Consider playing this game:

- For what value of X are you indifferent to playing?
  - X = 20
  - X = 30
  - X = 40
  - X = 50
  - X = 55

- Certain equivalent is value of game to you
Risk Premium

• A slightly different game:

- Expected monetary value (EMV) = expected dollar value of game (here = $10,000)
- Risk premium = EMV – CE = $3,000
  - How much you would pay (give up) to avoid risk
  - This is what insurance is all about

Insure car?

- yes
  - 0.5
    - $20,000
  - 0.5
    - $0
- no
  - $7,000 ← Say this is our CE

- Play?
  - yes
    - 0.5
      - $20,000
  - no
    - $7,000

- Insure car?
  - no
    - 0.02
      - $30,000
  - yes
    - 0.98
      - $1000

\[ \text{EMV} = \text{Expected dollar value of game} = \$10,000 \]
\[ \text{Risk premium} = \text{EMV} - \text{CE} = \$3,000 \]

This is what insurance is all about.
Let’s Do a Real Test

• Game set-up
  ▪ I will flip a fair coin
  ▪ If “heads”, you win $50. If “tails”, you win $0
  ▪ How much would you be willing to pay me to play?
    o $1 ?
    o $10 ?
    o $20 ?
    o $24.99 ?
    o $25.01 ?
    o $30 ?
  ▪ Who is willing to bid highest?
    o How did you determine that value?
Recall Our Friend, Utility Curves

- Utility curve determines your “risk preference”
  - Can be different in different parts of the curve
Exponential Utility Curves

- Many people have exponential (risk averse) curves

\[ U(x) = 1 - e^{-x/R} \]

- \( R \) is your “risk tolerance”
- Larger \( R \) = less risk aversion
  - Makes utility function more “linear”
  - \( R \approx \) highest value of \( Y \) for which you would play:

Play?

- yes
  - 0.5
  - \$Y

- no
  - 0.5
  - -$Y/2
  - $0
How Rational Are You?

• Which option would you choose?

Choice A preferred:
\[1.00 \times U(1,000,000) > 0.89 \times U(1,000,000) + 0.01 \times U(0) + 0.10 \times U(5,000,000)\]

Choice D preferred:
\[0.89 \times U(0) + 0.11 \times U(1,000,000) < 0.90 \times U(0) + 0.10 \times U(5,000,000)\]

• How many chose A and D?
How Rational Are You?

- Which option would you choose?

<table>
<thead>
<tr>
<th>Choice D preferred:</th>
<th>Choice A preferred:</th>
</tr>
</thead>
<tbody>
<tr>
<td>$1.00 \ U(1,000,000) &lt; 0.89 \ U(1,000,000) + 0.01 \ U(0) + 0.10 \ U(5,000,000)$</td>
<td>$1.00 \ U(1,000,000) &gt; 0.89 \ U(1,000,000) + 0.01 \ U(0) + 0.10 \ U(5,000,000)$</td>
</tr>
</tbody>
</table>

You are inconsistent with utility theory (Allais Paradox)
- For any choice of utility function
How Rational Are You?

• Which option would you choose?

<table>
<thead>
<tr>
<th>Choice?</th>
<th>100%</th>
<th>$1,000,000</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>89%</td>
<td>$1,000,000</td>
</tr>
<tr>
<td></td>
<td>1%</td>
<td>$0</td>
</tr>
<tr>
<td>B</td>
<td>10%</td>
<td>$5,000,000</td>
</tr>
</tbody>
</table>

Choice A preferred:

\[ 1.00 \text{U}(1,000,000) > 0.89 \text{U}(1,000,000) + 0.01 \text{U}(0) + 0.10 \text{U}(5,000,000) \]

<table>
<thead>
<tr>
<th>Choice?</th>
<th>89%</th>
<th>$0</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>11%</td>
<td>$1,000,000</td>
</tr>
<tr>
<td></td>
<td>90%</td>
<td>$0</td>
</tr>
<tr>
<td>D</td>
<td>10%</td>
<td>$5,000,000</td>
</tr>
</tbody>
</table>

Choice D preferred:

\[ 0.89 \text{U}(0) + 0.11 \text{U}(1,000,000) < 0.90 \text{U}(0) + 0.10 \text{U}(5,000,000) \]

• Human behavior is not always axiomatically consistent