(Some Of) The Math

Precise calculation of humidity's effects on a piston engine's horsepower in high density altitude situations requires much more math than the average pilot has available during pre-flight planning. That said, you shouldn't just trust us on this, and some math is instructive.

For example, an engine's effective power resulting from internal friction can be expressed through Equation 1. And the ambient air's density due to water-vapor displacement is found in Equation 2. The resulting ambient pressure can be determined with the expression found in Equation 3.

$$P_{effective} = P_{internal} - Loss_{friction}$$

Equation 1

Beginning chemistry teaches us the ideal gas law:

$$PV = nRT$$

where P is the gas pressure (or sum of pressures of each constituent gas), V is a specified volume (such as a liter), n is the number of moles of gas (from adding that of each constituent), R is the ideal gas constant (a value depending on units of measure) and T is the absolute temperature, such as degrees Kelvin.

Equation 2

$$P_A = P_D + P_V$$

Ambient pressure (P_A) is dry air pressure (P_D) plus water vapor pressure (P_V).

Equation 3