



Fundamentals of Engineering Economics

Edited by Kal Renganathan Sharma

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Sneak Preview

Fundamentals of Engineering Economics

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Dedication

This book is dedicated to my eldest son R. Hari Subrahmanyam Sharma (alias Ramkishan) who turned nine on Aug-13-2010.

About the Author

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Preface

The economy has changed rapidly. Both the nation's economy and the world economy has undergone changes since the World War II. The end of cold war has given impetus to rise of globalization. China and India are now invited to attend G20 meetings. Engineering education imparts a variety of skills to the student. Skills from economics can be synergistically applied. The engineering economy is a field of endeavor that explains different methods to evaluate alternates available to the business owner. Engineering Economy is the study of the feasibility and evaluation of the cost of possible solutions to engineering problems. When benefits outweigh costs the alternate becomes an acceptable one. The lowest cost among alternates can be selected by using different methods discussed in detail in the textbook. This is calculated at a certain interest rate over a certain prescribed period of time.

The inverse problem of determining the interest rate, i , given the F , A and N is explained in detail in this work. The binomial series expansion of $(1+i)^N$ is used to obtain mathematical expressions. N can be estimated given the future amount, F , uniform series of payments, A and interest rate i by obtaining the logarithms where necessary.

The fundamental principles, concepts and methods of engineering economy are provided. Current trends and issues are reflected in the worked examples and end of chapter exercises. Alternates are drawn from case studies. These include the Keystone pipeline project, CW of World Trade Center, six different methods to prepare bioethanol, biodiesel plant in Taiwan, micro power plant, combined cycle power plant, meglumine antimonate drug from supercritical extraction, on-shore oil well, solar hats, stirling dish solar power plant, photovoltaic panel solar power plant, liquefaction plants, copper chlorine thermochemical cycle for hydrogen, energy efficient windows, continuous mass polymerization process to manufacture ABS, renovation of Macy's department store, heap leaching and agitation leaching of gold, rechargeable batteries for electric car, PEVs and HEV, hybrid electric vehicles, four different cooling tower designs, oil refinery, economics of life insurance, social security, printing press vs. e-book, anti-allergic cream, sequestration by dimethyl carbonate formation, micro-filtration, SWRO, sea water reverse osmosis plant, catalytic process to manufacture CNTs, carbon nanotubes, hexane extraction of rice bran oil, municipal garbage collection truck, activated carbon from bamboo, polypropylene gas manufacture, custom foam fabricator, car rental, coffee house, frozen yoghurt parlor, short path distillation, olive oil business, bonds from private sector, Chevy volt, public internet, gas sales and convenience store, condominiums at Galveston beach, outpatient drug treatment center, overseas travel ticket, snack factory. Break-even points in flower shop, soda beverage, cars, quadratic price-demand relations for tomatoes, peaches, inelastic supply of common salt, dualistic relations of price and demand, Le-Chatellier-Samuelson principle are discussed in detail. G20 nations and GDP estimates by PPP, purchasing power parity and the changing world

order in economies is touched upon. Life-cycle costs of aviation lighting, LED, photocopier, HVAC systems are discussed. Depreciation, taxes, replacement analysis are discussed.

Unique Features

Optimization concepts are discussed in detail. Brainstorming can be used to develop alternates for a given problem.

- The five methods of analysis, PW, FW, AW, IRR and ERR can be used to evaluate the alternates. Evaluation of alternates can be used to invest in the more profitable process, selection of the lower cost alternate, quantitate the savings accrued from implementation of a process improvement and assessment of environmental impact of chemical processes. Alternates can be mutually exclusive, independent projects and screening by other criteria.
- When the PWs of both alternates are within 20% of each other the projects can be adjudged as too close to call within the sensitivity of the estimates of the capital and operating expenses and expected revenues.
- Rudiments of household finance are discussed.
- The capitalization worth factors and sinking fund factors are calculated and presented as annuity tables as well as in graphical form.
- In addition to P/A, F/A, A/F, A/P, F/P, P/F closed form analytical expressions to calculate the interest rate, i and pay period, N has been developed.
- Benefit/Cost Ratio of public sector projects are discussed

Chapter 1.0

Overview of Engineering Economy

Main Topics Discussed in this Chapter

- Definitions of Engineering, Economy
- Alternates and Rules of Brainstorming
- Economic Merits of Alternates
- Deviation Analysis, Decision Analysis
- Action Plan
- Principles of Engineering Economy
- Steps of Problem Solving

1.1 What Is Engineering, What Is Economy, and What Is Engineering Economy?

Technological advances in machines, materials, computers, structures, and electronics have changed the job description of the engineer rapidly. Economic merits of the different alternatives available to the solution of a given problem can be evaluated in a systematic manner. The dollars-and-cents side of decision making is discussed in detail in this book. According to an estimate in 2005, there are about 240 million vehicles on the road in the United States. The economy fueled by the automotive sector is large.

Engineering is defined by ABET (Accreditation for Engineering and Technology) as the profession in which the knowledge gained in physics, chemistry, life sciences, and mathematics is applied to make products in large scale that increase the prosperity of man. This must be achieved with a judicious choice of materials, at the lowest cost in a manner that is benign to the environment, and that keeps all the stakeholders safe. Examples of engineering achievements can be seen in the top engineering inventions of the 20th century. According to the National Academy of Engineering, the top 20 engineering achievements of the 20th century are listed in Table 1.0 (1).

Economy consists of the sum total of all income from goods produced and services offered in a state or nation. It deals with the interactions between people and wealth. The size of the United States' economy can be measured using parameters such as GDP (Gross Domestic Product) GNP (Gross National Product) is different from GDP with respect to inclusion of income earned abroad. GDP sticks to within the domicile of the nation. The sizes of the economies of 20 nations that meet regularly as G20 are listed in Table 2.0. The 19 nations, other than the European Union, are listed according to the sizes of their economies. The numbers in Table 2.0 were developed by the prices laid down by the IMF, the International Monetary Fund, for the year 2008.

Table 1.0 Top 20 Engineering Achievements of the 20th Century

#	Feat	#	Feat
1	Electrification	11	Highways
2	Automobile	12	Spacecraft
3	Airplane	13	Internet
4	Water Supply and Distribution	14	Imaging
5	Electronics	15	Household Appliances
6	Radio and Television	16	Health Technologies
7	Agricultural Mechanization	17	Petroleum and Petrochemical Technologies
8	Computers	18	Laser and Fiber Optics
9	Telephone	19	Nuclear Technologies
10	Air Conditioning and Refrigeration	20	High Performance Materials

Table 2.0 GDP of G20 Nations (Purchasing Power Parity or PPP)

#	Nation	GDP (in Billions of US\$) PPP	#	Nation	GDP (in Billions of US\$) PPP
1	United States	14,256	11	Mexico	1466
2	China	7903	12	South Korea	1364
3	Japan	4159	13	Canada	1281
4	India	3526	14	Indonesia	962
5	Germany	2806	15	Turkey	880
6	United Kingdom	2139	16	Australia	851
7	Italy	2118	17	Argentina	584
8	Russia	2110	18	South Africa	493
9	France	2108	19	Saudi Arabia	370
10	Brazil	2013	20	European Union+	14,793

The combined GDP of 19 nations listed in Table 2.0 is about 51 trillion US dollars. This is a significant portion of the *world economy*.

Currency exchange rates used to be based upon the wealth of nations as measured by the amount of gold each nation possessed. The wealth of a nation is not the same as the nation's economy. The calculation of the size of economy varies among one method to another. The PPP method used to calculate the size of the G20 economies listed in Table 2.0 is called the *Purchasing Power Parity* method. This idea can be traced back to the School of Salamanca in the 16th century. The concept stems from the development of exchange rates between two countries based on long-term considerations of relative price levels between the two countries. Identical goods are expected to have the same price and cannot vary with markets. According to Wikipedia (2), more haircuts can be purchased in Thanjavur, India, for 1 US dollar than in San Francisco, California. The PPP method provides for cost-of-living differences between different regions in the world. In 2003, 1 US\$ was equivalent to 1.8 yuan (Chinese) using PPP method. The nominal exchange rate is 1 US\$ exchanged at 7.6 yuan (Chinese). Based on PPP, China is the world's second largest economy and India is the world's fourth largest economy. India recently added 100 million cellular phones. It has the second largest sugar production by the sugarcane industry. The cement and paper industries are large in India. The population of both China and India are more than 1 billion each. When the economic activities of *all people* are taken into account, the sizes of their economies go through a sudden jump in value! According to Mahatma Gandhi, India consisted of 300,000 villages during the freedom struggle from Great Britain. According to the 2001 India census, 74% of Indians live in 638,365 different villages. The middle-class wallet in India is bulging. The world's least expensive car was launched recently in India: Tata Nano can be picked up for Rs. 1 lakh (nominally about 2105 US\$). The discussions of G20 and a PPP method of calculation are illustrative of the need to be better informed about the evaluation methods of economic alternatives offered by engineering solutions. The *basis* used for the calculations is important.

Engineering Economy is the study of the feasibility and evaluation of the cost of possible solutions to engineering problems. When benefits outweigh costs, the alternate becomes an *acceptable* one. The lowest cost among alternates can be selected by using different methods discussed in detail in the textbook. This is calculated at a

certain interest rate over a certain prescribed period of time. Here are some alternates that can be resolved into one selected for implementation by using one of the methods explained in later chapters:

- (i) The inclusion of ER fluids (electro rheological fluids) as automatic transmission fluids by Chrysler Corp. is going to increase the mpg of the new line called Dodge Cognizance by 15%. It extends the life of the transmission by 20,000 miles. How much can the company afford to spend in order to implement this invention?
- (ii) You are hired by a leading credit card company, Ford Chase Bank. One of their directors, Julie Hollas, wants you to perform a small calculation for her. A customer wants to charge a Japanese robot to his credit card. The price of the robot, including sales tax, is \$850.50. How many years will it take to pay off the credit card balance if the monthly payment is \$16.70 and the annualized credit card interest rate is 23%?
- (iii) Gasoline prices have skyrocketed in the nation. The national average price per gallon of gasoline has risen to \$4. The president is considering increasing off-shore drilling to get more oil. Each oil rig would cost \$10 million. It would require 70,000 oil rigs to deliver 0.5 billion gallons of gas for automobiles every week. The utility costs run to \$120,000 per year. The situation is expected to continue for the next four years. Calculate the IRR for this investment. The MARR can be taken as 8.0%.
- (iv) Calculate the monthly payment on a 2007 Toyota Corolla costing \$12,999. Another \$1000 was needed to obtain the title, license plate, and taxes. After cash down of \$1500, the number of pay periods was 72 months. The interest rate per annum is 7%. A \$2500 one-time charge for power train warranty up to 100,000 miles was levied up front.
- (v) Alice Jones operates a flower shop in downtown Houston. It costs her \$5 per day to pay the rent, \$1 per day for the water used to preserve the freshness of the flowers, and \$2.5 per day for air conditioning the flowers per day. The cost to pluck and bring the flowers from the garden in rural Texas to Houston city runs her a quarter per flower. The price-demand relation for the flowers takes the form of:

$$p = 0.65 - 0.001D$$

Calculate the break-even points. Construct the total revenue and total cost as a function of demand, D in the attached graph paper. What is the demand at maximum profit to Alice?

- (vi) K. R. Sridhar, CEO of Bloom Box, was featured on CBS's *60 Minutes*. Bloom Box makes *micro power plants* using SOFC, solid oxide fuel cell technology. A bloom box can be purchased for \$3000. It consists of miniaturized fuel cells made of silica. The cost of electricity to power up a new home would be 8.0 cents per kWh. Should the existing utility company charge 12.5 cents per kWh, calculate the number of years it would take for a bloom box to be a good investment for new homeowner Jack Tripper. Jack Tripper is the head of a family of 6 members with 4 children. Use the present worth method to evaluate the single project of micro power plants for individual homes. Assume that 600 kWh of electricity is consumed every month at the Tripper residence. ($i=10\%$).
- (vii) You are hired by Cowboy Investments upon graduation. They are developing a new investment plan for customers named "U-Pay-Now & I-Pay-Later." The deal is that the client pays \$500 every month to Cowboy Investments. After a said period in a number of years, Cowboy Investments will have the client cease payments and begin to receive \$500 every month forever. At 10% annualized interest rate (the historic performance of Dow Jones), how many years would you recommend be the said period?
- (viii) Furniture-to-Stay offers you the following deal: A sofa, loveseat, and chair are available for \$1250. A mattress is built in with the sofa, which can be pulled out when you have guests over. This is at an additional cost of \$200. The delivery charge is \$100 and a 3-year warranty for stain resistance is available for \$200. For the first 3 years there is no interest rate charged (i.e., "No Interest 'Til 2012").

For the following three years, an annualized interest rate of 12% is charged. Calculate the monthly payment over 6 years.

- (ix) Sam Malone is considering whether to invest in solar panels. This homeowner has gathered the following information for his town:
 - (a) Average cost of residential energy is 12 cents per kWh
 - (b) Government subsidy runs to 60% of investment by homeowner
 - (c) Each square foot of panel produces 18 kWh every year and the cost of installation per square foot of solar panel is \$99.

Sam has 385 sq. ft. of roof space. What is the break-even point in years for the installation of solar panels? Assume an interest rate of 5% per year.

- (x) Should overnight delivery courier mail be conducted using airplanes flown by pilots or personal rapid transit systems without onboard operators?
- (xi) Should assembly lines for putting together desktop computers be filled with workers or by automated robots?
- (xii) Should college computer labs be serviced using a hotline or by a manned computer help desk?

Example 1.0 Start of Technocrats of Texas

A team of alumni and faculty from a leading university in Texas conceived a business plan to develop a consulting service on how to assess, prevent, and remediate the damage caused by oil spills such as the recent one by BP America in Houston. One hundred professionals and technicians are going to join the venture. A new building is obtained at lease in Hempstead, Texas. How would you develop the alternates for setting up the utilities, such as electrification of the building?

Alternate A: To sign up with companies such as Reliant Energy under one of their plans.

Alternate B: To install solar panels and generate all the electricity needs of the enterprise.

Alternate C: To buy enough fuel cells and install a micro power plant to meet all the electricity needs of the enterprise.

1.2 Seven Principles of Engineering Economy

The foundation of the discipline of Engineering Economy can be seen in terms of seven principles (3). These seven principles are:

- 1.0 Make a List of Alternates: Plan A, Plan B, etc.
- 2.0 What Is Different among the Alternates?
- 3.0 Be Clear on What You Want.
- 4.0 Develop Common Performance Measures.
- 5.0 Meet ALL Relevant Criteria.
- 6.0 Weigh the Risk Against the Projected Rewards.
- 7.0 Check the Results of Action Plan and Revise Plan If/When Necessary.

The decision has to come from the alternates developed. The alternates can be developed using a *brainstorming session*. The more creative and resourceful the team members are, the better the selection of alternates available

for a go/no-go decision would be. The problem can be reformulated and restated to ease the flow of alternates. An open mind is recommended during the development of alternates. The method may not be used to justify a certain course of action. Four rules of brainstorming were dictated by Osborn (4). These are as follows:

- (a) Negative feedback can become overly critical and stifle creative juices and alternates from flowing.
- (b) Poet-like free flow of ideas is welcome.
- (c) Quantity breeds quality.
- (d) Improvement can be aimed. Combinations can work out.

The basic steps of brainstorming include:

- (a) Preliminary Discussion: Problem is stated and participants get warmed up. This acts as a prelude to the main session.
- (b) Brainstorming Main Session: An unrelated problem is first brainstormed. Then the assigned problem is brainstormed. Ideas are allowed to flow and are recorded objectively.
- (c) The ideas are evaluated for possible flowering into alternates.

In Principle 2, deviation analysis is used and the focus is on the differences. The future outcomes from the alternates are set as higher priority. Based on differences among alternates, a future course of action is selected. Goal setting is extremely important as emphasized in Principle 3. A common unit of measure (such as dollars and cents) totals costs or total profits that can be generated from the alternate considered is captured in Principle 4. All relevant criteria as mentioned in Principle 5 are important. For instance, retail giant Wal-Mart posts low prices for its customers. However, the company had to pay several million dollars as compensation for discrimination based on the skin color of an African American woman. She was apprehended for forging her money order. Later, she was cleared of any wrongdoing. The Civil Rights Act of 1964, signed into law by President Lyndon B. Johnson, must be followed in all activities of the enterprise. The risks assumed in a potential venture must be identified and understood. The payoff or the reward-to-risk ratio can be considered before taking a decision. One can follow the *Plan-Do-Check*. The results from implementation of the plan can be checked against goals identified. If needed, the plan can be revised.

1.3 Summary

Engineering is defined by ABET (Accreditation for Engineering and Technology) as the profession in which the knowledge gained in physics, chemistry, life sciences, and mathematics is applied to make products in large scale that increase the prosperity of man. This must be achieved with a judicious choice of materials, at the lowest cost in a manner that is benign to the environment, and that keeps all the stakeholders safe. *Economy* consists of the sum total of all income from goods produced and services offered in a state or nation. It deals with the interactions between people and wealth. *Engineering Economy* is the study of the feasibility and evaluation of the cost of possible solutions to engineering problems. When benefits outweigh costs, the alternate becomes an *acceptable* one. The lowest cost among alternates can be selected by using different methods discussed in detail in the textbook.

Examples of alternates are given such as electro rheological fluids for automatic transmission fluid, a pay-off period for a Japanese robot using a credit card, off-shore drilling, monthly car payment, flower shop, micro power plant, pay-now-cash-in-later schemes, deferred interest, solar panels, overnight mail delivery, use of robots in assembly lines in place of labor, college computer lab help desk, etc. The GDP of nations is discussed. The top engineering achievements of the 20th century are listed.

The seven principles of engineering economy are: (i) develop alternates; (ii) differences among alternates; (iii) what do you want?; (iv) develop common performance measures; (v) meet all relevant criteria; (vi) weigh the risks against the projected rewards; (vii) check the results of action plan and revise the plan if necessary. Brainstorming sessions can be used to develop alternates. The four rules of brainstorming are not to give negative feedback; encourage poet-like free flow of ideas; quantity breeds quality; and improvements and combinations are good. The main steps of brainstorming include: (i) preliminary session; (ii) brainstorming session; (iii) evaluation of ideas and development of alternates.

1.4 References

1. G. Constable and B. Somerville, *A Century of Innovation: Twenty Engineering Achievements That Transformed Our Lives*. The National Academies Press (2003), Washington, DC.
2. http://en.wikipedia.org/wiki/Purchasing_power-parity.
3. W. G. Sullivan, E. M. Wicks, and C. P. Koelling, *Engineering Economy*, 14th Edition. Pearson Prentice Hall (2009), Upper Saddle River, NJ.
4. A. F. Osborn, *Applied Imagination*, 3rd Edition. Charles Scribner's Sons (1963), New York, NY.
5. *Houston Chronicle*, Sunday, June 6th 2010, D2 of Business Section.

1.5 Exercises

- 1.0 What are the differences between GDP and GNP ?
- 2.0 What is the connection between a nation's GDP and its wealth?
- 3.0 Based on PPP (Purchasing Power Parity), China and India moved up in the rankings based on the size of a nation's GDP, while Australia moved down. Why is this?
- 4.0 What is engineering, what is economy, and what is engineering economy?
- 5.0 What are the rules of brainstorming?
- 6.0 Which of the principles of engineering economy is required by law?
- 7.0 What does the "Plan-Do-Check" cycle mean?
- 8.0 Why should risks be weighed against rewards?
- 9.0 What is the importance of a common unit of measure?
- 10.0 Why should a consistent viewpoint be maintained when comparing alternates?

Problems

- 11.0 Rahall Gandhi has purchased a new home in Fairfield, Texas. The price of the 1776 sq. ft. home is \$131,000. Develop the alternates for Mr. Gandhi to buy homeowner's insurance for hazards such as floods, fire, hurricane, windstorm, etc. (Hint: consider deductibles).
- 12.0 After starring in a summer blockbuster film, actress Julia Roberts explores purchasing a mansion near Houston. She is willing to sign a mortgage amount up to \$1.5 million. Action Mortgage gives out 15-year loans over \$417,000 at 5.625% fixed rate. Develop the alternates for Julia to apply for the mortgage. Consideration may be given to an ARM (adjustable rate mortgage), fixed-rate 30-year mortgage, fixed-rate 15-year mortgage, or FHA (federal housing loan). Some of the lenders and rates offered are shown in Table 3.0 (5).

Table 3.0 Mortgage Interest Rate List

#	Lender	15-yr loans over \$417,000	30-yr loans over \$417,000
1	Action Mortgage	5.125%	5.625%
2	Allegiance Financial Services	5.375%	6.125%
3	Home Loan Specialists	5.0%	5.75%
4	Mortgage Associates	6.25%	6.75%
5	Residential Finance	6.75%	7.0%
6	Texas Mortgage Link	7.0%	7.375%

- 13.0 About five years ago the rides at AstroWorld were dismantled and the 104 acres housing the amusement park were left barren. Fort Worth Investment Partnership has purchased the property recently. The undisclosed purchase price can be estimated at \$100 million. The old AstroWorld property sits across Loop 610 from Reliant Park and near a light-rail stop. Develop alternates for use of this land. Choose from real estate development, hotel development, amusement park, horse racing track, etc.
- 14.0 Develop alternates for the following scenario: Enterprise Products Partners and Duncan Energy partners have announced that Acadian Gas has entered into an additional long-term contract with a shipper to transport natural gas on Acadian's Haynesville Extension pipeline, now under construction. It increases total capacity commitments by 200 million cu. ft. per day. Work on the 270-mile Haynesville Extension is expected to be finished in the 3rd quarter of 2011.
- 15.0 You have been awarded a contract to provide design and early engineering services for development of the Araromi Refinery project in Nigeria. You shall provide services for a 160,000 barrel-per-day Greenfield refinery and marine facility that will produce motor gasoline, automotive gas oil, and kerosene and jet fuel. What are the alternates in order to deliver the same amount of fuel in terms of calorific value?
- 16.0 Richard Stock arrived in the United States from Great Britain in order to pursue graduate studies in chemical engineering. He wanted to apply for a credit card. Select two or three from the following that would be suitable alternates for Richard. Discuss which of the seven principles of engineering economy can be used in the selection.
- (1) A credit card is offered by the local credit union. The interest rate is at the prime lending rate. The credit line is low at \$1000.
 - (2) Chase Bank offers a credit line of \$12,000, but the interest rate is 24%.
 - (3) Macy's department store offers a credit line of \$10,000 at an interest rate of 20%, but you have to shop at Macy's stores. It is not valid in other locations.
 - (4) Chevron Oil Co. offers a credit card that offers a credit line of \$2800 at an interest rate of 10%.
 - (5) The local bank offers personal loans up to \$5000 with collateral of your automobile.
- 17.0 Mary Corleone is ready to go to college. The Eduserv provides student loans at low interest rates. Mary's friend is willing to pay for her tuition and living expenses. Wells Fargo Bank is willing to give papa Michael Corleone a home equity loan at little over the prime rate to pay for his daughter's

college education. Develop the alternates available to Mary to obtain the financial resources needed to pay for college tuition.

18.0 Upon graduation you have been hired by Consolidation Coal Co. The coal contains 3% sulfur-containing compounds. When coal-fired steam boilers are used to raise steam, which is then used to turn turbines that are used to raise electricity, the sulfur can cause SO_2 emissions that can pollute the atmosphere. One way to keep the environment clean is to remove the sulfur from the coal fuel before usage. Another method would be to scrub the gases from the boiler plant using calcium oxide lining. CaO would react with SO_2 to form CaSO_4 . The exit gases would be devoid of sulfur dioxide. Pyropower has developed a fluidized bed combustor (FBC) that mixes the coal and CaO and then the combustion process takes place. The SO_2 and other SO_x gases are captured *in situ* in the FBC. Develop the alternates for clean coal technologies. Which of the seven principles was used in the analysis?

19.0 Anita Murthy wanted to visit with Ann Tataglia in Boston. Anita has to travel from Morgantown, West Virginia. She called up the Hertz car rental company, who would allow her to rent a new car for a week. Anita will pay for the gas, and there are no caps on the driving mileage. A Greyhound bus can take her from Morgantown to Pittsburgh. She can also fly Continental Airlines from Pittsburgh to Boston. From Logan Airport, Anita can hail a taxicab to Ann's place. Her friend's friend can drive her in his car to Boston. Develop the alternates for Anita to travel to Ann Tataglia's in Boston.

Victor Whiting was planning on having six guests over at his new home in Cypress, Texas.

20.0 He can purchase Pillsbury flour and a recipe book from Wal-Mart and bake his own bread in a bread maker. The Pepperidge Farm truck delivers fresh loaves Mondays and Thursdays. What are the alternates for making bread available for Mr. Whiting's guests?

11.0 George Tataseo bought a new car that can run on different fuels. He knows a gas pump that supplies fuel at the following prices:

Gasoline	\$2.49 per gallon
Diesel	\$2.00 per gallon
Ethanol-Gasoline Blend, E20	\$1.75 per gallon

If George's Dodge Colt gave him 30 mpg, how much money can be saved by using E20 instead of gasoline or diesel when driving 28,600 miles?