Given:
An equipment manager for a football team fills a football with 12 psig of air in a room with a temperature of 70°F. He also fills up another ball with 14 psig of air in the same room with the same temperature. Both balls are then taken outside where the outside temperature is 50°F.

$P_{1a} := 12\ \text{psi}$ $\quad P_{1b} := 14\ \text{psi}$ $\quad T_1 := 70\ °\text{F} = 529.67\ °\text{Ra}$ $\quad T_2 := 50\ °\text{F} = 509.67\ °\text{Ra}$

Required:
Assuming the volume does not change, what is the new pressure in each football.

Solution:
It is always good practice when dealing with gauge pressure and the Ideal Gas Law to go ahead and express all your pressures in absolute terms. Thus

$$P_{1a} := P_{1a} + 14.7\ \text{psi} = 26.7\ \text{psi}$$

$$P_{1b} := P_{1b} + 14.7\ \text{psi} = 28.7\ \text{psi}$$

It should also be noted that the Ideal Gas Law expects the temperature values to be in absolute terms. The absolute temperature values are not explicitly calculated here because Smath Solver does it for us. However, if this problem were to be worked by hand the temperature values would need to be in Kelvin.

Now beginning with the Ideal Gas Law

$$P \cdot V = m \cdot R \cdot T$$

Rearranging to solve for the ratio of pressure to temperature shows

$$\frac{P}{T} = \frac{m \cdot R}{V}$$

It is stated that the volume is assumed to remain constant throughout the process. It will also be assumed that the mass inside the footballs remain constant. Thus the right hand side may be seen asconstant throughout the process. Thus

$$\frac{m \cdot R}{V} = C \quad \text{and} \quad \frac{P_1}{T_1} = \frac{P_2}{T_2}$$

Solving for P_2 for both footballs may then be found by

$$\boxed{P_{2a} := P_{1a} \cdot \frac{T_2}{T_1} = 25.69\ \text{psi}}$$

$$\boxed{P_{2b} := P_{1b} \cdot \frac{T_2}{T_1} = 27.62\ \text{psi}}$$

Note: These values are shown in absolute pressure and not gauge pressure.