Consider any quantity Q. We define

$$\begin{aligned}\text{change in } Q &\equiv \Delta Q\,,\\ \text{relative change in } Q &\equiv \frac{\Delta Q}{Q}\,, \quad \text{and}\\ \text{percent change in } Q &\equiv \frac{\Delta Q}{Q}\cdot 100\%\,.\end{aligned}$$

If changes are small, then

$$\begin{aligned}\text{change in } Q &\approx dQ\,,\\ \text{relative change in } Q &\approx \frac{dQ}{Q}\,, \quad \text{and}\\ \text{percent change in } Q &\approx \frac{dQ}{Q}\cdot 100\%\,.\end{aligned}$$

EXAMPLE: Consider an ideal gas whose temperature increases by 2% and whose volume decreases by 4%. What is the approximate % change in pressure?

For an ideal gas, $PV = mRT$, or since m and R are constants,

$$P \;=\; k\,\frac{T}{V} \;=\; kTV^{-1}\,, \tag{1}$$

where were merely let $k = mR =$ constant.

Given:

$$\%\text{ change in } T \;\equiv\; \frac{\Delta T}{T}\cdot 100\% \;=\; 2\% \tag{2}$$

$$\%\text{ change in } V \;\equiv\; \frac{\Delta V}{V}\cdot 100\% \;=\; -4\% \tag{3}$$

Want:

$$\%\text{ change in } P \;=\; \frac{\Delta P}{P}\cdot 100\%\,.$$

First, since P is a function of T and V ($P = P(T,V)$), then the differential of P is

$$dP \;=\; \frac{\partial P}{\partial T}\,dT \;+\; \frac{\partial P}{\partial V}\,dV\,.$$

Then since changes are small,

$$\Delta P \;\approx\; \frac{\partial P}{\partial T}\,\Delta T \;+\; \frac{\partial P}{\partial V}\,\Delta V\,. \tag{4}$$

From Eq. (1),

$$\begin{aligned}
\frac{\partial P}{\partial T} &= \frac{\partial}{\partial T}\Big(kTV^{-1}\Big) = kV^{-1} = \frac{k}{V}\,, \\
\frac{\partial P}{\partial V} &= \frac{\partial}{\partial V}\Big(kTV^{-1}\Big) = kT(-V^{-2}) = -\frac{kT}{V^2}\,.
\end{aligned}$$

So from Eq. (4),

$$\begin{aligned}
\Delta P &\approx \frac{\partial P}{\partial T}\,\Delta T \,+\, \frac{\partial P}{\partial V}\,\Delta V \\
&= \frac{k}{V}\,\Delta T \,-\, \frac{kT}{V^2}\,\Delta V\,.
\end{aligned}$$

Divide this equation by P to obtain

$$\begin{aligned}
\frac{\Delta P}{P} &\approx \frac{k}{PV}\,\Delta T \,-\, \frac{kT}{PV^2}\,\Delta V \\
&= \frac{\Delta T}{T} \,-\, \frac{\Delta V}{V}\,, \qquad\qquad \text{(since } PV = kT\text{)}\,.
\end{aligned}$$

Multiply this equation by 100% to obtain

$$\begin{aligned}
\frac{\Delta P}{P}\cdot 100\% &\approx \frac{\Delta T}{T}\cdot 100\% \,-\, \frac{\Delta V}{V}\cdot 100\% \\
&= (+2\%) - (-4\%) \\
&= +6\%\,.
\end{aligned}$$

CONCLUSION: Increasing the temperature by 2% and decreasing the volume by 4% will **increase the pressure by approximately 6%**.