$$\overline{PQ} = \frac{\partial x}{\partial u} du\,\mathbf{i} + \frac{\partial y}{\partial u} du\,\mathbf{j}$$

$$\overline{PR} = \frac{\partial x}{\partial v} dv\,\mathbf{i} + \frac{\partial y}{\partial v} dv\,\mathbf{j}$$

$$dA = |\overline{PQ} \times \overline{PR}|$$

$$= \left| \frac{\partial(x,y)}{\partial(u,v)} \right| du\,dv$$