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CIS 418

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A dream of chances

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Those dreams are built from losing lottery tickets, by Brooklyn-based artists Adam Eckstrom and Lauren Was and it's entitled Ghost of a Dream. The tickets were discarded by unlucky patrons. "Chance city" was built by the artist Jean Shin.

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Are you risk averse?

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Suppose you owned a lottery ticket that was 50% likely to result in \$100 loss and \$125 gain.

How much would you accept for this ticket?

Expected Monetary Value (EMV)

$$50\% \times \$125 + 50\% \times (-\$100) = \$12.5$$

Certainty Equivalent

the price at which

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ticket.

Risk premium (RP)

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how much of the EMV you'd be willing to forgo to avoid the risk of losing money.

$$RP = EMV - CE$$

If $RP > 0$ you are risk averse.

If $RP < 0$ you are risk prone.

If $RP = 0$ you are risk neutral.

A monetary utility function translates wealth Assignment Project Exam Help into

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Does this utility function represents the utility of a risk-averse, risk-neutral or risk-prone decision maker?

Explain by showing an example.

Expected Utility vs. Certainty Equivalent

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Risk
Premium
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Under the expected utility model, decision makers make choices that maximize their expected utility. The same choices **also** maximize the certainty equivalent.

Assignment Project Exam Help Various functions can be used to model risk

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- Risk-averse function: Concave.
- Risk-neutral function: Linear.
- Risk-prone function: Convex.

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Are you risk averse?

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Here is an explanation by Veritasium:

<https://www.youtube.com/watch?v=vBX-KulgJ1o>

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Example 1: A simple portfolio problem

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There is an investment that for e estimated returns \$4.3 or \$0 with equal probability.

My current wealth is \$14,000. How much of \$14,000 should I invest?

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-- The more I invest, the more my net wealth, but my risk goes up as

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My optimal investment would depend on my risk preference

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- A decision maker shows constant risk aversion if she has the same positive risk premium for any two risky opportunities that have respective outcomes that differ only by a constant amount.

Therefore, her expected utility would be modeled by a **negative exponential** function:

$$EU = 1 - e^{-CE/R}$$

- A decision maker shows decreasing risk aversion if she has decreasing risk premium for any two risky opportunities that have respective outcomes that differ only by a constant amount.

Therefore, her expected utility would be modeled by a **logarithmic** function:

$$EU = \ln(CE + A)$$

- R, A = Risk tolerance.

Risk premium as a function of initial wealth

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Lower risk premiums = higher risk

Risk as a function of initial wealth

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With the logarithmic utility the percentage of total wealth invested in the risky investment stays the same as the amount of wealth changes.

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Optimize by maximizing CE

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Assignment Project Exam Help Calculate the Certainty Equivalent

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The expected utility of the uncertain in ual to the utility of certainty equivalent.

Negative Exponential Utility

$$EU_{gamble} = 1 - e^{-CE/R}$$

utility of certainty equivalent

⇓

$$e^{-CE/R} = 1 - EU_{gamble}$$

⇓

$$-CE/R = \ln(1 - EU_{gamble})$$

⇓

$$CE = -R \ln(1 - EU_{gamble})$$

Logarithmic Utility

$$CE = A$$

⇓

$$\exp(EU_{gamble}) = CE - A$$

⇓

$$CE = \exp(EU_{gamble}) - A$$

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Calculate the Expected Utility

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Investment: for every 1\$ invested, returns \$4.3 or \$0 with equal probability.

My current wealth is \$14,000.

Calculate EMV, CE and RP for \$2000 investment.

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Initial Wealth

Investment

R (risk toleranc

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$$EU = 1 - \exp(-12,000 / R)$$

	Probability	Net Wea	
Lose	0.5	\$ 12,000.00	0.943891
Win	0.5	\$ 20,600.00	0.99288
Expected		\$ 16,300.00	0.968385

CE \$ 14,389.93

RP \$ 1,910.07

$$CE = -R \cdot \ln(1 - 0.968)$$

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Example 2: Keep the investment?

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The decision maker owns an investment that will result in personal wealth of either \$21,000 or \$11,000 in today's dollars with equal probability

Q1. The decision maker can choose to

- Keep the investment
- Sell this investment now for \$14,000
- Sell half of the investment and keep the other half

Which option will be

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Q2. What is the minimum price that the decision maker will accept now for the entire investment?

Assume the decision maker has *constant risk aversion* with *risk tolerance* parameter $R = \$4166$.

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Option 1: Write VBA Functions

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- To increase efficiency, we can write a function to calculate the Negative Exponential Utility and the Certainty Equivalent:

Function NEXPEU(CE, R)

NEXPEU =

End Function <https://eduassistpro.github.io/>

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Function CE_NEXPEU(EU, R)

CE_NEXPEU = -R * Log(1 - EU)

End Function

Option 2: ~~Compare the expected utilities (or CEs)~~ Assignment Project Exam Help

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keep

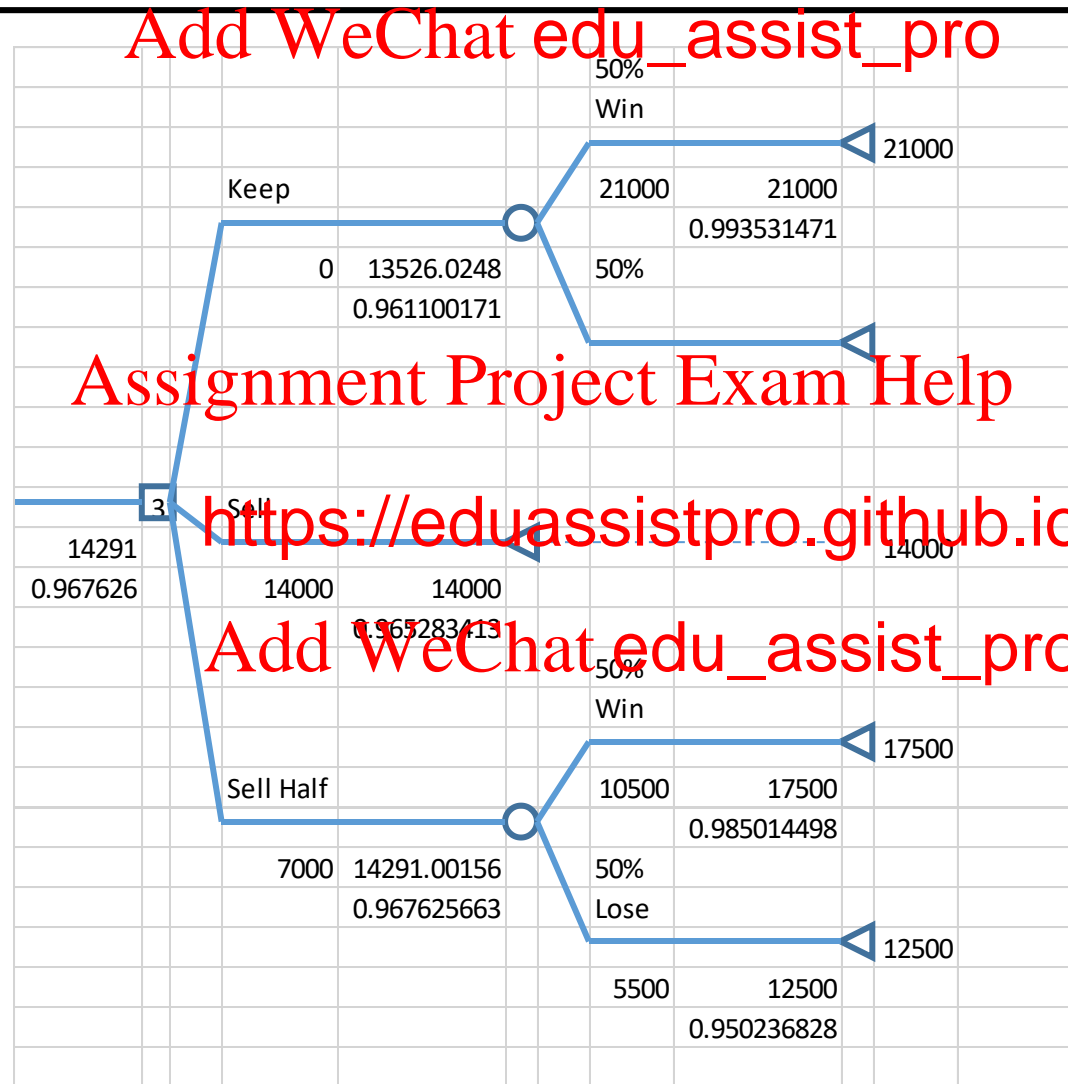
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Sell for 14K

Decision: Sell $\frac{1}{2}$ for 7K

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Option 3: Use a decision tree



For this investor, the second 50% of this investment are worth less than 7K in t the first 50%

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**Q2: The minimum this investor will accept
right now for the investment is \$13,256**

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Example 3: Bet on what horse?

I would like to bet \$5000 on a horse. I y beliefs about the probability of winning are given below.

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So if I place \$100 bet on Tea Biscuit, and Tea Biscuit comes in first I would get \$1800. That will happen with 15% probability. With 85% probability Tea Biscuit will not come in first, and I will lose my \$100.

Sample spreadsheet to compare utilities of betting on different horses

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$$EU = 1 - e^{-CE/R}$$

What if you could split the bet among the horses?

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<i>Risk tolerance parameter</i>								
R	\$ 25,000							
	Waste O'Time	Fool's Folly	First in Ninth	Save Your Money	Tea Biscuit			
Prob of coming first	35%	10%	10%	30%	15%			
Payout on \$1 bet	\$ 2.50	\$ 4.00	\$ 4.50	\$ 5.00	\$ 18.00			
Bets	\$ 400.00	\$ 1,000.00	\$ 1,500.00	\$ 2,000.00	\$ 100.00	Expected		
Winning if first	\$ 1,000.00	\$ 4,000.00	\$ 6,750.00	\$ 10,000.00	\$ 1,800.00	\$4,695.00	CE	
Utility if first	0.09	0.15	0.24	0.33	0.07	\$ 0.16	\$4,403.39	

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Built a spreadsheet that includes the above

- What would be your objective?
- What are the decision variables?
- What are the constraints?

Optimize using two different objectives: risk-averse vs. risk-neutral.
Compare the results.