

**Numbered Figures for
Prospect Theory
for Risk and Ambiguity**

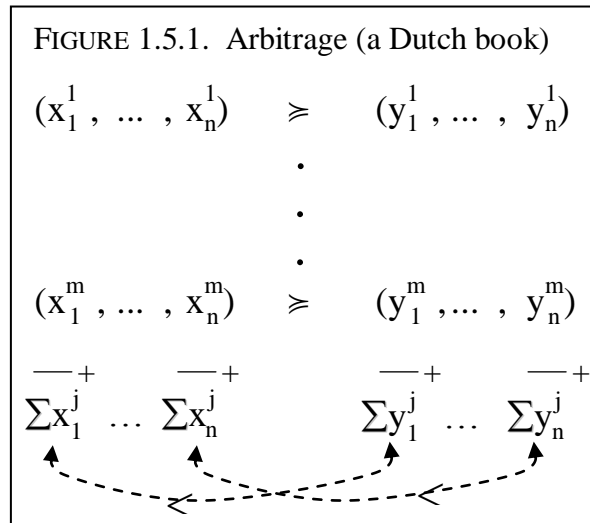
by Peter P. Wakker (2010);
provided on internet July 2013 (with permission of CUP)

The figures were made using the drawing facilities of MS-Word. If no elucidation is added to a figure, then it was made using only facilities of MS Word. Sometimes there are curves "drawn by hand" which means using the curve-mouse-drawing facilities of MS-Word.

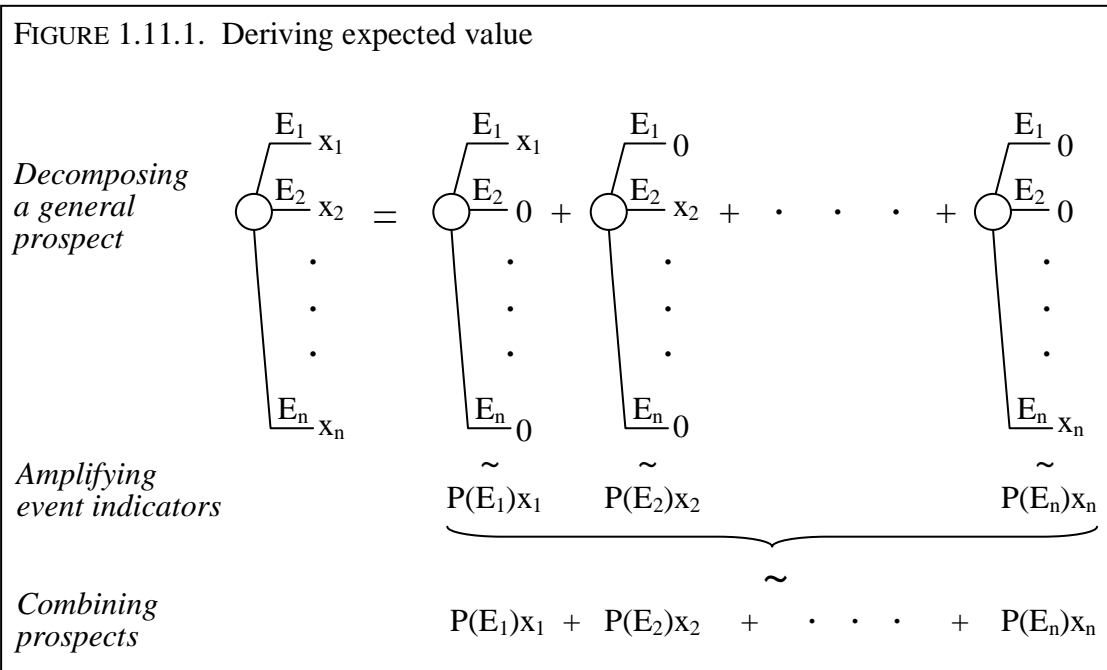
Sometimes I used graphs of functions. Those graphs I made using the program Scientific Workplace. I would then turn them into wmf windows metafiles. Those I introduced as picture in the MS Word drawing program. (I actually learned over time that it works better to first introduce pictures in Powerpoint, and then transfer them from powerpoint to MS Word, so this is how I did it.) I would then only take the curve from the wmf file and nothing else, so I would drop all letters, axes, and so on from the wmf file. Those I would all make using MS Word.

Apart from 3 exceptions (added where relevant), I never kept the Sc. Workplace TeX input file, but I could remake those easily.

p. 26:

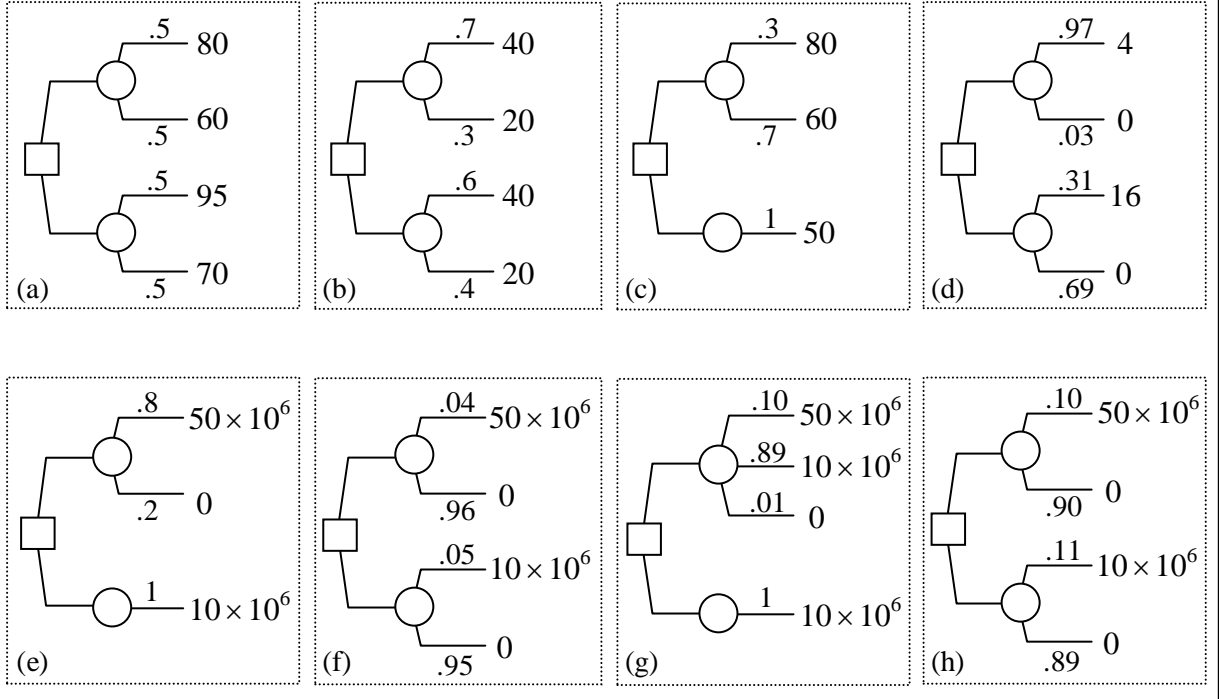


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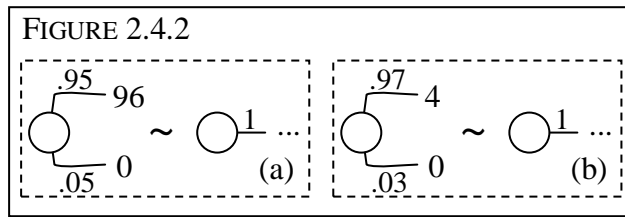


p. 51:

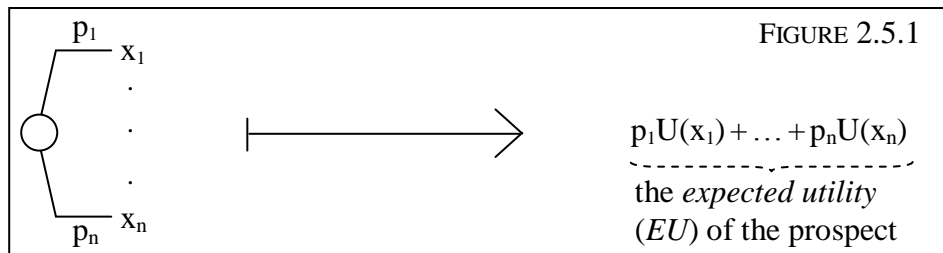
FIGURE 2.4.1.



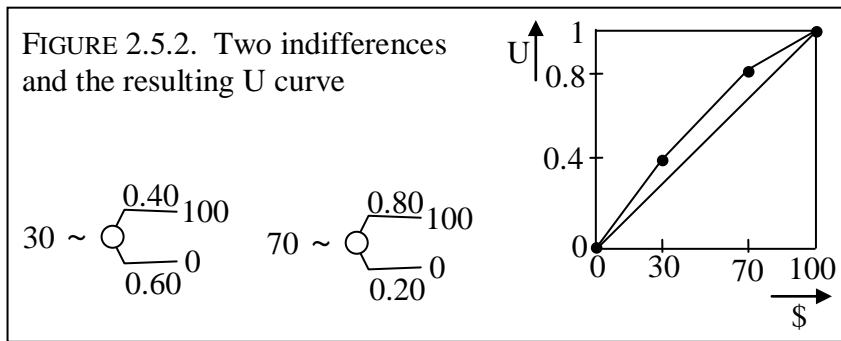
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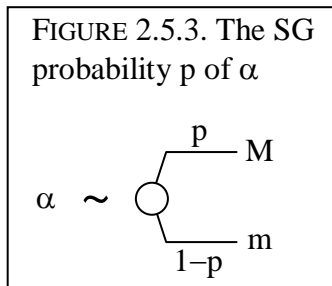
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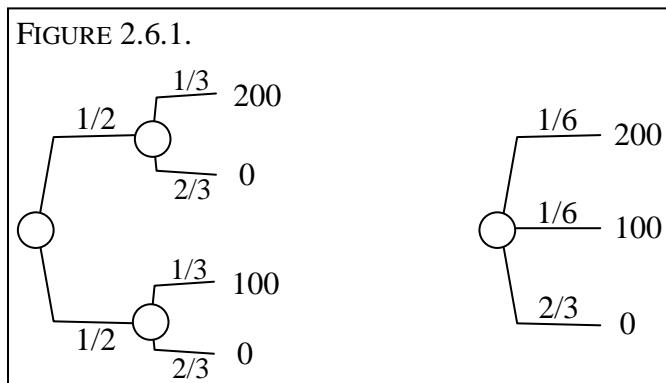
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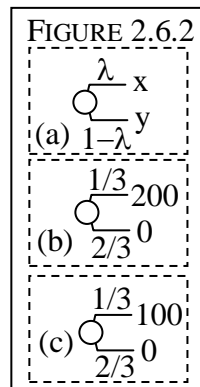
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p. 59:

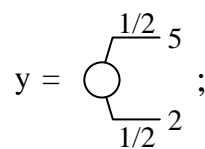
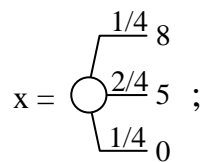


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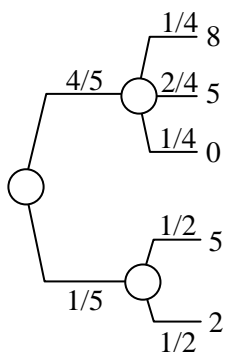


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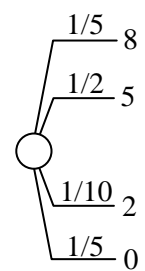
FIGURE 2.6.3.

 $(\lambda = 4/5)$

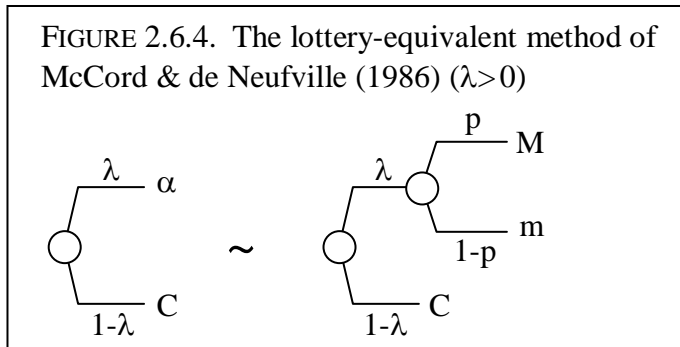
The mixture $x_{4/5}y$
can be depicted as



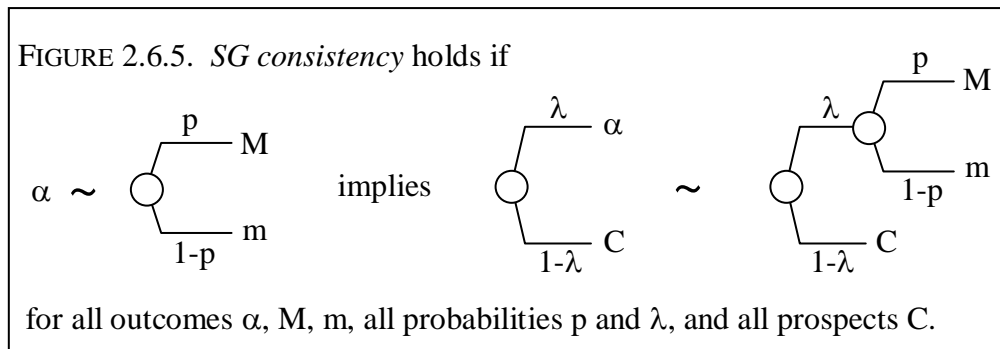
and is equal to



p. 61:

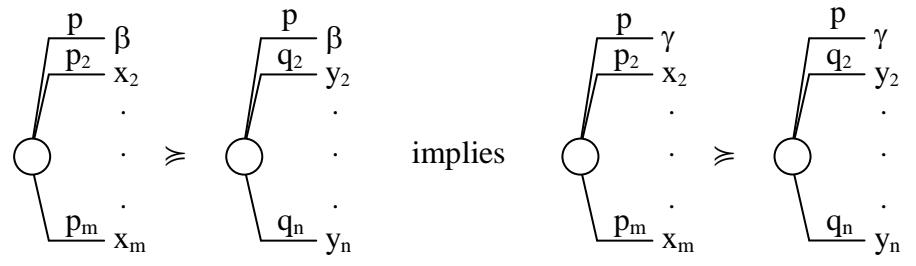


p. 62:

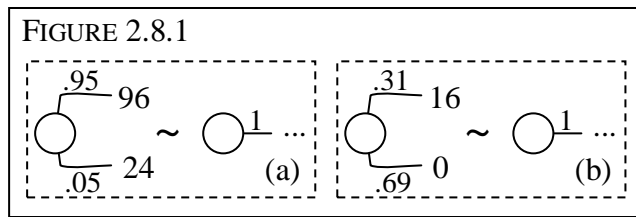


p. 65:

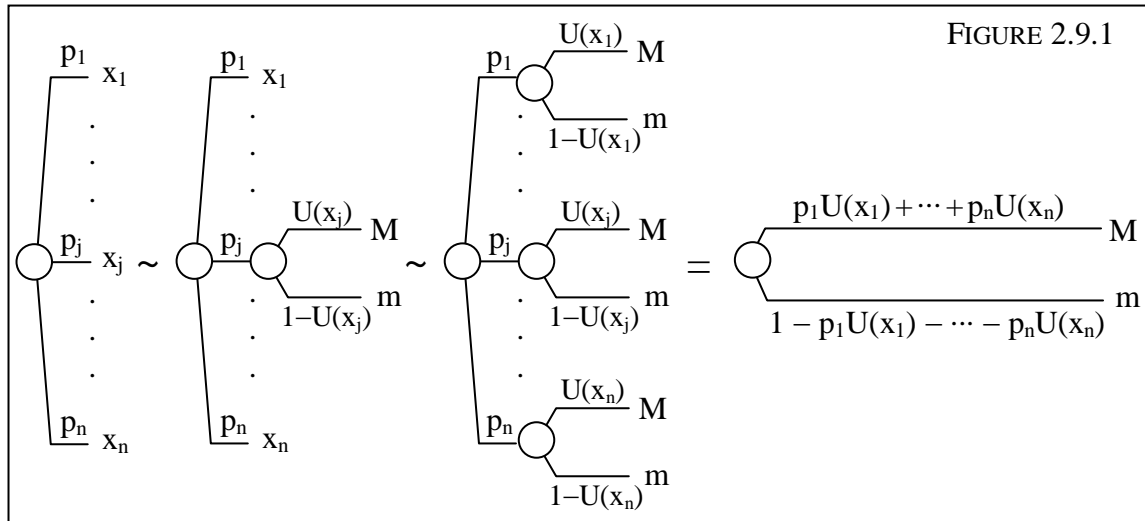
FIGURE 2.7.1. The sure-thing principle for risk



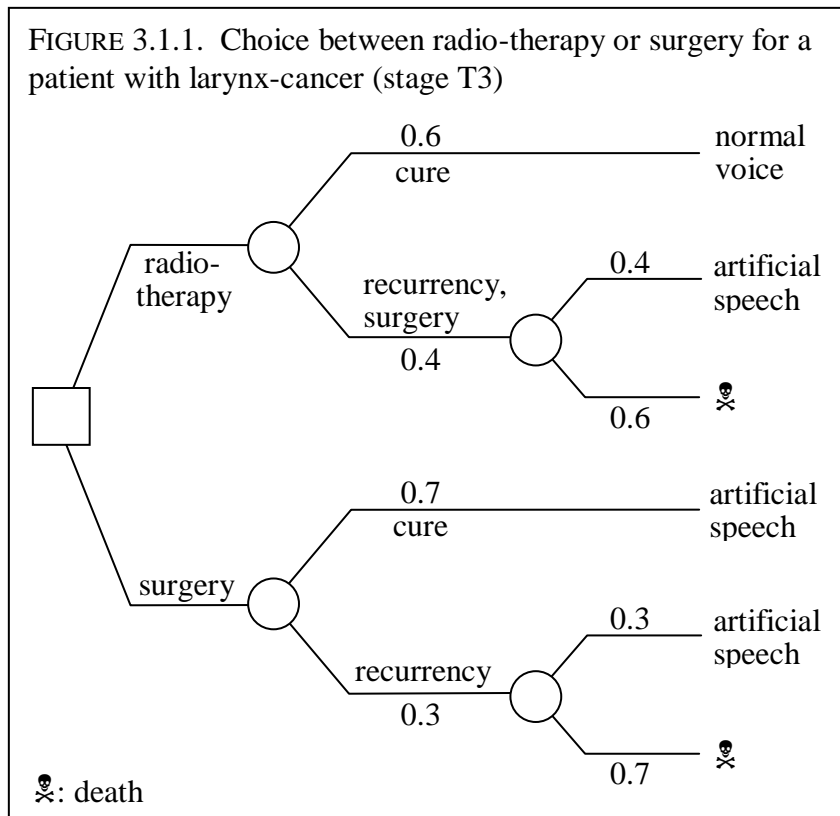
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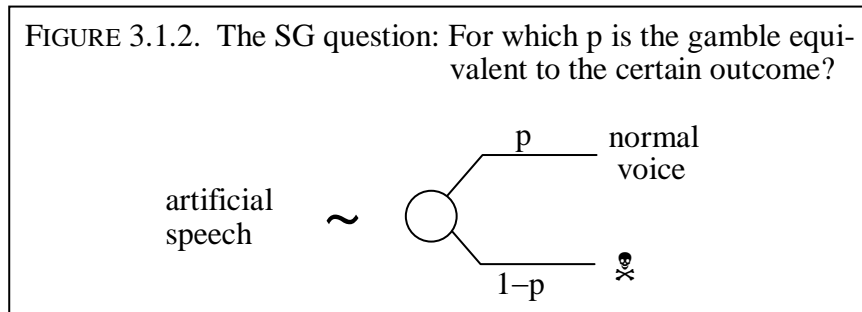
p. 68:



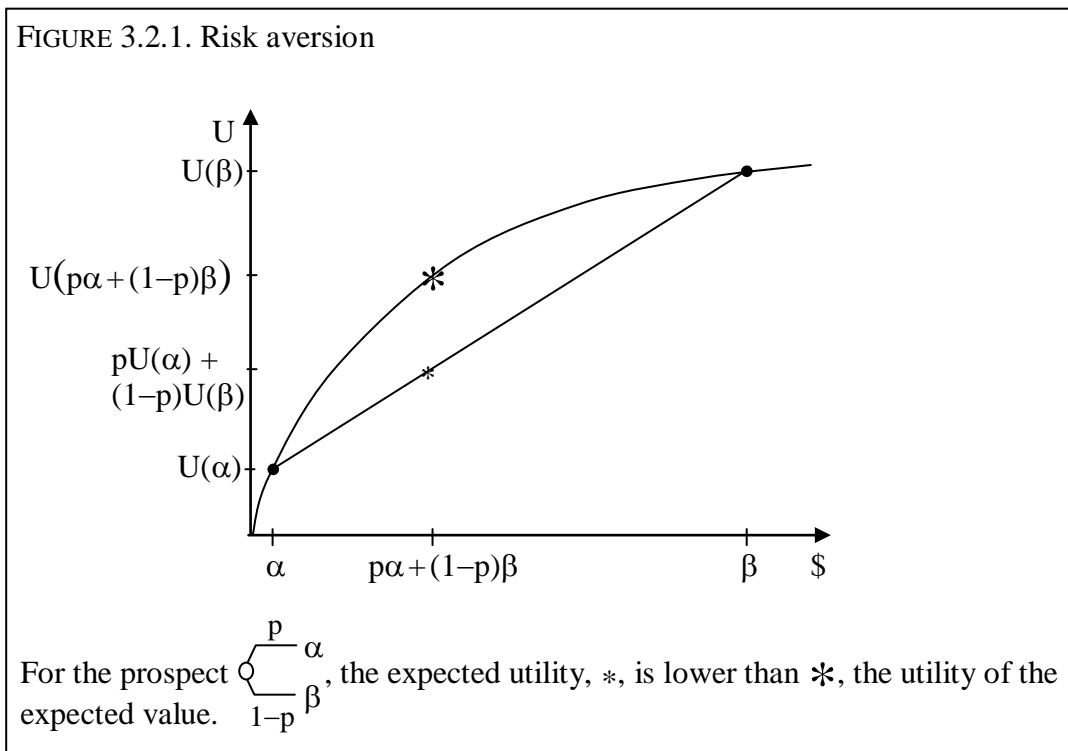
p. 70:



p. 71:

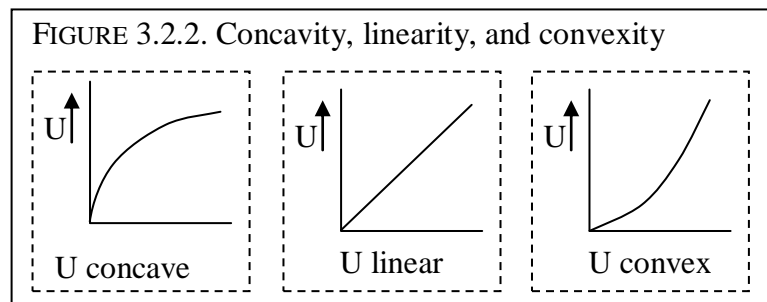


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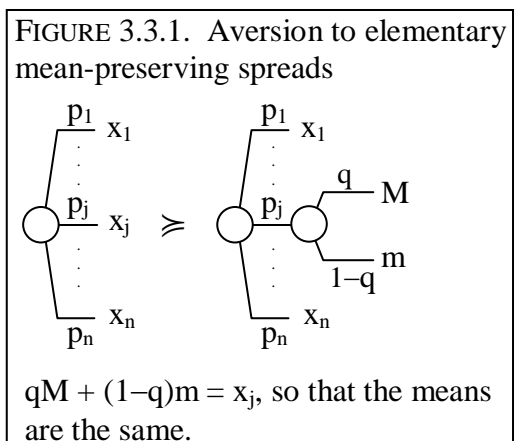
ELUCIDATION: This Figure was made using only MS Word. I drew the curves by hand.

p. 72:

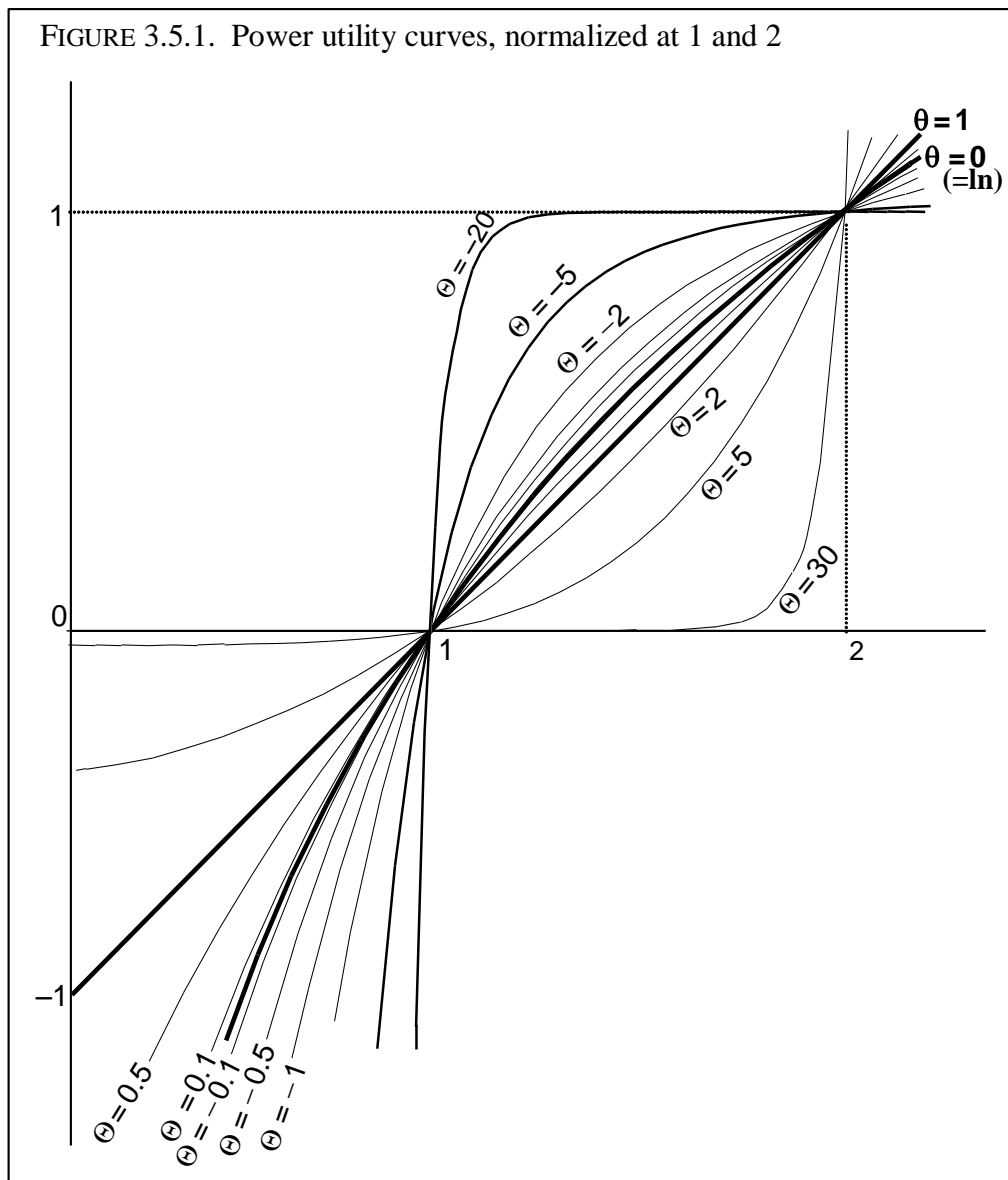


ELUCIDATION: This Figure was made using only MS Word. I drew the curves by hand.

p. 75:



p. 79:



ELUCIDATION: This Figure contains a graph of the following function, drawn fat, and indicated in the figure by $\theta=0$:

$$u(\alpha) = \frac{\ln(\alpha) - 1}{\ln(2) - 1}$$

, further the function, also drawn fat, and indicated in the figure by $\theta=1$:

$$u(\alpha) = \alpha - 1$$

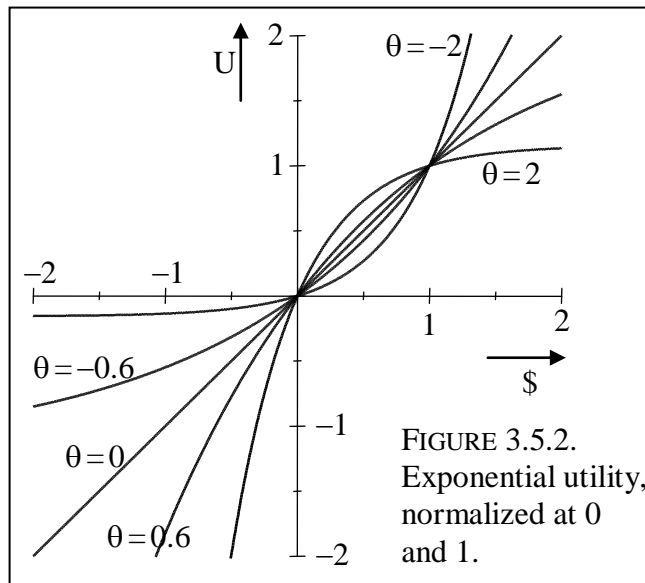
and further the functions (not drawn fat)

$$u(\alpha) = \frac{\alpha^\theta - 1}{2^\theta - 1}$$

for the other θ values indicated in the figure ($\theta = -20, -5, -2, -1, -0.5, -0.1, 0.1, 0.5, 2, 5$, and 30).

I made the graphs using Scientific Workplace (did not keep input files) as explained above.

p. 81:



ELUCIDATION: This Figure contains graphs of the function:

$u(\alpha) = \alpha$ (indicated in the figure by $\theta=0$)

and of the functions

$$u(\alpha) = \frac{1 - \exp(-\theta\alpha)}{1 - \exp(-\theta)}$$

for the other θ 's as indicated ($\theta = -2, -0.6, 0.6$, and 2).

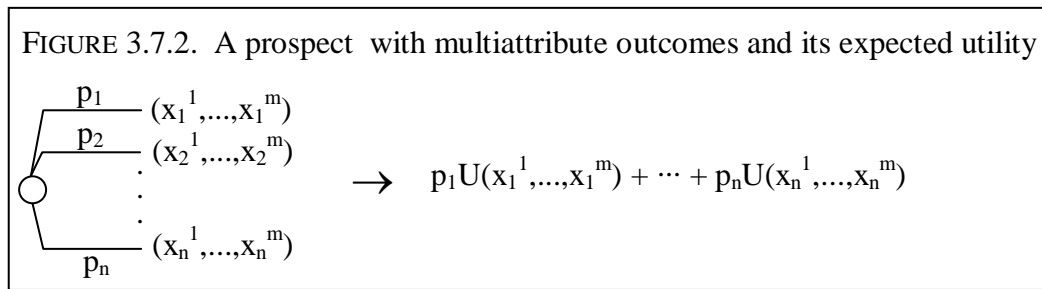
I made the graphs using Scientific Workplace (did not keep input files) as explained above.

p. 86:

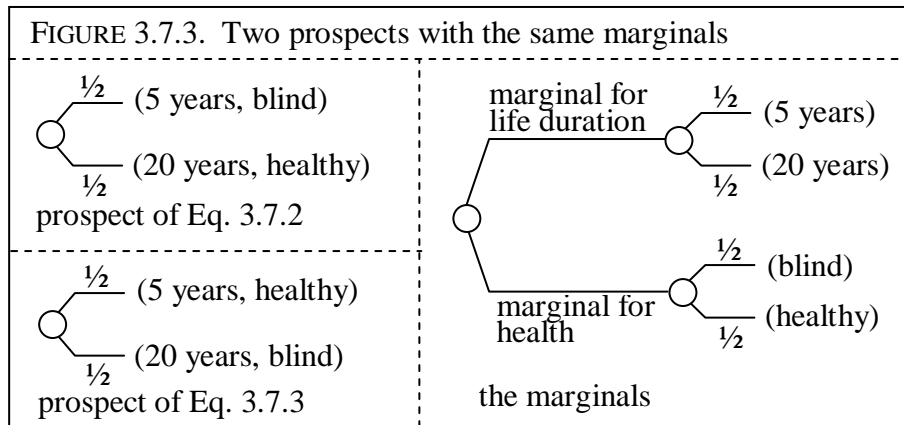
FIGURE 3.7.1. *SG invariance*

$$(Q,T) \sim \begin{array}{c} \diagup \text{p} \text{---} (Q,M) \\ \bigcirc \\ \diagdown \text{1-p} \text{---} (Q,0) \end{array} \Rightarrow (H,T) \sim \begin{array}{c} \diagup \text{p} \text{---} (H,M) \\ \bigcirc \\ \diagdown \text{1-p} \text{---} (H,0) \end{array}$$

p. 87:

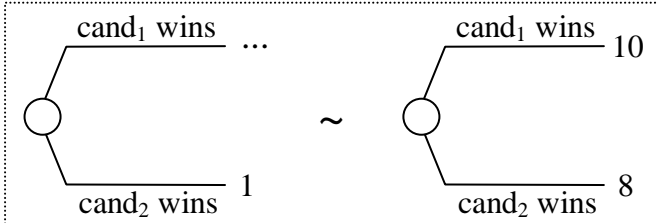


p. 88:

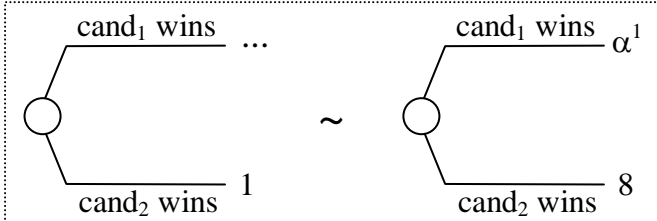


p. 96:

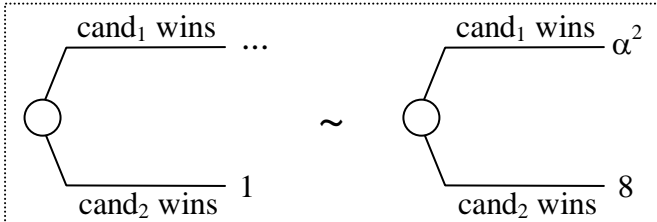
FIGURE 4.1.1 [TO Upwards]. Eliciting $\alpha^1 \dots \alpha^4$ for unknown probabilities



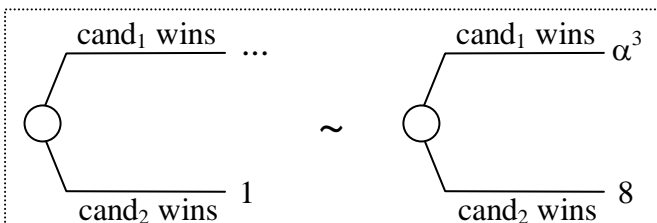
(a) Your switching value on the dotted line is α^1 .



(b) Your switching value on the dotted line is α^2 .



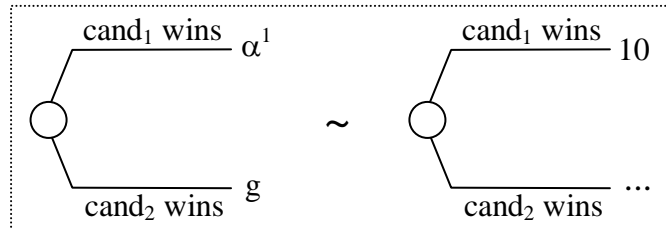
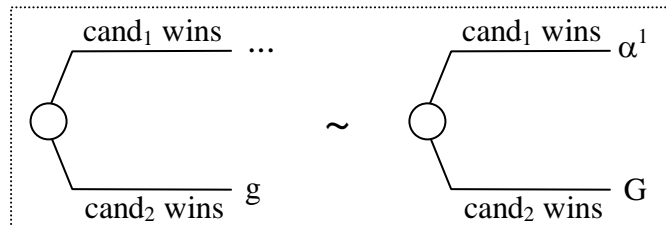
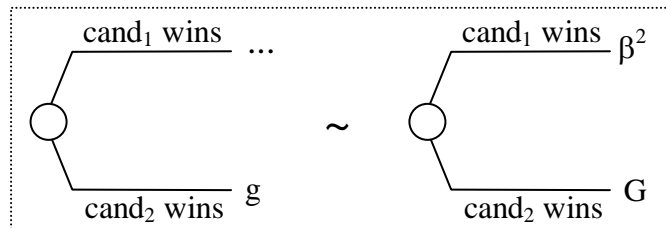
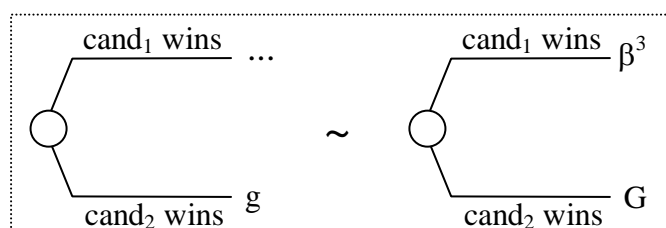
(c) Your switching value on the dotted line is α^3 .



(d) Your switching value on the dotted line is α^4 .

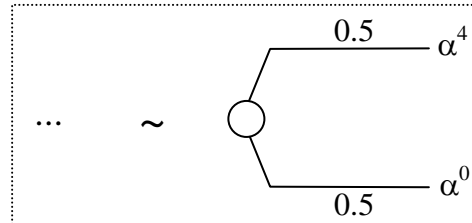
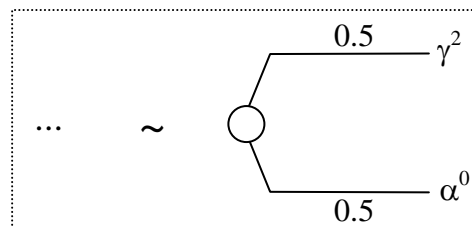
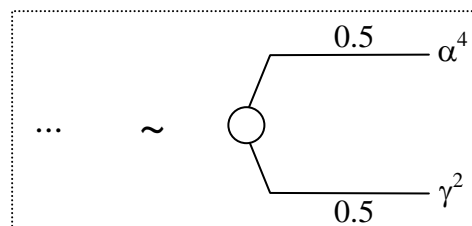
Indicate in each Fig. which outcome on the dotted line ... makes the two prospects indifferent (the switching value).

p. 97:

FIGURE 4.1.2 [2nd TO Upwards]. Eliciting $\beta^2, \beta^3, \beta^4$ (a) Your switching value on the dotted line is G .(b) Your switching value on the dotted line is β^2 .(c) Your switching value on the dotted line is β^3 .(d) Your switching value on the dotted line is β^4 .

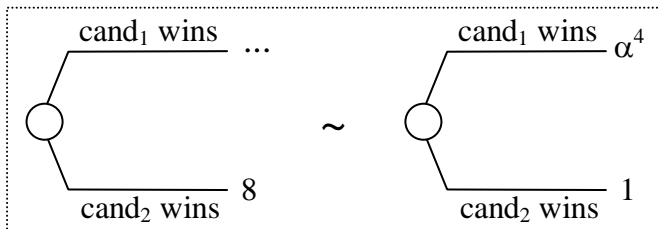
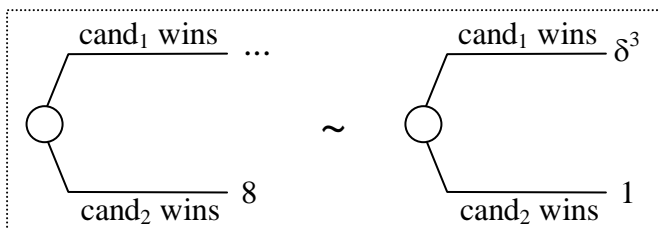
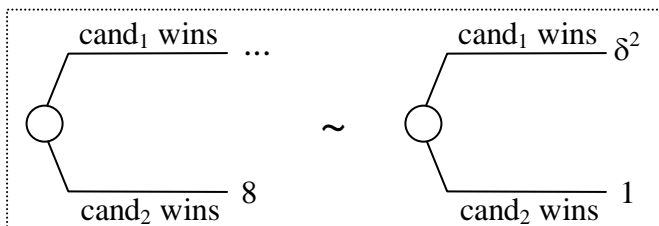
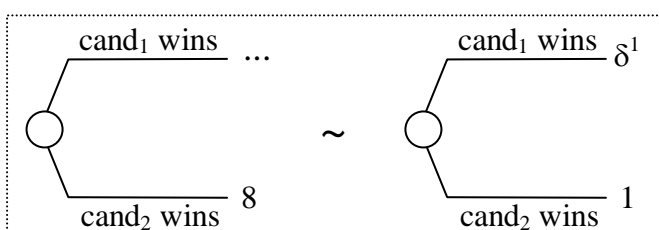
Indicate in each fig. which outcome on the dotted line ... makes the two prospects indifferent (the switching value).

p. 98:

FIGURE 4.1.3 [CEs]. Eliciting $\gamma^2, \gamma^1, \gamma^3$ (a) Elicitation of γ^2 .(b) Elicitation of γ^1 .(c) Elicitation of γ^3 .

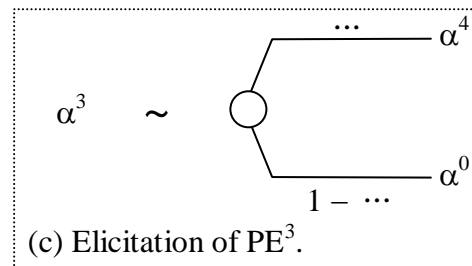
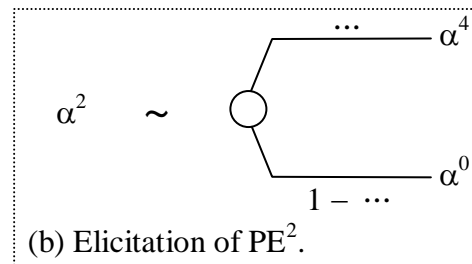
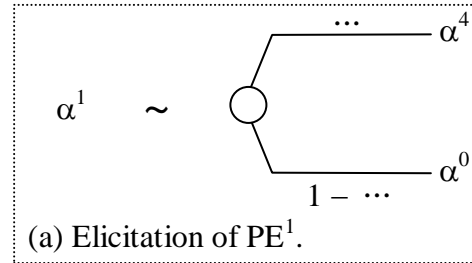
Indicate in each Fig. which outcome on the dotted line \dots , if received with certainty, is indifferent to the prospect.

p. 99:

FIGURE 4.1.4 [TO Downwards]. Eliciting $\delta^3 \dots \delta^0$ (a) Your switching value on the dotted line is δ^3 .(b) Your switching value on the dotted line is δ^2 .(c) Your switching value on the dotted line is δ^1 .(d) Your switching value on the dotted line is δ^0 .

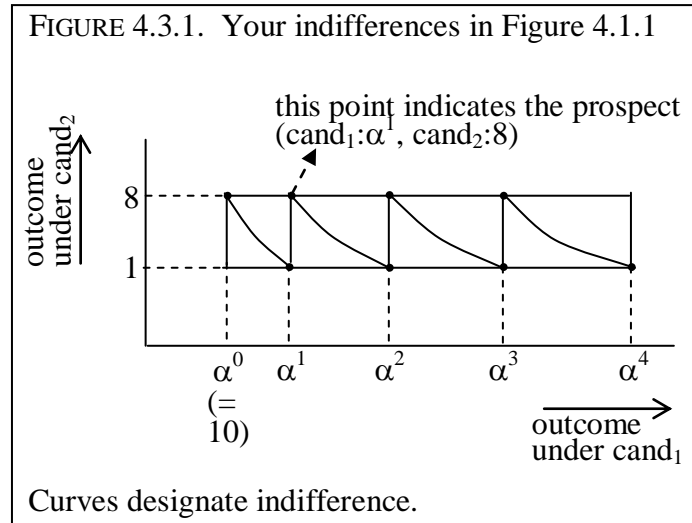
Indicate in each fig. which outcome on the dotted line ... makes the two prospects indifferent (the switching value).

p. 100:

FIGURE 4.1.5 [*PEs*]. Eliciting PE^1 , PE^2 , PE^3 

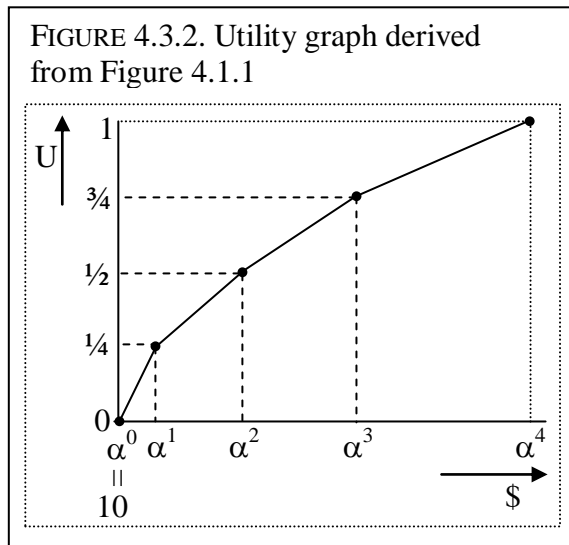
Indicate in each Fig. which probability on the dotted lines ... makes the prospect indifferent to receiving the sure amount to the left.

p. 104:

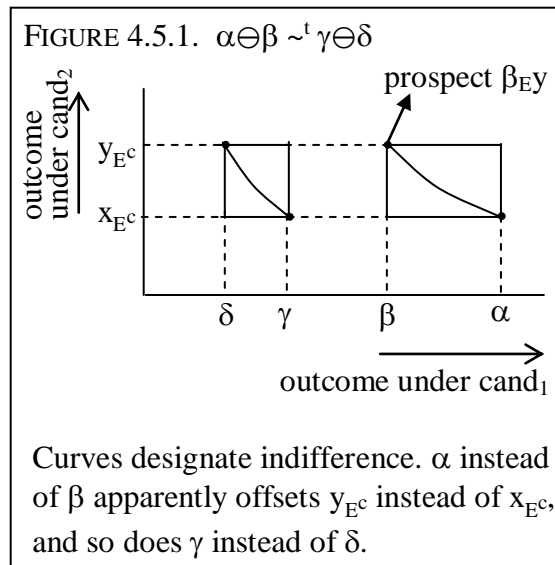


ELUCIDATION: This Figure was made using only MS Word. I drew the curves by hand.

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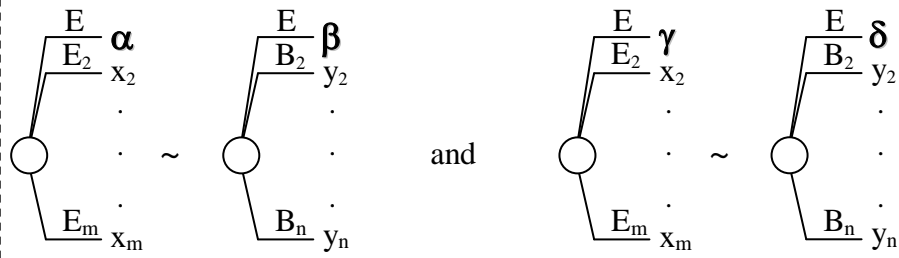


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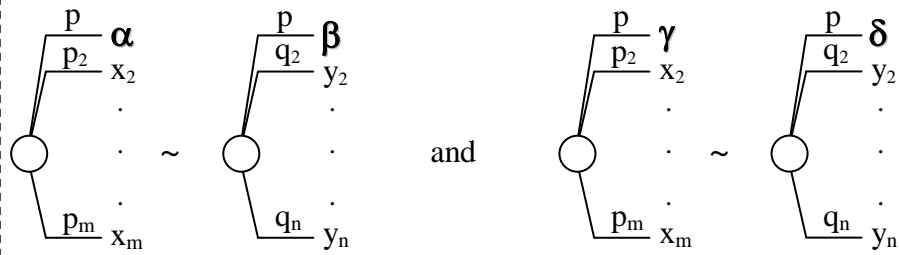


ELUCIDATION: This Figure was made using only MS Word. I drew the curves by hand.

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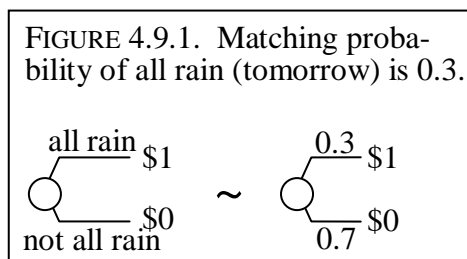
FIG. 4.7.1a. $\alpha \ominus \beta \sim^t \gamma \ominus \delta$ for uncertainty

E_2, \dots, E_m : outcome events of x beyond E ;
 B_2, \dots, B_n : outcome events of y beyond E .
 E is nonnull.

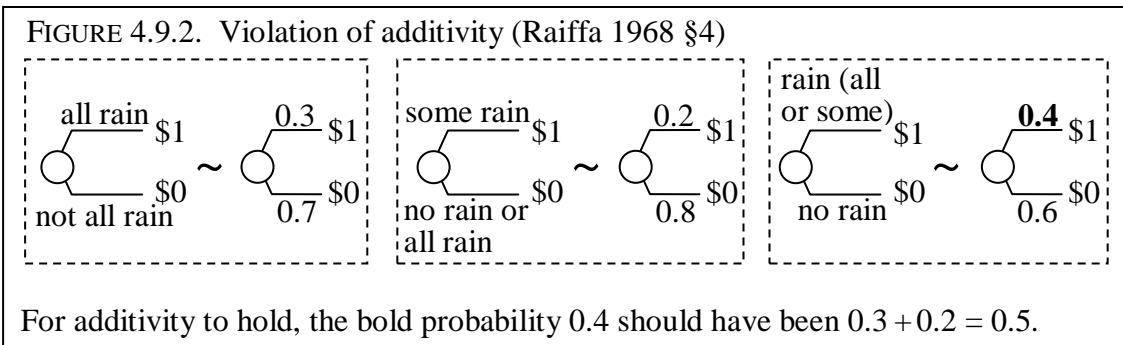
FIG. 4.7.1b. $\alpha \ominus \beta \sim^t \gamma \ominus \delta$ for risk

p_2, \dots, p_m : outcome probabilities of x beyond p ;
 q_2, \dots, q_n : outcome probabilities of y beyond p .
 $p > 0$.

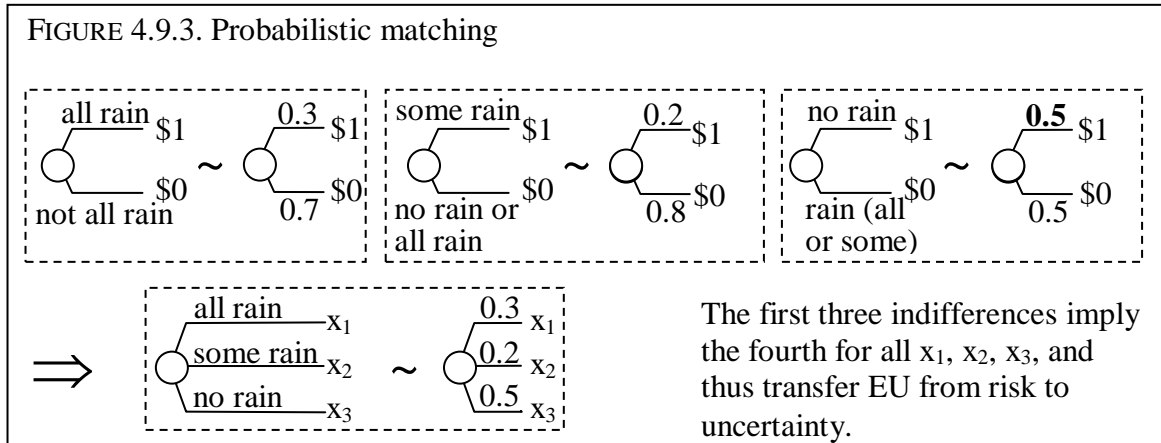
p. 120:



p. 121:



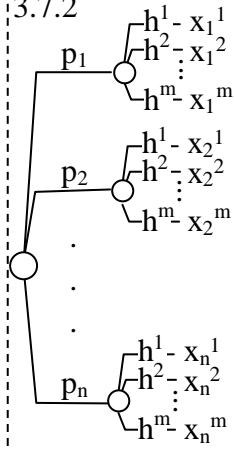
p. 121:



p. 123:

FIGURE 4.9.4. Different presentations and evaluations of multi-stage prospects

FIG. 4.9.4a. An analog of the multiattribute utility prospect of Figure 3.7.2



\Downarrow
 $\sum_{j=1}^n p_j (\sum_{i=1}^m q^i u(x_j^i))$:
 the evaluation by
 Eq. 3.7.7.

FIG. 4.9.4b. Anscombe & Aumann's model as mostly used today

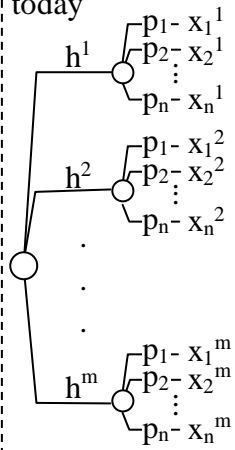
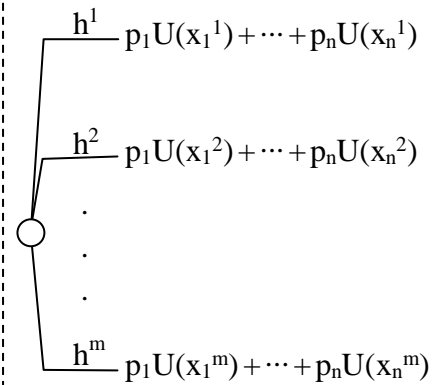
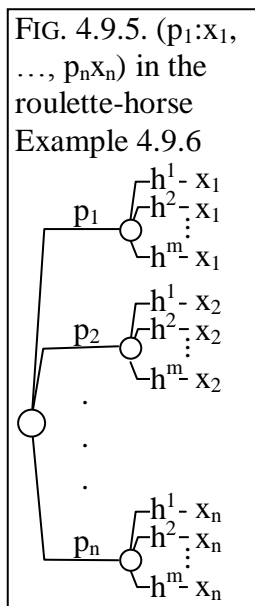
 \Rightarrow

FIG. 4.9.4c. A step in the evaluation of prospects in Anscombe & Aumann's model

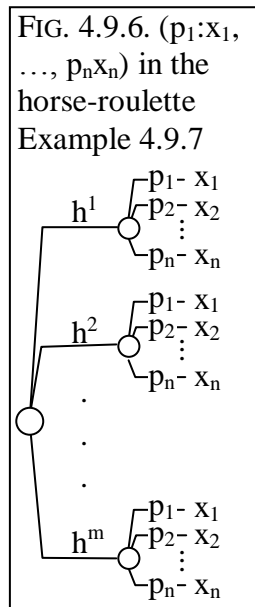


\Downarrow
 $\sum_{i=1}^m q^i (\sum_{j=1}^n p_j u(x_j^i))$:
 A rewriting of Eq.
 3.7.7.

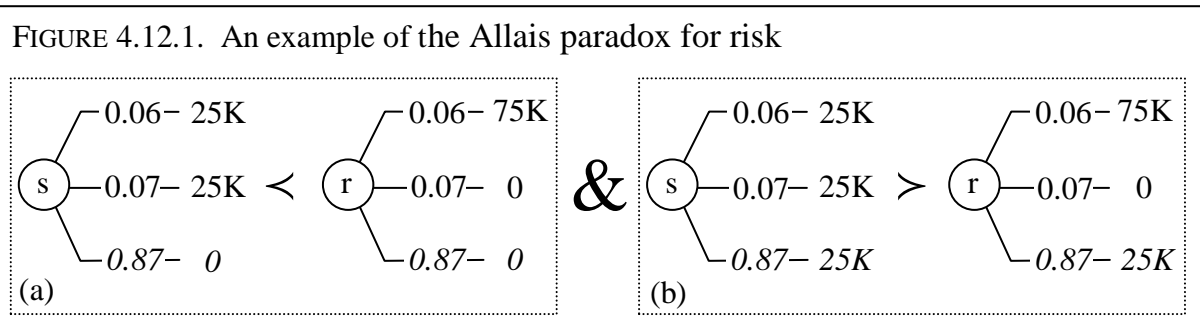
p. 126:



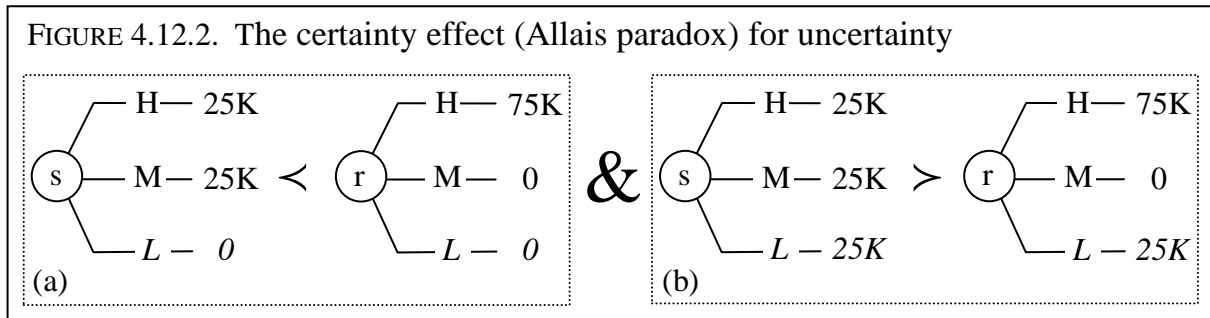
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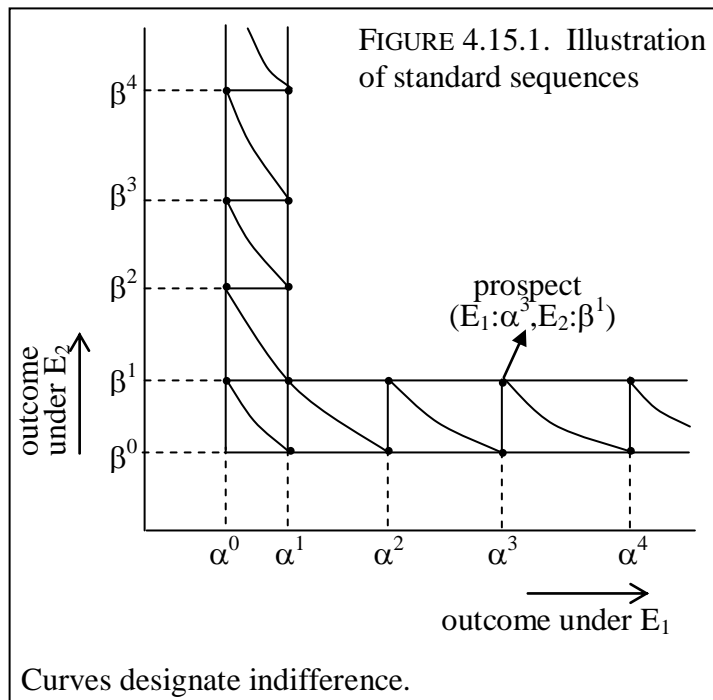
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p. 134:

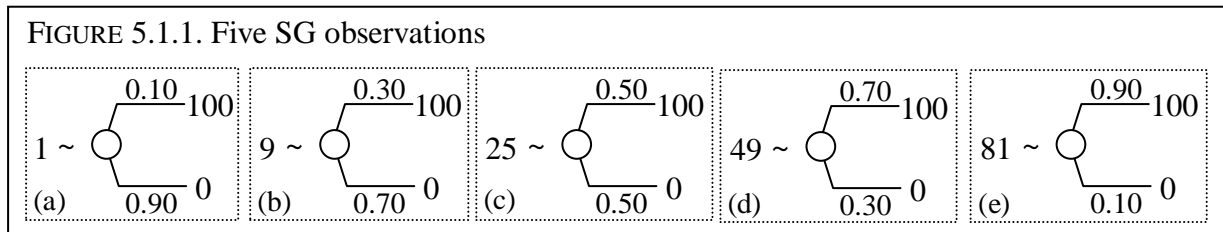


p. 140:



ELUCIDATION: This Figure was made using only MS Word. I drew the curves by hand.

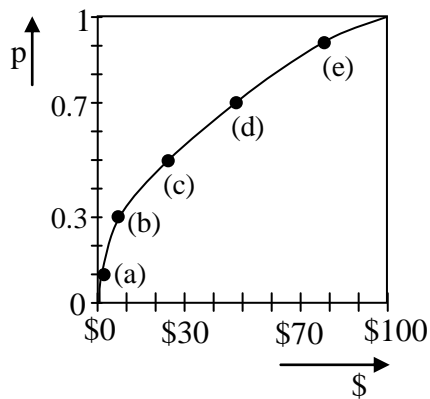
p. 146:



p. 146:

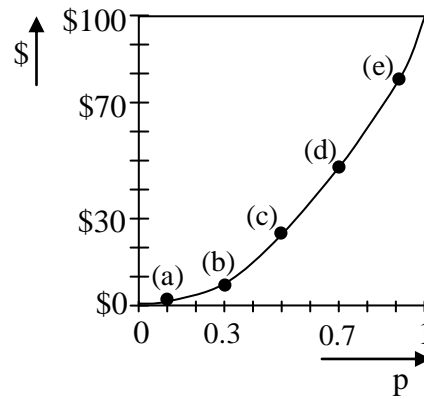
FIGURE 5.1.2. Two pictures to summarize the data of Figure 5.1.1

FIG. a. A display of the data



Under expected utility, the curve can be interpreted as the utility function, normalized at the extreme amounts.

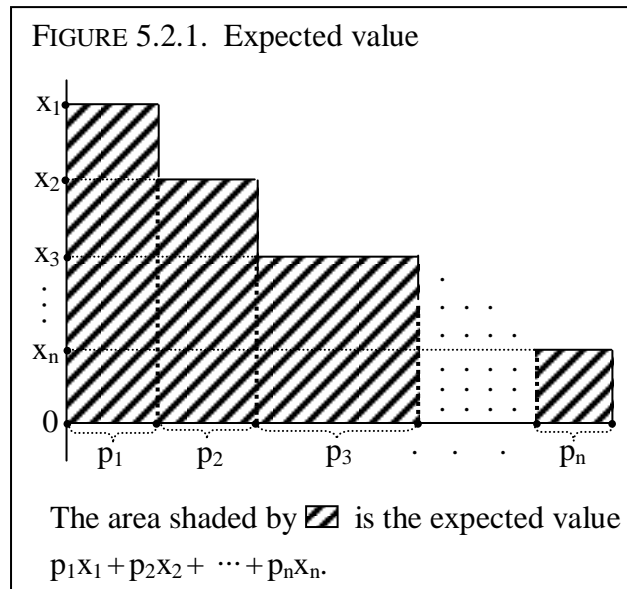
FIG. b. An alternative way to display the same data



Under Eq. 5.1.2, the curve can be interpreted as the probability weighting function w , to be normalized at the extreme amounts ($w=0$ at \$0 and $w=1$ at \$100).

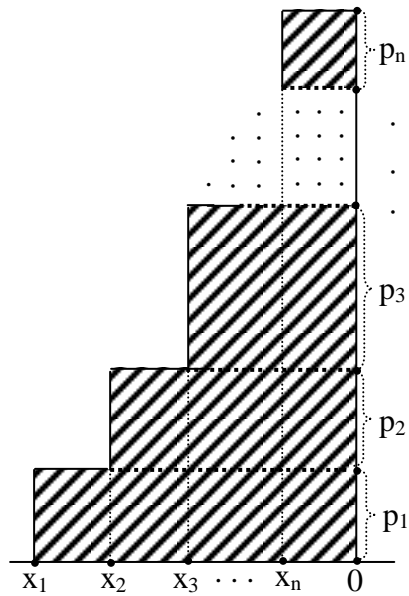
ELUCIDATION: This Figure was made using only MS Word. I drew the curves by hand. The right curve should be obtained from the left one by rotating left and flipping horizontally.

p. 150:



p. 150:

FIG. 5.2.2a. Expected value after rotating left




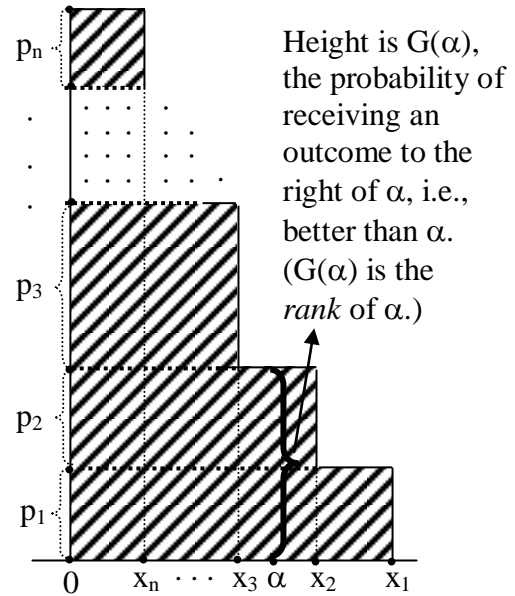

The area shaded by  is the expected value.

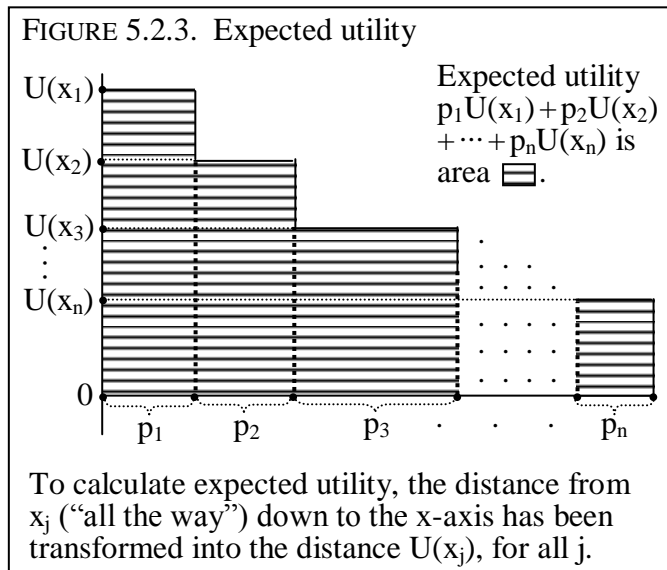
FIG. 5.2.2b. Expected value after (rotating left and) flipping horizontally



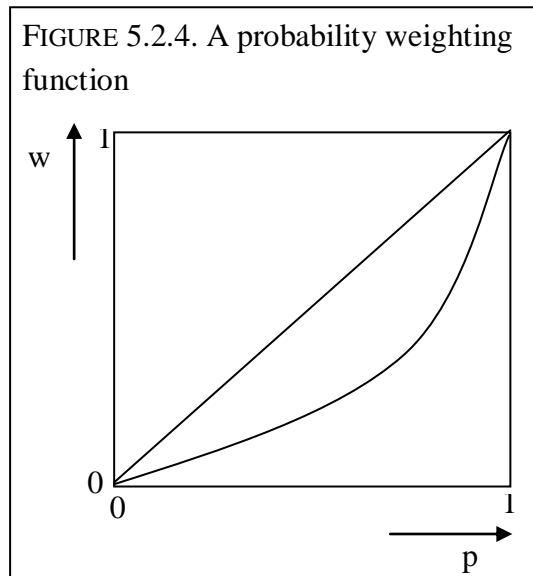
Height is $G(\alpha)$, the probability of receiving an outcome to the right of α , i.e., better than α . ($G(\alpha)$ is the *rank* of α .)

The area shaded by  is the expected value.

p. 151:

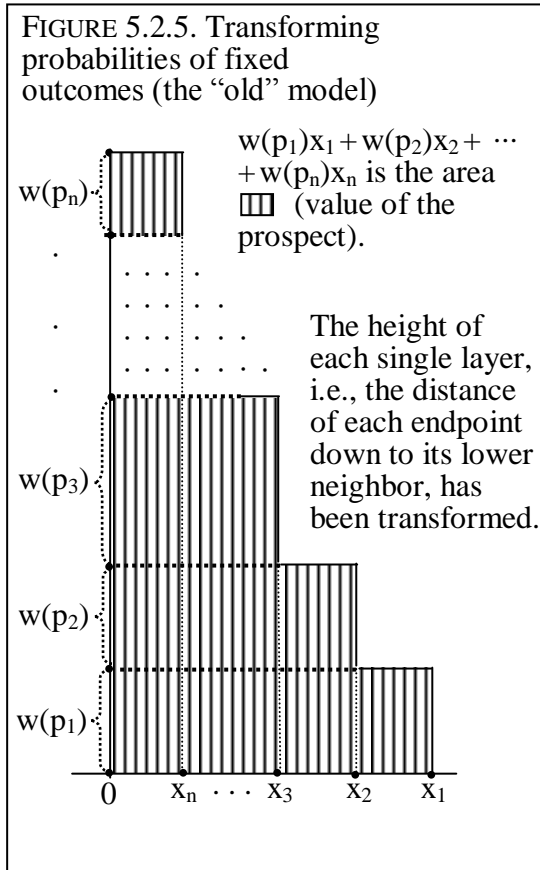


p. 152:



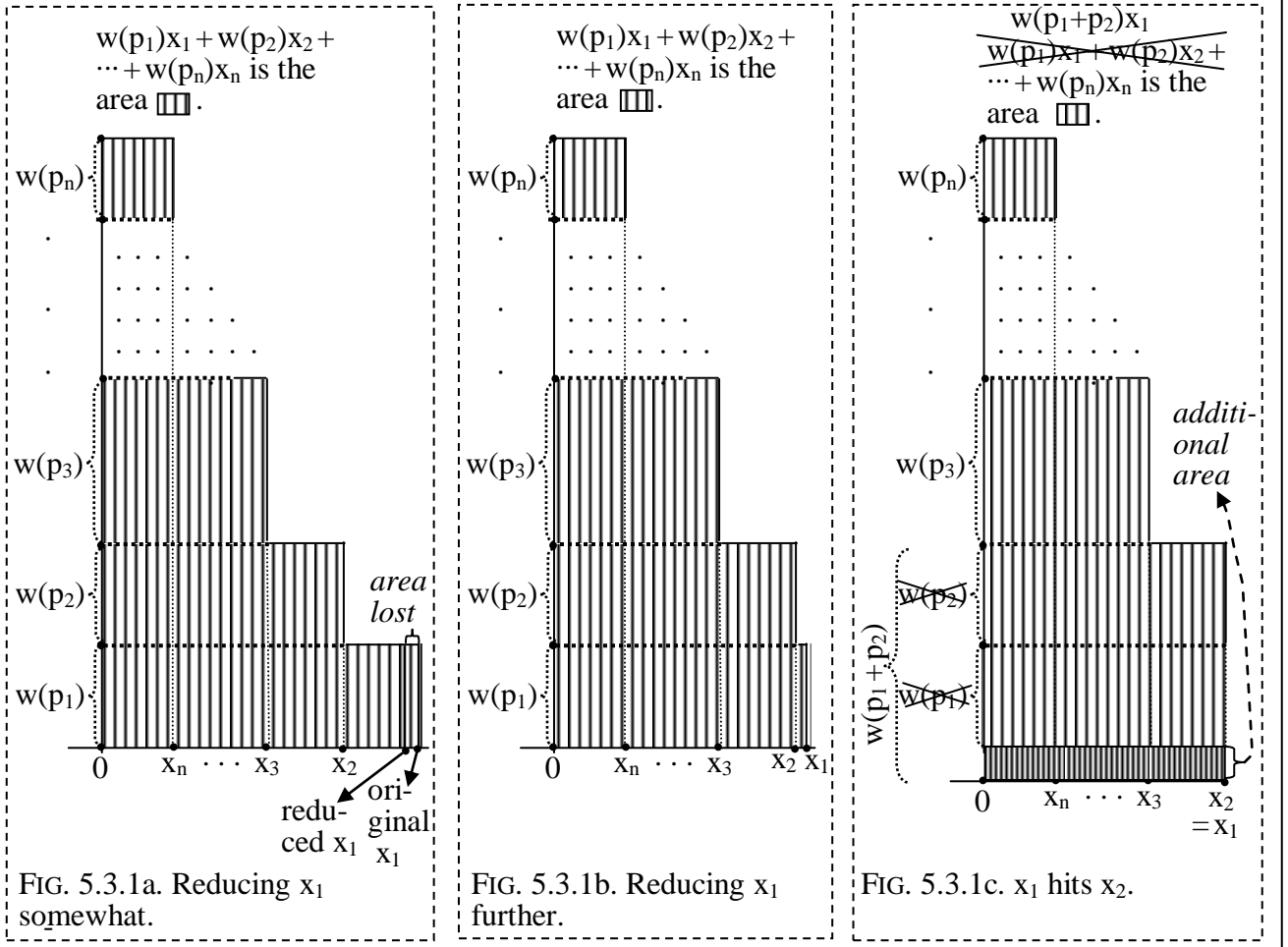
ELUCIDATION: This Figure was made using only MS Word. I drew the curve by hand.

p. 152:



p. 154:

FIGURE 5.3.1. Eq. 5.2.1 violates stochastic dominance



p. 157:

FIGURE 5.4.1. The usefulness of ranks

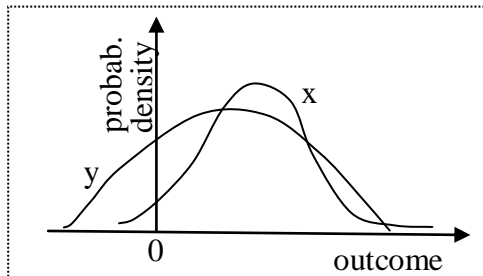


FIG. a. Probability densities, the continuous analogs of outcome probabilities

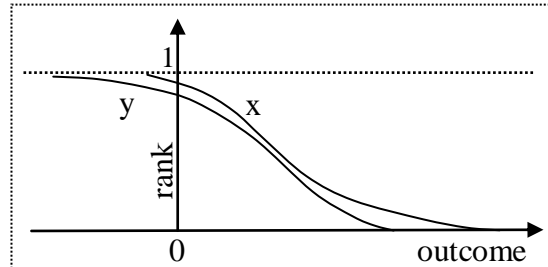


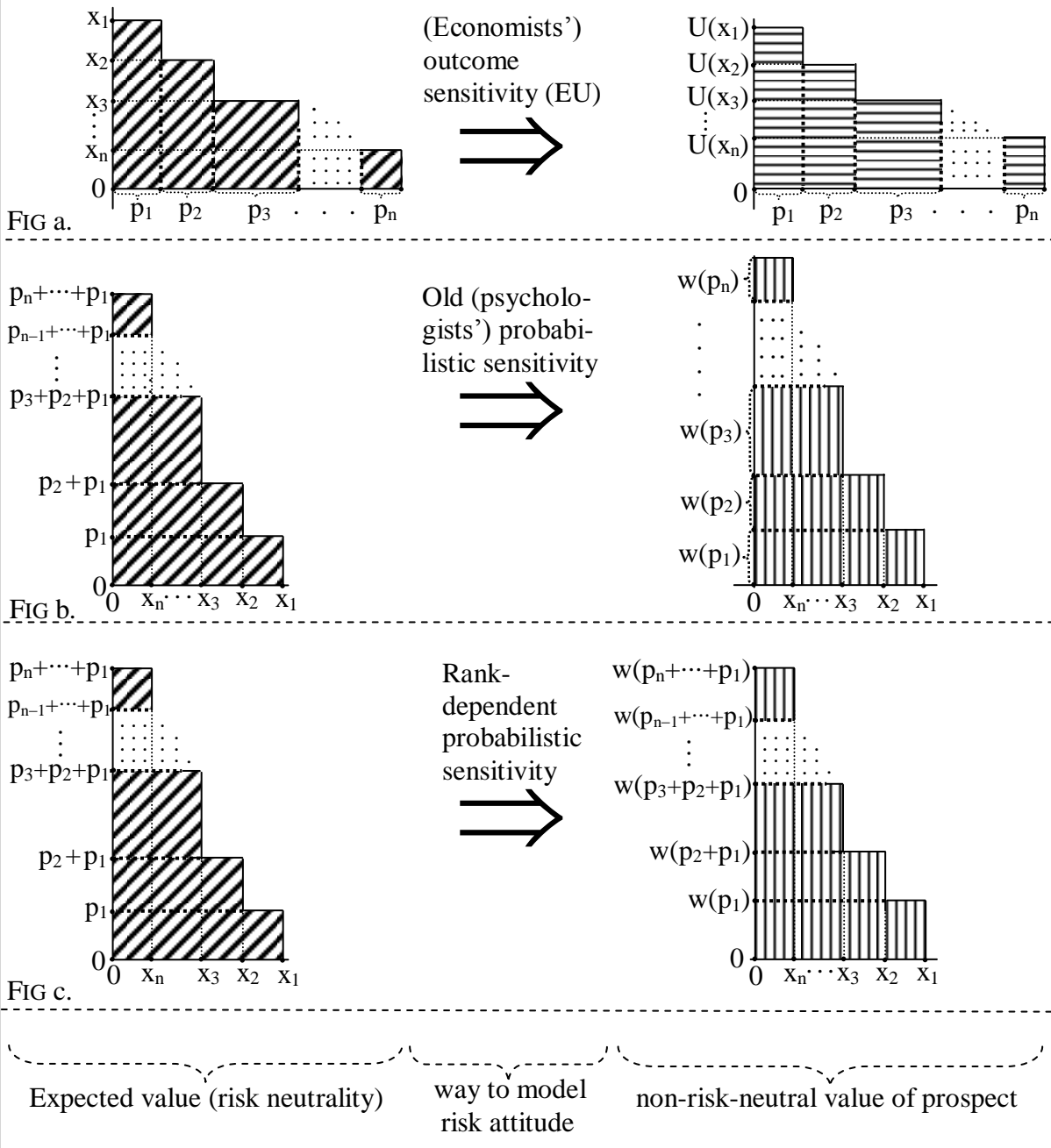
FIG. b. Ranks, being 1 minus the distribution function

Fig. b displays the same prospects as Fig. a, but now in terms of ranks, i.e., the probability of receiving a strictly better outcome, which is 1 minus the usual “distribution function.”

ELUCIDATION: This Figure was made using only MS Word. I drew the curves by hand.

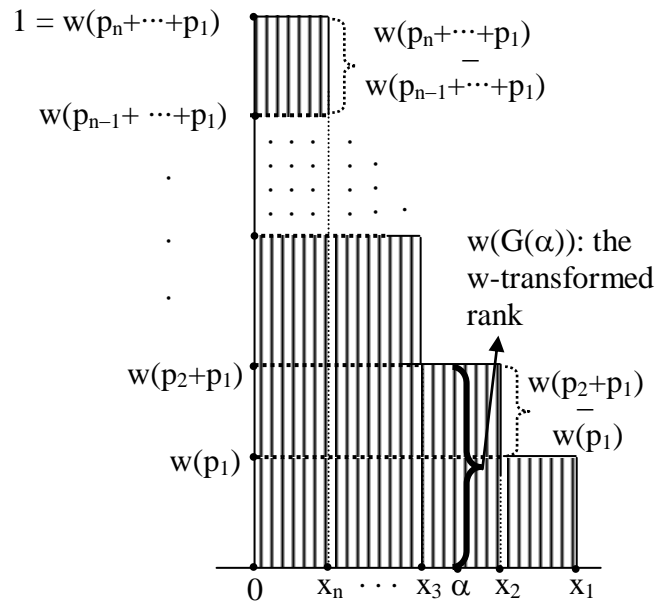
p. 162:

FIGURE 5.5.1. Combination of preceding figures, with rank dependence as an application of an economic technique to a psychological dimension.



p. 163:

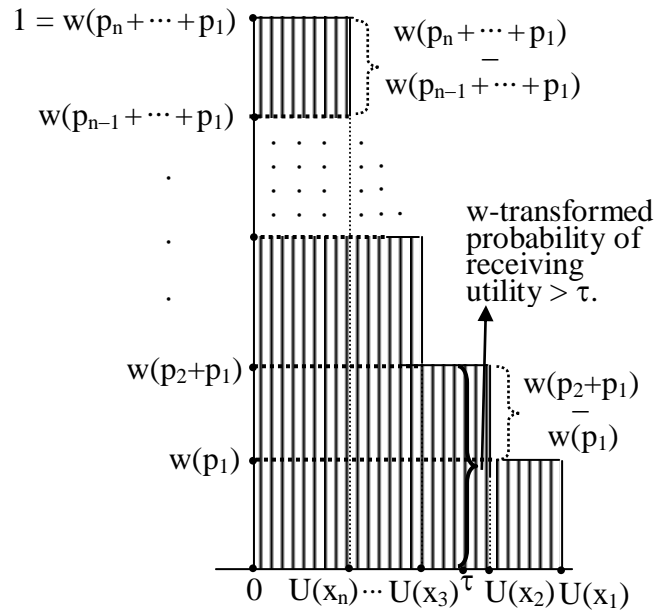
FIGURE 5.5.2. Rank-dependent utility with linear utility



The area shaded by $\square\square\square$ is the value of the prospect. Distances of endpoints of layers (“all the way”) down to the x -axis are transformed, similar to Figure 5.2.3. The endpoint of the last layer now remains at a distance of 1 from the x -axis, reflecting normalization of the bounded probability scale.

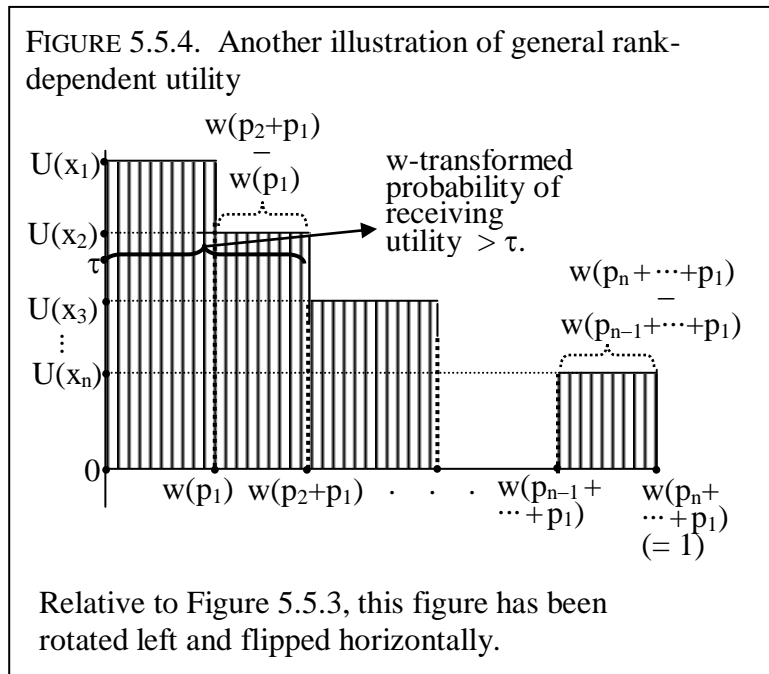
p. 164:

FIGURE 5.5.3. Rank-dependent utility with general utility

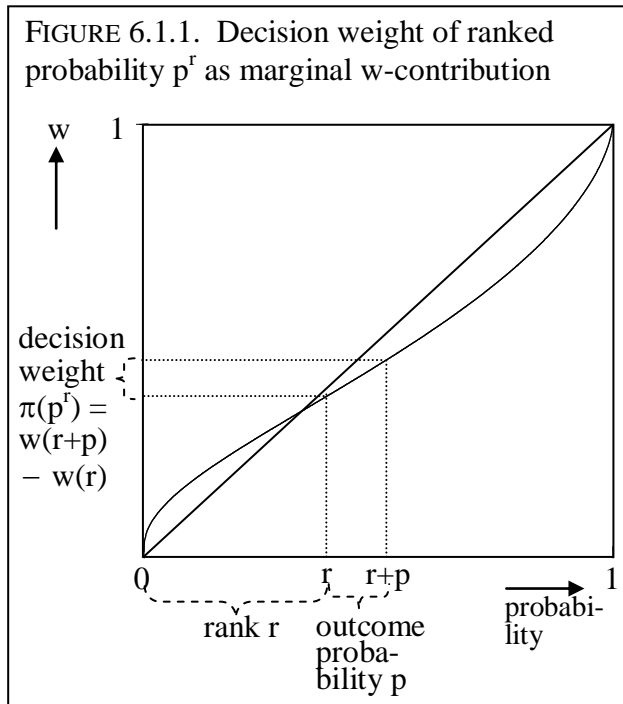


For points on the y-axis ("endpoints of layers"), their distance down to the x-axis are transformed using w . For points on the x-axis ("endpoints of columns"), their distances leftwards to the y-axis are transformed using U .

p. 164:

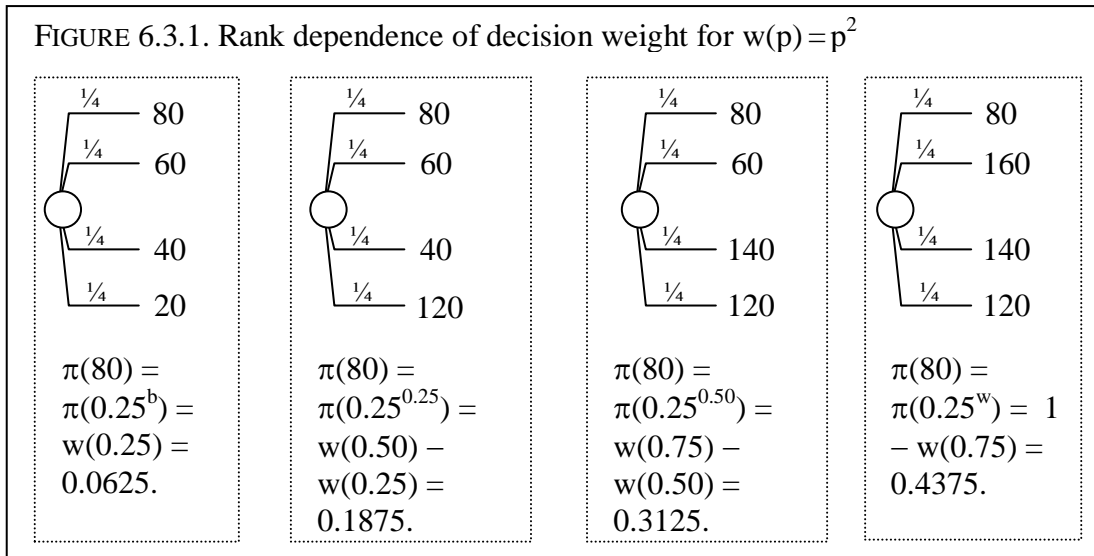


p. 170:

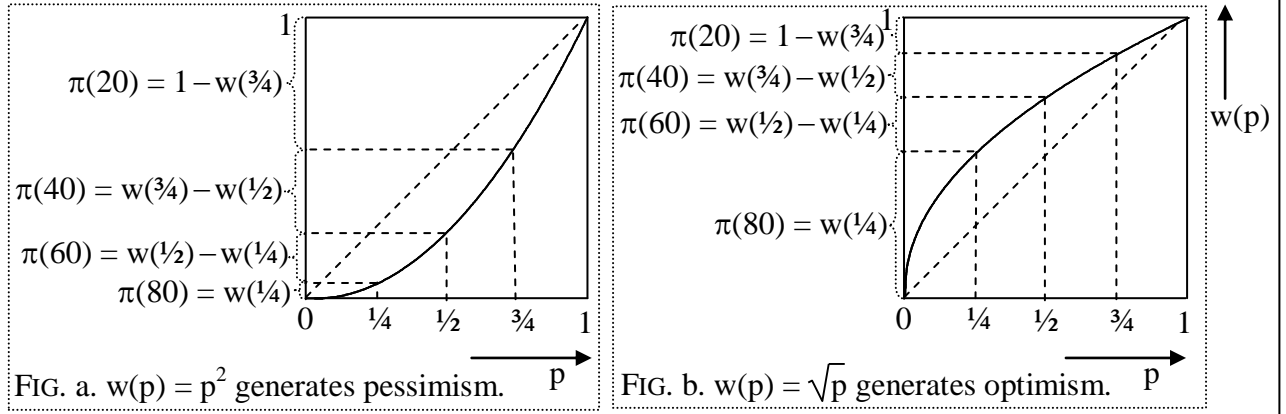


ELUCIDATION: This Figure was made using only MS Word. I drew the curve by hand.

p. 173:



p. 173:

FIGURE 6.3.2. Decision weights $\pi(\alpha)$ of outcomes α from graphs of weighting functions

ELUCIDATION: Figure 6.3.2a contains the graph of the function:

$$w(p) = p^2.$$

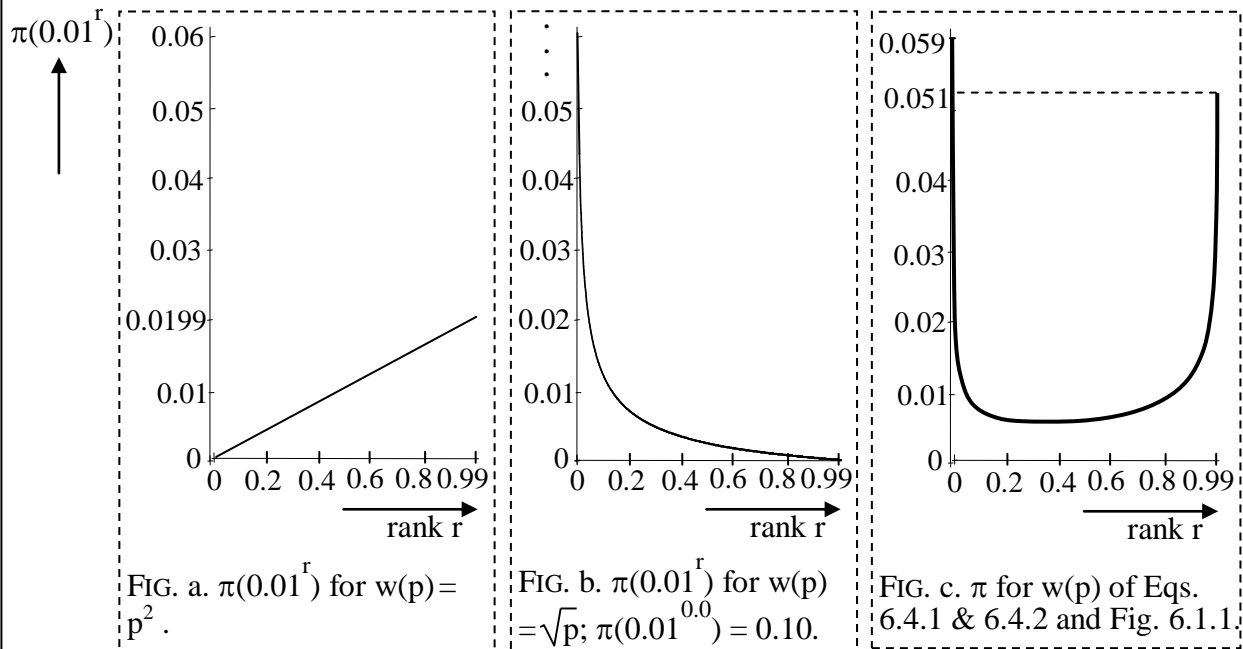
Figure 6.3.2b contains the graph of the function:

$$w(p) = \sqrt{p}.$$

I made the graphs using Scientific Workplace as explained above.

p. 178:

FIGURE 6.4.1. Dependence of decision weight on rank



$$\pi(p^r) = w(p+r) - w(r) \approx pw'(r) \text{ for } p=0.01.$$

ELUCIDATION: Figure 6.4.1b contains the graph of the function:

$$\sqrt{p+0.01} - \sqrt{p}.$$

I made the graphs using Scientific Workplace as explained above. The TeX input file can be obtained here:

[http://people.few.eur.nl/wakker/ptbook/figures/textfilesfigs/fig.6.4.1b_pi\(0.01\)sqrt.tex](http://people.few.eur.nl/wakker/ptbook/figures/textfilesfigs/fig.6.4.1b_pi(0.01)sqrt.tex)

ELUCIDATION: Figure 6.4.1c contains the graph of the function:

$$w(p) = \left(\exp(-(-\ln(p+0.01))^a) \right)^b - \left(\exp(-(-\ln(p))^a) \right)^b$$

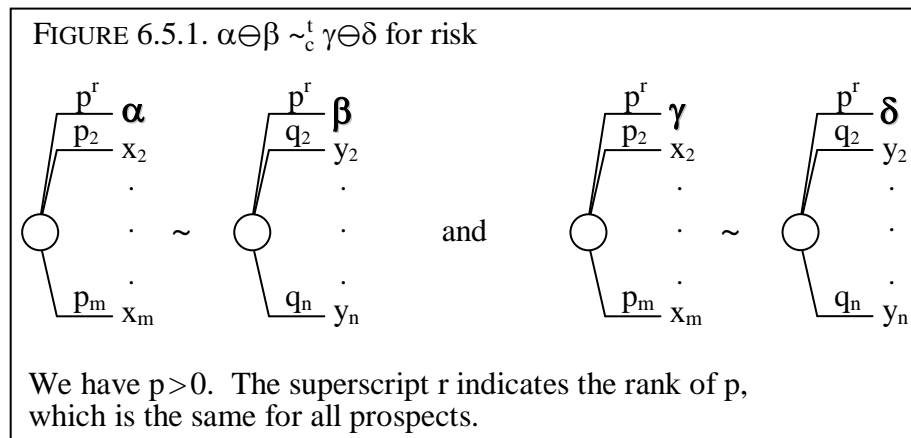
with

$$a = 0.65 \text{ and } b = 1.0467.$$

I made the graphs using Scientific Workplace as explained above. The TeX input file can be obtained here:

[http://people.few.eur.nl/wakker/ptbook/figures/textfilesfigs/fig.6.4.1c_pi\(0.01\)prelec.tex](http://people.few.eur.nl/wakker/ptbook/figures/textfilesfigs/fig.6.4.1c_pi(0.01)prelec.tex)

p. 183:



pp. 186 & 187:

Figure 6.5.2. Four indifferences

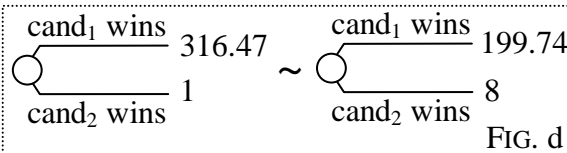
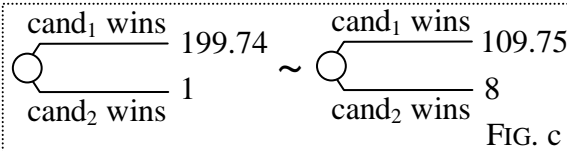
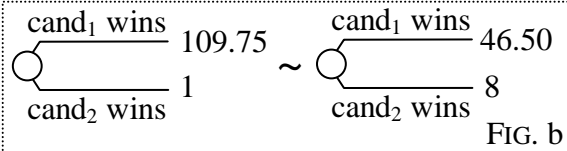
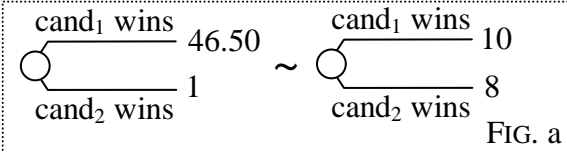
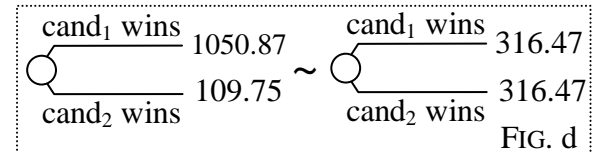
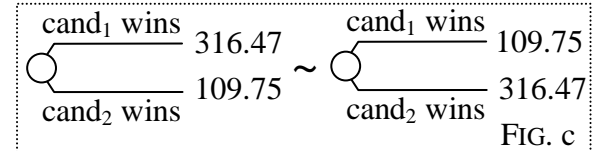
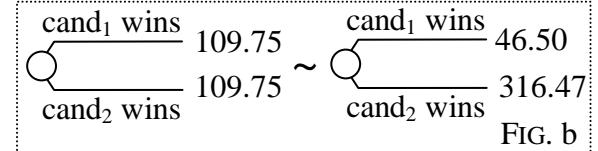
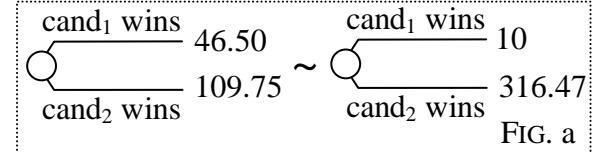
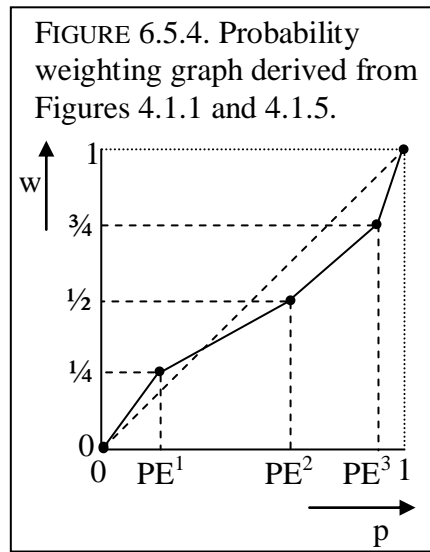


Figure 6.5.3. Four indifferences

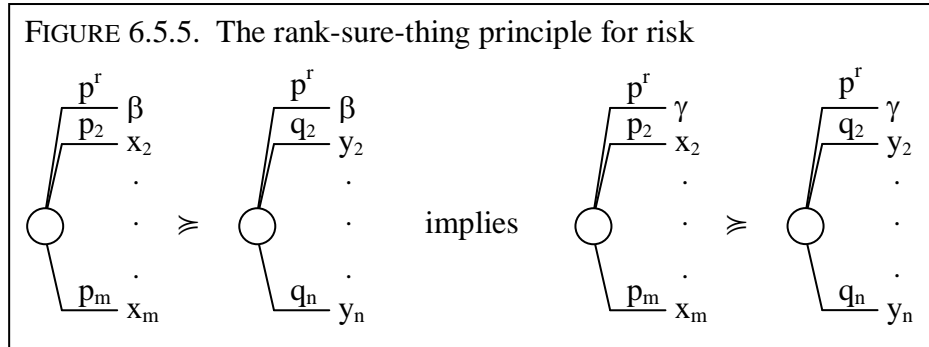


ELUCIDATION: I put here two figures because they belong together.

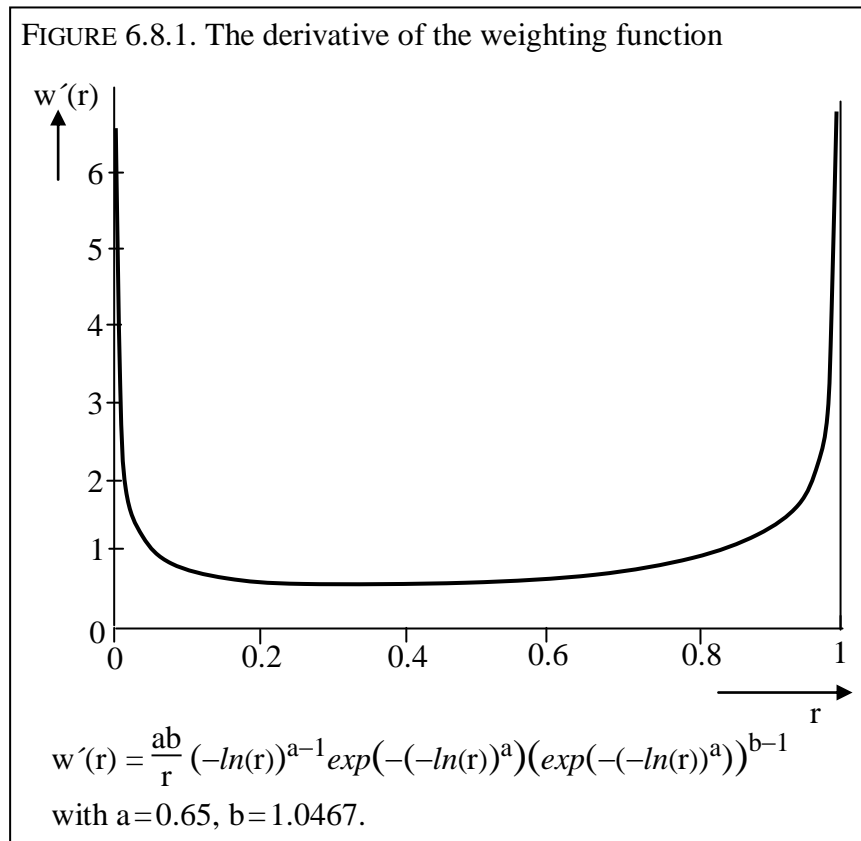
p. 188:



p. 189:



p. 198:



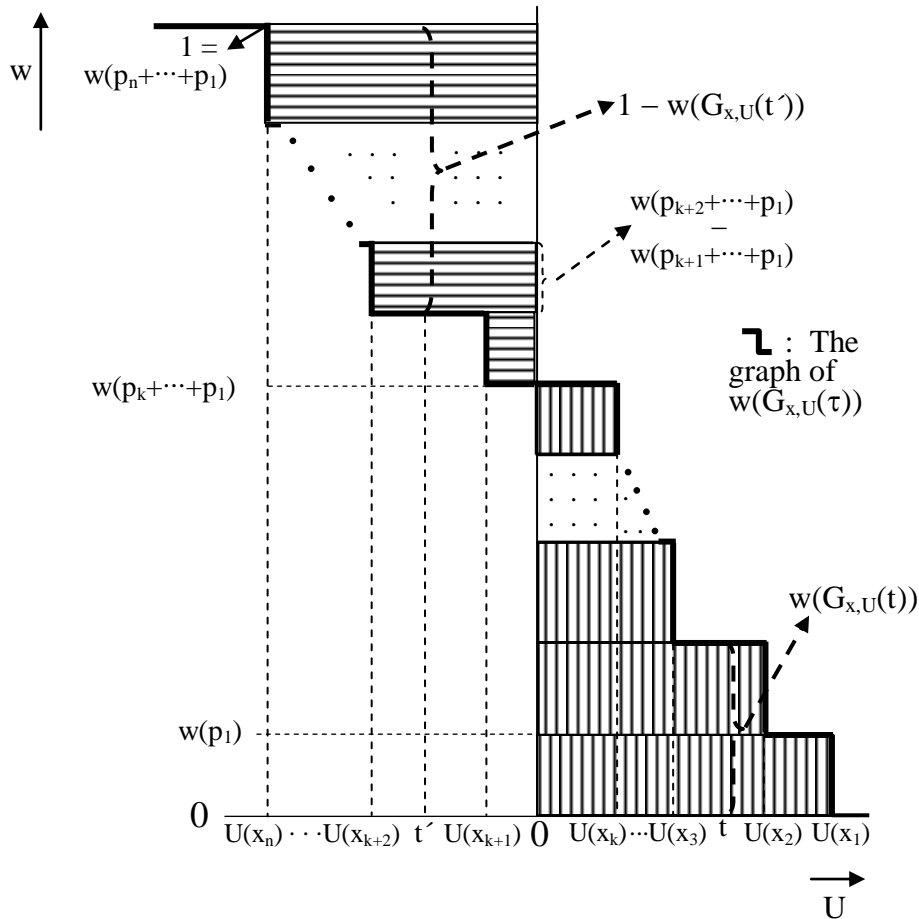
ELUCIDATION: The figure contains the graph of the function indicated in the legend.

I made the graphs using Scientific Workplace as explained above. The TeX input file can be obtained here:

<http://people.few.eur.nl/wakker/ptbook/figures/texfilesfigs/fig.6.8.1deriv.prelec.tex>

p. 200:

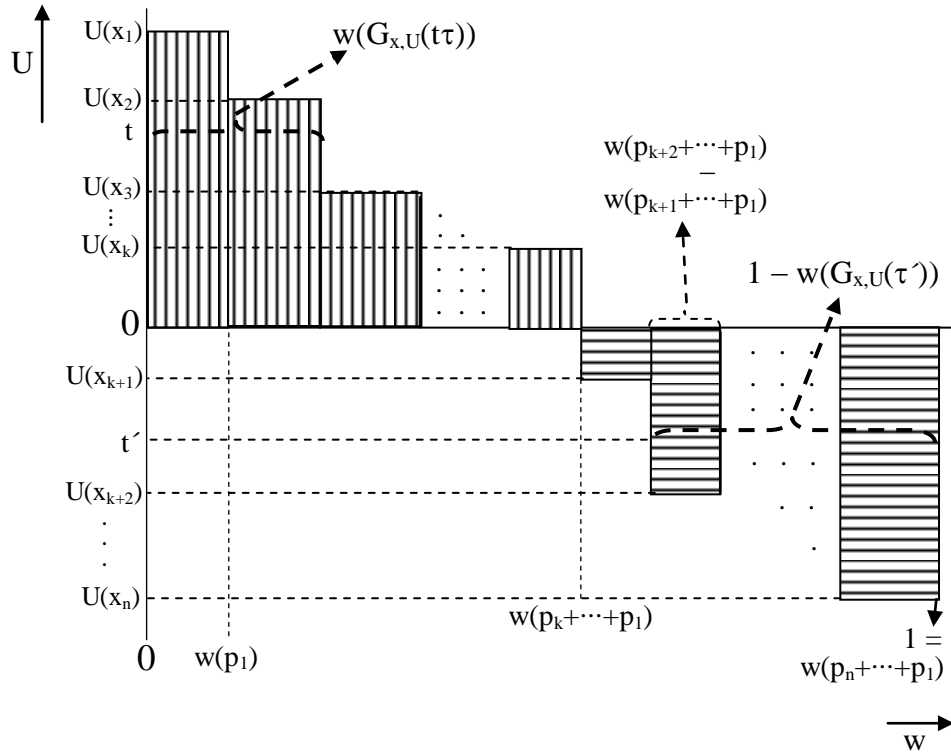
FIGURE 6.9.1. RDU of a prospect with positive and negative utilities



The prospect is $p_1 x_1 \dots p_n x_n$, with $U(x_1) \geq \dots \geq U(x_k) \geq 0 \geq U(x_{k+1}) \geq \dots \geq U(x_n)$. $w(G_{x,U}(t))$ is the w -transform of the probability of receiving utility $> t$. The figure illustrates Eq. 6.9.1. For $t > 0$ the integrand is $w(G_{x,U}(t))$, and for $t' < 0$ it is the negative of $1 - w(G_{x,U}(t))$. RDU is the area \square minus the area \equiv .

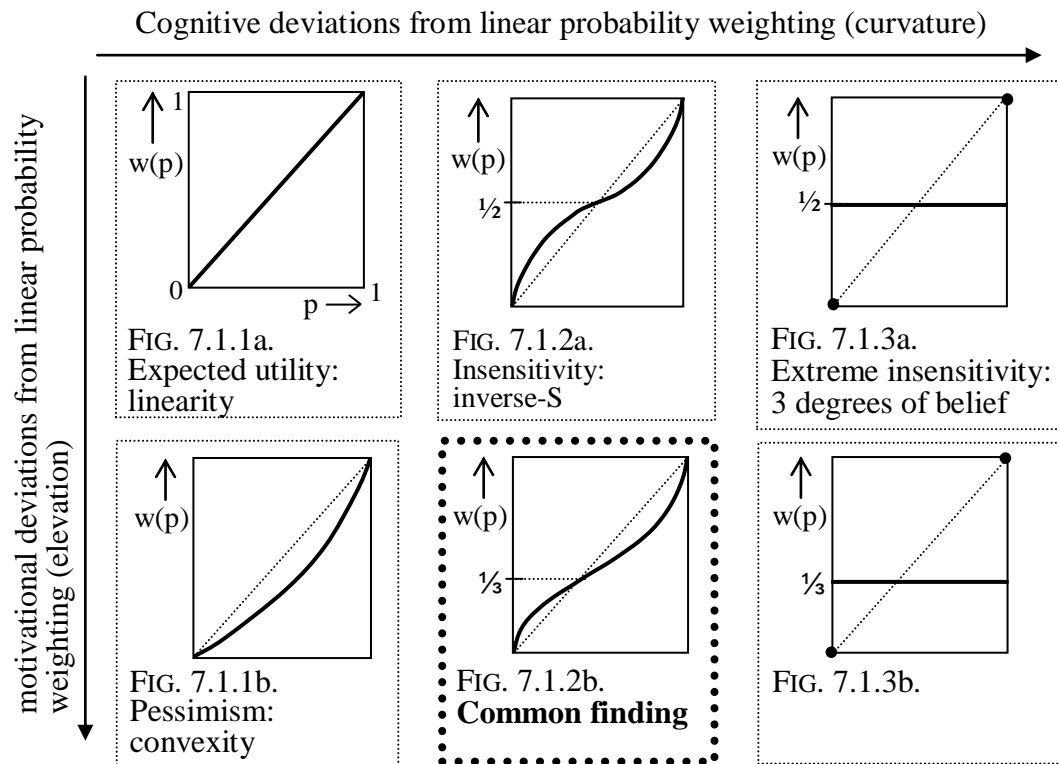
p. 201:

FIGURE 6.9.2. An illustration alternative to Figure 6.9.1



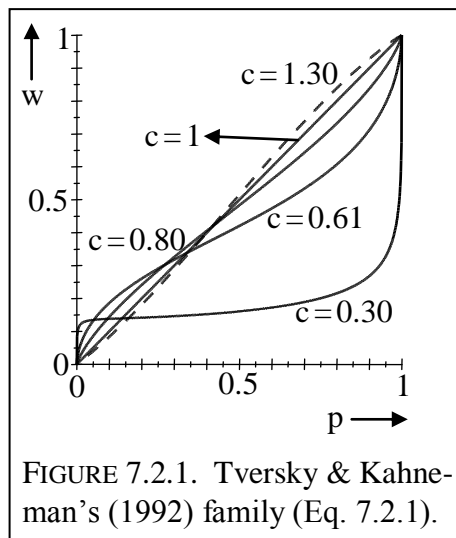
This figure has resulted from Figure 6.9.1 by rotating left and flipping horizontally.

p. 205:



ELUCIDATION: This Figure was made using only MS Word. The curves were drawn by hand.

p. 207:



ELUCIDATION: This Figure contains graphs of the function

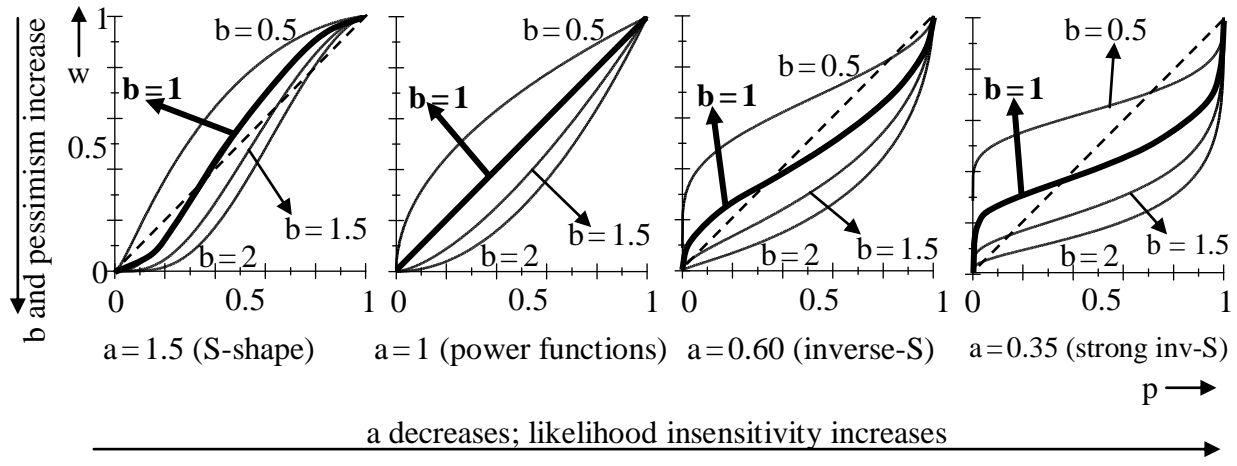
$$w(p) = \frac{p^c}{(p^c + (1-p)^c)^{1/c}}$$

with the c 's as indicated in the figure.

I made the graphs using Scientific Workplace (did not keep input files) as explained above.

p. 208:

FIGURE 7.2.2. Prelec's compounding invariance family (Eq. 6.4.1)



ELUCIDATION: This Figure contains graphs of the function

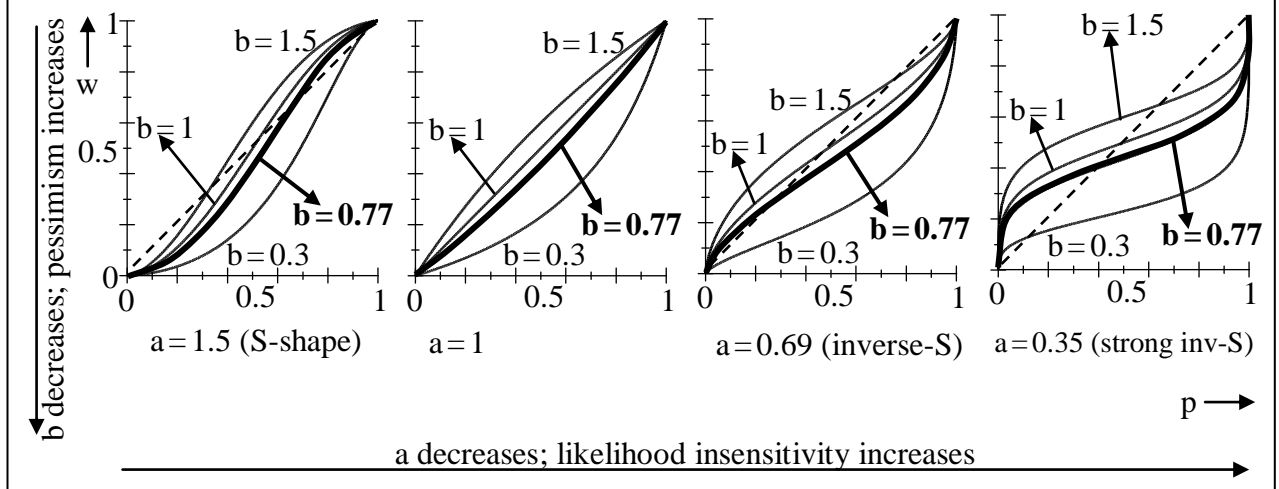
$$w(p) = (\exp(-(-\ln(p))^a))^b$$

with a and b as indicated in the figures.

I made the graphs using Scientific Workplace (did not keep input files) as explained above.

p. 208:

FIGURE 7.2.3. The family of Eq. 7.2.4



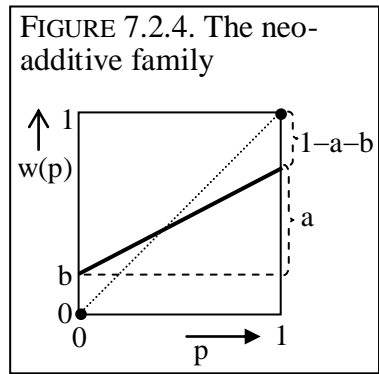
ELUCIDATION: This Figure contains graphs of the function

$$w(p) = \frac{bp^a}{bp^a + (1-p)^a}$$

with a and b as indicated in the figures.

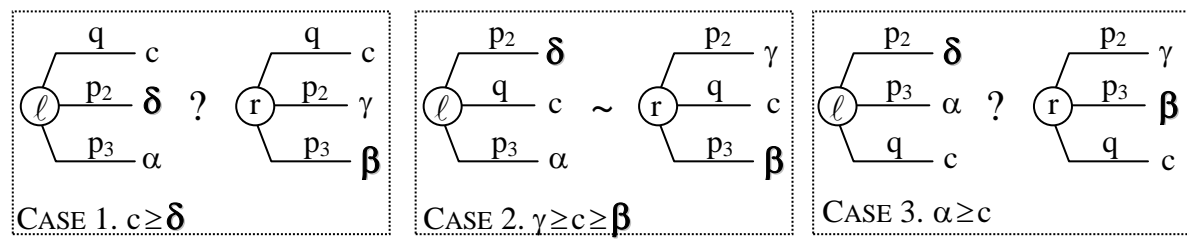
I made the graphs using Scientific Workplace (did not keep input files) as explained above.

p. 209:



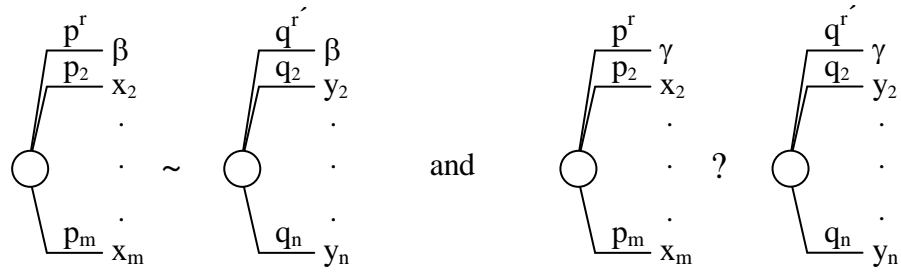
p. 215:

FIGURE 7.4.1. Testing the sure-thing principle



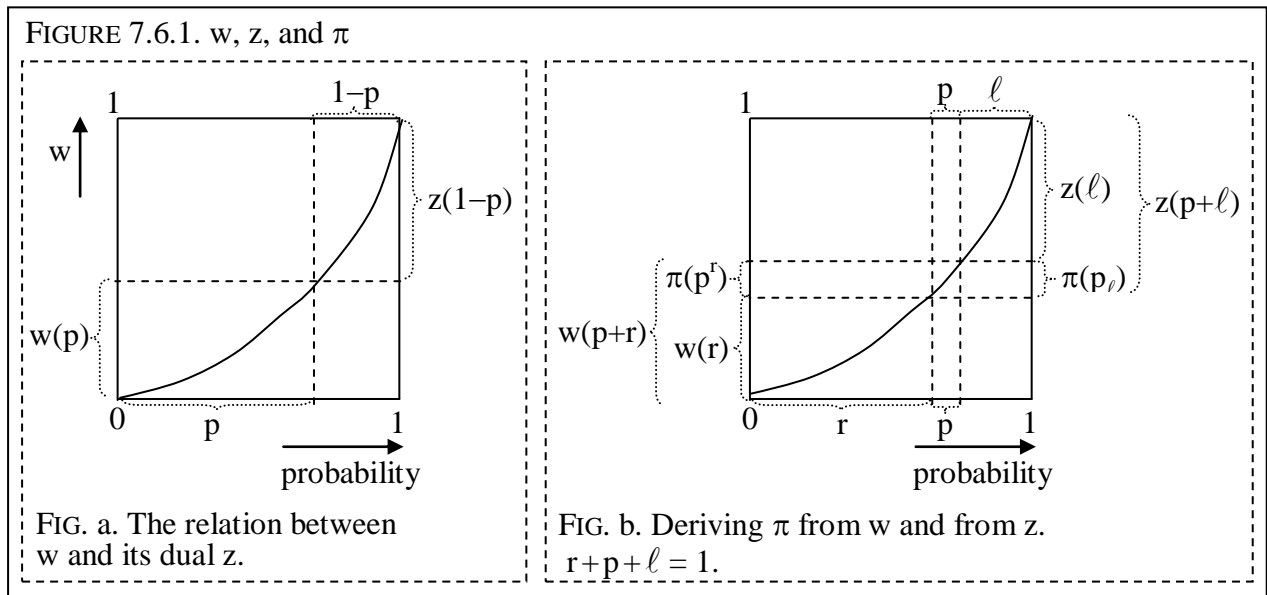
p. 218:

FIGURE 7.5.1.



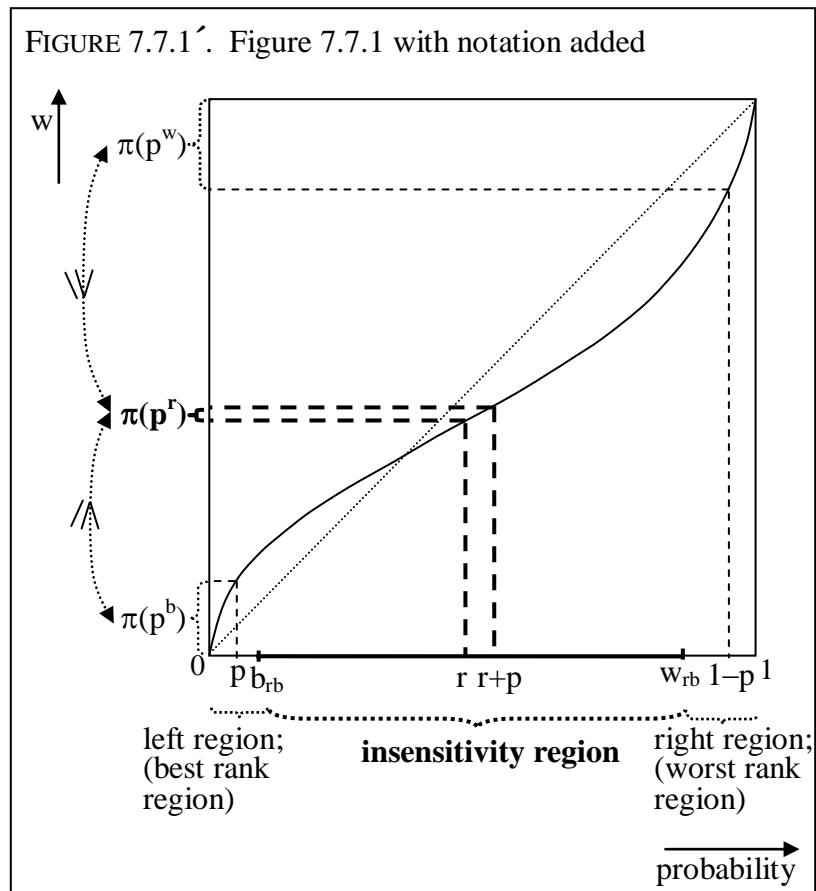
The superscript r indicates the rank of p , and is the same in the first and third prospect. The superscript r' indicates the rank of q , and is the same in the second and fourth prospect.

p. 220:



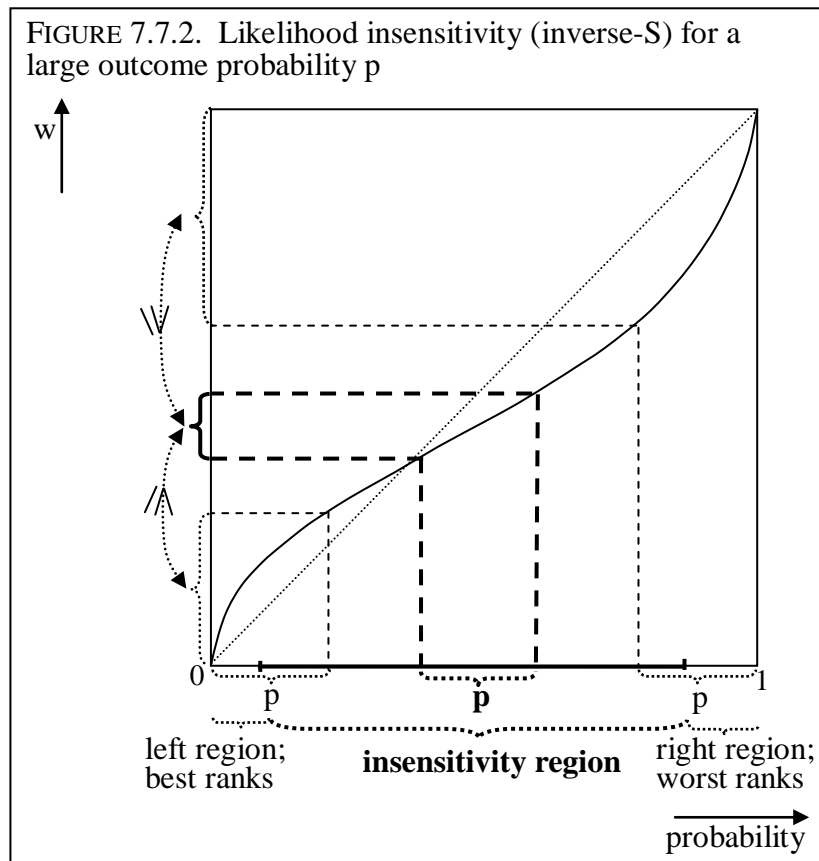
ELUCIDATION: This Figure was made using only MS Word. The curve in the two figures should be the same and was drawn by hand.

p. 224:



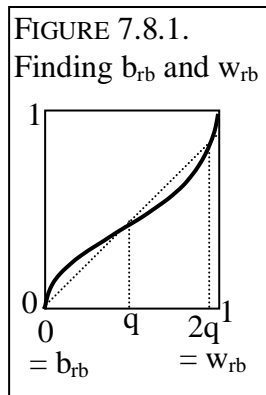
ELUCIDATION: This Figure was made using only MS Word. The curve should be the same as the one in Figure 7.7.1.

p. 226:



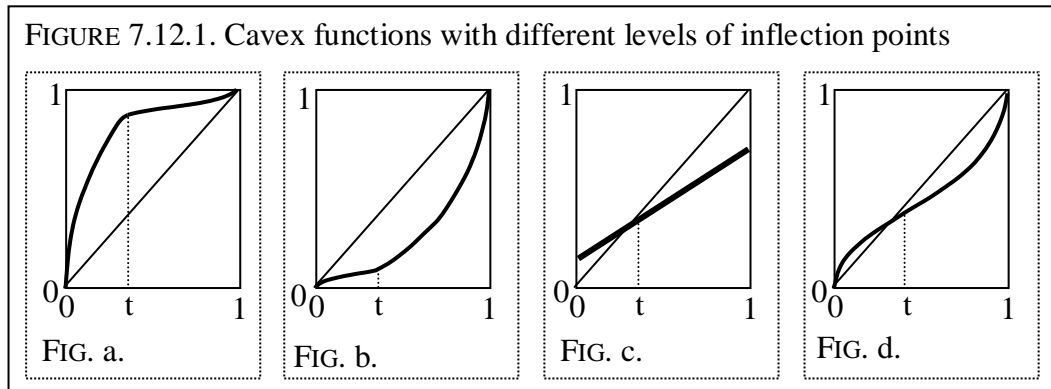
ELUCIDATION: This Figure was made using only MS Word. The curve should be the same as the one in Figure 7.7.1.

p. 227:



ELUCIDATION: This Figure was made using only MS Word. The curve was drawn by hand.

p. 232:



ELUCIDATION: This Figure was made using only MS Word. The curves were drawn by hand.

p. 235:

FIGURE 8.1.1.

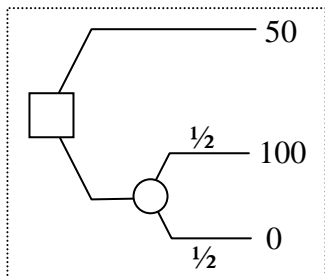


FIG. 8.1.1a. A choice between gain-prospects.

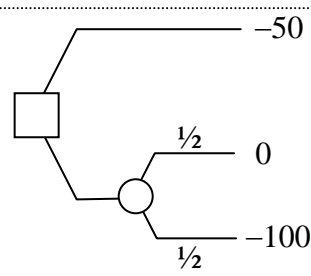


FIG. 8.1.1b. A choice between loss-prospects.

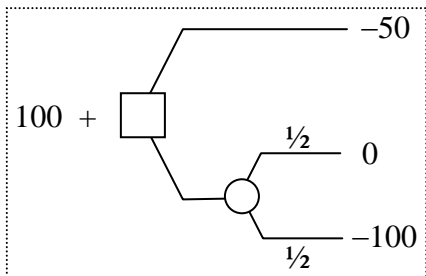
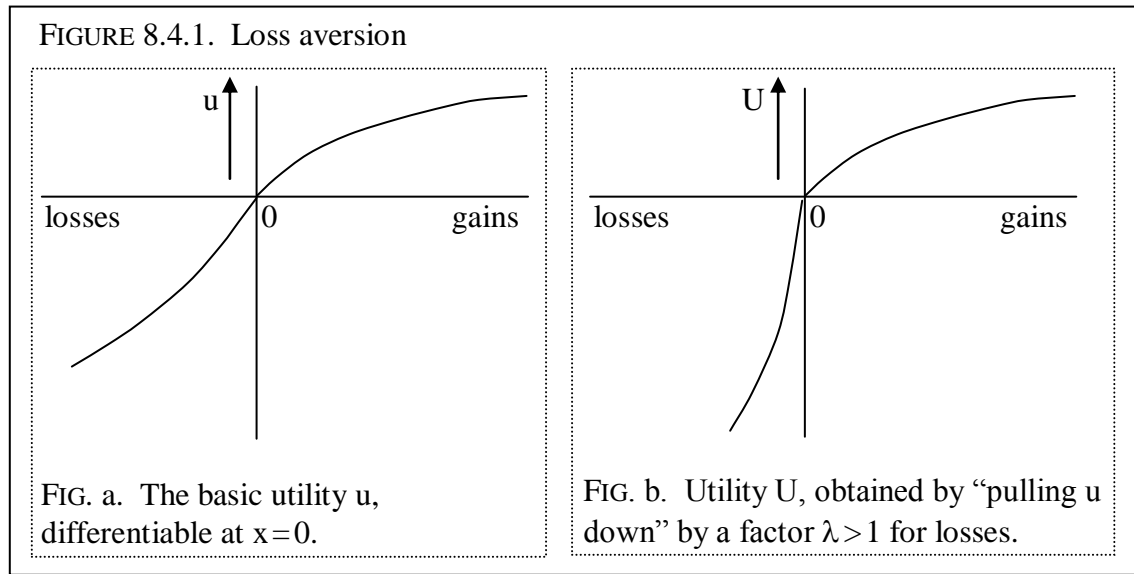


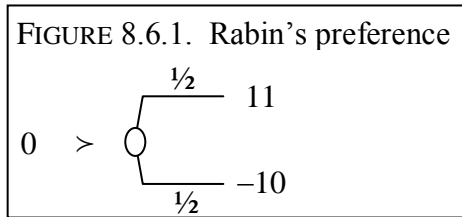
FIG. 8.1.1c. A choice between loss-prospects, but with an external side-payment.

p. 240:



ELUCIDATION: This Figure was made using only MS Word. The curves were drawn by hand.

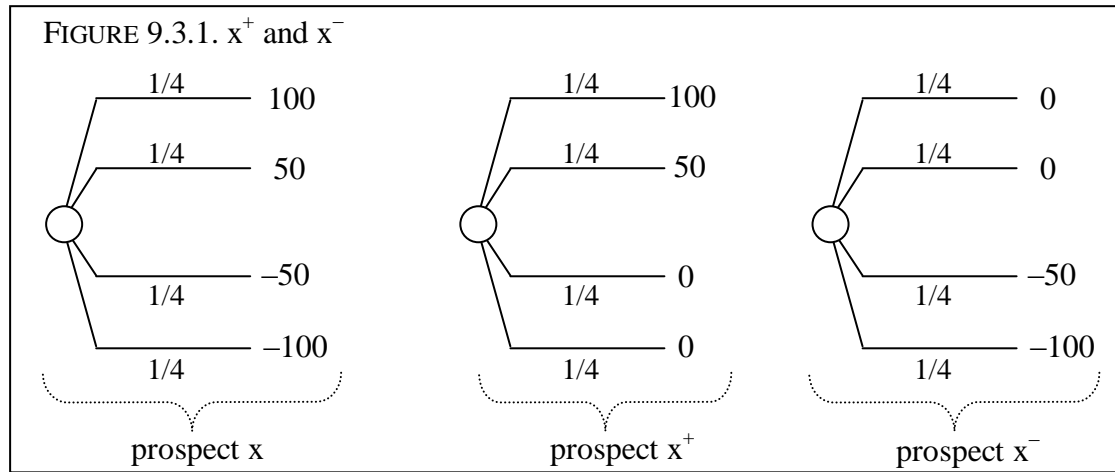
p. 242:



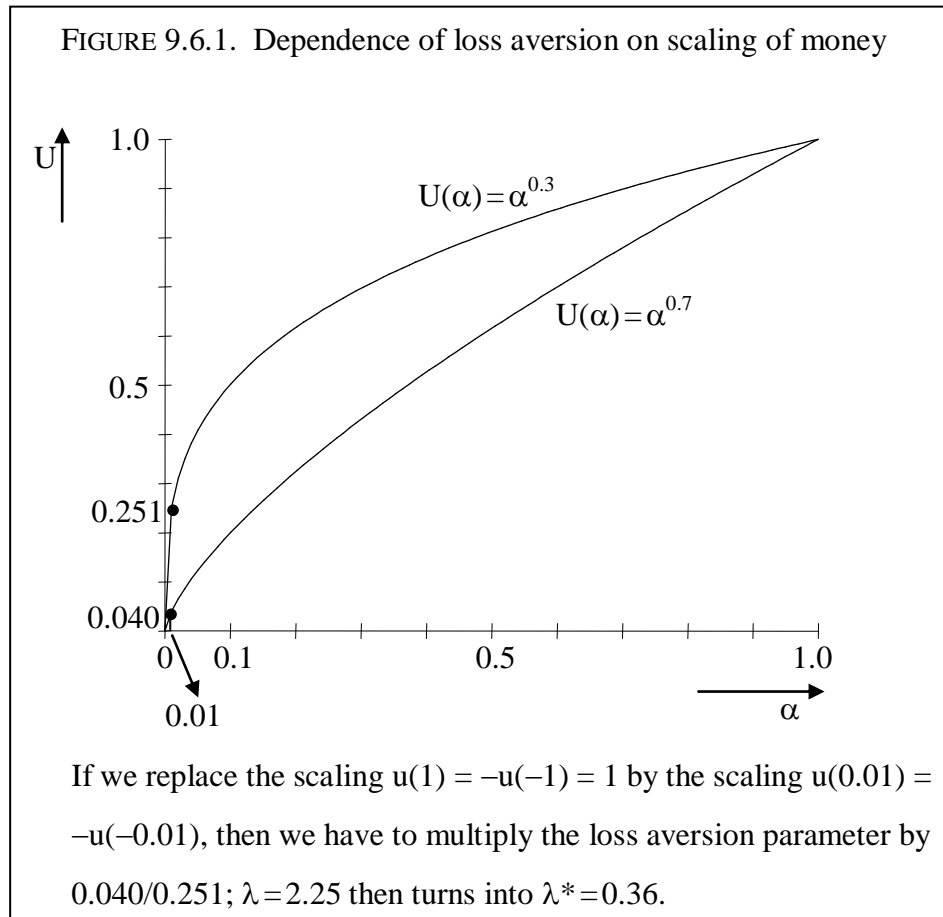
p. 249:

FIGURE 8.9.1. Decompositions of final wealth				
		decomposition of final wealth F	interpretation	evaluation
classical model		F	final wealth	$U^*(F)$
	I constant: inno- cuous rescaling of outcomes	$I + \alpha$	initial wealth + outcome	$U(\alpha)$
reference dependence	ρ variable: fundamental breakaway from classical model	$I + \rho + \alpha$	initial wealth + reference point + outcome	$U(\rho, \alpha)$
Bold printing indicates a fundamental breakaway from the classical model.				

p. 255:



p. 269:



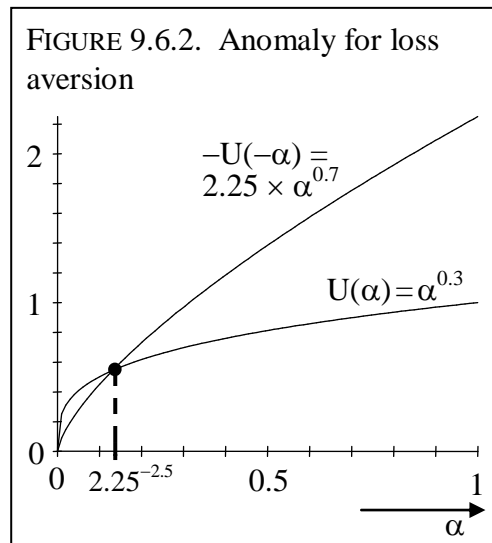
ELUCIDATION: This Figure contains graphs of the functions as indicated, being

$$U(\alpha) = \alpha^{0.3}$$

and

$$U(\alpha) = \alpha^{0.7}.$$

p. 270:



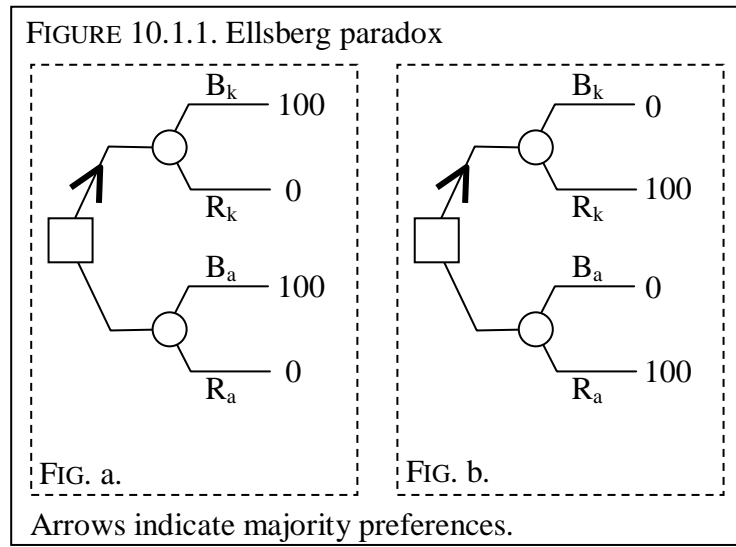
ELUCIDATION: This Figure contains graphs of the functions as indicated, being

$$\alpha^{0.3}$$

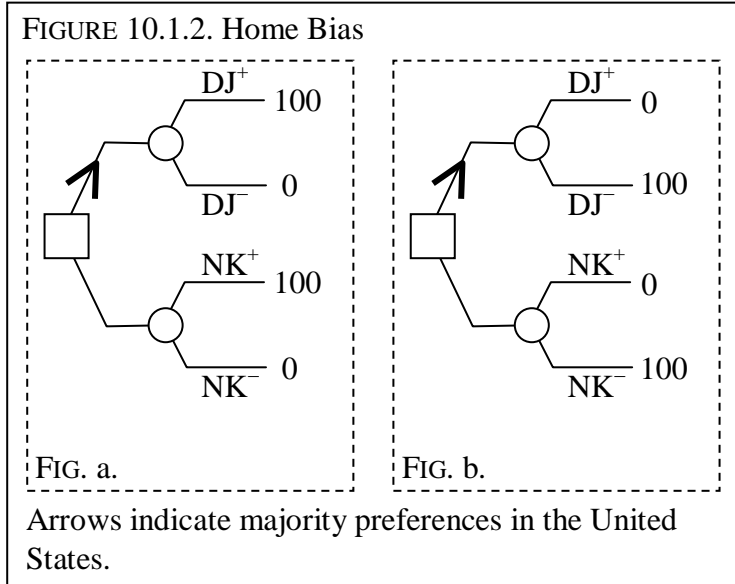
and

$$2.25 \times (\alpha^{0.7}).$$

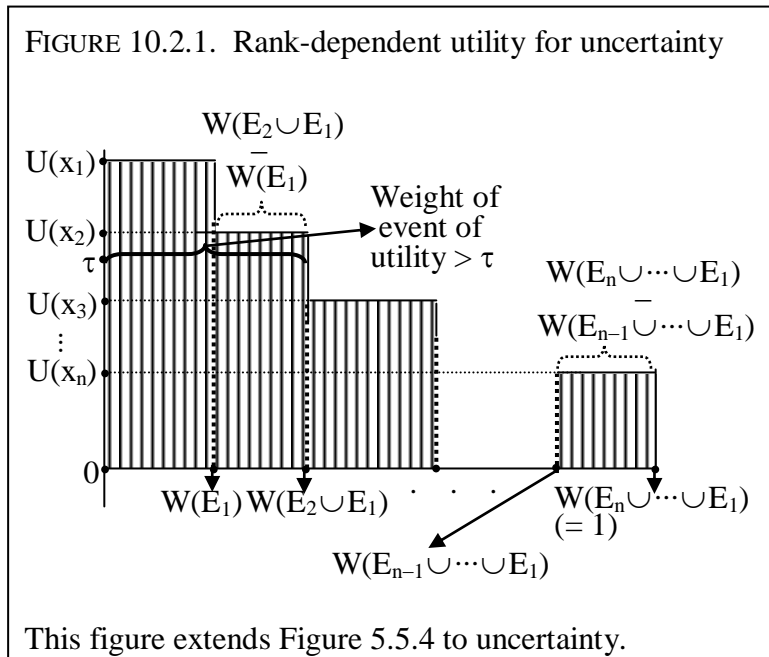
p. 281:



p. 281:

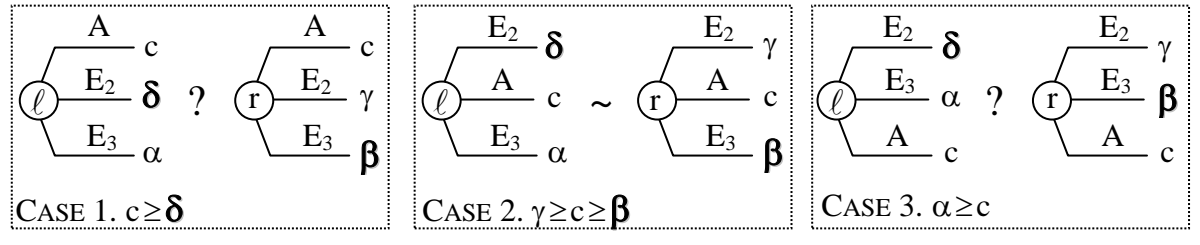


p. 284:



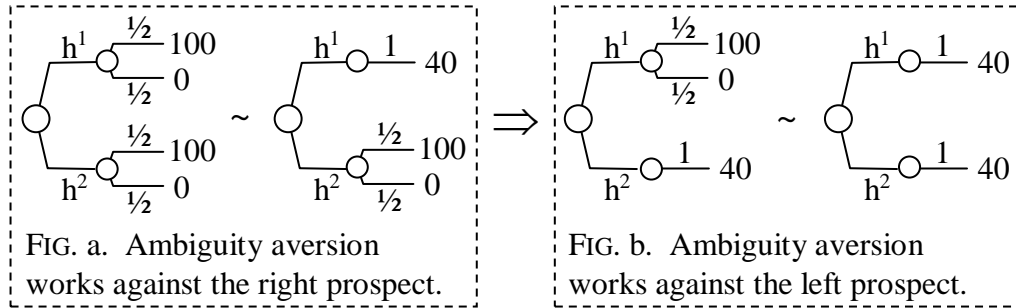
p. 293:

FIGURE 10.4.1. Testing the sure-thing principle



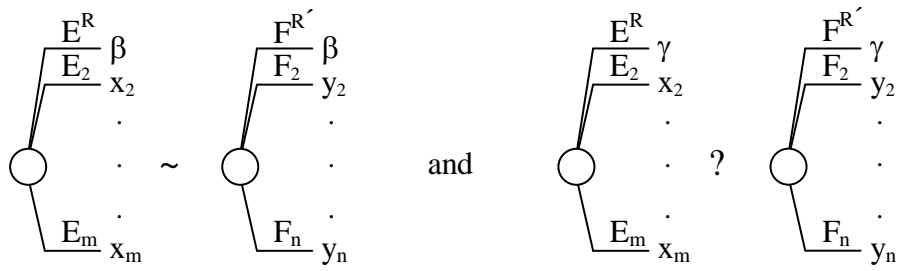
p. 302:

FIGURE 10.7.1. An implication of Anscombe & Aumann (1963) that is implausible under ambiguity aversion



p. 306:

FIGURE 10.9.1.



The superscript R indicates the rank of E , and is the same in the first and third prospect. The superscript R' indicates the rank of F , and is the same in the second and fourth prospect.

p. 322:

FIGURE 11.3.1. Various components contributing to risk premium

<i>CE</i>	<i>Theory</i>	<i>Separate additions to risk premium</i>	
15.00	EV		
14.57	EU (U)	0.43 is risk premium due to U	2.32 is total risk premium under RDU(U,W)
13.65	RDU (U,w)	0.92 is additional risk premium due to w	
12.68	RDU (U,W)	0.97 is additional risk premium due to unknown probability	

p. 323:

FIGURE 11.3.2. Various components contributing to risk premium

<i>CE</i>	<i>Theory</i>	<i>Separate additions to risk premium</i>	
2.00	EV		
1.87	EU (U)	0.13 is risk premium due to U	0.51 is total risk premium under RDU(U,W)
1.68	RDU (U,w)	0.19 is additional risk premium due to w	
1.49	RDU (U,W)	0.19 is additional risk premium due to unknown probability	

p. 350:

FIGURE 12.5.1. Ambiguity aversion versus loss aversion

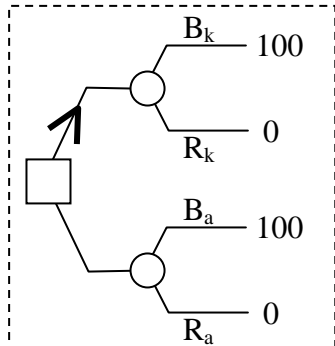


FIG. a. A straight choice between ambiguous and unambiguous prospect.

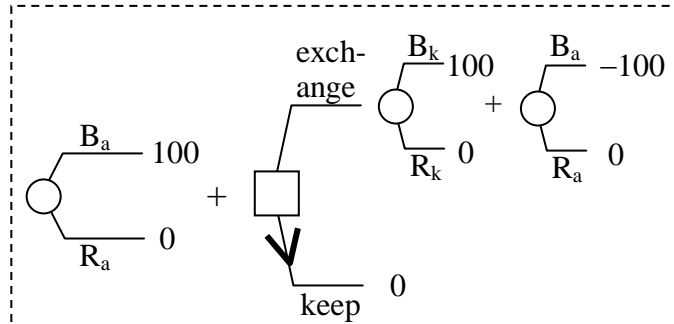


FIG. b. Prior endowment with ambiguous prospect, followed by choice to keep or exchange for unambiguous.

Arrows indicate majority preferences.

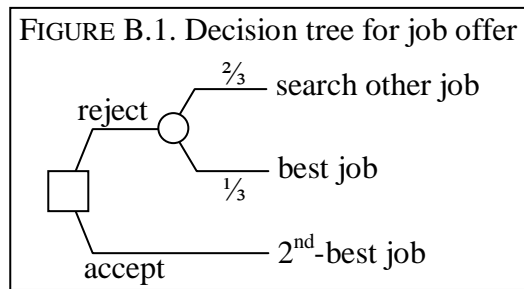
p. 352:

FIGURE 12.6.1. Two prospects x, y				
	50 balls		50 balls	
	E ₁	E ₂	E ₃	E ₄
x	4000	8000	4000	0
y	4000	4000	8000	0

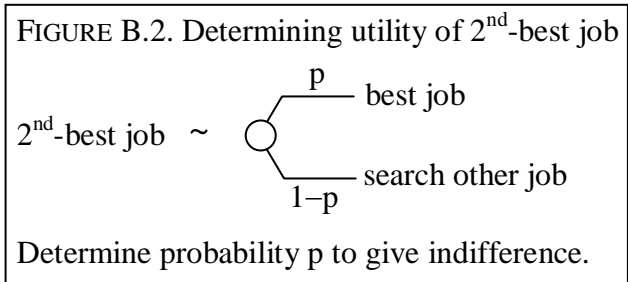
p. 353:

FIGURE 12.6.2. Six prospects				
	50 balls		50 balls	
	E ₁	E ₂	E ₃	E ₄
x	4000	8000	4000	0
y	4000	4000	8000	0
x'	4000	8000	4000	4000
y'	4000	4000	8000	4000
x''	0	8000	4000	4000
y''	0	4000	8000	4000

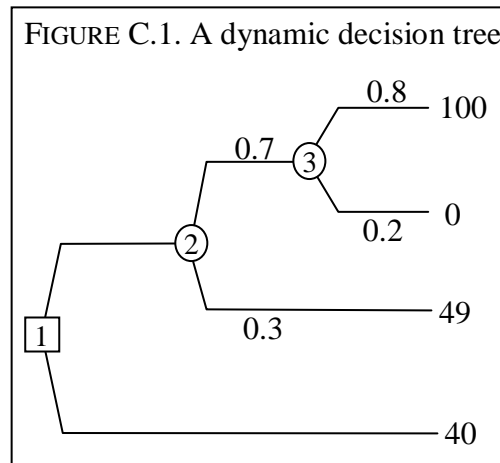
p. 368:



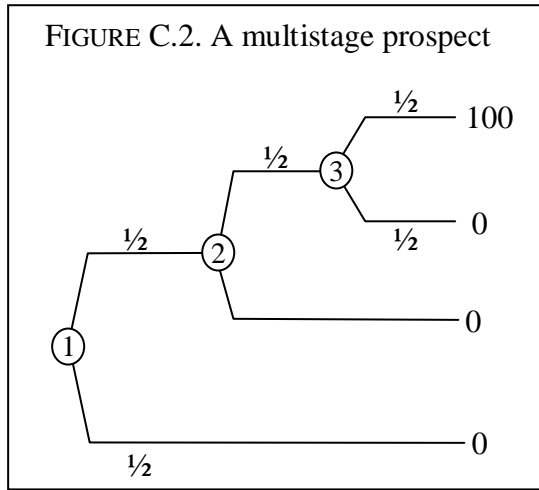
p. 368:



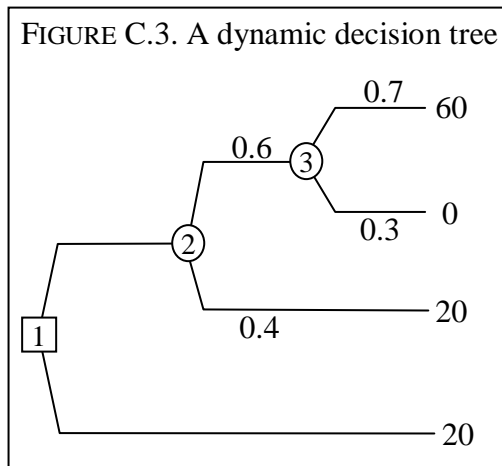
p. 381:



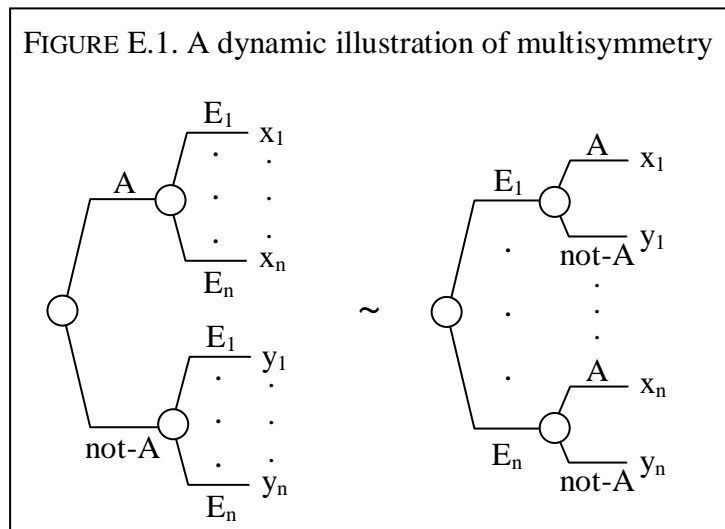
p. 382:



p. 383:



p. 388:



p. 388:

