Math 120 – Section 2.2 (add-on): **Synthetic Division**

When dividing a polynomial by a binomial of the form "$x-a$", a shortcut to the long division process can be used. This shortcut is called "synthetic division" and comes from condensing the repeated values in the calculation and eliminating the understood powers of the variable.

A long division problem like this.........

$$
\begin{array}{r|l}
 & x^2 - x + 3 + \dfrac{5}{x-2} \\
\cline{2-2}
x-2 & x^3 - 3x^2 + 5x - 1 \\
 & \underline{x^3 - 2x^2} \\
 & \quad -1x^2 + 5x \\
 & \quad \underline{-1x^2 + 2x} \\
 & \qquad\qquad 3x - 1 \\
 & \qquad\qquad \underline{3x - 6} \\
 & \qquad\qquad\quad 5
\end{array}
$$

becomes this with the synthetic division shortcut...........

$$
\begin{array}{r|rrrr}
2 & 1 & -3 & 5 & -1 \\
 & & 2 & -2 & 6 \\
\hline
 & 1 & -1 & 3 & 5
\end{array}
\longrightarrow \quad x^2 - x + 3 + \frac{5}{x-2}
$$

Note: $\textit{divisor}\overline{\big)\textit{dividend}}^{\,\textit{quotient}}$

When the divisor is "$x-a$", "a" is put in the upper left corner. The first row of numbers are the coefficients of the dividend in descending degree order. Start the process by bringing down the first coefficient. Multiply this number by the corner number and put the result under the next coefficient. Then add the column of numbers. Repeat the process until you finish all columns. The last row gives you the coefficients of the quotient, starting with a term of degree one less than the dividend. The last number in the row is the remainder.

Examples:

1) $(2y^2 - 3y + 5) \div (y - 3)$