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Prob-comp-SamplingDist.R

# Basic probability computations with the sampling distribution of
sample means

# A bottling company uses a machine to fill bottles with olive oil.
The bottles are designed
# to contain 475 ml.  Historically, the contents vary according to a
normal distribution
# with a mean of 473 ml and a standard deviation of 3 ml.

# Draw the curve.  In this problem we'll be working with the sampling
distribution for samples
# of 16 bottles.  This distribution has a mean equalling the
population mean and a standard
# deviation computed as the population standard deviation by the
square root of the sample size.

# Compute a set of fill values extending +/- four standard deviations
from the mean

the.mean = 473
the.std.err = 3/sqrt(16)

fills=seq(473-4*the.std.err,473+4*the.std.err,0.01)

# Compute densities for the range of fill values
fill.dens=dnorm(fills,the.mean,the.std.err)

# Plot the curve
plot(fills,fill.dens,type="l",yaxs="i")

##################################################
# Find the probability that the mean of a sample of 16 bottles is less
than 470 ml.
# We can see on the plot that this will be a very small area under the
curve, so I
# won't try to draw it.

prob.less.470 = pnorm(470,the.mean,the.std.err)
prob.less.470

##################################################
# Find the probability that the mean of a sample of 16 bottles is more
than 475 ml.

# Plot the area to be found
fills.sub=seq(475,473+4*the.std.err,0.01)
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fills.dens.sub=dnorm(fills.sub,the.mean,the.std.err)

cord.h=c(475,475,fills.sub,473+4*the.std.err)
cord.v=c(0,dnorm(475,the.mean,the.std.err),fills.dens.sub,0)

polygon(cord.h,cord.v,col="red")

# Compute the probability
prob.more.475=1-pnorm(475,the.mean,the.std.err)
text(475.5,0.05,round(prob.more.475,4))

################################################
# Find the probabilty that the mean of a sample of 16 bottles is
between 470 and 475 ml.

# Plot the area to be found
fills.sub=seq(470,475,0.01)
fills.dens.sub=dnorm(fills.sub,the.mean,the.std.err)

cord.h=c(470,470,fills.sub,475,475)
cord.v=c(0,dnorm(470,the.mean,the.std.err),fills.dens.sub,dnorm(475,th
e.mean,the.std.err),0)

polygon(cord.h,cord.v,col="skyblue")

# Compute the probability
prob.470.to.475=pnorm(475,the.mean,the.std.err)-
pnorm(470,the.mean,the.std.err)
text(473,0.05,round(prob.470.to.475,4))
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