Problem 1. Consider a modal model $\mathcal{M} = \langle W, R, V \rangle$ to be used in the analysis of epistemic modals, such as in “John might be the murderer” or “The murderer must have known the victim”.

(a) What does the accessibility relation $R$ represent intuitively?

(b) Discuss whether it is reasonable —formally and/or intuitively— to assume that $R$ is:

(i) transitive

$$\forall u, v, w \in W: (uRv \land vRw) \rightarrow uRw$$

(ii) reflexive

$$\forall w \in W: wRw$$

(iii) serial

$$\forall w \in W \exists v \in W: wRv$$

Problem 2. Prove that $\Box$ and $\Diamond$ are duals in classical modal logic. (Discuss briefly whether this is empirically adequate.)

Problem 3. Look at the models (9) and (10) on page 23 of Gamut (1991).

(a) Determine the truth value of each formula at world $w_1$ of each model:

(i) $\Diamond \Diamond p$

(ii) $\Box \Diamond p$

(iii) $p \rightarrow \Box \neg p$

(b) Determine whether each formula is valid on each model, i.e., true at each world:

(i) $\Box p$

(ii) $\Diamond p \lor \Diamond \neg p$

(iii) $p \rightarrow \Diamond \Diamond p$

Problem 4. State and discuss two problems for a material implication analysis of natural language conditionals.

Problem 5. Kratzer’s (1991) theory of modality features (i) a modal base $f$ and (ii) an ordering source $g$. Both are functions from worlds to sets of propositions.

(a) What do these functions capture in intuitive terms?
(b) How can we translate any given \( f \) and \( g \) into an enriched modal model \( \mathcal{M} = \langle W, R, V, \{\leq\} \rangle \)?

(c) Discuss advantages and disadvantages of using either \( f \) and \( g \), or enriched modal models.

**Problem 6.** This is about comparing different order-sensitive implication analyses for conditional.

(a) Name the main formal difference between the theories of conditionals of Stalnaker (1968) and of Lewis (1973).

(b) What implication does this formal difference have for the analysis of natural language conditionals?

(c) Which side are you on? What is the “better” analysis of conditionals?

**Problem 7.** According to Lewis (1973) counterfactuals are to be analyzed in terms of enriched modal models whose accessibility and ordering relations model comparative similarity between possible worlds. Consider the following situation (taken from Kratzer (1989), page 625):

“Last year, a zebra escaped from the Hamburg zoo. The escape was made possible by a forgetful keeper who forgot to close the door of a compound containing zebras, giraffes, and gazelles. A zebra felt like escaping and took off. The other animals preferred to stay in captivity.”

Now consider the following example:

(1) If a different animal had escaped, it would have been another zebra.”

(a) Kratzer would say this sentence is false. Do you agree? Why (not)?

(b) If it is false, this may be taken as a problem for the account of counterfactuals in terms of similarity. Explain!

(c) Do you agree that this is a problem, or do you see an obvious solution?

**References**


