

Week 1 HW Ellen Chancey

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Question 1.2

100 questions on a multiple choice test. There are 4 options for each question, one is correct. A student randomly guesses on each question. There are 100 trials, each with 2 possible outcomes - right or wrong. Each trial has a 0.25 probability that the outcome is "correct".

A. Specify the distribution of the number of correct answers

The distribution of outcomes is binomial because the answer is either wrong or right for each trial. Across 100 trials, there can be between 0 and 100 correct answers.

B. Find the mean and standard deviation of that distribution. Would it be surprising if the student made at least 50 correct responses? Why?

The mean of the binomial distribution is the $E(y) = \pi n$.

```
n <- 100 # trials
p <- 0.25 # probability that correct outcome is selected for one trial
c <- 4 # number of outcomes
mu <- p*n
mu
## [1] 25
```

The variance of the binomial distribution is $\pi(1 - \pi)$

```
var <- n*p*(1-p)
var
## [1] 18.75
```

It would be surprising for a student to obtain 50 correct response because the mean + the standard deviation is 43.75. It is unlikely a student would obtain 50 correct answers given these statistics.

```
low <- mu - var
low
## [1] 6.25
high <- mu + var
high
## [1] 43.75
```

C. Specify the distribution of (n_1, n_2, n_3, n_4) where n_j is the number of times the student picked choice j .

D. Find $E(n_j)$ and $var(n_j)$. Show that $cov(n_j, n_k) = -6.25$ and $corr(n_j, n_k) = -0.333$

Question 1.4

Russian roulette, where a bullet is placed in one of six chambers of a pistol, the chamber is spun and a random chamber is selected at random.

A. What is the probability of doing this six times where none of the trials results in a bullet firing?

The probability that in six trials, it never fires is 0.3348

```
n <- 6 # number of trials
y <- 0 # number of fires
p <- 1/6 # probability that is fires in one trial
prob <- (choose(n,y))*(p^y)*((1-p)^n-y)
prob
## [1] 0.334898
```

Supplemental Question

Find $E(Y)$ and $Var(Y)$ when $Y = Poi(\mu)$

Session Info

```
sessionInfo()

## R version 3.4.1 (2017-06-30)
## Platform: x86_64-w64-mingw32/x64 (64-bit)
## Running under: Windows 10 x64 (build 16299)
##
## Matrix products: default
##
## locale:
## [1] LC_COLLATE=English_United States.1252
## [2] LC_CTYPE=English_United States.1252
## [3] LC_MONETARY=English_United States.1252
## [4] LC_NUMERIC=C
## [5] LC_TIME=English_United States.1252
##
## attached base packages:
## [1] stats      graphics  grDevices  utils      datasets  methods   base
##
## loaded via a namespace (and not attached):
## [1] compiler_3.4.1  backports_1.1.0 magrittr_1.5    rprojroot_1.2
## [5] tools_3.4.1     htmltools_0.3.6 yaml_2.1.14     Rcpp_0.12.13
## [9] stringi_1.1.5   rmarkdown_1.6  knitr_1.16      stringr_1.2.0
## [13] digest_0.6.12   evaluate_0.10.1
```