Review for Exam 2

Problem 1. You have just opened a new nightclub, Russ'Techno Pitstop, but are unsure of how high to set the cover charge (entrance fee). One week you charged $10 per guest and averaged 300 guests per night. The next week you charged $15 per guest and averaged 250 guests per night.
a. Find a linear demand equation showing the number of guests q per night as a function of the cover charge p.
b. Find the nightly revenue R as a function of the cover charge p.
c. The club will provide two free nonalcoholic drinks for each guest, costing the club $3 per head. In addition, the nightly overheads (rent, salaries, dancers, DJ, etc.) amount to $3000. Find the cost C as a function of the cover charge p.
d. Now find the profit in terms of the cover charge p, and hence determine the cover charge you should charge for a maximum profit.

Problem 2. The market research department of a Baby Buggy Co. predicts that the demand for a product is given by $q = -6p + 384$ units, where q is the number of buggies it can sell in a month if the price is p per buggy (in dollars). Find the monthly revenue function and find the price that maximizes the monthly revenue and find the maximum monthly revenue.

Problem 3. A company that produces motorcycles has a production cost (per unit) of

$$C(x) = 2000 - 15x + 0.05x^2$$

where C is the cost in dollars to manufacture a motorcycle and x is the number of motorcycles produced. How many motorcycles should be produced in order to minimize the cost of each motorcycle? What is the corresponding minimum cost?

Problem 4. A bacteria culture starts with 2000 bacteria. Two hours later there are 3500 bacteria. Find an exponential model for the size of the culture as a function of time t in hours, and use the model to predict how many bacteria there will be after 5 hours.

Problem 5. After several drinks, a person has a blood alcohol level of 400 mg/dL (milligrams per deciliter). If the amount of alcohol in the blood decays exponentially, with one fourth being removed every hour, find the person's blood alcohol level after five hours.

Problem 6. How long, to the nearest year, will it take an investment to triple if it is continuously compounded at 10% per year?

Problem 7. The **half-life** of a substance is the time it takes half of the substance in a sample to decay. The amount of *radium-226* remaining in a sample that originally contained 100 grams is approximately
$$A(t) = 100(0.999567)^t$$
where t is time in years. Find the half-life to the nearest 100 years.

Problem 8. You take out a 15-month, $10,000 loan at 11% simple interest. How much would you owe at the end of the 15 months?

Problem 9. A $4000 loan, taken now, with a simple interest rate of 8% per year, will require a total repayment of $4640. When will the loan mature?

Problem 10. You are expecting a tax refund of $1500 in 3 weeks. A tax preparer offers you an "interest-free" loan of $1500 for a fee of $60 to be repaid by your refund check when it arrives in 3 weeks. Thinking of the fee as interest, what simple interest rate would you be paying on this loan?

Problem 11. When I was considering what to do with my $20,000 Lottery winnings, my broker suggested I invest half of it in gold, the value of which was growing by 5.2% per year, and the other half in CDs, which were yielding 4.8% per year, compounded every 2 months. Assuming that these rates are sustained, how much will my investment be worth in 10 years?

Problem 12. During the year ending April 2002, the MSCI World Index depreciated by approximately 3.4%. Assuming that this trend were to continue, how much would a $100,000 investment in an MSCI index fund be worth in 3 years?

Problem 13. Jennifer's pension plan is an annuity with a guaranteed return of 5% per year (compounded monthly). She can afford to put $300 per month into the fund, and she will work for 45 years before retiring. If her pension is then paid out monthly based on a 20-year payout, how much will she receive per month?

Problem 14. Meg's pension plan is an annuity with a guaranteed return of 5% per year (compounded quarterly). She would like to retire with a pension of $12,000 per quarter for 25 years. If she works 45 years before retiring, how much money must she and her employer deposit each quarter?