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Auditor's Approach to Statistical Sampling, Volume 1 (Supplementary Section). Introduction to Statistical Concepts and Estimation of Dollar Values

American Institute of Certified Public Accountants. Professional Development Division

(Supplementary Section)

1

AN AUDITOR'S APPROACH TO STATISTICAL SAMPLING

AN INTRODUCTION TO STATISTICAL CONCEPTS AND ESTIMATION OF DOLLAR VALUES

Individual Study Program
Professional Development Division
American Institute of Certified Public Accountants

NOTICE TO READERS

This programed learning text is a publication of the staff of the American Institute of Certified Public Accountants and is not to be regarded as an official pronouncement of the Institute. It was prepared by Teaching Systems Corporation, programing consultants; Saul Beldock, CPA, and Morton J. Rossman, CPA, consultants; and Ira M. Landis, CPA, Manager, Auditing Procedure. The members of the Committee on Statistical Sampling assisted in an advisory capacity.

AN INTRODUCTION TO STATISTICAL CONCEPTS AND ESTIMATION OF DOLLAR VALUES

SUPPLEMENTARY SECTION

Programed for the

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by

Teaching Systems Corporation

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APPENDIX 1

Relationship of Statistical Sampling to Generally Accepted Auditing Standards

A Special Report by the Committee on Statistical Sampling of the American Institute of Certified Public Accountants

INTRODUCTION

The committee on statistical sampling issued a special report entitled "Statistical Sampling and the Independent Auditor" which was published in THE JOURNAL OF ACCOUNTANCY in February 1962. This report dealt with the general nature of statistical sampling and its applicability to auditing, and concluded with the following paragraph:

> A broader education in and knowledge of statistical sampling and further research as to its applicability on the part of the profession is desirable.

In line with this conclusion the committee has given further attention to the relationship of statistical sampling to generally accepted auditing standards and believes that publication of its views on this matter may serve a useful purpose.

The following excerpts from the February 1962 special report are quoted to provide some background to the subsequent reference to statistical sampling by the committee on auditing procedure and to serve as an introduction to the matters discussed in this report:

> The committee is of the opinion that the use of statistical sampling is permitted under generally accepted auditing standards.
>
> Statistical samples are evaluated in terms of "precision," which is expressed as a range of values, plus and minus, around the sample result, and "reliability" (or confidence) which is expressed as the proportion of such ranges from all possible similar samples of the same size that would include the actual population value.
>
> Although statistical sampling furnishes the auditor with a measure of precision and reliability, statistical techniques do not define for the auditor the values of each required to provide audit satisfaction.
>
> Specification of the precision and reliability necessary in a given test is an auditing function and must be based upon judgment in the same way as is the decision as to audit satisfaction required when statistical sampling is not used.

In December 1963 the committee on auditing procedure issued *Auditing Standards and Procedures* (Statement on Auditing Procedure No. 33), which included the following comments concerning statistical sampling:

> In determining the extent of a particular audit test and the method of selecting items to be examined, the auditor might consider using statistical sampling techniques which have been found to be advantageous in certain instances. The use of statistical sampling does not reduce the use of judgment by the auditor but provides certain statistical measurements as to the results of audit tests, which measurements may not otherwise be available (p. 37).

The two sources from which the foregoing excerpts were taken make it clear that statistical sampling is not a fundamentally different audit approach, and that its use is permissive rather than mandatory under generally accepted auditing standards.

The committee believes that interest in the use of statistical sampling is increasing. Accordingly, this report is issued to discuss more specifically a way in which statistical precision and reliability can be related to generally accepted auditing standards and to point out some of the factors to be considered by the auditor in deciding what degree or level of each is satisfactory for a particular sample; it is not issued to propose definitive numerical criteria for these measurements nor to discuss their mathematical aspects.

GENERALLY ACCEPTED AUDITING STANDARDS

The auditing standards to which statistical sampling is most directly related are the three standards of field work:

1. The work is to be adequately planned and assistants, if any, are to be properly supervised.
2. There is to be a proper study and evaluation of the existing internal control as a basis for reliance thereon and for the determination of the resultant extent of the tests to which auditing procedures are to be restricted.
3. Sufficient competent evidential matter is to be obtained through inspection, observation, inquiries and confirmations to afford a reasonable basis for an opinion regarding the financial statements under examination.

Since the ultimate objective of the first and second of these standards is to contribute to the "reasonable basis for an opinion" comprehended in the third, the three standards are discussed in reverse order in this report.

THIRD STANDARD—EVIDENTIAL MATTER

The opinion referred to in the third standard of field work ordinarily is to the effect that the financial statements present fairly the financial position and results of operations in conformity with generally accepted accounting principles applied on a basis consistent with that of the preceding year. Materiality is implicit in the concept of fair presentation. Similarly, some degree of uncertainty is implicit in the concept of a reasonable basis for an opinion.

Although "precision" and "reliability" are statistically inseparable, the committee believes that one of the ways in which these measurements can be usefully adapted to the auditor's purposes is by relating precision to materiality and reliability to the reasonableness of the basis for his opinion.

Materiality and sampling precision

Evaluation of the precision of an audit sample in monetary terms con-

tributes directly to the auditor's ultimate purpose since such evaluation can be related to his judgment as to the monetary amount of errors that would be material. Evaluation of precision in terms of the frequency of deviations from internal control procedures or of other errors not evaluated in monetary terms contributes to the auditor's ultimate purpose by influencing his judgment as to the reliability of the records and the likelihood of errors having a material effect.

In making decisions with respect to the results of a sample the auditor should consider the precision of the sample as well as the estimate derived from it. For the purpose of some audit tests the auditor may be concerned with both the upper and lower precision limits; for others he may be concerned with only one of these limits. For example, if a sample results in an estimate that an asset is overstated by $10,000 with an upper precision limit of $12,000 at the reliability level desired by the auditor, he usually would be concerned with the estimate of $10,000 and the upper limit of $12,000 because his primary interest in such circumstances would center on the maximum amount by which the asset might be overstated.

The auditor's decision as to the monetary amount or frequency of errors that would be considered material should be based on his judgment in the circumstances in the particular case. In addition to the statistical evaluation, the auditor should also consider the nature and cause of errors revealed by the sample and their possible relation to other phases of his examination.

Reasonableness and sampling reliability

For the purpose of relating sampling reliability to the reasonableness of the basis for an opinion, it should be understood that the ultimate risk against which the auditor and those who rely on his opinion require reasonable protection is a combination of two separate risks. The first of these is that material errors will occur in the accounting process by which the financial statements are developed. The second is that any material errors that occur will not be detected in the auditor's examination.

The auditor relies on internal control to reduce the first risk, and on his tests of details and his other auditing procedures to reduce the second. The relative weight to be given to the respective sources of reliance—and, accordingly, the sampling reliability desired for his tests of details are matters for the auditor's judgment in the circumstances. The committee believes that reliability levels used in sampling applications in other fields are not necessarily relevant in determining appropriate levels for applications in auditing because the auditor's reliance on sampling is augmented by other sources of reliance that may not be available in other fields.

Sufficiency and sample size

After the auditor's judgment has been expressed by specifying the precision and reliability desired, statistical formulas or tables can be used in determining the sample size that will be sufficient to achieve these objectives. In this manner, statistical sampling can be related to compliance with the third standard of field work concerning the sufficiency of evidential matter to be obtained.

Competence and sample evaluation

The competence of evidential matter as referred to in the third standard of field work is solely a matter of auditing judgment that is not comprehended in the statistical design and evaluation of an audit sample. In a strict sense, the statistical evaluation relates only to the probability that items having certain characteristics in terms of monetary amounts, quantities, errors, or other features of interest will be included in the sample—not to the auditor's treatment of such items. Consequently, the use of statistical sampling does not directly affect the auditor's decisions as to the auditing procedures to be performed, the acceptability of the evidential matter obtained with respect to individual items in the sample, or the action which might be taken in the light of the nature and cause of particular errors.

SECOND STANDARD—INTERNAL CONTROL

The second standard of field work requires an evaluation of internal control as a basis for determining the extent of audit tests. Compliance with this standard involves two problems: (1) evaluating the internal control, and (2) relating the extent of tests to this evaluation.

Extent of tests

The second standard of field work recognizes that the extent of tests required to constitute sufficient evidential matter under the third standard should vary inversely with the auditor's reliance on internal control. These standards taken together imply that the combination of the auditor's reliance on internal control and on his auditing procedures should provide a reasonable basis for his opinion in all cases, although the portion of reliance derived from the respective sources may properly vary between cases. For statistical samples designed to test the validity or bona fides of accounting data and to be evaluated in monetary terms, the committee believes the foregoing concept should be applied by specifying reliability levels that vary inversely with the subjective reliance assigned to internal control and to any other auditing procedures or conditions relating to the particular matters to be tested by such samples.

Evaluation of internal control

The evaluation of internal control involves two phases, as indicated in the following excerpt from *Auditing Standards and Procedures* (Statement on Auditing Procedure No. 33):

> Adequate evaluation of a system of internal control requires knowledge and understanding of the procedures and methods prescribed and a reasonable degree of assurance that they are in use and are operating as planned (p. 32).

The auditor's knowledge of the procedures prescribed by the client ordinarily is obtained by inquiry or reference to written instructions, and his understanding of their function and limitations is based on his training, experience, and judgment. On this basis, the auditor makes a preliminary evaluation of the effectiveness of the prescribed procedures, assuming that compliance with them is satisfactory. Statistical sampling is not applicable to this phase of the evaluation.

As to the second phase, statistical sampling may be applied to test compliance with internal control procedures that leave an audit trail in the form of documentary evidence of compliance. This evidence may consist of signatures, initials, and the like, which indicate preparation, checking, or approval of documents such as purchase

orders, receiving reports, vouchers, checks, sales invoices, and credit memorandums. The committee believes that samples taken for this purpose should be evaluated in terms of the frequency and nature of deviations from any procedures the auditor considers essential to his preliminary evaluation of internal control, and that their influence on his final evaluation of internal control should be based on his judgment as to the effect of such deviations on the risk of material errors in the financial statements. Since samples taken for this purpose are intended to provide a basis for relying on compliance with internal control procedures, the committee believes they should be evaluated at a reliability level the auditor considers reasonable in the light of factors other than the procedures themselves.

On the other hand, statistical sampling generally is not applicable to tests of compliance with internal control procedures that depend primarily on appropriate segregation of duties and leave no audit trail of documentary evidence in this respect. Although statistical sampling may be applied to test the accuracy of records such as bank reconcilements, customers' accounts, footings, and postings, these tests provide no affirmative evidence concerning the segregation of duties because the related records may very well be accurate even in the absence of this element of internal control. Consequently, in the absence of documentary evidence in the form of signatures, initials, and the like, evidence of appropriate segregation of duties is usually obtained by the auditor through his original inquiries or reference to written instructions and through supplemental corroborative inquiries and observation of office personnel and routines.

FIRST STANDARD—AUDIT PLANNING AND SUPERVISION

The committee believes the foregoing discussion of matters to be considered in applying statistical sampling and in correlating it with other aspects of an audit demonstrates that proper use of statistical sampling requires audit planning and supervision as comprehended in the first standard of field work. In addition to the statistical problems involved in designing, selecting, and evaluating samples, audit planning and supervision are required in defining errors or other features of interest for sample purposes, specifying sample objectives in terms of reliability and precision related to such purposes, applying the definition of errors or other features of interest in examining sample items, and deciding on the significance of sample evaluations in relation to other information obtained during an audit.

This report presents the considered opinion of the nine members of the committee on statistical sampling, reached on a formal vote after examination of the subject matter by the committee and the technical services division. Except where formal adoption by the Council or the membership of the Institute has been asked and secured, the authority of the statements rests upon the general acceptability of the opinions so reached.

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APPENDIX 2. SYMBOLIC NOTATION

SYMBOL	PRONUNCIATION	MEANING
$\sum$	Sigma (capital)	summation
n	---	sample size
N	---	population size
x_j	x-sub-j	elements in the sample; or, the value of the jth element
$\bar{x}$	x-bar	sample mean
$\bar{X}$	Capital X-bar	population mean
X	---	population total
$\hat{}$	Caret	indicates estimated value
S_{X_j}	Capital S (with subscript capital X-sub-j)	estimated standard deviation of a population
σ_{X_j}	small sigma (with subscript capital X-sub-j)	true standard deviation of a population
$\hat{\sigma}_{\bar{x}}$	Sigma x-bar (caret)	standard error of the mean (estimated)
A	---	precision of the estimate
R	---	reliability expressed as a "percentage of confidence"
U	---	number of standard errors of the mean

APPENDIX 3. BASIC FORMULAS

1. Sample mean: $$\bar{x} = \frac{\sum_{j=1}^{j=n} x_j}{n}$$

2. The estimated population standard deviation:

$$S_{X_j} = \sqrt{\frac{\sum_{j=1}^{j=n} (x_j - \bar{x})^2}{n-1}} \qquad (2a)$$

Short-cut computational formula:

$$S_{X_j} = \sqrt{\frac{\sum_{j=1}^{j=n} (x_j)^2 - n\bar{x}^2}{n-1}} \qquad (2b)$$

3. Estimate of total: $\hat{X} = \bar{x}N$

4. Standard error of the mean (estimated): $\sigma_{\hat{\bar{x}}} = \frac{S_{X_j}}{\sqrt{n}}$

5. Sample size: $\sqrt{n} = \frac{S_{X_j} \cdot U_R \cdot N}{A}$ (see notes below)

NOTES: 1. n must be rounded up to next whole number.

2. It is advisable to add 10% to the computed n.

EXHIBIT 1

ABC STORE

1. The ABC Store, one of the largest department stores in the country, has retained your firm as independent auditors. You are working on the customer accounts receivable.

2. ABC has 240,000 outstanding customer accounts. Of these, 51,000 contain overdue amounts. 9,000 of these contain at least one amount that has been overdue for three months or more. You need to know the total of these three-month overdue amounts.

3. These 9,000 accounts are kept in an open file on punch-card equipment so that they can be located numerically. Thus, the auditor can ask for the information on, say, the 450th account in this file, but after the information is printed out he must compute the total of amounts that are three or more months overdue.

4. You have decided to estimate the total of the three-month overdue amounts by means of a statistical sample. The materiality of the total of three-month overdue amounts is such that you wish to be 80% certain of coming within $20,000 of the correct total.

NOTE: This example was constructed for illustrative purposes and does not give consideration to auditing steps required in order to ascertain that there are no three-month overdue amounts included in the remaining accounts.

EXHIBIT 2

SAMPLING OBJECTIVES

	ABC STORE	XYZ SHOE COMPANY
POPULATION	The 9000 customer accounts receivable that contain at least one amount overdue three months or more.	
INFORMATION TO BE OBTAINED	Total dollar value of the amounts that are overdue three months or more.	
DESIRED PRECISION		
DESIRED RELIABILITY		

EXHIBIT 3

XYZ SHOE COMPANY

1. In the course of an audit of the XYZ Shoe Company, wholesalers and jobbers in many different lines of shoes, you are checking the inventory (at cost) of shoes in the warehouse. You want your estimate to deviate from the actual value by no more than $2,000 in either direction.

2. The inventory is divided into 300 lots. To compute the value of each lot, it is necessary to go to the appropriate warehouse location, make an exact itemization of the contents of the lot, and compute the value by referring to the cost ticket for each item in the lot.

3. Your estimate will be based on a representative sample of the inventory. The sample size will be large enough so that you can be 90% certain that the actual value will fall somewhere within the precision limits given.

4. Each lot has a code designation, established by the Company, which indicates the lot's composition and warehouse location. The 300 lots are listed on the following pages (Exhibit 3-A). Glance at this now. Then return to Frame 2-2.

EXHIBIT 3-A (continued on the next page)

Lot	Number	Lot	Number	Lot	Number
PJ-3A6N	001	TW-5U6N	051	XF-3E2N	101
RN-9Q4S	002	CV-7Q8E	052	LB-1A2E	102
GC-7E2S	003	PZ-9L4W	053	SR-7E4W	103
ML-1E4W	004	LK-5Q4S	054	VC-518E	104
SW-3U6N	005	LD-9I6N	055	WZ-3A2N	105
DY-5A6S	006	VP-3Q2N	056	BX-7E2E	106
WL-9Q8W	007	SM-9A6N	057	GV-7A4E	107
TB-7E4S	008	NW-3L8E	058	LW-3A6W	108
FH-3A4E	009	KW-5A6W	059	BP-7E6S	109
HX-5Q6N	010	HD-3A6W	060	GF-1E4N	110
LT-1U8S	011	XJ-9Q2E	061	HR-5A4W	111
GR-3A2E	012	RM-5A4W	062	TH-3U6E	112
WD-5L4S	013	GS-1U2S	063	JV-1U6W	113
FN-7U2W	014	JH-5E6E	064	KL-9A6N	114
NP-7O4E	015	WK-7Q2W	065	MB-3U8W	115
KB-3U2S	016	DF-1I8E	066	NC-9Q4E	116
DX-9L4E	017	VF-3A4S	067	RB-7U2S	117
NP-5A8N	018	SK-9I4S	068	TK-1A2S	118
VT-5A2W	019	GT-5E8N	069	QJ-3A6N	119
RH-1Q4W	020	BP-314E	070	LK-9E8W	120
QS-3E6E	021	TH-5U6N	071	ZM-512W	121
FL-5A2N	022	WD-9I8E	072	VN-7I2E	122
RM-5Q8S	023	JM-7U6W	073	DR-3A5W	123
ND-9U4S	024	CK-3A6E	074	YD-1Q2S	124
LP-7I6W	025	VB-7I4E	075	FD-9A2S	125
BQ-1I2S	026	RT-5A4W	076	HT-5E6S	126
GL-7U4N	027	FC-1I8N	077	JX-7I2W	127
KT-9Q6S	028	CD-3A6S	078	NM-3A8S	128
FX-3E4W	029	SL-5E8E	079	PM-1Q2E	129
MF-3A8E	030	MG-3R4W	080	KR-9Q4N	130
DG-5Q6N	031	ST-1U2S	081	HW-5U4N	131
BD-7L2W	032	JN-7Q8W	082	RF-5U8E	132
GN-9U6E	033	TL-3I2N	083	GB-3U6W	133
WR-3A4N	034	CP-3Q2N	084	PT-1U8N	134
XD-3Q8W	035	KC-5U4E	085	KG-5A8N	135
FV-5U4N	036	DG-3A6N	086	VT-7E2A	136
TJ-3A8E	037	PT-7A2S	087	SP-9E4W	137
PC-7Q4S	038	TG-5A8N	088	XN-3A4N	138
KW-3L4N	039	XZ-106S	089	NJ-5I6W	139
ZL-5A8E	040	YQ-3A4N	090	QC-108N	140
DT-1U2S	041	WN-7E8E	091	RQ-3E6S	141
MB-7E6E	042	JL-1E2N	092	TB-9I2N	142
TC-1E2N	043	KP-3A4S	093	TC-1E2N	143
RV-3Q2W	044	RV-7I6W	094	PS-7Q2N	144
SF-9A4W	045	BC-5A2N	095	CX-5A8W	145
LX-5Q6S	046	DF-3E8S	096	FM-1I6N	146
BR-9Q2N	047	GW-1Q6N	097	RK-3A6S	147
QG-5I4S	048	JN-7Q6N	098	JV-9E2E	148
RJ-7U6S	049	TS-5I4S	099	RJ-7U6S	149
NH-3I4E	050	RH-7A2N	100	LV-518W	150

EXHIBIT 3-A (continued)

Lot	Number	Lot	Number	Lot	Number
DG-3U6N	151	RS-3I2E	201	ST-3A4N	251
PF-3U6N	152	BL-4Q6S	202	BS-3U8E	252
DP-5U2S	153	CK-7U4S	203	LV-5U4E	253
NG-514E	154	WR-7A8S	204	KT-3E2N	254
BF-714N	155	SG-7E8W	205	PS-7U8W	255
FM-5Q8S	156	RW-5U6S	206	SR-lU4N	256
LP-5Y6W	157	NH-lQ2S	207	BD-lQ6W	257
XM-3Q4E	158	RH-3A2S	208	PL-lU6S	258
RT-3E6E	159	DL-lQ6W	209	DR-3E8N	259
SX-lA4S	160	VT-3U6W	210	WS-lQ6N	260
TW-lU2E	161	HR-lI4E	211	JT-3Q4W	261
HD-3Q2W	162	HR-lE8N	212	LM-lU8W	262
SN-916N	163	SP-5U8S	213	VC-5A4N	263
TN-9A6S	164	LT-5A2W	214	RD-9A2W	264
HM-3E8N	165	MN-3E6N	215	XR-7Q8N	265
TM-lI7W	166	WL-lA4E	216	NM-7A4E	266
HS-5Q6S	167	LK-5W2W	217	RG-lU8N	267
VT-9U2E	168	NW-7A6S	218	SM-5E4N	268
PR-5Y8W	169	TH-3E4N	219	HP-712W	269
WS-7Q8S	170	TM-9Y2S	220	DH-7U8E	270
RS-lU2N	171	SC-9Q8W	221	HV-5A4E	271
TS-3I4W	172	HT-3U8E	222	HC-3I6S	272
HY-lE6S	173	HF-lA6S	223	VM-lI8N	273
BS-5A6E	174	RM-lI6N	224	TS-7U6W	274
UN-7E6N	175	RP-5E4E	225	TR-5A4S	275
CR-3E6S	176	TW-7Q2E	226	NC-lE6S	276
RS-3A4N	177	PC-3E8N	227	DS-3U2N	277
FR-lE6S	178	RD-3U2N	228	HX-3U4W	278
MR-lQ4E	179	LM-918S	229	SH-lA8W	279
RD-3U8W	180	XG-5E4W	230	VM-3Q2W	280
TH-9Y6S	181	RH-5U6W	231	BV-3A6E	281
RW-7E6S	182	WX-5Q8W	232	PH-lU4S	282
NH-3A2N	183	BC-9A2N	233	TJ-5E8S	283
RL-5Q6N	184	JR-7A4W	234	MP-5U6W	284
RF-7U8W	185	BD-7Q8N	235	FS-lU8W	285
SN-9E4N	186	MN-3Q6W	236	SJ-7A2N	286
WB-lA0N	187	VF-5U4E	237	RC-9A4W	287
WH-5E6N	188	RM-9E8E	238	TP-9U2N	288
TW-3A8N	189	GD-914W	239	GR-lQ4S	289
HT-lE6E	190	FB-5E2S	240	SN-9A8N	290
HN-5A2N	191	MF-5U8S	241	TJ-7Q2E	291
HR-lU2N	192	XW-318E	242	DM-7A4N	292
BR-lU8N	193	SG-3U4N	243	VX-3E6S	293
ST-3E4E	194	LK-7Q2N	244	JL-3Q6E	294
SR-3U6N	195	BN-7A8W	245	WL-9E8N	295
SB-9Q6W	196	JF-512E	246	SW-7A6N	296
DN-lE4E	197	NS-5E8S	247	CM-7E4S	297
FH-lQ2N	198	VD-7O2S	248	NB-7A8E	298
RS-7A8E	199	GR-7A4S	249	JD-5U2S	299
BW-9E8N	200	HT-5A2E	250	CJ-5A6E	300

EXHIBIT 4

SAMPLING PLAN: XYZ SHOE COMPANY

TYPE OF SAMPLING	Unrestricted random sampling with replacement
CORRESPONDENCE	Number each Lot from 1 through 300, to correspond to the random digits 001 through 300.
ROUTE	
STARTING POINT	Method: "Random Stab" Correspondence: First 3 digits in nearest usable line = Row; next digit = Column Starting Row: Starting Column:

EXHIBIT 5

PRELIMINARY SAMPLE: XYZ SHOE COMPANY

Element	Random Number	Lot Number	Value (x_j)	x_j^2
x_1	184	RL-5Q6N	$511	$261,121
x_2	190	HT-1E6E	467	218,089
x_3	280	VM-3Q2W	471	221,841
x_4	290	SN-9A8N	490	240,100
x_5	157	LP-5Y6W	535	286,225
x_6	064	JH-5E6E	502	252,004
x_7	148	JV-9E2E	545	297,025
x_8	250	HT-5A2E	479	229,441
x_9	276	NC-1E6S	467	218,089
x_{10}	158	XM-3Q4E	452	204,304
x_{11}	260	WS-1Q6N	531	281,961
x_{12}	276	NC-1E6S	467	218,089
x_{13}	120	LK-9E8W	516	266,256
x_{14}	100	RH-7A2N	534	285,156
x_{15}	183	NH-3A2N	490	240,100
x_{16}	167	HS-5Q6S	533	284,089
x_{17}	093	KP-3A4S	530	280,900
x_{18}	054	LK-5Q4S	525	275,625
x_{19}	204	WR-7A8S	513	263,169
x_{20}	254	KT-3E2N	469	219,961
x_{21}	080	MG-3R4W	465	216,225
x_{22}	148	JV-9E2E	497	247,009
x_{23}	036	FV-5U4N	475	225,625
x_{24}	109	BP-7E6S	526	276,676
x_{25}	117	RB-7U2S	489	239,121
x_{26}	100	RH-7A2N	469	219,961
x_{27}	241	MF-5U8S	492	242,064
x_{28}	168	VT-9U2E	507	257,049
x_{29}	295	WL-9E8N	492	242,064
x_{30}	132	RF-5U8E	471	221,841
STOPPING POINT: 499-3 n=30		SUBTOTALS:	$14,910	$7,431,180

EXHIBIT 6

SAMPLING PLAN: ABC STORE

TYPE OF SAMPLING	Unrestricted random sampling with replacement
CORRESPONDENCE	The random numbers 0001 through 9000 will correspond to the order in which the accounts are stored in the file. The random numbers 9001 through 9999, and 0000, are not used.
ROUTE	Consider the last 2 digits in the starting line and the first two in the adjacent column to be a four-digit number. Proceed down the starting column and continue if necessary at the top of the next column to the right.
STARTING POINT	Method: "Random Stab" Correspondence: First 3 digits in nearest usable line = Row; next digit = Column Starting Row: Starting Column:

EXHIBIT 7

PRELIMINARY SAMPLE: ABC STORE

Element	Random Number	Account Number	Total (x_j) of 3-Month Overdue Amounts	x_j^2
x_1	0733	619824	$25	$ 625
x_2	6927	103635	64	4,096
x_3	1877	215353	31	961
x_4	7074	405932	29	841
x_5	0476	172614	90	8,100
x_6	3249	529480	11	121
x_7	2609	957003	26	676
x_8	3449	293909	147	21,609
x_9	1860	857639	8	64
x_{10}	4608	026197	21	441
x_{11}	7883	811719	72	5,184
x_{12}	6497	668640	43	1,849
x_{13}	6697	175339	18	324
x_{14}	8781	842720	12	144
x_{15}	5574	400888	15	225
x_{16}	7779	833916	44	1,936
x_{17}	6777	801397	110	12,100
x_{18}	6618	755134	37	1,369
x_{19}	0070	639335	19	361
x_{20}	0296	196491	67	4,489
x_{21}	4059	159777	83	6,889
x_{22}	7544	475825	14	196
x_{23}	7524	251700	46	2,116
x_{24}	1859	765676	58	3,364
x_{25}	7380	391048	203	41,209
x_{26}	0195	191033	22	484
x_{27}	4885	422760	35	1,225
x_{28}	5543	572353	60	3,600
x_{29}	5773	424660	7	49
x_{30}	3076	078094	23	529
STOPPING POINT: 411-6		SUBTOTALS:	$1,440	$125,176

n=30

EXHIBIT 8

REFERENCE GUIDE FOR UNRESTRICTED RANDOM SAMPLING WITH REPLACEMENT

	STEPS	AID(S)	REMARKS
1.	STATE THE SAMPLING PROBLEM AS PRECISELY AS POSSIBLE	Appendix 1 discusses precision and reliability.	Auditor's judgment based on materiality and reasonableness.
2.	SPECIFY THE SAMPLING PLAN	Exhibit 2	It must be predetermined that unrestricted random sampling is appropriate. In any case, eliminate extreme values from the population and evaluate them separately.
3.	DRAW A PRELIMINARY SAMPLE OF 30 ITEMS IN ORDER TO ESTIMATE THE POPULATION STANDARD DEVIATION	Specify route and starting point as shown in Exhibit 4; use listing format similar to Exhibit 5.	With replacement sampling, numbers may be repeated.
4.	CALCULATE THE ESTIMATED STANDARD DEVIATION OF THE POPULATION	Worksheet 1; Square Root Table	S_{X_j}
4-A.	(OPTIONAL) ESTIMATE THE POPULATION TOTAL	---	$\hat{X} = \bar{x}N$
4-B.	(OPTIONAL) CALCULATE THE RELIABILITY OF THIS ESTIMATE AT DESIRED PRECISION and/or VICE VERSA	Worksheets 2 and 3	Of value only when N is small, or information requirements are of great latitude.
5.	CALCULATE THE REQUIRED SAMPLE SIZE	Worksheet 4	Precision (A) is of the estimate of the total. Add 10% to the computed n.

EXHIBIT 8 (continued)

REFERENCE GUIDE FOR UNRESTRICTED RANDOM SAMPLING WITH REPLACEMENT

	STEPS	AID(S)	REMARKS
6.	RANDOMLY DRAW THE ADDITIONAL ITEMS REQUIRED TO OBTAIN THE SAMPLE SIZE	Random Number Table	Continue from the stopping point using the same route.
7.	COMBINE THE TWO SAMPLES INTO ONE; CALCULATE THE COMBINED SAMPLE MEAN AND ESTIMATE THE STANDARD DEVIATION OF THE POPULATION BASED ON THE COMBINED SAMPLE	Worksheet 5	n in row 4 is taken from Column 10 of Worksheet 4.
8.	RECALCULATE THE ESTIMATE OF THE TOTAL USING NEW SAMPLE MEAN	$\bar{x}$ taken from row 5 of Worksheet 5	$\hat{X} = \bar{x}N$
9.	CALCULATE THE RELIABILITY OF THIS ESTIMATE AT DESIRED PRECISION AND VICE VERSA	Worksheets 2 and 3	Use the new S_{x_j} and n in computing the standard error of the mean.
10.	RE-TABULATE SAMPLE RESULTS	Use your own reporting format. See examples in Frame 6-36.	Estimate may be stated as range ($150,000 to $200,000) with confidence of R%; or as best estimate with precision limits ($175,000 ± $25,000) at given level of reliability.

WORKSHEET 1: STANDARD DEVIATION

Computational Formula: $$S_{X_j} = \sqrt{\frac{\sum_{j=1}^{j=n} (x_j)^2 - n\bar{x}^2}{n-1}}$$

(see rounding suggestions at bottom of worksheet)

	A.	B.	C.	D. = A÷C	E. = D^2	F. = C x E	G. = B − F	H. = G ÷ (n-1)	I. = $\sqrt{H}$
	Σx_j	$\Sigma(x_j)^2$	n	$\bar{x}$	$\bar{x}^2$	$n\bar{x}^2$	$\Sigma(x_j)^2 - n\bar{x}^2$	$S_{X_j}^2$	S_{X_j}
ABC STORE	$1,440	$125,176	30						
SAMPLE "Q"									
XYZ SHOE CO.									
GIANT FRANCHISE CO.									
Rounding (if necessary:	none	none	none	1 decimal	1 decimal	1 decimal	1 decimal	2 decimals	1 decimal

WORKSHEET 2: DETERMINATION OF RELIABILITY AT A GIVEN PRECISION LEVEL

	1	2	3	4 (2÷3)	5
	DESIRED PRECISION (A)	MAXIMUM $\lvert\bar{x} - \bar{X}\rvert$ (A ÷ N)	STANDARD ERROR OF THE MEAN ($\sigma_{\hat{\bar{x}}}$)	U_R	RELIABILITY (R)
NOTE: Round off results in columns 2, 3, and 4 to two decimals.	Auditor wants the actual total to differ from the estimated total by no more than this amount, with a degree of confidence as determined in Column 5.	If the sample mean differs from the actual population mean by more than this amount, the estimate of the total will be in error by more than the desired precision.	Estimated by the formula $S_{X_j} \div \sqrt{n}$	In order for the estimate to have the desired precision, $\lvert\bar{x} - \bar{X}\rvert$ must be no more than this number times $\sigma_{\hat{\bar{x}}}$.	Percentage of cases, given in Table 2, in which $\lvert\bar{x} - \bar{X}\rvert$ will not be more than U times $\sigma_{\hat{\bar{x}}}$.
ABC STORE (Preliminary)					
ABC STORE (Hypothetical)					
ABC STORE (Final)					
XYZ SHOE CO. (Preliminary)					
XYZ SHOE CO. (Final)					
GIANT FRANCHISE CO.					

WORKSHEET 3: DETERMINATION OF PRECISION AT A GIVEN RELIABILITY LEVEL

	1	2	3	4 (2 x 3)	5
	RELIABILITY (R)	U_R	STANDARD ERROR OF THE MEAN ($\sigma_{\hat{\bar{x}}}$)	MAXIMUM $\lvert\bar{x} - \bar{X}\rvert$ ($U_R \cdot \sigma_{\hat{\bar{x}}}$)	PRECISION (A)
NOTE: Round off results in columns 2, 3, and 4 to two decimals.	In this context, R is the desired degree of confidence that the error of the total estimate will not exceed the precision computed in Column 5.	Table 1 indicates that R% of the time a sample mean will differ from the population mean by no more than this number times $\sigma_{\hat{\bar{x}}}$.	Estimated by the formula $S_{X_j} \div \sqrt{n}$	Given the above $\sigma_{\hat{\bar{x}}}$ and U_R, then R% of the time $\bar{x}$ will not differ from $\bar{X}$ by more than this amount.	The maximum $\lvert\bar{x} - \bar{X}\rvert$ (R% of the time), multiplied by N. R% of the time, the error in the estimate of the total will not be greater than this amount in either direction.
ABC STORE (Preliminary)					
ABC STORE (Hypothetical)					
ABC STORE (Final)					
XYZ SHOE CO. (Preliminary)					
XYZ SHOE CO. (Final)					
GIANT FRANCHISE CO.					

WORKSHEET 4: SAMPLE SIZE

$$\sqrt{n} = \frac{S_{X_j} \cdot U_R \cdot N}{A}$$

NOTE ON ROUNDING

Column 4: nearest hundredth
Column 8: nearest tenth
Columns 9 and 10: next higher whole number

	1	2	3	4	5	6	7	8	9	10
	R	U_R	S_{X_j}	(2 x 3)	N	(4 x 5)	A	$\sqrt{n} = 6 \div 7$	n	n + 10% n
ABC STORE	80%	1.28	$44.0		9,000		$20,000			
POPULATION "Q"										
XYZ SHOE CO.										
GIANT FRANCHISE CO.										

WORKSHEET 5: COMBINED SAMPLE

		ABC STORE	XYZ SHOE CO.	GIANT FRANCHISE CO.	
1	Σx_j (preliminary)	$ 1,440			
2	Σx_j (additional)	$ 33,860			
3	Σx_j (combined)	$ 35,300			
4	n (combined)	706			
5	$\bar{x}$ (3 ÷ 4)				
6	$\Sigma(x_j)^2$ (preliminary)	$ 125,176			
7	$\Sigma(x_j)^2$ (additional)	$3,049,824			
8	$\Sigma(x_j)^2$ (combined)	$3,175,000			
9	$\bar{x}^2$	$ 2,500			
10	$n\bar{x}^2$ (4 x 9)	$1,765,000			
11	$\Sigma(x_j)^2 - n\bar{x}^2$ (8 − 10)	$1,410,000			
12	$S_{X_j}^2$ (11 ÷ n-1)				
13	S_{X_j} ($\sqrt{\text{row 12}}$)				

SUMMARY OF VOLUME ONE

Chapter 1

1. Statistical estimation makes it possible to achieve scientifically valid estimates based on relatively small samples from the body of data in which the auditor is interested. The latter is generally known as the "population."

2. When estimating a variable -- a quantity as opposed to a rate of occurrence -- the basic arithmetical procedure is to compute the arithmetic average of the sample values and multiply by the number of elements in the population to obtain the best estimate of the total population value.

3. The standards of accuracy are no different in a statistical estimate from any other estimate for auditing purposes. The auditor decides in advance how close an estimate he needs, depending on the materiality of the estimate in question, and the degree of confidence he needs to have in this estimate. Estimating the actual value "on the nose" is no more necessary in a statistical estimate than in any other kind of estimate for auditing purposes.

4. The concepts of accuracy in a statistical estimate are known as "precision" and "reliability." The former, expressed either as a dollar amount or as a percentage of the estimate, defines the maximum degree of error in either direction that will be acceptable. In statistical terms, the precision of an estimate describes the range of values, less than and more than the estimated figure, within which the true value is expected to fall. The lower and upper limits of this range are known as the "precision limits."

5. The reliability figure, usually expressed as a percentage, expresses the degree of confidence that the true value actually is included within the lower and upper precision limits. Statistically, the reliability figure expresses the proportion of cases in which the true value would be contained within the precision limits if the same estimating procedures were employed a large number of times.

6. Precision and reliability have no meaning unless paired with each other. If a lower precision figure is desired (that is, if the precision limits are made narrower), the

reliability is decreased because there is less chance that the narrower precision limits will contain the true value. On the other hand, if greater reliability is desired, and all other factors are held constant, the precision limits have to be widened because the increased confidence in the estimate makes it necessary to include a wider range of values into which the true value may be expected to fall.

7. The auditor begins any statistical estimation task by specifying the population. Broadly, this consists of the body of data under consideration. Specifically, the population consists of those units from which the sample will be drawn. The auditor also indicates the information he wishes to obtain about this population. This information can be either a variable (quantity) or an attribute (rate of occurrence).

8. The auditor also specifies the desired precision and reliability before selecting the sample. Appendix 1 to this volume expands on this subject.

Chapter 2

1. Since the mathematical basis of statistical estimation is composed of certain long-run laws of chance, the sample must be selected randomly. A random, as opposed to an arbitrary or judgmental, selection of the sample offers the best chance that the sample will be representative of the population.

2. A random number table is one device for helping to achieve randomness. Such a table is composed of randomly-generated digits 0 through 9. Each digit should appear in the table approximately the same number of times, and the order in which they appear is random.

3. The table can be used in many ways, but in this book we are only covering the technique of unrestricted random sampling. This technique gives every element in the population an equal chance of being selected in the sample. Another way of stating this is that every possible sample containing a given number of elements has an equal chance of being selected.

4. The first step in preparing to use the table is to establish correspondence between the digits in the table and the

elements in the population. The most basic method is to number each element in the population consecutively beginning with 1 preceded by a number of zeroes appropriate to the number of elements in the population.

5. For purposes of identification, most random number tables are divided into rows and columns. The two-page table used for teaching purposes in this book has six digits to a column, 10 columns to a row, and 50 rows to a page. The auditor specifies in advance whether he will go up or down the columns to select the numbers, and whether he will go to the left or right after reaching the end of a column. This is known as the route through the table. If an unusable (non-corresponding) number is encountered in the route, it is ignored.

6. The starting point can be determined by stabbing blindly with a pencil and beginning on the nearest line. A more sophisticated method is suggested in Chapter 3.

Chapter 3

1. Once an element has been randomly selected to be part of the sample, it cannot be ignored or excluded for any reason. If the auditor has reason to believe that unrestricted random sampling may result in a sample that would not truly reflect the population, he should either choose another sampling method or define his population in such a way as to make it more homogeneous.

2. The recommended method of doing this is to exclude at the outset all amounts over a certain figure decided upon in advance by the auditor. The extreme values are evaluated as a separate population, while the rest are sampled.

3. The question of how many elements to include in the sample depends on the degree of accuracy required and on the variability of the population. To estimate population variability, we usually begin with a preliminary sample of 30 items.

4. To achieve an added degree of randomness, the auditor can select the starting line and the starting digits randomly. This is done by having the digits in the line on which the

pencil lands correspond to the row, column, and digit position. For example, if the "stabbed" line is 467825, the sample would begin in Row 467, Column 8, with the second digit.

Chapter 4

1. As each number is drawn, or after the entire preliminary sample of 30 has been selected, the auditor records the random number, the corresponding physical number (if any), the dollar value in which he is interested, and the square of the value. The values and their squares are then summed.

2. A preliminary estimate of the total population value can be obtained by multiplying the sample mean by the number of elements in the population. If the true mean differs from the sample mean by any amount at all, as it invariably will, this amount will be magnified N times in the error of the total estimate (N is the number of elements in the population).

3. The extent to which the sample mean differs from the true mean is in any given case a matter of chance. However, we can affect this difference by increasing the sample size, and we can make statistically valid long-run predictions about the probable difference if we know the variability of the population.

4. We estimate the variability of the population by estimating the standard deviation of the population based on the sample. This quantity, by definition, is the square root of the sum of the squared deviations from the mean divided by n-1 (n = the number of elements in the sample).

5. Statistical notation used in this book is summarized in Appendix 2.

Chapter 5

1. Since we never compute the actual population mean, we can never know exactly the magnitude of the difference between it and the sample mean. It is known, however, that approximately 68% of the means of all possible random samples of a given size will not differ from the true population mean by more than the estimated standard deviation of the population divided by the square root of the sample size.

2. This quantity is the estimated standard error of the mean. (This distinction between the "estimated" and "actual" standard error of the mean is minor and theoretical.)

3. From statistical tables we can determine what percentage of the time a sample mean of a given size will differ from the true mean by no more than U times the standard error of the mean. U is a coefficient obtained from the table.

4. Given the desired precision, we can determine the reliability of an estimate by finding the maximum difference between sample mean and true mean that will allow us to meet our precision criterion; then computing its equivalent in terms of U times the standard error of the mean; then looking up R in Table 2 opposite the computed U value.

5. Given the desired reliability, we can determine the precision of an estimate by looking up U, which, when multiplied by the standard error of the mean, expresses the maximum difference between the sample mean and true mean R percent of the time. We multiply this by N to find the amount by which the true total value will not exceed the estimated value R percent of the time.

Chapter 6

1. The required sample size is determined by a formula that is derived from the concepts discussed in Chapter 5. It is recommended that 10% be added to the computed figure as a safety measure.

2. The additional elements are selected in the same manner as the preliminary sample, using the same route in the random number table and beginning from where the preliminary sample left off.

3. The preliminary and additional samples are treated as one combined sample. The mean and standard deviation are calculated. The final estimate of the total is made by multiplying the combined sample mean by N.

4. The precision and reliability of the final estimate are computed in the same manner described above, paragraphs 4 and 5 of the Chapter 5 summary. The auditor may report the computed precision at the desired reliability level, the computed reliability at the desired precision, or both.

QUESTIONS AND PROBLEMS

PART I. GIANT FRANCHISE COMPANY

As one step in attempting to establish a uniform policy of wages and hours for its 1,000 retail outlets, the Giant Franchise Company requested each retail manager to send in the figure for total overtime wages paid in 1965. There was a good deal of resistance to this request because of the amount of extra clerical labor required to compile this figure during the busy season. The company therefore agreed that it would contact only a sample of the retail outlets and that no manager would have to compile the figure unless picked by the "luck of the draw."

The following decisions were arrived at by company officials working with the auditors:

1. The sample would be chosen by means of unrestricted random sampling with replacement.

2. The differences in size and other relevant characteristics among the retail outlets were small enough so that all the 1,000 outlets would be eligible for selection in the sample.

3. The sample would be of sufficient size so that the estimate would be in error by no more than $14,000 in either direction. However, the company was willing to risk a 15% chance that the difference between the true value and the estimated value might be more than this amount.

The company has provided you with a complete alphabetical list of all 1,000 outlets. Based on the above information and the numerical data given below, your task is to produce:

A. A report to the company giving the best estimate with statements of precision and reliability; and

B. A set of working papers that will include everything you consider to be necessary and proper, but to include at the minimum all specifications that must be made before the sample is selected; all computational steps; and all random numbers drawn.

After you have drawn the thirty (30) random numbers for the preliminary sample, you are to assume that the sum of the sample values is $27,000 and the sum of the squared values is $24,404,400.

After you have drawn the random numbers for the additional sample, you are to assume that the sum of the additional values is $11,915 and the sum of the squared values is $10,969,075.

In accomplishing these tasks you may use Worksheets 1 through 5, all of which contain entry spaces for the Giant Franchise Company. You may also make up facsimiles of the formats in the Exhibits. However, you are free to use any format you wish. The guiding principle is: What would you physically do if you were presented with this problem in the field?

The following "ground rules" are suggested in order to obtain the maximum educational value from this exercise:

1. The programed text should not be referred to. The Supplementary Section, on the other hand, is intended as a reference guide and should be used liberally. Exhibit 8 outlines all the necessary procedures and may be consulted at any time.

2. Other persons and texts should not be consulted.

3. In order for your estimate to agree with the correct answer, you must follow all rounding off instructions given in the worksheets and tables. For $\sqrt{30}$, use 5.5.

The answers to this exercise are on page S-32.

PART II. QUESTIONS RELATING TO SAMPLING PROCEDURE AND AUDITOR'S JUDGMENT

(NOTE: Some of these questions are designed to be subtle and even tricky. Rather than trying to recall the "book answer," your best approach is to visualize the situation and decide what you would actually do. You are also advised to read Appendix 1 if you have not yet done so.)

1. Look at the decisions made by the Giant Franchise Company and its auditors in the statement of the problem in Part I. Which

of the statistical formulas listed in Appendix 3 were used to arrive at these decisions?

2. Again referring to the Giant Franchise problem in Part I, ignore everything after the first paragraph and assume that the circumstances were as follows:

> In order to help decide on the appropriate sampling plan, the company asked each of the 1,000 retail managers to supply a very quick estimate of the total overtime wages paid in 1965. Of these estimates, 25 were between $2,000 and $5,000. All the remaining estimates were between $700 and $1,200, with 175 of them being amounts between $1,000 and $1,200. Bearing in mind that these estimated figures were only for the purpose of deciding upon the sampling plan and not to be taken as usable data, from which population would you select the sample?
>
> a. all 1,000 retail outlets
>
> b. the 975 retail outlets that estimated $1,200 or less
>
> c. the 800 retail outlets that estimated $1,000 or less

3. Another company, faced with a similar sampling problem but different dollar magnitudes, decides to select the sample from the population of the 300 retail outlets that estimated less than $10,000. When the records for one of the stores selected in the sample are examined, it turns out that this store actually paid $11,500 in overtime wages in 1965. How would you interpret this situation?

   a. This does not contradict our population definition and causes no problem.

   b. Since this store does not belong in the population to begin with according to the specifications above, it should be taken out of the sample and another random number drawn.

   c. b. is correct, but rather than go to the expense of auditing another store, keep the $11,500 figure in the tabulation, since it will not affect the total estimate too much.

4. In establishing correspondence for the purpose of unrestricted random sampling, what is the basic principle?

5. Once more referring to the Giant Franchise Company problem, this time as originally stated in Part I, assume that in addition to an alphabetical list of every store, you have the following lists:

   - all 1,000 stores alphabetically by state and city
   - all 1,000 stores in descending order of 1964 sales
   - all 1,000 stores in chronological order of establishment

   Does it make any difference which of the four lists is used to establish correspondence? (YES/NO) If so, which list would you use? (NOTE: Your answer to question 4 may help you here.)

6. Still referring to the same problem, an auditor established correspondence by numbering the stores from 0001 through 1000. This was a valid plan, but he discovered that only 1 out of every 10 random numbers in the table proved to be usable. How could he have established correspondence so as to save himself some time and effort?

7. The same auditor started in the random number table by "stabbing" a line blindly with his pencil. He then began on that line according to his pre-established route. How could he have further randomized the selection of his starting point?

8. Why were 30 stores included in the preliminary sample rather than 10 or 50?

9. Instead of taking the preliminary sample, in what other way could the auditor have estimated the population standard deviation? What would have been the advantages and disadvantages of doing so?

10. When the additional sample is selected it turns out that one of the random numbers has already been used. The problem specified replacement sampling. What should be done?

    a. the repeating random number should be replaced with another one

    b. the overtime wage figure for that store should be listed and counted twice

    c. the same figure should be counted twice but, in addition, one extra store should be selected in the sample to compensate for the loss of information

    d. b. is correct, but in addition a correction formula has to be applied

PART III. NUMERICAL EXERCISES

(NOTE: These are routine practice exercises for the purpose of acquiring added confidence with the worksheets and an additional "feel" for the interpretation of sample data.)

1. A population of 1,200 elements has an estimated standard deviation of $23.2. How large a sample size is necessary to obtain a 90% reliable estimate of the total with a precision of $\pm$ $5,000?

2. A random sample of 64 items has a total dollar value of $35,840. The sum of squared values is $21,423,300. What is the best estimate at this point of:

    (1) The total dollar value for the population (N = 2200)

    (2) The standard deviation of the population

3. Based on the data in item #2 above, the auditor could be 75% confident that the true total population value is somewhere between $_____ and $_____.

4. Given the same sample results as above, the auditor could claim to be within $\pm$ $25,000 of the true value with a _____% degree of confidence.

5. What sample size should this auditor choose in order to be 80% confident of coming within $\pm$ $30,000 of the actual total?

ANSWERS

PART I. GIANT FRANCHISE COMPANY

(NOTE: The paragraph numbers correspond to the steps listed in Exhibit 8.)

1. The population, information to be obtained, desired precision, and desired reliability should be specified in writing. These are, respectively, "all 1,000 retail outlets," "total overtime wages paid in 1965," "$\pm$ $14,000," and "85%" (not 15%). The $\pm$ sign is important since without it, there is some ambiguity as to whether the difference in either direction might be as much as $7,000 or $14,000. If there is a 15% chance that the estimate is in error by more than $\pm$ $14,000, then the probability that it is not in error by more than this amount -- in other words, the reliability of this estimate -- is 100% $-$ 15% or 85%.

2. Correspondence is established by having the 1,000 stores correspond to numbers 0001 through 1000, or better (as discussed in Chapter 2) 001 through 999 with 000 standing for the 1,000th store on the list. The route should specify which digits are used, and what to do at the end of a column or page. The auditor should not always choose to go down and to the right, or to use digits only within a column. The starting point should be chosen randomly, letting three digits of the "stabbed" line correspond to the row number, one digit to the column number, and another digit (1 through 6) to the starting digit position within the starting column. It is also acceptable to begin directly on the "stabbed" line, but the fully randomized method is better (see Question 7 in Part II). Whatever plan you devise for correspondence, route, and starting point, it should all be specified in writing.

3. There is nothing to drawing the preliminary sample except selecting the correct random numbers as established in step 2 -- but this is not always an errorless procedure.

The accidental omission of a usable random number is more serious than it may seem, since it is logically equivalent to removing a selected element from the sample. This negates the chance basis of statistical estimation. Therefore, you should check both the clarity of your sampling plan specifications, and your accuracy in picking the random numbers.

4. The standard deviation based on the preliminary sample is $60.0 (note that it should be expressed to the nearest tenth according to the instructions, although in practice this is up to you). The

worksheet entries are, in order: $27,000 $24,404,400 30 $900.0 $810,000 $24,300,000 $104,400 $3,600 $60.0

4-A. This step, although optional, should most probably be taken at this point since it can be done mentally (X = 1,000 x $900 or $900,000) and provides the information that we are most probably in the range of less than a million dollars.

4-B. Since it is conceivable that the above point might be just what the company is interested in, it seems worthwhile to calculate the precision at 85% reliability. The answer is $15,710. The columns in Worksheet 3 should be filled in as follows: 85% 1.44 (not 1.45 from Table 2) $10.91 ($60 ÷ 5.5) $15.71 $15,710

With a precision of ± $14,000, the reliability would be 79%. The entries in Worksheet 2 are as follows: ± $14,000 $14 $10.91 1.28 79%

In doing this exercise you may have remembered that 1.28 is the U value for 80% reliability. This answer cannot be considered wrong. However, using Table 2 conservatively, 79% is the better answer.

At this point, some auditors who have read "between the lines" of this text may have made a final report without taking an additional sample. Based on the limited facts available in the statement of the problem, a strong case might be made that a precision of ± $15,710 is not so different from ± $14,000, or at least not significant enough to warrant the additional time and effort necessary to add additional elements to the sample.

On the other hand, as a general policy, changing the desired precision or reliability requirements in mid-stream is not advocated. What is advocated is a continual awareness that statistical estimation is an information-producing tool, not a policy determiner.

5. For a precision of ± $14,000 and a reliability of 85%, the minimum required sample size is 39 elements. It is suggested that 10% be added to this total, so that your answer should be 43. The entries in Worksheet 4 are as follows: 85% 1.44 $60.0 $86.40 1,000 $86,400 $14,000 6.2 39 43

6. You should have begun with the next usable random number after the stopping point in the preliminary sample.

7. Since the additional sample data was given, this step is simply a routine set of computations in Worksheet 5. The combined sample mean is $905.0; the standard deviation is $60.8. The rows in Worksheet 5 should be filled in as follows: $27,000

$11,915 $38,915 43 $905.0 $24,404,400 $10,969,075 $35,373,475 $819,025 $35,218,075 $155,400 $3,700 (divide by 42, not 43) $60.8

8. $\hat{X}$ = $905,000

9. The reliability with precision of ± $14,000 is 86%. The crucial step is to determine the new standard error of the mean by dividing the new standard deviation, 60.8, by 6.6, which is the square root of the new sample size, 43. The result is $9.21. Columns 1 and 2 of Worksheet 2 are the same as before, ± $14,000 and $14 respectively. U_R is 1.52; R from Table 2 is 86%.

The precision at 85% reliability is ± $13,260. U is 1.44 (from Table 1); the standard error of the mean is $9.21 (see above); Column 4 is $13.26 (Worksheet 3).

10. The best estimate of the total is $905,000. There is an 85% chance that the true value differs from this amount by no more than $13,260 in either direction. There is an 86% chance that the true value does not differ from this amount by more than $14,000 in either direction.

PART II. QUESTIONS RELATING TO SAMPLING PROCEDURE AND AUDITOR'S JUDGMENT

1. No statistical formulas are used in arriving at these decisions, which fall mainly in the realm of "auditor's judgment." The decision as to precision and reliability requirements must be based on the circumstances of each individual case. This is discussed in Appendix 1.

2. b. and c. are both correct, but the preference goes to b. Although $1,000 might be a logical cut-off point, it seems clear from the facts of this case that the 975 retail outlets constitute a fairly homogeneous population. If you were to take out 175 of these for a complete count you would gain very little accuracy and involve yourself in a lot more work.

It is not correct, however, to include all 1,000 retail outlets in the sampling population. To do so would result in a very large variability and a very large sample size. The best procedure is to make a separate examination of the 25 outlets which estimated between $2,000 and $5,000, and take an unrestricted random sample from the remaining 975.

3. a. is the correct answer. The population was defined as "all retail outlets that estimated under $10,000." Even though the actual figure for this store is $11,500, this does not contradict anything in our definition of the population.

4. Every element should have an equal chance of being selected in the sample.

5. Based on the above principle, it makes no difference which list is used provided that each store is listed once and only once. However, if we were to use "systematic" sampling, in which we go down the list and pick every nth element, the straight alphabetical list would be the least likely to introduce bias. This will be discussed in another volume in this series.

6. The digits 000 could have been used to correspond to the 1,000th element in the population.

7. Correspondence could be established between the digits in the "stabbed" line and the rows and columns in the tables. For example, the line 428146 might indicate a starting point of Row 428, Column 1, beginning with the 4th digit in that line.

8. A preliminary sample of only ten items, or in general, less than thirty, does not provide enough information for us to make a good estimate of the population standard deviation. No harm is done from a statistical point of view if more than thirty elements are selected in the preliminary sample, but it may well turn out that more elements are selected than are actually needed. Thirty is the generally used figure.

9. Rather than obtaining the actual amounts from the thirty retail outlets in the preliminary sample, the estimated figures might have been used to provide a rough estimate of the population standard deviation. The obvious disadvantage is inaccuracy. The advantage to skipping the preliminary stage is that we can determine our final sample size immediately, thus saving an extra phase of tabulations and computations.

10. b. is the only correct answer. A correction formula has to be applied when we sample without replacement. This subject is covered briefly in Frames 3-28 through 3-31.

PART III. NUMERICAL EXERCISES

1. 92 (Worksheet 4: 90% 1.64 $23.2 $38.05 1,200 $45,660 $\pm$ $5,000 9.1 83 91.3 $\longrightarrow$ 92)

2. $\bar{x}$ = $560 so the best estimate is $1,232,000. The standard deviation is $146.5. (Worksheet 1: $35,840 $21,423,300 64 $560 $313,600 $20,070,400 $1,352,900 $21,475 146.5)

3. $1,185,690 and $1,278,310 (Worksheet 3: 75% 1.15 $18.3 $21.05 $46,310

4. 46% (Worksheet 2: $25,000 $11.4 $18.3 .62 46%)

5. 209 (Worksheet 4: 80% 1.28 $146.5 $187.52 2,200 $412,544 $30,000 13.8 190 209)

TABLE 1. CONVERSION OF RELIABILITY PERCENTAGES TO U VALUES

Percentage of cases (R) in which $\lvert\bar{x} - \bar{X}\rvert$ will be no more than U standard errors	U
65%	± .93
70%	± 1.04
75%	± 1.15
80%	± 1.28
85%	± 1.44
90%	± 1.64
95%	± 1.96
99%	± 2.58

TABLE 2. CONVERSION OF U VALUES TO RELIABILITY PERCENTAGES

U	R	U	R	U	R	U	R
± 0.1	7%	± 1.05	70%	± 1.55	87%	± 2.05	95%
± 0.2	15%	± 1.10	72%	± 1.60	89%	± 2.10	96%
± 0.3	23%	± 1.15	74%	± 1.65	90%	± 2.15	96%
± 0.4	31%	± 1.20	76%	± 1.70	91%	± 2.20	97%
± 0.5	38%	± 1.25	78%	± 1.75	91%	± 2.25	97%
± 0.6	45%	± 1.30	80%	± 1.80	92%	± 2.30	97%
± 0.7	51%	± 1.35	82%	± 1.85	93%	± 2.35	98%
± 0.8	56%	± 1.40	83%	± 1.90	94%	± 2.40	98%
± 0.9	63%	± 1.45	86%	± 1.95	94%	± 2.45	98%
± 1.00	68%	± 1.50	86%	± 2.00	95%	± 2.56 or greater	99%

U = number of standard errors of the mean
R = percentage of cases in which $\lvert\bar{x} - \bar{X}\rvert$ will not exceed U
All percentages have been rounded down.

TABLE OF RANDOM NUMBERS (For Teaching Purposes Only)

	0	1	2	3	4	5	6	7	8	9
401	730375	546982	628517	847721	847649	852176	647040	596451	706191	202592
402	577144	678883	095712	427883	982540	452927	007375	449085	203673	954252
403	172294	620115	758411	960691	854582	622675	823075	245348	416814	389209
404	374742	775394	740671	992500	214885	553165	196092	557744	093087	308258
405	154327	704145	690521	371515	042049	687585	805318	594260	369203	162148
406	043594	194720	335054	074150	868149	291979	807173	807240	722136	447034
407	236422	037901	430881	517545	484195	564530	941901	952951	437818	883490
408	445051	673677	650682	973832	925397	225074	091848	854700	111985	634534
409	075510	446182	813046	269551	369966	106879	917355	439304	584045	915775
410	851057	153471	931678	208102	149952	146358	571457	730556	484069	079497
411	887657	150199	150573	148635	632415	246161	739830	765381	184055	348840
412	779408	000884	743443	073119	286237	087526	348180	449815	126404	845502
413	360175	420241	193538	554505	563686	954699	950608	008816	050150	548073
414	081973	855068	435104	307664	535215	635250	121930	694547	399699	169059
415	093648	965749	674361	877580	005554	983006	674575	596592	960741	211415
416	134232	514117	182047	133664	062208	129144	682037	790287	778865	657542
417	625007	739816	229314	600023	725330	463568	436266	922615	618181	925432
418	405999	366419	961993	215067	771616	586206	267305	813339	272162	214754
419	556259	669424	252413	979357	704810	586633	313550	637809	466238	813493
420	559713	987043	268084	557031	104813	396329	567467	629712	029787	896595
421	283399	935025	077309	376620	473476	821229	642661	613693	035815	458153
422	963175	721912	446259	107305	112126	678550	403154	479300	482199	791911
423	747059	306418	129474	034518	205849	012856	342298	413781	434341	074821
424	078030	816719	727051	818082	415098	462765	693458	823473	267467	099907
425	221260	636917	135838	868151	956384	487511	968740	039835	261701	211498
426	723634	774125	303612	776218	866193	925802	779947	098206	765356	811704
427	211103	536116	957193	186236	271093	316362	547326	970225	381780	700029
428	124090	761913	555743	700592	569454	235430	198113	096597	826993	395049
429	665718	823792	056463	911488	614326	795651	416748	760031	934483	684457
430	916749	666301	677415	935272	913440	673230	269574	148749	455996	327114
431	654423	114547	355057	504349	827587	013407	336454	259420	712797	002190
432	765187	829841	958722	129149	362676	425869	271290	858506	195895	860448
433	267678	072925	382080	323683	503880	120718	776468	929101	731019	890844
434	064343	961645	387235	855524	800724	863070	745185	356213	436107	559780
435	586123	747090	783034	119948	419677	626904	766901	842269	520645	599278
436	177853	125316	026101	504066	349909	607332	491214	817760	678800	729656
437	870773	580336	928769	413280	837843	367626	094497	730104	870826	864873
438	018460	801619	952145	878263	169723	560234	494284	995968	173413	979032
439	221872	050751	276077	734879	840837	690018	603022	555379	509622	716871
440	722346	136167	179789	331661	937878	355546	081702	404637	897691	743872
441	057699	117422	467299	940595	994339	619178	834900	045886	321875	270884
442	611633	720460	990713	041266	250962	237364	974889	689948	445022	952863
443	815421	506374	969328	248177	641359	417666	971917	621298	193870	574160
444	957191	660858	203076	583707	455267	400387	814127	422625	565975	361451
445	992985	645934	683456	113353	452688	407755	746261	717274	307832	626192
446	259822	014371	821586	064550	363668	911477	798218	756552	192253	420487
447	260733	725749	471312	603084	693967	847867	771076	375172	937413	057735
448	324049	011740	767520	095792	617526	808466	187457	392726	814845	638027
449	118299	106088	696972	883344	380596	924500	701973	706694	870913	081618
450	692647	807840	904182	744818	862106	254602	960134	760994	554308	721781

TABLE OF RANDOM NUMBERS (For Teaching Purposes Only)

	0	1	2	3	4	5	6	7	8	9
451	478061	577332	596040	679395	819473	910546	039824	034686	924555	936400
452	745813	625957	658723	754622	932222	312205	218759	674180	674048	318757
453	293307	111218	372141	619862	402323	490415	686697	243052	848836	701824
454	680933	621907	064828	204548	357795	347302	755111	962733	627424	874650
455	734343	584790	304429	338859	767349	012550	768659	130679	573854	526443
456	824483	943428	947183	254787	563096	628581	875726	421843	656180	138301
457	315669	696070	913163	379964	889270	650819	208384	412249	928154	137038
458	857594	835487	653524	818441	371607	543813	664978	441122	369354	495699
459	572369	757272	148775	080482	202006	026140	289950	170911	322064	462806
460	498462	788385	486225	819208	857005	302225	427938	893616	724444	893290
461	597795	507535	250837	487561	527642	894323	776858	448012	340545	255993
462	510005	152702	875508	377081	553181	359746	243861	978897	460659	521285
463	671654	699699	351888	604765	451875	451568	202106	585722	609201	383902
464	251120	483022	863685	876078	895816	549425	999036	971990	177993	384054
465	233358	237232	462388	897187	113330	431542	263364	146447	256364	212822
466	972199	627270	276009	148961	676021	235481	795128	946180	988364	022699
467	487475	178632	605007	721320	037047	902717	246995	752849	666413	892865
468	163899	977508	537101	648330	656348	973279	559645	807837	026111	401588
469	851582	889925	485434	306977	281116	410656	397161	945831	586890	359668
470	641452	163959	158061	373834	159130	491169	163474	352127	955379	544967
471	428618	791131	915983	036805	852215	883630	943572	016606	191504	501148
472	530956	606037	884890	109753	555573	716846	272145	279754	312717	555691
473	881210	812923	859909	386371	607325	048792	500801	146559	979353	928452
474	721557	312217	347058	376273	628822	465485	392150	790168	180715	400268
475	495472	098447	880777	117165	136748	715453	973988	589257	416646	152897
476	771510	458509	853662	914223	627356	598655	202181	055515	651668	938505
477	479748	060158	756687	514816	804690	756695	095337	050472	209993	629531
478	971359	145456	550796	867310	707518	708579	933399	850893	255239	489786
479	339372	523056	724084	473119	288975	024447	264187	085576	146801	585270
480	497688	146482	686478	553959	915223	508789	383911	672296	475308	050104
481	054032	747195	819157	100601	050073	349790	782830	986371	484907	661624
482	548484	415988	962442	241873	496524	817073	092699	429505	111496	824455
483	955706	347778	320770	330343	626226	920841	379344	894236	878999	392248
484	262279	967882	260798	686989	478953	531060	321365	304436	916725	136544
485	248289	943044	276493	651300	765699	242987	037550	008529	922831	701214
486	252427	671756	120529	531277	392346	126606	925613	804734	091026	749160
487	534439	257820	956836	610484	798181	554628	886926	248751	352409	004041
488	250794	441873	100760	579850	603957	405648	565400	575105	544176	117704
489	038457	013600	183375	924942	760472	932774	432711	950997	122067	301683
490	100486	180203	846358	168307	855618	463442	843031	541085	469214	017318
491	516300	654207	167776	295443	232008	418322	195238	354220	984392	024336
492	069797	182097	093261	574395	483007	460245	608998	679515	307710	291886
493	950705	184028	317280	549888	456237	942467	733218	587162	170713	329319
494	559295	546115	567472	608764	391328	033502	838128	876777	032916	075391
495	222795	669746	927129	441041	137998	228746	156294	372411	139815	068101
496	255423	963196	712310	584640	704476	878048	597591	579922	826795	742543
497	732157	190474	316021	630517	956321	514136	110178	558187	598352	591786
498	721720	280275	054213	965270	715638	120131	869954	125346	831413	089144
499	215948	290787	664568	132356	908142	403241	045257	382601	797118	407927
500	866028	157257	656269	257578	295169	565016	168307	826952	028313	800675

SQUARE ROOT TABLE

No.	Square	Square Root	No.	Square	Square Root	No.	Square	Square Root	No.	Square	Square Root	No.	Square	Square Root
1	1	1.000	21	441	4.583	41	1,681	6.403	61	3,721	7.810	81	6,561	9 000
2	4	1.414	22	484	4.690	42	1,764	6.481	62	3,844	7.874	82	6,724	9.055
3	9	1.732	23	529	4.796	43	1,849	6.557	63	3,969	7.937	83	6,889	9 110
4	16	2.000	24	576	4.899	44	1,936	6.633	64	4,096	8.000	84	7,056	9.165
5	25	2.236	25	625	5.000	45	2,025	6.708	65	4,225	8.062	85	7,225	9.220
6	36	2.449	26	676	5.099	46	2,116	6.782	66	4,356	8.124	86	7,396	9.274
7	49	2.646	27	729	5.196	47	2,209	6.856	67	4,489	8.185	87	7,569	9.327
8	64	2.828	28	784	5.291	48	2,304	6.928	68	4,624	8.246	88	7,744	9 381
9	81	3.000	29	841	5.385	49	2,401	7.000	69	4,761	8.307	89	7,921	9.434
10	100	3.162	30	900	5.477	50	2,500	7.071	70	4,900	8.367	90	8,100	9.487
11	121	3.317	31	961	5.568	51	2,601	7.141	71	5,041	8.426	91	8,281	9.539
12	144	3.464	32	1,024	5.657	52	2,704	7.211	72	5,184	8.485	92	8,464	9.592
13	169	3.606	33	1,089	5.745	53	2,809	7.280	73	5,329	8.544	93	8,649	9 644
14	196	3.742	34	1,156	5.831	54	2,916	7.348	74	5,476	8.602	94	8,836	9.695
15	225	3.873	35	1,225	5.916	55	3,025	7.416	75	5,625	8.660	95	9,025	9.747
16	256	4.000	36	1,296	6.000	56	3,136	7.483	76	5,776	8.718	96	9,216	9.798
17	289	4.123	37	1,369	6.083	57	3,249	7.550	77	5,929	8.775	97	9,409	9.849
18	324	4.243	38	1,444	6.164	58	3,364	7.616	78	6,084	8.832	98	9,604	9.899
19	361	4.359	39	1,521	6.245	59	3,481	7.681	79	6,241	8.888	99	9,801	9.950
20	400	4.472	40	1,600	6.325	60	3,600	7.746	80	6,400	8.944	100	10,000	10.000

1. To find the square root of a number between 1 and 10,000, look up the nearest two numbers in the "Square" column. For instance, what is the square root of 2,346? In the "Square" column we see that the square root of 2,304 is 48 and the square root of 2,401 is 49. Since 2,346 is slightly less than halfway between these two squares, the best guess of its square root to the nearest 10th would seem to be 48.4.

2. Squaring 48.4, the result is 2,342.6. Our desired square root is therefore a little more than 48.4, but is it as much as 48.5? Squaring 48.5 yields 2,352.3. Our first result was a little closer to the mark, so to the nearest 10th, the square root of 2,346 is 48.4.

3. For numbers over 10,000, begin by dividing the number by 100 and ignoring all decimals. For example, what is the square root of 27,614.89? We divide by 100 and then find the square root of 276 as shown in the above example. The best guess would seem to be about 16.6. We now have to multiply this by 10 since we originally divided the square by 100. We therefore square 166, examine the result, and keep working backward and forward until we have the square root of 27,614.89 to the desired degree of accuracy. With a machine, this takes very little time.

TABLE OF RANDOM NUMBERS

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
1	10480	15011	01536	02011	81647	91646	69179	14194	62590	36207	20969	99570	91291	90700
2	22368	46573	25595	85393	30995	89198	27982	53402	93965	34095	52666	19174	39615	99505
3	24130	48360	22527	97265	76393	64809	15179	24830	49340	32081	30680	19655	63348	58629
4	42167	93093	06243	61680	07856	16376	39440	53537	71341	57004	00849	74917	97758	16379
5	37570	39975	81837	16656	06121	91782	60468	81305	49684	60672	14110	06927	01263	54613
6	77921	06907	11008	42751	27756	53498	18602	70659	90655	15053	21916	81825	44394	42880
7	99562	72905	56420	69994	98872	31016	71194	18738	44013	48840	63213	21069	10634	12952
8	96301	91977	05463	07972	18876	20922	94595	56869	69014	60045	18425	84903	42508	32307
9	89579	14342	63661	10281	17453	18103	57740	84378	25331	12566	58678	44947	05585	56941
10	85475	36857	53342	53988	53060	59533	38867	62300	08158	17983	16439	11458	18593	64952
11	28918	69578	88231	33276	70997	79936	56865	05859	90106	31595	01547	85590	91610	78188
12	63553	40961	48235	03427	49626	69445	18663	72695	52180	20847	12234	90511	33703	90322
13	09429	93969	52636	92737	88974	33488	36320	17617	30015	08272	84115	27156	30613	74952
14	10365	61129	87529	85689	48237	52267	67689	93394	01511	26358	85104	20285	29975	89868
15	07119	97336	71048	08178	77233	13916	47564	81056	97735	85977	29372	74461	28551	90707
16	51085	12765	51821	51259	77452	16308	60756	92144	49442	53900	70960	63990	75601	40719
17	02368	21382	52404	60268	89368	19885	55322	44819	01188	65255	64835	44919	05944	55157
18	01011	54092	33362	94904	31273	04146	18594	29852	71585	85030	51132	01915	92747	64951
19	52162	53916	46369	58586	23216	14513	83149	98736	23495	64350	94738	17752	35156	35749
20	07056	97628	33787	09998	42698	06691	76988	13602	51851	46104	88916	19509	25625	58104
21	48663	91245	85828	14346	09172	30168	90229	04734	59193	22178	30421	61666	99904	32812
22	54164	58492	22421	74103	47070	25306	76468	26384	58151	06646	21524	15227	96909	44592
23	32639	32363	05597	24200	13363	38005	94342	28728	35806	06912	17012	64161	18296	22851
24	29334	27001	87637	87308	58731	00256	45834	15398	46557	41135	10367	07684	36188	18510
25	02488	33062	28834	07351	19731	92420	60952	61280	50001	67658	32586	86679	50720	94953
26	81525	72295	04839	96423	24878	82551	66566	14778	76797	14780	13300	87074	79666	95725
27	29676	20591	68086	26432	46901	20849	89768	81536	86645	12659	92259	57102	80428	25280
28	00742	57392	39064	66432	84673	40027	32832	61362	98947	96067	64760	64584	96096	98253
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35	09763	83473	73577	12908	30883	18317	28290	35797	05998	41688	34952	37888	38917	88050
36	91567	42595	27958	30134	04024	86385	29880	99730	55536	84855	29080	09250	79656	73211
37	17955	56349	90999	49127	20044	59931	06115	20542	18059	02008	73708	83517	36103	42791
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42	34914	63976	88720	82765	34476	17032	87589	40836	32427	70002	70663	88863	77775	69348
43	70060	28277	39475	46473	23219	53416	94970	25832	69975	94884	19661	72828	00102	66794
44	53976	54914	06990	67245	68350	82948	11398	42878	80287	88267	47363	46634	06541	97809
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Table of 105,00 Random Decimal Digits, Statement 4914, Interstate Commerce Commission, May, 1949. Reproduced by permission of Bureau of Transport Economics and Statistics, Interstate Commerce Commission, Washington.

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67	21581	57802	02050	89728	17937	37621	47075	42080	97403	48626	68995	43805	33386	21597
68	55612	78095	83197	33732	05810	24813	86902	60397	16489	03264	88525	42786	05269	92532
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72	50001	38140	66321	19924	72163	09538	12151	06878	91903	18749	34405	56087	82790	70925
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83	60336	98782	07408	53458	13564	59089	26445	29789	85205	41001	12535	12133	14645	23541
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85	97656	63175	89303	16275	07100	92063	21942	18611	47348	20203	18534	03862	78095	50136
86	03299	01221	05418	38982	55758	92237	26759	86367	21216	98442	08303	56613	91511	75928
87	79626	06486	03574	17668	07785	76020	79924	25651	83325	88428	85076	72811	22717	50585
88	85636	68335	47539	03129	65651	11977	02510	26113	99447	68645	34327	15152	55230	93448
89	18039	14367	61337	06177	12143	46609	32989	74014	64708	00533	35398	58408	13261	47908
90	08362	15656	60627	36478	65648	16764	53412	09013	07832	41574	17639	82163	60659	75567
91	79556	29068	04142	16268	15387	12856	66227	38358	22478	73373	88732	09443	82558	05250
92	92608	82674	27072	32534	17075	27698	98204	63863	11951	34648	88022	56148	34925	57031
93	23982	25835	40055	67006	12293	02753	14827	23235	35071	99704	37543	11601	35503	85171
94	09915	96306	05908	97901	28395	14186	00821	80703	70426	75647	76310	88717	37890	40129
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96	42488	78077	69882	61657	34136	79180	97526	43092	04098	73571	80799	76536	71255	64239
97	46764	86273	63003	93017	31204	36692	40202	35275	57306	55543	53203	18098	47625	88684
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99	86591	81482	52667	61582	14972	90053	89534	76036	49199	43716	97548	04379	46370	28672
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105	60578	06483	28733	37867	07936	98710	98539	27186	31237	80612	44488	97819	70401	95419
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107	97458	14229	12063	59611	32249	90466	33216	19358	02591	54263	88449	01912	07436	50813
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111	36247	27850	73958	20673	37800	63835	71051	84724	52492	22342	78071	17456	96104	18327
112	70994	66986	99744	72438	01174	42159	11392	20724	54322	36923	70009	23233	65438	59685
113	99638	94702	11463	18148	81386	80431	90628	52506	02016	85151	88598	47821	00265	82525
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115	24038	65541	85788	55835	38835	59399	-3790	35112	01324	39520	76210	22467	63275	32286
116	74976	14631	35908	28221	39470	91548	12854	30166	09073	75887	36782	00268	97121	57676
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122	19689	90332	04315	21358	97248	11188	39062	63312	52496	07349	79178	33692	57352	72862
123	42751	35318	97513	61537	54955	08159	00337	80778	27507	95478	21252	12746	37554	97775
124	11946	22681	45045	13964	57517	59419	58045	44067	58716	58840	45557	96345	33271	53464
125	96518	48688	20996	11090	48396	57177	83867	86464	14342	21545	46717	72364	86954	55580
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128	97025	66492	56177	04049	80312	48028	26408	43591	75528	65341	49044	95495	81256	53214
129	62814	08075	09788	56350	76787	51591	54509	49295	85830	59860	30883	89660	96142	18354
130	25578	22950	15227	83291	41737	79599	96191	71845	86899	70694	24290	01551	80092	82118
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133	71944	60227	63551	71109	05624	43836	58254	26160	32116	63403	35404	57146	10909	07346
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135	25946	27623	11258	65204	52832	50880	22273	05554	99521	73791	85744	29276	70326	60251
136	01353	39318	44961	44972	91766	90262	56073	06606	51826	18893	83448	31915	97764	75091
137	99083	88191	27662	99113	57174	35571	99884	13951	71057	53961	61448	74909	07322	80960
138	52021	45406	37945	75234	24327	86978	22644	87779	23753	99926	63898	54886	18051	96314
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140	25282	69106	59180	16257	22810	43609	12224	25643	89884	31149	85423	32581	34374	70873
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159	69742	99303	62578	83575	30337	07488	51941	84316	42067	49692	28616	29101	03013	73449
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161	18348	19855	42887	08279	43206	47077	42637	45606	00011	20662	14642	49984	94509	56380
162	59614	09193	58064	29086	44385	45740	70752	05663	49081	26960	57454	99264	24142	74648
163	75688	28630	39210	52897	62748	72658	98059	67202	72789	01869	13496	14663	87645	89713
164	13941	77802	69101	70061	35460	34576	15412	81304	58757	35498	94830	75521	00603	97701
165	96656	86420	96475	86458	54463	96419	55417	41375	76886	19008	66877	35934	59801	00497
166	03363	82042	15942	14549	38324	87094	19069	67590	11087	68570	22591	65232	85915	91499
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175	47615	23169	39571	56972	20628	21788	51736	33133	72696	32605	41569	76148	91544	21121
176	16948	11128	71624	72754	49084	96303	27830	45817	67867	18062	87453	17226	72904	71474
177	21258	61092	66634	70335	92448	17354	83432	49608	66520	06442	59664	20420	39201	69549
178	15072	48853	15178	30730	47481	48490	41436	25015	49932	20474	53821	51015	79841	32405
179	99154	57412	09858	65671	70655	71479	63520	31357	56968	06729	34465	70685	04184	25250
180	08759	61089	23706	32994	35426	36666	63988	98844	37533	08269	27021	45886	22835	78451
181	67323	57839	61114	62112	47547	58023	64630	34886	98777	75442	95592	06141	45096	73117
182	09255	13986	84834	20764	72206	89393	34548	93438	88730	61805	78955	18952	46436	58740
183	36304	74712	00374	10107	85061	69228	81969	92216	03568	39630	81869	52824	50937	27954
184	15884	67429	86612	47367	10242	44880	12060	44309	46629	55105	66793	93173	00480	13311
185	18745	32031	35303	08134	33925	03004	59929	95418	04917	57596	24878	61733	92834	64454
186	72934	40086	88292	65728	38300	42323	64068	98373	48971	09049	59943	36538	05976	82118
187	17626	02944	20910	57662	80181	38579	24580	90529	52303	50436	29401	57824	86039	81062
188	27117	61399	50967	41399	81636	16663	15634	79717	94696	59240	25543	97989	63306	90946
189	93995	18678	90012	63645	85701	85269	62263	68331	00389	72571	15210	20769	44686	96176
190	67392	89421	09623	80725	62620	84162	87368	29560	00519	84545	08004	24526	41252	14521
191	04910	12261	37566	80016	21245	69377	50420	85658	55263	68667	78770	04533	14513	18099
192	81453	20283	79929	59839	23875	13245	46808	14124	74703	35769	95588	21014	37078	39170
193	19480	75790	48539	23703	15537	48885	02861	86587	74539	65227	90799	58789	96257	02708
194	21456	13162	74608	81011	55512	07481	93551	72189	76261	91206	89941	15132	37738	59284
195	89406	20912	46189	76376	25538	87212	20748	12831	57166	35026	16817	79121	18929	40628
196	09866	17414	55977	16419	01101	69343	13305	94302	80703	57910	36933	57771	42546	03003
197	86541	24681	23421	13521	28000	94917	07423	57523	97234	63951	42876	46829	09781	58160
198	10414	96941	06205	72222	57167	83902	07460	69507	10600	08858	07685	44472	64220	27040
199	49942	06683	41479	58982	56288	42853	92196	20632	62045	78812	35895	51851	83534	10689
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202	04909	58485	70686	93930	34880	73059	06823	80257	44193	08337	47655	75932	29209	41954
203	46582	73570	33004	51795	86477	46736	60460	70345	37322	19987	67143	41129	89514	46892
204	29242	89792	88634	60285	07190	07795	27011	85941	01852	43096	31173	43730	48505	17958
205	68104	81339	97090	20601	78940	20228	22803	96070	10251	62711	66200	74330	13820	18966
206	17156	02182	82504	19880	93747	80910	78260	25136	62018	62919	73801	57195	83457	70597
207	50711	94789	07171	02103	99057	98775	37997	18325	88281	61091	97889	79977	04544	72963
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209	75629	82729	76916	72657	58992	32756	01154	84890	04107	17469	59346	68651	97433	89491
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212	76829	47229	19706	30094	69430	92399	98749	22081	52564	90431	35208	40323	87505	10227
213	39708	30641	21267	56501	95182	72442	21445	17276	90344	33199	02522	97883	09515	65930
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215	25903	61370	66081	54076	67442	52964	23823	02718	28786	06121	29680	55295	67086	57574
216	71345	03422	01015	68025	19703	77313	04555	83425	46763	95315	23150	15116	18017	42730
217	61454	92263	14647	08473	34124	10740	40839	05620	62418	73374	92577	06755	21856	56272
218	80376	08909	30470	40200	46558	61742	11643	92121	22294	26648	69676	46198	00331	85186
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220	12191	88527	58852	51175	11534	87218	04876	85584	78465	82182	03412	13217	14313	70593
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222	31588	96798	43668	12611	01714	77266	55079	24690	84716	77732	35363	85525	17015	56344
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225	31606	64782	34027	56734	09365	20008	93559	78384	99219	61747	96111	86965	33233	29812
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237	61691	04944	43111	28325	82319	65589	66046	98498	46941	81427	44447	70357	18864	15525
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239	19436	87291	71684	74859	76501	93456	95714	92518	10683	75617	78841	25315	74041	71554
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241	82244	67549	76491	09761	74494	91307	64222	66592	67270	38593	18094	95095	08649	25047
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243	94095	95970	07826	25991	37584	56966	68623	83454	49461	97707	12479	25041	40565	18313
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245	69902	08995	27821	11758	64989	61902	32121	28165	21326	97375	44801	66977	08232	06807
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247	75850	56992	25165	55906	62339	88958	91717	15756	78817	35541	01177	06869	10543	57652
248	29648	22086	42581	85677	20251	39641	65786	80689	49066	14456	91681	69371	18292	39377
249	82740	28443	42734	25518	82827	35825	90288	32911	79666	52959	01475	83321	24991	80102
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251	89429	26726	15563	94972	78739	04419	60523	31022	23728	37647	16476	11170	68376	56874
252	43427	25412	25587	21276	44426	17369	29010	45337	90245	92053	41447	14897	18753	68291
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254	61888	71246	24246	23487	78639	92006	63846	92263	33212	26516	93662	72399	88244	33922
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265	27848	51107	05761	02159	53911	01952	59273	32250	39647	29908	49075	23061	07795	95047

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267	29418	03091	06364	13151	40663	43633	87954	69800	24773	62596	52476	60631	50503	94116
268	38222	31231	79415	44558	62490	26936	49628	16307	98535	44822	99574	58487	85020	68881
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274	98071	52677	74920	74461	52266	26967	68284	31612	40335	28865	98949	64492	96905	29184
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282	39663	61401	21471	42702	70588	53144	27087	05591	57759	51394	98873	45625	61069	78783
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287	13982	25736	10087	16762	02564	27250	79316	83848	38684	20552	44402	85153	94526	41256
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295	79954	89601	23881	46951	69084	33477	87968	15639	82409	34125	36264	52112	27102	87334
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298	29766	83452	66202	02485	72704	97821	70614	53616	39080	30355	15340	27298	41795	35185
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306	64654	91085	65818	03313	39273	46384	66677	14148	87552	38383	67435	21072	63866	74644
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311	70232	86076	61527	56123	48514	53935	86784	42351	67586	07432	61499	01773	97463	58815
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314	39333	47453	66174	04546	10594	64271	61026	39471	55981	18628	67943	35599	37209	34061
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317	22763	16508	24866	13177	07464	51730	65802	95718	28560	11332	74272	59189	53167	13133
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323	29830	34899	85457	19548	83355	52479	77801	01596	48890	56104	68733	40830	58611	59181
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326	99390	08217	56276	09263	82685	30451	25742	41105	74711	42007	02082	93025	86641	28952
327	68622	80897	08902	10867	91379	30068	84289	45020	92459	03831	08531	63496	98230	42884
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333	85528	97879	27814	08219	02908	71582	31439	00360	72264	87245	65903	42298	28061	81889
334	32590	55079	33556	83169	92087	77939	53792	78795	58159	86394	41749	91623	26973	81474
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343	70965	00390	08878	15373	70276	71889	86953	37931	23286	20508	40100	22486	37323	35429
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346	15665	28659	54952	53217	76898	88931	25786	55912	85269	29212	84976	08888	94332	58528
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348	17952	73276	52567	48489	64264	24220	55498	97548	98437	26033	39026	17377	43519	27425
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351	06433	80674	24520	18222	10610	05794	37515	48619	62866	33963	14045	79451	04934	45576
352	39298	47829	72648	37414	75755	04717	29899	78817	03509	78673	73181	29973	18664	04555
353	89884	59651	67533	68123	17730	95862	08034	19473	63971	37271	31445	49019	49405	46925
354	61512	32155	51906	61662	64130	16688	37275	51262	11569	08697	91120	64156	40365	74297
355	99653	47635	12506	88535	36553	23757	34209	55803	96276	26130	47949	14877	69594	83041
356	95913	11085	13772	76638	48423	25018	99041	77529	81360	18180	97421	55541	90275	18213
357	55864	44004	13122	44115	01601	50541	00147	77685	58788	33016	61173	93049	04694	43534
358	35334	82410	91601	40617	72876	33967	73830	15405	96554	88265	34537	38526	67924	40474
359	57729	88646	76487	11622	96297	24160	09903	14047	22917	60718	66487	46346	30949	03173
360	86648	89317	63677	70119	94739	25875	38829	68377	43918	77653	04127	69930	43283	35766
361	30574	06039	07967	32422	76791	39725	53711	93385	13421	67957	20384	58731	53396	59723
362	81307	13114	83580	79974	45929	85113	72268	09858	52104	32014	53115	03727	98624	84616
363	02410	96385	79007	54939	21410	86980	91772	93307	34116	49516	42148	57740	31198	70336
364	18969	87444	52233	62319	08598	09066	95288	04794	01534	92058	03157	91758	80611	45357
365	87863	80514	66860	62297	80198	19347	73234	86265	49096	97021	92582	61422	75890	86442
366	68397	10538	15438	62311	72844	60203	46412	65943	79232	45702	67055	39024	57383	44424
367	28529	45247	58729	10854	99058	18260	38765	90038	94209	04055	27393	61517	23002	96560
368	44285	09452	15867	70418	57012	72122	36634	97283	95943	78363	36498	40662	94188	18202
369	86299	22510	33571	23309	57040	29285	67870	21913	72958	75637	99936	58715	07943	23748
370	84842	05748	90894	61658	15001	94055	36308	41161	37341	81838	19389	80336	46346	91895
371	56970	10799	52098	04184	54967	72938	56834	23777	98392	31417	98547	92058	02277	50315
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373	55503	21383	02464	26141	68779	66388	75242	82690	74099	77885	23813	10054	11900	44653
374	47019	06683	33203	29608	54553	25971	69573	83854	24715	48866	65745	31131	47636	45137
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377	36458	28285	30424	98420	72925	40729	22337	48293	86847	43186	42951	37804	85129	28993
378	95752	96065	36847	87729	81679	59186	59437	33225	31280	41232	34750	91097	60752	69783
379	26768	02513	58454	56958	20575	76746	49878	06846	32828	24425	30249	78801	26977	92074
380	42613	72456	43636	58085	06766	60227	96414	32671	45587	79620	84831	38156	74211	82752
381	95457	12176	65482	25596	02678	54592	63607	82096	21913	75544	55228	89796	05694	91552
382	95276	67524	63564	95958	39750	64379	46059	51666	10433	10945	55306	78562	89630	41230
383	66954	53574	64776	92345	95110	59448	77249	54044	67942	24145	42294	27427	84875	37022
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385	03704	23322	83214	59337	01695	60666	97410	55064	17427	89110	74018	44865	53197	74810
386	21538	16997	33210	60337	27976	70661	08250	69599	60264	84549	78007	88450	06488	72274
387	57178	16739	98310	70348	11317	71623	55510	64756	87759	92354	78694	63638	80939	98644
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389	69799	83300	16498	80733	96422	58078	99643	39847	96884	84567	33697	39578	90197	80532
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391	33570	34761	98939	78784	09977	29398	93896	78227	90110	81378	96659	37008	04050	04228
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393	64079	07733	36512	56186	99098	48850	72527	08486	10951	26832	39763	02485	71688	90936
394	63491	84886	67118	62063	74958	20946	28147	39338	32169	03713	93510	61244	73774	01245
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396	52360	46658	66511	04172	73085	11795	52594	13287	82531	04388	64693	11934	35051	68576
397	74622	12142	68355	65635	21828	39539	18988	53609	04001	19648	14053	49623	10840	31915
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402	93320	80269	56684	39192	53220	74539	26393	00787	94490	23386	38454	33466	32159	77439
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413	75898	02275	90768	31902	52114	36634	46803	97970	92216	55398	75320	70475	82931	20172
414	22729	21695	90824	80500	09332	54667	46696	38166	02005	24615	85613	25948	75389	25765
415	28733	62663	23644	16416	47135	39137	62190	31032	58702	03805	67252	23712	92697	19071
416	51323	37770	42114	79742	59905	38480	25293	32993	36946	62701	51198	72941	52215	85257
417	69325	65551	49927	68073	56979	49454	79451	60753	70872	07422	06399	75240	80847	78231
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422	73302	84917	75128	34085	86208	98399	79433	61960	01720	87458	24023	89971	09532	68155
423	42785	24350	05933	65282	12832	75382	29826	33197	81781	53542	63985	57022	22712	61343
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428	78459	91322	50072	77941	65046	78363	21951	42319	46472	67617	34134	05905	61251	51040
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433	70558	85169	01086	97202	10390	01819	88167	21851	87837	85287	69883	08289	74968	46947
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435	95216	75262	60351	02643	00063	20824	67468	89441	84055	47035	29741	47972	61914	66864
436	49087	61399	47781	32173	96672	04528	15881	46764	20115	03226	79308	31970	49804	85150
437	24808	79068	70787	43106	97133	37236	77888	48451	20788	44648	70350	54965	57715	94826
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439	61178	79295	58926	21977	28435	32631	23062	31822	70462	05965	22312	33013	74612	23733
440	37444	56047	23208	34710	12147	28558	58817	98807	56775	08129	08794	23646	92846	61706
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444	45610	26370	13094	34500	36750	54517	85011	26567	01021	32485	58903	43529	24191	91832
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447	79400	83852	52174	42577	18553	14023	69629	61913	41050	69689	57284	38160	57756	16762
448	42799	46647	36718	49704	17150	07935	62372	39933	20838	27652	54801	41067	08240	35163
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451	85018	23508	91507	76455	54941	72711	39406	94620	27963	96478	21559	19246	38097	44926
452	11904	73678	08272	62941	02349	71389	45605	60947	60775	73181	43264	56895	04232	59604
453	75344	98489	86268	73652	98210	44546	27174	27499	53523	63110	57106	20865	91683	80688
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459	93077	72941	92779	23581	24548	56415	61927	64416	29934	00755	09418	14230	62887	92683
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461	11338	12903	14514	27585	45068	05520	56321	22693	35089	07694	04252	23791	60249	83010
462	23853	68500	92274	87026	99717	01542	72990	43413	59744	44595	71326	91382	45114	20245
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471	22145	85304	35348	82854	55846	18076	12415	30193	42776	85611	57635	51362	79907	77364
472	27153	08662	61078	52433	22184	33998	87436	37430	45246	11400	20986	43996	73122	88474
473	00301	49425	66682	25442	83668	66236	79655	83312	93047	12088	86937	70794	01041	74867
474	43815	43272	73778	63469	50083	70696	13558	98995	58159	04700	90443	13168	31553	67891
475	14689	86482	74157	46012	97765	27552	49617	51734	20849	70198	67906	00880	82899	66065
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477	86939	60429	01137	86168	78257	86249	46134	51865	09836	73966	65711	41699	11732	17173
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479	16045	67736	18608	18198	19468	76358	69203	02760	28625	70476	76410	32988	10194	94917
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482	47422	21296	16785	66393	39249	51463	95963	07929	66728	47761	81472	44806	15592	71357
483	24133	39719	14484	58613	88717	29289	77360	09030	39605	87507	85446	51257	89555	75520
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489	33583	68291	50547	96085	62180	27453	18567	55524	86088	00069	59254	24654	77371	26409
490	02878	33223	39199	49536	56199	05993	71201	78852	65839	32719	13758	23937	90740	16866
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493	12997	55013	18662	81724	24305	37661	18956	50064	39500	17450	18030	63124	48061	59412
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502	05200	50533	59428	02797	16833	10038	18901	40743	99449	49825	44637	72724	42649	67052
503	82828	41316	92617	31346	89263	06589	07121	07151	23905	98435	50453	12983	04738	76421
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517	01647	00311	44989	21900	96079	15793	13148	01433	78721	02647	25454	53913	97554	41578
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519	79975	06153	08932	59185	71386	19070	87098	19392	13899	56096	83645	45871	35950	52272
520	49744	54713	37053	77467	15348	03383	96086	93295	12413	55774	97318	66402	11209	52495
521	40922	94903	29638	46870	14108	84391	87313	65969	43349	85142	25650	01896	48680	51236
522	53319	48020	77444	51447	07916	99506	83504	22290	63835	45589	04884	92760	70462	00538
523	76682	10559	85446	56236	85919	76388	59850	03262	60347	31077	07165	26588	31296	56112
524	48869	97229	69581	84581	71728	45150	16901	88717	62699	24828	89469	35483	76532	30256
525	95961	19279	38078	17473	43945	21562	90937	52140	73771	56084	08775	94820	78139	25987
526	16521	25945	94076	91201	92272	41233	58614	18912	58454	34011	85969	83621	92099	19131
527	78282	26332	44072	55104	16895	98311	56005	23331	21939	03463	53828	78930	30987	40988
528	43473	39179	53174	43498	72674	13087	54261	01844	45738	93150	13240	16694	59155	67589
529	06513	31352	09177	21367	64725	23784	18125	74873	83971	92678	96950	69821	41119	43312
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533	42829	54398	93338	90705	00626	97752	93482	27726	51835	23966	50279	26329	25754	43530
534	81128	63461	10925	44382	73365	98875	77605	27351	49177	36914	50258	62361	38229	89608
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536	19525	10375	27010	42791	49471	90607	98103	31752	04842	13693	84292	48485	76178	41716
537	26570	99202	73924	59888	01827	93314	63949	35394	12989	05867	11568	45056	16609	20470
538	04772	17749	01537	96036	02102	02622	06007	52239	61201	57415	35609	38761	19589	24238
539	49129	12491	62552	64323	44856	29045	76871	80449	81351	73642	48643	23848	48390	56829
540	19937	75104	57780	95871	94547	53541	77723	54114	90290	62627	65151	15687	81062	06729

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543	16375	88048	29625	08111	92924	53335	09525	88290	17679	08945	25816	11848	95106	22031
544	38745	91458	30363	95005	55854	38628	13599	73065	40870	82576	37089	86738	16284	44725
545	09937	17776	86425	88916	80594	28347	08092	64255	55604	78635	13197	72213	95102	36723
546	30097	47192	27960	15937	42080	61048	14358	44508	72683	51088	55368	85587	27046	11198
547	02410	60124	62825	42947	74590	89730	16073	28184	30078	92578	83789	08044	76238	47599
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550	60640	14199	48263	71533	94235	42431	44114	90993	41149	06159	39242	11163	14764	19246
551	31630	67734	78201	94545	80152	62327	83165	31035	82295	11824	06765	29501	62849	50419
552	25101	98983	36993	40028	58036	14075	05980	57094	45527	18766	77741	12985	14112	65058
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556	68210	16228	34801	40972	22887	89759	09095	00587	03998	13659	64179	98567	69313	84637
557	32367	69587	66162	44358	69844	73042	88091	07288	74971	47066	36927	53520	58309	58605
558	14684	42446	01751	37459	31945	03627	47690	97813	45272	42789	99315	26662	15833	37246
559	64260	04661	39957	01200	84800	27930	98937	76108	11043	29101	01767	78894	92922	66537
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561	20966	71492	32323	11867	47523	24094	23334	78839	81588	67374	43855	24512	81956	75721
562	20498	68176	02027	22358	15907	13247	44784	82957	53009	73379	44093	58405	38515	85531
563	56320	79875	60634	17556	52153	63549	03661	78290	96447	04192	30157	63198	75932	02367
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565	49366	90095	73459	12225	28483	35358	99941	63054	54358	80748	54049	85937	64718	21466
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582	87556	31521	19669	16311	01767	67301	63016	01227	27273	79256	50368	88653	23329	86500
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592	94500	19764	94752	73077	74726	86176	31623	14569	89225	09606	73432	95276	21237	36807
593	66375	34653	37125	84780	92759	09781	06912	96802	92502	97497	67702	49763	25950	49924
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613	43053	60600	98921	43720	77342	26186	64554	46226	64244	10703	49564	69737	32948	43060
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625	18350	74940	07044	11210	53622	00779	36027	51496	01694	57895	84570	18271	54461	42210
626	79960	18784	13376	03415	84450	78874	22050	19730	92598	54291	60658	73188	03446	49864
627	45420	24157	16374	22384	56892	84941	97157	99656	33978	81436	10955	98991	10456	35727
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635	89870	73755	48525	32765	50818	71468	37876	28334	07762	16180	45346	78324	20422	85784
636	81493	24124	67928	12735	41249	24180	54740	44290	58903	38681	04066	69393	84595	42173
637	43630	32189	08532	43055	08080	84208	06295	07813	24068	67549	43051	78581	02095	03471
638	60234	18992	13283	96334	39746	07472	25295	07871	34201	49520	52178	07290	89767	63890
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640	09657	36088	05976	88267	62683	57675	85265	10856	06525	37911	52332	55752	25054	30436
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646	79236	54729	47052	49717	22312	06735	58347	04402	03838	97049	35378	38579	24489	86899
647	41337	52635	48056	43317	11599	26382	41305	04589	92877	52732	53130	45275	30183	15962
648	73732	99966	30485	45994	30195	40239	52751	64124	67778	60982	12167	63134	10730	11350
649	92113	55625	03726	76886	64237	33300	48004	37440	76329	80441	74766	70630	97855	88039
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663	94539	92056	65825	27167	69783	48976	07466	76421	71439	98358	21989	77098	86413	62724
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680	19882	28056	10093	45334	89019	23914	12549	69492	09859	46366	22224	63308	95897	20408
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688	00528	63679	57762	88094	26402	25925	10598	09606	41596	90916	25311	91501	63286	87423
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690	85652	55278	23342	30372	47987	19936	89623	38221	45073	67291	57082	13194	39749	75753
691	16543	93477	41421	34710	59498	55069	70504	08544	80118	77512	88070	03943	84969	02116
692	50315	17150	14006	10453	96007	41512	36027	60557	57141	50544	80556	47441	56506	62857
693	73876	27245	79551	56241	53843	66714	24050	26354	14915	62391	85724	57468	34621	22325
694	26749	07215	99485	51013	50210	69934	73613	95543	94599	13955	29586	62507	90618	52247
695	89438	39457	58255	75693	72570	17885	07259	10273	25229	52788	55762	14772	50200	55909
696	24388	81801	22581	26331	47945	11717	42187	06031	02488	09199	74752	65757	27989	81532
697	19688	39199	20531	96205	50355	14725	38656	79167	44771	43966	73425	79632	77181	84817
698	07943	07018	03516	05747	94259	73583	43619	99509	02102	08279	57372	53487	10885	95017
699	90391	97135	97952	83722	35578	82905	41761	66670	43482	34931	94438	93341	60927	31368
700	61564	65108	76451	71430	08671	84975	36182	70787	79442	29461	01209	20022	93055	28312
701	79681	63467	02927	86515	71330	04490	47372	68791	27576	02044	03784	94581	60105	75131
702	30305	20743	10302	71391	18138	23412	11858	47818	22324	52031	10600	49892	34101	71430
703	32763	33847	58250	64362	87550	94978	22888	78355	34651	41604	51892	89533	81610	72641
704	59166	21978	40456	13084	31782	00518	18621	60508	93095	74017	17416	76900	25261	63227
705	55843	94845	30006	51045	17428	50657	68237	02969	30500	43569	28051	22505	07159	78162

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708	24626	54219	12284	06890	05239	42846	24773	15025	15161	51340	54739	99433	54328	47800
709	48002	32024	17230	37523	47488	31080	29352	61444	04011	56275	19259	72475	53451	43397
710	03742	00004	98249	12256	94253	95378	88918	98167	46646	19727	24181	83358	28999	11769
711	17749	89193	37944	53702	49918	65397	72597	63520	77429	68355	21003	00657	02157	68031
712	34837	36219	22048	97047	68804	09633	28689	80484	59331	77577	30376	10021	78267	78049
713	99451	37922	90191	39229	07564	41077	91554	46657	74652	84677	49671	94805	82406	99797
714	74045	00036	53137	15250	19646	20451	46677	53620	74712	17246	96626	28587	33618	46845
715	98998	98774	98159	00032	97323	81490	21552	35001	10913	48910	91015	62408	83253	19770
716	61513	02266	36871	85993	23028	67082	93486	45110	86288	34493	66710	04268	04955	49074
717	67056	19960	53863	63917	68283	31123	17443	32019	19695	85622	46808	03535	91566	36785
718	83036	04625	93284	14368	10979	95800	72182	77004	07320	79516	00915	53209	00884	65464
719	71901	25497	76987	74388	41605	39295	75622	41203	87987	09672	81312	08728	49867	95245
720	46484	77860	02062	92917	70275	40593	93265	92722	39193	47099	39046	85989	24607	72287
721	18312	05137	64361	86541	17794	32313	52847	08862	36752	32624	11035	92500	35016	18519
722	63093	94089	17725	19607	19340	19022	50080	21998	49864	07107	64287	41647	75264	09320
723	38109	69439	62094	49578	37728	17809	11563	10073	17299	69328	88068	04754	51698	11641
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725	92320	12828	57972	83551	63054	95028	50857	40315	04962	36431	54964	33961	89397	70359
726	42226	72413	67949	96906	17848	21446	35722	10376	84226	16403	14642	23253	07162	57664
727	01094	08525	21349	41981	55232	76652	00857	77173	63362	64936	96601	95816	14729	35398
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746	87639	11791	63380	25952	20838	13638	32782	23841	16936	91384	20472	81876	85484	35003
747	65676	78482	33343	65797	56005	15782	27311	64066	28230	36207	06446	09976	09463	56698
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804	07397	95853	45764	43803	76659	57736	44801	45623	23714	69657	87971	24757	94493	78723
805	74998	53337	13860	89430	95825	65893	96572	73975	19577	87947	23962	78235	64839	73456
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809	66561	56130	30356	54034	53996	98874	78001	29707	91938	72016	16429	69726	41990	33673
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813	41494	89270	48063	12253	00383	96010	41457	54657	46881	75255	29242	07537	53186	95083
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817	48117	83879	52509	29339	87735	97499	42848	81449	80024	81312	59469	91169	70851	90165
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819	61512	79376	88184	29415	50716	93393	96220	82277	64510	43374	09107	28813	41848	08813
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843	78097	59495	45090	74592	47474	56157	88287	47032	66341	38328	70538	91105	12056	36125
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853	30636	03463	50326	69684	38422	59826	47858	90601	50834	88109	43882	15687	06212	19886
854	23794	51463	67574	48953	73512	46239	10953	04622	60650	35048	34705	90502	31011	81004
855	01117	60216	29314	65537	84029	00741	40851	96344	13861	43421	57107	60813	06877	52161
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860	17101	42181	45798	68745	24190	16539	32330	21732	65547	94356	38651	35102	16327	17886
861	30742	93358	95730	52535	34404	76057	21325	87526	93020	94861	83865	61393	89645	00773
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872	63615	69083	00118	47991	99521	88655	94451	67445	99377	75528	40794	30140	82298	85868
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875	61992	28258	27359	61002	16882	44018	85376	66756	14395	66865	67036	78374	43612	77134
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878	19130	59917	28850	76593	02389	80759	18481	02724	57578	35705	89265	25033	13767	95888
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880	84122	36454	70776	17000	83017	07027	98058	41274	22476	27436	30798	62287	21235	00249
881	76320	32120	91585	39640	23470	86000	68204	23980	17625	53197	35128	76385	02848	61680
882	09234	36233	94404	42812	39210	25967	12232	38195	16649	96739	64610	96067	89561	15772
883	16206	70598	95378	70573	42636	53862	81334	65439	28858	07619	59608	61460	00681	43226
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887	66817	18439	53188	35155	24309	88284	74644	25454	19606	61460	52684	36568	68108	45653
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897	37171	34598	87234	28324	85927	23465	80833	62872	40826	10066	64858	33605	24848	30881
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909	26132	07856	14223	02824	66094	88093	35794	69015	67498	97087	25936	52239	07472	74585
910	26892	74387	97124	32851	83465	51300	58546	12579	43451	48661	79351	58231	11824	77723
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1079	88014	27583	78167	25057	93552	74363	30951	41367	81193	86710	41226	27067	33267	60753
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1083	49631	93771	80200	84622	31413	33756	15218	81976	79409	94895	23730	66665	06133	52448
1084	99683	58162	45516	39761	77600	15175	67415	88801	77378	91513	89678	07672	57062	91729
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1088	15232	48027	15832	62924	11509	95853	02747	61889	08567	76588	07718	32505	37265	26390
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1093	55548	19096	04130	23104	60534	44842	16954	99466	37192	28518	63412	54607	62493	60940
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1102	21791	24764	53674	30093	45134	24073	24316	59727	95062	88513	63804	44547	19920	37719
1103	63501	05040	71881	17759	91881	69614	11891	27729	60387	80028	56757	90152	85907	27714
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1247	88547	92465	86970	27058	75111	35954	04908	39278	35048	22782	57676	02777	85138	13520
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1249	16426	72091	47835	13637	03540	50764	33141	61687	44597	55932	70676	38083	66787	93793
1250	12577	67820	43932	31786	09878	30754	35826	55219	49221	51126	11788	45411	53835	37723

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1254	86027	57571	51844	97271	13490	05891	10381	21075	49707	16163	24928	72412	55791	37027
1255	65484	08659	79586	22646	00116	48807	24045	30468	25964	94816	25391	25628	77531	40804
1256	71995	61936	01207	83302	48590	99785	67234	86537	19243	19807	09504	70473	00090	99520
1257	00850	34022	65122	18191	10762	27345	31013	97627	07453	47702	37245	69370	61961	19905
1258	53680	89928	28841	15902	39075	80965	92066	90991	88070	83977	11311	30138	43493	06360
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1261	63601	34750	89718	27983	33003	71523	25577	87683	44167	86715	83986	21460	62964	98014
1262	06022	73871	60775	96719	56248	39782	41168	24996	68906	94024	53417	75097	47998	72263
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1267	55404	84898	08063	89735	55805	23658	29708	95836	22118	54763	65647	61295	41510	87822
1268	82280	18547	56385	97424	09154	23655	27047	91188	16529	87563	37573	09953	31184	59565
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1271	91981	50674	00549	34128	91791	22038	19425	12454	96737	70866	63815	52298	12923	34504
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1275	10886	26404	74644	35325	59263	74350	44764	52972	61260	82303	60964	67652	78663	78897
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1414	04765	31821	44593	46422	51428	58416	91270	55106	70638	59222	25845	33319	77335	29238
1415	18824	06096	70524	95836	24943	25359	78956	98953	88610	76011	88314	76641	47188	63556

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
1416	47405	97469	90403	49420	45421	08755	98228	34796	88746	66820	26942	20890	93616	12668
1417	43258	95534	87336	44598	21812	47574	37461	71134	51379	02560	59287	18163	32017	34079
1418	78054	38053	76625	40189	85260	15936	19764	06393	52717	26632	03845	84789	57660	06534
1419	98009	48697	99745	57271	27845	89662	97060	34924	74216	40330	62163	84100	03510	87018
1420	89539	20545	01572	80160	99113	60898	15979	21744	31802	00506	70014	34224	24303	60213
1421	50971	68414	12747	98328	01385	03650	28584	46795	61672	18108	53097	98729	74866	73116
1422	08985	78498	12409	90670	70068	44249	86142	58168	49415	81671	40515	47715	14092	65155
1423	56387	98581	50840	43657	79899	79340	56881	39843	73894	04555	17874	01733	77115	24638
1424	95291	50890	88317	18046	23068	10820	87401	91948	77129	11243	71657	03462	75057	05700
1425	48269	12957	89398	73619	77078	38993	52967	80016	64932	44532	18121	93764	49174	82724
1426	30129	45255	61883	86928	40119	10822	81133	28040	49345	19326	81373	61492	45306	82317
1427	60384	92751	24437	92878	41118	45281	95549	34677	50057	11832	95817	72517	29479	09776
1428	90697	21527	45677	01301	32776	90315	24528	24802	44516	96779	92902	60511	33634	52737
1429	69348	59490	41924	15472	63892	04948	54391	86001	21344	19270	71069	18425	29397	24754
1430	31541	95745	00621	81689	34455	81882	85116	57733	55992	50017	69765	09465	52352	30175
1431	07365	84787	80609	25283	43880	74610	57662	59244	24173	03354	79635	76874	22007	15860
1432	32863	12770	71142	62515	68375	82877	56590	32717	83166	75115	57813	88814	40352	80827
1433	41459	65791	87317	31296	21168	07674	03736	96448	44439	32621	21884	41834	09015	86305
1434	70246	16564	57312	07083	91043	80663	33807	91347	09334	14579	22283	25043	51437	21623
1435	81769	34679	87801	46900	19251	48485	98608	68556	71292	63616	23231	96106	74890	98186
1436	58710	07935	41379	88812	98238	51991	27332	16278	22901	83504	91681	99962	95007	67523
1437	93137	62174	33395	37878	94351	38641	42854	62566	31140	73489	51051	44116	71495	49005
1438	92028	33566	76951	38293	59501	26781	35827	91719	09878	42461	06902	65924	35159	77071
1439	77643	97236	96376	43223	94208	43244	21477	64603	07954	96465	86425	04285	59298	94413
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1441	94061	44835	98120	78478	95414	08809	49294	85821	42752	70197	41772	01040	37368	53650
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1443	99631	98431	76974	63349	87461	39090	18052	66650	96938	68938	96831	33274	12612	62788
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1445	62332	76895	13101	41226	11923	94970	16685	23620	11918	86257	11694	43880	24531	27272
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1448	08537	80929	66352	83924	21331	79310	93710	60398	74570	91901	94755	55198	11729	49801
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1453	72078	39251	50886	46430	53994	56049	36030	71580	10161	70116	16556	95669	62817	05335
1454	63675	45810	44199	84436	13081	31652	36509	10949	05446	30913	60149	66850	89498	07155
1455	60595	74791	23267	37039	84875	87192	93298	46426	39072	98984	17404	28804	99841	61663
1456	45204	01095	86043	30604	28361	63342	48430	41094	64356	01440	86840	33363	12019	49913
1457	39994	25083	60371	97716	52655	58508	50026	50928	20567	17379	96141	06955	69389	92222
1458	06909	70912	30714	90653	83792	38309	42841	39378	16075	50103	15226	71790	42099	51455
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1461	44229	68964	76398	97736	29356	19720	30957	40275	55062	07333	94037	64528	45791	95969
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1463	79746	45302	92695	80348	90693	32522	98359	82507	29368	74058	82667	05911	64996	69916
1464	41917	70277	95306	28321	40298	83054	80470	38497	41582	40297	10731	21011	76868	76451
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1467	44950	55990	23779	93362	46063	58980	84151	09106	62520	65630	41521	27747	23516	97984
1468	19099	87872	79283	53751	80925	24221	74310	16851	21678	65600	78803	32680	75685	43132
1469	60213	68931	09542	71109	12758	25464	82318	08841	21851	19698	11087	71475	20908	85700
1470	58554	88248	81547	61101	13373	31787	17293	86404	54460	03941	62491	64924	13200	71641

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
1471	75826	10975	99991	75722	67780	84197	71507	75758	76840	92233	05862	88639	58977	82808
1472	35226	47738	87250	02131	18885	15470	44646	09361	73397	07561	90046	75443	83917	06696
1473	90137	47396	34336	75022	66586	04426	31440	41319	98881	80893	05531	91483	39232	69625
1474	61030	68038	88654	05986	85869	80044	46235	87084	59602	47088	13474	52449	98129	36933
1475	29523	08283	69819	14429	43131	20487	84369	03735	62873	39409	02302	52572	03324	91672
1476	05835	36457	15516	59987	43545	84159	39716	59021	20280	81563	62981	69666	74467	35031
1477	89456	73108	57063	46675	89930	85054	75680	04749	24886	48813	81276	89273	51686	84876
1478	44830	07509	23981	71725	10318	27204	23296	30808	11774	64813	41995	94873	75090	92732
1479	39864	47322	31251	82524	45643	**31038**	20455	**52442**	07923	84812	55808	92271	45642	27748
1480	94135	03380	81698	48694	52326	75025	50761	49392	01977	73439	78111	27989	68394	42038
1481	69240	52865	81175	30481	17890	64355	96345	39127	40278	98317	96973	92922	35319	59978
1482	79725	53403	89131	02804	26309	78157	29432	63674	41654	94507	32291	12131	48062	02443
1483	71198	93772	90685	29615	42387	72649	38219	30609	12734	23021	27494	87883	57993	82685
1484	09108	41317	42548	80675	32823	12150	66274	86189	66343	34571	75186	90986	08158	77741
1485	16637	65387	79852	38250	44973	45612	44938	93563	84733	82490	26738	95624	30208	40971
1486	63847	13687	45157	64816	50626	31236	34127	66409	15890	00972	48832	40660	16763	99106
1487	33924	92613	47288	49738	37532	82272	44805	75734	29660	59459	97949	35695	40757	84117
1488	72094	93704	50741	90556	72074	27652	85568	57142	58994	17869	25244	19737	96043	32528
1489	10274	87910	51552	22331	60297	22908	96064	11109	49773	00279	19375	84259	20675	89986
1490	45853	62407	77906	62399	95568	32481	10186	89765	63761	33384	05725	42448	97040	20117
1491	90163	21938	53874	51545	72222	78362	48573	18920	00208	95789	69375	93781	77688	47444
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1493	13829	31033	62790	91935	56721	21673	52965	78889	49018	24644	18625	61261	38054	52462
1494	09775	54186	21927	51460	26755	22921	50617	29806	37217	66079	73265	49426	86030	26047
1495	09592	17859	56164	**45701**	20939	92689	69421	75699	41219	29399	60373	56207	79282	01324
1496	42639	84884	69790	90784	34940	18891	69850	88330	51508	90991	53445	91947	67709	98816
1497	21655	81382	78529	20469	22066	96281	97864	17825	51975	23291	68971	41836	79125	96935
1498	80111	69552	54281	44357	98385	21425	72915	35041	27883	43938	64536	07481	51673	54470
1499	09761	22879	57602	28894	07030	91155	95164	52878	01407	63108	81643	95870	00561	52117
1500	47808	83766	69073	93127	76351	14177	05713	23110	29841	40650	83094	93585	20405	91235