Example problems  (From Lillesand and Kiefer, 4th edition).

1. Assume that two road intersections shown on a photograph can be located on a 1:25,000 scale
   topographic map. The measured distance between the intersections is 47.2 mm on the map
   and 94.3 mm on the photograph.
   a) What is the scale of the photograph?
   b) At that scale, what is the length of a fence line that measures 42.9 mm on the
      photograph?

Solution:
   a) The ground distance between the intersections is determined from the map scale as
      \[ 0.472 \text{ m} \times 25,000/1 = 1,180 \text{ m} \]
      By direct ratio, the photo scale is
      \[ S = \frac{0.0943}{1180} \text{ m} = \frac{1}{12,513} \text{ or } 1:12,500 \]
      (Note that because only three significant, or meaningful, figures were presented in the
      original measurement was, only three significant figures are indicated in the result.)

   b) The ground length of the 42.0 mm fence line is
      \[ D = \frac{d}{S} = \frac{0.0429}{1/12,500} = 536.25 \text{ m} \text{ or } 536 \text{ m} \]

2. A camera equipped with a 152 mm (6") focal-length lens is used to take a vertical photograph
   from a flying height of 2780 m above mean sea level. If the terrain is flat and located at an
   elevation of 500 m, what is the scale of the photograph?

Solution:
   \[ \frac{f}{H-h} = \frac{0.152 \text{ m}}{2780 \text{ m} - 500 \text{ m}} = \frac{1}{15,000} \text{ or } 1:15,000 \]

3. Assume that a vertical photograph was taken at a flying height of 5000 m above sea level
   using a camera with a 152 mm focal-length lens.
   a) Determine the photo scale at points A and B, which lie at elevations of 1200 and 1960 m.
   b) What ground distance corresponds to a 20.1 mm photo distance measured at each of these
      elevations?

Solution:
   a) \[ S_A = \frac{f}{H-h_A} = \frac{0.152 \text{ m}}{5000 \text{ m} - 1200 \text{ m}} = \frac{1}{25,000} \text{ or } 1:25,000 \]
      \[ S_B = \frac{f}{H-h_B} = \frac{0.152 \text{ m}}{5000 \text{ m} - 1960 \text{ m}} = \frac{1}{20,000} \text{ or } 1:20,000 \]
   c) The ground distance corresponding to a 20.1 mm photo distance is
      \[ D_A = \frac{d}{S_A} = \frac{0.0201 \text{ m}}{1/25,000} = 502.5 \text{ m} \]
      \[ D_B = \frac{d}{S_B} = \frac{0.0201 \text{ m}}{1/20,000} = 402 \text{ m} \]
4. A rectangular agricultural field measures 8.65 cm long and 5.13 cm wide on a vertical photograph having a scale of 1:20,000. Find the area of the field at ground level.

**Solution:**

\[
\text{Ground length} = \frac{\text{photo length}}{1/S} = \frac{0.0865 \, m}{1/20,000} = 1730 \, m
\]

\[
\text{Ground width} = \frac{\text{photo width}}{1/S} = \frac{0.0513 \, m}{1/20,000} = 1026 \, m
\]

\[
\text{Ground area} = 1730 \, m \times 1026 \, m = 1,774,980 \, m^2 = 177 \, ha
\]

5. The area of a lake is 52.2 cm² on a 1:7500 vertical photograph. Find the ground area of the lake.

**Solution:**

\[
\text{Ground area} = \frac{\text{photo area}}{1/S^2} = \frac{0.0052 \, m^2}{1/7500^2} = 293,625 \, m^2 = 29.4 \, ha
\]

6. A flooded area is covered by 129 dots on a 25 dot/cm² grid on a 1:20,000 vertical aerial photograph. Find the ground area covered.

**Solution:**

\[
\text{Dot density} = \frac{1 \, cm^2}{25 \, dots} \times 20,000^2 = 16,000,000 \, cm^2 / dot = 0.16 \, ha / dot
\]

\[
\text{Ground area} = 129 \, dots \times 0.16 \, ha/dot = 20.6 \, ha
\]

There are several other appropriate photogrammetric problems in Chapter 3 of Lillesand and Kiefer, 4th edition. There is also an extended problem worked out in Schott's text on Remote Sensing, Chapter 5.