3f.pdf

1. (1)

1	$(p \wedge q) \wedge r$	premise
2	$p \wedge q$	$\wedge e_1$, 1
3	q	$\wedge e_2$, 2
4	$s \wedge t$	premise
5	s	$\wedge e_1$, 4
6	$q \wedge s$	$\wedge i$, 3, 5

(2)

1	$p \to q$	assumption
2	p	assumption
3	q	$\to e$, 2, 1
4	$q \to r$	premise
5	r	$\to e$, 3, 4
6	$p \to r$	$\to i$, 2-5
7	$(p \to q) \to (p \to r)$	$\to i$, 1-6

(3)

1	q	assumption
2	p	assumption
3	$q \to p$	$\to i$, 1-2
4	$p \to (q \to p)$	$\to i$, 2-3
5	$p \to (p \to (q \to p))$	$\to i$, 2-4
6	$q \to (p \to (p \to (q \to p)))$	$\to i$, 1-5

(4)

1	p	assumption
2	$p \to q \wedge r$	premise
3	$q \wedge r$	$\to e$, 1, 2
4	q	$\wedge e_1$, 3
5	r	$\wedge e_2$, 3
6	$p \to q$	$\to i$, 1-4
7	$p \to r$	$\to i$, 1-5
8	$(p \to q) \wedge (p \to r)$	$\wedge i$, 6, 7

(5)

1	$p \wedge \neg p$	premise
2	p	$\wedge e_1$, 1
3	$\neg p$	$\wedge e_2$, 1
4	$\bot$	$\neg e$, 2,3
5	$\neg(r \to q) \wedge (r \to q)$	$\bot e$, 4

2.(5)

1	$\forall x \neg P(x)$	premise
2	$\neg \exists x P(x)$	$\neg \exists x \phi \dashv\vdash \forall x \neg \phi$ $\phi = P(x)$, 1

2.(1)

1	S	assumption
2	$\exists x(S \to Q(x))$	premise
3	x_0 $S \to Q(x_0)$	assumption
4	$Q(x_0)$	$\to e$, 1, 3
5	$\exists x Q(x)$	$\exists x$ i 4
6	$\exists x Q(x)$	$\exists x$ e 2, 3-5
7	$S \to \exists x Q(x)$	$\to i$, 1-6

(2)

1	$\forall x P(x) \to S$	premise
2	$\exists x(P(x) \to S)$	3手第4页. $\exists x(\phi \to \psi) \dashv\vdash \forall x \phi \to \psi$ $\phi = P(x)$, $\psi = S$

(3)

1	$\forall x(P(x) \wedge Q(x))$	premise
2	$P(x_0) \wedge Q(x_0)$	$\forall x$ e 1
3	$P(x_0)$	$\wedge e_1$, 2
4	$\forall x P(x)$	$\forall x$ i 3
5	$Q(x_0)$	$\wedge e_2$, 2
6	$\forall x Q(x)$	$\forall x$ i 5
7.	$\forall x P(x) \wedge \forall x Q(x)$	$\wedge i$ 4,6

(4)

1	$\neg \forall x \neg P(x)$	premise
2	$\exists x \neg\neg P(x)$	$\neg \forall x \phi \dashv\vdash \exists x \neg \phi$ $\phi = \neg P(x)$, 1
3	x_0 $\neg\neg P(x_0)$	assumption
4	$P(x_0)$	$\neg\neg e$ 3
5	$\exists x P(x)$	$\exists x$ i 4
6	$\exists x P(x)$	$\exists x$ e 2, 3-5