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ESTIMATION OF A COST FUNCTION FOR A NAVAL AIR REWORK FACILITY

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NAVAL POSTGRADUATE SCHOOL

Monterey, California

THESIS

ESTIMATION OF A COST FUNCTION FOR A NAVAL AIR REWORK FACILITY

by

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March 1973

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by

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ABSTRACT

The objective of this study was to estimate a cost function from a Constant Elasticity of Substitution production function and a Cobb-Douglas production function for the aircraft rework and engine repair programs at the Naval Air Rework Facility, North Island, San Diego, California. The cost functions were estimated by multiple regression analysis, from data aggregated from actual data taken from production records of the two programs. An attempt was made to validate the two cost functions that were obtained, and a methodology was outlined for comparing predicted costs to actual production costs at the Naval Air Rework Facility.

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I. INTRODUCTION

A. ORGANIZATION, NARFNI

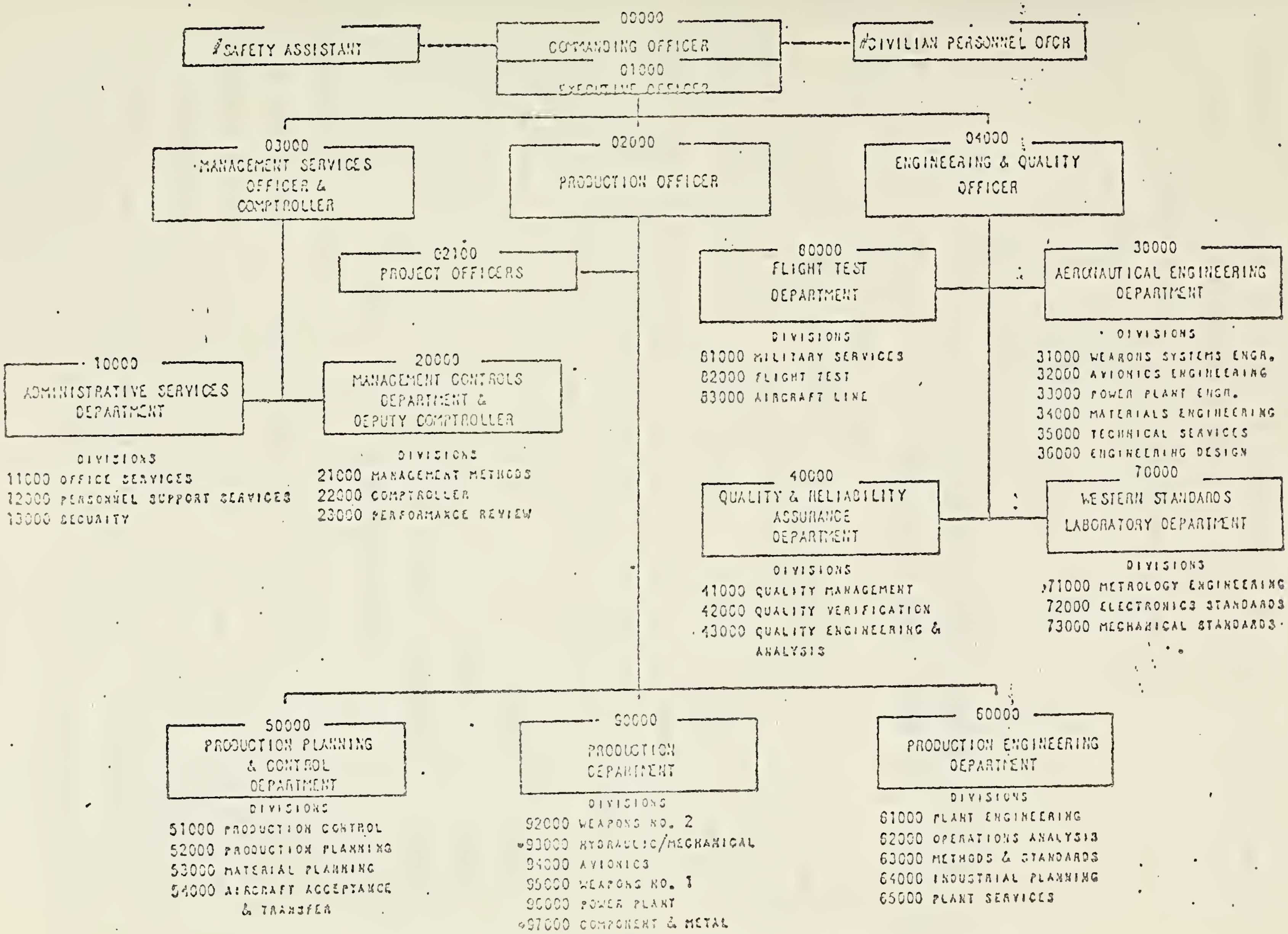
The Naval Air Rework Facility, Naval Air Station, North Island, San Diego, California, (NARFNI) is one of seven rework facilities serving the U.S. Navy and the U.S. Marine Corps. It is directly responsible for all major maintenance, incorporation of technical changes, and repair of extensively damaged West Coast based F-4, F-8, C-2, and E-2 aircraft and H-3, H-46, and H-53 helicopters.

Bradley [1] covers the organization and operating proceedures at NARFNI in a very detailed manner. What follows is a brief description of NARFNI.

NARFNI is directly responsible to the Naval Air Systems Command Representative, Pacific, who through the Commander, Naval Air Systems Command, is responsible to provide aircraft maintenance to the Commander-in-chief, Pacific Fleet, in the operational chain of command.

NARFNI is composed of nine major divisions (Figure 1), and each division is composed of a direct labor force and an indirect labor force. The direct labor force encompasses all skilled tradesmen, while the indirect labor force encompasses all managerial and administrative personnel.

All aircraft in the Naval Service are scheduled for preventive maintenance on a regular Progressive Aircraft Rework Cycle (PAR Cycle) during their life span. While undergoing PAR, necessary modifications to existing systems are made and major overhaul of component parts is carried out. Prior to induction into a specific PAR Cycle, an estimate, based on historical data of man hours required to rework similar aircraft,



NAVAL AIR REWORK FACILITY, SAN DIEGO, ORGANIZATIONAL CHART

FIGURE 1

is obtained. This estimate is referred to as Production Load Norm (NORM). Managers then plan the rework cycle for each aircraft, ordering material as required and allocating existing manpower.

NARFNI is engaged in three major programs:

1. Airframe Repair
2. Engine Repair
3. Component Repair

Most of the work is for the Naval Air Systems Command Representative, Pacific. Small amounts of work are done for other customers, particularly the Air Force and the Coast Guard.

Most of the work at NARFNI is done on a fixed price contract basis. Costs negotiated in this contract between the customer and NARFNI include direct labor and direct material costs, as well as an overhead cost to cover indirect labor, station support services, and employee benefits.

NARFNI is funded primarily by the Navy Industrial Fund (NIF). Basically the NIF system provides a working capital fund to finance continuing cycles of ongoing operations. Receipts derived from these operations are used to perpetuate the fund. All work done by NARFNI is paid for initially out of the NIF which is then reimbursed from customer appropriations. NARFNI is required by NAVAIRSYSCOM to plan and control its financial affairs in an attempt to incur zero loss at the end of each fiscal year. Prices for services rendered during each quarter are established through negotiations with the customer at the beginning of each quarter during the Quarterly Fleet Readiness Support Conference. It is NARFNI's goal to balance deficits or surplusses in one quarter with compensating surplusses and deficits the next, thus maintaining the NIF at a constant value.

B. WIPICS

In 1972 NARFNI installed a computerized Work in Process Inventory Control System (WIPICS) developed by the Rohr Corporation, Chula Vista, California. Spooner [2] gives a good overview of the history behind the installation of WIPICS at NARFNI and the details involved in actual day to day operation of WIPICS. The system employs many of the latest advances in computer technology which include real time data file updating and information retrieval with communications via Touch Tone[1] Ⓡ telephones and remote teletypewrite terminals. Basically, the system operates as follows. Each individual item or component is assigned a unique register number which is used for all WIPICS transactions. Each time the status or location of the component changes, a transaction updates the computer. The system provides immediate audio response (pre-recorded voice) for simple questions and printed reports for more detailed questions. A query as to the location or status of a component or part is answered with current information on that item.

C. PRIOR THESIS WORK

The Management Systems Development Office (MSDO) at North Island and NARFNI have been charged by higher authority with determining the cost-effectiveness of WIPICS as one factor in justification of continuing the use of WIPICS at NARFNI and possible installation of WIPICS at other rework facilities. In conjunction with this, a project is continuing at the Naval Postgraduate School to develop a methodology for auditing cost-effectivenss analysis of major technological changes. This methodology is then to be applied to WIPICS at NARFNI.

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[1] Touch Tone Ⓡ is a registered trade mark.

Three recent graduates of the Operations Research Curriculum at the Naval Postgraduate School each wrote a thesis as part of the above project. Spooner [2] wrote on "Evaluation of a Technological Change in Production". He outlined the methodology one might use in determining the cost-effectiveness of WIPICS, but he did not actually apply his methodology. In theory, his work takes one from production functions to cost functions to product transformation curves. Bradley [1] used actual production data taken from "pre-WIPICS" production records to estimate a continuous Cobb-Douglas production function for the aircraft rework, engine repair, and component repair programs. Meyers [3] constructed a linear economic model for the aircraft rework and engine repair programs which predicts resource requirements and costs for several alternative objective functions.

D. SCOPE OF THIS STUDY

Bradley [1] did not carry his research to the next step, which, following Spooner's methodology, is to estimate a cost function for each program of the NARF. There is also evidence which indicates the the existence of certain flaws in using Bradley's estimated Cobb-Douglas production functions to directly construct cost functions. This is covered in more detail in the next chapter.

The purpose of this study is to estimate a cost function for the aircraft rework and engine repair programs at NARFNI through multiple regression analysis of actual production data at NARFNI from March, 1970, to August, 1971. This is the second step in Spooner's three step methodology for determining the cost-effectiveness of WIPICS. Using methods of reduced form estimation, a cost function will be estimated from a Constant Elasticity of Substitution (CES) production function and a

Cobb-Douglas production function. The two cost functions will then be compared to determine which one more accurately predicts total production costs. Finally, a methodology will be outlined for comparing the best cost equation and the Linear Programming (LP) Model to the data and to each other.

II. THE PROBLEM

A. APPLICATION OF THE COBB-DOUGLAS MODEL

Spooner [2, p. 33] discusses a computerized prorating program designed to prorate the raw data provided by NARFNI for each engine and aircraft that underwent repair during a specified period. Assuming seven day work weeks and equal distribution of labor hours and material dollars on a daily basis, the program prorates NORM, direct labor dollars, direct labor hours, direct material costs, and overhead costs for each individual engine and aircraft.

Using aggregated prorated data obtained from the prorate program, Bradley [1] estimated Cobb-Douglas production functions for aircraft rework and engine repair programs at NARFNI as follows (the equations are presented in logarithmic form to facilitate display of standard error of each coefficient, shown in parenthesis, and overall R^2, shown at the right of each equation):

Aircraft

$$\ell n APH = 4.04 + \underset{(.044)}{.38104 \ell n APL} - \underset{(.018)}{.23714 \ell n APM} + \underset{(.044)}{.88208 \ell n N} \qquad R^2 = .920$$

Engines

$$\ell n APH = -1.898 + \underset{(.009)}{.92210 \ell n APL} + \underset{(.011)}{.25135 \ell n APM} \qquad R^2 = .981$$

APH is aggregate prorated hours of norm, APL is aggregate prorated hours of labor, APM is aggregate prorated material dollars, and N is number of jobs in shop.

From Naval Air Rework Facility Production and Planning Notices dated 17 June 1971, and 26 July 1971, forecast workload requirements for engine and aircraft programs during third quarter fiscal 1972 were obtained. This information was then used in Bradley's models to predict quarterly direct labor requirements and total cost. One result of comparing actual and predicted data appears in Figure 2. Here an isoquant was plotted for the aircraft rework program, holding N constant and plotting labor versus material. An interesting result immediately became evident - all production data points fell in the upper left hand portion of the curve. Furthermore, when the isocost line was plotted for the program (using prices of labor and material from Meyers' thesis), the theoretical point of most efficient operation, which is the point of tangency between the isoquant curve and the isocost line (Point A), fell far out of the region of actual operation. This implies one of two things; either NARFNI is operating very inefficiently, or the Cobb-Douglas production function, as Bradley estimated it, is not a good description of the actual process by which managers decide on quantities of inputs to use in the repair programs at NARFNI. Given the number of variables which enter into the production process at NARFNI that are not included in Bradley's model, i.e. managerial decisions and constraints on such items as work flow, allocation of resources, and overtime hours permitted, the latter reason

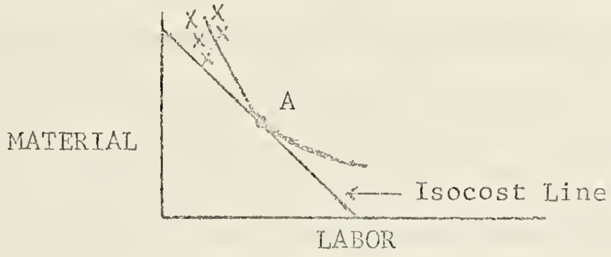

Figure 2. Plot of Cobb-Douglas Model (Aircraft)

given above appears to be more realistic than the former. All of the estimation conducted in this study was carried out under the assumption that NARFNI was in fact operating efficiently.

B. NEED FOR A COST MODEL

The problem is one of estimating a realistic cost function for NARFNI as the second step in Spooner's three step process for determining the cost-effectiveness of WIPICS. This cost function can then be used to complete the third step, which is formulation of product transformation curves.

Because of the problems encountered in application of Bradley's Cobb-Douglas production functions, it was decided to use methods of reduced form estimation to obtain a cost function and provide estimates of the coefficients in the CES and Cobb-Douglas models. Another reason for not using Bradley's model was the desire to include penalty costs, as determined by Meyers [3], in a cost function as a measure of pipeline cost per unit. Penalty costs are the daily costs to the Navy for having an aircraft or engine in the rework cycle. Penalty costs for aircraft are computed by dividing procurement cost by expected life. Penalty costs for engines are determined by dividing procurement cost by ten years. By including an index of the price of labor (prorated labor costs divided by prorated labor hours) and an index of pipeline costs (aggregated penalty costs divided by daily number of items in shop), predicted costs will be responsive to increases in wages as well as increased sophistication of the items undergoing rework.

III. DERIVING COST FUNCTIONS

A. THEORY

1. General

The theory behind the derivation of cost functions in this chapter is based on three very important assumptions. First, we assume that it is the objective of the NARF to minimize costs. The second assumption is that the NARF has no control over prices of labor or penalty costs per item per day. Third, we assume that output is fixed at any desired level and the NARF does an imperfect job of minimizing costs for a given level of output. The reason for this is that when the NARF makes a decision it doesn't know exactly what the prices will be, and it does not know until an item arrives exactly how extensive a rework will be required. According to Nerlove [4, p. 107], the fundamental duality between costs and production functions assures us that the relation between the cost function, obtained emperically, and the underlying production function is unique.

2. CES Production Function

The general form of the CES production function is as follows [5, p. 284]:

$$Y = \gamma(\delta X_1^{-\rho} + (1-\delta)X_2^{-\rho})^{-\sigma/\rho}$$

where γ is an efficiency parameter, ρ is a substitution parameter, and δ is a distribution parameter. σ is a measure of returns to scale, i.e., if $\sigma = 1$, there are constant returns to scale, and if $\sigma > 1$ or $\sigma < 1$ there are increasing or decreasing returns to scale respectively. Y is production output, while X_1 and X_2 are inputs to production.

What follows is the derivation of a cost function from the production function and marginal productivity relations. See Walters [5, p. 284] for a more detailed explanation.

$$\min C = P_1X_1 + P_2X_2 \tag{1}$$

$$\text{s.t.}\, Y = \gamma(\delta X_1^{-\rho} + (1 - \delta)X_2^{-\rho})^{-\sigma/\rho}$$

where C is production cost, P_1 is the price of input X_1, and P_2 is the price of input X_2. Forming the Lagrange Equation and taking partial derivatives,

$$\mathcal{L} = P_1X_1 + P_2X_2 - \lambda[Y - \gamma(\delta X^{-\rho} + (1 - \delta)X_2^{-\rho})^{-\sigma/\rho}] \tag{2}$$

$$\frac{\partial \mathcal{L}}{\partial X_1} = \frac{-\sigma}{\rho}\gamma(\delta X_1^{-\rho} + (1 - \delta)X_2^{-\rho})^{(-\sigma/\rho)-1}(1 - \delta)(-\rho)X_1^{-\rho-1} = \lambda P_1 \tag{3}$$

$$\frac{\partial \mathcal{L}}{\partial X_2} = \frac{-\sigma}{\rho}\gamma(\delta X_1^{-\rho} + (1- \delta)X_2^{-\rho})^{(-\sigma/\rho)-1}(\delta)(-\rho)X_2^{-\rho-1} = \lambda P_2 \tag{4}$$

Forming the ratio of equations (3) and (4),

$$\frac{P_1}{P_2} = \frac{(1 - \delta)X_1^{-\rho-1}}{\delta X_2^{-\rho-1}} \tag{5}$$

Thus,

$$X_1 = \left[\frac{\delta P_1}{(1 - \delta)P_2}\right]^{\frac{1}{-\rho-1}} X_2 \ \mu \tag{6}$$

where μ is a random error term due to imperfect minimization of costs.

Now,

$$\frac{X_1}{X_2} = \left[\frac{P_1}{(1 - \delta)P_2}\right]^{\frac{1}{-\rho-1}} \mu \qquad (7)$$

Taking natural logarithms of both sides of (7).

$$\ell n(X_1/X_2) = a + b\ell n(P_2/P_1) + \ell n \quad \mu \qquad (8)$$

where

$$a = \left(\frac{\delta}{1 - \delta}\right)^{\frac{1}{-\rho-1}} \quad \text{and } b= \frac{1}{-\rho-1}$$

Substituting back into the cost equation,

$$X_2 = \frac{C}{P_1(X_1/X_2) + P_2} \qquad (9)$$

The production function is now

$$Y = \gamma([\delta + (1 - \delta)(X_1/X_2)^{-\rho}]X_2)^{-\sigma/\rho} \qquad (10)$$

Solving for X_2,

$$X_2 = \left[\frac{\left(\frac{Y}{\gamma}\right)^{-\rho/\sigma}}{\delta + (1 - \delta)(X_1/X_2)^{-\rho}}\right]^{1/-\rho} \qquad (11)$$

Taking natural logs of both sides of equation (11),

$$\ell nX_2 = \left[-\frac{1}{\sigma}\ \ell n\ \gamma\right] + \left(\frac{1}{\sigma}\right)\ell nY + \left(\frac{1}{-\rho}\right)\left[\delta + (1 - \delta)(X_1/X_2)^{-\rho}\right] \qquad (12)$$

To simplify handling equation (12), let

$$\ell n X_2 = [\alpha] + \beta \ell n Y + (\omega)[D] \tag{13}$$

The final form of the cost equation is

$$C = (P_2 + P_1(X_1/X_2))e^{\alpha} Y^{\beta} e^{\omega D} e^{\epsilon} \tag{14}$$

where ϵ is a random error term.

3. Cobb-Douglas Production Function

The general form of the Cobb-Douglas production function is [5, p. 275]:

$$Y = AX_1^{\alpha} X_2^{\beta}$$

where Y is production output, X_1 and X_2 are production inputs, and α and β are elasticities of production with respect to X_1 and X_2 respectively. Once again the specification of the production function is changed so that Y is non-random, but X_1 and X_2 are random variables, due to the fact that the NARFNI does an imperfect job of minimizing costs for a given level of output and has no control over prices. With this in mind, a cost function is derived as follows:

$$\min C = P_1 X_1 + P_2 X_2 \tag{15}$$

$$\text{s.t.} Y = AX_1^{\alpha} X_2^{\beta}$$

Forming the Lagrangian Equation and taking partial derivatives,

$$\mathcal{L} = P_1 X_1 + P_2 X_2 - \lambda(Y - AX_1^{\alpha} X_2^{\beta}) \tag{16}$$

$$\frac{\partial \mathcal{L}}{\partial X_1} = P_1 - \lambda \alpha A X_1^{\alpha - 1} X_2^{\beta} \mu_1 = 0 \tag{17}$$

$$\frac{\partial \mathcal{L}}{\partial X_2} = P_2 - \lambda \beta A X_1^{\alpha} X_2^{\beta - 1} \mu_2 = 0 \tag{18}$$

$$\frac{\partial \mathcal{L}}{\partial \lambda} = Y - A X_1^{\alpha} X_2^{\beta} e^{\mu} = 0 \tag{19}$$

where the μ's are random variables associated with error (again, due to imperfect minimization of costs). Taking the ratio of equations (17) and (18),

$$\frac{\alpha X_2}{\beta X_1} = \frac{P_1}{P_2} \mu \tag{20}$$

Solving for inputs X_1 and X_2, the following cost function is obtained:

$$C = \left[\frac{Y}{A} \left(\frac{\alpha}{B} + 1 \right)^{\beta} \left(\frac{\beta}{\alpha} + 1 \right)^{\alpha} P_1^{\alpha} P_2^{\beta} \right]^{1/(\alpha + B)} \mu^{-\frac{\beta}{\alpha + B}\left(\frac{\beta \mu}{\alpha} + 1 \right)} \tag{21}$$

B. PRODUCT TRANSFORMATION CURVES

Spooner [2, Appendix E] contains a complete theoretical derivation of product transformation curves from cost functions. Basically, a product transformation curve is obtained by rewriting a cost function in terms of output. The result of the substitution is a nonlinear relationship between two or more outputs. By looking at two outputs at a time, setting the others equal to a constant, and setting cost equal to

a constant, graphical analysis can be applied to the overall cost function. After plotting one output against the other, the shape of the product transformation curve will indicate increasing, constant, or decreasing returns to scale (see Figure 3).

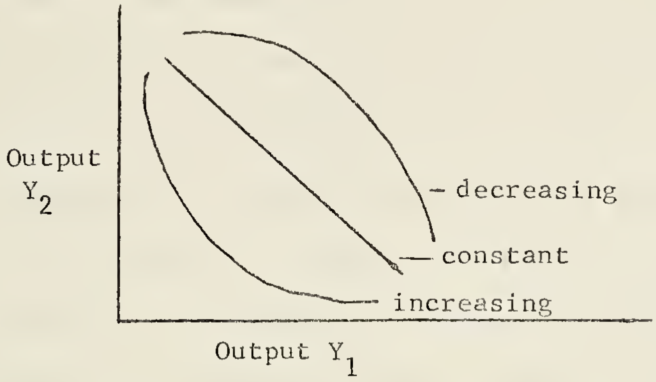

Figure 3. Product Transformation Curves, Returns to Scale

Product transformation curves may also be used as one way of comparing the effects of WIPICS on production at NARFNI. A comparison could be made between before WIPICS and after WIPICS transformation curves, keeping the total budget constant and keeping prices of resources and inputs the same for the two periods. One should be very careful in evaluating the results of such a comparison because of the many factors which enter into production at NARFNI but do not appear in a cost function, particularly management decisions.

IV. ESTIMATING COST FUNCTIONS

A. PRORATING WITH PENALTY COSTS

The raw data on each aircraft and engine job completed during the period February, 1970 to August, 1971, which appears in Meyers' thesis [3, Appendix A] was run through the computer prorate program in Spooner's thesis [2, Appendix B] in order to provide daily aggregated, prorated data which could be used in a linear regression. In addition, penalty costs for each type of engine and aircraft (see Table I and Table II) were incorporated into Spooner's prorate computer program so that these costs could be used in estimating a cost function for NARFNI. The codes shown in Tables I and II are as defined by Meyers [3, p. 16]. The method used to incorporate these costs into the program was simply to read the aircraft or engine code from the raw data card for all items that were in shop each day, and then the appropriate daily penalty costs were aggregated for each day of the period under observation. The aggregated prorated data used to estimate the cost functions in this thesis appear in Appendix A (aircraft) and Appendix B (engines). Spooner's prorate programs, rewritten to include penalty costs, appear in Appendix D (aircraft) and Appendix E (engine).

The interest in penalty costs stems from the fact that this appeared to be the only way to quantify unit pipeline costs, and it was considered desirable to include pipeline costs in any cost model of NARFNI.

TABLE I. DAILY ENGINE PENALTY COSTS

CODE	TYPE ENGINE	PENALTY COST
51	T58-GE-8B	17.81
53	T58-GE-8B	17.81
55	T58-GE-8B	17.81
57	T58-GE-8B	17.81
81	T58-GE-8B	17.81
82	T58-GE-8B	17.81
83	T58-GE-8B	17.81
84	T58-GE-8B	17.81
85	T58-GE-8F	17.81
86	T58-GE-8F	17.81
87	T58-GE-8F	17.81
89	T58-GE-8F	17.81
63	T64-GE-6B	34.25
65	T64-GE-6B	34.25
66	T64-GE-6B	34.25
67	T64-GE-6B	34.25
69	T64-GE-413	45.25
56	T56 ALL MODELS	27.01
71	J57 ALL MODELS	57.53
72	J57 ALL MODELS	57.53
73	J57 ALL MODELS	57.53
74	J57 ALL MODELS	57.53
75	J57 ALL MODELS	57.53
91	J79-GE-8B	61.64
92	J79-GE-8C	61.64
95	J79-GE-10	49.39

TABLE II DAILY AIRCRAFT PENALTY COSTS

CODE	TYPE AIRCRAFT	PENALTY COST
10	C-2A	280.29
11	E-2B	280.29
21	F-4J	85.34
22	F-4B	94.38
23	RF-4B	77.02
25	F-8J	66.05
26	F-8H	68.59
27	RF-8G	47.48
31	CH-3B	43.76
32	RH-3A	51.64
33	SH-3A	43.76
34	SH-3A/G	36.43
35	SH-3D	36.43
41	CH-46A	37.08
42	CH-46D	37.08
43	CH-46F	37.08
44	UH-46A	28.56
45	UH-46D	28.56
48	CH-53A	41.46
49	CH-53D	41.46

B. REGRESSION PROCEEDURES AND RESULTS

1. CES Proceedures

For the CES production function a cost function was estimated as follows (all values used were taken from the prorated data, cut on each end to eliminate start up and shut down effects as per Spooner [2, p. 33]):

$$\min C = PI\ (I) + PL\ (L)$$

$$\text{s.t.} N = \gamma(\delta L^{-\rho} + (1 - \delta) I^{-\rho})^{-\sigma/\rho}$$

where $PI = \dfrac{\text{penalty cost}}{\#\text{ of items in shop}}$

$PL = \dfrac{\text{direct labor cost}}{\text{direct man hours}}$

I = number of items in shop

L = direct man hours

N = NORM

Following the proceedure as set forth in the previous chapter, equations (1) through (8), the first stepwise linear regression was run on equation (8) of Chapter 3. This equation is listed below, with $\ell n\ \mu$ representing the natural log of the error term:

$$\ell n(I/L) = a + b\ell n(PL/PI) + \ell n\ \mu \tag{1}$$

where $a = \left(\dfrac{\delta}{1 - \delta}\right)^{\frac{1}{-\rho-1}}$ and $b = \dfrac{1}{\rho + 1}$. The error was assumed to be normally distributed with a mean of zero and constant variance.

The regression on equation (1) provided an estimate of (I/L), which will be indicated as $(\widehat{I/L})$, for use in the following equation:

$$L^* = \frac{C}{PI(I/L) + PL} \tag{2}$$

which corresponds to equation (9) in the previous Chapter. Here C equals direct labor cost plus overhead cost plus penalty cost. The regression on equation (1) also provided the parameters for obtaining the quantity $\hat{D}$ in equation (4) below. The final equation on which a second stepwise linear regression was run was (see equation (12), Chapter III):

$$\ell n L^* = -\left[\frac{1}{\sigma}\,\ell n\,\gamma\right] + \left(\frac{1}{\sigma}\right)\ell n N + \left(\frac{1}{-\rho}\right)\left[\delta + (1-\delta)(\widehat{I/L})^{-\rho}\right] + \epsilon \tag{3}$$

where ϵ is a random error term. Simplifying the quantities in equation (3), let

$$\ell n L^* = a + b\,\ell n N + C[\hat{D}] + \epsilon \tag{4}$$

The second regression provided estimates of the coefficients of the independent variables.

All regressions in this thesis were run using the SNAP/IEDA statistical package available at the Naval Postgraduate School Computer Center.

2. CES Regression Results

The results of the first CES regression for the aircraft and engine programs are presented in Tables III and IV respectively. The low R^2 (.05) in the aircraft regression is an indication of possible problems in applying the CES production function to the production process at NARFNI (R^2 is the square of the multiple correlation between the dependent variable and those independent variables which were included in the

TABLE III. FIRST CES STEPWISE REGRESSION OF AIRCRAFT DATA

STEP	1
Entered	PL/PI
Previously Entered	-----
R^2	.054
Standard Error of Dependent Var.	.036
Coefficients	
Constant	-4.010
PI/PL	.233
Standard Error of Coefficients	
PI/PL	.058
CV	-.0078

TABLE IV. FIRST CES STEPWISE REGRESSION OF ENGINE DATA

STEP	1
Entered	PL/PI
Previously entered	----
R^2	.440
Standard error of dependent var.	.074
Coefficients	
Constant	-0.219
PI/PL	1.324
Standard Error of Coefficients	
PI/PL	.079
CV	- .0266

regression at that step -- it measures the proportion of variation in the dependent variable that is explained by the independent variable). Rao and Miller [6, p. 16] point out that a high R^2 may imply the appropriateness of a regression equation for explaining the movements of a dependent variable, but a low R^2 does not necessairly imply that the regression equation is inappropriate. Another possible problem appeared when the value of δ was computed. It is specified by Walters [5, p. 284] that $0 \leq \delta \leq 1$ in a CES production function. This means that the expected value of the constant in the first regression runs was a positive number less than one. This was not the case for either program. As a matter of interest, the coefficient of variation (CV), which is standard error divided by mean of the dependent variable, is listed in all tabled regression results in this Chapter. It is a measure of dispersion of the dependent variable in comparison to the mean due to lack of a perfect fit with the data.

Looking at the results of the second regression of the aircraft data (Table V), the extremely high R^2 (.988) indicates a good fit with the data. Both independent variables, N and D, were found th have significant coefficients after examination of their respective standard errors (when computation of the standard deviation is based on the estimate of the variance rather than the variance itself, it is called standard error).

In the engine program (Table VI), both independent variables were again found to have coefficients significantly different from zero. R^2 in this case (.798) was not nearly as high as it was for the aircraft program, but it is certainly acceptable.

The value of ρ, computed from the coefficient of D in each case (the coefficient of D equals $-\frac{1}{\rho}$), shows ρ to fall well within the

TABLE V SECOND CES STEPWISE REGRESSION OF AIRCRAFT DATA

<u>STEP</u>	1	2
Entered	N	D
Previously entered		N
R^2	.977	.988
Standard error of dependent variable	.012	.009
Coefficients		
Constant	1.596	2.063
N	.897	.880
D		-2.388
Standard Error of Coefficients		
N	.008	.006
D		.149
CV		.0006

TABLE VI SECOND CES REGRESSION OF ENGINE DATA

STEP	1	2
Entered	N	D
Previously entered		N
R^2	.775	.798
Standard error of dependent variable	.066	.062
Coefficients		
Constant	.753	2.344
N	.983	.929
D		4.566
Standard Error of Coefficients		
N	.028	.028
D		.721
CV		.0075

expected region. This value was .419 for the aircraft program and -.219 for the engine program. The expected value of ρ is a number between minus one and infinity. As ρ approaches minus one the result is a flat isoquant, and as ρ increases in a positive direction the elasticity of substitution becomes smaller and smaller (essentially this is the case of fixed coefficients). For a more detailed explanation of this, see Walters [5, p. 286].

The final estimated cost functions were:

$$\text{(aircraft)} \qquad C = (PL + PI(\widehat{I/L}))e^{2.063}N^{.880}e^{-2.388(\hat{D})} \tag{5}$$

$$\text{(engines)} \qquad C = (PL + PI(\widehat{I/L}))e^{2.344}N^{.929}e^{4.566(\hat{D})} \tag{6}$$

3. Cobb-Douglas Proceedures

For the Cobb-Douglas production function, a cost function was estimated using the general theory presented in equations (15) through (21) in Chapter III. The specific equations used in the estimation proceedure were:

$$\min C = PL(L) + M + PI(I)$$

$$\text{s.t.} N = AL^{\alpha} I^{\beta} M^{\gamma}$$

All variables are as previously defined, and M is material costs (again, prorated data was used in all cases). A stepwise linear regression was run on the following equation:

$$\log C = a + \frac{1}{\alpha + \beta + \gamma} \log N + \frac{\alpha}{\alpha + \beta + \gamma} \log PL + \frac{\beta}{\alpha + \beta + \gamma} \log PI + \epsilon \ . \tag{7}$$

$$\text{where} \quad a = \log\left(\frac{\alpha + \beta + \gamma}{\gamma}\right) - \frac{1}{\alpha + \beta + \gamma} \log A + \frac{\alpha}{\alpha + \beta + \gamma} \log \left(\frac{\gamma}{\alpha}\right) + \frac{\beta}{\alpha + \beta + \gamma} \log \left(\frac{\gamma}{\beta}\right) .$$

Again, the error term is assumed to be normally distributed with a mean of zero and constant variance. The regression provided estimates of the coefficients of N, PL, and PI.

4. Cobb-Douglas Regression Results

The results of the regressions run on equation (7) are presented in Tables VII and VIII for the aircraft and engines programs, respectively. Examination of this tabulated data prvides a good indication that the cost functions estimated from the Cobb-Douglas production function may turn out to be valid and accurate cost functions.

In the aircraft data regression, all coefficients were significant, and the value of R^2 (.960) was an indication of a good fit with the data. The regression on the engine data showed only NORM to have a significant coefficient. The coefficient of PL(-.027) had a standard error of .113, and the coefficient of PI(.101) had a standard error of .051, indicating that neither coefficient was significantly different from zero. R^2 for the engine data was .848.

The resulting cost functions for the aircraft and engine programs were:

$$\text{(aircraft)} \quad C = 10^{.421} N^{.751} PL^{2.629} PI^{-.275} \tag{8}$$

$$\text{(engines)} \quad C = 10^{1.749} N^{.860} \tag{9}$$

TABLE VII COBB-DOUGLAS STEPWISE REGRESSION OF AIRCRAFT DATA

STEP	1	2	3
Entered	N	PL	PI
Previously entered		N	N PL
R^2	.645	.949	.960
Standard error of dep. var.	.024	.009	.008
Coefficients			
Constant	1.678	-0.049	0.421
N	0.824	0.769	0.751
PL		2.453	2.629
PI			-0.275
Standard error of Coefficients			
N	.036	.014	.012
PL		.060	.056
PI			.030
CV	.0049	.0018	.0016

TABLE VIII COBB-DOUGLAS STEPWISE REGRESSION OF ENGINE DATA

STEP	1	2	3
Entered	N	PI	PL
Previously entered		N	PI N
R^2	.848	.849	.849
Standard error of dep. var.	.020	.020	.020
Coefficients			
Constant	1.749	1.539	1.554
N	.860	.876	.876
PI		.097	.101
PL			-.027
Standard error of coefficents			
N	.019	.021	.021
PI		.047	.051
PL			.113
CV	.0044	.0044	.0044

V. VALIDATION

A. APPLICATION OF THE COST MODELS

The prorated data was broken down into nine consecutive 30 day intervals beginning with julian date 0191 and ending with julian date 1095. Average daily values of NORM, total costs (labor plus material plus penalty), PL, and PI were computed for each period. This was done for both the aircraft and engine programs (see Appendix C).

For validation of the CES cost functions, the values of NORM, PL, PI, $\widehat{I/L}$, and $\hat{D}$ were computed for the nine 30 day periods and then used in equations (5) and (6) in Chapter IV. The results of these runs, shown in Table IX, are evidence that the CES cost function can in fact be used to predict costs at NARFNI (remembering that actual costs shown here are average daily prorated direct labor cost plus overhead cost plus penalty cost). The worst prediction occurs in the first engine prediction, where the difference between predicted and actual cost is only approximately four thousand dollars out of thirty eight thousand, or less than 10%. The percent of error for each program as shown in Tables IX and X was computed by subtracting actual cost from predicted cost and dividing by actual cost. The same independent variables used above, less $\widehat{I/L}$ and $\hat{D}$, were then fed into the estimated Cobb-Douglas cost functions which appear at the end of Chapter IV (equations (8) and (9)). Actual and predicted costs for the aircraft and engine programs are listed in Table X for each of the nine 30 day periods. An examination of the data in Table X shows the Cobb-Douglas cost functions to also be predicting costs with fairly good accuracy (again, a reminder that actual costs here are the sum of direct labor, material, and penalty costs).

TABLE IX ACTUAL AND PREDICTED TOTAL COSTS (CES)

AIRCRAFT

PREDICTED	ACTUAL	% ERROR
96,896.19	98,561.24	- 1.69
116,596.25	117,882.93	- 1.09
113,573.44	112,113.25	+ 1.30
116,616.94	115,304.52	+ 1.14
119,525.25	118,598.68	+ .78
110,645.50	109,015.75	+ 1.50
113,536.06	113,658.38	- .08
121,063.69	122,274.12	- .99
114,884.63	115,261.18	- .33

ENGINES

PREDICITED	ACTUAL	% ERROR
34,439.70	38,230.57	- 9.93
36,684.21	39,975.95	- 8.25
30,655.29	32,061.61	- 4.38
36,398.64	36,459.35	- .17
36,644.64	36,471.29	+ .48
29,525.21	30,294.42	- 2.55
35,207.98	34,942.32	+ .76
33,748.04	32,864.77	+ 2.70
29,846.05	29,806.54	+ .13

TABLE X ACTUAL AND PREDICTED TOTAL COSTS (COBB-DOUGLAS)

AIRCRAFT

PREDICTED	ACTUAL	% ERROR
67,304.50	68,452.51	- 1.68
79,858.06	80,122.31	- .33
77,338.25	74,926.64	+ 3.26
78,968.56	78,632.10	+ .43
81,799.38	82,816.17	- 1.23
77,561.00	77,510.11	+ .06
82,942.81	82,667.20	+ .33
89,536.81	89,337.36	+ .22
84,495.63	85,059.84	- .67

ENGINES

PREDICTED	ACTUAL	% ERROR
41,720.43	45,946.33	- 9.20
44,015.41	45,183.24	- 2.59
37,536.84	36,286.71	+ 3.45
43,974.30	41,814.51	+ 5.16
43,680.50	41,564.47	+ 5.09
34,941.77	33,638.37	+ 3.90
41,488.91	41.437.46	+ .12
39,378.77	39.130.91	+ .63
35,189.98	36,008.00	- 2.27

B. PREDICTION INTERVALS

A prediction interval can be obtained for the Cobb-Douglas aircraft cost function and the engine cost function using methods outlined in Theil [7, p. 135]. This method proceeds as follows. First, return the cost equation to logarithmic form. Then let,

$$Y^* = W'C + \epsilon^*$$

where Y^* is a single observation of cost in log form, W' is a one row vector, with each column containing given values of the independent variables, C is a one column vector with each row being a coefficient of one independent variable, and ϵ^* is the random error term with a mean of zero. Let Z be a matrix of observations on which the regression was run. The first column is all ones, and the remaining columns are data columns. There are as many rows as there are numbers of observations. i.e.,

$$Z = \begin{bmatrix} 1 & N_1 & PL_1 & PI_1 \\ \cdot & \cdot & \cdot & \cdot \\ \cdot & \cdot & \cdot & \cdot \\ \cdot & \cdot & \cdot & \cdot \\ 1 & N_N & PL_N & PI_N \end{bmatrix} .$$

Now $\dfrac{W'C - Y^*}{\sqrt{S^2(1 + W'(Z'Z)^{-1}W)}}$ has a student's t distribution with n-k degrees of freedom. Here n equals number of observations and k equals number of independent variables in the cost equation. S^2 is an estimate of variance. Selecting a $1 - \alpha$ confidence interval,

$$P[- t_{\alpha/2} \leq t_{(n-k)} \leq t_{\alpha/2}] = 1-\alpha$$

Let

$$V = t_{\alpha/2} \cdot S \cdot \sqrt{1 + W'(Z'Z)^{-1}W} \quad , \text{ so that}$$

$$P[W'C - V \leq Y^* \leq W'C + V] = 1 - \alpha$$

Taking antilogs,

$$[10^{(W'C - V)} \leq C \leq 10^{(W'C + V)}]$$

is a $1 - \alpha$ prediction interval for cost.

C. METHODOLOGY FOR COMPARISON WITH LP MODEL

A good way to determine the validity of an estimated cost function would be to compare actual costs with estimated costs obtained from the cost function and estimated costs obtained from Meyers [3] LP model. To make the comparison realistic, several important factors must be considered. First, the objective function of the LP model must be to minimize costs. Second, the values of NORM and PL, as well as penalty costs and material costs used in the LP model, must also be used in the cost function. In the LP model, the actual values of NORM for the period of time under observation should be used in the production vector Y. This constrains the model to minimize costs subject to actual values of NORM. The activity vector Z need not be changed, but prices of labor and material used in the resource vector R must coincide with the prices used in the cost function. There remains the task of breaking the data down by type of aircraft or engine and the type of work done on that item for use in the activity vector Z.

Ideally, the two methods of cost prediction should each be run over several periods of time, either 30 day intervals, or monthly, or perhaps

quarterly. This provides enough data points to carry out a meaningful comparison of the two models.

The criteria for determining which cost model is better at predicting costs, as outlined below, is sketchy at best. The lack of independence between the time periods eliminates most conventional statistical tests which might apply. Naturally, if one model is consistently and obviously better than the other, no test need be applied. But if one model is better than the other at times, and then at times worse then the other, the criteria outlined here may aid in determining a "best" model.

The criteria is simply this; take the difference between actual and predicted costs for each time period and square this number. Then sum the squared numbers over the periods of time. Doing this for each model will provide a "mean squared error" (MSE) term for the models,

$$\mathrm{MSE} = \frac{\sum_{i=1}^{n} (C_{pi} - C_{Ai})^2}{n}$$

where n = number of periods

C_{pi} = predicted cost for period i

C_{Ai} = actual cost for period i

The model with the smallest MSE should be considered the best cost model. Naturally, if the two values of MSE are very nearly the same, there remains a problem of determining whether or not they are significantly different. This problem will not be addressed in this thesis.

As a matter of interest, the values of MSE for the CES and Cobb- Douglas cost functions estimated in Chapter IV of this thesis were as follows:

CES aircraft	1,486,812
CES engines	3,180,710
Cobb-Douglas aircraft	1,083,037
Cobb-Douglas engines	3,584,340

VI. CONCLUSIONS AND FUTURE STUDY

A. CONCLUSIONS

The cost functions estimated from the CES production function were:

$$\text{(aircraft)} \qquad C = (PL + PI(\widehat{I/L}))e^{2.063}N^{.880}e^{-2.388(\hat{D})}$$

$$\text{(engines)} \qquad C = (PL + PI(\widehat{I/L}))e^{2.344}N^{.929}e^{4.566(\hat{D})}$$

These cost functions were concluded to be a valid means of predicting costs at NARFNI after several validation runs showed predicted and actual average prorated daily costs to compare favorably.

The cost functions estimated from the Cobb-Douglas production function were:

$$\text{(aircraft)} \qquad C = 10^{.421}N^{.751}PL^{2.629}PI^{-.275}$$

$$\text{(engines)} \qquad C = 10^{1.749}N^{.860}$$

The coefficients of PL and PI were not significant in the engine program. A possible explanation for the relatively high coefficient of PL and the negative coefficient of PI in the aircraft program is that as the cost per unit of items being repaired increases, penalty costs increase, and due to the complexity of the more expensive items, number in shop decreases. Also due to the complexity of more expensive items being repaired, the cost of labor increases rapidly as more skilled tradesman are required.

The cost functions derived from the Cobb-Douglas production function were also concluded to be a valid means of predicting costs at NARFNI.

Predicted and actual average daily prorated costs compared favorably when examined over nine 30 day intervals.

Based on the methodology outlined in this thesis for comparing cost prediction models, the cost functions estimated in this thesis predict costs with approximately the same accuracy.

B. FUTURE STUDY

A prime area for future study would be to compare the LP model, the Cobb-Douglas cost equation estimated in this thesis, and actual total production costs at NARFNI for several selected periods of time, using the methodology outlined in Chapter IV of this thesis. This would provide a more firm idea of just how accurate and useful the Cobb-Douglas cost function really is.

Another area that could be improved is the method used to determine penalty costs. Rather than simply dividing procurement cost by an expected life for each type aircraft or engine, a more realistic method to use could be as follows:

$$\text{Penalty Cost} = \begin{array}{l}\text{Cost of all a/c, allowing} \\ \text{rotable spares}\end{array} - \begin{array}{l}\text{Cost of all a/c, without} \\ \text{rotable spares}\end{array}$$

In other words, the true cost to the Navy for having an aircraft at NARFNI is the cost of an aircraft that had to go to the fleet to replace it (rotable spares). Dividing this figure by the average length of time an aircraft or engine is undergoing rework would provide a daily penalty cost.

Finally, some method of including management decisions and constraints in a production function must be devised. New equipment, improved proceedures, increased worker efficiency as a result of labor force cuts,

hiring and firing policies, and constraints on such items as overtime hours permitted, all enter into the production process at NARFNI, but finding a method to quantify these areas and incorporate them into a production function is a most difficult problem.

APPENDIX A

SUMMARY OF DAILY STATISTICS OF NARF (AIRCRAFT)

DATA FOR JULIAN DATES 0069 TO 1235

TOTAL NUMBER OF OBSERVATIONS = 365

DAY	JUL DATE	NORM	DIR MH	DIR LAB$	DIR MTL$	AFC MH	OVHD$	PEN$	# IN SHOP
1	69	140.60	146.49	873.54	170.13	24.77	1000.99	94.38	1.
2	70	293.47	303.53	1808.26	358.81	52.91	2073.93	188.76	2.
3	71	293.47	303.53	1808.26	358.81	52.91	2073.93	188.76	2.
4	72	293.47	303.53	1808.26	358.81	52.91	2073.93	188.76	2.
5	73	293.47	303.53	1808.26	358.81	52.91	2073.93	188.76	2.
6	74	293.47	303.53	1808.26	358.81	52.91	2073.93	188.76	2.
7	75	293.47	303.53	1808.26	358.81	52.91	2073.93	188.76	2.
8	76	293.47	303.53	1808.26	358.81	52.91	2073.93	188.76	2.
9	77	293.47	303.53	1808.26	358.81	52.91	2073.93	188.76	2.
10	78	293.47	303.53	1808.26	358.81	52.91	2073.93	188.76	2.
11	79	293.47	303.53	1808.26	358.81	52.91	2073.93	188.76	2.
12	80	293.47	303.53	1808.26	358.81	52.91	2073.93	188.76	2.
13	81	293.47	303.53	1808.26	358.81	52.91	2073.93	188.76	2.
14	82	293.47	303.53	1808.26	358.81	52.91	2073.93	188.76	2.
15	83	293.47	303.53	1808.26	358.81	52.91	2073.93	188.76	2.
16	84	293.47	303.53	1808.26	358.81	52.91	2073.93	188.76	2.
17	85	293.47	303.53	1808.26	358.81	52.91	2073.93	188.76	2.
18	86	293.47	303.53	1808.26	358.81	52.91	2073.93	188.76	2.
19	87	293.47	303.53	1808.26	358.81	52.91	2073.93	188.76	2.
20	88	293.47	303.53	1808.26	358.81	52.91	2073.93	188.76	2.
21	89	293.47	303.53	1808.26	358.81	52.91	2073.93	188.76	2.
22	90	293.47	303.53	1808.26	358.81	52.91	2073.93	188.76	2.
23	91	293.47	303.53	1808.26	358.81	52.91	2073.93	188.76	2.
24	92	293.47	303.53	1808.26	358.81	52.91	2073.93	188.76	2.
25	93	293.47	303.53	1808.26	358.81	52.91	2073.93	188.76	2.
26	94	293.47	303.53	1808.26	358.81	52.91	2073.93	188.76	2.
27	95	293.47	303.53	1808.26	358.81	52.91	2073.93	188.76	2.
28	96	293.47	303.53	1808.26	358.81	52.91	2073.93	188.76	2.
29	97	393.47	400.03	2377.40	562.19	67.62	2722.75	274.10	3.
30	98	458.96	463.45	2754.15	714.90	67.62	3153.51	340.15	4.
31	99	458.96	463.45	2754.15	714.90	67.62	3153.51	340.15	4.
32	100	458.96	463.45	2754.15	714.90	67.62	3153.51	340.15	4.
33	101	458.96	463.45	2754.15	714.90	67.62	3153.51	340.15	4.
34	102	458.96	463.45	2754.15	714.90	67.62	3153.51	340.15	4.
35	103	458.96	463.45	2754.15	714.90	67.62	3153.51	340.15	4.

36	104	566.65	569.25	3383.56	967.66	83.41	3871.63	425.49	5.
37	105	671.86	681.26	4030.98	1236.95	103.81	4621.99	705.78	6.
38	106	671.86	681.26	4030.98	1236.95	103.81	4621.99	705.78	6.
39	107	671.86	681.26	4030.98	1236.95	103.81	4621.99	705.78	6.
40	108	671.86	681.26	4030.98	1236.95	103.81	4621.99	705.78	6.
41	109	671.86	681.26	4030.98	1236.95	103.81	4621.99	705.78	6.
42	110	790.10	803.42	4756.57	1423.91	128.62	5455.17	800.16	7.
43	111	790.10	803.42	4756.57	1423.91	128.62	5455.17	800.16	7.
44	112	872.03	898.64	5316.36	1575.04	148.33	6079.34	866.21	8.
45	113	980.64	1001.83	5937.00	1861.66	165.11	6774.62	951.55	9.
46	114	980.64	1001.83	5937.00	1861.66	165.11	6774.62	951.55	9.
47	115	980.64	1001.83	5937.00	1861.66	165.11	6774.62	951.55	9.
48	116	980.64	1001.83	5937.00	1861.66	165.11	6774.62	951.55	9.
49	117	1230.60	1233.84	7315.04	2466.95	199.23	8356.27	1176.74	12.
50	118	1230.60	1233.84	7315.04	2466.95	199.23	8356.27	1176.74	12.
51	119	1230.60	1233.84	7315.04	2466.95	199.23	8356.27	1176.74	12.
52	120	1390.27	1402.23	8316.66	2829.90	233.45	9474.68	1330.67	14.
53	121	1483.79	1518.98	8999.17	3079.19	251.77	10261.06	1610.96	15.
54	122	1483.79	1518.98	8999.17	3079.19	251.77	10261.06	1610.96	15.
55	123	1483.79	1518.98	8999.17	3079.19	251.77	10261.06	1610.96	15.
56	124	1582.05	1612.84	9555.75	3311.92	276.27	10895.04	1705.34	16.
57	125	1582.05	1612.84	9555.75	3311.92	276.27	10895.04	1705.34	16.
58	126	1582.05	1612.84	9555.75	3311.92	276.27	10895.04	1705.34	16.
59	127	1651.06	1680.38	9965.72	3461.02	276.27	11363.44	1773.93	17.
60	128	1651.06	1680.38	9965.72	3461.02	276.27	11363.44	1773.93	17.
61	129	1651.06	1680.38	9965.72	3461.02	276.27	11363.44	1773.93	17.
62	130	1651.06	1680.38	9965.72	3461.02	276.27	11363.44	1773.93	17.
63	131	1651.06	1680.38	9965.72	3461.02	276.27	11363.44	1773.93	17.
64	132	1651.06	1680.38	9965.72	3461.02	276.27	11363.44	1773.93	17.
65	133	1651.06	1680.38	9965.72	3461.02	276.27	11363.44	1773.93	17.
66	134	1842.82	1867.38	11075.61	3906.27	316.58	12623.55	1927.86	19.
67	135	1932.57	1976.01	11713.56	4192.14	336.83	13360.38	2208.15	20.
68	136	1932.57	1976.01	11713.56	4192.14	336.83	13360.38	2208.15	20.
69	137	1932.57	1976.01	11713.56	4192.14	336.83	13360.38	2208.15	20.
70	138	1932.57	1976.01	11713.56	4192.14	336.83	13360.38	2208.15	20.
71	139	2025.59	2062.91	12228.61	4381.16	342.14	13914.05	2245.23	21.
72	140	2025.59	2062.91	12228.61	4381.16	342.14	13914.05	2245.23	21.
73	141	2128.22	2182.74	12914.50	5203.50	343.50	14712.25	2286.69	22.
74	142	2315.49	2371.49	14034.94	5563.31	369.80	15988.95	2438.08	24.
75	143	2315.49	2371.49	14034.94	5563.31	369.80	15988.95	2438.08	24.
76	144	2315.49	2371.49	14034.94	5563.31	369.80	15988.95	2438.08	24.
77	145	2388.54	2440.72	14456.48	5744.66	369.80	16459.71	2504.13	25.
78	146	2456.72	2512.52	14874.77	5873.25	415.56	16923.60	2541.21	26.
79	147	2456.72	2512.52	14874.77	5873.25	415.56	16923.60	2541.21	26.
80	148	2525.57	2575.95	15242.73	5992.38	419.46	17338.66	2577.64	27.
81	149	2525.57	2575.95	15242.73	5992.38	419.46	17338.66	2577.64	27.
82	150	2525.57	2575.95	15242.73	5992.38	419.46	17338.66	2577.64	27.
83	151	2525.57	2575.95	15242.73	5992.38	419.46	17338.66	2577.64	27.

84	152	2525.57	2575.95	15242.73	5992.38	419.46	17338.66	2577.64	27.
85	153	2612.72	2680.45	15875.17	6334.92	437.83	18053.34	2662.98	28.
86	154	2612.72	2680.45	15875.17	6334.92	437.83	18053.34	2662.98	28.
87	155	2790.04	2881.92	17107.88	6881.09	468.13	19452.98	3028.61	30.
88	156	2961.25	3035.07	18015.77	7171.32	497.59	20476.51	3131.74	32.
89	157	2961.25	3035.07	18015.77	7171.32	497.59	20476.51	3131.74	32.
90	158	2961.25	3035.07	18015.77	7171.32	497.59	20476.51	3131.74	32.
91	159	3153.70	3257.43	19320.61	8265.57	517.66	22017.02	3258.53	34.
92	160	3365.24	3462.31	20531.26	8600.78	587.70	23425.06	3389.99	36.
93	161	3445.12	3556.64	21112.24	8901.93	608.26	24079.43	3475.33	37.
94	162	3534.48	3637.68	21577.92	9082.56	609.83	24632.69	3511.76	38.
95	163	3640.22	3761.45	22327.11	9497.32	636.78	25496.18	3597.10	39.
96	164	3640.22	3761.45	22327.11	9497.32	636.78	25496.18	3597.10	39.
97	165	3640.22	3761.45	22327.11	9497.32	636.78	25496.18	3597.10	39.
98	166	3756.74	3892.70	23106.25	9861.34	655.95	26457.11	3877.39	40.
99	167	3956.74	4100.82	24338.42	10467.11	685.30	27914.26	4006.49	42.
100	168	3956.74	4100.82	24338.42	10467.11	685.30	27914.26	4006.49	42.
101	169	4096.85	4232.05	25119.76	10750.57	698.14	28826.98	4109.62	44.
102	170	4196.92	4346.10	25819.88	11056.28	721.68	29633.84	4194.96	45.
103	171	4196.92	4346.10	25819.88	11056.28	721.68	29633.84	4194.96	45.
104	172	4196.92	4346.10	25819.88	11056.28	721.68	29633.84	4194.96	45.
105	173	4276.16	4429.55	26301.42	11265.13	724.49	30232.26	4231.38	46.
106	174	4276.16	4429.55	26301.42	11265.13	724.49	30232.26	4231.38	46.
107	175	4276.16	4429.55	26301.42	11265.13	724.49	30232.26	4231.38	46.
108	176	4351.52	4499.19	26706.86	11404.23	777.36	30738.47	4268.46	47.
109	177	4460.18	4623.87	27455.36	11789.62	805.70	31633.05	4353.80	48.
110	178	4460.18	4623.87	27455.36	11789.62	805.70	31633.05	4353.80	48.
111	179	4460.18	4623.87	27455.36	11789.62	805.70	31633.05	4353.80	48.
112	180	4881.39	5033.73	29951.91	12999.13	807.50	34287.95	4740.24	53.
113	181	4993.27	5153.07	30686.10	13281.77	807.50	35039.04	4856.30	55.
114	182	5374.74	5522.11	32895.71	14513.52	880.11	37811.25	5294.90	58.
115	183	5490.02	5634.95	33594.08	14870.39	892.77	38619.94	5380.23	59.
116	184	5490.02	5634.95	33594.08	14870.39	892.77	38619.94	5380.23	59.
117	185	5490.02	5634.95	33594.08	14870.39	892.77	38619.94	5380.23	59.
118	186	5490.02	5634.95	33594.08	14870.39	892.77	38619.94	5380.23	59.
119	187	5601.13	5715.01	34053.80	15145.73	907.58	39203.61	5417.31	60.
120	188	5734.99	5844.31	34847.62	15458.39	908.38	40130.83	5502.65	61.
121	189	5915.17	6012.32	35861.11	16003.32	931.80	41339.90	5601.76	63.
122	190	6024.38	6125.83	36550.58	16272.89	932.61	42153.54	5687.10	64.
123	191	6094.55	6183.18	36882.49	16475.04	941.87	42574.10	5724.18	65.
124	192	6094.55	6183.18	36882.49	16475.04	941.87	42574.10	5724.18	65.
125	193	6094.55	6183.18	36882.49	16475.04	941.87	42574.10	5724.18	65.
126	194	6213.12	6304.10	37634.32	16731.86	942.59	43434.06	5809.52	66.
127	195	6369.94	6416.86	38319.30	17386.51	954.32	44323.94	5853.52	67.
128	196	6574.49	6627.96	39612.54	17887.29	971.29	45845.01	6219.14	69.
129	197	6643.46	6682.46	39938.61	18117.94	983.29	46244.32	6247.70	70.
130	198	6769.21	6808.56	40723.16	18389.27	984.05	47144.89	6333.04	71.
131	199	6769.21	6808.56	40723.16	18389.27	984.05	47144.89	6333.04	71.

132	200	6769.21	6808.56	40723.16	18389.27	984.05	47144.89	6333.04	71.
133	201	6902.32	6888.97	41261.57	18701.23	983.48	47784.85	6141.68	72.
134	202	7020.89	7001.80	41961.66	18976.07	984.36	48598.50	6227.02	73.
135	203	7079.71	7048.93	42250.83	19089.57	992.69	48953.86	6264.10	74.
136	204	7200.00	7171.33	43014.35	19347.74	993.41	49826.87	6349.44	75.
137	205	7149.55	7073.80	42469.84	19691.93	985.63	49261.32	6270.73	75.
138	206	7149.55	7073.80	42469.84	19691.93	985.63	49261.32	6270.73	75.
139	207	7149.55	7073.80	42469.84	19691.93	985.63	49261.32	6270.73	75.
140	208	7239.72	7161.75	43006.50	19945.89	1006.17	49889.57	6551.02	76.
141	209	7297.43	7212.70	43373.68	20146.18	1062.94	50333.10	6600.57	76.
142	210	7355.10	7284.53	43838.54	20263.02	1059.51	50881.28	6648.84	76.
143	211	7610.63	7519.10	45273.89	20801.68	1096.06	52562.57	6775.63	78.
144	212	7568.25	7540.16	45320.25	20723.05	1050.31	52661.48	6782.31	78.
145	213	7568.25	7540.16	45320.25	20723.05	1050.31	52661.48	6782.31	78.
146	214	7568.25	7540.16	45320.25	20723.05	1050.31	52661.48	6782.31	78.
147	215	7775.84	7716.35	46405.87	21161.80	1060.97	53917.62	6904.73	80.
148	216	7775.84	7716.35	46405.87	21161.80	1060.97	53917.62	6904.73	80.
149	217	7967.73	7806.14	47014.91	20892.50	1095.01	54622.61	6972.64	81.
150	218	8083.88	7894.07	47586.99	21162.07	1151.72	55267.77	7051.30	82.
151	219	8232.51	8055.82	48445.68	21421.24	1180.44	56192.76	7145.68	83.
152	220	8232.51	8055.82	48445.68	21421.24	1180.44	56192.76	7145.68	83.
153	221	8232.51	8055.82	48445.68	21421.24	1180.44	56192.76	7145.68	83.
154	222	8559.04	8336.50	50142.72	21916.14	1222.01	58119.86	7334.14	86.
155	223	8381.91	8182.26	49246.35	21472.38	1189.21	57051.45	7228.47	84.
156	224	8505.47	8307.92	50013.91	21721.74	1219.07	57941.96	7298.26	85.
157	225	8621.50	8432.28	50797.51	21896.66	1255.22	58774.81	7399.32	86.
158	226	8260.53	8055.16	48608.12	20652.84	1175.98	56163.70	7218.31	82.
159	227	8260.53	8055.16	48608.12	20652.84	1175.98	56163.70	7218.31	82.
160	228	8260.53	8055.16	48608.12	20652.84	1175.98	56163.70	7218.31	82.
161	229	8373.56	8148.27	49199.26	20910.04	1215.84	56809.96	7312.69	83.
162	230	8603.73	8362.06	50526.51	21384.18	1262.39	58235.38	7473.11	85.
163	231	8609.10	8338.81	50393.97	21451.89	1248.04	58112.83	7429.23	85.
164	232	8636.20	8407.27	50813.00	21239.49	1248.77	58551.19	7482.03	86.
165	233	8637.93	8409.57	50838.29	21306.67	1246.97	58566.55	7482.03	86.
166	234	8637.93	8409.57	50838.29	21306.67	1246.97	58566.55	7482.03	86.
167	235	8637.93	8409.57	50838.29	21306.67	1246.97	58566.55	7482.03	86.
168	236	8877.93	8634.29	52213.12	21718.33	1295.54	60028.64	7645.00	88.
169	237	8950.68	8717.97	52743.75	21587.83	1340.42	60502.68	7725.96	89.
170	238	8872.72	8641.77	52308.48	21123.08	1326.70	59919.67	7649.66	88.
171	239	8915.48	8690.13	52624.12	21185.89	1338.36	60285.72	7590.00	88.
172	240	8849.99	8626.71	52247.37	21033.18	1338.36	59854.96	7523.95	87.
173	241	8849.99	8626.71	52247.37	21033.18	1338.36	59854.96	7523.95	87.
174	242	8849.99	8626.71	52247.37	21033.18	1338.36	59854.96	7523.95	87.
175	243	8972.15	8613.11	52271.52	20963.14	1323.49	59743.86	7511.39	87.
176	244	9074.98	8720.35	52912.89	21275.10	1352.36	60480.02	7791.68	88.
177	245	9028.20	8735.71	53037.17	21178.11	1299.49	60592.16	7798.36	88.
178	246	9289.97	8989.00	54583.03	21652.57	1358.17	62225.00	7978.08	90.
179	247	9289.97	8989.00	54583.03	21652.57	1358.17	62225.00	7978.08	90.

180	248	9219.80	8931.65	54251.12	21450.41	1348.91	61804.44	7941.00	89.
181	249	9119.74	8817.61	53551.00	21144.71	1325.38	60997.58	7855.66	88.
182	250	8683.71	8366.64	50810.93	20039.77	1257.21	57831.44	7514.30	84.
183	251	8922.81	8568.66	52012.54	20658.83	1303.78	59213.86	7624.35	86.
184	252	8838.30	8430.20	51171.94	20250.88	1270.66	58268.57	7295.80	85.
185	253	8983.29	8569.42	52009.13	20466.86	1300.91	59150.67	7381.14	86.
186	254	9162.89	8758.97	53167.19	20796.96	1346.56	60404.53	7519.28	88.
187	255	8910.48	8513.02	51683.88	19878.93	1314.25	58612.02	7353.75	85.
188	256	8910.48	8513.02	51683.88	19878.93	1314.25	58612.02	7353.75	85.
189	257	9059.76	8661.63	52603.69	20206.79	1363.54	59487.56	7448.13	86.
190	258	9238.84	8838.73	53668.12	20825.83	1397.09	60638.30	7744.08	88.
191	259	9044.07	8637.44	52435.18	20215.82	1349.00	59228.25	7590.15	86.
192	260	9053.36	8649.77	52532.89	19862.95	1386.55	59168.17	7614.11	86.
193	261	9167.79	8767.72	53273.40	20038.86	1475.19	59885.48	7708.48	87.
194	262	9167.79	8767.72	53273.40	20038.86	1475.19	59885.48	7708.48	87.
195	263	9167.79	8767.72	53273.40	20038.86	1475.19	59885.48	7708.48	87.
196	264	8630.86	8279.50	50271.13	18907.88	1431.78	56444.89	7367.91	82.
197	265	8882.58	8573.86	52060.03	19480.20	1479.32	59354.55	7514.15	84.
198	266	8231.50	7998.82	48627.63	17536.32	1430.72	55208.74	7131.29	78.
199	267	8316.84	8143.99	49528.07	17577.91	1440.80	56048.31	7232.35	79.
200	268	8248.16	8072.62	49097.38	17457.70	1432.56	55553.38	7166.30	78.
201	269	8040.82	7877.46	47900.25	17021.38	1393.83	54174.98	7012.37	76.
202	270	8040.82	7877.46	47900.25	17021.38	1393.83	54174.98	7012.37	76.
203	271	8003.03	7840.78	47642.50	17012.75	1375.90	53714.99	6957.20	75.
204	272	7623.67	7538.46	45725.90	16207.98	1290.46	51308.22	6764.84	72.
205	273	7190.27	7048.29	42661.49	15340.79	1293.58	47734.10	6421.30	67.
206	274	7284.64	7148.07	43235.79	15574.66	1316.95	48332.18	6515.68	68.
207	275	7402.72	7251.46	43913.06	15779.48	1348.85	48871.16	6605.68	69.
208	276	7402.72	7251.46	43913.05	15779.48	1348.85	48871.16	6605.68	69.
209	277	7402.72	7251.46	43913.06	15779.48	1348.85	48871.16	6605.68	69.
210	278	7614.68	7473.33	45268.48	16287.25	1387.43	50287.10	6952.02	71.
211	279	7986.88	7317.42	47494.57	17626.82	1415.23	52562.25	7219.95	75.
212	280	8070.83	7897.35	47994.11	17836.34	1415.74	53038.82	7285.99	76.
213	281	8188.05	8008.61	48688.21	17929.24	1461.58	53611.13	7143.84	77.
214	282	8188.05	8008.61	48688.21	17929.24	1461.58	53611.13	7143.84	77.
215	283	8188.05	8008.61	48688.21	17929.24	1461.58	53611.13	7143.84	77.
216	284	8188.05	8008.61	48688.21	17929.24	1461.58	53611.13	7143.84	77.
217	285	8135.61	7973.27	48435.12	17920.47	1458.00	53341.09	7114.22	77.
218	286	8332.19	8174.16	49659.35	18223.31	1507.35	54552.47	7268.15	79.
219	287	8482.39	8327.63	50601.62	18647.95	1535.62	55508.98	7399.61	81.
220	288	8759.96	8601.07	52269.20	19450.87	1592.80	57220.07	7765.23	83.
221	289	8877.49	8708.07	52923.34	19761.65	1627.81	57814.59	7859.61	84.
222	290	8777.49	8622.73	52408.79	19602.99	1627.06	57228.61	7793.57	83.
223	291	8777.49	8622.73	52408.79	19602.99	1627.06	57228.61	7793.57	83.
224	292	8657.49	8524.57	51820.52	19199.13	1628.66	56421.93	7513.28	82.
225	293	8751.63	8502.39	52311.56	19406.43	1622.98	56779.45	7579.33	83.
226	294	8668.52	8532.57	51884.66	19281.14	1596.64	56273.13	7530.42	83.
227	295	8617.76	8525.46	51889.77	19168.30	1624.29	56082.97	7514.99	82.

228	296	8703.27	8620.00	52474.46	19219.95	1640.95	56645.98	7600.33	83.
229	297	8703.27	8620.00	52474.46	19219.95	1640.95	56645.98	7600.33	83.
230	298	8703.27	8620.00	52474.46	19219.95	1640.95	56645.98	7600.33	83.
231	299	8879.52	8783.87	53503.70	19952.39	1678.88	57637.76	7685.67	84.
232	300	8766.48	8701.32	53006.83	19631.91	1677.45	57042.20	7644.21	83.
233	301	8701.18	8636.51	52683.29	19815.30	1670.61	56478.79	7602.76	82.
234	302	8784.51	8731.62	53257.19	20033.54	1722.85	57086.10	7639.84	83.
235	303	8631.55	8599.14	52498.25	19714.81	1706.08	56035.85	7573.55	82.
236	304	8631.55	8599.14	52498.25	19714.81	1706.08	56035.85	7573.55	82.
237	305	8631.55	8599.14	52498.25	19714.81	1706.08	56035.85	7573.55	82.
238	306	8763.40	8739.01	53396.53	20069.96	1728.53	56780.09	8122.83	83.
239	307	8673.33	8661.88	52959.86	19891.77	1718.42	56085.23	7852.23	82.
240	308	8632.01	8600.17	52590.41	19964.51	1686.44	55591.95	7823.90	82.
241	309	8668.70	8654.31	52951.95	20290.00	1713.88	55830.82	7878.34	83.
242	310	8599.69	8573.24	52461.32	20119.05	1698.43	55252.54	7834.58	82.
243	311	8599.69	8573.24	52461.32	20119.05	1698.43	55252.54	7834.58	82.
244	312	8599.69	8573.24	52461.32	20119.05	1698.43	55252.54	7834.58	82.
245	313	8659.45	8651.96	52927.56	20283.91	1718.70	55742.93	7878.34	83.
246	314	8685.60	8702.31	53280.03	20350.35	1739.43	55993.59	7904.13	83.
247	315	8685.60	8702.31	53280.03	20350.35	1739.43	55993.59	7904.13	83.
248	316	8880.76	8893.66	54500.23	20670.87	1789.26	57156.88	8026.54	85.
249	317	8784.86	8795.03	53936.23	20318.68	1755.79	56426.63	7999.54	84.
250	318	8784.86	8795.03	53936.23	20318.68	1755.79	56426.63	7999.54	84.
251	319	8784.86	8795.03	53936.23	20318.68	1755.79	56426.63	7999.54	84.
252	320	8976.88	9041.72	55365.78	20730.34	1799.66	57705.35	8137.67	86.
253	321	8889.93	8970.48	54953.61	20431.93	1787.42	57242.41	8100.59	85.
254	322	9026.74	9128.86	55980.79	21221.35	1801.27	58109.20	8217.14	87.
255	323	9017.61	9141.57	56118.25	20925.64	1817.95	58077.55	8261.02	87.
256	324	9091.85	9207.15	56526.04	21115.64	1835.01	58466.71	8304.78	88.
257	325	9091.85	9207.15	56526.04	21115.64	1835.01	58466.71	8304.78	88.
258	326	9091.85	9207.15	56526.04	21115.64	1835.01	58466.71	8304.78	88.
259	327	8965.46	9074.29	55747.14	20582.71	1819.91	57518.83	8033.53	87.
260	328	8889.61	8987.39	55306.57	20832.29	1822.29	56888.41	8024.79	86.
261	329	8888.61	8995.55	55385.11	20932.43	1829.28	56827.68	7829.84	86.
262	330	8888.61	8995.55	55385.11	20932.43	1829.28	56827.68	7829.84	86.
263	331	8404.37	8551.20	52705.96	19926.01	1757.45	53958.07	7542.61	82.
264	332	8404.37	8551.20	52705.96	19926.01	1757.45	53958.07	7542.61	82.
265	333	8404.37	8551.20	52705.96	19926.01	1757.45	53958.07	7542.61	82.
266	334	8426.28	8579.23	52897.09	20032.54	1762.55	54096.09	7579.69	83.
267	335	8541.96	8710.86	53703.90	20324.05	1787.90	54908.23	7859.98	84.
268	336	8748.41	8948.52	55228.20	20796.42	1842.92	56335.09	8048.74	86.
269	337	8538.32	8762.83	54142.57	20146.07	1778.11	55066.93	7870.38	84.
270	338	8548.04	8808.06	54474.20	20028.09	1814.98	55290.86	7923.30	84.
271	339	8548.04	8808.06	54474.20	20028.09	1814.98	55290.86	7923.30	84.
272	340	8548.04	8808.06	54474.20	20028.09	1814.98	55290.86	7923.30	84.
273	341	8660.54	8910.28	55103.64	20877.30	1820.73	55924.23	7964.76	85.
274	342	8580.21	8812.50	54526.46	20713.32	1800.28	55278.74	7921.00	84.
275	343	8672.73	8959.92	55507.43	20590.30	1874.59	56119.32	8041.35	85.

276	344	8526.17	8808.93	54573.69	19813.42	1864.30	55069.15	7963.46	83.
277	345	8612.54	8906.91	55210.29	20111.79	1857.45	55626.69	8036.84	84.
278	346	8566.00	8877.19	55044.12	20157.80	1840.79	54317.58	8036.84	84.
279	347	8511.19	8820.95	54696.38	20032.14	1840.79	53967.96	7989.36	83.
280	348	8511.19	8820.95	54696.38	20032.14	1840.79	53967.96	7989.36	83.
281	349	8817.70	9133.14	56682.53	20634.77	1901.25	55898.16	8392.06	86.
282	350	8617.31	8955.19	55604.32	19996.32	1858.33	54725.76	8074.70	84.
283	351	8463.76	8827.82	54860.17	19858.45	1797.20	53854.35	7967.71	83.
284	352	8363.21	8733.23	54348.31	19517.39	1794.08	53190.07	7882.37	82.
285	353	8234.05	8617.12	53639.93	19184.18	1758.00	52457.81	7787.99	81.
286	354	7766.69	8159.97	50833.30	18086.38	1667.60	49613.68	7518.40	77.
287	355	7766.69	8159.97	50833.30	18086.38	1667.60	49613.68	7518.40	77.
288	356	7733.65	8130.31	50749.40	18075.74	1602.90	49327.55	7554.23	76.
289	357	7810.09	8200.84	51210.43	18644.61	1603.30	49700.49	7630.52	77.
290	358	7613.49	8000.39	49984.04	18276.81	1569.42	48469.33	7467.55	75.
291	359	7613.49	8000.39	49984.04	18276.81	1569.42	48469.33	7467.55	75.
292	360	7613.49	8000.39	49984.04	18276.81	1569.42	48469.33	7467.55	75.
293	361	7429.54	7834.94	48940.57	17804.94	1537.26	47455.93	7364.42	73.
294	362	7519.37	7913.05	49431.24	18036.60	1552.62	47943.50	7408.18	74.
295	363	7388.94	7785.00	48631.64	17837.43	1521.09	47170.17	7313.80	73.
296	364	7544.21	7956.54	49749.14	18160.08	1547.36	48203.25	7414.57	75.
297	365	6772.11	7113.69	44661.64	16467.87	1346.94	42962.81	6485.52	69.
298	1001	6772.11	7113.69	44661.64	16467.87	1346.94	42962.81	6485.52	69.
299	1002	6772.11	7113.69	44661.64	16467.87	1346.94	42962.81	6485.52	69.
300	1003	6772.11	7113.69	44661.64	16467.87	1346.94	42962.81	6485.52	69.
301	1004	7048.43	7413.47	46557.70	17359.58	1406.79	44813.80	6888.22	72.
302	1005	7161.49	7540.79	47364.10	17611.42	1429.04	45594.54	6982.60	73.
303	1006	7243.16	7622.11	47874.55	17867.57	1451.74	46109.57	7026.36	74.
304	1007	7438.95	7870.59	49475.59	18378.16	1522.95	47588.80	7159.17	76.
305	1008	7406.43	7848.43	49355.46	18270.64	1538.23	47482.20	7136.88	76.
306	1009	7406.43	7848.43	49355.46	18270.64	1538.23	47482.20	7136.88	76.
307	1010	7406.43	7848.43	49355.46	18270.64	1538.23	47482.20	7136.88	76.
308	1011	7649.53	8097.17	50954.27	19421.50	1571.40	49063.94	7263.68	78.
309	1012	7649.53	8097.17	50954.27	19421.50	1571.40	49063.94	7263.68	78.
310	1013	7826.14	8278.75	52103.71	19944.48	1662.71	50181.31	7395.14	80.
311	1014	7926.14	8397.16	52879.27	20215.97	1683.33	50896.41	7442.61	81.
312	1015	7898.32	8369.00	52709.27	20246.30	1675.43	50721.62	7391.99	81.
313	1016	7898.32	8369.00	52709.27	20246.30	1675.43	50721.62	7391.99	81.
314	1017	7898.32	8369.00	52709.27	20246.30	1675.43	50721.62	7391.99	81.
315	1018	7932.30	8430.71	53122.83	20584.26	1711.82	51106.51	7621.66	82.
316	1019	7922.31	8422.37	53110.57	20707.26	1717.51	51036.69	7612.62	82.
317	1020	7868.23	8383.93	52900.96	20735.58	1717.80	50845.52	7546.80	82.
318	1021	7976.80	8500.67	53664.74	21087.87	1727.36	51549.39	7612.84	83.
319	1022	8176.43	8705.39	54997.34	21647.98	1789.30	52818.29	7735.26	85.
320	1023	8176.43	8705.39	54997.34	21647.98	1789.30	52818.29	7735.26	85.
321	1024	8176.43	8705.39	54997.34	21647.98	1789.30	52818.29	7735.26	85.
322	1025	8349.23	8898.66	56252.89	22063.26	1890.25	54019.84	7871.22	86.
323	1026	8455.06	9023.93	56972.36	22605.68	1911.16	54721.23	7956.56	87.

324	1027	8583.63	9167.73	57919.99	22938.91	1940.86	55629.10	8041.90	88.
325	1028	8716.40	9293.20	58752.27	23125.29	1971.28	56402.62	8103.57	89.
326	1029	8733.15	9287.29	58785.91	23201.65	1979.50	56339.98	7908.62	89.
327	1030	8538.50	9069.59	57476.18	22611.40	1927.72	55004.59	7784.02	86.
328	1031	8446.28	8974.64	56895.59	22420.18	1913.93	54407.43	7503.74	85.
329	1032	8576.85	9104.70	57748.84	22873.73	1965.26	55298.16	7746.54	86.
330	1033	8514.34	9040.94	57358.46	22574.84	1955.80	54942.97	7689.53	85.
331	1034	8585.45	9107.27	57780.44	22894.82	1968.11	55360.05	7726.61	86.
332	1035	8783.32	9336.24	59245.59	23484.67	2003.49	56754.24	7877.99	88.
333	1036	8847.32	9400.00	59658.55	23761.48	2015.57	57159.96	7915.07	89.
334	1037	8847.32	9400.00	59658.55	23761.48	2015.57	57159.96	7915.07	89.
335	1038	8847.32	9400.00	59658.55	23761.48	2015.57	57159.96	7915.07	89.
336	1039	8706.88	9263.41	58800.76	22889.38	2004.51	56329.49	7836.54	87.
337	1040	8481.93	9043.70	57455.12	21692.33	1996.90	55008.64	7700.70	85.
338	1041	8481.93	9043.70	57455.12	21692.33	1996.90	55008.64	7700.70	85.
339	1042	8795.81	9374.63	59553.20	22975.21	2064.38	57077.46	7874.97	88.
340	1043	8720.43	9293.93	59059.13	22777.72	2043.13	56584.72	7831.21	87.
341	1044	8509.23	9080.01	57740.84	22497.25	1995.27	55306.61	7651.50	85.
342	1045	8509.23	9080.01	57740.84	22497.25	1995.27	55306.61	7651.50	85.
343	1046	8509.23	9080.01	57740.84	22497.25	1995.27	55306.61	7651.50	85.
344	1047	8742.03	9296.07	59100.55	23193.93	2051.24	56680.25	7789.63	87.
345	1048	8742.03	9296.07	59100.55	23193.93	2051.24	56680.25	7789.63	87.
346	1049	8942.91	9516.37	60513.89	23963.27	2099.96	57837.37	7865.15	89.
347	1050	8942.91	9516.37	60513.89	23963.27	2099.96	57837.37	7865.15	89.
348	1051	8533.85	9091.06	57786.53	23202.26	2002.53	55206.49	7496.67	85.
349	1052	8533.85	9091.06	57786.53	23202.26	2002.53	55206.49	7496.67	85.
350	1053	8644.05	9187.55	58383.72	23618.02	2064.65	55854.05	7754.67	86.
351	1054	8571.99	9108.57	57895.91	23416.48	2033.74	55365.66	7710.91	85.
352	1055	8497.47	9076.61	57669.60	22820.61	2105.04	55293.55	7678.93	85.
353	1056	8508.45	9118.97	57944.77	22886.00	2109.69	55553.96	7729.55	85.
354	1057	8597.16	9188.26	58375.99	23122.90	2128.37	55989.46	7773.30	86.
355	1058	8597.16	9188.26	58375.99	23122.90	2128.37	55989.46	7773.30	86.
356	1059	8381.46	8974.48	57029.57	22600.78	2086.22	54682.21	7584.55	84.
357	1060	8487.12	9083.96	57713.23	22960.86	2112.33	55369.80	7864.83	85.
358	1061	8455.81	9031.05	57355.24	22955.39	2091.91	55068.86	7814.21	85.
359	1062	8545.72	9116.27	57912.91	23104.46	2103.56	55601.08	7893.80	85.
360	1063	8644.16	9189.79	58368.27	23380.29	2124.15	56068.17	7937.56	86.
361	1064	8743.32	9258.46	58936.27	23676.84	2134.66	56637.14	7786.37	87.
362	1065	8743.32	9258.46	58936.27	23676.84	2134.66	56637.14	7786.37	87.
363	1066	8601.66	9177.14	58425.32	23420.69	2111.96	56122.11	7742.61	86.
364	1067	8851.34	9408.04	59856.30	24497.11	2132.08	57589.72	7850.11	88.
365	1068	8852.18	9407.39	59850.12	24589.30	2124.49	57612.86	7850.11	88.
366	1069	8690.23	9216.57	58575.26	23538.70	2149.46	56444.09	7750.07	85.
367	1070	8690.23	9216.57	58575.26	23538.70	2149.46	56444.09	7750.07	85.
368	1071	8757.51	9321.99	59226.61	23803.56	2219.67	57154.64	7740.25	86.
369	1072	8559.82	9092.67	57793.00	23335.88	2180.45	55767.64	7412.49	84.
370	1073	8455.28	8968.38	57002.63	23070.48	2151.98	55024.73	7327.15	83.
371	1074	8566.17	9097.35	57810.13	23451.53	2181.72	55823.60	7607.43	84.

372	1075	8530.89	9051.23	57476.39	23373.17	2175.73	55596.38	7556.81	84.
373	1076	8356.50	8853.90	56233.35	23111.97	2156.49	54420.82	7405.43	82.
374	1077	8640.20	9158.58	58173.48	24051.31	2251.23	56315.29	7612.16	85.
375	1078	8640.20	9158.58	58173.48	24051.31	2251.23	56315.29	7612.16	85.
376	1079	8334.65	8856.81	56262.41	23159.46	2186.08	54438.09	7417.42	81.
377	1080	8334.65	8856.81	56262.41	23159.46	2186.08	54438.09	7417.42	81.
378	1081	8433.35	8971.64	56952.83	23447.84	2218.61	55179.93	7488.35	82.
379	1082	8352.42	8873.77	56303.20	23456.76	2194.29	54620.96	7412.05	81.
380	1083	8221.68	8727.20	55326.64	23408.04	2184.04	53752.98	7278.45	80.
381	1084	8298.60	8822.45	55881.01	23749.54	2196.06	54359.19	7344.50	81.
382	1085	8310.08	8813.51	55814.40	23766.35	2199.49	54293.18	7344.50	81.
383	1086	7969.27	8463.90	53655.72	22744.22	2116.90	52195.42	7140.73	77.
384	1087	7878.02	8359.70	52845.06	22499.02	2074.16	51459.09	7093.25	76.
385	1088	7901.51	8363.16	52854.36	22525.19	2063.56	51474.68	7099.93	76.
386	1089	7636.26	8089.20	51114.68	22221.82	2008.96	49825.60	6705.97	74.
387	1090	7046.56	7448.08	46782.41	21097.82	1820.44	45768.21	6299.06	69.
388	1091	7197.86	7609.21	47762.48	21327.52	1871.66	46777.60	6623.10	71.
389	1092	7093.01	7486.50	46948.05	20977.82	1845.92	46029.67	6528.72	70.
390	1093	7093.01	7486.50	46948.05	20977.82	1845.92	46029.67	6528.72	70.
391	1094	7188.41	7575.62	47513.71	21203.33	1878.83	46557.31	6809.01	71.
392	1095	7274.35	7651.28	47977.96	21261.22	1897.98	47026.55	6852.77	72.
393	1096	7391.99	7784.27	48842.18	21599.25	1938.17	47859.19	6947.14	73.
394	1097	7453.53	7852.15	49256.49	21777.93	1959.52	48280.88	6984.22	74.
395	1098	7453.53	7852.15	49256.49	21777.93	1959.52	48280.88	6984.22	74.
396	1099	7439.46	7802.01	48900.96	21476.51	1969.30	47986.63	6961.93	74.
397	1100	7439.46	7802.01	48900.96	21476.51	1969.30	47986.63	6961.93	74.
398	1101	7439.46	7802.01	48900.96	21476.51	1969.30	47986.63	6961.93	74.
399	1102	7525.40	7874.20	49349.86	21568.79	1996.93	48426.45	7005.69	75.
400	1103	7412.90	7785.06	48805.85	21243.10	1971.84	47852.09	6961.93	74.
401	1104	7370.81	7736.48	48497.91	20742.42	1971.47	47525.05	6957.55	74.
402	1105	7576.52	7977.75	50029.72	21061.20	2051.81	49020.21	7285.32	76.
403	1106	7675.00	8093.52	50748.52	21463.15	2059.31	49743.86	7326.78	77.
404	1107	7675.00	8093.52	50748.52	21463.15	2059.31	49743.86	7326.78	77.
405	1108	7675.00	8093.52	50748.52	21463.15	2059.31	49743.86	7326.78	77.
406	1109	7675.00	8093.52	50748.52	21463.15	2059.31	49743.86	7326.78	77.
407	1110	7562.20	7970.98	49979.34	21115.93	2030.43	48959.22	7039.81	76.
408	1111	7044.29	7387.64	46275.64	19767.75	1887.99	45597.14	6689.41	72.
409	1112	6799.41	7167.34	44883.84	19402.43	1809.12	44259.99	6578.89	70.
410	1113	6972.52	7373.55	46225.88	19879.98	1850.82	45532.14	6701.30	72.
411	1114	6972.52	7373.55	46225.88	19879.98	1850.82	45532.14	6701.30	72.
412	1115	6972.52	7373.55	46225.88	19879.98	1850.82	45532.14	6701.30	72.
413	1116	6972.52	7373.55	46225.88	19879.98	1850.82	45532.14	6701.30	72.
414	1117	6972.66	7362.83	46158.00	19825.61	1827.63	45443.84	6701.30	72.
415	1118	6972.66	7362.83	46158.00	19825.61	1827.63	45443.84	6701.30	72.
416	1119	6892.95	7313.73	45863.57	19426.83	1793.73	45123.71	6686.52	71.
417	1120	6822.75	7227.51	45313.54	19276.73	1776.98	44601.13	6592.14	70.
418	1121	6822.75	7227.51	45313.54	19276.73	1776.98	44601.13	6592.14	70.
419	1122	6822.75	7227.51	45313.54	19276.73	1776.98	44601.13	6592.14	70.

420	1123	6926.52	7327.47	45945.25	19601.64	1781.30	45219.18	6633.59	71.
421	1124	7011.08	7417.50	46565.74	19741.49	1825.89	45821.42	6675.18	71.
422	1125	7016.50	7434.14	46718.52	19553.11	1832.50	46015.77	6675.18	71.
423	1126	6414.09	6760.41	42477.54	17514.89	1631.66	41801.76	6069.08	66.
424	1127	6200.99	6539.82	41078.29	16802.62	1580.46	40452.00	5948.88	64.
425	1128	6200.99	6539.82	41078.29	16802.62	1580.46	40452.00	5948.88	64.
426	1129	6200.99	6539.82	41078.29	16802.62	1580.46	40452.00	5948.88	64.
427	1130	6200.99	6539.82	41078.29	16802.62	1580.46	40452.00	5948.88	64.
428	1131	6200.99	6539.82	41078.29	16802.62	1580.46	40452.00	5948.88	64.
429	1132	6195.41	6536.66	41036.33	16851.87	1577.02	40417.71	5924.29	64.
430	1133	6077.59	6417.12	40297.18	16481.81	1545.05	39658.55	5644.00	63.
431	1134	6063.65	6382.63	40063.35	16295.81	1552.42	39443.94	5593.39	63.
432	1135	6063.65	6382.63	40063.35	16295.81	1552.42	39443.94	5593.39	63.
433	1136	6063.65	6382.63	40063.35	16295.81	1552.42	39443.94	5593.39	63.
434	1137	6063.65	6382.63	40063.35	16295.81	1552.42	39443.94	5593.39	63.
435	1138	5984.41	6322.41	39742.23	16078.89	1528.08	39052.19	5549.63	62.
436	1139	6064.12	6407.88	40267.32	16448.34	1536.37	39547.14	5591.09	63.
437	1140	5878.85	6194.14	38934.89	15919.22	1496.79	38205.42	5454.11	61.
438	1141	5880.59	6195.11	38945.70	15795.29	1498.70	38176.87	5454.11	61.
439	1142	5804.32	6117.26	38465.09	15500.12	1462.99	37689.18	5417.04	60.
440	1143	5804.32	6117.26	38465.09	15500.12	1462.99	37689.18	5417.04	60.
441	1144	5804.32	6117.26	38465.09	15500.12	1462.99	37689.18	5417.04	60.
442	1145	5868.84	6181.32	38855.54	15645.36	1487.46	38056.82	5454.11	61.
443	1146	5763.01	6056.06	38136.07	15102.94	1466.54	37355.43	5368.78	60.
444	1147	5853.48	6143.52	38672.57	15217.99	1488.08	37861.63	5412.54	61,
445	1148	5830.67	6136.57	38625.94	15237.84	1480.88	37796.40	5405.86	61.
446	1149	5927.28	6221.15	39151.48	15308.99	1505.90	38290.55	5449.61	62.
447	1150	5677.89	5954.22	37459.06	14555.05	1422.88	36662.07	5292.33	59.
448	1151	5677.89	5954.22	37459.06	14555.05	1422.88	36662.07	5292.33	59.
449	1152	5677.89	5954.22	37459.06	14555.05	1422.88	36662.07	5292.33	59.
450	1153	5677.89	5954.22	37459.06	14555.05	1422.88	36662.07	5292.33	59.
451	1154	5649.23	5933.84	37320.96	14482.59	1435.04	36517.99	5263.36	59.
452	1155	5564.07	5826.34	36658.10	14346.61	1409.61	35820.18	5182.40	58.
453	1156	5419.99	5666.89	35675.66	14039.01	1372.96	34813.93	4853.87	57.
454	1157	5419.99	5566.89	35675.66	14039.01	1372.96	34813.93	4853.87	57.
455	1158	5419.99	5666.89	35675.66	14039.01	1372.96	34813.93	4853.87	57.
456	1159	5247.93	5500.43	34636.06	13623.66	1336.15	33769.44	4529.84	55.
457	1160	5033.07	5301.80	33413.00	13493.21	1293.38	32536.43	4400.74	53.
458	1161	5042.25	5282.20	33779.52	13469.79	1293.78	32427.67	4350.13	53.
459	1162	5082.50	5315.20	33490.64	13512.96	1316.43	32637.98	4356.80	53.
460	1163	4957.23	5185.39	32664.23	13169.23	1287.86	31839.21	4262.43	52.
461	1164	4841.05	5066.89	31907.93	12872.95	1263.76	31113.69	4168.06	51.
462	1165	4841.05	5066.89	31907.93	12872.95	1263.76	31113.69	4168.06	51.
463	1166	4459.17	4655.56	29294.40	11931.26	1154.10	28564.66	3721.59	47.
464	1167	4164.59	4319.98	27293.71	11010.55	1075.52	26635.52	3473.28	44.
465	1168	4234.77	4392.91	27741.75	11366.18	1101.72	27099.64	3510.36	45.
466	1169	4347.67	4507.88	28447.73	11720.23	1104.25	27851.75	3551.82	46.
467	1170	4268.88	4413.39	27850.86	11524.20	1063.91	27275.21	3504.34	45.

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468 1171 4268.88 4413.39 27850.86 11524.20 1063.91 27275.21 3504.34  45.
469 1172 4043.44 4181.18 26411.32 10712.61 1027.95 25849.60 3388.72  42.
470 1173 4043.44 4181.18 26411.32 10712.61 1027.95 25849.60 3388.72  42.
471 1174 3805.02 3967.63 25061.55 10213.69  984.24 24515.00 3250.58  40.
472 1175 3491.38 3616.18 22837.36  9251.69  853.75 22343.90 2809.86  37.
473 1176 3387.61 3516.22 22205.64  8926.79  849.43 21725.85 2768.40  36.
474 1177 3387.61 3516.22 22205.64  8926.79  849.43 21725.85 2768.40  36.
475 1178 3387.61 3516.22 22205.64  8926.79  849.43 21725.85 2768.40  36.
476 1179 3307.12 3437.27 21673.23  8647.27  839.09 21248.39 2731.32  35.
477 1180 3130.77 3221.22 20257.25  8710.91  764.54 19864.76 2631.04  33.
478 1181 2030.08 2069.10 12857.43  6041.78  466.67 12680.46 1596.01  23.
479 1182 2030.08 2069.10 12857.43  6041.78  466.67 12680.46 1596.01  23.
480 1183 2030.08 2069.10 12857.43  6041.78  466.67 12680.46 1596.01  23.
481 1184 2030.08 2069.10 12857.43  6041.78  466.67 12680.46 1596.01  23.
482 1185 2030.08 2069.10 12857.43  6041.78  466.67 12680.46 1596.01  23.
483 1186 2030.08 2069.10 12857.43  6041.78  466.67 12680.46 1596.01  23.
484 1187 2030.08 2069.10 12857.43  6041.78  466.67 12680.46 1596.01  23.
485 1188 2030.08 2069.10 12857.43  6041.78  466.67 12680.46 1596.01  23.
486 1189 2030.08 2069.10 12857.43  6041.78  466.67 12680.46 1596.01  23.
487 1190 2030.08 2069.10 12857.43  6041.78  466.67 12680.46 1596.01  23.
488 1191 2030.08 2069.10 12857.43  6041.78  466.67 12680.46 1596.01  23.
489 1192 2030.08 2069.10 12857.43  6041.78  466.67 12680.46 1596.01  23.
490 1193 2030.08 2069.10 12857.43  6041.78  466.67 12680.46 1596.01  23.
491 1194 1941.37 1975.81 12283.48  5650.36  458.04 12119.55 1554.55  22.
492 1195 1941.37 1975.81 12283.48  5650.36  458.04 12119.55 1554.55  22.
493 1196 1862.80 1877.73 11663.38  5351.78  446.68 11506.17 1488.50  21.
494 1197 1757.14 1764.40 10964.29  5087.36  419.82 10811.95 1208.21  20.
495 1198 1757.14 1764.40 10964.29  5087.36  419.82 10811.95 1208.21  20.
496 1199 1757.14 1764.40 10964.29  5087.36  419.82 10811.95 1208.21  20.
497 1200 1652.49 1633.70 10139.61  4851.38  396.24  9999.34 1113.83  19.
498 1201 1652.49 1633.70 10139.61  4851.38  396.24  9999.34 1113.83  19.
499 1202 1652.49 1633.70 10139.61  4851.38  396.24  9999.34 1113.83  19.
500 1203 1652.49 1633.70 10139.61  4851.38  396.24  9999.34 1113.83  19.
501 1204 1652.49 1633.70 10139.61  4851.38  396.24  9999.34 1113.83  19.
502 1205 1652.49 1633.70 10139.61  4851.38  396.24  9999.34 1113.83  19.
503 1206 1652.49 1633.70 10139.61  4851.38  396.24  9999.34 1113.83  19.
504 1207 1509.89 1495.91  9291.27  4651.30  345.56  9195.07 1032.99  17.
505 1208 1248.50 1250.71  7777.93  4107.51  291.40  7772.46  904.01  14.
506 1209 1179.64 1189.10  7404.06  3833.48  276.59  7414.45  866.93  13.
507 1210  893.27  885.98  5518.69  3187.83  213.86  5573.04  476.83  10.
508 1211  893.27  885.98  5518.69  3187.83  213.86  5573.04  476.83  10.
509 1212  893.27  885.98  5518.69  3187.83  213.86  5573.04  476.83  10.
510 1213  893.27  885.98  5518.69  3187.83  213.86  5573.04  476.83  10.
511 1214  893.27  885.98  5518.69  3187.83  213.86  5573.04  476.83  10.
512 1215  719.58  709.95  4426.01  2465.06  197.94  4494.73  369.32   8.
513 1216  652.92  634.55  3946.66  2132.94  181.50  4032.20  332.24   7.
514 1217  652.92  634.55  3946.66  2132.94  181.50  4032.20  332.24   7.
515 1218  485.50  456.02  2835.27  1642.96  111.03  2931.99  251.40   5.
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516	1219	485.50	456.02	2835.27	1642.96	111.03	2931.99	251.40	5.
517	1220	485.50	456.02	2835.27	1642.96	111.03	2931.99	251.40	5.
518	1221	393.57	377.38	2354.12	1431.57	69.60	2455.18	207.64	4.
519	1222	393.57	377.38	2354.12	1431.57	69.60	2455.18	207.64	4.
520	1223	393.57	377.38	2354.12	1431.57	69.60	2455.18	207.64	4.
521	1224	393.57	377.38	2354.12	1431.57	69.60	2455.18	207.64	4.
522	1225	234.33	227.68	1428.80	886.08	24.76	1512.17	126.80	2.
523	1226	234.33	227.68	1428.80	886.08	24.76	1512.17	126.80	2.
524	1227	234.33	227.68	1428.80	886.08	24.76	1512.17	126.80	2.
525	1228	234.33	227.68	1428.80	886.08	24.76	1512.17	126.80	2.
526	1229	234.33	227.68	1428.80	886.08	24.76	1512.17	126.80	2.
527	1230	234.33	227.68	1428.80	886.08	24.76	1512.17	126.80	2.
528	1231	121.43	112.71	722.82	532.04	22.23	760.05	85.34	1.
529	1232	121.43	112.71	722.82	532.04	22.23	760.05	85.34	1.
530	1233	121.43	112.71	722.82	532.04	22.23	760.05	85.34	1.
531	1234	121.43	112.71	722.82	532.04	22.23	760.05	85.34	1.
532	1235	121.43	112.71	722.82	532.04	22.23	760.05	85.34	1.

SUMMARY OF DAILY STATISTICS OF NARF (ENGINES)

DATA FOR JULIAN DATES 0140 TO 1230

TOTAL NUMBER OF OBSERVATIONS = 1532

DAY	JUL DATE	NORM	DIR MH	DIR LAB$	DIR MTL$	OVHD$	PENALTY$	# IN SHOP
1	140	10.24	15.36	89.62	174.71	102.98	57.33	1.
2	141	32.74	40.36	234.05	300.09	276.28	118.97	2.
3	142	32.74	40.36	234.05	300.09	276.28	118.97	2.
4	143	32.74	40.36	234.05	300.09	276.28	118.97	2.
5	144	32.74	40.36	234.05	300.09	276.28	118.97	2.
6	145	62.25	71.59	418.94	996.24	493.02	270.94	5.
7	146	97.25	109.59	638.53	1161.91	759.05	320.33	6.
8	147	117.00	132.75	773.69	1249.73	919.34	431.36	8.
9	148	163.18	175.45	1019.10	1447.34	1207.64	591.78	11.
10	149	163.18	175.45	1019.10	1447.34	1207.64	591.78	11.
11	150	163.18	175.45	1019.10	1447.34	1207.64	591.78	11.
12	151	163.18	175.45	1019.10	1447.34	1207.64	591.78	11.
13	152	196.48	203.42	1180.28	1566.73	1408.32	702.81	13.
14	153	233.56	238.04	1381.20	1714.29	1656.74	801.59	15.
15	154	310.27	322.61	1873.38	2944.36	2260.96	1074.46	21.
16	155	351.88	377.42	2188.18	3683.78	2662.37	1215.55	24.
17	156	387.44	418.34	2427.25	4174.83	2941.62	1356.64	27.
18	157	387.44	418.34	2427.25	4174.83	2941.62	1356.64	27.
19	158	387.44	418.34	2427.25	4174.83	2941.62	1356.64	27.
20	159	450.59	486.94	2827.82	4875.02	3442.91	1519.73	31.
21	160	522.11	573.36	3327.18	5495.58	4062.48	1693.65	35.
22	161	619.78	682.08	3957.85	6113.52	4857.53	2025.10	42.
23	162	711.89	783.59	4550.11	6950.13	5601.38	2292.01	48.
24	163	820.87	885.09	5139.81	8339.56	6354.31	2641.27	56.
25	164	820.87	885.09	5139.81	8339.56	6354.31	2641.27	56.
26	165	820.87	885.09	5139.81	8339.56	6354.31	2641.27	56.
27	166	954.76	1014.84	5893.50	9906.59	7320.67	2924.99	65.
28	167	1059.67	1134.94	6591.35	11038.00	8249.77	3256.44	72.
29	168	1184.52	1262.45	7334.89	12581.54	9227.60	3604.18	81.
30	169	1297.92	1374.55	8090.13	14448.27	10224.30	3994.50	90.
31	170	1347.61	1439.50	8471.28	15115.77	10743.61	4197.22	94.
32	171	1347.61	1439.50	8471.28	15115.77	10743.61	4197.22	94.
33	172	1347.61	1439.50	8471.28	15115.77	10743.61	4197.22	94.
34	173	1468.24	1553.49	9143.13	16078.53	11643.40	4552.02	103.
35	174	1570.68	1645.71	9683.26	17328.43	12383.11	4817.62	109.

36	175	1637.64	1719.08	10117.59	17906.96	13021.41	5075.29	115.
37	176	1727.89	1830.88	10777.47	19188.35	13932.00	5357.45	121.
38	177	1780.22	1685.05	11093.00	19715.56	14373.85	5516.34	125.
39	178	1780.22	1885.05	11093.00	19715.56	14373.85	5516.34	125.
40	179	1780.22	1885.05	11093.00	19715.56	14373.85	5516.34	125.
41	180	1913.76	2008.90	11820.93	21042.15	15381.23	5883.38	134.
42	181	1993.22	2109.88	12416.30	21866.09	16212.42	6105.16	140.
43	182	1850.37	1952.69	11507.84	20519.66	15223.28	5768.29	132.
44	183	1847.33	1956.49	11529.55	20831.13	15285.72	5768.29	132.
45	184	1847.33	1956.49	11529.55	20831.13	15285.72	5768.29	132.
46	185	1847.33	1956.49	11529.55	20831.13	15285.72	5768.29	132.
47	186	1847.33	1956.49	11529.55	20831.13	15285.72	5768.29	132.
48	187	1956.48	2044.06	12065.21	22547.13	16002.76	5928.43	137.
49	188	2045.88	2136.08	12612.99	23466.75	16770.41	6199.59	144.
50	189	2081.47	2170.88	12824.53	24441.37	17134.43	6232.20	146.
51	190	2103.78	2172.14	12838.48	24507.50	17231.92	6260.63	148.
52	191	2185.41	2218.43	13121.80	24923.08	17627.87	6454.27	154.
53	192	2185.41	2218.43	13121.80	24923.08	17627.87	6454.27	154.
54	193	2185.41	2218.43	13121.80	24923.08	17627.87	6454.27	154.
55	194	2169.99	2225.66	13168.58	25009.36	17775.16	6357.14	151.
56	195	2243.01	2290.98	13554.88	25969.26	18336.77	6488.64	155.
57	196	2196.22	2281.35	13476.80	25330.90	18303.68	6469.58	153.
58	197	2217.64	2307.89	13636.21	25932.39	18572.21	6447.60	156.
59	198	2199.87	2291.46	13547.39	25993.50	18481.34	6416.02	156.
60	199	2199.87	2291.46	13547.39	25993.50	18481.34	6416.02	156.
61	200	2199.87	2291.46	13547.39	25993.50	18481.34	6416.02	156.
62	201	2273.11	2356.84	13933.85	27068.39	19075.32	6631.16	162.
63	202	2209.06	2310.74	13671.69	27041.30	18761.12	6447.82	155.
64	203	2141.29	2241.10	13280.74	26222.74	18238.83	6342.36	154.
65	204	2164.85	2266.00	13439.33	26746.59	18488.88	6369.48	156.
66	205	2123.93	2221.42	13180.40	26905.41	18164.26	6266.69	156.
67	206	2123.93	2221.42	13180.40	26905.41	18164.26	6266.69	156.
68	207	2123.93	2221.42	13180.40	26905.41	18164.26	6266.69	156.
69	208	2179.15	2288.76	13584.25	27258.21	18732.86	6439.22	159.
70	209	2170.63	2291.26	13604.30	27184.57	18788.41	6363.82	159.
71	210	2212.27	2332.83	13854.45	27300.39	19174.27	6404.71	160.
72	211	2243.11	2347.90	13948.19	27569.34	19312.38	6513.40	162.
73	212	2053.74	2156.39	12745.89	25083.60	17702.15	5895.37	149.
74	213	2053.74	2156.39	12745.69	25083.60	17702.15	5895.37	149.
75	214	2053.74	2156.39	12745.89	25083.60	17702.15	5895.37	149.
76	215	2141.60	2239.78	13247.13	25978.00	18385.50	6047.57	154.
77	216	2193.20	2289.38	13561.15	26184.54	18813.50	6103.22	156.
78	217	2223.89	2318.95	13744.97	26252.30	19077.25	6117.40	157.
79	218	2273.92	2369.62	14056.13	26685.68	19511.38	6258.63	158.
80	219	2253.46	2355.99	13979.21	26557.09	19408.84	6209.24	157.
81	220	2253.46	2355.99	13979.21	26557.09	19408.84	6209.24	157.
82	221	2253.46	2355.99	13979.21	26557.09	19408.84	6209.24	157.
83	222	2272.81	2366.24	14057.89	25877.02	19528.89	6235.38	158.

84	223	2279.97	2372.14	14108.43	25407.27	19595.43	6165.80	157.
85	224	2337.47	2422.02	14419.54	25812.96	20032.13	6231.48	160.
86	225	2274.00	2361.70	14063.46	25305.26	19539.00	6025.87	156.
87	226	2293.52	2392.60	14248.48	24827.35	19796.27	6032.52	155.
88	227	2293.52	2392.60	14248.48	24827.35	19796.27	6032.52	155.
89	228	2293.52	2392.60	14248.48	24827.35	19796.27	6032.52	155.
90	229	2227.64	2315.93	13805.66	23838.45	19238.52	5816.30	150.
91	230	2214.13	2280.86	13598.40	23757.44	18957.59	5749.37	146.
92	231	2352.96	2408.00	14362.25	25030.33	20007.76	6074.97	154.
93	232	2377.77	2442.03	14572.68	25509.41	20296.87	6200.80	157.
94	233	2387.45	2443.91	14584.49	25569.36	20325.24	6156.85	156.
95	234	2387.45	2443.91	14584.49	25569.36	20325.24	6156.85	156.
96	235	2387.45	2443.91	14584.49	25569.36	20325.24	6156.85	156.
97	236	2418.51	2473.78	14790.34	26020.29	20609.62	6280.97	156.
98	237	2444.79	2490.21	14903.37	26398.75	20692.57	6371.30	157.
99	238	2427.62	2463.98	14755.79	25781.97	20465.30	6352.12	155.
100	239	2464.89	2492.70	14929.53	26146.21	20686.83	6432.86	157.
101	240	2386.62	2411.46	14438.94	25212.97	20007.07	6154.72	149.
102	241	2386.62	2411.46	14438.94	25212.97	20007.07	6154.72	149.
103	242	2386.62	2411.46	14438.94	25212.97	20007.07	6154.72	149.
104	243	2324.55	2338.08	13991.02	24568.72	19390.30	5907.30	143.
105	244	2274.45	2284.01	13673.45	24090.99	18924.52	5772.17	139.
106	245	2219.86	2248.79	13461.04	23237.02	18618.29	5741.97	134.
107	246	2241.91	2283.06	13663.74	23280.71	18891.73	5853.00	136.
108	247	2260.97	2297.55	13739.43	23504.19	18994.24	5917.30	138.
109	248	2260.97	2297.55	13739.43	23504.19	18994.24	5917.30	138.
110	249	2260.97	2297.55	13739.43	23504.19	18994.24	5917.30	138.
111	250	2260.97	2297.55	13739.43	23504.19	18994.24	5917.30	138.
112	251	2209.82	2250.09	13438.49	23149.93	18592.96	5653.36	135.
113	252	2113.95	2157.89	12868.31	21848.64	17775.64	5501.11	131.
114	253	2019.48	2078.12	12357.89	21013.67	17070.63	5258.31	126.
115	254	1953.97	2009.32	11880.76	20358.50	16388.86	5042.11	120.
116	255	1953.97	2009.32	11880.76	20358.50	16388.86	5042.11	120.
117	256	1953.97	2009.32	11880.76	20358.50	16388.86	5042.11	120.
118	257	1977.63	2036.43	12029.01	20540.66	16588.52	5088.62	120.
119	258	2061.32	2107.96	12421.35	21180.15	17100.70	5253.27	125.
120	259	1981.27	2028.81	11948.68	20340.74	16423.75	5001.17	120.
121	260	1959.01	2011.63	11836.39	19963.48	16233.40	4939.14	121.
122	261	1928.31	1974.86	11611.87	19454.93	15901.07	4873.20	120.
123	262	1928.31	1974.86	11611.87	19454.93	15901.07	4873.20	120.
124	263	1928.31	1974.86	11611.87	19454.93	15901.07	4873.20	120.
125	264	1918.14	1955.24	11482.01	19366.67	15690.66	4827.01	117.
126	265	1840.18	1879.02	10991.04	19181.08	14992.82	4673.68	112.
127	266	1795.12	1841.29	10750.11	18569.01	14588.61	4647.66	113.
128	267	1856.23	1898.22	11083.08	19526.87	14869.03	4880.20	118.
129	268	1754.20	1768.26	10299.62	18082.54	13732.84	4628.18	113.
130	269	1754.20	1768.26	10299.62	18082.54	13732.84	4628.18	113.
131	270	1754.20	1768.26	10299.62	18082.54	13732.84	4628.18	113.

132	271	1777.63	1788.36	10426.94	18116.08	13799.32	4823.86	119.
133	272	1880.75	1889.55	11018.20	19242.40	14540.19	5062.07	125.
134	273	1987.76	1995.57	11644.91	20384.41	15312.41	5318.10	132.
135	274	1821.71	1837.17	10712.47	18466.00	13930.65	5024.55	126.
136	275	1919.54	1925.03	11239.03	19087.21	14545.78	5346.45	133.
137	276	1919.54	1925.03	11239.03	19087.21	14545.78	5346.45	133.
138	277	1919.54	1925.03	11239.03	19087.21	14545.78	5346.45	133.
139	278	1927.04	1936.55	11307.78	19036.30	14609.36	5390.27	133.
140	279	2047.79	2047.17	11959.73	20148.27	15370.61	5670.80	140.
141	280	2038.44	2024.14	11831.78	20060.03	15135.73	5632.24	139.
142	281	2064.86	2038.34	11918.33	20585.26	15187.05	5734.65	139.
143	282	2099.74	2087.30	12213.39	20585.52	15518.45	5903.00	142.
144	283	2099.74	2087.30	12213.39	20585.52	15518.45	5903.00	142.
145	284	2099.74	2087.30	12213.39	20585.52	15518.45	5903.00	142.
146	285	2149.59	2133.62	12493.71	21070.36	15819.72	6001.55	145.
147	286	2149.99	2114.02	12370.52	21302.90	15596.61	5986.14	147.
148	287	2214.45	2179.90	12759.58	21669.29	16065.02	6132.50	149.
149	288	2244.45	2216.66	12984.31	21853.39	16311.02	6389.63	151.
150	289	2251.18	2217.39	12998.63	21533.67	16278.02	6411.88	152.
151	290	2251.18	2217.39	12998.63	21533.67	16278.02	6411.88	152.
152	291	2251.18	2217.39	12998.63	21533.67	16278.02	6411.88	152.
153	292	2217.05	2169.52	12724.96	21447.50	15978.24	6257.29	148.
154	293	2270.03	2243.11	13158.68	22143.84	16498.54	6321.84	153.
155	294	2272.86	2241.92	13144.68	22318.30	16502.35	6202.53	150.
156	295	2393.32	2357.69	13834.11	23479.28	17347.77	6486.09	155.
157	296	2442.38	2394.25	14053.64	23607.39	17589.76	6614.93	158.
158	297	2442.38	2394.25	14053.64	23607.39	17589.76	6614.93	158.
159	298	2442.38	2394.25	14053.64	23607.39	17589.76	6614.93	158.
160	299	2400.36	2341.96	13744.20	23088.21	17165.96	6437.33	156.
161	300	2409.15	2351.78	13806.63	23075.37	17224.20	6411.58	155.
162	301	2489.55	2423.01	14226.07	23752.70	17769.27	6588.16	160.
163	302	2578.12	2516.65	14780.06	24204.85	18467.36	6864.64	165.
164	303	2418.14	2379.40	13984.34	22404.13	17403.77	6448.52	161.
165	304	2418.14	2379.40	13984.34	22404.13	17403.77	6448.52	161.
166	305	2424.30	2369.68	14047.51	22444.14	17479.91	6510.15	162.
167	306	2351.58	2326.74	13679.18	21581.92	17019.30	6195.79	156.
168	307	2356.72	2334.18	13731.33	21683.57	17083.76	6232.22	157.
169	308	2463.54	2409.63	14185.43	21856.52	17644.64	6380.50	160.
170	309	2525.59	2457.48	14470.11	22650.20	17996.28	6517.28	163.
171	310	2386.02	2293.76	13520.41	21398.44	16815.86	6159.54	155.
172	311	2386.02	2293.76	13520.41	21398.44	16815.86	6159.54	155.
173	312	2386.02	2293.76	13520.41	21398.44	16815.86	6159.54	155.
174	313	2304.96	2251.73	13290.77	21246.93	16530.79	6152.80	155.
175	314	2219.57	2177.43	12872.56	20585.36	16011.05	6051.23	152.
176	315	2219.57	2177.43	12872.56	20585.36	16011.05	6051.23	152.
177	316	2322.97	2241.88	13266.55	21144.16	16496.40	6187.05	156.
178	317	2370.36	2284.29	13547.27	21752.10	16841.50	6205.54	157.
179	318	2370.36	2284.29	13547.27	21752.10	16841.50	6205.54	157.

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180   319 2377.66 2292.94 13599.15 21822.68 16903.23 6223.34 158.
181   320 2384.50 2309.06 13726.00 22012.22 17070.49 6145.83 157.
182   321 2370.13 2278.04 13568.15 22074.94 16864.58 6210.11 156.
183   322 2290.00 2195.65 13123.86 21689.47 16271.39 6131.80 153.
184   323 2275.40 2187.32 13112.94 21878.36 16241.49 6153.68 152.
185   324 2303.72 2211.58 13278.27 22133.68 16452.12 6220.88 154.
186   325 2303.72 2211.58 13278.27 22133.68 16452.12 6220.88 154.
187   326 2303.72 2211.58 13278.27 22133.68 16452.12 6220.88 154.
188   327 2248.61 2163.74 13038.55 21918.98 16133.27 6207.38 153.
189   328 2199.21 2157.85 13037.96 21567.73 16122.09 6155.15 151.
190   329 2248.12 2211.53 13455.35 21802.04 16616.47 6380.88 154.
191   330 2248.12 2211.53 13455.35 21802.04 16616.47 6380.88 154.
192   331 2248.12 2211.53 13455.35 21802.04 16616.47 6380.88 154.
193   332 2248.12 2211.53 13455.35 21802.04 16616.47 6380.88 154.
194   333 2248.12 2211.53 13455.35 21802.04 16616.47 6380.88 154.
195   334 2284.98 2234.50 13657.58 21930.17 16849.08 6511.23 156.
196   335 2284.98 2234.50 13657.58 21930.17 16849.08 6511.23 156.
197   336 2297.64 2240.35 13701.82 22061.94 16914.34 6434.57 155.
198   337 2392.06 2360.77 14473.01 23140.49 17853.97 6683.67 160.
199   338 2314.97 2294.97 14108.86 22193.61 17382.96 6608.36 156.
200   339 2292.93 2285.17 14072.05 22105.30 17325.76 6506.92 153.
201   340 2292.93 2285.17 14072.05 22105.30 17325.76 6506.92 153.
202   341 2292.93 2285.17 14072.05 22105.30 17325.76 6506.92 153.
203   342 2321.18 2314.66 14253.61 22698.78 17541.40 6472.45 153.
204   343 2325.06 2327.43 14336.52 22778.99 17641.46 6467.02 152.
205   344 2233.60 2244.03 13844.13 21980.87 17023.57 6284.75 146.
206   345 2156.74 2177.39 13437.51 21257.92 16488.77 6026.35 140.
207   346 1909.04 1963.22 12156.00 18933.68 14888.65 5561.75 126.
208   347 1893.40 1948.04 12060.47 18862.38 14770.04 5500.12 125.
209   348 1893.40 1948.04 12060.47 18862.38 14770.04 5500.12 125.
210   349 1832.63 1894.00 11748.12 18715.65 14348.40 5327.08 123.
211   350 1858.78 1908.61 11838.72 18549.52 14442.02 5321.64 124.
212   351 1815.51 1923.15 11959.95 17814.25 14607.25 5257.21 121.
213   352 1784.84 1897.67 11788.40 17195.14 14398.43 5164.34 118.
214   353 1567.99 1676.03 10414.98 14318.54 12706.14 4493.10 105.
215   354 1567.99 1676.03 10414.98 14318.54 12706.14 4493.10 105.
216   355 1589.97 1697.13 10545.20 14474.34 12860.29 4629.88 108.
217   356 1607.18 1718.13 10617.98 14941.83 12945.25 4564.05 107.
218   357 1502.36 1591.60  9729.86 14307.14 11818.13 4405.94 106.
219   358 1400.12 1501.76  9143.42 13812.89 11102.72 4141.07 102.
220   359 1400.12 1501.76  9143.42 13812.89 11102.72 4141.07 102.
221   360 1400.12 1501.76  9143.42 13812.89 11102.72 4141.07 102.
222   361 1400.12 1501.76  9143.42 13812.89 11102.72 4141.07 102.
223   362 1479.64 1583.35  9649.06 14583.20 11698.52 4295.64 106.
224   363 1582.10 1687.60 10291.70 15411.60 12450.85 4487.36 110.
225   364 1723.39 1809.67 11045.57 16586.58 13336.57 4817.27 118.
226   365 1768.67 1851.80 11303.77 16872.18 13633.19 5010.41 123.
227  1001 1768.67 1851.80 11303.77 16872.18 13633.19 5010.41 123.
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228	1002	1768.67	1851.80	11303.77	16872.18	13633.19	5010.41	123.
229	1003	1768.67	1851.80	11303.77	16872.18	13633.19	5010.41	123.
230	1004	1763.23	1830.75	11166.98	16520.92	13449.02	4874.87	117.
231	1005	1879.08	1951.35	11908.61	17849.49	14328.66	5155.39	124.
232	1006	1957.15	2002.18	12220.77	18439.80	14680.40	5344.34	129.
233	1007	1947.92	1997.45	12203.27	18505.55	14629.30	5342.97	128.
234	1008	1995.51	2056.23	12573.72	19288.09	15041.70	5515.65	135.
235	1009	1995.51	2056.23	12573.72	19288.09	15041.70	5515.65	135.
236	1010	1995.51	2056.23	12573.72	19288.09	15041.70	5515.65	135.
237	1011	1992.80	2053.71	12570.18	19681.45	15014.27	5373.73	134.
238	1012	2071.12	2110.26	12932.80	20343.71	15421.59	5505.23	138.
239	1013	2150.56	2180.17	13368.53	21345.29	15929.22	5718.95	142.
240	1014	2123.55	2146.90	13170.43	21020.72	15667.91	5683.33	140.
241	1015	2191.58	2218.78	13620.54	21745.40	16189.72	5965.67	148.
242	1016	2191.58	2218.78	13620.54	21745.40	16189.72	5965.67	148.
243	1017	2191.58	2218.78	13620.54	21745.40	16189.72	5965.67	148.
244	1018	2196.43	2209.06	13567.07	22616.95	16108.65	5821.96	144.
245	1019	2237.35	2231.36	13706.73	23117.80	16285.42	5886.75	144.
246	1020	2278.87	2259.08	13879.95	24311.69	16488.43	5948.38	145.
247	1021	2297.14	2284.18	14038.85	24117.81	16672.95	6046.72	147.
248	1022	2260.40	2268.92	13958.94	23878.38	16579.93	5974.36	145.
249	1023	2260.40	2268.92	13958.94	23878.38	16579.93	5974.36	145.
250	1024	2260.40	2268.92	13958.94	23878.38	16579.93	5974.36	145.
251	1025	2259.59	2257.14	13896.18	23351.08	16491.07	5956.66	144.
252	1026	2243.10	2235.06	13814.50	23840.21	16380.68	5863.39	144.
253	1027	2209.11	2180.72	13486.37	23516.27	15993.25	5722.32	141.
254	1028	2250.75	2206.90	13651.54	24033.09	16203.84	5774.76	142.
255	1029	2217.26	2157.45	13345.02	23873.95	15867.67	5591.37	138.
256	1030	2217.26	2157.45	13345.02	23873.95	15867.67	5591.37	138.
257	1031	2217.26	2157.45	13345.02	23873.95	15867.67	5591.37	138.
258	1032	2192.12	2126.51	13153.10	24098.34	15663.71	5514.31	135.
259	1033	2200.39	2140.05	13242.02	24087.86	15782.87	5607.52	136.
260	1034	2187.98	2145.96	13292.11	23812.23	15858.27	5539.19	136.
261	1035	2236.24	2196.98	13610.13	24323.79	16257.93	5611.95	139.
262	1036	2174.82	2119.19	13135.86	23540.66	15720.58	5436.62	135.
263	1037	2174.82	2119.19	13135.86	23540.66	15720.58	5436.62	135.
264	1038	2174.82	2119.19	13135.86	23540.66	15720.58	5436.62	135.
265	1039	2092.31	2040.40	12660.67	22568.73	15180.61	5073.59	126.
266	1040	2076.02	2028.32	12602.45	22274.45	15127.37	5027.09	125.
267	1041	2134.90	2082.87	12945.74	22736.70	15582.30	5179.00	128.
268	1042	2171.66	2111.12	13158.38	23124.12	15869.82	5200.85	131.
269	1043	2063.53	2013.74	12563.59	22430.61	15173.14	4869.30	124.
270	1044	2063.53	2013.74	12563.59	22430.61	15173.14	4869.30	124.
271	1045	2063.53	2013.74	12563.59	22430.61	15173.14	4869.30	124.
272	1046	2063.53	2013.74	12563.59	22430.61	15173.14	4869.30	124.
273	1047	2114.98	2045.04	12781.56	23078.60	15494.52	4813.35	124.
274	1048	2147.30	2085.04	13051.27	23508.20	15889.48	4996.32	126.
275	1049	2147.48	2100.88	13165.94	23818.82	16055.47	5003.46	125.

276	1050	2040.19	2001.87	12551.75	21498.93	15381.04	4862.36	118.
277	1051	2040.19	2001.87	12551.75	21498.93	15381.04	4862.36	118.
278	1052	2040.19	2001.87	12551.75	21498.93	15381.04	4862.36	118.
279	1053	2035.04	1999.33	12547.70	20392.74	15495.46	4902.26	118.
280	1054	1950.62	1920.18	12078.58	19560.92	14969.20	4790.83	114.
281	1055	1964.54	1936.63	12174.89	20164.73	15205.66	4777.23	115.
282	1056	1941.61	1934.98	12182.34	19780.02	15303.32	4789.48	115.
283	1057	1925.31	1932.92	12155.51	19796.42	15355.37	4759.42	114.
284	1058	1925.31	1932.92	12155.51	19796.42	15355.37	4759.42	114.
285	1059	1925.31	1932.92	12155.51	19796.42	15355.37	4759.42	114.
286	1060	1935.33	1947.72	12257.25	20164.79	15578.14	4875.77	115.
287	1061	1891.09	1865.52	11740.71	20292.17	14995.45	4715.63	110.
288	1062	1919.28	1869.70	11759.88	20646.96	15088.81	4684.05	110.
289	1063	1985.07	1907.40	11991.73	21165.24	15423.21	4888.02	115.
290	1064	2015.65	1937.26	12145.88	21628.34	15686.88	5001.42	116.
291	1065	1998.98	1919.76	12036.30	21411.55	15554.09	4944.09	115.
292	1066	1998.98	1919.76	12036.30	21411.55	15554.09	4944.09	115.
293	1067	2084.85	1980.00	12397.89	22773.60	16055.32	5096.05	118.
294	1068	2158.96	2046.67	12799.40	23237.59	16601.82	5196.20	121.
295	1069	2165.53	2061.84	12879.91	23217.38	16753.75	5259.35	121.
296	1070	2205.62	2102.59	13131.46	23439.56	17137.52	5412.51	124.
297	1071	2000.03	1924.11	12006.82	21866.64	15713.02	5017.79	113.
298	1072	2000.03	1924.11	12006.82	21866.64	15713.02	5017.79	113.
299	1073	2000.03	1924.11	12006.82	21866.64	15713.02	5017.79	113.
300	1074	1833.65	1829.42	11386.00	20920.48	14975.12	4662.72	106.
301	1075	1889.50	1901.98	11812.83	21969.96	15543.47	4828.47	111.
302	1076	1834.90	1848.56	11466.76	20591.35	15122.80	4729.92	108.
303	1077	1777.13	1848.28	11422.14	20226.25	15066.40	4733.25	106.
304	1078	1577.56	1643.50	10079.00	18372.45	13300.11	4271.76	99.
305	1079	1577.56	1643.50	10079.00	18372.45	13300.11	4271.76	99.
306	1080	1577.56	1643.50	10079.00	18372.45	13300.11	4271.76	99.
307	1081	1609.66	1664.42	10181.41	19589.16	13434.13	4310.31	101.
308	1082	1579.95	1619.13	9860.70	19565.39	12997.85	4024.25	97.
309	1083	1604.96	1643.50	9977.68	19705.16	13139.27	4021.31	97.
310	1084	1610.70	1647.82	9967.64	19374.47	13090.79	3932.23	96.
311	1085	1663.76	1692.64	10238.86	19799.03	13421.56	4083.07	100.
312	1086	1663.76	1692.64	10238.86	19799.03	13421.56	4083.07	100.
313	1087	1663.76	1692.64	10238.86	19799.03	13421.56	4083.07	100.
314	1088	1672.79	1703.29	10300.70	19889.25	13501.08	4144.71	101.
315	1089	1863.41	1873.58	11321.28	22260.29	14769.79	4526.89	110.
316	1090	1937.09	1955.31	11800.56	23048.43	15355.07	4677.72	114.
317	1091	1653.94	1662.03	10044.14	19199.14	12946.58	3951.81	92.
318	1092	1624.00	1650.44	9971.20	18914.95	12815.49	3939.83	90.
319	1093	1624.00	1650.44	9971.20	18914.95	12815.49	3939.83	90.
320	1094	1624.00	1650.44	9971.20	18914.95	12815.49	3939.83	90.
321	1095	1617.44	1631.21	9845.85	19024.30	12563.72	3927.58	90.
322	1096	1675.75	1682.36	10153.67	19729.19	12914.42	4065.88	92.
323	1097	1748.16	1742.43	10509.00	20337.27	13340.61	4159.09	93.

324	1098	1814.96	1791.97	10809.94	20804.62	13636.20	4378.20	98.
325	1099	1801.03	1771.11	10686.38	20560.22	13410.45	4475.72	99.
326	1100	1801.03	1771.11	10686.38	20560.22	13410.45	4475.72	99.
327	1101	1801.03	1771.11	10686.38	20560.22	13410.45	4475.72	99.
328	1102	1801.81	1780.69	10740.50	20412.34	13444.50	4458.18	96.
329	1103	1884.12	1858.43	11206.49	21644.11	13936.84	4648.38	102.
330	1104	1936.96	1909.76	11516.23	22175.52	14296.77	4712.91	103.
331	1105	1973.64	1938.23	11698.70	22690.07	14468.14	4767.86	105.
332	1106	1980.95	1942.04	11722.31	22587.68	14458.86	4729.59	106.
333	1107	1980.95	1942.04	11722.31	22587.68	14458.86	4729.59	106.
334	1108	1980.95	1942.04	11722.31	22587.68	14458.86	4729.59	106.
335	1109	2022.43	1954.46	11804.23	22890.14	14499.29	4762.68	105.
336	1110	2028.70	1961.98	11853.30	23321.63	14508.11	4736.67	106.
337	1111	2041.66	1961.44	11862.79	23540.73	14456.85	4736.66	106.
338	1112	2028.39	1937.92	11729.03	23374.38	14243.46	4707.98	106.
339	1113	2074.29	1980.74	11993.86	23865.77	14538.52	4791.61	108.
340	1114	2074.29	1980.74	11993.86	23865.77	14538.52	4791.61	108.
341	1115	2074.29	1980.74	11993.86	23365.77	14538.52	4791.61	108.
342	1116	2070.72	1975.96	11951.54	22891.47	14409.33	4854.87	106.
343	1117	2126.38	2029.91	12314.30	23875.41	14772.79	5053.27	110.
344	1118	2084.97	1984.29	12057.20	23334.43	14379.29	4958.69	108.
345	1119	2115.04	2019.95	12287.54	23577.97	14603.84	5044.95	112.
346	1120	2125.89	2017.90	12282.70	23177.43	14561.87	4997.20	110.
347	1121	2125.89	2017.90	12282.70	23177.43	14561.87	4997.20	110.
348	1122	2125.89	2017.90	12282.70	23177.43	14561.87	4997.20	110.
349	1123	2090.58	1976.11	12037.26	22187.12	14205.01	5020.28	109.
350	1124	2127.49	2021.61	12339.07	22545.77	14499.22	5039.61	109.
351	1125	2153.83	2052.15	12541.58	22991.34	14678.17	5210.74	113.
352	1126	2160.07	2047.02	12525.36	22593.66	14600.71	5280.32	114.
353	1127	2043.27	1950.86	11920.46	21124.57	13880.78	4933.75	107.
354	1128	2061.01	1965.32	12012.04	21265.54	13980.20	4995.39	108.
355	1129	2061.01	1965.82	12012.04	21265.54	13980.20	4995.39	108.
356	1130	2061.01	1965.82	12012.04	21265.54	13980.20	4995.39	108.
357	1131	2088.28	1997.37	12237.62	21906.67	14159.34	4909.25	107.
358	1132	2075.32	1968.17	12088.45	22095.46	13855.25	4873.37	107.
359	1133	2088.46	1998.66	12283.20	22197.78	14037.41	4978.83	108.
360	1134	2162.17	2070.58	12754.26	23536.09	14493.12	5119.64	113.
361	1135	2219.26	2123.74	13096.94	23843.61	14810.51	5262.24	115.
362	1136	2219.26	2123.74	13096.94	23843.61	14810.51	5262.24	115.
363	1137	2219.26	2123.74	13096.94	23843.61	14810.51	5262.24	115.
364	1138	2208.47	2099.39	12972.06	23573.99	14555.24	5304.94	117.
365	1139	2147.18	2057.03	12744.33	23039.18	14185.29	5085.95	112.
366	1140	2104.28	2008.27	12487.56	22826.75	13760.02	4936.49	109.
367	1141	2137.98	2032.35	12672.40	23175.80	13905.35	5014.57	110.
368	1142	2155.36	2046.82	12765.05	23648.74	13912.15	5124.24	113.
369	1143	2155.36	2046.82	12765.05	23648.74	13912.15	5124.24	113.
370	1144	2155.36	2046.82	12765.05	23648.74	13912.15	5124.24	113.
371	1145	2121.39	2020.87	12626.41	22965.15	13660.70	4991.22	110.

372	1146	2096.10	2013.96	12623.94	22817.18	13542.77	4958.68	111.
373	1147	2080.10	2021.28	12688.64	22986.36	13546.20	4948.81	110.
374	1148	2056.52	1997.91	12550.79	22694.11	13358.47	4947.56	109.
375	1149	2084.36	2016.95	12670.15	23186.59	13485.34	4995.43	111.
376	1150	2084.36	2016.95	12670.15	23186.59	13485.34	4995.43	111.
377	1151	2084.36	2016.95	12670.15	23186.59	13485.34	4995.43	111.
378	1152	2084.36	2016.95	12670.15	23186.59	13485.34	4995.43	111.
379	1153	2119.37	2048.47	12866.12	23928.89	13659.81	4968.04	111.
380	1154	2132.97	2055.00	12906.40	24166.91	13668.75	4906.40	110.
381	1155	2130.55	2053.77	12900.79	24051.83	13620.39	4783.13	108.
382	1156	2086.45	2018.36	12680.42	23567.05	13390.54	4574.86	103.
383	1157	2086.45	2018.36	12680.42	23567.05	13390.54	4574.86	103.
384	1158	2086.45	2018.36	12680.42	23567.05	13390.54	4574.86	103.
385	1159	2107.17	2031.95	12752.91	23970.80	13451.13	4598.22	105.
386	1160	2150.16	2063.16	12970.34	24463.68	13670.89	4739.30	108.
387	1161	2125.18	2038.97	12796.89	24035.39	13513.66	4732.38	106.
388	1162	2105.57	2008.63	12618.09	23986.85	13300.70	4607.58	105.
389	1163	2045.87	1955.61	12282.57	23489.20	12966.70	4586.60	102.
390	1164	2045.87	1955.61	12282.57	23489.20	12966.70	4586.60	102.
391	1165	2045.87	1955.61	12282.57	23489.20	12966.70	4586.60	102.
392	1166	1891.85	1834.74	11497.55	21344.07	12178.63	4205.88	92.
393	1167	1843.80	1782.69	11148.80	20913.27	11860.21	4120.83	89.
394	1168	1754.61	1691.66	10568.71	19729.10	11260.89	3990.79	85.
395	1169	1679.81	1621.63	10077.93	19141.87	10801.98	3785.29	81.
396	1170	1679.81	1621.63	10077.93	19141.87	10801.98	3785.29	81.
397	1171	1679.81	1621.63	10077.93	19141.87	10801.98	3785.29	81.
398	1172	1647.59	1606.62	9951.12	18721.47	10776.40	3675.78	78.
399	1173	1533.66	1504.47	9269.95	17217.00	10180.77	3527.76	73.
400	1174	1515.15	1484.50	9114.80	17858.12	10077.75	3456.42	71.
401	1175	1451.17	1426.53	8663.62	17830.38	9774.20	3414.97	70.
402	1176	1550.54	1525.38	9265.61	19657.91	10557.59	3732.16	77.
403	1177	1550.54	1525.38	9265.61	19657.91	10557.59	3732.16	77.
404	1178	1550.54	1525.38	9265.61	19657.91	10557.59	3732.16	77.
405	1179	1631.86	1603.38	9742.37	20835.35	11180.32	3922.64	81.
406	1180	1753.38	1712.48	10405.64	22760.76	12043.74	4253.00	88.
407	1181	1871.92	1830.90	11131.88	24873.45	12987.49	4522.79	94.
408	1182	1735.05	1703.85	10359.93	22862.01	12175.58	4189.82	86.
409	1183	1545.24	1523.82	9257.03	20933.05	11032.67	3802.01	77.
410	1184	1548.64	1529.46	9290.95	20961.56	11077.47	3819.82	78.
411	1185	1548.64	1529.46	9290.95	20961.56	11077.47	3819.82	78.
412	1186	1548.64	1529.46	9290.95	20961.56	11077.47	3819.82	78.
413	1187	1464.63	1445.06	8777.55	19978.35	10528.45	3647.15	75.
414	1188	1428.05	1406.27	8540.80	19648.65	10284.39	3536.12	73.
415	1189	1384.40	1382.84	8399.91	19296.01	10130.25	3412.84	71.
416	1190	1291.60	1292.08	7848.51	18468.34	9531.37	3178.53	67.
417	1191	1291.60	1292.08	7848.51	18468.34	9531.37	3178.53	67.
418	1192	1291.60	1292.08	7848.51	18468.34	9531.37	3178.53	67.
419	1193	1226.56	1227.85	7460.44	17425.80	9110.39	3077.08	64.

420	1194	1200.28	1190.48	7235.44	17018.40	8862.14	3009.88	62.
421	1195	1174.33	1172.08	7123.45	16844.77	8748.29	2906.47	59.
422	1196	1084.78	1071.16	6510.38	15780.77	8067.86	2740.49	55.
423	1197	1042.27	1032.98	6277.96	15244.91	7806.84	2629.46	53.
424	1198	1042.27	1032.98	6277.96	15244.91	7806.84	2629.46	53.
425	1199	1042.27	1032.98	6277.96	15244.91	7806.84	2629.46	53.
426	1200	982.59	978.59	5951.16	14510.28	7428.86	2456.79	50.
427	1201	930.30	917.26	5577.13	13802.31	7002.87	2246.25	46.
428	1202	833.79	805.94	4896.89	12024.65	6189.12	1978.94	41.
429	1203	731.19	721.24	4385.04	10707.04	5563.97	1703.69	36.
430	1204	677.44	667.88	4059.65	10186.09	5188.58	1543.27	33.
431	1205	677.44	667.88	4059.65	10186.09	5188.58	1543.27	33.
432	1206	671.04	660.48	4016.09	10132.53	5131.46	1525.46	32.
433	1207	639.04	629.21	3829.94	9755.18	4903.61	1476.07	31.
434	1208	531.85	529.02	3225.00	8031.62	4143.38	1234.78	25.
435	1209	465.45	453.69	2768.22	7229.93	3609.19	1062.11	22.
436	1210	446.69	432.72	2642.71	6817.25	3449.71	1026.49	20.
437	1211	378.87	368.97	2255.13	5087.74	2954.32	874.52	17.
438	1212	378.87	368.97	2255.13	5087.74	2954.32	874.52	17.
439	1213	378.87	368.97	2255.13	5087.74	2954.32	874.52	17.
440	1214	300.47	294.04	1801.92	3918.22	2364.22	683.99	13.
441	1215	186.93	184.48	1130.34	2579.34	1503.07	326.40	7.
442	1216	85.56	86.16	527.59	1196.53	712.90	178.23	4.
443	1217	18.75	23.61	144.53	208.61	187.42	79.45	2.
444	1218	3.40	5.64	33.91	28.51	44.81	17.81	1.
445	1219	3.40	5.64	33.91	28.51	44.81	17.81	1.
446	1220	3.40	5.64	33.91	28.51	44.81	17.81	1.
447	1221	3.40	5.64	33.91	28.51	44.81	17.81	1.
448	1222	3.40	5.64	33.91	28.51	44.81	17.81	1.
449	1223	3.40	5.64	33.91	28.51	44.81	17.81	1.
450	1224	3.40	5.64	33.91	28.51	44.81	17.81	1.
451	1225	3.40	5.64	33.91	28.51	44.81	17.81	1.
452	1226	3.40	5.64	33.91	28.51	44.81	17.81	1.
453	1227	3.40	5.64	33.91	28.51	44.81	17.81	1.
454	1228	3.40	5.64	33.91	28.51	44.81	17.81	1.
455	1229	3.40	5.64	33.91	28.51	44.81	17.81	1.
456	1230	3.40	5.64	33.91	28.51	44.81	17.81	1.

APPENDIX C

AVERAGE DAILY AGGREGATED DATA FOR NINE 30 DAY PERIODS

NORM

AIRCRAFT	ENGINES
7143.99	2181.62
8735.46	2321.78
8400.21	1929.38
8602.12	2319.26
8746.54	2301.25
7874.49	1775.17
8071.96	2167.55
8637.05	2039.90
8160.86	1789.84

PL

AIRCRAFT	ENGINES
5.99	5.92
6.05	5.97
6.07	5.87
6.09	5.87
6.15	6.02
6.23	6.15
6.31	6.15
6.36	6.25
6.33	6.13

PI

AIRCRAFT	ENGINES
86.75	40.58
87.33	40.50
91.01	41.07
92.89	41.17
93.93	40.68
96.81	42.08
91.69	40.76
90.06	40.97
91.26	42.84

APPENDIX D

AIRCRAFT PRORATE PROGRAM

```
      DIMENSION PMTR(20),IMATR(20)
      DIMENSION ABOX(700),BBOX(700),CBOX(700),DBOX(700),EBOX(700)
      DIMENSION FBOX(700),RBOX(700),SBOX(700),TBOX(700)
      DATA PMTR,IMATR/20*0.0,20*0/
      DATA ABOX,BBOX,CBOX,DBOX,EBOX,FBOX,RBOX,SBOX,TBOX/700*0.0,
     6700*0.0,700*0.0,700*0.0,700*0.0,700*0.0,700*0.0,700*0.0,700*0.0/
      DATA LK,MODCUR,ERROR/1,0,0.0/
C
C     READ IN PENALTY COSTS
C
      READ (5,5000) (PMTR(J),J=1,20)
 5000 FORMAT (10F7.2)
C
C     READ IN AIRCRAFT CODES
C
      READ (5,5001) (IMATR(K),K=1,20)
 5001 FORMAT (20I2)
C
C     READ IN FIRST AND LAST JULIAN DATE, AND NUMBER OF CARDS
C
      READ (5,9000) JSTART,JSTOP,NCARD
 9000 FORMAT (2X,I4,2X,I4,2X,I4)
      DO 1000 I=1,NCARD,1
C
C     READ IN RAW DATA
C
      READ (5,9001,END=9999) IAC,IN,IOUT,NORM,IAFH,MH,LAB,MAT,KOHD
 9001 FORMAT (I2,12X,I4,1X,I4,1X,I5,1X,I5,1X,I5,1X,I6,1X,I6,1X,I6)
      IDAYS=IOUT-IN
      IF (IDAYS.GE.635) IDAYS=IDAYS-635
      IF (IDAYS.LE.0) ERROR=ERROR+1.0
      PNORM=FLOAT(NORM)/FLOAT(IDAYS)
      PIAFH=FLOAT(IAFH)/FLOAT(IDAYS)
      PMH=FLOAT(MH)/FLOAT(IDAYS)
      PLAB=FLOAT(LAB)/FLOAT(IDAYS)
      PMAT=FLOAT(MAT)/FLOAT(IDAYS)
      PKOHD=FLOAT(KOHD)/FLOAT(IDAYS)
      JDAYS=IN-JSTART+1
      IF (JDAYS.GE.635) JDAYS=JDAYS-635
      KDAYS=IDAYS+JDAYS-1
C
C     BRING IN APPROPRIATE PENALTY COST
```

```
C
      DO 70 K=1,20
      IF (IAC.EQ.IMATR(K)) GO TO 50
      GO TO 60
   50 PCOST=PMTR(K)
   60 CONTINUE
   70 CONTINUE
      DO 1000 J=JDAYS,KDAYS,1
      ABOX(J)=ABOX(J)+PNORM
      BBOX(J)=BBOX(J)+PMH
      CBOX(J)=CBOX(J)+PLAB
      DBOX(J)=DBOX(J)+PMAT
      RBOX(J)=RBOX(J)+PIAFH
      SBOX(J)=SBOX(J)+PKOHD
      TBOX(J)=TBOX(J)+PCOST
      EBOX(J)=EBOX(J)+1.0
 1000 CONTINUE
C
C     PRINT COMPUTED DATA
C
 9999 WRITE (6,9500) JSTART,JSTOP,NCARD
 9500 FORMAT ('1',////,18X,'SUMMARY OF DAILY STATISTICS OF NARF',
     1'  ( AIRCRAFT )',/,27X,
     2'DATA FOR JULIAN DATES ',I4,' TO ',I4,/,27X,
     3'TOTAL NUMBER OF OBSERVATIONS =',I4,///,7X,'JULIAN',15X,
     4'DIRECT',6X,'DIRECT',5X,'DIRECT',7X,'AFC',22X,'PENALTY',5X,
     5'# IN',/,1X,'DAY',4X,'DATE',8X,'NORM',4X,'MANHOURS',4X,
     6'LAB COST',3X,'MATL COST',4X,'MANHOURS',3X,'OVHD COST',8X,
     7'COST',5X,'SHOP',/)
      K=JSTOP-JSTART
      IF (K.GE.635) K=K-634
      LDAYS=JSTART
      DO 2000 I=1,K,1
      WRITE (6,9501) I,LDAYS,ABOX(I),BBOX(I),CBOX(I),DBOX(I),RBOX(I),
     6SBOX(I),TBOX(I),EBOX(I)
 9501 FORMAT (I4,4X,I4,7F12.2,5X,F4.0)
      LDAYS=LDAYS+1
      IF (LDAYS.EQ.0366) LDAYS=1001
 2000 CONTINUE
      WRITE (6,9508) ERROR
 9508 FORMAT (10X,'NUMBER OF ERRORS =',F3.0)
      STOP
      END
```

APPENDIX E

ENGINE PRORATE PROGRAM

```
      DIMENSION PMTR(28),IMATR(28)
      DIMENSION ABOX(700),BBOX(700),CBOX(700),DBOX(700),EBOX(700)
      DIMENSION FBOX(700),SBOX(700),TBOX(700)
      DATA PMTR,IMATR/28*0.0,28*0/
      DATA ABOX,BBOX,CBOX,DBOX,EBOX,FBOX,SBOX,TBOX/700*0.0,700*0.0,
     6700*0.0,700*0.0,700*0.0,700*0.0,700*0.0,700*0.0/
      DATA LK,MODCUR,ERROR/1,0,0.0/
C
C     READ IN PENALTY COSTS
C
      READ (5,5000) (PMTR(J),J=1,28)
 5000 FORMAT (10F7.2)
C
C     READ IN ENGINE CODES
C
      READ (5,5001) (IMATR(K),K=1,28)
 5001 FORMAT (28I2)
C
C     READ IN FIRST AND LAST JULIAN DATE, AND NUMBER OF CARDS
C
      READ (5,9000) JSTART,JSTOP,NCARD
 9000 FORMAT (2X,I4,2X,I4,2X,I4)
C
C     READ IN RAW DATA
C
      DO 1000 I=1,NCARD,1
      READ (5,9001,END=9999) IAC,IN,IOUT,NORM,MH,LAB,MAT,KOHD
 9001 FORMAT (I2,12X,I4,1X,I4,1X,I5,7X,I5,1X,I6,1X,I6,1X,I6)
      IDAYS=IOUT-IN
      IF (IDAYS.GE.635) IDAYS=IDAYS-635
      IF (IDAYS.LE.0) ERROR=ERROR+1.0
      PNORM=FLOAT(NORM)/FLOAT(IDAYS)
      PMH=FLOAT(MH)/FLOAT(IDAYS)
      PLAB=FLOAT(LAB)/FLOAT(IDAYS)
      PMAT=FLOAT(MAT)/FLOAT(IDAYS)
      PKOHD=FLOAT(KOHD)/FLOAT(IDAYS)
      JDAYS=IN-JSTART+1
      IF (JDAYS.GE.635) JDAYS=JDAYS-635
      KDAYS=IDAYS+JDAYS-1
C
C     BRING IN APPROPRIATE PENALTY COST
C
```

```
      DO 70 K=1,28
      IF (IAC.EQ.IMATR(K)) GO TO 50
      GO TO 60
   50 PCOST=PMTR(K)
   60 CONTINUE
   70 CONTINUE
      DO 1000 J=JDAYS,KDAYS,1
      ABOX(J)=ABOX(J)+PNORM
      BBOX(J)=BBOX(J)+PMH
      CBOX(J)=CBOX(J)+PLAB
      DBOX(J)=DBOX(J)+PMAT
      SBOX(J)=SBOX(J)+PKOHD
      TBOX(J)=TBOX(J)+PCOST
      EBOX(J)=EBOX(J)+1.0
 1000 CONTINUE
 9999 WRITE (6,9500) JSTART,JSTOP,NCARD
 9500 FORMAT ('1',////,18X,'SUMMARY OF DAILY STATISTICS OF NARF',
     1'   ( ENGINES ) ',/,27X,
     1'DATA FOR JULIAN DATES ',I4,' TO ',I4,/,27X,
     2'TOTAL NUMBER OF OBSERVATIONS =',I4,///,7X,'JULIAN',15X,'DIRECT',
     36X,'DIRECT',5X,'DIRECT',20X,'PENALTY',5X,'# IN',/,1X,'DAY',
     44X,'DATE',8X,'NORM',4X,'MANHOURS',4X,'LAB COST',3X,'MATL COST',
     53X,'OVHD COST',8X,'COST',5X,'SHOP',/)
      K=JSTOP-JSTART
      IF (K.GE.635) K=K-634
      LDAYS=JSTART
      DO 2000 I=1,K,1
      WRITE (6,8501) I,LDAYS,ABOX(I),BBOX(I),CBOX(I),DBOX(I),SBOX(I),
     6TBOX(I),EBOX(I)
 9501 FORMAT (I4,4X,I4,6F12.2,5X,F4.0)
      WRITE (7,8501) I,LDAYS,ABOX(I),BBOX(I),CBOX(I),DBOX(I),SBOX(I),
     8TBOX(I),EBOX(I)
 8501 FORMAT (I3,1X,I4,1X,F7.2,1X,F7.2,1X,F8.2,1X,F8.2,1X,F8.2,1X,
     9F7.2,1X,F4.0)
      LDAYS=LDAYS+1
      IF (LDAYS.EQ.0366) LDAYS=1001
 2000 CONTINUE
      WRITE (6,9508) ERROR
 9508 FORMAT (10X,'NUMBER OF ERRORS =',F3.0)
      STOP
      END
```

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ABSTRACT

The objective of this study was to estimate a cost function from a Constant Elasticity of Substitution production function and a Cobb-Douglas production function for the aircraft rework and engine repair programs at the Naval Air Rework Facility, North Island, San Diego, California. The cost functions were estimated by multiple regression analysis from data aggregated from actual data taken from production records of the two programs. An attempt was made to validate the two cost functions that were obtained, and a methodology was outlined for comparing predicted costs to actual production costs at the Naval Air Rework Facility.

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