

JIS

JAPANESE INDUSTRIAL STANDARD

Glossary of Terms Used in Operations Research

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JAPANESE INDUSTRIAL STANDARD

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Glossary of Terms Used in
Operations ResearchZ 8121-1967
(Reaffirmed: 1984)1. General Rules

1.1 Scope This Japanese Industrial Standard specifies the main terms used in Operations Research and their pronunciations and meanings.

Further, English equivalents of those terms are shown for reference.

1.2 Classification The terms for Operations Research are classified into the following nine divisions:

- A Operations research in general
- B Inventory theory
- C Investment and replacement theory
- D Mathematical programming
- E Scheduling method
- F Queueing theory
- G Simulation
- H Theory of games
- I Information and search theory

2. Terms for Operations Research

The main terms are specified as shown below.

Remark: Where two or more terms are shown in parallel, preferential use shall be made according to the order indicated.

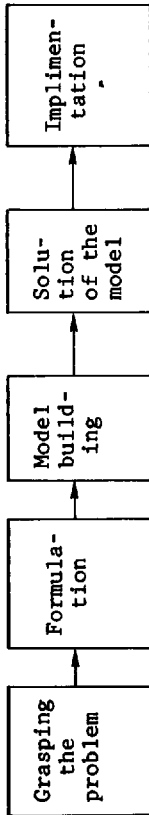
(A) General

No.	Term	Meaning	English equivalent (Reference)
A 1	OPERESHONZU RISACHI, UN'EIKENKYŪ	A technique which offers the solution of problems to the decision-maker by applying scientific methods and tools to the problems related to the policy of system operation. This technique originated in the activities of physical scientists and technologists, psychologists, management scientists, and the like who participated in the studies by military authorities concerning the strategy, military operation, and weapons of U.S.A. and England during World War II and cooperated in the solution of problems. After the war, this technique came to be adopted in general government offices and companies as well as the military authorities. The feature of this technique is in the point of seeking the solution of problems quantitatively from various standpoints with the cooperation of experts in a wide range of fields.	operations research (US), operational research (BS)
A 2	KEIEIKAGAKU	A system of principles and methods for finding scientifically the answers to problems involved in management (for example, problems of production planning, marketing policy, and inventory administration).	management science
A 3	KAGAKUTEKIKANRI (HŌ)	Broadly, operation management based on survey, analysis, measurement, and the like which are regarded as the methods characteristic of modern sciences. Scientific management is a term contrasted to drifting management (management relying on tradition and assumption). In a narrow sense, it means the management system proposed by F.W. Taylor (U.S.A.) (1856 to 1915), that is, the Taylor system. Its feature is in the task management of workers in which management is performed by deciding a fair day's work based on work study and time study.	scientific management

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No.	Term	Meaning	English equivalent (Reference)
A 4	KŌDŌKAGAKU	A scientific standpoint to study the behavior of human group mainly by statistic and quantitative methods. In English, behavioral science in singular form means KŌDŌKAGAKU, and behavioral sciences in plural form is translated into Japanese as KŌDŌSHOKAGAKU, which is the general term for psychology, sociology, cultural anthropology, and so forth.	behavioral science
A 5	NINGEN KŌGAKU	A technique of deciding on machine designs, establishment of working methods and working environment, and the like to accord with the abilities and limits of man.	human engineering (US), ergonomics (BS)
A 6	SAIBANETIKKUSU	A science of handling in a unifying and synthetic manner the functions, such as nerves and sensation in human behavior, and the functions of communication and control in machines.	cybernetics
A 7	SĀBOKIKO	A mechanism of making the output automatically follow a preliminarily established target value when the input of the apparatus to be controlled changes arbitrarily.	servo-mechanism
A 8	TAIKEI	A system in which various kinds of constituent elements maintain an organic order and act toward the same purpose. In particular, a system with human functions as its constituent elements is called an organization. A system constituting a part of a larger system is called a subsystem.	system

(Cont'd)

No.	Term	Meaning	English equivalent (Reference)
A 9	TAIKEIKŌGAKU	A technique of analyzing and designing the constituent elements of the system being considered, its organizational construction, flow of information, control mechanism, and the like in order to attain the purpose of the system most effectively.	system(s) engineering
A 10	NINGENKIKAIKEI	A system with human beings and apparatus and machinery operated by human beings as its constituent elements.	man-machine system
A 11	JŌHSHORITAIKEI	System for the collection, arrangement, storage, retrieval, and transmission of information. A communication system is a system for information transmission and is a part of the information system.	information system
A 12	TEISHIKIKA	The act of clarifying the conditions, purpose, and the measure for evaluation of a problem and thereby limiting the scope of examination. The procedure of Operations Research is understood as follows:  <pre> graph LR A[Grasping the problem] --> B[Formulation] B --> C[Model building] C --> D[Solution of the model] D --> E[Implementation] </pre>	formulation
A 13	MOKEI	A presentation which expresses a subject by iconography (for example, diagrams and photographs), symbols (for example, musical characters and mathematical formulas), or analogous phenomena. The model is called iconic model, symbolic model, analogue model, or the like according to its form of expression. Among symbolic models, especially those using mathematical symbols are called mathematical models.	model

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No.	Term	Meaning	English equivalent (Reference)																																				
A 14	KAKURITSUTEKIMOKEI	A mathematical model containing stochastic variables. A mathematical model not containing stochastic variables is called a deterministic model.	stochastic model																																				
A 15	KŌZŌBUNSEKI	The act of clarifying the mutual relations between various parts constituting a system and their relations to the whole system. Examples are: the act of finding the demand function and supply function which formulate the quantitative relations of economic phenomena; input-output analysis.	structure analysis																																				
A 16	SANGYŌ RENKANBUNSEKI TŌNYŪ SANSHUTSUBUNSEKI	An analysis based on the table (input-output table) showing the relations of mutual dependence between various divisions of national economy. Table 1. Model of Input-Output Table <table><tr><th> Buying division Selling division </th><th>1 Agri- culture</th><th>2 In- dustry</th><th>3 Service business</th><th>Final demand</th><th>Total demand</th></tr><tr><td>1. Agriculture</td><td>20</td><td>30</td><td>20</td><td>30</td><td>100</td></tr><tr><td>2. Industry</td><td>20</td><td>80</td><td>40</td><td>60</td><td>200</td></tr><tr><td>3. Service business</td><td>30</td><td>50</td><td>40</td><td>30</td><td>150</td></tr><tr><td>Value added</td><td>30</td><td>40</td><td>50</td><td>-</td><td>120</td></tr><tr><td>Total input</td><td>100</td><td>200</td><td>150</td><td>120</td><td>570</td></tr></table>	Buying division Selling division	1 Agri- culture	2 In- dustry	3 Service business	Final demand	Total demand	1. Agriculture	20	30	20	30	100	2. Industry	20	80	40	60	200	3. Service business	30	50	40	30	150	Value added	30	40	50	-	120	Total input	100	200	150	120	570	input-output analysis
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No.	Term	Meaning	English equivalent (Reference)																
		Table 2. Input Coefficient Table <table data-bbox="344 671 635 1499"> <tr> <th></th><th data-bbox="355 1102 411 1208">1 Agriculture</th><th data-bbox="355 943 411 1027">2 Industry</th><th data-bbox="355 784 411 891">3 Service business</th></tr> <tr> <td data-bbox="440 1299 464 1492">1. Agriculture</td><td data-bbox="440 1102 464 1208">0.20</td><td data-bbox="440 943 464 1027">0.15</td><td data-bbox="440 784 464 891">0.13</td></tr> <tr> <td data-bbox="512 1340 536 1492">2. Industry</td><td data-bbox="512 1102 536 1208">0.20</td><td data-bbox="512 943 536 1027">0.40</td><td data-bbox="512 784 536 891">0.27</td></tr> <tr> <td data-bbox="584 1238 608 1492">3. Service business</td><td data-bbox="584 1102 608 1208">0.30</td><td data-bbox="584 943 608 1027">0.25</td><td data-bbox="584 784 608 891">0.27</td></tr> </table> For example, in the industry division of Table 1, the proportional quantities of the products of respective divisions that have been supplied as materials for producing the output of 200 units are shown in the vertical column under the head of industry, that is, as clearly seen, 30 units of agricultural products, 80 units of industrial products, and 50 units of service were required. The quotients obtained by dividing these quantities by the output 200 units are the input coefficients of the industry division. This input coefficient table is used for economic prediction, economic planning, and the like.		1 Agriculture	2 Industry	3 Service business	1. Agriculture	0.20	0.15	0.13	2. Industry	0.20	0.40	0.27	3. Service business	0.30	0.25	0.27	
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A 17	MOKUTEKIKANSŪ	A formula showing the relations of the measure, or yardstick, for evaluating the degree of purpose attainment (for example, total cost, profit rate, and invested capital rate) to the various related variables.	objective function																
A 18	HIYŌKANSŪ	A function showing the relations of cost to the various related variables.	cost function																
A 19	SAITEKIK	The act of supremely attaining the purpose of a system under given environment and conditions.	optimization																

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No.	Term	Meaning	English equivalent (Reference)
A 20	SON'EKIBUNKITEN	The point at which the line of cost intersects the line of earnings drawn against the quantity of production (or the quantity of sales) If the quantity of production or the quantity of sales is larger than the break-even point, the earnings are larger than the cost, and if the former is smaller, the result is reversed. In other words, this point is the turning point of loss and gain.	break-even point
A 21	GURAFURIRON	A unified mathematical theory concerning graphs (groups of points and lines). The graph referred to here is not something like a statistical diagram but includes a wide range such as sociograms in sociology and communication networks in communication, and has a wide scope of application in the theory of games, linear programming, network problem, and the like.	theory of graphs
A 22	HAKKENTEKI PUROGURAMU	A method of seeking the optimal one among a number of solutions by trial and error using electronic computers.	heuristic program
A 23	JOHŌKENSAKU	The act of detecting and extracting necessary information from a group of information recorded in a certain form. Remark: It is often abbreviated as IR.	information retrieval
A 24	BAITAIKEIKAKU	Planning of the ratios of respective media (newspapers, magazines, television, radio, etc.) to be used for conveying advertisements and the schedule therefor. A combination of media is called media mix. The aim of the media plan is to find the media mix requiring less expense and having a large advertising effect.	media plan
A 25	BUTTEKI RYUTSU KANRI	Total management of transportation, storage, packing, shipping, and the like of primary materials and products.	physical distribution management

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No.	Term	Meaning	English equivalent (Reference)
A 26	JUYOYOSOKU	Forecasting of the quantity of demand for goods or services. The methods of demand forecast include preference survey, time series analysis, metrical model method, and so forth.	demand forecasting
A 27	DANRYOKUSEI BUNSEKI	Analysis of the variation of the variable in question by using the ratio between the rates of change $\frac{dX}{X}$ and $\frac{dY}{Y}$ of two variables X and Y. The coefficient of elasticity of Y with respect to X is defined by the following formula: $\eta = \frac{dY}{Y} \div \frac{dX}{X} = \frac{dY}{dX} \cdot \frac{Y}{X}$ For example, if demand Y increases by 8 % corresponding to an increase of 10 % in income X, the income-related elasticity coefficient of demand, η , is 0.8 (= 0.08/0.10). The value of η may become either positive or negative. When the absolute value of η is larger than 1, the considered variable is said to be high in elasticity or be elastic, and when it is smaller than 1, the variable is said to be low in elasticity or be inelastic.	analysis of elasticity
A 28	JIKEIRETSUBUNSEKI	Analysis of the construction of a series of variables changing with time, such as economic statistics and meteorological statistics. In time series analysis, it is usual to perform analysis by dividing variations into trend variation, cyclic variation, seasonal variation, and random variation.	time series analysis
A 29	KISETSUHENDŌ	Variation taking one year as one cycle. For example, the amount of issue of Bank of Japan notes, sales of department stores, the revenue and expenditure balance of the general public finance with private economy, and the like have a large seasonal variation.	seasonal variation

(Cont'd)

No.	Term	Meaning	English equivalent (Reference)
A 30	KISETSUHENDŌSHISŪ	An index for indicating seasonal variation. The calculation methods for the index of seasonal variation include the monthly average method, method of moving averages, method of link relatives, fourier series method, and the like.	index of seasonal variation
A 31	IDŌHEIKINHŌ	A method of finding the trend curve by calculating the average value for a given number of terms before and after each term in a time series and connecting those average values. For example, the 3-month moving averages of monthly indices $Y_1, Y_2, \dots, Y_n$ are: $y_2 = \frac{Y_1 + Y_2 + Y_3}{3}$ $y_3 = \frac{Y_2 + Y_3 + Y_4}{3}$ $\dots\dots\dots$ $y_{n-1} = \frac{Y_{n-2} + Y_{n-1} + Y_n}{3}$ Where averaging is made by weighting the respective terms, the method is called the method of weighted moving averages.	method of moving averages
A 32	SHISŪHEIKATSUHŌ	A kind of the method of moving averages initiated by R.G. Brown. For example, where the demand in month t is given as $X(t)$, the average demand $\bar{X}(t)$ by the exponential smoothing method is found by: $\bar{X}(t) = \alpha X(t) + (1-\alpha)\bar{X}(t-1)$ wherein α is a constant suitably decided in the range $0 < \alpha < 1$.	exponential smoothing

(Cont'd)

No.	Term	Meaning	English equivalent (Reference)
A 33	RENKANHIRITSUHŌ, RENKANSHISUHŌ	A kind of calculation method for the index of seasonal variation by using the ratio to the value of the preceding month. The method is applied according to the following procedure: (1) Find link relatives $r_{jm} = y_{jm}/y_{j, m-1}$ from time series values (y_{jm}; time series value of jth year, mth month.) But when $m=1$, $r_{jm} = y_{jm}/y_{j-1, 12}$ (2) Arrange the values of mth month for n years, $r_{1m}, r_{2m}, \dots, r_{nm}$ in the order of largeness, and find median link relations index r_m' as their median. (3) Find corrected median link relatives ρ_m from $\rho_m = \frac{r_m}{A}$ where $A = (r_1' r_2' \dots r_{12}')^{1/12}$ (4) Find link relatives index R_m from $R_m = \rho_1 \rho_2 \dots \rho_m$ (5) Calculate index of seasonal variation S_m from $S_m = R_m/M$ where $M = (R_1 + R_2 + \dots + R_{12})/12$	method of link relatives

(Cont'd)

No.	Term	Meaning	English equivalent (Reference)
A 34	GONPERUTSU KYOKUSEN	A curve defined by equation $y = kBe^{ax}$ (where k, B, and c are constants) According to the Gompertz's law, assuming that in a group of organisms, first k_0 pieces of individual bodies are born simultaneously and k_1 pieces of them remain alive when they are x years old, the graph of k_1 becomes a curve as shown by the above formula. Makeham added a factor S^x to this equation and changed it into the form of $y = kS^x B e^{ax}$ The Gompertz - Makeham curve satisfies a differential equation of the form $y'/y = a + b e^{-ay}$. If, in this equation, the condition $a=0$ is particularly applied, it becomes the differential equation of the Gompertz curve.	Gompertz curve
A 35	ROJISUTIKKUKYOKUSEN	A curve defined by equation $y = \frac{k}{1 + me^{-ax}}$ (where a, k, and m are constants) As the law of population increase, a logistic curve is often used. The logistic curve satisfies the differential equation $\frac{dy}{dt} = ay \left(1 - \frac{y}{k} \right)$	logistic curve

(B) Inventory Theory

No.	Term	Meaning	English equivalent (Reference)
B 1	ZAİKOKANRITAIKEI	A system for planning and controlling the quantity of inventory. The inventory management system has relations particularly close to the production system and the sales and distribution system.	inventory management system

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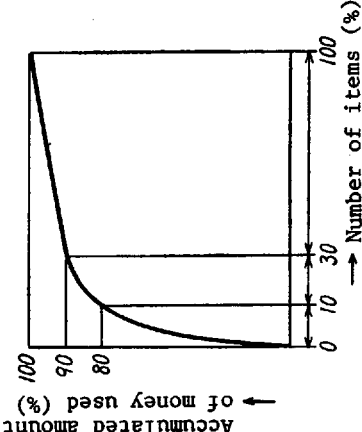
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No.	Term	Meaning	English equivalent (Reference)
B 2	ZAIKOMOKEI	A model used to analyze and investigate the inventory management system and find a proper controlling method. The inventory model is in many cases symbolically expressed and handled mathematically, analytically, or by the simulation method. Remark: In making an inventory model, the following conditions are particularly important. (1) Structure of demand (2) Uncertainty of period of supply (3) Stocking capacity (4) Stocking cost for inventory (5) Ordering cost and loss caused by absence of stock (6) Accommodation of inventory funds (7) Production capacity of plant (8) Sales and distribution route	inventory model
B 3	ZAIKOSUIJUN	The stock at a certain point of time or in a given period. The average stock in a given period is called the average stock. Remark: The inventory level is sometimes expressed by the amount of money.	inventory level
B 4	KISHUZAIKORYŌ	Stock at the beginning of the unit period.	initial stock
B 5	KIMATSUZAIKORYŌ	Stock at the end of the unit period.	stock on hand at the end of period

(Cont'd)

No.	Term	Meaning	English equivalent (Reference)
B 6	ZAİKOKAITENRITSU	The number of times of turning over of stock in a given period, expressed by the formula: $\text{Turnover of inventories} = \frac{\text{Quantity required in a given period}}{\text{Stock}}$ Remark: The quantity required is also sometimes called the demanded quantity or quantity of use.	turnover of inventories
B 7	SĀBISURITSU	The ratio of the quantity delivered within the time limit of delivery to the demanded quantity.	service ratio
B 8	SHINAGIREKAKURITSU	Probability of shortage of stock occurring in a given period.	shortage probability
B 9	CHŌTATSUKIKAN	The period from the time of ordering to the time the goods are supplied, inspection is completed, and all is ready for meeting the demand for delivery any time.	lead time
B 10	HATCHŪ KANKAKU	The time interval from an order to the next ordering.	ordering cycle (interval)

(Cont'd)

No.	Term	Meaning	English equivalent (Reference)
B 11	EBĪSHĪ BUNSEKI	Where the number of items of inventory is very large, the method of efficient priority control by arranging them in the order of largeness of the amount of money used and classifying them into the three classes of A, B and C. Remark: Example of cumulative curve  Such a cumulative curve is generally known as the Pareto curve.	ABC analysis
B 12	HATCHŪTENHŌSHIKI	An inventory management system in which no ordering interval is particularly specified and a given quantity is reordered when the stock has decreased to a given level (reordering point). The reordering point is determined as the sum of estimated demand in the lead time and the safety allowance.	reordering point method
B 13	TEIKIHATCHŪHŌSHIKI	An inventory management system in which the reordering interval is preliminarily determined and a reordering quantity determined at each time according to the present stock, demand quantity, and the like.	periodic reordering method

(Cont'd)

No.	Term	Meaning	English equivalent (Reference)
B 14	ESUESU HOSHIMI	A kind of periodic reordering method in which when the stock has reached a given point (reordering point s) or lower, only the deficit is reordered so as to make the stock a given quantity S , and when the stock is intermediate between s and S , no reordering is made.	S-s policy
B 15	ANZENYOYU	The quantity of stock held in excess to prevent shortage in stock caused by estimation errors of demand or supply. Remark: This is also called safety inventory, reserve quantity, or minimum stock quantity.	safety allowance
B 16	KEIZAIHATCHURYO	Such a reordering quantity as minimizes the sum of the inventory-carrying cost and reordering cost (or setup cost) in a given period. A representative calculation formula for economic ordering quantity is as follows: $Q = \sqrt{\frac{2RC_0}{p_i}}$ where Q : economic ordering quantity R : estimated yearly required quantity C_0 : ordering cost for each order p : purchasing unit price i : yearly rate of inventory-carrying cost	economic ordering quantity, economic lot size
B 17	HATCHUHIYO	The cost involved in relation to ordering, generally consisting of office supplies cost, correspondence cost, labor cost, transport cost, acceptance inspection cost, and the like.	ordering cost

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No.	Term	Meaning	English equivalent (Reference)
B 18	DANDORIHİYŌ	The amount of various costs involved in alteration of the kind of processed goods in the production line.	setup cost
B 19	HOKANHIYŌ	The amount of costs required for holding the stocked goods, generally consisting of stocktaking loss cost (caused by decay, deterioration, damage, loss, outage, leakage, etc.), in-plant transport cost, property cost (building and facility cost, ground rent, house rent, maintenance cost, repair cost, depreciation cost, fire insurance premium, lighting cost, etc.), warehouse labor cost, fund cost, and the like.	inventory-carrying cost
B 20	CHINPUKASONSHITSU	The loss caused by the decrease in economic worth of goods in stock accompanying the transition of fashion and the development of technological innovation.	obsolescence loss
B 21	SHINAGIRESONSHITSU	The amount of various expenses and losses arising when the inventory becomes so short as to make it impossible to meet the demand. The shortage loss includes the following elements: (1) Loss of trust due to shortage (2) Reparation for delay caused by delayed delivery (3) Arrangement cost for supplementing the deficient goods.	shortage loss

(C) Investment and Replacement Theory

No.	Term	Meaning	English equivalent (Reference)
C 1	HIYŌ	The expenditure for a certain scheme. The outflow of the capital itself, such as reimbursement of loans, is not included in the cost.	cost



(Cont'd)

No.	Term	Meaning	English equivalent (Reference)
C 2	TOSHIGAKU	Such a cost as is relatively large in amount and has a long-lasting effect. In particular, it is often used to mean the initial investment, for example, costs for the purchase and installation of mechanical equipment.	investment
C 3	SŌGYŌHIYŌ	The amount of costs of relatively small amount expended in each period. There is the following relation: Total cost of a certain period = investment in that period + operating cost in that period.	operating cost
C 4	SHŪEKI	The amount of income as the result of a scheme. Incoming of the capital itself, such as loaning or an increase in capital, is not included in the revenue.	revenue
C 5	HŌSHŪ	The amount obtained by subtracting the operating cost from the revenue. Remark: The word profit usually used corresponds to the amount obtained by subtracting depreciation costs and interests from the return herein mentioned.	return
C 6	SHOBUNKACHI, JUNZANKA	The net revenue obtained by subtracting expenses from the selling price when disposing of equipment or the like. It is decided on the basis of the selling market price at each point of time regardless of the book value (depreciation balance) or residual value (disposal value at expiration of life) in the finance.	disposal value
C 7	SHŌMIGAKURYŪRETSU	The time series of net amounts obtained by subtracting the cost from the revenue produced at each point of time.	stream of net cash flows

(Cont'd)

No.	Term	Meaning	English equivalent (Reference)
C 8	GENZAIKACHI, GENKA	The value obtained by converting the amount of income or expenditure at a future point of time to the present value by discounting.	present worth
C 9	SAISHŪKACHI, SHŪKA	The value obtained by converting the amount of income or expenditure at a certain point of time to the value at the final point of time by incremental calculation.	final worth
C 10	NENKINKANSANCHI	The value obtained by converting the amount of income or expenditure to the amount of each term equal payment. It normally means the converted value of the amount of each term end equal payment. Where it particularly means the value of each term opening equal payment, it is distinguished by the expression each term opening equal payment adjusted annual worth.	adjusted annual worth
C 11	SHŌMIGENKA	The present worth of the stream of net cash flows. When the stream of net cash flows is given as $V_0, V_1, \dots, V_n$, and the calculating interest rate as i , the net present worth is expressed by: $P = \sum_{j=0}^n \frac{V_j}{(1+i)^j}$	net present worth
C 12	SHŌMISHŪKA	The final value of the stream of net cash flows. When the stream of net cash flows is given as $V_0, V_1, \dots, V_n$, and the calculating interest rate as i , the net final worth is expressed by: $S = \sum_{j=0}^n V_j(1+i)^{n-j}$	net final worth

(Cont'd)

No.	Term	Meaning	English equivalent (Reference)
C 13	SHŌMINENKINKANSANCHI	The adjusted annual worth of the stream of net cash flows. The net adjusted annual worth has the following relations: M = Net present worth x capital recovery factor = Net final worth x sinking fund factor	net adjusted annual worth
C 14	HŌSHŪRITSU	The rate of return on investment. When the initial investment is given as I and the returns at respective period ends as $R_1, R_2, \dots, R_n$, the rate of return on investment, ρ, is found from the following formula: $\sum_{j=1}^n \frac{R_j}{(1+\rho)^j} = I$	rate of return on investment
C 15	KAISHŪKIKAN	The period until the amount of investment is completely recovered by the returns of respective periods. There are cases where adjustment is made by the calculating interest rate and cases where not.	pay-back period
C 16	SHIKINHIYŌ	The expenses such as interests paid for utilization of outside funds. The ratio of the cost of fund to the fund used is called the fund interest rate.	cost of fund
C 17	KEISANRIRITSU	The rate of interest used for discounting or incremental calculation. As the calculating rate, the weighted average of various fund interest rates or the rate of return the investment aims at is used.	calculating rate