R TUTORIAL, #11:
NORMAL DISTRIBUTIONS

The (>) symbol indicates something that you will type in.
A bullet (•) indicates what the R program should output (and other comments).

STANDARD NORMAL PROBABILITY DISTRIBUTION

• Plot the standard normal "z" curve.
> Type: curve(dnorm, xlim = c(-3, 3), ylim = c(0, 0.5), xlab = "z", ylab="f(z)")
- • 'dnorm' gives us the density function values of the (presumably standard) normal distribution.

• Find $P(Z < -1.24)$.
> Type: pnorm(-1.24)
- • Observe that the result is consistent with our *z* table.
- • 'pnorm' is the cdf (cumulative density function) of the (presumably standard) normal distribution.

• Graph and shade for the above problem.
> Type: z = -1.24
- • Change this value if you'd like to do a graph for another value of *z*, where $-3 < z < 3$.

> Type: x = c(-3, seq(-3, z, by=.001), z)
> Type: y = c(0, dnorm(seq(-3, z, by=.001)), 0)
> Type: polygon(x, y, col="red")
- • We are approximating the region of interest by a filled-in polygon with many close vertices that lie on the density curve.
- • The 'polygon' command requires that a command such as 'plot' or 'curve' has already been entered.
- • The 'x' vector contains the *x*-coordinates of the vertices of the polygon that we want to fill in.
- • The 'y' vector contains the *y*-coordinates of the vertices.
- • The bottom left corner of the polygon is at the point $(-3, 0)$. That's why -3 is the first entry of the *x* vector and 0 is the first entry of the *y* vector.
- • The bottom right corner of the polygon is at the point $(z, 0)$. That's why *z* is the last entry of the *x* vector and 0 is the last entry of the *y* vector.

• Find $P(0 < Z < 1.24)$

> Type: pnorm(1.24) - pnorm(0)

• Clear the way for a new plot.

> Type: plot.new()

• If we don't input this command, we will just be adding on to our previous plots.

> Type: curve(dnorm, xlim = c(-3, 3), ylim = c(0, 0.5), xlab = "z", ylab="f(z)")

• This draws the standard normal density curve again, and it sets up the parameters for our plotting window again.

• Graph and shade for the above problem.

> Type: zleft = 0

> Type: zright = 1.24

• Change these values if you'd like to do a graph for other values of zleft or zright, where both values are between -3 and 3.

> Type: x = c(zleft, seq(zleft, zright, by=.001), zright)

> Type: y = c(0, dnorm(seq(zleft, zright, by=.001)), 0)

> Type: polygon(x, y, col="red")

• Find $P(Z > -1.24)$

> Type: 1 - pnorm(-1.24)

• Clear the way for a new plot.

> Type: plot.new()

> Type: curve(dnorm, xlim = c(-3, 3), ylim = c(0, 0.5), xlab = "z", ylab="f(z)")

• Graph and shade for the above problem.

> Type: z = -1.24

• Change this value if you'd like to do a graph for another value of *z*, where $-3 < z < 3$.

> Type: x = c(z, seq(z, 3, by=.001), 3)

> Type: y = c(0, dnorm(seq(z, 3, by=.001)), 0)

> Type: polygon(x, y, col="red")

PERCENTILES OF THE STANDARD NORMAL

• Find P_{85}, the 85th percentile of the standard normal "z" distribution.

• This is the same as the 0.85 quantile.

> Type: qnorm(0.85)

• Clear the way for a new plot.

> Type: plot.new()

> Type: curve(dnorm, xlim = c(-3, 3), ylim = c(0, 0.5), xlab = "z", ylab="f(z)")

• Graph and shade for the above problem.

> Type: prob = 0.85

• Change this value if you'd like to do another quantile.

> Type: x = c(-3, seq(-3, qnorm(prob), by=.001), qnorm(prob))

> Type: y = c(0, dnorm(seq(-3, qnorm(prob), by=.001)), 0)

> Type: polygon(x, y, col="red")

• 85% of the total area under the curve is shaded red. (This includes the tiny piece to the left of $z = -3$; our figure cuts it off.)

GO BACK, CHANGE SOME VALUES, AND EXPERIMENT!

GENERAL NORMAL PROBABILITY DISTRIBUTIONS

• In our IQ examples, we have $X \sim N(\mu = 100 \text{ pts.}, \ \sigma = 15 \text{ pts.})$.

• Find $P(80 \text{ pts.} < X < 95 \text{ pts.})$.

> Type: pnorm(95, mean=100, sd=15) - pnorm(80, mean=100, sd=15)

• Find $P(X > 125 \text{ pts.})$.

> Type: 1 - pnorm(125, mean=100, sd=15)

PERCENTILES OF A GENERAL NORMAL

• Find P_{75}, the 75th percentile of the above distribution.

• This is the same as the 0.75 quantile.

> Type: qnorm(0.75, mean=100, sd=15)