SDM4 in R: Randomness and Probability (Chapter 15)

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March 3, 2016

Introduction and background

This document is intended to help describe how to undertake analyses introduced as examples in the Fourth Edition of *Stats: Data and Models* (2014) by De Veaux, Velleman, and Bock. More information about the book can be found at http://wps.aw.com/aw_deveaux_stats_series. This file as well as the associated R Markdown reproducible analysis source file used to create it can be found at http://www.amherst.edu/~nhorton/sdm4.

This work leverages initiatives undertaken by Project MOSAIC (http://www.mosaic-web.org), an NSF-funded effort to improve the teaching of statistics, calculus, science and computing in the undergraduate curriculum. In particular, we utilize the `mosaic` package, which was written to simplify the use of R for introductory statistics courses. A short summary of the R needed to teach introductory statistics can be found in the mosaic package vignettes (http://cran.r-project.org/web/packages/mosaic).

Chapter 15: Randomness and Probability

Section 15.1: Center (the Expected Value)

We can replicate the calculation on page 390:

```
library(mosaic); library(readr); options(digits=3)
x <- c(10000, 5000, 0)
prob <- c(1/1000, 2/1000, 997/1000)
sum(prob)   # sums to 1
```

```
## [1] 1
```

```
expect <- sum(x*prob); expect  # expected value
```

```
## [1] 20
```

Section 15.2: Spread (The Standard Deviation)

We can continue with the example from page 392:

```
xminmu <- x - expect; xminmu
```

```
## [1] 9980 4980  -20
```

```
myvar <- sum(xminmu^2*prob); myvar
```

```
## [1] 149600
```

```r
sd <- sqrt(myvar); sd
```

```
## [1] 387
```

Section 15.3: Shifting and Combining Random Variables

Let's replicate the values from the example on page 394:

```r
ex <- 5.83; varx <- 8.62^2
ed <- ex+5; ed
```

```
## [1] 10.8
```

```r
vard <- varx; vard
```

```
## [1] 74.3
```

```r
sqrt(vard)
```

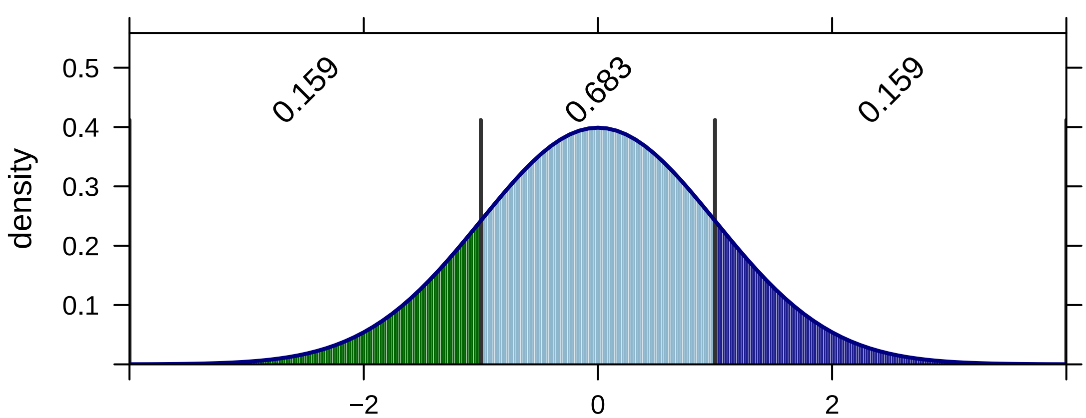
```
## [1] 8.62
```

Section 15.5: Continuous random variables

Let's replicate Figure 15.1 (page 400):

```r
xpnorm(c(-1, 1), mean=0, sd=1)
```

```
##
## If X ~ N(0, 1), then
##
##  P(X <= -1) = P(Z <= -1) = 0.159
##      P(X <=  1) = P(Z <=  1) = 0.841
##  P(X >  -1) = P(Z >  -1) = 0.841
##      P(X >   1) = P(Z >   1) = 0.159
```



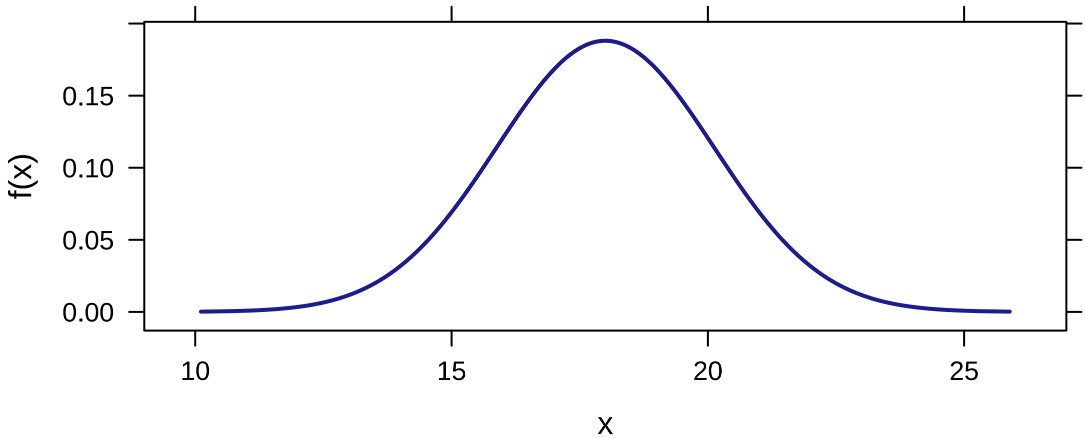
```
## [1] 0.159 0.841
```

and the Think/Show/Tell/Think on pages 402 and 403:

```
sdval <- sqrt(4.50); sdval
```

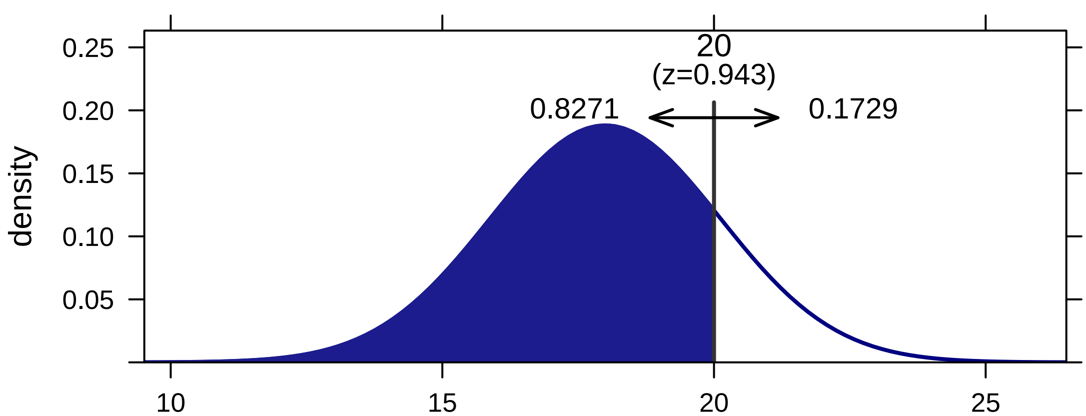
```
## [1] 2.12
```

```
plotDist("norm", params=list(18, sdval), xlab="x", ylab="f(x)")
```




```
xpnorm(20, mean=18, sd=sdval)  # note how exact value is different from the table!
```

```
##
## If X ~ N(18, 2.12), then
##
##  P(X <= 20) = P(Z <= 0.943) = 0.827
##  P(X >  20) = P(Z >  0.943) = 0.173
```



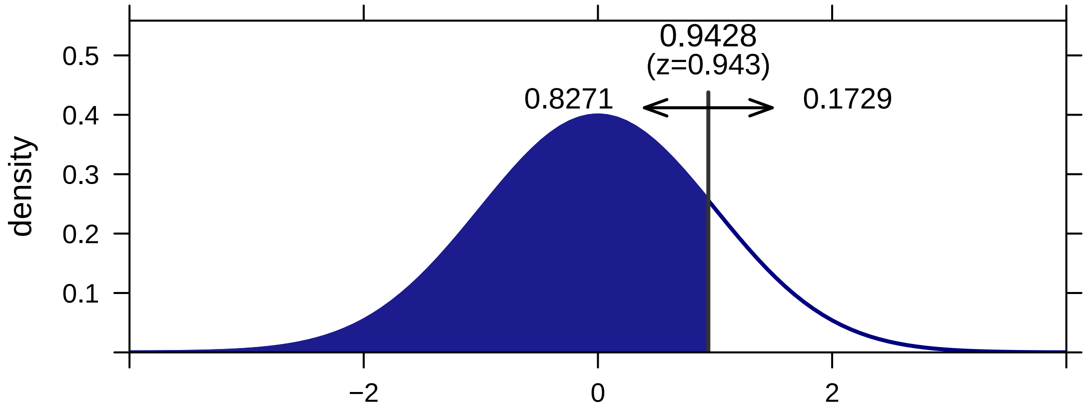

```
## [1] 0.827
```

```
zval <- (20-18)/sdval; zval
```

```
## [1] 0.943
```

```r
xpnorm(zval, mean=0, sd=1)
```

```
##
## If X ~ N(0, 1), then
##
##  P(X <= 0.943) = P(Z <= 0.943) = 0.827
##  P(X >  0.943) = P(Z >  0.943) = 0.173
```




```
## [1] 0.827
```