SDM4 in R: Comparing Counts (Chapter 24)

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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://nhorton.people.amherst.edu/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). A paper describing the mosaic approach was published in the *R Journal*: https://journal.r-project.org/archive/2017/RJ-2017-024.

Chapter 24: Comparing Counts

Section 24.1: Goodness-of-fit tests

Here we verify the calculations of expected counts for ballplayers by month (page 656).

```
ballplayer <- c(137, 121, 116, 121, 126, 114,
                102, 165, 134, 115, 105, 122)
national <- c(0.08, 0.07, 0.08, 0.08, 0.08, 0.08,
              0.09, 0.09, 0.09, 0.09, 0.08, 0.09)
n <- sum(~ ballplayer)
n
```

```
## [1] 1478
```

```
sum(~ national)
```

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

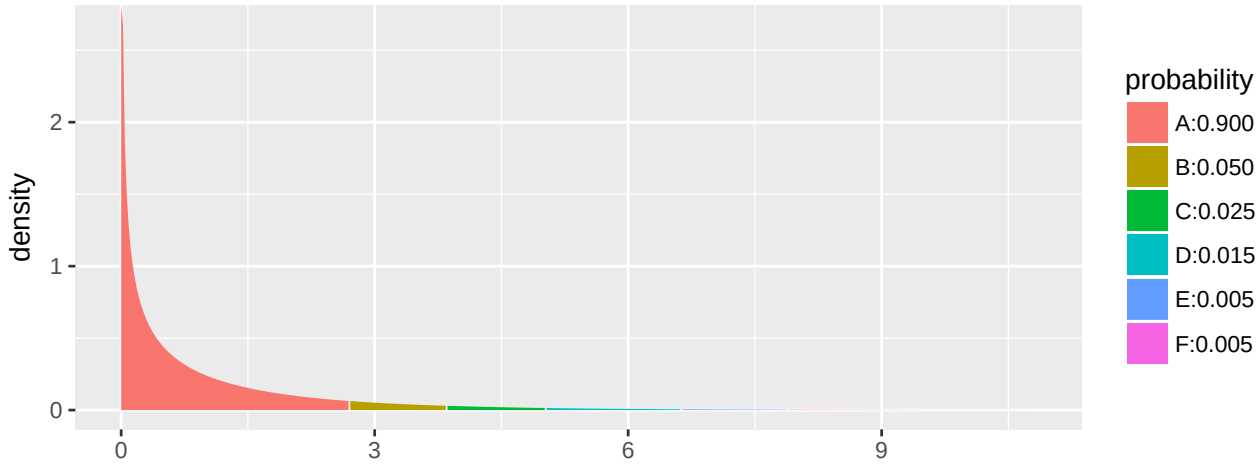
```
expect <- n*national
cbind(ballplayer, expect)
```

```
##       ballplayer expect
##  [1,]        137 118.24
##  [2,]        121 103.46
##  [3,]        116 118.24
##  [4,]        121 118.24
##  [5,]        126 118.24
##  [6,]        114 118.24
##  [7,]        102 133.02
##  [8,]        165 133.02
```

```
##  [9,]        134 133.02
## [10,]        115 133.02
## [11,]        105 118.24
## [12,]        122 133.02
```

The chi-square quantile values in the table on the bottom of page 658 can be verified using the `xqt()` function.

```
xqchisq(c(.90, .95, .975, .99, .995), df = 1)
```




```
## [1] 2.7055 3.8415 5.0239 6.6349 7.8794
```

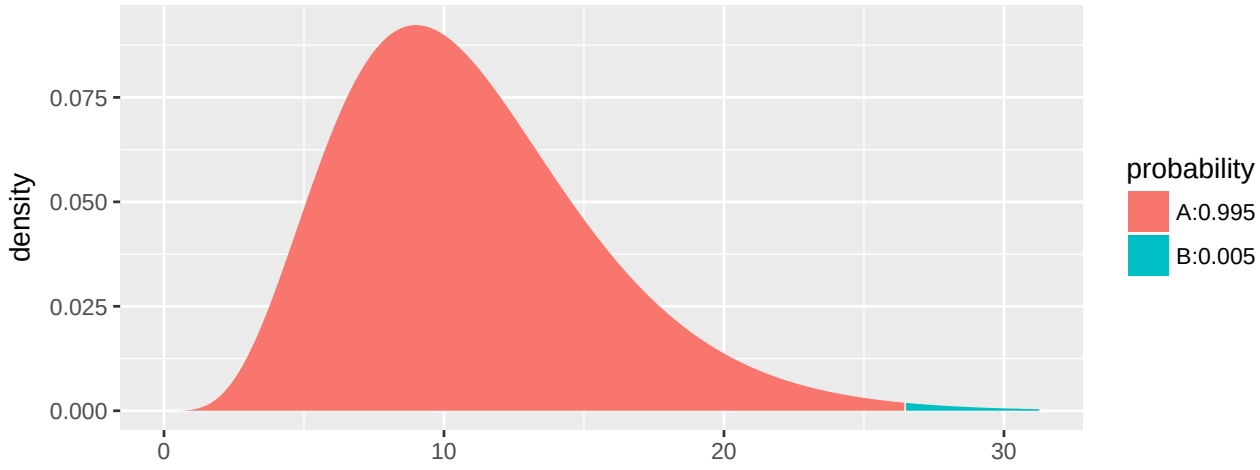
These results match the first row: other values can be calculated by changing the `df` argument.

The goodness of fit test on page 659 can be verified by calculating the chi-square statistic.

```
chisq <- sum((ballplayer-expect)^2/expect)
chisq
```

```
## [1] 26.484
```

```
1-xpchisq(chisq, df = 11)
```




```
## [1] 0.005494
```

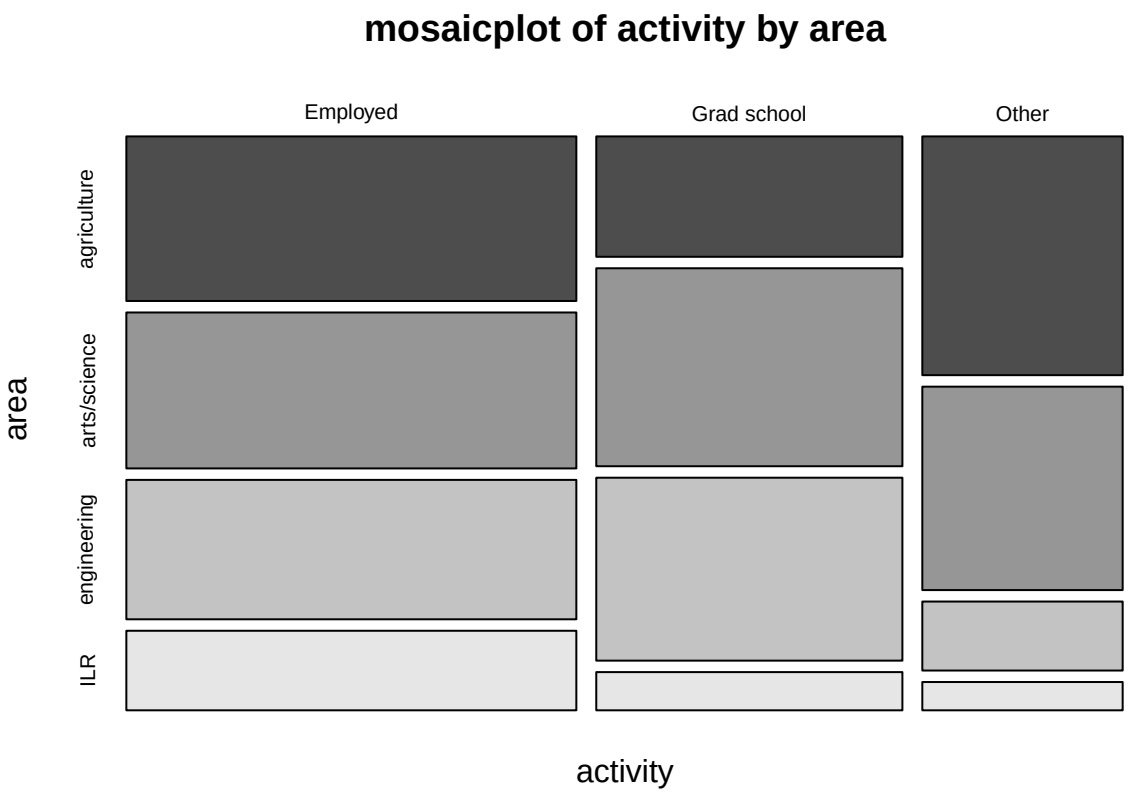
Section 24.2: Chi-square test of homogeneity

Data from one university regarding the association between postgraduation activity and area of study is displayed in Table 24.1 (page 663).

```
area <- c(rep("agriculture", 209), rep("arts/science", 198),
          rep("engineering", 177), rep("ILR", 101),
      rep("agriculture", 104), rep("arts/science", 171),
          rep("engineering", 158), rep("ILR", 33),
      rep("agriculture", 135), rep("arts/science", 115),
          rep("engineering", 39), rep("ILR", 16))
activity <- c(rep("Employed", 685), rep("Grad school", 466),
              rep("Other", 305))
tally(~ activity + area, margins = TRUE)
```

```
##              area
## activity      agriculture arts/science engineering  ILR Total
##   Employed            209          198         177  101   685
##   Grad school         104          171         158   33   466
##   Other               135          115          39   16   305
##   Total               448          484         374  150  1456
```

```
mosaicplot(tally(~ activity + area), main = "mosaicplot of activity by area",
  color = TRUE)
```




```
xchisq.test(tally(~ activity + area))
```

```
##
##  Pearson's Chi-squared test
##
## data:  x
## X-squared = 93.7, df = 6, p-value <2e-16
##
##   209      198      177      101
## (210.77) (227.71) (175.95) ( 70.57)
## [ 0.0149] [ 3.8754] [ 0.0062] [13.1215]
## <-0.122> <-1.969> < 0.079> < 3.622>
##
##   104      171      158       33
## (143.38) (154.91) (119.70) ( 48.01)
## [10.8181] [ 1.6720] [12.2543] [ 4.6918]
## <-3.289> < 1.293> < 3.501> <-2.166>
##
##   135      115       39       16
## ( 93.85) (101.39) ( 78.34) ( 31.42)
## [18.0470] [ 1.8277] [19.7590] [ 7.5689]
## < 4.248> < 1.352> <-4.445> <-2.751>
##
## key:
##  observed
##  (expected)
##  [contribution to X-squared]
##  <Pearson residual>
```

Section 24.3: Examining the residuals

Note that the `xchisq.test()` function displays the standardized residuals as the last item in each cell of the table (and these match the results in Table 24.4 (page 668).