$$F(t) = B_0(t)\,P_0 + B_1(t)\,P_1 + B_2(t)\,P_2 + B_3(t)\,P_3$$

$$B_0(t) = (1-t)^3$$

$$B_1(t) = 3t(1-t)^2$$

$$B_2(t) = 3t^2(1-t)$$

$$B_3(t) = t^3$$

$$t = u$$

$$F(u) = (1-u)^3 P_0 + 3u(1-u)^2 P_1 + 3u^2(1-u) P_2 + u^3 P_3$$

$$F(u) \stackrel{?}{=} t_0$$

$$t_0 = (1-u)\, s_0 + u\, s_1 = (1-u)\left((1-u) r_0 + u r_1 \right) + u\left((1-u) r_1 + u r_2 \right) =$$

$$= (1-u)\left[(1-u)\left((1-u) P_0 + u P_1 \right) + u\left((1-u) P_1 + u P_2 \right) \right] +$$

$$u\left[(1-u)\left((1-u) P_1 + u P_2 \right) + u\left((1-u) P_2 + u P_3 \right) \right]$$

$$= (1-u)^3 P_0 + u(1-u)^2 P_1 + u(1-u)^2 P_1 + u^2(1-u) P_2 + u(1-u)^2 P_1 + u^2(1-u) P_2$$

$$+ u^2(1-u) P_2 + u^3 P_3$$

$$= (1-u)^3 P_0 + 3u(1-u)^2 P_1 + 3u^2(1-u) P_2 + u^3 P_3 = F(u)$$