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| **Primal Problem:**  *Max U(x) s.t. y ≥ p’x* | |  | **Dual Problem:**  *Min p’x s.t. U(x) ≥ u0* | |
| Lagrangian  *Max L(x,λ) = U(x) + λ( y - p’x)* | |  | Lagrangian  *Min L(x,φ) = p’x + φ (u0 - U(x))* | |
| *λ* is the Marginal Utility of Income | | Interpretation of Lagrange multiplier | *φ* is the Marginal Cost of Utility | |
| Solve ↓ | |  | Solve ↓ | |
| Argmax: *xm(p,y)* | | *xm(p,E(p,u)) = xh(p,V(p,y))*  Slutsky equation | Argmin: *xh(p,u)* | |
| Roy’s Identity ↑ | Plug into *U(x*) ↓ |  | Plug into *p’x*  ↓ | Shephard’s Lemma ↑ |
| Indirect Utility: *V(p,y)* | | ← (solve *E(.)* for *u*)  Invert  → (solve *V(.)* for *y*) | Expenditure: *E(p,u)* | |
| Properties of *V(p,y)* | |  | Properties of *E(p,u)* | |
| 1. Continuous on RN++\* R+ 2. Homogeneous of degree zero in prices and income: this means if you change all prices and income by the same proportion, you do not change utility; there is no money allusion. 3. Strictly increasing in y 4. Non-increasing in p 5. Quasi-convex in p and y 6. And it Satisfies Roy’s Identity: an application of the *Envelope Theorem* | |  | 1. E(P, u) is zero for the lowest possible level of utility   1. Continuous on its domain RN++\* u 2. Homogeneous of degree one in prices: this means if you change all prices by some proportion, you have to increase expenditure level by the same proportion to hold utility constant. 3. Non-decreasing in p 4. For all p>>0, E strictly increasing and unbounded in u 5. Concave in p 6. Shephard’s Lemma: | |