

Applications

Chapter 3 – Problem #1 – Choose Your Own Future

Note: Information with a * should be documented with research from the WEB, your career center, magazines, auto advertisements etc. Site sources for data values. Support all answers graphically and algebraically, if possible.

Scenario:



You recently graduated from _____ College/University at age _____ with a degree in _____ . You landed your first job with _____ (company)* in _____, _____ (City/State), and your beginning salary is _____.* (Go to www.salaryexpert.com) You have decided, based on those great lessons several years ago in Precalculus ☺, that you will begin to invest wisely so that your golden years can be spent traveling, _____ and _____.



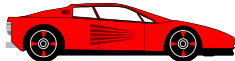
Investment decisions:

1. Retirement:

You will invest _____% of your beginning salary each month (\$ _____/month) until you retire. The mutual fund you've chosen is _____.* The current yearly investment return is _____%.* The 10-year return is _____%.* The Morning Star rating is _____* (www.morningstar.com) (Make note of any fees or loads for your fund. We will not use them in our calculations, but it is important to keep these in mind when choosing a fund). Graph the value of your investment over time.

- Find the monetary value of the annuity when you retire at age 65. Assume the fund maintains its average APR for the last ten years.
- Assume you will live until the ripe old age of 100. How much could you withdraw each month if the value of the fund was \$0 at the time of death?

2. Transportation:



You decide to buy a car or truck. Your first choice is a _____ . The cost of the car is _____* (you may reference Kelly blue book at www.kbb.com). You make a down payment of \$ _____. (maximum of 20%). You decide to pay off the loan by making monthly payments for 6 years. The APR compounded monthly is _____.* (Go to www.stcu.org) What is your monthly payment? What is total interest paid on the loan?

3. Credit Card:



You plan on using your credit card to finance a trip to Hawaii for 6 people. The total charges on the credit card bill will be \$10,000. Find a credit card on www.lowcards.com . What is the interest rate* on the credit card (ongoing rate, not the introductory rate)? The minimum payment on credit card debt is calculated as a percentage of your current balance. The minimum payment drops as your balance is paid. Try to find your minimum payment percentage. Go to <http://www.bankrate.com/brm/calc/MinPayment.asp> and find the total cost of the trip if you paid the minimum each month. Try to find and graph a function that models your balance as you pay off your card.

4. A home



Congratulations. You have now been out of college for 6 years and are married. You and your spouse have decided to buy a new home. You both work, and you've received several raises and a couple promotions since you started your career. The economy has been great, and your income is now 30% higher than it was when you started your career. Your spouse is just beginning his/her career as a _____ and earns _____ year*. The median value for the price for a home* in your city is _____. (Go to www.realtor.com) Assume you buy a home* close to this value, and make a down payment of 10%. You will have a \$ _____ mortgage for either 15 or 30 years. The APR for the 15 year loan is _____*. The APR for the 30 year loan is _____*. (Go to www.eloan.com) Now you've got to decide how quickly you can pay it off your loan. Find the monthly payment for both loans. Do you feel these are reasonable payments based on your monthly income? What does a bank consider a reasonable payment based on your income? What is the total interest paid on each loan? Which loan would you choose and why? Try to find a function that models your principle as you pay off your home loan. Then, graph the amortization and color the interest red and the principal blue. (Use <http://www.bankrate.com/brm/amortization-calculator.asp>)

Problem #2 – CSI - Spokane

You now work for CSI. A corpse was discovered in a motel room at midnight and its temperature was 84°F . The temperature of the room is kept constant at 65°F . Two hours later, the temperature of the corpse had dropped to 81°F . Given k is a constant for the object in question, S is the surrounding temperature, t represents the time and θ (of time) is the temperature at the given time, Newton's Law of Cooling states:

$$k(t_1 - t_2) = -\ln\left(\frac{\theta(t_1) - S}{\theta(t_2) - S}\right)$$



Find the time of death to the nearest minute. Be sure to include a graph of hours since death as a function of body temperature.

Problem #3 – Engineering 101

The Gateway Arch in St. Louis, Missouri is not a parabola but is a shape known as a catenary. The catenary is the name given to the shape formed by the graph of the hyperbolic cosine (abbreviated cosh) and is the shape of a uniform flexible cable, or chain whose ends are supported from the same height. The word catenary comes from the Latin word for chain. The arch has a height of approximately 625 feet and a span of approximately 600 feet. The hyperbolic cosine is defined as:

$$\cosh x = \frac{1}{2}e^x + \frac{1}{2}e^{-x}$$

- On the same set of axes, graph $f(x) = \frac{1}{2}e^x$, $g(x) = \frac{1}{2}e^{-x}$, and $h(x) = (f + g)(x)$.
- Create a parabolic model that matches the arch at the vertex and at ground level.
- The equation that gives the shape of the arch is $c(x) = 693.8597 - 68.7672 \cosh(0.0100333x)$. Define x and $c(x)$ in terms of the situation and rewrite the Gateway Arch equation into exponential function form.
- Graph the parabolic and exponential models on the same graph and compare.
- Build a scale model of the arch perfectly and research why the catenary was the chosen shape.

