1. Compute $\frac{dz}{dt}$ for

$$z = xe^{xy}, \ x = t^2, y = t^{-1}$$

**Solution:** There really isn’t all that much to do here other than using the formula.

$$\frac{dz}{dt} = \frac{\partial f}{\partial x} \frac{dx}{dt} + \frac{\partial f}{\partial y} \frac{dy}{dt}$$

$$= (e^{xy} + yxe^{xy})(2t) + x^2e^{xy}(-t^{-2})$$

$$= 2t(e^{xy} + yxe^{xy}) - t^{-2}x^2e^{xy}$$

So, technically we’ve computed the derivative. However, we should probably go ahead and substitute in for $x$ and $y$ as well at this point since we’ve already got $t$s in the derivative. Doing this gives,

$$\frac{dz}{dt} = 2t(e^{t} + te^{t}) - t^{-2}t^4e^{t} = 2te^{t} + t^2e^{t}$$

Note that in this case it might actually have been easier to just substitute in for $x$ and $y$ in the original function and just compute the derivative as we normally would. For comparison’s sake let’s do that.

$$\frac{dz}{dt} = 2te^{t} + t^2e^{t}$$

The same result for less work. Note however, that often it will actually be more work to do the substitution first.