

Rules of Inference and Quantification

| Rule of Inference | Tautology | Name |
|--|--|------------------------|
| $\begin{array}{c} p \\ \hline \therefore p \vee q \end{array}$ | $p \rightarrow (p \vee q)$ | Addition |
| $\begin{array}{c} p \wedge q \\ \hline \therefore p \end{array}$ | $(p \wedge q) \rightarrow p$ | Simplification |
| $\begin{array}{c} p \\ q \\ \hline \therefore p \wedge q \end{array}$ | $((p) \wedge (q)) \rightarrow (p \wedge q)$ | Conjunction |
| $\begin{array}{c} p \\ p \rightarrow q \\ \hline \therefore q \end{array}$ | $[p \wedge (p \rightarrow q)] \rightarrow q$ | Modus Ponens |
| $\begin{array}{c} \neg q \\ p \rightarrow q \\ \hline \therefore \neg p \end{array}$ | $[\neg q \wedge (p \rightarrow q)] \rightarrow \neg p$ | Modus Tollens |
| $\begin{array}{c} p \rightarrow q \\ q \rightarrow r \\ \hline \therefore p \rightarrow r \end{array}$ | $[(p \rightarrow q) \wedge (q \rightarrow r)] \rightarrow (p \rightarrow r)$ | Hypothetical Syllogism |
| $\begin{array}{c} p \vee q \\ \neg p \\ \hline \therefore q \end{array}$ | $[(p \vee q) \wedge \neg p] \rightarrow q$ | Disjunctive Syllogism |

| Rule of Inference | Name |
|---|----------------------------|
| $\begin{array}{c} \forall x P(x) \\ \hline \therefore P(c) \text{ if } c \in U \end{array}$ | Universal Instantiation |
| $\begin{array}{c} P(c) \text{ for an arbitrary } c \in U \\ \hline \therefore \forall x P(x) \end{array}$ | Universal Generalization |
| $\begin{array}{c} \exists x P(x) \\ \hline \therefore P(c) \text{ for some element } c \in U \end{array}$ | Existential Instantiation |
| $\begin{array}{c} P(c) \text{ for some element } c \in U \\ \hline \therefore \exists x P(x) \end{array}$ | Existential Generalization |