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Department of Statistics

Statistics 12 **Instructor: Nicolas Christou**

Lab 5

Introduction

A quick reminder on how to use the sample function in R.. We used it lab 4.
Sample from a fair die. Roll the die 10 times.

```
x <- c(1,2,3,4,5,6)
sample(x, 10, replace=TRUE)
```

This above assumes the die is fair, so the probability is $\frac{1}{6}$ for each value of $X = 1, 2, 3, 4, 5, 6$.

Suppose now we want to assign different probabilities for each value of X. For example:

X	$P(X = x)$
1	0.1
2	0.2
3	0.3
4	0.1
5	0.1
6	0.2

Again roll the die 10 times.

```
x <- c(1,2,3,4,5,6)
sample(x, 10, prob=c(0.1, 0.2, 0.3, 0.1, 0.1, 0.2), replace=TRUE)
```

Practice using the commands above and then answer the following questions:

1. Part A
   Assume we roll two fair dice and we denote with X the sum of the two numbers.
   a. Create the sums (2 to 12).
   b. Take a sample of size $n = 100$ from this distribution. Compute the sample mean and sample standard deviation of these 100 sums.
   c. Repeat (b) using larger samples: $n = 1000$ and $n = 10000$. Compute the sample mean and sample standard deviation in each case. Also construct the histogram using the case when $n = 10000$.
   d. Compute $E[X]$ and var$[X]$ using handout #21, pages 2 and 5. Compare the sample mean and sample standard deviation from (b) and (c) with the theoretical values of the mean and standard deviation from (d).

2. Part B
   Now consider the roulette problem (see handout #21, page 3).
   a. Assume the player will bet on four joining numbers. Let X be the player's payoff. Compute $E[X]$ and var$[X]$ using handout #21, pages 2 and 5.
   b. Create the probability distribution of X.
   c. Take a sample of size $n = 100$ from this distribution. Compute the sample mean and sample standard deviation of these 100 games.
   d. Repeat (c) using larger samples: $n = 1000$ and $n = 10000$. Compute the sample mean and sample standard deviation in each case. Also construct the histogram using the case when $n = 10000$. Compare the sample mean and sample standard deviation with the theoretical values from (a).
   e. Repeat questions a-d when the player bets on a single number.