**First Law of Decision Science:**
"What we receive depends in part on what actions we freely choose to take, and in part on circumstances that are entirely outside of our control."

**Second Law of Decision Science:**
"Some of the circumstances that are outside of our control are predictable, others are unpredictable."

Decision Analysis is based on making a clear conceptual distinction between actions we freely choose to take, and circumstances that are entirely outside of our control. In other words, if something is partly controllable, decision analysis needs to know what part is controllable and what part is not.

_Ecclesiastes 9:11 "The race is not to the swift or the battle to the strong, nor does food come to the wise or wealth to the brilliant or favor to the learned; but time and chance happen to them all."_
## Conflicting Objectives in Various Flavors of Decision Making

<table>
<thead>
<tr>
<th>Type of Decision</th>
<th>Conflicting &quot;Objectives&quot;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Multiple Objectives</td>
<td>My car should have a low price&lt;br&gt;It should also be roomy &amp; luxurious</td>
</tr>
<tr>
<td><strong>Risky Decisions</strong></td>
<td>Do well in rain;&lt;br&gt;Do well in shine</td>
</tr>
<tr>
<td>Games</td>
<td>Do well if opponent attacks on left&lt;br&gt;Do well if opponent attacks on right</td>
</tr>
<tr>
<td>Social Choice</td>
<td>Satisfy you&lt;br&gt;Satisfy me</td>
</tr>
</tbody>
</table>
Payoff Matrix

The Payoff Matrix is an expression of the First Law of Decision Science.

Each row represents one action that the decision maker might or might not freely choose to perform;

Each column represents a possible state of nature, totally beyond our control.

At the time the decision must be made the decision maker assumes that one of the columns represents the actual decision situation, but does not know which column is the correct one.

The cells of the matrix represent payoffs that the decision maker would receive if he chose the action represented by a particular row and the actual state of nature were the one represented by a particular column.
What is a Decision Rule?

The payoff matrix assigns each alternative action a row of possible payoffs.

A decision rule converts this row of payoffs into a single number that somehow represents the whole row. This makes it easy to pick the alternative action whose representative number is better than the other alternative actions' representative numbers.

Several decision rules exist; each has a different way to convert a row of possible payoffs into a single representative number--

for example:

- the best possible payoff for an alternative action,
- the worst possible payoff for an alternative action,
- weighted average of the best & worst possible payoff for an alternative action,
- the maximum possible regret for an alternative action,
- the simple average of the possible payoffs for an alternative action,
- the statistical expectation of the possible payoffs for an alternative action,
- the statistical expectation of the possible regrets of an alternative action.
Decision Rules: Greed and Fear Under Ignorance

Pure Greed: Maximax Rule "Go for the gold!"
Pure Fear: Maximin Rule "Cover your assets"
Combining Greed and Fear: Hurwicz Rule "Seek a balance"
Fear of Gult: Minimax Regret Rule "I'd hate myself if it went wrong"

- In effect, regret focuses attention where our actions make the most edifference.

Equal Averaging: The Principle of Insufficient Reason
(Laplace-Bayes; maximum entropy)

Each rule constructs an ‘argument” in favor of its selected alternative. All are fallible. The best approach is to look at several to see what makes the most sense in this situation.