

# The Living Histogram- Making Marketing Statistics Exciting

Charlie Drehmer  
DePaul University



November 2016

$H = \frac{p^2}{2m} + \frac{1}{2} m \omega^2 x^2$  (P.1098)  $\langle \psi | H | \psi \rangle = \dots$   
 $H | \psi \rangle = E | \psi \rangle$  (P.1114)  $\langle \psi | H | \psi \rangle = \dots$   $E = \frac{1}{2} m \omega^2 \langle x^2 \rangle$

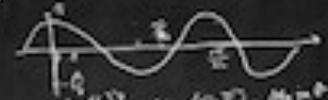
$\frac{d^2 r}{dt^2} = \frac{d^2 r}{dr^2} \left(\frac{dr}{dt}\right)^2 + \frac{dr}{dt} \frac{d}{dt} \left(\frac{1}{r^2}\right)$   
 $\frac{d^2 r}{dt^2} = \frac{d^2 r}{dr^2} \left(\frac{dr}{dt}\right)^2 - \frac{2}{r^3} \left(\frac{dr}{dt}\right)^2$



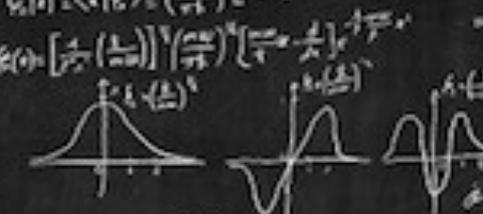
$\hat{X} = \sqrt{\frac{m\omega}{\hbar}} X$ ,  $\hat{P} = \frac{1}{\sqrt{m\omega\hbar}} P$   
 $[\hat{X}, \hat{P}] = i\hbar$  (Heisenberg)  
 $\hat{H} = \frac{1}{2} (\hat{X}^2 + \hat{P}^2)$   
 $\hat{H} | \psi \rangle = E | \psi \rangle$

$(a) \begin{bmatrix} 0 & \sqrt{1} & 0 & 0 \\ 0 & 0 & \sqrt{1} & 0 \\ 0 & 0 & 0 & \sqrt{5} \\ 0 & 0 & 0 & 0 & \sqrt{5} \end{bmatrix}$  (ii)  $\begin{bmatrix} 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \\ 0 & \sqrt{5} & 0 & 0 \\ 0 & 0 & \sqrt{5} & 0 \\ 0 & 0 & 0 & \sqrt{5} \\ 0 & 0 & 0 & 0 & 0 \end{bmatrix}$

$\int_0^{\infty} \frac{dr}{(r^2 - a^2)^2} = \dots$   
 $\frac{d^2 r}{dt^2} = -\frac{1}{r^3} \left(\frac{dr}{dt}\right)^2 - \frac{d^2 r}{dr^2} \left(\frac{dr}{dt}\right)^2$   
 $\frac{d^2 r}{dr^2} = -\frac{1}{r^3} \left(\frac{dr}{dt}\right)^2 - \frac{d^2 r}{dr^2} \left(\frac{dr}{dt}\right)^2$



$a = \frac{1}{\sqrt{2}} (x + i p)$   
 $a^\dagger = \frac{1}{\sqrt{2}} (x - i p)$   
 $[a, a^\dagger] = 1$



$\frac{d^2 r}{dt^2} = -\frac{1}{r^3} \left(\frac{dr}{dt}\right)^2 - \frac{d^2 r}{dr^2} \left(\frac{dr}{dt}\right)^2$   
 $\frac{d^2 r}{dr^2} = -\frac{1}{r^3} \left(\frac{dr}{dt}\right)^2 - \frac{d^2 r}{dr^2} \left(\frac{dr}{dt}\right)^2$

$\hat{H} = a a^\dagger - \frac{1}{2} E = m c^2$

$\langle P \rangle = \dots$

$E = m c^2 + m^2 c^2$

$a^\dagger | \psi_0 \rangle = \sqrt{n+1} | \psi_{n+1} \rangle$   
 $a | \psi_0 \rangle = \sqrt{n} | \psi_{n-1} \rangle$

$\frac{d^2 \psi}{dx^2} + k^2 \psi = 0$

$E = m c^2 \left[ 1 + \left(\frac{v}{c}\right)^2 \right]^2$

$a | \psi_0 \rangle = \frac{1}{\sqrt{2}} a a^\dagger | \psi_0 \rangle = \frac{1}{\sqrt{2}} (a^\dagger a + 1) | \psi_0 \rangle$   
 $= \frac{1}{\sqrt{2}} | \psi_{-1} \rangle$

$\lambda_1 | R \rangle + \lambda_2 | L \rangle \Rightarrow \dots$

$\Delta t = \Delta \tau \left( 1 - \frac{v^2}{c^2} \right)^{1/2}$

$X | \psi_0 \rangle = \sqrt{\frac{\hbar}{m\omega}} \frac{1}{\sqrt{2}} (a + a^\dagger) | \psi_0 \rangle$   
 $= \sqrt{\frac{\hbar}{2m\omega}} [ \sqrt{1} | \psi_1 \rangle + \sqrt{1} | \psi_{-1} \rangle ]$

$\langle X \rangle = \dots$

$\frac{d^2 p}{dt^2} = \dots$

$P | \psi_0 \rangle = \sqrt{m\omega\hbar} \frac{1}{\sqrt{2}} (a - a^\dagger) | \psi_0 \rangle$   
 $= \sqrt{\frac{m\omega\hbar}{2}} [ \sqrt{1} | \psi_1 \rangle - \sqrt{1} | \psi_{-1} \rangle ]$

$\langle P \rangle = \dots$

$\frac{d^2 p}{dt^2} = \dots$









**Anything is Possible**

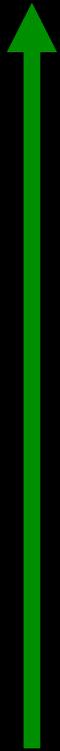
# How do you create engagement?



# How do you create engagement?



# How do you create engagement?



## *Process of Learning*

Teach → Master

Do → Understand

Show → Remember

Tell → Forget

# How many shirts should we order?



**How tall are MKT 202 students?**

# How tall are MKT 202 students?

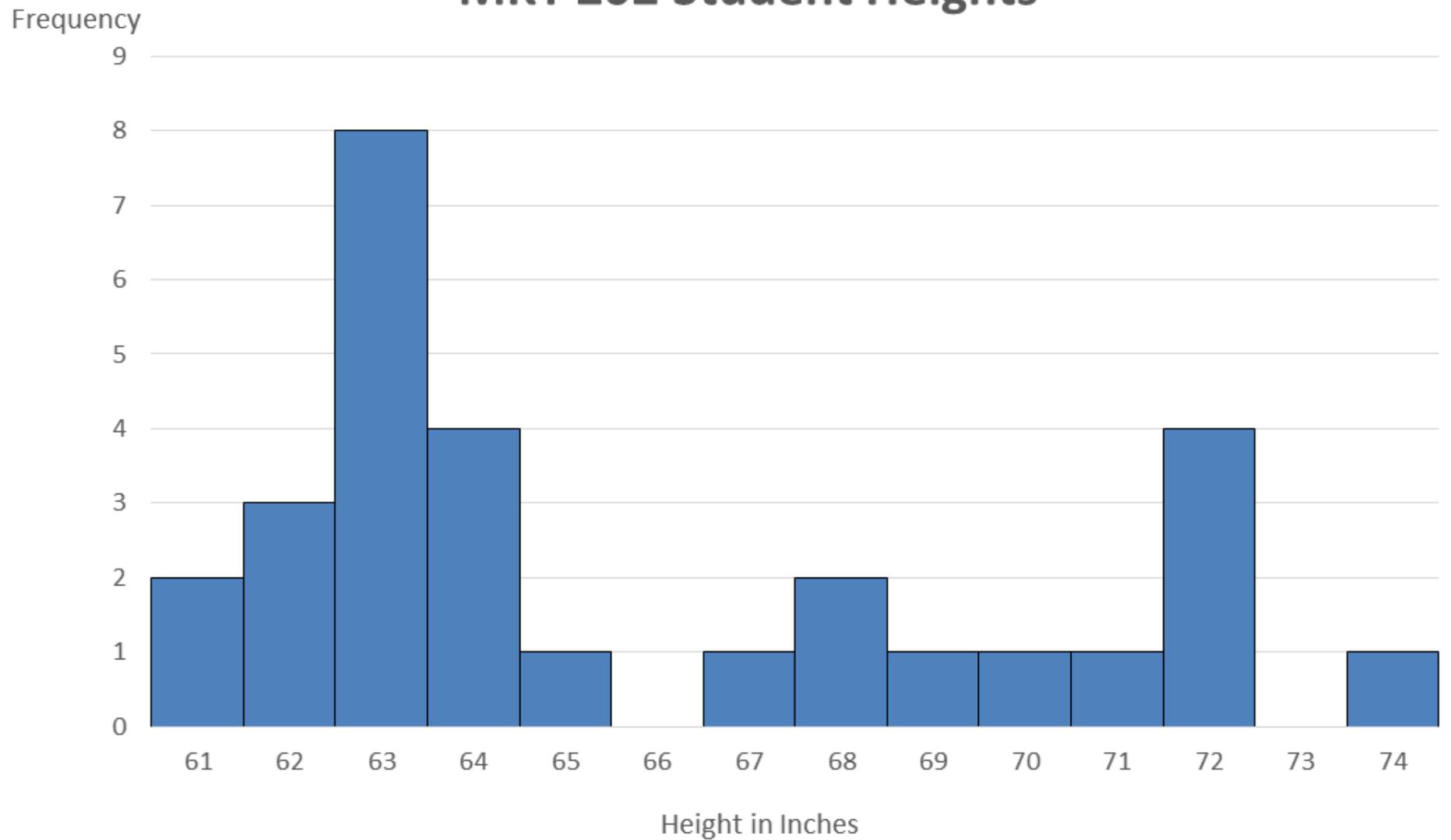
## Let's construct a living histogram





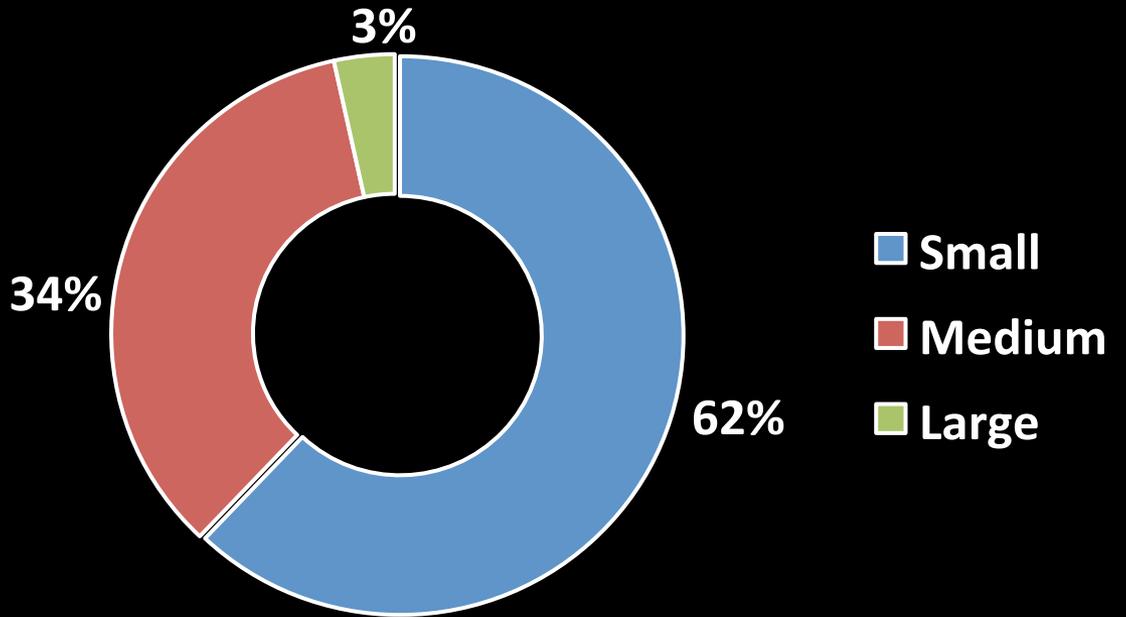


# MKT 202 Student Heights





## MKT 202 Shirt Sizes





**Anything is Possible**



**Anything is Possible**