**8.3 Inverses of Square Matrices**

Inverse of a matrix = $A^{-1}$ where $A∙A^{-1}=I$

Ex: Show that *B* is the inverse of *A*

 $A=\left[ \begin{matrix} 2&-1\\-3& 1\end{matrix} \right]$ $A∙B=I?$

 $B=\left[ \begin{matrix}-1&-1\\-3&-2\end{matrix} \right]$ $\left[ \begin{matrix} 2&-1\\-3& 1\end{matrix} \right]∙\left[ \begin{matrix}-1&-1\\-3&-2\end{matrix} \right]=$

**Finding the inverse of a** $2×2$ **matrix**

 $A=\left[ \begin{matrix}a&b\\c&d\end{matrix} \right]$ $A^{-1}=\frac{1}{ad-bc}\left[ \begin{matrix} d&-b\\-c& a\end{matrix} \right]$

Ex: find the inverse of $\left[ \begin{matrix}5&-1\\3& 4\end{matrix} \right]$ $A^{-1}=\frac{1}{\left(5\right)\left(4\right)-(3)(-1)}\left[ \begin{matrix} 4&1\\-3&5\end{matrix} \right]$

 $A^{-1}=\frac{1}{23}\left[ \begin{matrix} 4&1\\-3&5 \end{matrix}\right]$

 $A^{-1}=\left[ \begin{matrix}\frac{4}{23}&\frac{1}{23}\\\frac{-3}{23}&\frac{5}{23}\end{matrix} \right]$

Ex: find the inverse of $\left[ \begin{matrix} 2&-4\\-2& 4\end{matrix} \right]$ $A^{-1}=\frac{1}{\left(2\right)\left(4\right)-(-2)(-4)}\left[ \begin{matrix} 2&-4\\-2& 4\end{matrix} \right]$

 $A^{-1}=\frac{1}{0}\left[ \begin{matrix} 2&-4\\-2& 4\end{matrix} \right]$

 $no inverse exists$ (can’t divide by 0)

**Finding the inverse of a** $3×3$ **matrix (or larger)**

We will use the matrix abilities of our calculator to find the inverse of a $3×3$ matrix (or larger)

Ex: find the inverse of $\left[ \begin{matrix}1& 1&1\\3& 5&4\\0&-1&0\end{matrix} \right]$ Enter the matrix into matrix A

 $A^{-1}$ =

**Solving a system of equations using an inverse matrix**

$\left\{\begin{matrix} x+ y+ z=-1\\3x+5y+4z=2\\3x+6y+5z=0\end{matrix}\right.$ $A∙X=B$ $A=\left[ \begin{matrix}1&1&1\\3&5&4\\3&6&5\end{matrix} \right]$

 $A∙X=B$ $X=\left[ \begin{matrix}x\\y\\z\end{matrix} \right]$

 $A^{-1}∙A∙X=A^{-1}∙B$

 $B=\left[ \begin{matrix}-1\\ 2\\ 0\end{matrix} \right]$

 $I∙X=A^{-1}∙B$

 $X=A^{-1}∙B=\left[\begin{matrix} 1\\ 7\\-9\end{matrix} \right]$ $x=1, y=7, z=-9$

Ex:

$\left\{\begin{matrix}2x+3y+5z=4\\33x+5y+9z=7\\5x+9y+17z=13\end{matrix}\right.$ $A=\left[ \begin{matrix} 2&3& 5\\33&5& 9\\ 5&9&17\end{matrix} \right]$ $B=\left[ \begin{matrix} 4\\ 7\\13\end{matrix} \right]$

 $X=A^{-1}∙B=\left[ \begin{matrix}0\\\frac{1}{2}\\\frac{1}{2}\end{matrix} \right]$ $x=0, y=\frac{1}{2}, z=\frac{1}{2}$