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A Comparative Study of the Different Methods of Investment Appraisal with Special Reference to the Discounted Cash Flow 1/

1/ This material has been prepared as a background paper for this workshop by UNIDO Consultant, Dr. B. Prasad, of the Industrial Development Bank of India. The aim is to present factual information regarding Different Methods of Investment Appraisal as a basis for discussion of this subject by participants. The views and opinions expressed in this paper are based on the Consultant's original study and do not necessarily reflect the views of the Secretariat of UNIDO. This document has been reproduced without formal editing.

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A Comparative Study of the different Methods of Investment Appraisal, with Special reference to the Discounted Cash Flow

Introduction:

Financial appraisal of projects is an important part of resources allocation. In any country - and more so in a developing economy, resources are limited and in order to put them to efficient use some kind of control or screening becomes necessary to determine whether or not certain projects shall be undertaken; and if alternatives are available which ones shall be chosen. In deciding priorities, financial return or profitability of the projects will no doubt play a very important role, but other factors like national requirements, foreign exchange earnings, choice of technology, availability of specalised know-how, interrelationship with other sectors, skill formation etc., will also have to be weighed. To ascertain the relative financial returns on industrial investments, various methods of appraisal are in use, but the most recent one is the Discounted Cash Flow (D.C.F.). It is claimed that, apart from its theoretical superiority, the technique of D.C.F. has altered the emphasis of investment policy, not only of industrial business units but also of economy as a whole. However, it should be emphasised that, for the economic betterment of any country, what is basically important is not the evaluation technique adopted but the presence of abundant sound investment opportunities, from which to make the choice. A system of selection of investments, however perfect in itself, can be of little use if adequate investment opportunities are not available. That is, if the circumstances in the economy are capable of affording only poor investment opportunities, even the best method of selection will lead to poor results. This important first step of ensuring the best possible investment alternatives is largely a Governmental task, involving the creation of an atmosphere that is conducive to the generation and development of imaginative and soundly conceived investment possibilities.

Alternative Techniques of Investment Appraisal

Granting that an adequate supply of investment alternatives is available, the next step is to determine the expected cash flow patterns of the different projects. Evaluation of future cash flows which are associated with the different projects is possible only if the cost of capital is known. Leaving aside the risk factors, this cost of capital is, in effect, the exchange rate between present and future sums of money. Assuming the relevant cash-flow patterns - outflow and inflow - in regard to alternative proposals are known, the next task is to coordinate them in some meaningful way, which will help in screening, ranking and selecting projects rationally. To meet this technical problem, various methods of investment appraisal have been developed and it is proposed to study them in this note in some detail.

The methods of investment appraisal may be divided into two main categories:

I. Traditional or Conventional Methods, which included:-

(a) Rate of Return;

(b) Payback Period (Recoupment Period);

(c) Necessity - Postponability; and

(d) Annual Return on Capital Employed

II. Discounting Methods, which include -

(a) Annual Capital Charge;

(b) Discounted Cash Flow ; and

(c) Net Present Value

I. Traditional Methods :

Although conventional methods normally include only the four types mentioned above, these have many variants and each variant may lead to different results. For instance, investments or cash outflows are variously measured in terms of gross or net fixed assets, with or without gross or net working capital and occasionally taking into consideration things like future reinvestment requirements and break-up or terminal recovery values. Receipts or cash inflows are measured in terms of profits before or after taxes sometimes adjusted to account for depreciation and other non-cash charges, and with other costs fully or incrementally allocated. If different departments of a particular industrial unit used different variants of the conventional methods, appraising and ranking of the various projects would be meaningless. Of course, the Company's executives could specify any one method, e.g., earning before depreciation but after taxes, and that would substantially solve the problem of differing calculations of the relevant cash-flows. But even then, the traditional methods would lead to incorrect ranking of the projects, since their application is subject to the following two major defects :

(i) Traditional methods do not take sufficient cognisance of the differences in the expected economic lives of various projects. Of two projects offering equal rates of return, an investor would naturally like to invest in the one with a longer lease of life, although it is not easy to decide whether it would be better to take up a four-year project with a 15 per cent return as against a six-year project having a 10 per cent

return. The time factor is a very important consideration, and this has to be accounted for suitably.

(ii) Traditional methods show incorrect ranking of projects in situations where investments (cash outflows) and/or receipts (cash inflows) are spread out unevenly over the years. Having outlined the limitations of the traditional methods generally, we may now proceed to discuss these methods individually.

(a) Rate of Return Method

The rate of return on capital is defined as the ratio of profit to capital. This method has many variants, but the important ones are as listed below:

(a) Average gross annual income, before depreciation, expressed as a percentage of investments in fixed assets. The formula for calculating this percentage is:

$$\frac{\text{Total gross income before depreciation}}{\text{No. of years life x initial investment}} =$$

Average gross annual income for n years per rupee of initial investment.

(b) Average net annual income, after depreciation, expressed as a percentage of investments in fixed assets, including initial development and research expenditure. The formula for calculating the percentage is:

$$\frac{\text{Total net income, i.e., Cash Proceeds less depreciation}}{\text{No. of years life x initial investment}} =$$

Average net annual income for n years per rupee of initial investment

(c) Average net annual income after depreciation, expressed as percentage of one-half of investment. The formula for calculating the percentage is:

$$\frac{\text{Total net income, i.e., Cash Proceeds less depreciation}}{\text{No. of years life x half initial investment}} =$$

Average net annual income for n years per rupee of average investment in fixed assets over n years.

(d) Average net annual income, after depreciation, expressed as a percentage of the total of average working capital together with one-half of initial investment on fixed assets. The formual for calculating the percentage is:

$$\frac{\text{Total net income, i.e., Cash Proceeds less depreciation}}{\text{No. of years life x (average working capital + half initial investment)}} =$$

Average net annual income for n years per rupee of average investment over n years in both fixed and net current assets.

Profit can either be gross or net of tax; but it seems desirable to take it after tax as the general aim of investment is to maximise income after tax. Profits after tax can be either intial profits or average profits. Since average profits take into account also the profits of later years - it may be better to take into account only average profits. Similarly, captial base could be total investment or half the total investment; in the latter case it would approximate more closely to the average amount of Capital. Again, capital might include only

the capital expenditure, or it may as well include associated outlays currently written up as expenses. The most serious drawbacks of the rate of return method are as under:

(i) It fails to take into account the uneven nature of the actual year-toyear earnings as compared to the over-all rate of return. This limitation arises because under this method projects with the same capital cost, life and over-all profitability would be ranked equally, whereas in fact the earnings may be spread out differently over the period. This will be clear from the following illustration:

Let us consider three projects A, B and C, each having a total capital cost of Rs. 1000, a total life of 5 years and residual value of assets as zero. Assuming straight-line method of depreciation of Rs. 200 a year and tax at the rate of 50 per cent charged to profits after depreciation in each case, the details of earning will be as under:

Table - 1 Details of Earnings

(In rupees)

Year	Gross Earnings Project			Less Depreciation of equal amount	Less tax at equal rate of 50% of profits Project			Profits after tax Project		
	A	B	C		A	B	C	A	B	C
1	400	200	600	200	100	-	200	100	-	200
2	400	300	500	200	100	50	150	100	50	150
3	400	400	400	200	100	100	100	100	100	100
4	400	500	300	200	100	150	50	100	150	50
5	400	600	200	200	100	200	-	100	200	-
Total	2000	2000	2000	1000	500	500	500	500	500	500

Since all the projects have the same total gross earnings over the period, their average gross earnings are also the same. As the rate of return method is based on average profits, it would rank the three projects equally. This would mean a 10 per cent return on investment (Rs.100/Rs.1000) or a 20 per cent return on 'average' (half) capital (Rs.100/Rs.500). Evidently, the three investments cannot be ranked as equally attractive, though their total earnings are the same. However, as project C's earnings arise earlier than A's and B's, and A's earnings arise earlier than B's, C is preferable to A and B, and A is preferable to B. The projects would, therefore, correctly rank as C,A and B. In ranking projects, regard must be had for the earlier earnings because the amount representing differences in annual earnings can be gainfully employed elsewhere during the life-times of the projects.

If we examine the figures of the net profits (i.e. profits after tax), the position is no better and the projects - with Rs. 500 as net profits in each case - would again be incorrectly ranked as equally attractive. It will be seen that the three projects have different profit trends, viz., A shows constant profits, while B and C have rising and falling profit trends respectively. Here also, the net result is the same - C's net profits arise earlier than A's and B's, and A's net profits earlier than B's.

(ii) It does not take into account the gestation or pre-production period between the commencement of a project and the time when it begins

to produce an income. The rate of return, as seen in the example of the three projects, would have remained unchanged even if the projects had taken two years to commence production. This defect is sometimes remedied by charging a nominal rate of interest on capital outlays during the pre-production period.

(iii) In cases of constant cash inflows, the rate of return based on 'average' capital will be half the rate calculated on the basis of initial capital and will unduly show preference for short-term projects and for those having large cash inflows in earlier years.

(iv) This method cannot be used for segregating and comparing the returns on investments financed from external resources with those financed with internal resources. The problem assumes great significance where expansion of a firm is financed through retained profits. Unless a firm can show better results internally, there will be no justification in retaining profits, if the same profits could earn a better return outside.

Having examined the limitations of the rate of return method in some details, it now remains to be said that the only point in favour of this method is simplicity in calculation.

(b) Payback Period Method

The payback period may be defined as the length of time taken for the stream of cash proceeds produced by an investment to equal the original cash outlay required by the investment. For arriving at the payback period, the following formula may be used:

$$\text{Payback period} = \frac{\text{Cost of project}}{\text{Annual increase in income or saving in cost}}$$

Since the purpose of this method is to calculate the period over which the net cash generated by the investment will recover the cost of the project, the depreciation on investment has to be ignored, but care has to be taken to deduct tax on the additional profits. Ordinarily, in applying this method, some maximum payback period is fixed and all investments with payback periods greater than this are rejected.

The payback method has some disadvantages, which are discussed below :

(i) A major defect is that it ranks projects incorrectly because it ignores the years after the payback period. The goal of an industrial undertaking is to earn profits and not merely to be concerned with getting the investment back. If the goal is to make profits, what really matters is the earnings after the pay-back period. An industrial project may pay back in 4 years but produce no earnings thereafter; while another projects, with a six-year payback, may have a ten-year earning life. Applying the payback method, it will be argued that the first project would rank ahead of the second (since the payback period was shorter), although the second is actually the better choice. The payback approach ignores the useful life of the investment and also the trend of earnings over time.

(ii) This method is based on and attaches too much importance to 'time' or 'liquidity' concept rather than 'profitability' concept. But a firm should aim at maximising profits and not at remaining liquid for its own sake. The method has rightly been nick-named as 'fish-hook' method [illegible]

recovering the bait rather than the fish - since it takes into account an aspect which is not very important and relevant.

(iii) Investment in projects with a low payback period is referred to as part of a 'dynamic' investment policy, but this is irrational. It may be that the firm may miss a wide range of profitable investments because of the insistance on shorter payback periods, as some schemes with longer payback periods may turn out to be more profitable.

(iv) Payback method is said to be a practical method of ranking investment projects under conditions of risk. As it is a time concept, it would appear prime facie to be suited only to risks of a time nature. The method would work satisfactorily under conditions where the estimated net cash flow from a project is likely to accrue uninterruptedly for a certain period only and thereafter disappear suddenly and completely. Such extreme external risks in business, are however, rare and the risks that one normally encounters relate to lower sales, higher costs or unsuspected teething trouble etc. Payback does not measure such risks as it is an 'all or nothing' indicator.

Table 2 below gives the annual net cash flows of two projects each having a capital cost of Rs.100 and a payback period of 4 years.

Table - 2, showing Annual net cash flows

Year	Annual net cash flows of project A capital outlay Rs. 100	B
1	25	40
2	25	40
3	25	10
4	25	10
5	25	25
6	25	25

It will be observed that although project B recovers 80% of capital cost within two years as against only 50 per cent recovered by A, yet both the projects would rank equally because the payback period for both the projects is the same. Here, in ranking the projects, the method covers only the 'time' risk and other possible risks are not considered at all.

(v) This method does not set any objective cut-off criterion to separate projects that improve the firm's profits from those which do not. The problem of fixing a period as ceiling for payback, in any firm, can at best be tackled only arbitrarily.

(vi) Finally, payback discourages investments in projects turning out new products as these may sometime be associated with initial losses. Even if profits are eventually substantially high, such projects will not be undertaken.

Having considered the short comings of the payback method, we shall now examine its merits. These are :

(i) It is simple to operate because it is easily understandable.

(ii) It concentrates on the earnings in the near future which are valuable and certain, rather than on those in the distant future.

(iii) It safeguards liquidity by preventing investments that tie up funds for long periods.

(iv) It can be safely applied to industries which are subject to rapid technological changes, i.e., industries where plant is likely to be outmoded long before the end of its technical life, generally within 2 to 4 years of its use.

(c) Necessity - Postponability Method :

This method measures the attractiveness of a project on the basis of urgency. Thus, [illegible] investments

get the highest priority and those which can be postponed have to wait indefinitely. The need for this method is felt when a firm is, what may be called, in a situation of capital rationing. The shortcomings of this method are :

(i) Its use may result in postponement of a highly profitable cost-saving project, especially when there is a continuing stream of 'once and for all' opportunites to invest in marginal projects.

(ii) Urgency need not necessarily be synonymous with profitability. For instance, repairs to a damaged railway bridge may not be as profitable as laying down a new railway line; yet in order to avoid loss on daily earnings, repairs to the bridge may claim priority.

(d) Annual Return on Capital Employed Method

This method assesses the profitability of a business as a whole. The annual profit earned during a particular year on the capital employed (i.e. the capital employed on the aggregate of past projects) is taken into account. The application of this method may be satisfactory for a sufficiently large business which has fairly even-aged and conventionally depreciated distribution of assets. But its use as a general measure of profitability for determining ranking is quite unsatisfactory. The method has many shortcomings and is open to abuse. These may be discussed as under :

(i) Since all projects during a period are considered as a whole, little can be known about their character individually. As a result, unprofitable investments in some projects may pass undetected since they get mixed up with other profitable investments. Also, since capital employed is measured either at year-end

or at an average figure at the beginning of each year, it is possible to run down working capital deliberately so as to reduce the effect of one year's low profits on the profit/capital ratio. If working capital is run down below the required minimum in one year, it will have its impact on the profits in the following year. But the reduced profits of the second year can be concealed by taking the average and showing modium profits for two years.

(ii) Another unsatisfactory character of the method is that it treats a single year in isolation. This may result in worthwhile projects being left out because a single year so chosen may show lower annual return on capital. Where projects have a longish period they inevitably temporarily lower the annual return on capital as they increase the amount of capital employed while temporarily making no contribution to profits. But if the projects are sound, it may be worthwhile undertaking them and the temporary set-back in their annual return on capital should not stand in the way.

(iii) Significant fluctuations in the return on capital may occur because of the manner in which the assets are valued aand depreciated in the books rather than an increase or decline in working efficiency. For instance, if depreciation funds are reinvested at the year-end without increasing fresh equity capital periodically, the net profits as percentage of capital employed will show an increasing

or constant trend - which will result not from increased efficiency but from the financial policy pursued.

II. Discounting Methods

The basic assumption of discounting methods is that money has a time value. A given amount of money now is normally worth more than an equal amount of money at some distant time, because it permits profitable investment or consumption in the interval.

We will now take up the discounting methods one by one.

(a) Annual Capital Charge Method

This method is also known as the 'Annuity Method'. This is not much used except in certain types of industries where operating costs remain more or less stable. In Britain, the method is commonly used in public utilities and nationalised industries where the cash flows are generally constant.

This method recognises the fact that 'interest' cost (the cost of capital) and depreciation (the recovery of capital, apart from residual value) are the two items of cost which are associated with the use of capital. To determine whether any investment is profitable, it must be known whether the net cash inflow will be sufficient to cover both. The annual capital charge formula aims at calculating the average annual charge (depreciation plus interest) and comparing this with the annual net cash inflow (which is assumed to be constant from year to year). If the net cash inflow exceeds the capital charge, the project is acceptable. In short, the annual capital charge method aims at charging depreciation on a sinking fund basis so that the full capital invested in a project will be recovered at the end of the project's life. Depreciation is charged on the sinking fund basis because this involves the aggregate annual depreciation

provision being less than the total initial capital to be depreciated. Notionally, the annual depreciation provisions can be reinvested at the firm's cost of capital in the interval between when it is set aside and the end of the project's life. Also, it charges (interest) on the full initial capital. As the initial capital is deemed to be recovered only at the end of the project's life 'interest' is due on it for each year of the project's life.

We now turn to the shortcomings of the method, which are as follows:

(i) Before computing a sinking fund, a basic assumption of a firm's cost of capital has to be made, but it may be difficult to obtain an agreed specific definition of the cost of capital.

(ii) In cases of irregularity in the cash flows, there will be need for either turning them into regular cash inflows or alternately, for ignoring the irregularity.

(iii) Cost of capital is related to the cost of borrowing, i.e., interest, In nationalised institutions, Government imposes restrictions on borrowings beyond certain prescribed rates of interest. Under these conditions, the 'cost' of capital cannot be easily determined and this limits the use of the annual charge method. It is evident that, in the absence of knowledge of true cost of capital, sinking funds cannot be operated.

Popularity of this method in nationalised industries may be related to the fact that the majority of concerns finance their requirements by borrowed capital and have, therefore, to make formal provision for amortisation of capital viz. the Sinking Funds.

(b) Discounted Cash Flow Method

We have seen that the traditional methods of appraisal of investment projects are not satisfactory since they either do not take into account the entire life of a project or do not give sufficient weight to the timings of future cash flows. The discounted cash flow concept is unique in the sense that it provides a method of investment appraisal which takes into account the timings of the cash flows (in and out) over the entire life of the project. The D.C.F. method is based on the notion of present value; that is, the present value of a sum of money to be paid or received in the future is less than its nominal future value. This difference between the present value and nominal future value arises from the fact that there is an investment rate of opportunity cost associated with receiving a sum of money later rather than earlier. In general, this investment rate can be considered to be the compound rate of interest that the money might be expected to earn between the present time and the date of receipt in future. The D.C.F. method takes this factor into consideration and determines the ranking of an investment by finding out the present cash value of a sum to be received in future discounted at compound interest. The figures could either be taken from readily available tables or calculated on the basis of the following formulae

$$V = \frac{C}{(1 + r)n}$$

where V = Present Value

C = Cash Flow

r = Rate of interest

n = number of years

Where proceeds for a number of years have to be considered, the formula may be expanded as -

$$\frac{C1}{(1+r)} + \frac{C2}{(1+r)^2} + \frac{C3}{(1+r)^3} + \frac{Cn}{(1+r)^n}$$

The present value of a sum to be received at some future time should be such an amount which can, with predetermined compound rate, equal the sum to be received in future.

The concept of Present Value is illustrated in the Table Below :

Table - 3 - Present Value of Rs.1000 over a period of years

Number of years	Discount Rate 5% Factor	5% Amount	10% Factor	10% Amount	15% Factor	15% Amount
0	1.000	1000.000	1.000	1000.000	1.000	1000.000
1	0.952	952	0.909	969	0.870	870
2	0.907	907	0.826	826	0.756	756
3	0.864	864	0.751	751	0.658	658
4	0.823	823	0.683	683	0.572	572
5	0.784	784	0.621	621	0.497	497

Thus, if an investment project has an investment rate of 15 per cent, then Rs.1000 to be received at the end of five years has a present value in year 0 of just Rs.497 only. The same thing can be expressed by saying that Rs.497 is the sum of money which if invested in year 0 at an interest rate of 15 per cent would increase to Rs.1000 at the end of year 5. It will be seen that the present value of a sum decreases as the investment rate and period of years into the future increase and vice-versa. If we increase the investment rate higher and higher, the present value would decline at some stage to zero and would thereafter become negative. With the present value approach, any pattern of cash flows (out and in) can thus be converted into their equivalent and directly comparable present value.

Most of the aggregate cash flows of industrial enterprises have normally the following charateristics :

(i) The annual cash flow for the first year or for a few initial years is negative.

(ii) All the subsequent annual cash flows are positive.

(iii) The aggregate cash flow is positive.

Investment rate or earning power is defined as the deferment rate which just makes the present value of the aggregate cash flow zero. Such a rate of interest can be found by trial and error. If at a certain rate of interest the present value of cash proceeds (cash inflow) exceeds the present value of cash outflows (investments), then some higher rate of interest would make them equal. By a process of trial and error, the correct investment rate can be determined.

An example of the calculations involved in the D.C.F. method would illustrate this point. Table 4 below shows the calculations in respect of a project with a total cost of Rs.8,000 spread over two years, and with total future earnings of Rs.12,000.

Table - 4 - Calculation of Investment Rate

Year	Estimated cash-flow and inflow		Present value at year 0					
			Case No. 1			Case No.2		
			10% discount factor	Present value Rs.		15% discount factor	Present value Rs.	
0	- 5,000		1.000	- 5,000		1.000	- 5,000	
1	- 3,000		0.909	- 2,727		0.870	- 2,610	
2	+ 2,000		0.826	+ 1,652		0.756	+ 1,512	
3	+ 4,000	12,000	0.751	+ 3,004	8,754	0.658	+ 2,632	7,576
4	+ 6,000		0.683	+ 4,098		0.572	+ 3,432	
				+ 1,027			- 24	

In the first case, with a 10 per cent investment rate, the present value of the future proceeds is Rs. 8,754 and this

exceeds the present value of the investment by Rs.1027. Again in thr second case, with the investment rate rasied to 15 per cent, the present value of the proceeds comes to Rs.7576 and this falls short of the present value of the investment by Rs.3. Since the D.C.F. yield is that at which the investment is exactly recovered, by interpolation this would be about 14 per cent.

The calculation of D.C.F. yield is best done graphically. In the above example, we can select a few investment rates and calculate the corresponding present values at year 0. Working out at 10 per cent, 15 per cent., 20 per cent and 30 per cent investment rates, we can put the results as in table 5.

Table 5 - Present value at different investment rates

Investment rate	Present value at year 0 Rs.
0 per cent	+ 4,000
10 "	+ 1,027
15 "	- 3
20 "	- 900
30 "	- 2,200

We can plot the results on a graph which will (not attached) appear as shown in graph 1 attached.

From the graph, we can read off the investment rate at the point where the curve cuts the axis which is about 14 per cent. At this rate the present value of the aggregate cash flow must equal zero. To be doubly sure, the investment rate as shown by the graph should, however, be checked arithmetically by the method just discussed. With a little practice, the calculations can be made fairly quickly and accurately.

We may now turn to the consideration of how this method could be used for ranking different projects.

The proposition of the D.C.F. yield method is that the best investment is the one from which the proceeds would yield the highest rate of compound interest in equating present value with future proceeds. Thus, when a business enterprise is faced with alternative projects and has to select only the most profitable one, all that need be done is to calculate the D.C.F. yields for all the projects and select the one which shows the highest yield.

Once a project has been selected on the basis of D.C.F. yield, it will mean that the project is expected to pay the investment back by the end of its life together with the D.C.F. yield all through the project's life on the unit sinking balance of capital. The following example can be worked out to illustrate the point :

Investment at the end of year 0 = Rs. 1,000

Life of the project = 5 years

Expected cash flow = Rs.300 for 5 years

D.C.F. yield = 8 per cent

Table 6 below shows how the cash inflow of Rs.300 at the end of each year will be utilised towards capital repayments and interest receipts.

Table - 6

Year	Cash flow	Repaid of	
		Compound interest at 8 per cent p.a. on Rs.	On a capital sum being unrepaid of Rs.
1	300	80	241
2	300	39	285
3	300	31	309
4	300	25	325
5	300	25	325
	1500	500	1500

From table 6, it would appear that not only the capital investment of Rs.1000 has been fully repaid but also a total interest of Rs 250 has been earned during the period. This will be found as being equal to 8 per cent on the capital sums repaid.

As shown in table 7 below, the investment rate is also equal to 8 per cent on the outstanding balance all through the project's life at any time.

Table - 7 Investment rate on outstanding balances

Year	Capital outstanding at beginning of year (Rs.)	8 per cent interest on capital outstanding Rs.	Cash flow	Capital repayment
1	1000	80	250	170
2	830	65	250	185
3	645	51	250	199
4	446	35	250	215
5	231	19	250	231
		250	1250	1000

It would appear that the concept of D.C.F. yield is closely associated with the cost of capital in screening investment proposals. In order that a particular project is accepted for investment, it would be necessary to ensure that it earns a D.C.F. yield which is at least equal to or greater than the cost of capital. It is a "challenge" rate, and any proposal not earning this rate would be rejected under this criterion. Thus, basically, the concept seems to be only an application of an important principle of micro-economic theory in the field of management

accounting. The D.C.F. method seeks to answer the question that the optimum economic scale of an enterprise is achieved at the point where marginal cost equal marginal revenues. The cost of capital would clearly indicate the minimum acceptable cut-off rate of return against which to test proposed investments.

Limitations of D.C.F.

We shall now proceeds to study the defects of D.C.F. method as a technique of capital investment appraisal.

(i) The trial and error iterations necessarily involved in D.C.F. calculations can be time-consuming; and tiresome in the cases of projects with complex cash-flow patterns or for organisations having to process more than a few projects at a time. It is difficult to determine factors like future price levels, costs and length of life, tax allowances, scrap values etc., necessary to evaluate the cash inflows. Therefore, the results of D.C.F. can at best be a guess work. In order to avoid undue optimism or pitfalls in cases of large projects, it would be desirable to make D.C.F. calculations on the basis of three sets of assumptions - 'most likely', 'best' and 'worst' - as the range in the rate of returns would throw light on the degree of risk involved in accepting a particular project.

(ii) Sometimes one may get two D.C.F. yields for the same investment with the result that both the rates will be vitiated. This will happen when a large outflow of

funds is followed by a large inflow of funds.

(iii) At times, it may be wrong to choose a particular project out of the alternatives available merely on the ground that it shows a higher D.C.F. yield. A satisfactory ranking may not be provided by the D.C.F. method where the question is not of accepting or rejecting, but of choosing from alternative means of achieving a given objective. It may be that the alternative showing a higher D.C.F. yield involves relatively a small amount of capital; or it may be that it is for a shorter period of time. For instance, it will not be wise to choose a project involving an investment of Rs.10,000 at 15 per cent return for 2 years as against one requiring the same amount of investment at 12 per cent for 8 years. Similarly it is equally unwise to select a project requiring Rs.100 capital at 20 per cent return over another requiring Rs.1000 as capital at 18 per cent return - if the lives of the two projects are the same.

In the examples cited above, D.C.F. yield fails to provide the correct answer and such cases have to be dealt with by other methods. For instance this could be done by evaluating the difference in profitability between two alternatives, or finding the 'present value' of each project discounted at the minimum desired rate of return. *

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* This anticipates the net present value method which is discussed below in this note.

(iv) D.C.F. method does not work satisfactorily when there are sufficiently large negative cash flows in the later period of a project's life. Such a situation, however, could be met by splitting up the project and preparing two series of net cash flows- one in the usual way, and the other from the start of the negative cash flows. The negative cash flows, in such a situation, should be treated as fresh investment.

(v) It may be difficult to apply the D.C.F. method to a project whose life is different from the lives of the fixed assets which form the project.

Merits of D.C.F.

In spite of the limitation of D.C.F. listed above, the method has certain special merits which may be discussed as under :

(i) D.C.F. takes into account the irregular pattern of tax savings, which are due to changes in tax policies.

(ii) D.C.F. recognises the importance of the time pattern of profits and the capital expenditure involved in a project. An appreciation of the D.C.F. technique seems all the more important in developing countries because of the prevailing higher investment rates.

(iii) D.C.F. is a better measure of profitability when we attempt to assess the return for risk-bearing. This is because the risk is related to time which in turn is related to the amount of capital outstanding which D.C.F. takes into account.

(iv) D.C.F. reduces wrong investment decisions within an enterprise to a tolerable level.

(c) Net Present Value Method :

This method is a variant of the D.C.F. method and utilises the same basic technique as is used for the D.C.F. Here, however, the first step is to stipulate an appropriate percentage rate and then calculate the present value of the cash proceeds using this percentage. The next step is to subtract the original cost (or present value of the original cost) from the present value of the future proceeds and the resulting surplus (or deficit) would be the net present value of the investment. In other words, if the firm borrowed money at the stipulated rate of interest to pay for the investment, the net present value would represent the present net 'worth' of the investment to the business. The 'accept or reject' criterion will be to accept all independent investments whose net present value is greater than or equal to zero and to reject all investments whose present value is less than zero. For example, if the cost of capital is 10 per cent, a firm could make a maximum immediate outlay of Rs.11,000 in expectation of receiving Rs.12,100 a year later. If it can receive Rs.12,100 with an actual outlay of only Rs.10,000, the net present value of the investment would be Rs.1,000. This Rs.1,000 represents the difference between the actual outlay of Rs.10,000 and Rs.11,000, the maximum the firm would be willing to spend to receive back Rs.12,000 a year later.

The most important question would be to consider the rate of interest which a firm should stipulate in calculating the present value. For this

purpose, three rates of interest have been suggested as alternatives. The first is to take the rate of interest at which the firm can borrow (in whatever form) for making the investment. In this case, any surplus resulting over the present value would represent a real addition to the profits of the firm. Secondly, it is suggested that in making new investment a firm should seek to earn atleast the current rate of return and it would therefore be appropriate to use this rate for determining the present value. There seems to be considerable weight in the argument. Thirdly, it may be socially desirable for a firm to continue to raise and invest additional capital even if this new capital reduces its overall average rate of return i.e., it should continue to seek new capital to the point where the marginal return is equal to the marginal cost. This argument seems to ignore the important element of risk and does not take into account the fact that, if capital is lost in a risky venture, the social marginal cost will no longer be merely the interest payable for the use of capital but will include the capital as well.

Normally, only the cost of capital or the current rate of return on capital are employed in measuring the present value of an investment. This may be illustrated by an example.

Let us assume two projects, each costing Rs 6,000, with the following cash inflow :

End of year	Project A Rs.	Project B Rs.
1	1,000	2,000
2	2,000	3,000
3	3,000	2,000
4	2,000	1,000
5	2,000	1,000

Scrap values are taken as nil and income and profits taxes are ignored.

The Management might wish to know:

(a) which scheme would be more profitable ;

(b) whether either or both would be worth undertaking, assuming cost of capital to be 5%;

(c) whether either or both projects would yield the present rate of return of 15 per cent on capital employed.

Table - 8 below shows the present value of - 1 Rs at 5 per cent and 15 per cent rates of discount.

Table - 8 Present value of Re .1

Receipt at end of year	At 5% discount rate	At 15% discount rate
1	0.9524	0.8696
2	0.9070	0.7561
3	0.8638	0,6575
4	0.8227	0.5718
5	0.7835	0.4972

Table 9 below shows the profitability of the two projects.

Table - 9 Profitability of the Projects

Year	Present value of receipts			
	Discount rate 5%		Discount rate 15%	
	Project A Rs	Project B Rs	Project A Rs	Project B Rs
1	952.4	1904.8	869.6	1739.2
2	1814.0	2721.0	1512.2	2268.4
3	2591.4	1727.6	1972.6	1315.0
4	2645.4	822.8	2143.6	978.8
5	1567.0	783.6	994.4	497.2
Total present value	9570.2	7959.8	8492.4	6798.6
Cost of project	6000.0	6000.0	6000.0	6000.0
Net present value	3570.2	1959.8	492.4	798.6

Thus, the following conclusions can be drawn :

(a) Project A is more profitable, with either rate ;

(b) both projects would yield a profit if finance was available at 5 per cent;

(c) both projects would produce a higher rate of return on capital employed than the current rate of return

Under the circumstances, the management can be advised to take up both the projects if they are independent of one another and project A if they are alternatives.

Comparative Assessment of D.C.F. Yield and Net Present Value Methods :

Since both the methods are primarily based on the principle of 'present value', it seems worthwhile to compare the relative efficiency in their working. It would appear that for certain kinds of rankings, both methods would give identical results. For example, where the problem is one of screening, i.e., separating 'go or accept' decisions from 'no go or reject' investments, either method can be applied with equal efficiency, since both will normally yield the same result. This will be necessarily true if the cash flow corresponding to the investment consists of one or more periods of cash outlays followed only by periods of cash inflows. Since most independent investments have cash-flow patterns that meet this criterion, in practice the D.C.F. yield and net present value methods would give the same 'accept' or 'reject' decisions. Thus if the D.C.F. yield from a project is equal to or more greater than a firm's cost of capital, the project in question would appear acceptable whichever of the

two methods is used; provided that, in calculating the net present value, only the cost of capital is used as the discount rate. Putting the same thing another way, any project with D.C.F. yield greater than its relevant cost of capital rate will have a positive net present value and therefore appear acceptable whichever of the two methods is used.

It may, however, be often necessary to 'rank' as well as 'screen' investment alternatives. For example, an oil company may need additional transport facilities for its products. Should it build a pipe-line or acquire additional tanks and make the shipment by water? Either of these alternatives may be profitable, but the company would like to choose the one which is more profitable. If it is decided to build the pipe-line, another question for consideration will be whether to instal a 9 or 12 inches diameter pipe-line? Again, the problem will be to choose the more profitable of the two alternatives. In the above examples, it is necessary to rank as well as screen alternative investments. Frequently, a company may have two or more proposals, any one of which would be acceptable; but because they are mutually exclusive, only one of them has to be accepted.

It will be seen that the D.C.F. and the net present value methods do not give the same results when it comes to ranking of projects. The D.C.F. yield method would be found deficient in ranking investments which are mutually exclusive for the reason that it neglects 'incremental cash flows'. We shall examine this in some detail.

Incremental Cash Flows :

Let us assume that the cost of capital for a company is 5 per cent and it has to choose one of the projects, A and B, each costing Rs .15,000 and Rs .20,000 respectively. Suppose the life of the projects in either case is one year and they realise cash proceeds : A - .17,250 (earning 15 per cent) and B - Rs .22,600 (earning 13 per cent). According to the D.C.F. method, the correct choice would be Project A because it earns higher yield, i.e., 15 per cent as against B which earns only 13 per cent.

If we take into account only the yield ignoring the size of the investment, correct ranking may not be arrived at. One important difference between the two projects is that Project B requires an additional outlay of Rs.5000 and fetches additional cash proceeds of Rs.5350. The yield of the incremental investment is 7 per cent which is worth considering by a company which can obtain funds from the market at 5 per cent. Under the circumstances, it would be desirable to choose Project B.

Again, the D.C.F. method will not rank two mutually exclusive projects correctly when they have different yields - but the same initial outlay. Let us consider two projects, A and B, requring investment outlay of Rs 100 each, the cost of capital in either case being 5 per cent. The details of earnings are set out in the following table.

Investment	Year	Cash flows Outlays Rs	Cash flows Proceeds Rs	D.C.F yield %	Net present value at 5%
A	0	100	-	25	19
	1	-	125		
	2	-	-		
	3	-	-		
B	0	100	-	22	40
	1	-	-		
	2	-	50		
	3	-	120		

It will appear that the D.C.F. yield for Project A is 25%, while for Project B it is only 22% and the first reaction would be to select Project A against Project B. But if we calculate the net present value of both the projects at 5 per cent discount (which is the cost of capital), the ranking would be reversed and Project B would be preferable to Project A - because the net present value of Project A is less than the net present value of Project B. Now the question has to be considered as to which project is more profitable when the cost of capital is 5 per cent.

Table 10 attempts to make an incremental comparison of the two projects.

Table - 10 Incremental Comparison of the two Projects

Year	Project B - A cash flows Outlay	Proceeds	D.C.F yield %
0	Nil	-	-
1	125	-	20
2	-	50	-
3	-	120	-

It will be observed that the cash inflow of Project B is Rs.125 less in year 1 and Rs.70 and

Rs.120 more than Project A in years 2 and 3, respectively. Project A is equivalent at a notional investment of Rs.125 at the end of year 1, the return on which is the earnings of Project B in the year 2 and 3. In table 10 it is shown that the D.C.F. yield on this notional investment is 20 per cent, which is much higher than the cost of capital rate of 5 per cent. Thus of the two Projects considered, the right choice is Project B. Of course, if B/A had shown a rate of return of less than 5 percent this would mean that Project A would be the alternative preferred.

The problem may be looked at in another way. Supposing it is decided to abandon Project B in preference to A. That would mean that a revenue of Rs.125 in the first year was being paid for by notional repayments of Rs.50 and Rs.120 in the following two years. This would be repayment at a notional interest rate of 20 per cent, which is much too high. This calculation, therefore, again shows that the right choice is Project B and not A.

Selection of discount rate for determining Net Present Value - its effects on the ranking of projects :

From table 11, it will be seen that even in the net present value method, ranking of projects changes according to the discount rate that is selected in calculating the present value of the proceeds. The lower the discount rate, the greater will be the present value of the larger but later future proceeds associated with a project. However, just the opposite results would emerge if the discount rate is raised to an unusual high level.

Table - 11 net present value at differing rates of discount

	Initial investment Rs.	Annual cash inflows Year 1 Rs.	Year 2 Rs.	Year 3 Rs.	Net present value 0% Rs.	6% Rs.	30% Rs.	D.C.F. yield Rs.
Project A	10,000	2,000	4,000	12,000	8,000	5,526	(-634)	27%
Project B	10,000	10,000	3,000	3,000	6,000	4,620	831	37%

If we judge the two projects purely on the basis of the D.C.F. yield, Project B is preferable to Project A, yielding as it does 37% as against Project A which yields only 27%. But if we take the net present value, the ranking of the two projects will be reversed. At 6 per cent discount rate, Project A will appear more profitable, but if we raise the discount rate to 30 per cent, the ranking will change and project B will become more profitable than Project A. If we work out net present value for the two projects at different rates of discount we find that upto 12 per cent discount rate Project A is more profitable. But if we raise the discount rate to 13 per cent and more, Project B becomes more profitable. The break-even point lies somewhere between 12 and 13 per cent. This can be seen from table - 12, given below:

Table - 12 net Present value at selected rates of discount

	Net Present Value					
	10%	12%	13%	14%	15%	16%
Project A	4134	3518	3218	2930	1574	940
Project B	3821	3457	3278	3102	2451	1809

This exposition of ranking highlights the importance of choosing the correct rate of discount when using the net present value method.

To avoid lengthy procedure of having to calculate net present value at different rates of

discount, this could be better done graphically. *
(not attached) This is illustrated in graph 2 attached.

Limitation of the net present value method:

Like other methods, this method is also subject to certain limitations :

(i) The net Present Value method does not work satisfactorily when it comes to measuring the return offered for risk-bearing. This is because the method cannot provide figures of capital outstanding per unit of time (Risk is related to time in the sense that it increases with the time factor).

(ii) The question of a firm's cost of capital (particularly its effects on net present value when the cost of capital is chaning) cannot be solved satisfactorily unless a series of calculations are made. This may sometimes be cumbersome and confusing.

(iii) The method, though theoretically sound, requires an estimate to be made of the future earnings. This may be an extremely difficult task. It must, however, be realised that no method which fails to take into account the pattern of future earnings can produce a rational basis for investment.

* It will be seen that the intercepts on the horizontal axis of the graph represent the respective D.C.F. yields for the two projects. This is clearly so, because we defined D.C.F. yield as that rate of discount which reduce a cash flow stream to zero. As indicated in the graph, the D.C.F. rates on the two projects also correspond to net present values of zero.

The two special merits of the net present value method are as under :

(i) The net present value concept has the advantage of being arithentically a good deal easier to use than the D.C.F. yield method.

(ii) When the D.C.F. yield method and the net present value methods lead to different decisions in ranking of projects, the present value method tends to give better decisions.

To summarise, the Discounting Methods of calculating earning power have been evolved to deal with the situation presented by unequal economic lives and irregular cash-flow patterns which the traditional methods of financial appraisal fail to take into account. Three discounting methods have been presented, of which the D.C.F. yield and net Present Value Methods are the more important. In particular, the net Present Value Method has been found to give the greatest degree of comparability between projects both for purposes of screening and ranking of investments.

APPENDIX I

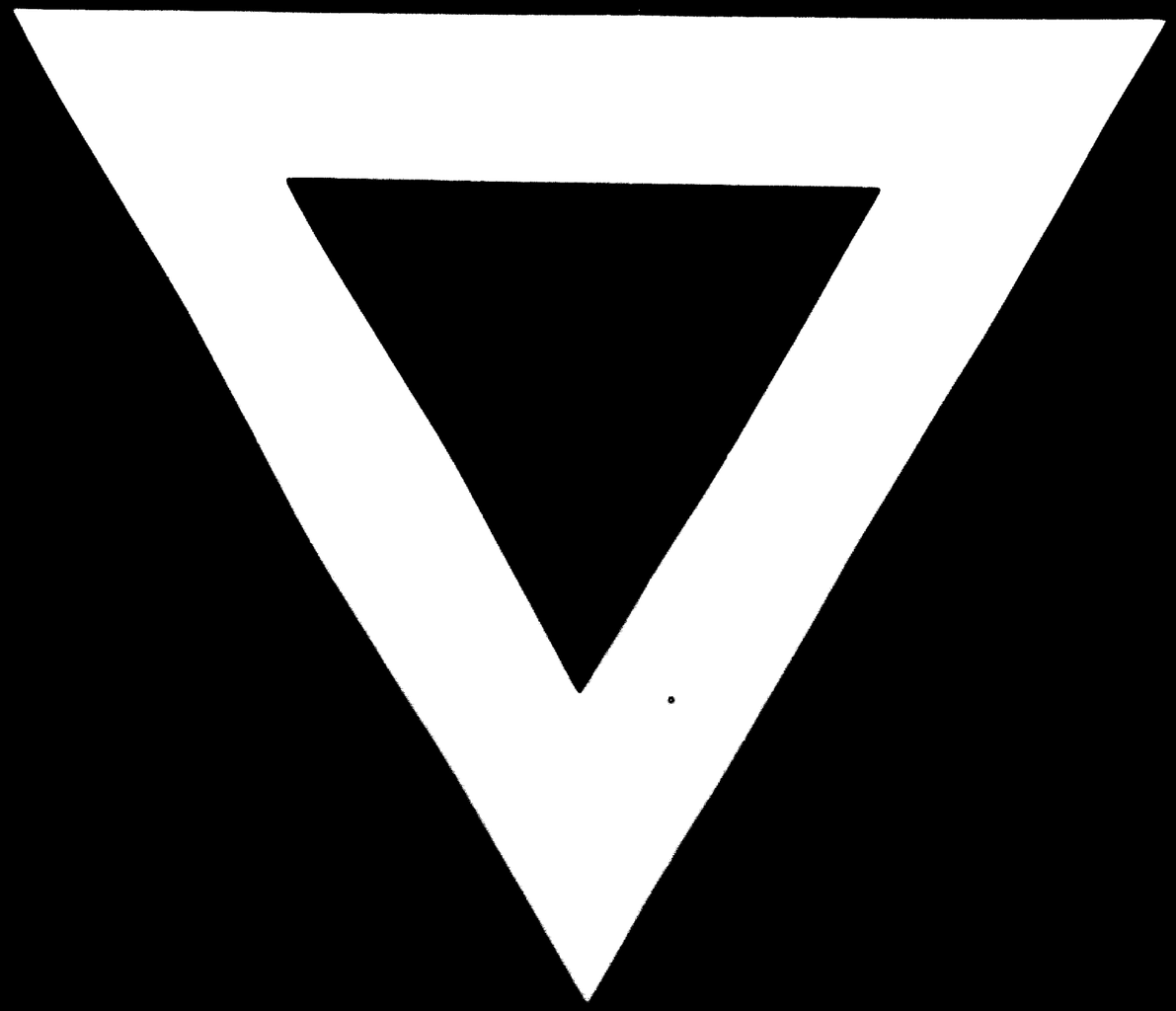
DISCOUNT TABLES

PRESENT VALUE OF Re. 1

(Assuming that the Re.1 is received in a payment on the last day of the year)

Years hence	1%	2%	3%	4%	5%	6%	7%	8%	9%	10%	11%	12%	13%	14%	15%	Years Hence
1	.990	.980	.971	.962	.952	.943	.935	.926	.917	.909	.901	.893	.885	.877	.870	1
2	.980	.961	.943	.925	.907	.890	.873	.857	.842	.826	.812	.797	.783	.769	.756	2
3	.971	.942	.915	.889	.864	.840	.816	.794	.772	.751	.731	.712	.693	.675	.658	3
4	.961	.924	.888	.855	.823	.792	.763	.735	.708	.683	.659	.636	.613	.592	.572	4
5	.951	.906	.863	.822	.784	.747	.713	.681	.650	.621	.593	.567	.543	.519	.497	5
6	.942	.888	.837	.790	.746	.705	.666	.630	.596	.564	.535	.507	.480	.456	.432	6
7	.933	.871	.813	.760	.711	.665	.623	.583	.547	.513	.482	.452	.425	.400	.376	7
8	.923	.853	.789	.731	.677	.627	.582	.540	.502	.467	.434	.404	.376	.351	.327	8
9	.914	.837	.766	.703	.645	.592	.544	.500	.460	.424	.391	.361	.333	.308	.284	9
10	.905	.820	.744	.676	.614	.558	.508	.463	.422	.386	.352	.322	.295	.270	.247	10
11	.896	.804	.722	.650	.585	.527	.475	.429	.388	.350	.317	.287	.261	.237	.215	11
12	.887	.788	.701	.625	.557	.497	.444	.397	.356	.319	.286	.257	.231	.208	.187	12
13	.879	.773	.681	.601	.530	.469	.415	.368	.326	.290	.258	.229	.204	.182	.163	13
14	.870	.758	.661	.577	.505	.442	.388	.340	.299	.263	.232	.205	.181	.160	.141	14
15	.861	.743	.642	.555	.481	.417	.362	.315	.275	.239	.209	.183	.160	.140	.123	15
16	.853	.728	.623	.534	.458	.394	.339	.292	.252	.218	.188	.163	.141	.123	.107	16
17	.844	.714	.605	.513	.436	.371	.317	.270	.231	.198	.170	.146	.125	.108	.093	17
18	.836	.700	.587	.494	.416	.350	.296	.250	.212	.180	.153	.130	.111	.095	.081	18
19	.828	.686	.570	.475	.396	.331	.277	.232	.194	.164	.138	.116	.098	.083	.070	19
20	.820	.673	.554	.456	.377	.312	.258	.215	.178	.149	.124	.104	.087	.073	.061	20
21	.811	.660	.538	.439	.359	.294	.242	.199	.164	.135	.112	.093	.077	.064	.053	21
22	.803	.647	.522	.422	.342	.278	.226	.184	.150	.123	.101	.083	.068	.056	.046	22
23	.795	.634	.507	.406	.326	.262	.211	.170	.138	.112	.091	.074	.060	.049	.040	23
24	.788	.622	.492	.390	.310	.247	.197	.158	.126	.102	.082	.066	.053	.043	.035	24
25	.780	.610	.478	.375	.295	.233	.184	.146	.116	.092	.074	.059	047	.038	.030	25
30	.742	.552	.412	.308	.231	.174	.131	.099	.075	.057	.044	.033	.026	.020	.015	30
40	.672	.453	.307	.208	.142	.097	.067	.046	.032	.022	.015	.011	.008	.005	.004	40
50	.608	.372	.228	.141	.087	.054	.034	.021	.013	.009	.005	.003	.002	.001	.001	50

Years hence	16%	18%	20%	22%	24%	25%	26%	28%	30%	35%	40%	45%	50%	55%	60%	Years Hence
1	.862	.847	.833	.820	.806	.800	.794	.781	.769	.741	.714	.690	.667	.645	.625	1
2	.743	.718	.694	.672	.650	.640	.630	.610	.592	.549	.510	.476	.444	.416	.391	2
3	.641	.609	.579	.551	.524	.512	.500	.477	.455	.406	.364	.328	.296	.269	.244	3
4	.552	.516	.482	.451	.423	.410	.397	.373	.350	.301	.260	.226	.198	.173	.153	4
5	.476	.437	.402	.370	.341	.328	.315	.291	.269	.223	.186	.156	.132	.112	.095	5
6	.410	.370	.335	.303	.275	.262	.250	.227	.207	.165	.133	.108	.088	.072	.060	6
7	.354	.314	.279	.249	.222	.210	.198	.178	.159	.122	.095	.074	.059	.047	.037	7
8	.305	.266	.233	.204	.179	.168	.157	.139	.123	.091	.068	.051	.039	.030	.023	8
9	.263	.225	.194	.167	.144	.134	.125	.108	.094	.067	.048	.035	.026	.019	.015	9
10	.227	.191	.162	.137	.116	.107	.099	.085	.073	.050	.035	.024	.017	.012	.009	10
11	.195	.162	.135	.112	.094	.086	.079	.066	.056	.037	.025	.017	.012	.008	.006	11
12	.168	.137	.112	.092	.076	.069	.062	.052	.043	.027	.018	.012	.008	.005	.004	12
13	.145	.116	.093	.075	.061	.055	.050	.040	.033	.020	.013	.008	.005	.003	.002	13
14	.125	.099	.078	.062	.049	.044	.039	.032	.025	.015	.009	.006	.003	.002	.001	14
15	.108	.084	.065	.051	.040	.035	.031	.025	.020	.011	.006	.004	.002	.001	.001	15
16	.093	.071	.054	.042	.032	.028	.025	.019	.015	.008	.005	.003	.002	.001	.001	16
17	.080	.060	.045	.034	.026	.023	.020	.015	.012	.006	.003	.002	.001	.001		17
18	.069	.051	.038	.028	.021	.018	.016	.012	.009	.005	.002	.001	.001			18
19	.060	.043	.031	.023	.017	.014	.012	.009	.007	.003	.002	.001				19
20	.051	.037	.026	.019	.014	.012	.010	.007	.005	.002	.001	.001				20
21	.044	.031	.022	.015	.011	.009	.008	.006	.004	.002	.001					21
22	.038	.026	.018	.013	.009	.007	.006	.004	.003	.001	.001					22
23	.033	.022	.015	.010	.007	.006	.005	.003	.002	.001						23
24	.028	.019	.013	.008	.006	.005	.004	.003	.002	.001						24
25	.024	.016	.010	.007	.005	.004	.003	.002	.001	.001						25
30	.012	.007	.004	.003	.002	.001	.001	.001								30
40	.005	.002	.001													40
50	.002															50



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