Coefficient of Pressure:

\begin{equation}

C\_p = \frac{p-p\_\infty}{\frac{1}{2}\rho\_\infty V\_\infty^2} = \frac{p-p\_\infty}{q\_\infty}

\end{equation}

\begin{equation}

C\_p = 1-\frac{V^2 }{V\_\infty^2}

\end{equation}

Coefficient of Lift

\begin{equation}

C\_L = \frac{L}{\frac{1}{2}\rho\_\infty V\_\infty^2 S} = \frac{L}{q\_\infty S}

\end{equation}

Coefficient of Drag

\begin{equation}

C\_D = \frac{D}{\frac{1}{2}\rho\_\infty V\_\infty^2 S} = \frac{D}{q\_\infty S}

\end{equation}

Planform Area

\begin{equation}

S = c \cdot b

\end{equation}

Sectional Coefficient of Lift

\begin{equation}

C\_l = \frac{l}{\frac{1}{2}\rho\_\infty V\_\infty^2 c} = \frac{l}{q\_\infty c}

\end{equation}

Sectional Coefficient of Drag

\begin{equation}

C\_d = \frac{d}{\frac{1}{2}\rho\_\infty V\_\infty^2 c} = \frac{d}{q\_\infty c}

\end{equation}

The normal force over the $i^{th}$ segment of the airfoil

\begin{equation}

n\_i = -\frac{1}{2}(p\_i + p\_{i+1})cos \theta \Delta s\_i

\label{eq:n\_i}

\end{equation}

Simplified ...

\begin{equation}

n\_i = -\frac{1}{2}(p\_i + p\_{i+1})\Delta x\_i

\end{equation}

Axial force

\begin{equation}

a\_i = \frac{1}{2}(p\_i + p\_{i+1})sin \theta \Delta s\_i

\end{equation}

Normal force

\begin{equation}

a\_i = \frac{1}{2}(p\_i + p\_{i+1})\Delta y\_i

\end{equation}

Total axial and normal forces

\begin{equation}

n = - \sum\_{n=1}^{n} \frac{1}{2}(p\_i + p\_{i+1})\Delta x\_i

\end{equation}

\begin{equation}

a = - \sum\_{n=1}^{n} \frac{1}{2}(p\_i + p\_{i+1})\Delta y\_i

\end{equation}

Note that $\Delta x\_i = x\_{i+1} - x\_i$ and $\Delta y\_i = y\_{i+1} - y\_i$.

Normal Force

\begin{equation}

C\_n \equiv \frac{n}{\frac{1}{2}\rho\_\infty V\_\infty^2 c} = - \sum\_{i=1}^{n} \frac{1}{2} \bigg( \frac{p\_i - p\_\infty}{\frac{1}{2}\rho\_\infty V\_\infty^2 } + \frac{p\_{i+1} - p\_\infty}{\frac{1}{2}\rho\_\infty V\_\infty^2 } \bigg) \frac{\Delta x\_i}{c} - \frac{p\_\infty}{\frac{1}{2}\rho\_\infty V\_\infty^2 c} \sum\_{i=1}^{n}\Delta x\_i

\end{equation}

employing simplifications...

\begin{equation}

C\_n = -\sum\_{i=1}^{n}\frac{1}{2}(C\_{p\_i}+C\_{p\_{i+1}}) \frac{\Delta x\_i}{c}

\end{equation}

\begin{equation}

C\_a = \sum\_{i=1}^{n}\frac{1}{2}(C\_{p\_i}+C\_{p\_{i+1}}) \frac{\Delta y\_i}{c}

\end{equation}

Exact normal and axial force coefficients

\begin{equation}

C\_n = - \oint C\_p \,\frac{dx}{c}

\end{equation}

\begin{equation}

C\_a = \oint C\_p \,\frac{dy}{c}

\end{equation}

Lift and Drag coefficients

\begin{equation}

C\_l = C\_n cos\alpha - C\_a sin \alpha

\end{equation}

\begin{equation}

C\_d = C\_n sin\alpha + C\_a cos \alpha

\end{equation}