Math 1060 ~ Trigonometry

$\sin^2 u + \cos^2 u = 1$

$\sin 2u = 2\sin u \cos u$

$\dfrac{a}{\sin A} = \dfrac{b}{\sin B} = \dfrac{c}{\sin C}$

$c^2 = a^2 + b^2 - 2ab\cos C$

22 The Unit Vector and Vector Applications

Learning Objectives

In this section you will:

- Use vectors in component form to solve applications.
- Find the unit vector in a given direction.
- Perform operations on vectors in terms of i and j.
- Use vectors to model forces.

The Unit Vector

It is often useful in solving problems to find a vector in the same direction as the given vector, but of magnitude 1. This is called a <u>unit vector</u>. If $\|\boldsymbol{v}\| = 1$, then $\hat{\boldsymbol{v}}$ is a unit vector.

If $\boldsymbol{v}$ is a nonzero vector, then $\dfrac{\boldsymbol{v}}{\|\boldsymbol{v}\|}$ is a unit vector in the direction of $\boldsymbol{v}$.

Ex 1: Find a unit vector in the direction of $\boldsymbol{v} = \langle 3,-4 \rangle$.

The <u>Principal Unit Vectors</u>

It is also useful to have names for the principal unit vectors.
- The vector $\hat{\boldsymbol{i}}$ is defined by $\hat{\boldsymbol{i}} = \langle 1,0 \rangle$.
- The vector $\hat{\boldsymbol{j}}$ is defined by $\hat{\boldsymbol{j}} = \langle 0,1 \rangle$

This gives us another way to describe vectors. Thus $\langle a,b \rangle$ may also be $a\hat{\boldsymbol{i}} + b\hat{\boldsymbol{j}}$.

Ex 2: Describe the vector from example 1 in terms of unit vectors.

Applications of Vectors

Vectors are useful in airplane navigation.

Ex 3: A plane is flying N 30º E at 400 mph and the wind is blowing west at 40 mph. What is the effective direction and speed of the plane?

a) Draw a picture.

b) Place the vectors for proper addition.

c) Remember: the resultant is from the tail

   of the first to the tip of the last.

d) Now do the math.

Vectors may be used to analyze forces acting on an object.

Ex 4: Two forces are pushing on an object, one exerts 30 lbs of pressure and a second exerts 20 lbs of pressure. The angle between the two forces is 70º. What is the resultant force on the object?

Ex 5: A 500-lb rock is being wheeled up a 30 degree ramp. What force
is necessary to keep it from rolling back down the ramp? What is
the weight the ramp is actually supporting?