Valuing Unmarketed Goods and Environmental Amenity

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- or adjust market prices \(\rightarrow shadow\,\text{prices}\) [C&B Ch. 5; FP Ch. 7.2; S&W Ch8; DoF]

- or use the changes in consumer’s and producers’ surplus when prices change. [C&B Ch. 7; S&W Ch 9,10; FP Ch. 8.4; DoF]
Other values?

but: value of convenience
    value of time saved
    value of new road
    value of increased quietness ?
    value of privacy

But: what if there are no markets?

[C&B Ch. 12; FP Ch. 11; S&W Ch 11; DoF]
Then Use Opportunity-Cost Prices

Q: what is forgone sacrificed given up?
Then Use Opportunity-Cost Prices

Q: what is sacrificed?  
   given up

A: • with over-the-counter prices: Money
• with going to hospital (or AGSM):
   — time
   — forgone income
   — fees
• with using a road/bridge/tunnel
   — time
   — out-of-pocket money

eg $2.20 Harbour Bridge v. other
Willingness to pay

Q: how can we express in $ what is given up?
Willingness to pay

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A: use individual’s valuation (CS) — “willingness to pay”
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A: use individual’s valuation (CS) — “willingness to pay”

How? –
1. by asking (CV)
2. by revealed choice.
otherwise –
3. by opportunity-cost methods
Eight Methods of Evaluating Non-Traded Impacts.

Here we consider eight methods of evaluating non-traded impacts:

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5. Defensive expenditure: revealed cost of protection (4.4)
6. The Change-in-Cost method: benefits = costs avoided (4.5)
7. The Change-in-Output method: benefits = higher value of output (4.6)
8. The Replacement Cost method: revealed value & costs of replacement (4.7)
2. Valuing willingness to pay (Consumer’s Surplus):

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   b. minimum they’d accept to live with the pollution? Willingness To Accept WTA (min.)

3. *Cost-based measures*
   — what is the cost of abating the pollution?

Property rights
Coase theorem — bargaining over externality
3. Value of Time Saved

Numerical example: what is the value to Joe of a faster commute home?

Joe’s wage rate is $10/hr, and

Joe would pay up to $8/hr not to work.
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Joe’s wage rate is $10/hr, and Joe would pay up to $8/hr not to work.

∴ Joe’s value of increased leisure = $10 + (−$8) = $2/hr
   (= his forgone wage payments + his forgone enjoyment of working)
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What if Joe can cut his commuting time and enjoy more leisure?

Say he would pay up to $3/hr to avoid commuting.
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∴ Joe values his reduction in commuting time at $5/hr = $2 − (−$3),

since the value to Joe of a reduction in commuting time
= the benefit to Joe of increased leisure ($2)
− the forgone benefit to Joe of commuting (−$3)
The Value of Time Saved ...
= max. amount of money beneficiaries would be willing to pay to obtain the saving
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e.g. a new road → less commuting time

value of reduction in commuting time $V_c$ per time unit
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\[ V_c = MB_L - MB_c > 0, \text{ where } MB_L = \text{forgone wage payments } w + \text{forgone benefits of working } MB_w \] (−ve) (work is a “bad”)
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\[ \therefore V_c = w + MB_w - MB_c \]
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e.g. (values from surveys and revealed preferences)
\( w = $10/hr \)
\( MB_w \equiv (\text{forgone}) \text{ benefits of working} = -$8/hr \)
\( MB_c \equiv (\text{forgone}) \text{ benefits of commuting} = -$3/hr \)
(\[ \therefore MB_L \equiv (\text{forgone}) \text{ benefits of leisure} = 10 - 8 = $2/hr \])
\[ \therefore V_c = w + MB_w - MB_c = 10 - 8 + 3 = $5/hr \]
The Manly Jetcat: Estimate $V_c$, the value of shorter commuting time.

compare Jet Cat from Manly with ordinary ferry

assume passengers prefer \[
\begin{align*}
\text{lower fares} \\
\text{shorter trips}
\end{align*}
\]

the Jet Cat is 20 minutes faster at $5.50 more expensive. (check)
The complete demand curve: Hotelling/Clawson.

travel costs ~ individuals different costs
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travel costs ~ individuals different costs
e.g. consumers’ surplus lost if a theatre closes
the opportunity cost of going to the theatre

opportunity cost = price of the ticket + travel time
and other costs

Observe only 1 point on each group’s demand curve: assume a single curve, or estimate each separately.
– National Parks
– method used to estimate value of visiting NPs
3.1 The Travel Cost Method [C&B pp. 276, S&Th pp. 88]

Can be applied to any activity where the quantity consumed varies in response to the (opportunity) cost of travel to undertake it, e.g. recreation.

Steps:
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5. Assume that visitors across zones respond to entrance fees and travel costs in the same way.

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6. Simulate the number of visits with a particular entrance fee.
### Travel Cost Example

<table>
<thead>
<tr>
<th>Zone of visitor origin</th>
<th>Average travel cost ($/car)</th>
<th>Total car visits</th>
<th>Population of zone</th>
<th>Total car visits per 1000 pop.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>150</td>
<td>5</td>
<td>30</td>
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<td>4</td>
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<td>3</td>
<td>1</td>
<td>3</td>
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<tr>
<td>Total</td>
<td></td>
<td>241</td>
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</tr>
</tbody>
</table>
### Travel Cost Example

**TC: Basic Data**

<table>
<thead>
<tr>
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</tr>
</thead>
<tbody>
<tr>
<td>1</td>
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<td>8</td>
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<td>6</td>
<td>12</td>
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<td>3</td>
<td>0</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td><strong>241</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**TC: simulation of $2/car entry fee**

<table>
<thead>
<tr>
<th>Zone of visitor origin ('000)</th>
<th>Average travel cost ($/car) visits</th>
<th>Entrance fee ($/car)</th>
<th>Total visit cost ($/car)</th>
<th>Pop. of zone</th>
<th>Total visits</th>
<th>Total visits per 1000</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>2</td>
<td>4</td>
<td>5</td>
<td>16</td>
<td>80</td>
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<tr>
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<td>4</td>
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</tr>
<tr>
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<td>6</td>
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<td>4</td>
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<td>6</td>
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<tr>
<td><strong>Total</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td><strong>126</strong></td>
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</tr>
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Simulation of Travel Cost Method
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- Zone 1 visitors now face a cost/car of $4/visit.
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- Before the fee, Zone 2 visitors, faced with an equal cost, came at the rate of 16 visits/1000/year, so now Zone 1 → visits/year = 3 × 16 = 80
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- Etc.
  Note that a cost of $12/car chokes off demand, previously from Zone 6, now from Zone 5 as well.
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<table>
<thead>
<tr>
<th>Simulated entrance fee</th>
<th>Simulated number of visits/year</th>
</tr>
</thead>
<tbody>
<tr>
<td>$0$</td>
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</tr>
<tr>
<td>$2$</td>
<td>126</td>
</tr>
<tr>
<td>$4$</td>
<td>62</td>
</tr>
<tr>
<td>$6$</td>
<td>32</td>
</tr>
<tr>
<td>$8$</td>
<td>15</td>
</tr>
<tr>
<td>$10$</td>
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- Demand schedule:

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<td>32</td>
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</table>

7. Calculate the value.
The consumer surplus = the area above the price ($0/visit) below the demand curve plotted from the above table = $700 total.
Sydney Harbour Travel [S&W pp. 150–156]

Q: “how do you travel?”; “what’s the next best alternative?”
e.g. Manly Jet Cat ($8.00 & 15 min.) v. ferry ($2.50 & 35 min.)

Then the slope of green line → $??? per minute saved i.e. price,
value of time saved. Line of indifference between slow and fast
modes. Min. number of wrong responses to the SW.
Assumptions: individual rationality, equal values.
Estimating the Relationship — NFX

\[ C_i = a_i + bT_i + M_i \]

where

- \( C_i \) total cost of mode \( i \)
- \( a_i \) intrinsic value \( i \)
- \( T_i \) time spent travelling
- \( M_i \) money cost (fare +)

The probability of using ferry instead of the Jet Cat \( p_F \) is (using the logit transform – NOT FOR EXAMS):

\[ p_F = \frac{e^{\Delta C}}{1 + e^{\Delta C}} = f(\Delta C) \]

\[ \Delta C = C_{JC} - C_F \]

\[ \log \frac{p_F}{1 - p_F} = \Delta CR = a_{JC} - a_F + b\Delta T + \Delta M \]
4. Valuing the Environment

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   Negotiating positions depend on the prior allocation of property rights.

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3. A decision balancing the net economic benefits against the costs to particular groups.
   (distributional impacts)
Use, Option, and Existence Values

Total Economic Value = Actual Use Value + Option Value + Existence Value

To determine these:
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3. **Contingent Valuation Method** (see 4.3)
   - Asks people what they are Willing To Pay for the benefit or what they are willing To Accept as compensation.
   - It’s very general, but may be costly to perform, and has severe qualifications (see below).
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Example: Road through the Grampians
[Sinden & Thampapillai, Box 6.1, p. 93]

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| Benefits & costs             | Alternative |   |
|------------------------------|-------------|
|                              | A  | B  |
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Environmental Amenities vs. Manufactured Goods

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$\Rightarrow$
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The lower slope at point B (new price ratio)

⇒ a higher value of environmental amenity in terms of manufactured goods.

Against this: expectations of a higher level per generation.
4.2 Hedonic Prices [C&B pp. 279, S&Th pp. 93]

(Johansson Ch 7)
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- compute incremental effect of \( Z \) on price \( P_h \)

But beware of double counting!
Graphically:

- Environmental quantity $Z$
  - e.g. decibels

- $$/\text{unit}
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    path-dependent:
    A to B to C  1.3%
    A to C       0.9%
Example: CV converts environmental ratings to $

[Sinden & Thampapillai, Box 6.2, p.97]

CV: value of recreational visit per group — ranged from $7 to $30, they said

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Example: \textit{CV converts environmental ratings to $}

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\textbf{CV:} value of recreational visit per group — ranged from $7 to $30, they said

Then: agency scored each on 10 environmental factors and found a correlation:

$\Delta$ 1 unit in rating $\rightarrow$ increase of $8$ per visit
4.4 Defensive Expenditure [C&B p. 272, S&Th p. 99]

Agents sometimes willing to sacrifice to defend their existing position.

When the action exactly maintains their utility, the expenditure measures the avoided loss in CS.
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Examples:
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4.5 The Change-in-Cost Method [S&Th pp. 100]

A project may lower the costs of production.

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Example: tollway benefits > cost of toll for those who pay it
4.6 *The Change-in-Output Method* [S&Th pp. 102]

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The value of a project which supplies more soil conservation can be derived from changes in the value of an associated output, such as agricultural produce.
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The value of a project which supplies more soil conservation can be derived from changes in the value of an associated output, such as agricultural produce.

e.g. Lower erosion or salinity should also improve the market value of the land, as in Hedonic Pricing.

So: the benefit is proportional to the $\Delta$ output value
4.7 The Replacement-Cost Method [C&B p. 273, S&Th pp. 104]

Can obtain a range for the value of an existing benefit from the costs of replacing it.
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e.g. lack of replacement of a burnt-out bridge implies that the value of the bridge is less than its replacement cost.

A range:

\[
\text{Minimum replacement cost} < \text{Value of benefit} < \text{Maximum replacement cost}
\]
Example: Benefits of fishing on the Ovens

[Sinden & Thampapillai, Box 6.3, p.105]

Anglers visit the Ovens River:
they spend \(~\$43\) and catch 1–5 trout per visit

Next best alternative would cost \(~\$151/\text{visit}\), they said.
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$\Rightarrow$ the marginal cost of the best replacement = $151 - 43 = $108/trip

On average 15 visits per year to the Ovens, and 9 visits per year to the next best.

Plot the implied demand curve.
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$\therefore$ the Annual total benefit of the Ovens = $1296/\text{year/angler}$
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e.g. clean air, clean water, low noise.

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- special interest groups  
- emission permits, e.g. CFCs in Australia
Example: Proposed Gold Mine: NSW South Coast.

Environmental Impact Statement:

detail of the mine proposal
Financial Appraisal
economic appraisal
abatement undertaken
social effects—local
economic effects
“public” goods
water supply/pollution *
landscape
wildlife
noise

dust
prostitution/. . .
—
employment
infrastructure
—
closing down ?
    moving away
    rehabilitation
### Summary tables:

*Methods of estimating values.*

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<tr>
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(Source: Sinden & Thampapillai, pp. 88–89)

e.g. airport noise
5. Criticisms of Contingent Valuation

Introduction

(Report of the NOAA Panel on Contingent Valuation, as a response to the litigation over damages from the 1989 Exxon Valdez disaster in King William Sound, Alaska.)

Estimation of fall in values of damaged environmental amenity.

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Use Values and Existence Values

Use values:
- information revealed in market transactions — out-of-pocket expenses
- losses to those who make active use of the affected areas:
  eg.
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How to evaluate passive-use values?
No direct market transactions to observe.
No indirect methods → clues to lost values?
Answer: Contingent Valuation.


**Contingent Valuation**

—the direct elicitation of these values from individuals through carefully designed and administered sample surveys.

Typically:
**Contingent Valuation**

— the direct elicitation of these values from individuals through carefully designed and administered sample surveys.

Typically:

provide responents with information about hypothetical government programs that would reduce the likelihood of a future adverse environmental event.

Respondents given some specific information about the exact nature of the damages to be prevented.

Respondents confronted with questions that provide information about the economic sacrifice (their WTP) they would have to make to support the environmental program.
Why Not Willingness to Accept?

What is their Willingness To Pay (WTP)?

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CV is controversial:

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- respondents may not take the questions seriously, since they’re not binding (talk is cheap¹)
Criticisms of the Contingent Valuation Method

(See Hausman & Diamond in Package)

First: The impossibility of external validation of CV results. Experiments may provide an artificial opportunity to pay for environmental goods, including passive use. Then compare CV WTP with “real” results.
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**eg. Seip & Strand:**

CV WTP for membership in a Norwegian environmental organisation was very much greater than the actual responses when the real opportunity was offered to a similar group: only 6 of 64.
Examples of CV WTP

eg. Duffield & Patterson:
The environment amenity was maintenance of flow of Montana rivers, with spawning grounds for two rare species of fish. Two groups of passive-use respondents polled by mail:
Group 1:
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   WTP for ordinary market goods (strawberries).
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Compare expressed WTP with actual.

CV WTP > actual by up to 50%

(although casual design)

Still possible to conclude that CV WTP reflects actual market demand, although significantly higher.
Six Concerns With CV:

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Weakest rationality: consistency:

• If prices fall, individual purchaser better off (private goods and public goods)
• WTP should be an increasing function of the scale of the program
• Falling marginal WTP (as scale of project increases) shouldn’t result in very abrupt falls.
But some studies suggest that WTP doesn’t increase with the scale:

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• Give a lack of external validation \( \rightarrow \) want internal consistency.
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But there are many types of possible environmental damage:

→ much for each household to pay
→ overestimates for large numbers of environmental problems, especially when exist substitutes too.
5.3 CV: Information Provision and Acceptance

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i.e. What if respondents rely on a set of heuristics, such as
   • “These environmental accidents are seldom as bad as we’re led to believe.”
   • “Authorities almost always put too good a face on these things.”

— then they’re answering a different set of questions.
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Do such responses to CV questions also reflect a warm glow from expressed support of environmental protection, rather than actual WTP?

If so, that would explain the lack of scale effects mentioned in 5.1 above.
5.5 CV: Absence of a Meaningful Budget Constraint

“What current or planned expenditures would you forgo to pay for the environmental protection program?”
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5.6 CV: Extent of the Market

Undersampling and zero sampling of a subgroup of the relevant population only justified if the subgroup has a predictably low WTP for protecting the resource.
Design of CV Instruments

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The latter is *the Panel’s preferred form*: realistic, no strategic reason not to answer truthfully, possible to validate with property tax referendums.
CV: Addressing the Embedding Problem

CV: Time Dimension of the Passive Use Losses
6. Irreversibility, or Forgoing Options

(From Pearce on the Gordon-below-Franklin — see Package.)

Suppose: direct costs: $1,
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If \( P = 0.2 \), \( k + g = 0.01 \), then \( \sqrt{D} > 0.547 \), ∴ \( D = 0.299 \)
and \( D/P > 0.299/0.2 = 1.497 \): ∴ for \( NPV > 0 \), \( D > 150\% \) \( P \).
Let's put numbers in for the Gordon-below-Franklin:

The N.P.V. of the dam is given by

\[ NPV(D) = -1 + \frac{D}{r+k} - \frac{P}{r-g} \]

where \( D \) is the benefit perpetuity discounted at \( r \) p.a., with technological decay of \( k \) p.a.

and \( P \) is the forgone, lost benefits, with a real rate of growth of \( g \) p.a.

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So that if the initial year’s preservation benefit > $750,000

then \( NPV(D) < 0 \), so \textbf{STOP!}
7. What Is the Value of Human Life?

*Life: Nature of the Valuation* [C&B pp. 284]

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  & from 2. *knowledge that person obtains utility while alive*

  e.g. rescue strangers
Subjective values of life.

so
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so subjective — not all lives equally valuable—*(is, not ought)*

vary by (a) probability of dying
(b) life expectancy
(c) quality of life

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     &\text{driving car} \\
     &? \\
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Ethical issue — utilitarian perspective. Dread factor.
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   life-support
   drugs
   chemicals
   —choice among lives: who will be saved?
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b. possibility of causing loss of life
   compare value of desired end
   v. probability of causing death
Life: Rationality

Moral issues; but *not* making a decision is a decision itself

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   - costs usually clear → threshold problem
   - benefits?
   
   voluntary donations ⇒ individual choices?
   e.g. dialysis machines prolong life — clear
   CAT scanners, MRI → better diagnosis → lives saved – whose?
   
   longer-run decisions to prevent death
   - e.g. kidney dialysis machines, CAT scanners, NMR machines
   - often need representatives to decide
   e.g. value of additional lives saved by another doctor (marginal value of a doctor)

or group-insurance approach
   - e.g. willingness to pay for option of having an ICU → voluntary
   HMOs
   → involuntary tax system

   cultural guidelines (“women and children first”)

b.
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   voluntary donations ⇒ individual choices?
   e.g. dialysis machines prolong life — clear
   CAT scanners, MRI → better diagnosis → lives saved – whose?
   longer-run decisions to prevent death
   e.g. kidney dialysis machines, CAT scanners, NMR machines
   — often need representatives to decide
   e.g. value of additional lives saved by another doctor (marginal value
   of a doctor)

or group-insurance approach
   – e.g. willingness to pay for option of having an ICU → voluntary
   HMOs
   → involuntary tax system

   cultural guidelines (“women and children first”)

b. causing possible deaths
   e.g. fire department hazardous to firemen

probabilities are crucial when there are risks.
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