(21pts) 1. Concepts

(a) Suppose that the Dow Chemical Company anticipated that profits over the next three years to be as follows:

<table>
<thead>
<tr>
<th>Year</th>
<th>Expected Profits (Millions)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2012</td>
<td>$10,180</td>
</tr>
<tr>
<td>2013</td>
<td>$11,250</td>
</tr>
<tr>
<td>2014</td>
<td>$15,775</td>
</tr>
</tbody>
</table>

Calculate the value of the Dow Chemical Company today. Assume the discount rate to be three percent.

\[
\text{Value of Dow Chemical Company} = \frac{10,180}{1+0.03} + \frac{11,250}{(1+0.03)^2} + \frac{15,775}{(1+0.03)^3} = 349,924
\]

(b) What is the relationship, if any, between the discount rate and the computation of the value of the firm?

the greater the discount rate, the lower the value of the firm. Inverse relationship between the
discount rate and the value of the firm

(c) True or False.

Given the utility function, \( U = \sqrt{y} \), the marginal utility of income is constant.

Note that \( y \) corresponds to income. Provide evidence to support your answer.

\[ MU = \frac{1}{2\sqrt{y}} \]

(d) True or False.

Let \( U = 4y^2 + 2y^2 \) denote the utility function of a key decision-maker. This decision-maker is a risk taker. Provide evidence to support your answer.

\[ MU = 12y^2 + 4y \Rightarrow y < MU. \text{ Consequently, this decision-maker is a risk taker.} \]

(e) (i) A certainty equivalent factor \( \alpha < 1 \) implies what type of risk attitude?

Risk aversion

(ii) A certainty equivalent factor \( \alpha = 1 \) implies what type of risk attitude?

Risk neutrality

(f) The expected value in dollar terms of a risky project is $500,000.

The certainty equivalent adjustment factor (\( \alpha \)) is equal to 0.8. What is the certainty equivalent of this project?

\[
\alpha = \text{Certainty Equivalent} = \text{EV Risky Project} \times \alpha = 0.8 \times 500,000 = 400,000
\]
(2pts) (g) A minor league baseball team is trying to predict ticket sales for the upcoming season and is considering changing ticket prices. The elasticity of ticket sales with respect to the size of the local population is estimated to be 0.7. If the local population increases from 60,000 to 61,500, what is the predicted change in ticket sales? Please give your answer in terms of percentage change.

\[ \% \Delta \text{ticket sales} = 0.7 \times \% \Delta \text{local population} \]

\[ \% \Delta \text{ticket sales} = (0.7)(2.5) = 1.75\% \]

(1pt) (h) __Risk__ is defined as the situation where all possible outcomes of managerial decisions and their probabilities are not completely known. (Fill in the blank.)

(1pt) (i) If a decision-maker is risk neutral, then the risk premium is __0__. (Fill in the blank.)

(1pt) (j) If a decision-maker is risk loving, then the risk premium is __negative (< 0)__. (Fill in the blank.)

(1pt) (k) What is the distinguishing feature between the notion of business profit and the concept of economic profit? __Economic profit considers opportunity cost whereas business profit does not take into account the notion of opportunity cost__.

(1pt) (l) The economist associated with the topic of risk analysis is __Frank Knight__.

(2pts) (m) Suppose an individual’s utility function is related to income. Denote this utility as \( U(y) \). It is known that \( U(50) = 10 \), \( U(100) = 15 \), and \( U(150) = 18 \). Does this person have decreasing, constant, or increasing marginal utility of income? Circle the correct answer. Show all work.

\[ \begin{align*}
U(50) &= 10 \\
U(100) &= 15 \\
U(150) &= 18
\end{align*} \]

\[ \frac{\Delta U}{\Delta y} = \frac{5}{50} = 0.1 \]

\[ \frac{\Delta U}{\Delta y} = \frac{3}{50} = 0.06 \]

As \( y \) \uparrow, \( MU \downarrow \)
2. Information concerning the financial situation for the Coca-Cola Company in 2010 is given as follows:

<table>
<thead>
<tr>
<th>Sales Revenue ($ million)</th>
<th>Net Income ($ million)</th>
<th>Net Worth($ million)</th>
</tr>
</thead>
<tbody>
<tr>
<td>26,193</td>
<td>6,172</td>
<td>15,143</td>
</tr>
</tbody>
</table>

(a) Calculate the profit margin for the Coca-Cola Company.

\[
\text{Profit Margin} = \frac{\text{Net Income}}{\text{Sales Revenue}} = \frac{6,172}{26,193} \times 100\% = 23.56\%
\]

For every dollar of sales revenue, net income is almost 23.56 cents.

(b) Calculate the return on equity for the Coca-Cola Company. Interpret this answer.

\[
\text{Return on Equity (ROE)} = \frac{\text{Net Income}}{\text{Net Worth}} = \frac{6,172}{15,143} \times 100\% = 40.76\%
\]

For every dollar of equity (or net worth), net income is nearly 40.76 cents, alternatively, net income is nearly 41.76% of equity.

3. Suppose that for Timely Products, Inc., the total cost function (TC) is given by

\[\text{TC} = 15Q - 0.6Q^2 + 0.05Q^3\]

where \(Q\) corresponds to the level of output produced by Timely Products, Inc.

(a) What is the marginal cost (MC) function of the firm?

\[MC = \frac{dTC}{dQ} = 15 - 1.2Q + 0.15Q^2\]

(b) What is the average total cost (ATC) function of the firm?

\[\text{ATC} = \frac{\text{TC}}{Q} = 15 - 0.6Q + 0.05Q^2\]

(c) What is the breakeven price for Timely Products, Inc.? To find the minimum of ATC:

\[
\text{breakeven price} = \min \text{ ATC.}
\]

To find the minimum of ATC:

\[
\text{FOC} \quad \frac{d\text{ATC}}{dQ} = -0.6 + 0.15Q = 0 \quad Q = 6
\]

Replace \(Q = 6\) in ATC function

\[15 - 0.6(6) + 0.05(36)\]

\[= 13.20\]

\[\$13.20\] is the break-even price.
(10pts) 4. Nothing But Coffee, Inc., recently introduced a unique new coffee maker to handle the use of whole beans. Monthly demand and cost relations for the company's coffee maker are as follows:

\[
\begin{align*}
P &= 120 - 0.5Q \\
TC &= 420 + 60Q + Q^2
\end{align*}
\]

(5pts) (a) Derive the expression for profit for Nothing But Coffee, Inc. Express your answer in terms of Q.

\[
\Pi = TR - TC = PQ - TC = \quad \text{(Profit)}
\]

\[
\Pi = 120Q - 0.5Q^2 - 420 - 60Q - Q^2
\]

\[
\Pi = -420 + 60Q - 1.5Q^2
\]

(3pts) (b) What value of Q maximizes profit for Nothing But Coffee, Inc.? Please indicate the first-order and second-order conditions to substantiate your answer.

\[
\text{FOC } \quad \frac{d\Pi}{dQ} = 60 - 3Q = 0 \quad Q = 20
\]

\[
\text{SOC } \quad \frac{d^2\Pi}{dQ^2} = -3 < 0 \quad \text{Insures a maximum}
\]

(1pt) (c) What price should Nothing But Coffee, Inc. charge in order to maximize profit?

\[
\text{When } Q = 20 \quad P = 120 - 0.5Q
\]

\[
P = 120 - 10
\]

\[
P = $110
\]

(1pt) (d) What is the maximum level of profit that Nothing But Coffee, Inc. may earn?

\[
\text{When } Q = 20 \quad \Pi = -420 + 60(20) - 1.5(400)
\]

\[
\Pi = $180
\]
(13pts) 5. Suppose that the demand and supply curves for a lumber/forest product are given as follows:

\[ Q_d = 80 - 30P \]
\[ Q_s = -20 + 20P \]

(Q_d and Q_s are measured in thousands of board feet and P is price in dollars.)

(a) What is the minimum price for which quantity demanded is zero?

\[ Q_d = 80 - 30P \text{ and } Q_d = 0 \]
\[ \text{Then } 0 = 80 - 30P \Rightarrow 30P = 80 \]
\[ P = \frac{8}{3} = \$2.67 \]

(b) Find the market equilibrium price (P) and quantity (Q).

\[ \text{equate } Q_d = Q_s \]
\[ 80 - 30P = -20 + 20P \]
\[ 100 = 50P \]
\[ 2 = P \text{ when } P = \$2 \]
\[ Q_d = 20 = Q_s \]

(c) When the price is $2.25 does a surplus or shortage exist?

\[ \text{when } P = \$2.25 \]
\[ Q_d = 12.5 \text{ units} \]
\[ Q_s = 25 \text{ units} \]

\[ Q_s > Q_d \Rightarrow \text{ a surplus} \]

(d) What is the level of excess demand or excess supply when the price is $2.25?

Excess supply of 12.5 units

(e) What is the elasticity of demand and supply at the equilibrium price?

\[
\text{elasticity of demand } \frac{-30P}{Q_d} = \frac{-30(2)}{20} = -3
\]
\[
\text{elasticity of supply } \frac{20P}{Q_s} = \frac{20(2)}{20} = 2
\]

(f) Derive the inverse demand curve.

\[ 80 - 30P = Q_d \]
\[ 30P = 80 - Q_d \]
\[ \frac{P}{3} = \frac{80 - Q_d}{30} \text{ is the inverse demand curve} \]
6. The demand for the Coca-Cola product Dasani (bottled water) is given as:

\[ Q_D = 0.75P_D^{-0.7} P_{AQF}^{0.4} P_{PL}^{0.5} P_{TEA}^{-0.6} I^{0.3} A^{0.1}, \]

where \( Q \) denotes the quantity of Coca-Cola Dasani sold, \( P_D \) denotes the price of Dasani, \( P_{AQF} \) denotes the price of AquaFina, \( P_{PL} \) represents the price of private label brands of bottled water, \( P_{TEA} \) represents the price of tea, \( I \) represents U.S. disposable income, and \( A \) represents the level of advertising expenditures associated with the Dasani product.

(a) What is the technical name of this type of demand function?

\[ \text{multiplicative demand function} \]

(b) True or False. A price reduction for Dasani bottled water, all other factors invariant, will increase the number of units sold and sales revenue. Provide evidence to support your answer.

\[ \begin{align*}
A \text{ price reduction will increase the number of units sold,} \\
\text{but a price reduction will result in a decrease in sales revenue.}
\end{align*} \]

\[ \text{The own-price elasticity of demand is 0.7, make correct} \]

(c) If Pepsi raises the price of AquaFina by 6 percent, then the quantity of Dasani sold rises by 2.4 percent, all other factors invariant. Show all work.

\[ \frac{\% \Delta Q_D}{\% \Delta P_{AQF}} = 0.4 \]
\[ \% \Delta Q_D = 0.4 \times (6) = 2.4 \]

(d) Tea and Dasani bottled water are \[ \text{complements} \]. Provide evidence to support your answer.

\[ \text{cross-price elasticity of demand between tea and} \]
\[ \text{Dasani bottled water} \]
\[ -0.6 \]
\[ \text{negative cross-price elasticity} \]
\[ \text{complements} \]

(e) True or False. The chief competitor of Dasani bottled water is private label brands of bottled water. Provide evidence to support your answer.

\[ \text{cross-price elasticity of Dasani bottled water w/ private label brands} \]
\[ -0.5 \]
\[ \text{cross-price elasticity of Dasani bottled water w/ AquaFina} \]
\[ 0.4 \]

(f) Consider the following scenario. The price of Dasani bottled water rises by 3 percent, the price of private label brands falls by 2 percent, income falls by 5 percent, and advertising expenditures increases by 4 percent. What is the net effect on the quantity of Dasani bottled water sold?

\[ \%
\]
\[ \Delta Z = 3 \%
\]
\[ \%
\]
\[ \Delta P = -2 \%
\]
\[ \%
\]
\[ \Delta I = -5 \%
\]
\[ \%
\]
\[ \Delta A = 4 \%
\]
\[ \%
\]
\[ \Delta Q_D = (-4, 2, 6) \%
\]

(g) If we center attention on income, how would Dasani bottled water be classified? Provide evidence to support your answer.

\[ \text{income elasticity is 0.3} \]
\[ \text{necessary or necessary good} \]

(h) List two additional factors, besides those that have been given, that would potentially affect the demand for Dasani bottled water.

\[ \text{seasonality} \]
\[ \text{prices of other bottled water brands} \]
\[ \text{Prices of other nonalcoholic beverages} \]
\[ \text{population} \]
Johnny Rockets is a retro 1950s hamburger restaurant chain. The company has a limited amount of capital for expansion and must carefully weigh available alternatives. Currently the company is considering opening additional restaurants in Las Vegas, Nevada or Dallas, Texas. Weekly profit projections for these two potential outlets under two possible scenarios related to the economy and their probabilities are given as follows:

<table>
<thead>
<tr>
<th>City</th>
<th>Scenario (State of Nature)</th>
<th>Annual Profit Contribution</th>
<th>Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dallas</td>
<td>Recession</td>
<td>$2,500</td>
<td>.4</td>
</tr>
<tr>
<td>Dallas</td>
<td>Status Quo</td>
<td>$3,000</td>
<td>.6</td>
</tr>
<tr>
<td>Las Vegas</td>
<td>Recession</td>
<td>$2,000</td>
<td>.7</td>
</tr>
<tr>
<td>Las Vegas</td>
<td>Status Quo</td>
<td>$4,000</td>
<td>.3</td>
</tr>
</tbody>
</table>

(a) Calculate expected value of profit for Dallas and Las Vegas. Which is the more attractive location?

\[
EV_D = .4(\$2,500) + .6(\$3,000) = $2,800
\]

\[
EV_{LV} = .7(\$2,000) + .3(\$4,000) = $2,600
\]

Dallas is the more attractive location in terms of expected value or weighted average profit.

(b) Calculate the standard deviation of profit for Dallas and Las Vegas. Which is the more attractive location?

\[
\sigma_D^2 = .4(4,500-2,800)^2 + .6(3,000-2,800)^2 = 60,000
\]

\[
\sigma_D = 244.95
\]

\[
\sigma_{LV}^2 = .7(2,000-2,600)^2 + .3(4,000-2,600)^2 = 840,000
\]

\[
\sigma_{LV} = 891.62
\]

Dallas is the more attractive location in terms of absolute risk.

(c) Calculate the coefficient of variation of profit for Dallas and Las Vegas?

\[
CV_D = \frac{\sigma_D}{EV_D} = 0.0875
\]

\[
CV_{LV} = \frac{\sigma_{LV}}{EV_{LV}} = 0.3525
\]
8. John Deere, Inc. considers profit scenarios for the next fiscal year.

<table>
<thead>
<tr>
<th>Business Conditions</th>
<th>Profit</th>
<th>Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Excellent</td>
<td>$300,000</td>
<td>0.1</td>
</tr>
<tr>
<td>Conventional (Typical)</td>
<td>$175,000</td>
<td>0.6</td>
</tr>
<tr>
<td>Abysmal</td>
<td>$60,000</td>
<td>0.3</td>
</tr>
</tbody>
</table>

\[ E \pi = 0.1(\$300,000) + 0.6(\$175,000) + 0.3(\$60,000) = \$153,000 \]

(b) Suppose the utility function for the CFO (Chief Financial Officer) is given by \( U = \ln \pi \), where \( \pi \) corresponds to profit.

(i) Calculate the MU of profit for this decision-maker.

\[ MU = \frac{1}{\pi} \]

(ii) Is the CFO a risk taker, risk averter, or neutral to risk?

\[ \text{risk averter } \Rightarrow MU > 0 \]

(c) Calculate the expected value of utility for the CFO when \( U = \ln \pi \). Show all work.

\[ \text{expected utility} = 0.1(12.61) + 0.6(12.07) + 0.3(11.00) = 11.81 \]

(d) What is the risk premium when \( U = \ln \pi \). Show all work.

\[ R_{\text{risk premium}} = EV_{\pi} - \pi^* = \$153,000 - \pi^* \]

\[ \ln \pi^* = 11.805 \]

\[ \pi^* = e^{11.805} = \$133,961.60 \]

\[ R_{\text{risk premium}} = \$19,038.40 \]
9. Suppose two projects offer the following payoff matrix:

<table>
<thead>
<tr>
<th>State of Nature</th>
<th>Probability</th>
<th>Project A</th>
<th>Project B</th>
<th>Max Payoff</th>
</tr>
</thead>
<tbody>
<tr>
<td>Status quo</td>
<td>0.60</td>
<td>$1,000</td>
<td>$200</td>
<td>$1,000</td>
</tr>
<tr>
<td>Recession</td>
<td>0.25</td>
<td>-$300</td>
<td>$20</td>
<td>$20</td>
</tr>
<tr>
<td>Boom</td>
<td>0.15</td>
<td>$2,000</td>
<td>$1,500</td>
<td>$1,500</td>
</tr>
</tbody>
</table>

-300  

20

(a) Which project should one choose if a maximin decision rule is used?

worst outcome for Project A   \(-300\)
worst outcome for Project B   \(20\)

choose Project B if a maximin decision rule is used
"best" of the worst outcomes

(b) Which project should one choose if a minimax regret decision rule is used?

Your answer must provide the opportunity loss or regret matrix.

<table>
<thead>
<tr>
<th>Project A regret matrix (or opportunity loss)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project B</td>
</tr>
<tr>
<td>$0</td>
</tr>
<tr>
<td>$320</td>
</tr>
<tr>
<td>$0</td>
</tr>
</tbody>
</table>

max regret \(\$320\) \(\$800\)

choose Project A if a minimax regret decision rule is used

(c) Suppose that probabilities of status quo, recession, and boom change to 0.50, 0.30, and 0.20 respectively. Do your answers given in (a) and (b) change? If so, how?

Answers to (a) and (b) do not change

Game theoretic strategies such as the maximin decision rule or the minimax regret decision rule are invariant with probabilities.