Answer Key: Midterm Exam

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1. 160w @ 13% efficient would produce 160(24)(365)(.13) = 182,208 wh per year or 182.2 khw/year.

   At 15 cents per kwh, this is a benefit of \$27.33 per year.

   If we assume that the price of electricity will rise at approximately the same rate as overall prices, then we should apply a real discount rate for future streams of income. Real discount rates typically range from 2% to 4%.

   The NPV of a steady stream of payments forever = P/r. Thus,
   @ a discount rate of 4%, this project pays \$27.33/.04 = \$683.25 < \$800
   @ a discount rate of 3%, this project pays \$27.33/.03 = \$911.00 > \$800

   The IRR = 3.4%, and the payback period is no less than 800/27.33 = 29 years even at r = 0%.

   These panels are likely to ultimately pay off, but it will take a long time to do so. Obviously factors like available subsidies, expected increases in electricity prices, and installation costs may all affect the decision.

2. a. U(no ticket) = ln(10,000) = 9.2103
   U(ticket) = .999 ln(9900) + .001 ln(259900) = 9.1911 + 0.0125 = 9.2036 < 9.2103. Bad idea.

   b. U(no ticket) = ln(100,000) = 11.5129
   U(ticket) = .999 ln(99900) + .001 ln(259900) = 11.5004 + 0.0128 = 11.5132 > 11.5129. Good idea.

3. With a monopolist we want to max π = TR - TC = pq - 4q for two periods.

   Using the LaGrangian method
   $\max \pi = p_1q_1 - 4q_1 + [p_2q_2 - 4q_2]/(1+r) - \lambda(10 - q_1 - q_2)$
   $\max \pi = (20 - q_1)q_1 - 4q_1 + [(20 - q_2)q_2 - 4q_2]/(1+r) - \lambda(10 - q_1 - q_2)$
   $\partial U/\partial q_1 = 20 - 2q_1 - 4 - \lambda = 0$
   $\partial U/\partial q_2 = (20 - 2q_2 - 4)/(1+r) - \lambda = 0$
   $\partial U/\partial \lambda = 10 - q_1 - q_2 = 0$
   $20 - 2q_1 - 4 = (20 - 2q_2 - 4)/(1+r)$
   $q_1 + q_2 = 10 \Longrightarrow q_1 = 10 - q_2$
   $20 - 2(10 - q_2) - 4 = (20 - 2q_2 - 4)/(1+.10)$
   $-4 + 2q_2 = (16 - 2q_2) / (1.1) = 14.545 - 1.818q_2$
   $3.818q_2 = 18.545 \Longrightarrow q_2 = 4.86$, $q_1 = 5.14$, $p_2 = 15.14$, $p_1 = 14.86$, $CS_2 = 4.86(20 - 15.14)/2 = 11.81$, $CS_1 = 5.14(20 - 14.86)/2 = 13.21$, $\pi_2 = 4.86(15.14 - 4) = 54.14$, $\pi_1 = 5.14(14.86 - 4) = 55.82$.
   Total welfare = (13.21 + 55.82) + (11.81 + 54.14)/1.1 = 69.03 + 59.95 = 128.98

Under a price ceiling, the price in period 1 is now 12.

p_1 = 12 ===> $q_1 = 20 - p_1 = 8$, $\pi_1 = 8(12 - 4) = 64$, $CS_1 = 8(8)/2 = 32$
$p_2 = 12$, $q_2 = 10 - 8 = 2$ (shortgage), $\pi_1 = 2(12 - 4) = 16$, $CS_2 = 2(2)/2 + 2(18 - 12) = 14$
Total welfare = (64 + 32) + (16 + 14)/1.1 = 96 + 27.27 = 123.27

The imposition of the price ceiling has increased consumer surplus at the expense of firm profits. Overall welfare is lower under the price ceiling since we get shortages in the future years.

4. There are many acceptable answers here.
   - Since the benefits are accruing primarily to the poor and middle class, if we have a distributional preference towards these groups, we may favor the project even if it has negative benefits overall.
   - These projects may have positive benefits but they are not undertaken due to status quo bias. The subsidy may help eliminate this bias.
   - These projects may have positive benefits but they are not undertaken due to informational bias. Consumers may not realize their benefits. The subsidy may help eliminate this bias.
   - Consumers may not have personal discount rates that are far higher than societally efficient discount rates. The subsidy may help eliminate this inefficiency.
   - There may be environmental or national defense externalities associated with energy consumption that consumers do not take into account when making decisions. Subsidizing conservation may move to a more efficient allocation.
   - There may be inefficiencies in the intertemporal distribution of resources over time that subsidizing conservation may help alleviate.
   - From a macroeconomic aspect, since this is stimulus spending rather than investment spending, it does not need to satisfy cost benefit analysis in the same way.