## Answer on Question \#80352 - Math - Quantitative Methods

## Question

For the equation $y=5+4 x^{\wedge} 2+5 x^{\wedge} 3$
(a) Find the equation for the linear approximation when $x=3$.
(b) Find the equation for the quadratic approximation, also when $x=3$.

## Solution

(a) The tangent line to the function for $\mathrm{x}=3$ is the linear approximation:

$$
\begin{gathered}
L(x)=y(3)+y^{\prime}(3)(x-3) \\
y(3)=5+4 \cdot 3^{2}+5 \cdot 3^{3}=176 \\
y^{\prime}(x)=8 x+15 x^{2} \rightarrow y^{\prime}(3)=159 \\
L(x)=176+159(x-3)=159 x-301
\end{gathered}
$$

(b) The quadratic approximation also uses the point $\mathrm{x}=3$ to approximate nearby values, but uses a parabola instead of just a tangent line:

$$
\begin{gathered}
Q(x)=y(3)+y^{\prime}(3)(x-3)+\frac{1}{2} y^{\prime \prime}(3)(x-3)^{2}=L(x)+\frac{1}{2} y^{\prime \prime}(3)(x-3)^{2} \\
y^{\prime \prime}(x)=8+30 x \rightarrow y^{\prime \prime}(3)=98 \\
Q(x)=159 x-301+\frac{1}{2} 98(x-3)^{2}=49 x^{2}-135 x+140
\end{gathered}
$$



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