# Seminar Economics and Psychology of Risk & Time

## Assignment 1

### Group 7


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TASK 1

a)

$u(x)= x/10$     (0.2, 40), (0.6, 50), (0.2, 30)

$EV = 0.2 \times (40/10) + 0.6 \times (50/10) + 0.2 \times (30/10) = 4.4$

CE: $m/10 = 4.4$
$m=44$

The certainty equivalent is 44.

b)
$u(x)= x/10$     $w(p)=p^2$

Probability of outcome q or better:
$q=40$, $p=(0.2) + (0.6) = 0.8$

$q=50$, $p = (0.6)$     $q = 30$ , $p = (0.2) + (0.6) = 0.8$

$q= 30$, $p=(0.2) + (0.6) = 0.8$

Probability outcome is strictly better than b:
$b=40$, $p=0.6$,     $b=50$, $p=0$,     $b=30$, $p=(0.2) + (0.6) = 0.8$

$w(p)=p^2$
$w(0.8) - w(0.6) = (0.8)^2 - (0.6)^2 = 0.28$
$w(0.6) - w(0.0) = (0.0)^2 - (0.0)^2 = 0.36$
$w(1) - w(0.8) = (1)^2 - (0.8)^2 = 0.36$

Expected utility, using these updated probability weights is:
$EV = 0.28 \times (40/10) + 0.36 \times (50/10) + 0.36 \times (30/10) = 4$

CE: $m/10 = 4$
$m = 40$

The certainty equivalent is 40.

#2a)

Under EU, a preference for prospect A over B implies:

$$u(3000) > 0.8(4000) + 0.2(0)$$

dividing both sides by 4 & adding 0.75(0)

$$0.75(0) + 0.25\,u(3000) > 0.2(4000) + 0.05(0) + 0.75(0)$$

A preference for prospect D over C implies

$$0.2(4000) + 0.8(0) > 0.25(3000) + 0.75(0)$$

$\Rightarrow$ Under EU, an individual cannot simultaneously prefer (A and D) or (B and C).

(b)

$EV(A) = 3000 \qquad D(A) = 3000$

$EV(B) = EU = 3200$

$D(B) = 0.8 \times (4000 + 0.0002 \times (4000 - 3200)^2) + 0.2 \times (0 -$
$0.0002 \times (0 - 3200)^2) = 3302.4 - 409.6 = 2892.8$

Hence, $D(A) > D(B)$

$EV(C) = EU = 750$

$D(C) = 0.25 \times (3000 + 0.0002 \times (3000 - 750)^2) + 0.75 \times$
$(0 - 0.0002 \times (0 - 750)^2) = 1003.125 - 84 = 918.75$

$EV(D) = EU = 800$

$D(D) = 0.2 \times (4000 + 0.0002 \times (4000 - 800)^2) + 0.8 \times (0 -$
$0.0002 \times (0 - 800)^2) = 1209.6 - 102.4 = 1107.2$

Hence, $D(D) > D(C)$

(c) Using the parametarization by Tversky & Kahnemann:

CPT(A)

| $x$ | $p$ | $\pi$ | $\pi U(x)$ |
|---|---|---|---|
| 3000 | 1 | $w^+(1) - w^+(0) = 1$ | 1147.80 |

CPT(B)

| $x$ | $p$ | $\pi$ | $u(x)$ | $U(x)$ |
|---|---|---|---|---|
| 4000 | 0.8 | $w^+(0.8) - w^+(0) = 0.607$ | 63.245 | 1478.47 |

$\pi U(x) = 897.43$

CPT(C)

| $x$ | $p$ | $\pi$ | $u(x)$ | $\pi U(x)$ |
|---|---|---|---|---|
| 3000 | 0.25 | $w^+(0.25) = 0.2907$ | 1147.8 | 333.67 |

CPT(D)

| $x$ | $p$ | $\pi$ | $u(x)$ | $\pi U(x)$ |
|---|---|---|---|---|
| 4000 | 0.2 | $w^+(0.2) = 0.261$ | 1478.47 | 385.53 |

$\Rightarrow CPT(A) > CPT(B)$ & $CPT(D) > CPT(C)$

3] A) $(0.25, \$75; 0.25, \$50; 0.25, \$25; 0.25, \$0)$

| X | p | $\pi$ | $u(x) = U(x)$ | $\pi * U(x)$ |
|---|---|---|---|---|
| 75 | 0.25 | $w^+(0.25) - w^+(0) = 0.29074$ | 44.674 | 12.989 |
| 50 | 0.25 | $w^+(0.50) - w^+(0.25) = 0.12990$ | 31.268 | 4.062 |
| 25 | 0.25 | $w^+(0.75) - w^+(0.50) = 0.14763$ | 16.990 | 2.508 |
| 0 | 0.25 | $w^+(1) - w^+(0.75) = 0.43173$ | 0 | 0 |

$u^+(x) = x^{0.88}$ if $x \geq 0$

$u^-(x) = 2.25 * -(-x)^{0.88}$ if $x < 0$

$\lambda = 2.25$

$$w^+(p) = \frac{p^{0.61}}{(p^{0.61} + (1-p)^{0.61})^{1/0.61}}$$

$$w^-(p) = \frac{p^{0.69}}{(p^{0.69} + (1-p)^{0.69})^{1/0.69}}$$

$$w^+(0.25) = \frac{0.25^{0.61}}{(0.25^{0.61} + (0.75)^{0.61})^{1/0.61}} = 0.29074$$

$$w^+(0) = \frac{0^{0.61}}{(0^{0.61} + 1^{0.61})^{1/0.61}} = 0$$

$$w^+(0.50) = \frac{0.50^{0.61}}{(0.50^{0.61} + 0.50^{0.61})^{1/0.61}} = 0.42064$$

$$w^+(0.75) = \frac{0.75^{0.61}}{(0.75^{0.61} + 0.25^{0.61})^{1/0.61}} = 0.56827$$

$$w^+(1) = \frac{1^{0.61}}{(1^{0.61} + 0^{0.61})^{1/0.61}} = 1$$

$u(75) = 75^{0.88} = 44.674$

$u(50) = 50^{0.88} = 31.268$

$u(25) = 25^{0.88} = 16.990$

$u(0) = 0^{0.88} = 0$

$0.29074 - 0 = 0.29074$

$0.42064 - 0.29074 = 0.12990$

$0.56827 - 0.42064 = 0.14763$

$1 - 0.56827 = 0.43173$

$CPT = 12.989 + 4.062 + 2.508 + 0 = 19.559$

$CE^{0.88} = 19.559 \Rightarrow \boxed{CE = 29.339}$

$EV = \frac{1}{4}(75) + \frac{1}{4}(50) + \frac{1}{4}(25) + \frac{1}{4}(0) = 37.5$

$RP = 37.5 - 29.339 \Rightarrow \boxed{RP = 8.161}$

B) (0.25, \$50; 0.25, \$25; 0.25, \$0; 0.25, -\$25)

| X | P | $\pi$ | $u(x) = Ux$ | $\pi * u(x)$ |
|---|---|---|---|---|
| 50 | 0.25 | $w^+(0.25) - w^+(0) = 0.29074$ | 31.268 | 9.091 |
| 25 | 0.25 | $w^+(0.50) - w^+(0.25) = 0.12990$ | 16.990 | 2.207 |
| 0 | 0.25 | $w^+(0.75) - w^+(0.50) = 0.14763$ | 0 | 0 |
| -25 | 0.25 | $w^-(0.25) - w^-(0) = 0.29352$ | -38.227 | -11.220 |

$$w^-(0.25) = \frac{(0.25)^{0.69}}{((0.25)^{0.69} + (0.75)^{0.69})^{1/0.69}} = 0.29352$$

$$w^-(0) = \frac{0^{0.69}}{(0^{0.69} + 1^{0.69})^{1/0.69}} = 0$$

$$u^-(-25) = 2.25 * -(+25)^{0.88} = -38.227$$

$CPT = 9.091 + 2.207 + 0 + {-11.220} = 0.078$

$CE^{0.88} = 0.078 \Rightarrow \boxed{CE = 0.055}$

$EV = \frac{1}{4}(50) + \frac{1}{4}(25) + \frac{1}{4}(0) + \frac{1}{4}(-25) = 12.5$

$RP = 12.5 - 0.055 \Rightarrow \boxed{RP = 12.445}$

C) (0.25, \$25; 0.25, \$0; 0.25, -\$25; 0.25, -\$50)

| X | P | $\pi$ | $u(x) = U(x)$ | $\pi * u(x)$ |
|---|---|---|---|---|
| 25 | 0.25 | $w^+(0.25) - w^+(0) = 0.29074$ | 16.990 | 4.940 |
| 0 | 0.25 | $w^+(0.50) - w^+(0.25) = 0.12990$ | 0 | 0 |
| -25 | 0.25 | $w^-(0.50) - w^-(0.25) = 0.16047$ | -38.227 | -6.134 |
| -50 | 0.25 | $w^-(0.25) - w^-(0) = 0.29352$ | -70.352 | -20.650 |

$$w^-(0.50) = \frac{(0.50)^{0.69}}{((0.50)^{0.69} (0.50)^{0.69})^{1/0.69}} = 0.45399$$

$0.45399 - 0.29352 = 0.16047$

c) continued

$u^-(-50) = 2.25 * -(+50)^{0.88} = -70.352$

$CPT = 4.940 + 0 + -6.134 + -120.650 = -21.844$

$2.25 * -(-CE)^{0.88} = -21.844$

$\Rightarrow \boxed{CE = -13.2361}$

$EV = \frac{1}{4}(25) + \frac{1}{4}(0) + \frac{1}{4}(-25) + \frac{1}{4}(-50) = -12.50$

$RP = -12.50 + 13.236 = 0.736$

$\boxed{RP = 0.736}$

D) $(0.25, \$0;\ 0.25, -\$25;\ 0.25, -\$50;\ 0.25, -\$75)$

| X | P | $\pi$ | $u(x) = Ux$ | $\pi * U(x)$ |
|---|---|---|---|---|
| 0 | 0.25 | $w^+(0.25) - w^+(0) = 0.29074$ | 0 | 0 |
| -25 | 0.25 | $w^-(0.75) - w^-(0.50) = 0.17241$ | -38.227 | -6.591 |
| -50 | 0.25 | $w^-(0.50) - w^-(0.25) = 0.16047$ | -70.352 | -11.289 |
| -75 | 0.25 | $w^-(0.25) - w^-(0) = 0.29352$ | -100.516 | -29.503 |

$$w^-(0.75) = \frac{0.75^{0.69}}{(0.75^{0.69} + 0.25^{0.69})^{1/0.69}} = 0.62640$$

$0.62640 - 0.45399 = 0.17241$

$u^-(-75) = 2.25 * -(+75)^{0.88} = -100.516$

$CPT = 0 + -6.591 + -11.289 + -29.503 = -47.383$

$2.25 * -(-CE)^{0.88} = -47.383$

$\Rightarrow \boxed{CE = -31.909}$

$EV = \frac{1}{4}(0) + \frac{1}{4}(-25) + \frac{1}{4}(-50) + \frac{1}{4}(-75) = -37.5$

$RP = -37.5 + +31.909 = -5.591$

$\boxed{RP = -5.591}$

#4)

| | stolen (10%) | accident (~~6~~6%) | nothing (84%) |
|---|---|---|---|
| full ins. | 30 K | 30 K | 30 K |
| theft ins. | 32 K | 7 K | 32 K |
| no ins. | 10 K | 10 K | 35 K |

(a) EU(full ins.): ~~$0.1 \times 5 \times 30^{0.2}$~~ $1 \times 5 \times 30^{0.2} = 9.872$

EU(theft ins.): $0.94 \times 5 \times 32^{0.2} + 0.06 \times 5 \times 7^{0.2} =$

$= 9.4 + 0.4427 = 9.8427$

EU(no ins.): $0.16 \times 5 \times 10^{0.2} + 0.84 \times 5 \times 35^{0.2}$

$= 1.2679 + 8.5519 = 9.8198$

$\Rightarrow$ Alan will take full insurance!

(b)

RDU(full ins.) $= u(30) \times [w(1) - w(0)]$

$= 9.87175 \times 1$

RDU(theft ins.) $= u(32) \times [w(0.94)] + u(7) \times [w(1) - w(0.94)]$

$= 10 \times 0.9146 + 7.3789 \times 0.0854$

$= 9.146 + 0.63 = 9.7762$

RDU(no ins.) $= u(10) \times [w(1) - w(0.84)] + u(35) \times [w(0.84)]$

$= 7.9245 \times (1 - 0.8053) + 10.1808 \times 0.8053$

$= 1.5429 + 8.1986 = 9.7415$

$\Rightarrow$ Alan will take full insurance!

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Q5 $E=(0.5:-3000,\ 0.5:4500)$ $F=(0.25:-6000;\ 0.75:3000)$

$G=(0.5:-1500;\ 0.5:4500)$ $H=(0.25:-3000;\ 0.75:3000)$

$w^+=w(p)=p^2$ $u^+(x)=x^5$ $u^-(x)=-2x^5$

$CPT(E)=w^-(0.5)u^-(-3000)+w^+(0.5)u^+(4500)=$

$0.25\times(-2)\times3000^5+0.25\times4500^5=4.6\times10^{22}$

$CPT(F)=w^-(0.25)u^-(-6000)+w^+(0.75)u^+(3000)=$

$0.0625\times(-2)\times6000^5+0.75^2\times3000^5=-8.35\times10^{17}$

$CPT(E)>CPT(F)$

$CPT(G)=w^-(0.5)u^-(-1500)+w^+(0.5)u^+(4500)$

$=0.25\times(-2)\times1500^5+\cancel{0.25}\ 0.25\times4500^5=4.58\times10^{17}$

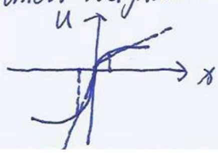
$CPT(H)=w^-(0.25)u^-(3000)+w^+(0.75)u^+(3000)=$

$0.0625\times(-2)(3000)^5+0.75^2\times3000^5=1.06\times10^{17}$

$CPT(G)>CPT(H)$

using the example from the slides, with S-shaped ~~(utility)~~ CPT
people's choice doesn't invalid the S-shaped (utility) CPT

The intuition is that losing x hurts you more than gaining x brings you pleasure. although people should prefer 0.75:3000 than 0.5:4500, the possible loss of 6000 with probability of 0.25 hurts too much which weighout the gain (extra utility) from 0.75:3000




A second possible explanation that comes to the same conclusion that we do not agree with the statement by Levy and Levy (2002) is the following:
Looking at the probability weighting of cumulative prospect theory, shows that small probabilities are overweighted and moderate and large probabilities are underweighted.

Why do people prefer E over F? In prospect F there is a small probability of a very large negative outcome. Since it is a small probability and a negative outcome, people are pessimistic according to CPT. Prospect E on the other hand has equal moderate probabilities and is hence preferred over a prospect with a small overweighted outcome of loosing 6000 with probability 0.25.

The same logic holds for prospects G and H. In Prospect H there is a small probability of a very large negative outcome. Since it is a small probability and a negative outcome, people are pessimistic according to CPT and hence prefer prospect G over prospect H.