[redacted]

[redacted]

REPORT
RAC-R-20

31 DECEMBER 1966

Cost Analysis of Supersonic Transport in Airline Operation

Volume II

by

Research Analysis Corporation
Robert A. Booth
Ansel V. Gould
Samuel A. LaMar
Lawrence G. Regan, *Study chairman*

Resource Management Consultants, Inc.
James L. Johnston
James C. Willyard

STATEMENT NO. 1
Distribution of This Document is Unlimited

RAC RESEARCH ANALYSIS CORPORATION
McLean, Virginia

[redacted]

F
210

[redacted]

NOTICES

When Government drawings, specifications, or other data are used for any purpose other than in connection with a definitely related Government procurement operation, the United States Government thereby incurs no responsibility nor any obligation whatsoever; and the fact that the Government may have formulated, furnished, or in any way supplied the said drawings, specifications, or other data, is not to be regarded by implication or otherwise as in any manner licensing the holder or any other person or corporation, or conveying any rights or permission to manufacture, use, or sell any patented invention that may in any way be related thereto.

Co[redacted] been placed in the [redacted]llection. U[redacted] Governm[redacted]nt [redacted]gencies may ob[redacted] from DDC. A[redacted]s request from:

Clearinghouse for Federal Scientific & Technical Information
5285 Port Royal Road
Springfield, Virginia 22151

DDC release to Clearinghouse for Federal Scientific and Technical Information (CFSTI) is authorized.

[redacted]

[redacted]

SCIENCE AND ENGINEERING DEPARTMENT
REPORT RAC-R-20
Published 31 December 1966

Copy 45 of 220

Cost Analysis of Supersonic Transport in Airline Operation

Volume II

by

Research Analysis Corporation
Robert A. Booth
Ansel V. Gould
Samuel A. LaMar
Lawrence G. Regan, *Study Chairman*

Resource Management Consultants, Inc.
James L. Johnston
James C. Willyard

This study has been prepared by the Research Analysis Corporation for the Office of Supersonic Transport Development, Federal Aviation Agency, under Contract No. FA-SS-66-12. Contents of this study reflect the views of the contractor, who is responsible for the facts and the accuracy of the data presented herein, and do not necessarily reflect the official views or policies of the FAA. This study does not constitute a standard, specification, or regulation.

RAC RESEARCH ANALYSIS CORPORATION
McLean, Virginia

[redacted]

FOREWORD

The development and introduction into operation of the supersonic transport (SST) is a matter of national policy. This policy will be made at the Executive level partly through economic analyses. The Federal Aviation Agency (FAA) has a major responsibility in conducting the economic analyses of airline operations involving the SST and advanced subsonic jet airliners. This report describes an analysis of the aircraft operating costs and represents the contribution of Research Analysis Corporation to the FAA SST program.

The source of much of the information received from the aviation industry has not been identified in this report because of the need to respect the proprietary nature of the data.

C. G. Whittenbury
Head, Science & Engineering Department

ACKNOWLEDGMENTS

A study of the introduction of a new aircraft into airline service requires that the projection of the operational environment be the prime consideration in the estimate of operating costs. For this reason emphasis was placed on the views expressed by the airlines. The authors express grateful appreciation for the time and effort of many airline personnel visited during the conduct of this study.

The individual airlines and personnel contacted are identified in Appendix F. Special thanks are due to Mr. George P. Hitchings and Mr. D. Lloyd Jones of American Airlines, whose staff prepared a helpful critique of an earlier report. The TWA staff of Mr. R. Verne Radcliffe were most cooperative, in particular Mr. Ross Santy, who provided valuable suggestions in the development of the indirect cost relations. Messrs. E. Arnold, W. Sherwood and D. Gaffe under the staff headed by Mr. N. Parment of TWA at Kansas City provided valuable assistance. Thanks also are extended to the staff of Mr. William Crilly of Eastern Airlines for their help in this study. A special thank you is due Mr. Ed Kelly and Miss Norma Fleer of the Air Transport Association for making available to RAC the statistical data on airline operations compiled by that organization.

The counsel of Mr. Jay Constantz and Mr. Frank Lewis of the CAB in particular are appreciated and the cooperation and guidance furnished by all members of the Federal Aviation Agency SST Economics staff were of special value.

The manufacturers provided vital input on performance of the aircraft examined in this report. The cooperation of Mr. W. Kennedy and Mr. Robert Stoessel of Lockheed Aircraft is gratefully acknowledged, as is the assistance of Mr. C. Jackson and Mr. K. Sansborne of the Boeing Company.

Appreciation is also expressed to the subcontractor, Resources Management Consultants, for their participation and contribution to the maintenance costs during this study.

Certain members of the Research Analysis Corporation are due thanks in the completion of this report. Mr. Jean Du Vivier as consultant assisted in the design of the Mission Performance Model, and Mr. Richard Parker's services contributed much to the model development. A major contribution was made also by Dr. Harold E. Fassberg. Thanks are extended also to Mrs. L. Rinehart, Mrs. B. Knott and Mrs. B. Foster for aid in the handling of the large volume of statistical data.

Mr. L. G. Regan, Chairman of the Study, wishes to thank personally the many aircraft companies, airlines, and individuals who generously assisted the Study Group in obtaining data for the Study.

CONTENTS

Tables

[redacted]

Cost Analysis of Supersonic Transport in Airline Operation

Volume II

VOL. I: AD 652 311

[redacted]

ABBREVIATIONS

AFI	aircraft fuel issued
AFS	aircraft fleet size
ASM	available seat-miles
ATA	Air Transport Association
BAARINC	Booz-Allen Applied Research, Inc.
BAC	Boeing Aircraft Corporation
CAB	Civil Aeronautics Board
CAT	clear-air turbulence
CER	cost-estimating relations
DOC	direct operating cost
FAA	Federal Aviation Agency
GE	General Electric Company
IDA	Institute for Defense Analyses
IOC	indirect operating cost
LAC	Lockheed Aircraft Corporation
MISST	Mission-Supersonic Transport
MTSFC	maximum thrust specific fuel consumption
NE	number of engines
NE	Northeast
OCMODL	Operating Cost Model
ORI	Operations Research, Inc.
P	piston aircraft
PA	Pan American, Atlantic
PAX	passengers
P.D.	property damage
P.L.	public liability
PP	Pan American, Pacific
P&W	Pratt and Whitney
PRC	Planning Research Corporation
RAM	revenue aircraft miles
RMC	Resources Management Corporation
RPMs	revenue passenger miles
SST	supersonic transport
TOC	total operating cost
TV	year of the first flight

SURVEY OF METHODOLOGY

DIRECT OPERATING COSTS

The economic implications of SST have been studied by several groups. Consequently there exists a legacy of techniques for the estimation of SST operating costs. The Air Transport Association devised two systems of equations for predicting airline operating costs, one in 1960[1] and a proposed draft set in 1966. The latter method has not yet been given official publication because of the many suggestions for improvement that were offered by airline personnel and equipment manufacturers. The 1966 set of equations, based on turbojet and turbofan experience and accumulated in large part subsequent to 1960, are more appropriate for estimating the SST costs.

Aircraft and aircraft engine manufacturers also have produced cost-estimating techniques. Eight such techniques are considered in this document. The most recent are those generated by LAC[2] and BAC.[3]

To facilitate discussion the names of the groups formulating estimating techniques have been coded in the following manner.

ATA60	Air Transport Association, 1960
ATA66	Air Transport Association, 1966
ORI	Operations Research Incorporated, 1964
PRC	Planning Research Corporation, 1964
LAC66	Lockheed Aircraft Company, 1966
GE	General Electric Company, 1965
P and W	Pratt and Whitney Aircraft, 1965
FAA66	Modified ATA60 for DOC and Boeing-Lockheed for IOC
BAC66	Boeing Aircraft Company, 1966

The BAC formulas were received too late for CER evaluation; however, the operation costs are compared in the section on Airline Operating Cost Results in Vol I of this report.

The two engine manufacturers have offered separate techniques for estimating the costs of maintaining aircraft engines.[4,5] While other direct-operating costs are not discussed by the engine manufacturers, the engine maintenance data are of sufficient magnitude to warrant review of these separate techniques.

Methodology Review

A primary feature of the eight aircraft operating-cost techniques is number of equations. The PRC method comprises 38 equations, not including the procurement cost formula. The ATA60 is the smallest, having only 19 equations. The P and W method, concerned only with engines, has six equations. The ATA66, ORI, and LAC methods have 25, 24, and 28 equations, respectively. The engine-only technique of GE has four equations.

The underlying assumption is that system cost estimates are obtained by summing the estimates of the system's cost elements, e.g., crew costs, fuel, airframe maintenance and labor, and material. This method, used by the airframe manufacturers, consists of the following procedural steps: (a) the proposed system is reduced to the small cost elements comprising the system, (b) each cost element in the proposed system is compared with existing like elements, (c) the cost of the existing elements is "scaled-up" to reflect the engineers' judgment of increased complexity, and (d) the resulting cost level is assigned to the elements of the system to be costed. The costs of all elements are then summed to achieve a system cost. The quality of the cost estimate depends on (a) the soundness of engineers' judgment, and (b) the capability of identifying subsystems and establishing associated aircraft and airline costs.

The component-by-component technique is applied to achieve aircraft operating costs when applicable cost experience is lacking.

The methodology adopted by all of the cited groups is complex and requires computer programming to compare the method results. None of the groups attempt to predict aggregations of operating costs such as total direct maintenance of flight equipment, total aircraft operating expense less depreciation, or the many combinations of maintenance costs. Since maintenance is identified by labor and material categories and, if performed in-house, by contract, many subtotals of maintenance are possible. The simplification that would result from such practice is clear.

There is another advantage not quite as evident, however. It has been advised that caution should be exercised when testing data reported by airlines. The claim is made that despite an attempt by the CAB to standardize the reporting system, variations in airline accounting practices cause the same costs to be categorized differently. Sometimes airline policy causes a task to be performed differently, resulting in reporting peculiarities. An airline, for example, may elect to have some maintenance contracted thus shifting costs from in-house categories. To establish the degree to which this practice occurs, assuming the above observations to be accurate, the examination of several levels of aggregation would appear beneficial. Benefit may result from a determination of the levels at which aggregation occurs, followed by the formulation of adjustments for each airline within the predictive equation with the use of discontinuity variables.[6] Not only is it possible to improve the simplicity of the predictive technique, it also is possible to test and quantify complex differences in the data.

Some weak points encountered in the eight-method survey are not applicable to each of the eight methods. However, the weak points are important considerations in order to test and evaluate performance using actual cost experience. One example is the cost of the manufacturer's product. The major interest of P and W and GE is that the cost implication of their predictive equations reflect the engine that is manufactured by the respective company. For most part P and W and GE exclude nacelle maintenance, removal and installation, inventory costs, and many other costs that are not engine overhaul.

This factor makes comparison with actual costs difficult as like items are not being measured.

Another approach to costing is the use of predicted complexity factors, using as a basis the subsonic aircraft system and subsystems for escalating to similar maintenance costs for the SST. All four manufacturers (BAC, LAC, P and W, and GE) and airlines have expressed a preference for estimating operating costs using the system and subsystem method. The LAC, GE, and, to some degree, the ATA60 and ATA66 equations were developed using data other than that reported to the CAB. A comparison of the results with the CAB actuals shows variable differences. A need exists for both approaches; one based on historical relations and one based on operational estimates that reflect best technical judgments in the untried SST environment.

INDIRECT OPERATING COSTS

Indirect operating cost is that cost associated primarily with the ground activities of airline operations.

In June 1964 the FAA established a requirement for the formulation of predictive equations for airline indirect costs to (a) provide a realistic method for estimating indirect costs for use in economic model computations required for the Phase II A Supersonic Transport and (b) permit submission of reasonable indirect cost formulas to the Air Transport Association of America for possible integration into a standard method estimating the total operating expense of transport aircraft.

The formulation of these estimating equations was undertaken as a joint project by BAC and LAC (BAC-LAC formulas). Subsequent to this initial effort further work was done on indirect operating costs predictive equations by ORI and PRC. In 1966 LAC undertook to further examine more exact ways of estimating indirect operating cost.

The data discussed in this report is a further extension of the effort to establish IOC formulas.

In actual airline practice no standard method of estimating IOCs exists. Each airline pursues in a manner most suitable for its operations its own method of estimating and controlling indirect operating costs. These methods, of course, vary widely between different airlines. Traditionally, indirect operating costs have been thought of in terms of their ratio to the total operating costs. Because indirect costs are affected by management policy, discretionary decisions, and the amount of traffic carried, the ratio of IOC to TOC varies widely between airlines. The IOC-TOC ratio of each airline fluctuates from year to year reflecting varying operating conditions.

Figures 1 and 2 illustrate historical IOC-TOC ratios for four domestic carriers and three US Flag international carriers.

These charts dramatically point up the facts that (a) equations developed from industry average statistics will not predict accurately the IOCs of any particular airline, and (b) the use of these equations by an airline would require coefficients developed for that airline with modifications made from year to year reflecting changes in airline policy.

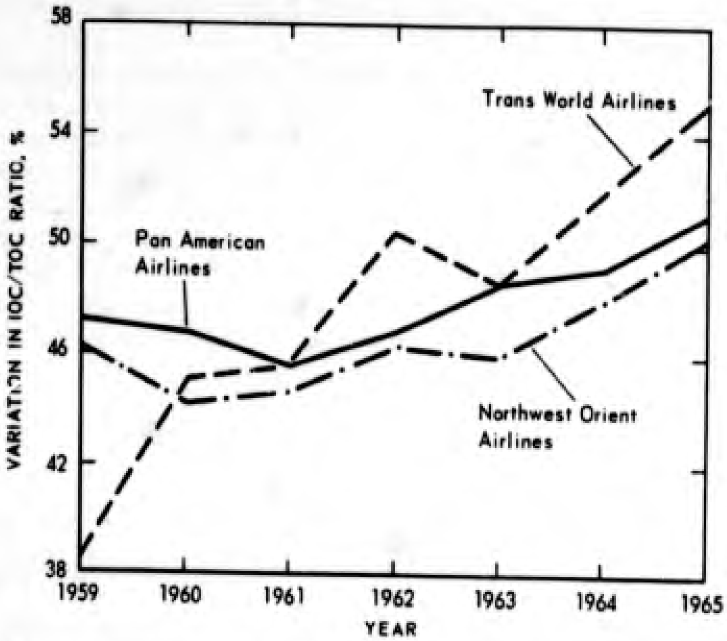


Fig. 1—Variations in Yearly IOC/TOC Ratio, International Airlines

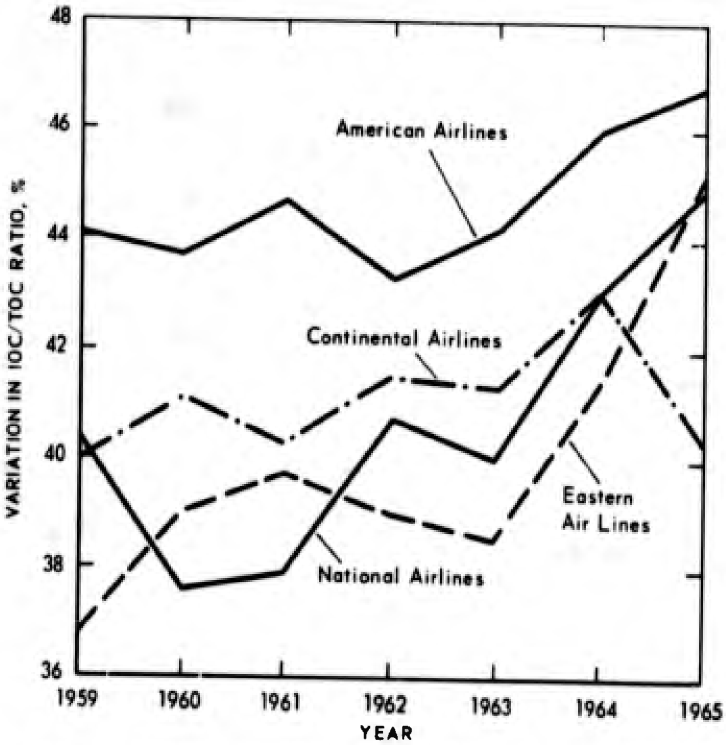


Fig. 2—Variations in Yearly IOC/TOC Ratio, Domestic Airlines

The value of the equations as presented lies in their use as predictors of airline industry IOCs as an aid in establishing total operating costs for economic study considerations.

Methodology Review

In undertaking the study of indirect operating costs an extensive review was made of available reports on the SST. In addition the cost-estimating relations developed by the organizations listed were reviewed and analyzed.

Operations Research, Inc.	ORI
Planning Research Corporation	PRC
Boeing-Lockheed	FAA66
Lockheed	LAC66

The review of the CERs included detailed discussions with personnel of airlines and airframe manufacturers to obtain plans and opinions of persons who have had lengthy and extensive experience in these matters and who have a vested interest in the airline industry.

Evaluation of Previous CERs

The CERs developed by ORI are composed of five formulas associated with the costs reported in various functional accounts of CAB Form 41. These are contained in ORI report No. 295 dated 15 Dec 1964. The groupings of expenses are shown in Table 1.

The costs identified in items 3, 4, and 5 of Table 1 are simple groupings of expenses that are easily identified. These three groupings account for 10 to 14 percent of total indirect-operating costs and vary between individual airlines.

TABLE 1

ORI Expense Groupings and Related CAB Form 41 Accounts

ORI expense group	Form 41 functional accounts
Costs incident to dispatching, handling, and servicing aircraft at terminals	6100 Aircraft servicing 6300 Servicing administration
Costs associated with the promotion, sale, handling, and servicing of all types of air traffic	5500 Passenger service 6200 Traffic service 6300 Servicing administration 6500 Reservations and sales 6600 Advertising and publicity
Costs associated with the maintenance of ground property and equipment and the associated burden	5200 Direct maintenance 5300 Maintenance burden
Costs associated with general and administrative activities	6800 General and administrative
Depreciation charges for all types of ground equipment and property	7000 Depreciation and amortization

TABLE 2

Comparison of Predicted Aircraft Servicing Costs vs Actual Costs

Year	k_{15}, dollars	Departures, maximum takeoff gross weight	C_{15}, thous of dollars	Actual costs, thous of dollars	Ratio of predicted costs to actual costs, %
1962	1.17	237,353,327	277,703	189,008	146
1963	1.17	248,250,080	290,452	206,439	141
1964	1.17	296,581,353	347,000	216,650	159
1965	1.17	311,618,295	364,593	238,184	153

TABLE 3

Comparison of Predicted Traffic Servicing Costs vs Actual Costs

Year	k_{16}	Y, thous of dollars	C_{16}, thous of dollars	Actual costs, thous of dollars	Ratio of predicted costs to actual costs, %
1962	0.262	1,899,065	497,555	536,003	92
1963	0.262	2,083,050	545,759	584,848	93
1964	0.262	2,365,773	619,832	672,659	92
1965	0.262	2,759,994	723,118	805,604	90

TABLE 4

Actual Industry Costs for Nine Airlines

(Thousands of dollars)

Functional account	1962	1963	1964	1965
6300 allocated prorata to each of the groupings below	39,246	41,285	42,270	39,942
Item 1				
6100	175,512	192,213	203,302	226,545
6300	13,496	14,226	13,348	11,639
Total	189,008	206,439	216,650	238,184
Item 2				
5500	155,766	172,508	204,079	254,940
6200	128,497	140,059	157,602	192,836
6300	25,750	27,059	28,922	28,303
6500	173,735	183,837	210,681	237,690
6600	52,255	61,385	71,375	91,835
Total	536,003	584,848	672,659	805,604

The CERs derived from these costs show strong correlation with the selected variables used for each individual CER. The costs identified in items 1 and 2 of Table 1, however, are aggregates of many dissimiliar activities. Although these activities can be related to general headings of aircraft servicing and air-traffic servicing, in reality they represent a broad spectrum of activities having little or no relation to each other.

Since items 1 and 2 represent 87 to 90 percent of the total indirect-operating costs, a check was made of these two items against the reported costs of nine domestic airlines for a 4-year period to examine the predictive accuracy. The nine airlines represented are American Airlines (AA), Braniff International (BN), Continental Airlines (CO), Delta Air Lines, Inc. (DL), Eastern Air Lines (EA), National Airlines, Inc. (NA), Northwest Airlines, Inc (NW), Trans World Airlines, Inc (TW), and United Air Lines (UA). The tabulated cost comparison results are presented in Tables 2, 3, and 4.

Item 1: Aircraft Servicing

Aircraft Servicing costs were derived through use of ORI formula C_{15} (see Table 2). The following assumptions served as a base.

$$\text{ORI formula } C_{15} = k_{15}(W_g/1000)$$

where C_{15} = costs accrued against Functional Account 6100 Aircraft Servicing plus prorata allocation of Account 6300 Servicing Administration

k_{15} = \$1.17 (from ORI report)

$$W_g/1000 = \frac{\text{aircraft departures} \times \text{maximum takeoff gross weight}}{1000}$$

The W_g /1000 numbers were derived from CAB Form 41 statistics of total departures of all types of aircraft times the respective maximum takeoff gross weight (see App D for the appropriate derivation).

Item 2: Traffic Servicing

Traffic Servicing costs were ascertained in the following manner based on the assumptions stated.

$$\text{ORI formula } C_{16} = k_{16} Y$$

where C_{16} = costs accrued against Functional Accounts 5500, 6200, 6500, and 6600 plus allocation of 6300

k_{16} = .262 (from ORI report)

Y = total yearly passenger revenues for nine airlines as reported in Form 41 Accounts 3901.1 and 3901.2

Actual costs obtained from CAB Form 41 statistics are shown in Tables 3 and 4.

The indirect operating costs predicted by the ORI formulas were compared with costs predicted by the other methodologies. The results of this comparison of two types of aircraft are shown in Figs. 3 and 5 for domestic operations and in Figs. 4 and 6 for international operations. The comparison

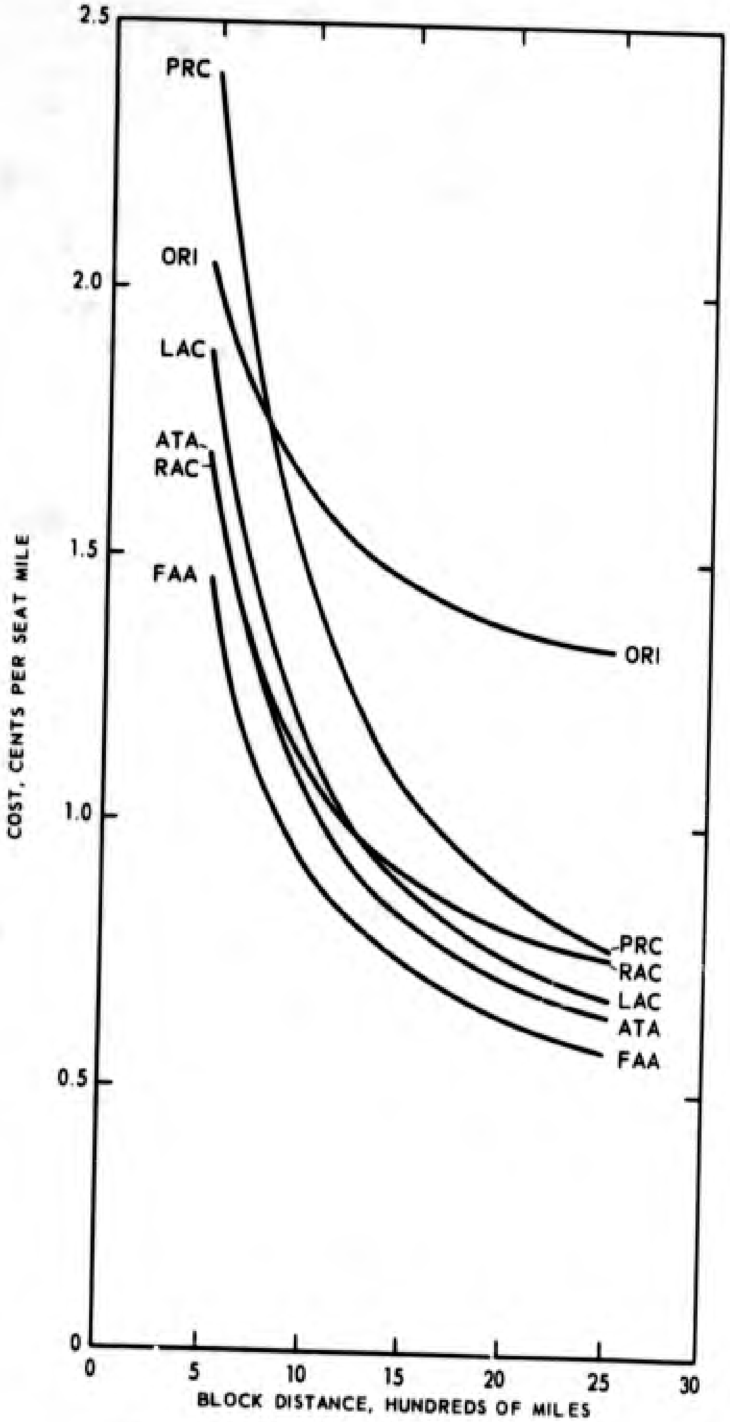


Fig. 3—Indirect Operating Costs for US SST Domestic Operations

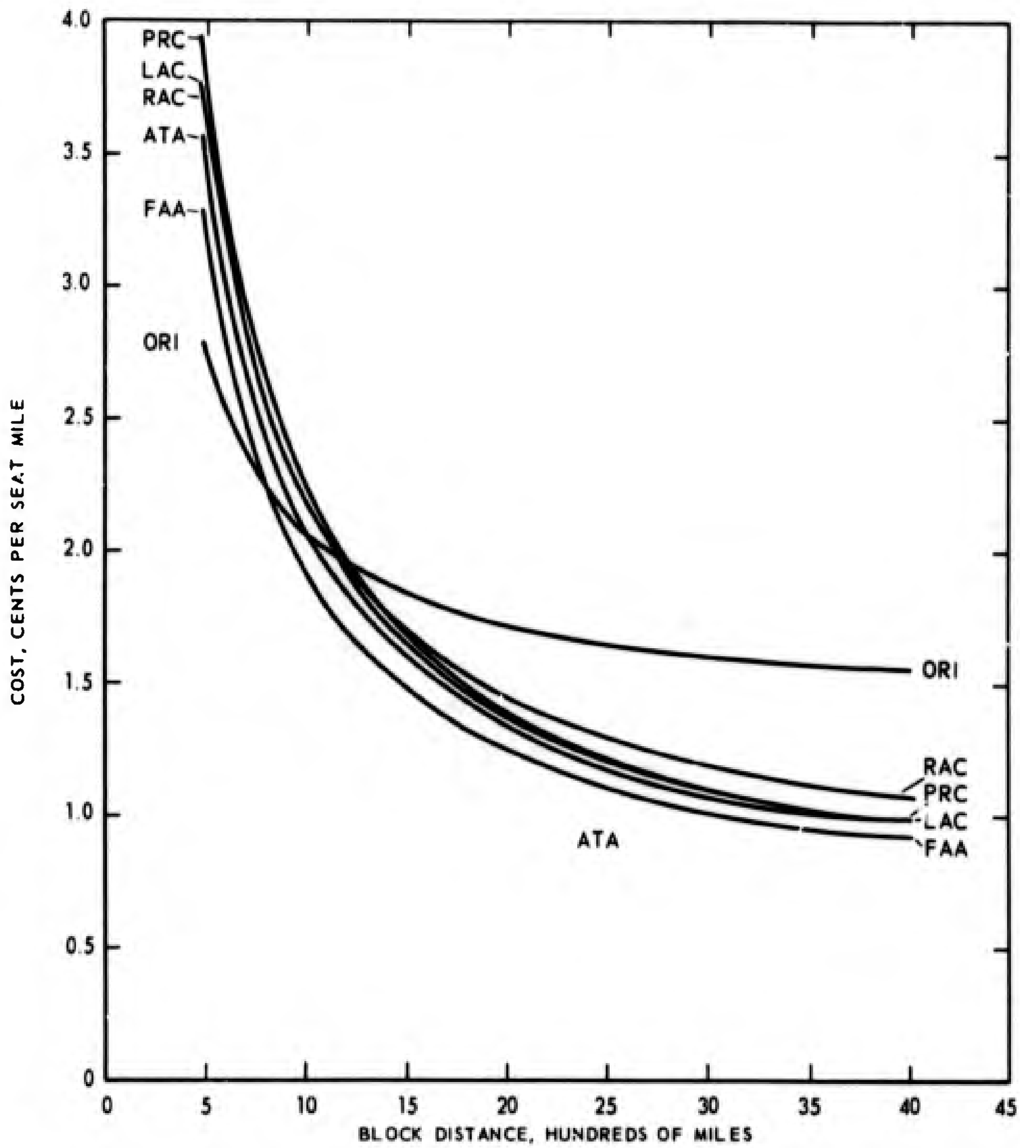


Fig. 4—Indirect Operating Costs for US SST International Operations

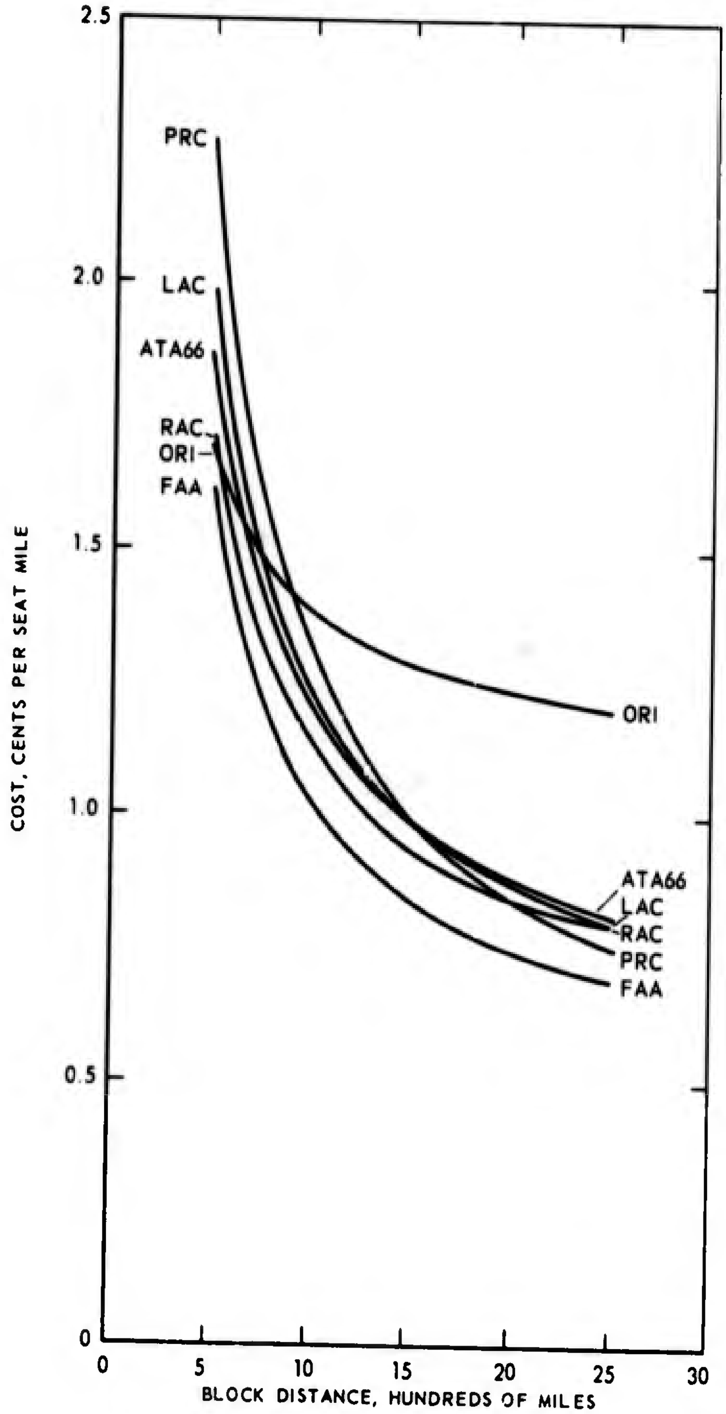


Fig. 5—Indirect Operating Cost for 707-320B Domestic Operations

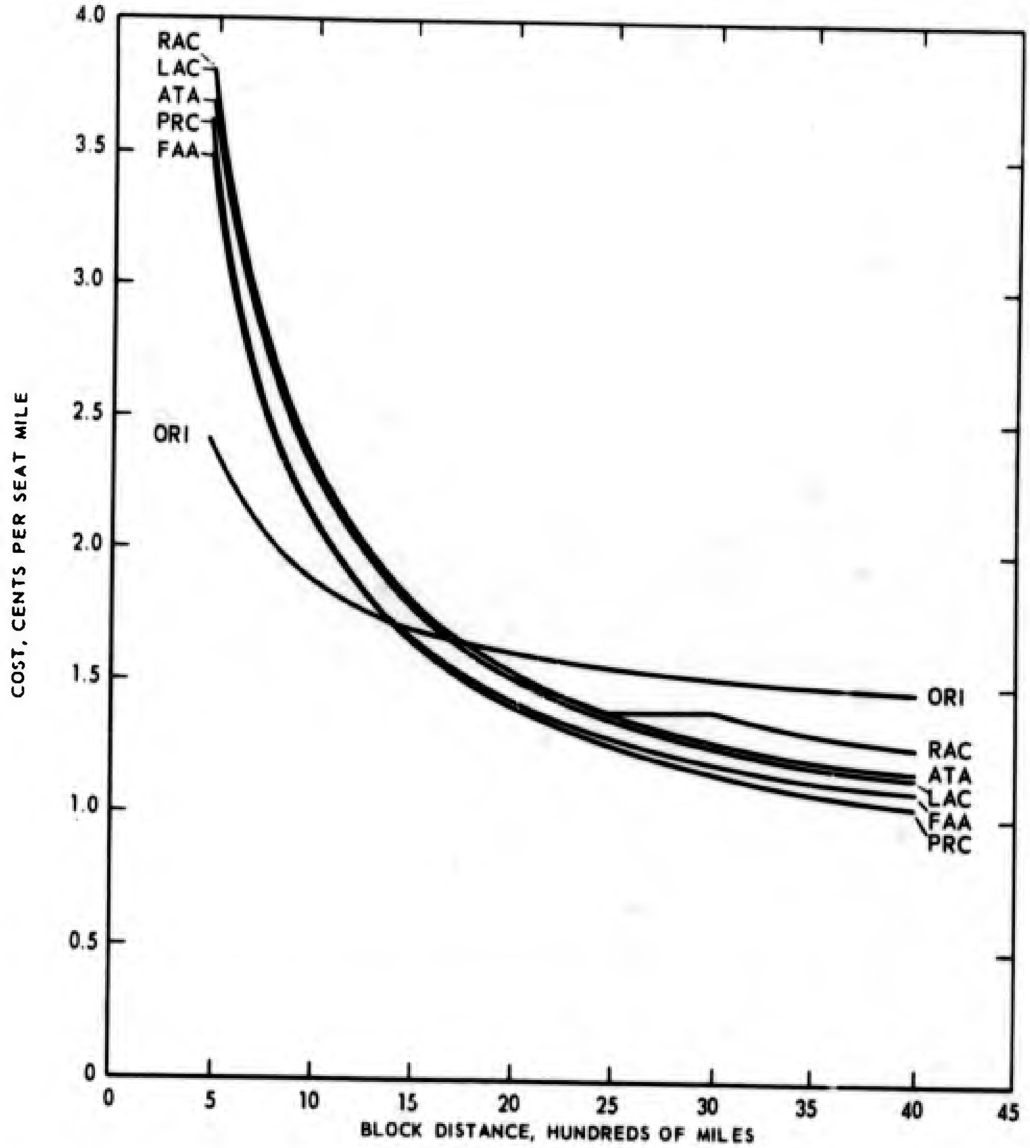


Fig. 6—Indirect Operating Costs for 707-320B International Operations

of domestic operations of the US SST shows that costs predicted by the ORI CERs are more than 50 percent greater than costs predicted by other methodologies and more than 35 percent greater on the US SST in international operations. With this evident difference in predicted costs the decision was made to concentrate on the other methods.

An analysis of the predictive equations developed by Boeing-Lockheed (BAC-LAC) (FAA Ground Rule method), Planning Research Corporation, and LAC66 indicated that these methodologies were essentially the same. However, the equations developed in the LAC66 method predicted costs based on aircraft departures instead of dollars per block hour as in the FAA Ground Rule FAA66 method. Initial examination of the LAC66 equations indicated that this method represented a refinement over many of the equations since the costs represented are most closely identified with ground departure activities. Therefore cost should be measured in terms of departure rather than in terms of dollars per block hour. Statistics were compiled on airline operations covering the 7-year period 1959–1965. These data were used as appropriate in the analysis of each of the 10 equations. Each of the formulas was analyzed for relevancy and for possible improvement. In all cases, coefficients were developed that differed from those shown in the FAA66 and LAC66 methods and reflected the use of data established by the broader statistical base.

RAC Eqs 3 to 10 predict costs of the same activities predicted in the FAA66 and LAC66 Eqs 3 to 10. RAC Eq 1, however, differs in that all costs associated with Ground Property and Equipment Maintenance, Burden, and Depreciation are included in the one equation, whereas the FAA and LAC equations differentiated between the local and system expenses of these items and included these expenses in Eqs 1 and 2. An examination of the data reported on Schedule P-9.2, i.e., Ground Servicing Expenses by Geographic Location, revealed the difficulties involved in identifying costs against local or system accounts. Many arbitrary decisions would have to be made by the analyst in apportioning these expenses. Discussions were held with representatives from several airlines relative to this problem; the difficulty in identifying local or system expenses in many General Ground Property and Equipment categories was emphasized. Further, the expenses in these accounts approximate only 4 to 6 percent of the total indirect operating costs, depending on the individual airline.

For the reasons given resultant simplification of the formulas together with the expense prediction of Ground Property and Equipment is included in RAC formula, Eq 1. RAC Eq 2 predicts only those costs associated with Aircraft Servicing, less Aircraft Control, plus an allocated portion of Service Administration.

PRICE INDICES

A review of US economic history was made to determine whether inflationary or deflationary trends underlie the yearly airline operating costs collected for the 1959–1965 period. Where such trends are found to exist, application of a price index is required for a comparison of costs incurred in different time periods.

Our economic history reflects a generally increasing level of prices. For example, manufacturing hourly wages have increased from $1.45 per hour in 1950 to $2.26 per hour in 1960.[7] This represents an average annual increase of 4⅓ percent.

The wage trend is not the only factor in the determination of labor cost changes. Productivity also affects the cost of performing a given task. If a worker earning $1.45 per hour produced one unit per hour in 1950, and this same worker earning $2.26 per hour can produce 1.56 units per hour in 1960, the labor cost per unit remains $1.45 per unit. Thus the labor cost has remained constant and an adjustment is not required before comparison can be made. However, if the worker's hourly production does not increase at the same rate as his wage, then some adjustment is required to obtain comparable costs in the two time periods.

The estimate of productivity for the airline industry is based on RPMs per airline employee. This measure does not reflect the cargo operation of the industry. However, the passenger revenues are the dominant part of the total airline revenues (87 percent in 1964). Thus it is not likely that omitting cargo productivity will distort the analysis to any serious degree.

Several other measures were candidates for expressing productivity. Revenue aircraft miles and available seat-miles both were rejected in favor of RPMs because the latter incorporates distance traveled and passengers carried.

The FAA suggested that cost-predicting formulas produce cost estimates phrased in constant 1967 dollars. One method of accommodating this requirement was to examine the 1959–1965 data, extrapolate the trend to 1967, and then make the proper adjustment so all costs could be expressed in constant 1967 terms.

The method selected to predict airline operating costs was that of estimating relations based on operating experience. This resulted in the collection of airline operating costs by year for the period 1959–1965. The data were obtained from the CAB Form 41 concerned with airline operating costs. Before these costs could be treated as homogeneous and predictive equations derived, certain airline industry cost-time trends and productivity rates had to be examined. The findings of this examination provide a rough indication of the nature of adjustment to the 1959–1965 data and reflect the inflationary or deflationary movement in airline operating costs. It was necessary to account for the effects of time on the airline operating costs for the period specified.

The major categories of airline operating costs shown in Table 5 were obtained for 1964. Depreciation accounts for 10 percent of the overall airline operating costs, POL costs represent 15.7 percent, maintenance material requires 11.7 percent, and other indirect expense equals 21.7 percent of the total operating cost figure. Labor cost is the largest segment of airline operating cost, representing 40.9 percent of the total.

Airline labor-based costs were examined to determine if any significant trends were evidenced in the period 1958–1964. This time period corresponds roughly to the time frame of the yearly costs obtained for this study. The average annual wage for all airline employees was selected to test the possible trend(s) over a specified period of time. The computation was made as indicated.

$$\text{Average annual wage} = \frac{\text{total airline payroll}}{\text{total airline employees}}$$

TABLE 5

1964 Operating Cost Breakdown

Description of cost	Amount, dollars	Percent
Total operating cost	3,674,097	100.0
Depreciation	367,191	10.0
Direct flight expense other than labor	578,560	15.7
Maintenance expense other than labor	430,373	11.7
Indirect and ground expense other than labor	795,314	21.7
Wages	1,502,659	40.9
Flying operations	415,713	11.3
Maintenance	294,905	8.0
Indirect and ground expense	792,041	21.6

TABLE 6

Price Index Data

Year	Number of employees	Payroll, dollars	Average annual salary, dollars	RPMs	RPMs per employee
1958	147,150	882,184	5995	31,499,437	214,063
1959	160,690	1,046,571	6513	36,371,811	226,348
1960	192,771	1,083,853	6659	38,862,794	238,757
1961	166,493	1,187,470	7132	39,830,846	239,234
1962	169,073	1,234,271	7300	43,760,413	258,826
1963	175,439	1,347,816	7683	50,342,042	287,063
1964	187,938	1,502,664	7996	58,463,654	311,079
1965[a]					

[a]Not available at report publication date, 15 Dec 66.

The data concerned with the three factors of this computation are shown in Table 6.

An upward trend averaging 4.8 percent per year for the period 1958–1964 is indicated in Fig. 7. The time period 1958–1964 was selected because this was the latest 7-year period (the number of years contained in the data) for which employment and earnings data were conveniently available.

For the period 1958–1964 labor-based costs reflect an apparent uniform rate of increase (see Table 6). The estimate of productivity per worker is shown to be increasing at a like rate. As illustrated in Fig. 7, productivity increased about 45 percent, mechanic's salary about 35 percent, and copilot's salary about 42 percent. The implication can be drawn that costs, in relation to productivity, have changed very little (if at all) in the observed 7-year period. The net difference between the mechanics' salary increases and the offsetting productivity rate varies ±5 percent. The difference for pilots and copilots is 1.5 percent. When the differences among airlines and the aggregated nature

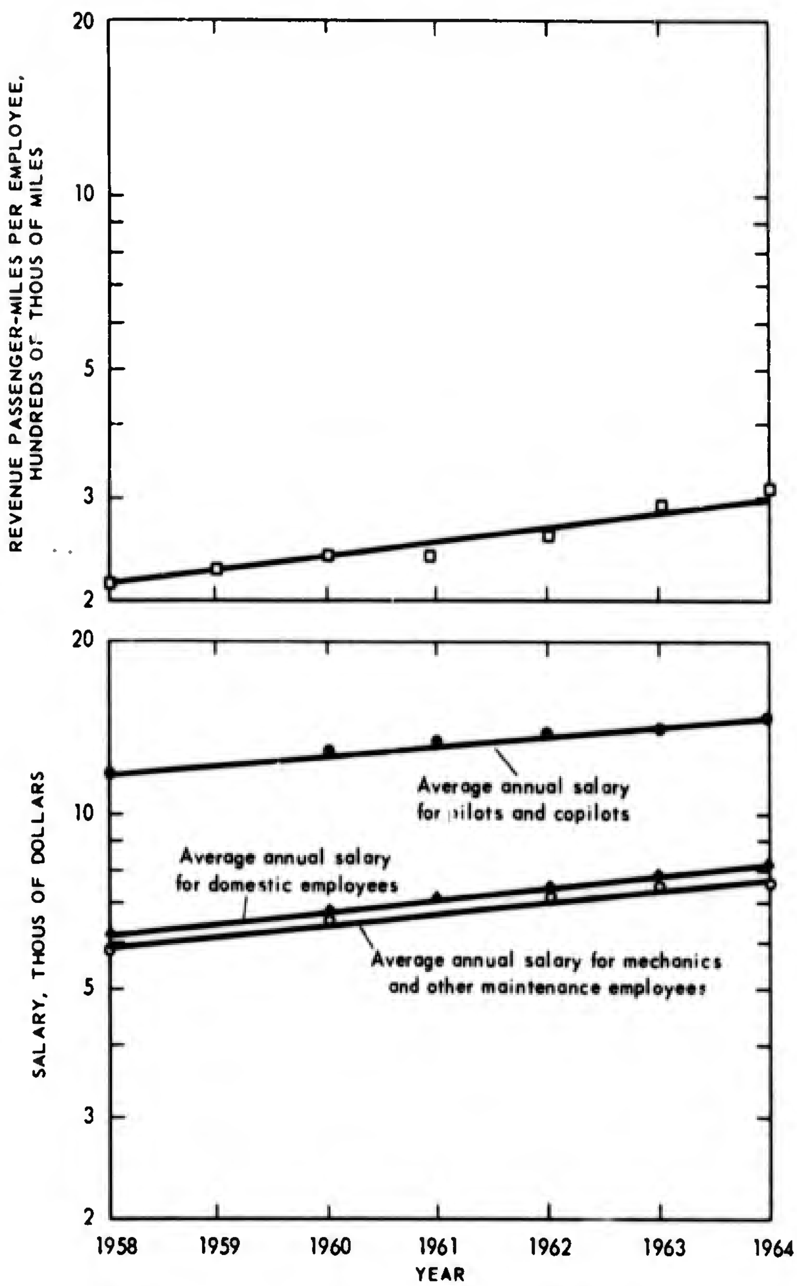


Fig. 7—Average Annual Airline Salaries and Productivity in Relation to Time

of the data are considered, 5 percent and 1.5 percent errors are well below the level of significance, and it appears reasonable to extrapolate the findings to the 1959–1965 data. Recent airline labor negotiations have not changed the trend of the last several years. Consequently it is unlikely that wage increases will change at a rate much different from productivity, the comparison that is being examined here.

Productivity, reflected by more efficient utilization of equipment and personnel, has been examined to determine trends in given time periods. CAB measures output in terms of overall revenue ton-miles.[8] Productivity is calculated by the formula:

Productivity = output/employees = RPMs/total airline employees

where the lower line indicates that the trend of productivity is increasing at the same rate as average annual wage. Thus labor-based costs for a task in one year is about the same as average annual wage. Labor-based cost for a task in one year is about the same as another and price adjustment is not required.

In the interest of simplifying the analysis it was assumed that the 1959–1964 data essentially reflected the 1967 wage-productivity base and that further adjustment would not tend to improve the subsequent regression fits nor change the US SST cost estimate.

The preceding discussion of time trends in the labor-based costs, adjusted for productivity, does not answer the question of trends in the remaining cost categories, i.e., fuel and oil, maintenance, and some indirect costs. These remaining costs were grouped with labor-based costs and examined to determine if the trends remained unchanged.

The conclusion reached is that the same trend(s) exist in the overall operating expenses. The findings suggest that there are no definite upward or downward trends existing except within rather narrow (plus or minus a few percent) bounds. There does not appear to exist a pronounced inflationary or deflationary trend during the time period 1958–1966. Additional information concerning the details of cost-productivity trend computation is included in App A.

Wage and Price Index Adjustments

Direct comparison of the costs resulting from the eight methods was possible. However, to make such comparison, care was exercised in observing that each technique is based on samples oriented in different time periods.

The LAC method and the two ATA methods do not adjust for price differences. The equations used in the ORI and PRC methods were oriented toward the prediction of 1963 dollars. The sample used by PRC covered several years, and the costs were adjusted by using labor and material indexes developed from the aircraft manufacturing industry. These indexes are cited as App A of a PRC report.[9] This appendix was not available for examination during the conduct of this study.

ORI handled the problem of adjusting for price differences by including only 1962 and 1963 costs in the sample. Although ORI did not adjust the 1962 costs, the lack of adjustment for a 1-year period would not be expected to affect the results to any serious degree.

An alternative method of handling a sample that draws cost observations from many years is to account for both the change in prices and the change in output. If, for example, the output per worker and the average wage per worker increase at the same rate, the cost of performing a given task does not change even though the worker is paid more per hour.[10] For discussion of development of price adjustment see App A, "Cost Productivity Trends in the Airline Industry."

INFORMATION AND DATA ACQUISITION

The study of US SST operating cost feasibility required the acquisition of a large amount of aircraft-characteristic data and airline operating statistics. Aircraft physical and performance data were necessary as input to the cost models. Airline operating statistics were used in the development and testing of both direct- and indirect-cost equations.

Aircraft Characteristic Data

The several cost models programmed for examination and comparison required a variety of characteristics data for subsonic and supersonic aircraft. Partial data are listed in Table 7 as actual values used in implementing the cost models. The complete data list is shown in the computer cost model output sheets. A detailed discussion of data requirements is contained in the section on cost model implementation.

Cost model utilization required a primary input of aircraft block time and fuel burned as functions of range or block distance. These data were obtained from the various subsonic aircraft manufacturers very early in the program. Final SST time and fuel information were not provided until the end of the program, concurrent with proposed submittals from LAC and BAC.

Payload Range

Payload-range information used in this study for comparative purposes is shown in Fig. 8.

Basis for this payload-range diagram is concerned with (a) fuel reserve requirements, (b) en route conservatism of fuel consumption rates in pounds, (c) holding allowances, (d) distance to alternate airport, and (e) air maneuver. The task was to verify or measure the degree of concurrence of the airlines to the values established by the FAA 1966 economic ground rules (see App E).

In our discussions with the airlines the majority (almost two-thirds) accepted the 1500-lb conservatism allowance for en route fuel consumption. In regard to reserve fuel (20-min allowance by the FAA) over half of the airlines accepted. Similarly there appeared to be little opposition to the 300-mile alternate distance or the 9-min air maneuver allowance. Accordingly RAC adapted the FAA66 flight conservatism allowances for all computations of operating cost and payload-range performance.

Determination of Seat Capacity

The importance of seating capacity in the determination of seat-mile costs is obvious. Each new aircraft model is available in a wide variety of seat arrangement reflecting, from the standpoint of the operator, the particular

RAC-R-20, Vol II

ERRATA

P 20, Table 7, 13th line down should read:

Reading across: 7.2 – 9.4 – 19.0 – 40.0 – 40.0 – 16.0 –

TABLE 7

Aircraft-Characteristic Data

Characteristic	B-707-320B		DC-8-63		B-747		L-2000-7A[a]		B-2707[b]		Concorde	
	Domestic	International	Domestic	International	Domestic	International	Domestic	International	Domestic	International	Domestic	International
Airframe weight, lb	121,300	—	138,589	—	298,000	—	194,512	—	242,400	—	137,000	—
Baggage, tons	1.51	1.87	2.05	2.60	3.04	4.46	2.09	2.99	2.46	3.56	1.16	1.44
Cruise mach number	1.00	—	1.00	—	1.00	—	2.7	—	2.7	—	2.2	—
Cruise velocity, mph	540	—	540	—	550	—	1,780	—	1,780	—	1,450	—
Engine weight, lb	4,200	—	4,190	—	8,400	—	10,247	—	11,125	—	5,600	—
Number of engines	4	—	4	—	4	—	4	—	4	—	4	—
Gross weight, lb	326,000	—	350,000	—	680,000	—	595,000	—	675,000	—	357,000	—
Mail and freight, tons	1.63	2.79	2.33	4.01	6.10	10.70	1.50	—	1.50	—	0.77	1.28
Passengers, first class	30	14	40	20	75	33	46	28	56	32	21	12
Passengers, coach	119	147	162	204	274	351	195	230	227	272	94	112
Passengers, total	149	161	202	224	349	384	241	258	283	304	115	124
Engine thrust, lb	18,000	—	18,000	—	44,000	—	61,000	—	632,000	—	35,080	—
Total plane cost, millions of dollars	72	—	94	—	190	—	400	—	400	—	160	—
Airframe cost, thous of dollars	60,400	—	82,300	—	158,900	—	347,900	—	347,900	—	125,800	—
Engine cost, dollars	267,500	—	267,500	—	740,000	—	1,302,500	—	1,302,500	—	825,000	—

[a]P and W.
[b]GE.

FOR OFFICIAL USE ONLY

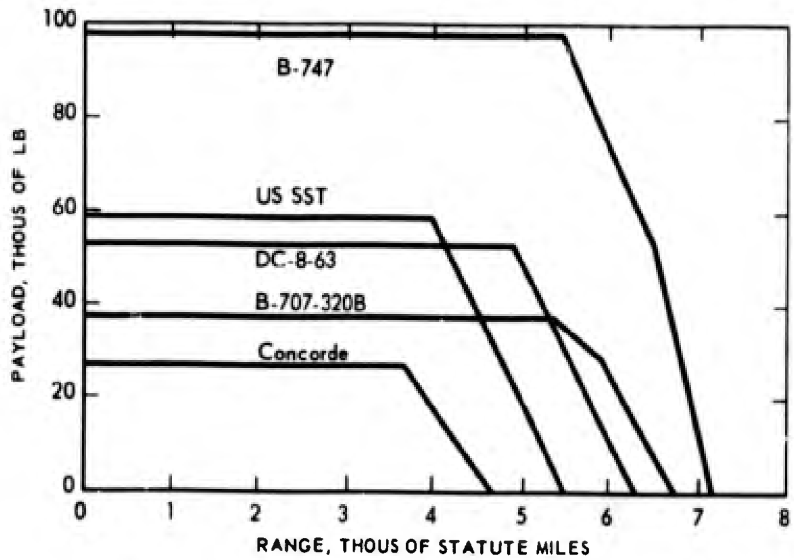


Fig. 8—Payload as a Function of Range for Passenger Configuration in International Operation

market preferences typical of his route system. In most cases this preference is diverse, requiring a high ratio of first-class seats for some route segments and high-density coach seating on others. Examples are portions of the Chicago-New York route where one operator provided at certain times of the day only first-class service. The New York-Puerto Rico market, by contrast, is characterized by high-density coach configurations. Seat capacity today varies from 112 to 135 seats on the B-707/DC-8 aircraft on the major trunk routes.

The problem was, then, to define a typical seat configuration for each of the aircraft. Since, for example, BAC offered seating arrangements for the B-747 which varied from 330 to 490 seats, it was necessary to interview the airlines individually to establish the average seats aboard each type of aircraft.

Most of the airlines contacted showed preference for seat layouts that required a much lower density than was offered by the aircraft manufacturer. In the case of one US SST model offered to the airlines, over 90 percent preferred fewer seats than the maximum provided; 62 percent preferred 3 percent less than maximum available; another 11 percent preferred 6 percent fewer seats than offered; the next 11 percent chose seating of 10 percent less; and 8 percent would have chosen seating arrangements requiring 15 percent less than suggested by the aircraft manufacturer.

The same type of discussion with the airlines on the other models (DC-8-63, B-747, and the Concorde) resulted in the development of seat capacity shown in Table 8. For seat-mile costing of the US SST the average number of seats on the BAC and LAC designs were utilized after adjustment of seating configuration as proposed in the 6 Sep 66 manufacturers' submittals.

Domestic configurations are based on 80 percent coach and 20 percent first class. International configurations are based on 90 percent coach and 10 percent first class. Seating capacities were produced from a space analysis

TABLE 8

Aircraft Seating Capacity

Aircraft	Domestic			International		
	First class	Coach	Total	First class	Coach	Total
707-320B	30	119	149	14	147	161
DC-8-63	40	162	202	20	204	224
B-747	75	274	349	33	351	384
Concorde	21	94	115	12	112	124
L-2000	46	195	241	28	230	258
B-2707	56	227	283	32	272	304

provided by American Airlines. Provisions for lavatories were made from the formula:

$$\text{Lavatories} = \frac{\text{number of seats} - 20}{40} + 1$$

Galleys were provided on the basis of one per 20 first-class passengers and one per 50 coach passengers. Baggage and cargo volumes were converted to weight and are tabulated in Table 7.

Also considered were the number of exits per passenger for emergency evacuation. At the present time the FAA is revising requirements in this respect.

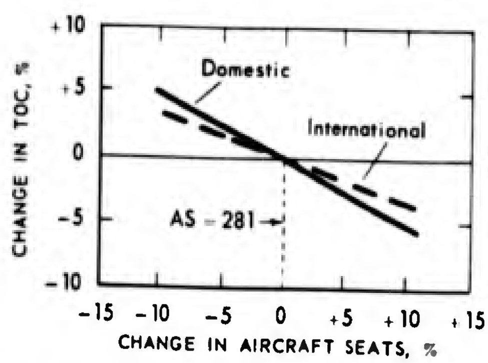


Fig. 9—Seat Allocation in Relation to Sensitivity

Figure 9 measures the sensitivity of seat allocation on total operating cost per seat mile.

Aircraft Data Sources

Aircraft characteristic data used in this study were obtained from a variety of sources. Because of the diversity of the required information it was necessary to approach aircraft manufacturers and airlines directly for certain data, in addition to relying on standard published sources such as (a) "Aeroplane and Commercial Aviation News," (b) "Jane's All the World's

Aircraft," (c) Civil Transport Data Sheets of Aviation Studies, Inc., (d) "Aviation Week" data sheets, and (e) Air Force Standard Aircraft Characteristic Charts.

Source of Airline Operating Statistics

US Certified Airlines report financial and operating information to the CAB on a monthly, quarterly, and annual basis. These data include operating revenue, expense, and traffic statistics and are reported according to a prescribed format CAB Form 41.

Direct Operating Costs. Direct operating cost data were compiled as shown in Table 9 and were identified by year, airline, and aircraft type.

TABLE 9

Cost Data from FAA and CAB Statistical Records

Years	Airlines			Aircraft types
1959	American	Eastern	Pacific Northern	Piston
to	Braniff	National	Panagra	Turbojet
1965	Continental	Northeast	Trans World	Turbofan
	Capital	Northwest	United	Turboprop
	Delta	Pan American	Western	Turboprop

System characteristics were obtained primarily from CAB Airport Activity Handbooks and the CAB "Statistical Handbook of Aviation."

Indirect Operating Costs. Statistics were compiled on the airlines listed for the years 1959–1965.

Domestic operations	International operations
American	American
Braniff	Braniff
Continental	Delta
Delta	Eastern
Eastern	Northwest
National	Trans World
Northwest	United
Trans World	
United	

Form 41 provides for the reporting of indirect operating costs under the accompanying Functional Accounts list:

5200 Maintenance—Ground Equipment
5300 Applied Maintenance Burden, Ground Property, and Equipment
5500 Passenger Service
6100 Aircraft Servicing
6200 Traffic Servicing
6300 Servicing Administration
6500 Reservations and Sales
6600 Advertising and Publicity
6800 General and Administrative
7000 Depreciation—Ground Property and Equipment

Under each Functional Account are Objective Accounts which identify specific cost functions. The Objective Account statistics as well as other data were obtained from the Form 41 schedules shown in Table 10.

TABLE 10

Form 41 Schedules of Specific Cost Functions

Schedule	Description
B-5	Property and Equipment
B-10	Developmental and Preoperating Costs
P-3	Transport Revenues and Depreciation Amortization (7000)
P-5.2	Aircraft Operating Expenses
P-6	Direct Maintenance (5200), Maintenance Burden (5300), and Passenger Service (5500)
P-7	General Administration (6800) and Aircraft Servicing (6100)
P-8	Traffic Servicing (6200), Servicing Administration (6300), Reservation and Sales (6500), and Advertising and Publicity (6600)
P-9.2	Distribution of Ground Servicing Expenses by Geographic Location
P-10	Payroll
T-1	Monthly Statement of Summarized Traffic and Capacity Statistics
T-3	Quarterly Statement of Aircraft Operating Statistics
T-4	On-Line Airport Activity Data

Included in App D is a matrix showing the format of the data compilation.

REFERENCES

1. Air Transportation Association, "Standard Method of Estimating Comparative Direct Operating Costs of Transport Airplanes," Washington, D. C., 1960.
2. Robert F. Stoessel, Eugene L. Keefe, Charles E. Sowle, and Ray A. Tedrick, "More Realism in a Standard Method for Estimating Airline Operating Expense," Lockheed Aircraft Company, Burbank, Calif., 1966.
3. The Boeing Supersonic Transport, "Cost Factors," Nov 66.
4. Daniel R. Moss, Ltr, subject: "Proposed Revision to the Standard Method of Estimating Comparative Operating Costs of Transport Airplanes," 12 Aug 65, General Electric Company, Evendale, Ohio.
5. Paul Hall, "P and W Proposed Revision to ATA Direct Operating Cost Method," Pratt and Whitney Aircraft, East Hartford, Conn., 1965.
6. Mordecai Ezekiel and Karl A. Fox, A Method of Correlation and Regression Analysis, John Wiley & Sons, Inc., New York, 1963, p 343.
7. Dept of Labor, Bureau of Labor Statistics, Employment and Earnings Statistics for the US 1900–1962, US Govt Printing Office, Washington, D. C., 1963.
8. Civil Aeronautics Board, Handbook of Airline Statistics, 1963 ed, US Govt Printing Office, Washington, D. C., 1964.
9. G. H. Johnson, H. D. Orenstein, and R. B. Ulvestad, "Methodology for Estimating Development, Production and Operating Costs of Transport Aircraft," Planning Research Corporation, Washington, D. C., 15 Dec 64.
10. Paul A. Samuelson, Economics, McGraw-Hill Book Company, New York.

Appendix A

COST-PRODUCTIVITY TRENDS IN THE AIRLINE INDUSTRY

INTRODUCTION

The sample of airline operating costs obtained from CAB Forms 41, reported in the RAC SST interim report, covers the years 1959-1965.[1] Thus there exists a requirement to examine these costs for an inflationary or deflationary time trend in order to have a homogeneous unbiased sample from which to derive sound cost-estimating relations.

It is not sufficient to examine only the economic rents for factors (e.g., wage rates); productivity must also be examined because increases in productivity offset increases in economic rents.[2]

For the analysis of SST and competing alternatives the FAA has suggested that the predicted costs be quoted in constant 1967 dollars. Thus not only must the sample be examined for inflationary time trends, but the trends should be extrapolated to 1967 and adjustment made to the sample to reflect constant 1967 dollars.

LABOR COSTS

As indicated in Fig. A1, labor-based costs are a sizable percent (40.9 in 1964) of all operating costs incurred in the airline industry. Thus the discussion of this category separately appears to be in order. The total payroll costs were examined and adjusted by a measure of airline-industry productivity.

Mathematical Derivation

An index was derived using the following process:

$$L_{ij} = (S_{ij}/E_{ij})/(P_j/E_{ij}) = S_{ij}/P_j$$

where L_{ij} = the labor cost-productivity index expressed in dollars per mile for the ith cost in year j

S_{ij} = total ith payroll for year j

E_{ij} = number of i employees in year j

P_j = the revenue passenger miles for year j

The cost-productivity index was then plotted on a semilog graph (where constant percentage increases appear as a straight line). The graph was then examined to determine the degree to which a cost for a service in one year differs from a cost for the same service in another year. Such an index shows more than increases in wage per worker; it shows how labor-based costs have changed when appropriately adjusted for productivity-per-worker changes.

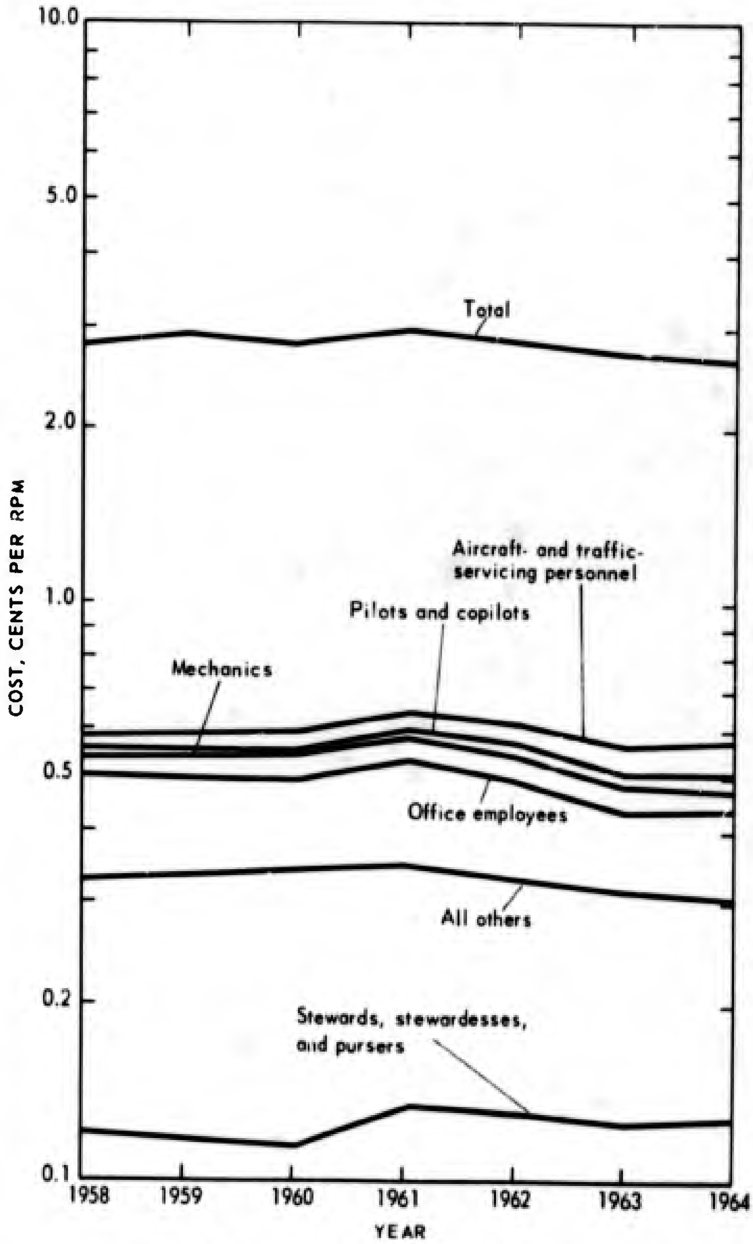


Fig. A1—Payroll Cost per RPM in Recent Years[4]

Productivity Expressed as Revenue Passenger Miles

Revenue passenger miles (RPMs) was selected as a rough measure of productivity in the airline industry. The CAB recognizes the difficulty of arriving at a precise statement of productivity by listing three "crude measures" in their handbook—revenue ton-miles, available ton-miles, and dollar revenues.[3] All these measures are of course highly intercorrelated with each other and with RPMs. The latter is true because passenger revenues are the dominant part of the total airline revenues (87 percent in 1964). RPMs was felt to be a slightly better measure than available seat-miles because it reflects not only the capacity but also the number of customers who take advantage of the transportation service. Since the SST study is essentially an analysis of passenger transportation, excluding cargo considerations, RPMs was chosen over ton-miles. However, as noted above, they are very closely related.

The sample of CAB Form 41 costs comprises domestic trunk and international operations, and the measures of productivity used in this price index analysis include domestic, local, and helicopter operations. Conceptually these expressions are not comparable. The initial impression is that local and helicopter operations are less efficient than domestic trunk operations, and, if the former was removed, the rate of increase in RPMs might be greater. However, local and helicopter RPMs are barely 4 percent of total certificated route air carriers' RPMs.[3] Thus it is not likely that excluding local and helicopter RPMs will make much difference.

Labor-Based Cost Trend Conclusions

Figure A1 presents the total certificated air carrier payroll per RPM as a function of time. This measure, as described previously, is a rough estimate of labor costs adjusted for productivity. The key feature of this time series is of course the slope, which can probably best be described as being nearly horizontal. The change in total labor cost per RPM from 1958 to 1964 is barely 8 percent, and the change is slightly downward. This seems to indicate that there is not an inflationary trend in labor costs, or, putting it differently, the increases in salary per worker have, generally speaking, been offset by increases in productivity per worker.

The plots of some separate labor categories also appear in Fig. A1 and, generally speaking, show about the same trend.

NONLABOR AND TOTAL COSTS

The preceding discussion of time trends in the labor-based costs, adjusted for productivity, did not answer the question of trends in the remaining cost categories. Two approaches were taken to address this question: The first was to examine the overall—labor and nonlabor—operating costs for possible differences in trend from the labor-only cost-time series. The second was to study the nonlabor costs by themselves.

Mathematical Derivation

The derivation of the overall and nonlabor operating cost-productivity index is similar to the formulation of the labor index.

$$\Pi = O_j/T_j$$

where Π_j = the total cost-productivity index in cents per mile for year j
O_j = the overall operating expenses in year j
T_j = the revenue ton-miles for year j; this measure was used because the arithmetic was conveniently available in the CAB Handbook*,[3]

The formulation of the labor-based cost-productivity index revealed that it was not necessary to know the number of employees. Thus the formulation of the overall and nonlabor index benefits from not having to quantify a similar nonlabor unit.

Overall Cost-Productivity Index

The first approach to measuring the time effects on nonlabor costs was to examine the overall operating costs. Figures A2a and A2b present the overall operating cost-productivity index, and the trend is very similar to that of the labor-based index. The conclusion reached is that, generally speaking, overall costs have also been offset by increases in productivity. There is no definite upward or downward trend existing except within rather narrow (plus or minus a few percent) bounds.

As indicated earlier, the question has been raised covering the behavior of productivity of the industry excluding local and helicopter operations. As can be observed in Fig. 2b, the trend of domestic trunk operations (which makes up most of the CAB Form 41 sample) has almost exactly the same trend as the overall measure of cost productivity.

The net change in the index of the two indexes shown in Fig. A2 are 8 and 2 percent, respectively. Assuming that this error is not explained by the predictive equation derived from a sample of costs where no time adjustment has taken place, the addition to the error of the equation would be on the order of ±1 to 4 percent at the extremes. It is not likely that this would significantly affect predicted airline operating costs for a future aircraft such as the SST.

The change from the beginning to the end of the domestic trunk index is about 2 percent. How the time series moves from 1964 to 1967 is of course anyone's guess. However, judging from the absence of any definite upward or downward trend, there is no reason to expect the movement to be much different.

Although no predominant pattern appears, the time series seems to arch slightly. It is indeed risky to assign any conclusive causes to the series. However, two events seem to coincide with the modest movements: First, the period 1958–1962 saw the introduction of long-range turbojet aircraft and the resultant change in the commercial aircraft fleet from piston to jet. Second, the period after 1961 was relatively free of labor disputes causing serious interruptions in service. (The exception was the Eastern Airlines flight engineers' strike, which disrupted service from 23 Jun to 30 Sep 62.[3])

*An index was calculated using RPMs, and the slope was virtually identical with the index based on revenue ton-miles.

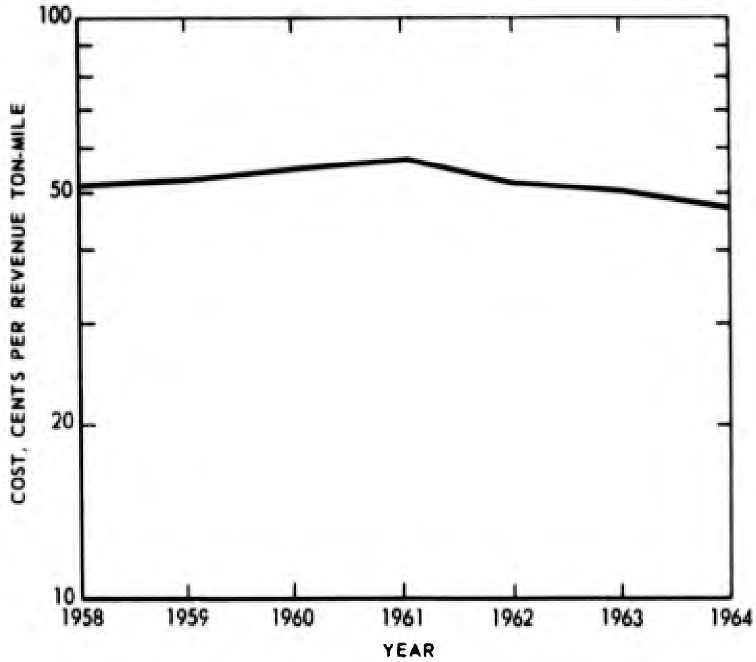


Fig. A2a—Overall Operating Expense of Total Certificated Route Air Carriers[3] in Recent Years

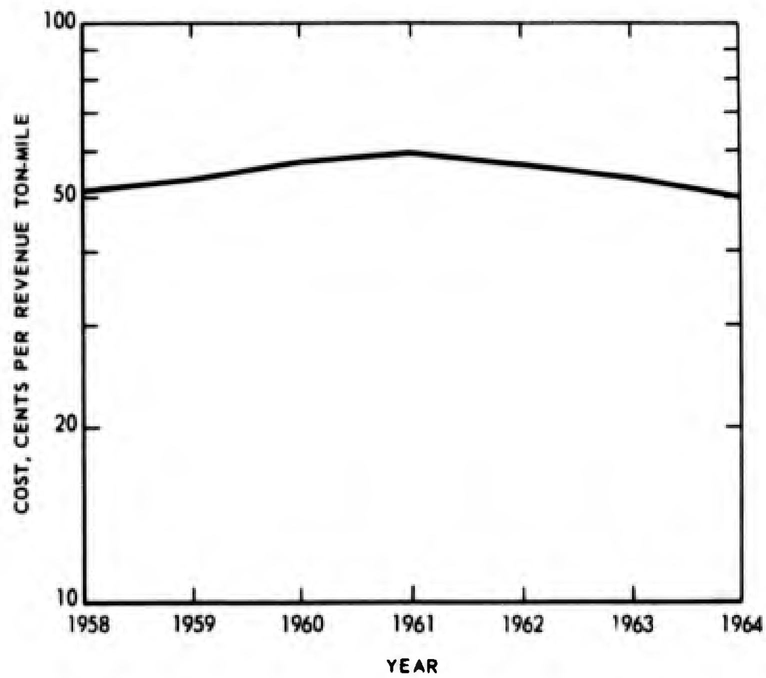


Fig. A2b—Overall Operating Expense of Total Domestic Trunk Operations[3] in Recent Years

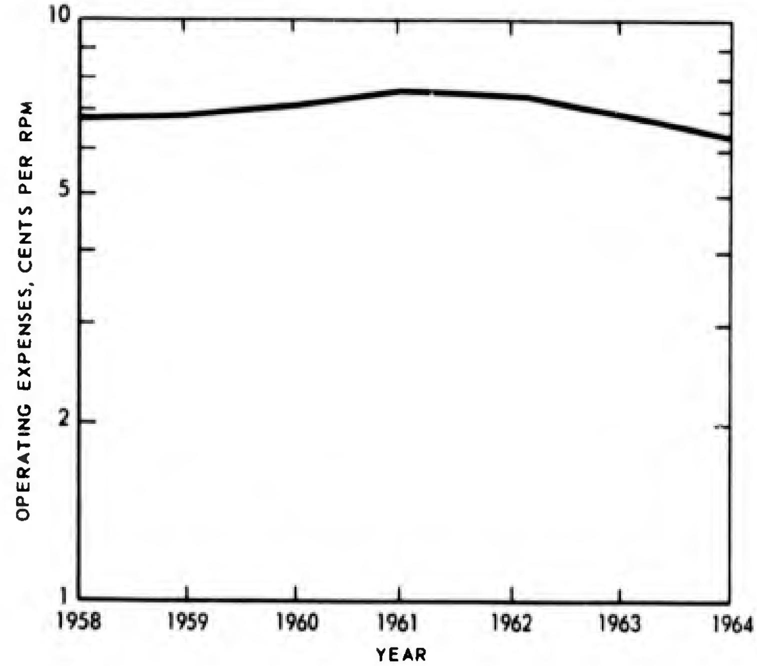


Fig. A3a—Overall Operating Expenses per RPM[3,4] in Recent Years

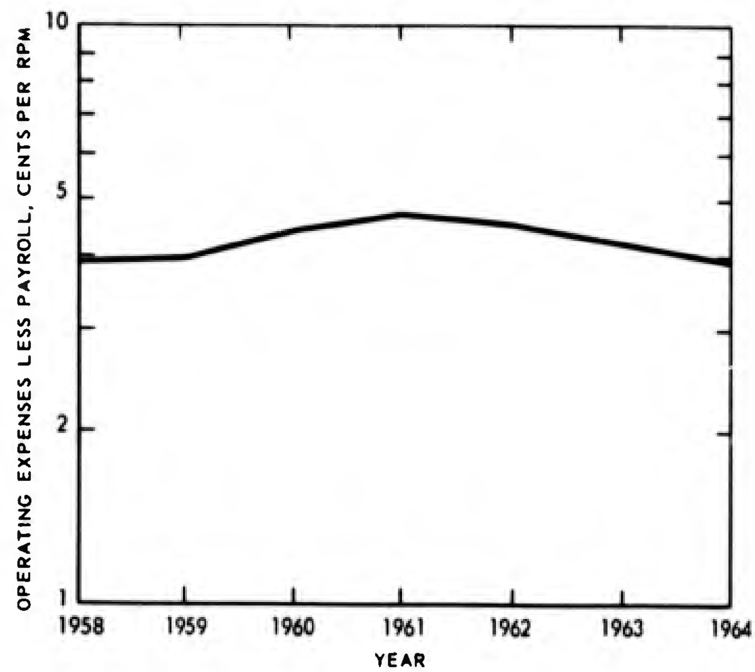


Fig. A3b—Overall Operating Expenses Less Payroll per RPM[3,4] in Recent Years

Looking forward from 1964 to 1967, it is evident that (a) sizable numbers of short-range turbofan aircraft are being introduced, and (b) the mechanics are currently negotiating with industry representatives, raising the possibility of a work stoppage. (Wage-settlement results from the negotiations are of course in doubt. However, there is reason to believe that the Executive Branch will attempt to hold cost increases in line with productivity increases.)[5] Thus, if either of these phenomena affect the airline-industry cost-productivity index, it may be possible that the index may swing up in the 1964–1967 time period.

Nonlabor Cost-Productivity Index

After having examined the labor-based operating costs and the overall operating costs, the question might legitimately be raised as to whether the trends are similar because labor-based costs make up about 40 percent of the overall costs. To answer this question, nonlabor costs were also examined, and the results indicate that the nonlabor cost-time trend is almost identical with the overall cost trend. Figures A3a and A3b display the time series.

REFERENCES

1. Research Analysis Corporation, "A Cost Analysis of the Supersonic Transport in Airline Operations," unpublished manuscript, 25 May 66.
2. Bela Gold, "Foundations of Productivity Analysis," University of Pittsburgh Press, Pittsburgh, 1955.
3. Civil Aeronautics Board, Handbook of Airline Statistics, 1965 ed, US Govt Printing Office, Washington, D. C., 1965.
4. Federal Aviation Agency, FAA Statistical Handbook of Aviation, US Govt Printing Office, Washington, D. C., 1959, 1961–1965.
5. Lyndon B. Johnson, "Economic Report of the President," US Govt Printing Office, Washington, D. C., 1966, pp 5–13.

Appendix B

REGRESSION ANALYSIS

Tables

This appendix presents a description of the regression technique utilized and an example cost-estimating equation based on the technique.

One multiple regression run is included in this Appendix. The results have been analyzed and a brief interpretation follows. However, it should be noted that this is a sample equation that does not include all the considerations necessary to estimate the cost of the SST. The material is presented to illustrate the first approach that was taken to provide some insight into the factors that affected airline direct operating costs in the last 7 years and to introduce the computer program that performs the arithmetic. This multiple regression technique was not accepted as the method for use but does represent one approach to SST cost estimating.

The airline direct operating cost data for the multiple regression run is that obtained from CAB statistical records. The approach used to derive the equations is multiple regression analysis. The variables that were candidates for membership in the predictive equation are listed in Table B1 with the symbols used by the computer program. The printout of the multiple regression run is presented in Table B2. The general form of the predictive equation is: $Y = A_o + A_1 X_1 + \ldots + A_n X_n$

where Y = the dependent variable; in this case it is total airline direct-operating cost less depreciation. It was assumed that productivity increases offset price and wage increases, and consequently the costs are in millions of constant 1967 dollars.

A_o = the constant or fixed cost.

X_n = the nth variable (e.g., fuel consumption and revenue passenger miles).

A_n = the regression derived cost coefficient associated with one unit of X_n.

The equation may also be expressed as

$$Y = a_o \sum_{i=1}^{n} a_i x_i$$

Table B2 contains 15 equations, one for each procedural step. To illustrate the form of the equations the more common form of the first equation is presented.

$$V_{TE\text{-}TD}(10^{-6}) = 0.9180 + 0.1352\,(10^{-5})\,V_{RDM}$$

TABLE B1

Predictive Equation Variables

DEFINITION LIST

CODE	DESCRIPTION
01TE-TD	TOTAL EXPENSE - TOTAL DEPRECIATION
02TMA	TOTAL MAINTENANCE AIRFRAME
03TME	TOTAL MAINTENANCE ENGINE
04TMO	TOTAL MAINTENANCE OTHER
05POL	FUEL + OIL COST
06FC	FUEL COST
07TME	TOTAL MAINTENANCE EXPENSE
08AFS	AVERAGE FLEET SIZE
09NP	NUMBER OF PASSENGERS
10LF	LOAD FACTOR
11RBH	REVENUE BLOCK HOURS
12MPAH	MILES/ AIRBORNE HOUR
13TDM	5278 TOTAL DIRECT MAINTENANCE
14AMB	5300 APPL MAINTENANCE BURDEN
15TAOE	TOTAL AIRCRAFT OPERATING EXPENSE
16FUEL	5145.1 FUEL COST
17RPM	REVENUE PASSENGER MILES
18ASM	AVAILABLE SEAT MILES
19RAM	REVENUE AIRCRAFT MILES
20RAH	REVENUE AIRCRAFT HOURS
21ADA	AIRCRAFT DAYS ASSIGNED
22%B2AH	PERCENT BLOCK TO AIRBORNE HOURS
23AFI	AIRCRAFT FUEL ISSUED
24ADP	AIRCRAFT DEPARTURES PERFORMED
25M/BH	MILES PR BLOCK HOUR
26YOO	YEAR OF OPERATION
27ONES	ONES VARIABLE
28*Y59	ADJUSTMENT, YEAR 1959
29*Y60	ADJUSTMENT, YEAR 1960
30*Y61	ADJUSTMENT, YEAR 1961
31*Y62	ADJUSTMENT, YEAR 1962
32*Y63	ADJUSTMENT, YEAR 1963
33*Y64	ADJUSTMENT, YEAR 1964
34*Y65	ADJUSTMENT, YEAR 1965
35*D	ADJUSTMENT, DOMESTIC
36*P	ADJUSTMENT, PISTON
37*T	ADJUSTMENT, TURBOPROP
38*J	ADJUSTMENT, TURBOJET
39*F	ADJUSTMENT, TURBOFAN
40*AA	ADJUSTMENT, AMERICAN AIRLINES
41*BN	ADJUSTMENT, BRANIFF AIRLINES
42*CO	ADJUSTMENT, CONTINENTAL AIRLINES
43*DL	ADJUSTMENT, DELTA AIRLINES
44*EA	ADJUSTMENT, EASTERN AIRLINES
45*NA	ADJUSTMENT, NATIONAL AIRLINES
46*NE	ADJUSTMENT, NORTHEAST AIRLINES
47*NW	ADJUSTMENT, NORTHWEST AIRLINES
48*PA	ADJUSTMENT, PAN AMERICAN AIRLINES ATLANTIC
49*PP	ADJUSTMENT, PAN AMERICAN AIRLINES PACIFIC
50*PL	ADJUSTMENT, PAN AMERICAN AIRLINES LATIN AMERICA
51*PK	ADJUSTMENT, PAN AMERICAN AIRLINES ALASKA
52*TW	ADJUSTMENT, TRANS WORLD AIRLINES
53*UA	ADJUSTMENT, UNITED AIRLINES
54*WA	ADJUSTMENT, WESTERN AIRLINES
55OL	OVERALL LENGTH
56WS	WING SPAN
57OH	OVERALL HEIGHT

DEFINITION LIST (CONTINUED)

CODE	DESCRIPTION
58BOW	BASIC OPERATING WEIGHT
59MP	MAX PAYLOAD
60MTOW	MAX TAKE OFF WEIGHT
61MLW	MAX LANDING WEIGHT
62WA	WING AREA
63WL	WING LOADING
64MS	MAX SPEED
65HCS	HIGH CRUISE SPEED
66TCS	TYPICAL CRUISE SPEED
67AS	APPROACH SPEED
68TOD	TAKE OFF DISTANCE
69LD	LANDING DISTANCE
70MPR	MAX PAYLOAD RANGE
71MFR	MAX FUEL RANGE
72NE	NUMBER OF ENGINES
73EDW	ENGINE DRY WEIGHT
74UTIL	UTILIZATION
75MTOT	MAX TAKE OFF THRUST
76MCT	MAX CONTINUOUS THRUST
77MTSFC	MAX TAKE OFF SPECIFIC FUEL CONSUMPTION
78TY	TIME YEAR OF FIRST FLIGHT
79P/RPM	POLS PER REVENUE PASSENGER MILE
80EP	ENGINE PRICE

FOR OFFICIAL USE ONLY

TABLE B2

Multiple Regression Run Printout

```
BMD02R - STEPWISE REGRESSION - VERSION OF APR.  9, 1964
HEALTH SCIENCES COMPUTING FACILITY, UCLA

PROBLEM CODE                       PLT+TX
NUMBER OF CASES                       506
NUMBER OF ORIGINAL VARIABLES           80
NUMBER OF VARIABLES ADDED               0
TOTAL NUMBER OF VARIABLES              80
NUMBER OF SUB-PROBLEMS                  9
```

VARIABLE		MEAN	STANDARD DEVIATION
TE-TD	1	0.1462737E 02	0.1254419E 02
TMA	2	0.1319389E 01	0.1152217E 01
TME	3	0.1448946E 01	0.1778084E 01
TMO	4	0.3131161E 00	0.3447555E 00
POL	5	0.4188270E 01	0.5905273E 01
FC	6	0.1356922E 00	0.9440474E-01
TME	7	0.5845272E 01	0.5278039E 01
AFS	8	0.1254259E 02	0.1131555E 02
NP	9	0.5312450E 02	0.1976091E 02
LF	10	0.5509929E 00	0.8244617E-01
RAH	11	0.3557160E 05	0.3077914E 05
MPAH	12	0.3454935E 03	0.1209374E 03
TDM	13	0.3494766E 01	0.3075317E 01
AMB	14	0.2347509E 07	0.2393571E 07
TAOE	15	0.1769834E 09	0.1531809E 08
FUEL	16	0.4327926E 07	0.5941477E 07
RPM	17	0.5266383E 09	0.5395098E 09
ASM	18	0.9433456E 09	0.9471539E 09
RAM	19	0.1014198E 08	0.6795793E 07
RAM	20	0.3114346E 05	0.2659170E 05
ADA	21	0.5594843E 04	0.4129500E 04
/82AH	22	0.1132760E 01	0.5051262E-01
AFI	23	0.3727734E 04	0.3943141E 08
ADP	24	0.2497334E 05	0.2675344E 05
M/BH	25	0.3081049E 03	0.1145559E 03
VON	26	0.1462176E 04	0.1895072E 01
ONES	27	0.1000000E 01	0.
*Y59	28	0.1166008E 00	0.3212616E 00
*Y60	29	0.1146245E 00	0.3138834E 00
*Y61	30	0.1422925E 00	0.3496955E 00
*Y62	31	0.1521739E 00	0.3595446E 00
*Y63	32	0.1640316E 00	0.3706704E 00
*Y64	33	0.1600791E 00	0.3670619E 00
*Y65	34	0.1501976E 00	0.3575183E 00
*D	35	0.7430830E 00	0.4373653E 00
*P	36	0.4150198E 00	0.4932129E 00
*T	37	0.1086957E 00	0.3115648E 00
*J	38	0.2984190E 00	0.4583169E 00
*F	39	0.1778656E 00	0.3827775E 00
*AA	40	0.4268538E-01	0.2023588E 00
*AN	41	0.8102767E-01	0.2731475E 00
*CO	42	0.4545455E-01	0.2035043E 00
*OL	43	0.6324111E-01	0.2434368E 00
*FA	44	0.1106719E 00	0.3140357E 00
*NA	45/	0.6916996E-01	0.2539939E 00
*NE	46	0.4545455E-01	0.2035049E 00
*NW	47	0.9486552E-01	0.2420500E 00
*PA	48	0.5328854E-01	0.2463975E 00
*PP	49	0.2371541E-01	0.1523116E 00
*PL	50	0.5138340E-01	0.2208968E 00
*PK	51	0.7905138E-02	0.8866311E-01
*TW	52	0.9486123E-01	0.2947075E 00
*UA	53	0.1146245E 00	0.3188433E 00
*WA	54	0.4545455E-01	0.2035049E 00
OL	55	0.1215568E 03	0.2419775E 02
WS	56	0.1234612E 03	0.1533454E 02
OH	57	0.3443592E 02	0.7119965E 01
BOW	58	0.9722955E 05	0.3410179E 05
MP	59	0.3089625E 05	0.1311897E 05
MTOW	60	0.1403596E 06	0.9874956E 05
MLW	61	0.1344992E 06	0.5441363E 05
WA	62	0.1746544E 04	0.6592717E 03
WL	63	0.4730566E 02	0.1839756E 02
MS	64	0.4377213E 03	0.1295260E 03
HCS	65	0.3969596E 03	0.1214595E 03
TCS	66	0.3774190E 03	0.1031095E 03
AS	67	0.1215909E 03	0.1522141E 02
TOO	68	0.7124491E 04	0.1953380E 04
LD	69	0.4981908E 04	0.1524963E 04
MPR	70	0.3162802E 04	0.1124645E 04
MFR	71	0.4166244E 04	0.1247831E 04
NE	72	0.3957708E 01	0.4910140E 00
FOW	73	0.3364474E 04	0.1132923E 04
UTIL	74	0.3635294E 00	0.8938417E-01
MTOT	75	0.9869743E 04	0.6553412E 04
MCT	76	0.7397431E 04	0.5559681E 04
MTSFC	77	0.6027640E 00	0.1433380E 00
TV	78	0.5550733E 02	0.5670962E 01
P/MPM	79	0.1335843E 00	0.9540634E-01
EP	80	0.1259367E 05	0.8147453E 05

FOR OFFICIAL USE ONLY

```
SUB-PROBLEM    1
 DEPENDENT VARIABLE              1
 MAXIMUM NUMBER OF STEPS        15
 F-LEVEL FOR INCLUSION       3.840
 F-LEVEL FOR DELETION        3.840
 TOLERANCE LEVEL             0.001

  STEP NUMBER     1
  VARIABLE ENTERED    19

  MULTIPLE R              0.9478
  STD. ERROR OF EST.      4.0059
```

ANALYSIS OF VARIANCE

	DF	SUM OF SQUARES	MEAN SQUARE	F RATIO
REGRESSION	1	71402.463	71402.463	4449.424
RESIDUAL	504	8087.977	16.048	

VARIABLES IN EQUATION

VARIABLE		COEFFICIENT	STD. ERROR	F TO REMOVE
(CONSTANT		0.91904960E 00)		
RAM	19	0.13518730E-05	0.2027E-07	4449.4241

VARIABLES NOT IN EQUATION

VARIABLE		PARTIAL CORR.	TOLERANCE	F TO ENTER
TMA	2	0.73026	0.2255	574.7421
TME	3	0.47723	0.2576	148.3400
TMO	4	0.30740	0.4790	52.4917
POL	5	0.32001	0.5974	57.3891
FC	6	0.12104	0.9816	7.4783
TME	7	0.81857	0.1660	1021.5331
AFS	8	-0.19379	0.5022	19.6265
NP	9	0.34601	0.9880	68.4109
LF	10	0.11497	0.9861	6.7379
RSH	11	-0.32538	0.2843	59.5591
MPAH	12	0.23737	0.9596	30.0323
TOM	13	0.68684	0.1930	449.1897
AME	14	0.68456	0.2733	443.6048
TADE	15	0.92965	0.1055	3202.4694
FUEL	16	0.31874	0.6026	56.8831
RPM	17	0.44235	0.1554	122.3702
ASM	18	0.38287	0.1489	86.4015
RAH	20	-0.32720	0.2555	60.3086
ADA	21	-0.19379	0.5022	19.6264
/R2AH	22	-0.12041	0.9999	7.3996
AFI	23	0.49230	0.2314	160.9011
ADP	24	-0.30543	0.6829	51.7512
M/BH	25	0.23573	0.9673	29.5969
YOD	26	0.17636	0.9953	16.1477
ONES	27	-0.00000	1.0000	0.0000
*Y59	28	-0.28864	1.0000	45.7148
*Y60	29	-0.06477	1.0000	2.1191
*Y61	30	0.13677	0.9950	9.5889
*Y62	31	0.05990	0.9992	1.8111
*Y63	32	0.05901	0.9999	1.7574
*Y64	33	0.08443	0.9994	3.6115
*Y65	34	-0.02444	0.9924	0.3007
*D	35	-0.22219	0.9405	26.1220
*P	36	-0.14092	0.9499	10.1907
*T	37	-0.19431	0.9907	19.7374
*J	38	0.32917	0.9921	61.1237
*F	39	-0.05822	0.9893	1.7110
*AA	40	0.16025	0.9503	13.2567
*BN	41	-0.11268	0.9609	6.4683
*CO	42	-0.11172	0.9926	6.3580
*DL	43	-0.05172	1.0000	1.3489
*FA	44	-0.01056	0.9967	0.0561
*NA	45	-0.06508	0.9832	2.1393
*NF	46	-0.01542	0.9841	0.1196
*NW	47	-0.07482	0.9843	2.8320
*PA	48	0.19514	0.9985	19.9122
*PP	49	0.18034	0.9989	16.9085
*PL	50	0.12171	0.9828	7.5628
*PK	51	-0.00896	0.9924	0.0404
*TW	52	0.07475	0.9820	2.8265
*UA	53	-0.10300	0.8975	5.3940
*WA	54	-0.12963	0.9958	8.5965
OL	55	0.35802	0.9898	73.9507
WS	56	0.37367	0.9989	81.6332
OH	57	0.25933	0.9727	36.2660
BOW	58	0.36611	0.9933	77.8539
MP	59	0.32815	0.9942	60.7002
MTOW	60	0.35524	0.9935	72.6423
MLW	61	0.35995	0.9891	74.8696
WA	62	0.35584	0.9956	72.9236
WL	63	0.35497	0.9833	72.5155
MS	64	0.27998	0.9630	42.7499
MCS	65	0.27721	0.9595	40.2554
TCS	66	0.26854	0.9559	39.0911
AS	67	0.29507	0.9665	47.9720
TOD	68	0.36977	0.9990	79.6696
LD	69	0.30907	0.9642	53.1247
MPR	70	0.36045	1.0000	75.1104
MFR	71	0.33178	0.9999	62.2175
NE	72	0.35560	0.9987	72.8129
EOW	73	0.35485	0.9997	72.4621
UTIL	74	-0.04461	0.9529	1.0031
MTOT	75	0.25791	0.9815	35.8424
MCT	76	0.23894	0.9824	30.4550
MTSFC	77	0.33112	0.9918	61.9423
TY	78	0.17143	0.9654	15.2307
P/RPM	79	0.11855	0.9804	7.1694
EP	80	0.25792	0.9790	35.8154

STEP NUMBER 2
VARIABLE ENTERED 23

MULTIPLE R 0.9607
STD. ERROR OF EST. 3.4903

ANALYSIS OF VARIANCE

	DF	SUM OF SQUARES	MEAN SQUARE	F RATIO
REGRESSION	2	73362.642	36681.321	3010.984
RESIDUAL	503	6127.799	12.183	

VARIABLES IN EQUATION

VARIABLE		COEFFICIENT	STD. ERROR	F TO REMOVE
(CONSTANT		0.12292179E 01)		
RAM	19	0.44361845E-06	0.3671E-07	660.7043
AFI	23	0.10290734E-06	0.8113E-08	160.9011

VARIABLES NOT IN EQUATION

VARIABLE		PARTIAL CORR.	TOLERANCE	F TO ENTER
TMA	2	0.67776	0.1946	426.5175
TME	3	0.53292	0.2574	199.0152
TMO	4	0.36763	0.4787	78.4499
POL	5	0.17819	0.5219	16.4671
FC	6	0.22877	0.9584	27.7239
TME	7	0.84501	0.1595	1253.4689
AFS	8	0.34133	0.2006	66.2004
NP	9	0.06716	0.6220	2.2746
LF	10	0.14346	0.9957	10.5491
RAH	11	0.23341	0.0707	28.9218
MPAH	12	-0.14556	0.5255	10.8658
TOM	13	0.70682	0.1782	501.1740
AMR	14	0.70020	0.2653	487.8468
TAOE	15	0.90657	0.0787	2316.0463
FUEL	16	0.17338	0.5238	15.5581
RPM	17	0.06338	0.0465	2.0247
ASM	18	-0.14031	0.0308	10.0815
RAH	20	0.25132	0.0587	33.8450
ADA	21	0.34133	0.2006	66.2006
/92AH	22	0.05179	0.8903	1.3500
ADP	24	0.08109	0.3290	3.3226
M/RH	25	-0.14006	0.5408	10.0454
YOD	26	-0.00222	0.8649	0.0025
ONES	27	0.00000	1.0000	0.0000
*Y59	28	-0.14442	0.8797	10.6929
*Y60	29	0.01180	0.9768	0.0699
*Y61	30	0.15675	0.9950	12.6445
*Y62	31	0.02269	0.9926	0.2585
*Y63	32	0.00777	0.9886	0.0303
*Y64	33	0.01482	0.9783	0.1102
*Y65	34	-0.08822	0.9913	3.9373
*D	35	-0.10406	0.8697	5.4959
*P	36	0.19050	0.6474	18.9028
*T	37	-0.06523	0.9108	2.1450
*J	38	0.01499	0.5749	0.1129
*F	39	-0.16360	0.9617	13.8047
*AA	40	0.23807	0.9420	30.1621
*BN	41	-0.11986	0.9606	7.3175
*CO	42	-0.12370	0.9925	7.8005
*DL	43	-0.04801	0.9996	1.1599
*EA	44	0.01608	0.9942	0.1298
*NA	45	-0.07889	0.9832	3.1437
*NE	46	0.00899	0.9820	0.0397
*NW	47	-0.06756	0.9833	2.3018
*PA	48	0.14342	0.9773	10.5419
*PP	49	0.11414	0.9709	6.6261
*PL	50	0.08314	0.9727	3.4961
*PK	51	-0.01983	0.9921	0.1976
*TW	52	0.03756	0.9748	0.7091
*UA	53	-0.06943	0.8908	2.4319
*WA	54	-0.11265	0.9917	6.4518
OL	55	0.01054	0.4849	0.0558
WS	56	0.10082	0.6161	5.1555
OH	57	-0.10793	0.5378	5.9167
ROW	58	0.02613	0.4909	0.3429
MP	59	0.02278	0.5927	0.2607
MTOW	60	0.00846	0.4919	0.0394
MLW	61	0.00392	0.4672	0.0077
WA	62	-0.00164	0.4726	0.0014
WL	63	0.08497	0.6282	3.6503
MS	64	-0.09220	0.5095	4.3043
HCS	65	-0.10637	0.5037	5.7454
TCS	66	-0.10370	0.5140	5.4568
AS	67	-0.00409	0.6126	0.0084
TOD	68	0.06055	0.5476	1.8470
LD	69	-0.00695	0.5726	0.0242
MPR	70	0.16144	0.7679	13.4675
MFR	71	0.13109	0.7797	8.7770
NF	72	0.27490	0.9344	40.7473
EOW	73	0.07147	0.6135	2.5921
UTIL	74	-0.24222	0.8579	31.2873
MTOT	75	-0.13198	0.5111	8.8988
MCT	76	-0.13594	0.5481	9.4517
MTSFC	77	0.05594	0.6431	1.5757
TY	78	-0.09184	0.7318	4.2701
P/RPM	79	0.23309	0.9535	28.8383
FP	80	-0.10932	0.5426	6.0724

STEP NUMBER 3
VARIABLE ENTERED 8

MULTIPLE R 0.9653
STD. ERROR OF EST. 3.2840

ANALYSIS OF VARIANCE

	DF	SUM OF SQUARES	MEAN SQUARE	F RATIO
REGRESSION	3	74076.585	24692.195	2289.585
RESIDUAL	502	5413.855	10.785	

VARIABLES IN EQUATION

VARIABLE		COEFFICIENT	STD. ERROR	F TO REMOVE
(CONSTANT		0.67163527E 00)		
AFS	8	0.23464116E 00	0.2884E-01	66.2006
RAM	19	0.42848230E-05	0.7212E-06	35.2965
AFI	23	0.17907578E-06	0.1208E-07	219.7944

VARIABLES NOT IN EQUATION

VARIABLE		PARTIAL CORR.	TOLERANCE	F TO ENTER
TMA	2	0.62692	0.1611	324.4097
TMF	3	0.58181	0.2570	256.3777
TMD	4	0.30795	0.4469	52.4878
POL	5	0.17528	0.5210	15.8798
FC	6	0.22490	0.9558	26.6896
TMF	7	0.82892	0.1457	1100.2354
NP	9	0.15746	0.5903	12.7374
LF	10	0.15979	0.9853	13.1278
RAM	11	-0.05485	0.0279	1.5119
MPAM	12	-0.01086	0.4418	0.0590
TDM	13	0.70097	0.1732	483.9675
AMB	14	0.66291	0.2173	392.7694
TADE	15	0.90273	0.0739	2205.9307
FUEL	16	0.17072	0.5231	15.0399
RPM	17	0.21992	0.0399	25.4623
ASM	19	0.02054	0.0243	0.2114
RAM	20	-0.00225	0.0265	0.0025
ADA	21	0.00063	0.0000	0.0002
/R2AM	22	-0.10951	0.7297	6.0813
ADP	24	-0.18950	0.1947	18.6616
M/RM	25	0.00356	0.4458	0.0063
YOD	26	-0.00515	0.8648	0.0133
ONES	27	0.00000	1.0000	0.0000
*Y53	28	-0.08563	0.8474	3.7004
*Y60	29	0.00149	0.9759	0.0011
*Y61	30	0.13006	0.9845	8.6204
*Y62	31	-0.02400	0.9753	0.2886
*Y63	32	-0.00248	0.9878	0.0031
*Y64	33	0.03015	0.9767	0.4557
*Y65	34	-0.06172	0.9735	1.9155
*D	35	-0.14694	0.8622	10.7502
*P	36	0.10647	0.5980	5.7447
*T	37	-0.05090	0.9094	1.3013
*J	38	-0.01885	0.5637	0.1781
*F	39	-0.05376	0.8505	1.4522
*AA	40	0.24871	0.9418	33.0344
*BN	41	-0.10255	0.9560	5.3250
*CD	42	-0.08157	0.9731	3.3556
*DL	43	-0.02055	0.9925	0.2116
*FA	44	-0.04359	0.9670	0.9539
*NA	45	-0.05509	0.9769	1.5251
*NF	46	0.02036	0.9811	0.2078
*NW	47	-0.01886	0.9621	0.1783
*PA	48	0.13836	0.9758	9.7776
*PP	49	0.11457	0.9706	6.6638
*PL	50	0.08806	0.9727	3.9156
*PK	51	-0.00[illegible]7	0.9906	0.0244
*TW	52	-0.00648	0.9589	0.0210
*UA	53	-0.13470	0.8672	9.2583
*WA	54	-0.09525	0.9870	4.[illegible]871
DL	55	0.12574	0.4414	8.0436
WS	56	0.15559	0.6058	12.4287
DH	57	0.00317	0.4912	0.0050
ROW	58	0.13077	0.4551	8.7168
MP	59	0.11698	0.5570	6.9393
MTOW	60	0.10658	0.4592	5.7563
MLW	61	0.10916	0.4313	6.0418
WA	62	0.08115	0.4491	3.3215
WL	63	0.21407	0.5473	24.0614
MS	64	0.02298	0.4532	0.2648
MCS	65	0.00517	0.4505	0.0134
TCS	66	0.00704	0.4607	0.0248
AS	67	0.09277	0.5715	4.3496
TOD	68	0.10252	0.5416	5.3533
LD	69	0.05087	0.5582	1.2997
MPR	70	0.26737	0.7233	38.5711
MFR	71	0.23400	0.7343	29.0217
NE	72	0.33702	0.9212	64.1990
EOW	73	0.12938	0.6010	8.5291
UTIL	74	-0.06212	0.5802	1.9406
MTOT	75	-0.02847	0.4413	0.4065
MCT	76	-0.02759	0.4897	0.3817
MTSFC	77	0.08067	0.6409	3.2815
TY	78	0.02469	0.6524	0.3055
P/RPM	79	0.22795	0.9505	27.4600
CP	80	0.00967	0.4779	0.0469

STEP NUMBER 4
VARIABLE ENTERED 72

MULTIPLE R 0.9633
STD. ERROR OF EST. 3.0949

ANALYSIS OF VARIANCE

	DF	SUM OF SQUARES	MEAN SQUARE	F RATIO
REGRESSION	4	74691.518	18672.879	1949.419
RESIDUAL	501	4799.923	9.579	

VARIABLES IN EQUATION

VARIABLE		COEFFICIENT	STD. ERROR	F TO REMOVE
(CONSTANT		-0.86235752E 01)		
AFS	8	0.26067820E 00	0.2737E-01	90.7060
RAM	19	0.42692155E-06	0.6797E-07	39.4509
AFI	23	0.17230434E-06	0.1141E-07	227.8492
NE	72	0.23415131E 01	0.2922E 00	64.1990

VARIABLES NOT IN EQUATION

VARIABLE		PARTIAL CORR.	TOLERANCE	F TO ENTER
TMA	2	0.61019	0.1556	296.5977
TMF	3	0.54655	0.2413	212.9742
TMO	4	0.26401	0.4308	37.4609
POL	5	0.17411	0.5204	15.6309
FC	6	0.24533	0.9559	32.0207
TME	7	0.81263	0.1343	972.2043
NP	9	0.06569	0.5401	2.1672
LF	10	0.15074	0.9824	11.6254
RDH	11	0.02456	0.0264	0.3017
MPAH	12	-0.07061	0.4302	2.4912
TOM	13	0.67297	0.1606	413.6754
AMB	14	0.64822	0.2289	362.3597
TAOF	15	0.89048	0.0660	1919.0064
FUEL	16	0.17018	0.5225	14.9118
RPM	17	0.21439	0.0398	24.0843
ASM	18	-0.01317	0.0240	0.0867
RAM	20	0.06136	0.0257	1.9270
ADA	21	0.00065	0.0009	0.0002
/82AM	22	-0.04206	0.6975	0.8862
ADP	24	-0.08751	0.1732	3.8593
M/BH	25	-0.05843	0.4327	1.7131
YOD	26	-0.04264	0.8556	0.9109
ONES	27	0.00000	1.0000	0.0000
*Y59	28	-0.03933	0.8295	0.7745
*Y60	29	0.04204	0.9636	0.8851
*Y61	30	0.10617	0.9764	5.6999
*Y62	31	-0.05338	0.9694	1.4287
*Y63	32	-0.02596	0.9836	0.3347
*Y64	33	0.03335	0.9767	0.5567
*Y65	34	-0.06244	0.9734	1.9569
*D	35	-0.11368	0.8509	6.5461
*P	36	0.14927	0.5922	11.3639
*T	37	-0.12014	0.8792	7.3223
*J	38	-0.03512	0.5686	0.6174
*F	39	-0.02659	0.8443	0.3538
*AA	40	0.25430	0.9411	34.5703
*BN	41	-0.10939	0.9560	6.0543
*CO	42	-0.04827	0.9617	1.1678
*DL	43	-0.02360	0.9925	0.2795
*FA	44	-0.04758	0.9670	1.1345
*NA	45	-0.05008	0.9764	1.2572
*NF	46	0.09690	0.9409	4.7394
*NW	47	-0.04179	0.9596	0.8749
*PA	48	0.13127	0.9739	8.7676
*PP	49	0.12028	0.9706	7.3398
*PL	50	0.07583	0.9703	2.8918
*PK	51	-0.01504	0.9902	0.1132
*TW	52	-0.00806	0.9599	0.0325
*UA	53	-0.16553	0.8639	14.0958
*WA	54	-0.09998	0.9870	5.0482
DL	55	-0.01541	0.3664	0.1188
WS	56	0.03017	0.5165	0.4555
DH	57	-0.09252	0.4489	4.3169
BOW	58	0.00297	0.3892	0.0044
MP	59	0.01747	0.5068	0.1527
MTOW	60	0.00121	0.4142	0.0007
MLW	61	-0.01095	0.3777	0.0599
WA	62	-0.02557	0.4063	0.3272
WL	63	0.03596	0.3948	0.6466
MS	64	-0.03847	0.4395	0.7411
HCS	65	-0.05862	0.4364	1.7239
TCS	66	-0.07340	0.4382	2.7081
AS	67	-0.02649	0.5036	0.3512
TOD	68	0.02818	0.5134	0.3975
LD	69	0.00529	0.5478	0.0140
MPR	70	0.09480	0.4925	4.5343
MFR	71	0.08082	0.5518	3.2870
FDW	73	0.07635	0.5928	2.9314
UTIL	74	-0.05495	0.5796	1.5088
MTGT	75	-0.03793	0.4611	0.7202
MCT	76	-0.03448	0.4896	0.5950
MTSFC	77	0.02736	0.6237	0.3747
TV	78	-0.08101	0.5976	3.3031
P/RPM	79	0.24846	0.9502	32.8966
FP	80	-0.01735	0.4751	0.1506

STEP NUMBER 5
VARIABLE ENTERED 40

MULTIPLE R 0.9714
STD. ERROR OF EST. 2.9962

ANALYSIS OF VARIANCE

	DF	SUM OF SQUARES	MEAN SQUARE	F RATIO
REGRESSION	5	75001.860	15000.372	1670.949
RESIDUAL	500	4488.580	8.977	

VARIABLES IN EQUATION

VARIABLE		COEFFICIENT	STD. ERROR	F TO REMOVE
(CONSTANT		-0.82751244E 01)		
AFS	8	0.25820646E 00	0.2650E-01	94.9312
RAM	19	0.39549015E-06	0.6602E-07	35.8874
AF1	23	0.17555341E-06	0.1107E-07	251.9895
*AA	40	0.27811445E 01	0.4730E 00	34.5703
NE	72	0.22951859E 01	0.2830E 00	65.7651

VARIABLES NOT IN EQUATION

VARIABLE		PARTIAL CORR.	TOLERANCE	F TO ENTER
TMA	2	0.59955	0.1525	280.0319
TME	3	0.51806	0.2282	183.0539
TMO	4	0.26061	0.4298	36.3611
POL	5	0.18217	0.5204	17.1278
FC	6	0.25482	0.9555	34.6520
TME	7	0.80096	0.1141	893.0388
NP	9	0.05292	0.5383	1.4015
LF	10	0.11152	0.9523	6.2843
RHH	11	0.07108	0.0256	2.5341
MPAH	12	-0.07552	0.4302	2.8626
TUM	13	0.65252	0.1519	370.0172
AMR	14	0.61660	0.1914	306.0873
TAOF	15	0.88636	0.0634	1828.7159
FUEL	16	0.17830	0.5225	16.3845
RPM	17	0.16168	0.0374	13.3944
ASM	18	-0.03675	0.0238	0.6749
RAH	20	0.11893	0.0247	7.1588
ADA	21	0.00062	0.0000	0.0002
/R2AH	22	-0.08188	0.6833	3.3677
ADP	24	-0.06230	0.1712	1.9445
M/BH	25	-0.05738	0.4326	1.6486
YOO	26	-0.05752	0.8534	1.6564
ONES	27	-0.00000	1.0000	0.0000
*Y59	28	-0.02396	0.8261	0.2865
*Y60	29	0.04284	0.9636	0.9173
*Y61	30	0.11013	0.9764	6.1266
*Y62	31	-0.05714	0.9694	1.6343
*Y63	32	-0.03084	0.9834	0.4749
*Y64	33	0.03490	0.9767	0.6049
*Y65	34	-0.07239	0.9726	2.6287
*D	35	-0.13687	0.8465	9.5268
*P	36	0.15207	0.5921	11.8130
*T	37	-0.12137	0.8791	7.4603
*J	38	0.02601	0.5374	0.3379
*F	39	-0.09057	0.7994	4.1268
*RN	41	-0.09892	0.9532	4.9315
*CO	42	-0.03703	0.9594	0.6851
*DL	43	-0.00174	0.9851	0.0015
*FA	44	-0.01283	0.9484	0.0822
*NA	45	-0.03645	0.9730	0.6640
*NE	46	0.11153	0.9383	6.2850
*NW	47	-0.02291	0.9529	0.2620
*PA	48	0.15252	0.9701	11.8839
*PP	49	0.13615	0.9686	9.4251
*PL	50	0.08877	0.9698	3.9635
*PK	51	-0.01346	0.9901	0.0905
*TW	52	0.02783	0.9410	0.3869
*UA	53	-0.11640	0.8225	6.8538
*WA	54	-0.08708	0.9932	3.8126
OL	55	-0.00991	0.3662	0.0490
WS	56	0.05728	0.5116	1.6424
OH	57	-0.09933	0.4488	4.9722
ROW	58	0.00796	0.3891	0.0316
MP	59	0.01964	0.5068	0.1925
MTOW	60	0.01173	0.4136	0.0686
MLW	61	-0.00937	0.3777	0.0439
WA	62	-0.01073	0.4049	0.0575
WL	63	0.03002	0.3945	0.4503
MS	64	-0.05034	0.4388	1.2675
MCS	65	-0.07068	0.4358	2.5054
TCS	66	-0.08479	0.4377	3.6137
AS	67	-0.02587	0.5036	0.3342
TOD	68	0.06040	0.5063	1.8249
LD	69	0.00799	0.5478	0.0318
MPR	70	0.09550	0.4824	4.5933
MFR	71	0.07640	0.5514	2.9296
EOW	73	0.08857	0.5821	3.9456
UTIL	74	-0.01394	0.5641	0.0956
MTOT	75	-0.05006	0.4603	1.2534
MCT	76	-0.04999	0.4882	1.2500
MTSFC	77	0.08871	0.5931	3.9578
TY	78	-0.08726	0.5975	3.8284
P/RPM	79	0.25743	0.9502	35.4148
EP	80	-0.03087	0.4740	0.4760

STEP NUMBER 6
VARIABLE ENTERED 79

MULTIPLE R 0.9733
STD. ERROR OF EST. 2.8981

ANALYSIS OF VARIANCE

	DF	SUM OF SQUARES	MEAN SQUARE	F RATIO
REGRESSION	6	75299.311	12549.885	1494.202
RESIDUAL	499	4191.129	8.399	

VARIABLES IN EQUATION

VARIABLE		COEFFICIENT	STD. ERROR	F TO REMOVE
(CONSTANT		-0.95103337E 01)		
AFS	8	0.25000713E 00	0.2567E-01	94.8495
RAM	19	0.39987947E-06	0.6386E-07	39.2084
AFI	23	0.17955734E-06	0.1072E-07	280.3846
*AA	40	0.27465438E 01	0.4575E 00	37.0932
NE	72	0.23237743E 01	0.2738E 00	72.0314
P/RPM	79	0.82092778E 01	0.1379E 01	35.4148

VARIABLES NOT IN EQUATION

VARIABLE		PARTIAL CORR.	TOLERANCE	F TO ENTER
TMA	2	0.61097	0.1522	296.6237
TMF	3	0.52582	0.2278	190.3118
TMO	4	0.24455	0.4256	31.6783
POL	5	0.04521	0.3525	1.0201
FC	6	-0.10994	0.0005	6.0927
TME	7	0.79869	0.1117	877.3357
NP	9	0.07873	0.5341	3.1057
LF	10	0.12137	0.9518	7.4458
RRH	11	0.06587	0.0256	2.1703
MPAH	12	-0.02205	0.4107	0.2422
TOM	13	0.65748	0.1511	380.0016
AMB	14	0.60241	0.1862	283.6643
TAOF	15	0.87858	0.0594	1685.2557
FUEL	16	0.04066	0.3546	0.8265
RPM	17	0.14841	0.0372	11.2162
ASM	18	-0.04703	0.0238	1.1041
RAH	20	0.10650	0.0246	5.7240
ADA	21	0.00067	0.0000	0.0002
/R2AH	22	-0.06521	0.6796	2.1267
ADP	24	-0.04708	0.1705	1.1062
M/RH	25	-0.01011	0.4177	0.0509
YOO	26	-0.03330	0.8451	0.5527
ONES	27	-0.00000	1.0000	0.0000
*Y59	28	-0.04695	0.8205	1.0999
*Y60	29	0.02400	0.9580	0.2871
*Y61	30	0.11530	0.9764	6.7096
*Y62	31	-0.04534	0.5669	1.0260
*Y63	32	-0.03044	0.9834	0.4620
*Y64	33	0.05513	0.9718	1.5181
*Y65	34	-0.07485	0.9726	2.8056
*D	35	-0.12527	0.8432	7.9401
*P	36	0.08438	0.5432	3.5710
*T	37	-0.08065	0.8527	3.2602
*J	38	0.05712	0.5307	1.6299
*F	39	-0.07766	0.7964	3.0215
*HN	41	-0.08588	0.9494	3.7003
*CO	42	-0.06680	0.9497	2.2320
*OL	43	0.01078	0.9829	0.0579
*FA	44	-0.00633	0.9477	0.0199
*NA	45	-0.01576	0.9664	0.1237
*NF	46	0.11589	0.9383	6.7796
*NW	47	-0.01798	0.9524	0.1610
*PA	48	0.11774	0.9465	7.0006
*PP	49	0.13456	0.9691	9.1827
*PL	50	0.09507	0.9687	4.5423
*PK	51	-0.02005	0.9996	0.2003
*TW	52	0.01596	0.9388	0.1270
*UA	53	-0.11390	0.8220	6.5459
*WA	54	-0.08465	0.9927	3.5965
OL	55	0.01252	0.3635	0.0781
WS	56	0.02018	0.5004	0.2030
OM	57	-0.05510	0.4338	1.5166
ROW	58	0.01973	0.3884	0.1940
MP	59	0.03486	0.5053	0.6059
MTOW	60	0.02800	0.4121	0.3907
MLW	61	0.01221	0.3752	0.0743
WA	62	0.00164	0.4039	0.0013
WI	63	0.06259	0.3992	1.9585
MS	64	-0.00017	0.4221	0.0000
MCS	65	-0.01669	0.4140	0.1388
TCS	66	-0.02889	0.4158	0.4160
AS	67	0.02049	0.4880	0.2092
TOD	68	0.06033	0.5063	1.8194
LD	69	0.04788	0.5360	1.1443
MPR	70	0.07211	0.4775	2.6028
MFR	71	0.04133	0.5400	0.8520
EOW	73	0.08144	0.5812	3.3252
UTIL	74	-0.00530	0.5634	0.0140
MTOT	75	-0.01314	0.4506	0.0861
MCT	76	-0.01432	0.4785	0.1021
MTSFC	77	0.11663	0.5882	6.8676
TV	78	-0.04960	0.5831	1.2283
FP	80	0.00792	0.4634	0.0312

STEP NUMBER 7
VARIABLE ENTERED 17

MULTIPLE R 0.9739
STD. ERROR OF EST. 2.8689

ANALYSIS OF VARIANCE

	DF	SUM OF SQUARES	MEAN SQUARE	F RATIO
REGRESSION	7	75391.626	10770.232	1308.569
RESIDUAL	498	4098.814	8.231	

VARIABLES IN EQUATION

VARIABLE		COEFFICIENT	STD. ERROR	F TO REMOVE
(CONSTANT		-0.91924562E 01)		
AFS	8	0.28554599E 00	0.2754E-01	107.5166
RPM	17	0.41104635E-08	0.1227E-08	11.2162
RAM	19	0.24632655E-06	0.7809E-07	9.9492
AFI	23	0.15234437E-06	0.1337E-07	129.8714
*AA	40	0.23982446E 01	0.4675E 00	26.3137
NE	72	0.22778224E 01	0.2714E 00	70.4473
P/RPM	79	0.74771310E 01	0.1349E 01	33.1000

VARIABLES NOT IN EQUATION

VARIABLE		PARTIAL CORR.	TOLERANCE	F TO ENTER
TMA	2	0.62321	0.1521	315.6084
TMF	3	0.53082	0.2278	194.9821
TMO	4	0.26928	0.4183	38.8553
POL	5	0.03625	0.3911	0.6540
FC	6	-0.10900	0.0005	5.9763
TME	7	0.79469	0.1097	851.8003
NP	9	0.00265	0.3923	0.0035
LF	10	0.05274	0.6974	1.3863
RBH	11	0.10988	0.0238	6.0742
MPAH	12	-0.02752	0.4103	0.3766
TOM	13	0.66414	0.1511	392.2200
AMR	14	0.59060	0.1771	266.2189
TAOF	15	0.87699	0.0586	1655.5960
FUEL	16	0.03178	0.3532	0.5024
ASM	18	-0.14525	0.0175	10.7110
RAH	20	0.14282	0.0235	10.3492
ADA	21	0.00075	0.0000	0.0003
/B2AH	22	-0.05447	0.6755	1.4790
ADP	24	-0.00550	0.1569	0.0151
M/RH	25	-0.01785	0.4166	0.1584
YUO	26	-0.03665	0.8447	0.6685
ONES	27	0.00000	1.0000	0.0000
*Y59	28	-0.04647	0.8204	1.0757
*Y60	29	0.01312	0.9527	0.0856
*Y61	30	0.12228	0.9750	7.5443
*Y62	31	-0.03583	0.9624	0.6388
*Y63	32	-0.02302	0.9807	0.2635
*Y64	33	0.04831	0.9693	1.1624
*Y65	34	-0.08275	0.9705	3.4269
*D	35	-0.10697	0.8271	5.7529
*P	36	0.06744	0.5351	2.2711
*T	37	-0.05326	0.8202	1.4139
*J	38	0.07844	0.5213	3.0766
*F	39	-0.10459	0.7750	5.4967
*BN	41	-0.08138	0.9491	3.3133
*CO	42	-0.04628	0.9288	1.0669
*DL	43	0.00492	0.9813	0.0120
*FA	44	0.00691	0.9412	0.0180
*NA	45	-0.01430	0.9663	0.1017
*NE	46	0.12287	0.9370	7.6179
*NW	47	-0.00773	0.9478	0.0297
*PA	48	0.12960	0.9421	8.4909
*PP	49	0.11782	0.9522	6.9959
*PL	50	0.07518	0.9494	2.8252
*PR	51	-0.01539	0.9889	0.1178
*TW	52	0.00285	0.9315	0.0040
*UA	53	-0.11687	0.8219	6.8828
*WA	54	-0.10267	0.9709	5.2952
OL	55	-0.00685	0.3574	0.0233
WS	56	-0.00245	0.4888	0.0030
OM	57	-0.05469	0.4338	1.4907
BOW	58	0.00148	0.3825	0.0011
MP	59	0.00953	0.4903	0.0452
MTOW	60	0.01415	0.4084	0.0995
MLW	61	-0.00451	0.3704	0.0101
WA	62	-0.01639	0.3982	0.1336
WL	63	0.05566	0.3891	1.5447
MS	64	-0.00577	0.4215	0.0166
MCS	65	-0.01693	0.4160	0.1425
TCS	66	-0.03095	0.4157	0.4766
AS	67	0.02193	0.4879	0.2391
TOD	68	0.05280	0.5047	1.3894
LD	69	0.04019	0.5343	0.8041
MPR	70	0.06103	0.4744	1.8580
MFR	71	0.01696	0.5250	0.1430
EDW	73	0.06242	0.5703	1.9440
UTIL	74	0.01643	0.5518	0.1342
MTOT	75	-0.02387	0.4494	0.2833
MCT	76	-0.02428	0.4765	0.2931
MTSFC	77	0.14809	0.5682	11.1437
TY	78	-0.04535	0.5825	1.0244
FP	80	0.00364	0.4630	0.0066

STEP NUMBER 8
VARIABLE ENTERED 77

MULTIPLE R 0.9745
STD. ERROR OF EST. 2.8401

ANALYSIS OF VARIANCE

	DF	SUM OF SQUARES	MEAN SQUARE	F RATIO
REGRESSION	8	75481.514	9435.189	1169.712
RESIDUAL	497	4008.926	8.066	

VARIABLES IN EQUATION

VARIABLE		COEFFICIENT	STD. ERROR	F TO REMOVE
(CONSTANT		-0.11077456E 02)		
AFS	8	0.29477615E 00	0.2740E-01	115.7233
RPM	17	0.48699556E-08	0.1236E-08	15.5204
RAM	19	0.26582849E-06	0.7754E-07	11.7558
AFI	23	0.13278614E-06	0.1447E-07	84.1767
*AA	40	0.26739216E 01	0.4731E 00	32.3474
NF	72	0.21091465E 01	0.2734E 00	59.5250
MTSFC	77	0.37729947E 01	0.1130E 01	11.1437
P/RPM	79	0.82370390E 01	0.1360E 01	36.6988

VARIABLES NOT IN EQUATION

VARIABLE		PARTIAL CORR.	TOLERANCE	F TO ENTER
TMA	2	0.62343	0.1517	315.3377
TMF	3	0.57607	0.2262	189.7889
TMO	4	0.26047	0.4153	36.0998
POL	5	0.01946	0.3464	0.1879
FC	6	-0.14374	0.0005	10.4638
TME	7	0.79166	0.1082	832.7959
NP	9	-0.05246	0.3452	1.3686
LF	10	0.02510	0.6718	0.3127
RBH	11	0.10347	0.0238	5.3672
MPAH	12	-0.09801	0.3410	4.8110
TDM	13	0.66059	0.1499	384.0323
AMR	14	0.58627	0.1758	259.7687
TADE	15	0.87497	0.0560	1619.7281
FUEL	16	0.01505	0.3485	0.1124
ASM	18	-0.11391	0.0144	6.4164
RAH	20	0.13147	0.0233	8.7242
ADA	21	0.00081	0.0000	0.0003
/92AH	22	-0.02134	0.6400	0.2260
ADP	24	-0.00032	0.1567	0.0001
M/BH	25	-0.08793	0.3452	3.8652
YOO	26	-0.03421	0.8444	0.5810
ONFS	27	0.00000	1.0000	0.0000
*Y59	28	-0.03922	0.8192	0.7640
*Y60	29	0.00729	0.9511	0.0264
*Y61	30	0.11620	0.9725	6.7886
*Y62	31	-0.03562	0.9674	0.6302
*Y63	32	-0.02398	0.9807	0.2831
*Y64	33	0.05048	0.9692	1.2672
*Y65	34	-0.07910	0.9696	3.1228
*D	35	-0.08212	0.7993	3.3678
*P	36	0.13027	0.4668	8.5632
*T	37	-0.06293	0.8172	1.9721
*J	38	-0.04986	0.2281	1.2361
*F	39	-0.04953	0.6487	1.2196
*BN	41	-0.09351	0.9430	4.3751
*CU	42	-0.05267	0.9274	1.3798
*DL	43	-0.00437	0.9775	0.0095
*FA	44	0.00845	0.9410	0.0354
*NA	45	0.00289	0.9533	0.0041
*NE	46	0.12630	0.9368	8.0402
*NW	47	0.01063	0.9335	0.0560
*PA	48	0.13816	0.9400	9.6517
*PP	49	0.11845	0.9527	7.0579
*PL	50	0.05689	0.9321	1.6104
*PK	51	-0.02696	0.9829	0.3608
*TW	52	-0.00342	0.9298	0.0058
*UA	53	-0.12591	0.8198	7.9893
*WA	54	-0.08255	0.9496	3.4034
DL	55	-0.06471	0.3118	2.0856
WS	56	-0.02427	0.4787	0.2923
DH	57	-0.10441	0.3957	5.4668
RUW	58	-0.05094	0.3406	1.2904
WP	59	-0.02662	0.4627	0.3518
MTOW	60	-0.03668	0.3647	0.6682
MLW	61	-0.05886	0.3278	1.7241
WA	62	-0.05518	0.3740	1.5149
WL	63	-0.01104	0.3123	0.0605
WS	64	-0.06798	0.3604	2.3029
WCS	65	-0.08233	0.3522	3.3852
TCS	66	-0.09892	0.3503	4.8915
AS	67	-0.06795	0.3497	2.3006
TOD	68	-0.01128	0.4137	0.0631
LD	69	-0.03655	0.4087	0.6635
MPR	70	0.04674	0.4495	1.0858
MFR	71	0.03777	0.5153	0.7085
EOW	73	-0.00041	0.4678	0.0001
UTIL	74	0.00917	0.5504	0.0417
MTOT	75	-0.06432	0.4194	2.0607
MCT	76	-0.05471	0.4584	1.4889
TY	78	-0.10681	0.5073	5.7241
FP	80	-0.05136	0.4075	1.3117

STEP NUMBER 9
VARIABLE ENTERED 48

MULTIPLE R 0.9750
STD. ERROR OF EST. 2.8157

ANALYSIS OF VARIANCE

	DF	SUM OF SQUARES	MEAN SQUARE	F RATIO
REGRESSION	9	75558.035	8395.337	1058.916
RESIDUAL	496	3932.405	7.928	

VARIABLES IN EQUATION

VARIABLE		COEFFICIENT	STD. ERROR	F TO REMOVE
(CONSTANT		-0.11030703E 02)		
AFS	8	0.29446531E 00	0.2717E-01	117.4880
HPM	17	0.51589136E-08	0.1229E-08	17.6187
RAM	19	0.27643387E-06	0.7694E-07	12.9094
AFI	23	0.12609651E-05	0.1451E-07	75.5295
*AA	40	0.27492011E 01	0.4667E 00	34.6959
*PA	48	0.16983534E 01	0.5467E 00	9.6517
NE	72	0.20581141E 01	0.2715E 00	57.4549
HTSFC	77	0.39349544E 01	0.1122E 01	12.3053
P/RPM	79	0.75722314E 01	0.1365E 01	30.7785

VARIABLES NOT IN EQUATION

VARIABLE		PARTIAL CORR.	TOLERANCE	F TO ENTER
THA	2	0.61623	0.1489	303.0553
THF	3	0.54726	0.2241	211.6300
THO	4	0.24545	0.4067	31.7325
PUL	5	-0.00147	0.3385	0.0011
FC	6	-0.12478	0.0005	7.9285
THF	7	0.78956	0.1072	819.4201
NP	9	-0.07505	0.3372	2.8042
LF	10	0.00894	0.6625	0.0395
RBH	11	0.09055	0.0235	4.0918
HPAH	12	-0.09802	0.3410	4.8019
TOH	13	0.66813	0.1499	399.1417
AHR	14	0.57639	0.1703	246.2637
TADE	15	0.87250	0.0548	1578.2796
FUEL	16	-0.00556	0.3409	0.0153
ASH	18	-0.12159	0.0164	7.4279
RAH	20	0.11411	0.0228	6.5299
ADA	21	0.00085	0.0000	0.0004
/R2AH	22	-0.01101	0.6364	0.0600
ADP	24	0.01198	0.1555	0.0710
H/RH	25	-0.08982	0.3452	4.0259
YDO	26	-0.02453	0.8401	0.3005
ONES	27	0.00000	1.0000	0.0000
*Y59	28	-0.04902	0.8146	1.1923
*Y60	29	0.00210	0.9498	0.0022
*Y61	30	0.11978	0.9722	7.2057
*Y62	31	-0.03486	0.9423	0.6023
*Y63	32	-0.02130	0.9803	0.2246
*Y64	33	0.05104	0.9692	1.2931
*Y65	34	-0.07412	0.9679	2.7341
*D	35	-0.02414	0.6454	0.2887
*P	36	0.13115	0.4668	8.6628
*T	37	-0.05825	0.8160	1.6850
*J	38	-0.05560	0.2278	1.5352
*F	39	-0.05075	0.6497	1.2782
*BN	41	-0.08423	0.9378	3.5367
*CO	42	-0.04234	0.9216	0.8891
*DL	43	0.00317	0.9746	0.0050
*CA	44	0.02292	0.9312	0.2602
*NA	45	0.01287	0.9485	0.0820
*NE	46	0.13487	0.9344	9.1706
*NW	47	0.02363	0.9257	0.2766
*PP	49	0.12883	0.9483	8.3537
*PL	50	0.04739	0.9275	2.2581
*PK	51	-0.02282	0.9919	0.2578
*TW	52	0.01202	0.9185	0.0714
*UA	53	-0.11478	0.8128	6.6088
*WA	54	-0.07676	0.9475	2.9341
OL	55	-0.07736	0.3096	2.9801
WS	56	-0.03839	0.4741	0.7305
OH	57	-0.11764	0.3928	6.9462
ROW	58	-0.06447	0.3377	2.0662
MP	59	-0.04807	0.4526	1.1666
MTOC	60	-0.05458	0.3592	1.4792
MLW	61	-0.07190	0.3253	2.5722
WA	62	-0.06925	0.3706	2.3853
WL	63	-0.02482	0.3993	0.3050
MS	64	-0.07141	0.3602	2.5374
MCS	65	-0.08390	0.3922	3.5089
TCS	66	-0.09929	0.3503	4.9282
AS	67	-0.06915	0.3497	2.3782
TOD	68	-0.03484	0.4025	0.6015
LD	69	-0.04096	0.4086	0.8319
MPR	70	0.03856	0.4676	0.7371
MFR	71	0.02225	0.5085	0.2452
EDW	73	-0.01044	0.4654	0.0540
UTIL	74	0.00029	0.5481	0.0000
MTOT	75	-0.07526	0.4172	2.8200
MCT	76	-0.06595	0.4559	2.1960
TV	78	-0.10529	0.5071	5.5488
FP	80	-0.06003	0.4061	1.7904

STEP NUMBER 10
VARIABLE ENTERED 46

MULTIPLE R 0.9754
STD. ERROR OF EST. 2.7928

ANALYSIS OF VARIANCE

	DF	SUM OF SQUARES	MEAN SQUARE	F RATIO
REGRESSION	10	75629.563	7562.956	969.691
RESIDUAL	495	3840.876	7.800	

VARIABLES IN EQUATION

VARIABLE		COEFFICIENT	STD. ERROR	F TO REMOVE
(CONSTANT		-0.11402457E 02)		
AFS	8	0.24981933E 00	0.2700E-01	123.2752
RPM	17	0.53177310E-08	0.1220E-08	18.9933
RAM	19	0.26819193E-06	0.7636E-07	12.3346
AFI	23	0.12590429E-06	0.1439E-07	76.5433
*AA	40	0.28007635E 01	0.4632E 00	36.5533
*NE	46	0.18673234E 01	0.6166E 00	9.1706
*PA	48	0.17828439E 01	0.5429E 00	10.7826
NE	72	0.22184650E 01	0.2745E 00	65.3307
MTSFC	77	0.39891734E 01	0.1113E 01	12.8517
P/RPM	79	0.75358266E 01	0.1354E 01	31.0162

VARIABLES NOT IN EQUATION

VARIABLE		PARTIAL CORR.	TOLERANCE	F TO ENTER
TMA	2	0.61302	0.1479	297.4066
TME	3	0.54191	0.2221	205.3865
TMO	4	0.23843	0.4045	29.7772
PCL	5	-0.00297	0.3384	0.0043
FC	6	-0.12269	0.0005	7.5503
TME	7	0.78586	0.1055	797.7633
NP	9	-0.04742	0.3214	1.1132
LF	10	0.01316	0.6618	0.0856
RAH	11	0.08804	0.0235	3.8592
MPAH	12	-0.07644	0.3307	2.9031
TOM	13	0.66345	0.1481	388.3960
AMB	14	0.57139	0.1688	239.4675
TAOE	15	0.87298	0.0546	1580.9896
FUEL	16	-0.00706	0.3408	0.0246
ASM	18	-0.12331	0.0164	7.6268
RAH	20	0.11265	0.0228	6.3495
ADA	21	0.00086	0.0000	0.0004
/82AH	22	-0.03493	0.6177	0.6033
ADP	24	0.01526	0.1554	0.1151
M/RH	25	-0.06689	0.3337	2.2203
Y00	26	-0.02949	0.8391	0.4300
ONES	27	0.00000	1.0000	0.0000
*Y59	28	-0.04330	0.8129	0.9278
*Y60	29	0.00830	0.9478	0.0340
*Y61	30	0.11658	0.9712	6.8068
*Y62	31	-0.03955	0.9613	0.7741
*Y63	32	-0.02454	0.9798	0.2976
*Y64	33	0.05271	0.9691	1.3763
*Y65	34	-0.07478	0.9679	2.7783
*D	35	-0.04298	0.6338	0.9142
*P	36	0.12757	0.4662	8.1718
*T	37	-0.06995	0.8109	2.4221
*J	38	-0.05860	0.7277	1.7023
*F	39	-0.03451	0.6386	0.5889
*BN	41	-0.07107	0.9274	2.5091
*CO	42	-0.02899	0.9120	0.4154
*DL	43	0.01230	0.9703	0.0748
*EA	44	0.03496	0.9243	0.6045
*NA	45	0.02618	0.9397	0.3389
*NW	47	0.03697	0.9173	0.6763
*PP	49	0.13308	0.9478	8.9065
*PL	50	0.07555	0.9247	2.8361
*PK	51	-0.01898	0.9810	0.1780
*TW	52	0.02012	0.9154	0.2001
*UA	53	-0.11009	0.8113	6.0609
*WA	54	-0.06831	0.9430	2.3162
DL	55	-0.04238	0.2863	0.8889
WS	56	-0.00922	0.4515	0.0420
OH	57	-0.08539	0.3667	3.6282
BOW	58	-0.03082	0.3150	0.4697
MP	59	-0.02054	0.4328	0.2085
MTOW	60	-0.02561	0.3417	0.3242
MLW	61	-0.03959	0.3047	0.7756
WA	62	-0.04402	0.3563	0.9589
WL	63	0.01752	0.2803	0.1517
MS	64	-0.04231	0.3417	0.8857
MCS	65	-0.06137	0.3410	1.8677
TCS	66	-0.07207	0.3334	2.5794
AS	67	-0.04347	0.3357	0.9351
TOD	68	-0.02188	0.3986	0.2366
LD	69	-0.00665	0.3815	0.0218
MPR	70	0.06310	0.4540	1.9746
MFR	71	0.05005	0.4891	1.2407
FOW	73	0.03301	0.4212	0.5389
UTIL	74	0.00556	0.5473	0.0153
MTUT	75	-0.05253	0.4039	1.3669
MCT	76	-0.04369	0.4424	0.9447
TY	78	-0.06948	0.4637	2.3963
EP	80	-0.03385	0.3896	0.5666

STEP NUMBER 11
VARIABLE ENTERED 49

MULTIPLE R 0.9759
STD. ERROR OF EST. 2.7708

ANALYSIS OF VARIANCE

	DF	SUM OF SQUARES	MEAN SQUARE	F RATIO
REGRESSION	11	75697.939	6881.631	896.381
RESIDUAL	494	3792.500	7.677	

VARIABLES IN EQUATION

VARIABLE		COEFFICIENT	STD. ERROR	F TO REMOVE
(CONSTANT		-0.11853182E 02)		
AFS	8	0.29453432E 00	0.2695E-01	120.3460
RPM	17	0.48779614E-08	0.1219E-08	16.0000
RAM	19	0.29970253E-06	0.7649E-07	15.3512
AFI	23	0.12496552E-06	0.1428E-07	76.4635
*AA	40	0.29070933E 01	0.4610E 00	39.7714
*NE	46	0.19080034E 01	0.6110E 00	9.7226
*PA	48	0.18860954E 01	0.5398E 00	12.2340
*PP	49	0.24415053E 01	0.8315E 00	8.9065
NE	72	0.22292195E 01	0.2723E 00	66.4789
MTSFC	77	0.39351632E 01	0.1104E 01	13.0307
P/RPM	79	0.74368427E 01	0.1344E 01	30.6536

VARIABLES NOT IN EQUATION

VARIABLE		PARTIAL CORR.	TOLERANCE	F TO ENTER
TMA	2	0.61164	0.1474	294.6701
TMF	3	0.55965	0.2206	224.8346
TMO	4	0.22119	0.3931	25.3613
POL	5	-0.00697	0.3381	0.0240
FC	6	-0.11856	0.0005	7.0284
TMF	7	0.78569	0.1050	795.2185
NP	9	-0.05553	0.3204	1.5251
LF	10	0.00177	0.6569	0.0015
RHH	11	0.07033	0.0230	2.4508
MPAH	12	-0.07655	0.3307	2.9060
TOM	13	0.67221	0.1480	406.4202
AMR	14	0.56323	0.1654	229.0525
TAOE	15	0.87051	0.0535	1542.3790
FUEL	16	-0.01103	0.3405	0.0600
ASM	18	-0.11360	0.0163	6.4453
RAH	20	0.08804	0.0218	3.8511
AOA	21	0.00088	0.0000	0.0004
/RZAH	22	-0.00091	0.5773	0.0004
AOP	24	0.02299	0.1549	0.2608
M/RH	25	-0.07397	0.3329	2.7122
Y30	26	-0.02176	0.8361	0.2336
UNES	27	0.00000	1.0000	0.0000
*Y59	28	-0.05070	0.8107	1.2707
*Y60	29	0.00832	0.9478	0.0341
*Y61	30	0.11556	0.9710	6.6721
*Y62	31	-0.04003	0.9613	0.7913
*Y63	32	-0.02328	0.9797	0.2672
*Y64	33	0.05192	0.9691	1.3323
*Y65	34	-0.06797	0.9647	2.2815
*U	35	-0.00348	0.5774	0.0060
*P	36	0.12821	0.6662	8.2388
*T	37	-0.07282	0.8106	2.6279
*J	38	-0.04818	0.2262	1.1469
*F	39	-0.04010	0.6376	0.7940
*RN	41	-0.06617	0.9258	2.1679
*CO	42	-0.07628	0.9116	0.3408
*OL	43	0.01918	0.9678	0.1814
*EA	44	0.04322	0.9211	0.9225
*NA	45	0.03256	0.9378	0.5233
*NW	47	0.04271	0.9158	0.9011
*PL	50	0.08715	0.9189	3.7728
*PK	51	-0.01735	0.9808	0.1486
*TW	52	0.03469	0.9051	0.5941
*UA	53	-0.10041	0.8059	5.0207
*WA	54	-0.06338	0.9614	1.9883
OL	55	-0.04999	0.2855	1.2353
WS	56	-0.02165	0.4478	0.2268
OH	57	-0.09066	0.3662	4.0853
ROW	58	-0.04254	0.3128	0.8940
MP	59	-0.03831	0.4257	0.7248
MTOW	60	-0.04166	0.3372	0.8499
MLW	61	-0.04741	0.3018	1.1105
WA	62	-0.05602	0.3538	1.5519
WL	63	0.00632	0.2783	0.0197
WS	64	-0.04374	0.3417	0.9450
MCS	65	-0.06153	0.3410	1.8738
TCS	66	-0.07005	0.3333	2.4311
AS	67	-0.04098	0.3356	0.8295
TOD	68	-0.04619	0.3883	0.9648
LD	69	-0.00864	0.3814	0.0348
MPR	70	0.04495	0.4447	0.9982
MFR	71	0.02550	0.4715	0.3209
FOW	73	0.02523	0.4197	0.3141
UTIL	74	-0.01569	0.5338	0.1214
MTOT	75	-0.05899	0.4031	1.7216
MCT	76	-0.05187	0.4409	1.3299
TY	78	-0.07579	0.4629	2.8486
FP	80	-0.04363	0.3877	0.9401

STEP NUMBER 12
VARIABLE ENTERED 36

MULTIPLE R 0.9763
STD. ERROR OF EST. 2.7507

ANALYSIS OF VARIANCE

	DF	SUM OF SQUARES	MEAN SQUARE	F RATIO
REGRESSION	12	75760.276	6313.356	834.410
RESIDUAL	493	3730.164	7.546	

VARIABLES IN EQUATION

VARIABLE		COEFFICIENT	STD. ERROR	F TO REMOVE
(CONSTANT		-0.12979977E 02)		
AFS	8	0.27303496E 00	0.2769E-01	97.2476
RPM	17	0.46688346E-08	0.1213E-08	14.8196
RAM	19	0.32617319E-06	0.7650E-07	18.1809
AFI	23	0.12825819E-06	0.1423E-07	81.2729
*P	36	0.10432715E 01	0.3635E 00	8.2388
*AA	40	0.30229554E 01	0.4594E 00	43.2983
*NF	46	0.18456057E 01	0.6079E 00	9.2166
*PA	48	0.18806129E 01	0.5359E 00	12.3148
*PP	49	0.24725966E 01	0.8255E 00	8.9721
NE	72	0.22453410E 01	0.2705E 00	68.9153
MTSFC	77	0.51652695E 01	0.1173E 01	19.5402
P/RPM	79	0.63756170E 01	0.1384E 01	21.2114

VARIABLES NOT IN EQUATION

VARIABLE		PARTIAL CORR.	TOLERANCE	F TO ENTER
TMA	2	0.62775	0.1467	319.9788
THE	3	0.55867	0.2201	223.2307
TMD	4	0.27404	0.3582	39.9497
POL	5	0.00355	0.3359	0.0062
FC	6	-0.04286	0.0003	0.9054
TMF	7	0.78873	0.1049	809.9212
NP	9	0.01610	0.2276	0.1275
LF	10	0.02029	0.6437	0.2027
RBH	11	0.05086	0.0224	1.2760
MPAH	12	0.01828	0.1694	0.1644
TDM	13	0.69240	0.1468	453.1077
AMB	14	0.55427	0.1611	218.1795
TADE	15	0.87025	0.0532	1535.5227
FUEL	16	0.00006	0.3780	0.0000
ASM	18	-0.11773	0.0163	6.9149
RAH	20	0.05935	0.0206	1.7393
ADA	21	0.00091	0.0000	0.0004
/B2AH	22	-0.00970	0.5746	0.0463
ADP	24	0.05493	0.1465	1.4891
M/HH	25	0.01519	0.1958	0.1136
YDD	26	0.01401	0.7734	0.0966
ONES	27	-0.00000	1.0000	0.0000
*Y59	28	-0.08643	0.7594	3.7027
*Y60	29	0.00083	0.9446	0.0003
*Y61	30	0.11251	0.9700	6.3081
*Y62	31	-0.03556	0.9600	0.6259
*Y63	32	-0.01973	0.9789	0.1916
*Y64	33	0.06147	0.9644	1.8663
*Y65	34	-0.04947	0.9427	1.2070
*D	35	-0.01197	0.5750	0.0705
*T	37	-0.00242	0.5633	0.0029
*J	38	-0.04125	0.2254	0.8388
*F	39	0.03748	0.4418	0.6921
*BN	41	-0.06963	0.9253	2.3970
*CU	42	-0.00956	0.8958	0.0450
*DL	43	0.01083	0.9636	0.0577
*EA	44	0.03428	0.9163	0.5790
*NA	45	0.02853	0.9368	0.4008
*NW	47	0.04340	0.9158	0.9285
*PL	50	0.08720	0.9189	3.7702
*PK	51	-0.01528	0.9806	0.1149
*TW	52	0.03358	0.9050	0.5553
*UA	53	-0.10160	0.8059	5.1313
*WA	54	-0.04738	0.9252	1.1072
UL	55	0.00480	0.2343	0.0113
WS	55	-0.03474	0.4433	0.5945
OH	57	-0.01139	0.2153	0.0639
ROW	58	0.00950	0.2629	0.0444
WP	59	0.03103	0.3167	0.4743
MTOW	60	0.02256	0.2605	0.2506
MLW	61	0.01697	0.2324	0.1417
WA	62	-0.00867	0.3037	0.0353
WL	63	0.09590	0.1999	4.5669
WS	64	0.05764	0.1876	1.6400
MCS	65	0.04509	0.1635	1.0025
TCS	66	0.03589	0.1534	0.6346
AS	67	0.03917	0.2270	0.7560
TOD	68	-0.01295	0.3643	0.0812
LD	69	0.05512	0.3047	1.4992
MPR	70	0.04684	0.4447	1.0920
MFR	71	0.04717	0.4592	1.0974
EDW	73	0.01365	0.4162	0.0917
UTIL	74	0.02342	0.4972	0.2701
MTOT	75	0.02749	0.2453	0.3709
MCT	76	0.03903	0.2619	0.7505
TY	78	0.00307	0.2906	0.0046
FP	80	0.04954	0.2309	1.2104

STEP NUMBER 13
VARIABLE ENTERED 18

MULTIPLE R 0.9766
STD. ERROR OF EST. 2.7343

ANALYSIS OF VARIANCE

	DF	SUM OF SQUARES	MEAN SQUARE	F RATIO
REGRESSION	13	75811.977	5831.690	779.997
RESIDUAL	472	3670.444	7.477	

VARIABLES IN EQUATION

VARIABLE		COEFFICIENT	STD. ERROR	F TO REMOVE
(CONSTANT		-0.12442267E 02)		
AFS	8	0.24922938E 00	0.2909E-01	72.7940
RPM	17	0.64711269E-08	0.1387E-08	21.7728
ASM	18	-0.26426243E-08	0.1005E-08	6.9149
RAM	19	0.42078555E-06	0.8412E-07	25.0198
AFI	23	0.15131438E-06	0.1664E-07	82.6926
*P	36	0.10664187E 01	0.3614E 00	8.7065
*AA	40	0.29071457E 01	0.4534E 00	40.1510
*NE	46	0.18480018E 01	0.6043E 00	9.3534
*PA	48	0.19467090E 01	0.5333E 00	13.3243
*PP	49	0.22915920E 01	0.8235E 00	7.7445
NE	72	0.23353392E 01	0.2710E 00	74.2425
MTSFC	77	0.44764851E 01	0.1197E 01	13.9905
P/RPM	79	0.52447058E 01	0.1377E 01	20.5665

VARIABLES NOT IN EQUATION

VARIABLE		PARTIAL CORR.	TOLERANCE	F TO ENTER
TMA	2	0.62163	0.1437	309.7228
TMF	3	0.55134	0.2156	214.4353
TMD	4	0.26497	0.3541	37.0447
POL	5	0.00160	0.3358	0.0013
FC	6	-0.04172	0.0003	0.8561
TME	7	0.78554	0.1019	791.2146
NP	9	0.02532	0.2263	0.3149
LF	10	-0.04857	0.4684	1.1609
RBH	11	0.02771	0.0219	0.3774
MPAH	12	0.04137	0.1635	0.8418
TOM	13	0.68764	0.1405	440.4143
AMR	14	0.55315	0.1607	216.4626
TAOF	15	0.87351	0.0531	1580.8961
FUEL	16	-0.00200	0.3379	0.0020
RAH	20	0.03897	0.0199	0.7469
ADA	21	0.00077	0.0000	0.0003
/B2AH	22	-0.02437	0.5461	0.2918
ADP	24	0.04556	0.1454	1.0214
M/RH	25	0.04192	0.1771	0.8643
YOU	26	0.03880	0.7419	0.7404
ONES	27	-0.00000	1.0000	0.0000
*Y59	28	-0.10981	0.7355	5.9927
*Y60	29	-0.00920	0.9379	0.0416
*Y61	30	0.10905	0.9687	5.9089
*Y62	31	-0.02991	0.9575	0.4398
*Y63	32	-0.00871	0.9701	0.0372
*Y64	33	0.06763	0.9622	2.2562
*Y65	34	-0.04351	0.9399	0.9311
*D	35	-0.02361	0.5696	0.2737
*T	37	-0.01981	0.5515	0.1927
*J	38	-0.04583	0.2251	1.0335
*F	39	0.05794	0.4300	1.6539
*BN	41	-0.07554	0.9234	2.8180
*CD	42	-0.00694	0.8953	0.0236
*DL	43	-0.00131	0.9534	0.0008
*FA	44	0.04208	0.9126	0.8710
*NA	45	0.02906	0.9367	0.4149
*NW	47	0.03823	0.9135	0.7185
*PL	50	0.08941	0.9187	3.9570
*PK	51	-0.01075	0.9790	0.0567
*TW	52	0.04727	0.8938	1.0998
*UA	53	-0.10979	0.8028	5.9911
*WA	54	-0.04598	0.9250	1.0355
OL	55	0.04323	0.7123	0.9191
WS	56	-0.00329	0.4114	0.0053
DH	57	0.01560	0.2044	0.1196
BOW	58	0.05343	0.2320	1.4054
MP	59	0.09057	0.2589	4.0605
MTOW	60	0.06747	0.2299	2.2453
MLW	61	0.05983	0.2068	1.7641
WA	62	0.02720	0.2779	0.3635
WL	63	0.14222	0.1703	10.1367
MS	64	0.07997	0.1419	3.1403
HCS	65	0.06587	0.1590	2.1399
TCS	66	0.05657	0.1491	1.5764
AS	67	0.06600	0.2168	2.1483
TOD	68	0.00377	0.3571	0.0070
LD	69	0.09160	0.2817	4.1547
MPP	70	0.06903	0.4310	2.3509
MFR	71	0.09477	0.4130	3.9890
FOW	73	0.06522	0.3527	2.0973
UTIL	74	0.03313	0.4841	0.5395
MTOT	75	0.06495	0.2245	2.0800
MCT	76	0.07453	0.2423	2.7426
TV	78	0.01847	0.2859	0.1675
FP	80	0.08669	0.2127	3.7181

STEP NUMBER 14
VARIABLE ENTERED 63

MULTIPLE R 0.9771
STD. ERROR OF EST. 2.7093

ANALYSIS OF VARIANCE

	DF	SUM OF SQUARES	MEAN SQUARE	F RATIO
REGRESSION	14	75986.383	5420.456	738.455
RESIDUAL	491	3604.058	7.340	

VARIABLES IN EQUATION

VARIABLE		COEFFICIENT	STD. ERROR	F TO REMOVE
(CONSTANT		-0.14418782E 02)		
AFS	8	0.25151125E 00	0.2945E-01	76.0219
RPM	17	0.63723425E-08	0.1374E-08	21.4942
ASM	18	-0.37186814E-08	0.1052E-08	12.5063
RAM	19	0.47394039E-06	0.8501E-07	31.0827
AFI	23	0.16642752E-06	0.1716E-07	94.0940
*P	36	0.18969182E 01	0.4430E 00	18.3323
*AA	40	0.27548829E 01	0.4571E 00	36.3229
*NE	46	0.25920590E 01	0.6416E 00	16.1970
*PA	49	0.17711076E 01	0.5313E 00	11.1127
*PP	49	0.13294713E 01	0.8238E 00	5.4857
WL	63	0.50587463E-01	0.1589E-01	10.1367
NE	72	0.17550419E 01	0.3246E 00	29.2402
MTSFC	77	0.28438459E 01	0.1292E 01	4.8452
P/RPM	79	0.59725742E 01	0.1367E 01	19.0876

VARIABLES NOT IN EQUATION

VARIABLE		PARTIAL CORR.	TOLERANCE	F TO ENTER
TMA	2	0.63358	0.1435	328.6113
TME	3	0.54422	0.2129	206.2007
TMO	4	0.27791	0.3525	41.0132
POL	5	0.00143	0.3358	0.0010
FC	6	-0.05730	0.0003	1.6141
TME	7	0.78654	0.1015	794.8769
NP	9	-0.03555	0.1893	0.6201
LF	10	-0.03988	0.4665	0.7807
RAH	11	0.02861	0.0215	0.4015
MPAH	12	-0.02805	0.1283	0.3860
TOM	13	0.68590	0.1397	435.0831
AMP	14	0.55714	0.1607	220.5591
TAOF	15	0.87154	0.0509	1548.1490
FUEL	16	-0.00196	0.3379	0.0019
RAH	20	0.04229	0.0199	0.8777
ADA	21	0.00072	0.0000	0.0003
/R2AH	22	-0.00830	0.5598	0.0338
ADP	24	0.05443	0.1450	1.4562
M/RH	25	-0.02220	0.1438	0.2417
YOD	26	0.03400	0.7410	0.5670
ONES	27	-0.00000	1.0000	0.0000
*Y59	28	-0.10702	0.7349	5.6770
*Y60	29	-0.01170	0.9376	0.0670
*Y61	30	0.11369	0.9681	6.4168
*Y62	31	-0.03010	0.9575	0.4444
*Y63	32	-0.00334	0.9687	0.0055
*Y64	33	0.05966	0.9586	1.7505
*Y65	34	-0.04519	0.9399	1.0029
*O	35	-0.01486	0.5674	0.1083
*T	37	0.04436	0.4544	0.9662
*J	38	-0.02036	0.2176	0.2032
*F	39	-0.02361	0.3022	0.2732
*BN	41	-0.06199	0.9138	1.8901
*CO	42	0.02479	0.8531	0.3013
*DL	43	0.00185	0.9529	0.0017
*EA	44	0.03661	0.9111	0.6578
*NA	45	0.02583	0.9362	0.3271
*NW	47	0.02362	0.9037	0.2736
*PL	50	0.08129	0.9150	3.2592
*PK	51	-0.01708	0.9772	0.1429
*TW	52	0.03422	0.8857	0.5746
*UA	53	-0.10924	0.8027	5.9177
*WA	54	-0.03779	0.9217	0.7008
OL	55	-0.08701	0.1015	3.7378
WS	56	-0.09031	0.3021	4.0296
OH	57	-0.07909	0.1394	3.0847
ROW	58	-0.06992	0.1132	2.4075
MP	59	0.01049	0.1727	0.0540
MTOW	60	-0.03962	0.1246	0.7703
MLW	61	-0.05841	0.1032	1.6777
WA	62	-0.05067	0.2092	1.2613
MS	64	-0.01972	0.1015	0.1907
MCS	65	-0.02891	0.0977	0.4098
TCS	66	-0.05206	0.0827	1.3315
AS	67	-0.00306	0.1663	0.0046
TOD	68	-0.07110	0.2900	2.4898
LO	69	0.03360	0.2288	0.5537
MPR	70	-0.02787	0.2571	0.3809
MFR	71	-0.00229	0.2420	0.0026
FDW	73	-0.04124	0.1938	0.8349
UTIL	74	0.00964	0.4706	0.0455
MTOT	75	-0.02700	0.1420	0.3576
MCT	76	-0.02260	0.1417	0.2505
TY	78	-0.12743	0.1322	8.0887
EP	80	-0.01497	0.1127	0.1099

STEP NUMBER 15
VARIABLE ENTERED 78

MULTIPLE R 0.9774
STD. ERROR OF EST. 2.6999

ANALYSIS OF VARIANCE

	DF	SUM OF SQUARES	MEAN SQUARE	F RATIO
REGRESSION	15	75944.911	5062.994	699.717
RESIDUAL	490	3545.529	7.2[illegible]	

VARIABLES IN EQUATION

VARIABLE		COEFFICIENT	STD. ERROR	F TO REMOVE
(CONSTANT		-0.77951957E 01)		
AFS	8	0.23762912E 00	0.2905E-01	66.8972
RPM	17	0.62620794E-09	0.1365E-08	21.0345
ASM	18	-0.47121246E-08	0.1058E-08	15.8399
RAM	19	0.54351271E-06	0.8733E-07	38.2547
AFI	23	0.16681272E-06	0.1704E-07	95.8889
*P	36	0.15323516E 01	0.4582E 00	11.1857
*AA	40	0.27051779E 01	0.4542E 00	35.4769
*NE	46	0.23877542E 01	0.6606E 00	13.8912
*PA	48	0.15092465E 01	0.5355E 00	7.9317
*PP	49	0.18099222E 01	0.8192E 00	4.8837
WL	63	0.98345283E-01	0.2319E-01	18.1995
NE	72	0.14331031E 01	0.3415E 00	17.6057
MTSFC	77	0.23625631E 01	0.1294E 01	3.3343
TY	78	-0.16506573E 00	0.5935E-01	8.0947
P/RPM	79	0.59822334E 01	0.1357E 01	19.4763

VARIABLES NOT IN EQUATION

VARIABLE		PARTIAL CORR.	TOLERANCE	F TO ENTER
TMA	2	0.62910	0.1421	370.2819
TME	3	0.55439	0.2125	216.9790
TMO	4	0.27373	0.3515	39.6080
POL	5	-0.00403	0.3352	0.0079
FC	6	-0.08626	0.0003	3.6654
TME	7	0.78307	0.0999	775.2048
NP	9	-0.04440	0.1885	0.9658
LF	10	-0.03868	0.4664	0.7328
RHH	11	0.01055	0.0211	0.0544
MPAH	12	-0.04014	0.1272	0.7893
TDM	13	0.68985	0.1396	444.0716
AMB	14	0.54700	0.1539	208.7817
TAOF	15	0.87376	0.0508	1578.7210
FUEL	16	-0.00740	0.3373	0.0268
RAH	20	0.01900	0.0192	0.1765
ADA	21	0.00074	0.0000	0.0003
/M2AH	22	0.01345	0.5429	0.0885
ADP	24	0.06247	0.1445	1.9156
M/BH	25	-0.04016	0.1411	0.7899
VOD	26	0.05661	0.7201	1.5723
ONES	27	-0.00000	1.0000	0.0000
*Y59	28	-0.12132	0.7276	7.3055
*Y60	29	-0.01914	0.9346	0.1792
*Y61	30	0.11198	0.9677	6.1979
*Y62	31	-0.03407	0.9567	0.5682
*Y63	32	-0.00314	0.9687	0.0048
*Y64	33	0.07199	0.9510	2.5398
*Y65	34	-0.03457	0.9328	0.5851
*D	35	-0.00071	0.5599	0.0000
*T	37	0.06388	0.4450	2.0034
*J	38	-0.06801	0.1927	2.2722
*F	39	0.00193	0.2901	0.0018
*HN	41	-0.05819	0.9128	1.6615
*CO	42	0.01959	0.8516	0.1878
*OL	43	-0.00502	0.9502	0.0123
*EA	44	0.06205	0.8792	1.8897
*NA	45	0.02738	0.9361	0.3668
*NW	47	0.02693	0.9032	0.3521
*PL	50	0.06711	0.9019	2.2120
*PK	51	-0.03521	0.9588	0.6070
*TW	52	0.03054	0.9869	0.4565
*UA	53	-0.11951	0.7987	7.0860
*WA	54	-0.02899	0.9170	0.4113
OL	55	-0.11564	0.0974	6.6275
WS	56	-0.13065	0.2800	8.4920
OH	57	-0.09388	0.1378	4.3477
BOW	58	-0.10994	0.1047	5.9822
MP	59	-0.06296	0.1287	1.9396
MTOW	60	-0.11386	0.0969	6.4228
PLW	61	-0.11204	0.0901	6.2166
WA	62	-0.10908	0.1781	5.8882
MS	64	-0.00489	0.1001	0.0117
HCS	65	-0.01966	0.0972	0.1987
TCS	66	-0.03406	0.0809	0.5681
AS	67	0.01634	0.1676	0.1307
TOD	68	-0.11824	0.2522	6.9335
LD	69	0.02632	0.2780	0.3390
MPR	70	-0.04675	0.2520	1.0712
MFR	71	-0.01394	0.2401	0.0937
EDW	73	-0.08178	0.1779	3.2923
UTIL	74	-0.01966	0.4472	0.1853
MTOT	75	-0.06335	0.1321	1.9706
MCT	76	-0.05158	0.1352	1.3043
FP	80	-0.02086	0.1125	0.2125

SPECIFIED STEP REACHED

LIST OF ACTUALS, ESTIMATES,
RATIOS AND RESIDUALS

FOR OFFICIAL USE ONLY

CASE	VALUE	CASE	VALUE	CASE	VALUE	CASE	VALUE	CASE	VALUE
1	0.4458700E 02	103	0.1424000E 01	205	0.8733000E 01	307	0.2467000E 01	409	0.5298000E 01
2	0.3856900E 01	104	0.4591000E 01	206	0.2542500E 02	308	0.1440900E 02	410	0.1432300E 02
3	0.7632000E 01	105	0.3934000E 01	207	0.1936000E 01	309	0.1325000E 01	411	0.1293000E 01
4	0.1142300E 02	106	0.2895300E 02	208	0.1580000E 01	310	0.8[illegible]4000E 01	412	0.1256100E 02
5	0.5286000E 01	107	0.2793600E 02	209	0.2440000E 01	311	0.5885000E 01	413	0.1160600E 02
6	0.3660700E 02	108	0.2162700E 02	210	0.1408700E 02	312	0.257[illegible]000E 01	414	0.2852000E 01
7	0.4470500E 02	109	0.1878200E 02	211	0.5336000E 01	313	0.1019100E 02	415	0.9693000E 01
8	0.5304000E 01	110	0.1257100E 02	212	0.4608000E 01	314	0.9728000E 01	416	0.6986000E 01
9	0.4219900E 02	111	0.1740200E 02	213	0.4551000E 01	315	0.9080000E 01	417	0.1443800E 02
10	0.1037100E 02	112	0.2374000E 02	214	0.1811100E 02	316	0.3193300E 02	418	0.4758000E 01
11	0.1519200E 02	113	0.3064800E 02	215	0.4761000E 01	317	0.2570000E 02	419	0.1148900E 02
12	0.3590600E 02	114	0.2231000E 01	216	0.2928000E 01	318	0.4848300E 02	420	0.9529000E 01
13	0.2664800E 02	115	0.1625300E 02	217	0.3001000E 01	319	0.4167000E 01	421	0.2341700E 02
14	0.6067500E 02	116	0.1909000E 01	218	0.2306300E 02	320	0.1174000E 02	422	0.1476900E 02
15	0.2101000E 02	117	0.2508400E 02	219	0.1198600E 02	321	0.3437200E 02	423	0.1726600E 02
16	0.2353500E 02	118	0.8510000E 01	220	0.1352000E 01	322	0.1018500E 02	424	0.7784000E 01
17	0.3750500E 02	119	0.4077200E 02	221	0.2513400E 02	323	0.3782100E 02	425	0.2592100E 02
18	0.6430000E 01	120	0.1818400E 02	222	0.9068000E 01	324	0.2548000E 01	426	0.1700000E 02
19	0.4375000E 01	121	0.1508700E 02	223	0.3849400E 02	325	0.2925000E 01	427	0.6221000E 01
20	0.1912600E 02	122	0.9677000E 01	224	0.5125000E 01	326	0.3757000E 01	428	0.4383400E 02
21	0.3982800E 02	123	0.4057100E 02	225	0.2809000E 01	327	0.3056600E 02	429	0.3722000E 01
22	0.2154100E 02	124	0.2845300E 02	226	0.1857900E 02	328	0.2980000E 01	430	0.1603000E 02
23	0.5064000E 01	125	0.9865000E 01	227	0.5017000E 01	329	0.5502000E 01	431	0.2053000E 01
24	0.7727000E 01	126	0.4929200E 02	228	0.2135000E 01	330	0.1913000E 01	432	0.2126000E 02
25	0.2135700E 02	127	0.8713000E 01	229	0.6255000E 01	331	0.4208000E 01	433	0.2953000E 01
26	0.4516000E 01	128	0.2458600E 02	230	0.4716000E 01	332	0.2406300E 02	434	0.4947000E 01
27	0.1352900E 02	129	0.1798000E 01	231	0.9502000E 01	333	0.6744000E 01	435	0.7072000E 01
28	0.1536000E 01	130	0.1588800E 02	232	0.5789000E 01	334	0.1016700E 02	436	0.7394000E 01
29	0.2923500E 02	131	0.7169000E 01	233	0.1190000E 01	335	0.2104300E 02	437	0.1908600E 02
30	0.5867000E 01	132	0.5703000E 01	234	0.1650200E 02	336	0.9474000E 01	438	0.5560000E 00
31	0.2627000E 01	133	0.5620000E 01	235	0.7341000E 01	337	0.8689000E 01	439	0.2[illegible]38000E 02
32	0.4263000E 01	134	0.1124800E 02	236	0.1140400E 02	338	0.7512000E 01	440	0.2673800E 02
33	0.1378600E 02	135	0.4217000E 01	237	0.3693400E 02	339	0.2747000E 02	441	0.1095200E 02
34	0.3115900E 02	136	0.1100700E 02	238	0.1670200E 02	340	0.8097000E 01	442	0.3392000E 01
35	0.1581100E 02	137	0.2611500E 02	239	0.7060000E 00	341	0.4192000E 01	443	0.6307000E 01
36	0.1758200E 02	138	0.1461300E 02	240	0.1860000E 01	342	0.5704000E 01	444	0.1257300E 02
37	0.1230600E 02	139	0.2732000E 01	241	0.5268200E 02	343	0.3079400E 02	445	0.3603000E 01
38	0.2031100E 02	140	0.1590600E 02	242	0.4556000E 01	344	0.3733900E 02	446	0.3065000E 01
39	0.1455900E 02	141	0.5326000E 01	243	0.1151800E 02	345	0.1857600E 02	447	0.7203000E 01
40	0.3414300E 02	142	0.5070000E 01	244	0.3209100E 02	346	0.9893000E 01	448	0.1907000E 01
41	0.2555900E 02	143	0.3427600E 02	245	0.1357400E 02	347	0.4050000E 00	449	0.2419000E 01
42	0.9037000E 01	144	0.7520000E 01	246	0.5366000E 01	348	0.2334000E 01	450	0.2839000E 01
43	0.4037500E 02	145	0.4928000E 01	247	0.4896900E 02	349	0.3664400E 02	451	0.5454000E 01
44	0.1559100E 02	146	0.3932000E 02	248	0.4928000E 01	350	0.1285500E 02	452	0.7790000E 01
45	0.1499800E 02	147	0.5511000E 01	249	0.4526000E 01	351	0.1771400E 02	453	0.5165000E 01
46	0.1300300E 02	148	0.5279000E 01	250	0.2703200E 02	352	0.5147000E 01	454	0.3641600E 02
47	0.3976700E 02	149	0.1063700E 02	251	0.1704400E 02	353	0.1313100E 02	455	0.5586000E 01
48	0.2334200E 02	150	0.1404700E 02	252	0.4344400E 02	354	0.2930000E 02	456	0.1241300E 02
49	0.1149200E 02	151	0.3229000E 01	253	0.9604000E 01	355	0.6395000E 01	457	0.2708000E 01
50	0.4976300E 02	152	0.1801900E 02	254	0.2434300E 02	356	0.2925200E 02	458	0.2829900E 02
51	0.8591000E 01	153	0.4662000E 01	255	0.8125000E 01	357	0.9757000E 01	459	0.1795200E 02
52	0.2676500E 02	154	0.1546300E 02	256	0.2217700E 02	358	0.1135500E 02	460	0.3845000E 01
53	0.1792000E 01	155	0.1696200E 02	257	0.6503000E 01	359	0.9146000E 01	461	0.6588000E 01
54	0.4519000E 00	156	0.3542600E 02	258	0.8468000E 01	360	0.1525800E 02	462	0.8914000E 01
55	0.4300000E 01	157	0.1920000E 01	259	0.2034300E 02	361	0.1591900E 02	463	0.2633400E 02
56	0.5059000E 01	158	0.4635800E 02	260	0.6749000E 01	362	0.2588600E 02	464	0.1714400E 02
57	0.1142600E 02	159	0.4877000E 01	261	0.4002000E 01	363	0.8804000E 01	465	0.2064100E 02
58	0.3665600E 02	160	0.9677000E 01	262	0.5752000E 01	364	0.1673800E 02	466	0.8506000E 01
59	0.6515000E 01	161	0.2424900E 02	263	0.2560900E 02	365	0.1532000E 01	467	0.6097400E 02
60	0.1710000E 01	162	0.3326000E 01	264	0.6565000E 01	366	0.1757000E 01	468	0.5747000E 01
61	0.1062000E 01	163	0.3902000E 01	265	0.2549000E 01	367	0.5820000E 01	469	0.1627100E 02
62	0.8770000E 00	164	0.4257600E 02	266	0.5101000E 01	368	0.4166000E 01	470	0.1152200E 02
63	0.4803000E 01	165	0.7174000E 01	267	0.2244900E 02	369	0.1848300E 02	471	0.2202000E 01
64	0.2558000E 01	166	0.9937000E 01	268	0.2661700E 02	370	0.6748000E 01	472	0.2111100E 02
65	0.1064300E 02	167	0.3976600E 02	269	0.4418000E 01	371	0.7124000E 01	473	0.4261000E 01
66	0.6047000E 01	168	0.2277000E 02	270	0.1765600E 02	372	0.1833000E 02	474	0.8089000E 01
67	0.8270000E 00	169	0.5661400E 02	271	0.1163200E 02	373	0.6115000E 01	475	0.1208300E 02
68	0.1635000E 02	170	0.1425200E 02	272	0.7807000E 01	374	0.7508000E 01	476	0.2109000E 02
69	0.2070000E 01	171	0.2524500E 02	273	0.4930000E 01	375	0.8546000E 01	477	0.2036600E 02
70	0.1539200E 02	172	0.2137000E 02	274	0.4161900E 02	376	0.7282000E 01	478	0.1975000E 01
71	0.3900900E 02	173	0.6730000E 01	275	0.7191000E 01	377	0.3476000E 01	479	0.1850000E 01
72	0.1988100E 02	174	0.8484000E 01	276	0.1603400E 02	378	0.3922000E 01	480	0.3447000E 01
73	0.7873000E 01	175	0.2155600E 02	277	0.5529000E 01	379	0.1418400E 02	481	0.1256300E 02
74	0.1092000E 01	176	0.5883000E 01	278	0.1308400E 02	380	0.9379000E 01	482	0.1145000E 02
75	0.3116000E 01	177	0.9056000E 01	279	0.2734600E 02	381	0.2169500E 02	483	0.6070000E 01
76	0.1499400E 02	178	0.5258000E 01	280	0.7736000E 01	382	0.2819800E 02	484	0.1524900E 02
77	0.5011100E 02	179	0.2866000E 02	281	0.2553900E 02	383	0.3826800E 02	485	0.9620000E 00
78	0.3617000E 01	180	0.9145000E 01	282	0.1134200E 02	384	0.1248300E 02	486	0.1132600E 02
79	0.1478000E 01	181	0.1652000E 01	283	0.1392400E 02	385	0.7982000E 01	487	0.6620000E 01
80	0.1122300E 02	182	0.4747000E 01	284	0.1058600E 02	386	0.7163000E 01	488	0.1360800E 02
81	0.4166000E 01	183	0.1042500E 02	285	0.1318400E 02	387	0.3277000E 02	489	0.1198100E 02
82	0.3201900E 02	184	0.3742400E 02	286	0.2432300E 02	388	0.1801900E 02	490	0.8222000E 01
83	0.3695800E 02	185	0.1299600E 02	287	0.1705700E 02	389	0.1054900E 02	491	0.3095400E 02
84	0.5813000E 01	186	0.2143300E 02	288	0.3785900E 02	390	0.3319400E 02	492	0.2167400E 02
85	0.4196100E 02	187	0.1327800E 02	289	0.8624000E 01	391	0.7346000E 01	493	0.1025100E 02
86	0.9568000E 01	188	0.1298300E 02	290	0.2629100E 02	392	0.1186800E 02	494	0.4972000E 01
87	0.1224500E 02	189	0.1547200E 02	291	0.1743000E 01	393	0.2725000E 01	495	0.2292000E 01
88	0.3878400E 02	190	0.3363700E 02	292	0.1702000E 01	394	0.2205800E 02	496	0.4317000E 01
89	0.2664200E 02	191	0.4483000E 01	293	0.5038000E 01	395	0.3272000E 01	497	0.7944000E 01
90	0.5899800E 02	192	0.1498700E 02	294	0.2054000E 01	396	0.1012300E 02	498	0.3788000E 01
91	0.1703900E 02	193	0.4015000E 01	295	0.3859000E 01	397	0.4313600E 02	499	0.1193600E 02
92	0.8316000E 01	194	0.6601000E 01	296	0.1764700E 02	398	0.8603000E 01	500	0.2560000E 01
93	0.1645500E 02	195	0.2561000E 02	297	0.4755000E 01	399	0.3538900E 02	501	0.1010900E 02
94	0.2547000E 01	196	0.7849000E 01	298	0.4537000E 01	400	0.5740000E 01	502	0.23[illegible]7000E 01
95	0.5200000E-01	197	0.3542900E 02	299	0.1839000E 02	401	0.3153800E 02	503	0.2473000E 01
96	0.6206000E 01	198	0.1627300E 02	300	0.2237000E 01	402	0.1009300E 02	504	0.6794000E 01
97	0.1286300E 02	199	0.1515700E 02	301	0.2521900E 02	403	0.8789000E 01	505	0.2055400E 02
98	0.5115000E 01	200	0.4475000E 01	302	0.1547000E 01	404	0.6788000E 01	506	0.1487800E 02
99	0.1234500E 02	201	0.3674800E 02	303	0.2752800E 02	405	0.5098800E 02		
100	0.4488000E 01	202	0.2754400E 02	304	0.4653000E 01	406	0.5019000E 01		
101	0.3093900E 02	203	0.1530700E 02	305	0.3648600E 02	407	0.1097600E 02		
102	0.8789000E 01	204	0.3463100E 02	306	0.2601000E 01	408	0.4649000E 02		

FOR OFFICIAL USE ONLY

FOR OFFICIAL USE ONLY

LIST OF ACTUALS, ESTIMATES, RATIOS AND RESIDUALS

CASE	VALUE	CASE	VALUE	CASE	VALUE	CASE	VALUE	CASE	VALUE
1	0.5166957E 02	103	0.3176092E 01	205	0.7902526E 01	307	0.3250315E 01	409	0.7364691E 01
2	0.4806417E 01	104	0.5095312E 01	206	0.2849158E 02	308	0.1430055E 02	410	0.1732077E 02
3	0.9394594E 01	105	0.2198275E 01	207	0.6588252E 00	309	0.2631708E 01	411	-0.1729669E 01
4	0.1161744E 02	106	0.1226119E 02	208	-0.1961415E 01	310	0.8920639E 01	412	0.1313510E 02
5	0.6613057E 01	107	0.2476439E 02	209	0.4470038E 01	311	0.4958754E 01	413	0.1162074E 02
6	0.4237464E 02	108	0.2049964E 02	210	0.1510908E 02	312	0.3728922E 01	414	-0.1050115E 01
7	0.4861303E 02	109	0.1946175E 02	211	0.5946317E 01	313	0.1011930E 02	415	0.1025291E 02
8	0.6594169E 01	110	0.1413469E 02	212	0.6201389E 01	314	0.1078671E 02	416	0.9976323E 01
9	0.4254151E 02	111	0.1747405E 02	213	0.8216479E 01	315	0.1085817E 02	417	0.1559461E 02
10	0.1121352E 02	112	0.2432219E 02	214	0.1531968E 02	316	0.2885094E 02	418	0.4087521E 01
11	0.1441536E 02	113	0.3227376E 02	215	0.6499450E 01	317	0.2240198E 02	419	0.1122886E 02
12	0.3000436E 02	114	0.5951520E 01	216	0.3422696E 01	318	0.2363283E 02	420	0.1148603E 02
13	0.2713034E 02	115	0.1446724E 02	217	0.4126429E 01	319	0.5394749E 01	421	0.2548180E 02
14	0.6520366E 02	116	0.7349960E 01	218	0.2405574E 02	320	0.1495437E 02	422	0.1906900E 02
15	0.2103334E 02	117	0.2529666E 02	219	0.4511404E 01	321	0.3317063E 02	423	0.2299336E 02
16	0.2995655E 02	118	0.7614170E 01	220	0.3913622E 01	322	0.1119679E 02	424	0.5437463E 01
17	0.4392234E 02	119	0.3447925E 02	221	0.2519179E 02	323	0.2487790E 02	425	0.2281119E 02
18	0.5320557E 01	120	0.1558739E 02	222	0.9712923E 01	324	0.2761839E 01	426	0.1622462E 02
19	0.3399357E 01	121	0.1447713E 02	223	0.3817510E 02	325	0.3684763E 01	427	0.6434558E 01
20	0.2095733E 02	122	0.1130474E 02	224	0.7094269E 01	326	0.3484808E 01	428	0.3975228E 02
21	0.4017594E 02	123	0.3819590E 02	225	0.3525423E 01	327	0.3027848E 02	429	0.4622363E 01
22	0.1363414E 02	124	0.2994577E 02	226	0.1740506E 02	328	0.2288053E 01	430	0.1429952E 02
23	0.5935555E 01	125	0.9300856E 01	227	0.6001277E 01	329	0.5230425E 01	431	0.5322182E 01
24	0.7722101E 01	126	0.6599239E 02	228	0.4271072E 01	330	0.2286909E 01	432	0.2227095E 02
25	0.1987575E 02	127	0.7707619E 01	229	0.3872715E 01	331	0.4036832E 01	433	0.2624402E 01
26	0.6525964E 01	128	0.2441336E 02	230	0.2813996E 01	332	0.2551394E 02	434	0.5347337E 01
27	0.1257273E 02	129	0.5064010E 00	231	0.9755572E 01	333	0.7080500E 01	435	0.6371736E 01
28	0.1266657E 01	130	0.1601428E 02	232	0.4120938E 01	334	0.4566555E 01	436	0.7218777E 01
29	0.2508614E 02	131	0.5497655E 01	233	0.2245464E 01	335	0.2105468E 02	437	0.1449693E 02
30	0.7130571E 01	132	0.6259971E 01	234	0.1789846E 02	336	0.1175217E 02	438	0.3336624E 01
31	0.3657124E 01	133	0.6339916E 01	235	0.8306750E 01	337	0.1000691E 02	439	0.3383621E 02
32	0.5076355E 01	134	0.1964252E 02	236	0.1314597E 02	338	0.7957963E 01	440	0.2744229E 02
33	0.1915528E 02	135	0.4757432E 01	237	0.3582000E 02	339	0.2566838E 02	441	0.9849054E 01
34	0.3667258E 01	136	0.1077010E 02	238	0.1540977E 02	340	0.1092909E 02	442	0.4526279E 01
35	0.1745115E 02	137	0.2548365E 02	239	-0.1794901E-02	341	0.4891318E 01	443	0.6959035E 01
36	0.2355426E 02	138	0.1036384E 02	240	0.1631444E 01	342	0.6148467E 01	444	0.1415314E 02
37	0.1451141E 02	139	0.3659997E 01	241	0.4745549E 02	343	0.2924996E 02	445	0.4575074E 01
38	0.2046253E 02	140	0.1419722E 02	242	0.5531447E 01	344	0.3708489E 02	446	0.4165885E 01
39	0.1377478E 02	141	0.6943634E 01	243	0.1246658E 02	345	0.2029204E 02	447	0.4727880E 01
40	0.3720624E 02	142	0.5370479E 01	244	0.3179694E 02	346	0.9244068E 01	448	0.5536369E 00
41	0.2665513E 02	143	0.3247603E 02	245	0.1602129E 02	347	0.9552855E 00	449	0.2670437E 00
42	0.7013742E 01	144	0.4534414E 01	246	0.6035716E 01	348	0.3039853E 01	450	0.3124519E 01
43	0.4501141E 02	145	0.3047246E 01	247	0.4611669E 02	349	0.1900347E 02	451	0.5855916E 01
44	0.1502760E 02	146	0.3769363E 02	248	0.5462445E 01	350	0.1515427E 02	452	0.8813065E 01
45	0.1591541E 02	147	0.7187876E 01	249	0.4097522E 01	351	0.1639419E 02	453	0.8318128E 01
46	0.1025768E 02	148	0.4559657E 01	250	0.2420017E 02	352	0.5855484E 01	454	0.3885277E 02
47	0.3151316E 02	149	0.5245076E 01	251	0.1492034E 02	353	0.1254307E 02	455	0.6667770E 01
48	0.3125902E 02	150	0.1123782E 02	252	0.5210921E 02	354	0.2438290E 02	456	0.1173512E 02
49	0.1059415E 02	151	0.6396601E 01	253	0.7866425E 01	355	0.5282781E 01	457	0.3014967E 01
50	0.4712598E 02	152	0.1657131E 02	254	0.2675663E 02	356	0.2965582E 02	458	0.3082719E 02
51	0.7715277E 01	153	0.3469516E 01	255	0.4546357E 01	357	0.9860457E 01	459	0.1974928E 02
52	0.2056756E 02	154	0.1961419E 02	256	0.2195155E 02	358	0.1127767E 02	460	0.4289422E 01
53	0.4491456E 00	155	0.1537014E 02	257	0.6736499E 01	359	0.7887509E 01	461	0.6535329E 01
54	0.1638736E 01	156	0.3231138E 02	258	0.4906037E 01	360	0.1468476E 02	462	0.1196065E 02
55	0.4775655E 01	157	0.1665543E 01	259	0.2010474E 02	361	0.1228121E 02	463	0.2977346E 02
56	0.4469754E 01	158	0.4392283E 02	260	0.9104377E 01	362	0.2607169E 02	464	0.2172997E 02
57	0.1503630E 02	159	0.5715191E 01	261	0.9319956E 01	363	0.8901597E 01	465	0.1528307E 02
58	0.3501313E 02	160	0.1119352E 02	262	0.5883963E 01	364	0.1737026E 02	466	0.7802573E 01
59	0.5332234E 01	161	0.3952055E 02	263	0.2337738E 02	365	0.6215096E 00	467	0.5780546E 02
60	0.3477771E 01	162	0.3759418E 02	264	0.8321178E 01	366	-0.1452374E 01	468	0.6632601E 01
61	0.4166713E 02	163	0.5931715E 01	265	0.3391946E 01	367	0.8528198E 01	469	0.1554663E 02
62	0.3235155E 00	164	0.4307720E 02	266	0.5539485E 01	368	0.6238249E 01	470	0.1511099E 02
63	0.3315146E 01	165	0.7792160E 01	267	0.2092543E 02	369	0.1888767E 02	471	0.1471651E 01
64	0.2051134E 01	166	0.9377660E 01	268	0.2878652E 02	370	0.7186870E 01	472	0.2621240E 02
65	0.7511565E 01	167	0.3624473E 02	269	0.4451166E 01	371	0.7746507E 01	473	0.5090556E 01
66	0.2470155E 01	168	0.1472167E 02	270	0.1790096E 02	372	0.1668379E 02	474	0.8507526E 01
67	0.1427355E 01	169	0.6174430E 02	271	0.1045149E 02	373	0.5256431E 01	475	0.1269099E 02
68	0.1739546E 02	170	0.1421987E 02	272	0.7553775E 01	374	0.5994619E 01	476	0.2418795E 02
69	0.2175952E 01	171	0.2630002E 02	273	0.5746506E 01	375	0.8863602E 01	477	0.2294651E 02
70	0.1994541E 02	172	0.2372943E 02	274	0.4375510E 02	376	0.6371280E 01	478	-0.6332474E 00
71	0.7726154E 02	173	0.4957441E 01	275	0.9365717E 01	377	0.4630085E 01	479	0.2257310E 01
72	0.1727157E 02	174	0.8706178E 01	276	0.1415402E 02	378	0.4226966E 01	480	0.3746966E 01
73	0.3902452E 01	175	0.1952103E 02	277	0.6195021E 01	379	0.1311871E 02	481	0.1487790E 02
74	0.9159964E 00	176	0.7732095E 01	278	0.1369071E 02	380	0.1030905E 02	482	0.1235495E 02
75	0.4403055E 01	177	0.9522572E 01	279	0.2742490E 02	381	0.1878918E 02	483	0.4332689E 01
76	0.1217436E 02	178	0.5230735E 01	280	0.7179516E 01	382	0.2563008E 02	484	0.1750105E 02
77	0.5365431E 02	179	0.2439727E 02	281	0.2661455E 02	383	0.3482093E 02	485	0.6379155E 01
78	0.4653394E 01	180	0.2425771E 01	282	0.1152881E 02	384	0.1202989E 02	486	0.1033904E 02
79	0.1362750E 02	181	0.2145551E 01	283	0.1335927E 02	385	0.8926797E 01	487	0.7062055E 01
80	0.1212754E 02	182	0.5036738E 01	284	0.1069115E 02	386	0.7846769E 01	488	0.1349451E 02
81	0.5147165E 01	183	0.1151267E 02	285	0.1721556E 02	387	0.2437297E 02	489	0.1141357E 02
82	0.3275438E 02	184	0.2316090E 02	286	0.2522729E 02	388	0.1654711E 02	490	0.9326853E 01
83	0.5299455E 02	185	0.1414444E 02	287	0.1317775E 02	389	0.9375474E 01	491	0.2896619E 02
84	0.7219737E 01	186	0.2358439E 02	288	0.3429729E 02	390	0.3395346E 02	492	0.2732344E 02
85	0.4336691E 02	187	0.1052256E 02	289	0.8607570E 01	391	0.7820382E 01	493	0.1110249E 02
86	0.3922747E 01	188	0.1481759E 02	290	0.2967619E 02	392	0.1067923E 02	494	0.6516886E 01
87	0.1234117E 02	189	0.1452638E 02	291	0.4849727E 00	393	0.2610976E 01	495	0.3162671E 01
88	0.3268360E 02	190	0.4512216E 02	292	-0.1470953E 01	394	0.2409629E 02	496	0.3990657E 01
89	0.2599461E 02	191	0.7649455E 01	293	0.7414275E 01	395	0.4449760E 01	497	0.7703410E 01
90	0.6213395E 02	192	0.1407693E 02	294	0.2337482E 01	396	0.9884826E 01	498	0.4396838E 01
91	0.1713747E 02	193	0.6098639E 01	295	0.3733239E 01	397	0.4595396E 02	499	0.1062799E 02
92	0.1322795E 02	194	0.7070646E 01	296	0.1794884E 02	398	0.1093250E 02	500	0.4079769E 01
93	0.1709249E 02	195	0.2560149E 02	297	0.5034696E 01	399	0.2826524E 02	501	0.9392196E 01
94	-0.2459605E 01	196	0.7202866E 01	298	0.5779012E [illegible]	400	0.4721618E 01	502	0.5408742E 01
95	-0.3056595E 01	197	0.3367862E 02	299	0.1606850E 02	401	0.3006459E 02	503	0.4336795E 01
96	0.5111352E 01	198	0.1555294E 02	300	0.2832460E 01	402	0.8948625E 01	504	0.6918009E 01
97	0.1595135E 02	199	0.1499136E 02	301	0.3137532E 02	403	0.8239237E 01	505	0.1734618E 02
98	0.7261365E 01	200	0.9409801E 01	302	0.6519470E 01	404	0.4886299E 01	506	0.1521015E 02
99	0.1160114E 02	201	0.3333223E 02	303	0.2562151E 02	405	0.5713696E 02		
100	0.3783117E 01	202	0.2441776E 02	304	0.6529907E 01	406	0.4225386E 01		
101	0.2473244E 02	203	0.1230564E 02	305	0.3504729E 02	407	0.1300289E 02		
102	0.1022276E 02	204	0.3306057E 02	306	0.5246238E 01	408	0.3529690E 02		

FOR OFFICIAL USE ONLY

LIST OF ACTUALS, ESTIMATES,
RATIOS AND RESIDUALS

FOR ~~OFFICIAL~~ USE ONLY

CASE	VALUE	CASE	VALUE	CASE	VALUE	CASE	VALUE	CASE	VALUE
1	0.9403589E 00	103	0.5194984E 00	205	0.1105369E 01	307	0.7590034E 00	409	0.7193784E 00
2	0.8025280E 00	104	0.9010244E 00	206	0.8973488E 00	308	0.1007584E 01	410	0.8269265E 00
3	0.9120359E 00	105	0.1789585E 01	207	0.4219472E 01	309	0.5034753E 00	411	-0.7479744E 00
4	0.9832631E 00	106	0.2341354E 01	208	-0.8054589E 00	310	0.9207860E 00	412	0.9567979E 00
5	0.7992552E 00	107	0.9718563E 00	209	0.5274797E 00	311	0.1186790E 01	413	0.9987319E 00
6	0.1130598E 01	108	0.1077425E 01	210	0.9323510E 00	312	0.6894754E 00	414	-0.2715892E 01
7	0.9196095E 00	109	0.9650725E 00	211	0.9620798E 00	313	0.1007086E 01	415	0.9453905E 00
8	0.8043494E 00	110	0.8823567E 00	212	0.7430593E 00	314	0.9018508E 00	416	0.1188839E 01
9	0.9826855E 00	111	0.9957610E 00	213	0.7320393E 00	315	0.8362369E 00	417	0.9258325E 00
10	0.9746653E 00	112	0.9764551E 00	214	0.1182282E 01	316	0.1106520E 01	418	0.1164031E 01
11	0.1053496E 01	113	0.9496201E 00	215	0.7324137E 00	317	0.1147220E 01	419	0.1073167E 01
12	0.1290037E 01	114	0.3743622E 00	216	0.8554685E 00	318	0.2051511E 01	420	0.8296164E 00
13	0.9821984E 00	115	0.1121431E 01	217	0.7271928E 00	319	0.7724178E 00	421	0.9189495E 00
14	0.9305442E 00	116	0.6617123E 00	218	0.9587317E 00	320	0.9187953E 00	422	0.7745030E 00
15	0.9960065E 00	117	0.9419854E 00	219	0.1348903E 01	321	0.1036218E 01	423	0.7561937E 00
16	0.7857227E 00	118	0.1049047E 01	220	0.3456601E 00	322	0.9096392E 00	424	0.1431550E 01
17	0.9174954E 00	119	0.1192508E 01	221	0.9977059E 00	323	0.1520265E 01	425	0.1136328E 01
18	0.1103184E 01	120	0.1166607E 01	222	0.9336015E 00	324	0.9225737E 00	426	0.1047790E 01
19	0.1110672E 01	121	0.1014841E 01	223	0.1008354E 01	325	0.7938096E 00	427	0.9668109E 00
20	0.9121734E 00	122	0.8557101E 00	224	0.7222105E 00	326	0.1078108E 01	428	0.1102679E 01
21	0.9713567E 00	123	0.1062460E 01	225	0.7467838E 00	327	0.1010156E 01	429	0.8052158E 00
22	0.1103408E 01	124	0.9634762E 00	226	0.1067448E 01	328	0.1304603E 01	430	0.1124161E 01
23	0.8531472E 00	125	0.1004504E 01	227	0.8359698E 00	329	0.1051922E 01	431	0.3857440E 00
24	0.1000541E 01	126	0.1071749E 01	228	0.4998745E 00	330	0.8365003E 00	432	0.9546068E 00
25	0.1131751E 01	127	0.1101849E 01	229	0.1615146E 01	331	0.1047402E 01	433	0.1175209E 01
26	0.6920052E 00	128	0.9356872E 00	230	0.1675905E 01	332	0.9431316E 00	434	0.9251333E 00
27	0.1076059E 01	129	0.3549144E 01	231	0.9740075E 00	333	0.9524751E 00	435	0.1109949E 01
28	0.1210470E 01	130	0.9909658E 00	232	0.1404791E 01	334	0.1062765E 01	436	0.1021443E 01
29	0.1213458E 01	131	0.1215568E 01	233	0.4898764E 00	335	0.9994452E 00	437	0.1143085E 01
30	0.8227465E 00	132	0.9110265E 00	234	0.9219800E 00	336	0.8061491E 00	438	0.2894878E 00
31	0.7183214E 00	133	0.9866471E 00	235	0.9537391E 00	337	0.8683004E 00	439	0.8387464E 00
32	0.8397734E 00	134	0.1073024E 01	236	0.8675145E 00	338	0.9439602E 00	440	0.9743357E 00
33	0.9807729E 00	135	0.8906140E 00	237	0.1031100E 01	339	0.1070188E 01	441	0.1111985E 01
34	0.8986640E 00	136	0.1021996E 01	238	0.1093058E 01	340	0.7408468E 00	442	0.7496015E 00
35	0.9632731E 00	137	0.1024775E 01	239	-0.3928986E 01	341	0.8570788E 00	443	0.9063038E 00
36	0.9554362E 00	138	0.1335539E 01	240	0.1138696E 01	342	0.9277109E 00	444	0.8883541E 00
37	0.8479116E 00	139	0.7900299E 00	241	0.1109434E 01	343	0.1052788E 01	445	0.7875293E 00
38	0.9986653E 00	140	0.1104797E 01	242	0.9236513E 00	344	0.1006798E 01	446	0.7392977E 00
39	0.9264735E 00	141	0.9754635E 00	243	0.9094657E 00	345	0.9154328E 00	447	0.1070620E 01
40	0.9158636E 00	142	0.7256585E 00	244	0.1009315E 01	346	0.1070200E 01	448	0.3444495E 01
41	0.1044961E 01	143	0.1012078E 01	245	0.8472475E 00	347	0.4239570E 00	449	0.9054497E 01
42	0.1131299E 01	144	0.9811384E 00	246	0.8885676E 00	348	0.7678002E 00	450	0.9080385E 00
43	0.1155790E 01	145	0.8566522E 00	247	0.1060956E 01	349	0.9395061E 00	451	0.9313658E 00
44	0.1154329E 01	146	0.1059836E 01	248	0.9021602E 00	350	0.8482759E 00	452	0.8839149E 00
45	0.1005510E 01	147	0.7667075E 00	249	0.1104570E 01	351	0.1080504E 01	453	0.6209330E 00
46	0.9761428E 00	148	0.1442554E 01	250	0.1113336E 01	352	0.8790050E 00	454	0.9372818E 00
47	0.1022067E 01	149	0.1522818E 01	251	0.1143674E 01	353	0.1046873E 01	455	0.8402818E 00
48	0.9174654E 00	150	0.1269976E 01	252	0.8340944E 00	354	0.1201662E 01	456	0.1057765E 01
49	0.1047134E 01	151	0.7474125E 00	253	0.1093913E 01	355	0.1210537E 01	457	0.8981057E 00
50	0.1054326E 01	152	0.1087361E 01	254	0.9097933E 00	356	0.9853862E 00	458	0.9179886E 00
51	0.1113515E 01	153	0.1200846E 01	255	0.1771559E 01	357	0.9895079E 00	459	0.9089952E 00
52	0.9678268E 00	154	0.9614553E 00	256	0.1010270E 01	358	0.1006857E 01	460	0.1169256E 01
53	0.3671936E 00	155	0.1067560E 01	257	0.9653183E 00	359	0.1159555E 01	461	0.1008059E 01
54	0.1784995E 00	156	0.1096338E 01	258	0.9508157E 00	360	0.1039037E 01	462	0.7465253E 00
55	0.9305415E 00	157	0.1146051E 01	259	0.1011851E 01	361	0.1296207E 01	463	0.9152185E 00
56	0.7845773E 00	158	0.9492874E 00	260	0.7412219E 00	362	0.9928775E 00	464	0.7889566E 00
57	0.3143344E 00	159	0.4533396E 00	261	0.4585877E 00	363	0.9890360E 00	465	0.1070421E 01
58	0.1044636E 01	160	0.9565177E 00	262	0.9791709E 00	364	0.9636009E 00	466	0.1090153E 01
59	0.9532333E 00	161	0.9612164E 00	263	0.1093461E 01	365	0.2464966E 01	467	0.1054814E 01
60	0.4609427E 00	162	0.8362622E 00	264	0.7899508E 00	366	-0.1209743E 01	468	0.8664776E 00
61	0.2561055E 01	163	0.6593907E 00	265	0.7511912E 00	367	0.6824419E 00	469	0.1046594E 01
62	0.2666412E 01	164	0.9383132E 00	266	0.9210101E 00	368	0.6678156E 00	470	0.7474215E 00
63	0.1225271E 01	165	0.9206699E 00	267	0.1072610E 01	369	0.9891637E 00	471	0.1496279E 01
64	0.1242606E 01	166	0.1305971E 01	268	0.9246341E 00	370	0.9389345E 00	472	0.8053821E 00
65	0.1417165E 01	167	0.1141240E 01	269	0.9859085E 00	371	0.9196403E 00	473	0.8370402E 00
66	0.1358841E 01	168	0.1211707E 01	270	0.9843160E 00	372	0.1098671E 01	474	0.9508052E 00
67	0.5793476E 00	169	0.9107537E 00	271	0.1112952E 01	373	0.1163337E 01	475	0.9528433E 00
68	0.9619906E 00	170	0.1032259E 01	272	0.1032976E 01	374	0.1252457E 01	476	0.8682334E 00
69	0.7212414E 00	171	0.9598950E 00	273	0.9549371E 00	375	0.9664242E 00	477	0.8975423E 00
70	0.9215580E 00	172	0.1021050E 01	274	0.9511631E 00	376	0.1142941E 01	478	-0.3118844E 01
71	0.1100747E 01	173	0.9352320E 00	275	0.7693610E 00	377	0.7507422E 00	479	0.8195597E 00
72	0.1093140E 01	174	0.9977190E 00	276	0.1079434E 01	378	0.9260999E 00	480	0.9199492E 00
73	0.9767634E 00	175	0.1099127E 01	277	0.8924808E 00	379	0.1081245E 01	481	0.8444067E 00
74	0.1192915E 01	176	0.7569769E 00	278	0.9763659E 00	380	0.9097830E 00	482	0.9266040E 00
75	0.7075519E 00	177	0.9510034E 00	279	0.1015206E 01	381	0.1154654E 01	483	0.1400978E 01
76	0.1239222E 01	178	0.9930165E 00	280	0.1077512E 01	382	0.1100192E 01	484	0.8712618E 00
77	0.1013249E 01	179	0.1174393E 01	281	0.9595379E 00	383	0.1098994E 01	485	0.1476916E 00
78	0.7761973E 00	180	0.8602787E 00	282	0.9599456E 00	384	0.1037752E 01	486	0.1095450E 01
79	0.9444930E 00	181	0.5905553E 00	283	0.1042350E 01	385	0.8829595E 00	487	0.9374042E 00
80	0.9273334E 00	182	0.9614468E 00	284	0.1019179E 01	386	0.9128598E 00	488	0.1008619E 01
81	0.9393617E 00	183	0.4968377E 00	285	0.7644572E 00	387	0.1115652E 01	489	0.1049719E 01
82	0.9775546E 00	184	0.1584590E 01	286	0.9641562E 00	388	0.1137298E 01	490	0.8817486E 00
83	0.9125742E 00	185	0.9143305E 00	287	0.1294379E 01	389	0.1259511E 01	491	0.1072327E 01
84	0.3261533E 00	186	0.9171593E 00	288	0.1103755E 01	390	0.9776914E 00	492	0.7932307E 00
85	0.9680759E 00	187	0.1223491E 01	289	0.1002373E 01	391	0.9393403E 00	493	0.9233074E 00
86	0.9635123E 00	188	0.9004973E 00	290	0.4859290E 00	392	0.1111316E 01	494	0.7629410E 00
87	0.9719665E 00	189	0.1057914E 01	291	0.3564615E 01	393	0.1043671E 01	495	0.7247019E 00
88	0.1186440E 01	190	0.9576926E 00	292	-0.9096964E 00	394	0.9154105E 00	496	0.1084494E 01
89	0.1065719E 01	191	0.5985749E 00	293	0.6793168E 00	395	0.7353705E 00	497	0.1031205E 01
90	0.9445344E 00	192	0.1094650E 01	294	0.8747232E 00	396	0.1024095E 01	498	0.8619206E 00
91	0.9942563E 00	193	0.9798374E 00	295	0.1036365E 01	397	0.9386786E 00	499	0.1123072E 01
92	0.7422964E 00	194	0.7335728E 00	296	0.9809961E 00	398	0.7869198E 00	500	0.6274879E 00
93	0.9627510E 00	195	0.1032864E 01	297	0.9459173E 00	399	0.1252032E 01	501	0.1077467E 01
94	-0.9553837E-01	196	0.1092482E 01	298	0.7850823E 00	400	0.1215685E 01	502	0.4765317E 00
95	-0.1660213E-01	197	0.1081665E 01	299	0.1145902E 01	401	0.1049008E 01	503	0.5702367E 00
96	0.1146548E 01	198	0.1118193E 01	300	0.7733900E 00	402	0.1127883E 01	504	0.9820746E 00
97	0.8063936E 00	199	0.1019079E 01	301	0.8037847E 00	403	0.1066725E 01	505	0.1183701E 01
98	0.7043544E 00	200	0.9537928E 00	302	0.3422968E 00	404	0.1389190E 01	506	0.9791629E 00
99	0.1044158E 01	201	0.1100825E 01	303	0.1074410E 01	405	0.8923821E 00		
100	0.1186323E 01	202	0.9724201E 00	304	0.7120984E 00	406	0.8062150E 00		
101	0.1250746E 01	203	0.1219538E 01	305	0.1052444E 01	407	0.8441203E 00		
102	0.3793104E 00	204	0.9098918E 00	306	0.4921487E 00	408	0.1317113E 01		

FOR ~~OFFICIAL USE~~ ONLY

LIST OF ACTUALS, ESTIMATES, RATICS AND RESIDUALS

CASE	VALUE
1	-0.3081571E 01
2	-0.9499167E 00
3	-0.1756594E 01
4	-0.1944401E 00
5	-0.1327457E 01
6	0.4224573E 01
7	-0.3904926E 01
8	-0.1293144E 01
9	-0.7635073E 00
10	-0.9425245E 00
11	0.7769143E 00
12	0.6902047E 01
13	-0.4427752E 00
14	-0.4527464E 01
15	-0.2404115E-01
16	-0.6414538E 01
17	-0.3377027E 01
18	0.5014429E 00
19	0.4354427E 00
20	-0.1441318E 01
21	-0.1447840E 00
22	0.2100814E 01
23	-0.4716535E 00
24	0.4098012E-02
25	0.2486246E 01
26	-0.2004463E 01
27	0.9562639E 00
28	0.2675492E 00
29	0.5150636E 01
30	-0.1763574E 01
31	-0.1930128E 01
32	-0.8133613E 00
33	-0.3582421E 00
34	-0.4513591E 01
35	-0.6608642E 00
36	-0.2971257E 01
37	-0.2207316E 01
38	-0.3162575E-01
39	-0.1424784E 01
40	-0.3137261E 01
41	0.1074972E 01
42	0.1048259E 01
43	0.5442170E 01
44	0.2473526E 01
45	0.4216593E-01
46	-0.2444740E 00
47	0.8578362E 00
48	-0.1954926E 01
49	0.5138530E 00
50	0.2564121E 01
51	0.8757926E 00
52	-0.8497419E 00
53	0.1304856E 01
54	-0.2487734E 01
55	-0.4746555E 00
56	-0.1149358E 01
57	-0.2417043E 01
58	0.1532472E 01
59	-0.3192310E 00
60	-0.2167791E 01
61	0.6473247E 00
62	0.5480961E 00
63	0.8431156E 00
64	0.4990521E 00
65	0.3132935E 01
66	0.1268815E 01
67	-0.6103446E 00
68	-0.1906852E 01
69	-0.8009519E 00
70	-0.3557906E 01
71	0.2747119E 01
72	0.1409536E 01
73	-0.1472420E 00
74	0.1765357E 00
75	-0.1287855E 01
76	0.2796017E 01
77	0.4569827E 00
78	-0.1042838E 01
79	-0.9675076E-01
80	-0.4754451E 00
81	-0.9413454E 00
82	-0.7359921E 00
83	-0.3560447E 01
84	-0.1397737E 01
85	-0.1393810E 01
86	-0.1454257E 01
87	-0.9216663E-01
88	0.6095599E 01
89	0.1443346E 01
90	-0.3200316E 01
91	-0.4346649E-01
92	-0.2313512E 01
93	-0.6366969E 00
94	0.2912604E 01
95	0.3145709E 01
96	0.7946477E 00
97	-0.3949344E 01
98	-0.2146365E 01
99	0.5448359E 00
100	0.7064312E 00
101	0.6202140E 01
102	-0.1233742E 01
103	-0.1902092E 01
104	-0.5043117E 00
105	0.1739729E 01
106	0.1663181E 02
107	-0.8099914E 00
108	0.1552359E 01
109	-0.4797507E 00
110	-0.1563690E 01
111	-0.7404590E-01
112	-0.5721931E 00
113	-0.1425960E 01
114	-0.3720520E 01
115	0.1785708E 01
116	-0.4759197E 00
117	-0.2026418E 00
118	0.6958295E 00
119	0.6292751E 01
120	0.2534914E 01
121	0.2438732E 00
122	-0.1631737E 01
123	0.2345195E 01
124	-0.1193779E 01
125	0.4514354E-01
126	0.3239904E 01
127	0.8053924E 00
128	-0.1827360E 01
129	0.1291399E 01
130	-0.1452784E 00
131	0.1271345E 01
132	-0.5569715E 00
133	-0.7122157E 00
134	0.7654509E 00
135	-0.5231923E 00
136	0.2358391E 00
137	0.6314479E 00
138	0.3672174E 01
139	-0.7250971E 00
140	0.1508779E 01
141	-0.7576343E 00
142	-0.1337474E 01
143	0.3970724E 00
144	-0.1914414E 01
145	-0.1159296E 01
146	0.2220367E 01
147	-0.1676978E 01
148	0.1619543E 01
149	0.3651924E 01
150	0.2839181E 01
151	-0.9675909E 00
152	0.1447649E 01
153	0.6124845E 00
154	-0.2551189E 01
155	0.1071862E 01
156	0.3112919E 01
157	0.2734158E 00
158	-0.2504429E 01
159	-0.8341917E 00
160	-0.1516524E 01
161	-0.1190151E 01
162	-0.6326179E 01
163	-0.1929705E 01
164	-0.5041977E 00
165	-0.6131504E 00
166	0.5933993E-01
167	0.5521247E 01
168	0.1974324E 01
169	-0.5520798E 01
170	0.3213453E-01
171	-0.1055024E 01
172	0.4405725E 00
173	-0.1227641E 01
174	-0.1017934E-01
175	0.1446968E 01
176	-0.1919045E 01
177	-0.4565719E 00
178	-0.3279448E-01
179	0.4252734E 01
180	-0.1241771E 01
181	-0.1193551E 01
182	-0.2077380E 00
183	-0.1147474E 01
184	0.1345610E 02
185	-0.1196439E 01
186	-0.1345935E 01
187	0.2425444E 01
188	-0.1434590E 01
189	0.3455159E 00
190	-0.1445942E 01
191	-0.3006455E 01
192	0.9190722E 00
193	-0.8263940E-01
194	-0.6636862E 00
195	0.3045148E 00
196	0.5661358E 00
197	0.2759375E 01
198	0.1720057E 01
199	0.2550421E 00
200	-0.4348006E 00
201	0.1365770E 01
202	-0.7837584E 00
203	0.2701525E 01
204	-0.3429570E 01
205	0.8324738E 00
206	-0.3066582E 01
207	0.1477179E 01
208	0.3541615E 01
209	-0.2230038E 01
210	-0.1022084E 01
211	-0.2103174E 00
212	-0.1593349E 01
213	-0.1665879E 01
214	0.2792324E 01
215	-0.1737650E 01
216	-0.4946861E 00
217	-0.1125929E 01
218	-0.9927404E 00
219	0.3074394E 01
220	-0.2561422E 01
221	-0.5779290E-01
222	-0.6449734E 00
223	0.3183006E 00
224	-0.1971269E 01
225	-0.7164228E 00
226	0.1173945E 01
227	-0.9842765E 00
228	-0.2136072E 01
229	0.2392285E 01
230	0.1902004E 01
231	-0.2535719E 00
232	0.1649102E 01
233	-0.1145464E 01
234	-0.1396415E 01
235	-0.9657499E 00
236	-0.1741571E 01
237	0.1113997E 01
238	0.1292229E 01
239	0.7077959E 00
240	0.2265521E 00
241	0.5194509E 01
242	-0.9754670E 00
243	-0.1144578E 01
244	0.2969639E 00
245	-0.2447293E 01
246	-0.6727160E 00
247	0.2812307E 01
248	-0.5344447E 00
249	0.4284783E 00
250	0.2751826E 01
251	0.2143462E 01
252	-0.8645206E 01
253	0.7345752E 00
254	-0.2413676E 01
255	0.3534643E 01
256	0.2254515E 00
257	-0.23 4986E 00
258	-0.4310375E 00
259	0.2392643E 00
260	-0.2355377E 01
261	-0.131795 E 01
262	-0.1243630E 00
263	0.2231623E 01
264	-0.1756178E 01
265	-0.8434462E 00
266	-0.4374866E 00
267	0.1523572E 01
268	-0.2149523E 01
269	-0.6314623E-01
270	-0.2449574E 00
271	0.1140512E 01
272	0.2492254E 00
273	-0.8365044E 00
274	-0.2134904E 01
275	-0.2155718E 01
276	0.1179917E 01
277	-0.4640910E 00
278	-0.3167138E 00
279	0.4170973E 00
280	0.5564963E 00
281	-0.1075549E 01
282	-0.4848072E 00
283	0.5657276E 00
284	0.2048597E 00
285	-0.4051558E 01
286	-0.9042926E 00
287	0.3879250E 01
288	0.3558708E 01
289	0.2047973E-01
290	-0.3395193E 01
291	0.1254027E 01
292	0.3572953E 01
293	-0.2378275E 01
294	-0.2834823E 00
295	0.1357611E 00
296	-0.3419544E 00
297	-0.2724956E 00
298	-0.1242012E 01
299	0.2341505E 01
300	-0.6554605E 00
301	-0.6155318E 01
302	-0.2972470E 01
303	0.1906490E 01
304	-0.1879997E 01
305	0.1839706E 01
306	-0.2683998E 01
307	-0.7833149E 00
308	0.1084535E 00
309	-0.1306700E 01
310	-0.7066392E 00
311	0.9262460E 00
312	-0.1157922E 01
313	0.7170260E-01
314	-0.1058707E 01
315	-0.1778167E 01
316	0.3074058E 01
317	0.3298022E 01
318	0.2485017E 02
319	-0.1227749E 01
320	-0.1214365E 01
321	0.1201366E 01
322	-0.1011747E 01
323	0.1294310E 02
324	-0.2138390E 00
325	-0.7597626E 00
326	0.2721916E 00
327	0.3075180E 00
328	0.6969471E 00
329	0.2715749E 00
330	-0.3739090E 00
331	0.1711678E 00
332	-0.1450937E 01
333	-0.3365001E 00
334	0.6004448E 00
335	-0.1168132E-01
336	-0.2278168E 01
337	-0.1317906E 01
338	-0.4459625E 00
339	0.1801619E 01
340	-0.2832089E 01
341	-0.6993175E 00
342	-0.4444672E 00
343	0.1544039E 01
344	0.2521095E 00
345	-0.1716041E 01
346	0.6489317E 00
347	-0.5502855E 00
348	-0.7058532E 00
349	-0.2359470E 01
350	-0.2299270E 01
351	0.1319805E 01
352	-0.7086862E 00
353	0.5879337E 00
354	0.6917096E 01
355	0.1112219E 01
356	-0.4338224E 00
357	-0.1034566E 00
358	0.7733190E-01
359	0.1258491E 01
360	0.5732434E 00
361	0.3637785E 01
362	-0.1856945E 00
363	-0.9759712E-01
364	-0.6322618E 00
365	0.9104905E 00
366	0.3209374E 01
367	-0.2708198E 01
368	-0.2072249E 01
369	-0.2046719E 01
370	-0.4380701E 00
371	-0.6225068E 00
372	0.1646213E 01
373	0.8585689E 00
374	0.1513381E 01
375	-0.2976023E 00
376	0.9107197E 00
377	-0.1154085E 01
378	-0.3129643E 00
379	0.1065790E 01
380	-0.9300519E 00
381	0.2905816E 01
382	0.2567925E 01
383	0.3447071E 01
384	0.4541103E 00
385	-0.1044797E 01
386	-0.6837693E 00
387	0.3397030E 01
388	0.2271890E 01
389	0.2173526E 01
390	-0.7574553E 00
391	-0.4743821E 00
392	0.1198769E 01
393	0.1140243E 01
394	-0.2038295E 01
395	-0.1177760E 01
396	0.2381740E 00
397	-0.2817943E 01
398	-0.2329499E 01
399	0.7123757E 01
[illegible]	-0.1018302E 01
401	0.1473415E 01
402	0.1144375E 01
403	0.5497630E 00
404	0.1901701E 01
405	-0.6148957E 01
406	-0.1206386E 01
407	-0.2026986E 01
408	0.1119310E 02
409	-0.2066691E 01
410	-0.2997766E 01
411	0.3021669E 01
412	-0.5740969E 00
413	-0.1473693E-01
414	0.3902115E 01
415	-0.5599059E 00
416	0.1109677E 01
417	-0.1156614E 01
418	0.6704795E 00
419	0.2601414E 00
420	-0.1957031E 01
421	-0.2064802E 01
422	-0.4300004E 01
423	-0.5627338E 01
424	0.2344537E 01
425	0.3109814E 01
426	0.7753770E 00
427	-0.2135579E 00
428	0.4041724E 01
429	-0.9003631E 00
430	0.1704483E 01
431	-0.3269182E 01
432	-0.1010950E 01
433	0.3285992E 00
434	-0.4003373E 00
435	0.7007638E 00
436	0.1552227E 00
437	0.2309076E 01
438	-0.2388624E 01
439	-0.5456211E 01
440	-0.7042856E 00
441	0.1102964E 01
442	-0.1134779E 01
443	-0.6520351E 00
444	-0.1589140E 01
445	-0.9720739E 00
446	-0.1080885E 01
447	0.4751197E 00
448	0.1353363E 01
449	0.2150956E 01
450	-0.2875193E 00
451	-0.4019159E 01
452	-0.1023045E 01
453	-0.3153124E 01
454	-0.2436776E 01
455	-0.1061770E 01
456	0.6778836E 00
457	-0.3969667E 01
458	-0.2528181E 01
459	-0.1797279E 01
460	0.5565785E 00
461	0.5267137E-01
462	-0.3025653E 01
463	-0.2439456E 01
464	-0.6585966E 01
465	0.1357926E 01
466	0.7034272E 00
467	0.3168562E 01
468	-0.8856008E 00
469	0.7243725E 00
470	-0.3588988E 01
471	0.7103492E 00
472	-0.5101402E 01
473	-0.8295560E 00
474	-0.4185256E 00
475	-0.5979962E 00
476	-0.3187045E 01
477	-0.2580511E 01
478	0.2604247E 01
479	-0.4073096E 00
480	-0.2799460E 00
481	-0.2314902E 00
482	-0.4069510E 00
483	0.1737311E 01
484	-0.2253055E 01
485	-0.5436154E 01
486	0.9869636E 00
487	-0.4470549E 00
488	0.1134924E 00
489	0.5674280E 00
490	-0.1102453E 01
491	0.2087810E 01
492	-0.5669463E 00
493	-0.8514777E 00
494	-0.1544886E 01
495	-0.8704709E 00
496	0.3363431E 01
497	0.2409302E 00
498	-0.6068375E 00
499	0.1308009E 01
500	-0.1519740E 01
501	0.7268144E 00
502	-0.3101742E 01
503	-0.1863795E 01
504	-0.1240079E 00
505	0.3189822E 01
506	-0.3321451E 00

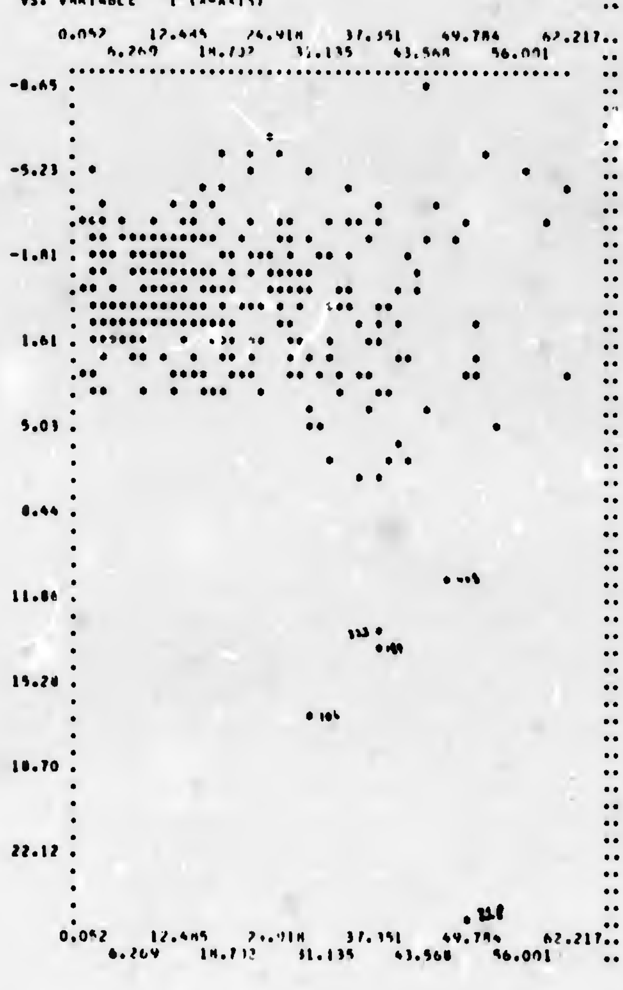
DURBIN-WATSON D STATISTIC 1.94705

FOR ~~OFFICIAL USE~~ ONLY

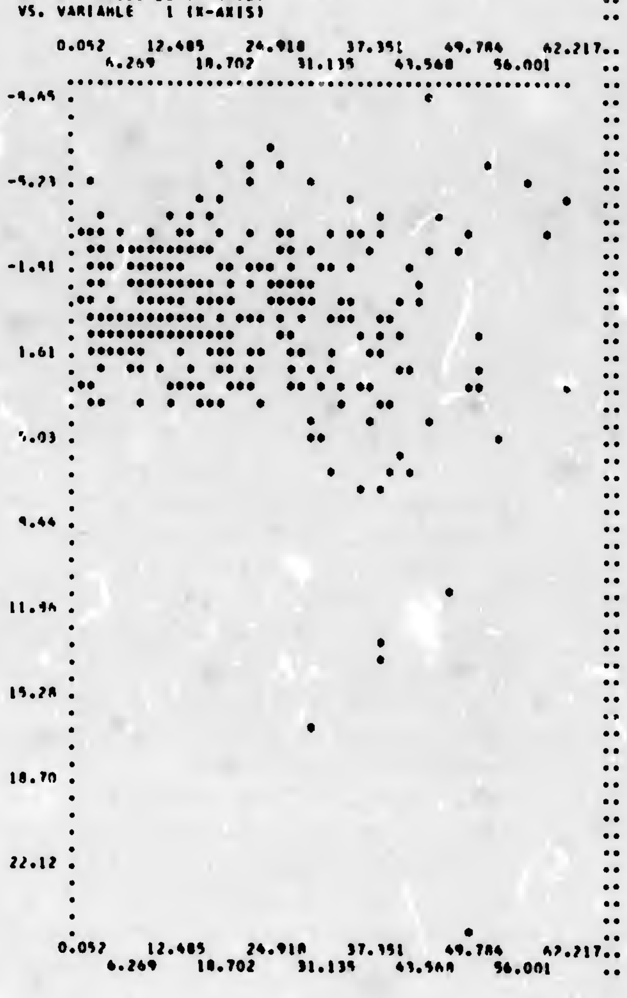
SUMMARY TABLE

STEP NUMBER	VARIABLE ENTERED	VARIABLE REMOVED	MULTIPLE R	RSQ	INCREASE IN RSQ	F VALUE TO ENTER OR REMOVE	NUMBER OF INDEPENDENT VARIABLES INCLUDED
1	RAM 19		0.9478	0.8983	0.8983	4449.5241	1
2	API 23		0.9607	0.9229	0.0247	160.9011	2
3	AFS 8		0.9653	0.9319	0.0090	65.2004	3
4	NE 72		0.9693	0.9396	0.0077	64.1980	4
5	RAA 49		0.9714	0.9435	0.0039	34.5703	5
6	P7MPH 79		0.9733	0.9473	0.0037	35.4148	6
7	RP4 17		0.9739	0.9484	0.0012	11.2162	7
8	MTSFC 77		0.9745	0.9496	0.0011	11.1437	8
9	RPA 49		0.9750	0.9505	0.0010	9.6517	9
10	RNF 46		0.9754	0.9514	0.0009	9.1706	10
11	RPP 47		0.9759	0.9523	0.0009	8.9065	11
12	RP 36		0.9763	0.9531	0.0008	8.2388	12
13	ASM 14		0.9766	0.9537	0.0007	6.9149	13
14	WL 53		0.9771	0.9547	0.0009	10.1367	14
15	TY 78		0.9774	0.9554	0.0007	8.0887	15

PLOT OF RESIDUALS (Y-AXIS)
VS. VARIABLE 1 (X-AXIS)



PLOT OF RESIDUALS (Y-AXIS)
VS. VARIABLE 1 (X-AXIS)



where $V_{TE\text{-}TD}$ = total airline direct-operating cost less depreciation for any type aircraft.

V_{RAM} = revenue aircraft miles flown by a given type aircraft in a given year.

The last step, in more common algebraic form, is

$$\begin{aligned} V_{TE\text{-}TD}(10^{-6}) = & -7.7852 + 0.1668\,(10^{-6})\,V_{AFI} + 0.2376\,V_{AFS} + 0.5435\,(10^{-6})\,V_{RAM} \\ & + 2.7052\,V_{*AA} + 0.6262\,(10^{-8})\,V_{RPM} + 5.9823\,V_{P/RPM} \\ & + 0.0989\,V_{WL} + 1.4331\,V_{NE} - 0.4212\,(10^{-8})\,V_{ASM} + 2.3878\,V_{*NE} \\ & + 1.5324\,V_{*P} - 0.1651\,V_{TY} + 1.5082\,V_{*PA} - 1.8099\,V_{*PP} \\ & + 2.3626\,V_{MTSFL} \end{aligned}$$

where the variables, listed in order of their significance as measured by their F statistic, are

V_{AFI} = the gallons of fuel consumed
V_{AFS} = the approximate fleet size (aircraft days assigned/365)
V_{*AA} = the adjustment for American Airlines
V_{RPM} = the revenue passenger miles
$V_{P/RPM}$ = the fuel consumed per revenue passenger mile
V_{WL} = the wing loading
V_{NE} = the number of engines per aircraft
V_{ASM} = the available seat miles
V_{*NE} = the adjustment for Northeast Airlines
V_{*P} = the adjustment for piston aircraft
V_{TY} = the year of the first flight of the aircraft
V_{*PA} = the adjustment for Pan Am, Atlantic
V_{*PP} = the adjustment for Pan Am, Pacific, and
V_{MTSFC} = the maximum thrust specific fuel consumption.

It is not clear that all the variables listed above are needed to provide a reasonable estimate of operating costs. In general the use of fewer variables is preferred; however it is notable that not only do design characteristics appear as variables; operating variables also appear. This condition offers some indication that a final equation set will be sensitive to both characteristics (i.e., the way the aircraft is designed and the manner in which it is operated).

The first page of Table B2 presents the mean and standard deviations of all the variables. The dependent variable for the subproblem is variable number one, TE-TD, or direct-operating cost less depreciation. (This dependent variable is in millions of 1967 dollars.) Note that the standard deviation of this variable is 86 percent of the mean (12.546/14.627 = 0.86). At the top of the first page of the table the number of observations is listed (506), as is the number of variables (80).

Page 2 of Table B2 indicates that the dependent variable is 1 (direct-operating cost less depreciation), the maximum number of steps is 15 (a present value), and the F level is 3.84 (the threshold value for 500° of freedom at the 0.95 level of confidence). The remainder of this page and the next 14 pages of Table B2 present the 15 steps where one variable was added at each step if it had the highest "F to enter" above the threshold value.

The first variable to enter (number 19) is revenue aircraft miles. This variable was selected because it contributed most to the goodness of fit. The correlation is 4.0059,or 27.4 percent of the mean of the dependent variable. The equation written in conventional form would appear

$$(TE - TD)/10^6 = 0.918 + 0.00000135RAM.$$

The coefficient of revenue aircraft miles (RAMs) appears small because RAM is a relatively large number. The mean is listed on page 1 of Table B2 as 10.14 million. The variable having the highest simple correlation with TE-TD was RAM, and consequently it was chosen. However, the RAM correlation was only slightly higher than that of available seat-miles (ASM), RPMs, and revenue aircraft hours.

In Step 2 the addition of aircraft fuel issued (AFI) is given in gallons. With this variable in the equation the standard-error-to-mean ratio drops to 23.8 percent (14. 63/3.49 = 0.238). AFI is a variable of particular interest because it can serve as proxy for almost all the important factors affecting operating costs. This variable reflects aircraft hours in the air, miles flown, and the way the aircraft is flown because of airline route structure; and, most important, it reflects the performance characteristics of the aircraft. The aircraft performance variables are numbered 55 through 77, and, when the "F to enter" values are inspected for these variables before and after the introduction of AFI, a striking decrease is noted. The circumstance supports the contention that AFI is explaining much of the same variance as are the aircraft characteristics.

In the next two steps the average fleet size (AFS) and the number of engines (NE) are added to the equation. Both factors have logical coefficients and contribute to a further reduction in the standard error.

Step 5 introduces the adjustment variable for airline X. This phenomenon suggests that if the equation is to be used to predict airline X's direct-operating cost, then 2.78 million dollars must be added to the result. This is not to say that airline X is an inefficient producer. It may be that it includes costs in the direct accounts, on a consistent basis, that other airlines include in indirect-cost accounts.

The next several steps show more of the same variables entering the equation. Fuel and oil per passenger mile or gas mileage (P/RPM), RPM, MTSFC, Pan Am, Atlantic (*PA), Northeast (*NE), Pan Am, Pacific (*PP), and the "dummy" variable for *P, are the new members. For the most part they emphasize the importance of variance represented in the equation, or they add to the list of airlines for which adjustment is necessary. It is clear that miles and numbers of aircraft are factors of extreme importance, as is fuel consumption. At this point only three factors are represented in the equation, i.e., passenger miles (AFS, RPM, ASM, and RAM), fuel consumption (AFI, NE, *P, MTSFC, and P/RPM), and airline adjustment (*AA, *NE, *PA, and *PP). This suggests that some exponential form of passenger miles and fuel will provide a better fit with fewer variables.

Available seat miles (ASM), wing loading (WL), and year of the first flight (TY) are the last three variables added. Wing loading is somewhat related to the fuel category since the variable is the relation of the wing area (where most fuels are stored) and the take-off weight (a sizable percentage of which is fuel). ASM comes into the equation with a negative coefficient. By itself this would indicate that the more ASMs, the less the direct-operating cost. This of course is illogical. However, ASM is highly correlated with RPM (R = 0.984) and RAM (R = 0.923), both of which have positive coefficients. Since these two later variables are in the equation the appropriate interpretation should be that aircraft operating cost increases at a decreasing rate with miles flown.

The four pages of Table B2 following step 15 present the actual costs (the dependent variable), the estimated costs, the ratios (actuals/estimates), and the residuals (actuals - estimates), respectively. The last page of Table B2 is a summary of the preceding 15 steps. Also appearing on this page is a plot of the residuals vs the actuals. As shown in this plot, most observations are clustered around the zero residual point, as expected. There are a few scattered points (labeled 408, 323, 184, 106, and 318 on the graph) that deviate markedly from the prevailing pattern. It is possible that these observations are errors or statistical anomolies. However, there are only five of these points, less than one percent of the sample. It is doubtful that an accounting of these would affect the results to any significant degree.

Appendix C

COST-ESTIMATING EQUATIONS, PARTIAL DIFFERENTIALS, AND CURVE FORMS

This appendix contains the results of performing the qualitative tests described under the section "Cost Model Development and Construction." Also included are the equations developed by the ATA Spec 100 Method.

Identification of the various methods follows.

Method	Origin
1	ATA36
2	ORI
3	PRC
4	LAC 66
FAA 66	FAA 66
ATA Spec 100	ATA Spec 100

Method 1

1. Flight crew:

(a) Subsonic (average cruising speed < 350 mph) $C_{am} = \frac{1}{V_b}\{134\times 10^{-6}(TOGW_{max}) + 84.5\}$

(average cruising speed > 350 mph) $C_{am} = \frac{1}{V_b}\{85.4\times 10^{-6}(TOGW_{max}) + 117\}$

$$\frac{\partial C}{\partial V_b} = -\frac{C}{V_b^2} = -\frac{1}{V_b^2}\{85.4\times 10^{-6}(TOGW_{max}) + 117\}$$

or

$$\frac{\partial C}{\partial V_b} = -\frac{1}{V_b^2}\{134\times 10^{-6}(TOGW_{max}) + 84.5\}$$

$$\frac{\partial C}{\partial U} = 0$$

$$\frac{\partial C}{\partial W} = \frac{134\times 10^{-6}}{V_b} \text{ or } \frac{85.4\times 10^{-6}}{V_b}$$

$$\frac{\partial V_b}{\partial W} = \frac{134\times 10^{-6}}{C_{am}} \text{ or } \frac{85.4 + 10^{-6}}{C_{am}}$$

Plots (4) (10) (1) (11) (12)

(b) Supersonic $C_{am} = \frac{1}{V_b}\{86.4\times 10^{-6}(TOGW_{max}) + 157\}$

$$\frac{\partial C}{\partial V_b} = \frac{1}{V_b^2}\{86.4\times 10^{-6}(TOGW_{max}) + 157\}$$

$$\frac{\partial C}{\partial U} = 0$$

$$\frac{\partial C}{\partial W} = \frac{86.4 \times 10^{-6}}{V_b}$$

$$\frac{\partial V_b}{\partial W} = \frac{86.4 \times 10^{-6}}{C_{am}}$$

Plots (4) (10) (1) (11) (12)

2. Fuel and oil:

$$C_{am} = \frac{1.02}{D} \{F_b C_{ft} + 0.135 N_e C_{ot} t_b\}$$

$$\frac{\partial C}{\partial V_b} = 1.02 \left(\frac{C_{ft}}{D} \frac{dF_b}{dV_b} - 0.135 \frac{N_e C_{ot}}{V_b^2} \right)$$

$$\frac{\partial C}{\partial U} = 0$$

$$\frac{\partial C}{\partial W} = \frac{1.02}{D} C_{ft} \frac{dF_b}{dW}$$

Plots (6) (7) (13) (15)

3. Maintenance:

$$C_{am} \text{ (total)} = 1.02 \frac{t_f}{t_b V_b} \{11.78 + 10^{-6} [5.20 C_a + 234.5 W_a + 46.2 N_e C_e] + N_e R_L K_{1e}\}$$

$$\frac{\partial C}{\partial V_b} = -\frac{1.02}{V_b^2} \{11.78 + N_e R_L K_{1e} + 10^{-6} [5.20 C_a + 234.5 W_a + 46.2 N_e C_e]\}$$

$$\frac{\partial C}{\partial U} = 0$$

$$\frac{\partial C}{\partial W} = 1.02 \frac{t_f}{t_b V_b} \{234.5 \times 10^{-6}\}$$

Plots (14) (10) (1) (11)

(a) Airframe labor $C_{am} = 1.02 \frac{t_f}{t_b V_b} \{10.5 + 234.5 \times 10^{-6} W_a\}$

$$\frac{\partial C}{\partial V_b} = -\frac{1.02}{V_b^2} \{10.5 + 234.5 \times 10^{-6} W_a\}$$

$$\frac{\partial C}{\partial U} = 0$$

$$\frac{\partial C}{\partial W} = 1.02 \frac{t_f}{t_b V_b} (234.5 \times 10^{-6})$$

Plots (14) (10) (1) (11)

(b) Airframe material $C_{am} = 1.02 \frac{t_f}{t_b V_b} \{5.20 \times 10^{-6} C_a + 1.28\}$

$$\frac{\partial C}{\partial V_b} = -\frac{1.02}{V_b^2} \{5.20 \times 10^{-6} C_a + 1.28\}$$

$$\frac{\partial C}{\partial U} = \frac{\partial C}{\partial W} = 0$$

Plots (14) (10) (1) (11)

(c) Engine labor

$$C_{am} = 1.02 \frac{t_f}{t_b V_b} N_e R_L K_{1e}$$

$$\frac{\partial C}{\partial V_b} = -\frac{1.02}{V_b^2} N_e R_L K_{1e}$$

$$\frac{\partial C}{\partial U} = \frac{\partial C}{\partial W} = 0$$

Plots (14) (10) (1) (11)

(d) Engine material

$$C_{am} = 1.02 \frac{t_f}{t_b V_b} \{46.2 \times 10^{-6} N_e C_e\}$$

$$\frac{\partial C}{\partial V_b} = \frac{1.02}{V_b^2} \{46.2 \times 10^{-6} N_e C_e\}$$

$$\frac{\partial C}{\partial U} = \frac{\partial C}{\partial W} = 0$$

Plots (14) (10) (1) (11)

(e) Burden (None)

4. Depreciation:

$$C_{am} = \frac{1}{V_b D_a U} \{1.10 C_t + 0.30 N_e C_e\}$$

$$\frac{\partial C}{\partial V_b} = -\frac{1}{V_b D_a U} \left\{1.10 C_t + 0.30 N_e C_e\right\} \left[\frac{1}{U} \frac{dU}{dV_b} + \frac{1}{V_b}\right]$$

$$\frac{\partial C}{\partial U} = -\frac{1}{V_b D_a U^2} \{1.10 C_t + 0.30 N_e C_e\}$$

$$\frac{\partial C}{\partial W} = 0$$

$$\frac{\partial U}{\partial V_b} = \frac{1.10 C_t + 0.30 N_e C_e}{D_a C_{am} V_b^2}$$

Plots (4) (5) (1) (2) (3)

5. Insurance:

$$C_{am} = \frac{(IRA) C_t}{U V_b}$$

$$\frac{\partial C}{\partial V_b} = -\frac{(IRA) C_t}{U V_b} \left\{\frac{1}{V_b} + \frac{1}{U} \frac{dU}{dV_b}\right\}$$

$$\frac{\partial C}{\partial U} = -\frac{(IRA) C_t}{U^2 V_b}$$

$$\frac{\partial U}{\partial V_b} = \frac{(IRA) C_t}{C_{am} V_b^2}$$

Plots (4) (5) (1) (2) (3)

Method 2

1. **Flight crew:**

(a) Pilot

$$C_1 = N_1\left(K_1 + K_1' \log_{10}\frac{Pd}{t_b}\right)t_b$$

$$\frac{\partial C}{\partial V_b} = -N_1\frac{D}{V_b^2}\left\{K_1 + K_1'\log\frac{Pd}{t_b} - \frac{K_1'}{\text{in }10}\right\}$$

$$\frac{\partial C}{\partial U} = 0$$

$$\frac{\partial C}{\partial W} = N_1 K_1' t_b\left(\frac{1}{P\text{ in }10}\right)$$

Plots (4) (17) (1) (18)

(b) Copilot

$$C_2 = N_2\left(K_2 + K_2'\log_{10}\frac{Pd}{t_b}\right)t_b$$

$$\frac{\partial C}{\partial V_b} = N_2\frac{dt_b}{dV_b}\left\{K_2 - \frac{K_2'}{\text{in }10} + K_2\log\frac{Pd}{t_b}\right\} = -N_2\frac{D}{V_b^2}\left\{K_2 - \frac{K_2'}{\text{in }10} + K_2\log_{10}PV_b\right\}$$

$$\frac{\partial C}{\partial U} = 0$$

$$\frac{\partial C}{\partial W} = \frac{N_2 K_2' t_b}{P\text{ in }10}$$

Plots (4) (17) (1) (18)

(c) Engineer

$$C_3 = N_3 t_b\left(K_3 + K_3'\log_{10}\frac{Pd}{t_b}\right) = N_3\frac{d}{V_b}\left(K_3 + K_3'\log_{10}PV_b\right)$$

$$\frac{\partial C}{\partial V_b} = N_3\frac{dt_b}{dV_b}\left\{K_3 - K_3'\text{ in }10 + K_3'\log_{10}\frac{Pd}{t_b}\right\}$$

$$= N_3\frac{d}{V_b^2}\left\{\frac{K_3'}{\text{in }10} - K_3 - K_3'\log_{10}PV_b\right\}$$

$$\frac{\partial C}{\partial U} = 0$$

$$\frac{\partial C}{\partial W} = N_3 t_b K_3'\left(\frac{1}{P\text{ in }10}\right)$$

Plots (4) (17) (1) (18)

2. **Fuel and oil:**

$$C = 1.03\left\{\frac{K_4 W_f}{D} + N_e K_4' G_0 t_b\right\}$$

$$\frac{\partial C}{\partial V_b} = 1.03 N_e K_4' G_0\left(-\frac{D}{V_b^2}\right) = -1.03 N_e K_4' G_0\left(\frac{t_b^2}{D}\right)$$

$$\frac{\partial C}{\partial U} = 0$$

$$\frac{\partial C}{\partial W_f} = \frac{1.03\,K_4}{D}\,\frac{dW_f}{dW}$$

Plots (16) (13) (1) (15)

3. **Maintenance:**

$$C\ (\text{total}) = 0.91 K_7 t_b \left\{ \frac{1 + K_{11}}{W_1 + W_2} \left(\left[12.915 + 0.0001825 W_A \right] W_1 + \left[2.348 + 0.747 V_K \right] W_2 \right) \right.$$

$$+ 34.637 + 0.004683 (P_A + P_f) - 4.7335 t + N_e \left[-60.593 + 0.039 F^\circ + \frac{3.347 T}{W_e} \right]$$

$$\left. + K_{11} \left[-26.41 + 0.01697 F^\circ + \frac{2.0214 T}{W_e} \right] \right\} \equiv \alpha t_b$$

$$\frac{\partial C}{\partial V_b} = \frac{D \alpha}{V_b^2}$$

$$\frac{\partial C}{\partial U} = \frac{\partial C}{\partial W} = 0$$

Plots ④①

(a) Airframe labor and other

$$C_7 = \frac{0.91 K_7 t_b}{W_1 + W_2} \{ (12.915 + 0.0001825 W_A) W_1 + (2.348 + 0.747 V_K) W_2 \};$$

$$W_1 = \left(\frac{40{,}100}{W_A - 89{,}800} \right)^2, \quad W_2 = \left(\frac{152}{V_k - 392} \right)^2$$

$$\frac{\partial C}{\partial V_b} = \frac{0.91 K_7 D}{(W_1 + W_2) V_b^2} \{ (12.915 + 0.0001825 W_a) W_1 + (2.348 + 0.747 V_K) W_2 \}$$

$$\frac{\partial C}{\partial U} = \frac{\partial C}{\partial W} = 0$$

Plots ④①

(b) Airframe material and other

$$C = 0.91 K_7 t_b \{ 34.637 + 0.004683 (P_A + P_f) - 4.7335 t \}$$

$$\frac{\partial C}{\partial V_b} = -0.91 K_7 \{ 34.637 + 0.004683 (P_A + P_f) - 4.7335 t \} \frac{D}{V_b^2}$$

$$\frac{\partial C}{\partial U} = \frac{\partial C}{\partial W} = 0$$

Plots ④①

(c) Engine labor

$$C_9 = 0.91 K_7 t_b N_e \left\{ -26.41 + 0.01697 F^\circ + \frac{2.0214 T}{W_e} \right\}$$

$$\frac{\partial C}{\partial V_b} = -0.91 K_7 N_e \left\{ -26.41 + 0.01697 F^\circ + \frac{2.0214 T}{W_e} \right\} \frac{D}{V_b^2}$$

$$\frac{\partial C}{\partial U} = \frac{\partial C}{\partial W} = 0$$

Plots ④①

(d) Engine material

$$C = 0.91\,K_7 N_e t_b \left\{ -60.593 + 0.039\,F^o + \frac{3.347\,T}{W_e} \right\}$$

$$\frac{\partial C}{\partial V_b} = -0.91\,K_7 N_e \left\{ -60.593 + 0.039\,F^o + \frac{3.347\,T}{W_e} \right\} \frac{D}{V_b^2}$$

$$\frac{\partial C}{\partial U} = \frac{\partial C}{\partial W} = 0$$

Plots (4)(1)

(e) Burden

$$C_{11} = K_{11}\,(C_7 + C_9)$$

$$\frac{\partial C}{\partial V_b} = -\frac{0.91\,K_7 N_e D}{V_b^2} \left\{ \frac{1}{W_1 + W_2} \left[\left(12.915 + 0.0001825\,W_A\right) W_1 + \left(2.348 + 0.747\,V_k\right) W_2 \right] + 0.01697\,F^o - 26.41 + \frac{2.0214\,T}{W_e} \right\} K_{11}$$

$$\frac{\partial C}{\partial U} = \frac{\partial C}{\partial W} = 0$$

Plots (4)(1)

4. Depreciation:

$$C = \frac{t_b}{U} \left\{ \frac{P_f (1 + S_f)(1 - R_f)}{L_f} + \frac{4P_e (1 + S_e)(1 - R_e)}{L_e} + \frac{P_A (1 + S_A)(1 - R_A)}{L_A} \right\} = \frac{t_b}{U}\beta$$

$$\frac{\partial C}{\partial V_b} = -\beta \left(\frac{dt_b}{dV_b} - \frac{1}{U^2} \frac{dU}{dV_b} \right) = -\frac{\alpha D}{U V_b} \left(\frac{1}{V_b} + \frac{1}{U} \frac{dU}{dV_b} \right)$$

$$\frac{\partial C}{\partial U} = -\frac{C}{U} = -\frac{\alpha D}{U^2 V_b}$$

$$\frac{\partial C}{\partial W} = 0$$

$$\frac{\partial C}{\partial V_b} = -\frac{\alpha D}{C V_b^2}$$

Plots (4)(5)(1)(2)(3)

5. Insurance:

$$C = \frac{K P_o t_b}{U}$$

$$\frac{\partial C}{\partial V_b} = C \left\{ \frac{dt_b}{dV_b} - \frac{1}{U} \frac{dU}{dV_b} \right\} = \frac{K P_o D}{U V_b} \left\{ -\frac{1}{U} \frac{dU}{dV_b} - \frac{1}{V_b} \right\}$$

$$\frac{\partial C}{\partial U} = -\frac{C}{U}$$

$$\frac{\partial C}{\partial W} = 0$$

$$\frac{\partial U}{\partial V_b} = -\frac{K P_o D}{U V_b^2}$$

Plots (4)(5)(1)(2)(3)

Method 3

1. Flight crew:

(a) Pilot $$C = \frac{D_b}{V_b}\left\{a_1 + a_2 V_b + a_3 \frac{W_g}{1000}\right\}$$

$$\frac{\partial C}{\partial V_b} = -\frac{D_b}{V_b^2}\left\{a_1 + a_3 \frac{W_g}{1000}\right\}$$

$$\frac{\partial C}{\partial U} = 0$$

$$\frac{\partial C}{\partial W} = \frac{D_b\, a_3}{1000\, V_b}$$

Plots (16) (10) (1) (11)

(b) Copilot $$C = \frac{D_b}{V_b}\left\{a_4 + a_5 V_b + a_6 \frac{W_g}{1000}\right\}$$

$$\frac{\partial C}{\partial V_b} = -\frac{D_b}{V_b^2}\left\{a_4 + a_6 \frac{W_g}{1000}\right\}$$

$$\frac{\partial C}{\partial U} = 0$$

$$\frac{\partial C}{\partial W} = \frac{D_b\, a_6}{V_b (1000)}$$

Plots (16) (10) (1) (11)

(c) Engineer $$C = \frac{D_b}{V_b}\left\{a_7 + a_8 V_b + a_9 \frac{W_g}{1000}\right\}$$

$$\frac{\partial C}{\partial V_b} = -\frac{D_b}{V_b^2}\left\{a_7 + a_9 \frac{W_g}{1000}\right\}$$

$$\frac{\partial C}{\partial U} = 0$$

$$\frac{\partial C}{\partial W} = \frac{D_b\, a_9}{V_b (1000)}$$

Plots (16) (10) (1) (11)

2. Fuel and oil:

$$C = \frac{D_b}{V_b}\left[N_e C_o O_b\right] + \frac{(1+N_t)\, C_f\, F_s}{F_W}$$

$$\frac{\partial C}{\partial V_b} = -\frac{D_b}{V_b^2}\left[N_e C_o O_b\right] + \frac{(1+N_t)\, C_f \frac{dF_s}{dV_b}}{F_W}$$

$$\frac{\partial C}{\partial U} = 0$$

$$\frac{\partial C}{\partial W} = \frac{(1+N_t)\, C_f}{F_W}\,\frac{dF_s}{dW}$$

Plots (4) (1) (13) (15)

3. Maintenance:

$$C\ (\text{total}) = \frac{D_b}{V_b}\left\{ N_e\left(\left[a_{20}a_{21}\frac{T_h}{1000}\right]\frac{a_{22}}{H_{eo}} + a_{23} + \frac{a_{26}C_e - a_{27}}{a_{28}H_{eo} + a_{29}}\right) + a_{18} + a_{19}\frac{W_a}{1000}\right.$$

$$\left. + a_{24} + a_{25}\frac{C_{sp2}}{1000}\right\} + a_{30}\left(C_{11} + C_{12}\right)$$

$$\frac{\partial C}{\partial V_b} = -\frac{1}{V_b}\left(C - \text{burden}\right)$$

$$\frac{\partial C}{\partial U} = 0$$

$$\frac{\partial C}{\partial W} = \frac{a_{19}D_b}{1000\,V_b}$$

Plots (4) (10) (1) (11)

(a) Airframe labor $C = \frac{D_b}{V_b}\left\{a_{18} + a_{19}\frac{W_a}{1000}\right\}$

$$\frac{\partial C}{\partial V_b} = -\frac{a_{18} + a_{19}W_a/1000}{V_b^2}D_b$$

$$\frac{\partial C}{\partial U} = 0$$

$$\frac{\partial C}{\partial W} = \frac{a_{19}D_b}{1000\,V_b}$$

Plots (4) (10) (1) (11)

(b) Airframe material $C = \frac{D_b}{V_b}\left\{a_{24} + a_{25}\frac{C_{spa}}{1000}\right\}$

$$\frac{\partial C}{\partial V_b} = -\frac{D_b}{V_b^2}\left(a_{24} + a_{25}\frac{C_{spa}}{1000}\right)$$

$$\frac{\partial C}{\partial U} = \frac{\partial C}{\partial W} = 0$$

Plots (4) (1)

(c) Engine labor $C = \frac{D_b N_e}{V_b}\left\{\left(a_{20} + a_{21}\frac{T_h}{1000}\right)\frac{a_{22}}{H_{eo}} + a_{23}\right\}$

$$\frac{\partial C}{\partial V_b} = -\frac{D_b N_e}{V_b^2}\left\{\left(a_{20} + a_{21}\frac{T_h}{1000}\right)\frac{a_{22}}{H_{eo}} + a_{23}\right\}$$

$$\frac{\partial C}{\partial U} = \frac{\partial C}{\partial W} = 0$$

Plots (4) (1)

(d) Engine material $C = \frac{D_b N_e}{V_b}\left\{\frac{a_{26}C_e - a_{27}}{a_{28}H_{eo} + a_{29}}\right\}$

$$\frac{\partial C}{\partial V_b} = -\frac{D_b N_e}{V_b^2}\left\{\frac{a_{26} C_e - a_{27}}{a_{28} H_{eo} + a_{29}}\right\}$$

$$\frac{\partial C}{\partial U} = \frac{\partial C}{\partial W} = 0$$

Plots (4)(1)

(e) Burden $C = a_{30}(C_{11} + C_{12})$

$$\frac{\partial C}{\partial V_b} = \frac{\partial C}{\partial U} = \frac{\partial C}{\partial W} = 0$$

No plots

4. Depreciation:

$$C = \frac{D_b}{V_b}\left\{\frac{(1+S_a)(C_a - R_a)}{D_{ya} U_a} + N_e \frac{(1+S_e)(C_e - R_e)}{D_{ye} U_e} + \frac{(1+S_t)(C_t - R_t)}{D_{yt} U_t}\right\}$$

$$\frac{\partial D}{\partial V_b} = -C\left\{\frac{1}{U}\frac{dU}{dV_b} + \frac{1}{V_b}\right\}$$

$$\frac{\partial C}{\partial U} = -\frac{1}{U} C, \text{ where } U_a = U_e = U_t = U$$

$$\frac{\partial C}{\partial W} = 0$$

Plots (4)(5)(1)(2)

5. Insurance:

$$C = \frac{I_r C_t}{U_a}\frac{D_b}{V_b} + I_s \text{ (for SST)}$$

$$\frac{\partial C}{\partial U} = -\frac{I_r C_t D_b}{U_a^2 V_b}$$

$$\frac{\partial C}{\partial V_b} = -\frac{I_r C_t D_b}{U_a V_b}\left(\frac{1}{U_a}\frac{dU_a}{dV_b} + \frac{1}{V_b}\right)$$

$$\frac{\partial C}{\partial W} = 0$$

Plots (4)(5)(1)(2)

Method 4

1. Flight Crew:

(a) Subsonic (method 1) $C_{DH} = \frac{1}{U}\left|21{,}000 + 80 V_c + 0.13 W_{max}\right| + 9.00$

$$\frac{\partial C}{\partial V_c} = \frac{1}{U}\left\{80 + 0.13\frac{dW_{max}}{dV_c}\right\} - \frac{1}{U}(C_{DH} - 9.00)\frac{dU}{dV_c}$$

$$\frac{\partial C}{\partial W_{max}} = \frac{0.13}{U}$$

$$\frac{\partial C}{\partial U} = -\frac{1}{U^2}\left|21{,}000 + 80 V_c + 0.13 W_{max}\right|$$

Plots (19)(20)(11)(21)(5)(10)

(b) Subsonic (method 2)

$$C_{DH} = \frac{1}{U_c}\{69{,}000 + 0.047 W_{max}\} + 9.00$$

$$\frac{\partial C}{\partial V_c} = 0.047 \frac{dW_{max}}{dV_c}$$

$$\frac{\partial C}{\partial U_c} = -\frac{1}{U_c^2}\{69{,}000 + 0.047 W_{max}\}$$

$$\frac{\partial C}{\partial W_{max}} = \frac{0.047}{U_c}$$

Plots (19) (20) (11) (21) (5) (10)

(c) Supersonic

$$C_{DH} = \frac{1}{U_c}\{82{,}000 + 0.047 W_{max}\} + 9.00$$

$$\frac{\partial C}{\partial V_c} = 0.047 \frac{dW_{max}}{dV_c}$$

$$\frac{\partial C}{\partial U_c} = -\frac{1}{U_c^2}\{82{,}000 + 0.047 W_{max}\}$$

$$\frac{\partial C}{\partial W_{max}} = \frac{0.047}{U_c}$$

Plots (19) (20) (11) (21) (5) (10)

2. Fuel and Oil:

$$C_{DT} = \frac{F_b C_{ft}}{6.7} + C_{ot} N t_b$$

$$\frac{\partial C}{\partial V_b} = -\frac{0.016\, C_{ot} ND}{V_b^2} + \frac{dF_b}{dV_b}\frac{C_{ft}}{6.7}$$

$$\frac{\partial C}{\partial U} = 0$$

$$\frac{\partial C}{\partial W} = \frac{C_{ft}}{6.7}\frac{dF_b}{dW}$$

Plots (6) (7) (13) (15)

3. Maintenance:

$$C \text{ (subsonic total)} = R\left\{3.00 + 86\frac{W_{af}}{10^6} + 0.0041 W_{af}^{1/2} + t\left[0.50 + 0.40 N_e + 4.5 W_{af} \times 10^{-6} + 0.024 W_{af}^{1/2} + 18 \times 10^{-6} TN_e\right] + \left[12 \times 10^{-6} T + 0.20\right] N_e\right\}$$
$$+ 6.00 + 112 \times 10^{-6} W_{af} + 3.1 \times 10^{-6} C_{af} + 24 \times 10^{-6} C_e N_e$$
$$+ t\left\{2.10 \times 10^{-6}\left[14 W_{af} + 3.1 C_{af} + 24 C_e N_e\right]\right\}$$

$$\frac{\partial C}{\partial W_{af}} = 10^{-6}(112 + 14t) + \frac{0.00205 + 0.012t}{W_{af}^{1/2}} + R(86 + 4.5t)$$

$$\frac{\partial C}{\partial V_b} = -\frac{1}{V_b^2}\{2.10 \times 10^{-6}(W_{af}[14 + 4.5R] + 3.1 C_{af} + 0.024 W_{af}^{1/2})$$
$$+ N_e(0.4R + 10^{-6}[18TR + 38C_e]) + 0.5R\}$$

$$\frac{\partial C}{\partial U} = 0$$

$$C\text{ (supersonic total)} = R\{2.00 + 3.6\times10^{-6}W_{af}^{1/2} + M_c^{1/2}(1.00 + 50\times10^{-6} + 0.0041W_{af}^{1/2})$$

$$+ N_e(0.20 + 12\times10^{-6}T) + t(0.50 + 4.5\times10^{-6}W_{af} + 0.024[W_{af}M_c^{1/2}]$$

$$+ [0.40 + 1.8\times10^{-6}T]N_e)\} + 4.80 + 10^{-6}(112W_{af} + 1.5C_{af})$$

$$+ M_c^{1/2}(1.20 + 1.6\times10^{-6}C_{af}) + t\{0.40 + 14\times10^{-6}W_{af}$$

$$+ (1.70 + 3.1\times10^{-6}C_{af})M_c^{1/2}\}$$

$$\frac{\partial C}{\partial W_{af}} = 10^{-6}(112 + 14t + R[36 + 50M_c^{1/2} + 4.5t]) : \left(\frac{M_cR}{W_{af}}\right)^{1/2}(0.0025 + 0.012t)$$

$$\frac{\partial C}{\partial V_b} = -\frac{1}{V_b^2}\{0.40 + ([14 + 4.5R]W_{af} + 3.1C_{af}M_c^{1/2}\times10^{-6} + M_c^{1/2}(1.70$$

$$+ 0.024W_{af}^{1/2}R) + 0.50R \quad N_e(0.40R + 10^{-6}[38C_e + 1.8RT])\}$$

$$\frac{\partial C}{\partial M_c} = \frac{1}{2M_c^{1/2}}(1.20 + 10^{-6}[1.6C_{af} + 50RW_{af}] + 0.0041W_{af}^{1/2}R$$

$$+ t[0.024W_{af}R + 1.70 + 3.1\times10^{-6}C_{af}] + R)$$

$$\frac{\partial C}{\partial U} = 0$$

Plots for subsonic and supersonic totals (16) (1) (13) (22) (23) (24)

(a) Airframe labor

$$\text{Subsonic} - C_{HF} = 3.00 + 86W_{af}/10^6 + 0.0041W_{af}^{1/2} + t_f\{0.50$$

$$+ 4.5W_{af}/10^6 + 0.024W_{af}^{1/2}\}$$

$$\frac{\partial C}{\partial V_b} = \frac{1}{V_b^2}\{0.50 + 4.5\times10^{-6}W_{af} + 0.024W_{af}^{1/2}\}$$

$$\frac{\partial C}{\partial U} = 0$$

$$\frac{\partial C}{\partial W_{af}} = 86\times10^{-6} + 4.5t\times10^{-6} + \frac{0.00205 + 0.012t}{W_{af}^{1/2}}$$

Plots (16) (1) (13) (22)

$$\text{Supersonic} - C_{HF} = 2.00 + 3.6\times10^{-6}W_{af} + M_c^{1/2}(1.00 + 50\times10^{-6}W_{af} + 0.0041W_{af}^{1/2})$$

$$+ t_f\{0.50 + 4.5\times10^{-6}W_{af} + 0.024(W_{af}M_c)^{1/2}\}$$

$$\frac{\partial C}{\partial V_b} = -\frac{1}{V_b^2}\{0.50 + 4.5\times10^{-6}W_{af} + 0.024(W_{af}M_c)^{1/2}\}$$

$$\frac{\partial C}{\partial U} = 0$$

$$\frac{\partial C}{\partial W_{af}} = 36\times10^{-6} + 50\times10^{-6}M_c^{1/2} + 4.5\times10^{-6}t + M_c^{1/2}\left(\frac{0.00205 + 0.012t}{W_{af}^{1/2}}\right)$$

$$\frac{\partial C}{\partial M_c} = \frac{1}{2M_c^{1/2}}\{1.00 + 50\times10^{-6}W_{af} + 0.0041W_{af}^{1/2} + 0.024t\,W_{af}\}$$

Plots (16) (1) (13) (22) (23) (24)

(b) Airframe material

Subsonic – $C_{DF} = 6.00 + 112 \times 10^{-6} W_{af} + 3.1 \times 10^{-6} C_{af} + t_f \{2.10 + 14 \times 10^{-6} W_{af} + 3.1 \times 10^{-6} C_{af}\}$

$$\frac{\partial C}{\partial V_b} = -\frac{1}{V_b^2}\{2.10 + 14 \times 10^{-6} W_{af} + 3.1 \times 10^{-6} C_{af}\}$$

$$\frac{\partial C}{\partial U} = 0$$

$$\frac{\partial C}{\partial W_{af}} = 10^{-6}\{112 + 14t\}$$

Plots (16) (10) (1) (11)

Supersonic – $C_{DF} = 4.80 + 112 \times 10^{-6} W_{af} + 1.5 \times 10^{-6} C_{af} + (1.20 + 1.6 \times 10^{-6} C_{af}) M_c^{1/2} + t_f \{0.40 + 14 \times 10^{-6} W_{af} + (1.70 + 3.1 \times 10^{-6} C_{af}) M_c^{1/2}\}$

$$\frac{\partial C}{\partial V_b} = -\frac{1}{V_b^2}\{0.40 + 14 \times 10^{-6} W_{af} + (1.70 + 3.1 \times 10^{-6} C_{af}) M_c^{1/2}\}$$

$$\frac{\partial C}{\partial U} = 0$$

$$\frac{\partial C}{\partial W_{af}} = 112 \times 10^{-6} + 14 \times 10^{-6} t$$

$$\frac{\partial C}{\partial M_c} = \frac{1}{2M_c^{1/2}}(1.20 + 1.6 \times 10^{-6} C_{af} + t[1.70 + 3.1 \times 10^{-6} C_{af}])$$

Plots (16) (10) (1) (11) (23) (24)

(c) Engine labor $C_{HF} = (0.20 + 12 \times 10^{-6} T + t_f \{0.40 + 18 \times 10^{-6} T\}) N_e$

$$\frac{\partial C}{\partial V_b} = -\frac{N_e}{V_b^2}\{0.40 + 18 \times 10^{-6} T\}$$

$$\frac{\partial C}{\partial U} = \frac{\partial C}{\partial W_{af}} = 0$$

Plots (16) (1)

(d) Engine material $C_{DF} = (24 + 38 t_f) \times 10^{-6} C_e N_e$

$$\frac{\partial C}{\partial V} = 10^{-6} C_e N_e \frac{38}{V_b^2}$$

$$\frac{\partial C}{\partial W} = \frac{\partial C}{\partial U} = 0$$

Plots (16) (1)

4. Depreciation:

$$C_{DY} = \frac{1}{D_a}\{C_t + K_{SPA}(C_t - N_e C_e) + K_{SPE} C_e N_e\}$$

$$\frac{\partial C}{\partial V_b} = \frac{\partial C}{\partial U} = \frac{\partial C}{\partial W} = 0$$

No plots

5. Insurance:

$$C_{DY} = I_a \times C_t$$

$$\frac{\partial C}{\partial V_b} = \frac{\partial C}{\partial U} = \frac{\partial C}{\partial W} = 0$$

No plots

FAA-66

1. Flight crew:

(a) Pilot

$$C_{am} = \frac{1}{V_b}\left\{E + \left(1 + K_V + K_T + K_I + K_P\right)\left(\frac{BP_P}{AH} + \left[DNF\right]\left[HRF_P\right] + MRF_P + GWF_P + ODP_P\right)\right\} = \frac{1}{V_b}\left(\gamma_P\right)$$

$$\frac{\partial C}{\partial V_b} = -\frac{\gamma_P}{V_b^2}$$

$$\frac{\partial C}{\partial U} = \frac{\partial C}{\partial W} = 0$$

Plots (4)(1)

(b) Copilot

$$C_{am} = \frac{1}{V_b}\left\{E + \left(1 + K_V + K_T + K_I + K_P\right)\left(\frac{BP_{CP}}{AH} + \left[DNF\right]\left[HRF_{cP}\right] + MRF_{cP} + GWF_{cP} + ODP_{cP}\right)\right\} = \frac{1}{V_b}\left(\gamma_{cP}\right)$$

$$\frac{\partial C}{\partial V_b} = -\frac{\gamma_{cP}}{V_b^2}$$

$$\frac{\partial C}{\partial U} = \frac{\partial C}{\partial W} = 0$$

Plots (4)(1)

(c) Engineer

$$C_{am} = \frac{1}{V_b}\left\{E + \left(1 + K_V + K_T + K_I + K_P\right)\left(\frac{BP_E}{AH} + \left[DNE\right]\left[HRF_E\right] + MRF_E + GWF_E + ODP_E\right)\right\} = \frac{1}{V_b}\left(\gamma_E\right)$$

$$\frac{\partial C}{\partial V_b} = -\frac{\gamma_E}{V_b^2}$$

$$\frac{\partial C}{\partial U} = \frac{\partial C}{\partial W} = 0$$

Plots (4)(1)

2. Fuel and oil:

$$C_{am} = \left[E_{gm} + F_{cl} + F_{am} + F_{cr} + F_d\right]\left(\frac{C_{1b}}{D}\right)$$

$$\frac{\partial C}{\partial U} = 0$$

$$\frac{\partial C}{\partial W} = \frac{dF_{cr}}{dW}\left(\frac{C_{1b}}{D}\right)$$

$$\frac{\partial C}{\partial V_b} = \frac{dF_{cr}}{dV_b}\left(\frac{C_{1b}}{D}\right)$$

where F_b = block fuel, lb

C_{1b} = fuel cost per lb

Plots (6)(7)(8)(9)

3. Maintenance:

$$C_{am}\,(\text{total}) = \frac{1.03}{V_b}\{1.890\,R_L\,(K_{La} + N_e K_{Le}) + 1.233\,(K_{Ma} + K_{Me} N_e)\} = \frac{1.03\beta}{V_b}$$

$$\frac{\partial C}{\partial V_b} = -\frac{1.03\beta}{V_b^2}$$

$$\frac{\partial C}{\partial U} = \frac{\partial C}{\partial W} = 0$$

Plots (4)(1)

(a) Airframe labor $C_{am} = \frac{1.03}{V_b} K_{La} R_L$

$$\frac{\partial C}{\partial V_b} = -\frac{1.03 K_{La} R_L}{V_b^2}$$

$$\frac{\partial C}{\partial U} = \frac{\partial C}{\partial W} = 0$$

Plots (4)(1)

(b) Airframe material $C_{am} = \frac{1.03}{V_b} K_{Ma}$

$$\frac{\partial C}{\partial V_b} = -\frac{1.03 K_{Ma}}{V_b^2}$$

$$\frac{\partial C}{\partial U} = \frac{\partial C}{\partial U} = 0$$

Plots (4)(1)

(c) Engine labor $C_{am} = \frac{1.03}{V_b} N_e K_{Le} R_L$

$$\frac{\partial C}{\partial V_b} = -\frac{1.03 N_e K_{Le} R_L}{V_b^2}$$

$$\frac{\partial C}{\partial U} = \frac{\partial C}{\partial W} = 0$$

Plots (4)(1)

(d) Engine material $C_{am} = \frac{1.03}{V_b} K_{Me} N_e$

$$\frac{\partial C}{\partial V_b} = -\frac{1.03 K_{Me} N_e}{V_b^2}$$

$$\frac{\partial C}{\partial U} = \frac{\partial C}{\partial W} = 0$$

Plots (4)(1)

(e) Burden $C_{am} = \frac{1.03}{V_b} [0.890 R_L (K_{La} + N_e K_{Le}) + (0.233 K_{Ma} + N_e K_{Me})] = \frac{1.03}{V_b} \alpha$

$$\frac{\partial C}{\partial V_b} = \frac{1.03\alpha}{V_b^2}$$

$$\frac{\partial C}{\partial U} = \frac{\partial C}{\partial W} = 0$$

Plots (4)(1)

4. **Depreciation:**

$$C_{am} = \frac{1}{D_a U V_b} [K_{Da} C_a + K_{De} C_e N_e + K_{DP} C_P N_e + K_{Dt} C_t + K_{Ds} (K_{spa} C_{spa} + K_{spe} C_e N_e [SPF])] = \frac{1}{D_a U V_b} (\delta)$$

$$\frac{\partial C}{\partial V_b} = -\frac{\delta}{D_a U V_b} \left\{ \frac{1}{V_b} + \frac{1}{U} \frac{dU}{dV_b} \right\}$$

$$\frac{\partial C}{\partial W} = 0$$

$$\frac{\partial C}{\partial U} = -\frac{\delta}{D_a V_b U^2}$$

$$\frac{\partial U}{\partial V_b} = -\frac{\delta}{C D_a V_b^2}$$

Plots (1)(2)(3)(4)(5)

5. **Insurance:**

$$C_{am} = \frac{[IRA][CT]}{U V_b} + [PL \text{ and } PD]$$

$$\frac{\partial C}{\partial V_b} = \frac{[IRA][CT]}{U V_b^2}$$

$$\frac{\partial C}{\partial W} = 0$$

$$\frac{\partial C}{\partial U} = -\frac{[IRA][CT]}{U^2 V_b}$$

$$\frac{\partial U}{\partial V_b} = -\frac{[IRA][CT]}{C V_b^2}$$

Plots (1)(2)(3)(4)(5)

ATA Specification 100 (Maintenance)

(a) Airframe labor $C_{hr} = 1.2093\left(\frac{W_e}{10^4}\right)\left(\frac{S_a - 670}{670}\right) + 2.500\left(\frac{W_e}{10^5}\right)$

$$\frac{\partial C}{\partial W} = \frac{1.2093 W_e}{10^4}\left(\frac{S_a - 670}{670}\right) + \frac{2.500}{10^5}$$

$$\frac{\partial C}{\partial V} = \frac{1.2093 W_e}{670(10^4)}$$

$$\frac{\partial C}{\partial U} = 0$$

Note: S_a = cruise speed or V

Plots (11) (19)

$$C_{flt} = 2.118\left(\frac{W_e}{10^4}\right)\left(\frac{S_a - 670}{670}\right) + 7.800\left(\frac{W_e}{10^5}\right)$$

(To convert C_{flt} to C_{hr}, multiply C_{flt} by $\frac{1}{hr\,t}$ where t is time in hours. This applies to all equations for cost per flight.)

$$\frac{\partial C}{\partial W} = \frac{2.118}{10^4}\left(\frac{S_a - 670}{670}\right) + \frac{7.800}{10^5}$$

$$\frac{\partial C}{\partial V} = \frac{1.2093 W_e}{670(10^4)} - \frac{\left[2.118\left(\frac{W_e}{10^4}\right)\left(\frac{S_a - 670}{670}\right) + \frac{7.800 W_e}{10^5}\right]}{V^2}$$

$$\frac{\partial C}{\partial U} = 0$$

Plots (11) (9)

(b) Airframe material $C_{hr} = 0.9714\left(\frac{W_e}{10^4}\right)\left(\frac{S_a - 670}{670}\right) + 2.071\left(\frac{W_e}{10^5}\right)$

$$\frac{\partial C}{\partial W} = \frac{0.9714 W_e}{10^4}\left(\frac{S_a - 670}{670}\right) + \frac{2.071}{10^5}$$

$$\frac{\partial C}{\partial V} = \frac{0.9714 W_e}{670(10^4)}$$

$$\frac{\partial C}{\partial U} = 0$$

Plots (11) (19)

$$C_{flt} = 2.352\left(\frac{W_e}{10^4}\right)\left(\frac{S_a - 670}{670}\right) + 6.093\left(\frac{W_e}{10^5}\right)$$

$$\frac{\partial C}{\partial W} = \frac{2.352}{10^4}\left(\frac{S_a - 670}{670}\right) + \frac{6.093}{10^5}$$

$$\frac{\partial C}{\partial V} = \frac{0.9714 W_e}{670(10^4)} - \frac{\left[2.352\left(\frac{W_e}{10^4}\right)\left(\frac{S_a - 670}{670}\right) + \frac{6.093 W_e}{10^5}\right]}{V^2}$$

$$\frac{\partial C}{\partial U} = 0$$

Plots (11) (9)

(c) Engine labor

$$C_{hr} = 0.6684\left(W_q^{1/2}\right)\left(\frac{T^{1/2}}{10^3}\right)\left(N_e\right)$$

$$\frac{\partial C}{\partial W} = \frac{1}{2}\left(\frac{0.6684}{W_q^{1/2}}\right)\left(\frac{T^{1/2}}{10^3}\right)\left(N_e\right)$$

$$\frac{\partial C}{\partial V} = \frac{1}{2}\left[\frac{0.6684 W_q^{1/2}}{T^{1/2}(10^3)}\right]\left(N_e\right)\left(\alpha\right)$$

$$\frac{\partial C}{\partial U} = 0$$

Note: α equals factor of proportionality to velocity.

Plots (18) (9)

$$C_{flt} = 0.1122\left(W_q^{1/2}\right)\left(\frac{T^{1/2}}{10^3}\right)\left(N_e\right)$$

$$\frac{\partial C}{\partial W} = \frac{1}{2}\left[\frac{0.1122 T^{1/2}}{W_q^{1/2}(10^3)}\right]\left(N_e\right)$$

$$\frac{\partial C}{\partial V} = \frac{1}{2}\left[\frac{0.6684 W_q^{1/2}}{T^{1/2}(10^3)}\right]\left(N_e\right)\left(\alpha\right) - \frac{0.1122\,(W_q^{1/2})\,(T^{1/2})}{V^2}\left(N_e\right)$$

$$\frac{\partial C}{\partial U} = 0$$

Plots (18) (9)

(d) Engine material

$$C_{hr} = 10.144\left(W_q^{1/2}\right)\left(\frac{T}{10^6}\right)\left(N_e\right)$$

$$\frac{\partial C}{\partial W} = \frac{1}{2}\left(\frac{10.144}{W_q^{1/2}}\right)\left(\frac{T^{1/2}}{10^3}\right)\left(N_e\right)$$

$$\frac{\partial C}{\partial V} = \frac{10.144 W_q^{1/2}}{10^6}\left(N_e\right)\left(\alpha\right)$$

$$\frac{\partial C}{\partial U} = 0$$

Plots (18) (19)

$$C_{flt} = 2.126\left(W_q^{1/2}\right)\left(\frac{T}{10^6}\right)\left(N_e\right)$$

$$\frac{\partial C}{\partial W} = \frac{1}{2}\left[\frac{2.126\,T^{1/2}}{W_q^{1/2}(10^3)}\right]\left(N_c\right)$$

$$\frac{\partial C}{\partial V} = \left(\frac{10.144\,W_q^{1/2}}{10^6}\right)\left(N_c\right)\left(\alpha\right) - \left[\frac{2.126\,(W_q^{1/2})\,(T)}{V^2\,(10^6)}\right]\left(N_c\right)$$

$$\frac{\partial C}{\partial U} = 0$$

Plots (18)(9)

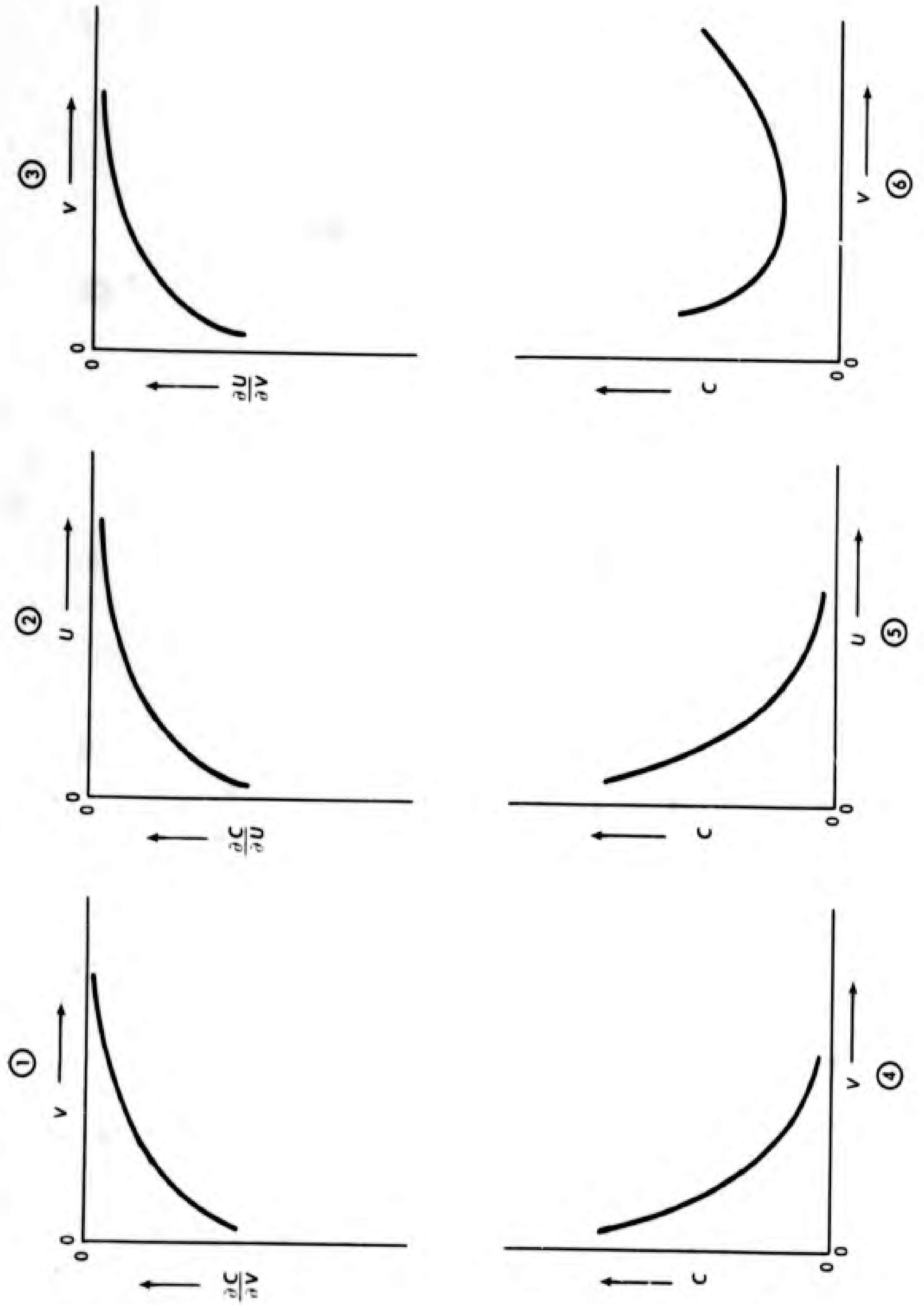


Fig. C1—Plots 1 to 24

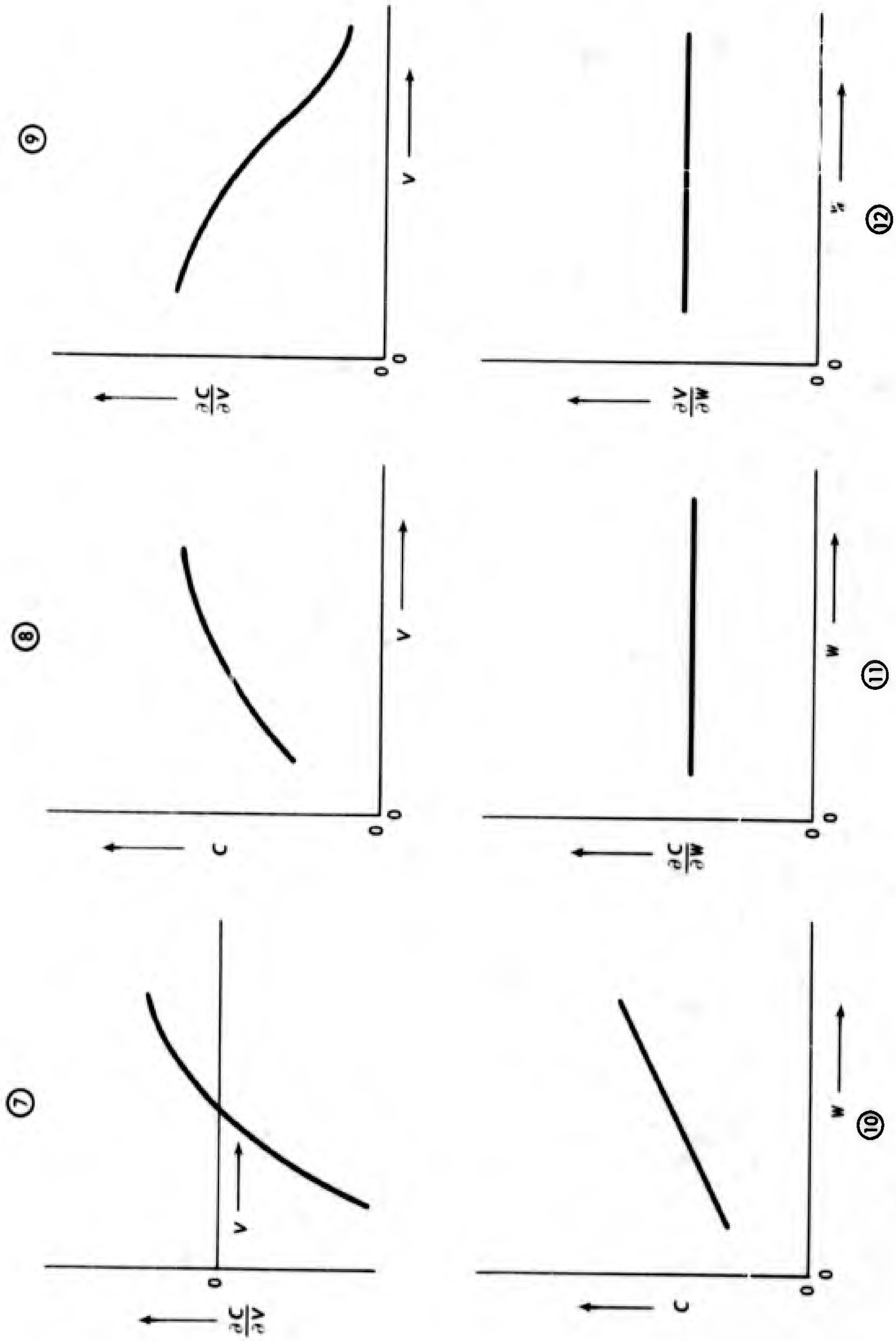


Fig. C1—Continued

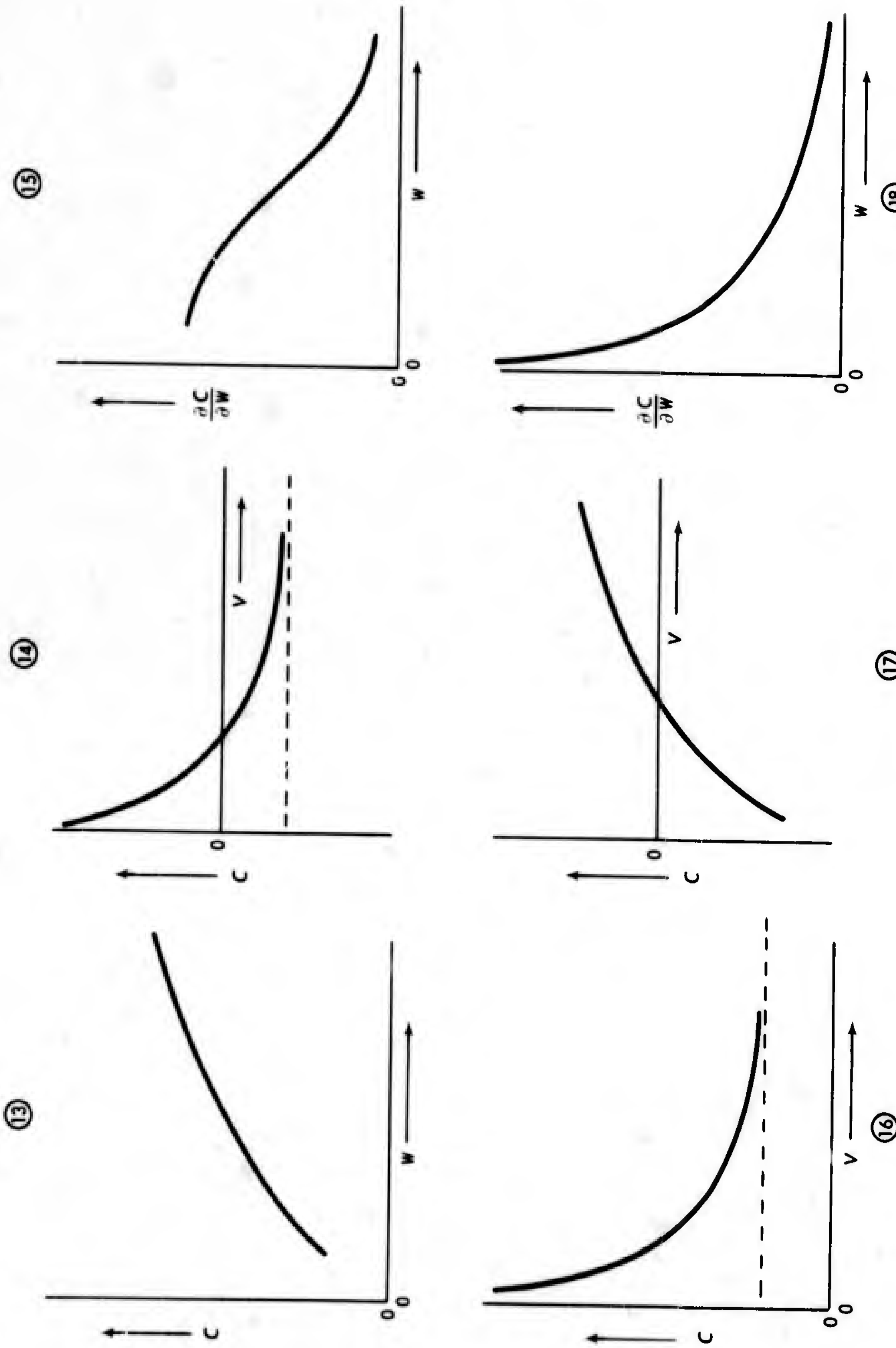


Fig. C1—Continued

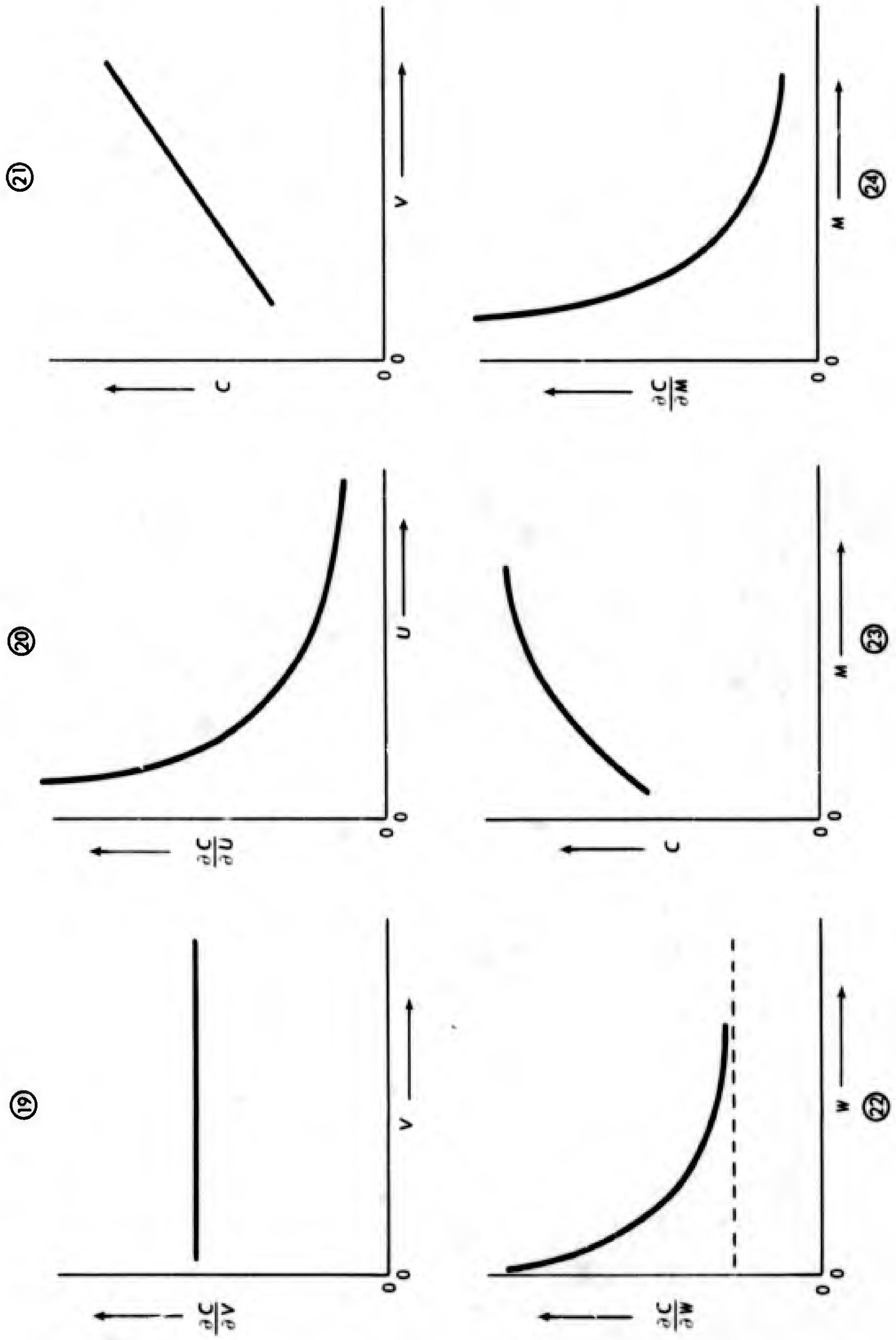


Fig. C1—Continued

BLANK PAGE

Appendix D

INDIRECT OPERATING COST DATA

Figures

Tables

This appendix contains a compilation of data used in the derivation of IOC CERs.

TABLE D1

Coefficient Determination—Equation 2

Airline	Year	Aircraft departures (1)	Depart × MTOGW, thous of lb (2)	Acct 6100 + 6300A, dollars (3)	Coefficient Col 3 ÷ Col 2 (4)
			Domestic Operations		
AA	63	244,755	34,764,697	33,116,964	.00095
	64	249,103	39,671,056	36,739,203	.00092
BN	63	120,194	12,576,168	5,264,160	.00042
	64	123,307	12,462,268	5,434,774	.00043
CO	63	79,406	7,897,832	3,595,607	.00046
	64	64,779	8,687,618	3,816,211	.00043
DL	63	191,549	21,663,094	17,970,194	.00083
	64	211,398	27,055,688	19,294,400	.00071
EA	63	413,930	52,470,104	30,325,403	.00058
	64	398,319	50,895,230	33,743,958	.00066
NA	63	84,897	12,982,357	5,089,473	.00039
	64	106,002	17,701,360	5,872,621	.00033
NW	63	98,904	14,657,981	9,271,616	.00063
	64	125,215	19,215,472	9,857,032	.00051
TW	63	168,326	30,157,770	24,249,045	.00080
	64	288,486	59,675,769	27,483,384	.00046
VA	63	484,940	60,080,077	50,910,327	.00085
	64	486,724	61,216,862	47,623,728	.00077
Totals	63	1,886,901	248,250,080	179,792,789	.00072
	64	2,053,333	296,581,353	189,865,311	.00064
			International Operations		
PAA	63	98,696	23,122,899	49,309,274	.00213
	64	116,885	28,032,875	53,070,460	.00189
TW	63	17,692	5,204,777	7,831,938	.00150
	64	18,422	5,736,232	9,496,937	.00165
NW	63	5,994	1,619,228	4,533,515	.00280
	64	6,340	1,833,124	5,465,939	.00298
Totals	63	122,382	29,946,904	61,674,727	.00206
	64	141,647	35,602,231	68,033,336	.00194

TABLE D2

Coefficient Determination—Equation 4: Domestic and International Operations–1965

Airline	Acct, thous of dollars (1)	Attendant block hours (2)	Coefficient $ per block hr Col 1 ÷ Col 2 (3)
Domestic			
AA	13,222	1348,921	9.80
EA	11,934	1104,506	10.80
TW	12,327	1829,156	6.74
UA	18,807	3335,354	5.64
DL	6,271	767,134	8.17
NW	4,384	476,075	9.21
NA	3,294	410,140	8.03
BN	2,413	343,868	7.02
CO	3,247	262,606	12.36
Industry total or average	75,529	9877,760	7.65
International			
NW	1,916	213,328	8.98
TW	7,254	471,780	15.37
PAA	23,729	1918,318	12.37
Industry total or average	32,899	2603,426	12.64

TABLE D3

Coefficient Derivation–Denominator—Equation 4: Domestic Operations–1965

Aircraft	Revenue aircraft hours (1)	Block ratio (2)	Block hours Col 1 × Col 2 (3)	Attendants (4)	Attendant block hours Col 3 × Col 4 (5)
American					
CV-990	49,120	114.8	56,390	4	225,560
B-707	81,471	110.9	90,351	4	361,404
B-720	65,387	110.2	72,056	4	288,224
B-727	53,904	119.9	64,631	3	193,893
DC-6	48,394	124.1	60,057	2	120,114
DC-6B	10,611	123.2	13,073	2	26,146
DC-7	785	112.4	882	2	1,764
Electra	55,713	118.3	65,908	2	131,816
Total	365,385	116.7	423,348		1,348,921
Braniff					
Viscount 810	766	111.2	852	2	1,704
CV340/440	40,280	117.5	47,329	2	94,658
B-707-200	5,752	113.7	6,540	4	26,160
B-707-300	2,076	120.8	2,508	4	10,032
B-720	17,508	114.6	20,064	4	80,256

TABLE D3 (continued)

Aircraft	Revenue aircraft hours (1)	Block ratio (2)	Block hours Col 1 × Col 2 (3)	Attendants (4)	Attendant block hours Col 3 × Col 4 (5)
DC-7C	6,086	117.3	7,139	2	14,278
DC-6	12,320	116.4	14,340	2	28,680
Electra	24,494	115.2	28,217	2	56,434
BAC-1 11	13,272	119.3	15,833	2	31,666
Total	122,554	116.2	142,822		343,868
Continental					
Viscount 800	32,843	110.9	36,423	2	72,846
B-707-100	15,334	109.3	16,760	4	67,040
B-707-300C	538	109.9	591	4	2,364
B-720	26,368	109.0	28,741	4	114,964
DC-6	42	114.3	48	2	96
DC-6B	1,649	113.1	1,865	2	3,730
DC-3	1,131	124.3	1,406	1	1,406
DC-7B	73	109.6	80	2	160
Total	77,978	112.5	85,914		262,606
Delta					
CV-880	47,220	117.4	55,436	4	221,744
CV340/440	45,893	122.3	56,127	2	112,254
DC-6	25,692	121.3	31,164	2	62,328
DC-7B	43,599	117.7	51,316	2	102,632
DC-8-33	2,624	117.1	3,073	4	12,292
DC-8-50	55,627	115.0	63,971	4	255,884
Total	220,655	118.4	261,087		767,134
Eastern					
CV340/440	932	118.67	1,106	2	2,212
CV440	46,151	119.74	55,261	2	110,522
L-1049C	11,544	124.19	14,336	2	28,672
L-1049G	12,767	124.41	15,883	2	31,766
B-707-300B	1,772	116.63	2,067	4	8,268
B-720	44,215	114.70	50,714	4	202,856
B-727	87,278	115.70	100,980	3	302,940
DC-7B	14,422	120.99	17,449	4	69,796
DC-8-20	23,707	113.75	26,967	4	107,868
DC-8-30	1,031	111.06	1,145	4	4,580
DC-8-50	2,097	116.40	2,441	4	9,764
Electra	96,704	116.47	112,631	2	225,262
Total	342,620	117.73	400,980		1,104,506
National					
B-727	21,857	114.70	25,070	3	75,210
DC-8 8-20	27,895	111.20	31,019	4	124,076
DC-8 8-50	22,253	110.20	24,523	4	98,092
Electra	47,539	118.60	56,381	2	112,762
Total	119,544	113.60	136,993		410,140

TABLE D3 (continued)

Aircraft	Revenue aircraft hours (1)	Block ratio (2)	Block hours Col 1 × Col 2 (3)	Attendants (4)	Attendant block hours Col 3 × Col 4 (5)
Northwest					
B-707-300B	11,582	114.5	13,261	4	53,044
B-720	48,365	116.4	56,297	4	225,188
B-727	18,259	123.1	22,477	3	67,431
DC-7C	10,153	119.55	12,138	2	24,276
DC-6B	1,239	127.6	1,581	2	3,162
Electra	42,906	120.0	51,487	2	102,974
Total	132,504	120.1	157,241		476,075
Trans-World					
CV-880	71,993	115.1	82,864	4	331,456
L-1049G	11,319	117.8	13,334	2	26,668
L-1649	254	111.9	284	3	852
B-707 300B	148,607	115.0	170,898	4	683,592
B-707-300	5,981	114.4	6,842	4	27,368
B-707-300B	2,711	115.4	3,128	4	12,512
B-707-300C	572	118.0	675	4	2,700
B-707-100	47,697	114.5	54,613	4	218,452
B-707-100B	84,850	109.2	92,656	4	370,624
B-727	44,368	116.4	51,644	3	154,932
Total	418,352	114.8	476,938		1,829,156
United					
Viscount	89,741	118.8	106,612	2	213,224
CV340/440	24,034	127.9	30,739	2	61,478
B-720	100,304	112.4	112,742	4	450,968
B-727	87,616	117.2	102,686	3	308,604
DC-6	60,612	120.2	72,856	2	1,457,122
DC-6B	78,779	121.4	95,638	2	191,276
DC-8-50	38,274	108.6	41,566	4	166,264
DC-8-20	59,772	109.1	65,211	4	260,844
DC-8-10	27,499	111.5	30,661	4	122,644
SE-210	43,103	119.4	51,465	2	102,930
Total	609,734	116.7	710,176		3,335,354
Industry total	2,409,326		2,795,507		9,877,760

TABLE D4

Coefficient Derivation—Denominator—Equation 4: International Operations–1965

Aircraft	Revenue aircraft hours (1)	Block ratio (2)	Block hours Col 1 × Col 2 (3)	Attendants (4)	Attendant block hours Col 3 × Col 4 (5)
Northwest					
B-707	27,771	105.3	29,243	6	175,458
B-720	7,112	106.5	7,574	5	37,870
Total	34,883	105.9	36,817		213,328
Trans World					
B-727	2	138.3	2.7	4	108
L-1049G	380	132.6	504	4	2,016
L-749	828	130.4	1,080	2	2,160
B-707 300	33,579	107.7	36,165	6	216,990
B-707 300B	28,236	107.0	30,213	6	181,278
B-707 300	10,828	106.5	11,532	6	69,192
B-707 100	1	135.9	1.4	6	8
B-707 100B	4	116.9	4.7	6	28
Total	73,858	122	79,503		471,780
Pan American					
DC-8 8-30	51,567	110.7	57,076	6	342,456
DC-7B	12	103.0	12.4	4	50
DC-7C	5,392	117.5	6,337	4	25,348
DC-6B	35,288	117.4	41,422	3	124,266
B-707	207,104	108.3	224,278	6	1,345,668
B-720	14,717	109.4	16,106	5	80,530
Total	314,080	112	120,953		1,918,318
Industry total	422,821	115.8	461,551		1,257,759

TABLE D5

Coefficient Determination—Equation 4:
Domestic and International Operations—1964

Airline	Acct, thous of dollars (1)	Attendant block hours, thous (2)	Coefficient $ per block hr Col 1 × Col 2 (3)
Domestic			
AA	11,263	1,216	9.26
EA	10,364	1,098	9.43
TW	10,457	1,082	9.66
UA	14,609	1,821	8.02
DL	5,214	689	7.56
NA	2,626	335	7.83
BN	2,058	323	6.37
CO	2,421	258	9.38
Industry total or average	59,012	6,822	8.65
International			
NW	1,477	165	
TW	5,429	373	
PAA	20,339	1,614	
Industry total or average	27,245	2,152	12.66

TABLE D6

Coefficient Derivation—Denominator—Equation 4:
Domestic Operations—1964

Aircraft	Revenue aircraft hours (1)	Block ratio (2)	Block hours Col 1 × Col 2 (3)	Attendants (4)	Attendant block hours Col 3 × Col 4 (5)
American					
DC-7	4,379	116.0	5,080	2	10,160
DC-6B	13,484	122.3	16,491	2	32,982
DC-6	56,415	120.7	68,093	2	136,186
B-720	63,967	111.1	71,067	4	284,268
B-727	15,455	121.1	18,716	3	56,148
ELECTRA	59,506	118.0	70,217	2	140,434
B-707 100B	74,675	111.4	83,188	4	332,752
CV-240	6,449	125.1	8,068	1	8,068
CV-990	46,788	115.1	53,853	4	215,412
Total	341,118		394,773		1216,410
Braniff					
DC-6	23,594	115.7	27,298	2	54,596
B-720	14,780	114.3	16,894	4	67,576
DC-7C	4,284	115.0	4,927	2	9,854

TABLE D6 (continued)

Aircraft	Revenue aircraft hours (1)	Block ratio (2)	Block hours Col 1 × Col 2 (3)	Attendants (4)	Attendant block hours Col 3 × Col 4 (5)
ELECTRA	22,947	115.4	26,481	2	52,962
VISCOUNT 810	688	117.4	808	2	1,616
B-707 200	5,578	114.1	6,364	4	25,456
B-707 300	1,769	118.8	2,102	4	8,408
CV-340	43,383	116.8	50,671	2	101,342
Total	117,023		135,545		321,810
Continental					
DC-7/7B	509	112.6	573	2	1,146
DC-6B	1,657	113.1	1,874	2	3,748
DC-6	45	106.7	48	2	96
B-720	22,300	108.3	24,151	4	96,604
VISCOUNT 800	32,913	111.4	36,665	2	73,330
DC-3	1,230	125.9	1,549	1	1,549
B-707 100	16,526	109.1	18,030	4	72,120
B-707 300	2,402	105.6	2,537	4	10,148
Total	77,582		85,427		258,741
Delta					
DC-8 -33	1,391	117.4	1,633	4	6,532
DC-8 -50	43,696	114.7	50,119	4	200,476
DC-7	39,866	118.1	47,082	2	94,164
DC-6	26,796	119.4	31,994	2	63,988
CV-880	43,941	116.5	51,191	4	204,764
CV-340	48,459	123.2	59,701	2	119,402
Total	204,149		241,720		689,326
Eastern					
DC 8-20	27,148	114.64	31,122	4	124,488
DC 8-30	856	112.03	959	4	3,836
DC 8-50	52	120.77	63	4	252
DC-7/7B	27,232	119.20	32,461	2	64,922
DC-71	52,761	117.84	62,174	2	124,348
B-720	47,284	115.05	54,400	4	217,600
B-727	33,375	114.74	38,294	3	114,882
ELECTRA	98,214	117.82	115,716	2	231,432
L-1049	14,065	123.50	17,370	2	34,740
L-1049C	14,107	122.27	17,249	2	34,498
L-1049G	13,487	122.49	16,520	2	33,040
B-707-200	1,735	111.35	1,932	4	7,728
CV-440	43,566	120.81	52,632	2	105,264
C-340	767	116.78	849	2	1,698
Total	374,609		441,741		1,098,728

TABLE D6 (continued)

Aircraft	Revenue aircraft hours (1)	Block ratio (2)	Block hours Col 1 × Col 2 (3)	Attendants (4)	Attendant block hours Col 3 × Col 4 (5)
National					
DC-8-20	26,166	111.4	29,149	4	116,596
DC-8-50	21,682	111.3	24,132	4	96,528
DC-7	5,499	114.7	6,307	2	12,614
B-727	557	112.5	627	3	1,881
ELECTRA	45,754	118.4	54,173	2	108,346
Total	99,658		114,388		335,965
Northwest					
DC-8-30	4	121.0	5	4	20
DC-6B	11,010	128.0	14,093	2	28,186
B-727	120	128.0	154	3	462
DC-7C	11,914	121.0	14,420	2	28,840
ELECTRA	42,487	121.0	51,409	2	102,818
B-707-300	7,768	116.0	9,011	4	36,044
Total	73,303		76,114		196,370
Trans World					
L-1649A	1,892	111.6	2,111	3	6,333
B-727	12,702	115.5	14,671	3	44,013
CV-880	69,872	119.6	83,567	4	334,268
L-1049G	26,770	115.3	30,866	2	61,732
L-749	42,815	118.4	50,693	2	101,386
B-707-300	7,933	112.4	8,917	4	35,668
B-707-300	1,057	116.2	1,228	4	4,912
B-707-300	641	112.1	719	4	2,876
B-707-100	45,106	115.1	51,917	4	207,668
B-707-100B	65,031	109.1	70,949	4	283,796
Total	273,819		315,638		1082,652
United					
DC-8-50	29,080	109.2	31,755	4	127,020
DC-8-20	49,196	109.5	53,870	4	215,480
DC-8-10	36,953	112.2	41,461	4	165,844
DC-7	314	116.2	365	2	730
DC-6B	84,302	119.6	100,825	2	201,650
DC-6	62,763	119.5	75,002	2	150,004
B-720	94,467	112.5	106,275	4	425,100
B-727	29,267	115.8	33,891	3	135,564
SE-210	41,502	117.8	48,889	2	97,778
VISCOUNT 700	95,027	118.3	112,417	2	224,834
CV-340	30,639	125.9	38,575	2	77,150
Total	553,510		643,325		1821,154
Industry total	2114,771		2448,671		6995,200

TABLE D7

Coefficient Derivation—Denominator—Equation 4: International Operations–1964

Aircraft	Revenue aircraft hours (1)	Block ratio (2)	Block hours Col 1 × Col 2 (3)	Attendants (4)	Attendant block hours Col 3 × Col 4 (5)
Northwest					
DC-8-30	1,612	105.0	1,693	6	10,158
B-707 300B	18,270	105.0	19,184	6	115,104
B-720B	7,608	107.0	8,141	5	40,705
Total	27,490		29,018		165,967
Trans World					
B-707 300	34,634	107.7	37,301	6	223,806
300B	16,866	106.9	18,030	6	108,180
300B	5,735	106.8	6,125	6	36,750
100	11	108.5	12	6	72
100B	10	110.2	11	6	66
L-749	722	130.3	941	2	1,882
L-1049G	433	131.4	569	4	2,276
CV-880	4	118.3	5	5	25
Total	58,706		62,994		373,057
Pan American					
DC-6	34,004	123.5	42,008	3	126,024
DC-7B	3,750	107.5	4,033	4	16,132
DC-7C	7,407	117.4	8,698	4	34,792
DC-8-30	57,613	109.3	62,987	6	377,922
B-707	153,616	107.6	165,285	6	991,710
B-720	12,412	108.8	13,507	5	67,535
Total	268,802		296,518		1614,115
Industry total	354,998		388,530		2153,139

TABLE D8

Number of Seats/Attendant Computation

Aircraft type	Seats[a]	Attendants	Average number seats/attendant
	Domestic		
707	112	4	28
707	126	4	31
720	111	4	28
720	109	4	27
720	106	4	26
727	93	4	23
727	112	3	37
727	94	3	31
DC8	122	5	24
DC8	135	5	27
990	106	4	26
111	69	2	35
CARA	64	2	32
DC6	56	2	28
Total			403[b]
	International		
707	133	6	22
707	141	6	23
707	125	5	25
DC8	127	6	21
720	125	5	25
727	98	4	25
Total			141[c]

[a]Varying number of seats in same type of aircraft reflects individual airline configuration.

[b]Average number seats = $\frac{403}{14}$ = 28.78; use 29.

[c]Average number seats = $\frac{141}{6}$ = 23.5; use 23.

TABLE D9

Coefficient Determination—Equation 5:
Domestic—1963–1965

Airline	RPM 1st class, thous (1)	2.06 × Col 1, thous (2)	RPM coach, thous (3)	Weighted RPMs, thous Col 2 + Col 3 (4)	5551 Food $, thous (5)	Coefficient $ per RPM Col 5 ÷ Col 4 (6)
			1963			
AA	2,517,076	5,185,176	5,114,831	10,300,007	15,168	.00147
EA	1,442,108	2,970,742	3,284,474	6,255,216	8,420	.00134
TW	1,510,201	3,111,014	3,790,801	6,901,815	8,850	.00128
UA	3,147,253	6,483,341	5,253,692	11,737,033	19,705	.00168
Subtotal	8,616,638	17,750,273	17,443,798	35,194,071	52,143	.00148
DL	1,064,723	2,193,329	1,978,830	4,172,159	5,805	.00139
NA	334,848	689,786	1,388,319	2,078,105	3,101	.00149
NW	492,208	1,013,948	1,133,594	2,147,542	3,724	.00173
Subtotal	1,891,779	3,897,063	4,500,743	8,397,806	12,630	.00150
BN	511,641	1,053,980	685,737	1,739,717	2,721	.00156
CO	300,332	618,683	896,628	1,515,311	2,630	.00173
Subtotal	811,973	1,672,663	1,582,365	3,255,028	5,351	.00164
Total	11,320,390	23,319,999	23,526,906	46,846,905	70,124	.00149
			1964			
AA	2,815,416	5,799,756	5,127,865	10,927,621	19,203	.00175
EA	1,463,103	3,013,992	4,016,705	7,030,697	11,700	.00166
TW	1,791,478	3,690,444	4,739,077	8,429,521	12,484	.00148
UA	2,514,459	5,179,785	6,453,966	11,633,751	22,726	.00195
Subtotal	8,534,456	17,683,977	20,337,613	38,021,590	66,113	.00173
DL	1,055,521	2,174,373	2,463,756	4,638,129	6,645	.00143
NA	346,698	714,197	1,718,493	2,432,690	3,989	.00164
NW	497,573	1,025,000	1,545,911	2,570,911	4,719	.00183
Subtotal	1,899,792	3,913,570	5,728,160	9,641,730	15,353	.00159
BN	534,977	1,102,052	804,423	1,906,475	3,168	.00166
CO	280,188	577,187	1,065,341	1,642,528	3,080	.00187
Subtotal	815,165	1,679,239	1,869,764	3,549,003	6,248	.00176
Total	11,299,413	23,276,786	27,935,537	51,212,323	87,714	.00171
			1965			
AA	2,974,442	6,127,350	6,070,515	12,197,865	24,093	.00197
EA	1,448,315	2,983,528	5,120,553	8,104,081	15,516	.00191
TW	1,848,732	3,808,387	5,742,451	9,550,838	16,559	.00173
UA	2,971,705	6,121,712	7,913,152	14,034,864	28,136	.00200
Subtotal	9,243,194	19,040,977	24,846,671	43,887,648	84,304	.00192
DL	2,204,879	4,542,050	3,152,748	7,694,798	8,634	.00112
NA	414,047	852,936	2,249,099	3,102,035	5,229	.00168
NW	541,077	1,114,618	1,974,717	3,089,335	6,233	.00201
Subtotal	3,160,003	6,509,604	7,376,564	13,886,168	20,096	.00144
BN	550,034	1,133,070	1,030,956	2,164,026	3,685	.00170
CO	288,182	593,654	1,098,265	1,691,919	3,787	.00223
Subtotal	838,216	1,726,724	2,129,221	3,855,945	7,472	.00193
Total	13,241,413	27,277,305	34,352,456	61,629,761	111,872	.00181

TABLE D10

Coefficient Determination—Equation 5: International—1963–1965

Airline	RPM 1st class, thous (1)	3.44 × Col 1 thous (2)	RPM coach, thous (3)	Weighted RPMs, thous Col 2 + Col 3 (4)	5551 Food $, thous (5)	Coefficient $ per RPM Col 5 ÷ Col 4 (6)
			1963			
NW [a]						
PAA	732,325	2,519,198	6,232,855	8,752,053	11,152	.00127
TW	133,849	460,440	1,430,193	1,890,633	2,533	.00134
Total	866,174	2,979,638	7,663,048	10,642,686	13,685	.00128
			1964			
NW	59,465	204,559	565,864	770,423	1,038	.00135
PAA	783,430	2,694,999	7,412,363	10,107,362	12,110	.00120
TW	186,511	641,597	1,869,844	2,511,441	2,714	.00108
Total	1,029,406	3,541,156	9,848,071	13,389,226	15,862	.00118
			1965			
NW	74,710	257,002	713,337	970,339	1,520	.00156
PAA	883,739	3,040,062	7,984,822	11,024,884	14,266	.00129
TW	248,434	854,612	2,385,099	3,239,711	3,503	.00108
Total	1,206,883	4,151,677	11,083,258	15,234,935	19,289	.00126

[a]Data not available.

TABLE D11

Coefficient Determination—Equation 7:
Domestic and International–1964

Airline	6226.4 + 6300 Alloc., thous of dollars (1)	Tons M + Exp + Ft (2)	Pax. Enplaned, thous (3)	Pax. Bag, tons, (4)	Total tons Col 2 + Col 4 (5)	Coefficient Col 1 ÷ Col 5 (6)
			Domestic			
AA	26,419	218,083	9,985	149,788 [a]	367,871	71.81
EA	11,793	98,775	12,225	183,387 [a]	282,162	41.80
TW	14,627	93,780	7,411	111,172 [a]	204,952	71.37
VA	27,300	235,512	14,109	211,645 [a]	447,157	61.05
DL	8,087	72,377	6,043	90,650 [a]	163,027	49.61
NA	2,928	33,100	2,748	41,231 [a]	74,331	39.39
BN	3,215	42,338	3,343	50,158 [a]	92,496	34.76
CO	4,404	21,948	1,894	28,420 [a]	50,368	87.44
Industry total or average [b]	98,776	815,913	57,763	866,455 [a]	1,682,368	58.71
			International			
TW	3,007	13,288	782	15,645 [c]	28,933	10,395
PAA	17,201	148,186	5,325	106,509 [c]	254,695	6,754
Industry total or average [a]	20,209	161,174	6,108		283,628	71.25

[a] Col 3 × 30 lb ÷ 2000.
[b] Statistics on Northwest are not included in these computations, as the dollars reported were obviously in error.
[c] Col 3 × 40 lb ÷ 2000.

TABLE D12

Tons of Mail, Express, Freight, and Baggage per Departure:
Domestic Operations–1964

Airline	Revenue aircraft departures	Tons per departure mail, express freight, baggage	Tons per departure mail, express freight
AA	254,213	1.44	.857
EA	403,650	.70	.247
TW	184,048	1.11	.509
VA	497,826	.89	.473
DL	215,428	.75	.336
NA	100,742	.73	.328
NW	114,184	.93	.486
BN	124,144	.74	.341
CO	65,481	.77	.335
Industry total or average	1,956,716	.914	.445

TABLE D13

Predictive Equation Results[a,b]

a. RAC, LAC66 (adjusted), and FAA66

Equation	1962, thous of dollars	1963, thous of dollars	1964, thous of dollars	1965, thous of dollars
		RAC		
1	54,574	59,500	63,225	66,641
2	151,906	158,880	189,812	199,435
3	29,797	30,435	33,120	33,906
4	52,003	59,101	62,904	70,444
5	80,036	88,416	97,822	113,237
6	194,180	221,913	250,067	292,630
7	43,900	50,170	56,549	66,158
8	144,202	160,496	183,623	217,416
9	5,018	5,413	6,740	8,574
10	80,754	86,667	95,949	109,808
Total	836,370	920,991	1,039,811	1,178,249
		LAC[c]		
1	28,338	30,896	32,830	34,604
2	174,454	182,463	217,986	229,038
3	31,589	32,266	35,111	35,946
4	61,181	69,530	74,005	82,875
5	102,603	112,932	124,579	131,686
6	199,402	227,881	256,793	300,500
7	20,921	23,916	26,965	31,529
8	132,493	147,464	168,714	199,763
9	4,596	4,957	6,172	7,852
10	75,264	80,506	90,233	104,694
Total	1,033,991	1,132,137	1,273,170	1,411,022
		FAA		
1	28,338	30,896	32,830	34,604
2	174,454	182,463	217,986	229,038
3	31,127	31,794	34,598	35,420
4	57,782	65,668	69,894	78,271
5	69,019	76,506	81,406	89,453
6	189,907	217,030	244,565	286,190
7	37,625	42,999	48,496	56,702
8	129,412	144,035	164,790	195,117
9	3,539	3,817	4,753	6,047
10	80,754	86,667	95,949	109,808
Total	801,957	881,875	995,267	1,120,650

b. Industry Actuals

Account	1962, thous of dollars	1963, thous of dollars	1964, thous of dollars	1965, thous of dollars
5200	13,958	14,885	17,207	19,671
5300	13,644	13,941	15,572	17,644
5500	155,766	172,508	204,079	254,940
6100	175,508	192,193	203,302	226,545
6200	128,497	140,059	157,602	192,836
6300	39,246	41,285	42,270	39,942
6500	173,735	183,837	210,681	237,690
6600	52,255	61,385	71,375	91,835
6800	83,902	87,564	95,011	110,330
7000	27,305	19,396	27,405	29,307
Total	863,816	927,053	1,044,504	1,220,740

[a]Based on nine domestic airlines.

[b]See Fig. 7 for plot of these numbers.

[c]Dollars associated with burden; flight equipment has not been included.

TABLE D14

Miscellaneous Data Used in Computing Coefficients

Revenue Ton Miles—Freight and Express Only (9 Airlines Total)

Year	RTM
1962	528,308,281
1963	569,831,020
1964	709,482,246
1965	902,542,307

Revenue Ton Miles—Mail, Express, Freight, Excess Baggage (9 Airlines Total)

Year	RTM
1964	906,857,344
1965	1,129,943,182

Available Seat Miles (9 Domestic Airlines Total)

Year	ASM
1962	56,438,023,000
1963	63,920,248,000
1964	71,383,325,000
1965	84,568,969,000

Revenue Passenger Miles (9 Domestic Airlines Total)

Year	RPM
1962	30,812,399,000
1963	34,294,095,000
1964	39,235,870,000
1965	46,456,533,000

Revenue Aircraft Miles (9 Domestic Airlines Total)

Year	RAM
1962	691,439,554
1963	713,204,168
1964	768,652,582
1965	886,069,216

TABLE D14 (continued)

Revenue Passenger Miles (Coach-9 Domestic Airlines Total)

Year	RPM-Coach
1962	20,348,586,000
1963	22,975,741,000
1964	27,933,531,000
1965	34,352,489,000

Revenue Passenger Miles (1st Class-9 Domestic Airlines Total)

Year	RPM-1st class
1962	10,463,813,000
1963	11,318,354,000
1964	11,302,339,000
1965	12,104,044,000

Revenue Passengers Enplaned (9 Domestic Airlines Total)

Year	Pax. enplaned
1962	47,476,841
1963	54,257,519
1964	61,141,283
1965	71,547,678

Tons of Baggage Enplaned

Year	30 lb/bag (RAC)	40 lb/bag (FAA66)
1962	71,215	94,953
1963	81,386	108,515
1964	91,711	122,282
1965	107,321	143,095

Tons of Mail, Express and Freight Enplaned for RAC Method

Year	Cargo, tons
1962	676,542 (Estimated)[a]
1963	773,167 (Estimated)[a]
1964	871,491 Statistical
1965	1,019,549 (Estimated)[a]

Tons of Mail, Express and Freight Enplaned for FAA66 Method

Year	Cargo, tons
1962	676,065 (Estimated)[b]
1963	772,626 (Estimated)[b]
1964	871,491 Statistical
1965	1,018,836 (Estimated)[b]

TABLE D14 (continued)

Block Hours-9 Domestic Airlines

Year	Aircraft hours	Block to airborne-ratio %	Aircraft block hours
1962	2,099,983	115.2	2,419,180
1963	2,159,081	115.8	2,500,215
1964	2,220,948	115.7	2,569,636
1965	2,410,775	116.1	2,798,909

Aircraft Departures-9 Domestic Airlines

Year	Departures
1962	1,847,352
1963	1,886,901
1964	2,053,333
1965	2,102,106

Aircraft Departures x Max. Takeoff Gross Weight

Year	Depart MTOGW	Avg. MTOGW
1962	237,353,327,000	128,483 (Estimated)
1963	248,250,080,000	131,565 Statistical
1964	296,581,353,000	144,439 Statistical
1965	311,618,295,000	148,241 (Estimated)

[a]This estimate based on the ratio established using 1964 actual number reported by 9 domestic airlines for tons of mail, express, and freight enplaned:

$$\text{Ratio} = \frac{\text{Tons of mail, express, freight enplaned}}{\text{Tons of passenger baggage (30 lb/bag)}} = \frac{871,491}{97,711} = 9.5$$

[b]Estimate based on ratio established as above but using 40 lb/bag: Ratio = 7.12.

The statistics below were compiled in an approach attempting to correlate aircraft servicing costs with the various types of aircraft having different seating capacities. These data show pounds of MTOGW per seat. These data were not used in establishing the coefficient but are included here as a matter of possible interest to the reader.

TABLE D15

Pounds of Maximum Take-off Gross Weight per Available Seat

Aircraft	Maximum take-off gross weight	Seats	Pounds of MTOGW per available seat
DC8-50	315,000	125	2,520
8-61	325,000	251	1,300
8-62	335,000	189	1,775
8-63	350,000	251	1,400
DC9-10	78,500	83	945
9-20	85,000	97	875
B707-320	331,600	140	2,360
720	234,000	120	1,950
727-30	152,000	95	1,600
727-200	169,000	102	1,670
737-100	97,000	99	980
737-200	97,000	115	845
747	680,000	392	1,730
CV-880	191,000	106	1,800
CV-990	239,000	106	2,250
BAC-111	78,500	69	1,140
LAC Elec	113,000	84	1,340
Caravelle	95,900	64	1,500

TABLE D16

American Airlines, Inc.—Domestic, 1961:
Station Aircraft Departures and Passengers Enplaned per Year[a]

Station	Avg. no. of employees	Aircraft departure ranges				
		0–1,100	1,101–3,000	3,001–6,000	6,001–10,000	10,001–20,000
Akron	9		1,886 13,490			
Albany	77			4,535 68,282		
Baltimore	88		2,167 72,745			
Boston	827					10,168 373,839
Buffalo	481					11,089 280,529

TABLE D16 (continued)

Station	Avg. no. of employees	Aircraft departure ranges				
		0–1,100	1,101–3,000	3,001–6,000	6,001–10,000	10,001–20,000
Charleston, W. Va.	23		1,308 12,047			
Chicago Midway	1553				6,215 155,525	
Chicago O'Hare	745					17,969 763,433
Cincinnati	285					12,032 236,759
Cleveland	220				7,910 169,445	
Columbus	52			5,299 56,321		
Dallas	671					13,889 410,060
Dayton	41			3,709 35,505		
Detroit	—					11,764 422,486
Douglas	—	705 2,456				
Elkins	1	69 228				
El Paso	124			4,718 88,981		
Ft Worth-Dallas	1178			3,573 35,323		
Hartford	102			4,296 64,592		
Houston	16	693 14,075				
Indianapolis	55			3,264 53,918		
Johnstown	—		2,450 53,682			
Joplin	1	692 3,561				
Knoxville	35		1,512 25,894			
Little Rock	36		1,893 32,136			
Los Angeles	2464					10,985 599,504

TABLE D16 (continued)

Station	Avg. no. of employees	Aircraft departure ranges				
		0–1,100	1,101–3,000	3,001–6,000	6,001–10,000	10,001–20,000
Louisville	51			3,944 65,970		
Memphis	132		2,468 62,049			
Midland	4	699 3,954				
Milwaukee	6	335 7,333				
Nashville	292				7,130 120,585	
New York La Guardia	2884					19,157 623,308
New York Kennedy	1405					15,084 830,271
Newark	—			4,117 105,630		
Oakland	13	916 6,016				
Oklahoma City	68			4,116 63,701		
Parkersburg, W. Va.	—	85 458				
Peoria	6	675 3,532				
Philadelphia	117		2,425 52,042			
Phoenix	153			5,763 165,088		
Pittsburgh	15	676 11,874				
Providence	62		2,722 70,643			
Roanoke	4	316 7,005				
Rochester	105				8,451 135,646	
San Antonio	68	751 11,047				
San Diego	129			3,693 85,482		
San Francisco	668			4,581 215,197		

TABLE D16 (continued)

Station	Avg. no. of employees	Aircraft departure ranges				
		0–1,100	1,101–3,000	3,001–6,000	6,001–10,000	10,001–20,000
Springfield, Ill.	2		1,231 5,609			
Springfield, Mass.	0	691 6,054				
St Louis	235				7,960 196,944	
Syracuse	148				7,832 149,935	
Tucson	117			5,004 87,820		
Tulsa	3033			4,865 81,174		
Washington, D. C. National	581					11,737 283,343
Wilkes-Barre	1	503 3,069				
Toronto	56		1,274 53,806			

[a]The top number of each pair of numbers in a column is aircraft departures, and the bottom number is passengers enplaned.

TABLE D17

Continental Airlines—Domestic, 1961:
Station Aircraft Departures and Passengers Enplaned per Year[a]

Station	Avg. no. of employees	Aircraft departure ranges				
		0–1,100	1,101–3,000	3,001–6,000	6,001–10,000	10,001–20,000
Abilene	7		2,122 15,670			
Alamogordo	2	809 2,184				
Albuquerque	45			3,575 68,716		
Amarillo	5		1,622 23,482			
Austin	12		1,887 24,095			
Bartlesville	1	130 94				

TABLE D17 (continued)

Station	Avg. no. of employees	Aircraft departure ranges				
		0–1,100	1,101-3,000	3,001–6,000	6,001–10,000	10,001-20,000
Big Spring	1	680 718				
Bryan	—		1,370 3,404			
Carlsbad	2		1,126 2,674			
Chicago Midway	11	24 469				
Chicago O'Hare	171		2,333 123,899			
Clovis	1	685 1,492				
Colorado Springs	18			3,180 28,514		
Dallas	84			3,453 115,071		
Denver	135				7,041 217,333	
Dodge City	1	136 99				
El Paso	81			5,875 87,654		
Ft Worth-Dallas	8		2,773 6,891			
Garden City	1	136 104				
Great Bend	—	133 95				
Hobbs	3		1,591 2,547			
Houston	86			3,114 84,174		
Hutchinson	2	272 544				
Kansas City	69		2,818 80,248			
Lawton			1,116 3,518			
Los Angeles	144			3,870 183,026		
Lubbock	21			4,458 33,339		

1,101

TABLE D17 (continued)

Station	Avg. no. of employees	Aircraft departure ranges				
		0– 1,100	1,101– 3,000	3,001– 6,000	6,001– 10,000	10,001– 20,000
Manhattan, Kans.	2	125 142				
Midland	47			5,107 61,301		
Oklahoma City	6		1,288 8,439			
Phoenix	33		1,346 13,535			
Pueblo	0	844 2,253				
Roswell	4		1,715 8,944			
Salina	1	135 364				
San Angelo	3		1,753 5,005			
San Antonio	34		2,301 38,484			
Sante Fe	5		1,740 6,332			
Temple	5		1,715 6,464			
Topeka	1	137 108				
Tucson	15	729 7,787				
Tulsa	22		2,175 25,709			
Waco	3		2,043 5,537			
Wichita	13		1,782 25,108			
Wichita Falls	2		1,129 3,800			

[a]The top number of each pair of numbers in a column is aircraft departures, and the bottom number is passengers enplaned.

TABLE D18

Northwest Orient Airlines—Domestic, 1961: Station Aircraft Departures and Passengers Enplaned per Year[a]

Station	Avg. no. of employees	Aircraft departure ranges				
		0–1,100	1,101–3,000	3,001–6,000	6,001–10,000	10,001–20,000
Atlanta	29		1,218 18,807			
Baltimore	1	469 7,751				
Billings	22		1,476 18,747			
Bismarck	7	1,080 8,940				
Bozeman	3	361 1,361				
Butte	3	531 3,666				
Chicago Midway	168			3,080 63,651		
Chicago O'Hare	77			4,511 161,049		
Cleveland	27		2,127 28,533			
Detroit	128			5,129 118,620		
Fargo	19		1,747 21,423			
Ft Lauderdale			1,587 10,292			
Grand Forks	5	482 19,325				
Great Falls	11		1,136 15,977			
Helena	3	468 2,075				
Jamestown	2	521 884				
Madison	17		2,632 21,656			
Miami	54	860 13,010				
Milwaukee	82			5,056 88,461		
Minneapolis	254				9,553 282,612	
Missoula	6	922 6,783				

TABLE D18 (continued)

Station	Avg. no. of employees	Aircraft departure ranges				
		0– 1,100	1,101– 3,000	3,001– 6,000	6,001– 10,000	10,001– 20,000
Newark		801 31,786				
New York Kennedy	175		2,833 137,591			
Pittsburgh	22		2,067 33,026			
Portland	38		1,849 27,289			
Rochester	18		2,575 28,584			
Seattle	104		3,000 114,085			
Spokane	70			3,855 61,699		
St Petersburg		453 4,910				
Tampa	29		1,120 13,411			
Washington, D.C., National	77		1,837 68,767			
Yakima	7		1,211 4,366			

[a]The top number of each pair of numbers in a column is aircraft departures, and the bottom number is passengers enplaned.

TABLE D19

Trans World Airlines—Domestic, 1961:
Station Aircraft Departures and Passengers Enplaned per Year[a]

Station	Avg. no. of employees	Aircraft departure ranges				
		0– 1,100	1,101– 3,000	3,001– 6,000	6,001– 10,000	10,001– 20,000
Albany	21		1,281 13,977			
Albuquerque	36			3,622 84,882		
Allentown	10		1,192 9,166			
Amarillo	31		1,622 23,482			
Atlanta	28		1,400 30,634			
Baltimore	62		2,132 59,168			

TABLE D19 (continued)

Station	Avg. no. of employees	Aircraft departure ranges				
		0– 1,100	1,101– 3,000	3,001– 6,000	6,001– 10,000	10,001 20,000
Binghamton	22		1,251 12,112			
Boston	157			3,037 100,951		
Chicago Midway	391			5,718 126,284		
Chicago O'Hare	181					10,734 368,789
Cincinnati	116			3,831 74,328		
Cleveland	48		1,361 38,304			
Columbus	166				7,769 149,774	
Dayton	212				9,917 199,060	
Denver	43	936 16,279				
Detroit	91		1,626 54,722			
Ft Wayne	10	810 8,347				
Fresno	10	688 8,530				
Harrisburg	24		1,939 29,591			
Hartford	24		1,428 25,814			
Indianapolis	130			5,514 123,770		
Kansas City	397				9,849 320,105	
Las Vegas	84		2,765 95,701			
Los Angeles	942				10,958 442,628	
Louisville	45		2,854 44,578			
Miami	62	877 31,282				
Nashville	14	875 12,806				
New York La Guardia	621			4,512 153,574		

TABLE D19 (continued)

Station	Avg. no. of employees	Aircraft departure ranges				
		0– 1,100	1,101– 3,000	3,001– 6,000	6,001– 10,000	10,001– 20,000
New York Kennedy	—				8,512 432,904	
Newark	—		2,376 59,984			
Oakland	15	687 4,375				
Oklahoma City	44		1,515 38,466			
Philadelphia	409			4,323 160,984		
Phoenix	126		2,985 98,073			
Pittsburgh	349					13,357 148,164
Reading	5	683 4,606				
San Francisco	374			5,354 261,972		
Scranton	9	1,084 9,547				
South Bend	7	799 8,714				
St Louis	429					13,956 360,274
Tampa	19		1,169 18,284			
Terre Haute	4	711 4,390				
Toledo	1	96 595				
Tucson	24		1,450 15,516			
Tulsa	33		1,322 16,808			
Washington, D. C. National	167			4,616 103,215		
Wheeling	3	213 868				
Wichita	55		2,107 39,335			
Williamsport	4	608 3,661				

[a]The top number of each pair of numbers in a column is aircraft departures, and the bottom number is passengers enplaned.

TABLE D20

United Air Lines—Domestic, 1961:
Station Aircraft Departures and Passengers Enplaned per Year[a]

Station	Avg. no. of employees	Aircraft departure ranges					
		0–1,100	1,101–3,000	3,001–6,000	6,001–10,000	10,001–20,000	20,001 and over
Akron	55			5,378 54,783			
Allentown	18		1,690 19,904				
Atlanta	159			5,459 104,882			
Bakersfield	12		2,779 16,555				
Baltimore	175			5,951 211,909			
Birmingham	50		1,937 20,900				
Boise	39			3,543 58,126			
Boston	223			3,728 106,075			
Buffalo	145			5,097 82,265			
Burbank	2	149 3,577					
Cedar Rapids	29			3,971 11,686			
Charleston, S. C.	33		1,664 20,293				
Charleston, W. Va.	45	286 3,391					
Charlotte, N. C.	7	505 2,969					
Chattanooga	19	950 8,190					
Chicago Midway	969					12,014 197,963	
Chicago O'Hare	1,124						32,015 1,226,576
Cleveland	644						21,972 542,662

TABLE D20 (continued)

Station	Avg. no. of employees	Aircraft departure ranges					
		0– 1,100	1,101– 3,000	3,001– 6,000	6,001– 10,000	10,001– 20,000	20,001 and over
Columbus, Ga.	—	541 10,151					
Columbus, Ohio	24		1,583 27,723				
Davenport	—	1,030 12,966					
Dayton	28		2,118 27,860				
Denver	768					13,272 441,835	
Des Moines	62			4,314 93,920			
Detroit Metro	—		2,140 48,241				
Detroit Mich	464					10,568 198,390	
Elko	3	710 3,554					
Elmira	—	784 2,781					
Ely	3	710 2,615					
Eugene	15		2,115 12,759				
Flint	19		2,123 11,874				
Ft Wayne	27			3,007 41,085			
Fresno	42			4,030 55,712			
Grand Junction	0	712 5,185					
Grand Rapids	45			3,226 42,521			
Greensboro	9	489 2,605					
Harrisburg	4	406 1,899					
Hartford	69			4,413 71,800			

TABLE D20 (continued)

Station	Avg. no. of employees	Aircraft departure ranges					
		0–1,100	1,101–3,000	3,001–6,000	6,001–10,000	10,001–20,000	20,001 and over
Huntsville	25		1,233 16,740				
Jacksonville	12	733 7,153					
Kansas City	39		1,790 42,966				
Knoxville	47		2,467 29,967				
Lansing, Ill.	—	284 2,974					
Lansing, Mich.	22		1,722 14,060				
Las Vegas	44		2,174 77,166				
Lincoln	18		1,960 22,839				
Long Beach	9	679 1,379					
Los Angeles I.	1,312						23,693 977,857
Medford	17		1,768 19,748				
Memphis	26	699 9,825					
Merced	6	983 3,308					
Miami	124		1,297 25,562				
Milwaukee	111			4,582 77,260			
Minneapolis	95		2,711 79,694				
Mobile	21	971 15,017					
Modesto	8		1,332 4,448				
Moline	39			3,293 44,153			
Monterey	16		1,779 21,146				

TABLE D20 (continued)

Station	Avg. no. of employees	Aircraft departure ranges					
		0–1,100	1,101–3,000	3,001–6,000	6,001–10,000	10,001–20,000	20,001 and over
Muskegon	16		1,634 12,775				
New Orleans	39	832 14,448					
New York La Guardia	605			3,083 82,373			
New York Kennedy	90					10,572 503,440	
Newark	452				7,835 196,630		
Newport News	—		1,818 19,008				
Norfolk	90		2,670 56,691				
Oakland	72		2,995 26,870				
Omaha	255				7,608 183,777		
Pendleton	17			3,352 26,032			
Philadelphia	335				9,170 254,501		
Pittsburgh	355					10,753 232,117	
Portland	429					14,443 294,887	
Providence	15	986 6,760					
Raleigh	10	492 2,478					
Reno	65			5,865 103,294			
Richmond	13	944 11,938					
Roanoke	—	168 2,182					
Rochester, Minn.	—	562 6,470					
Rochester, N. Y.	71			3,971 44,102			
Sacramento	84				7,659 147,112		
Saginaw	—						

TABLE D20 (continued)

Station	Avg. no. of employees	Aircraft departure ranges					
		0– 1,100	1,101– 3,000	3,001– 6,000	6,001– 10,000	10,001– 20,000	20,001 and over
Salem, Ore.	11		2,094 5,422				
Salinas	3		2,201 1,261				
Salt Lake City	208			5,386 183,398			
San Diego	140			4,458 166,005			
San Francisco	1,732						24,321 1,016,051
Santa Barbara	13		1,766 17,558				
Seattle	792					10,637 397,872	
South Bend	26		2,952 30,401				
Spokane	32	996 31,466					
Stockton	11		1,745 7,541				
Tampa	33		1,267 13,837				
Toledo	48			5,960 80,199			
Tri-Cities (Tenn.)	5	619 7,117					
Visalia	7		1,345 7,041				
Walla Walla	0	204 449					
Washington, D. C. National	440					14,110 255,841	
West Palm Beach	7	639 4,029					
Williamsport	4	787 2,028					
Youngstown	40			4,724 45,645			
Vancouver	59		1,817 65,205				

[a]The top number of each pair of numbers in a column is aircraft departures, and the bottom number is passengers enplaned.

TABLE D21

Northwest Orient Airlines—International, 1961:
Station Aircraft Departures and Passengers Enplaned per Year[a]

Station	Avg. no. of employees	Aircraft departure ranges				
		0– 1,100	1,101– 3,000	3,001– 6,000	6,001– 10,000	10,001– 20,000
Fargo	2	95 947				
Grand Forks	2	280 7,580				
Minneapolis	19	279 10,978				
New York Kennedy	15	49 1,898				
Portland	6	92 909				
Seattle	48	760 42,713				
Anchorage	73		1,127 25,243			
Edmonton	6	294 4,038				
Shemya Aleuti	13	— 8				
Winnipeg	10	919 16,767				
Honolulu	8	60 1,972				
Manila	25	151 6,284				
Naha Okinawa	21	500 8,389				
Seoul	25	246 9,888				
Taipeh	17	118 4,888				
Tokyo	175	880 31,795				

[a]The top number of each pair of numbers in a column is aircraft departures, and the bottom number is passengers enplaned.

TABLE D22

Pan American Airways—International, 1961: Station Aircraft Departures and Passengers Enplaned per Year[a]

Station	Avg. no. of employees	Aircraft departure ranges				
		0–1,100	1,101–3,000	3,001–6,000	6,001–10,000	10,001–20,000
Baltimore	18	564 13,770				
Boston	56		1,422 22,821			
Brownsville	8	162 621				
Chicago O'Hare	21	316 7,140				
Detroit	13	541 5,047				
Houston	33	475 18,151				
Los Angeles	210		1,687 85,661			
Miami	371			4,279 180,783		
New Orleans	22	363 7,765				
New York Kennedy	684				6,142 433,006	
Philadelphia	16	526 9,270				
Portland	11	634 9,718				
San Francisco	741		1,723 79,787			
Seattle	132		1,129 48,127			
Tampa	3	20 220				
Anchorage	3	58 —				
Annette Is.	17	766 9,890				
Eagle, Alaska	38	164 5,403				
Fairbanks	—	189 7,814				

[a]The top number of each pair of numbers in a column is aircraft departures, and the bottom number is passengers enplaned.

TABLE D22 (continued)

Station	Avg. no. of employees	Aircraft departure ranges				
		0– 1,100	1,101– 3,000	3,001– 6,000	6,001– 10,000	10,001– 20,000
Frobisher Bay	2	48 —				
Gander	3	278 112				
Goose Bay	—	3 —				
Juneau	17	468 10,490				
Montreal	2	22 —				
Winnipeg	3	62 —				
Barbados	2	447 2,761				
Bermuda	34	666 53,625				
Camaguey, Cuba	1	33 983				
Ciudad	26	737 11,302				
Curacao	12	566 5,106				
Ft-de-France	1	329 2,787				
Georgetown	—	106 1,122				
Guatemala City	132		1,620 23,980			
Panama City	113	939 38,191				
Havana	73	408 50,193				
Kingston	67	1,021 11,179				
Managua	—	386 5,827				
Merida, Mex.	—	468 6,661				
Mexico City	—	843 36,202				

TABLE D22 (continued)

Station	Avg. no. of employees	Aircraft departure ranges				
		0– 1,100	1,101– 3,000	3,001– 6,000	6,001– 10,000	10,001– 20,000
Montego Bay	30	843 11,348				
Nassau	34		1,304 66,863			
Pointe à Pitre	1	326 2,625				
Port au Prince	60		1,159 15,369			
Port of Spain	74	770 11,467				
St Croix	1	322 3,455				
San Jose	10	755 14,268				
San Juan	299			3,117 248,383		
San Salvador	32	943 12,663				
Tegucigalpa	28	619 5,757				
Asuncion	1	95 1,059				
Barranquilla	15	519 7,738				
Belem	2	56 885				
Brasilia	3	160 972				
Buenos Aires	—	202 9,432				
Caracas	177		1,630 36,605			
Cayenne	5	102 674				
Georgetown	8	117 913				
Maracaibo	31	473 3,767				
Montevideo	46	90 1,190				

TABLE D22 (continued)

Station	Avg. no. of employees	Aircraft departure ranges				
		0–1,100	1,101–3,000	3,001–6,000	6,001–10,000	10,001–20,000
Paramaribo	17	165 2,123				
Rio de Janeiro	51	508 8,630				
Santo Domingo	6	214 4,601				
Sao Paulo	31	304 2,983				
Amsterdam	27	418 1,565				
Berlin	255					10,807 513,058
Brussels	32	418 2,074				
Cologne	9	662 17,604				
Copenhagen	17	146 2,107				
Düsseldorf	54	1,038 15,450				
Frankfurt	348			5,168 159,572		
Glasgow	19	31 132				
Hamburg	55			3,118 106,253		
Hanover	—		1,325 68,533			
Helsinki	10	88 1,285				
Keflavik	6	138 520				
Largs	27		1,169 50,898			
London	367			3,450 104,355		
Munich	34		1,268 31,292			

TABLE D22 (continued)

Station	Avg. no. of employees	Aircraft departure ranges				
		0– 1,100	1,101– 3,000	3,001– 6,000	6,001– 10,000	10,001– 20,000
Nuremberg	10	355 13,317				
Oslo	11	181 1,454				
Prestwick	—	308 1,321				
Shannon	23	973 8,467				
Stockholm	16	180 1,053				
Stuttgart	34		1,259 24,149			
Barcelona	18	294 8,6[illegible]3				
Lisbon	61	404 14,638				
Nice	12	296 5,542				
Paris	182		1,567 41,122			
Rome	115		1,323 32,904			
Santa Maria	34	257 2,164				
Vienna	28	331 5,308				
Accra Gold Coast	17	170 3,292				
Ankara	62	557 5,652				
Baghdad	21	130 1,605				
Beirut	88	939 14,175				
Dakar Senegal	34	219 1,849				
Ist[illegible]ul Yesi	49	499 6,115				

TABLE D22 (continued)

Station	Avg. no. of employees	Aircraft departure ranges				
		0–1,100	1,101–3,000	3,001–6,000	6,001–10,000	10,001–20,000
Istanbul Turk	—	539 9,335				
Johannesburg	26	51 1,901				
Lagos	12	37 155				
Leopoldville	14	103 2,188				
Robertsfield	—	215 3,961				
Teheran	54	458 9,949				
Bangkok	106	613 17,646				
Calcutta	22	396 13,485				
Canton Is.	2	76 2,685				
Guam Is.	54	259 4,584				
Hong Kong	118	700 26,573				
Honolulu	568		3,187 138,952			
Manila	73	206 11,783				
New Delhi	19	199 5,048				
Rangeon	1	202 2,771				
Saigon	3	241 6,180				
Singapore	37	154 6,271				
Suva Fiji	34	462 3,286				
Tandjungpinan	1	101 3,284				
Tokyo	280		1,896 62,704			

TABLE D22 (continued)

Station	Avg. no. of employees	Aircraft departure ranges 0–1,100	1,101–3,000	3,001–6,000	6,001–10,000	10,001–20,000
Wake Is.	67	682 442				
Auckland	18	103 3,102				
Sydney	49	154 4,422				
Karachi	51	410 4,837				

[a]The top number of each pair of numbers in a column is aircraft departures, and the bottom number is passengers enplaned.

TABLE D23

Trans World Airlines—International, 1961:
Station Aircraft Departures and Passengers Enplaned per Year[a]

Station	Avg. no. of employees	Aircraft departure ranges 0–1,100	1,101–3,000	3,001–6,000	6,001–10,000	10,001–20,000
Boston	—	189 1,700				
Los Angeles	—	102 1,752				
New York Kennedy	—		1,947 78,033			
San Francisco	—	50 1,564				
Washington, D. C. Dulles	—	240 5,046				
Frankfurt	98	506 21,113				
London	166	966 25,575				
Shannon	51	144 3,168				
Athens	70	729 15,384				
Geneva	63	321 1,540				
Lisbon	71		1,282 33,706			

TABLE D23 (continued)

Station	Avg. no. of employees	Aircraft departure ranges				
		0– 1,100	1,101– 3,000	3,001– 6,000	6,001– 10,000	10,001– 20,000
Madrid	88	528 27,165				
Milan	76	382 3,742				
Paris	204		1,498 29,173			
Rome	232		1,517 40,105			
Santa Maria	3	172 1,616				
Zurich	41	241 1,508				
Algiers	6	77 760				
Cairo	128	282 5,029				
Dhahran	26	176 2,107				
Tel Aviv	32	134 2,714				
Tunis	10	72 623				
Bangkok	16	29 678				
Bombay	61	119 2,720				
Colombo	4	58 825				

[a]The top number of each pair of numbers in a column is aircraft departures, and the bottom number is passengers enplaned.

TABLE D24

American Airlines, Inc.—Domestic, 1963:
Station Aircraft Departures and Passengers Enplaned per Year[a]

Station	Avg. no. of employees	Aircraft departure ranges					
		0–1,100	1,101–3,000	3,001–6,000	6,001–10,000	10,001–20,000	20,001 and over
Akron	1.2	265 1,008					
Albany	65		2,791 61,159				
Baltimore	64		2,092 42,465				
Boston	759				7,983 309,890		
Buffalo	488					10,257 301,815	
Charleston, W. Va.	18		1,248 14,963				
Chicago O'Hare	1915						28,758 1,191,501
Cincinnati	302					11,226 248,974	
Cleveland	247				7,733 207,560		
Columbus	40			4,828 60,121			
Dallas	1415					13,975 551,074	
Dayton	39			3,982 40,573			
Detroit	577					12,029 536,107	
Douglas	4	715 2,424					
El Paso	88			3,766 92,980			
Ft Worth-Dallas	96		1,630 15,998				
Hartford	91		2,038 39,224				
Houston	11	654 12,289					

TABLE D24 (continued)

Station	Avg. no. of employees	Aircraft departure ranges					
		0–1,100	1,101–3,000	3,001–6,000	6,001–10,000	10,001–20,000	20,001 and over
Indianapolis	38			3,039 60,434			
Joplin	—	458 1,729					
Knoxville	28		1,416 26,433				
Little Rock	34		1,790 44,104				
Los Angeles	2462					12,507 637,428	
Louisville	47			4,403 100,073			
Memphis	152			5,411 158,779			
Midland	—	588 3,626					
Milwaukee	3	232 3,143					
Nashville	310				7,186 140,055		
New York Kennedy	1686					19,906 1,036,832	
New York La Guardia	2728					10,606 375,953	
Newark	227			4,196 189,623			
Oakland	10	704 4,739					
Oklahoma City	47			4,227 86,131			
Philadelphia	[illegible]		2,455 60,940				
Phoenix	162			5,529 183,995			
Pittsburgh	—	598 8,622					
Providence	57		2,549 75,479				

TABLE D24 (continued)

Station	Avg. no. of employees	Aircraft departure ranges					
		0–1,100	1,101–3,000	3,001–6,000	6,001–10,000	10,001–20,000	20,001 and over
Rochester	89				8,224 160,202		
San Antonio	59	706 7,442					
San Diego	78			3,028 95,766			
San Francisco	634			4,870 174,035			
Springfield, Mass.	—	460 2,796					
St Louis	214				7,488 238,168		
Syracuse	123				6,765 151,160		
Tucson	79			3,939 87,360			
Tulsa	4244			4,745 96,273			
Washington, D. C. Dulles	46	1,064 68,571					
Washington, D. C. National	483				9,235 282,306		
Wilkes-Barre	—	462 2,562					
Toronto	49	1,090 44,352					

[a]The top number of each pair of numbers in a column is aircraft departures, and the bottom number is passengers enplaned.

TABLE D25

Continental Airlines—Domestic, 1963:
Station Aircraft Departures and Passengers Enplaned per Year[a]

Station	Avg. no. of employees	Aircraft departure ranges				
		0–1,100	1,101–3,000	3,001–6,000	6,001–10,000	10,001–20,000
Abilene	6		1,677 13,194			
Alamagordo	2	370 1,054				
Albuquerque	44			4,501 76,178		
Amarillo	4	1,066 11,948				
Austin	11		1,856 24,643			
Bryan	2	1,073 2,781				
Carlsbad	1	580 1,365				
Clovis	1	581 1,529				
Colorado Springs	17			[illegible],801 34,477		
Dallas	66			4,595 116,577		
Denver	136				7,786 259,033	
El Paso	93			5,962 91,070		
Ft Worth-Dallas	6		1,668 3,415			
Hobbs	2		1,187 1,542			
Houston	90			3,099 112,314		
Kansas City	85		1,277 51,892			
Lawton	1	682 2,114				
Los Angeles	184			5,259 281,796		
Lubbock	17			3,954 38,337		

TABLE D25 (continued)

Station	Avg. no. of employees	Aircraft departure ranges				
		0–1,100	1,101–3,000	3,001–6,000	6,001–10,000	10,001–20,000
Midland	49			5,502 71,793		
Chicago O'Hare	168			3,579 189,367		
Oklahoma City	2	692 5,267				
Phoenix	23		2,179 35,826			
Pueblo	—	352 973				
Roswell	3		1,480 5,227			
San Angelo	3		1,871 6,284			
San Antonio	38		2,340 60,228			
Santa Fe	4		1,106 3,413			
Temple	4		1,358 5,775			
Tucson	17		1,454 22,853			
Tulsa	22	836 11,973				
Waco	[illegible]		1,628 4,859			
Wichita	13		2,031 29,519			
Wichita Falls	2	694 3,257				

[a]The top number of each pair of numbers in a column is aircraft departures, and the bottom number is passengers enplaned.

TABLE D26

Northwest Orient Airlines—Domestic, 1963:
Station Aircraft Departures and Passengers Enplaned per Year[a]

Station	Avg. no. of employees	Aircraft departure ranges				
		0– 1,100	1,101– 3,000	3,001– 6,000	6,001– 10,000	10,001– 20,000
Atlanta	40		2,227 59,297			
Baltimore	—	14 246				
Billings	24		2,380 29,785			
Bismarck	6		1,392 15,308			
Bozeman	3	689 2,758				
Butte	3	674 4,624				
Chicago O'Hare	23					10,443 404,762
Cleveland	32			3,702 71,307		
Detroit	141				8,501 225,793	
Fargo	23		3,000 32,944			
Ft Lauderdale	5	950 10,917				
Grand Forks	7		1,651 10,991			
Great Falls	12		1,569 25,423			
Jamestown	2	639 1,567				
Madison	17			3,037 39,772		
Miami	96		1,865 59,489			
Milwaukee	73				8,090 152,397	
Minneapolis	339					19,968 330,219
Missoula	8		1,307 11,572			

TABLE D26 (continued)

Station	Avg. no. of employees	Aircraft departure ranges				
		0–1,100	1,101–3,000	3,001–6,000	6,001–10,000	10,001–20,000
Newark	25		1,180 41,580			
New York Kennedy	178			3,520 178,488		
Pittsburgh	36			3,657 82,953		
Portland	25		2,936 55,680			
Rochester	18			3,610 44,537		
Seattle	14[illegible]			4,841 146,335		
Spokane	50			5,170 84,094		
St Petersburg	—	286 3,502				
Tampa	23		1,789 33,735			
Washington, D. C. Dulles	11	397 20,347				
Washington, D. C. National	104			3,558 154,252		
Yakima	6		1,196 5,212			
Winnipeg	12	1,082 24,341				

[a]The top number of each pair of numbers in a column is aircraft departures, and the bottom number is passengers enplaned.

TABLE D27

Trans World Airlines—Domestic, 1963:
Station Aircraft Departures and Passengers Enplaned per Year[a]

Station	Avg. no. of employees	Aircraft departure ranges				
		0– 1,100	1,101– 3,000	3,001– 6,000	6,001– 10,000	10,001– 20,000
Albany	4	921 9,168				
Albuquerque	103			3,145 111,512		
Allentown	—	711 6,301				
Amarillo	23		1,195 25,736			
Atlanta	19	554 21,443				
Baltimore	65		2,401 88,189			
Binghamton	5		1,138 11,332			
Boston	237			4,245 174,750		
Cincinnati	83			3,174 77,539		
Cleveland	45		1,749 56,016			
Columbus	131				6,799 189,740	
Dayton	208				7,787 207,177	
Denver	35		1,255 20,445			
Detroit	68	665 33,963				
Dulles	—	844 20,588				
Ft Wayne	3	447 6,456				
Fresno	7	504 4,956				
Harrisburg	15		1,393 22,989			
Hartford	38		1,897 47,679			

TABLE D27 (continued)

Station	Avg. no. of employees	Aircraft departure ranges				
		0– 1,100	1,101– 3,000	3,001– 6,000	6,001– 10,000	10,001– 20,000
Indianapolis	116			5,282 157,056		
Kansas City	343				8,739 360,528	
Las Vegas	79			3,115 117,096		
Los Angeles	795					13,318 513,094
Louisville	30		2,107 34,681			
Miami	37	442 20,911				
Nashville	12		1,109 17,291			
Newark	98		1,722 31,685			
New York Kennedy	1380					15,545 770,213
Chicago O'Hare	665					19,265 681,093
Oakland	18		1,729 24,341			
Oklahoma City	9	1,081 40,514				
Philadelphia	333			5,751 37,781		
Phoenix	152		2,703 98,221			
Pittsburgh	402					12,298 434,739
San Francisco	424				6,545 307,556	
Scranton	1	704 7,240				
South Bend	2	445 5,165				
St Louis	581					13,803 432,271
Tampa	16	884 16,803				

TABLE D27 (continued)

Station	Avg. no. of employees	Aircraft departure ranges				
		0–1,100	1,101–3,000	3,001–6,000	6,001–10,000	10,001–20,000
Terre Haute	—	717 4,485				
Tucson	15	1,082 17,067				
Tulsa	26		1,145 16,472			
Washington, D. C. National	228			4,205 98,882		
Wichita	37		1,979 42,506			
Williamsport	—	691 3,364				

[a]The top number of each pair of numbers in a column is aircraft departures, and the bottom number is passengers enplaned.

TABLE D28

United Airlines—Domestic, 1963:
Station Aircraft Departures and Passengers Enplaned per Year[a]

Station	Avg. no. of employees	Aircraft departure ranges					
		0–1,100	1,101–3,000	3,001–6,000	6,001–10,000	10,001–20,000	20,001 and over
Akron	40			4,917 57,334			
Allentown	21		1,417 21,345				
Atlanta	224					11,214 175,308	
Asheville	15		2,437 23,209				
Bakersfield	12		2,918 20,592				
Baltimore	173				7,453 193,860		
Birmingham	43			3,635 45,554			
Boise	41			3,644 63,481			
Boston	245		2,534 97,505				

TABLE D28 (continued)

Station	Avg. no. of employees	Aircraft departure ranges					
		0–1,100	1,101–3,000	3,001–6,000	6,001–10,000	10,001–20,000	20,001 and over
Buffalo	161				9,683 159,397		
Cedar Rapids	29			3,638 52,594			
Charleston, S. C.	35			3,802 55,682			
Charlotte, N. C.	9		1,249 5,751				
Chattanooga	16		1,954 18,072				
Chicago O'Hare	2192						48,409 1,674,804
Cleveland	841						24,681 714,011
Columbus, Ohio	29		2,790 47,208				
Dayton	32		2,778 43,715				
Denver	910					12,856 468,909	
Des Moines	64			4,552 108,265			
Detroit	525					14,324 274,626	
Elko	3	719 4,090					
Elmira	4		1,270 7,875				
Ely, Nev.	3	570 2,280					
Eugene, Ore.	15		2,090 14,830				
Flint	18			3,766 21,945			
Ft Wayne	28			3,372 54,391			
Fresno	39			4,430 57,195			
Grand Junction	—	724 8,030					
Grand Rapids	41			5,562 82,844			

TABLE D28 (continued)

Station	Avg. no. of employees	Aircraft departure ranges					
		0– 1,100	1,101– 3,000	3,001– 6,000	6,001– 10,000	10,001– 20,000	20,001 and over
Greensboro	10		1,966 14,395				
Harrisburg	—	688 4,254					
Hartford	77			4,203 88,189			
Huntsville	22		2,448 39,648				
Jacksonville	15		1,426 28,976				
Kansas City	35	830 27,563					
Knoxville	48			5,166 62,102			
Lansing, Mich.	25			3,837 41,708			
Las Vegas	48		2,417 92,585				
Lincoln	18		1,310 16,196				
Los Angeles	1414						22,107 919,280
Medford, Ore.	16		1,733 17,952				
Memphis	23		1,199 18,119				
Merced	5	861 3,723					
Miami	100		2,899 89,626				
Milwaukee				5,185 95,844			
Minneapolis	155			3,981 148,678			
Mobile	22		1,528 24,375				
Modesto	8		1,540 7,357				
Moline	36			3,710 70,129			
Monterey	17		2,048 29,940				

TABLE D28 (continued)

Station	Avg. no. of employees	Aircraft departure ranges					
		0– 1,100	1,101– 3,000	3,001– 6,000	6,001– 10,000	10,001– 20,000	20,001 and over
Muskegon	18		1,863 18,037				
New Orleans	39		1,216 22,627				
New York Kennedy	1039				8,704 352,411		
New York La Guardia	432		2,946 106,925				
Newark	650					16,058 591,822	
Newport News	20			1,188 41,316			
Norfolk	54			5,010 109,337			
Oakland	37		2,262 19,613				
Omaha	317				7,107 203,797		
Pendleton	14		2,807 18,935				
Philadelphia	452					12,234 344,208	
Pittsburgh	478					16,510 439,686	
Portland, Ore.	450					15,561 360,448	
Providence	—	510 3,987					
Raleigh, N. C.	14		1,996 24,828				
Reno	67				6,587 128,334		
Richmond	23		1,475 21,755				
Rochester	47				6,678 87,348		
Sacramento	96				6,873 129,353		
Saginaw	26			3,907 46,626			
Salem, Ore.	11		1,419 4,172				

TABLE D28 (continued)

Station	Avg. no. of employees	Aircraft departure ranges					
		0– 1,100	1,101– 3,000	3,001– 6,000	6,001– 10,000	10,001– 20,000	20,001 and over
Salt Lake	270				6,687 203,472		
San Diego	116			3,259 140,541			
San Francisco	1885						23,892 903,757
Santa Barbara	15		1,952 23,460				
Seattle	826					11,565 385,144	
South Bend	26			3,329 44,483			
Spokane	28	1,081 26,294					
Stockton	14		1,892 8,353				
Tampa	28		2,528 36,309				
Toledo	44			5,041 86,376			
Tri-Cities (Tenn.)	11		1,736 17,190				
Visalia	7		1,304 7,552				
Washington, D. C. Dulles	104			3,190 91,159			
Washington, D. C. National	641					19,380 399,306	
West Palm Beach	7	655 3,350					
Williamsport	4		1,313 4,768				
Winston-Salem	—			4,144 52,801			

[a]The top number of each pair of numbers in a column is aircraft departures, and the bottom number is passengers enplaned.

TABLE D29

Northwest Orient Airlines—International, 1963:
Station Aircraft Departures and Passengers Enplaned per Year[a]

Station	Avg. no. of employees	Aircraft departure ranges				
		0–1,100	1,101–3,000	3,001–6,000	6,001–10,000	10,001–20,000
Chicago O'Hare	46	249 12,359				
New York Kennedy	—	103 4,125				
Portland	16	560 5,425				
Seattle	60	1,038 46,921				
Anchorage	87		1,396 28,398			
Honolulu	18	326 16,845				
Manila	23	158 5,125				
Naha	—	657 13,871				
Seoul	24	252 16,323				
Taipeh	—	197 8,112				
Tokyo	175	1,040 45,709				

[a]The top number of each pair of numbers in a column is aircraft departures, and the bottom number is passengers enplaned.

TABLE D30

Pan American Airways—International, 1963:
Station Aircraft Departures and Passengers Enplaned per Year[a]

Station	Avg. no. of employees	Aircraft departure ranges				
		0–1,100	1,101–3,000	3,001–6,000	6,001–10,000	10,001–20,000
Baltimore	47	619 14,658				
Chicago	—	428 22,183				
Detroit Metro	14	403 5,862				
Fort Worth–Houston	—	341 6,688				
Houston	32	362 22,728				
Los Angeles	215		2,011 123,626			
Miami	367			3,322 186,987		
New Orleans	21	154 10,196				
Newport	—	46 2,273				
New York Kennedy	237				7,500 538,322	
Philadelphia	24	538 13,075				
Portland	11	636 9,539				
San Francisco	303		1,900 102,599			
Seattle	107		1,201 48,108			
Tampa	3	103 1,224				
Washington, D. C. Dulles	— —	45 377				
Anchorage	5	149 —				
Annette Is.	24	685 10,365				
Fairbanks	—	455 14,216				

TABLE D30 (continued)

Station	Avg. no. of employees	Aircraft departure ranges				
		0–1,100	1,101–3,000	3,001–6,000	6,001–10,000	10,001–20,000
Gander	2	56				
		2				
Juneau	21	441				
		10,515				
Winnipeg	2	169				
		—				
Barbados	15	573				
		6,108				
Bermuda	37	631				
		61,977				
Curacao	15		1,548			
			93,036			
Ft-de-France	1	620				
		6,856				
Georgetown	—	156				
		1,989				
Guatemala City	137		1,386			
			25,739			
Kingston	73		1,322			
			19,856			
Managua	—	433				
		12,620				
Merida	1	826				
		10,132				
Mexico City	1	878				
		48,026				
Montego Bay	53		1,604			
			20,547			
Nassau	35	1,090				
		63,544				
Panama City	—		1,760			
			77,778			
Pointe à Pitre	13	317				
		2,870				
Port of Spain	84	772				
		15,281				
St Croix	1	514				
		8,711				
St Johns	31	648				
		8,925				
St Lucia	—	62				
		298				

TABLE D30 (continued)

Station	Avg. no. of employees	Aircraft departure ranges				
		0– 1,100	1,101– 3,000	3,001– 6,000	6,001– 10,000	10,001– 20,000
St Martins	3	207 1,285				
San Jose	25	706 16,781				
San Juan	320			3,800 331,481		
San Salvador	29	410 11,728				
Tegucigalpa	30	204 5,806				
Asuncion	2	95 1,141				
Barranquilla	15	224 5,471				
Belem	4	16 358				
Brasilia	6	204 1,011				
Buenos Aires	—	250 9,934				
Caracas	172	1,074 29,436				
Maracaibo	22	61 712				
Montevideo	48	98 2,080				
Paramaribo	17	111 2,616				
Recife	3	64 465				
Rio de Janeiro	—	596 13,749				
Santa Maria	—	100 3,787				
Santo Domingo	46		1,356 47,489			
Sao Paulo	41	204 6,429				
Amsterdam	28	531 3,937				

~~FOR OFFICIAL USE ONLY~~

TABLE D30 (continued)

Station	Avg. no. of employees	Aircraft departure ranges				
		0– 1,100	1,101– 3,000	3,001– 6,000	6,001– 10,000	10,001– 20,000
Berlin	252					12,476 677,491
Brussels	37	296 2,142				
Cologne	6	691 31,064				
Copenhagen	20	194 4,174				
Dover	—	13 —				
Düsseldorf	57	826 27,762				
Frankfurt	424				6,027 216,301	
Hamburg	57		2,694 143,930			
Hanover	—		2,856 180,112			
Helsinki	12	51 630				
Keflavik	3	119 1,013				
London	600		1,967 129,488			
Mildenhall	—	16 —				
Munich	46		1,902 65,488			
Nuremburg	12	617 35,967				
Oslo	12	98 140				
Prestwick	—	140 607				
Shannon	99	647 6,684				
Stockholm	17	99 492				
Stuttgart	47		1,466 52,120			

TABLE D30 (continued)

Station	Avg. no. of employees	Aircraft departure ranges				
		0– 1,100	1,101– 3,000	3,001– 6,000	6,001– 10,000	10,001– 20,000
Barcelona	19	360 11,669				
Belgrade	9	128 1,413				
Lisbon	66	604 18,517				
Nice	15	354 6,320				
Paris	192		1,716 48,010			
Rome	140		1,532 45,528			
Vienna	28	336 5,310				
Accra	24	225 2,535				
Ankara	54	309 7,880				
Baghdad	14	49 818				
Beirut	94		1,205 19,823			
Conakry	2	41 233				
Dakar	31	235 2,720				
Istanbul	49	1,018 20,987				
Johannesburg	23	51 1,897				
Lagos	18	156 3,289				
Leopoldville	25	104 2,448				
Rabat	1	67 582				
Roberts Field	3	77 1,212				
Angola	—	199 3,938				
Teheran	59	614 13,201				

TABLE D30 (continued)

Station	Avg. no. of employees	Aircraft departure ranges				
		0–1,100	1,101–3,000	3,001–6,000	6,001–10,000	10,001–20,000
Bangkok	153	761 14,427				
Calcutta	20	724 25,119				
Djakarta	—	53 2,266				
Guam Is.	56	345 150				
Hilo	—	15 —				
Hong Kong	123	755 23,656				
Honolulu	537			3,276 178,014		
Karachi	50	411 5,152				
Manila	71	457 20,675				
New Delhi	—	410 8,442				
Papeete	—	1 27				
Rangoon	1	208 2,620				
Saigon	8	530 7,039				
Singapore	—	53 1,661				
Singapore Mal.	40	103 3,757				
Suva	37	366 3,109				
Tafuna	—	154 3,964				
Tokyo	275		2,199 82,548			
Wake Is.	63	200 402				
Auckland	20	105 3,006				
Sydney	49	156 4,774				

[a]The top number of each pair of numbers in a column is aircraft departures, and the bottom number is passengers enplaned.

TABLE D31

Trans World Airlines—International, 1963:
Station Aircraft Departures and Passengers Enplaned per Year[a]

Station	Avg. no. of employees	Aircraft departure ranges				
		0– 1,100	1,101– 3,000	3,001– 6,000	6,001– 10,000	10,001– 20,000
Boston	—	480 5,556				
Chicago O'Hare	—	126 2,300				
Detroit Metro	—	134 1,450				
Detroit Mich.	—	7 82				
Los Angeles I.	—	186 4,268				
New York Kennedy	—			3,271 133,841		
San Francisco	—	169 4,410				
Washington, D. C. Dulles	—	2 —				
Washington, D. C. National	—	788 13,716				
Frankfort	120	979 27,830				
London	197		1,362 37,847			
Shannon	40	202 3,876				
Athens	81	1,036 44,516				
Geneva	55	571 4,633				
Lisbon	69	623 20,351				
Madrid	91	731 42,842				
Milan	112		1,127 14,056			
Paris	275		2,289 54,300			
Rome	251		2,177 63,174			
Santa Maria	3	50 1,584				

TABLE D31 (continued)

Station	Avg. no. of employees	Aircraft departure ranges 0–1,100	1,101–3,000	3,001–6,000	6,001–10,000	10,001–20,000
Zurich	14	470				
		2,614				
Cairo	106	306				
		9,401				
Dhahran	23	103				
		2,689				
Tel Aviv	43	244				
		11,676				
Bombay	48	51				
		1,495				

[a]The top number of each pair of numbers in a column is aircraft departures, and the bottom number is passengers enplaned.

In establishing the coefficients the statistics of each airline were programmed and computer printouts were obtained for analysis for each of 7 years. Tables D32 to D40 are examples of the printout. Table D32 shows each functional account of direct and indirect costs, the dollars reported against that account, and the percent value of each account against the total.

Table D33 shows the coefficient value or the value used to derive the coefficient for each item number, the percent of the total value of each functional account within an item, and percent of total value of each item relative to the total of all items.

Table D34 reflects data used in evaluating labor costs and their effect on IOCs. Shown are the percentage value of the labor accounts as a function of the total dollars of that particular functional account.

Tables D35 to D40 are data used in further evaluation efforts. These represent groupings of data from selected combinations of airlines to study the effect, if any, on operational costs as experienced by airlines of various sizes.

TABLE D32

AMERICAN AIRLINES		1965	DOMESTIC
DIRECT OPERATING COSTS	1000 DOLLARS	PERCENT DOC	PERCENT TOC
5100 FLIGHT OPERATIONS	119058	42.18	22.43
INSURANCE	4446	1.58	0.84
5200 DIR. MAINTENANCE	59177	20.97	11.15
5300 MAINT BURDEN FLTEQ	44042	15.60	8.30
7000 DEPREC FLT EQUIP	51916	18.39	9.78
7000 DEVPRE	1818	0.64	0.34
7000 DDPEXP + OTHERS	1780	0.63	0.34
TOTAL DIRECT OPER. COSTS	282237		53.16
INDIRECT OPERATING COSTS	1000 DOLLARS	PERCENT IOC	PERCENT TOC
5200 TORMAN - ORMANI	4841	1.95	0.91
5300 MAINT BURDEN GRDEQ	4900	1.97	0.92
7000 DEPMEQ + DEPGGP	5029	2.02	0.95
5500 PASSENGER SERVICE	49919	20.08	9.40
6100 AIRCRAFT SERVICE	45462	18.28	8.56
6200 TRAFFIC SERVICE	41383	16.64	7.79
6300 SERVICE ADMIN EXP	9677	3.89	1.82
6500 RESERV AND SALE	46888	18.86	8.83
6600 ADVER AND PUB EXP	18128	7.29	3.41
6800 GEN AND ADMIN EXP	22434	9.02	4.23
TOTAL INDIRECT OPER. COSTS	248661		46.84
TOTAL OPERATING COSTS	530898		
RATIO INDIRECT TO DIRECT OPERATING COSTS			0.881

TABLE D33

FUNCTIONAL ACCOUNTS PERCENT OF TOTALS BY ITEM NUMBERS

AMERICAN AIRLINES 1965 DOMESTIC

ITEM NUMBER 1	6.9878890 E-01		PERCENT OF TOTAL
TOTAL	1.4771000 E 04	PERCENT	5.87
5200	4.8420000 E 03	32.78	
5300	4.9000000 E 03	33.17	
7000	5.0290000 E 03	34.05	
ITEM NUMBER 2	4.1003489 E 07		PERCENT OF TOTAL
TOTAL	4.1003489 E 04	PERCENT	16.30
6100	3.7734219 E 04	92.03	
6300	3.2692702 E 03	7.97	
ITEM NUMBER 3	8.9991683 E 06		PERCENT OF TOTAL
TOTAL	8.9991684 E 03	PERCENT	3.58
6100	7.8077806 E 03	86.76	
6300	1.1913878 E 03	13.24	
ITEM NUMBER 4	1.3222512 E 07		PERCENT OF TOTAL
TOTAL	1.3222512 E 04	PERCENT	5.26
5500	1.3222512 E 04	100.00	
ITEM NUMBER 5	1.9751714 E-03		PERCENT OF TOTAL
TOTAL	2.4093000 E 04	PERCENT	9.58
5500	2.4093000 E 04	100.00	
ITEM NUMBER 6	4.7625731 E 00		PERCENT OF TOTAL
TOTAL	5.4304369 E 04	PERCENT	21.58
6200	1.4080137 E 04	25.93	
6300	1.7902317 E 03	3.30	
6500	3.8434000 E 04	70.78	
ITEM NUMBER 7	3.1743973 E 07		PERCENT OF TOTAL
TOTAL	3.1743973 E 04	PERCENT	12.62
6200	2.8317863 E 04	89.21	
6300	3.4261103 E 03	10.79	
ITEM NUMBER 8	4.3379465 E-03		PERCENT OF TOTAL
TOTAL	3.9236814 E 04	PERCENT	15.60
5500	1.2541000 E 04	31.96	
6500	1.0248000 E 04	26.12	
6600	1.6447814 E 04	41.92	
ITEM NUMBER 9	6.6534075 E-03		PERCENT OF TOTAL
TOTAL	1.7771864 E 03	PERCENT	0.71
6500	9.7000000 E 01	5.46	
6600	1.6801865 E 03	94.54	
ITEM NUMBER 10	5.0084724 E-02		PERCENT OF TOTAL
TOTAL	2.2434000 E 04	PERCENT	8.92
6800	2.2434000 E 04	100.00	
TOTAL FUN ACCOUNTS	2.5158551 E 05		

TABLE D34

PERCENT LABOR OBJECTIVE ACCOUNTS OF TOTAL FUNCTIONAL ACCOUNT

AMERICAN AIRLINES 1965 DOMESTIC

35.72	LABOR ACCOUNTS	5225.1,.2,.3
18.72	LABOR ACCOUNTS	5524,5528.1
48.26	LABOR ACCOUNTS	5551
2.44	LABOR ACCOUNTS	5521,30,31,35
15.81	LABOR ACCOUNTS	6126.2
43.37	LABOR ACCOUNTS	6121,26.1,28.1,30,31,35
2.55	LABOR ACCOUNTS	6221,26.1,28.1,30,31,35
23.54	LABOR ACCOUNTS	6226.3
49.94	LABOR ACCOUNTS	6226.4
43.74	LABOR ACCOUNTS	6521,26.1,26.3,26.4,28.1,30,31,33,35

TABLE D35

AVERAGE OPERATING COSTS 1965 DOMESTIC

	TOTAL OP COSTS	DIRECT OP COSTS		INDIRECT OP COSTS		RATIO
	1000 DOLLARS	1000 DOLLARS	PERCENT	1000 DOLLARS	PERCENT	INDIRECT TO DIRECT
INDUSTRY AVERAGE	300649.	165011.	54.89	135637.	45.11	0.822
GROUP 1 AA,EA,TW,UA	508628.	276127.	54.29	232500.	45.71	0.842
GROUP 2 DL,NW,NA	159371.	90162.	56.57	69209.	43.43	0.768
GROUP 3 BN,CO	96607.	55053.	56.99	41554.	43.01	0.755

TABLE D36

SELECTED GROUP

DOMESTIC 1965

GROUP 1
AA, EA, TW, UA

	TOTAL	AVERAGE
ITEM NUMBER 1	2.3968825 E 00	5.9922061 E-01
ITEM NUMBER 2	1.5922072 E 08	3.9805100 E 07
ITEM NUMBER 3	3.2553630 E 07	8.1384073 E 06
ITEM NUMBER 4	5.6291712 E 07	1.4072928 E 07
ITEM NUMBER 5	7.6282583 E-03	1.9070646 E-03
ITEM NUMBER 6	1.7046196 E-02	4.2615489 E-03
ITEM NUMBER 7	9.7603307 E 07	2.4400827 E 07
ITEM NUMBER 8	1.8466824 E-02	4.6167061 E-03
ITEM NUMBER 9	3.2196977 E-02	8.0492444 E-03
ITEM NUMBER 10	1.9662955 E-01	4.9157387 E-02

Note 1 — Coefficient values are shown for item numbers (equation number) 1, 5, 6, 8, 9, and 10 and are the average value based on statistics of the group of airlines shown.

Note 2 — The numbers shown for item numbers 2, 3, 4, and 7 are the values to be used in the numerator when computing the coefficient. The denominator values for these equations are shown elsewhere in this report.

TABLE D37

SELECTED GROUP

DOMESTIC 1965

GROUP 2
DL, NW, NA

	TOTAL	AVERAGE
ITEM NUMBER 1	1.6516678 E 00	5.5055594 E-01
ITEM NUMBER 2	3.9680334 E 07	1.3226778 E 07
ITEM NUMBER 3	2.8469762 E 06	9.4899207 E 05
ITEM NUMBER 4	1.3950981 E 07	4.6503270 E 06
ITEM NUMBER 5	5.3165560 E-03	1.7721853 E-03
ITEM NUMBER 6	1.0856061 E-02	3.6186868 E-03
ITEM NUMBER 7	1.3170115 E 07	4.3900383 E 06
ITEM NUMBER 8	1.2180716 E-02	4.0602386 E-03
ITEM NUMBER 9	3.0978239 E-02	1.0326079 E-02
ITEM NUMBER 10	1.2181333 E-01	4.0604444 E-02

Note 1 — Coefficient values are shown for item numbers (equation number) 1, 5, 6, 8, 9, and 10 and are the average value based on statistics of the group of airlines shown.

Note 2 — The numbers shown for item numbers 2, 3, 4, and 7 are the values to be used in the numerator when computing the coefficient. The denominator values for these equations are shown elsewhere in this report.

TABLE D38

SELECTED GROUP

DOMESTIC 1965

GROUP 3
BN,CO

		TOTAL	AVERAGE
ITEM NUMBER	1	9.5021633 E-01	4.7510817 E-01
ITEM NUMBER	2	9.5469186 E 06	4.7734593 E 06
ITEM NUMBER	3	3.2528466 E 06	1.6264233 E 06
ITEM NUMBER	4	5.6616029 E 06	2.8308015 E 06
ITEM NUMBER	5	3.9411302 E-03	1.9705651 E-03
ITEM NUMBER	6	7.5195970 E-03	3.7597985 E-03
ITEM NUMBER	7	8.7075130 E 06	4.3537565 E 06
ITEM NUMBER	8	1.0851567 E-02	5.4257836 E-03
ITEM NUMBER	9	2.1694138 E-02	1.0847069 E-02
ITEM NUMBER	10	1.0440044 E-01	5.2200218 E-02

Note 1 — Coefficient values are shown for item numbers (equation number) 1, 5, 6, 8, 9, and 10 and are the average value based on statistics of the group of airlines shown.

Note 2 — The numbers shown for item numbers 2, 3, 4, and 7 are the values to be used in the numerator when computing the coefficient. The denominator values for these equations are shown elsewhere in this report.

TABLE D39

INDUSTRY ITEM TOTALS 1965 DOMESTIC

(9 AIRLINES)		TOTAL	AVERAGE
ITEM NUMBER	1	4.9987665 E 00	5.9682158 E-01
ITEM NUMBER	2	2.0844797 E 08	2.3160086 E 07
ITEM NUMBER	3	3.8653452 E 07	4.2948280 E 06
ITEM NUMBER	4	7.5904296 E 07	8.4338106 E 06
ITEM NUMBER	5	1.6885944 E-02	1.8762160 E-03
ITEM NUMBER	6	3.5421853 E 01	3.9124010 E-03
ITEM NUMBER	7	1.1948093 E 08	1.3275659 E 07
ITEM NUMBER	8	4.1499107 E-02	4.6110119 E-03
ITEM NUMBER	9	8.4869353 E-02	9.4299280 E-03
ITEM NUMBER	10	4.2284331 E-01	4.6982590 E-02

Note 1 — Coefficient values are shown for item numbers (equation number) 1, 5, 6, 8, 9, and 10 and are the average value based on statistics of the group of airlines shown.

Note 2 — The numbers shown for item numbers 2, 3, 4, and 7 are the values to be used in the numerator when computing the coefficient. The denominator values for these equations are shown elsewhere in this report.

TABLE D40

Data Matrix

5521	5530	5531	5535	5557	5568		XXXX
6121	6126.1	6128.1	6131	6135	6136	6157	XXXX
6168	6144.2						XXXX
6221	6228.1	6230	6231	6235	6236	6257	XXXX
6268							XXXX
5543.9	5544.1	5550	5553	5556	5558	5563	XXXX
5571	6138	6143.9	6144.1	6149	6150	6153	XXXX
6171	6177.9	6237	6238	6242.9	6243.9	6244.1	XXXX
6250	6253	6256	6258	6271	6277.9	6521	XXXX
6526.1	6526.3	6526.4	6528.1	6530	6531	6533	XXXX
6535	6536	6537	6538	6539.1	6539.2	6541	XXXX
6542.9	6543.9	6544.1	6550	6553	6557	6559	XXXX
6563	6564	6568	6571	6577.9			XXXX
FLTOPS	INSPLD	INSPSI	DRMAN1	MANBDN	TDFLEQ	DEVPRE	XXXX
ODPEXP	OTHERS	DRMAN2	TDRMAN	MANBRD	DEPMEQ	DEPGGP	XXXX
TPSSER	TACSER	TTRSER	TADSER	RESALS	TADPUD	TGNADM	XXXX
RPMFCL	RPMCOA	RPMCPF	RPMCPC	ASMFCL	ASMCOA	ASMCPF	XXXX
ASMCPC	ATMSRF	RAMFCL	RAMCOA	RAMCPS	RACHRS	ADACEQ	XXXX
FULGAL	PABHRS	RTMMLP	RTMMLN	FORMAL	EXPRES	FRIGHT	XXXX
TRVACD							XXXX
3901.1	3901.2	3906.1	3906.2	3906.3	3907	7075.6	XXXX
AVLSMI	RVACMI	REPSOR	FCCASM	EXCBAG	PAXENP	RVPXMI	XXXX
5524	5528.1	5536	5551	6126.2	6130	6137	XXXX
6226.1	6226.3	6226.4	5537	5538	5541	5577.9	XXXX
5225.1	5225.2	5225.3					XXXX

3901.1	OPERATING REVENUE-PASSENGER-FIRST CLASS	(21,1)
3901.2	OPERATING REVENUE-PASSENGER-COACH	(21,2)
3906.1	OPERATING REVENUE-PROPERTY-EXPRESS	(21,3)
3906.2	OPERATING REVENUE-PROPERTY-FREIGHT	(21,4)
3906.3	OPERATING REVENUE-PROPERTY-EXCESS BAGGAGE	(21,5)
3907	OPERATING REVENUE-CHARTER	(21,6)
5225.1	LABOR-AIRFRAMES	(25,1)
5225.2	LABOR-AIRCRAFT ENGINES	(25,2)
5225.3	LABOR-OTHER FLIGHT EQUIPMENT	(25,3)
5521	GEN. MANAGEMENT PERSONNEL	(1,1)
5524	OTHER FLIGHT PERSONNEL	(23,1)
5528.1	TRAINEES AND INSTRUCTORS	(23,2)
5530	COMMUNICATIONS PERSONNEL	(1,2)
5531	RECORD KEEPING AND STATISTICAL PERSONNEL	(1,3)
5535	OTHER PERSONNEL	(1,4)
5536	PERSONNEL EXPENSES	(23,3)
5537	COMMUNICATIONS PURCH.	(24,4)
5538	LIGHT,HEAT,POWER,AND WATER	(24,5)
5541	PROFESSIONAL AND TECHNICAL FEES AND EXPENSES	(24,6)
5543.9	OTHER SERVICE-OUTSIDE	(6,1)
5544.1	RENTALS	(6,2)
5550	STATISTICAL,PRINTING + OFFICE SUPPLIES	(6,3)
5551	PASSENGER FOOD EXPENSE	(23,4)
5553	OTHER SUPPLIES	(6,4)
5556	INSURANCE-TRAFFIC LIABILITY	(6,5)
5557	INSURANCE-EMPLOYEE WELFARE	(1,5)
5558	INJURIES,LOSS + DAMAGE	(6,6)
5563	INTERRUPTED TRIP EXPENSE	(6,7)
5568	TAXES-PAYROLL	(1,6)
5571	OTHER EXPENSES	(7,1)
5577.9	OTHER UNCLRD. EXP. CRS.	(24,7)
6121	GEN. MANAGEMENT PERSONNEL	(2,1)

TABLE D40 (continued)

6126.1	AIRCRAFT AND TRAFFIC HANDLING PERSONNEL	(2,2)
6126.2	AIRCRAFT CONTROL PERSONNEL	(23,5)
6128.1	TRAINEES AND INSTRUCTORS	(2,3)
6130	COMMUNICATIONS PERSONNEL	(23,6)
6131	RECORD KEEPING AND STATISTICAL PERSONNEL	(2,4)
6135	OTHER PERSONNEL	(2,5)
6136	PERSONNEL EXPENSES	(2,6)
6137	COMMUNICATIONS PURCH.	(23,7)
6138	LIGHT,HEAT,POWER,WATER	(7,2)
6143.9	OTHER SERVICE-OUTSIDE	(7,3)
6144.1	RENTALS	(7,4)
6144.2	LANDING FEES	(3,2)
6149	SHOP + SERVICE SUPPLIES	(7,5)
6150	STATISTICAL,PRINTING + OFFICE SUPPLIES	(7,6)
6153	OTHER SUPPLIES	(7,7)
6157	INSURANCE-EMPLOYEE WELFARE	(2,7)
6168	TAXES-PAYROLL	(3,1)
6171	OTHER EXPENSES	(8,1)
6177.9	OTHER UNCLRD. EXP. CRS.	(8,2)
6221	GEN. MANAGEMENT PERSONNEL	(4,1)
6226.1	AIRCRAFT AND TRAFFIC HANDLING PERSONNEL	(24,1)
6226.3	PASSENGER HANDLING PERSONNEL	(24,2)
6226.4	CARGO HANDLING PERSONNEL	(24,3)
6228.1	TRAINEES AND INSTRUCTORS	(4,2)
6230	COMMUNICATIONS PERSONNEL	(4,3)
6231	RECORD KEEPING AND STATISTICAL PERSONNEL	(4,4)
6235	OTHER PERSONNEL	(4,5)
6236	PERSONNEL EXPENSES	(4,6)
6237	COMMUNICATIONS PURCH.	(8,3)
6238	LIGHT,HEAT,POWER,WATER	(8,4)
6242.9	OTHER SERVICE-ASSOC. COS.	(8,5)
6243.9	OTHER SERVICE-OUTSIDE	(8,6)
6244.1	RENTALS	(8,7)
6250	STATISTICAL,PRINTING + OFFICE SUPPLIES	(9,1)
6253	OTHER SUPPLIES	(9,2)
6256	INSURANCE-TRAFFIC LIABILITY	(9,3)
6257	INSURANCE-EMPLOYEE WELFARE	(4,7)
6258	INJURIES,LOSS + DAMAGE	(9,4)
6268	TAXES-PAYROLL	(5,1)
6271	OTHER EXPENSES	(9,5)
6277.9	OTHER UNCLRD. EXP. CRS.	(9,6)
6521	GENERAL MANAGEMENT PERSONNEL	(9,7)
6526.1	AIRCRAFT + TRAFFIC HANDLING PERSONNEL	(10,1)
6526.3	PASSENGER HANDLING PERSONNEL	(10,2)
6526.4	CARGO HANDLING PERSONNEL	(10,3)
6528.1	TRAINEES AND INSTRUCTORS	(10,4)
6530	COMMUNICATIONS PERSONNEL	(10,5)
6531	RECORD KEEPING + STATISTICAL PERSONNEL	(10,6)
6533	TRAFFIC SOLICITORS	(10,7)
6535	OTHER PERSONNEL	(11,1)
6536	PERSONNEL EXPENSES	(11,2)
6537	COMMUNICATIONS PURCH.	(11,3)
6538	LIGHT,HEAT,POWER,WATER	(11,4)
6539.1	COMMISSIONS-PASSENGER	(11,5)
6539.2	COMMISSIONS-PROPERTY	(11,6)
6541	PROFESSIONAL + TECHNICAL FEES + EXPENSES	(11,7)
6542.9	OTHER SERVICES-ASSOC. COS.	(12,1)
6543.9	OTHER SERVICES-OUTSIDE	(12,2)
6544.1	RENTALS	(12,3)

TABLE D40 (continued)

6550	STATISTICAL,PRINTING + OFFICE SUPPLIES	(12,4)
6553	OTHER SUPPLIES	(12,5)
6557	INSURANCE-EMPLOYEE WELFARE	(12,6)
6559	TARIFFS,SCHEDULES,TIMETABLES	(12,7)
6563	INTERRUPTED TRIP EXPENSE	(13,1)
6564	MEMBERSHIPS	(13,2)
6568	TAXES-PAYROLL	(13,3)
6571	OTHER EXPENSES	(13,4)
6577.9	OTHER UNCLRD. EXP. CRS.	(13,5)
7075.6	DEPRECIATION-FLIGHT EQUIPMENT	(21,7)
ADACEQ	AIRCRAFT DAYS ASSIGNED-CARRIER EQUIPMENT	(18,7)
ASMCOA	AVAIL. SEAT MILES-COACH	(17,6)
ASMCPC	AVAIL. SEAT MILES-COMBINATION PASSENGER-COACH	(18,1)
ASMCPF	AVAIL. SEAT MILES-COMBINATION PASSENGER-FIRST CLASS	(17,7)
ASMFCL	AVAIL. SEAT MILES-FIRST CLASS	(17,5)
ATMSRF	AVAIL. TON MILES-SCHED. REV. FLTS.	(18,2)
AVLSMI	AVAILABLE SEAT MILES	(22,1)
DEVPRE	AMORT. DEVEL. AND PREOP.	(14,7)
DEPGGP	DEPRECIATION-GEN. GRAD. PROP.	(15,7)
DEPMEQ	DEPRECIATION-MAINTENANCE EQUIPMENT,BGRS.	(15,6)
DRMAN1	DIRECT MAINTENANCE-FLIGHT EQUIPMENT	(14,4)
DRMAN2	DIRECT MAINTENANCE-FLIGHT EQUIPMENT	(15,3)
EXCBAG	REVENUE TON-MILES-EXCESS BAGGAGE	(22,5)
EXPRES	EXPRESS	(19,6)
FCCASM	PERCENT COACH AVAILABLE SEAT-MILES (1965 ONLY)	(22,4)
FLTOPS	FLIGHT OPERATIONS	(14,1)
FORMAL	FOREIGN MAIL	(19,5)
FRIGHT	FREIGHT	(19,7)
FULGAL	AIRCRAFT FUEL ISSUED-GALLONS	(19,1)
INSPLD	PUBLIC LIABILITY AND PROPERTY DAMAGE INSURANCE	(14,2)
INSPSI	PROV. PUBLIC LIABILITY AND PROPERTY DAMAGE SELF-INSURANCE	(14,3)
MANBDN	APPLIED MAINTENANCE BURDEN-FLIGHT EQUIPMENT	(14,5)
MANBRD	APPLIED MAINTENANCE BURDEN-GR.EQ.	(15,5)
ODPEXP	OB. AND DET. PROV.-EXP. PTS.	(15,1)
OTHERS	OTHER INTANGIBLES	(15,2)
PABHRS	PERCENT BLOCK-TO-BLOCK AIRBORNE HOURS	(19,2)
PAXENP	NUMBER OF REVENUE PASSENGER ENPLANEMENTS	(22,6)
RAMCOA	REVENUE AIRCRAFT MILES-COACH	(18,4)
RAMCPS	REVENUE AIRCRAFT MILES-COMBINATION PASSENGERS	(18,5)
RAMFCL	REVENUE AIRCRAFT MILES-FIRST CLASS	(18,3)
RACHRS	REVENUE AIRCRAFT HOURS	(18,6)
RESALS	TOTAL RESERV. AND SALES EXP.	(16,5)
REPSOR	NUMBER OF REVENUE PASSENGER ORIGINATIONS	(22,3)
RPMCOA	REVENUE PASSENGER MILES-COACH	(17,2)
RPMCPC	REVENUE PASSENGER MILES-COMBINATION PASSENGER-COACH	(17,4)
RPMCPF	REVENUE PASSENGER MILES-COMBINATION PASSENGER-FIRST CLASS	(17,3)
RPMFCL	REVENUE PASSENGER MILES-FIRST CLASS	(17,1)
RTMMLN	REVENUE TON-MILES-US MAIL-NON-PRIORITY	(19,4)
RTMMLP	REVENUE TON-MILES-US MAIL-PRIORITY	(19,3)
RVACMI	REVENUE AIRCRAFT MILES	(22,2)
RVPXMI	TOTAL REVENUE PASSENGER MILES	(22,7)
TACSER	TOTAL AIRCRAFT SERVICE EXP.	(16,2)
TADPUD	TOTAL ADVER. AND PUB. EXPENSES	(16,6)
TADSER	TOTAL SERVICE ADMIN. EXP.	(16,4)
TDFLEQ	TOTAL DEPRECIATION-FLIGHT EQUIPMENT	(14,6)
TDRMAN	TOTAL DIRECT MAINTENANCE	(15,4)
TGNADM	TOTAL GENERAL AND ADMIN. EXP.	(16,7)
TPSSER	TOTAL PASSENGER SERVICE	(16,1)
TRVACD	TOTAL REVENUE AIRCRAFT DEPARTURES	(20,1)
TTRSER	TOTAL TRAFFIC SERVICE EXP.	(16,3)

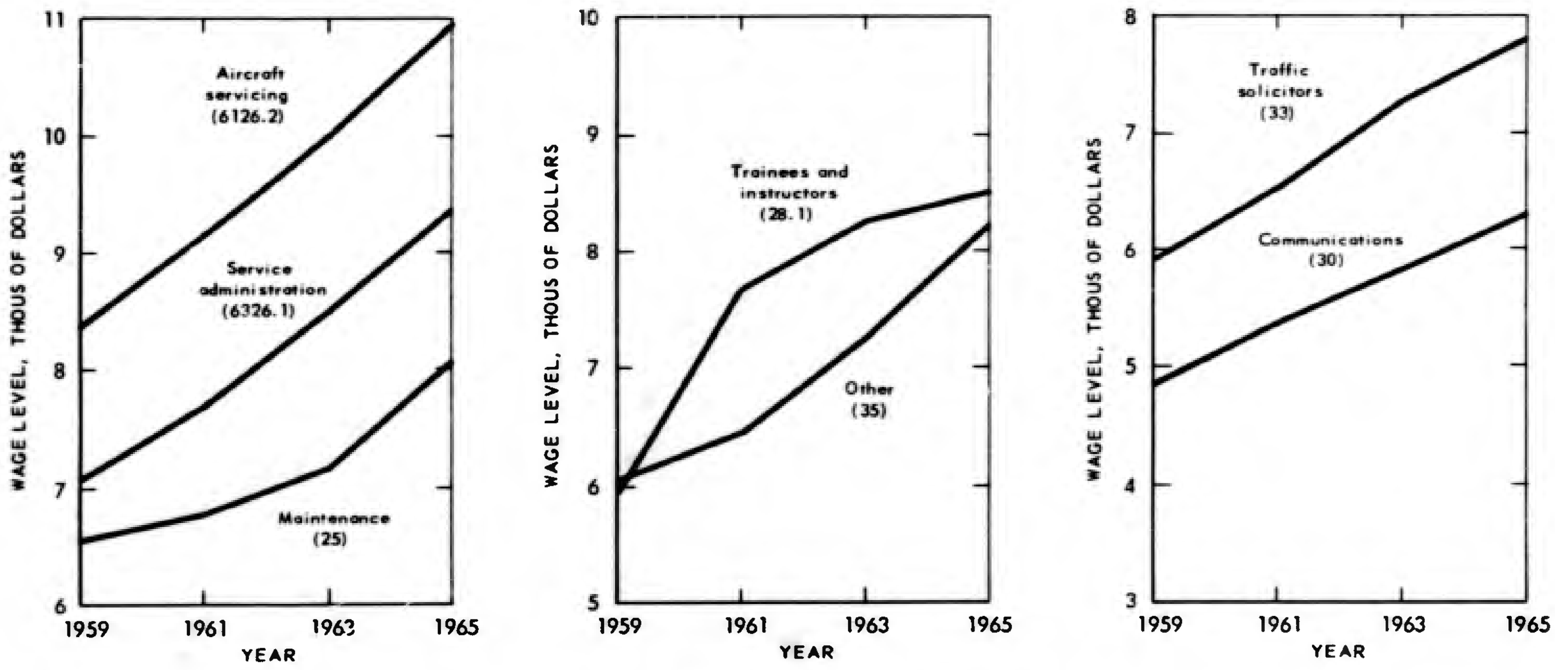


Fig. D1—Industry Average Wage of Personnel

Overall average increase 9.1 percent.

(Numbers in parenthesis indicate objective account.)

FOR OFFICIAL USE ONLY

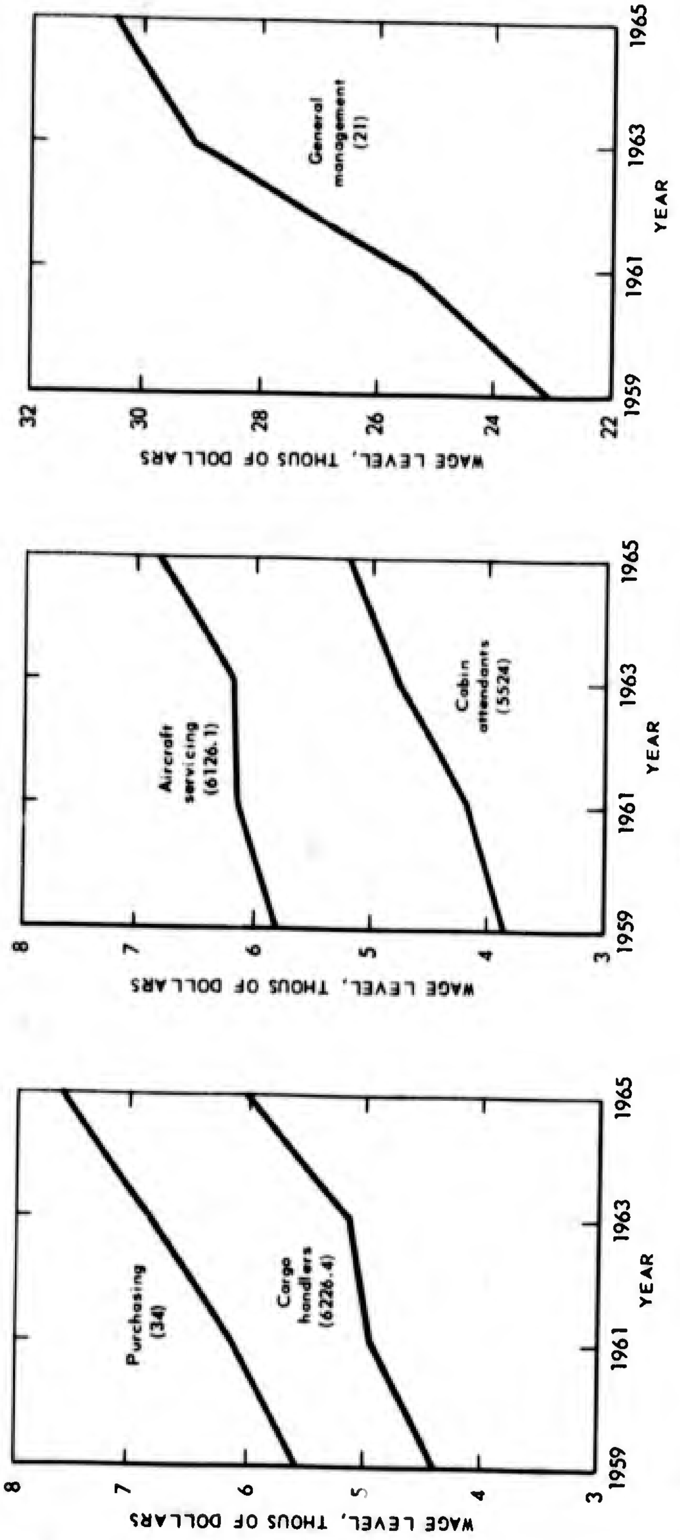


Fig. D1—Continued

FOR OFFICIAL USE ONLY

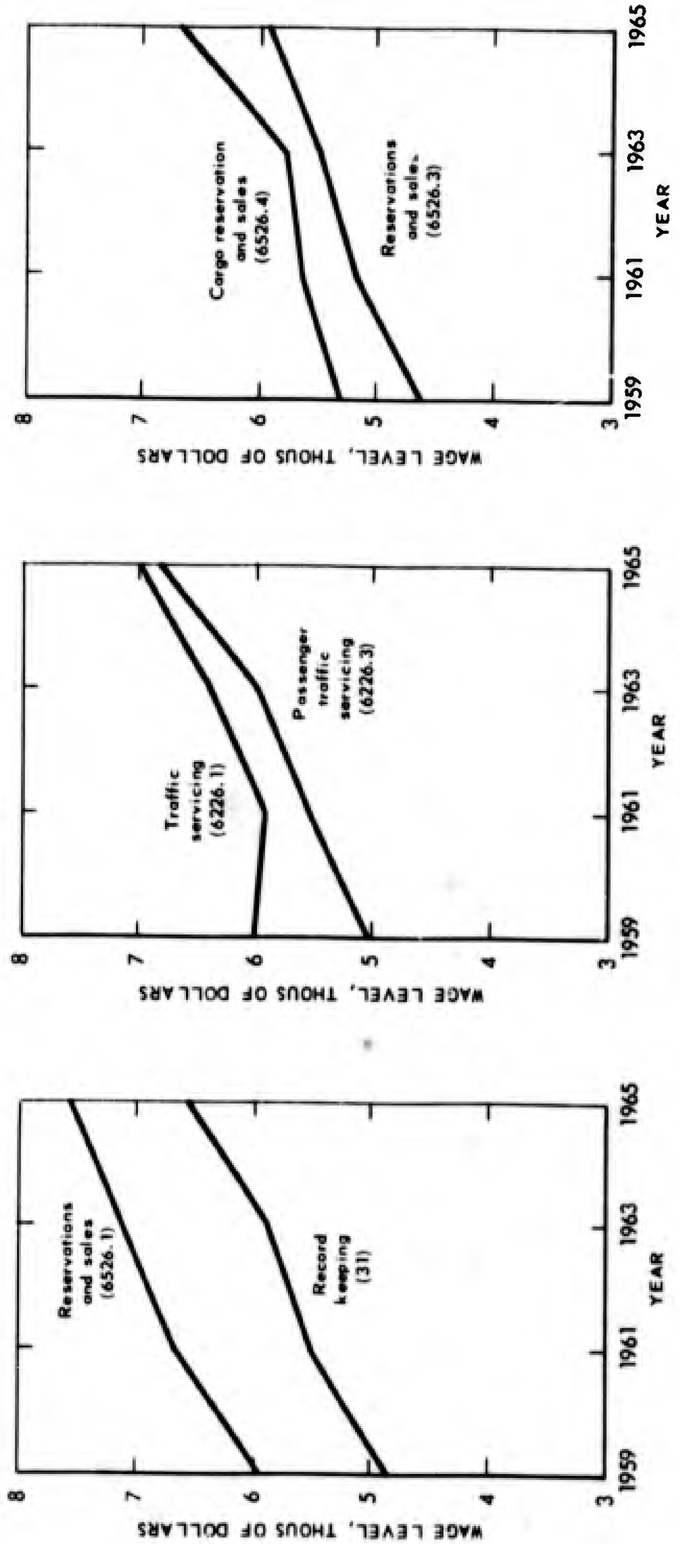


Fig. D1—Continued

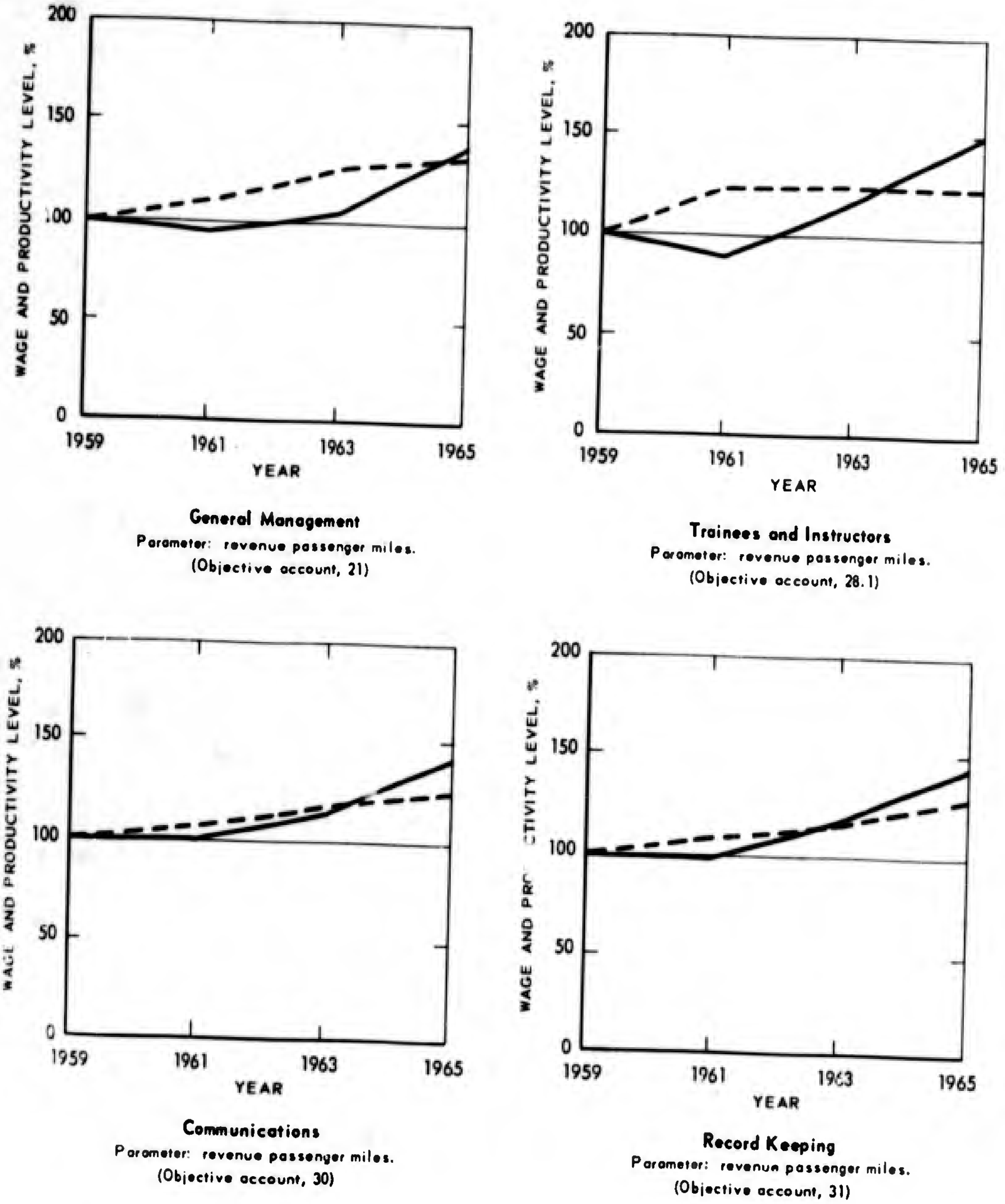
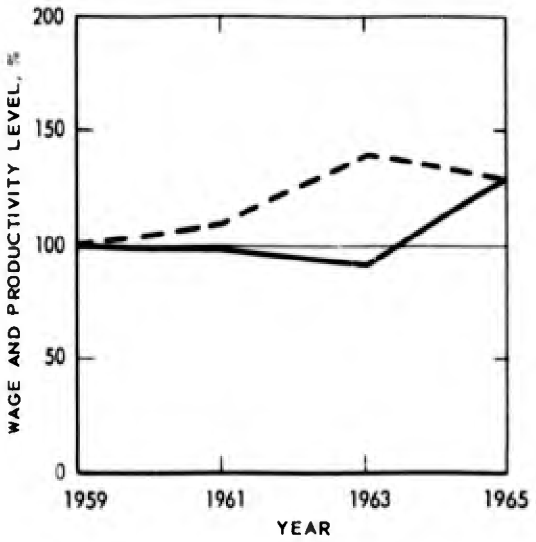
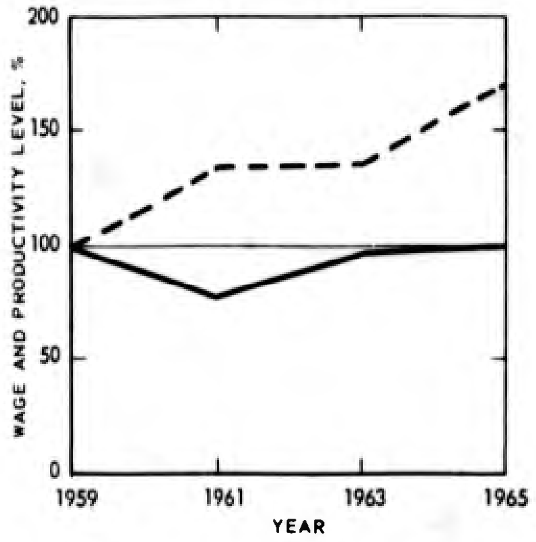


Fig D2—Industry Average Wage of Personnel Compared with Productivity—Base Year 1959

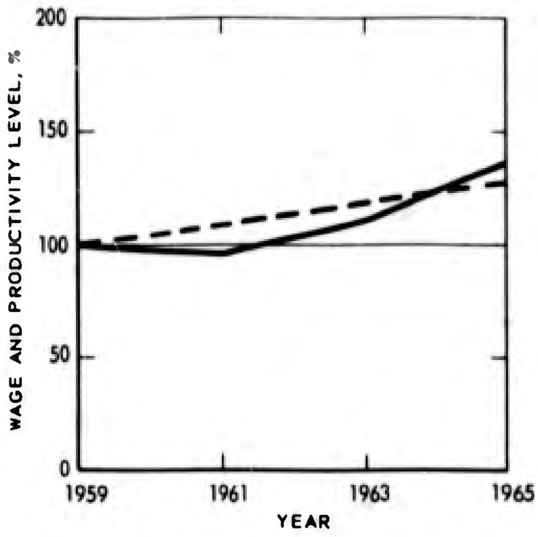
——— Productivity — — — Wage



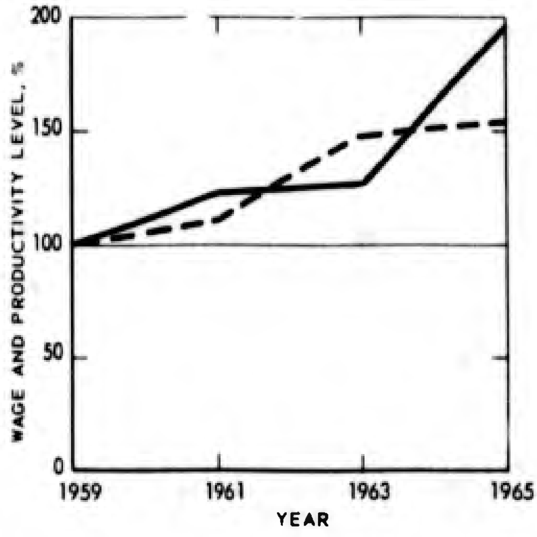
Service Administration
Parameter: revenue passenger miles.
(Objective account, 6326.1)



General Reservation and Sales
Parameter: revenue passenger miles.
(Objective account, 6526.1)

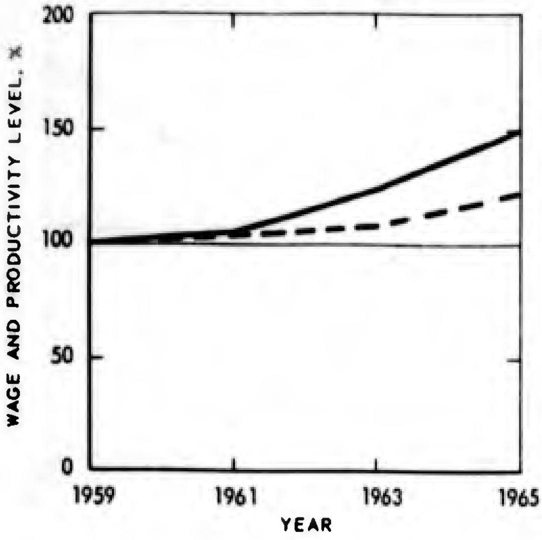


Passenger Reservation and Sales
Parameter: revenue passenger miles.
(Objective account, 6526.3)

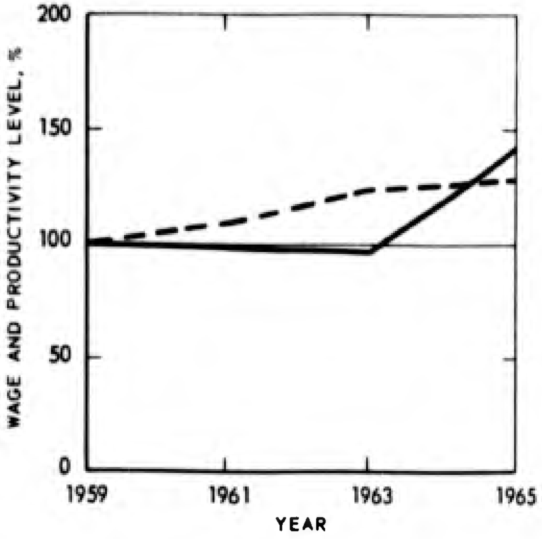


Cargo Reservation and Sales
Parameter: freight ton miles.
(Objective account, 6526.4)

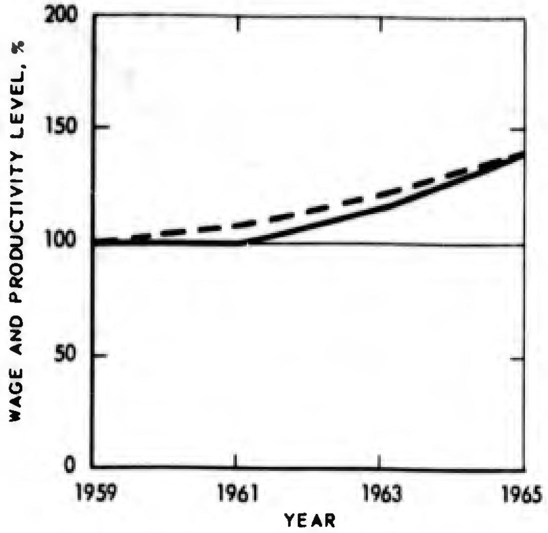
Fig. D2—Continued



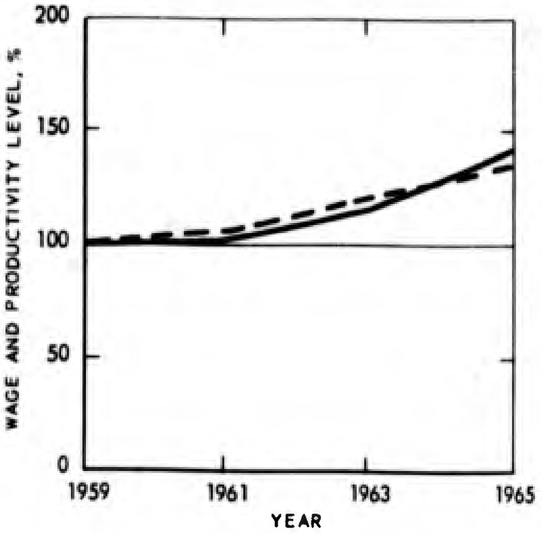
Maintenance
Parameter: revenue passenger miles.
(Objective account, 25)



Traffic Solicitors
Parameter: revenue passenger miles.
(Objective account, 33)

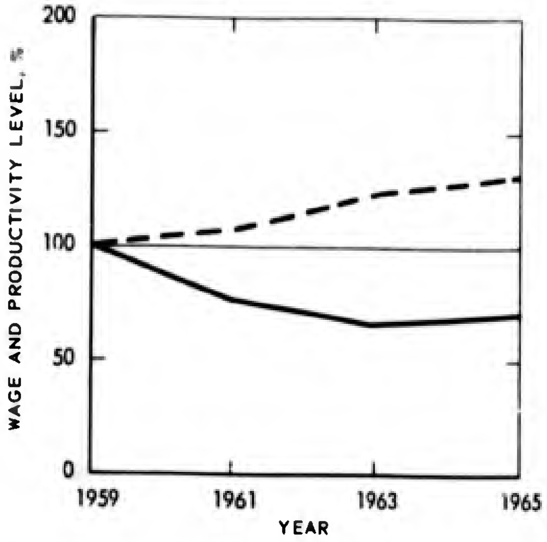


Purchasing
Parameter: revenue passenger miles.
(Objective account, 34)

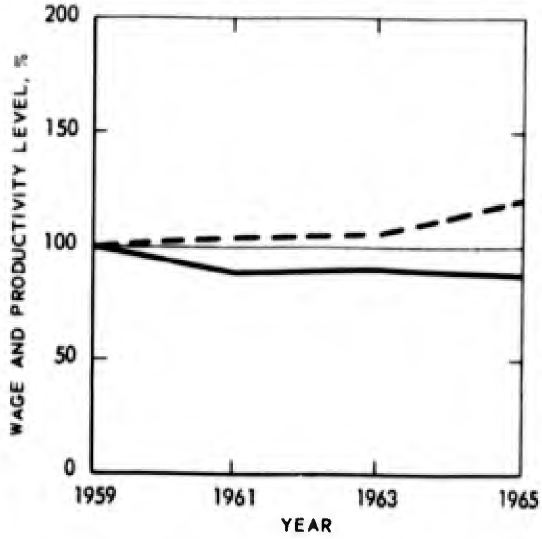


Other
Parameter: revenue passenger miles.
(Objective account, 35)

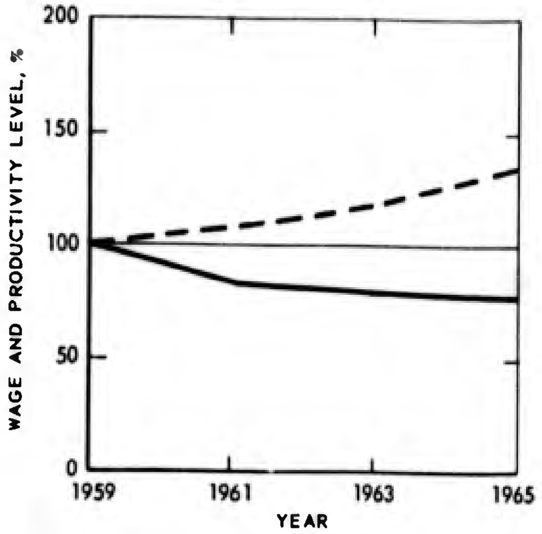
Fig. D2—Continued



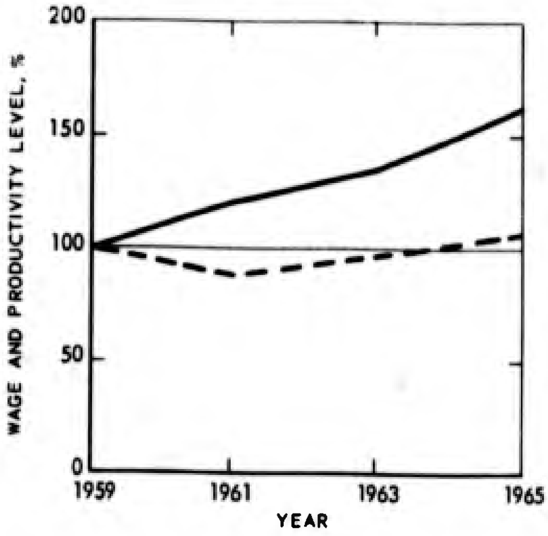
Cabin Attendants
Parameter: flight hours.
(Objective account, 5524)



Aircraft Servicing
Parameter: departures.
(Objective account, 6126.1)

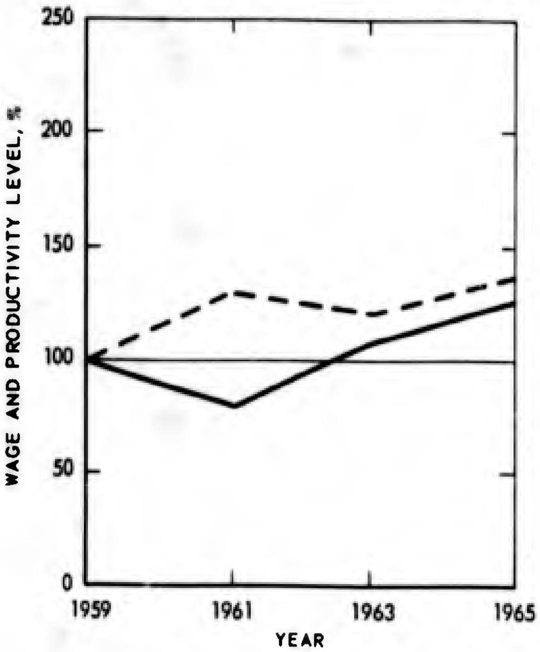


Aircraft Control
Parameter: departures.
(Objective account, 6126.2)

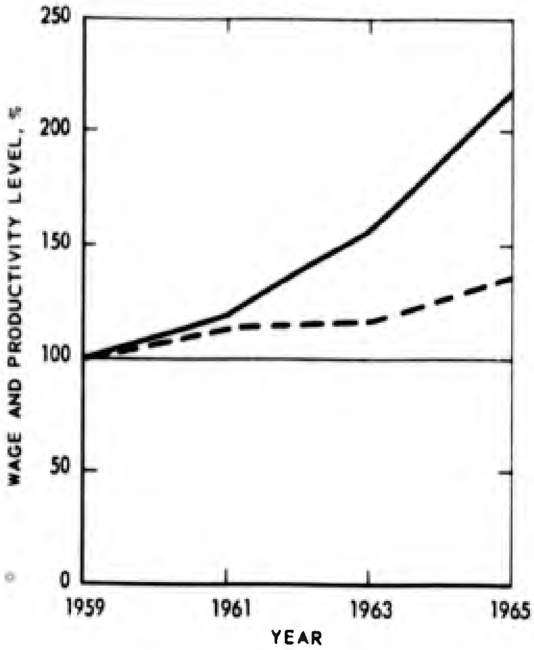


Passenger Traffic Servicing
Parameter: revenue passenger orig.
(Objective account, 6226.1)

Fig. D2—Continued



Passenger Traffic Servicing
Parameter: revenue passenger orig.
(Objective account, 6226.3)



Cargo Handling
Parameter: freight ton-miles
(Objective account, 6226.4)

Fig. D2—Continued

Appendix E

FAA GROUND RULES

Figures

FOR OFFICIAL USE ONLY

SST 66-3

SUPERSONIC TRANSPORT

ECONOMIC MODEL

GROUND RULES

OFFICE OF SUPERSONIC TRANSPORT DEVELOPMENT
FEDERAL AVIATION AGENCY
WASHINGTON, D. C.
JUNE 30, 1966

168

RAC-R-20

FOR OFFICIAL USE ONLY

SUPERSONIC TRANSPORT

ECONOMIC MODEL

GROUND RULES

INTRODUCTION

In order to provide an effective means for determining the relative economics of proposed supersonic transport designs resulting from contract effort, an economic model has been established for use by the manufacturers in conducting their analysis.

These rules, when used in conjunction with the associated performance and design specification data, will provide the basis for computing direct and indirect operating costs anticipated with the aircraft configuration proposed. All costs should be stated in constant 1967 dollars.

SST ECONOMIC MODEL GROUND RULES

I. PERFORMANCE

A. Basic Mission and Mission Fuel Requirements

1. Taxi Out - 10 minutes at ramp weight accounting for time and fuel at taxi thrust.

2. Takeoff - Takeoff gross weight, accounting for time and fuel required to attain 35 ft. altitude.

3. Clean up and accelerate to climb speed accounting for time, distance, and fuel to the beginning of climb.

4. Departuer Air Maneuvering Fuel and Time - 4 minutes at 5,000 feet; at a speed not to exceed 250 knots EAS; takeoff gross weight. No credit for distance.

5. Begin climb at selected airspeed schedule and accelerate to cruise airspeed and altitude accounting for time, distance, and fuel; sonic boom overpressure limit 2.0 psf over land areas (assume for domestic operations) and 2.5 psf for transoceanic overflight (assume for international operations).

6. Cruise - Cruise climb taking into account time, distance, and fuel. Engine power and aircraft weight to be commensurate with cruise requirements. Sonic boom overpressure limit of 1.5 psf over land areas (assume for domestic operations) and 1.7 psf transoceanic overflight (assume for international operations). (If step-climb cruise procedures are followed, account for time, fuel and distance to accomplish each step-climb in increments of 4,000 feet or multiples thereof.)

7. Deceleration - Decelerate to descent airspeed/Mach number at cruise altitude accounting for time, distance, and fuel. Engine power to be commensurate with bleed requirements.

8. Descent - From cruise altitude to 1500 feet accounting for time, distance, and fuel. Engine power commensurate with bleed requirements. Sonic boom limit 1.5 psf overpressure for both domestic and international operations.

9. Destination Air Maneuvering, Approach and Landing Fuel and Time - Equivalent to 5 minutes at 5,000 feet, at a speed not to exceed 250 knots, EAS, and a weight corresponding to takeoff gross weight minus the enroute and enroute reserve fuel. No credit for distance.

SST ECONOMIC MODEL GROUND RULES

I. PERFORMANCE (continued)

A. 10. Taxi-In - 5 minutes at taxi thrust at a weight corresponding to the takeoff gross weight minus enroute (through approach and landing) and enroute reserve fuel. For costing purposes only.

B. Reserve Mission and Reserve Fuel Requirements

1. Enroute - 5% block fuel.

2. Missed Approach - Level off, accelerate, clean up and climb from sea level to 1500 feet, using fuel flow commensurate with power requirements. Initial weight for maneuver shall correspond to takeoff gross weight minus enroute, and enroute reserve fuel.

3. Diversion to Alternate - Divert subsonically 300 statute miles including climb from 1500 feet to best subsonic cruise altitude and then descend to sea level at alternate. Initial weight for maneuver shall correspond to takeoff gross weight minus enroute, missed approach and enroute reserve fuel.

4. Holding - Hold 20 minutes at 15,000 feet over alternate at an initial weight corresponding to takeoff gross weight minus enroute, enroute reserve, missed approach, and diversion to alternate fuel.

NOTE: See Attachment A for basic mission and fuel reserve profiles.

C. Sonic Boom

The SST should have acceptable sonic boom characteristics for unrestricted airline operation over populated land areas as well as over ocean and unpopulated land areas. As a measure of sonic boom acceptability, the following are interim objectives until additional substantiating data are obtained. Trade-off studies should be provided to show the effect of different sonic boom levels on aircraft economics.

a. Land overflight (assume for domestic operations)

Transonic acceleration and supersonic climb - 2.0 psf
Initial cruise - 1.5 psf
Descent - 1.5 psf

b. Transoceanic overflight (assume for international operations)

Transonic acceleration and supersonic climb - 2.5 psf
Initial cruise - 1.7 psf
Descent - 1.5 psf

D. Airport and Community Noise Objectives

The SST should be capable of operating in an airline environment with airport and community noise levels that are acceptable to the public. As interim objectives, until additional substantiating data are obtained, the following maximum airport and community noise levels (for maximum design gross weights and standard day conditions) are established for the purpose of defining the operational capability of the SST and providing a reference for comparative airport evaluations. Compliance with these objectives should not necessitate undue maneuvering or critical speed limiting maneuvers.

Economic analyses shall be based upon the performance capabilities of the aircraft employing noise abatement procedures to minimize community and airport noise levels. In addition, the Contractor will furnish trade-off studies to examine the effect of different noise levels on aircraft economics, including the values stated below:

1. Approach, at one mile from runway threshold - 109 PNdb.

2. During takeoff roll, at 1500 feet either side of the runway centerline 116 PNdb.

3. Takeoff at three miles from brake release - 105 PNdb.

The noise levels, in PNdb, should be progressively less as the outward distance from points (1) and (3) above increases.

E.	Engine TBO	3,000 hours 1/
F.	Utilization	3,000 block hours/year
G.	Flight Profile	Cruise climb, standard day, zero wind and U.S. Standard Atmosphere 1962 (Geometric)

1/ TBO as estimated during FAA evaluations may be a different value.

SST ECONOMIC MODEL GROUND RULES

II. ECONOMIC ANALYSIS

A. Distance Factor

International	1.01
Domestic	1.03

B. Aircraft Sales Price

Manufacturers' price to airlines (constant 1967 dollars), based on 200 aircraft & 1,200 equivalent engines at a stabilized production rate of 3 aircraft per month plus a royalty to repay total development cost through aircraft certification (royalty per aircraft equals total development cost through aircraft certification divided by 300)

C. Direct Operating Cost

The ATA formula, adjusted to constant 1967 dollars, will be used with the following exceptions and/or inputs:

1. Flight Crew — $200/block hour (3-man crew)

2. Fuel — Domestic 11¢/U.S. Gal.
International 12¢/U.S. Gal.
Density 6.7 lbs./Gal. Use heating value of 18,400 BTU/lb.

3. Oil — $7.50/U.S. Gal.
Density 8.1 lbs./Gal.

4. Insurance — 3% (average for life of aircraft) times sales price of complete aircraft (PL & PD factor not included).

5. Depreciation

a. Airframe — Airframe portion of sales price (constant 1967 dollars), excluding development cost:
- Life - 15 years
- Spares - 15% airframe sales price, excluding development cost
- Residual Value - zero

SST ECONOMIC MODEL GROUND RULES

b. Engines	Engine portion of sales price (1967 dollars), excluding development cost: Life - 15 years Spares - 40% dom. & 50% int. x engine sales price, excluding development cost Residual Value - zero
c. Development Royalty	Total development cost through certification divided by 300 aircraft, amortized over 15 years
6. Maintenance Costs	Direct Labor & Direct Materials - Flight Equipment: 1960 ATA Formula, 2/ adjusted by the following correction factors, based on the year 1964 and adjusted to constant 1967 dollars: Aircraft Labor 1.25 Engine Labor 3.19 Aircraft Materials 0.51 Engine Materials 1.04 Applied Maintenance Burden: 1.7 times total direct labor - flight equipment
7. Engine Spare Parts Price Factor	Use 1.3 for maintenance; delete for depreciation
D. <u>Indirect Operating Cost</u>	"Method of Estimating Airline Indirect Expenses", dated 8/20/64, prepared by the Boeing Company and Lockheed Aircraft Corporation, as summarized in Attachment B, adjusted to constant 1967 dollars.

2/ (a) Thrust factor to be used in ATA Formula for engine maintenance labor is defined as follows: "That thrust required per engine for a maximum gross weight takeoff, standard day, sea level static for the particular SST aircraft/engine combination being considered."
(b) Exclude development cost from sales price in ATA Formula for computing airframe & engine material maintenance costs.

SST ECONOMIC MODEL GROUND RULES

III. ECONOMIC POTENTIAL

A. Average Domestic Distance	1,455 statute miles
B. Average International Distance	1,980 statute miles
C. Current Average Yield	Domestic Coach 5.66¢/statute mile First Class 6.50¢/statute mile International Coach 5.50¢/statute mile First Class 8.55¢/statute mile
D. Mixed Configuration	Domestic - Coach 80% First Class 20% International - Coach 90% First Class 10%
E. Seat Pitch	Domestic - Coach 36" First Class 38" International - Coach 34" First Class 40"
F. Minimum Seat Width	17½"
G. Load Factor	Domestic - 55% International - 55%
H. Mail/Express Revenue	3,000 pounds @ 10 lbs./cu. ft. Domestic - $.30/ton mile International - $.40/ton mile
I. Passenger and Baggage Weights	200 pounds per passenger, domestic & international. Includes 40 lbs. free baggage

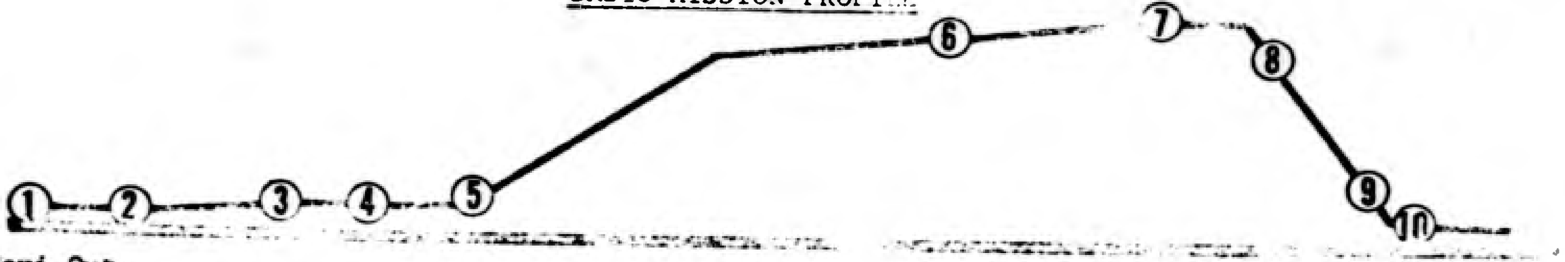
J. Cost per Seat Mile and per Passenger Mile

Seat mile cost will be computed for each trip as follows:
Trip cost in dollars, reflecting payload weights and number of passengers based on the average passenger load factor and segments flown for required fuel stops, divided by the total trip distance times the maximum number of seats which can be occupied on the longest leg of the trip.

System seat mile cost will be computed by summing the products of the seat mile cost per trip multiplied by the number of times each trip is flown and by dividing by the total number of trips.

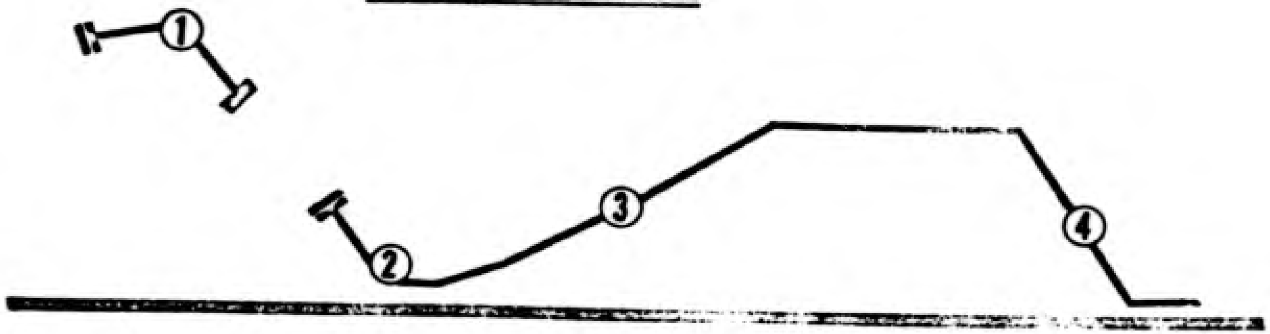
Passenger mile cost may be computed by dividing the seat mile cost, which reflects the average passenger load, by the passenger load factor.

BASIC MISSION PROFILE



(1) Taxi Out.
(2) Takeoff.
(3) Cleanup and Accelerate to Climb Speed.
(4) Departure Air Maneuvering Fuel.
(5) Begin Climb.
(6) Cruise Climb.
(7) Deceleration.
(8) Descent.
(9) Destination Air Maneuvering, Approach, and Landing.
(10) Taxi-In.

FUEL RESERVE PROFILE



(1) Enroute.
(2) Missed Approach.
(3) Diversion to Alternate.
(4) Holding.

Fig. E1—Sample Profiles

METHOD OF ESTIMATING AIRLINE INDIRECT EXPENSES

Domestic Formulas
$/Block Hour

ITEM 1. $\$/\text{hr.} = 0.31 \left(\frac{\text{Aircraft Direct Maintenance Labor Dollars}}{\text{Aircraft Block Hours}}\right)$

ITEM 2. $\$/\text{hr.} = 1.05 \left(\frac{\text{Aircraft Departures}}{\text{Aircraft Block Hours}}\right)\left(\frac{\text{Maximum Design Landing Weight}}{1000}\right)$

ITEM 3. $\$/\text{hr.} = 16.85 \left(\frac{\text{Aircraft Departures}}{\text{Aircraft Block Hours}}\right)$

ITEM 4. $\$/\text{hr.} = 8.50 \left(\frac{\text{Coach Seats}}{40} + \frac{\text{First Class Seats}}{20}\right)$

ITEM 5. $\$/\text{hr.} = 0.51 \left[(\text{Saleable Coach Seats} \times \text{Load Factor}) + (1.75 \times \text{Saleable First Class Seats} \times \text{Load Factor})\right]$

ITEM 6. $\$/\text{hr.} = 4.00 \left[\frac{(\text{Saleable Coach Seats} \times \text{Load Factor}) + (\text{Saleable First Class Seats} \times \text{Load Factor})}{\text{Aircraft Block Hours}}\right] (\text{Passenger Enplaned to On Board Ratio}^{*})$

ITEM 7. $\$/\text{hr.} = 48.80 \left[\frac{(\text{Tons of Baggage On Board} \times \text{Passenger Enplaned to On Board Ratio}^{*}) + (\text{Tons of Mail, Express and Freight On Board} \times \text{Cargo Enplaned to On Board Ratio}^{*})}{\text{Aircraft Block Hours}}\right]$

ITEM 8. $\$/\text{hr.} = 0.0042 \left[(\text{Saleable Coach Seats} \times \text{Load Factor}) + (\text{Saleable First Class Seats} \times \text{Load Factor})\right] \left(\frac{\text{Flight Distance}}{\text{Aircraft Block Hours}}\right)$

ITEM 9. $\$/\text{hr.} = 0.0067 \ (\text{Tons of Freight On Board}) \left(\frac{\text{Flight Distance}}{\text{Aircraft Block Hours}}\right)$

ITEM 10. $\$/\text{hr.} = 0.0475 \left(\frac{\text{Total Operating Expense Except General and Administrative and Flight Equipment Depreciation}^{**}}{\text{Aircraft Block Hours}}\right)$

TOTAL INDIRECT EXPENSE = Sum of Items 1 through 10.

*Enplaned to On Board Ratio notes:

(1) See Figure 1 for Domestic Passenger values.

(2) Cargo value equals 75% of Passenger value except as indicated by (3) below.

(3) Passenger and Cargo values of 1.0 are applicable to turnaround operations.

**Flight equipment rental or lease costs should be considered depreciation for the purpose of computing General and Administrative expense. (ITEM 10)

METHOD OF ESTIMATING AIRLINE INDIRECT EXPENSES

International Formulas
\$/Block Hour

ITEM 1. $\$/\text{hr.} = 0.41 \left(\frac{\text{Aircraft Direct Maintenance Labor Dollars}}{\text{Aircraft Block Hours}}\right)$

ITEM 2. $\$/\text{hr.} = 2.60 \left(\frac{\text{Aircraft Departures}}{\text{Aircraft Block Hours}}\right)\left(\frac{\text{Maximum Design Landing Weight}}{1000}\right)$

ITEM 3. $\$/\text{hr.} = 60.80 \left(\frac{\text{Aircraft Departures}}{\text{Aircraft Block Hours}}\right)$

ITEM 4. $\$/\text{hr.} = 11.55 \left(\frac{\text{Coach Seats}}{24} + \frac{\text{First Class Seats}}{12}\right)$

ITEM 5. $\$/\text{hr.} = 0.46 \left[(\text{Saleable Coach Seats} \times \text{Load Factor}) + (3.50 \times \text{Saleable First Class Seats} \times \text{Load Factor})\right]$

ITEM 6. $\$/\text{hr.} = 11.60 \left[\frac{(\text{Saleable Coach Seats} \times \text{Load Factor}) + (\text{Saleable First Class Seats} \times \text{Load Factor})}{\text{Aircraft Block Hours}}\right]$ (Passenger Enplaned to On Board Ratio*)

ITEM 7. $\$/\text{hr.} = 59.80 \left[\frac{(\text{Tons of Baggage On Board} \times \text{Passenger Enplaned to On Board Ratio*}) + (\text{Tons of Mail, Express and Freight On Board} \times \text{Cargo Enplaned to On Board Ratio*})}{\text{Aircraft Block Hours}}\right]$

ITEM 8. $\$/\text{hr.} = 0.0074 \left[(\text{Saleable Coach Seats} \times \text{Load Factor}) + (\text{Saleable First Class Seats} \times \text{Load Factor})\right]\left(\frac{\text{Flight Distance}}{\text{Aircraft Block Hours}}\right)$

ITEM 9. $\$/\text{hr.} = 0.0219 \left[(\text{Tons of Freight On Board})\right]\left(\frac{\text{Flight Distance}}{\text{Aircraft Block Hours}}\right)$

ITEM 10. $\$/\text{hr.} = 0.0565 \left(\frac{\text{Total Operating Expense Except General and Administrative and Flight Equipment Depreciation**}}{\text{Aircraft Block Hours}}\right)$

TOTAL INDIRECT EXPENSE = Sum of Items 1 through 10.

*Enplaned to On Board Ratio notes:

(1) See Figure 2 for International Passenger values.

(2) Cargo value equals 75% of Passenger value except as indicated by (3) below.

(3) Passenger and Cargo values of 1.0 are applicable to turnaround operations.

**Flight Equipment rental or lease costs should be considered depreciation for the purpose of computing General and Administrative expense. (ITEM 10)

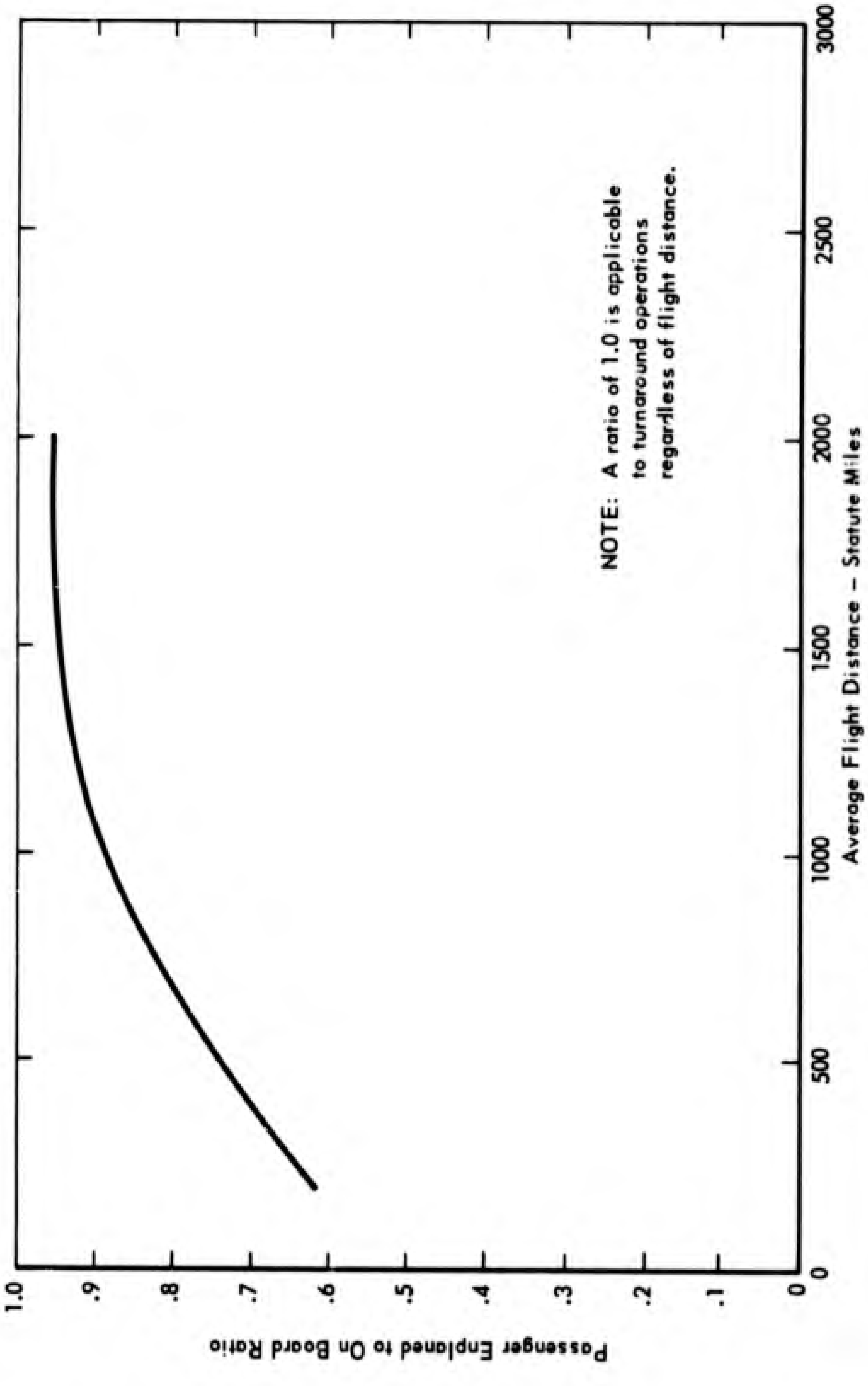


Fig. E2—Passenger-Enplaned to On-Board Ratio as a Function of Average Flight Distance, Domestic Operation

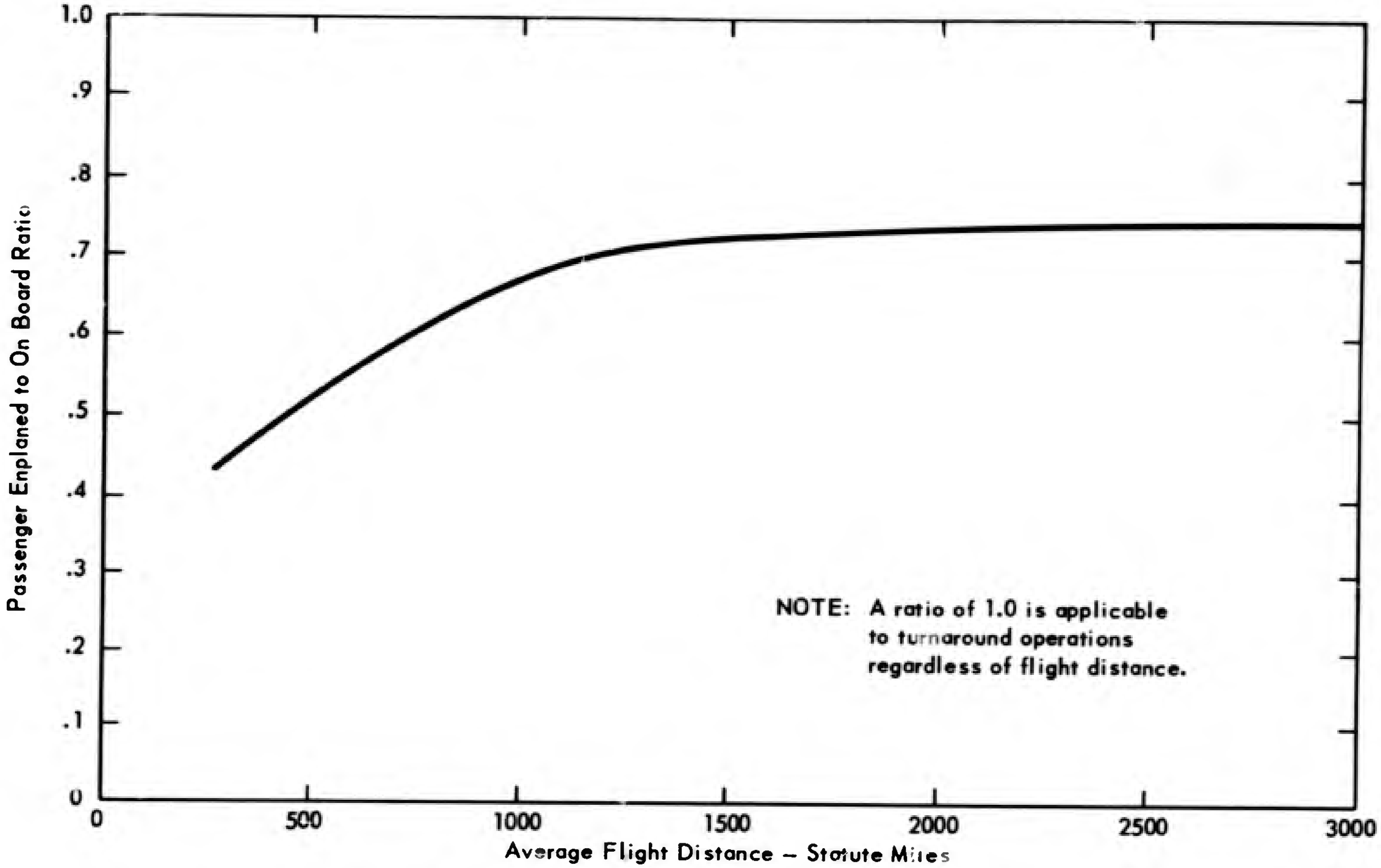


Fig. E3—Passenger-Enplaned to On-Board Ratio as a Function of Average Flight Distance, International Operation

Appendix F

LIST OF CONTACTS

CHRONOLOGICAL LISTING OF VISITS MADE DURING STUDY

Visit Dates	Company	Location
March 19	North American	Washington, D.C.
April 18	Pratt and Whitney	West Palm Beach, Florida
April 22	General Electric, Avondale Plant	Cincinnati, Ohio
April 26-28	American Airlines TWA Eastern Airlines Pan Am	New York, New York
April 28-29	Lockheed	Burbank, California
May 2-3	Boeing	Seattle, Washington
May 12	Eastern TWA	New York, N.Y.
May 16-17	American Pan Am	New York, N.Y.
June 27-July 1	TWA Eastern Pratt and Whitney	Kansas City, Kansas Miami, Florida West Palm Beach, Florida
July 24-29	Boeing Lockheed	Seattle, Washington Burbank, California

VISIT REPORT

COMPANY VISITED: North American Aviation Offices, Washington, D.C.

DATE: 19 March 1966

PERSONS CONTACTED: Mr. G. Hillery, local representative
Mr. D. Baldwin, Los Angeles Div.

AREAS OF DISCUSSION AND INFORMATION OBTAINED:

1. R.A. Booth and Mr. C. Sites of RMC were briefed on work done by NAA for the SST Phase I competition. Main emphasis was placed on computer programs that NAA developed for the economic analysis.

TRIP REPORT

SUBMITTED BY: Lawrence G. Regan - RAC
James L. Johnston - RMC

COMPANY VISITED: Pratt & Whitney Florida Research and Development Center, West Palm Beach, Florida

DATE: April 18, 1966

PERSONS CONTACTED: Mr. Gordon Titcomb
Mr. James Landsdale
Mr. William King.
Mr. L. Weldon
Mr. Kieth Carrier
Mr. Bruce Terell
Mr. Jack Craig
Mr. Sid Nuzum, Washington Representative
Mr. Paul Hall, East Hartford Plant

AREAS OF DISCUSSION AND INFORMATION OBTAINED:

1. Discussed proposed P & W SST engine.

2. Reviewed their methods for estimating procurement and operating costs.

TRIP REPORT

SUBMITTED BY: James L. Johnston

COMPANY VISITED: General Electric, Evandale Plant
Cincinnati, Ohio

DATE: 22 April 1966

PERSONS CONTACTED: Mr. B. Gordon
Mr. D. Grierson
Mr. J. Melzer
Mr. D. Moss
Mr. J. Stiles

AREAS OF DISCUSSION AND INFORMATION OBTAINED:

1. Description of SST engine.

2. Methodology for estimating engine maintenance costs.

FOR OFFICIAL USE ONLY

TRIP REPORT

SUBMITTED BY: Lawrence G. Regan

COMPANY VISITED: American Airlines, New York, N.Y.
TWA
Eastern
Pan American

DATE: 26-28 April 1966

PERSONS CONTACTED:

American - Mr. George Hitchings
Mr. Dave Blandell
Mr. Joe Evans
Mr. Bob Griffin
Mr. Frank Colp

TWA - Mr. R. Verne Radcliffe
Mr. Art. R. Smock
Mr. Colton Daly
Mr. Neil M. Effman
Mr. Robert L. Kinhoff
Mr. Ross Santy

Eastern - Mr. W.M. Crilly
Mr. Henry Sweezy
Mr. Wes A. Holdohl
Mr. Marcy B. Fannon
Mr. E. Dan Morton
Mr. John P. Doty

Pan American - Mr. Sam Kaufman
Mr. Lee Monson
Mr. Bill Hibbs
Mr. Borger

AREAS OF DISCUSSION AND INFORMATION OBTAINED:

1. The primary purpose of the trip was to establish contact with the necessary airline personnel interested in the SST and to brief them on the FAA and contractor study effort in process.

2. The lengthy discussions included the following:

(a) model design

(b) fuel reserves

(c) approach to the direct operating cost

(d) the use of the British approach (BAC) to figure maintenance costs by Eastern

(e) PAA method for computing maintenance cost.

TRIP REPORT

SUBMITTED BY: S.A. LaMar - RAC

COMPANY VISITED: Lockheed-California Company, Burbank, California

DATE: April 28-29, 1966

PERSONS CONTACTED: W.R. Kennedy
W. Siegenthaler
E.L. Keefe
R.F. Kuechenberg
W.P. Erickson
D. Gardetto

AREAS OF DISCUSSION AND INFORMATION OBTAINED:

1. The derivation of the indirect operating cost formulas was traced and the significance of the various parameters chosen to measure activities was discussed.

2. A discussion was held relative to the items of ground support equipment that will be required for the SST.

TRIP REPORT

SUBMITTED BY: S.A. LaMar - RAC

COMPANY VISITED: The Boeing Company, Seattle, Washington

DATE: May 2-3, 1966

PERSONS CONTACTED: W. Bone
M.E. Miller
K. Sansburn
M.G. Dolan
R.T. Dixon

AREAS OF DISCUSSION AND INFORMATION OBTAINED:

1. The derivation of the indirect operating cost formulas was traced and the significance of the various parameters chosen to measure activities was discussed.

2. A tentative list of ground support equipment that will be required for SST operations was provided.

TRIP REPORT

SUBMITTED BY: S.A. Lamar

COMPANY VISITED: Eastern Airlines, New York, N.Y.
TWA

DATE: May 12, 1966

PERSONS CONTACTED: Eastern - R.L. Arnold
M.B. Fannon
V.P. Sacchetti
TWA - R. Santy

AREAS OF DISCUSSION AND INFORMATION OBTAINED:

Discussions in depth were held on all aspects of indirect operating costs and the formulation of predictive equations.

TRIP REPORT

SUBMITTED BY: S.A. LaMar

COMPANY VISITED: American Airlines, New York, N.Y.
Pan American

DATE: May 16-17, 1966

PERSONS CONTACTED: American - J. Evans

Pan Am - J. Borger
W. Hibbs

AREAS OF DISCUSSION AND INFORMATION OBTAINED:

Discussions in depth were held on all aspects of indirect costs and the formulation of predictive equations.

TRIP REPORT

SUBMITTED BY: Lawrence G. Regan

COMPANY VISITED: Trans World Airlines, Kansas City, Kansas
Eastern Airlines, Miami, Florida
Pratt & Whitney, West Palm Beach, Florida

DATE: June 27 - July 1, 1966

PERSONS CONTACTED:

TWA - Ed Carroll
Don Graff
Bill Sherwood

Eastern - R. Wilson
Charles Nichols

Pratt & Whitney - Jack Craig
Paul Hunt
Jim Lonsdale
Gordon Titcomb

AREAS OF DISCUSSION AND INFORMATION OBTAINED:

1. Discussion with TWA was generally directed towards engine and airframe maintenance costs.

2. Discussion with Eastern Airlines was concerned entirely with subsonic costs on the 707 aircraft.

3. Levels of engine maintenance and labor costs on the subsonics were the topics of main interest at Pratt and Whitney.

TRIP REPORT

SUBMITTED BY: L.G. Regan

COMPANY VISITED: The Boeing Company, Seattle, Washington
Lockheed-California Co., Burbank, California

DATE: July 24 - 29, 1966

PERSONS CONTACTED:

Boeing - H.W. Withington
Charles Jackson
Bill Bone
Leo Culgat
Gene Miller
Henry Montgomery
Mark M. Smaky

Lockheed - Robert Stoessel
Bill Kennedy
Ray Fisher

AREAS OF DISCUSSION AND INFORMATION OBTAINED:

The main topics of discussion at Boeing were:

1. Availability and timing

2. Maintenance cost methodology for the SST

3. Utilization levels expected.

Discussion at Lockheed included the following:

1. Utilization of the SST.

2. Maintenance pooling--Mr. Fisher is confident that airlines will pool maintenance.

US GOVERNMENT AGENCIES

Civil Aeronautics Board

G. Stillwagon
F. Lewis
J. Constantz
S. Brown
M. Burnett

Federal Aviation Agency

A. H. Skaggs
L. Irons
R. Westburg
S. Gaffen
O. H. Mendenhall

National Aeronautics and Space Agency

E. Foss

MANUFACTURERS

The Boeing Corporation

C. E. Jackson
A. Stutz
R. Doll
W. Bone
M. E. Miller
L. B. Ririe
K. Sansburn
L. T. Goodmanson
D. Bale
L. Vargha
R. Snodgrass
W. C. West
J. Bostrom
C. S. Howell
J. D. McMinn
H. Montgomery
M. M. Smaby
M. G. Dolan
L. Culvat
J. W. Becker
H. B. Phelps
N. Barr
R. T. Dixon
D. M. Rognlie
G. C. Weldin

Douglas Aircraft Corporation

H. Kimbriel
B. Guarneri
H. Bayer
G. Harris

General Electric Corporation

D. R. Moss
J. Melzer
B. J. Gordon
J. Stiles
D. Girierson
A. Rhodes

Lockheed Aircraft Corporation

R. A. Bailey
P. A. Colman
W. P. Kennedy
R. F. Stoessel
J. F. McDonald
J. E. Reed
R. G. Fliedner
G. A. Busch
J. A. Shite
B. D. O'Laughlin
R. W. Child
W. Siegenthaler
R. F. Kuenchenberg
W. P. Erickson
E. L. Keefe
D. Gardetto
R. Fisher

North American Aviation, Inc.

D. Baldwin
G. Hillery

Pratt & Whitney

J. Craig
J. Lonsdace
G. Titcomb
B. Terell
J. S. Nuzum
P. Hall

AIRLINES

Air Transport Association

E. Kelly
E. Thomas
N. Fleer

American Airlines

G. P. Hitchings
D. Blandell
S. J. Evans
R. Griffin
F. Colp
R. J. Sutherland

Braniff International

R. V. Carlston

Continental Airlines

F. G. Colnar

Delta Airlines

P. Pate

Eastern Airlines

W. M. Crilly
H. Sweezy
W. A. Holdohl
M. B. Fannon
E. D. Morton
J. P. Doty
R. L. Arnold
V. P. Sacchetti
R. Wilson
C. Nichols

Pan American Airways

S. Kaufman
L. Monson
W. F. Hibbs
J. Borger
C. K. Brooke
C. Kneisec

Transworld Airlines

R. V. Radcliffe
A. R. Smock
C. Daly
N. M. Effman
R. L. Kinhoff
R. Santy
E. Carroll
D. Graf
W. Sherwood

United Airlines

H. Hubert
J. G. Brown
H. Kincaid
S. M. deVoursney

RESEARCH ORGANIZATIONS

Booz-Allen Applied Research, Inc.

T. Clancy

Cornell Aeronautical Laboratories

C. D. Mayerson
R. W. Schultz

Institute for Defense Analyses

N. Asher
W. Beazer
W. Miskanen

Planning Research Corporation

R. Ulvestad
R. Morris

Resource Management Corporation

L. Sanchez
J. Willyard
J. Johnston

BLANK PAGE

BIBLIOGRAPHY

ECONOMICS AND STATISTICS

Air Transport Association, "Standard Method of Estimating Comparative Direct Operating Costs of Transport Airplanes," Washington, D. C., June 1960.

Air Transport Association, "Standard Method of Estimating Comparative Direct Operating Costs of Transport Airplanes," Washington, D. C., June 1965 (Draft).

Robert F. Stoessel, Eugene L. Keefe, and Charles E. Sowle and Ray A. Tedrick, "More Realism in a Standard Method for Estimating Airline Operating Expense," Lockheed Aircraft Company, Burbank, Calif., Mar 66.

Robert G. Steiner, "Proposed New ATA Formula," The Boeing Company, Renton, Washington, 8 Dec 66. (Ltr to Mr. Lawrence G. Regan, Research Analysis Corporation, McLean, Va.)

Daniel R. Moss, "Proposed Revision to the Standard Method of Estimating Comparative Operating Costs of Transport Airplanes," General Electric Company, Evendale, Ohio, 12 Aug 65. (Ltr to Mr. Allen W. Dallas, Air Transport Association.)

Paul Hall, "P & W Proposed Revision to ATA Direct Operating Cost Method," Pratt & Whitney Aircraft, East Hartford, Sept 65. (Second Technique)

Modecai Ezekiel and Karl A. Fox, Methods of Correlation and Regression Analysis, John Wiley & Sons, Inc., New York, 1963.

F. B. Brown, D. S. Orland, J. P. Bowling, R. J. Byer and N. Simat, Cost Estimating Relations for Aircraft, Vol I, Vol 22, and Vol 222, Operations Research Incorporated, Silver Spring, Md., 15 Dec 64.

G. H. Johnson, H. D. Orenstein and R. B. Ulvestad, "Methodology for Estimating Development, Production and Operating Costs of Transport Aircraft," Planning Research Corporation, Washington, D. C., 15 Dec 64.

Paul A. Samuelson, Economics, McGraw-Hill Book Company, New York, 1946, pp 67-69, 292-334.

Paul Hall, "Basic Data-Airline Reports to the CAB," Pratt & Whitney Aircraft, East Hartford, 12 Oct 65.

W. J. Dixon (ed), BMD Biomedical Computer Programs, Health Sciences Computing Facility, Department of Preventative Medicine and Public Health, School of Medicine, University of California, Los Angeles, 1 Jan 64, p 240.

Paul Hall, "Time Between Overhaul," Pratt & Whitney Aircraft, SS-1230RI3, East Hartford, 1966.

Dept of Labor, Bureau of Labor Statistics, Employment and Earnings Statistics for the US 1900–1962, US Govt Printing Office, Washington, D. C., 1963, pp 34–35.

Federal Aviation Agency, FAA Statistical Handbook of Aviation, US Govt Printing Office, Washington, D. C., 1965 Ed, Sept 1965.

Civil Aeronautics Board, Handbook of Airline Statistics (1963 Ed), US Govt Printing Office, Washington, D. C., 1964, p 11.

AIRCRAFT PERFORMANCE

Civil Aeronautics Board, "Uniform System of Accounts and Reports, 1 June 1965," July 1965.

NASA, "Conference on Aircraft Operating Problems," SP-83, May 1965.

Subsonic

Boeing Co., "Data Characterized by Aircraft 707-320B," 1965.
——, "Boeing Jet Family Document—Comparative Performance and Operating Costs," S-239, December 1965.
——, "Summary of Basic Performance Characteristics of All 707, 720 and 727 Models of Boeing Transports," D6-9311, March 1965.
——, "Performance of the Boeing Jet Transport Model 747 with JT9D Engines," D6-58131, April 1966.
——, "Boeing Model 747," D6-58205, May 1966.
CAB, "Air Carrier Analytical Charts and Summaries—12 Months Ending June 30, 1965," Vol VII-2, July 1965.
Douglas Aircraft Co., Inc., "Loading Summary, Domestic 124 Passenger, Basic Airplane JT4A-9 or 10 Engines," 1966.
——, "Douglas Cargo Development, DC-8F Model 55," September 1965.
——, "The Douglas DC-8 Super 60's and DC-9 Series Airplanes," December 1965.
——, "A Progress Report on the Douglas DC-10," 1966.
——, "DC-8F Jet Trader," 43171, November 1962.
——, "Design Pages of Douglas DC-8 Family," 1962.
——, "The Commercial C-5A in the Future Air Transport System," 49786, May 1965.
——, "A Compilation of Competitive Aircraft Data," SM-23784, 1959.
SAE, "Aircraft for Long Range and Long Endurance Missions," 869D, April 1964.
——, "Requirements for Long Range—Long Endurance Aircraft," 869A, April 1964.

Supersonic

Aerospace Electrical Society, "Supersonic Aircraft Avionics Symposium March 3 and Beyond," (Including Maintenance and Avionics Flight Life Estimates), Technical Papers, July 1964.
Air Force Systems Command, "Supersonic Air Commerce—Problems and Projects," FTD-TT-64-463/1+2, November 1964.
Boeing Co., "Today: Growing Technology, Growing Capability, Growing System—Boeing Supersonic Moving Forward Through the Jet Age," 1965.
——, "Commercial Supersonic Transport Program, Phase II-C, Interim Aircraft Performance Report," D6-19901-2, November 1965.
——, "Boeing SST Model 733," April 1965.
British Aircraft Corp. and Sud Aviation, "Concorde," 1965.
——, "Progress Report on Concorde," No. 2, January 1966.
Congressional Hearings, 89th Congress, 1965.
——, 86th Congress, 1960.
Cornell Aeronautical Laboratory, Inc., "Supersonic Transport Systems Analysis," Second Interim Report BM-1786-G-2 January 1964 and Final Report January 1965.
Federal Aviation Agency, "Performance Data on Concorde," Section 5, 1966.
NASA, "A Simulator Study of Airspace Requirements for the Supersonic Transport," TN D-1964, September 1963.
——, "Performance Tradeoffs and Research Problems for Hypersonic Transport," July 1965.
——, "Exploratory Studies of Mechanical Cycling Fatigue Behavior of Materials for the Supersonic Transport," CR-28 April 1964.
——, "Phase II-C Interim Assessment of the Lockheed L-2000-7 Configuration," May 1966.
SAE, "Concorde—A Concept for International Industrial Collaboration," 911F, October 1964.
——, "Some Technical Aspects of Concorde," 853C, April 1964.
——, "Performance and Flying Qualities of the Double-Delta SST," 911J, 1965.
——, "Variable Sweep Application to the SST," April 1964.

OPERATIONS

Aviation Report Supplement, "Civil and Military Aircraft Inventories, Exports and Production," No. 88, March 1960.

Aviation Report Supplement, "Airline Ownership, Fleets and Liner Prices," No. 98, January 1961.
——, "The US Aircraft Industry," No. 100, March 1961.
NASA, "Conference on Aircraft Operating Problems," A Compilation of Papers Presented May 1965.
SAE, "Planning for the Introduction of a New Aircraft into an Airline Fleet," 841D, 1964.

Airline

Airborne Instruments Laboratory, "Statistical Analysis of Aircraft Delay," 1400-6, July 1965.
Air Transport Association, "Standard Method of Estimating Comparative Direct Operating Costs of Transport Airlines," June 1960.
American Society of Civil Engineers, "Application of Supersonic Transport to Airline Operations," October 1964.
Boeing Co., "Flight Operations and Safety," D6-8680-10, Vol X-A, November 1964.
Civil Aeronautics Board, "Historical Review of Trunkline Suspensions and Deletions At Points Served by Local Service Carriers, Jan 1, 1949 to Dec 31, 1963," January 1964.
——, "Chronological and Carrier Summaries, Supplement No. 2—Jan 1, 1949 to Dec 31, 1963," November 1964.
——, "Local Service Air Carriers' Unit Costs, Year Ended Sept 30, 1965," December 1965.
——, "Air Carrier Financial Statistics," Vol XIII-2, 1965.
——, "Direct Operating Costs and Other Performance Characteristics of Transport Aircraft in Airline Service, Calendar Year 1964," 1965.
——, "Air Passenger Traffic Data Seasonally Adjusted Domestic Trunk Operations by Carrier and Class of Service, 1953–1964," December 1964.
——, "Air Carrier Traffic Statistics, 12 Months Ended Sept 30, 1965," Vol XI-9, 1965.
——, "Financial and Operating Statistics for Air Carriers," 1964.
——, "Local Service Air Carriers Selected Flight Load Data by City Pair, by Frequency Grouping, by Aircraft Type—12 Months Ended Dec 31, 1964," June 1965.
——, "Before and After Traffic and Service Supplement to Historical Review of Trunk Line Suspensions and Deletions At Points Served By Local Service Carriers, Jan 1, 1949 to Dec 31, 1963," May 1964.
Federal Aviation Agency, "Scheduled Air Carrier Flight Activity in the US, May 1965," RD65-76, July 1965.
Lockheed Aircraft Co., "More Realism in a Standard Method of Estimating Airline Operating Expense," No. OEA/SST/179, March 1966.
——, "Flight Operations and Safety," Vol X-A, No. LR18193, November 1964.
Pratt & Whitney, "Proposed Revision to ATA Direct Operating Cost Method," March 1966.
SAE, "Crash Protection of Air Transport Passengers," 920A, 1964.
——, "Scheduling the Supersonic Transport," 853B, 1964.
——, "Operating Techniques and Maintenance Practices for the Lockheed Supersonic Transport," 660295, April 1966.

Other

Air Transport Association, "1965 Facts and Figures—Air Transportation," 1966.
Boeing Co., "World Wide Airline Simulation Model," 1966.
——, "Winds for North American Air Routes," D6-9176, July 1962.
——, "Equivalent Winds for World Air Routes," Reviews in Geophysics No. 6, August 1962.
——, "Equivalent Winds for World Air Routes," Reviews in Geophysics D6-9177, July 1962.
——, "Temperature for World Air Routes," Reviews in Geophysics, August 1962. BOAC, "Difficulties and Advantages of Supersonic Civil Transport—a Discussion," October 1965.
Federal Aviation Agency, "Design for the National Airspace Utilization System," June 1962.
RAND Corp., "Some Military Aspects of Supersonic Transports," P-1575, December 1958.
Society of Automotive Engineers, "Crash Safety Tests of Two Transport Aircraft," 920C, 1964.

Society of Automotive Engineers, "Some Flight Deck Design Considerations for the SST," 911H, October 1964.

——, "Data for Fail-Safe Design of the SST Pressure Cabin," 858A, April 1964.

ECONOMICS

Dept of the Air Force, "USAF Planning Factors," Publications Manual 172-3, June 1965.

——, "USAF Planning Factors, Peacetime and Wartime," Vol I, Publications Manual 172-3, June 1965.

Aviation Studies (International) Ltd., "Aircraft Operating Costs, II—Fixed Wing Turbine Types," Supplement No. 90, May 1960.

——, "Civil and Military Aircraft Inventories, Exports and Production," Supplement No. 88, March 1960.

——, "1960–1970 Declared Forecasts of Traffic, Cargo, Fleets," Supplement No. 99, February 1961.

Boeing Co., "Air Travel Demand Studies, SST," January 1966.

——, "Boeing Recommendations for 1965 ATA Formula," 1966.

Federal Aviation Agency, "Direct Operating Costs and Other Performance Characteristics of Transport Aircraft in Airline Service," September 1965.

——, "SST Economic Model Ground Rules," SST 65-7 (REV), 1965.

Institute for Defense Analyses, "City Pairs Data," May 1966.

Lockheed Aircraft Co., "More Realism in a Standard Method for Estimating Airline Operating Expense," Briefing B-526, March 1966.

——, "Lockheed Comments on Proposed Revisions of the ATA Formula," SL/197963, August 1965.

——, "Use of (US) CAB Statistics on Operating Costs of Civil Transport Aircraft," SLR/1122, March 1953, (REV) July 1965.

Roadcap and Associates, Publishers, "World Airline Record," Sixth Edition, 1965.

Watson, J. D., "Airline Pricing in Canada," August 1965.

<u>Subsonic</u>

Aeronautical Research Institute of Sweden, "Pros and Cons of Supersonic Aviation in Relation to Gains or Losses in the Combined Time-Comfort Consideration," FFA Memo PE-16, 1964.

Congressional Hearing, 86th Congress, June 1960.

Federal Aviation Agency, "The National Airspace System 1965: Major Facilities, Functions, Maintenance Costs," RD-65-25, 1965.

——, "Census of US Civil Aircraft as of December 31, 1964," May 1965.

Northwestern University Transportation Center, "Prices of Used Commercial Aircraft 1959–1965," February 1959.

Society of Automotive Engineers, "A Progress Report on SAE Activities in Reliability and Maintainability," 856A, April 1964.

——, "Producing Jet Transport Reliability," 848B, April 1964.

——, "An Airline Approach to Reliability," 1964.

——, "Improving Reliability Through Performance Recording," 922B, 1964.

——, "Keeping Pace with Jet Transport Requirements Through Product Improvement," 850B, 1964.

Waters, M. H. L. <u>et al.</u>, "Some Technical Factors Influencing the Direct Operating Cost of a Medium Range Civil Jet Transport," February 1965.

<u>Supersonic</u>

Aerospace Reliability and Maintainability Conference, Volume of Technical Papers, May 1963.

Air Transport Association, "The Need for a Supersonic Transport," August 1964.

Aviation Studies (International), Ltd., "Financial Discipline for Cost Computation and Profitability of Major Turbine Aircraft," Supplement No. 95, October 1960.

Boeing Co., "Commercial Supersonic Transport Program, Phase IIA, Comprehensive Report," Volume XIII-A, 1965.

[redacted]

Boeing Co., "Design Economics SST," January 1966.
——, "Direct Operating Costs and Economic Analysis," Commercial SST Proposal, January 1965.
——, "Operating Cost Analyses," January 1966.
——, "Parametric and Tradeoff Studies," Vol XX-A, D6-8680-20, November 1964.
Clement, W. F., et al., "SST Economic Analysis of Navigation Requirements," 1964.
Congressional Hearing, 88th Congress, US Commercial Supersonic Aircraft Development Program.
Congressional Hearing on H. R. 7997—Fleet Costs, Expenditures and Funding of the Supersonic Transport.
Congressional Hearing, 89th Congress, 1966.
Connecticut General Life Insurance Co. Flight Forum. "The Supersonic Transport and National Priorities," April 1965.
Federal Aviation Agency, "United States Supersonic Transport Program. Questions and Answers," SST 65-11, July 1965
——, "United States Supersonic Transport Program," 65-10, July 1965.
International Air Transport Association, "The Supersonic Transport," September 1964.
Lockheed Aircraft Co., "Proposal for the Development of a Commercial Supersonic Transport, Direct Operating Costs, Part One," Vol M-VI, LR17335, January 1964.
——, "Alternate Economic Analysis Proposal for the Development of a Commercial Supersonic Transport," Appendix A, LR17336, January 1964.
——, "Supersonic Transport Development Phase II-A," Vol XIII-A, LR18196, November 1964.
——, "Proposal for the Development of a Commercial Supersonic Transport, Direct Operating Costs, Part Two," Vol M-VI, LR17335, January 1965.
——, "Supersonic Transport Impact on the Commercial Airplane Market," Study No. OEA/SST/170, September 1965.
——, "Operational Performance and Economics," Vols I and II, OEA/SST/176, November 1965.
——, "Parametric and Trade Off Studies," Vol XX-A, LR18203, November 1964.
NASA, "Supersonic Transport Feasibility Studies and Supporting Research," Proceedings of NASA Conference, September 1963, NASA Tm C-905, December 1963.
Society of Automotive Engineers, "The B-58 Reliability Program," SP-183, April 1960.
——, "Economic and Financial Aspects of the SST," 853A, 1964.
——, "Status Report on the Boeing Model 733—SST," 1964.
——, "The Assessment of SST Operating Costs," 911K, 1964.
Stanford Research Institute, "An Economic Analysis of the Supersonic Transport," September 1962.
United Research Inc., "The Feasibility of a Commercial Supersonic Transport Program," October 1960.

PROPULSION

Aviation Studies (International) Ltd., "Horizons in New Propulsion and Engine Statistics," Supplement No. 86, January 1960.
Boeing Co., "History of Engine Prices."
Society of Automotive Engineers, "Field Experience as an Aid to New Engine Development," 1964.
——, "Olympus 593—Tomorrow's Power Plant Today," 911E, October 1964.
——, "Application of Dynamic Simulation Techniques to Engine—Inlet Compatibility Problems on the SST," 911D, October 1964.
——, "Storage Behavior of High Temperature Jet Fuels," 1964.
——, "An Investigation of Catalytic Ignition of JP-5 and Air Mixtures," 918C, 1964.
——, "Application of Regenerative Engines to Current and Future Aircraft," 973C, January 1965.
——, "SST Fuels—A Major Airline Concern," 911C, October 1964.
——, "Delivery of Clean, Dry Thermally Stable Jet Fuel to Supersonic Aircraft by In-Field Catalytic Filtration," S-392, 1964.
——, "The SST Engine Problem—Science Vs Superstition," 911A, October 1964.

[redacted]

[redacted]

ELECTRONICS

Airborne Instruments Laboratory, "Capacity of Airport Systems in Metropolitan Areas," 1400-2, January 1964.

OTHER

NASA, "A Piloted Simulator Study of Longitudinal Handling Qualities of SST in the Landing Maneuver," TN D-2251, April 1964.

Society of Automotive Engineers, "Hydraulic Fluid Temperature Control on Aircraft Requiring Long Endurance at Supersonic Speeds," 927A, October 1964.

SONIC EFFECTS

NASA, "Ground Measurements of Sonic-Boom Pressures for Altitude Range of 10,000 to 75,000 Feet," TR-R-198, July 1964.

Society of Automotive Engineers, "Theoretical Study of the Propagation of Sound. Application to Anticipation of the Sonic Boom Produced by Supersonic Flight," 1964.

SPECIAL MATERIAL FROM CONTRACTORS

Economic Analysis of the Supersonic Transport, Part III—Contractors Reports:

A. Air Travel
B. Cost Performance
C. Sonic Boom
D. Route Simulation

GROUND SUPPORT EQUIPMENT

American Society of Civil Engineers, "Operation of the SST at Airports," October 1964.

——, "Operations of the SST in the Terminal Area," October 1964.

Boeing Co., "Airport Compatibility, SST," January 1966.

Federal Aviation Agency, "Indirect Operating Expense Parameters for Forecasting and Allocating Expense by Type of Aircraft," FAA Parameters and Alternate Parameters, 1966.

Society of Automotive Engineers, "Airport Compatibility with the SST—Problems of Ground Support Equipment," 650208, April 1965.

TWA, "The Realism of the Boeing Lockheed Indirect Cost Formula for the Prediction of SST Indirect Costs," No. 1-186, March 1966.

[redacted]