HW1 - R Notebook

Rachel M. Smith

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Question-1

General Parameters for Hypothesis Testing

Underlying Distribution. The data are assumed to occur *randomly* along a *Binomial Distribution.*

Assumed Population Proportion. Equal proportions across racial categories.

$$k \sim B(n, p)$$

$$\binom{n}{k}\pi^{n-k} = \frac{n!}{k!(n-k)!}\pi^k(1-\pi)^{n-k}$$

$$\pi_0 = 0.5$$

Null Hypothesis (H_0). The sample proportion (p) is equivalent to the proportion assumed to exist within the population (π_0).

$$H_0 : p - \pi_0 = 0$$

Alternative Hypothesis (H_1). The sample proportion (p) is not equivalent to the proportion assumed to exist within the population (π_0).

$$H_1 : p - \pi_0 \neq 0$$

Question-1*a*

Table 1: Known Values and Parameters for Binomial (*z-Score*) Test

N	P_{AA} †	P_{WH} ‡	π_0	$z_{critical}$
11769	0.084	0.916	0.5	1.96

Note: † P_{AA} = *Proportion (p) of traffic stops involving* ***American American (AA) drivers****.* ‡ P_{WH} = *Proportion (p) of traffic stops involving* ***White American (WH) drivers****.*

Question-1*.a.i. z-Score* ***Test Computation***

$$z = \frac{0.916 - 0.5}{\sqrt{\frac{0.5(1-0.5)}{11769}}} \Rightarrow \frac{0.416}{\sqrt{\frac{0.5(0.5)}{11769}}} \Rightarrow \frac{0.416}{\sqrt{\frac{0.25}{11769}}} \Rightarrow \frac{0.416}{\sqrt{0}} \Rightarrow \frac{0.416}{0.005}$$

$$z = \mathbf{90.26}$$

$$z = \frac{p - \pi_0}{SE_\pi}$$

$$SE_\pi = \sqrt{\frac{\pi_0(1-\pi_0)}{n}}$$

Question 1*.a.ii. z-Score Test* ***Confidence Interval*** *(CI_z)*

$$LCL_z = p - (1.96)(0.005) \Rightarrow p - 0.009 \Longrightarrow \mathbf{0.907}$$

$$UCL_z = p + (1.96)(0.005) \Rightarrow p + 0.009 \Longrightarrow \mathbf{0.925}$$

$$CI_z = \mathbf{0.91} < p < \mathbf{0.93}$$

$$CI_z = p \pm (z_{critical})(SE_\pi)$$

$$z_{critical} = 1.96$$

$$p = 0.916$$

Question-1.a.iii. z-Score ***Test Margin of Error*** *(ME_z)*

$$ME_z = \frac{(0.907 - 0.925)}{2}(100) \Rightarrow \frac{(-0.018)}{2}(100) \Rightarrow (-0.009)(100)$$

$$ME_z = \left(\frac{CI_z^+ - CI_z^-}{2}\right)(100)$$

ME_z = **-0.903**

Table 2: Summary of *z-Score* Test Calculations

N	*z-Score*	CI_z	ME_z
11,769	90.3	0.91 < π_0 < 0.93	0.9%

Summary

A binomal (*z-Score*) test was used to determine whether there was a significant difference between traffic stops involving White drivers and those involving African American drivers. Results for the *z-Score* test are provided in {+tbl:zscore}. Of the 11769 cases of traffic stops involving White or African American drivers, 0.916% involved White drivers, while 0.084% involved African American drivers. The difference score was computed as $z = 90.26$, with a 95% confidence interval of $CIs = 0.91, 0.93$. The null hypothesis (H_0) value of equal proportions ($\pi_0 = 0.5$) is not included in the computed *z-Score* confidence interval, suggesting that the observed difference in the sample's proportions is larger than would be expected by chance alone. The margin of error for these data was calculated at -0.903%.

Question-1b

Table 3: Summary of Known Values and Parameters for Pearson's χ^2 Goodness-of-Fit Test

N	n_{AA}†	n_{WH}‡	$z_{critical}$ $(df = 1)$
11769	985	10,782	3.84

NOTE: † n_{AA} = *Frequency value (n) of the proportion (p) of traffic stops involving* ***American American (AA) drivers****.*
‡ n_{WH} = *Frequency value (n) of the proportion (p) of traffic stops involving* ***White American (WH) drivers****.*

Question 1.b.i. Pearson χ^2 Computation

$$\chi^2 = \sum \frac{(O_i - E_i)^2}{E_i}$$

$$O_1 = 985$$

$$O_2 = 10,782$$

$$E_i = \frac{(O_1 + O_2)}{2}$$

$$E_i = \frac{(985 + 10782)}{2} \Rightarrow \frac{(11767)}{2}$$

$$E_i = \mathbf{5883.5}$$

$$\chi^2 = \frac{(985 - 5883.5)^2}{5883.5} + \frac{(10782 - 5883.5)^2}{5883.5}$$

$$\Longrightarrow \frac{(-4898.5)^2}{5883.5} + \frac{(4898.5)^2}{5883.5}$$

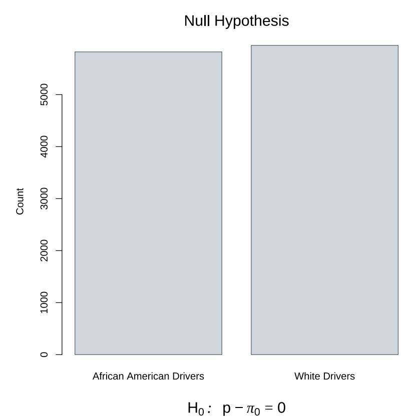
$$\Longrightarrow \frac{(23995302.25)}{5883.5} + \frac{(23995302.25)}{5883.5}$$

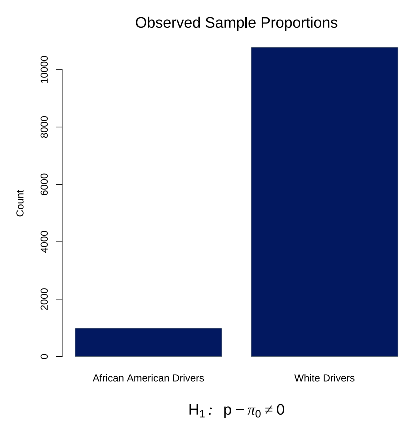
$$\Longrightarrow 4078.406 + 4078.406$$

$$\chi^2 = \mathbf{8156.812}$$

Summary

A Pearson chi-square (χ^2) test was conducted to determine whether there was a significant difference between traffic stops involve White drivers and those involving African American drivers. Of the 11769 cases of traffic stops involving White or African American drivers, 10782 involved White drivers, while 985 involved African American drivers. The computed difference, $\chi^2(1) = 8156.812$, was larger than the critical value for the two-tailed $1 - df$ test (3.84). These findings suggest that a significant difference exists between the two proportions in this sample than could be expected due to chance alone.





Question-2

Benchmarks Proportions for Expected Frequencies. Stewart and Covelli[1] identify the proportion of injury accidents as a, relatively, valid benchmark value for estimating the expected race-based proportions among drivers involved in Portland Police traffic stops. For this analysis, the benchmark proportions reflect the proportions of a sub-sample of the reported data comprised of only African American and White American drivers. Within this sub-sample, the *proportion of African American drivers involved in injury accidents is* .080389769. *Table 4* below provides a summary of the expected and observed proportions and corresponding frequencies using this benchmark for the sub-sample.

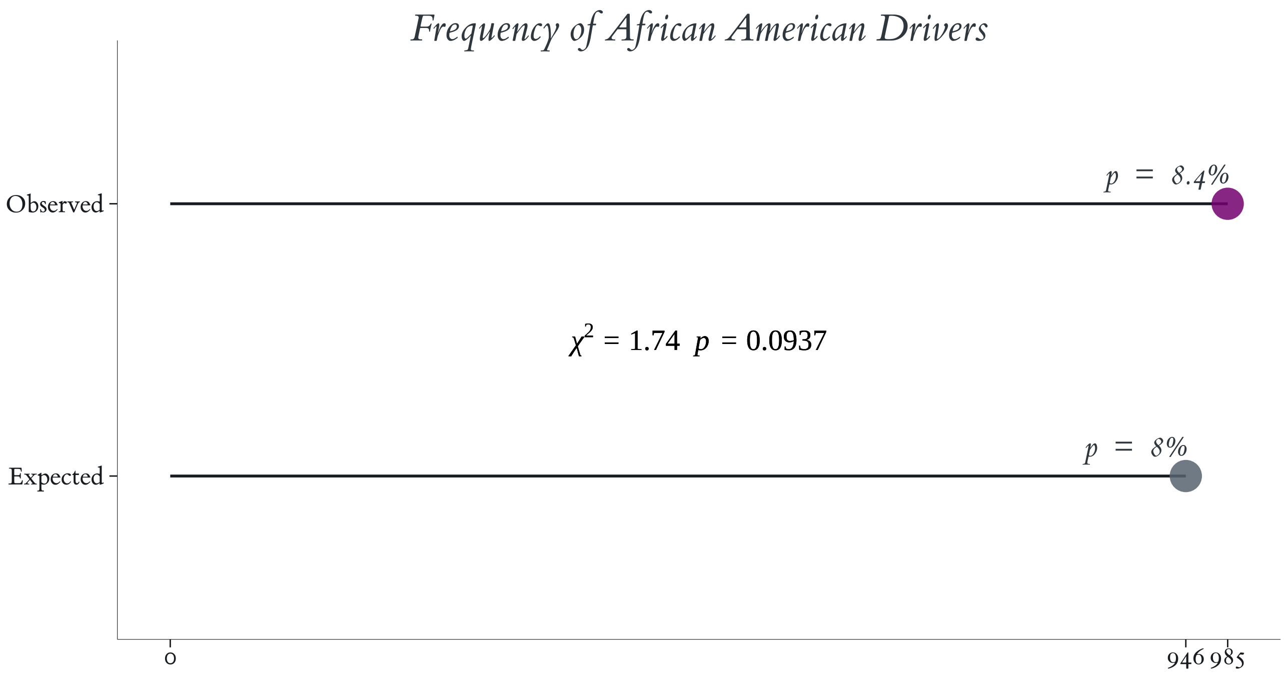
[1] "Stops Data Collection."

Table 4: Observed Traffic Stop Frequency per Race

Driver's Race	$P_{Benchmark}$	P_{Observed}$	$Frequency_{Expected}$	$Frequency_{Observed}$
White	0.92	0.916	10822	10784
African American	0.08	0.084	946	985

Table 5: 1-sample proportions test without continuity correction: *985 out of 11769*

H_1	π_0	df	p	χ_2	*p-value*	CI
greater	0.08	1	0.084	1.7	0.094	0.08, 1


Frequency of African American Drivers
Observed
Expected
p = 8.4%
p = 8%
χ² = 1.74 p = 0.0937
0
946
985

Question-3

Question-3a. Test of Racial Differences in Portland Police Pedestrian Stops

```
Chi-squared test for given probabilities
```

data: race2.sav
χ^2 = 1000, df = 4, p-value <0.0000000000000002

Question-3b

```
major minor
```

African American 21 99
White 78 332

$$E_A = \frac{(431 * 120)}{530} \Rightarrow \frac{51720}{530} \Rightarrow 97.585$$

$$E_B = \frac{(99 * 120)}{530} \Rightarrow \frac{11880}{530} \Rightarrow 22.415$$

$$E_C = \frac{(431 * 410)}{530} \Rightarrow \frac{176710}{530} \Rightarrow 333.415$$

$$E_D = \frac{(99 * 410)}{530} \Rightarrow \frac{40590}{530} \Rightarrow 76.585$$

$$\chi^2 = \Sigma\left(\frac{99 - 97.585}{97.585} + \frac{21 - 22.415}{22.415} + \frac{332 - 333.415}{333.415} + \frac{78 - 76.585}{76.585}\right)$$

$$\Rightarrow \Sigma\left(\frac{1.415}{97.585} + \frac{-1.415}{22.415} + \frac{-1.415}{333.415} + \frac{1.415}{76.585}\right)$$

$$\Rightarrow \Sigma\left(0.015 + (-0.063) + (-0.004) + (0.018)\right)$$

$$\chi^2 = -0.034$$

Phi statistic

$$\Phi = \frac{(AD - BC)}{(A+B)(C+D)(A+C)(B+D)} \frac{((21 * 332) - (99 * 78))}{(21+99)(78+332)(21+78)(99+332)} \Rightarrow \frac{-750}{2099314800} \Rightarrow -1.093 * 108$$

$$\Phi = \mathbf{0.016}$$

Relative risk ratio

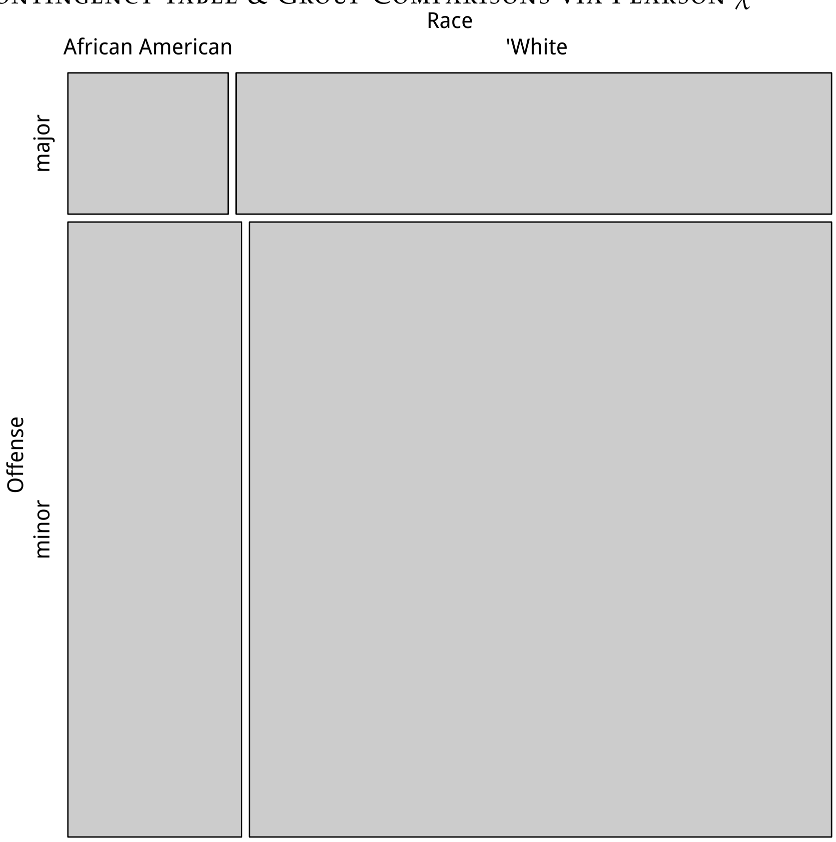
$$Risk = \frac{(\frac{n_{2+}}{n_{++}})}{(\frac{n_{1+}}{n_{++}})} \Rightarrow \frac{p_{2+}}{p_{1+}} \Rightarrow \frac{(410/530)}{(120/530)} = 3.417$$

Odds ratio

$$OR = \frac{n_{11}n_{22}}{n21n12} \Rightarrow \frac{(21332)}{(7899)} = 0.903$$

Question-3c

Contingency Table & Group Comparisons via Pearson χ^2



X^2 df P(> X^2)

Likelihood Ratio 0.14370 1 0.70463

Pearson 0.14201 1 0.70629

Phi-Coefficient : 0.016

Contingency Coeff.: 0.016

Cramer's V : 0.016

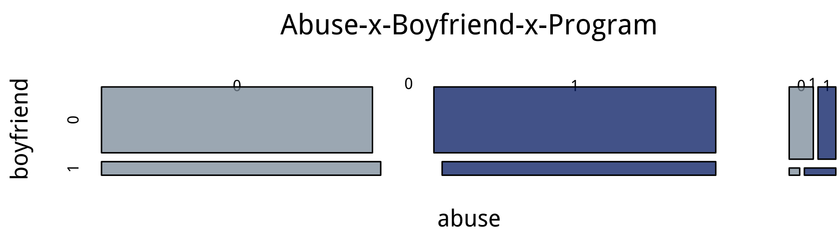
Question-4

```
>>      abuse        boyfriend        program
>>  Min.   :0.00   Min.   :0.000   Min.   :0.0
>>  1st Qu.:0.00   1st Qu.:0.000   1st Qu.:0.0
>>  Median :0.00   Median :0.000   Median :1.0
>>  Mean   :0.07   Mean   :0.164   Mean   :0.5
>>  3rd Qu.:0.00   3rd Qu.:0.000   3rd Qu.:1.0
>>  Max.   :1.00   Max.   :1.000   Max.   :1.0
>>                                 NA's   :9

>>
>>  Pearson's Chi-squared test
>>
>> data:  Q4dat[, 2] and Q4dat[, 1]
>> X-squared = 4, df = 1, p-value = 0.05

>>
>>  Pearson's Chi-squared test with Yates' continuity correction
>>
>> data:  xt0
>> X-squared = 3, df = 1, p-value = 0.07

>> --------------------------------------------------------------------
>> xt (xtabs, table)
>>
>> Summary:
>> n: 1'247, 3-dim table: 2 x 2 x 2
>>
>> Chi-squared test for independence of all factors:
>>   X-squared = 7.223, df = 4, p-value = 0.1245
>>
>>                 program    0    1  Sum
>> abuse boyfriend
>> 0     0               471  490  961
>>       1               100   98  198
>> 1     0                46   34   80
>>       1                 2    6    8
>> Sum   0               517  524 1041
>>       1               102  104  206
```



```
>> , , program = 0
>>
>>      boyfriend
>> abuse   0   1
>>     0 471 100
>>     1  46   2
>>
>> , , program = 1
>>
>>      boyfriend
>> abuse   0   1
>>     0 490  98
>>     1  34   6
```

```
>>
>>  Breslow-Day test on Homogeneity of Odds Ratios
>>
>> data:  xt
>> X-squared = 3, df = 1, p-value = 0.07
```

Non-Conditional Contingency Table. The table below provides frequency counts for the two levels of `boyfriend` (`0 = biological father`; `1 = not biological father`) and `abuse` (`0 = abuse`; `1 = no abuse`).

```
abuse   0   1
```

boyfriend
0 961 80
1 198 8

Conditional Contingency Tables. The tables below provide frequency counts for the two levels of `boyfriend` (`0 = biological father`; `1 = not biological father`) and `abuse` (`0 = no abuse`; `1 = abuse`), conditional upon the two levels of `program` (`0 = no program`; `1 = program`).

Control Group (`Program = 0`)

abuse boyfriend Freq Percent
1 0 0 471 37.8%
2 1 0 46 3.7%
3 0 1 100 8%
4 1 1 2 0.2%

Program Group (`Program = 1`)

```
>>      Boyfriend
>> Abuse 0            1
```

```
>>     0 "490(39.3%)" "98(7.9%)"
>>     1 "34(2.7%)"   "6(0.5%)"
```

The data for the remaing sets of analyses are from a national telephone interview study of batterer intervention program (BIP) standards advisory and compliance monitoring committees. Respondents were asked a series of questions varying in structure from *open-ended* to simple *yes-or-no*. These analyses will concern concern the discrete data collected in response to the following interview questions:

> Does your organization have methods for assessing programs' feedback about the standards?
> Do the standards apply to programs designed for all genders?
> Are there processes in place to revise the standards?
> > Is there a process for informing revisions through program evaluations and needs assessments
> > Is research information utilized in revising the standards?

The primary interest for the below analyses relate to an overarching effort to implement and sustain effective and appropriate anti-violence intervention strategies among female-identified perpetrators of same-sex violence. The above listed questions provide dichotomous (`0 = No`; `1 = Yes`) indicators of responding states' current organizational and ideological capacities for such intervention strategies.

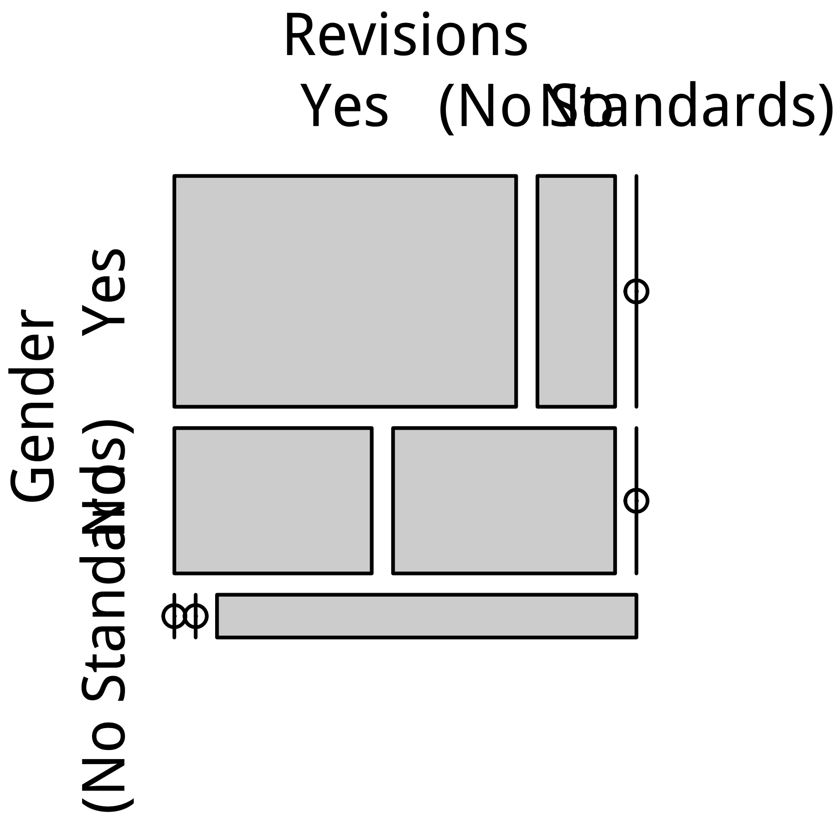
Table 6: 1-sample proportions test without continuity correction: *27 out of 49*

H_1	π_0	df	p	χ_2	*p-value*	CI
two.sided	0.5	1	0.71	6.7	0.009	0.55, 0.83

Question-5

A Pearson chi-square (χ^2) test was conducted to determine whether there was a significant difference between trafficthe number of states with gender-inclusive BIP standards and those with BIP standards specific only to male-identified perpetrators. Given that no precedent currently exists for gener inclusivity in U.S. states' BIP standards, the binomial test was conducted using 0.5 as the Null Hypothesis proportion. Of the 38 interviewed states with BIP stamdards, 27 have indicated that their standards are gender-inclusive. The computed difference, $\chi^2(1) = 1.739$, was larger than the critical value for the two-tailed $1 - df$ test (3.84). These findings suggest that a significant difference exists between the number of states with gender-inclusive BIP standards compared with the number of states without gender-inclusive standards.

Question-6




```
>>                       X^2 df          P(> X^2)
>> Likelihood Ratio 37.955  4 0.000000114451193
>> Pearson          55.345  4 0.000000000027504
>>
>> Phi-Coefficient   : NA
>> Contingency Coeff.: 0.728
>> Cramer's V        : 0.751
```

A Pearson chi-squared test was used to investigate whether states with gender-inclusive standards as compared with states with gender non-inclusive standards were more likely to have revisions processes in place versus not. The difference was significant, $\chi^2(1) = 55.345, p < 0.001$.

References[2]

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[2] **Note:** This document was created using ***R**-v3.3.1* R Core Team, *R*, and the following ***R**-packages*: *base-v3.3.* R Core Team, *R*, *bibtex-v0.4.* Francois, *Bibtex*, *dplyr-v0.5.* Wickham and Francois, *Dplyr*, *DT-v0.2.* Xie, *DT*, *extrafont-v0.17.* Chang, *Extrafont*, *ggplot2-v2.1.* Wickham, *Ggplot2*, *knitcitations-v1.0.* Boettiger, *knitcitations*, *knitr-v1.14.* Xie, *Dynamic Documents with R and Knitr*, *pander-v0.6.* Daroczi and Tsegelskyi, *Pander*, *papaja-v0.1.* Aust and Barth, *Papaja*, *plyr-v1.8.* Wickham, "The Split-Apply-Combine Strategy for Data Analysis.", *rmarkdown-v1.0.* Allaire et al., *rmarkdown*, *scales-v0.4.* Wickham, *Scales*, *tidyr-v0.6.* Wickham, *Tidyr*, *ggthemes-v3.2.* Arnold, *Ggthemes*, *gtable-v0.2.* Wickham, *Gtable*, *kableExtra-v0.0.* Zhu, *KableExtra*, *tufte-v0.2.* Xie and Allaire, *Tufte*, *descr-v1.1.* Aquino, *Descr*, *vcd-v1.4.* Meyer, Zeileis, and Hornik, "Residual-Based Shadings for Visualizing (Conditional) Independence".", *devtools-v1.12.* Wickham and Chang, *Devtools*, *highlight-v0.4.* Francois, *Highlight*, *sysfonts-v0.5.* Qiu and others, *Sysfonts*, and *showtext-v0.4.* Qiu, *Showtext*

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