_N-A)x(n_N-A)] \div (N-1)\} \qquad (3)$$

The closely related quantity known as the *variance* is simply the standard deviation multiplied by itself, i.e., the quantity in the brackets of Eq. (3).

In Figs. B-1 through B-4, we depict a situation where the average number of men over 4 one-week samples of a specific post (post "X") stays constant for each of four different institutions. However, the number of men allocated to the post varies each week for all four facilities except the first one, "Institution A." As the figures reveal, the degree of manning variation increases progressively from the first institution (Fig. B-1) through the last (Fig. B-4). As discussed above, the average and standard deviation should capture the clustering points and spread or dispersion of the manning data conveyed in the figures.

This is confirmed by the four figures and the following applications of Eqs. (1) and (3) to the four cases depicted.

[21] The mean and standard deviation are not the only measures for describing the central value and spread of a set of data, nor are they always the best such descriptors.

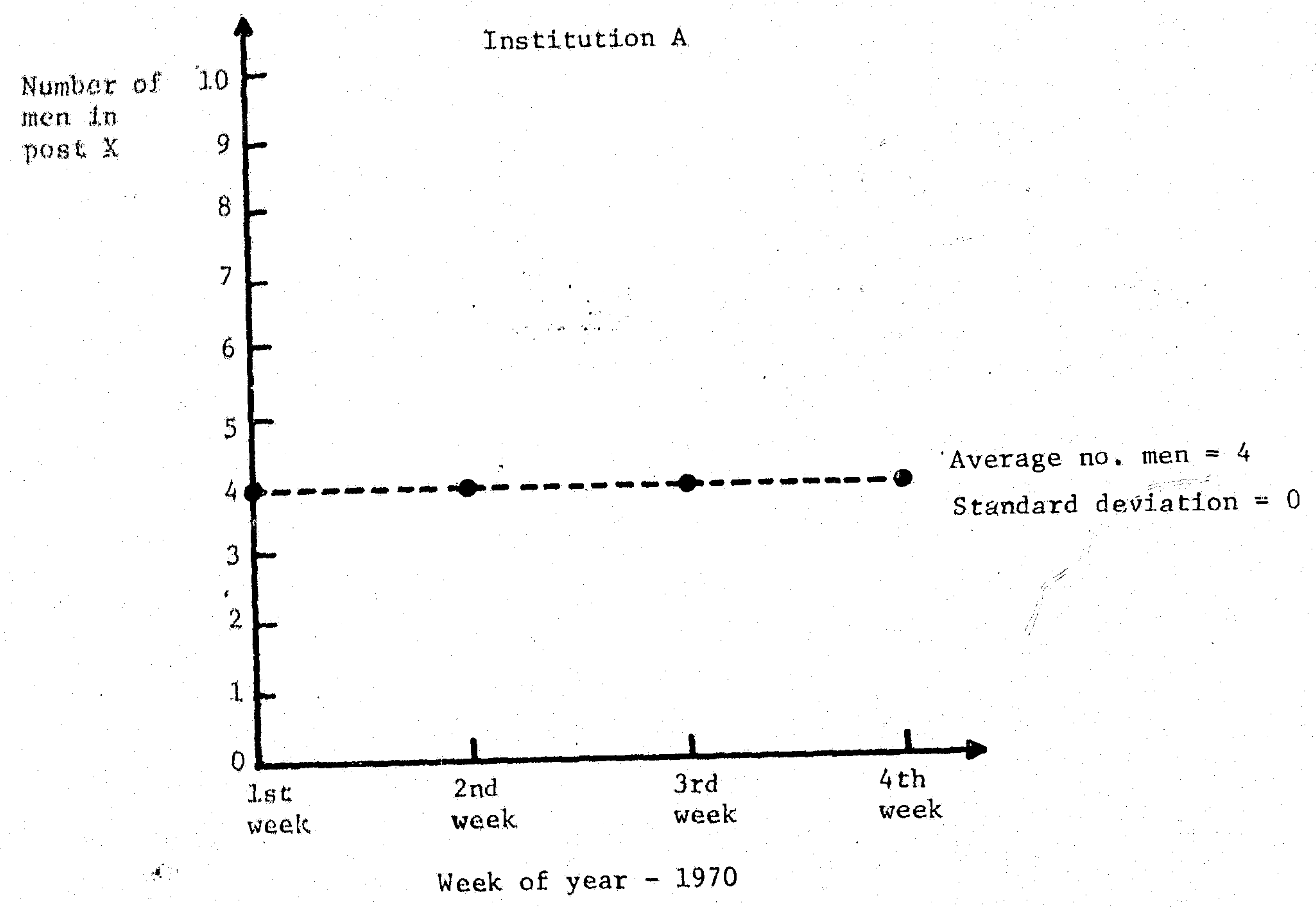

Fig. B-1. Illustrative manpower averages and standard deviations

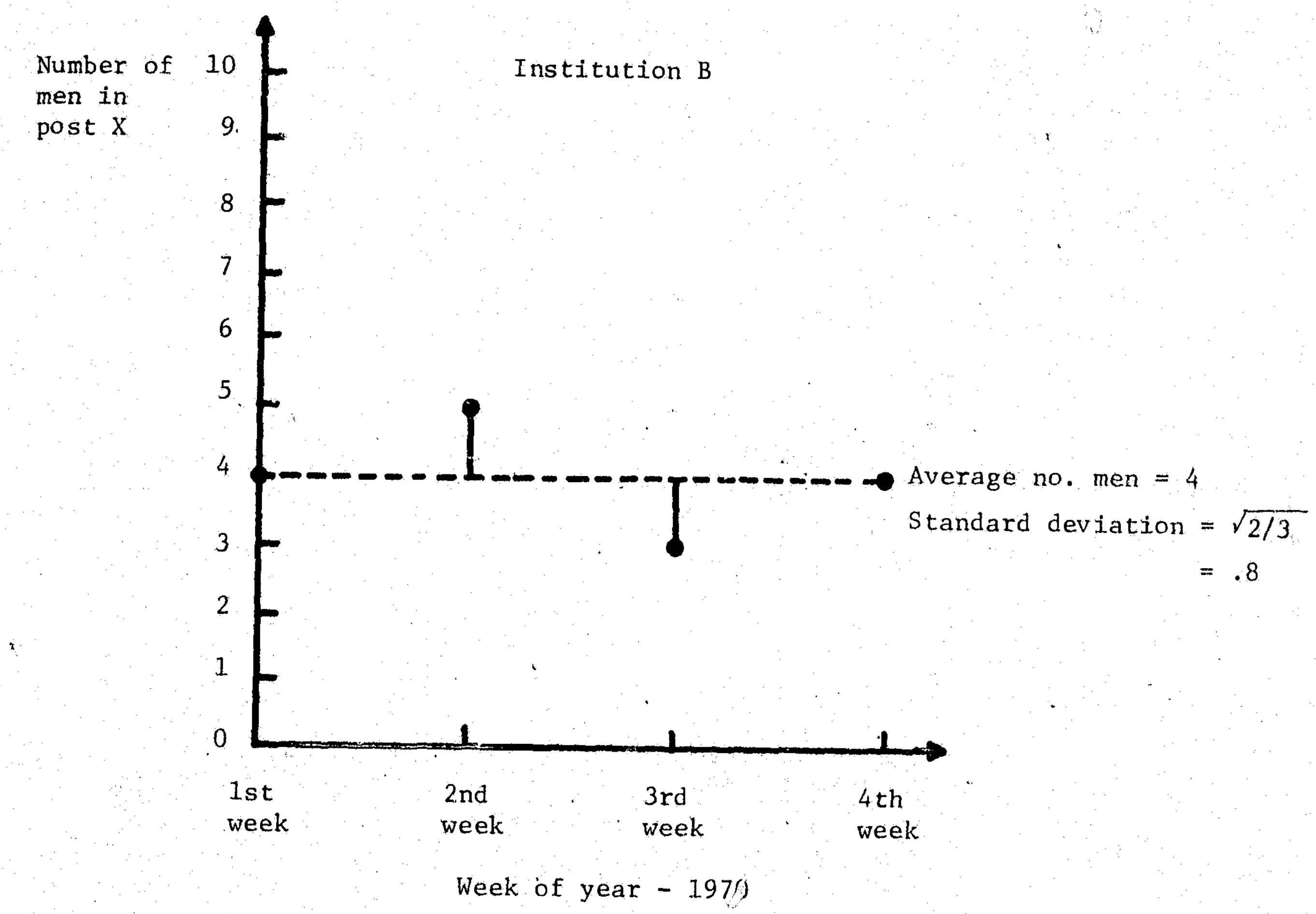

Fig. B-2. Illustrative manpower averages and standard deviations

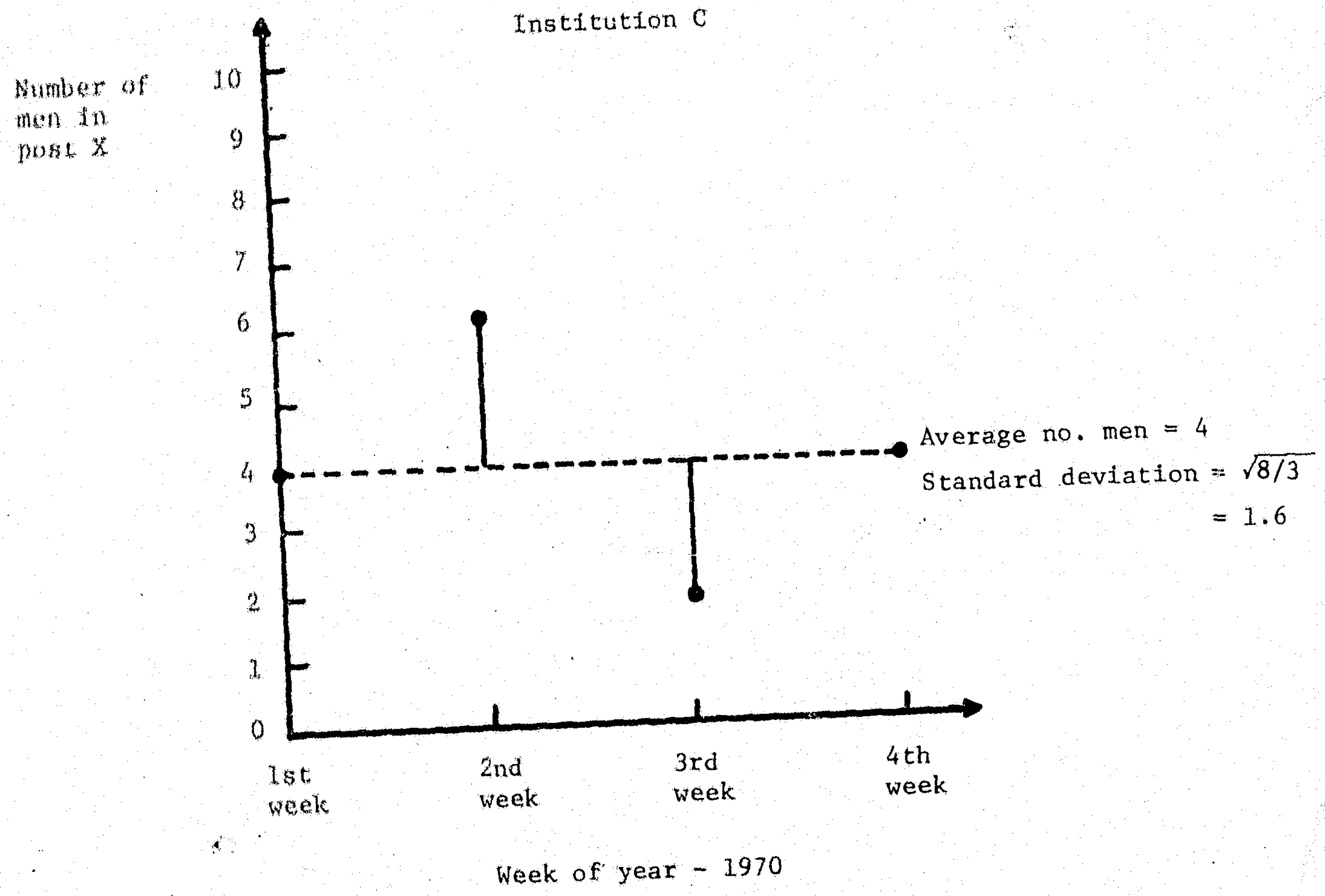

Fig. B-3. Illustrative manpower averages and standard deviations

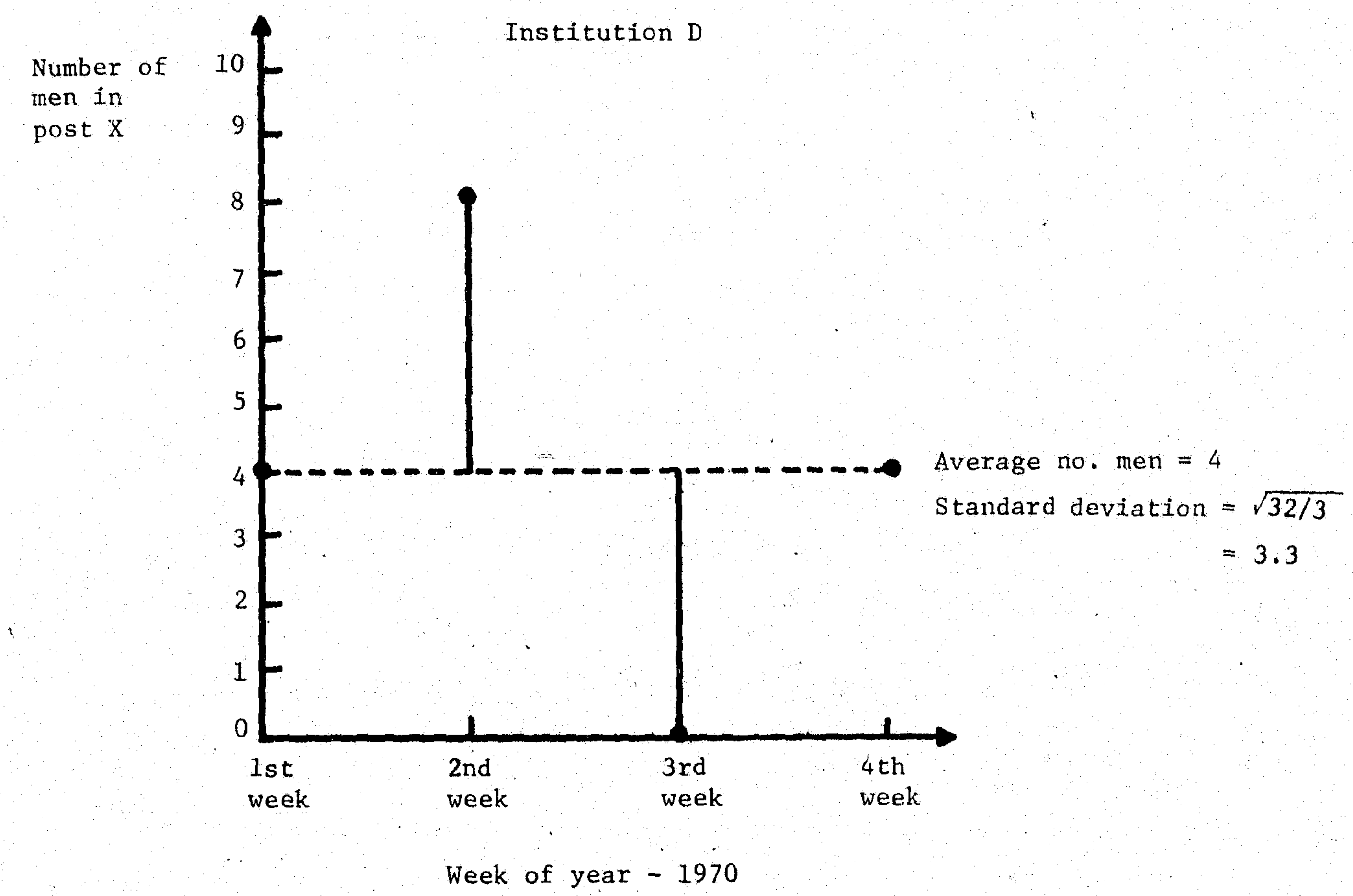

Fig. B-4. Illustrative manpower averages and standard deviations

Fig. B-1: Average of (4,4,4,4) = (4+4+4+4) ÷ 4 = 4

Standard Deviation of (4,4,4,4) = Square root of

$\{ [(4-4)\times(4-4)+(4-4)\times(4-4)+(4-4)\times(4-4)+(4-4)\times(4-4)] \div (4-1) \}$

$= \sqrt{0} = 0$

Fig. B-2: Average of (4,5,3,4) = (4+5+3+4) ÷ 4 = 4

Standard Deviation of (4,5,3,4) = Square root of

$\{ [(4-4)\times(4-4)+(5-4)\times(5-4)+(3-4)\times(3-4)+(4-4)\times(4-4)] \div (4-1) \}$

$= \sqrt{2/3} = .8$

Fig. B-3: Average of (4,6,2,4) = (4+6+2+4) ÷ 4 = 4

Standard Deviation of (4,6,2,4) = Square root of

$\{ [(4-4)\times(4-4)+(6-4)\times(6-4)+(2-4)\times(2-4)+(4-4)\times(4-4)] \div (4-1) \}$

$= \sqrt{8/3} = 1.6$

Fig. B-4: Average of (4,8,0,4) = (4+8+0+4) ÷ 4 = 4

Standard Deviation of (4,8,0,4) = Square root of

$\{ [(4-4)\times(4-4)+(8-4)\times(8-4)+(0-4)\times(0-4)+(4-4)\times(4-4)] \div (4-1) \}$

$= \sqrt{32/3} = 3.3$

Thus, even though the average post manning over the 4-week period is the same for each institution, the standard deviation is not. With the progressive increase in variability in the number of men posted each week from institution A to institution D, there is a corresponding increase in standard deviation.

The figures depict the average or central tendency as the horizontal line emanating from the number corresponding to the average given on the vertical scale called "Number of Men in Post X." The contributions of each data point to the standard deviation, i.e., the individual terms in the sum of Eq. (3) are depicted as the lines emanating perpendicularly from the horizontal average line to the data points above, below, or on the average line. When the lengths of these lines are squared (multiplied by themselves), added together, and divided by one less than the number of data points, we

obtain the *variance* of the data.[22] Clearly, as the sum of lengths of these vertical lines increases, as in Figs. B-1 through B-4, the variance and standard deviation must also grow.

[22] The square root of this result, according to Eq. (3), is then the standard deviation.

Appendix C

ILLUSTRATIVE INSTITUTIONAL MANPOWER REQUEST

INSTITUTION NAME/REQUEST DATE

POST NUMBER	AREA OF OPERATION	TOURS							DAYS PER WEEK
		12-8	5-1	6-2	8-4	11-7	1-9	4-12	
1	Tier 1-A	x			x			x	7
2	Tier 1-B	x			x			x	7
3	Tier 2-A	x			x			x	7
4	Tier 2-B	x			x			x	7
5	Tier 3	x			x			x	7
6	Tier 4	x			x			x	7
7	Tier 5	x			x			x	7
8	Dormitory -A	x			x			x	7
9	Dormitory -B	x			x			x	7
10	Dormitory -C	x			x			x	7
11	Annex - 1st Floor	x			x			x	7
12	Annex - 2nd Floor	x			x			x	7
13	Annex - 3rd Floor	x			x			x	7
14	Control Corridor Gate	x			x			x	7
15	Front Gate	x			x			x	7
16	Main Entrance Corridor Gate		x				x		7
17	Yard Vehicle Entrance - 1		x				x		7
18	Yard Vehicle Entrance - 2				x				6
19	Yard Patrol			x					6
20	Yard Patrol						x (2PM-6PM)		6
21	Kitchen		x		x		x		7
22	Messhall		x				x		7
23	Storeroom				x				6
24	Institutional Sanitation - A				x				7
25	Institutional Sanitation - B				x				7
26	Institutional Clothes Box				x				7

Fig. C-1. Illustrative institutional manpower request

INSTITUTION NAME/REQUEST DATE

POST NUMBER	AREA OF OPERATION	TOURS 12-8	5-1	6-2	8-4	11-7	1-9	4-12	DAYS PER WEEK
27	Deputy Warden's Office				x				6
28	Warden's Office				x				6
29	General Office - A	x			x			x	7
30	General Office - B		x				x		7
31	Receiving Room		x						7
32	Receiving Room Desk		x				x		7
33	Receiving Room						x		7
34	Receiving Room						x		7
35	Receiving Room Escort		x				x		7
36	Barber Shop				x				7
37	Institutional Maintenance				x				7
38	Paint Shop				x				6
39	Counsel-Visits Room				x				6
40	Recreation Officer				x		x		7
41	Writs & Transfers	x			x			x	7
42	Stairway Landing - A		x				x		7
43	Stairway Landing - B		x				x		7
44	Cross-over Bridge Gates		x				x		7
45	Outside Patrol	x			x			x	7
46	Clinic				x			x	7
47	Clinic Escort			x			x		7
48	Institutional Cashier		x				x		5
49	Institutional Commissary			x					5
50	Commissary Escort			x					5
51	Control Room	x			x			x	7
52	Visits (Female)						x		5

Fig. C-2. Illustrative institutional manpower request

INSTITUTION NAME/REQUEST DATE

S U M M A R Y O F P O S T S

No. of Posts	Type of Post	Manning Formula	Correctional Officers Required
19	3 tours of duty - 7 days	5.02	95.38
13	2 tours of duty - 7 days	3.35	43.55
8	1 tour of duty - 7 days	1.67	13.36
7 1/2	1 tour of duty - 6 days	1.44	10.80
4	1 tour of duty - 5 days	1.20	4.80
1	1 tour of duty - 5 days	1.20	1.20
		Total Required	169.09

Fig. C-3. Illustrative institutional manpower request

Appendix D

MATHEMATICAL DESCRIPTION OF THE MANPOWER ALLOCATION SCHEMES

I. DEFINITIONS AND MATHEMATICAL STATEMENTS OF DECISION RULES

This appendix is a mathematical treatment of the data manipulation, decision rules, and resultant manpower allocations presented in Sections III through VI. The definitions and equations that follow should help to clarify the earlier description of the manpower assignment scheme.

We define the following quantities as the parameters and variables used in the LR, CR, MIN, and MAX manpower assignment rules of Section V:

i = institutional index, ($i = 1,2,\ldots,I$).

I = total number of institutions considered.

j = post type according to the Table 1 typology, ($j = 1,2,\ldots,J$).

J = total number of post types in the typology.

A_{ijk} = actual manpower allocated to post j at institution i during sample week k, ($k = 1,2,\ldots K$).

K = total number of weekly manpower samples.

$\bar{A}_{ij}$ = average actual manpower allocations over last K samples A_{ijk}.

R_{ij} = requested manpower at institution i for post j.

M_{ij} = manpower allocated to institution i for post j in accordance with a decision rule.

Δ_{ij} = manpower change at institution i in post j; i.e., $(R_{ij} - \bar{A}_{ij})$.

$\bar{\Delta}_j$ = weighted average (by housing capacity across all I institutions) of the manpower changes in post type j.

σ_j = standard deviation of the manpower changes in post type j.

λ_j = variability threshold factor for post type j.

c_i = total housing capacity of the i^{th} institution.

C = total housing capacity of all I institutions.

Accordingly, we can identify the institutional entries of Table 5 as the $\bar{A}_{ij}$ (with $I = 7$) and those of Appendix A, Table A-1, as the A_{ijk} (with $K=2$, one week in April and July 1970). The quantities R_{ij} are the institutional manpower requests tabulated in Table 6. The manpower changes Δ_{ij} are the institutional entries of Table 7. Similarly, the weighted average manning change, $\bar{\Delta}_j$, and the standard deviation of the manning changes, σ_j, are the numbers presented respectively in columns 8 and 9 of Table 7.

From the above definitions, the following relations are established for $i = 1,2,\ldots,I$ and $j = 1,2,\ldots,J$:

$$\bar{A}_{ij} = \frac{1}{K}\sum_{k=1}^{K} A_{ijk} \tag{1}$$

$$\Delta_{ij} = R_{ij} - \bar{A}_{ij} \tag{2}$$

$$\bar{\Delta}_j = \frac{1}{C}\sum_{i=1}^{I} c_i\Delta_{ij} \tag{3}$$

where

$$C = \sum_{i=1}^{I} c_i \tag{4}$$

and

$$\sigma_j = \sqrt{\frac{1}{(I-1)}\sum_{i=1}^{I}(\Delta_{ij} - \bar{\Delta}_j)^2} \tag{5}$$

For the typology of Table 1 and the New York City Department of Correction detention institutions considered in this analysis, we have the following parameter values and index-institutional correspondences:

(6)

$i = 1 =$ BRX	$c_1 = 476$
$i = 2 =$ BRK	$c_2 = 841$
$i = 3 =$ BRQ	$c_3 = 194$
$i = 4 =$ WOM	$c_4 = 457$
$i = 5 =$ MAN	$c_5 = 932$
$i = 6 =$ QNS	$c_6 = 520$
$i = 7 =$ ARS	$c_7 = 2147$

For the case at hand, therefore,

$$I = 7$$
$$J = 28 \tag{7}$$
$$C = 5567$$

In terms of the preceding quantities, the decision rules described in Section V can be stated as the following for $i = 1,2,\ldots,I$ and $j = 1,2,\ldots,J$:

MAX: $M_{ij} = \max[\bar{A}_{ij}, R_{ij}]$ (8)

MIN: $M_{ij} = \min[\bar{A}_{ij}, R_{ij}]$ (9)

LR: $M_{ij} = R_{ij}$ if $\bar{A}_{ij} + \bar{\Delta}_j - \lambda_j\sigma_j \le R_{ij} \le \bar{A}_{ij} + \bar{\Delta}_j + \lambda_j\sigma_j$ (10a)

$= \max[0, \bar{A}_{ij} + \bar{\Delta}_j + \lambda_j\sigma_j]$ if $R_{ij} > \bar{A}_{ij} + \bar{\Delta}_j + \lambda_j\sigma_j$ (10b)

$= \max[0, \bar{A}_{ij} + \bar{\Delta}_j - \lambda_j\sigma_j]$ if $R_{ij} < \bar{A}_{ij} + \bar{\Delta}_j - \lambda_j\sigma_j$ (10c)

CR: $M_{ij} = R_{ij}$ if $\bar{A}_{ij} + \bar{\Delta}_j - \lambda_j\sigma_j \le R_{ij} \le \bar{A}_{ij} + \bar{\Delta}_j + \lambda_j\sigma_j$ (11a)

$= \max[0, \bar{A}_{ij} + \bar{\Delta}_j + \lambda_j\sigma_j]$ if $R_{ij} > \bar{A}_{ij} + \bar{\Delta}_j + \lambda_j\sigma_j$ (11b)

$= \max[0, R_{ij}]$ if $R_{ij} < \bar{A}_{ij} + \bar{\Delta}_j - \lambda_j\sigma_j$ (11c)

Accordingly, the OK, HIGH, and LOW regions illustrated in Fig. 1 can be written as the requests (R_{ij}) and manning changes (Δ_{ij}) satisfying the following:

OK: $\max[0, \bar{A}_{ij} + \bar{\Delta}_j - \lambda_j\sigma_j] \le R_{ij} \le \max[0, \bar{A}_{ij} + \bar{\Delta}_j + \lambda_j\sigma_j]$ (12a)

or

$\max[0, \bar{\Delta}_j - \lambda_j\sigma_j] \le \Delta_{ij} \le \max[0, \bar{\Delta}_j + \lambda_j\sigma_j]$ (12b)

HIGH: $R_{ij} > \max[0, \bar{A}_{ij} + \bar{\Delta}_j + \lambda_j\sigma_j]$ (13a)

or

$\Delta_{ij} > \max[0, \bar{\Delta}_j + \lambda_j\sigma_j]$ (13b)

LOW: $$0 \leq R_{ij} < \max [\ 0,\ \bar{A}_{ij} + \bar{\Delta}_j - \lambda_j\sigma_j\ ] \qquad (14a)$$

or
$$0 \leq \Delta_{ij} < \max [\ 0,\ \bar{\Delta}_j - \lambda_j\sigma_j\ ] \qquad (14b)$$

The quantity which has been referred to in Sections V and VI as the variability threshold is given by

$$\lambda_j\sigma_j = \text{Variability Threshold of Post Type } j \qquad (15)$$

while the quantities λ_j and σ_j have been separately defined as the variability threshold factor and standard deviation, respectively. The manpower computations of Tables E-1, E-3, E-5, and E-7 have been carried out by assigning the consecutive values of 0.5, 1.0, 1.5, and 2.0 to λ_j in Eqs. (11a, b, and c). Tables E-9, E-11, E-13, and E-15 were arrived at by applying the same values of λ_j to Eqs. (10a, b, and c). That is, in calculating the manpower allocations according to rules LR and CR of Eqs. (10-11), we set the variability threshold of post type j equal to a fixed constant times the standard deviation of manning change (σ_j) for that post. The same value of λ_j was applied to all posts once λ_j was fixed at either 0.5, 1, 1.5, or 2. As is implied by the subscript j in λ_j, this need not have been the case; different variability threshold factors (λ_j) can be selected for each of the posts in the typology.

II. ANALYTICAL PROPERTIES OF THE DECISION RULES

Several analytical features of the four decision rules presented in Part I are noteworthy in that they reveal relationships within and among the algorithms. The relationships are useful in distinguishing those results that are attributable to the rules themselves.

From Eqs. (8) and (9), it is obvious that the max and min operators assign values to M_{ij} in the MIN rule which are always less than or equal to those in the MAX rule. The proof is as follows:

I. If $\bar{A}_{ij} < R_{ij}$, then the assignments according to Eqs. (8) and (9) become (16a)

MAX: $$\max [\ \bar{A}_{ij},\ R_{ij}\ ] = R_{ij} \qquad (16b)$$

and

MIN: $$\min [\ \bar{A}_{ij},\ R_{ij}\ ] = \bar{A}_{ij} \qquad (16c)$$

Hence,

$$\max [\ \bar{A}_{ij},\ R_{ij}\ ] > \min [\ \bar{A}_{ij},\ R_{ij}\ ] \qquad (16d)$$

II. If $\bar{A}_{ij} > R_{ij}$, then Eqs. (8) and (9) give (17a)

MAX: $$\max [\ \bar{A}_{ij},\ R_{ij}\ ] = \bar{A}_{ij} \qquad (17b)$$

and

MIN: $$\min [\ \bar{A}_{ij},\ R_{ij}\ ] = R_{ij} \qquad (17c)$$

Hence,

$$\max [\ \bar{A}_{ij},\ R_{ij}\ ] > \min [\ \bar{A}_{ij},\ R_{ij}\ ] \qquad (17d)$$

III. Finally, if $\bar{A}_{ij} = R_{ij}$, the assignments become (18a)

MAX: $$\max [\ \bar{A}_{ij},\ R_{ij}\ ] = R_{ij} \text{ or } \bar{A}_{ij} \qquad (18b)$$

MIN: $$\min [\ \bar{A}_{ij},\ R_{ij}\ ] = R_{ij} \text{ or } \bar{A}_{ij} \qquad (18c)$$

Therefore,

$$\max [\ \bar{A}_{ij},\ R_{ij}\ ] = \min [\ \bar{A}_{ij},\ R_{ij}\ ] \qquad (18d)$$

We can also show that for any real value of λ_j, the LR rule assigns to M_{ij} a value that is greater than or equal to that assigned by the CR rule. Only three mutually exclusive and exhaustive cases need be considered:

I. $[\ \bar{A}_{ij} + \bar{\Delta}_j - \lambda_j\sigma_j\ ] \leq R_{ij} \leq [\ \bar{A}_{ij} + \bar{\Delta}_j + \lambda_j\sigma_j\ ]$

In this case, according to Eqs. (10a) and (11a) the LR and CR rules both assign the same value to M_{ij}, namely R_{ij}.

II. $R_{ij} > [\ \bar{A}_{ij} + \bar{\Delta}_j + \lambda_j\sigma_j\ ]$.

Here again, according to Eqs. (10b) and (11b) the LR and CR rules assign the same value to M_{ij}, namely max $[\ 0,\ \bar{A}_{ij} + \bar{\Delta}_j + \lambda_j\sigma_j\ ]$.

III. $R_{ij} < [\ \bar{A}_{ij} + \bar{\Delta}_j - \lambda_j\sigma_j\ ]$

In this case, the LR rule assigns the following to M_{ij}:

$$\text{LR:}\quad \max\ [\ 0,\ \bar{A}_{ij} + \bar{\Delta}_j - \lambda_j\sigma_j\ ], \tag{19a}$$

while the CR rule assigns

$$\text{CR:}\quad \max\ [\ 0,\ R_{ij}\ ] \tag{19b}$$

Physical reality demands that manpower allocations be non-negative; i.e., for $i = 1,2,\ldots,I$ and $j = 1,2,\ldots,J$

$$\bar{A}_{ij} \geq 0 \tag{20a}$$

$$R_{ij} \geq 0 \tag{20b}$$

Thus, the CR rule always assigns

$$\text{CR:}\quad \max\ [\ 0,\ R_{ij}\ ] = R_{ij} \tag{21a}$$

Now, since $R_{ij} \geq 0$ and since this case specifies that

$$\bar{A}_{ij} + \bar{\Delta}_j - \lambda_j\sigma_j > R_{ij}, \tag{21b}$$

we have

$$\bar{A}_{ij} + \bar{\Delta}_j - \lambda_j\sigma_j > R_{ij} \geq 0 \tag{21c}$$

or

$$\bar{A}_{ij} + \bar{\Delta}_j - \lambda_j\sigma_j > 0 \tag{21d}$$

Hence, for this case the LR rule always assigns to M_{ij} the following:

$$\text{LR:}\quad \max\ [\ 0,\ \bar{A}_{ij} + \bar{\Delta}_j - \lambda_j\sigma_j\ ] = \bar{A}_{ij} + \bar{\Delta}_j - \lambda_j\sigma_j \tag{21e}$$

In view of Eq. (21b), therefore, the LR assignment to M_{ij}, Eq. (21e), must be larger than that of CR for this case, Eq. (21a).

It is also easy to show that as λ_j increases, the values assigned to M_{ij} by LR and CR become equal once λ_j exceeds a certain level. As we have shown, LR always assigns to M_{ij} values that are greater than or equal to those given by CR for the same value of λ_j. The only difference between the two rules occurs when $R_{ij} < \bar{A}_{ij} + \bar{\Delta}_j - \lambda_j\sigma_j$. Since R_{ij} must be non-negative, this case will never arise when λ_j is so large that $\bar{A}_{ij} + \bar{\Delta}_j - \lambda_j\sigma_j$ is negative. Thus, if

$$\bar{A}_{ij} + \bar{\Delta}_j - \lambda_j\sigma_j < 0 \tag{22}$$

or

$$\lambda_j > (\ \bar{A}_{ij} + \bar{\Delta}_j\ )\ /\ \sigma_j \qquad i = 1,2,\ldots,I\ ;\ j = 1,2,\ldots,J;\ \sigma_j \neq 0 \tag{23}$$

then

$$R_{ij} \not< \bar{A}_{ij} + \bar{\Delta}_j - \lambda_j\sigma_j \tag{24}$$

since we always have

$$R_{ij} \geq 0 \tag{20b}$$

Hence, when λ_j satisfies Eq. (23), Eqs. (10c) and (11c) of the LR and CR are never exercised. Consequently, after the threshold given by

$$\lambda_j = (\bar{A}_{ij} + \bar{\Delta}_j) / \sigma_j \tag{25}$$

is exceeded, the values assigned to M_{ij} by LR and CR become identical.

In order to show that the CR rule assigns values to M_{ij} which never decrease as λ_j increases from zero, we need consider only two cases. The first case pertains to a value of λ_j such that any R_{ij} ($i = 1,2,\dots,I$; $j = 1,2,\dots,J$) lies in either the LOW or OK regions.

I. λ_j such that R_{ij} lies in LOW or OK region. If R_{ij} is already in the OK or LOW region, then according to Eq. (11a), Eq. (11c), and the fact that $R_{ij} \geq 0$, the same assignment is made to M_{ij}; i.e.,

$$\text{CR:} \quad M_{ij} = R_{ij} \qquad 0 \leq R_{ij} \leq \bar{A}_{ij} + \bar{\Delta}_j + \lambda_j \sigma_j \tag{26}$$

Increasing λ_j to λ_j^* so that

$$\lambda_j^* > \lambda_j \tag{27}$$

implies

$$\bar{A}_{ij} + \bar{\Delta}_j + \lambda_j^* \sigma_j > \bar{A}_{ij} + \bar{\Delta}_j + \lambda_j \sigma_j \tag{28}$$

since the standard deviation, σ_j, is always non-negative.

Hence,

$$0 \leq R_{ij} < \bar{A}_{ij} + \bar{\Delta}_j + \lambda_j^* \sigma_j \tag{29}$$

so that the CR rule still assigns to M_{ij} the value R_{ij} as in Eq. (26). Thus, the M_{ij} corresponding to this new, increased value of λ_j, namely λ_j^*, becomes M_{ij}^*:

$$\text{CR:} \quad M_{ij}^* = R_{ij} = M_{ij} \qquad 0 \leq R_{ij} < \bar{A}_{ij} + \bar{\Delta}_j + \lambda_j^* \sigma_j \tag{30}$$

Thus, the manpower assignment remains invariant with increased λ_j when R_{ij} falls in the LOW or OK region.

Now, we consider the remaining case in which R_{ij} exceeds the OK region corresponding to λ_j:

II. λ_j such that R_{ij} lies in HIGH region. If R_{ij} is in the HIGH region for the current value of λ_j, then according to Eq. (11b) of the CR rule, the manpower assignment is

$$\text{CR:} \quad M_{ij} = \max [0, \bar{A}_{ij} + \bar{\Delta}_j + \lambda_j \sigma_j] \quad \text{if} \quad R_{ij} > \bar{A}_{ij} + \bar{\Delta}_j + \lambda_j \sigma_j \tag{31}$$

Since $R_{ij} \geq 0$, we can therefore write

$$M_{ij} < \max [0, R_{ij}] = R_{ij} \tag{32}$$

Now if λ_j is increased to λ_j^*, i.e.,

$$\lambda_j^* > \lambda_j \tag{33}$$

so that R_{ij} falls into either the LOW or OK region, i.e.,

$$\lambda_j^* > \frac{R_{ij} - \bar{A}_{ij} - \bar{\Delta}_j}{\sigma_j} > \lambda_j \tag{34}$$

then the CR rule must assign to the corresponding M_{ij}^*,

$$\text{CR:} \quad M_{ij}^* = R_{ij} \tag{35}$$

as in case I. From this and Eq. (32), we obtain

$$M_{ij}^* = R_{ij} > M_{ij} \qquad \lambda_j^* > \lambda_j \tag{36}$$

In a similar fashion, we can prove that this non-decreasing property of the CR rule does not hold for the LR rule. That is, as λ_j is increased from zero, the values assigned to M_{ij} by the LR rule can decrease. To show this possibility, we need concentrate only on the region where the LR and CR rules differ; i.e., the case in which R_{ij} falls in the LOW region.

I. λ_j such that R_{ij} lies in the LOW region. If R_{ij} is in the LOW region initially, then by Eq. (10c) the LR rule assigns to M_{ij} the following:

$$\text{LR:} \quad M_{ij} = \max [\, 0,\ \bar{A}_{ij} + \bar{\Delta}_j - \lambda_j\sigma_j \,] \qquad R_{ij} < \bar{A}_{ij} + \bar{\Delta}_j - \lambda_j\sigma_j \tag{37}$$

Since $R_{ij} \geq 0$, Eq. (37) becomes

$$\text{LR:} \quad M_{ij} = \max [\, 0,\ \bar{A}_{ij} + \bar{\Delta}_j - \lambda_j\sigma_j \,] > \max [\, 0,\ R_{ij} \,] = R_{ij} \tag{38}$$

Now if λ_j is increased to λ_j^*,

$$\lambda_j^* > \lambda_j \tag{39}$$

so that R_{ij} falls into the OK region, i.e.,

$$\lambda_j^* > \frac{\bar{A}_{ij} - R_{ij} + \bar{\Delta}_j}{\sigma_j} > \lambda_j \tag{40}$$

then the LR rule must assign to the corresponding M_{ij}^* the value dictated by Eq. (10a), namely

$$\text{LR:} \quad M_{ij}^* = R_{ij} \tag{41}$$

From Eq. (38), however,

$$M_{ij} > R_{ij} = M_{ij}^* \qquad \lambda_j > \lambda_j^* \tag{42}$$

Thus, the possibility in the LR rule of a reduced allocation with increased λ_j is demonstrated.

Finally, we show that the LR and CR rules can produce higher manpower assignments than the MAX rule, as well as assignments that are less than the MIN rule.

I. LR and CR greater than MAX.

According to Eq. (8), the MAX rule assigns to M_{ij}

$$\text{MAX:} \quad M_{ij} = \max [\, \bar{A}_{ij},\ R_{ij} \,] \tag{43}$$

By Eq. (10b) or (11b), the LR or CR rule can assign values as big as

$$\text{LR / CR:} \quad M_{ij} = \max [\, 0,\ \bar{A}_{ij} + \bar{\Delta}_j + \lambda_j\sigma_j \,] \tag{44}$$

In order for this result to be bigger than that for MAX, the right-hand argument must be greater than the larger of the two arguments in Eq. (43). Thus, we need only pick λ_j such that

$$\lambda_j > \max \left[-\frac{\bar{\Delta}_j}{\sigma_j},\ \frac{R_{ij} - \bar{A}_{ij} - \bar{\Delta}_j}{\sigma_j} \right] \tag{45}$$

for any $i = 1,2,\ldots,I$ and $j = 1,2,\ldots,J$.

II. LR and CR greater than or equal to MIN

To demonstrate this, we need only consider the case in which R_{ij} and $\bar{A}_{ij}$ both lie in the HIGH region. According to Eqs. (10b) and (11b) of the LR and CR rules, the HIGH region is defined by

$$R_{ij} > \bar{A}_{ij} + \bar{\Delta}_j + \lambda_j\sigma_j \tag{46}$$

Since $\bar{\Delta}_j$ is the weighted average manning change in category j, it can assume negative values as is clear from the following restatement of Eq. (3):

$$\bar{\Delta}_j = \frac{1}{C}\sum_{i=1}^{I} c_i(R_{ij} - \bar{A}_{ij}) \qquad j = 1,2,\ldots,J \tag{47}$$

Thus, there exist $\bar{A}_{ij}$ such that

$$\bar{A}_{ij} > \bar{A}_{ij} + \bar{\Delta}_j + \lambda_j\sigma_j \tag{48}$$

whenever

$$\bar{\Delta}_j < 0 \tag{49}$$

and λ_j is restricted to

$$\lambda_j < -\frac{\bar{\Delta}_j}{\sigma_j} \tag{50}$$

Hence, $\bar{A}_{ij}$ and R_{ij} can simultaneously lie in the HIGH region. We can now identify two possibilities corresponding to $\bar{A}_{ij}$ either smaller or larger than R_{ij} in the HIGH region. If we consider the nontrivial case in which the edge of the HIGH region is greater than zero, then

$$\bar{A}_{ij} + \bar{\Delta}_j + \lambda_j\sigma_j > 0 \qquad (51)$$

With $\bar{A}_{ij} < R_{ij}$, the MIN rule assigns to M_{ij}:

MIN: $$M_{ij} = \min [\ \bar{A}_{ij}, R_{ij}\ ] = \bar{A}_{ij} \qquad (52)$$

The LR and CR rules assign, in view of Eq. (51),

LR / CR: $$M_{ij} = \max [\ 0, \bar{A}_{ij} + \bar{\Delta}_j + \lambda_j\sigma_j\ ] = \bar{A}_{ij} + \bar{\Delta}_j + \lambda_j\sigma_j \qquad (53)$$

But from Eq. (48) we have

LR / CR: $$M_{ij} = \bar{A}_{ij} + \bar{\Delta}_j + \lambda_j\sigma_j < \bar{A}_{ij} \qquad (54)$$

which is less than the MIN assignment. For $R_{ij} < \bar{A}_{ij}$ we can invoke Eq. (46) to demonstrate the same thing. The case $\bar{A}_{ij} = R_{ij}$ of course gives equality to the M_{ij} resulting from the MIN, LR, and CR rules.

Appendix E

MANPOWER ESTIMATES DETAILED BY POST CATEGORY, INSTITUTION, AND DECISION RULE

Table E-1

MANPOWER ALLOCATIONS:
DECISION RULE - LR/VARIABILITY THRESHOLD - $0.5\sigma_j$

POST CATEGORIES	BRX	BRK	BRQ	WOM	MAN	QNS	ARS	TOTAL
I	98.5	99.6	75.1	116.0	121.0	64.3	183.2	757.7
II	25.2	52.8	33.3	19.9	33.7	56.4	41.2	262.6
III	61.6	83.8	54.2	88.5	100.8	60.8	197.6	647.3
TOTAL	185.3	236.2	162.6	224.4	255.5	181.5	422.0	1667.5
POST SUBCATEGORIES								
I- 1	85.4	90.4	62.4	105.5	107.7	50.2	159.2	660.8
I- 2	7.5	3.2	6.2	.3	4.2	6.4	4.9	32.7
I- 3	5.6	6.0	6.5	10.2	9.1	7.7	19.1	64.1
II- 1	13.9	14.6	13.9	8.9	19.1	19.4	14.6	104.4
II- 2	.9	1.4	3.1	.9	.9	.9	3.9	11.9
II- 3	.0	13.1	3.4	.0	.0	14.9	1.3	32.6
II- 4	10.4	23.8	12.9	9.0	13.7	21.2	19.5	110.6
II- 5	.0	.0	.0	1.2	.0	.0	1.9	3.1
III- 1	.0	.0	1.4	1.5	.0	.0	9.1	11.9
III- 2	5.0	6.5	5.0	6.7	6.0	7.4	11.8	48.3
III- 3	10.5	14.4	3.6	14.7	30.9	8.6	15.6	98.3
III- 4	4.0	7.5	1.2	4.3	7.4	4.8	4.3	33.5
III- 5	.1	1.2	1.2	.2	1.2	1.2	.1	5.1
III- 6	19.1	21.6	13.6	19.6	18.9	16.6	43.2	152.4
III- 7	14.1	20.7	19.7	17.9	24.2	12.9	42.6	152.0
III- 8	1.6	1.2	.0	4.9	.0	1.2	4.8	13.7
III- 9	.4	.0	1.7	1.4	.6	.0	1.4	5.5
III-10	1.4	1.2	3.4	2.5	1.7	1.7	5.3	17.2
III-11	1.4	1.5	.7	.0	.7	1.4	1.2	6.9
III-12	.6	.0	.0	1.2	1.8	.0	1.2	4.9
III-13	.6	3.1	.6	1.9	2.9	3.0	2.4	14.3
III-14	.8	.4	.0	.3	.0	.0	.0	1.5
III-15	.0	1.8	.3	.0	2.4	.0	3.7	8.3
III-16	.1	.7	.1	1.8	.1	.1	1.2	3.9
III-17	.1	.1	.1	.1	.1	.1	4.8	5.3
III-18	.0	.0	.0	5.4	.0	.0	.0	5.4
III-19	.0	.0	.0	2.4	.0	.0	.0	2.4
III-20	1.9	1.9	1.9	1.9	1.9	1.9	45.0	56.3

Table E-2

SUMMARY OF REQUESTS IN HIGH OR LOW REGIONS*
DECISION RULE - LR/VARIABILITY THRESHOLD - $0.5\sigma_j$

POST SUBCATEGORIES	INSTITUTION BRX	BRK	BRQ	WOM	MAN	QNS	ARS
I- 1			+	+	+		-
I- 2	+	-		-	-	+	
I- 3	-	-		+	-		+
II- 1			+	+		+	
II- 2	-		+	-	-	-	+
II- 3		+				+	-
II- 4	-	-			-	-	+
II- 5	+	+	+		+	+	-
III- 1		+	+	-	+	+	-
III- 2		-			-	-	+
III- 3			+		+	+	-
III- 4	+	-		+	-		
III- 5	-			+			-
III- 6	-		-	-	-	-	+
III- 7		+	+	+			-
III- 8	+			-			
III- 9	+				-		
III-10				+			
III-11		-	+		+		
III-12	+	-	-		+	-	-
III-13	-	+	-	-	-	+	
III-14	+	-		+			
III-15		+	-		+		-
III-16		+	-	+	-	-	
III-17	-	-	-	-	-	-	+
III-18				-			
III-19				-			
III-20	-	-	-	-	-	-	+

*Those requests which occurred in the HIGH and LOW regions for the stated decision rule and variability threshold are indicated by "+" and "-", respectively.

Table E-3

MANPOWER ALLOCATIONS:
DECISION RULE - LR/VARIABILITY THRESHOLD - $1.0\sigma_j$

POST CATEGORIES	BRX	BRK	BRQ	WOM	MAN	QNS	ARS	TOTAL
I	98.6	98.8	76.0	135.3	139.7	66.2	165.4	781.0
II	23.3	56.9	37.1	19.8	30.0	62.2	42.6	271.8
III	50.8	86.2	49.0	80.3	95.3	52.9	204.8	619.2
TOTAL	172.7	241.9	164.1	235.4	263.9	181.2	412.7	1672.0

POST SUBCATEGORIES	BRX	BRK	BRQ	WOM	MAN	QNS	ARS	TOTAL
I- 1	85.4	90.4	65.3	125.0	127.2	50.2	139.7	683.2
I- 2	9.4	2.9	6.2	.0	4.1	8.3	4.9	35.7
I- 3	3.9	5.5	6.5	10.3	7.3	7.7	20.8	62.0
II- 1	13.9	14.6	16.6	9.6	19.1	22.1	14.6	110.6
II- 2	.0	1.4	4.2	.0	.0	.0	5.0	10.6
II- 3	.0	19.8	3.4	.0	.0	21.6	.0	44.8
II- 4	9.4	21.1	12.9	9.0	10.9	18.4	22.3	104.1
II- 5	.0	.0	.0	1.2	.0	.0	.6	1.8
III- 1	.0	.0	2.8	.1	.0	.0	7.9	10.7
III- 2	5.0	5.3	5.0	6.7	5.0	6.2	13.0	46.1
III- 3	10.5	14.4	6.8	14.7	34.2	11.8	12.4	104.9
III- 4	5.6	7.2	1.2	5.8	6.0	4.8	4.3	34.9
III- 5	.0	1.2	1.2	.8	1.2	1.2	.0	5.6
III- 6	7.9	21.6	3.4	8.4	13.6	8.1	54.4	117.3
III- 7	14.1	25.1	22.4	22.3	24.2	12.9	40.0	160.9
III- 8	2.4	1.2	.0	3.8	.0	1.2	4.8	13.4
III- 9	.7	.0	1.7	1.4	.3	.0	1.4	5.5
III-10	1.4	1.2	3.4	5.0	1.7	1.7	5.3	19.7
III-11	1.4	1.4	1.1	.0	1.1	1.4	1.2	7.5
III-12	.9	.0	.0	1.2	2.1	.0	1.2	5.4
III-13	.0	3.7	.0	1.7	2.4	3.5	2.4	13.8
III-14	1.0	.1	.0	.6	.0	.0	.0	1.7
III-15	.0	2.9	.0	.0	3.5	.0	2.6	9.0
III-16	.0	1.0	.0	2.1	.0	.0	1.2	4.2
III-17	.0	.0	.0	.0	.0	.0	4.9	4.9
III-18	.0	.0	.0	4.0	.0	.0	.0	4.0
III-19	.0	.0	.0	1.8	.0	.0	.0	1.8
III-20	.0	.0	.0	.0	.0	.0	47.8	47.8

CONTINUED

1 OF 2

Table E-3

MANPOWER ALLOCATIONS:
DECISION RULE - LR/VARIABILITY THRESHOLD - $1.0\sigma_j$

POST CATEGORIES	BRX	BRK	BRQ	WOM	MAN	QNS	ARS	TOTAL
I	98.6	98.8	78.0	155.3	138.7	66.2	165.4	781.0
II	23.3	56.9	37.1	19.8	30.0	62.2	42.6	271.8
III	50.3	86.2	49.0	80.3	95.3	52.9	204.8	619.2
TOTAL	172.7	241.9	164.1	235.4	263.9	181.2	412.7	1672.0

POST SUBCATEGORIES	BRX	BRK	BRQ	WOM	MAN	QNS	ARS	TOTAL
I- 1	85.4	90.4	65.3	125.0	127.2	50.2	139.7	683.2
I- 2	9.4	2.9	6.2	.0	4.1	8.3	4.9	35.7
I- 3	3.9	5.5	6.5	10.3	7.3	7.7	20.8	62.0
II- 1	13.9	14.6	16.6	9.6	19.1	22.1	14.6	110.6
II- 2	.0	1.4	4.2	.0	.0	.0	5.0	10.6
II- 3	.0	19.8	3.4	.0	.0	21.6	.0	44.8
II- 4	9.4	21.1	12.9	9.0	10.9	18.4	22.3	104.1
II- 5	.0	.0	.0	1.2	.0	.0	.6	1.8
III- 1	.0	.0	2.8	.1	.0	.0	7.9	10.7
III- 2	5.0	5.3	5.0	6.7	5.0	6.2	13.0	46.1
III- 3	10.5	14.4	6.8	14.7	34.2	11.8	12.4	104.9
III- 4	5.6	7.2	1.2	5.8	6.0	4.8	4.3	34.9
III- 5	.0	1.2	1.2	.8	1.2	1.2	.0	5.6
III- 6	7.9	21.6	3.4	8.4	13.6	8.1	54.4	117.3
III- 7	14.1	25.1	22.4	22.3	24.2	12.9	40.0	160.9
III- 8	2.4	1.2	.0	3.8	.0	1.2	4.8	13.4
III- 9	.7	.0	1.7	1.4	.3	.0	1.4	5.5
III-10	1.4	1.2	3.4	5.0	1.7	1.7	5.3	19.7
III-11	1.4	1.4	1.1	.0	1.1	1.4	1.2	7.5
III-12	.9	.0	.0	1.2	2.1	.0	1.2	5.4
III-13	.0	3.7	.0	1.7	2.4	3.5	2.4	13.8
III-14	1.0	.1	.0	.6	.0	.0	.0	1.7
III-15	.0	2.9	.0	.0	3.5	.0	2.6	9.0
III-16	.0	1.0	.0	2.1	.0	.0	1.2	4.2
III-17	.0	.0	.0	.0	.0	.0	4.9	4.9
III-18	.0	.0	.0	4.0	.0	.0	.0	4.0
III-19	.0	.0	.0	1.8	.0	.0	.0	1.8
III-20	.0	.0	.0	.0	.0	.0	47.8	47.8

Table E-4

SUMMARY OF REQUESTS IN HIGH OR LOW REGIONS*
DECISION RULE - LR/VARIABILITY THRESHOLD - $1.0\sigma_j$

POST SUBCATEGORIES	INSTITUTION BRX	BRK	BRQ	WOM	MAN	QNS	ARS
I- 1				+	+		-
I- 2	+					+	
I- 3	-				-		+
II- 1			+			+	
II- 2			+				
II- 3		+				+	
II- 4					-	-	+
II- 5		+	+			+	-
III- 1			+	-			
III- 2		-				-	+
III- 3			+		+	+	-
III- 4	+			+			
III- 5				+			
III- 6	-			-			+
III- 7		+		+			
III- 8				-			
III- 9	+				-		
III-10				+			
III-11			+		+		
III-12	+				+		
III-13		+				+	
III-14		-		+			
III-15		+			+		-
III-16		+		+			
III-17							+
III-18				-			
III-19				-			
III-20							+

*Those requests which occurred in the HIGH and LOW regions for the stated decision rule and variability threshold are indicated by "+" and "-", respectively.

Table E-5

MANPOWER ALLOCATIONS:
DECISION RULE - LR/VARIABILITY THRESHOLD - $1.5\sigma_j$

POST CATEGORIES	BRX	BRK	BRQ	WOM	MAN	QNS	ARS	TOTAL
I	98.8	98.8	78.0	143.3	156.4	68.0	164.1	807.5
II	23.3	63.6	40.5	19.8	29.4	64.2	43.8	284.6
III	51.8	90.3	51.6	85.2	97.6	54.2	210.9	641.5
TOTAL	173.9	252.7	170.0	248.3	283.4	186.4	418.8	1733.5

POST SUBCATEGORIES	BRX	BRK	BRQ	WOM	MAN	QNS	ARS	TOTAL
I- 1	85.4	90.4	65.3	133.0	146.8	50.2	137.9	709.0
I- 2	9.6	2.9	6.2	.0	4.1	10.1	4.9	37.8
I- 3	3.8	5.5	6.5	10.3	5.6	7.7	21.3	60.7
II- 1	13.9	14.6	19.4	9.6	19.1	24.9	14.6	116.0
II- 2	.0	1.4	4.8	.0	.0	.0	5.0	11.2
II- 3	.0	26.5	3.4	.0	.0	21.8	.0	51.7
II- 4	9.4	21.1	12.9	9.0	10.3	17.5	24.2	104.4
II- 5	.0	.0	.0	1.2	.0	.0	.0	1.2
III- 1	.0	.0	3.4	.0	.0	.0	7.9	11.3
III- 2	5.0	5.0	5.0	6.7	5.0	5.0	13.4	45.1
III- 3	10.5	14.4	8.4	14.7	35.1	14.1	11.8	109.0
III- 4	7.1	7.2	1.2	7.2	6.0	4.8	4.3	37.8
III- 5	.0	1.2	1.2	1.5	1.2	1.2	.0	6.3
III- 6	6.7	21.6	3.4	7.0	13.6	8.1	58.9	119.3
III- 7	14.1	28.2	22.4	26.6	24.2	12.9	40.0	168.4
III- 8	2.4	1.2	.0	2.8	.0	1.2	4.8	12.4
III- 9	1.0	.0	1.7	1.4	.0	.0	1.4	5.5
III-10	1.4	1.2	3.4	7.5	1.7	1.7	5.3	22.2
III-11	1.4	1.4	1.5	.0	1.4	1.4	1.2	8.3
III-12	1.2	.0	.0	1.2	2.4	.0	1.2	6.0
III-13	.0	4.1	.0	1.7	2.4	3.8	2.4	14.4
III-14	1.0	.0	.0	.9	.0	.0	.0	1.9
III-15	.0	3.6	.0	.0	4.6	.0	2.4	10.6
III-16	.0	1.2	.0	2.4	.0	.0	1.2	4.8
III-17	.0	.0	.0	.0	.0	.0	5.0	5.0
III-18	.0	.0	.0	2.5	.0	.0	.0	2.5
III-19	.0	.0	.0	1.1	.0	.0	.0	1.1
III-20	.0	.0	.0	.0	.0	.0	49.7	49.7

Table E-6

SUMMARY OF REQUESTS IN HIGH OR LOW REGIONS*
DECISION RULE - LR/VARIABILITY THRESHOLD - $1.5\sigma_j$

POST SUBCATEGORIES	INSTITUTION BRX	BRK	BRQ	WOM	MAN	QNS	ARS
I- 1					+		
I- 2						+	
I- 3					-		
II- 1			+			+	
II- 2							
II- 3		+					
II- 4							
II- 5							
III- 1							
III- 2							
III- 3							
III- 4	+						
III- 5				+			
III- 6							
III- 7				+			
III- 8				-			
III- 9	+				-		
III-10				+			
III-11			+				
III-12	+				+		
III-13							
III-14				+			
III-15					+		
III-16				+			
III-17							
III-18				-			
III-19				-			
III-20							

*Those requests which occurred in the HIGH and LOW regions for the stated decision rule and variability threshold are indicated by "+" and "-", respectively.

Table E-7

MANPOWER ALLOCATIONS:
DECISION RULE - LR/VARIABILITY THRESHOLD - $2.0\sigma_j$

POST CATEGORIES	BRX	BRK	BRQ	WOM	MAN	QNS	ARS	TOTAL
I	98.8	98.8	78.0	143.3	164.6	69.6	164.1	817.2
II	23.3	70.1	41.2	19.8	29.4	64.4	43.8	292.0
III	52.1	90.3	51.8	86.5	97.8	54.2	210.9	643.6
TOTAL	174.2	259.2	171.0	249.6	291.8	188.2	418.8	1752.8
POST SUBCATEGORIES								
I- 1	85.4	90.4	65.3	133.0	155.7	50.2	137.9	717.9
I- 2	9.6	2.9	6.2	.0	4.1	11.7	4.9	39.4
I- 3	3.8	5.5	6.5	10.3	4.8	7.7	21.3	59.9
II- 1	13.9	14.6	20.1	9.6	19.1	25.1	14.6	117.0
II- 2	.0	1.4	4.8	.0	.0	.0	5.0	11.2
II- 3	.0	33.0	3.4	.0	.0	21.8	.0	58.2
II- 4	9.4	21.1	12.9	9.0	10.3	17.5	24.2	104.4
II- 5	.0	.0	.0	1.2	.0	.0	.0	1.2
III- 1	.0	.0	3.4	.0	.0	.0	7.9	11.3
III- 2	5.0	5.0	5.0	6.7	5.0	5.0	13.4	45.1
III- 3	10.5	14.4	8.4	14.7	35.1	14.1	11.8	109.0
III- 4	7.2	7.2	1.2	7.2	6.0	4.8	4.3	37.9
III- 5	.0	1.2	1.2	2.1	1.2	1.2	.0	6.9
III- 6	6.7	21.6	3.4	7.0	13.6	8.1	58.9	119.3
III- 7	14.1	28.2	22.4	27.6	24.2	12.9	40.0	169.4
III- 8	2.4	1.2	.0	1.8	.0	1.2	4.8	11.4
III- 9	1.2	.0	1.7	1.4	.0	.0	1.4	5.7
III-10	1.4	1.2	3.4	10.0	1.7	1.7	5.3	24.7
III-11	1.4	1.4	1.7	.0	1.4	1.4	1.2	8.5
III-12	1.2	.0	.0	1.2	2.4	.0	1.2	6.0
III-13	.0	4.1	.0	1.7	2.4	3.8	2.4	14.4
III-14	1.0	.0	.0	1.2	.0	.0	.0	2.2
III-15	.0	3.6	.0	.0	4.8	.0	2.4	10.8
III-16	.0	1.2	.0	2.4	.0	.0	1.2	4.8
III-17	.0	.0	.0	.0	.0	.0	5.0	5.0
III-18	.0	.0	.0	1.1	.0	.0	.0	1.1
III-19	.0	.0	.0	.4	.0	.0	.0	.4
III-20	.0	.0	.0	.0	.0	.0	49.7	49.7

Table E-8

SUMMARY OF REQUESTS IN HIGH OR LOW REGIONS*
DECISION RULE - LR/VARIABILITY THRESHOLD - $2.0\sigma_j$

POST SUBCATEGORIES	INSTITUTION BRX	BRK	BRQ	WOM	MAN	QNS	ARS
I- 1							
I- 2							
I- 3							
II- 1							
II- 2							
II- 3							
II- 4							
II- 5							
III- 1							
III- 2							
III- 3							
III- 4							
III- 5							
III- 6				+			
III- 7							
III- 8							
III- 9				-			
III-10							
III-11				+			
III-12							
III-13							
III-14							
III-15				+			
III-16							
III-17							
III-18							
III-19				-			
III-20				-			

*Those requests which occurred in the HIGH and LOW regions for the stated decision rule and variability threshold are indicated by "+" and "-", respectively.

Table E-9

MANPOWER ALLOCATIONS:
DECISION RULE - CR/VARIABILITY THRESHOLD - $0.5\sigma_j$

POST CATEGORIES	BRX	BRK	BRQ	WOM	MAN	QNS	ARS	TOTAL
I	96.7	98.8	75.1	115.7	116.6	64.3	161.9	729.1
II	23.3	50.2	33.3	19.1	29.4	51.8	38.0	245.0
III	46.5	79.5	41.2	61.0	89.9	47.9	188.6	554.7
TOTAL	166.5	228.5	149.6	195.8	236.0	164.0	388.5	1528.8

POST SUBCATEGORIES	BRX	BRK	BRQ	WOM	MAN	QNS	ARS	TOTAL
I- 1	85.4	90.4	62.4	105.5	107.7	50.2	137.9	639.5
I- 2	7.5	2.9	6.2	.0	4.1	6.4	4.9	32.0
I- 3	3.8	5.5	6.5	10.2	4.8	7.7	19.1	57.6
II- 1	13.9	14.6	13.9	8.9	19.1	19.4	14.6	104.4
II- 2	.0	1.4	3.1	.0	.0	.0	3.9	8.4
II- 3	.0	13.1	3.4	.0	.0	14.9	.0	31.3
II- 4	9.4	21.1	12.9	9.0	10.3	17.5	19.5	99.7
II- 5	.0	.0	.0	1.2	.0	.0	.0	1.2
III- 1	.0	.0	1.4	.0	.0	.0	7.9	9.3
III- 2	5.0	5.0	5.0	6.7	5.0	5.0	11.8	43.5
III- 3	10.5	14.4	3.6	14.7	30.9	8.6	11.8	94.5
III- 4	4.0	7.2	1.2	4.3	6.0	4.8	4.3	31.8
III- 5	.0	1.2	1.2	.2	1.2	1.2	.0	5.0
III- 6	6.7	21.6	3.4	7.0	13.6	8.1	43.2	103.6
III- 7	14.1	20.7	19.7	17.9	24.2	12.9	40.0	149.5
III- 8	1.6	1.2	.0	1.4	.0	1.2	4.8	10.2
III- 9	.4	.0	1.7	1.4	.0	.0	1.4	4.9
III-10	1.4	1.2	3.4	2.5	1.7	1.7	5.3	17.2
III-11	1.4	1.4	.7	.0	.7	1.4	1.2	6.7
III-12	.6	.0	.0	1.2	1.8	.0	1.2	4.8
III-13	.0	3.1	.0	1.7	2.4	3.0	2.4	12.6
III-14	.8	.0	.0	.3	.0	.0	.0	1.2
III-15	.0	1.8	.0	.0	2.4	.0	2.4	6.7
III-16	.0	.7	.0	1.8	.0	.0	1.2	3.6
III-17	.0	.0	.0	.0	.0	.0	4.8	4.8
III-18	.0	.0	.0	.0	.0	.0	.0	.0
III-19	.0	.0	.0	.0	.0	.0	.0	.0
III-20	.0	.0	.0	.0	.0	.0	45.0	45.0

Table E-10

SUMMARY OF REQUESTS IN HIGH OR LOW REGIONS*
DECISION RULE - CR/VARIABILITY THRESHOLD - $0.5\sigma_j$

POST SUBCATEGORIES	INSTITUTION						
	BRX	BRK	BRQ	WOM	MAN	QNS	ARS
I- 1			+	+	+		-
I- 2	+	-		-	-	+	
I- 3	-	-		+	-		+
II- 1			+	+		+	
II- 2	-		+	-	-	-	+
II- 3		+				+	-
II- 4	-	-			-	-	+
II- 5	+	+	+		+	+	-
III- 1		+	+	-	+	+	-
III- 2		-			-	-	+
III- 3			+		+	+	-
III- 4	+	-		+	-		
III- 5	-			+			-
III- 6	-		-	-	-	-	+
III- 7		+	+	+			-
III- 8	+			-			
III- 9	+				-		
III-10				+			
III-11		-	+		+		
III-12	+	-	-		+	-	-
III-13	-	+	-	-	-	+	
III-14	+	-		+			
III-15		+	-		+		-
III-16	-	+	-	+		-	
III-17	-	-	-	-	-	-	+
III-18				-			
III-19				-			
III-20	-	-	-	-	-	-	+

*Those requests which occurred in the HIGH and LOW regions for the stated decision rule and variability threshold are indicated by "+" and "-", respectively.

Table E-11

MANPOWER ALLOCATIONS:
DECISION RULE - CR/VARIABILITY THRESHOLD - $1.0\sigma_j$

POST CATEGORIES	BRX	BRK	BRQ	WOM	MAN	QNS	ARS	TOTAL
I	98.6	98.8	78.0	135.3	136.1	66.2	163.6	776.6
II	23.3	56.9	37.1	19.8	29.4	61.2	41.9	269.7
III	49.6	85.8	49.0	70.7	95.0	51.5	204.0	605.3
TOTAL	171.5	241.5	164.1	225.8	260.5	179.2	409.5	1652.1

POST SUBCATEGORIES	BRX	BRK	BRQ	WOM	MAN	QNS	ARS	TOTAL
I- 1	85.4	90.4	65.3	125.0	127.2	50.2	137.9	631.4
I- 2	9.4	2.9	6.2	.0	4.1	8.3	4.9	35.7
I- 3	3.8	5.5	6.5	10.3	4.8	7.7	20.8	59.4
II- 1	13.9	14.6	16.6	9.6	19.1	22.1	14.6	110.6
II- 2	.0	1.4	4.2	.0	.0	.0	5.0	10.6
II- 3	.0	19.8	3.4	.0	.0	21.6	.0	44.8
II- 4	9.4	21.1	12.9	9.0	10.5	17.5	22.3	102.5
II- 5	.0	.0	.0	1.2	.0	.0	.0	1.2
III- 1	.0	.0	2.8	.0	.0	.0	7.9	10.7
III- 2	5.0	5.0	5.0	6.7	5.0	5.0	13.0	44.7
III- 3	10.5	14.4	6.8	14.7	34.2	11.8	11.8	104.3
III- 4	5.6	7.2	1.2	5.8	6.0	4.8	4.3	34.9
III- 5	.0	1.2	1.2	.8	1.2	1.2	.0	5.6
III- 6	6.7	21.6	3.4	7.0	13.6	8.1	54.4	114.8
III- 7	14.1	25.1	22.4	22.3	24.2	12.9	40.0	160.9
III- 8	2.4	1.2	.0	1.4	.0	1.2	4.8	11.0
III- 9	.7	.0	1.7	1.4	.0	.0	1.4	5.2
III-10	1.4	1.2	3.4	5.0	1.7	1.7	5.3	19.7
III-11	1.4	1.4	1.1	.0	1.1	1.4	1.2	7.5
III-12	.9	.0	.0	1.2	2.1	.0	1.2	5.4
III-13	.0	3.7	.0	1.7	2.4	3.6	2.4	13.8
III-14	1.0	.0	.0	.6	.0	.0	.0	1.6
III-15	.0	2.9	.0	.0	3.5	.0	2.4	8.8
III-16	.0	1.0	.0	2.1	.0	.0	1.2	4.2
III-17	.0	.0	.0	.0	.0	.0	4.9	4.9
III-18	.0	.0	.0	.0	.0	.0	.0	.0
III-19	.0	.0	.0	.0	.0	.0	.0	.0
III-20	.0	.0	.0	.0	.0	.0	47.8	47.8

Table E-12

SUMMARY OF REQUESTS IN HIGH OR LOW REGIONS*
DECISION RULE - CR/VARIABILITY THRESHOLD - $1.0\sigma_j$

POST SUBCATEGORIES	INSTITUTION						
	BRX	BRK	BRQ	WOM	MAN	QNS	ARS
I- 1				+	+		-
I- 2	+					+	
I- 3	-				-		+
II- 1			+			+	
II- 2			+				
II- 3		+				+	
II- 4					-	-	+
II- 5		+	+			+	-
III- 1			+	-			
III- 2		-				-	+
III- 3			+		+	+	-
III- 4	+			+			
III- 5				+			
III- 6	-			-			+
III- 7		+		+			
III- 8				-			
III- 9	+				-		
III-10				+			
III-11			+		+		
III-12	+				+		
III-13		+				+	
III-14		-		+			
III-15		+			+		-
III-16		+		+			
III-17							+
III-18				-			
III-19				-			
III-20							+

*Those requests which occurred in the HIGH and LOW regions for the stated decision rule and variability threshold are indicated by "+" and "-", respectively.

Table E-13

MANPOWER ALLOCATIONS:
DECISION RULE - CR/VARIABILITY THRESHOLD - 1.5σ_j

POST CATEGORIES	BRX	BRK	BRQ	WOM	MAN	QNS	ARS	TOTAL
I	98.8	95.8	78.0	143.3	155.7	63.0	164.1	806.7
II	23.3	63.6	40.5	19.8	29.4	64.2	43.8	284.6
III	51.8	90.3	51.6	80.1	97.5	54.2	210.9	636.4
TOTAL	173.9	252.7	170.0	243.2	282.6	186.4	413.8	1727.7

POST SUBCATEGORIES	BRX	BRK	BRQ	WOM	MAN	QNS	ARS	TOTAL
I- 1	85.4	90.4	65.3	133.0	146.8	50.2	137.9	709.0
I- 2	9.6	2.9	6.2	.0	4.1	10.1	4.9	37.8
I- 3	3.8	5.5	6.5	10.3	4.8	7.7	21.3	59.9
II- 1	13.9	14.6	19.4	9.6	19.1	24.9	14.6	116.0
II- 2	.0	1.4	4.8	.0	.0	.0	5.0	11.2
II- 3	.0	26.5	3.4	.0	.0	21.8	.0	51.7
II- 4	9.4	21.1	12.9	9.0	10.3	17.5	24.2	104.4
II- 5	.0	.0	.0	1.2	.0	.0	.0	1.2
III- 1	.0	.0	3.4	.0	.0	.0	7.9	11.3
III- 2	5.0	5.0	5.0	6.7	5.0	5.0	13.4	45.1
III- 3	10.5	14.4	8.4	14.7	35.1	14.1	11.8	109.0
III- 4	7.1	7.2	1.2	7.2	6.0	4.8	4.3	37.8
III- 5	.0	1.2	1.2	1.5	1.2	1.2	.0	6.3
III- 6	6.7	21.6	3.4	7.0	13.6	8.1	58.9	119.3
III- 7	14.1	28.2	22.4	26.6	24.2	12.9	40.0	168.4
III- 8	2.4	1.2	.0	1.4	.0	1.2	4.8	11.0
III- 9	1.0	.0	1.7	1.4	.0	.0	1.4	5.5
III-10	1.4	1.2	3.4	7.5	1.7	1.7	5.3	22.2
III-11	1.4	1.4	1.5	.0	1.4	1.4	1.2	8.3
III-12	1.2	.0	.0	1.2	2.4	.0	1.2	6.0
III-13	.0	4.1	.0	1.7	2.4	3.8	2.4	14.4
III-14	1.0	.0	.0	.9	.0	.0	.0	1.9
III-15	.0	3.6	.0	.0	4.6	.0	2.4	10.6
III-16	.0	1.2	.0	2.4	.0	.0	1.2	4.8
III-17	.0	.0	.0	.0	.0	.0	5.0	5.0
III-18	.0	.0	.0	.0	.0	.0	.0	.0
III-19	.0	.0	.0	.0	.0	.0	.0	.0
III-20	.0	.0	.0	.0	.0	.0	49.7	49.7

Table E-14

SUMMARY OF REQUESTS IN HIGH OR LOW REGIONS*
DECISION RULE - CR/VARIABILITY THRESHOLD - 1.5σ_j

POST SUBCATEGORIES	BRX	BRK	BRQ	WOM	MAN	QNS	ARS
				INSTITUTION			
I- 1					+		
I- 2						+	
I- 3					-		
II- 1			+			+	
II- 2							
II- 3		+					
II- 4							
II- 5							
III- 1							
III- 2							
III- 3							
III- 4	+						
III- 5				+			
III- 6							
III- 7				+			
III- 8				-			
III- 9	+				-		
III-10				+			
III-11			+				
III-12	+				+		
III-13							
III-14				+			
III-15					+		
III-16				+			
III-17							
III-18				-			
III-19				-			
III-20							

*Those requests which occurred in the HIGH and LOW regions for the stated decision rule and variability threshold are indicated by "+" and "-", respectively.

Table E-15

MANPOWER ALLOCATIONS:
DECISION RULE - CR/VARIABILITY THRESHOLD - 2.0σ_j

POST CATEGORIES	BRX	BRK	BRQ	WOM	MAN	QNS	ARS	TOTAL
I	98.8	98.8	78.0	143.3	164.6	69.6	164.1	817.2
II	23.3	70.1	41.2	19.8	29.4	64.4	43.8	292.0
III	52.1	90.3	51.8	84.6	97.8	54.2	210.9	641.7
TOTAL	174.2	259.2	171.0	247.7	291.8	188.2	418.8	1750.9

POST SUBCATEGORIES	BRX	BRK	BRQ	WOM	MAN	QNS	ARS	TOTAL
I- 1	85.4	90.4	65.3	133.0	155.7	50.2	137.9	717.9
I- 2	9.6	2.9	6.2	.0	4.1	11.7	4.9	39.4
I- 3	3.8	5.5	6.5	10.3	4.8	7.7	21.3	59.9
II- 1	13.9	14.6	20.1	9.6	19.1	25.1	14.6	117.0
II- 2	.0	1.4	4.8	.0	.0	.0	5.0	11.2
II- 3	.0	33.0	3.4	.0	.0	21.8	.0	58.2
II- 4	9.4	21.1	12.9	9.0	10.3	17.5	24.2	104.4
II- 5	.0	.0	.0	1.2	.0	.0	.0	1.2
III- 1	.0	.0	3.4	.0	.0	.0	7.9	11.3
III- 2	5.0	5.0	5.0	6.7	5.0	5.0	13.4	45.1
III- 3	10.5	14.4	8.4	14.7	35.1	14.1	11.8	109.0
III- 4	7.2	7.2	1.2	7.2	6.0	4.8	4.3	37.9
III- 5	.0	1.2	1.2	2.1	1.2	1.2	.0	6.9
III- 6	6.7	21.6	3.4	7.0	13.6	8.1	58.9	119.3
III- 7	14.1	28.2	22.4	27.6	24.2	12.9	40.0	169.4
III- 8	2.4	1.2	.0	1.4	.0	1.2	4.8	11.0
III- 9	1.2	.0	1.7	1.4	.0	.0	1.4	5.7
III-10	1.4	1.2	3.4	10.0	1.7	1.7	5.3	24.7
III-11	1.4	1.4	1.7	.0	1.4	1.4	1.2	8.5
III-12	1.2	.0	.0	1.2	2.4	.0	1.2	6.0
III-13	.0	4.1	.0	1.7	2.4	3.8	2.4	14.4
III-14	1.0	.0	.0	1.2	.0	.0	.0	2.2
III-15	.0	3.6	.0	.0	4.3	.0	2.4	10.8
III-16	.0	1.2	.0	2.4	.0	.0	1.2	4.3
III-17	.0	.0	.0	.0	.0	.0	5.0	5.0
III-18	.0	.0	.0	.0	.0	.0	.0	.0
III-19	.0	.0	.0	.0	.0	.0	.0	.0
III-20	.0	.0	.0	.0	.0	.0	49.7	49.7

Table E-16

SUMMARY OF REQUESTS IN HIGH OR LOW REGIONS*
DECISION RULE - CR/VARIABILITY THRESHOLD - 2.0σ_j

POST SUBCATEGORIES	INSTITUTION BRX	BRK	BRQ	WOM	MAN	QNS	ARS
I- 1							
I- 2							
I- 3							
II- 1							
II- 2							
II- 3							
II- 4							
II- 5							
III- 1							
III- 2							
III- 3							
III- 4							
III- 5				+			
III- 6							
III- 7							
III- 8				-			
III- 9							
III-10				+			
III-11							
III-12							
III-13							
III-14				+			
III-15							
III-16							
III-17							
III-18				-			
III-19				-			
III-20							

*Those requests which occurred in the HIGH and LOW regions for the stated decision rule and variability threshold are indicated by "+" and "-", respectively.

Table E-17

MANPOWER ALLOCATIONS:
DECISION RULE - MAX

POST CATEGORIES	BRX	BRK	BRQ	WOM	MAN	QNS	ARS	TOTAL
I	98.8	102.9	78.0	143.3	166.5	69.6	202.3	861.3
II	23.9	70.1	41.2	22.8	30.0	64.4	51.4	303.7
III	63.5	93.1	53.0	109.6	105.0	56.0	237.1	717.1
TOTAL	186.2	266.0	172.2	275.6	301.5	190.0	490.7	1882.1

POST SUBCATEGORIES	BRX	BRK	BRQ	WOM	MAN	QNS	ARS	TOTAL
I- 1	85.4	94.5	65.3	133.0	155.7	50.2	176.1	760.1
I- 2	9.6	2.9	6.2	.0	4.1	11.7	4.9	39.4
I- 3	3.8	5.5	6.5	10.3	6.7	7.7	21.3	61.8
II- 1	13.9	14.6	20.1	9.6	19.1	25.1	14.6	117.0
II- 2	.0	1.4	4.8	.0	.0	.0	5.0	11.2
II- 3	.0	33.0	3.4	.0	.0	21.8	1.7	59.9
II- 4	9.4	21.1	12.9	9.0	10.3	17.5	24.2	104.4
II- 5	.6	.0	.0	4.2	.6	.0	5.9	11.2
III- 1	1.7	.0	3.4	5.4	.0	.0	13.1	23.6
III- 2	5.0	5.1	5.0	6.7	5.0	5.9	13.4	46.1
III- 3	13.3	14.4	8.4	15.8	35.1	14.1	21.0	122.1
III- 4	7.2	7.8	1.2	7.2	7.8	4.8	4.3	40.3
III- 5	1.2	1.2	1.2	2.4	1.8	1.2	1.2	10.2
III- 6	6.7	21.6	3.4	7.0	13.6	8.1	58.9	119.3
III- 7	17.8	28.2	22.4	27.6	24.3	13.8	46.6	180.7
III- 8	2.4	1.2	.0	6.5	1.2	1.2	5.1	17.6
III- 9	1.2	.0	1.7	1.4	.9	.0	1.4	6.6
III-10	2.4	1.2	3.4	11.8	3.5	1.7	7.0	31.0
III-11	1.6	1.7	1.7	.0	1.4	1.4	1.2	9.0
III-12	1.2	.0	.0	1.2	2.4	.0	1.2	6.0
III-13	.0	4.1	.0	1.7	2.4	3.8	2.4	14.4
III-14	1.0	.6	.0	1.2	.0	.0	.0	2.8
III-15	.0	3.6	1.2	.0	4.8	.0	4.6	14.2
III-16	.0	1.2	.0	2.4	.0	.0	1.2	4.8
III-17	.0	.0	.0	.0	.0	.0	5.0	5.0
III-18	.0	.6	.0	7.7	.6	.0	.0	8.9
III-19	.9	.6	.0	3.6	.3	.0	.0	5.3
III-20	.0	.0	.0	.0	.0	.0	49.7	49.7

Table E-18

MANPOWER ALLOCATIONS:
DECISION RULE - MIN

POST CATEGORIES	BRX	BRK	BRQ	WOM	MAN	QNS	ARS	TOTAL
I	76.9	96.9	44.5	87.6	94.3	56.8	154.4	611.3
II	13.0	27.0	5.7	1.8	21.5	26.2	17.2	112.2
III	38.2	53.2	28.8	44.9	77.4	37.0	138.4	417.8
TOTAL	128.1	177.1	79.0	134.2	193.2	120.0	309.9	1141.3

POST SUBCATEGORIES	BRX	BRK	BRQ	WOM	MAN	QNS	ARS	TOTAL
I- 1	70.2	90.4	40.2	83.3	85.5	50.2	137.9	557.6
I- 2	3.5	2.9	2.4	.0	4.0	2.4	3.4	18.5
I- 3	3.3	3.6	1.9	4.3	4.8	4.2	13.2	35.2
II- 1	10.6	11.2	5.7	.6	15.8	11.2	10.4	65.3
II- 2	.0	.0	.0	.0	.0	.0	.9	.9
II- 3	.0	.0	.0	.0	.0	1.8	.0	1.8
II- 4	2.4	15.8	.0	.0	5.8	13.3	5.9	43.1
II- 5	.0	.0	.0	1.2	.0	.0	.0	1.2
III- 1	.0	.0	2.5	.0	.0	.0	7.9	10.4
III- 2	2.4	5.0	3.4	3.4	4.6	5.0	7.9	31.6
III- 3	10.5	14.0	2.4	14.7	29.8	7.4	11.8	90.6
III- 4	1.2	7.2	1.2	1.5	6.0	2.2	3.3	22.5
III- 5	.0	1.2	1.2	.0	1.2	1.2	.0	4.8
III- 6	5.5	4.1	.0	6.0	5.3	3.0	7.2	31.1
III- 7	14.1	16.1	15.0	13.3	24.2	12.9	40.0	135.5
III- 8	1.2	1.2	.0	1.4	.0	1.2	4.8	9.8
III- 9	.0	.0	1.5	1.2	.0	.0	1.2	3.9
III-10	1.4	1.2	1.7	.0	1.7	1.7	5.3	13.0
III-11	1.4	1.4	.0	.0	.0	1.2	1.2	5.2
III-12	.0	.0	.0	1.1	1.2	.0	1.2	3.5
III-13	.0	1.3	.0	1.3	2.3	1.2	1.2	7.3
III-14	.5	.0	.0	.0	.0	.0	.0	.5
III-15	.0	.6	.0	.0	1.2	.0	2.4	4.2
III-16	.0	.0	.0	1.1	.0	.0	1.0	2.1
III-17	.0	.0	.0	.0	.0	.0	4.4	4.4
III-18	.0	.0	.0	.0	.0	.0	.0	.0
III-19	.0	.0	.0	.0	.0	.0	.0	.0
III-20	.0	.0	.0	.0	.0	.0	37.6	37.6

Appendix F

HISTORICAL DETENTION CENSUS, SECURITY INCIDENT RATES, HOUSING CAPACITY, AND STAFF-TO-INMATE RATIOS: 1967-1969

Institutional manpower quotas at the seven detention facilities operated by the New York City Department of Correction changed little during 1967 and 1969 and remained constant in 1968. Bronx and Branch Queens in particular had no increase in quotas throughout 1967-1969. Fluctuations in the numbers of correctional officers (C.O.'s) actually assigned have also been small during this period, on the order of 3 percent or less of the average quotas or assignments. The numbers assigned have typically been close to and less than the average quotas at each institution.

During this period of essentially constant staffing, the inmate population underwent wide fluctuations, as is evident from Fig. F-1. The average daily census for the seven facilities grew 58 percent between 1967-1968 and 11 percent between 1968-1969; however, the changes at the individual institutions were often appreciably different from these averages (c.f., Tables F-2 and F-3).

These census figures are put in better perspective when compared with the institutional housing capacities of Table F-4. Over the 3 years, the ratios of average daily census to housing capacity were around 1.5, or 50 percent over capacity. The average ratios of maximum daily census to capacity ranged from 1.7 in 1967 to 2.0 in 1969. Bronx had the highest ratio on the basis of both the average and the maximum daily census during 1969. Branch Queens experienced the peak census-to-capacity ratios in 1967 and 1968 and had the highest average census-to-capacity ratio in 1967. The Women's House had the lowest ratio, yet it suffered the greatest growth in average daily population between 1967 and 1968 and had the highest rate of total incidents in 1967 and 1969 (second highest in 1968).

A summary of inmate security incidents that occurred during 1967 through 1969 at the seven detention facilities is given in Table F-5. These are the *reported* security violations of a serious nature which became of record in the Department's log of "Unusual Occurrences." These incident statistics are part of a more comprehensive survey which profiled incidents on the basis of institutional totals, rates, spatial and temporal distributions, as well as several inmate characteristics such as age, arrest

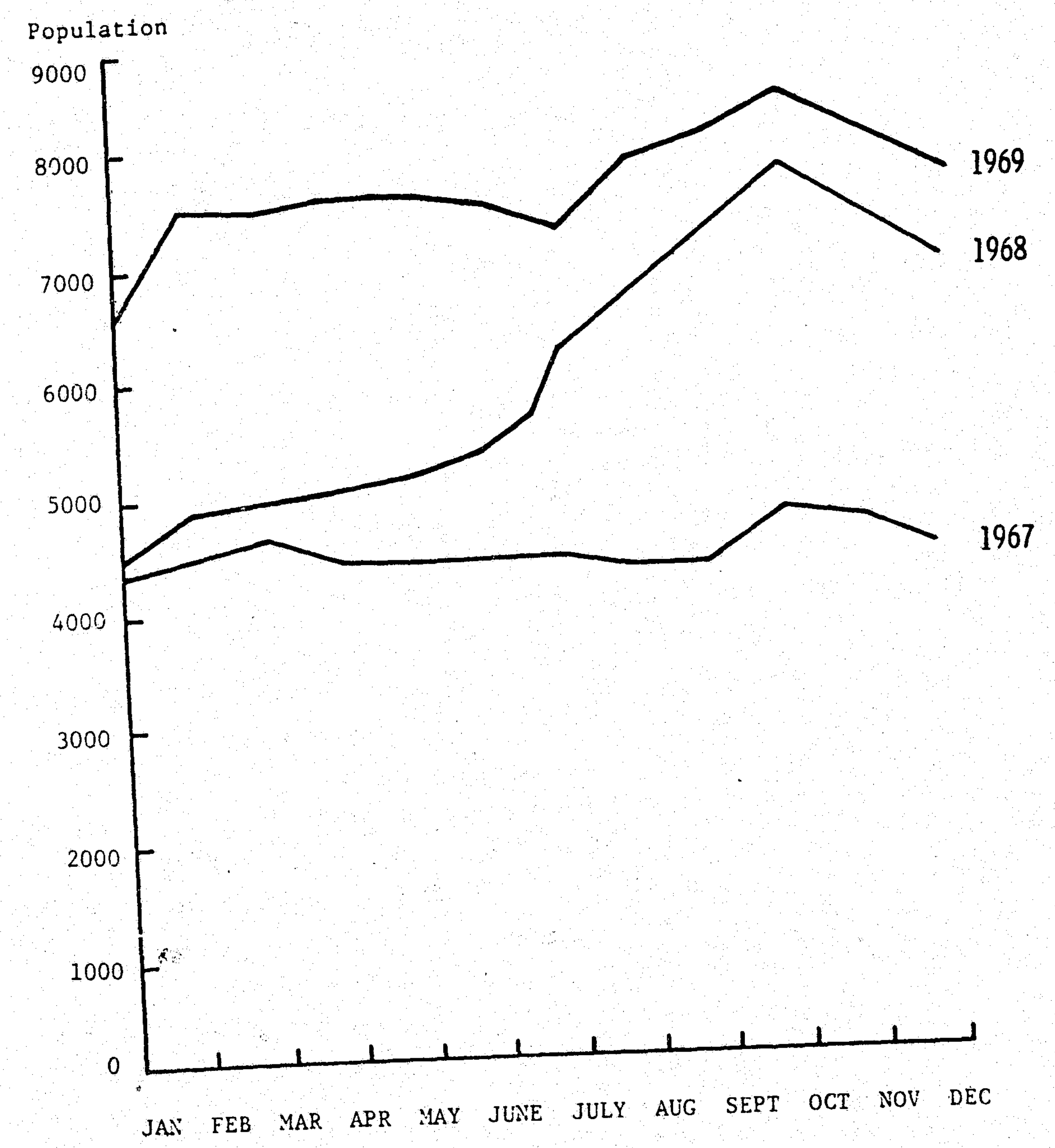

Fig. F-1. Average male detention population by month for 1967-69

Table F-1

SUMMARY STATISTICS

INSTITUTION	BRX	BRK	BRQ	WOM	MAN	QNS	ARS	SUM* TOT.	WTD.** AV.	STD. DEV.
(1) 1969 Quota	137	153	79	178	197	123	262	1129	-	-
(2) 1970 Allocations	141	184	81	161	203	122	382	1274	248	121
(3) 1970 Requests	174	259	169	251	292	189	419	1753	308	108
(4) Difference:(3)-(2)	33	75	88	90	89	67	37	479	-	-
(5) Difference:(2)-(1)	4	31	2	-17	6	-1	120	145	-	-
(6) Ratio: (3)÷(2)	1.2	1.4	2.1	1.6	1.4	1.6	1.1	1.4	-	-
(7) Ratio: (2)÷(3)	.81	.71	.48	.64	.70	.65	.91	.73	-	-
(8) 1969 Av. Daily C.O.'s per 1000 Pop***	20	15	38	42	16	18	14	-	23	12
(9) 1970 Req. C.O.'s per 1000 '69 Pop.	25	21	79	65	23	28	15	-	37	25
(10) 1969 Av. Daily Pop.÷Capacity	2.0	1.7	1.5	1.2	1.9	1.8	1.4	-	1.6	-
(11) % Total Housing Capacity†	8.6	15.	3.5	8.2	17.	9.3	39.	100	-	-
(12) 1969 Total Incident Rate ††	9.6	51.	6.8	89.	19.	31.	59.	-	38.	30.

*The differences of 145 C.O.'s between the 1969 total detention quota and the average 1970 actual allocations is partly due to the additional 165 C.O.'s authorized between November 1969 and April 1970. The Dec. '70 detention quota is 1464.

**The averages are weighted by the 1969 institutional capacities, i.e., the entry for each institution is multiplied by the ratio of its capacity to the total capacity of all 7 facilities; these products are then summed across all 7 institutions to form the weighted average.

***That is, the average number of daily C.O.'s assigned divided by the average daily inmate census (per thousand population).

†This is the percentage total detention housing capacity existing at each facility.

††Incident rate denotes the total number of inmate security violations reported at each institution for 1969 divided by the average daily inmate census (on a 1000 population basis).

Table F-2

MINIMUM, MAXIMUM, AND AVERAGE DAILY CENSUS
BY DETENTION INSTITUTION

	1967	1968	1969
ARS			
Min.		2113	2346
Max.		3173	3288
Mean		2990	3017
MAN			
Min.	1183	1412	1517
Max.	1698	1865	2119
Mean	1446	1642	1812
BRK			
Min.	1062	1175	1294
Max.	1296	1601	1577
Mean	1207	1317	1471
BRX			
Min.	649	653	708
Max.	882	920	1196
Mean	780	793	938
QNS			
Min.	820	596	756
Max.	995	1101	1020
Mean	934	895	911
BRQ			
Min.	303	236	207
Max.	418	448	376
Mean	349	339	294
WOM			
Min.	281	283	463
Max.	474	467	716
Mean*	387	371	527
ALL DET. HOUSES			
Mean	5103	8082	8970

*Women's House only; does not include females at Westfield State Farm where the average daily census was 35 in 1967, 33 in 1968, and 37 in 1969.

Table F-3

INMATE CENSUS

INSTITUTION	1969 APRIL*	1969 JULY	1969 OCT.	1969 3-MO. AV.**	1969 AV. DAILY CENSUS***	1968 APRIL	1968 JULY	1968 OCT.	1968 3-MO. AV.	1968 AV. DAILY CENSUS	1967 APRIL	1967 JULY	1967 OCT.	1967 3-MO. AV.	1967 AV. DAILY CENSUS
Bronx	831	978	1100	970	938	830	864	797	830	793	849	724	843	805	780
Brooklyn	1490	1500	1448	1479	1471	1292	1347	1568	1402	1317	1240	1195	1179	1205	1207
Br. Queens	286	300	303	296	294	353	413	315	361	339	349	356	343	349	349
Women's House	497	491	631	530	527	323	371	422	372	371	418	333	360	370	387
Manhattan	1832	1783	1981	1865	1812	1583	1729	1732	1681	1642	1615	1235	1464	1438	1446
Queens	936	950	1008	965	911	921	960	884	922	895	923	933	947	934	934
ARS****	2985	3082	3170	3079	3017	-	-	-	-	2990	-	-	-	-	-

*An entry under any month is the average daily total inmate population for the institution (averaged over the seven days corresponding to the week from which the correctional manpower data were sampled).

**This is the average inmate census for the three weeks of the three months in which the actual correctional manpower allocations were determined.

***This is the average daily census over the year for the specific institution; the census includes all inmate residents of the facility: detention inmates, sentenced help, sentenced individuals awaiting transfer, etc.

****The ARS did not open to adolescents until October 14, 1968; all ARS data are taken from this time.

Table F-4

INSTITUTIONAL CAPACITIES

DETENTION INSTITUTION	1967-1969 CAPACITY	1969 AV. CENSUS/CAP.*	1969 MAX.	1968 AV. CENSUS/CAP.	1968 MAX.	1967 AV. CENSUS/CAP.	1967 MAX.
Bronx	476	2.0	2.5	1.7	1.9	1.6	1.9
Brooklyn	841	1.7	1.9	1.6	1.9	1.4	1.5
Br. Queens	194	1.5	1.9	1.7	2.3	1.8	2.2
Women's House	457	1.2	1.6	0.8	1.0	0.8	1.0
Manhattan	932	1.9	2.3	1.8	2.0	1.6	1.8
Queens	520	1.8	2.0	1.7	2.1	1.8	1.9
ARS	2147	1.4	1.5	1.4	1.5	-	-
AVERAGE		1.6	2.0	1.5	1.8	1.5	1.7

*This is the ratio of average daily census over the year to the institutional inmate capacity.

charge, length of stay in detention until the incident, stage of court processing, weapon employed, and drug use.[23] Since the facilities have widely varying capacities (Table F-4) and average daily census (Table F-2), in order to draw meaningful comparisons between them the incidents data are presented as rates (i.e., the number of incidents of a particular type at an institution, divided by the institution's average daily thousand population). Of course, other institutional differences may also account for the incident rate disparities identified in Table F-5.

It is evident from Table F-5 that the incident rates have not varied widely in every incident category or in every institution during 1967-1969. Assault rates at Bronx and Queens have stayed rather uniform and consistently below the institutional averages. In this category and in the destruction of property, the Women's House has experienced both the highest rates and the most significant departures from the average rates. The property destruction rates at all other institutions have been consistently negligible (except at Queens during 1969). Escapes were nonexistent in 1969, as were attempted escapes in 1967. The average attempted escape rate has been increasing over the years. Interestingly, the suicide rates have been close to zero and steadily decreasing at every institution except the ARS during 1967-1969. The suicide rates were greatest at ARS in 1969 (1.3) and at Brooklyn in 1968 (1.5) where the adolescents were housed for part of that year. Over the years, actual and attempted self-inflicted injury rates have predominated at Brooklyn, although Queens had the greatest self-injury rate in 1969, and the Women's House had the highest attempted injury rate in 1968. Contraband rates have been greatest at the Women's House in 1969 and 1967 and at Queens in 1968.

As Table F-5 also indicates, the Women's House produced the highest rates in the greatest number of incidents (42 percent), has done so consistently in the assault and property destruction categories, and has almost always

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[23] See Liechenstein, M., "Inmate Incident Statistics in the New York City Department of Correction Detention Houses - I and II: 1967-1970," The New York City-Rand Institute; unpublished mimeograph.

Table F-5

INCIDENTS RATES: INCIDENTS VOLUME PER AVERAGE 1000 POPULATION

	BRONX			BRANCH QUEENS			BROOKLYN		
	1969	1968	1967	1969	1968	1967	1969	1968	1967
Assaults	2.1	1.3	1.3	3.4	0.0	8.6	8.8	6.8	4.1
Destroy Prop.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Escapes	0.0	1.3	0.0	0.0	0.0	2.9	0.0	0.8	0.0
Att. Escapes	1.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Suicides	0.0	0.0	0.0	0.0	0.0	2.9	0.7	1.5	1.7
Self-Inflicted Injury	0.0	2.5	3.8	3.4	0.0	8.6	11.6	43.3	21.5
Att. Self-Injury	1.1	1.3	0.0	0.0	0.0	0.0	15.6	0.8	5.8
Contraband	0.0	0.0	0.0	0.0	0.0	2.9	0.0	0.8	2.5

	WOMEN'S HOUSE OF DET.			MANHATTAN			QUEENS		
	1969	1968	1967	1969	1968	1967	1969	1968	1967
Assaults	17.7	14.9	26.1	6.6	2.4	2.1	2.2	2.2	2.1
Destroy Prop.	12.4	9.9	4.7	0.0	0.0	0.0	1.1	0.0	0.0
Escapes	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Att. Escapes	1.8	0.0	0.0	0.0	0.0	0.0	1.1	1.1	0.0
Suicides	0.0	0.0	0.0	1.1	0.0	3.5	1.0	1.1	0.0
Self-Inflicted Injury	7.1	5.0	4.7	6.1	3.7	9.7	15.4	0.0	0.0
Att. Self-Injury	14.2	2.5	4.7	1.1	0.6	1.4	5.5	0.0	0.0
Contraband	8.9	0.0	7.1	0.6	0.6	1.4	0.0	1.1	0.0

	ARS			ALL DET. INST. AVERAGE*			ALL DET. INST. STD. DEV.		
	1969	1968	1967	1969	1968	1967	1969	1968	1967
Assaults	10.9	1.5	-	8.1	3.2	4.9	5.7	5.3	9.9
Destroy Prop.	0.0	0.0	-	0.9	0.5	0.4	4.8	3.9	2.0
Escapes	0.0	0.4	-	0.0	0.4	0.2	0.0	0.5	1.2
Att. Escapes	0.7	0.0	-	0.6	0.1	0.0	0.7	0.4	0.0
Suicides	1.3	0.0	-	0.9	0.4	1.6	0.7	0.6	1.6
Self-Inflicted Injury	4.6	0.4	-	6.8	8.4	9.3	5.2	15.8	7.6
Att. Self-Injury	6.3	0.0	-	6.4	0.5	2.1	6.4	1.0	2.6
Contraband	5.0	0.0	-	2.3	0.4	1.8	3.5	0.5	2.7

*Weighted average (by the ratio of institution mean daily census to mean daily census of total detention population) of incidents rates (per 1000 average population).

departed from the institutional average by two standard deviations. Brooklyn had the highest rates in 21 percent of the cases, has predominated in the actual and attempted self-inflicted injury categories, and has fluctuated from the detention average by 1 to 2 standard deviations. The Queens House had the highest rates in 13 percent of the cases, but in different incident categories and in two different years. Such differences in incident rates may provide an important additional basis for establishing manpower allocational priorities among the detention facilities.

Another way of assessing need and perceiving differences among detention facilities is to contrast average daily correctional manpower with the average daily census at each site. On the basis of complete census data and the nine-week post schedule samples, we discover extraordinary differences in average daily correctional manpower per 1000 inmates among the seven detention institutions (see Tables F-6 - F-8). On the highest level of aggregation, the totals for the three post categories, we observe that the Women's House had the highest ratio in each of the 3 years (close to 2 standard deviations above average each year) and Branch Queens, the second highest (about 1 standard deviation above average in 1969, and around 0.5 standard deviation or less in 1967-1968). By contrast, the ARS had the most conservative ratio (approximately 1 standard deviation below average) in 1969 and 1968, followed closely by Brooklyn and Manhattan. Brooklyn had the lowest ratio in 1967; Queens and Manhattan were next in rank.

Even by separate post categories, the Women's House has operated with the highest staff-to-inmate ratios over the years. When we disaggregate process functions from the observation and circulation control categories, we find that the Women's House is still around 2 standard deviations above the institutional average. This is a considerable contrast to Brooklyn, which has had the lowest ratio in all years except 1969 when its ratio was 15 and the ARS's was 14, the minimum for that year.

Inspection of post subcategories reveals that although the Women's House had the highest ratios of officers to inmates at the aggregated levels, Branch Queens ranked highest in the clerical category during 1968 and 1969 and was close to the ratio for the Women's House in 1967. Finally, we note that Branch Queens has always held the greatest ratio in the mobile post category, i.e., work gang supervision and general interior patrol.

Table F-6

AVERAGE DAILY CORRECTIONAL MANPOWER PER 1000 INMATES - 1969

POST CATEGORIES	BRX	BRK	BRQ	WOM	MAN	QNS	ARS	AV.	STD. DEV.
I	12	8	24	22	8	7	7	13	7
II	1	2	2	2	2	3	1	2	1
III	7	5	12	17	7	8	6	9	4
TOTAL	20	15	38	42	16	18	14	23	12
POST SUBCATEGORIES									
I.1	11	7	18	21	6	7	6	11	6
2	1	0	1	0	0	0	0	0	1
3	1	0	4	1	1	0	1	1	1
II.1	1	1	2	0	1	2	0	1	1
2	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0
4	0	1	0	0	0	1	0	0	1
5	0	0	0	2	0	0	0	0	1
III.1	0	0	0	2	0	1	0	0	1
2	1	0	2	1	1	1	1	1	1
3	2	1	2	4	2	1	0	2	1
4	0	1	0	1	1	1	0	1	1
5	0	0	0	0	0	0	0	0	1
6	1	0	0	1	0	0	0	0	0
7	2	1	4	3	2	2	2	2	1
8	0	0	0	2	0	0	0	0	1
9	0	0	0	0	0	0	0	0	1
10	1	0	0	0	0	0	0	0	0
11	0	0	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0	0	0
13	0	0	0	1	0	0	0	0	0
14	0	0	0	0	0	0	0	0	0
15	0	0	0	0	0	0	0	0	0
16	0	0	0	1	0	0	0	0	0
17	0	0	0	0	0	0	0	0	0
18	0	0	0	1	0	0	0	0	0
19	0	0	0	1	0	0	0	0	0
20	0	0	0	0	0	0	1	0	0

Table F-7

AVERAGE DAILY CORRECTIONAL MANPOWER PER 1000 INMATES - 1968

POST CATEGORIES	BRX	BRK	BRQ	WOM	MAN	QNS	ARS.	AV.	STD. DEV.
I	15	9	20	36	8	8	6	15	11
II	2	2	2	1	2	4	1	2	1
III	9	6	11	24	8	8	6	10	6
TOTAL	25	17	33	60	18	19	13	26	16
POST SUBCATEGORIES									
I.1	11	8	15	34	7	7	6	13	10
2	1	0	1	0	0	0	0	1	1
3	3	0	4	2	1	1	1	2	1
II.1	1	1	2	0	1	2	0	1	1
2	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0
4	0	1	0	0	0	1	0	0	1
5	0	0	0	0	0	0	0	0	0
III.1	0	0	0	1	0	1	0	0	1
2	1	1	2	1	0	1	0	1	1
3	2	1	3	5	2	2	1	2	1
4	0	1	0	2	1	1	0	1	1
5	0	0	0	0	0	0	0	0	0
6	1	0	0	2	1	0	0	1	1
7	3	1	5	4	2	2	2	3	1
8	0	0	0	3	0	0	0	1	1
9	0	0	0	0	0	0	0	0	0
10	1	0	0	0	0	0	0	0	0
11	0	0	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0	0	0
13	0	0	0	1	1	0	0	0	1
14	0	0	0	0	0	0	0	0	0
15	0	0	0	0	0	0	0	0	0
16	0	0	0	1	0	0	0	0	0
17	0	0	0	0	0	0	0	0	0
18	0	0	0	2	0	0	0	0	1
19	0	0	0	1	0	0	0	0	0
20	0	0	0	0	0	0	1	0	0

Table F-8

AVERAGE DAILY CORRECTIONAL MANPOWER PER 1000 INMATES - 1967

POST CATEGORIES	BRX	BRK	BRQ	WOM	MAN	QNS	ARS*	AV.	STD. DEV.
I	14	8	18	32	9	8		15	9
II	2	2	2	1	3	3		2	1
III	9	6	9	26	8	7		11	8
TOTAL	25	15	30	59	20	19		28	16
POST SUBCATEGORIES									
I.1	13	7	14	31	8	7		13	9
2	1	0	1	0	0	0		0	1
3	1	0	4	1	1	1		1	1
II.1	1	1	2	0	2	2		1	1
2	0	0	0	0	0	0		0	0
3	0	0	0	0	0	0		0	0
4	0	1	0	0	1	1		1	1
5	0	0	0	1	0	0		0	0
III.1	0	0	0	1	0	1		0	1
2	1	0	1	1	0	1		1	1
3	2	2	2	5	3	2		3	1
4	0	1	0	1	1	1		1	1
5	0	0	0	0	0	0		0	0
6	1	1	0	2	1	0		1	1
7	3	1	4	5	2	2		3	1
8	0	0	0	3	0	0		1	1
9	0	0	0	0	0	0		0	0
10	1	0	0	0	0	0		0	0
11	0	0	0	0	0	0		0	0
12	0	0	0	0	0	0		0	0
13	0	0	0	1	0	0		0	0
14	0	0	0	0	0	0		0	0
15	0	0	0	0	0	0		0	0
16	0	0	0	1	0	0		0	0
17	0	0	0	0	0	0		0	0
18	0	0	0	4	0	0		1	1
19	0	0	0	1	0	0		0	0
20	0	0	0	0	0	0		0	0

*ARS did not exist in 1967.

Appendix G

HISTORICAL MANPOWER ALLOCATIONS: 1967-1970

Unless stated otherwise, all the manpower tables in this document state the *number* of correctional officers deployed in the various post categories of Table 1 for the first week of the month and year indicated. The tabulations reflect the number of men needed on an annual basis if the same post structure were repeated for each week of the year and if the effective number of annual working days per officer were 218.[24]

One of the most striking features of the C.O. manpower allocations made over the past 4 years (see Tables G-1 through G-10) is that despite wide variations in architecture, inmate census, and capacity among the seven maximum-security detention houses, the average manpower commitment to inmate processing operations has been close to 40 percent in each year. The balance, 60 percent, has been collectively allocated to observation, supervision, and circulation control.[25] Even by individual institution (c.f. Tables G-4 - G-10), these percentage distributions have departed from the averages by no more than 9 percent in 1969, 6 percent in 1968, and 7 percent in 1967. The pattern is still more consistent by institution across the years, the maximum spread in percentage manning to process tasks being 5 percent or less.

Of the twenty functions that constitute the process category, clerical activities, receiving room tasks, kitchen monitoring, and visit room supervision have jointly required about 26 percent of the total correctional force on the average in each year during 1967-1969. As percentages of the total process category, these posts have accounted for 62 percent in 1969, 62 percent in 1968, and 65 percent in 1967.

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[24] According to the Department's formula for vacation accrual, sick-leave allowance, etc., the expected number of annual working days per correctional officer (except those in court detention facilities or in the Transportation Division) is 218 or 1744 hours per year. Since a one-man, 8-hour tour per day post requires 2920 man-hours per year, such a post involves 1.67 correctional officers on an annual basis (for the Women's House, 1.68). Other posts scale accordingly, as discussed in Section II.

[25] The distributions of C.O. manpower were derived from nine-week samples of institutional post assignment schedules in accordance with the post typology developed in this Report. The typology distinguishes three main post categories: (1) observation and supervision of inmates in housing areas and work gangs; (2) control of inmates' movements throughout the buildings; (3) processing of inmates in the programs and activities connected with their detention. The 40-percent figure pertains to this third category, while the 60-percent figure refers to categories (1) and (2) together.

Although the average proportions of manning in the individual process categories have also been consistent, there have been some notable exceptions, for which only partial explanations come to mind. Manhattan, which operates a nighttime reception center, has had relatively high receiving room manning over the years. By contrast, Branch Queens, an institution with a small, long-term inmate composition, has had low reception staffing. Similarly, in the clerical category, the ARS has had exceptionally high percentage manning, while Branch Queens and the Women's House have been consistently low.[26]

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[26] A more comprehensive treatment of historical manpower allocations is presented in Liechenstein, M. and B. Schwartzfarb, "Analysis of Correctional Officer Manpower Allocations in the New York City Department of Correction," and in Liechenstein, M., "Recent Manpower Allocations and Requests in the New York City Department of Correction," The New York City-Rand Institute; unpublished mimeographs.

Table G-1

WEIGHTED AVERAGE MANPOWER ALLOCATIONS FOR ALL INSTITUTIONS*

	1969			1968			1967		
Post Categories	Av. by Cap.*	Av. % Total*	Std. Dev.	Av. by Cap.	Av. % Total	Std. Dev.	Av. by Cap.	Av. % Total	Std. Dev.
I	102	50	38	100	49	35	74	50	19
II	20	10	9	18	9	10	16	11	9
III	87	40	42	85	41	38	59	39	21
TOTAL	209	100	86	203	99	78	149	100	44

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*For each post category the weighted average manpower is computed by taking the number of C.O.'s employed in that category at an institution and multiplying by the institution's housing capacity. These products are summed across all the detention facilities and the result divided by the total detention housing capacity.

Table G-2

WEIGHTED AVERAGE MANPOWER ALLOCATIONS
FOR ALL INSTITUTIONS 1969-1970

POST CATEGORIES	1969 Allocations Wtd. Av. C.O.'s	Std. Dev.	Coef. Var.	Av. % Total	1970 Allocations Wtd. Av. C.O.'s	Std. Dev.	Coef. Var.	Av. % Total	1970-1969 1970 Minus 1969 Av. Allocations
I	102	38	37	50	126	60	47	51	24
II	20	9	45	10	22	10	49	10	2
III	86	42	49	40	100	56	55	39	14
TOTAL	208	86	41	100	248	121	49	100	40
POST SUBCATEGORIES									
I.1	89	34	38	44	115	55	47	47	26
2	4	2	59	2	3	1	45	1	-1
3	8	4	52	4	8	5	59	3	0
II.1	10	6	61	5	11	5	48	5	1
2	0	0	-	0	0	0	119	0	0
3	1	1	107	0	1	1	112	0	0
4	7	5	71	4	7	6	89	4	0
5	1	4	404	1	3	3	98	1	2
III.1	3	3	95	2	6	5	95	2	3
2	8	4	43	4	6	2	38	3	-2
3	14	8	59	7	18	10	53	8	4
4	4	3	65	2	4	3	73	2	0
5	1	1	161	0	1	1	46	1	0
6	5	2	48	3	6	3	48	2	1
7	26	15	57	12	29	15	51	11	3
8	5	4	81	2	3	3	83	1	-2
9	0	1	413	0	1	1	87	0	1
10	2	1	51	1	4	3	69	1	2
11	0	1	164	0	1	1	82	0	1
12	2	2	108	1	1	1	90	0	-1
13	1	1	131	1	1	1	67	1	0
14	0	0	-	0	0	0	203	0	0
15	1	1	153	0	2	2	93	1	1
16	0	1	462	0	0	1	114	0	0
17	1	1	119	0	2	2	119	0	1
18	1	2	313	0	1	3	351	0	0
19	1	2	147	1	1	1	264	0	0
20	11	13	119	4	15	17	119	4	4

Table G-3

WEIGHTED AVERAGE MANPOWER ALLOCATIONS
FOR ALL INSTITUTIONS*

POST CATEGORIES	1969 Av. by C.O.'s*	Av. % Total*	Std. Dev.	1968 Av. by C.O.'s	Av. % Total	Std. Dev.	1967 Av. by C.O.'s	Av. % Total	Std. Dev.
I	102	49	34	100	49	32	74	50	19
II	20	10	9	18	9	9	16	11	9
III	86	41	37	86	42	34	59	39	21
TOTAL	208	100	75	204	100	68	149	100	43
POST SUBCATEGORIES									
I.1	89	43	24	88	43	29	67	45	20
2	4	2	2	4	2	2	2	2	1
3	8	4	3	9	4	5	5	3	2
II.1	10	5	6	10	5	6	11	7	6
2	0	0	0	0	0	0	0	0	0
3	1	0	1	1	0	1	0	0	2
4	7	4	5	8	4	4	5	3	3
5	1	1	3	0	0	1	1	1	1
III.1	3	1	4	3	1	3	1	1	3
2	8	4	3	6	3	2	4	3	1
3	14	7	8	14	7	6	15	10	7
4	4	2	3	3	1	3	6	4	3
5	1	0	1	0	0	1	1	1	0
6	5	3	5	5	3	3	5	3	3
7	26	13	12	26	13	12	15	10	4
8	5	2	4	3	1	3	2	1	2
9	0	0	1	0	0	1	0	0	0
10	2	1	1	3	1	1	2	1	0
11	0	0	1	0	0	1	1	1	1
12	2	1	2	1	0	2	1	0	0
13	1	1	1	3	1	3	2	1	1
14	0	0	0	0	0	0	0	0	0
15	1	1	1	1	0	1	1	1	0
16	0	0	2	0	0	1	0	0	1
17	1	1	1	1	1	2	0	0	0
18	1	1	2	1	1	0	1	1	4
19	1	1	1	2	1	2	2	1	1
20	11	4	11	12	6	12	0	0	0

*For each post category the weighted average manpower is computed by taking the number of C.O.'s employed in that category at an institution and multiplying by the institution's total housing capacity. These products are summed across all the detention facilities and the result divided by the total detention housing capacity.

Table G-4

MANPOWER ALLOCATIONS - BRONX

POST CATEGORIES	1969 Av. No C.O.'s	1969 % Total	1969 Std. Dev.	1968 Av. No C.O.'s	1968 % Total	1968 Std. Dev.	1967 Av. No. C.O.'s	1967 % Total	1967 Std. Dev.
I	78	60	3	81	59	1	79	57	4
II	8	6	2	8	6	0	11	8	2
III	45	34	2	48	35	3	48	35	2
TOTAL	131	100	6	137	100	3	138	100	1
POST SUBCATEGORIES									
I.1	69	53	2	62	45	14	70	51	1
2	3	2	0	3	2	0	3	2	0
3	7	5	1	16	12	16	5	4	3
II.1	5	4	0	5	4	0	8	6	3
2	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0
4	3	2	2	3	2	0	3	2	2
5	1	1	1	1	1	1	1	1	0
III.1	0	0	0	0	0	0	0	0	0
2	5	4	0	5	4	0	4	3	1
3	11	8	0	11	8	0	11	8	1
4	1	1	0	1	1	0	1	1	0
5	1	1	0	1	1	1	1	1	1
6	5	4	0	6	4	0	6	4	0
7	14	11	0	15	11	1	17	12	0
8	1	1	0	1	1	0	1	1	0
9	0	0	0	1	1	0	0	0	0
10	3	2	0	3	2	0	3	2	0
11	1	1	0	1	1	0	1	1	1
12	0	0	0	0	0	0	0	0	0
13	0	0	1	1	1	1	1	1	1
14	0	0	0	0	0	0	0	0	0
15	0	0	0	0	0	0	0	0	0
16	0	0	0	0	0	0	0	0	0
17	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	1	1	3
20	0	0	0	0	0	0	0	0	0

Table G-5

MANPOWER ALLOCATIONS - BROOKLYN

POST CATEGORIES	1969 Av. No. C.O.'s	1969 % Total	1969 Std. Dev.	1968 Av. No. C.O.'s	1968 % Total	1968 Std. Dev.	1967 Av. No. C.O.'s	1967 % Total	1967 Std. Dev.
I	79	51	2	84	53	14	66	51	16
II	22	14	4	21	13	5	14	11	5
III	55	35	1	54	34	7	49	38	4
TOTAL	156	100	5	160	100	24	130	100	24
POST SUBCATEGORIES									
I.1	73	47	1	78	49	16	61	47	15
2	3	2	0	3	2	1	3	2	1
3	2	1	1	2	1	2	3	2	1
II.1	11	7	2	11	7	4	9	7	4
2	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0
4	12	8	3	11	7	3	6	5	2
5	0	0	0	0	0	0	0	0	0
III.1	0	0	0	0	0	0	0	0	0
2	5	3	0	5	3	1	4	3	1
3	13	8	1	13	8	4	13	10	2
4	8	5	0	6	4	0	6	5	1
5	2	1	1	2	1	0	1	1	1
6	5	3	1	5	3	1	5	4	1
7	14	9	1	13	8	3	10	8	3
8	2	1	0	2	1	1	1	1	0
9	0	0	0	0	0	0	0	0	0
10	2	1	0	2	1	0	1	1	0
11	2	1	1	2	1	1	1	1	1
12	0	0	0	0	0	0	0	0	0
13	2	1	1	2	1	0	1	1	0
14	0	0	1	0	0	0	0	0	0
15	2	1	1	2	1	1	1	1	1
16	0	0	0	2	1	1	0	0	0
17	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0
19	2	1	0	3	2	2	3	2	2
20	0	0	0	0	0	0	0	0	0

Table G-6

MANPOWER ALLOCATIONS - BRANCH QUEENS

POST CATEGORIES	1969 Av. No. C.O.'s	1969 % Total	1969 Std. Dev.	1968 Av. No. C.O.'s	1968 % Total	1968 Std. Dev.	1967 Av. No. C.O.'s	1967 % Total	1967 Std. Dev.
I	49	63	2	47	60	1	45	62	2
II	5	6	0	5	6	0	5	6	0
III	24	31	3	26	34	1	23	32	3
TOTAL	78	100	1	78	100	1	73	100	2
POST SUBCATEGORIES									
I.1	37	47	2	35	45	1	33	45	1
2	2	3	1	3	4	0	3	4	0
3	9	12	1	9	12	1	9	12	1
II.1	5	6	0	5	6	0	5	7	0
2	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0	0
III.1	2	2	1	1	1	1	1	1	1
2	5	6	2	4	5	1	3	4	0
3	5	6	1	7	9	0	7	9	2
4	1	1	1	2	2	0	2	2	0
5	2	2	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0	0	0
7	9	11	2	11	14	1	10	14	1
8	0	0	0	0	0	0	0	0	0
9	1	1	1	0	0	0	0	0	0
10	2	2	0	2	2	0	2	2	0
11	0	0	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0	0	0
13	0	0	0	0	0	0	0	0	0
14	0	0	0	0	0	0	0	0	0
15	0	0	0	0	0	0	0	0	0
16	0	0	0	0	0	0	0	0	0
17	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0

Table G-7

MANPOWER ALLOCATIONS - WOMEN'S HOUSE

POST CATEGORIES	1969 Av. No. C.O.'s	1969 % Total	1969 Std. Dev.	1968 Av. No. C.O.'s	1968 % Total	1968 Std. Dev.	1967 Av. No. C.O.'s	1967 % Total	1967 Std. Dev.
I	83	53	7	94	60	4	87	54	3
II	9	6	10	2	1	1	3	2	1
III	64	41	5	62	40	3	71	44	5
TOTAL	156	100	4	156	101	6	161	100	5
POST SUBCATEGORIES									
I.1	80	51	8	89	57	4	85	53	3
2	0	0	0	0	0	0	0	0	0
3	3	2	1	5	3	1	3	2	1
II.1	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0	0
5	9	6	10	2	1	1	3	2	1
III.1	6	4	4	3	2	1	3	2	2
2	5	3	1	3	2	2	4	3	1
3	13	8	1	13	8	4	13	8	2
4	3	2	2	5	3	0	3	2	1
5	0	0	0	0	0	0	0	0	0
6	5	3	1	5	3	1	5	3	1
7	11	7	2	11	7	1	15	9	2
8	8	5	1	8	5	1	6	4	1
9	2	1	0	2	1	0	2	1	0
10	0	0	0	0	0	0	2	1	1
11	0	0	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0	0	0
13	3	2	1	3	2	0	3	2	1
14	0	0	0	0	0	0	0	0	1
15	0	0	0	0	0	0	0	0	0
16	3	2	1	3	2	1	3	2	1
17	0	0	0	0	0	0	0	0	0
18	5	3	2	6	4	0	10	6	2
19	3	2	1	5	3	1	2	1	1
20	0	0	0	0	0	0	0	0	0

Table G-8

MANPOWER ALLOCATIONS - MANHATTAN

POST CATEGORIES	1969 Av. No. C.O.'s	1969 % Total	1969 Std. Dev.	1968 Av. No C.O.'s	1968 % Total	1968 Std. Dev.	1967 Av. No. C.O.'s	1967 % Total	1967 Std. Dev.
I	89	45	3	87	43	12	91	46	1
II	24	12	0	22	11	3	28	14	2
III	84	43	8	93	46	11	79	40	3
TOTAL	197	100	11	203	100	5	198	100	3
POST SUBCATEGORIES									
I.1	77	39	8	77	38	11	79	40	2
2	4	2	1	4	2	1	4	2	0
3	8	4	1	8	4	1	8	4	1
II.1	18	9	1	18	9	1	20	10	1
2	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0
4	6	3	1	4	2	3	8	4	1
5	0	0	0	0	0	0	0	0	0
III.1	0	0	0	0	0	0	0	0	0
2	10	5	10	4	2	0	4	2	0
3	31	16	3	26	13	2	26	13	2
4	8	4	0	8	4	0	10	5	1
5	0	0	0	0	0	0	0	0	0
6	6	3	2	8	4	1	8	4	0
7	20	10	1	22	11	1	20	10	1
8	2	1	0	2	1	1	2	1	0
9	0	0	0	0	0	0	0	0	0
10	2	1	1	2	1	1	2	1	1
11	0	0	0	0	0	0	0	0	0
12	4	2	3	4	2	3	2	1	0
13	2	1	0	8	4	11	2	1	0
14	0	0	0	0	0	0	0	0	0
15	2	1	1	2	1	0	2	1	0
16	0	0	0	0	0	0	0	0	0
17	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0
19	4	2	3	6	3	4	4	2	3
20	0	0	0	0	0	0	0	0	0

Table G-9

MANPOWER ALLOCATIONS - QUEENS

POST CATEGORIES	1969 Av. No. C.O.'s	1969 % Total	1969 Std. Dev.	1968 Av. No. C.O.'s	1968 % Total	1968 Std. Dev.	1967 Av. No. C.O.'s	1967 % Total	1967 Std. Dev.
I	48	42	1	48	40	0	52	43	1
II	18	16	2	22	18	0	21	17	2
III	48	42	2	51	42	4	48	40	3
TOTAL	114	100	4	121	100	4	121	100	4
POST SUBCATEGORIES									
I.1	43	38	0	44	36	0	48	40	1
2	1	1	0	1	1	0	1	1	0
3	3	3	1	4	3	1	4	3	0
II.1	10	9	0	11	9	2	12	10	1
2	0	0	0	0	0	0	0	0	0
3	1	1	0	1	1	0	2	2	1
4	7	6	1	10	8	2	6	5	2
5	0	0	0	0	0	0	0	0	0
III.1	7	6	0	6	5	1	6	5	0
2	5	4	0	5	4	0	5	4	0
3	8	7	1	13	11	3	10	8	2
4	5	4	0	4	3	2	5	4	0
5	1	1	1	1	1	0	0	0	0
6	2	2	0	2	2	0	4	3	1
7	14	12	0	14	12	1	13	11	1
8	1	1	0	1	1	0	1	1	0
9	0	0	0	0	0	0	0	0	0
10	1	1	0	1	1	0	1	1	1
11	1	1	0	1	1	1	1	1	0
12	0	0	0	0	0	0	0	0	0
13	1	1	0	1	1	1	1	1	0
14	0	0	0	0	0	0	0	0	0
15	0	0	0	0	0	0	0	0	0
16	0	0	0	0	0	0	0	0	0
17	0	0	0	0	0	0	0	0	0
18	2	2	3	0	0	0	0	0	0
19	0	0	0	1	1	1	0	0	0
20	0	0	0	0	0	0	0	0	0

Table G-10

MANPOWER ALLOCATIONS - ARS

POST CATEGORIES	1969 Av. No. C.O.'s	1969 % Total	1969 Std. Dev.	1968* No. C.O.'s	1968* % Total
I	140	48	13	133	48
II	23	8	1	22	8
III	129	44	7	122	44
TOTAL	292	100	16	277	100
POST SUBCATEGORIES					
I.1	123	42	12	117	42
2	6	2	0	6	2
3	12	4	2	14	5
II.1	9	3	1	8	3
2	0	0	0	0	0
3	3	1	0	3	1
4	9	3	1	11	4
5	0	0	0	0	0
III.1	6	2	1	6	2
2	12	4	1	8	3
3	12	4	2	11	4
4	3	1	2	0	0
5	0	0	1	0	0
6	6	2	2	6	2
7	44	15	5	42	15
8	9	3	0	3	1
9	0	0	0	0	0
10	3	1	0	6	2
11	0	0	0	0	0
12	3	1	0	0	0
13	0	0	0	3	1
14	0	0	1	0	0
15	0	0	0	0	0
16	0	0	1	0	0
17	3	1	1	3	1
18	0	0	0	0	0
19	0	0	0	0	0
20	29	10	1	31	11

*ARS started October 14, 1968; only the data for this month in 1968 are presented.

Appendix H

COMPUTER PROGRAMS FOR AUTOMATED MANPOWER ANALYSIS

The accompanying programs implement the manpower accounting and allocation scheme described in this Report. The programs are designed to operate with nationally available, commercial time-sharing computer services. Although written specifically for one such computer service, the language employed (viz., XTRAN) can be made compatible with other time-sharing facilities or with the Department's proposed proprietary computer system with only minor revisions to the present code.

The present version of the manpower allocation program is designed for use by someone, unfamiliar with computer technology, stationed at an ordinary teletype console or equivalent communications terminal. As such, the program provides numerous cues and instructions to the user. While at the console, the user can elect to type in new manpower data or to retrieve previously entered data from the computer files. The user can select any combination of the four decision rules developed in this document merely by responding "yes" or "no" to each option inquiry made by the computer. In addition, the user can choose any set of values for the degree of variability in manning deviation which he will tolerate in the Liberal Rule and Conservative Rule assignment policies discussed earlier (i.e., the values of the variability threshold factor). The program automatically prompts the user to indicate his preferences and, in turn, supplies the user with the consequent manpower allocations arrayed according to the post typology of Table 1 (which, for convenience, is printed out by the computer at the conclusion of the analysis session). Finally, a tableau is presented for each decision rule which indicates which posts and institutions had manpower allocations that departed from the norm. This is accomplished in the MAX and MIN assignment rules by printing "+" and "-" signs whenever requests either exceed or fall short of, respectively, the average actual post allocations at the institution. In the LR and CR printouts, the plus and minus signs designate requests that occur, correspondingly, in the HIGH and LOW manning regions for the variability threshold prescribed by the user (see Appendix D and Section V for definitions of these regions).

The program listings given in Figs. H-1 through H-7 accomplish the functions just described. The program is written modularly so that the program flow, decision rules, statistical computations, mode of data entry, retrieval and storage, and display formats are easily modified, refined, or adapted to the needs of other correctional jurisdictions. The statistical operations are carried out in the individual subroutines MEAN and STATS (Figs. H-3 and H-7); the decision rules in LIBCON AND MAXMIN (Figs. H-3 and H-4); the computational displays in TYPE, POST, and PRINT (Figs. H-4, H-5, and H-6); and the data retrieval, input, and overall program control in MAIN (Fig. H-1).

Figures H-8 through H-13 illustrate a typical execution of the manpower analysis program from a teletype console. The only typing or response demanded of the user is indicated by the underlined entries in the figures. The session begins by the user's typing his secret authorization code (Fig. H-8). Next, the computer language in which the program is written is entered ("XTRAN" in Fig. H-8). A request is made to compile the manpower program for execution and to store the compiled program in the file designated /MPBIN/ (the blank entry after "OLD FILE?" and elsewhere in the program indicates a carriage return on the teletype console). Once the program is compiled and stored, all the steps under "+COMPILE/MANPOWER/" can be avoided in future sessions.

The user elects to run the compiled program by typing "+RUN" (Fig. H-8). Since no special options or subroutines are required beyond those included in the program, the user presses the carriage return after "OPTIONS:" and "SPROG:" (Fig. H-8). Next, the program requests information on whether manning data have been previously entered. Since the affirmative response is given (Fig. H-8) by typing "1" on the console, the computer automatically retrieves the allocations and requests data formerly entered and stored on files. Having done this, the program then asks the user to select the decision rules he wishes to invoke (in Fig. H-8, MAX and LR are chosen). The computer immediately displays the manpower allocations in Fig. H-9 in accordance with the choice of MAX.

In the next illustration, Fig. H-10, the computer prints all the cases in which requests either exceed or fall short of the average manning assignments for each institution and post. Since the user also elected LR analysis, the computer asks for the desired variability threshold factor (Fig. H-11) and then calculates and prints the resultant manpower allocations, as well as those posts and institutions where the requests either fall below or exceed the variability tolerance (Fig. H-12). The program goes on to ask if any other variability thresholds should be tried under LR (bottom of Fig. H-12). Since the user indicates no by typing "0" after the inquiry, the session is concluded by printing out the post typology (Fig. H-13) for the user's convenience in interpreting the preceding computational results.


```
C     MAIN PROGRAM
DIMENSION A(7,28,5),AAV(7,28),R(7,28),S(28),D(28),C(8)
INTEGER Q,Z(10)
DATA C/476.,841.,194.,457.,932.,520.,2147.,5567./
DISPLAY $ $
DISPLAY $ $
DISPLAY #$MANPOWER ANALYSIS & ALLOCATION PROGRAM (VERSION-1)$
FOR I=1,3: DISPLAY $ $
DISPLAY #$MANPOWER ALLOCATIONS & REQUESTS DATA PREVIOUSLY ENTERED?$
DISPLAY #$TYPE HERE, 1=YES, 0=NO, THEN PRESS RETURN KEY: $,#
ACCEPT Z(0)
IF( Z(0).EQ. 0 ) GO TO 1
OPEN (3,INPUT,/SAMPLES/)
READ (3,20) K1
20 FORMAT (I2)
CLOSE (3)
OPEN (3,INPUT,/MPR/)
DO 2 J=1,28
2 READ (3,10) (R(I,J),I=1,7)
CLOSE (3)
OPEN (4,INPUT,/MPA/)
DO 3 K=1,K1
DO 3 J=1,28
3 READ(4,10) (A(I,J,K),I=1,7)
CLOSE (4)
GO TO 8
1 DISPLAY #$THE ORDER OF INSTITUTIONAL ENTRIES MUST BE AS FOLLOWS:$
DISPLAY #$BRX=1, BRK=2, BRQ=3, WOM=4, MAN=5, QNS=6, ARS=7 $
DISPLAY #$ENTER THE NO. OF WEEKLY SAMPLES TO BE INPUT HERE:$,#
ACCEPT K1
OPEN (3,OUTPUT,/SAMPLES/)
WRITE (3,20) K1
CLOSE (3)
DISPLAY $ $
DISPLAY $ $
DISPLAY #$INPUT MANPOWER ALLOCATION DATA$
DISPLAY #$DEPRESS SPACE KEY AFTER EACH ENTRY$
DISPLAY $ $
DISPLAY $ $
DO 4 K=1,K1
DISPLAY #$WEEKLY SAMPLE NO.$, K
DISPLAY #$POST CATEGORY    BRX     BRK     BRQ     WOM     MAN     QNS     ARS$
DO 4 J=1,28
DISPLAY #J,$             $,#
4 READ (0,19) (A(I,J,K),I=1,7)
DISPLAY $ $
19 FORMAT (24X,7(F5.1,4X))
DISPLAY $ $
DISPLAY #$ENTER MANPOWER REQUEST DATA$
DISPLAY $ $
DISPLAY #$POST CATEGORY    BRX     BRK     BRQ     WOM     MAN     QNS     ARS$
```

Fig. H-1. Computer program listings

```
DO 5 J=1,28
DISPLAY #J,$            $,#
5 READ(0,15) (R(I,J),I=1,7)
DISPLAY $ $
DISPLAY $ $
10 FORMAT (7F5.1 )
OPEN (3,OUTPUT,/MPR/)
DO 6 J=1,28
6 WRITE(3,10) (R(I,J),I=1,7)
CLOSE (3)
OPEN (4,OUTPUT,/MPA/)
DO 7 K=1,K1
DO 7 J=1,28
7 WRITE(4,10) (A(I,J,K), I=1,7)
CLOSE (4)
8 DISPLAY $ $
DISPLAY $ $
DISPLAY #$ENTER DECISION RULE OPTIONS BY TYPING 1=YES, 0=NO$
DISPLAY $ $
DISPLAY $ $
DISPLAY #$THEN PRESS THE RETURN KEY AFTER EACH CHOICE:$
DISPLAY #$MAXIMUM RULE? :$,#
ACCEPT Z(1)
DISPLAY #$MINIMUM RULE? :$,#
ACCEPT Z(2)
DISPLAY #$LIBERAL RULE? :$,#
ACCEPT Z(3)
DISPLAY #$CONSERVATIVE RULE? :$,#
DISPLAY $ $
DISPLAY $ $
ACCEPT Z(4)
CALL MEAN(A,AAV,K1)
Q=1
IF( Z(1).EQ.1 ) CALL MAXMIN(AAV,R,Q)
Q=2
IF( Z(2).EQ.1 ) CALL MAXMIN(AAV,R,Q)
IF( Z(3).EQ.1.OR.Z(4).EQ.1 ) CALL STATS(AAV,R,D,S,C)
Q=3
IF( Z(3).EQ.1 ) CALL LIBCON(AAV,R,D,S,Q)
Q=4
IF( Z(4).EQ.1 ) CALL LIBCON(AAV,R,D,S,Q)
CALL POST
STOP
END
```

Fig. H-2. Computer program listings


```
SUBROUTINE LIBCON(AAV,R,D,S,Q)
DIMENSION AAV(7,28),R(7,28),B(2),D(28),S(28),MM(7,28)
REAL M(8,32),L
INTEGER Q,Z(10)
1 IF (Q.EQ.1) DISPLAY #$MAXIMUM RULES
IF (Q.EQ.2) DISPLAY #$MINIMUM RULES
IF (Q.EQ.3) DISPLAY #$LIBERAL RULES
IF (Q.EQ.4) DISPLAY #$CONSERVATIVE RULES
DISPLAY $ $
DISPLAY $ $
DISPLAY #$ENTER DESIRED VARIABILITY THRESHOLD FACTOR HERE$
DISPLAY #$AND THEN DEPRESS RETURN KEY:$,#
ACCEPT L
DO 2 J=1,28
DO 2 I=1,7
B(1)=AAV(I,J) + D(J) -L*S(J)
B(2)=B(1) + 2.*L*S(J)
IF( R(I,J).GE.B(1).AND.R(I,J).LE.B(2) ) M(I,J)=R(I,J)
IF( R(I,J).GT.B(2) ) M(I,J)=AMAX1(0.,B(2))
IF( R(I,J).LT.B(1).AND.Q.EQ.3 ) M(I,J)=AMAX1(0.,B(1))
IF( R(I,J).LT.B(1).AND.Q.EQ.4 ) M(I,J)=R(I,J)
IF (R(I,J).GE.B(1).AND.R(I,J).LE.B(2)) MM(I,J)=1H
IF (R(I,J).GT.B(2)) MM(I,J)=1H+
IF (R(I,J).LT.B(1)) MM(I,J)=1H-
2 CONTINUE
CALL PRINT (M,L,Q)
CALL TYPE (MM,Q)
Z(5)=0
DISPLAY #$ARE THERE OTHER VARIABILITY THRESHOLD FACTORS FOR THIS RULE?$
DISPLAY  #$TYPE HERE, 1=YES, 0=NO AND PRESS RETURN KEY :$,#
ACCEPT Z(5)
IF(Z(5).EQ.1) GO TO 1
DISPLAY $ $
DISPLAY $ $
RETURN
END


SUBROUTINE MEAN(A,AAV,K1)
DIMENSION A(7,28,5),AAV(7,28)
DO 1 J=1,28
DO 1 I=1,7
AAV(I,J)=0.
DO 2 K=1,K1
2 AAV(I,J)=AAV(I,J) + A(I,J,K)
1 AAV(I,J)=AAV(I,J)/FLOAT(K1)
RETURN
END
```

Fig. H-3. Computer program listings

```
SUBROUTINE TYPE (MM,Q)
DIMENSION MM(7,28)
INTEGER Q
DISPLAY $ $
DISPLAY $ $
DISPLAY #$POST                          INSTITUTIONS$
DISPLAY #$SUBCATEGORIES   BRX  BRK  BRQ  WOM  MAN  QNS  ARS $
DISPLAY #$ $
DISPLAY $ $
DO 1 J=1,3
1 WRITE (0,25) J,(MM(I,J),I=1,7)
25 FORMAT($I-  $,I2,12X,7(A1,4X))
DISPLAY $ $
DISPLAY $ $
DO 2 J=4,8
2 WRITE (0,26) J-3,(MM(I,J),I=1,7)
26 FORMAT ($II- $,I2,12X,7(A1,4X))
DISPLAY $ $
DISPLAY $ $
DO 3 J=9,28
3 WRITE (0,27) J-8,(MM(I,J),I=1,7)
27 FORMAT($III-$,I2,12X,7(A1,4X))
DISPLAY $ $
DISPLAY $ $
IF (Q.LE.2) DISPLAY #$+ DENOTES REQUESTS HIGHER THAN AV. ALLOCATIONS$
IF (Q.LE.2) DISPLAY #$- DENOTES REQUESTS LOWER THAN AV. ALLOCATIONS$
IF (Q.GE.3) DISPLAY #$+ DENOTES REQUEST IN HIGH REGIONS
IF (Q.GE.3) DISPLAY #$- DENOTES REQUEST IN LOW REGIONS
DISPLAY $ $
DISPLAY $ $
RETURN
END


SUBROUTINE MAXMIN(AAV,R,Q)
DIMENSION AAV(7,28),R(7,28),MM(7,28)
REAL M(8,32)
INTEGER Q
REAL L
DO 1 J=1,28
DO 1 I=1,7
IF(Q.EQ.1) M(I,J)=AMAX1(AAV(I,J),R(I,J))
IF(Q.EQ.2) M(I,J)=AMIN1(AAV(I,J),R(I,J))
IF (R(I,J).GE.AAV(I,J)) MM(I,J)=1H+
IF (R(I,J).LT.AAV(I,J)) MM(I,J)=1H-
1 CONTINUE
CALL PRINT(M,L,Q)
CALL TYPE (MM,Q)
RETURN
END
```

Fig. H-4. Computer program listings


```
SUBROUTINE POST
DISPLAY $ $
DISPLAY $ $
DISPLAY $        POST TYPOLOGY $
DISPLAY $ $
DISPLAY $ $
DISPLAY #$I-    OBSERVATION & SUPERVISION$
DISPLAY $ $
DISPLAY #$      I-1 HOUSING AREA POSTS
DISPLAY #$      I-2 OUTSIDE POSTS
DISPLAY #$      I-3 MOBILE PATROL POST & GANGS$
DISPLAY $ $
DISPLAY $ $
DISPLAY #$II-   CIRCULATION CONTROLS
DISPLAY $ $
DISPLAY #$      II-1 GATE & MAIN ENTRANCES
DISPLAY #$      II-2 SALLYPORTS$
DISPLAY #$      II-3 BRIDGES, TUNNELS & ROTUNDA$
DISPLAY #$      II-4 ESCORTS$
DISPLAY #$      II-5 ELEVATORS$
DISPLAY $ $
DISPLAY $ $
DISPLAY #$III-  PROCESSINGS
DISPLAY $ $
DISPLAY #$      III-1 FEEDING (INMATE & OFFICER MESS HALLS)$
DISPLAY #$      III-2 KITCHENS
DISPLAY #$      III-3 RECEIVING ROOMS
DISPLAY #$      III-4 VISITS$
DISPLAY #$      III-5 COMMISSARYS
DISPLAY #$      III-6 RECREATION, LIBRARY & CHAPELS
DISPLAY #$      III-7 GENERAL OFFICE, SECURITY OFFICE,CONTROL ROOM,$
DISPLAY #$            STOREHOUSE,CASHIER,KEY & TOOL CONTROLS
DISPLAY #$      III-8 LAUNDRY (CLOTHES BOX & DISTRIBUTION) $
DISPLAY #$      III-9 BARBER SHOPS
DISPLAY #$      III-10 CLINICS
DISPLAY #$      III-11 COUNSEL ROOMS
DISPLAY #$      III-12 SOCIAL SERVICE $
DISPLAY #$      III-13 MAIL & PACKAGE ROOMS
DISPLAY #$      III-14 REVOLVER QUALIFICATION ( ARMS PRACTICE )$
DISPLAY #$      III-15 SKILLED MAINTENANCE (EXTERMINATOR,ROOFER,ELECTRICIAN)$
DISPLAY #$      III-16 EDUCATIONAL & VOCATIONAL PROGRAMS$
DISPLAY #$      III-17 BAKERY$
DISPLAY #$      III-18 RELIEFS
DISPLAY #$      III-19 TRANSFER OFFICER & MISCELLANEOUS$
DISPLAY #$      III-20 INFIRMARY$
DISPLAY #$ $
DISPLAY $ $
DISPLAY $ $
DISPLAY #$END OF SESSION - LOGOUTS
RETURN
END
```

Fig. H-5. Computer program listings

```
SUBROUTINE PRINT(M,L,Q)
REAL M(8,32)
INTEGER Q
REAL L
DISPLAY $ $
DISPLAY $ $
IF (Q.EQ.1) DISPLAY #$MAXIMUM RULES$
IF (Q.EQ.2) DISPLAY #$MINIMUM RULES$
IF (Q.EQ.3) DISPLAY #$LIBERAL RULE   $
IF (Q.EQ.3) DISPLAY #$VARIABILITY THRESHOLD FACTOR = $,L
IF (Q.EQ.4) DISPLAY #$CONSERVATIVE RULE $
IF (Q.EQ.4) DISPLAY #$VARIABILITY THRESHOLD FACTOR = $,L
DISPLAY $-$
DISPLAY $ $
DISPLAY #$              DECISION RULE MANPOWER ALLOCATIONS$
DISPLAY $ $
DISPLAY $ $
WRITE (0,10)
WRITE (0,18)
DISPLAY $ $
DISPLAY $ $
DO 1 I=1,7
M(I,29)=M(I,1)+M(I,2)+M(I,3)
M(I,30)=M(I,4)+M(I,5)+M(I,6)+M(I,7)+M(I,8)
M(I,31)=0.
DO 1 J=9,28
1 M(I,31)=M(I,J)+M(I,31)
DO 3 I=1,8
3 M(I,32)=M(I,29)+M(I,30)+M(I,31)
DO 2 J=1,32
M(8,J)=0.
DO 2 I=1,7
2 M(8,J)=M(8,J)+M(I,J)
WRITE (0,11) (M(I,29), I=1,8)
WRITE (0,12) (M(I,30), I=1,8)
WRITE (0,13) (M(I,31), I=1,8)
WRITE (0,14) (M(I,32), I=1,8)
DISPLAY $ $
DISPLAY $ $
DISPLAY #$POST SUBCATEGORIES$
DISPLAY $ $
DISPLAY $ $
DO 4 J=1,3
4 WRITE (0,15) J,(M(I,J),I=1,8)
DISPLAY $ $
DISPLAY $ $
DO 5 J=4,8
5 WRITE (0,16) J-3,(M(I,J),I=1,8)
DISPLAY $ $
DISPLAY $ $
```

Fig. H-6. Computer program listings


```
DO 6 J=9,28
6 WRITE (0,17) J-8,(M(I,J),I=1,8)
DISPLAY $ $
DISPLAY $ $
DISPLAY $ $
DISPLAY $ $
10 FORMAT ($POST                                 INSTITUTIONS)
11 FORMAT ($I$,12X,8(F5.1,2X))
12 FORMAT ($II$,11X,8(F5.1,2X))
13 FORMAT ($III$,10X,8(F5.1,2X))
14 FORMAT ($TOTAL$,7X,8(F6.1,1X))
15 FORMAT ($I-  $,I2,7X,8(F5.1,2X))
16 FORMAT ($II- $,I2,7X,8(F5.1,2X))
17 FORMAT ($III-$,I2,7X,8(F5.1,2X))
18 FORMAT ($CATEGORY     BRX   BRK   BRQ   WOM   MAN   QNS   ARS
RETURN                                                     TOTAL$)
END
```

```
SUBROUTINE STATS(AAV,R,D,S,C)
DIMENSION AAV(7,28),R(7,28),D(28),S(28),C(8)
DO 1 J=1,28
D(J)=0.
DO 2 I=1,7
2 D(J)=D(J)+C(I)*(R(I,J)-AAV(I,J))
1 D(J)=D(J)/C(8)
DO 3 J=1,28
S(J)=0.
DO 4 I=1,7
4 S(J)=S(J)+(R(I,J)-AAV(I,J)-D(J))**2
3 S(J)=SQRT( S(J)/6. )
RETURN
END
```

Fig. H-7. Computer program listings

```
COM-SHARE CENTER J 32
PLEASE LOG IN:J171RAND;MIL
READY, SYSTEM W04
 FEB 24 17:29
LAST LOGIN  FEB 24 17:25
PROJECT CODE: 3291

-XTRAN
VER.  FEB  8

+COMPILE /MANPOWER/
OUTPUT:/MPBIN/
OLD FILE? __
OPTIONS: NAMES
SUBROUTINE LIBCON(AAV,R,D,S,Q)
SUBROUTINE MAXMIN(AAV,R,Q)
SUBROUTINE MEAN(A,AAV,K1)
SUBROUTINE STATS(AAV,R,D,S,C)
SUBROUTINE PRINT(M,L,Q)
SUBROUTINE TYPE (MM,Q)
SUBROUTINE POST

+RUN
OPTIONS:__
SPROG:__
XLIBE  FEB  4


MANPOWER ANALYSIS & ALLOCATION PROGRAM (VERSION-1)


MANPOWER ALLOCATIONS & REQUESTS DATA PREVIOUSLY ENTERED?
TYPE HERE, 1=YES, 0=NO, THEN PRESS RETURN KEY: 1


ENTER DECISION RULE OPTIONS BY TYPING 1=YES, 0=NO
THEN PRESS THE RETURN KEY AFTER EACH CHOICE:


MAXIMUM RULE? :1
MINIMUM RULE? :0
LIBERAL RULE? :1
CONSERVATIVE RULE? : 0
```

Fig. H-8. Illustrative manpower analysis computer program execution

MAXIMUM RULE

DECISION RULE MANPOWER ALLOCATIONS

POST CATEGORIES	BRX	BRK	BRQ	WOM	MAN	QNS	ARS	TOTAL
			INSTITUTION					
I	98.8	102.9	78.0	143.3	166.5	69.6	202.3	861.3
II	23.9	70.1	41.2	22.8	30.0	64.4	51.3	303.7
III	63.5	93.0	53.0	109.5	104.9	55.9	237.1	717.1
TOTAL	186.2	266.0	172.2	275.6	301.4	190.0	490.7	1882.1

POST SUBCATEGORIES

I- 1	85.4	94.4	65.3	133.0	155.7	50.2	176.1	760.1
I- 2	9.6	2.9	6.2	0.0	4.1	11.7	4.9	39.4
I- 3	3.8	5.5	6.5	10.3	6.7	7.7	21.3	61.8
II- 1	13.9	14.6	20.1	9.6	19.1	25.1	14.6	117.0
II- 2	0.0	1.4	4.8	0.0	0.0	0.0	5.0	11.2
II- 3	0.0	33.0	3.4	0.0	0.0	21.8	1.7	59.9
II- 4	9.4	21.1	12.9	9.0	10.3	17.5	24.2	104.4
II- 5	0.6	0.0	0.0	4.2	0.6	0.0	5.9	11.2
III- 1	1.7	0.0	3.4	5.4	0.0	0.0	13.1	23.6
III- 2	5.0	5.1	5.0	6.7	5.0	5.9	13.4	46.0
III- 3	13.3	14.4	8.4	15.8	35.1	14.1	21.0	122.1
III- 4	7.2	7.8	1.2	7.2	7.7	4.8	4.3	40.2
III- 5	1.2	1.2	1.2	2.4	1.8	1.2	1.2	10.2
III- 6	6.7	21.6	3.4	7.0	13.6	8.1	58.9	119.3
III- 7	17.8	28.2	22.4	27.6	24.3	13.8	46.6	180.7
III- 8	2.4	1.2	0.0	6.5	1.2	1.2	5.1	17.5
III- 9	1.2	0.0	1.7	1.4	0.9	0.0	1.4	6.5
III-10	2.4	1.2	3.4	11.8	3.5	1.7	7.0	30.9
III-11	1.6	1.7	1.7	0.0	1.4	1.4	1.2	8.9
III-12	1.2	0.0	0.0	1.2	2.4	0.0	1.2	6.0
III-13	0.0	4.1	0.0	1.7	2.4	3.8	2.4	14.4
III-14	1.0	0.6	0.0	1.2	0.0	0.0	0.0	2.8
III-15	0.0	3.6	1.2	0.0	4.8	0.0	4.6	14.2
III-16	0.0	1.2	0.0	2.4	0.0	0.0	1.2	4.8
III-17	0.0	0.0	0.0	0.0	0.0	0.0	5.0	5.0
III-18	0.0	0.6	0.0	7.7	0.6	0.0	0.0	8.8
III-19	0.9	0.6	0.0	3.6	0.3	0.0	0.0	5.3
III-20	0.0	0.0	0.0	0.0	0.0	0.0	49.7	49.7

Fig. H-9. Illustrative manpower analysis computer program execution

POST SUBCATEGORIES	INSTITUTIONS BRX	BRK	BRQ	WOM	MAN	QNS	ARS
I- 1	+	-	+	+	+	+	-
I- 2	+	+	+	+	+	+	+
I- 3	+	+	+	+	-	+	+
II- 1	+	+	+	+	+	+	+
II- 2	+	+	+	+	+	+	+
II- 3	+	+	+	+	+	+	-
II- 4	+	+	+	+	+	+	+
II- 5	-	+	+	-	-	+	-
III- 1	-	+	+	-	+	+	-
III- 2	+	-	+	+	+	-	+
III- 3	-	+	+	-	+	+	-
III- 4	+	-	+	+	-	+	+
III- 5	-	+	+	+	-	+	-
III- 6	+	+	+	+	+	+	+
III- 7	-	+	+	+	-	-	-
III- 8	+	+	+	-	-	+	-
III- 9	+	+	+	+	-	+	+
III-10	-	+	+	+	-	+	-
III-11	-	-	+	+	+	+	+
III-12	+	+	+	+	+	+	+
III-13	+	+	+	+	+	+	+
III-14	+	-	+	+	+	+	+
III-15	+	+	-	+	+	+	-
III-16	+	+	+	+	+	+	+
III-17	+	+	+	+	+	+	+
III-18	+	-	+	-	-	+	+
III-19	-	-	+	-	-	+	+
III-20	+	+	+	+	+	+	+

\+ DENOTES REQUESTS HIGHER THAN AV. ALLOCATION
\- DENOTES REQUESTS LOWER THAN AV. ALLOCATIONS

Fig. H-10. Illustrative manpower analysis computer program execution

LIBERAL RULE

ENTER DESIRED VARIABILITY THRESHOLD FACTOR HERE
AND THEN DEPRESS RETURN KEY:1.0

LIBERAL RULE
VARIABILITY THRESHOLD FACTOR = 1

DECISION RULE MANPOWER ALLOCATIONS

POST CATEGORIES	INSTITUTION BRX	BRK	BRQ	WOM	MAN	QNS	ARS	TOTAL
I	98.6	98.8	78.0	135.3	138.7	66.2	165.4	781.0
II	23.3	56.9	37.1	19.8	30.0	62.2	42.6	271.8
III	50.8	86.2	49.0	80.3	95.3	52.9	204.8	619.2
TOTAL	172.7	241.9	164.1	235.4	263.9	181.2	412.7	1672.0

POST SUBCATEGORIES

I- 1	85.4	90.4	65.3	125.0	127.2	50.2	139.7	683.2
I- 2	9.4	2.9	6.2	0.0	4.1	8.3	4.9	35.7
I- 3	3.9	5.5	6.5	10.3	7.3	7.7	20.8	62.0
II- 1	13.9	14.6	16.6	9.6	19.1	22.1	14.6	110.6
II- 2	0.0	1.4	4.2	0.0	0.0	0.0	5.0	10.6
II- 3	0.0	19.8	3.4	0.0	0.0	21.6	0.0	44.8
II- 4	9.4	21.1	12.9	9.0	10.9	18.4	22.3	104.1
II- 5	0.0	0.0	0.0	1.2	0.0	0.0	0.6	1.8
III- 1	0.0	0.0	2.8	0.1	0.0	0.0	7.9	10.7
III- 2	5.0	5.3	5.0	6.7	5.0	6.2	13.0	46.1
III- 3	10.5	14.4	6.8	14.7	34.2	11.8	12.4	104.9
III- 4	5.6	7.2	1.2	5.8	6.0	4.8	4.3	34.9
III- 5	0.0	1.2	1.2	0.8	1.2	1.2	0.0	5.6
III- 6	7.9	21.6	3.4	8.4	13.6	8.1	54.4	117.3
III- 7	14.1	25.1	22.4	22.3	24.2	12.9	40.0	160.9
III- 8	2.4	1.2	0.0	3.8	0.0	1.2	4.8	13.4
III- 9	0.7	0.0	1.7	1.4	0.3	0.0	1.4	5.5
III-10	1.4	1.2	3.4	5.0	1.7	1.7	5.3	19.7
III-11	1.4	1.4	1.1	0.0	1.1	1.4	1.2	7.5
III-12	0.9	0.0	0.0	1.2	2.1	0.0	1.2	5.4
III-13	0.0	3.7	0.0	1.7	2.4	3.6	2.4	13.8
III-14	1.0	0.1	0.0	0.6	0.0	0.0	0.0	1.7
III-15	0.0	2.9	0.0	0.0	3.5	0.0	2.6	9.0
III-16	0.0	1.0	0.0	2.1	0.0	0.0	1.2	4.2
III-17	0.0	0.0	0.0	0.0	0.0	0.0	4.9	4.9
III-18	0.0	0.0	0.0	4.0	0.0	0.0	0.0	4.0
III-19	0.0	0.0	0.0	1.8	0.0	0.0	0.0	1.8
III-20	0.0	0.0	0.0	0.0	0.0	0.0	47.8	47.8

Fig. H-11. Illustrative manpower analysis computer program execution

POST SUBCATEGORIES	BRX	BRK	BRQ	WOM	MAN	QNS	ARS
			INSTITUTIONS				
I- 1				+	+		-
I- 2	+					+	
I- 3	-				-		+
II- 1			+			+	
II- 2			+				
II- 3		+				+	
II- 4					-	-	+
II- 5		+	+			+	-
III- 1			+	-			
III- 2		-				-	+
III- 3			+		+	+	-
III- 4	+			+			
III- 5				+			
III- 6	-			-			+
III- 7		+		+			
III- 8				-			
III- 9	+				-		
III-10				+			
III-11			+		+		
III-12	+				+		
III-13		+				+	
III-14		-		+			
III-15		+			+		-
III-16		+		+			
III-17							+
III-18				-			
III-19				-			
III-20							+

\+ DENOTES REQUEST IN HIGH REGION
\- DENOTES REQUEST IN LOW REGION

ARE THERE OTHER VARIABILITY THRESHOLD FACTORS FOR THIS RULE?
TYPE HERE, 1=YES, 0=NO AND PRESS RETURN KEY :0

Fig. H-12. Illustrative manpower analysis computer program execution

POST TYPOLOGY

I- OBSERVATION & SUPERVISION

I-I HOUSING AREA POST
I-2 OUTSIDE POST
I-3 MOBILE PATROL POST & GANGS

II- CIRCULATION CONTROL

II-1 GATE & MAIN ENTRANCE
II-2 SALLYPORTS
II-3 BRIDGES, TUNNELS & ROTUNDA
II-4 ESCORTS
II-5 ELEVATORS

III- PROCESSING

III-1 FEEDING (INMATE & OFFICER MESS HALLS)
III-2 KITCHEN
III-3 RECEIVING ROOM
III-4 VISITS
III-5 COMMISSARY
III-6 RECREATION, LIBRARY & CHAPEL
III-7 GENERAL OFFICE, SECURITY OFFICE,CONTROL ROOM, STOREHOUSE,CASHIER,KEY & TOOL CONTROL
III-8 LAUNDRY (CLOTHES BOX & DISTRIBUTION)
III-9 BARBER SHOP
III-10 CLINIC
III-11 COUNSEL ROOM
III-12 SOCIAL SERVICE
III-13 MAIL & PACKAGE ROOM
III-14 REVOLVER QUALIFICATION (ARMS PRACTICE)
III-15 SKILLED MAINTENANCE (EXTERMINATION,ROOFER,ELECTRIC)
III-16 EDUCATIONAL & VOCATIONAL PROGRAMS
III-17 BAKERY
III-18 RELIEF
III-19 TRANSFER OFFICER & MISCELLANEOUS
III-20 INFIRMARY

END OF SESSION - <u>LOGOUT</u>
STOP
($MAIN$)8+27

Fig. H-13. Illustrative manpower analysis computer program execution

Appendix I

COMPREHENSIVE POST TYPOLOGY

Table I-1

COMPREHENSIVE POST TYPOLOGY

01. OBSERVATION AND SUPERVISION

Posts primarily responsible for security of the institution and/or safety of the inmates.

01. Housing area post

02. Outside surveillance post

03. Outside work detail

04. Escort post

05. Relief post

06. Search

07. Court Holding or Assembly Pen

08. Court Feeder Pen

09. Small Court, entire function

02. CIRCULATION CONTROL

Posts primarily responsible for control of movement entering, within, and leaving the institution.

01. Gate

02. Bridge, tunnel, and rotunda

03. Elevator

04. Corridor patrol

03. PROCESSING SERVICES

Posts primarily responsible for initiating and updating inmate and personnel records, correspondence, and periodic reports.

01. Receiving Room

02. Administrative Offices (Warden's and Deputy Warden's Office, General Office, Personnel Office, Security Office, Cashier's Office, Court Register).

03. Storeroom

04. Control Room

05. Mail Room

06. Telephone Switchboard

07. Printing Services

04. BASIC INMATE SERVICES

Posts primarily responsible for delivery of basic required legal and health needs to the inmate population. This category includes custodial personnel who perform a function required by the service.

01. Meal services

02. Laundry services (includes clothes box)

03. Barber services

04. Maintenance services

05. Sanitation services

06. Religious services

07. Educational services (academic)

08. Powerhouse and heating services

09. Clothing services

05. OTHER INMATE SERVICES

Posts primarily responsible for maintaining and improving inmate morale and for providing programs and services to meet Departmental rehabilitation objectives. This category includes custodial personnel who perform a function required by the service.

01. Visiting services

02. Commissary services

03. Recreational services

04. Social services

05. Educational services (vocational)

06. Counsel services (other than legal)

07. Library services

08. Special programs

NOTE: Services that have traditionally been regarded as "vocational education shops" are not to be classified in the 05 section of the typology if the shop is production oriented.

Table I-1

06. CUSTODIAL SUPPORT SERVICES

Posts primarily responsible for providing custodial support for a service without which the service would not be rendered. This category is for custodial personnel only and those positions classified herein do not perform any function required by the service.

01. Meal services
02. Laundry services
03. Barber services
04. Counsel services (legal)
05. Counsel services (other than legal)
06. Maintenance services
07. Sanitation services
08. Religious services
09. Library services
10. Commissary services
11. Recreational services
12. Social services
13. Educational services (academic)
14. Educational services (vocational)
15. Special programs (e.g., Community Residential Facilities)
16. Medical, Mental Health, and Dental Services
17. Storeroom services
18. Court sessions (within institution)
19. Clothing services
20. Printing services

Table I-1

07. PERSONNEL TRAINING SERVICES

Posts primarily responsible for maintaining and improving personnel effectiveness through training.

01. Firearms Qualification
02. Emergency Training
03. In-service Training

08. TRANSPORTATION SERVICES

Posts primarily responsible for the movement of persons and supplies.

01. Transport of inmates -- Driver
02. Transport of inmates -- Escort
03. Transport of personnel
04. Transport of supplies
05. Vehicle maintenance
06. Vehicle and garage security
07. Clerical services
08. Dispatching services
09. Administrative Office

 Table I-1

09. INSTITUTIONAL ADMINISTRATION AND MANAGEMENT

Posts primarily responsible for effective leadership, management, and supervision at the institution level. This category includes only uniformed superior officer positions.

01. Command responsibility
02. Executive management
03. Administration services
04. Custody/Security services
05. Tour Command responsibility
06. General supervision
07. Control Room
08. Personnel and work schedules
09. Receiving Room
10. Visits
11. Meal services
12. Sanitation
13. Recreation
14. Program coordination
15. General Office
16. Maintenance
17. Commissary

END