

Legendre Transformation

- The tangent to the curve $U(S, V)$ at the point S is the function $T(S) = \left(\frac{\partial U}{\partial S}\right)_V$. Notice that as you vary S the slope varies. Show geometrically on the figure that the relation $ST = U - F$ holds.
- The function $S(T)$ can be inverted to give $T(S)$. From $dU = TdS - PdV$ and the relation $ST = U - F$ prove that $F(T, V)$.
- Prove that $S(T) = -\left(\frac{\partial F}{\partial T}\right)_V$

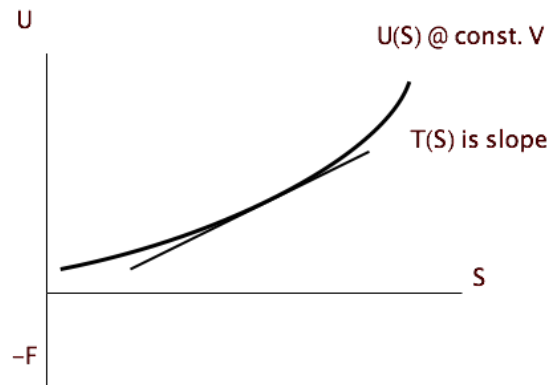


Figure 1: Geometric construction for Legendre transform. The curve is drawn for fixed V .