The Decision Matrix

- A *Decision problem* consists in the question of which act to choose, given a set of states, in order to obtain the best outcome.
- The only thing a decision maker have control at is acts.
- The ultimate goal is to find the best act.

Difference From Game Theory

- In game theory, a decision maker make decision based on the other decision maker(s) but that / these other decision makers **also make decision based on the decision maker**. So other decision makers cannot consider as states of world because it depends on acts of a decision maker

States

- The state is what in the natural that determines the outcomes of your decision.

- The states should always be **independent** to acts otherwise the formalization of the decision problem is not correct.

- States should be chosen such that the **value** (probability) of the outcomes under all states is **independent** of **whether the state occurs or not**

    - Example : you are making bet that a surgery can be live or death.
- The **importance** of state is to partition outcomes.

Outcomes

- The ranking of outcomes is **subjective**.

Ordinal Scales

- *Ordinal scales* is *qualitative comparison*. The number in that scale only **shows the order** of the outcome. It doesn't tell how much outcomes are difference to each other.
    - The number **can be arbitrary** as long as the number in the scale **show the order** of the outcomes
- For ordinal scales
    - It is positive monotone transformation
    - $f(x) \geq f(y)$ if and only if $x \geq y$

Cardinal Scales

- Both interval scales and ratio scales can be considered as ordinal scales.
- For interval scales, it accurately reflect differences between objects.
    - It is positive linear transformation
    - $f'(x) = kf(x) + m$
- For ratio scales, accurately reflect ratios between objects.
    - It is positive multiplication
    - $f'(x) = kf(x)$

Acts

- An *act* is a *function* from a set of states to a set of outcomes
    - primarily concerned with **particular** acts, rather than generic acts

Alternative set

- Every member is a particular act
- It has at least two different members
- The members are agent-identical
- The members are time-identical
- The members are performable
- The members are incompatible in pairs
- The members are jointly exhaustive

Rival Formalizations

- The problem of **rival formalizations** arises if two or more formalizations are *equally reasonable* and strictly better than all alternatives

Transformative decision rules

The principle of insufficient reason

- If in a formal decision problem the probabilities of states are unknown, then it may be transformed into another formal decision problem in which **equal probabilities** are assigned to all states.
- This principle is not quiet satisfied

Merger of states

- If **two or more** states yield **identical outcomes** under all acts, then those **repetitious states** should be **collapsed into one**, **if** the **probabilities** of the two states are **known** they should be added.