LIFE CYCLE COST ANALYSIS

UTAH DEPARTMENT OF TRANSPORTATION

ENGINEERING SERVICES DIVISION
VALUE ENGINEERING

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LIFE CYCLE COST ANALYSIS

1.0   INTRODUCTION

A cost effective choice over the life of an asset is essential in deciding between alternative fixed assets. Economically sound decisions regarding proposed expenditures require detailed analysis in order to make the proper choice. Low initial cost advantages may be offset by a short life and therefore high future costs.
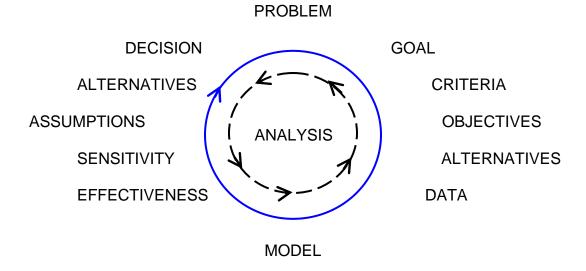
The time value of money and well-recognized procedures are important considerations in the decision making process. A formal analysis using engineering economics provides the answer. Design engineers may be doing this and not even know they used an economic process. Estimating the costs of alternative designs and then comparing them is engineering economics. This is done to find the design that best meets the needs of the user given specific traffic volume and loads at the lowest construction and maintenance costs over time.

Engineering economics provides a way to choose between alternatives when the expenditure of capital funds comes into play. Three basic steps are involved in conducting the economic analysis.
1.   Identify and define the different alternatives among which a selection is to be made.
2.   Identify and define the various elements or factors that may result in differences in the cost of the alternatives and remove from further consideration all events that have happened or may happen regardless of which alternative is selected.
3.   Reduce all of the alternatives to a comparable basis by translating all of the applicable factors to a common dollar base and then make a cost comparison among the alternatives over time, considering the time value of money through the use of compound interest.

With increasing costs, decreasing budgets, and environmental impacts, effective decision-making provides the best choice. Getting to that point can be a problem. A systems approach provides the direction. Before getting started consider the following:

Systems Analysis Diagram

PROBLEM

DECISION   GOAL

ALTERNATIVES   CRITERIA

ASSUMPTIONS   OBJECTIVES

                 ANALYSIS

SENSITIVITY   ALTERNATIVES

EFFECTIVENESS   DATA

MODEL

An economic study analyzes if the proposed improvement represents an attractive investment when compared with other possible uses of available resources. The project usually proves to be desirable when there is only one plan for a particular improvement. Projects with alternative methods for improvement require a determination of why to proceed with the proposal and which proposal is best. This is determined by finding whether the increment of investment between cheaper and more expensive plans also appears attractive.

Use the proper framework to accomplish the analysis. No matter how good the data, incorrect procedures can give erroneous results. The following guidelines provide the proper direction.

1. Economic studies are concerned with forecasting the future consequences of possible investment resources. Past events are not considered unless they affect the future.
2. Each alternative used to make choices must be fully and clearly spelled out.
3. The viewpoint taken in the analysis must be defined and observed.

Life cycle cost (LCC) analysis is the most appropriate economic evaluation process in deciding between alternatives. This analysis considers the cost of construction, rehabilitation, facility maintenance, and associated user impacts over a specific period encompassing the service life of all alternatives. Two important definitions are:

1. Life cycle costing — Economic assessment of an item, area, system, or facility and competing design alternatives considering all significant costs of ownership over the economic life, expressed in terms of equivalent dollars.
2. Life cycle design — Analysis that considers the construction, operation, and maintenance of a facility during its entire design life.

Life cycle costs include all costs anticipated over the life of the facility. Part of the analysis can include trade-offs among factors that may affect the life cycle cost of a pavement such as the relationship between the initial costs of construction and the future cost of maintenance. The analysis requires identifying and evaluating the economic consequences of various alternatives over time or the life cycle of the alternative.

Organization is the key to success. This begins by selecting the study area and establishing acceptable alternatives. Follow any established procedures and checklists and eliminate cost items common to all alternatives. Brainstorming is a good method to come up with different alternatives. Evaluate each alternative, make a selection with appropriate presentation, and implement the selection.

The process includes models based on the concepts associated with discounted cash flow analysis. All the costs expected to occur throughout the life of the highway or bridge are estimated and converted to an equivalent annual cost for purposes of comparison. Consider costs likely to occur during the life of the project in the LCC analysis. The costs are summarized over time by discounting all costs that occur at different times using the present worth method to account for the time value of money and can be shown as total present worth or an annualized cost.

Costs normally associated with pavement reconstruction include:
1. Initial Construction Costs
2. Maintenance Costs
3. Rehabilitation Costs
4. User Costs
5. Salvage Value
6. Energy Costs

Costs normally associated with bridges include:

1. Initial design, construction, and construction inspection
2. Periodic inspection and preventive maintenance
3. Scheduled maintenance and repair
4. Breakdown maintenance
5. Rehabilitation such as deck replacement and repair or replacement of superstructure
6. Upgrades to improve the level of service
7. Traffic delay costs attributable to maintenance, repair, rehabilitation, or total replacement
8. Demolition, site restoration, and, if appropriate, replacement net of any salvage value of the existing bridge at the end of its useful life.

Many costs will be the same for any specific project. Only differential costs require consideration for all project specific alternatives. In the case of highway bridges, life cycle cost analysis is inappropriate at this time because information on differential costs does not exist. As reliable data becomes available, consider

using LCC analysis for bridges. Traffic delay and increased inspection costs are not considered part of the true cost of a bridge.

Use LCC analysis, the availability of funds, project specific and environmental conditions or constraints, project constructability, and the ability of each alternative to serve the anticipated volumes in the decision process for selecting the most appropriate alternative.

2.0 ENGINEERING ECONOMICS

There are four concepts that form the basis of the life cycle analysis method.
1. Time value of money
2. Opportunity cost of capital
3. Discount rate
4. Analysis period

2.1 TIME VALUE OF MONEY

Rate of return and inflation are the two factors that attribute to the time value of money.

Rate of Return

The rate of return is the amount of money earned from the use of capital. Interest on a savings account illustrates the rate of return. The rate is calculated for a specific investment. The complexity of the determination varies depending on the length of time considered for the investment.

Inflation

Inflation is a general increase in the level of prices throughout the economy. A present dollar's purchasing power or worth is greater than a future dollar. Rates are not easily obtainable in that neither accurate nor universally acceptable predicting procedures exist for points far in the future. The use of unreliable inflation rates can lead to inaccurate results because analysis considers projects with lives up to 50 years.

Inflation affects different segments of the economy in varying ways. Inflation in the construction industry may be different from general consumer goods. This makes it difficult to select an appropriate rate for the alternatives being considered.

A diversity of opinions exists on handling inflation in LCC analysis. The manner significantly affects the outcome of the analysis. Two types of price changes exist, inflation and differential price trends. General increases in prices occur throughout the economy during an inflationary period. The difference between the price change for each item being evaluated and the overall economic price trend is differential pricing.

A choice between "constant" and "current" dollars must be made during economic analysis. Uninflated constant dollars represent price levels during the base year. Inflated current dollars represent possible future price levels projected for the costs at a future date. Highway agencies do not normally include inflation when analyzing alternatives because of the uncertainty in redicting future inflation rates. The constant dollar method is usually chosen because only differential inflation on future costs requires identification.

2.2   OPPORTUNITY COST OF CAPITAL

Opportunity cost is the foregone opportunity for an expected rate of return on capital when that capital serves another purpose. The lost potential return on a project represents the opportunity cost if a funded highway project was postponed to invest the funds.

2.3   DISCOUNT RATE

Use the discount rate as a means to compare alternative uses of funds by reducing the future expected costs or benefits to present day terms. Discount rates reduce costs or benefits to their present worth or annualized costs. The economics of the alternatives can then be compared. The term interest rate, associated with borrowing money, is often called the market interest rate. It includes an allowance for expected inflation and a return that represents the real cost of capital. Use a discount rate because the value of money is worth more today than a later date creating greater purchasing power.

Interest and inflation tend to reduce the future value of a fixed amount of money. For example, rehabilitating a pavement in several years will cost more because of inflation. Proper evaluation first requires the determination of the future cost based on the inflation rate. Using the interest rate, the present worth can be determined. One recommendation is to show the discount rate equal to the interest rate minus the inflation rate. Others suggest that the market interest rate minus inflation in terms of constant dollars be used to estimate the discount rate. Several scholars have suggested a discount rate of 4 percent based on evaluation of historical data.

No consistent national agreement exists on a single discount factor for use on public works projects. A survey in 1984 of DOT's in 45 states, the District of Columbia, and three Canadian provinces indicated a rate of four to ten percent for use in LCC analysis. The U.S. Department of Energy, Corps of Engineers, and the Office of Management and Budget use rates of seven, eight, and ten percent, respectively. A minority uses rates at the lower end to the range. Using low discount rates is inconsistent with the concepts of opportunity costs and reasonable social discount rates that are used for public works projects.

Some even argue that because a highway agency does not invest funds, an appropriate rate is zero percent. Two major flaws exist in this thinking. The

option disregards the opportunity cost of capital and it is inconsistent with the concept of the time value of money.

The AASHTO Red Book states that if future benefits and costs are in constant dollars, use only the real cost of capital represented in the discount rate used. The real cost of capital has been estimated at about four percent in recent years for low risk investments. The Portland Cement Association suggests typical values are in the range of one to two and a half percent based on three or four decades of data.

Selection of a low discount rate tends to place greater emphasis on cash flows occurring later in a project's life. The discount rate can significantly effect the outcome of the analysis. The lower the discount rate the greater the effect future dollars have on the present. The selection of a low discount rate gives greater emphasis to capital outlays in future years. Erroneous conclusions can result based on an analysis using an inappropriate discount rate.

An equation to determine the true interest rate or real discount rate takes into consideration interest rate, inflation rate, and the rate of increase in highway funding.

$$i^* \; = \; \{[(1 + i)(1 + q)]/(1 + f)\} - 1$$

- $i^* =$ True interest rate (discount rate) taking into account the effects of inflation
- $i =$ Interest rate (market)
- $q =$ Annual compound rate of increase in highway funding
- $f =$ Annual compound rate of increase in cost of highway construction or maintenance (inflation rate)

Another possibility for a discount rate comes from Eugene Grant and Grant Ireson. They recommend a discount rate of seven percent for highway economy studies. Their rate represents a reasonable opportunity cost and social discount rate.

UDOT Value Engineering reevaluates the discount rate on an annual basis and publishes the rate through the Standards Committee. Contact the Value Engineering Section for the current rate.
http://www.udot.utah.gov/main/f?p=100:pg:10025894658976591000:::1:T,V:106

Perform a sensitivity analysis on all analyses using discount rates between four and ten percent, inclusive because of the volatility of the issue and the possibility that a single discount rate may change over the years. The discount rate can affect the outcome of a life cycle cost analysis in that certain alternatives may be favored by higher or lower discount rates. High discount rates favor alternatives that stretch out costs over a period of time, since the future costs are discounted in relation to the initial cost. A low discount rate favors high initial cost alternatives since future costs are added in at almost face value. All costs are

treated equally regardless of when they occur when a discount rate is equal to zero. The discount rate will have a minor effect on the analysis and initial costs will have a larger effect where alternative strategies have similar maintenance, rehabilitation, and operating costs.

2.4   ANALYSIS PERIOD

The final component of performing an LCC analysis is to select an appropriate time period for comparing design alternatives. The analysis period is the total length of time the facility is expected to serve its intended function or the time frame before the component in question requires replacement or upgrade. This period may contain several maintenance and rehabilitation activities. This graph illustrates an example of these activities for pavement performance.

Performance Curve

Determining the analysis period for highway facilities may be subjective and may not equal the actual physical life. The recommended analysis period for new pavements is 25 - 40 years and 5 - 15 years for rehabilitation alternatives. Factors such as geometrics, traffic capacity, etc. may dictate a shorter period.

With these four key areas defined, Engineering Economics concludes with Discounted Cash Flow Analysis including formulas and sensitivity analysis. Procedures are then outlined.

2.5   DISCOUNTED CASH FLOW ANALYSIS

Three analysis options exist, present worth, annualized, and rate of return. The first two are the primary economic methods. The rate of return method requires more effort and calculations and does not have general support. The primary methods are discussed below.

Present Worth Method

The present worth method is an economic method that involves the conversion of all present and future expenses to a base cost of today. The present worth of some planned future expenditure is equivalent to the amount of money needed to

invest now at a given compound interest rate for the original investment plus interest to equal the expected cost at the time it is needed.

This allows the comparison of alternatives having outlays at different points in their lives on an equal basis. A disadvantage in using the present worth method is that the method can only be used to compare alternatives with equal analysis periods. The present worth method cannot be used to compare alternatives with lives of 20 and 50 years.

The following formulas represent the various factors used in life cycle analyses. In most cases actual manual calculations are not necessary because these factors have been calculated and tabulated for various interest rates. Tables of these factors are included in Appendix A of this manual. The following examples illustrate the use of these tables.

Life Cycle Analysis

Factor Name	Converts	Symbol	Formula
Single Payment Compound Interest	P to F	(F/P, i%,n)	$(1 + i)^n$
Present Worth	F to P	(P/F, i%,n)	$1/(1 + i)^n$
Uniform Series Sinking Fund	F to A	(A/F, i%,n)	$i/[1 + i)^n - 1]$
Capital Recovery	P to A	(A/P,i%,n)	$[i(1 + i)^n]/[(1 + i)^n - 1]$
Compound Amount	A to F	(F/A, i%,n)	$[(1 + i)^n - 1]/i$
Equal Series Present Worth	A to P	(P/A,i%,n)	$[(1 + i)^n - 1]/[i(1 + i)^n]$

The general form of the present worth equation for a single present worth of a future sum:

$$P = F[1/(1 + i)^n]$$

where P $\quad=\quad$ Present worth

F $\quad=\quad$ The future sum of money at the end of n years

n $\quad=\quad$ Number of years

i $\quad=\quad$ Discount rate

The factor $1/(1 + i)^n$ is also known as the Single Payment Present Worth (SPW).
or

(P/F,i%,n)

A simplified calculation for P involves multiplying F by the SPW or factor found in Appendix A.

Use the following equation for present worth of a series of end-of-year payments.

$$P = A\{[(1 + i)^n - 1]/[i(1 + i)^n]\}$$

where A = $\quad$ End-of-year payments in a uniform series for n years that is equivalent to P at discount rate i.

The factor $[(1 + i)^n - 1]/[i(1 + i)^n]$ is also known as the Uniform Present Worth Factor (UPW).

<div align="center">or</div>

<div align="center">(P/A,i%,n)</div>

A simplified calculation for P involves multiplying A by the UPW or factor found Appendix A.

Annualized Method

The annualized method is one of the most valuable tools of economic analysis. This method converts present and future expenditures to a uniform annual cost resulting in a common base of a uniform annual cost. Quality equates to accuracy. Divide expected costs, positive or negative, over the life of the system into uniform annual costs using the appropriate discount rate. This method converts initial, recurring, and nonrecurring costs into annual payments. Estimated uniform annual maintenance expenditures are recurring costs already in terms of annual cost. Future expenditures must be converted to present worth using the above equation before using the following equation to determine annualized cost.

$$A = P\{[i(1 + i)^n]/[(1 + i)^n - 1]\}$$

where P   =   Present worth
      A   =   Annualized cost or annual cost
      n   =   Number of years
      i   =   Discount rate

The factor $[i(1 + i)^n]/[(1 + i)^n - 1]$ is also know as the Uniform Capital Recovery Factor (UCR).

<div align="center">or</div>

<div align="center">(A/P,i%,n)</div>

A simplified calculation for A involves multiplying P by the UCR found in standard economic tables. The advantage of this method is that it can be utilized to calculate the annual cost of alternatives with different lives.
Various cash flow factors have been calculated and tabulated. The factors are available in most engineering economics texts. For ease of reference the tables are included in Appendix A of this manual.

Examples

See Appendix B for examples of Discounted Cash Flow.

2.6   SENSITIVITY ANALYSIS

Cost and benefit variables related to specific projects have varying effects such as discount rates, analysis period, and the costs of various factors including maintenance and user costs. Sensitivity is the relative effect that each variable may have on the choice of alternatives. Sensitivity analysis tests the effects of variations in these variables. Testing identifies the most influential variables and the extent of influence. The analysis may identify design options requiring further consideration in greater detail and variables requiring additional information. Project risk may also be identified. Sensitivity analysis takes place as part of an economic analysis in the formative stages of a project.

Inadequate input data, initial assumptions, accuracy of estimates, or any combination effects the outcome. Answer the following critical questions:
1.   How sensitive are the results of the analysis to variations in these uncertain parameters?
2.   Will these variations justify the selection of an alternative not currently being considered.
3.   How much variation in a given parameter is required to shift the decision to select alternation B rather than alternative A?

Sensitivity analysis has two purposes, to determine how sensitive the outputs from the life cycle cost analysis are to variations in certain inputs and to evaluate the risk and uncertainty related to a selected alternative. The designer can then determine the probability of making the wrong choice or selecting the wrong alternative. The analysis provides the greatest benefit when the difference between alternatives may not be very great. Accomplish the analysis when performing a more detailed life cycle cost analysis.

While this process is not difficult or time consuming, the entire LCC analysis process contains a great deal of uncertainty. The means to determine the effect of this uncertainty on numerous factors is found in sensitivity analysis. Results of analyses related to other agencies show that:
1.   Results of solutions by the annual cost method are markedly affected by interest rate. Low interest rates favor those alternatives that combine large capital investments with low maintenance or user costs. High interest rates favor reverse combinations.
2.   The assumption that a system will be used for an indefinite period of time becomes less significant as the interest rates increase and the time period grows longer. Forecasts into the future are less significant when interest rates are higher and the periods of time are longer than are short range forecasts using lower interest rates.
3.   The road will be resurfaced one more time with a ten percent discount rate before reconstruction if the resurfacing costs or reconstruction costs increased slightly. The pavement will be resurfaced one fewer time before reconstruction if these costs decreased slightly and a five percent discount rate is used.

3.0   COST FACTORS

3.1   INITIAL COSTS

The more common structural resurfacing or reconstruction rehabilitation
alternatives are remove and replace with new Portland Concrete Cement
Pavement (PCCP), remove and replace with new Asphalt Concrete Pavement
(ACP), or overlay with either ACP or PCCP. The District Materials Engineer and
the Pavement Design Engineer coordinate all details regarding the design of
alternatives.

Design and construction costs are the two types of costs included in this
category. Design costs are included only if the cost of designing one alternative
is different from the costs of another alternative. When design costs are identical
for all alternatives exclude them from the analysis. Source information for design
costs will be bid design hours. Construction cost is probably the most important
of the cost components and is used by more agencies than any other
component. The source of information for construction costs is previous bids,
previous projects, historical cost data, etc. Use the most current and accurate
data available. Be cautions with items when previous bids or contracts are not
available for new materials or techniques being used as part of the alternatives.
Accomplish a sensitivity analysis to determine the effect of cost variations on the
end result when a range of possible costs for the new items exists.

Reflect all unique costs associated with each alternative for construction costs.
Account for different roadway sections and material quantities for each
alternative. Do not include common items such as bridge and embankment
widening, guard rail replacement, etc. because of repetition. Each overlay option
requires some grade adjustment of adjacent ramps, guard rails, barriers, etc.
Include added costs unique to each alternative in the analysis.

3.2   MAINTENANCE COSTS

These costs are those associated with maintaining the pavement surface at an
acceptable level and are one of the most difficult areas to deal with in LCC
analysis. Inherent problems exist in obtaining accurate and reliable maintenance
costs. The type and extent of maintenance work performed at various time
intervals into the future directly influences the cost of pavement maintenance.
Predicting the type of maintenance required and the time frame very far in
advance is the main problem. Maintenance needs are influenced by pavement
performance. This area needs further work in order to improve prediction
capability.

To help alleviate some of the prediction problem and to possibly provide the
precision needed in LCC analysis the following is provided. National Cooperative
Highway Research Program (NCHRP) synthesis 46 provides some direction on
how to improve the reliability of maintenance cost data. NCHRP Synthesis 110
and 77 provide help to agencies in improving their capability for predicting future

maintenance needs and costs. Studies have been accomplished comparing performance characteristics and maintenance costs. The differential in maintenance requirements for the various alternatives being considered is the most important item. There is no need to include maintenance in the analysis if maintenance costs are identical for all alternatives.

Maintenance costs can also be adversely affected if a maintenance activity is delayed. The cost of maintenance significantly increases as pavement condition decreases. NCHRP Synthesis 58 provides extensive details on delayed activity. Truck load limits also adversely affecting maintenance costs. Pavement performance and costs significantly change with the failure to enforce weight limits. Consider the same relational affect for all projects and maintenance costs.

3.3   REHABILITATION COSTS

Rehabilitation costs are associated with pavement rehabilitation or restoration activities. Typical costs include chip seal coat, fabric interlayers, asphalt-rubber interlayers, open-graded friction course, and dense-graded asphalt concrete.

Compute costs consistent with and in the same manner as initial construction costs. With respect to pavement rehabilitation, projects are normally bid and constructed under the same criteria as new pavement construction. When considering rehabilitation costs relative to LCC analysis, two time frames come into play. The first time frame applicable to many projects begins at "time zero." This constitutes the beginning of an LCC analysis and applies where the pavement existed for years, requiring long-term improvements. Treat rehabilitation similar to initial construction in this case. The second time frame applies to future needs for a new pavement or a newly rehabilitated pavement. Accurate prediction of the future time when rehabilitation might be required is a major problem. Make the best estimate possible of the future time period using good historical performance data when required. Sensitivity analysis varying the time to rehabilitation helps determine to what extent time alters the final design selection.

The long time frames involved almost guarantee the occurrence of new materials and techniques applicable to the rehabilitation of pavements. Study these new materials as soon as possible using laboratory evaluations and project experimentation before the material is used. Consider only those projects demonstrating a high success rate for widespread use.

3.4   USER COSTS

User costs are associated with vehicle operating costs such as fuel consumption, parts, tires, etc. and user delay costs such as denial-of-use, delays due to speed changes, speed reductions, and idling time. Include these costs in the LCC analysis to the extent they might affect the choice of pavement alternatives.

Considering different surface types at the same general performance level, usually data are not precise enough to detect vehicle operating cost differences between two pavements. When considering paved versus unpaved roads and smooth versus rough pavements, significant user cost differences exist. Vehicle operating costs including fuel consumption increase as the pavement roughness increases. Cost increases caused by deteriorating pavement result in higher rates for freight and bus transportation services. Higher costs directly affect minimum allowable pavement performance levels and maintenance policies.

High user delay costs result from slow downs caused by construction and maintenance activities and denial-of-use costs stemming from the closure of a section of highway during major repairs. Increased vehicle operating costs result when longer alternative routes and traffic stoppage and slow down caused by construction, rehabilitation, and maintenance occur.

The American Associations of State Highway and Transportation Officials (AASHTO) "A Manual on User Benefit Analysis of Highway and Bus Transit Improvements" or Red Book provides a reference for user costs in addition to the ones mentioned previously. Assess the relative effect of user costs for different alternatives using sensitivity analysis if sufficient applicable data can be identified for the project being studied.

One method for determining user costs follows a 1986 California Department of Transportation study. The study found the average value of time to be $6.25 per vehicle-hour of delay. Based on a four percent inflation rate, $8.22 was used in 1993 calculations. Modify this for 1993 and future years based on the inflation rate chosen by the Value Engineering Section.

Use the following equation to determine user costs.

$$UC=(AVT)[(L/RS) - (L/IS)](ADT)(PT)(CP)$$

where
UC	=	User Cost
AVT	=	Average Value of Time ($8.22 or as determined)
L	=	Project Length
RS	=	Reduced speed through construction zone
IS	=	Initial speed prior to construction zone
ADT	=	Average daily traffic in current year (only portion of ADT affected by the project
PT	=	Percent of the traffic affected by the construction project. Perform traffic study to determine percent of traffic using facility during the period.
CP	=	Construction period

Consider the inclusion of User Costs very carefully given their minimal use.

3.5 SALVAGE VALUE

Salvage value are costs remaining at the end of a life cycle analysis. It may be more appropriately call residual value because this value can be either positive or negative. Some remaining life or value may by left for an alternative after completing the analysis period due to the nature of pavements. Base the determination of value on percent of pavement life remaining, experience, and historical data.

A negative value exists if it costs more to remove and dispose of the material than it is worth while a positive value is assessed for useful salvageable materials or remaining life. Include a salvage or residual value, positive or negative, in the LCC analysis if one can be assigned to a given pavement alternative at the end of the analysis period. Bring the value back to its present worth (PW) using the PW equation discussed previously. Use the proper discount rate and analysis period. Use the PW cost for the appropriate alternative if the alternative comparison is based on present worth. Use average yearly cost or benefit if the comparison is annualized. The equation to convert present worth to annual costs follows the PW equation discussion.

One method of calculating salvage valve follows the following equation.

$$SV = (CC)[(ERL)/(TEL)]$$

where SV = Salvage Value
      CC = Last construction or rehabilitation cost
     ERL = Expected remaining life
     TEL = Total expected life

3.6 ENERGY COSTS

Costs associated with energy are normally part of construction, maintenance, and rehabilitation costs. These costs are not included separately in LCC analysis. Analysis as a separate factor would be extremely difficult. Consider energy factors as one of the other factors after the LCC analysis is complete. Energy costs are part of other costs and not independent or overriding factors.

4.0 PROCEDURES

4.1 GENERATING ALTERNATIVE DESIGNS

The previous sections discussed cost factors and the economics of life cycle cost analysis. This section puts all that together, explaining the process to complete the analysis using a decision to construct or rehabilitate a pavement. Identify all alternatives meeting design requirements. Alternative examples for a new pavement are bituminous or Portland cement concrete and for rehabilitation, conventional overlay, recycling, placing a fabric or rubber interlayer before resurfacing, and removing and replacing the existing surface. The surface

condition drives the rehabilitation alternatives. A thorough understanding of problems and design parameters is essential to start the process.
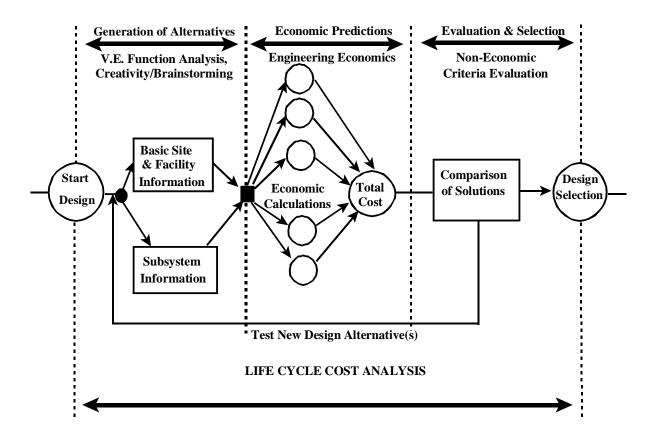
Identify unique site characteristics. Using the creative techniques set forth in the *Value Engineering Manual of Instruction*, identify all possible alternatives. There are no hard and fast rules about how to get ideas but the following are some of the systems that warrant consideration:

1. Association
2. Sounding Board
3. Checklist
4. Forced Relationship
5. Attribute Listing
6. Gordon Technique
7. Brainstorming
8. Idea Matrix
9. Morphological Analysis
10. Incubation

Ideas create other ideas. Creative effort is tiring so keep the flow of ideas coming fast. Do not stop to judge ideas. This kills further new ones. The surest way to stop ideas is to criticize them. Ideas are shy and if there is the slightest chance of ridicule they stay hidden.

1. Write ideas down immediately. Do not wait because they may be forgotten.
2. Do not judge or evaluate the ideas, the basic objective is to generate a wide range of possibilities.
3. Remember the choice of not taking any action.

The following illustrates the relationship between LCC analysis and value engineering.

Generation of Alternatives

V.E. Function Analysis, Creativity/Brainstorming

Economic Predictions

Engineering Economics

Evaluation & Selection

Non-Economic Criteria Evaluation

Start Design

Basic Site & Facility Information

Subsystem Information

Economic Calculations

Total Cost

Comparison of Solutions

Design Selection

Test New Design Alternative(s)

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AASHTO defines value engineering as the analysis of materials, processes, and products in which functions are related to cost and from which a selection may be made for the purpose of achieving the required function at the lowest overall cost consistent with the requirements for performance, reliability, and maintainability. Value engineering is an organized problem-solving effort that analyzes the various functions of construction, maintenance, rehabilitation, procedures, methods, etc. The objective is to obtain the lowest total cost of ownership consistent with the need for performance, reliability, quality, and maintainability.

A selection of the most promising choices is made after identifying all possible alternatives. No judgment or evaluation was made during the process to list all alternatives but it is now time to cut down the list. The following criteria can be used in making this evaluation.
1. Will the idea work? Can it be modified or combined with another?
2. What is the life cycle cost savings potential?
3. What are the chances for implementation?
4. Will it satisfy all of the user's needs?

All alternatives receive at least a preliminary evaluation before elimination. A list of advantages for each alternative helps cut down the list. Develop the remaining alternatives with more detail designs and cost estimates. The remaining alternatives must adequately perform all required objectives whether efficiently or not. Performing further analysis on alternatives that do not meet objectives is a waste of time and money. The remaining alternatives now enter design evaluation, including life cycle costing.

4.2   DESIGN EVALUATION

Further reduce remaining alternatives by comparing and ranking the ideas within each alternative. Use the following to help evaluate.
1. Rate the ability to perform the function as excellent, good, fair, poor.
2. Ease of implementation, including cost and schedule-rating:
   a. Simple idea – easy to implement.
   b. Moderately complex idea – moderately easy to implement.
   c. Complex idea – difficult to implement.
3. Magnitude of savings - initial and life cycle.

Judge advantages, disadvantages, and ideas objectively. Include in this process an estimate of the potential reduction in life cycle costs and how each alternative meets required functions. Develop the remaining alternatives including more detailed cost estimates. Be as accurate and consistent as possible between alternatives. Consider the following during this portion of the evaluation.
1. Will the idea work? Can it be modified or combined?
2. What is the life cycle savings potential?
3. What are the chances for implementation? Will it be relatively easy or difficult to make the change?
4. Will it satisfy all the user needs?

With the preliminary evaluation complete and the best available cost data on hand, the remaining alternatives are ready for LCC analysis.

4.3   DESIGN SELECTION

A final decision can be made now that the LCC analysis is complete. Even though the LCC analysis indicates one specific alternative, other considerations may require a different choice. Factors leading to this other choice that may override economics include traffic, soils characteristics, weather, performance of similar pavements in the area, adjacent existing pavement, stage construction, depressed surface or elevated design, highway system, conservation of aggregates, stimulation of competition, construction considerations, municipal preference and recognition of local industry, traffic safety, and availability of and adaptations of local materials or of local commercially produced paving mixes. The AASHTO "An Informational Guide on Project Procedures" sets guidance in this area.

The Federal Highway Administration (FHWA) developed a Policy statement on pavement type selection that is designed to provide the public with acceptable highway service at a minimal annual or life cycle cost while permitting maximum flexibility. This policy encourages the consideration of alternate designs and strategies in the type selection process. This policy is intended for use on both new and rehabilitated pavements. The FHWA policy states:

1. Base pavement type selection on engineering evaluation considering the factors contained in the 1960 AASHTO publication entitled "An Informational Guide on Project Procedures."
2. Determine an economic analysis based on life cycle costs of the pavement type. Estimates of life cycle costs become more accurate as pavement management procedures begin providing historical cost, serviceability, and performance data.   States without this data are encouraged to obtain it.
3. Perform an independent engineering and economic analysis and final pavement type determination prior to advertising on each pavement type being considered.
4. Alternate bids may be permitted if requested by the contracting agency where the analysis reflects that two or more initial designs and their forecasted performance are determined to be comparable or equivalent. The Division Administrator reviews and approves the analysis in the finding of equivalency prior to PS&E approval. Price adjustment clauses are not used when alternate bids are permitted.

This policy is written with the intention of taking advantage of fluctuating material prices while not compromising good design and pavement management practices.

Consider the probability of successful implementation and ease of maintenance before making a final decision. Consider a sensitivity analysis if two alternatives indicate close life cycle costs. This verifies the final choice as still the low cost even when input variables or conditions change slightly.

4.4   SYSTEM UPDATING

The selection of an alternative and its implementation does not end the process. Continue review of costs and performance. Update procedures based on this review. Alternatives selected on the basis of LCC analysis require periodic review to ensure response follows the planned approach.

4.5   EXAMPLES

See Appendix C for examples illustrating the complete Life Cycle Cost analysis process as it applies to the Utah Department of Transportation. These examples illustrate life cycle cost techniques used in comparison of alternatives for transportation projects. A sensitivity analysis is shown for each example with a graphical depiction of the resultant findings.

5.0   SUMMARY

The majority of this LCC procedure is based on the "Life Cycle Cost Analysis of Pavements" compiled by Dale E. Peterson for the National Cooperative Highway Research Program Synthesis of Highway Practice for the Highway Research Board, National Research Council. Most of the references used in this procedure were taken from Peterson's report.

5.1   CONCLUSIONS
1.   The use of LCC procedures to analyze new design alternatives is a proven and acceptable procedure.
2.   The process also applies in selecting pavement rehabilitation alternatives.

5.2   RECOMMENDATIONS

The following procedural steps apply when selecting between alternatives for new or rehabilitated pavements.
1.   Determine the site characteristic and other input data that may influence the pavement design or the rehabilitation design. Include a detailed evaluation of the existing pavement in rehabilitation planning.
2.   Identify various pavement management strategies that might be used to achieve the file requirements for the project.
3.   Identity all feasible alternatives satisfying project needs in all situations. Provide alternatives with the required structural service life for the analysis period. Use the creative techniques, particularly brain-storming, as previously identified, to generate alternatives.

4. Remove any item or items common to all alternatives from further consideration.
5. Select the analysis period. Use 25-40 years for new pavement construction. Use a time for rehabilitation projects comparable to the time until major reconstruction or replacement.
6. Select a suitable discount rate. While a four percent rate is recommended, select a rated based on guidance provided by the Value Engineer.
7. Determine time intervals for future maintenance and rehabilitation activities in order to predict performance characteristics of alternatives.
8. Estimate costs for each alternative, including future costs and as appropriate, user costs.
9. Calculate present worth or annualized costs for each alternative.
10. Conduct a sensitivity analysis for items or factors subject to variation to ensure selection of the proper alternative.
11. Evaluate alternatives against potentially overriding factors. Use the AASHTO "An Informational Guide to Project Procedures."
12. Select the most promising or preferred new pavement or rehabilitation design considering all evaluated factors.

6.0 GLOSSARY

Alternatives
Different courses of action or systems that will satisfy objectives and goals.

Analysis period
The time period used for comparing design alternatives. An analysis period may contain several maintenance and rehabilitation activities during the life cycle of the pavement being evaluated. It is sometimes referred to as the economic life, that period over which an investment is considered for satisfying a particular need. The length of time for the analysis period is established by the agency.

Annualized method
Economic method that requires conversion of all present and future expenditures to a uniform annual cost.

Benefit/cost analysis
Technique intended to relate the economic benefits of a solution to the costs incurred in providing the solution.

Brainstorming
A widely used creativity technique for generating a large quantity and wide variety of ideas for alternative ways of solving a problem or making a decision. All judgment and evaluation are suspended during the free-wheeling generation of ideas.

Cash-flow diagram
Schematic diagram of dollar costs and benefits with respect to time.

Constant dollars
Dollars that have not been adjusted for the effects of expected future inflation or deflation; sometimes referred to as dollars as of a specific date (for example, "1980 dollars").

Corrective maintenance
Type of maintenance used to take care of day-to-day emergencies and repair deficiencies as they develop. May include both temporary and permanent repairs; sometimes referred to as remedial maintenance.

Current dollars
An expression of costs stated at price levels prevailing at the time costs are incurred. Current dollars are inflated and represent price levels that may exist at some future date when the costs are incurred.

Denial-of-use costs
Extra costs occurring during the life cycle because occupancy, income, or production is delayed as a result of a process decision.

Depreciation
The cost allocation of a fixed asset over the estimated years of productive use. It is a process of allocation, not valuation. (Straight line; Declining balance; Sum of years—digits).

Design life
The length of time in years for which a pavement facility is being designed, including programmed rehabilitation. At the end of this period, the physical life of the facility is considered to be ended, i.e., the pavement structure has deteriorated to a point where total reconstruction is necessary.

Discount rate
A value in percent used as the means for comparing the alternative used for funds by reducing the future expected costs or benefits to present day terms. Discount rates are used to reduce various costs or benefits to their present worth or to uniform annual costs so that the economics of the different alternatives can be compared.

Engineering economics
Technique that allows the assessment of proposed engineering alternatives on the basis of considering their economic consequences over time.

Equivalent dollars
Dollars, both present and future, expressed in a common baseline reflecting the time value of money and inflation.

Escalation (differential) rate
That rate of inflation above the general devaluation of the purchasing power of the dollar.

Failure
Unsatisfactory performance of a pavement or portion such that it can no longer serve its intended purpose.

Flexible pavement
A pavement structure that maintains intimate contact with and distributes loads to the subgrade and depends on aggregate interlock, particle friction, and cohesion for stability.

Inflation
A continuing rise in the general price levels caused usually by an increase in the volume of money and credit relative to available goods.

Initial costs
Costs associated with initial development of a facility, including project costs (fees, real estate, site, etc.) as well as construction cost.

Interest
A ratio of the amount paid for using resources for a given period of time to the total investment. A term generally associated with borrowing money and is often referred to as market interest rates. The market interest rate includes both an allowance for expected inflation as well as a return that represents the real cost of capital.

Life cycle costing
An economic assessment of an item, area, system, or facility and competing design alternatives considering all significant costs of ownership over the economic life, expressed in terms of equivalent dollars.

Maintenance
Anything done to pavement after original construction until complete reconstruction, excluding shoulders and bridges. It includes pavement rehabilitation and restoration.

Minimum attractive rate of return
Reflects the cost of using resources and the risk that the project may fail to produce the expected results. The risk portion of the minimum attractive rate of return varies with different cost centers and even with projects within cost centers.

Non-recurring cost
Cost that occurs, or is expected to occur, only once.

Opportunity rate
That rate of return that the organization can make by investing its resources in the most beneficial or profitable projects to the limit of the resources available.

Pavement condition
The present status or performance of a pavement.

Pavement management system
A set of tools or methods that assist decision makers in finding optimum strategies for providing and maintaining pavements in a serviceable condition over a given period of time.

Pavement performance
Measure of accumulated service provided by a facility; i.e., the adequacy that it fills its purpose based on all indicators or measurement types.

Present worth method
Economic method that requires conversion of all present and future expenditures to a baseline of today's cost.

Preventive maintenance
The type of maintenance intended to keep the pavement above some minimum acceptable level at all times. It is used as a means of preventing further pavement deterioration that will require corrective maintenance. It may include either structural or nonstructural improvements to a pavement surface.

Rate of return
The interest rate that, over a period of time, equates the benefits derived from an opportunity to the investment cost of the project.

Recurring costs
Costs that recur on a periodic basis throughout the life of the project.

Rehabilitation
The act of restoring the pavement to a former condition so that it can fulfill its function.

Replacement costs
Those one-time costs to be incurred in the future to maintain the original function of the facility or item.

Rigid pavement
A pavement structure that distributes loads to the subgrade having as one course a Portland Cement Concrete slab of relatively high bending resistance.

Risk
Exists when each alternative will lead to one of a set of possible outcomes and there is a known probability of each outcome.

Salvage value
The value (positive if it has residual economic value and negative if requiring demolition) of competing alternatives at the end of the life cycle or the analysis period. Sometimes referred to as residual value.

Sensitivity analysis
A technique to assess the relative effect a change in input variables has on the resulting output.

Time value of money
Recognition that all organizations have limited resources (finances, people, facilities, equipment) and that the commitment of these to a project precludes their use for any other investment. Whether internal resources are used or borrowed, the interest that these resources can produce is a cost to the project.

Trade-offs
Giving up one thing to obtain something else.

Uncertainty
Exists when the probabilities of the outcomes are completely or partially unknown.

Useful life
The period of time over which a building element may be expected to give service. It may represent physical, technological, or economic life.

User costs
Those costs that are accumulated by the user of a facility. In a life cycle cost analysis these can be in the form of delay costs or change in vehicle operating costs.

Value engineering (VE)
An analysis of materials, processes, and products where functions are related to cost and from which a selection may be made for the purpose of achieving the required function at the lowest overall cost consistent with the requirements for performance, reliability, and maintainability; sometimes called value analysis.

APPENDIX A

Engineering Economic Tables for interest rates of 2-10, 12, and 15 percent.

INTEREST RATE = 1.0%							
n	(P/F)	(P/A)	(P/G)	(F/P)	(F/A)	(A/P)	(A/F)	n
1	0.9901	0.9901	0.0000	1.0100	1.0000	1.0100	1.0000	1
2	0.9803	1.9704	0.9803	1.0201	2.0100	0.5075	0.4975	2
3	0.9706	2.9410	2.9215	1.0303	3.0301	0.3400	0.3300	3
4	0.9610	3.9020	5.8044	1.0406	4.0604	0.2563	0.2463	4
5	0.9515	4.8534	9.6103	1.0510	5.1010	0.2060	0.1960	5
6	0.9420	5.7955	14.3205	1.0615	6.1520	0.1725	0.1625	6
7	0.9327	6.7282	19.9168	1.0721	7.2135	0.1486	0.1386	7
8	0.9235	7.6517	26.3812	1.0829	8.2857	0.1307	0.1207	8
9	0.9143	8.5660	33.6959	1.0937	9.3685	0.1167	0.1067	9
10	0.9053	9.4713	41.8435	1.1046	10.4622	0.1056	0.0956	10
11	0.8963	10.3676	50.8067	1.1157	11.5668	0.0965	0.0865	11
12	0.8874	11.2551	60.5687	1.1268	12.6825	0.0888	0.0788	12
13	0.8787	12.1337	71.1126	1.1381	13.8093	0.0824	0.0724	13
14	0.8700	13.0037	82.4221	1.1495	14.9474	0.0769	0.0669	14
15	0.8613	13.8651	94.4810	1.1610	16.0969	0.0721	0.0621	15
16	0.8528	14.7179	107.2734	1.1726	17.2579	0.0679	0.0579	16
17	0.8444	15.5623	120.7834	1.1843	18.4304	0.0643	0.0543	17
18	0.8360	16.3983	134.9957	1.1961	19.6147	0.0610	0.0510	18
19	0.8277	17.2260	149.8950	1.2081	20.8109	0.0581	0.0481	19
20	0.8195	18.0456	165.4664	1.2202	22.0190	0.0554	0.0454	20
21	0.8114	18.8570	181.6950	1.2324	23.2392	0.0530	0.0430	21
22	0.8034	19.6604	198.5663	1.2447	24.4716	0.0509	0.0409	22
23	0.7954	20.4558	216.0660	1.2572	25.7163	0.0489	0.0389	23
24	0.7876	21.2434	234.1800	1.2697	26.9735	0.0471	0.0371	24
25	0.7798	22.0232	252.8945	1.2824	28.2432	0.0454	0.0354	25
26	0.7720	22.7952	272.1957	1.2953	29.5256	0.0439	0.0339	26
27	0.7644	23.5596	292.0702	1.3082	30.8209	0.0424	0.0324	27
28	0.7568	24.3164	312.5047	1.3213	32.1291	0.0411	0.0311	28
29	0.7493	25.0658	333.4863	1.3345	33.4504	0.0399	0.0299	29
30	0.7419	25.8077	355.0021	1.3478	34.7849	0.0387	0.0287	30
31	0.7346	26.5423	377.0394	1.3613	36.1327	0.0377	0.0277	31
32	0.7273	27.2696	399.5858	1.3749	37.4941	0.0367	0.0267	32
33	0.7201	27.9897	422.6291	1.3887	38.8690	0.0357	0.0257	33
34	0.7130	28.7027	446.1572	1.4026	40.2577	0.0348	0.0248	34
35	0.7059	29.4086	470.1583	1.4166	41.6603	0.0340	0.0240	35
36	0.6989	30.1075	494.6207	1.4308	43.0769	0.0332	0.0232	36
37	0.6920	30.7995	519.5329	1.4451	44.5076	0.0325	0.0225	37
38	0.6852	31.4847	544.8835	1.4595	45.9527	0.0318	0.0218	38
39	0.6784	32.1630	570.6616	1.4741	47.4123	0.0311	0.0211	39
40	0.6717	32.8347	596.8561	1.4889	48.8864	0.0305	0.0205	40
41	0.6650	33.4997	623.4562	1.5038	50.3752	0.0299	0.0199	41
42	0.6584	34.1581	650.4514	1.5188	51.8790	0.0293	0.0193	42
43	0.6519	34.8100	677.8312	1.5340	53.3978	0.0287	0.0187	43
44	0.6454	35.4555	705.5853	1.5493	54.9318	0.0282	0.0182	44
45	0.6391	36.0945	733.7037	1.5648	56.4811	0.0277	0.0177	45
46	0.6327	36.7272	762.1765	1.5805	58.0459	0.0272	0.0172	46

INTEREST RATE = 1.0%

n	(P/F)	(P/A)	(P/G)	(F/P)	(F/A)	(A/P)	(A/F)	n
47	0.6265	37.3537	790.9938	1.5963	59.6263	0.0268	0.0168	47
48	0.6203	37.9740	820.1460	1.6122	61.2226	0.0263	0.0163	48
49	0.6141	38.5881	849.6237	1.6283	62.8348	0.0259	0.0159	49
50	0.6080	39.1961	879.4176	1.6446	64.4632	0.0255	0.0155	50
51	0.6020	39.7981	909.5186	1.6611	66.1078	0.0251	0.0151	51
52	0.5961	40.3942	939.9175	1.6777	67.7689	0.0248	0.0148	52
53	0.5902	40.9844	970.6057	1.6945	69.4466	0.0244	0.0144	53
54	0.5843	41.5687	1001.5743	1.7114	71.1410	0.0241	0.0141	54
55	0.5785	42.1472	1032.8148	1.7285	72.8525	0.0237	0.0137	55
56	0.5728	42.7200	1064.3188	1.7458	74.5810	0.0234	0.0134	56
57	0.5671	43.2871	1096.0780	1.7633	76.3268	0.0231	0.0131	57
58	0.5615	43.8486	1128.0843	1.7809	78.0901	0.0228	0.0128	58
59	0.5560	44.4046	1160.3296	1.7987	79.8710	0.0225	0.0125	59
60	0.5504	44.9550	1192.8061	1.8167	81.6697	0.0222	0.0122	60
65	0.5237	47.6266	1358.3903	1.9094	90.9366	0.0210	0.0110	65
70	0.4983	50.1685	1528.6474	2.0068	100.6763	0.0199	0.0099	70
75	0.4741	52.5871	1702.7340	2.1091	110.9128	0.0190	0.0090	75
80	0.4511	54.8882	1879.8771	2.2167	121.6715	0.0182	0.0082	80
85	0.4292	57.0777	2059.3701	2.3298	132.9790	0.0175	0.0075	85
90	0.4084	59.1609	2240.5675	2.4486	144.8633	0.0169	0.0069	90
95	0.3886	61.1430	2422.8811	2.5735	157.3538	0.0164	0.0064	95
100	0.3697	63.0289	2605.7758	2.7048	170.4814	0.0159	0.0059	100

INTEREST RATE = 2.00%

n	(P/F)	(P/A)	(P/G)	(F/P)	(F/A)	(A/P)	(A/F)	n
1	0.9804	0.9804	0.0000	1.0200	1.0000	1.0200	1.0000	1
2	0.9612	1.9416	0.9612	1.0404	2.0200	0.5150	0.4950	2
3	0.9423	2.8839	2.8458	1.0612	3.0604	0.3468	0.3268	3
4	0.9238	3.8077	5.6173	1.0824	4.1216	0.2626	0.2426	4
5	0.9057	4.7135	9.2403	1.1041	5.2040	0.2122	0.1922	5
6	0.8880	5.6014	13.6801	1.1262	6.3081	0.1785	0.1585	6
7	0.8706	6.4720	18.9035	1.1487	7.4343	0.1545	0.1345	7
8	0.8535	7.3255	24.8779	1.1717	8.5830	0.1365	0.1165	8
9	0.8368	8.1622	31.5720	1.1951	9.7546	0.1225	0.1025	9
10	0.8203	8.9826	38.9551	1.2190	10.9497	0.1113	0.0913	10
11	0.8043	9.7868	46.9977	1.2434	12.1687	0.1022	0.0822	11
12	0.7885	10.5753	55.6712	1.2682	13.4121	0.0946	0.0746	12
13	0.7730	11.3484	64.9475	1.2936	14.6803	0.0881	0.0681	13
14	0.7579	12.1062	74.7999	1.3195	15.9739	0.0826	0.0626	14
15	0.7430	12.8493	85.2021	1.3459	17.2934	0.0778	0.0578	15
16	0.7284	13.5777	96.1288	1.3728	18.6393	0.0737	0.0537	16
17	0.7142	14.2919	107.5554	1.4002	20.0121	0.0700	0.0500	17
18	0.7002	14.9920	119.4581	1.4282	21.4123	0.0667	0.0467	18
19	0.6864	15.6785	131.8139	1.4568	22.8406	0.0638	0.0438	19
20	0.6730	16.3514	144.6003	1.4859	24.2974	0.0612	0.0412	20
21	0.6598	17.0112	157.7959	1.5157	25.7833	0.0588	0.0388	21

INTEREST RATE = 2.00%							
n	(P/F)	(P/A)	(P/G)	(F/P)	(F/A)	(A/P)	(A/F)	n
22	0.6468	17.6580	171.3795	1.5460	27.2990	0.0566	0.0366	22
23	0.6342	18.2922	185.3309	1.5769	28.8450	0.0547	0.0347	23
24	0.6217	18.9139	199.6305	1.6084	30.4219	0.0529	0.0329	24
25	0.6095	19.5235	214.2592	1.6406	32.0303	0.0512	0.0312	25
26	0.5976	20.1210	229.1987	1.6734	33.6709	0.0497	0.0297	26
27	0.5859	20.7069	244.4311	1.7069	35.3443	0.0483	0.0283	27
28	0.5744	21.2813	259.9392	1.7410	37.0512	0.0470	0.0270	28
29	0.5631	21.8444	275.7064	1.7758	38.7922	0.0458	0.0258	29
30	0.5521	22.3965	291.7164	1.8114	40.5681	0.0446	0.0246	30
31	0.5412	22.9377	307.9538	1.8476	42.3794	0.0436	0.0236	31
32	0.5306	23.4683	324.4035	1.8845	44.2270	0.0426	0.0226	32
33	0.5202	23.9886	341.0508	1.9222	46.1116	0.0417	0.0217	33
34	0.5100	24.4986	357.8817	1.9607	48.0338	0.0408	0.0208	34
35	0.5000	24.9986	374.8826	1.9999	49.9945	0.0400	0.0200	35
36	0.4902	25.4888	392.0405	2.0399	51.9944	0.0392	0.0192	36
37	0.4806	25.9695	409.3424	2.0807	54.0343	0.0385	0.0185	37
38	0.4712	26.4406	426.7764	2.1223	56.1149	0.0378	0.0178	38
39	0.4619	26.9026	444.3304	2.1647	58.2372	0.0372	0.0172	39
40	0.4529	27.3555	461.9931	2.2080	60.4020	0.0366	0.0166	40
41	0.4440	27.7995	479.7535	2.2522	62.6100	0.0360	0.0160	41
42	0.4353	28.2348	497.6010	2.2972	64.8622	0.0354	0.0154	42
43	0.4268	28.6616	515.5253	2.3432	67.1595	0.0349	0.0149	43
44	0.4184	29.0800	533.5165	2.3901	69.5027	0.0344	0.0144	44
45	0.4102	29.4902	551.5652	2.4379	71.8927	0.0339	0.0139	45
46	0.4022	29.8923	569.6621	2.4866	74.3306	0.0335	0.0135	46
47	0.3943	30.2866	587.7985	2.5363	76.8172	0.0330	0.0130	47
48	0.3865	30.6731	605.9657	2.5871	79.3535	0.0326	0.0126	48
49	0.3790	31.0521	624.1557	2.6388	81.9406	0.0322	0.0122	49
50	0.3715	31.4236	642.3606	2.6916	84.5794	0.0318	0.0118	50
51	0.3642	31.7878	660.5727	2.7454	87.2710	0.0315	0.0115	51
52	0.3571	32.1449	678.7849	2.8003	90.0164	0.0311	0.0111	52
53	0.3501	32.4950	696.9900	2.8563	92.8167	0.0308	0.0108	53
54	0.3432	32.8383	715.1815	2.9135	95.6731	0.0305	0.0105	54
55	0.3365	33.1748	733.3527	2.9717	98.5865	0.0301	0.0101	55
56	0.3299	33.5047	751.4975	3.0312	101.5583	0.0298	0.0098	56
57	0.3234	33.8281	769.6100	3.0918	104.5894	0.0296	0.0096	57
58	0.3171	34.1452	787.6845	3.1536	107.6812	0.0293	0.0093	58
59	0.3109	34.4561	805.7154	3.2167	110.8348	0.0290	0.0090	59
60	0.3048	34.7609	823.6975	3.2810	114.0515	0.0288	0.0088	60
65	0.2761	36.1975	912.7085	3.6225	131.1262	0.0276	0.0076	65
70	0.2500	37.4986	999.8343	3.9996	149.9779	0.0267	0.0067	70
75	0.2265	38.6771	1084.6393	4.4158	170.7918	0.0259	0.0059	75
80	0.2051	39.7445	1166.7868	4.8754	193.7720	0.0252	0.0052	80

INTEREST RATE = 2.00%

n	(P/F)	(P/A)	(P/G)	(F/P)	(F/A)	(A/P)	(A/F)	n
85	0.1858	40.7113	1246.0241	5.3829	219.1439	0.0246	0.0046	85
90	0.1683	41.5869	1322.1701	5.9431	247.1567	0.0240	0.0040	90
95	0.1524	42.3800	1395.1033	6.5617	278.0850	0.0236	0.0036	95
100	0.1380	43.0984	1464.7527	7.2446	312.2323	0.0232	0.0032	100

INTEREST RATE = 3.00%

n	(P/F)	(P/A)	(P/G)	(F/P)	(F/A)	(A/P)	(A/F)	n
1	0.9709	0.9709	0.0000	1.0300	1.0000	1.0300	1.0000	1
2	0.9426	1.9135	0.9426	1.0609	2.0300	0.5226	0.4926	2
3	0.9151	2.8286	2.7729	1.0927	3.0909	0.3535	0.3235	3
4	0.8885	3.7171	5.4383	1.1255	4.1836	0.2690	0.2390	4
5	0.8626	4.5797	8.8888	1.1593	5.3091	0.2184	0.1884	5
6	0.8375	5.4172	13.0762	1.1941	6.4684	0.1846	0.1546	6
7	0.8131	6.2303	17.9547	1.2299	7.6625	0.1605	0.1305	7
8	0.7894	7.0197	23.4806	1.2668	8.8923	0.1425	0.1125	8
9	0.7664	7.7861	29.6119	1.3048	10.1591	0.1284	0.0984	9
10	0.7441	8.5302	36.3088	1.3439	11.4639	0.1172	0.0872	10
11	0.7224	9.2526	43.5330	1.3842	12.8078	0.1081	0.0781	11
12	0.7014	9.9540	51.2482	1.4258	14.1920	0.1005	0.0705	12
13	0.6810	10.6350	59.4196	1.4685	15.6178	0.0940	0.0640	13
14	0.6611	11.2961	68.0141	1.5126	17.0863	0.0885	0.0585	14
15	0.6419	11.9379	77.0002	1.5580	18.5989	0.0838	0.0538	15
16	0.6232	12.5611	86.3477	1.6047	20.1569	0.0796	0.0496	16
17	0.6050	13.1661	96.0280	1.6528	21.7616	0.0760	0.0460	17
18	0.5874	13.7535	106.0137	1.7024	23.4144	0.0727	0.0427	18
19	0.5703	14.3238	116.2788	1.7535	25.1169	0.0698	0.0398	19
20	0.5537	14.8775	126.7987	1.8061	26.8704	0.0672	0.0372	20
21	0.5375	15.4150	137.5496	1.8603	28.6765	0.0649	0.0349	21
22	0.5219	15.9369	148.5094	1.9161	30.5368	0.0627	0.0327	22
23	0.5067	16.4436	159.6566	1.9736	32.4529	0.0608	0.0308	23
24	0.4919	16.9355	170.9711	2.0328	34.4265	0.0590	0.0290	24
25	0.4776	17.4131	182.4336	2.0938	36.4593	0.0574	0.0274	25
26	0.4637	17.8768	194.0260	2.1566	38.5530	0.0559	0.0259	26
27	0.4502	18.3270	205.7309	2.2213	40.7096	0.0546	0.0246	27
28	0.4371	18.7641	217.5320	2.2879	42.9309	0.0533	0.0233	28
29	0.4243	19.1885	229.4137	2.3566	45.2189	0.0521	0.0221	29
30	0.4120	19.6004	241.3613	2.4273	47.5754	0.0510	0.0210	30
31	0.4000	20.0004	253.3609	2.5001	50.0027	0.0500	0.0200	31
32	0.3883	20.3888	265.3993	2.5751	52.5028	0.0490	0.0190	32
33	0.3770	20.7658	277.4642	2.6523	55.0778	0.0482	0.0182	33
34	0.3660	21.1318	289.5437	2.7319	57.7302	0.0473	0.0173	34
35	0.3554	21.4872	301.6267	2.8139	60.4621	0.0465	0.0165	35
36	0.3450	21.8323	313.7028	2.8983	63.2759	0.0458	0.0158	36

INTEREST RATE = 3.00%							
n	(P/F)	(P/A)	(P/G)	(F/P)	(F/A)	(A/P)	(A/F)	n
37	0.3350	22.1672	325.7622	2.9852	66.1742	0.0451	0.0151	37
38	0.3252	22.4925	337.7956	3.0748	69.1594	0.0445	0.0145	38
39	0.3158	22.8082	349.7942	3.1670	72.2342	0.0438	0.0138	39
40	0.3066	23.1148	361.7499	3.2620	75.4013	0.0433	0.0133	40
41	0.2976	23.4124	373.6551	3.3599	78.6633	0.0427	0.0127	41
42	0.2890	23.7014	385.5024	3.4607	82.0232	0.0422	0.0122	42
43	0.2805	23.9819	397.2852	3.5645	85.4839	0.0417	0.0117	43
44	0.2724	24.2543	408.9972	3.6715	89.0484	0.0412	0.0112	44
45	0.2644	24.5187	420.6325	3.7816	92.7199	0.0408	0.0108	45
46	0.2567	24.7754	432.1856	3.8950	96.5015	0.0404	0.0104	46
47	0.2493	25.0247	443.6515	4.0119	100.3965	0.0400	0.0100	47
48	0.2420	25.2667	455.0255	4.1323	104.4084	0.0396	0.0096	48
49	0.2350	25.5017	466.3031	4.2562	108.5406	0.0392	0.0092	49
50	0.2281	25.7298	477.4803	4.3839	112.7969	0.0389	0.0089	50
51	0.2215	25.9512	488.5535	4.5154	117.1808	0.0385	0.0085	51
52	0.2150	26.1662	499.5191	4.6509	121.6962	0.0382	0.0082	52
53	0.2088	26.3750	510.3742	4.7904	126.3471	0.0379	0.0079	53
54	0.2027	26.5777	521.1157	4.9341	131.1375	0.0376	0.0076	54
55	0.1968	26.7744	531.7411	5.0821	136.0716	0.0373	0.0073	55
56	0.1910	26.9655	542.2481	5.2346	141.1538	0.0371	0.0071	56
57	0.1855	27.1509	552.6345	5.3917	146.3884	0.0368	0.0068	57
58	0.1801	27.3310	562.8985	5.5534	151.7800	0.0366	0.0066	58
59	0.1748	27.5058	573.0384	5.7200	157.3334	0.0364	0.0064	59
60	0.1697	27.6756	583.0526	5.8916	163.0534	0.0361	0.0061	60
65	0.1464	28.4529	631.2010	6.8300	194.3328	0.0351	0.0051	65
70	0.1263	29.1234	676.0869	7.9178	230.5941	0.0343	0.0043	70
75	0.1089	29.7018	717.6978	9.1789	272.6309	0.0337	0.0037	75
80	0.0940	30.2008	756.0865	10.6409	321.3630	0.0331	0.0031	80
85	0.0811	30.6312	791.3529	12.3357	377.8570	0.0326	0.0026	85
90	0.0699	31.0024	823.6302	14.3005	443.3489	0.0323	0.0023	90
95	0.0603	31.3227	853.0742	16.5782	519.2720	0.0319	0.0019	95
100	0.0520	31.5989	879.8540	19.2186	607.2877	0.0316	0.0016	100

INTEREST RATE = 4.00%							
n	(P/F)	(P/A)	(P/G)	(F/P)	(F/A)	(A/P)	(A/F)	n
1	0.9615	0.9615	0.0000	1.0400	1.0000	1.0400	1.0000	1
2	0.9246	1.8861	0.9246	1.0816	2.0400	0.5302	0.4902	2
3	0.8890	2.7751	2.7025	1.1249	3.1216	0.3603	0.3203	3
4	0.8548	3.6299	5.2670	1.1699	4.2465	0.2755	0.2355	4
5	0.8219	4.4518	8.5547	1.2167	5.4163	0.2246	0.1846	5
6	0.7903	5.2421	12.5062	1.2653	6.6330	0.1908	0.1508	6
7	0.7599	6.0021	17.0657	1.3159	7.8983	0.1666	0.1266	7
8	0.7307	6.7327	22.1806	1.3686	9.2142	0.1485	0.1085	8

n	(P/F)	(P/A)	(P/G)	(F/P)	(F/A)	(A/P)	(A/F)	n
9	0.7026	7.4353	27.8013	1.4233	10.5828	0.1345	0.0945	9
10	0.6756	8.1109	33.8814	1.4802	12.0061	0.1233	0.0833	10
11	0.6496	8.7605	40.3772	1.5395	13.4864	0.1141	0.0741	11
12	0.6246	9.3851	47.2477	1.6010	15.0258	0.1066	0.0666	12
13	0.6006	9.9856	54.4546	1.6651	16.6268	0.1001	0.0601	13
14	0.5775	10.5631	61.9618	1.7317	18.2919	0.0947	0.0547	14
15	0.5553	11.1184	69.7355	1.8009	20.0236	0.0899	0.0499	15
16	0.5339	11.6523	77.7441	1.8730	21.8245	0.0858	0.0458	16
17	0.5134	12.1657	85.9581	1.9479	23.6975	0.0822	0.0422	17
18	0.4936	12.6593	94.3498	2.0258	25.6454	0.0790	0.0390	18
19	0.4746	13.1339	102.8933	2.1068	27.6712	0.0761	0.0361	19
20	0.4564	13.5903	111.5647	2.1911	29.7781	0.0736	0.0336	20
21	0.4388	14.0292	120.3414	2.2788	31.9692	0.0713	0.0313	21
22	0.4220	14.4511	129.2024	2.3699	34.2480	0.0692	0.0292	22
23	0.4057	14.8568	138.1284	2.4647	36.6179	0.0673	0.0273	23
24	0.3901	15.2470	147.1012	2.5633	39.0826	0.0656	0.0256	24
25	0.3751	15.6221	156.1040	2.6658	41.6459	0.0640	0.0240	25
26	0.3607	15.9828	165.1212	2.7725	44.3117	0.0626	0.0226	26
27	0.3468	16.3296	174.1385	2.8834	47.0842	0.0612	0.0212	27
28	0.3335	16.6631	183.1424	2.9987	49.9676	0.0600	0.0200	28
29	0.3207	16.9837	192.1206	3.1187	52.9663	0.0589	0.0189	29
30	0.3083	17.2920	201.0618	3.2434	56.0849	0.0578	0.0178	30
31	0.2965	17.5885	209.9556	3.3731	59.3283	0.0569	0.0169	31
32	0.2851	17.8736	218.7924	3.5081	62.7015	0.0559	0.0159	32
33	0.2741	18.1476	227.5634	3.6484	66.2095	0.0551	0.0151	33
34	0.2636	18.4112	236.2607	3.7943	69.8579	0.0543	0.0143	34
35	0.2534	18.6646	244.8768	3.9461	73.6522	0.0536	0.0136	35
36	0.2437	18.9083	253.4052	4.1039	77.5983	0.0529	0.0129	36
37	0.2343	19.1426	261.8399	4.2681	81.7022	0.0522	0.0122	37
38	0.2253	19.3679	270.1754	4.4388	85.9703	0.0516	0.0116	38
39	0.2166	19.5845	278.4070	4.6164	90.4091	0.0511	0.0111	39
40	0.2083	19.7928	286.5303	4.8010	95.0255	0.0505	0.0105	40
41	0.2003	19.9931	294.5414	4.9931	99.8265	0.0500	0.0100	41
42	0.1926	20.1856	302.4370	5.1928	104.8196	0.0495	0.0095	42
43	0.1852	20.3708	310.2141	5.4005	110.0124	0.0491	0.0091	43
44	0.1780	20.5488	317.8700	5.6165	115.4129	0.0487	0.0087	44
45	0.1712	20.7200	325.4028	5.8412	121.0294	0.0483	0.0083	45
46	0.1646	20.8847	332.8104	6.0748	126.8706	0.0479	0.0079	46
47	0.1583	21.0429	340.0914	6.3178	132.9454	0.0475	0.0075	47
48	0.1522	21.1951	347.2446	6.5705	139.2632	0.0472	0.0072	48
49	0.1463	21.3415	354.2689	6.8333	145.8337	0.0469	0.0069	49
50	0.1407	21.4822	361.1638	7.1067	152.6671	0.0466	0.0066	50
51	0.1353	21.6175	367.9289	7.3910	159.7738	0.0463	0.0063	51

INTEREST RATE = 4.00%

n	(P/F)	(P/A)	(P/G)	(F/P)	(F/A)	(A/P)	(A/F)	n
52	0.1301	21.7476	374.5638	7.6866	167.1647	0.0460	0.0060	52
53	0.1251	21.8727	381.0686	7.9941	174.8513	0.0457	0.0057	53
54	0.1203	21.9930	387.4436	8.3138	182.8454	0.0455	0.0055	54
55	0.1157	22.1086	393.6890	8.6464	191.1592	0.0452	0.0052	55
56	0.1112	22.2198	399.8054	8.9922	199.8055	0.0450	0.0050	56
57	0.1069	22.3267	405.7935	9.3519	208.7978	0.0448	0.0048	57
58	0.1028	22.4296	411.6540	9.7260	218.1497	0.0446	0.0046	58
59	0.0989	22.5284	417.3881	10.1150	227.8757	0.0444	0.0044	59
60	0.0951	22.6235	422.9966	10.5196	237.9907	0.0442	0.0042	60
65	0.0781	23.0467	449.2014	12.7987	294.9684	0.0434	0.0034	65
70	0.0642	23.3945	472.4789	15.5716	364.2905	0.0427	0.0027	70
75	0.0528	23.6804	493.0408	18.9453	448.6314	0.0422	0.0022	75
80	0.0434	23.9154	511.1161	23.0498	551.2450	0.0418	0.0018	80
85	0.0357	24.1085	526.9384	28.0436	676.0901	0.0415	0.0015	85
90	0.0293	24.2673	540.7369	34.1193	827.9833	0.0412	0.0012	90
95	0.0241	24.3978	552.7307	41.5114	1012.7846	0.0410	0.0010	95
100	0.0198	24.5050	563.1249	50.5049	1237.6237	0.0408	0.0008	100

INTEREST RATE = 5.00%

n	(P/F)	(P/A)	(P/G)	(F/P)	(F/A)	(A/P)	(A/F)	n
1	0.9524	0.9524	0.0000	1.0500	1.0000	1.0500	1.0000	1
2	0.9070	1.8594	0.9070	1.1025	2.0500	0.5378	0.4878	2
3	0.8638	2.7232	2.6347	1.1576	3.1525	0.3672	0.3172	3
4	0.8227	3.5460	5.1028	1.2155	4.3101	0.2820	0.2320	4
5	0.7835	4.3295	8.2369	1.2763	5.5256	0.2310	0.1810	5
6	0.7462	5.0757	11.9680	1.3401	6.8019	0.1970	0.1470	6
7	0.7107	5.7864	16.2321	1.4071	8.1420	0.1728	0.1228	7
8	0.6768	6.4632	20.9700	1.4775	9.5491	0.1547	0.1047	8
9	0.6446	7.1078	26.1268	1.5513	11.0266	0.1407	0.0907	9
10	0.6139	7.7217	31.6520	1.6289	12.5779	0.1295	0.0795	10
11	0.5847	8.3064	37.4988	1.7103	14.2068	0.1204	0.0704	11
12	0.5568	8.8633	43.6241	1.7959	15.9171	0.1128	0.0628	12
13	0.5303	9.3936	49.9879	1.8856	17.7130	0.1065	0.0565	13
14	0.5051	9.8986	56.5538	1.9799	19.5986	0.1010	0.0510	14
15	0.4810	10.3797	63.2880	2.0789	21.5786	0.0963	0.0463	15
16	0.4581	10.8378	70.1597	2.1829	23.6575	0.0923	0.0423	16
17	0.4363	11.2741	77.1405	2.2920	25.8404	0.0887	0.0387	17
18	0.4155	11.6896	84.2043	2.4066	28.1324	0.0855	0.0355	18
19	0.3957	12.0853	91.3275	2.5270	30.5390	0.0827	0.0327	19
20	0.3769	12.4622	98.4884	2.6533	33.0660	0.0802	0.0302	20
21	0.3589	12.8212	105.6673	2.7860	35.7193	0.0780	0.0280	21
22	0.3418	13.1630	112.8461	2.9253	38.5052	0.0760	0.0260	22
23	0.3256	13.4886	120.0087	3.0715	41.4305	0.0741	0.0241	23

n	(P/F)	(P/A)	(P/G)	(F/P)	(F/A)	(A/P)	(A/F)	n
			INTEREST RATE = 5.00%					
24	0.3101	13.7986	127.1402	3.2251	44.5020	0.0725	0.0225	24
25	0.2953	14.0939	134.2275	3.3864	47.7271	0.0710	0.0210	25
26	0.2812	14.3752	141.2585	3.5557	51.1135	0.0696	0.0196	26
27	0.2678	14.6430	148.2226	3.7335	54.6691	0.0683	0.0183	27
28	0.2551	14.8981	155.1101	3.9201	58.4026	0.0671	0.0171	28
29	0.2429	15.1411	161.9126	4.1161	62.3227	0.0660	0.0160	29
30	0.2314	15.3725	168.6226	4.3219	66.4388	0.0651	0.0151	30
31	0.2204	15.5928	175.2333	4.5380	70.7608	0.0641	0.0141	31
32	0.2099	15.8027	181.7392	4.7649	75.2988	0.0633	0.0133	32
33	0.1999	16.0025	188.1351	5.0032	80.0638	0.0625	0.0125	33
34	0.1904	16.1929	194.4168	5.2533	85.0670	0.0618	0.0118	34
35	0.1813	16.3742	200.5807	5.5160	90.3203	0.0611	0.0111	35
36	0.1727	16.5469	206.6237	5.7918	95.8363	0.0604	0.0104	36
37	0.1644	16.7113	212.5434	6.0814	101.6281	0.0598	0.0098	37
38	0.1566	16.8679	218.3378	6.3855	107.7095	0.0593	0.0093	38
39	0.1491	17.0170	224.0054	6.7048	114.0950	0.0588	0.0088	39
40	0.1420	17.1591	229.5452	7.0400	120.7998	0.0583	0.0083	40
41	0.1353	17.2944	234.9564	7.3920	127.8398	0.0578	0.0078	41
42	0.1288	17.4232	240.2389	7.7616	135.2318	0.0574	0.0074	42
43	0.1227	17.5459	245.3925	8.1497	142.9933	0.0570	0.0070	43
44	0.1169	17.6628	250.4175	8.5572	151.1430	0.0566	0.0066	44
45	0.1113	17.7741	255.3145	8.9850	159.7002	0.0563	0.0063	45
46	0.1060	17.8801	260.0844	9.4343	168.6852	0.0559	0.0059	46
47	0.1009	17.9810	264.7281	9.9060	178.1194	0.0556	0.0056	47
48	0.0961	18.0772	269.2467	10.4013	188.0254	0.0553	0.0053	48
49	0.0916	18.1687	273.6418	10.9213	198.4267	0.0550	0.0050	49
50	0.0872	18.2559	277.9148	11.4674	209.3480	0.0548	0.0048	50
51	0.0831	18.3390	282.0673	12.0408	220.8154	0.0545	0.0045	51
52	0.0791	18.4181	286.1013	12.6428	232.8562	0.0543	0.0043	52
53	0.0753	18.4934	290.0184	13.2749	245.4990	0.0541	0.0041	53
54	0.0717	18.5651	293.8208	13.9387	258.7739	0.0539	0.0039	54
55	0.0683	18.6335	297.5104	14.6356	272.7126	0.0537	0.0037	55
56	0.0651	18.6985	301.0894	15.3674	287.3482	0.0535	0.0035	56
57	0.0620	18.7605	304.5599	16.1358	302.7157	0.0533	0.0033	57
58	0.0590	18.8195	307.9243	16.9426	318.8514	0.0531	0.0031	58
59	0.0562	18.8758	311.1846	17.7897	335.7940	0.0530	0.0030	59
60	0.0535	18.9293	314.3432	18.6792	353.5837	0.0528	0.0028	60
65	0.0419	19.1611	328.6910	23.8399	456.7980	0.0522	0.0022	65
70	0.0329	19.3427	340.8409	30.4264	588.5285	0.0517	0.0017	70
75	0.0258	19.4850	351.0721	38.8327	756.6537	0.0513	0.0013	75
80	0.0202	19.5965	359.6460	49.5614	971.2288	0.0510	0.0010	80
85	0.0158	19.6838	366.8007	63.2544	1245.0871	0.0508	0.0008	85
90	0.0124	19.7523	372.7488	80.7304	1594.6073	0.0506	0.0006	90
95	0.0097	19.8059	377.6774	103.0347	2040.6935	0.0505	0.0005	95
100	0.0076	19.8479	381.7492	131.5013	2610.0252	0.0504	0.0004	100

INTEREST RATE = 6.00%							
n	(P/F)	(P/A)	(P/G)	(F/P)	(F/A)	(A/P)	(A/F)	n
1	0.9434	0.9434	0.0000	1.0600	1.0000	1.0600	1.0000	1
2	0.8900	1.8334	0.8900	1.1236	2.0600	0.5454	0.4854	2
3	0.8396	2.6730	2.5692	1.1910	3.1836	0.3741	0.3141	3
4	0.7921	3.4651	4.9455	1.2625	4.3746	0.2886	0.2286	4
5	0.7473	4.2124	7.9345	1.3382	5.6371	0.2374	0.1774	5
6	0.7050	4.9173	11.4594	1.4185	6.9753	0.2034	0.1434	6
7	0.6651	5.5824	15.4497	1.5036	8.3938	0.1791	0.1191	7
8	0.6274	6.2098	19.8416	1.5938	9.8975	0.1610	0.1010	8
9	0.5919	6.8017	24.5768	1.6895	11.4913	0.1470	0.0870	9
10	0.5584	7.3601	29.6023	1.7908	13.1808	0.1359	0.0759	10
11	0.5268	7.8869	34.8702	1.8983	14.9716	0.1268	0.0668	11
12	0.4970	8.3838	40.3369	2.0122	16.8699	0.1193	0.0593	12
13	0.4688	8.8527	45.9629	2.1329	18.8821	0.1130	0.0530	13
14	0.4423	9.2950	51.7128	2.2609	21.0151	0.1076	0.0476	14
15	0.4173	9.7122	57.5546	2.3966	23.2760	0.1030	0.0430	15
16	0.3936	10.1059	63.4592	2.5404	25.6725	0.0990	0.0390	16
17	0.3714	10.4773	69.4011	2.6928	28.2129	0.0954	0.0354	17
18	0.3503	10.8276	75.3569	2.8543	30.9057	0.0924	0.0324	18
19	0.3305	11.1581	81.3062	3.0256	33.7600	0.0896	0.0296	19
20	0.3118	11.4699	87.2304	3.2071	36.7856	0.0872	0.0272	20
21	0.2942	11.7641	93.1136	3.3996	39.9927	0.0850	0.0250	21
22	0.2775	12.0416	98.9412	3.6035	43.3923	0.0830	0.0230	22
23	0.2618	12.3034	104.7007	3.8197	46.9958	0.0813	0.0213	23
24	0.2470	12.5504	110.3812	4.0489	50.8156	0.0797	0.0197	24
25	0.2330	12.7834	115.9732	4.2919	54.8645	0.0782	0.0182	25
26	0.2198	13.0032	121.4684	4.5494	59.1564	0.0769	0.0169	26
27	0.2074	13.2105	126.8600	4.8223	63.7058	0.0757	0.0157	27
28	0.1956	13.4062	132.1420	5.1117	68.5281	0.0746	0.0146	28
29	0.1846	13.5907	137.3096	5.4184	73.6398	0.0736	0.0136	29
30	0.1741	13.7648	142.3588	5.7435	79.0582	0.0726	0.0126	30
31	0.1643	13.9291	147.2864	6.0881	84.8017	0.0718	0.0118	31
32	0.1550	14.0840	152.0901	6.4534	90.8898	0.0710	0.0110	32
33	0.1462	14.2302	156.7681	6.8406	97.3432	0.0703	0.0103	33
34	0.1379	14.3681	161.3192	7.2510	104.1838	0.0696	0.0096	34
35	0.1301	14.4982	165.7427	7.6861	111.4348	0.0690	0.0090	35
36	0.1227	14.6210	170.0387	8.1473	119.1209	0.0684	0.0084	36
37	0.1158	14.7368	174.2072	8.6361	127.2681	0.0679	0.0079	37
38	0.1092	14.8460	178.2490	9.1543	135.9042	0.0674	0.0074	38
39	0.1031	14.9491	182.1652	9.7035	145.0585	0.0669	0.0069	39
40	0.0972	15.0463	185.9568	10.2857	154.7620	0.0665	0.0065	40
41	0.0917	15.1380	189.6256	10.9029	165.0477	0.0661	0.0061	41
42	0.0865	15.2245	193.1732	11.5570	175.9505	0.0657	0.0057	42

INTEREST RATE = 6.00%

n	(P/F)	(P/A)	(P/G)	(F/P)	(F/A)	(A/P)	(A/F)	n
43	0.0816	15.3062	196.6017	12.2505	187.5076	0.0653	0.0053	43
44	0.0770	15.3832	199.9130	12.9855	199.7580	0.0650	0.0050	44
45	0.0727	15.4558	203.1096	13.7646	212.7435	0.0647	0.0047	45
46	0.0685	15.5244	206.1938	14.5905	226.5081	0.0644	0.0044	46
47	0.0647	15.5890	209.1681	15.4659	241.0986	0.0641	0.0041	47
48	0.0610	15.6500	212.0351	16.3939	256.5645	0.0639	0.0039	48
49	0.0575	15.7076	214.7972	17.3775	272.9584	0.0637	0.0037	49
50	0.0543	15.7619	217.4574	18.4202	290.3359	0.0634	0.0034	50
51	0.0512	15.8131	220.0181	19.5254	308.7561	0.0632	0.0032	51
52	0.0483	15.8614	222.4823	20.6969	328.2814	0.0630	0.0030	52
53	0.0456	15.9070	224.8525	21.9387	348.9783	0.0629	0.0029	53
54	0.0430	15.9500	227.1316	23.2550	370.9170	0.0627	0.0027	54
55	0.0406	15.9905	229.3222	24.6503	394.1720	0.0625	0.0025	55
56	0.0383	16.0288	231.4272	26.1293	418.8223	0.0624	0.0024	56
57	0.0361	16.0649	233.4490	27.6971	444.9517	0.0622	0.0022	57
58	0.0341	16.0990	235.3905	29.3589	472.6488	0.0621	0.0021	58
59	0.0321	16.1311	237.2542	31.1205	502.0077	0.0620	0.0020	59
60	0.0303	16.1614	239.0428	32.9877	533.1282	0.0619	0.0019	60
65	0.0227	16.2891	246.9450	44.1450	719.0829	0.0614	0.0014	65
70	0.0169	16.3845	253.3271	59.0759	967.9322	0.0610	0.0010	70
75	0.0126	16.4558	258.4527	79.0569	1300.9487	0.0608	0.0008	75
80	0.0095	16.5091	262.5493	105.7960	1746.5999	0.0606	0.0006	80
85	0.0071	16.5489	265.8096	141.5789	2342.9817	0.0604	0.0004	85
90	0.0053	16.5787	268.3946	189.4645	3141.0752	0.0603	0.0003	90
95	0.0039	16.6009	270.4375	253.5463	4209.1042	0.0602	0.0002	95
100	0.0029	16.6175	272.0471	339.3021	5638.3681	0.0602	0.0002	100

INTEREST RATE = 7.00%

n	(P/F)	(P/A)	(P/G)	(F/P)	(F/A)	(A/P)	(A/F)	n
1	0.9346	0.9346	0.0000	1.0700	1.0000	1.0700	1.0000	1
2	0.8734	1.8080	0.8734	1.1449	2.0700	0.5531	0.4831	2
3	0.8163	2.6243	2.5060	1.2250	3.2149	0.3811	0.3111	3
4	0.7629	3.3872	4.7947	1.3108	4.4399	0.2952	0.2252	4
5	0.7130	4.1002	7.6467	1.4026	5.7507	0.2439	0.1739	5
6	0.6663	4.7665	10.9784	1.5007	7.1533	0.2098	0.1398	6
7	0.6227	5.3893	14.7149	1.6058	8.6540	0.1856	0.1156	7
8	0.5820	5.9713	18.7889	1.7182	10.2598	0.1675	0.0975	8
9	0.5439	6.5152	23.1404	1.8385	11.9780	0.1535	0.0835	9
10	0.5083	7.0236	27.7156	1.9672	13.8164	0.1424	0.0724	10
11	0.4751	7.4987	32.4665	2.1049	15.7836	0.1334	0.0634	11
12	0.4440	7.9427	37.3506	2.2522	17.8885	0.1259	0.0559	12
13	0.4150	8.3577	42.3302	2.4098	20.1406	0.1197	0.0497	13
14	0.3878	8.7455	47.3718	2.5785	22.5505	0.1143	0.0443	14

INTEREST RATE = 7.00%							
n	(P/F)	(P/A)	(P/G)	(F/P)	(F/A)	(A/P)	(A/F)	n
15	0.3624	9.1079	52.4461	2.7590	25.1290	0.1098	0.0398	15
16	0.3387	9.4466	57.5271	2.9522	27.8881	0.1059	0.0359	16
17	0.3166	9.7632	62.5923	3.1588	30.8402	0.1024	0.0324	17
18	0.2959	10.0591	67.6219	3.3799	33.9990	0.0994	0.0294	18
19	0.2765	10.3356	72.5991	3.6165	37.3790	0.0968	0.0268	19
20	0.2584	10.5940	77.5091	3.8697	40.9955	0.0944	0.0244	20
21	0.2415	10.8355	82.3393	4.1406	44.8652	0.0923	0.0223	21
22	0.2257	11.0612	87.0793	4.4304	49.0057	0.0904	0.0204	22
23	0.2109	11.2722	91.7201	4.7405	53.4361	0.0887	0.0187	23
24	0.1971	11.4693	96.2545	5.0724	58.1767	0.0872	0.0172	24
25	0.1842	11.6536	100.6765	5.4274	63.2490	0.0858	0.0158	25
26	0.1722	11.8258	104.9814	5.8074	68.6765	0.0846	0.0146	26
27	0.1609	11.9867	109.1656	6.2139	74.4838	0.0834	0.0134	27
28	0.1504	12.1371	113.2264	6.6488	80.6977	0.0824	0.0124	28
29	0.1406	12.2777	117.1622	7.1143	87.3465	0.0814	0.0114	29
30	0.1314	12.4090	120.9718	7.6123	94.4608	0.0806	0.0106	30
31	0.1228	12.5318	124.6550	8.1451	102.0730	0.0798	0.0098	31
32	0.1147	12.6466	128.2120	8.7153	110.2182	0.0791	0.0091	32
33	0.1072	12.7538	131.6435	9.3253	118.9334	0.0784	0.0084	33
34	0.1002	12.8540	134.9507	9.9781	128.2588	0.0778	0.0078	34
35	0.0937	12.9477	138.1353	10.6766	138.2369	0.0772	0.0072	35
36	0.0875	13.0352	141.1990	11.4239	148.9135	0.0767	0.0067	36
37	0.0818	13.1170	144.1441	12.2236	160.3374	0.0762	0.0062	37
38	0.0765	13.1935	146.9730	13.0793	172.5610	0.0758	0.0058	38
39	0.0715	13.2649	149.6883	13.9948	185.6403	0.0754	0.0054	39
40	0.0668	13.3317	152.2928	14.9745	199.6351	0.0750	0.0050	40
41	0.0624	13.3941	154.7892	16.0227	214.6096	0.0747	0.0047	41
42	0.0583	13.4524	157.1807	17.1443	230.6322	0.0743	0.0043	42
43	0.0545	13.5070	159.4702	18.3444	247.7765	0.0740	0.0040	43
44	0.0509	13.5579	161.6609	19.6285	266.1209	0.0738	0.0038	44
45	0.0476	13.6055	163.7559	21.0025	285.7493	0.0735	0.0035	45
46	0.0445	13.6500	165.7584	22.4726	306.7518	0.0733	0.0033	46
47	0.0416	13.6916	167.6714	24.0457	329.2244	0.0730	0.0030	47
48	0.0389	13.7305	169.4981	25.7289	353.2701	0.0728	0.0028	48
49	0.0363	13.7668	171.2417	27.5299	378.9990	0.0726	0.0026	49
50	0.0339	13.8007	172.9051	29.4570	406.5289	0.0725	0.0025	50
51	0.0317	13.8325	174.4915	31.5190	435.9860	0.0723	0.0023	51
52	0.0297	13.8621	176.0037	33.7253	467.5050	0.0721	0.0021	52
53	0.0277	13.8898	177.4447	36.0861	501.2303	0.0720	0.0020	53
54	0.0259	13.9157	178.8173	38.6122	537.3164	0.0719	0.0019	54
55	0.0242	13.9399	180.1243	41.3150	575.9286	0.0717	0.0017	55
56	0.0226	13.9626	181.3685	44.2071	617.2436	0.0716	0.0016	56
57	0.0211	13.9837	182.5524	47.3015	661.4506	0.0715	0.0015	57

INTEREST RATE = 7.00%

n	(P/F)	(P/A)	(P/G)	(F/P)	(F/A)	(A/P)	(A/F)	n
58	0.0198	14.0035	183.6786	50.6127	708.7522	0.0714	0.0014	58
59	0.0185	14.0219	184.7496	54.1555	759.3648	0.0713	0.0013	59
60	0.0173	14.0392	185.7677	57.9464	813.5204	0.0712	0.0012	60
65	0.0123	14.1099	190.1452	81.2729	1146.7552	0.0709	0.0009	65
70	0.0088	14.1604	193.5185	113.9894	1614.1342	0.0706	0.0006	70
75	0.0063	14.1964	196.1035	159.8760	2269.6574	0.0704	0.0004	75
80	0.0045	14.2220	198.0748	224.2344	3189.0627	0.0703	0.0003	80
85	0.0032	14.2403	199.5717	314.5003	4478.5761	0.0702	0.0002	85
90	0.0023	14.2533	200.7042	441.1030	6287.1854	0.0702	0.0002	90
95	0.0016	14.2626	201.5581	618.6697	8823.8535	0.0701	0.0001	95
100	0.0012	14.2693	202.2001	867.7163	12381.6618	0.0701	0.0001	100

INTEREST RATE = 8.00%

n	(P/F)	(P/A)	(P/G)	(F/P)	(F/A)	(A/P)	(A/F)	n
1	0.9259	0.9259	0.0000	1.0800	1.0000	1.0800	1.0000	1
2	0.8573	1.7833	0.8573	1.1664	2.0800	0.5608	0.4808	2
3	0.7938	2.5771	2.4450	1.2597	3.2464	0.3880	0.3080	3
4	0.7350	3.3121	4.6501	1.3605	4.5061	0.3019	0.2219	4
5	0.6806	3.9927	7.3724	1.4693	5.8666	0.2505	0.1705	5
6	0.6302	4.6229	10.5233	1.5869	7.3359	0.2163	0.1363	6
7	0.5835	5.2064	14.0242	1.7138	8.9228	0.1921	0.1121	7
8	0.5403	5.7466	17.8061	1.8509	10.6366	0.1740	0.0940	8
9	0.5002	6.2469	21.8081	1.9990	12.4876	0.1601	0.0801	9
10	0.4632	6.7101	25.9768	2.1589	14.4866	0.1490	0.0690	10
11	0.4289	7.1390	30.2657	2.3316	16.6455	0.1401	0.0601	11
12	0.3971	7.5361	34.6339	2.5182	18.9771	0.1327	0.0527	12
13	0.3677	7.9038	39.0463	2.7196	21.4953	0.1265	0.0465	13
14	0.3405	8.2442	43.4723	2.9372	24.2149	0.1213	0.0413	14
15	0.3152	8.5595	47.8857	3.1722	27.1521	0.1168	0.0368	15
16	0.2919	8.8514	52.2640	3.4259	30.3243	0.1130	0.0330	16
17	0.2703	9.1216	56.5883	3.7000	33.7502	0.1096	0.0296	17
18	0.2502	9.3719	60.8426	3.9960	37.4502	0.1067	0.0267	18
19	0.2317	9.6036	65.0134	4.3157	41.4463	0.1041	0.0241	19
20	0.2145	9.8181	69.0898	4.6610	45.7620	0.1019	0.0219	20
21	0.1987	10.0168	73.0629	5.0338	50.4229	0.0998	0.0198	21
22	0.1839	10.2007	76.9257	5.4365	55.4568	0.0980	0.0180	22
23	0.1703	10.3711	80.6726	5.8715	60.8933	0.0964	0.0164	23
24	0.1577	10.5288	84.2997	6.3412	66.7648	0.0950	0.0150	24
25	0.1460	10.6748	87.8041	6.8485	73.1059	0.0937	0.0137	25
26	0.1352	10.8100	91.1842	7.3964	79.9544	0.0925	0.0125	26
27	0.1252	10.9352	94.4390	7.9881	87.3508	0.0914	0.0114	27
28	0.1159	11.0511	97.5687	8.6271	95.3388	0.0905	0.0105	28
29	0.1073	11.1584	100.5738	9.3173	103.9659	0.0896	0.0096	29

INTEREST RATE = 8.00%							
n	(P/F)	(P/A)	(P/G)	(F/P)	(F/A)	(A/P)	(A/F)	n
30	0.0994	11.2578	103.4558	10.0627	113.2832	0.0888	0.0088	30
31	0.0920	11.3498	106.2163	10.8677	123.3459	0.0881	0.0081	31
32	0.0852	11.4350	108.8575	11.7371	134.2135	0.0875	0.0075	32
33	0.0789	11.5139	111.3819	12.6760	145.9506	0.0869	0.0069	33
34	0.0730	11.5869	113.7924	13.6901	158.6267	0.0863	0.0063	34
35	0.0676	11.6546	116.0920	14.7853	172.3168	0.0858	0.0058	35
36	0.0626	11.7172	118.2839	15.9682	187.1021	0.0853	0.0053	36
37	0.0580	11.7752	120.3713	17.2456	203.0703	0.0849	0.0049	37
38	0.0537	11.8289	122.3579	18.6253	220.3159	0.0845	0.0045	38
39	0.0497	11.8786	124.2470	20.1153	238.9412	0.0842	0.0042	39
40	0.0460	11.9246	126.0422	21.7245	259.0565	0.0839	0.0039	40
41	0.0426	11.9672	127.7470	23.4625	280.7810	0.0836	0.0036	41
42	0.0395	12.0067	129.3651	25.3395	304.2435	0.0833	0.0033	42
43	0.0365	12.0432	130.8998	27.3666	329.5830	0.0830	0.0030	43
44	0.0338	12.0771	132.3547	29.5560	356.9496	0.0828	0.0028	44
45	0.0313	12.1084	133.7331	31.9204	386.5056	0.0826	0.0026	45
46	0.0290	12.1374	135.0384	34.4741	418.4261	0.0824	0.0024	46
47	0.0269	12.1643	136.2739	37.2320	452.9002	0.0822	0.0022	47
48	0.0249	12.1891	137.4428	40.2106	490.1322	0.0820	0.0020	48
49	0.0230	12.2122	138.5480	43.4274	530.3427	0.0819	0.0019	49
50	0.0213	12.2335	139.5928	46.9016	573.7702	0.0817	0.0017	50
51	0.0197	12.2532	140.5799	50.6537	620.6718	0.0816	0.0016	51
52	0.0183	12.2715	141.5121	54.7060	671.3255	0.0815	0.0015	52
53	0.0169	12.2884	142.3923	59.0825	726.0316	0.0814	0.0014	53
54	0.0157	12.3041	143.2229	63.8091	785.1141	0.0813	0.0013	54
55	0.0145	12.3186	144.0065	68.9139	848.9232	0.0812	0.0012	55
56	0.0134	12.3321	144.7454	74.4270	917.8371	0.0811	0.0011	56
57	0.0124	12.3445	145.4421	80.3811	992.2640	0.0810	0.0010	57
58	0.0115	12.3560	146.0987	86.8116	1072.6451	0.0809	0.0009	58
59	0.0107	12.3667	146.7173	93.7565	1159.4568	0.0809	0.0009	59
60	0.0099	12.3766	147.3000	101.2571	1253.2133	0.0808	0.0008	60
65	0.0067	12.4160	149.7387	148.7798	1847.2481	0.0805	0.0005	65
70	0.0046	12.4428	151.5326	218.6064	2720.0801	0.0804	0.0004	70
75	0.0031	12.4611	152.8448	321.2045	4002.5566	0.0802	0.0002	75
80	0.0021	12.4735	153.8001	471.9548	5886.9354	0.0802	0.0002	80
85	0.0014	12.4820	154.4925	693.4565	8655.7061	0.0801	0.0001	85
90	0.0010	12.4877	154.9925	1018.9151	12723.9386	0.0801	0.0001	90
95	0.0007	12.4917	155.3524	1497.1205	18701.5069	0.0801	0.0001	95
100	0.0005	12.4943	155.6107	2199.7613	27484.5157	0.0800	0.0000	100

INTEREST RATE = 9.00%							
n	(P/F)	(P/A)	(P/G)	(F/P)	(F/A)	(A/P)	(A/F)	n
1	0.9174	0.9174	0.0000	1.0900	1.0000	1.0900	1.0000	1
2	0.8417	1.7591	0.8417	1.1881	2.0900	0.5685	0.4785	2
3	0.7722	2.5313	2.3860	1.2950	3.2781	0.3951	0.3051	3
4	0.7084	3.2397	4.5113	1.4116	4.5731	0.3087	0.2187	4
5	0.6499	3.8897	7.1110	1.5386	5.9847	0.2571	0.1671	5
6	0.5963	4.4859	10.0924	1.6771	7.5233	0.2229	0.1329	6
7	0.5470	5.0330	13.3746	1.8280	9.2004	0.1987	0.1087	7
8	0.5019	5.5348	16.8877	1.9926	11.0285	0.1807	0.0907	8
9	0.4604	5.9952	20.5711	2.1719	13.0210	0.1668	0.0768	9
10	0.4224	6.4177	24.3728	2.3674	15.1929	0.1558	0.0658	10
11	0.3875	6.8052	28.2481	2.5804	17.5603	0.1469	0.0569	11
12	0.3555	7.1607	32.1590	2.8127	20.1407	0.1397	0.0497	12
13	0.3262	7.4869	36.0731	3.0658	22.9534	0.1336	0.0436	13
14	0.2992	7.7862	39.9633	3.3417	26.0192	0.1284	0.0384	14
15	0.2745	8.0607	43.8069	3.6425	29.3609	0.1241	0.0341	15
16	0.2519	8.3126	47.5849	3.9703	33.0034	0.1203	0.0303	16
17	0.2311	8.5436	51.2821	4.3276	36.9737	0.1170	0.0270	17
18	0.2120	8.7556	54.8860	4.7171	41.3013	0.1142	0.0242	18
19	0.1945	8.9501	58.3868	5.1417	46.0185	0.1117	0.0217	19
20	0.1784	9.1285	61.7770	5.6044	51.1601	0.1095	0.0195	20
21	0.1637	9.2922	65.0509	6.1088	56.7645	0.1076	0.0176	21
22	0.1502	9.4424	68.2048	6.6586	62.8733	0.1059	0.0159	22
23	0.1378	9.5802	71.2359	7.2579	69.5319	0.1044	0.0144	23
24	0.1264	9.7066	74.1433	7.9111	76.7898	0.1030	0.0130	24
25	0.1160	9.8226	76.9265	8.6231	84.7009	0.1018	0.0118	25
26	0.1064	9.9290	79.5863	9.3992	93.3240	0.1007	0.0107	26
27	0.0976	10.0266	82.1241	10.2451	102.7231	0.0997	0.0097	27
28	0.0895	10.1161	84.5419	11.1671	112.9682	0.0989	0.0089	28
29	0.0822	10.1983	86.8422	12.1722	124.1354	0.0981	0.0081	29
30	0.0754	10.2737	89.0280	13.2677	136.3075	0.0973	0.0073	30
31	0.0691	10.3428	91.1024	14.4618	149.5752	0.0967	0.0067	31
32	0.0634	10.4062	93.0690	15.7633	164.0370	0.0961	0.0061	32
33	0.0582	10.4644	94.9314	17.1820	179.8003	0.0956	0.0056	33
34	0.0534	10.5178	96.6935	18.7284	196.9823	0.0951	0.0051	34
35	0.0490	10.5668	98.3590	20.4140	215.7108	0.0946	0.0046	35
36	0.0449	10.6118	99.9319	22.2512	236.1247	0.0942	0.0042	36
37	0.0412	10.6530	101.4162	24.2538	258.3759	0.0939	0.0039	37
38	0.0378	10.6908	102.8158	26.4367	282.6298	0.0935	0.0035	38
39	0.0347	10.7255	104.1345	28.8160	309.0665	0.0932	0.0032	39
40	0.0318	10.7574	105.3762	31.4094	337.8824	0.0930	0.0030	40
41	0.0292	10.7866	106.5445	34.2363	369.2919	0.0927	0.0027	41
42	0.0268	10.8134	107.6432	37.3175	403.5281	0.0925	0.0025	42

INTEREST RATE = 9.00%							
n	(P/F)	(P/A)	(P/G)	(F/P)	(F/A)	(A/P)	(A/F)	n
43	0.0246	10.8380	108.6758	40.6761	440.8457	0.0923	0.0023	43
44	0.0226	10.8605	109.6456	44.3370	481.5218	0.0921	0.0021	44
45	0.0207	10.8812	110.5561	48.3273	525.8587	0.0919	0.0019	45
46	0.0190	10.9002	111.4103	52.6767	574.1860	0.0917	0.0017	46
47	0.0174	10.9176	112.2115	57.4176	626.8628	0.0916	0.0016	47
48	0.0160	10.9336	112.9625	62.5852	684.2804	0.0915	0.0015	48
49	0.0147	10.9482	113.6661	68.2179	746.8656	0.0913	0.0013	49
50	0.0134	10.9617	114.3251	74.3575	815.0836	0.0912	0.0012	50
51	0.0123	10.9740	114.9420	81.0497	889.4411	0.0911	0.0011	51
52	0.0113	10.9853	115.5193	88.3442	970.4908	0.0910	0.0010	52
53	0.0104	10.9957	116.0593	96.2951	1058.8349	0.0909	0.0009	53
54	0.0095	11.0053	116.5642	104.9617	1155.1301	0.0909	0.0009	54
55	0.0087	11.0140	117.0362	114.4083	1260.0918	0.0908	0.0008	55
56	0.0080	11.0220	117.4772	124.7050	1374.5001	0.0907	0.0007	56
57	0.0074	11.0294	117.8892	135.9285	1499.2051	0.0907	0.0007	57
58	0.0067	11.0361	118.2739	148.1620	1635.1335	0.0906	0.0006	58
59	0.0062	11.0423	118.6331	161.4966	1783.2955	0.0906	0.0006	59
60	0.0057	11.0480	118.9683	176.0313	1944.7921	0.0905	0.0005	60
65	0.0037	11.0701	120.3344	270.8460	2998.2885	0.0903	0.0003	65
70	0.0024	11.0844	121.2942	416.7301	4619.2232	0.0902	0.0002	70
75	0.0016	11.0938	121.9646	641.1909	7113.2321	0.0901	0.0001	75
80	0.0010	11.0998	122.4306	986.5517	10950.5741	0.0901	0.0001	80
85	0.0007	11.1038	122.7533	1517.9320	16854.8003	0.0901	0.0001	85
90	0.0004	11.1064	122.9758	2335.5266	25939.1842	0.0900	0.0000	90
95	0.0003	11.1080	123.1287	3593.4971	39916.6350	0.0900	0.0000	95
100	0.0002	11.1091	123.2335	5529.0408	61422.6755	0.0900	0.0000	100

INTEREST RATE = 10.00%							
n	(P/F)	(P/A)	(P/G)	(F/P)	(F/A)	(A/P)	(A/F)	N
1	0.9091	0.9091	0.0000	1.1000	1.0000	1.1000	1.0000	1
2	0.8264	1.7355	0.8264	1.2100	2.1000	0.5762	0.4762	2
3	0.7513	2.4869	2.3291	1.3310	3.3100	0.4021	0.3021	3
4	0.6830	3.1699	4.3781	1.4641	4.6410	0.3155	0.2155	4
5	0.6209	3.7908	6.8618	1.6105	6.1051	0.2638	0.1638	5
6	0.5645	4.3553	9.6842	1.7716	7.7156	0.2296	0.1296	6
7	0.5132	4.8684	12.7631	1.9487	9.4872	0.2054	0.1054	7
8	0.4665	5.3349	16.0287	2.1436	11.4359	0.1874	0.0874	8
9	0.4241	5.7590	19.4215	2.3579	13.5795	0.1736	0.0736	9
10	0.3855	6.1446	22.8913	2.5937	15.9374	0.1627	0.0627	10
11	0.3505	6.4951	26.3963	2.8531	18.5312	0.1540	0.0540	11
12	0.3186	6.8137	29.9012	3.1384	21.3843	0.1468	0.0468	12
13	0.2897	7.1034	33.3772	3.4523	24.5227	0.1408	0.0408	13
14	0.2633	7.3667	36.8005	3.7975	27.9750	0.1357	0.0357	14

INTEREST RATE = 10.00%							
n	(P/F)	(P/A)	(P/G)	(F/P)	(F/A)	(A/P)	(A/F)	N
15	0.2394	7.6061	40.1520	4.1772	31.7725	0.1315	0.0315	15
16	0.2176	7.8237	43.4164	4.5950	35.9497	0.1278	0.0278	16
17	0.1978	8.0216	46.5819	5.0545	40.5447	0.1247	0.0247	17
18	0.1799	8.2014	49.6395	5.5599	45.5992	0.1219	0.0219	18
19	0.1635	8.3649	52.5827	6.1159	51.1591	0.1195	0.0195	19
20	0.1486	8.5136	55.4069	6.7275	57.2750	0.1175	0.0175	20
21	0.1351	8.6487	58.1095	7.4002	64.0025	0.1156	0.0156	21
22	0.1228	8.7715	60.6893	8.1403	71.4027	0.1140	0.0140	22
23	0.1117	8.8832	63.1462	8.9543	79.5430	0.1126	0.0126	23
24	0.1015	8.9847	65.4813	9.8497	88.4973	0.1113	0.0113	24
25	0.0923	9.0770	67.6964	10.8347	98.3471	0.1102	0.0102	25
26	0.0839	9.1609	69.7940	11.9182	109.1818	0.1092	0.0092	26
27	0.0763	9.2372	71.7773	13.1100	121.0999	0.1083	0.0083	27
28	0.0693	9.3066	73.6495	14.4210	134.2099	0.1075	0.0075	28
29	0.0630	9.3696	75.4146	15.8631	148.6309	0.1067	0.0067	29
30	0.0573	9.4269	77.0766	17.4494	164.4940	0.1061	0.0061	30
31	0.0521	9.4790	78.6395	19.1943	181.9434	0.1055	0.0055	31
32	0.0474	9.5264	80.1078	21.1138	201.1378	0.1050	0.0050	32
33	0.0431	9.5694	81.4856	23.2252	222.2515	0.1045	0.0045	33
34	0.0391	9.6086	82.7773	25.5477	245.4767	0.1041	0.0041	34
35	0.0356	9.6442	83.9872	28.1024	271.0244	0.1037	0.0037	35
36	0.0323	9.6765	85.1194	30.9127	299.1268	0.1033	0.0033	36
37	0.0294	9.7059	86.1781	34.0039	330.0395	0.1030	0.0030	37
38	0.0267	9.7327	87.1673	37.4043	364.0434	0.1027	0.0027	38
39	0.0243	9.7570	88.0908	41.1448	401.4478	0.1025	0.0025	39
40	0.0221	9.7791	88.9525	45.2593	442.5926	0.1023	0.0023	40
41	0.0201	9.7991	89.7560	49.7852	487.8518	0.1020	0.0020	41
42	0.0183	9.8174	90.5047	54.7637	537.6370	0.1019	0.0019	42
43	0.0166	9.8340	91.2019	60.2401	592.4007	0.1017	0.0017	43
44	0.0151	9.8491	91.8508	66.2641	652.6408	0.1015	0.0015	44
45	0.0137	9.8628	92.4544	72.8905	718.9048	0.1014	0.0014	45
46	0.0125	9.8753	93.0157	80.1795	791.7953	0.1013	0.0013	46
47	0.0113	9.8866	93.5372	88.1975	871.9749	0.1011	0.0011	47
48	0.0103	9.8969	94.0217	97.0172	960.1723	0.1010	0.0010	48
49	0.0094	9.9063	94.4715	106.7190	1057.1896	0.1009	0.0009	49
50	0.0085	9.9148	94.8889	117.3909	1163.9085	0.1009	0.0009	50
51	0.0077	9.9226	95.2761	129.1299	1281.2994	0.1008	0.0008	51
52	0.0070	9.9296	95.6351	142.0429	1410.4293	0.1007	0.0007	52
53	0.0064	9.9360	95.9679	156.2472	1552.4723	0.1006	0.0006	53
54	0.0058	9.9418	96.2763	171.8719	1708.7195	0.1006	0.0006	54
55	0.0053	9.9471	96.5619	189.0591	1880.5914	0.1005	0.0005	55
56	0.0048	9.9519	96.8264	207.9651	2069.6506	0.1005	0.0005	56
57	0.0044	9.9563	97.0712	228.7616	2277.6156	0.1004	0.0004	57

INTEREST RATE = 10.00%							
n	(P/F)	(P/A)	(P/G)	(F/P)	(F/A)	(A/P)	(A/F)	N
58	0.0040	9.9603	97.2977	251.6377	2506.3772	0.1004	0.0004	58
59	0.0036	9.9639	97.5072	276.8015	2758.0149	0.1004	0.0004	59
60	0.0033	9.9672	97.7010	304.4816	3034.8164	0.1003	0.0003	60
65	0.0020	9.9796	98.4705	490.3707	4893.7073	0.1002	0.0002	65
70	0.0013	9.9873	98.9870	789.7470	7887.4696	0.1001	0.0001	70
75	0.0008	9.9921	99.3317	1271.8954	12708.9537	0.1001	0.0001	75
80	0.0005	9.9951	99.5606	2048.4002	20474.0021	0.1000	0.0000	80
85	0.0003	9.9970	99.7120	3298.9690	32979.6903	0.1000	0.0000	85
90	0.0002	9.9981	99.8118	5313.0226	53120.2261	0.1000	0.0000	90
95	0.0001	9.9988	99.8773	8556.6760	85556.7605	0.1000	0.0000	95
100	0.0001	9.9993	99.9202	13780.6123	137796.1234	0.1000	0.0000	100

INTEREST RATE = 12.00%							
n	(P/F)	(P/A)	(P/G)	(F/P)	(F/A)	(A/P)	(A/F)	n
1	0.8929	0.8929	0.0000	1.1200	1.0000	1.1200	1.0000	1
2	0.7972	1.6901	0.7972	1.2544	2.1200	0.5917	0.4717	2
3	0.7118	2.4018	2.2208	1.4049	3.3744	0.4163	0.2963	3
4	0.6355	3.0373	4.1273	1.5735	4.7793	0.3292	0.2092	4
5	0.5674	3.6048	6.3970	1.7623	6.3528	0.2774	0.1574	5
6	0.5066	4.1114	8.9302	1.9738	8.1152	0.2432	0.1232	6
7	0.4523	4.5638	11.6443	2.2107	10.0890	0.2191	0.0991	7
8	0.4039	4.9676	14.4714	2.4760	12.2997	0.2013	0.0813	8
9	0.3606	5.3282	17.3563	2.7731	14.7757	0.1877	0.0677	9
10	0.3220	5.6502	20.2541	3.1058	17.5487	0.1770	0.0570	10
11	0.2875	5.9377	23.1288	3.4785	20.6546	0.1684	0.0484	11
12	0.2567	6.1944	25.9523	3.8960	24.1331	0.1614	0.0414	12
13	0.2292	6.4235	28.7024	4.3635	28.0291	0.1557	0.0357	13
14	0.2046	6.6282	31.3624	4.8871	32.3926	0.1509	0.0309	14
15	0.1827	6.8109	33.9202	5.4736	37.2797	0.1468	0.0268	15
16	0.1631	6.9740	36.3670	6.1304	42.7533	0.1434	0.0234	16
17	0.1456	7.1196	38.6973	6.8660	48.8837	0.1405	0.0205	17
18	0.1300	7.2497	40.9080	7.6900	55.7497	0.1379	0.0179	18
19	0.1161	7.3658	42.9979	8.6128	63.4397	0.1358	0.0158	19
20	0.1037	7.4694	44.9676	9.6463	72.0524	0.1339	0.0139	20
21	0.0926	7.5620	46.8188	10.8038	81.6987	0.1322	0.0122	21
22	0.0826	7.6446	48.5543	12.1003	92.5026	0.1308	0.0108	22
23	0.0738	7.7184	50.1776	13.5523	104.6029	0.1296	0.0096	23
24	0.0659	7.7843	51.6929	15.1786	118.1552	0.1285	0.0085	24
25	0.0588	7.8431	53.1046	17.0001	133.3339	0.1275	0.0075	25
26	0.0525	7.8957	54.4177	19.0401	150.3339	0.1267	0.0067	26
27	0.0469	7.9426	55.6369	21.3249	169.3740	0.1259	0.0059	27
28	0.0419	7.9844	56.7674	23.8839	190.6989	0.1252	0.0052	28
29	0.0374	8.0218	57.8141	26.7499	214.5828	0.1247	0.0047	29

INTEREST RATE = 12.00%							
n	(P/F)	(P/A)	(P/G)	(F/P)	(F/A)	(A/P)	(A/F)	n
30	0.0334	8.0552	58.7821	29.9599	241.3327	0.1241	0.0041	30
31	0.0298	8.0850	59.6761	33.5551	271.2926	0.1237	0.0037	31
32	0.0266	8.1116	60.5010	37.5817	304.8477	0.1233	0.0033	32
33	0.0238	8.1354	61.2612	42.0915	342.4294	0.1229	0.0029	33
34	0.0212	8.1566	61.9612	47.1425	384.5210	0.1226	0.0026	34
35	0.0189	8.1755	62.6052	52.7996	431.6635	0.1223	0.0023	35
36	0.0169	8.1924	63.1970	59.1356	484.4631	0.1221	0.0021	36
37	0.0151	8.2075	63.7406	66.2318	543.5987	0.1218	0.0018	37
38	0.0135	8.2210	64.2394	74.1797	609.8305	0.1216	0.0016	38
39	0.0120	8.2330	64.6967	83.0812	684.0102	0.1215	0.0015	39
40	0.0107	8.2438	65.1159	93.0510	767.0914	0.1213	0.0013	40
41	0.0096	8.2534	65.4997	104.2171	860.1424	0.1212	0.0012	41
42	0.0086	8.2619	65.8509	116.7231	964.3595	0.1210	0.0010	42
43	0.0076	8.2696	66.1722	130.7299	1081.0826	0.1209	0.0009	43
44	0.0068	8.2764	66.4659	146.4175	1211.8125	0.1208	0.0008	44
45	0.0061	8.2825	66.7342	163.9876	1358.2300	0.1207	0.0007	45
46	0.0054	8.2880	66.9792	183.6661	1522.2176	0.1207	0.0007	46
47	0.0049	8.2928	67.2028	205.7061	1705.8838	0.1206	0.0006	47
48	0.0043	8.2972	67.4068	230.3908	1911.5898	0.1205	0.0005	48
49	0.0039	8.3010	67.5929	258.0377	2141.9806	0.1205	0.0005	49
50	0.0035	8.3045	67.7624	289.0022	2400.0182	0.1204	0.0004	50
51	0.0031	8.3076	67.9169	323.6825	2689.0204	0.1204	0.0004	51
52	0.0028	8.3103	68.0576	362.5243	3012.7029	0.1203	0.0003	52
53	0.0025	8.3128	68.1856	406.0273	3375.2272	0.1203	0.0003	53
54	0.0022	8.3150	68.3022	454.7505	3781.2545	0.1203	0.0003	54
55	0.0020	8.3170	68.4082	509.3206	4236.0050	0.1202	0.0002	55
56	0.0018	8.3187	68.5046	570.4391	4745.3257	0.1202	0.0002	56
57	0.0016	8.3203	68.5923	638.8918	5315.7647	0.1202	0.0002	57
58	0.0014	8.3217	68.6719	715.5588	5954.6565	0.1202	0.0002	58
59	0.0012	8.3229	68.7443	801.4258	6670.2153	0.1201	0.0001	59
60	0.0011	8.3240	68.8100	897.5969	7471.6411	0.1201	0.0001	60
65	0.0006	8.3281	69.0581	1581.8725	13173.9374	0.1201	0.0001	65
70	0.0004	8.3303	69.2103	2787.7998	23223.3319	0.1200	0.0000	70
75	0.0002	8.3316	69.3031	4913.0558	40933.7987	0.1200	0.0000	75
80	0.0001	8.3324	69.3594	8658.4831	72145.6925	0.1200	0.0000	80
85	0.0001	8.3328	69.3935	15259.2057	127151.7140	0.1200	0.0000	85
90	0.0000	8.3330	69.4140	26891.9342	224091.1185	0.1200	0.0000	90
95	0.0000	8.3332	69.4263	47392.7766	394931.4719	0.1200	0.0000	95
100	0.0000	8.3332	69.4336	83522.2657	696010.5477	0.1200	0.0000	100

INTEREST RATE = 14.00%							
n	(P/F)	(P/A)	(P/G)	(F/P)	(F/A)	(A/P)	(A/F)	n
1	0.8772	0.8772	0.0000	1.1400	1.0000	1.1400	1.0000	1
2	0.7695	1.6467	0.7695	1.2996	2.1400	0.6073	0.4673	2
3	0.6750	2.3216	2.1194	1.4815	3.4396	0.4307	0.2907	3
4	0.5921	2.9137	3.8957	1.6890	4.9211	0.3432	0.2032	4
5	0.5194	3.4331	5.9731	1.9254	6.6101	0.2913	0.1513	5
6	0.4556	3.8887	8.2511	2.1950	8.5355	0.2572	0.1172	6
7	0.3996	4.2883	10.6489	2.5023	10.7305	0.2332	0.0932	7
8	0.3506	4.6389	13.1028	2.8526	13.2328	0.2156	0.0756	8
9	0.3075	4.9464	15.5629	3.2519	16.0853	0.2022	0.0622	9
10	0.2697	5.2161	17.9906	3.7072	19.3373	0.1917	0.0517	10
11	0.2366	5.4527	20.3567	4.2262	23.0445	0.1834	0.0434	11
12	0.2076	5.6603	22.6399	4.8179	27.2707	0.1767	0.0367	12
13	0.1821	5.8424	24.8247	5.4924	32.0887	0.1712	0.0312	13
14	0.1597	6.0021	26.9009	6.2613	37.5811	0.1666	0.0266	14
15	0.1401	6.1422	28.8623	7.1379	43.8424	0.1628	0.0228	15
16	0.1229	6.2651	30.7057	8.1372	50.9804	0.1596	0.0196	16
17	0.1078	6.3729	32.4305	9.2765	59.1176	0.1569	0.0169	17
18	0.0946	6.4674	34.0380	10.5752	68.3941	0.1546	0.0146	18
19	0.0829	6.5504	35.5311	12.0557	78.9692	0.1527	0.0127	19
20	0.0728	6.6231	36.9135	13.7435	91.0249	0.1510	0.0110	20
21	0.0638	6.6870	38.1901	15.6676	104.7684	0.1495	0.0095	21
22	0.0560	6.7429	39.3658	17.8610	120.4360	0.1483	0.0083	22
23	0.0491	6.7921	40.4463	20.3616	138.2970	0.1472	0.0072	23
24	0.0431	6.8351	41.4371	23.2122	158.6586	0.1463	0.0063	24
25	0.0378	6.8729	42.3441	26.4619	181.8708	0.1455	0.0055	25
26	0.0331	6.9061	43.1728	30.1666	208.3327	0.1448	0.0048	26
27	0.0291	6.9352	43.9289	34.3899	238.4993	0.1442	0.0042	27
28	0.0255	6.9607	44.6176	39.2045	272.8892	0.1437	0.0037	28
29	0.0224	6.9830	45.2441	44.6931	312.0937	0.1432	0.0032	29
30	0.0196	7.0027	45.8132	50.9502	356.7868	0.1428	0.0028	30
31	0.0172	7.0199	46.3297	58.0832	407.7370	0.1425	0.0025	31
32	0.0151	7.0350	46.7979	66.2148	465.8202	0.1421	0.0021	32
33	0.0132	7.0482	47.2218	75.4849	532.0350	0.1419	0.0019	33
34	0.0116	7.0599	47.6053	86.0528	607.5199	0.1416	0.0016	34
35	0.0102	7.0700	47.9519	98.1002	693.5727	0.1414	0.0014	35
36	0.0089	7.0790	48.2649	111.8342	791.6729	0.1413	0.0013	36
37	0.0078	7.0868	48.5472	127.4910	903.5071	0.1411	0.0011	37
38	0.0069	7.0937	48.8018	145.3397	1030.9981	0.1410	0.0010	38
39	0.0060	7.0997	49.0312	165.6873	1176.3378	0.1409	0.0009	39
40	0.0053	7.1050	49.2376	188.8835	1342.0251	0.1407	0.0007	40
41	0.0046	7.1097	49.4234	215.3272	1530.9086	0.1407	0.0007	41
42	0.0041	7.1138	49.5904	245.4730	1746.2358	0.1406	0.0006	42

INTEREST RATE = 14.00%

n	(P/F)	(P/A)	(P/G)	(F/P)	(F/A)	(A/P)	(A/F)	n
43	0.0036	7.1173	49.7405	279.8392	1991.7088	0.1405	0.0005	43
44	0.0031	7.1205	49.8753	319.0167	2271.5481	0.1404	0.0004	44
45	0.0027	7.1232	49.9963	363.6791	2590.5648	0.1404	0.0004	45
46	0.0024	7.1256	50.1048	414.5941	2954.2439	0.1403	0.0003	46
47	0.0021	7.1277	50.2022	472.6373	3368.8380	0.1403	0.0003	47
48	0.0019	7.1296	50.2894	538.8065	3841.4753	0.1403	0.0003	48
49	0.0016	7.1312	50.3675	614.2395	4380.2819	0.1402	0.0002	49
50	0.0014	7.1327	50.4375	700.2330	4994.5213	0.1402	0.0002	50
51	0.0013	7.1339	50.5001	798.2656	5694.7543	0.1402	0.0002	51
52	0.0011	7.1350	50.5562	910.0228	6493.0199	0.1402	0.0002	52
53	0.0010	7.1360	50.6063	1037.4260	7403.0427	0.1401	0.0001	53
54	0.0008	7.1368	50.6511	1182.6656	8440.4687	0.1401	0.0001	54
55	0.0007	7.1376	50.6912	1348.2388	9623.1343	0.1401	0.0001	55
56	0.0007	7.1382	50.7270	1536.9922	10971.3731	0.1401	0.0001	56
57	0.0006	7.1388	50.7589	1752.1712	12508.3654	0.1401	0.0001	57
58	0.0005	7.1393	50.7875	1997.4751	14260.5365	0.1401	0.0001	58
59	0.0004	7.1397	50.8129	2277.1216	16258.0117	0.1401	0.0001	59
60	0.0004	7.1401	50.8357	2595.9187	18535.1333	0.1401	0.0001	60
65	0.0002	7.1414	50.9173	4998.2196	35694.4260	0.1400	0.0000	65
70	0.0001	7.1421	50.9632	9623.6450	68733.1785	0.1400	0.0000	70
75	0.0001	7.1425	50.9887	18529.5064	132346.4742	0.1400	0.0000	75
80	0.0000	7.1427	51.0030	35676.9818	254828.4415	0.1400	0.0000	80
85	0.0000	7.1428	51.0108	68692.9810	490657.0073	0.1400	0.0000	85
90	0.0000	7.1428	51.0152	132262.4674	944724.7670	0.1400	0.0000	90
95	0.0000	7.1428	51.0175	254660.0834	1818993.4528	0.1400	0.0000	95
100	0.0000	7.1428	51.0188	490326.2381	3502323.1295	0.1400	0.0000	100

INTEREST RATE = 15.00%

n	(P/F)	(P/A)	(P/G)	(F/P)	(F/A)	(A/P)	(A/F)	n
1	0.8696	0.8696	-0.0000	1.1500	1.0000	1.1500	1.0000	1
2	0.7561	1.6257	0.7561	1.3225	2.1500	0.6151	0.4651	2
3	0.6575	2.2832	2.0712	1.5209	3.4725	0.4380	0.2880	3
4	0.5718	2.8550	3.7864	1.7490	4.9934	0.3503	0.2003	4
5	0.4972	3.3522	5.7751	2.0114	6.7424	0.2983	0.1483	5
6	0.4323	3.7845	7.9368	2.3131	8.7537	0.2642	0.1142	6
7	0.3759	4.1604	10.1924	2.6600	11.0668	0.2404	0.0904	7
8	0.3269	4.4873	12.4807	3.0590	13.7268	0.2229	0.0729	8
9	0.2843	4.7716	14.7548	3.5179	16.7858	0.2096	0.0596	9
10	0.2472	5.0188	16.9795	4.0456	20.3037	0.1993	0.0493	10
11	0.2149	5.2337	19.1289	4.6524	24.3493	0.1911	0.0411	11
12	0.1869	5.4206	21.1849	5.3503	29.0017	0.1845	0.0345	12
13	0.1625	5.5831	23.1352	6.1528	34.3519	0.1791	0.0291	13
14	0.1413	5.7245	24.9725	7.0757	40.5047	0.1747	0.0247	14

INTEREST RATE = 15.00%							
n	(P/F)	(P/A)	(P/G)	(F/P)	(F/A)	(A/P)	(A/F)	n
15	0.1229	5.8474	26.6930	8.1371	47.5804	0.1710	0.0210	15
16	0.1069	5.9542	28.2960	9.3576	55.7175	0.1679	0.0179	16
17	0.0929	6.0472	29.7828	10.7613	65.0751	0.1654	0.0154	17
18	0.0808	6.1280	31.1565	12.3755	75.8364	0.1632	0.0132	18
19	0.0703	6.1982	32.4213	14.2318	88.2118	0.1613	0.0113	19
20	0.0611	6.2593	33.5822	16.3665	102.4436	0.1598	0.0098	20
21	0.0531	6.3125	34.6448	18.8215	118.8101	0.1584	0.0084	21
22	0.0462	6.3587	35.6150	21.6447	137.6316	0.1573	0.0073	22
23	0.0402	6.3988	36.4988	24.8915	159.2764	0.1563	0.0063	23
24	0.0349	6.4338	37.3023	28.6252	184.1678	0.1554	0.0054	24
25	0.0304	6.4641	38.0314	32.9190	212.7930	0.1547	0.0047	25
26	0.0264	6.4906	38.6918	37.8568	245.7120	0.1541	0.0041	26
27	0.0230	6.5135	39.2890	43.5353	283.5688	0.1535	0.0035	27
28	0.0200	6.5335	39.8283	50.0656	327.1041	0.1531	0.0031	28
29	0.0174	6.5509	40.3146	57.5755	377.1697	0.1527	0.0027	29
30	0.0151	6.5660	40.7526	66.2118	434.7451	0.1523	0.0023	30
31	0.0131	6.5791	41.1466	76.1435	500.9569	0.1520	0.0020	31
32	0.0114	6.5905	41.5006	87.5651	577.1005	0.1517	0.0017	32
33	0.0099	6.6005	41.8184	100.6998	664.6655	0.1515	0.0015	33
34	0.0086	6.6091	42.1033	115.8048	765.3654	0.1513	0.0013	34
35	0.0075	6.6166	42.3586	133.1755	881.1702	0.1511	0.0011	35
36	0.0065	6.6231	42.5872	153.1519	1014.3457	0.1510	0.0010	36
37	0.0057	6.6288	42.7916	176.1246	1167.4975	0.1509	0.0009	37
38	0.0049	6.6338	42.9743	202.5433	1343.6222	0.1507	0.0007	38
39	0.0043	6.6380	43.1374	232.9248	1546.1655	0.1506	0.0006	39
40	0.0037	6.6418	43.2830	267.8635	1779.0903	0.1506	0.0006	40
41	0.0032	6.6450	43.4128	308.0431	2046.9539	0.1505	0.0005	41
42	0.0028	6.6478	43.5286	354.2495	2354.9969	0.1504	0.0004	42
43	0.0025	6.6503	43.6317	407.3870	2709.2465	0.1504	0.0004	43
44	0.0021	6.6524	43.7235	468.4950	3116.6334	0.1503	0.0003	44
45	0.0019	6.6543	43.8051	538.7693	3585.1285	0.1503	0.0003	45
46	0.0016	6.6559	43.8778	619.5847	4123.8977	0.1502	0.0002	46
47	0.0014	6.6573	43.9423	712.5224	4743.4824	0.1502	0.0002	47
48	0.0012	6.6585	43.9997	819.4007	5456.0047	0.1502	0.0002	48
49	0.0011	6.6596	44.0506	942.3108	6275.4055	0.1502	0.0002	49
50	0.0009	6.6605	44.0958	1083.6574	7217.7163	0.1501	0.0001	50
51	0.0008	6.6613	44.1360	1246.2061	8301.3737	0.1501	0.0001	51
52	0.0007	6.6620	44.1715	1433.1370	9547.5798	0.1501	0.0001	52
53	0.0006	6.6626	44.2031	1648.1075	10980.7167	0.1501	0.0001	53
54	0.0005	6.6631	44.2311	1895.3236	12628.8243	0.1501	0.0001	54
55	0.0005	6.6636	44.2558	2179.6222	14524.1479	0.1501	0.0001	55
56	0.0004	6.6640	44.2778	2506.5655	16703.7701	0.1501	0.0001	56
57	0.0003	6.6644	44.2972	2882.5503	19210.3356	0.1501	0.0001	57
58	0.0003	6.6647	44.3144	3314.9329	22092.8859	0.1500	0.0000	58

INTEREST RATE = 15.00%

n	(P/F)	(P/A)	(P/G)	(F/P)	(F/A)	(A/P)	(A/F)	n
59	0.0003	6.6649	44.3296	3812.1728	25407.8188	0.1500	0.0000	59
60	0.0002	6.6651	44.3431	4383.9987	29219.9916	0.1500	0.0000	60
65	0.0001	6.6659	44.3903	8817.7874	58778.5826	0.1500	0.0000	65
70	0.0001	6.6663	44.4156	17735.7200	118231.4669	0.1500	0.0000	70
75	0.0000	6.6665	44.4292	35672.8680	237812.4532	0.1500	0.0000	75
80	0.0000	6.6666	44.4364	71750.8794	478332.5293	0.1500	0.0000	80
85	0.0000	6.6666	44.4402	144316.6470	962104.3133	0.1500	0.0000	85
90	0.0000	6.6666	44.4422	290272.3252	1935142.1680	0.1500	0.0000	90
95	0.0000	6.6667	44.4433	583841.3276	3892268.8509	0.1500	0.0000	95
100	0.0000	6.6667	44.4438	1174313.4507	7828749.6713	0.1500	0.0000	100

INTEREST RATE = 25.00%

n	(P/F)	(P/A)	(P/G)	(F/P)	(F/A)	(A/P)	(A/F)	n
1	0.8000	0.8000	0.0000	1.2500	1.0000	1.2500	1.0000	1
2	0.6400	1.4400	0.6400	1.5625	2.2500	0.6944	0.4444	2
3	0.5120	1.9520	1.6640	1.9531	3.8125	0.5123	0.2623	3
4	0.4096	2.3616	2.8928	2.4414	5.7656	0.4234	0.1734	4
5	0.3277	2.6893	4.2035	3.0518	8.2070	0.3718	0.1218	5
6	0.2621	2.9514	5.5142	3.8147	11.2588	0.3388	0.0888	6
7	0.2097	3.1611	6.7725	4.7684	15.0735	0.3163	0.0663	7
8	0.1678	3.3289	7.9469	5.9605	19.8419	0.3004	0.0504	8
9	0.1342	3.4631	9.0207	7.4506	25.8023	0.2888	0.0388	9
10	0.1074	3.5705	9.9870	9.3132	33.2529	0.2801	0.0301	10
11	0.0859	3.6564	10.8460	11.6415	42.5661	0.2735	0.0235	11
12	0.0687	3.7251	11.6020	14.5519	54.2077	0.2684	0.0184	12
13	0.0550	3.7801	12.2617	18.1899	68.7596	0.2645	0.0145	13
14	0.0440	3.8241	12.8334	22.7374	86.9495	0.2615	0.0115	14
15	0.0352	3.8593	13.3260	28.4217	109.6868	0.2591	0.0091	15
16	0.0281	3.8874	13.7482	35.5271	138.1085	0.2572	0.0072	16
17	0.0225	3.9099	14.1085	44.4089	173.6357	0.2558	0.0058	17
18	0.0180	3.9279	14.4147	55.5112	218.0446	0.2546	0.0046	18
19	0.0144	3.9424	14.6741	69.3889	273.5558	0.2537	0.0037	19
20	0.0115	3.9539	14.8932	86.7362	342.9447	0.2529	0.0029	20
21	0.0092	3.9631	15.0777	108.4202	429.6809	0.2523	0.0023	21
22	0.0074	3.9705	15.2326	135.5253	538.1011	0.2519	0.0019	22
23	0.0059	3.9764	15.3625	169.4066	673.6264	0.2515	0.0015	23
24	0.0047	3.9811	15.4711	211.7582	843.0329	0.2512	0.0012	24
25	0.0038	3.9849	15.5618	264.6978	1054.7912	0.2509	0.0009	25
26	0.0030	3.9879	15.6373	330.8722	1319.4890	0.2508	0.0008	26
27	0.0024	3.9903	15.7002	413.5903	1650.3612	0.2506	0.0006	27
28	0.0019	3.9923	15.7524	516.9879	2063.9515	0.2505	0.0005	28
29	0.0015	3.9938	15.7957	646.2349	2580.9394	0.2504	0.0004	29
30	0.0012	3.9950	15.8316	807.7936	3227.1743	0.2503	0.0003	30

INTEREST RATE = 25.00%							
n	(P/F)	(P/A)	(P/G)	(F/P)	(F/A)	(A/P)	(A/F)	n
31	0.0010	3.9960	15.8614	1009.7420	4034.9678	0.2502	0.0002	31
32	0.0008	3.9968	15.8859	1262.1774	5044.7098	0.2502	0.0002	32
33	0.0006	3.9975	15.9062	1577.7218	6306.8872	0.2502	0.0002	33
34	0.0005	3.9980	15.9229	1972.1523	7884.6091	0.2501	0.0001	34
35	0.0004	3.9984	15.9367	2465.1903	9856.7613	0.2501	0.0001	35
36	0.0003	3.9987	15.9481	3081.4879	12321.9516	0.2501	0.0001	36
37	0.0003	3.9990	15.9574	3851.8599	15403.4396	0.2501	0.0001	37
38	0.0002	3.9992	15.9651	4814.8249	19255.2994	0.2501	0.0001	38
39	0.0002	3.9993	15.9714	6018.5311	24070.1243	0.2500	0.0000	39
40	0.0001	3.9995	15.9766	7523.1638	30088.6554	0.2500	0.0000	40
41	0.0001	3.9996	15.9809	9403.9548	37611.8192	0.2500	0.0000	41
42	0.0001	3.9997	15.9843	11754.9435	47015.7740	0.2500	0.0000	42
43	0.0001	3.9997	15.9872	14693.6794	58770.7175	0.2500	0.0000	43
44	0.0001	3.9998	15.9895	18367.0992	73464.3969	0.2500	0.0000	44
45	0.0000	3.9998	15.9915	22958.8740	91831.4962	0.2500	0.0000	45
46	0.0000	3.9999	15.9930	28698.5925	114790.3702	0.2500	0.0000	46
47	0.0000	3.9999	15.9943	35873.2407	143488.9627	0.2500	0.0000	47
48	0.0000	3.9999	15.9954	44841.5509	179362.2034	0.2500	0.0000	48
49	0.0000	3.9999	15.9962	56051.9386	224203.7543	0.2500	0.0000	49
50	0.0000	3.9999	15.9969	70064.9232	280255.6929	0.2500	0.0000	50
51	0.0000	4.0000	15.9975	87581.1540	350320.6161	0.2500	0.0000	51
52	0.0000	4.0000	15.9980	109476.4425	437901.7701	0.2500	0.0000	52
53	0.0000	4.0000	15.9983	136845.5532	547378.2126	0.2500	0.0000	53
54	0.0000	4.0000	15.9986	171056.9414	684223.7658	0.2500	0.0000	54
55	0.0000	4.0000	15.9989	213821.1768	855280.7072	0.2500	0.0000	55
56	0.0000	4.0000	15.9991	267276.4710	1069101.8840	0.2500	0.0000	56
57	0.0000	4.0000	15.9993	334095.5888	1336378.3550	0.2500	0.0000	57
58	0.0000	4.0000	15.9994	417619.4860	1670473.9438	0.2500	0.0000	58
59	0.0000	4.0000	15.9995	522024.3574	2088093.4298	0.2500	0.0000	59
60	0.0000	4.0000	15.9996	652530.4468	2610117.7872	0.2500	0.0000	60
65	0.0000	4.0000	15.9999	1991364.8889	7965455.5557	0.2500	0.0000	65
70	0.0000	4.0000	16.0000	6077163.3573	24308649.4291	0.2500	0.0000	70
75	0.0000	4.0000	16.0000	18546030.7534	74184119.0137	0.2500	0.0000	75
80	0.0000	4.0000	16.0000	56597994.2427	226391972.9707	0.2500	0.0000	80
85	0.0000	4.0000	16.0000	172723371.1019	690893480.4076	0.2500	0.0000	85
90	0.0000	4.0000	16.0000	527109897.1615	2108439584.6461	0.2500	0.0000	90
95	0.0000	4.0000	16.0000	1608611746.7088	6434446982.8350	0.2500	0.0000	95
100	0.0000	4.0000	16.0000	4909093465.2977	19636373857.1909	0.2500	0.0000	100

INTEREST RATE = 4.00%							
n	(P/F)	(P/A)	(P/G)	(F/P)	(F/A)	(A/P)	(A/F)	N
1	0.9615	0.9615	0.0000	1.0400	1.0000	1.0400	1.0000	1
2	0.9246	1.8861	0.9246	1.0816	2.0400	0.5302	0.4902	2
3	0.8890	2.7751	2.7025	1.1249	3.1216	0.3603	0.3203	3
4	0.8548	3.6299	5.2670	1.1699	4.2465	0.2755	0.2355	4
5	0.8219	4.4518	8.5547	1.2167	5.4163	0.2246	0.1846	5
6	0.7903	5.2421	12.5062	1.2653	6.6330	0.1908	0.1508	6
7	0.7599	6.0021	17.0657	1.3159	7.8983	0.1666	0.1266	7
8	0.7307	6.7327	22.1806	1.3686	9.2142	0.1485	0.1085	8
9	0.7026	7.4353	27.8013	1.4233	10.5828	0.1345	0.0945	9
10	0.6756	8.1109	33.8814	1.4802	12.0061	0.1233	0.0833	10
11	0.6496	8.7605	40.3772	1.5395	13.4864	0.1141	0.0741	11
12	0.6246	9.3851	47.2477	1.6010	15.0258	0.1066	0.0666	12
13	0.6006	9.9856	54.4546	1.6651	16.6268	0.1001	0.0601	13
14	0.5775	10.5631	61.9618	1.7317	18.2919	0.0947	0.0547	14
15	0.5553	11.1184	69.7355	1.8009	20.0236	0.0899	0.0499	15
16	0.5339	11.6523	77.7441	1.8730	21.8245	0.0858	0.0458	16
17	0.5134	12.1657	85.9581	1.9479	23.6975	0.0822	0.0422	17
18	0.4936	12.6593	94.3498	2.0258	25.6454	0.0790	0.0390	18
19	0.4746	13.1339	102.8933	2.1068	27.6712	0.0761	0.0361	19
20	0.4564	13.5903	111.5647	2.1911	29.7781	0.0736	0.0336	20
21	0.4388	14.0292	120.3414	2.2788	31.9692	0.0713	0.0313	21
22	0.4220	14.4511	129.2024	2.3699	34.2480	0.0692	0.0292	22
23	0.4057	14.8568	138.1284	2.4647	36.6179	0.0673	0.0273	23
24	0.3901	15.2470	147.1012	2.5633	39.0826	0.0656	0.0256	24
25	0.3751	15.6221	156.1040	2.6658	41.6459	0.0640	0.0240	25
26	0.3607	15.9828	165.1212	2.7725	44.3117	0.0626	0.0226	26
27	0.3468	16.3296	174.1385	2.8834	47.0842	0.0612	0.0212	27
28	0.3335	16.6631	183.1424	2.9987	49.9676	0.0600	0.0200	28
29	0.3207	16.9837	192.1206	3.1187	52.9663	0.0589	0.0189	29
30	0.3083	17.2920	201.0618	3.2434	56.0849	0.0578	0.0178	30
Alternative 1	0.04							
1200000	84000	84000	1800	140000				
74198.616								
Alternative 2	0.04							
900000	350000	290000	1000	280000				
69382.383								

INTEREST RATE = 4.00%							
n	(P/F)	(P/A)	(P/G)	(F/P)	(F/A)	(A/P)	(A/F)	n
1	0.9615	0.9615	0.0000	1.0400	1.0000	1.0400	1.0000	1
2	0.9246	1.8861	0.9246	1.0816	2.0400	0.5302	0.4902	2
3	0.8890	2.7751	2.7025	1.1249	3.1216	0.3603	0.3203	3
4	0.8548	3.6299	5.2670	1.1699	4.2465	0.2755	0.2355	4
5	0.8219	4.4518	8.5547	1.2167	5.4163	0.2246	0.1846	5
6	0.7903	5.2421	12.5062	1.2653	6.6330	0.1908	0.1508	6
7	0.7599	6.0021	17.0657	1.3159	7.8983	0.1666	0.1266	7
8	0.7307	6.7327	22.1806	1.3686	9.2142	0.1485	0.1085	8
9	0.7026	7.4353	27.8013	1.4233	10.5828	0.1345	0.0945	9
10	0.6756	8.1109	33.8814	1.4802	12.0061	0.1233	0.0833	10
11	0.6496	8.7605	40.3772	1.5395	13.4864	0.1141	0.0741	11
12	0.6246	9.3851	47.2477	1.6010	15.0258	0.1066	0.0666	12
13	0.6006	9.9856	54.4546	1.6651	16.6268	0.1001	0.0601	13
14	0.5775	10.5631	61.9618	1.7317	18.2919	0.0947	0.0547	14
15	0.5553	11.1184	69.7355	1.8009	20.0236	0.0899	0.0499	15
16	0.5339	11.6523	77.7441	1.8730	21.8245	0.0858	0.0458	16
17	0.5134	12.1657	85.9581	1.9479	23.6975	0.0822	0.0422	17
18	0.4936	12.6593	94.3498	2.0258	25.6454	0.0790	0.0390	18
19	0.4746	13.1339	102.8933	2.1068	27.6712	0.0761	0.0361	19
20	0.4564	13.5903	111.5647	2.1911	29.7781	0.0736	0.0336	20
21	0.4388	14.0292	120.3414	2.2788	31.9692	0.0713	0.0313	21
22	0.4220	14.4511	129.2024	2.3699	34.2480	0.0692	0.0292	22
23	0.4057	14.8568	138.1284	2.4647	36.6179	0.0673	0.0273	23
24	0.3901	15.2470	147.1012	2.5633	39.0826	0.0656	0.0256	24
25	0.3751	15.6221	156.1040	2.6658	41.6459	0.0640	0.0240	25
26	0.3607	15.9828	165.1212	2.7725	44.3117	0.0626	0.0226	26
27	0.3468	16.3296	174.1385	2.8834	47.0842	0.0612	0.0212	27
28	0.3335	16.6631	183.1424	2.9987	49.9676	0.0600	0.0200	28
29	0.3207	16.9837	192.1206	3.1187	52.9663	0.0589	0.0189	29
30	0.3083	17.2920	201.0618	3.2434	56.0849	0.0578	0.0178	30
Alternative 1	0.04						
1200000	84000	84000	1800	140000			
74198.616							
Alternative 2	0.04						
900000	350000	290000	1000	280000			
69382.383							

INTEREST RATE = 4.00%							
n	(P/F)	(P/A)	(P/G)	(F/P)	(F/A)	(A/P)	(A/F)	n
1	0.9615	0.9615	0.0000	1.0400	1.0000	1.0400	1.0000	1
2	0.9246	1.8861	0.9246	1.0816	2.0400	0.5302	0.4902	2
3	0.8890	2.7751	2.7025	1.1249	3.1216	0.3603	0.3203	3
4	0.8548	3.6299	5.2670	1.1699	4.2465	0.2755	0.2355	4
5	0.8219	4.4518	8.5547	1.2167	5.4163	0.2246	0.1846	5
6	0.7903	5.2421	12.5062	1.2653	6.6330	0.1908	0.1508	6
7	0.7599	6.0021	17.0657	1.3159	7.8983	0.1666	0.1266	7
8	0.7307	6.7327	22.1806	1.3686	9.2142	0.1485	0.1085	8
9	0.7026	7.4353	27.8013	1.4233	10.5828	0.1345	0.0945	9
10	0.6756	8.1109	33.8814	1.4802	12.0061	0.1233	0.0833	10
11	0.6496	8.7605	40.3772	1.5395	13.4864	0.1141	0.0741	11
12	0.6246	9.3851	47.2477	1.6010	15.0258	0.1066	0.0666	12
13	0.6006	9.9856	54.4546	1.6651	16.6268	0.1001	0.0601	13
14	0.5775	10.5631	61.9618	1.7317	18.2919	0.0947	0.0547	14
15	0.5553	11.1184	69.7355	1.8009	20.0236	0.0899	0.0499	15
16	0.5339	11.6523	77.7441	1.8730	21.8245	0.0858	0.0458	16
17	0.5134	12.1657	85.9581	1.9479	23.6975	0.0822	0.0422	17
18	0.4936	12.6593	94.3498	2.0258	25.6454	0.0790	0.0390	18
19	0.4746	13.1339	102.8933	2.1068	27.6712	0.0761	0.0361	19
20	0.4564	13.5903	111.5647	2.1911	29.7781	0.0736	0.0336	20
21	0.4388	14.0292	120.3414	2.2788	31.9692	0.0713	0.0313	21
22	0.4220	14.4511	129.2024	2.3699	34.2480	0.0692	0.0292	22
23	0.4057	14.8568	138.1284	2.4647	36.6179	0.0673	0.0273	23
24	0.3901	15.2470	147.1012	2.5633	39.0826	0.0656	0.0256	24
25	0.3751	15.6221	156.1040	2.6658	41.6459	0.0640	0.0240	25
26	0.3607	15.9828	165.1212	2.7725	44.3117	0.0626	0.0226	26
27	0.3468	16.3296	174.1385	2.8834	47.0842	0.0612	0.0212	27
28	0.3335	16.6631	183.1424	2.9987	49.9676	0.0600	0.0200	28
29	0.3207	16.9837	192.1206	3.1187	52.9663	0.0589	0.0189	29
30	0.3083	17.2920	201.0618	3.2434	56.0849	0.0578	0.0178	30
Alternative 1	0.04							
97000	97000	483000	266000	16000	4000	132000		
41649.477								
Alternative 2	0.04							
483000	306000	266000	4000	1600	132000			
45534.979								

INTEREST RATE = 4.00%							
n	(P/F)	(P/A)	(P/G)	(F/P)	(F/A)	(A/P)	(A/F)	n
1	0.9615	0.9615	0.0000	1.0400	1.0000	1.0400	1.0000	1
2	0.9246	1.8861	0.9246	1.0816	2.0400	0.5302	0.4902	2
3	0.8890	2.7751	2.7025	1.1249	3.1216	0.3603	0.3203	3
4	0.8548	3.6299	5.2670	1.1699	4.2465	0.2755	0.2355	4
5	0.8219	4.4518	8.5547	1.2167	5.4163	0.2246	0.1846	5
6	0.7903	5.2421	12.5062	1.2653	6.6330	0.1908	0.1508	6
7	0.7599	6.0021	17.0657	1.3159	7.8983	0.1666	0.1266	7
8	0.7307	6.7327	22.1806	1.3686	9.2142	0.1485	0.1085	8
9	0.7026	7.4353	27.8013	1.4233	10.5828	0.1345	0.0945	9
10	0.6756	8.1109	33.8814	1.4802	12.0061	0.1233	0.0833	10
11	0.6496	8.7605	40.3772	1.5395	13.4864	0.1141	0.0741	11
12	0.6246	9.3851	47.2477	1.6010	15.0258	0.1066	0.0666	12
13	0.6006	9.9856	54.4546	1.6651	16.6268	0.1001	0.0601	13
14	0.5775	10.5631	61.9618	1.7317	18.2919	0.0947	0.0547	14
15	0.5553	11.1184	69.7355	1.8009	20.0236	0.0899	0.0499	15
16	0.5339	11.6523	77.7441	1.8730	21.8245	0.0858	0.0458	16
17	0.5134	12.1657	85.9581	1.9479	23.6975	0.0822	0.0422	17
18	0.4936	12.6593	94.3498	2.0258	25.6454	0.0790	0.0390	18
19	0.4746	13.1339	102.8933	2.1068	27.6712	0.0761	0.0361	19
20	0.4564	13.5903	111.5647	2.1911	29.7781	0.0736	0.0336	20
21	0.4388	14.0292	120.3414	2.2788	31.9692	0.0713	0.0313	21
22	0.4220	14.4511	129.2024	2.3699	34.2480	0.0692	0.0292	22
23	0.4057	14.8568	138.1284	2.4647	36.6179	0.0673	0.0273	23
24	0.3901	15.2470	147.1012	2.5633	39.0826	0.0656	0.0256	24
25	0.3751	15.6221	156.1040	2.6658	41.6459	0.0640	0.0240	25
26	0.3607	15.9828	165.1212	2.7725	44.3117	0.0626	0.0226	26
27	0.3468	16.3296	174.1385	2.8834	47.0842	0.0612	0.0212	27
28	0.3335	16.6631	183.1424	2.9987	49.9676	0.0600	0.0200	28
29	0.3207	16.9837	192.1206	3.1187	52.9663	0.0589	0.0189	29
30	0.3083	17.2920	201.0618	3.2434	56.0849	0.0578	0.0178	30
Alternative 2	0.04						
900000	350000	290000	1000	280000			
1199762.5							
Alternative 1	0.04						
1200000	84000	84000	1800	140000			
1283044.9							

INTEREST RATE = 4.00%							
n	(P/F)	(P/A)	(P/G)	(F/P)	(F/A)	(A/P)	(A/F)	n
1	0.9615	0.9615	0.0000	1.0400	1.0000	1.0400	1.0000	1
2	0.9246	1.8861	0.9246	1.0816	2.0400	0.5302	0.4902	2
3	0.8890	2.7751	2.7025	1.1249	3.1216	0.3603	0.3203	3
4	0.8548	3.6299	5.2670	1.1699	4.2465	0.2755	0.2355	4
5	0.8219	4.4518	8.5547	1.2167	5.4163	0.2246	0.1846	5
6	0.7903	5.2421	12.5062	1.2653	6.6330	0.1908	0.1508	6
7	0.7599	6.0021	17.0657	1.3159	7.8983	0.1666	0.1266	7
8	0.7307	6.7327	22.1806	1.3686	9.2142	0.1485	0.1085	8
9	0.7026	7.4353	27.8013	1.4233	10.5828	0.1345	0.0945	9
10	0.6756	8.1109	33.8814	1.4802	12.0061	0.1233	0.0833	10
11	0.6496	8.7605	40.3772	1.5395	13.4864	0.1141	0.0741	11
12	0.6246	9.3851	47.2477	1.6010	15.0258	0.1066	0.0666	12
13	0.6006	9.9856	54.4546	1.6651	16.6268	0.1001	0.0601	13
14	0.5775	10.5631	61.9618	1.7317	18.2919	0.0947	0.0547	14
15	0.5553	11.1184	69.7355	1.8009	20.0236	0.0899	0.0499	15
16	0.5339	11.6523	77.7441	1.8730	21.8245	0.0858	0.0458	16
17	0.5134	12.1657	85.9581	1.9479	23.6975	0.0822	0.0422	17
18	0.4936	12.6593	94.3498	2.0258	25.6454	0.0790	0.0390	18
19	0.4746	13.1339	102.8933	2.1068	27.6712	0.0761	0.0361	19
20	0.4564	13.5903	111.5647	2.1911	29.7781	0.0736	0.0336	20
21	0.4388	14.0292	120.3414	2.2788	31.9692	0.0713	0.0313	21
22	0.4220	14.4511	129.2024	2.3699	34.2480	0.0692	0.0292	22
23	0.4057	14.8568	138.1284	2.4647	36.6179	0.0673	0.0273	23
24	0.3901	15.2470	147.1012	2.5633	39.0826	0.0656	0.0256	24
25	0.3751	15.6221	156.1040	2.6658	41.6459	0.0640	0.0240	25
26	0.3607	15.9828	165.1212	2.7725	44.3117	0.0626	0.0226	26
27	0.3468	16.3296	174.1385	2.8834	47.0842	0.0612	0.0212	27
28	0.3335	16.6631	183.1424	2.9987	49.9676	0.0600	0.0200	28
29	0.3207	16.9837	192.1206	3.1187	52.9663	0.0589	0.0189	29
30	0.3083	17.2920	201.0618	3.2434	56.0849	0.0578	0.0178	30
Alternative 2	0.04						
483000	306000	266000	4000	1600	132000		
787392.38							
Alternative 1	0.04						
97000	97000	483000	266000	16000	4000	132000	
720204.15							

APPENDIX B

The following examples show each formula type interest tables. Assume a discount rate of 7% for each example. Any slight difference is due to rounding.

Example 1

A $40,000 pile jacketing will be required on a bridge in year 20 of its 50 year life. Find the *Present Worth* of that expenditure.

     Solution: Find P given F

$P = 40,000[1/(1.07)^{20}] = \underline{\$10,337}$

or

$P = 40,000 \times (P/F, 7\%, 20 \text{ yrs}) = 40,000 \times (0.2584) = \underline{\$10,336}$.

Example 2

Check Example 1 by finding the *Future Worth* in year 20 of an initial outlay of $10,337.

     Solution: Find F given P

$F = 10,337 \times (1 + 0.07)^{20} = \underline{\$40,001}$

or

$F = 10,337 \times (F/P, 7\%, 20) =$
    $10,337 \times (3.8697) = \underline{\$40,001}$

Example 3

A new roadway project costs $2,100,000.   Find the *Annual Worth* of this initial cost? Assume a 40 year life.

     Solution: Find A given P

$A = 2,100,000\{[0.07(1.07)^{40}]/[1.07^{40} - 1]\}$
  $= \underline{\$157,519}$

or

$A = \quad 2,100,000 \times (A/P, 7\%, 40) =$
     $2,100,000 \times (0.0750) = \underline{\$157,500}$

Example 4

Check Example 3 by finding the *Present Worth* of an annual outlay of $157,519.

Solution: Find P given A

$P = 157{,}519\{[(1.07)^{40} - 1]/[0.07(1.07)^{40}]\}$
  = $\underline{\$2{,}099{,}997}$

 or

$P =$ $157{,}519 \times (P/A, 7\%, 40) =$
     $157{,}519 \times (13.3317) = \underline{\$2{,}099{,}997}$

Example 5

Find the *Annual Worth* of a $750,000 bridge widening project in year 50 of the bridge life.

Solution: Find A given F

$A = 750{,}000\{(0.07)/[(1.07)^{50} - 1]\}$
  = $\underline{\$1{,}845}$

or

$A =$ $750{,}000 \times (A/F, 7\%, 50) =$
     $750{,}000 \times (0.0025) = \underline{\$1{,}875}$

Example 6

Check Example 5 by finding the *Future Worth* of an annual outlay of $1,845.

Solution: Find F given A

$F = 1{,}845[(1.07^{50} - 1)/(0.07)]$

or

$F =$ $1{,}845 \times (F/A, 7\%, 50 =$
     $1{,}845 \times (406.5289) = \underline{\$750{,}046}$

The above examples show the use of interest tables and simplify problem solving. The tables cannot be used if a discount rate or analysis period is not included in the tables. Use the formulas in this case.

The tables in Appendix A were created in Microsoft Excel and available at http://www.udot.utah.gov/main/f?p=100:pg::::1:T,V:106,23644

The files can be adjusted for percentage and year as needed.
1. Change cell C1 to the desired interest rate. For example, 0.075 for 7.5%.
2. Skip this step if only a new year is needed.
3. Insert a row between years 3 and 4 years if a fraction of a year is needed such as 3.5 years.
4. Copy the required formula from year one to the required cell for the new year.

APPENDIX C

The following examples illustrate the life cycle analysis techniques for highway projects based on The Utah Department of Transportation (UDOT) data.

Example 1

UDOT is attempting to analyze the most cost effective alternative for construction of a four lane Interstate Highway. The two alternatives are Portland Cement Concrete Pavement compared to Asphalt Concrete Pavement. The following costs per construction mile known for each alternative:

<u>**Portland Cement Concrete Pavement (Alternative 1)**</u>

Initial Construction Cost	$1,200,000
Joint Sealing (year 10 and 20)	$84,000
Routine Annual Maintenance	$1,800
Salvage	($140,000)

<u>**Asphaltic Concrete Pavement (Alternative 2)**</u>
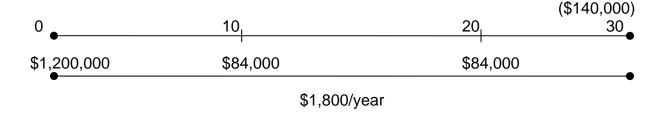
Initial Construction Cost	$900,000
Stage II Construction (year 10)	$350,000
Recycle Pavement (year 20)	$290,000
Routine Annual Maintenance	$1,000
Salvage	($280,000)

The estimated life of each alternative is 30 years. Use a 4% discount rate to find the best alternative.

<u>**Solution**</u>:

The alternative may be evaluated using either the Present Worth Method or the Annual Worth Method. Both solutions are shown. The first step is to construct a time line using the above costs. Then plug the appropriate values into the associated formula.

Alternative 1

Present Worth Method

P = $1,200,000 + $84,000 (P/F, 4%, 10) + $84,000 (P/F, 4%, 20)
+ $1,800 (P/A, 4%, 30) - $140,000 (P/F, 4%, 30)

= 1,200,000 + 84,000 (0.6756) + 84,000 (0.4564) + 1,800 (17.2920) - 140,000 (0.3083)

= $1,283,045   ANSWER

Annual Worth Method

A = $1,200,000 (A/P, 4%, 30) + $84,000 (P/F, 4%, 10) (A/P, 4%,30)
+ $84,000 (P/F, 4%, 20) (A/P, 4%, 30) + $1,800 - $140, 000 (A/F, 4%, 30)
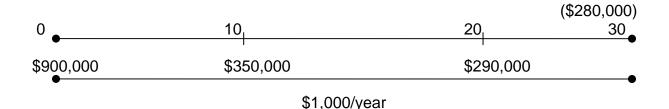
= 1,200,000 (0.0578) + 84,000 (0.6756) (0.0578) + 84,000 (0.4564) (0.0578)
+ 1,800 - 140,000 (0.0178)

= $74,199   ANSWER

Alternative 2

Present Worth Method

P = $900,000 + $350,000 (P/F, 4%, 10) + $290,000 (P/F, 4%, 20)
+ $1,000 (P/A, 4%, 30) - $280,000 (P/F, 4%, 30)

= 900,000 + 350,000 (0.6756) + 290,000 (0.4564) + 1,000 (17.2920) - 280,000 (0.3083)

= $1,199,762   ANSWER

Annual Worth Method

A = $900,000 (A/P, 4%, 30) + $350,000 (P/F, 4%, 10) (A/P, 4%,30)+ $290,000 (P/F, 4%, 20) (A/P, 4%, 30) + $1,000 - $280, 000 (A/F, 4%, 30)

=   900,000 (0.0578) + 350,000 (0.6756) (0.0578) + 290,000 (0.4564)
       (0.0578) + 1,000 - 280,000 (0.0178)

= $69,382   ANSWER

Comparison of Alternatives

	Alternative 1	Alternative 2
Present Worth	$1,283,045	$1,199,762
Annual Worth	$74,199	$69,382

Conclusion

Alternative 2 is the least expensive alternative in the comparison above. This example also illustrates that the use of either the annual worth or present worth method leads to the same conclusion.

Sensitivity Analysis

Cost Benefit Variable

Discount Rate
Analysis Period
Maintenance Cost
User Cost
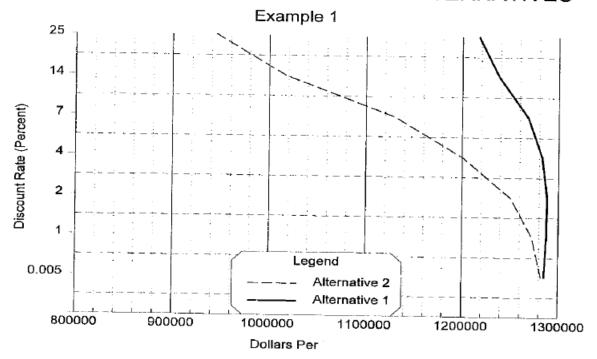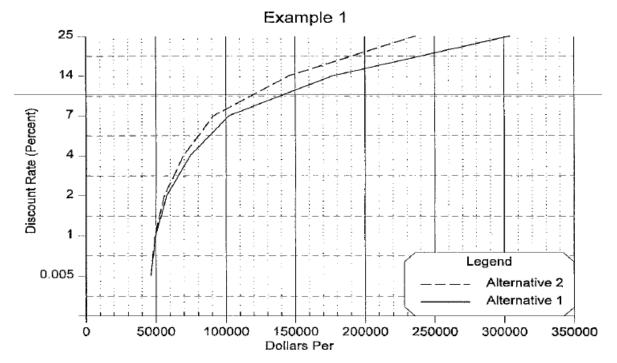
Present Worth Method		
Example 1		
Discount Rate	**Alternative 1**	**Alternative 2**
0.5%	$1,285,424	$1,282,146
1%	$1,287,471	$1,272,588
2%	$1,288,463	$1,250,100
4%	$1,283,045	$1,199,762
7%	$1,268,353	$1,128,490
14%	$1,238,627	$1,017,018
25%	$1,217,006	$944,573

Annual Worth Method		
Example 1		
Discount Rate	**Alternative 1**	**Alternative 2**
0.5%	$46,248	$46,130
1%	$49,887	$49,310
2%	$57,530	$55,817
4%	$74,199	$69,382
7%	$102,212	$90,941
14%	$176,880	$145,233
25%	$304,629	$236,436

COMPARISON - PRESENT WORTH ALTERNATIVES
Example 1

Legend
- - - - - Alternative 2
———— Alternative 1

Discount Rate (Percent)

Dollars Per

COMPARISON - ANNUAL WORTH ALTERNATIVES
Example 1

Legend
- - - - - Alternative 2
———— Alternative 1

Discount Rate (Percent)

Dollars Per

Example 2

A Value Engineering Study has identified two alternative solutions for rehabilitating a principal arterial highway. Select the most cost effective given the following information. The following costs per mile of construction are known for each alternative:

Alternative 1

Provide a bituminous surface treatment (BST) for the next 12 years followed by reconstruction with asphalt concrete pavement.

BST Applications (6 year cycles)	$97,000
Reconstruction (year 12)	$483,000
Annual Maintenance (years 1 - 12)	16,000
Annual Maintenance (years 13-30)	4,000
Resurfacing (year 24)	$266,000
Salvage	($132,000)

Alternative 2

Provide reconstruction now with rehabilitation in 12 years.
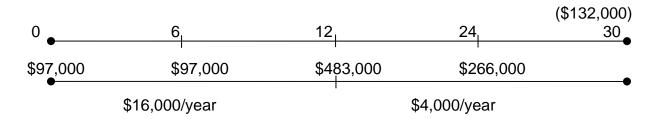
Reconstruction	$483,000
Rehabilitation (year 12)	$306,000
Annual Maintenance (year 1 -12)	$4,000
Annual Maintenance (year 13 - 30)	$1,600
Resurface (year 24)	$266,000
Salvage	$(132,000)

The estimated life of each alternative is 30 years. Use a 4% discount rate to find the best alternative.

Solution:

Evaluate using either the Present Worth Method or the Annual Worth Method. Both solutions are shown. The first step is to construct a time line using the above costs. Then use the appropriate values in the associated formula.

Alternative 1

($132,000)

| 0 | 6 | 12 | 24 | 30 |

$97,000 $97,000 $483,000 $266,000

$16,000/year $4,000/year

Present Worth Method

P   = $97,000 + $97,000 (P/F, 4%, 6) + $483,000 (P/F, 4%, 12) + $266,000 (P/F, 4%, 24) + $16,000 (P/A, 4%, 12) + 4,000 (P/A, 4%, 18) (P/F, 4%, 12) - $132,000 (P/F, 4%, 30)

    =   97,000 + 97,000 (0.7903) + 483,000 (0.6246) + 266,000 (0.3901) + 16,000 (9.3851) + 4,000 (12.6593) (0.6246) - 132,000 (0.3083)
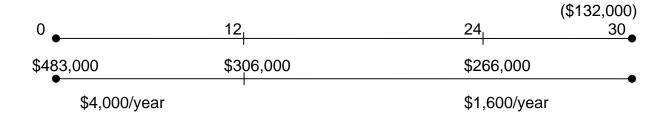
    =   <u>$720,204</u>   ANSWER

Annual Worth Method

A   = $97,000 (A/P, 4%, 30) + $97,000 (P/F, 4%, 6) (A/P, 4%,30) + $483,000 (P/F, 4%, 12) (A/P, 4%, 30) + $266,000 (P/F, 4%, 24) (A/P, 4%, 30) + 16,000 (P/A, 4%, 12) (A/P, 4% 30) + 4,000 (P/A, 4%, 18) (P/F, 4%, 12) (A/P, 4% 30) - $132, 000 (A/F, 4%, 30)

    =   97,000 (0.0578) + 97,000 (0.7903) (0.0578) + 483,000 (0.6246) (0.0578) + 266,000 (0.3901) (0.0578) + 16,000 (9.3851) (0.0578) + 4,000 (12.6593) (0.6246) (0.0578) - 132,000 (0.0178)

    =   <u>$41,650</u>   ANSWER

Alternative 2

($132,000)

| 0 | 12 | 24 | 30 |

$483,000 $306,000 $266,000

$4,000/year $1,600/year

Present Worth Method

P = $483,000 + $306,000 (P/F, 4%, 12) + $266,000 (P/F, 4%, 24)
+ 4,000 (P/A, 4%, 12) + $16000 (P/A, 4%, 18) (P/F, 4%, 12)
- $132,000 (P/F, 4%, 30)

   = 483,000 + 306,000 (0.6246) + 266,000 (0.3901) + 4,000 (9.3851)
+ 1,600 (12.6593) (0.6246) - 132,000 (0.3083)

   = <u>$787,392</u>   ANSWER

Annual Worth Method

A = $483,000 (A/P, 4%, 30) + $306,000 (P/F, 4%, 12) (A/P, 4%,30) +
$266,000 (P/F, 4%, 24) (A/P, 4%, 30) + $4,000 (P/A, 4% 12) (A/P, 4%, 30)
+ 1,600 (P/A, 4%, 18) (P/F, 4%, 12) (A/P, 4%, 30) - $132, 000 (A/F, 4%,
30)

   = 483,000 (0.0578) + 306,000 (0.6246) (0.0578) + 266,000 (0.3901)
(0.0578) + 4,000 (9.3851) (0.0578) + 1,600 (12.6593) (0.6246) (0.0578) -
132,000 (0.0178)

   = <u>$45,535</u>   ANSWER

<u>Comparison of Alternatives</u>

	Alternative 1	Alternative 2
Present Worth	$720,204	$787,392
Annual Worth	$41,650	$45,535

<u>Conclusion</u>

Alternative 1 in the comparison above is the least expensive alternative. This example
also illustrates that the use of either the annual worth or present worth method leads to
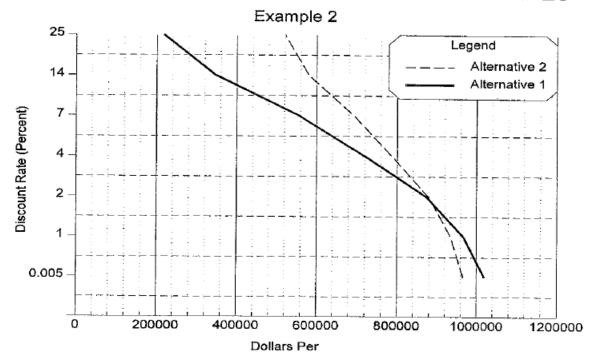the same conclusion.

Sensitivity Analysis

Cost Benefit Variable

Discount Rate
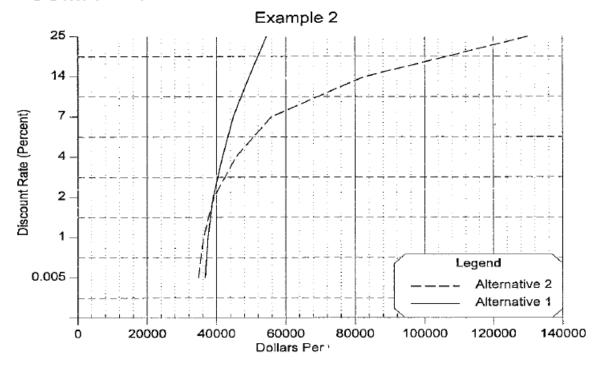Analysis Period
Maintenance Cost
User Cost

Present Worth Method Example 2		
Discount Rate	**Alternative 1**	**Alternative 2**
0.5%	$1,019,019	$965,914
1%	$966,867	$934,423
2%	$872,970	$877,999
4%	$720,204	$787,392
7%	$556,142	$692,885
14%	$346,246	$580,171
25%	$217,394	$520,453

Annual Worth Method Example 2		
Discount Rate	**Alternative 1**	**Alternative 2**
0.5%	$36,663	$34,753
1%	$37,464	$36,207
2%	$38,978	$39,203
4%	$41,650	$45,535
7%	$44,817	$55,837
14%	$49,445	$82,850
25%	$54,416	$130,275

COMPARISON - PRESENT WORTH ALTERNATIVES

Example 2

Legend
- - - - Alternative 2
——— Alternative 1

COMPARISON - ANNUAL WORTH ALTERNATIVES

Example 2

Legend
- - - - Alternative 2
——— Alternative 1

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