2.2 Equations of Lines

\[ \frac{\text{rise}}{\text{run}} = \frac{\text{change in } y}{\text{change in } x} = \frac{\text{something}}{0} \quad \text{Not defined} \]

\[ y = 2 \quad \text{slope} = \frac{2 - 2}{2 - 1} = \frac{0}{1} \]

Slopes of parallel lines

\[ y = \frac{1}{2}x - 1 \]
\[ y = \frac{1}{2}x + 1 \]

\[ y = mx + 2 \]
\[ y = mx + 1 \]
Perpendicular Lines

\[ y = \frac{2}{3}x + 1 \]
\[ y = -\frac{3}{2}x - 1 \]

\[-\frac{3}{2} = \frac{3}{2} = \frac{\text{rise}}{\text{run}}\]

Summary

\[ y = mx + b \]
\[ y = nx + c \]

\[ m = n \text{ parallel} \]
\[ m \cdot n = -1 \iff \text{perpendicular.} \]

Find an equation of the line satisfying the given conditions.

61. Through \((-1, 3)\) and perpendicular to the line through \((0, 1)\) and \((2, 3)\)

The line we want is perpendicular to

\[ m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{3 - 1}{2 - 0} = \frac{2}{2} = 1 \]

\[ m = \frac{-1}{m} = \frac{-1}{1} = -1 \]

Use \(m = -1\) and \((-1, 3)\) to get an equation.

\[ y = m(x - x_1) + y_1 \]
\[ = -1(x - (-1)) + 3 \]
\[ = -x - 1 + 3 \]
\[ y = -x + 2 \]
14. **Health** The accompanying table shows the number of deaths per 100,000 people from heart disease in selected years.* Let \( x = 0 \) correspond to 1960.

<table>
<thead>
<tr>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td>Deaths</td>
<td>559</td>
<td>483</td>
<td>412</td>
<td>322</td>
<td>258</td>
<td>217</td>
</tr>
</tbody>
</table>

\( x \) by decades since 1960

\( f(x) \) in hundreds

\( \rho_1 = (0, 5.59), \quad \rho_2 = (4.4, 2) \)

\[
m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{2 - 5.59}{4.4 - 0} = \frac{-3.59}{4.4}
\]

\( m \approx -0.816 \)

\[
f(x) = m(x - x_1) + y_1
\]

\[= -0.816(x - 0) + 5.59\]

\[
f(x) = -0.816x + 5.59\]
residual 

\[(x, y) = y - \hat{y} = y - f(x)\]

\[f(x) = -0.816x + 5.59\]

(0, 5.59) \rightarrow 5.59 - f(0) = 5.59 - (0 + 5.59) = 0 \quad \text{square} \quad 0.003136

(1, 4.83) \rightarrow 4.83 - f(1) = 4.83 - (-0.816(1) + 5.59) = 0.056 \quad 0.26244

(2, 4.12) \rightarrow 4.12 - f(2) = 4.12 - (-0.816(2) + 5.59) = 0.162 \quad 0.006084

(3, 3.22) \rightarrow 3.22 - f(3) = 3.22 - (-0.816(3) + 5.59) = 0.078 \quad 0.0094516

(4, 2.58) \rightarrow 2.58 - f(4) = 2.58 - (-0.816(4) + 5.59) = 0.054 \quad 0.6083616

\[\text{Sum of the squares of the residuals} \quad 0.28821616\]

Smaller is better.

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2.4 Linear Inequalities

\[3x + 2 = 17\]

\[3x = 15\]

\[x = 5\]

\[2 < 3 \rightarrow -2 > -3\]

\[2 < 3 \quad -1 < -2\]

\[3x + 2 > 17\]

\[3x > 15\]

\[x > 5\]

\((-\infty, 5)\)

\[4 - x \leq 11\]

\[x \geq -7\]

\[-4 \rightarrow -4\]

\[-x \leq 7\]

\[\frac{-x}{-1} \geq \frac{7}{-1}\]

\[\text{Sign changes by a negative direction.}\]