Statistics 1

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Lecture 4: 4.7

0.1 Counting

Coin & Die: Outcomes: two for coin, six for die. Thoes together have 12 outcomes.

0.1.1 Fundamental counting rule

If you have an event that can occur "m" ways and another event that can occur "n" ways, then together they can occur $m \cdot n$ ways.

Example

Four number security code

- 1^{st} digit can't be zero.

$$9 \cdot 10 \cdot 10 \cdot 10 = 9000.$$

probability of guessing: $\frac{1}{9000}$

If you have different arangements, which are all unique it's like the following. Given you have 5 unique items, you can have $5 \cdot 4 \cdot 3 \cdot 2 \cdot 1 = 120$ different arrangements. In conclusion, if you have 5 unique things, there are 5! constelations, if you have 10 unique things there are 10! constelations.

- Remember: $0! = 1$
- for any set of "n" **different** items, there are $n!$ different arrangements possible.

Example

There are 7 cool rides at D.L., how many different ways could you write all seven?
$7! = 5040$

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Lecture 5: 5.0

Chapter 1

Discrete Probabilities

$\rightarrow$ Countable of finite.

1.1 Vocabulary

Random variable	A variable, x, that has a value for each outcome of a procedure, that is determined by chance.
Probability distribution	Table that gives the probability for each value of a random variable.
Discrete random variable	A variable with a countable or finite number of values. (Chapter 5)
Continous random variable	A variable with an infinit amount of values. (usually measurements) (Chapter 6)

Table 1.1: Vocabulary

Example

Probability distribution:

x	$P(x)$
1	$\frac{1}{6}$
2	$\frac{1}{6}$
3	$\frac{1}{6}$
4	$\frac{1}{6}$
5	$\frac{1}{6}$
6	$\frac{1}{6}$

1.2 Histogram from Probability Distribution.

Horizontal	Values of random variable.
Vertical	Probability.

Example

Weighted die:

x	$P(x)$
1	.05
2	.15
3	.35
4	.30
5	.10
6	.05

Notitz:

$$0 \leq P(x) \leq 1.$$
$$\sum P(x) = 1.$$

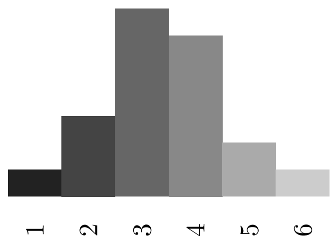


Figure 1.1: Prob. distribution of the weighted die

1.2.1 Mean, Variance, Standard Deviation

Mean:

$$\mu = \frac{\sum(x \cdot f)}{N}$$
$$\mu = \sum \left[\frac{x \cdot f}{N}\right]$$
$$= \sum \left[x \cdot \frac{f}{n}\right]$$
$$\mu = \sum [x \cdot P(x)] \leftarrow \text{mean, expected value}$$

x	$P(x)$	$x \cdot P(x)$	x^2	$x^2 \cdot P(x)$
1	.05	.05	1	.05
2	.15	.30	4	.60
3	.35	1.05	9	3.15
4	.30	1.20	16	4.8
5	.10	.50	25	2.5
6	.05	.30	36	1.8
	1.00	$\sum[x \cdot P(x)] = 3.4$		$\sum[x^2 \cdot P(x)] = 12.9$

So the mean is: $\mu = 3.4$

Variance: $\sigma^2 = \sum \left[x^2 \cdot P(x)\right] - \mu^2$

with a little solving of the table we then get:

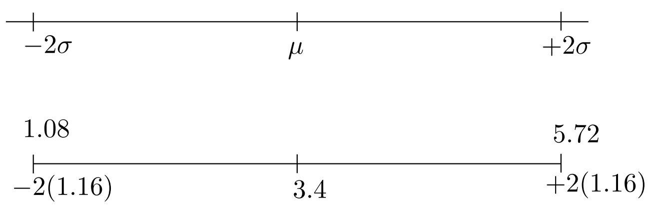
$$
\begin{aligned}
\sigma^2 &= 12.9 - (3.4)^2 \\
\sigma^2 &= 12.9 - 11.56 \\
\sigma^2 &= 1.34 \\
\sigma &= \sqrt{1.34} \\
\sigma &= 1.16
\end{aligned}
$$

remember standard deviation is just the sqareroot of the variance, as 1.16 above.

1.2.2 Usual vs. Unusual

Values are unusual if they lie outside of:

- $\mu + 2\sigma$
- $\mu - 2\sigma$



Here we took the dice example, and 1.08 as 5.72 mark our range of $\pm$ two standard deviations, whatever's outside is considered unusual. So we get 1 & 6 to be unusual.

If $P(A) \leq .05$ "A" is considered unusual.

Example

Flip a coin 1000 times

$$P(\text{exactly 501 heads}) = 0.0252 \leq .05 \Rightarrow \textit{unusual}$$

$$P(\text{501 or more heads}) = 0.487 \Rightarrow \textit{usual}$$