14.1 Multivariable Functions

**NWS Wind chill Chart**

<table>
<thead>
<tr>
<th>Temperature (°F)</th>
<th>Wind Chill (°F)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>35.74 + 0.6215T - 35.75V^{0.16} + 0.4275TV^{0.16}</td>
</tr>
</tbody>
</table>

Where: T = Air Temperature (°F), V = Wind Speed (mph)

Wind Chill = "feels like" temperature in °F

http://www.weather.gov/os/windchill/index.shtml

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Computer-generated graphs of functions

(a) \[ f(x, y) = (x^2 + 3y^2) e^{-x^2 - y^2} \]

(b) \[ f(x, y) = (x^2 + 3y^2) e^{-x^2 - y^2} \]
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Maple Commands
> with(plots):
> plot3d(sqrt(x*y), x=-1..1, y=-1..1);

Find and sketch the domain of the function \( f(x, y) = \sqrt{1 + x - y^2} \).

\[ 1 + x - y^2 \geq 0 \]
\[ x \geq y^2 - 1 \]
Level curves being lifted up to graphs of functions

Section 15.1  Figure 12

Topographic map

Level curves are curves of constant elevation above sea level

The point A is at a place on the mountain where the level curves are tightly packed.

This indicates rapid change in elevation, the mountain is steep here.

The point B is at a place on the mountain where the level curves are far apart.

This indicates that the mountain relatively flat here.
Average January sea-level temperatures measured in degrees Celsius

The level curves are called isothermals, they join areas with the same temperature

Atmospheric pressure measured in millibars

The level curves are called isobars

Surface winds
• are strongest where the isobars are tightly packed
• tend to flow from areas of high pressure across the isobars to areas of low pressure
The graph of \( h(x, y) = 4x^2 + y^2 \) is formed by lifting the level curves.

(a) Contour map

(b) Horizontal traces are raised level curves

Level curves and two views of \( f(x, y) = -xye^{-x^2-y^2} \)
14.1 Multivariable Functions

\[ f(x, y) = \frac{-3y}{x^2 + y^2 + 1} \]

VI (a) \( f(x, y) = |x| + |y| \)  
I (c) \( f(x, y) = \frac{1}{1 + x^2 + y^2} \)  
II (e) \( f(x, y) = (x - y)^2 \) 
(b) \( f(x, y) = |xy| \)  
(d) \( f(x, y) = (x^2 - y^2)^2 \)  
(f) \( f(x, y) = \sin(|x| + |y|) \)
53. \( z = \sin \sqrt{x^2 + y^2} \) B, III

54. \( z = x^2 y^2 e^{-x^2 - y^2} \) C, II

55. \( z = \frac{1}{x^2 + 4y^2} \) F, V

56. \( z = x^3 - 3xy^2 \) A, VI

57. \( z = \sin x \sin y \) D, IV

58. \( z = \sin^2 x + \frac{1}{4} y^2 \) E, I