# Microeconomic Analyses of Old Indian Texts

## Decisions

Harald Wiese

University of Leipzig

# Course overview

- Chapter I:
  Introduction: Old Indian literature and microeconomics

**Part A. Decision theory**

- Chapter II:
  Preferences
- **Chapter III:**
  **Decisions**
- Chapter IV:
  Decision theory for the Bhagavad Gita
- Chapter V:
  Monopoly theory and Kautilya's market tax

# Chapter III: Decisions

1. Decision theory: the simple models
2. Simple models in the Hitopadeśa
3. Decision theory: lotteries
4. Lotteries in the Hitopadeśa and the Pañcatantra
5. Lotteries against and in favor of God's existence

# Decision theory: the simple models

## description

| **action** | |
|---|---|
| production of umbrellas | 100 |
| production of sunshades | 64 |

- a set of actions $A$
- a set of consequences $C$ (profits)
- a consequence function $f : A \longrightarrow C$
- a preference relation $\succsim$ on $C$

# Decision theory: the simple models

## Theoretical prediction

An action $a^*$ with

$$\underbrace{f\left(a^*\right)}_{\in C} \succsim \underbrace{f\left(a\right)}_{\in C} \text{ for all } a \in A.$$

### Problem

*In our example, the firm will produce ??*

# Decision theory: the simple models

## States of the world

| | | **state of the world** | |
|---|---|---|---|
| | | bad weather | good w. |
| **action** | um-brellas | 100 | 81 |
| | sun-shades | 64 | 121 |

- a set of states of the world $W$
- tuples $(a, w)$ with $a \in A$ and $w \in W$ determine consequence: uncertain-consequence function

$$g : A \times W \rightarrow C$$

# Decision theory: the simple models

## analysis

Given a specific state of the world, which action is best?

| | | **state of the world** | |
|---|---|---|---|
| | | bad weather | good w. |
| **action** | um-brellas | 100 R | 81 |
| | sun-shades | 64 | 121 R |

Sometimes, one action is better than another one for all states of the world. We then say that *a* dominates *b*.

# Decision theory: the simple models

## dominance

Dominant action = best action for all states of the world (with R everywhere in the row)

| | | **state of the world** | |
|---|---|---|---|
| | | bad weather | good w. |
| **action** | um-brellas | 100 R | 181 R |
| | sun-shades | 64 | 121 |

# Decision theory: the simple models

## exercise on domination

| | | **weather** | | |
|---|---|---|---|---|
| | | bad | med. | good |
| **action** | green icecr. | 10 | 20 | 30 |
| | blue icecr. | 25 | 25 | 20 |
| | red icecr. | 8 | 15 | 25 |

# Decision theory: the simple models

## maxmin

Maxmin action = best action for pessimist

| | | **state of the world** | |
|---|---|---|---|
| | | bad weather | good w. |
| **action** | um-brellas | 100 | 81 P |
| | sun-shades | 64 P | 121 |

### Problem

*For the icecream matrix, find the maxmin action!*

# Simple models in the Hitopadeśa

## Investment and duty in short and long lifes

Contradictory?

> *A wise man should think about knowledge and money as if he were immune to old age and death; but he should perform his duties as if Death had already seized him by the hair.*

With respect to the first decision, we propose the actions

$$\begin{aligned} \text{invest} &= \text{save money/increase knowledge,} \\ \text{do not invest} &= \text{spend money/do not labor for education} \end{aligned}$$

and the states of the world

$$\begin{aligned} &\text{short life,} \\ &\text{long life.} \end{aligned}$$

# Simple models in the Hitopadeśa

## Investment decision

| | | **state of the world** | |
|---|---|---|---|
| | | short life | long life |
| **action** | invest | no use for cap./knowl. P | long use of cap./knowl. R |
| | do not invest | enjoym. money/leis. R | material pov./ spiritual pov. P **VB** |

**VB** = very bad outcome of poverty (material and spiritual)

# Simple models in the Hitopadeśa

## dharma decision

| | | **state of the world** | |
|---|---|---|---|
| | | short life | long life |
| **action** | dharma now | good karma R | good karma, little enjoym. in youth P |
| | dharma later | bad karma P **VB** | good karma, some enjoym. in youth R |

No contradiction!

> *A wise man should think about knowledge and money as if he were immune to old age and death; but he should perform his duties as if Death had already seized him by the hair.*

# Simple models in the Hitopadeśa

## Contradictory advice on investment decision

*The wealth of a rich man lie in what he gives away or enjoys; once he dies, others will play with his wife as well as his wealth.*
*Furthermore,*
*I think that your wealth is what you give away to distinguished people or what you consume day by day; the rest is what you keep for somebody else.*

# Simple models in the Hitopadeśa

## Fate and human effort: quotation

*One should not give up one's efforts, even when acknowledging the role of fate; without effort, one cannot obtain oil from sesame seeds.*
*And there is another verse on this:*
*Fortune gravitates towards eminant men who work hard; only cowards say it depends on fate.*
*Forget about fate and be a man–use your strength!*
*Then, if you don't succeed inspite of your efforts, what is there to blame?*

# Simple models in the Hitopadeśa

## Fate and human effort: interpretation

| | | **state of the world (fate)** | |
|---|---|---|---|
| | | favorable | unfavorable |
| **action** | lazy | 10 | 2 |
| | busy | 50 | 10 |

A payoff of 10: Then, if you don't succeed inspite of your efforts, what is there to blame?

Matrix interpretation: "Just as a cart cannot move on one wheel, so fate itself cannot be fulfilled without human effort."

# Simple models in the Hitopadeśa

## Fate and human effort with cost of effort

| | | **state of the world (fate)** | |
|---|---|---|---|
| | | favorable | unfavorable |
| **action** | lazy | 10 | 2 |
| | busy | $50 - c$ | $10 - c$ |

### Problem

*For which cost intervals is "busy" dominant? Or "lazy"?*

# Decision theory: lotteries

| | | **state of the world** | |
|---|---|---|---|
| | | bad w., $\frac{1}{4}$ | good w., $\frac{3}{4}$ |
| **action** | um-brellas | 100 | 81 |
| | sun-shades | 64 | 121 |

$$L_{\text{umbrella}} = \left[100, 81; \frac{1}{4}, \frac{3}{4}\right]$$

$$E\left(L_{\text{umbrella}}\right) = \frac{1}{4} \cdot 100 + \frac{3}{4} \cdot 81 = 85.75$$

# Lotteries in the Hitopadeśa and the Pañcatantra

## Fate and human effort revisited I

No talk about probabilities in the Hitopadeśa. Nevertheless:

| | | **state of the world (fate)** | |
|---|---|---|---|
| | | favorable, $p_{\text{fav}}$ | unfav., $p_{\text{unfav}}$ |
| **action** | lazy | 10 | 2 |
| | busy | $50 - c$ | $10 - c$ |

# Lotteries in the Hitopadeśa and the Pañcatantra

## Fate and human effort revisited II

$$
\begin{aligned}
L^c_{\text{lazy}} &= [10, 2; p_{\text{fav}}, p_{\text{unfav}}] \text{ and} \\
L^c_{\text{busy}} &= [50 - c, 10 - c; p_{\text{fav}}, p_{\text{unfav}}]
\end{aligned}
$$

with expected payoffs

$$
\begin{aligned}
E\left(L^c_{\text{lazy}}\right) &= p_{\text{fav}} \cdot 10 + (1 - p_{\text{fav}}) \cdot 2 = 2 + 8p_{\text{fav}} \\
E\left(L^c_{\text{busy}}\right) &= p_{\text{fav}} \cdot (50 - c) + (1 - p_{\text{fav}}) \cdot (10 - c) \\
&= 10 + 40p_{\text{fav}} - c
\end{aligned}
$$

$$
E\left(L^c_{\text{busy}}\right) > E\left(L^c_{\text{lazy}}\right) \Leftrightarrow c < 8 + 32p_{\text{fav}}
$$

# Lotteries in the Hitopadeśa and the Pañcatantra

## Investment and duty in short and long lifes revisited I

| | | **state of the world** | |
|---|---|---|---|
| | | short life, $p_{\text{short}}$ | long life, $p_{\text{long}}$ |
| **action** | invest | no use for cap./knowl. | long use of cap./knowl. R |
| | do not invest | enjoym. of money/leis. R | material pov./ spiritual pov. **VB** |

$$L_{\text{invest}} = [u(\text{no use}), u(\text{long use}); p_{\text{short}}, p_{\text{long}}] \text{ and}$$
$$L_{\text{not invest}} = [u(\text{enjoyment}), u(\text{poverty}); p_{\text{short}}, p_{\text{long}}].$$

# Lotteries in the Hitopadeśa and the Pañcatantra

## Investment and duty in short and long lifes revisited II

$$E\left(L_{\text{invest}}\right) > E\left(L_{\text{not invest}}\right),$$

$$p_{\text{short}} < \frac{u\left(\text{long use}\right) - u\left(\text{pov.}\right)}{\left[u\left(\text{enjoym.}\right) - u\left(\text{no use}\right)\right] + \left[u\left(\text{long use}\right) - u\left(\text{pov.}\right)\right]}$$

$$p_{\text{short}} < \frac{1}{\frac{\left[u(\text{enjoym.}) - u(\text{no use})\right]}{\left[u(\text{long use}) - u(\text{pov.})\right]} + 1}$$

Thus, investment is best, if the following conditions hold:

- $p_{\text{short}}$ is small or $p_{\text{long}}$ is large,
- $u\left(\text{enjoym.}\right)$ or $u\left(\text{pov.}\right)$ are small,
- $u\left(\text{no use}\right)$ and $u\left(\text{long use}\right)$ are large.

# Lotteries in the Hitopadeśa and the Pañcatantra

## Dissension among allies I

The lion and the bull:

- the lion king
- two jackals who are counselors to the king
- the bull who has befriended the lion

  *From that time onwards, every day [the lion] and [the bull] spent their time together in mutual affection ... As time went by, the lion made fewer kills and food became scarce. As a result [the jackal counselors], became very hungry ...*

One of the jackals manages to sow distrust between the two friends.

# Lotteries in the Hitopadeśa and the Pañcatantra

## Dissension among allies II

- $F$ (payoff for friendship)
- $V$ (payoff for victory over friend)
- $NF$ (payoff for loss of friendship and death of one animal or both animals, resulting from fighting)
- $D$ (payoff for death)

$$F > V > NF > D$$

- If only one animal attacks, the other will be killed.
- If both animals attack, friendship destroyed and death for one or both.
- If no animal attacks, friendship saved.

# Lotteries in the Hitopadeśa and the Pañcatantra

## Dissension among allies III

| | | Bull: attack $p_B$ | Bull: not attack $1 - p_B$ |
|---|---|---|---|
| Lion: attack $p_L$ | | $NF_L, NF_B$ | $V_L, D_B$ |
| Lion: not attack $1 - p_L$ | | $D_L, V_B$ | $F_L, F_B$ |

# Lotteries in the Hitopadeśa and the Pañcatantra

## Dissension among allies IV

- The lion assumes that the bull will attack with a probability of $p_B$.
- Given this probability it is best for the lion to attack whenever

$$p_B NF_L + (1 - p_B) V_L > p_B D_L + (1 - p_B) F_L$$

or

$$p_B > \frac{1}{1 + \frac{NF_L - D_L}{F_L - V_L}}.$$

i.e., whenever

- the lion assumes that the bull will attack with a high probability.
- $NF_L$ and $V_L$ are large, i.e., the lion does not fear the loss of friendship and enjoys victory over the bull.
- $D_L$ and $F_L$ are small, i.e., the lion is afraid of death and does not value friendship very highly.

# Lotteries in the Hitopadeśa and the Pañcatantra

## Dissension among allies V

Similarly, the bull will attack if he assumes a probability $p_L$ for an attack by the lion and if

$$p_L > \frac{1}{1 + \frac{NF_B - D_B}{F_B - V_B}}$$

holds. In the story, it is the lion who attacks first. Maybe, the lion imputed a higher attack probability to the bull than the other way around. Also, the bull is not too worried about dying in battle:

*To die in a war is for men the most glorious death of all.*

# Lotteries against and in favor of God's existence

## The loan lottery I

The birth-story of Brahma:

- a king who does not believe in the afterworld (*para-loka*) and holds other *Cārvāka* views
- the former Buddha = a Brahma deity (a god) intent on converting the king to virtuous attitudes and behavior:

> *"If convinced that good and bad deeds have*
> *happy and unhappy results in the next life,*
> *one avoids evil and strives for purity.*
> *But non-believers follow their whims.*

The king's pernicious false view was an affliction that spelled ruin, bringing calamity on the world. As a result, the Great One, that divine seer, felt compassion for the king."

# Lotteries against and in favor of God's existence

## The loan lottery II

The king is not convinced and comes up with a clever proposal:
"Well. great seer!

> *If the next world is not a bogey man for children,*
> *and if you think I should believe in it,*
> *then give me five hundred nishkas*
> *and I'll return you a thousand in another life!"*

# Lotteries against and in favor of God's existence

## The loan lottery III

$$
\begin{aligned}
L_{\text{loan}} &= \Big[ \underbrace{1000 - 500}_{\substack{\text{loan is repaid} \\ \text{in other world} \\ \text{that exists}}} \; , \; \underbrace{-500}_{\substack{\text{loan is not repaid} \\ \text{in other world} \\ \text{as o. w. does not exist}}} \; ; \; p_{asti}, \; p_{n\bar{a}sti} \Big] \\
&= [500, -500; p_{asti}, 1 - p_{asti}]
\end{aligned}
$$

# Lotteries against and in favor of God's existence

## The loan lottery IV

$$
\begin{aligned}
E\left(L_{\text{loan}}\right) &= p_{asti} \cdot 500 + (1 - p_{asti}) \cdot (-500) \\
&= \underbrace{-500}_{\substack{\text{loan given} \\ \text{in both cases}}} + p_{asti} \cdot \underbrace{1000}_{\substack{\text{repayment} \\ \text{if o. w. exists}}} > 0
\end{aligned}
$$

if

$$
p_{asti} > \frac{500}{1000} = \frac{1}{2}
$$

This seems a good test of whether the god himself believes in the other world. If he assumes a probability larger than $\frac{1}{2}$, he should–so argues the king–accept the lottery.

# Lotteries against and in favor of God's existence

## The loan lottery V

The god rejects the lottery:

> *"Even in this world, wealth seekers*
> *do not offer money to the wicked,*
> *nor to the greedy, fools or indolents [träge].*
> *For whatever goes there comes to ruin.*
>
> *But if they see someone who is modest,*
> *naturally calm and skilled in business,*
> *they will give him a loan, even without witnesses.*
> *For money entrusted to such a man brings reward.*
>
> *The same procedure for giving a loan*
> *should be used for the next world, king.*
> *But it would be improper to entrust money to you;*
> *for your conduct is corrupted by wicked views.*

# Lotteries against and in favor of God's existence

## The loan lottery VI

*Who would harrass you for a thousand nishkas*
*when you lie in hell, senseless, sick with pain,*
*brought there by your own actions*
*caused by the evil of your false views?*

...

*In the next world, where nihilists [nāstika] live*
*a thick darkness and icy wind tortures*
*people by tearing through their very bones.*
*What prudent man would go there to get money?*

# Lotteries against and in favor of God's existence

## The loan lottery VII

$$
\begin{aligned}
& L_{\text{loan, not paid back}} \\
= & \left[ \underbrace{-500}_{\substack{\text{loan is} \\ \text{not (!) repaid} \\ \text{in other world} \\ \text{that exists}}} , \underbrace{-500}_{\substack{\text{loan is} \\ \text{not repaid} \\ \text{in other world} \\ \text{as o. w. does not exist}}} ; \; p_{asti}, \; p_{n\bar{a}sti} \right] \\
= & \; [-500; 1]
\end{aligned}
$$

# Lotteries against and in favor of God's existence

## The hell lottery I

Understandably, the king is convinced:

> *"My mind almost runs wild with fear*
> *at learning of the punishments in hell.*
> *It practically burns with blazing thoughts*
> *regarding my plight on meeting that fate.*
>
> *Shortsightedly I trod the wrong path,*
> *my mind destroyed by evil views.*
> *Be then my path, recourse of the good!*
> *By my resort and refuge, sage!*
>
> *As you dispelled the darkness of my views*
> *like the rising sun dispels night,*
> *so tell me, seer, the path I should follow*
> *to avoid a bad rebirth after this life."*

# Lotteries against and in favor of God's existence

## The hell lottery II

The god is prepared to give this advice:

> *Conquer vice, so difficult to vanquish!*
> *Pass beyond greed, so difficult to overcome!*
> *You will thus reach the gleaming gold-gated city*
> *of the king of heavens, ablaze with fine gems [Juwel].*
>
> *May your mind, which once praised evil views,*
> *firmly cherish the creeds valued by good men.*
> *Abandon immoral beliefs proclaimed*
> *by those eager to pleasure fools.*
>
> ...

# Lotteries against and in favor of God's existence

## The hell lottery III

*With glory as its banner,*
*pity as its retinue [Gefolge]*
*and tranquility as*
*its lofty flag, king,*
*if you travel in this chariot [the virtue chariot]*
*glittering with wisdom*
*to benefit others and yourself,*
*you will certainly not enter hell.*

# Lotteries against and in favor of God's existence

## The hell lottery IV

$$L_{Cārvāka} = \Big[\underbrace{\text{pleasures in this life, but hell with endless horrors}}_{\text{other world exists}}, \underbrace{\text{pleasures in this life}}_{\text{other world does not exist}} ; \; p_{asti}, \; p_{nāsti}\Big]$$

$$= [-100\,000, \; 10; p_{asti}, p_{nāsti}]$$

with expected payoff

$$\begin{aligned} E\left(L_{Cārvāka}\right) &= p_{asti} \cdot (-100\,000) + (1 - p_{asti}) \cdot 10 \\ &= 10 - 100\,010 p_{asti} \end{aligned}$$

# Lotteries against and in favor of God's existence

## The hell lottery V

$$L_{\text{virtue}} = [\text{life of pity, tranquility, and wisdom, no hell; } 1]$$

$$E\left(L_{\text{virtue}}\right) = 2 \text{ (for example)}$$

$$E\left(L_{\text{virtue}}\right) > E\left(L_{C\bar{a}rv\bar{a}ka}\right)$$

$$\Leftrightarrow \quad p_{asti} > \frac{8}{100010} \approx \frac{8}{10000} = 0.0008$$

Thus, the king may not (really) believe in the other world, but prefers to play it safe.
Incidentally, Blaise Pascal presented a similar argument for believing in God.