

Lab #9: Hypothesis Testing - Dichotomous Variables Key

Since this assignment uses Pascal's triangle for a couple of the problems, here is one triangle (for N=12) that can be used for both problems.

N	Coefficients										N+1	2 ^N
1											2	2
2											3	4
3											4	8
4											5	16
5											6	32
6											7	64
7											8	128
8											9	256
9											10	512
10											11	1024
11											12	2048
12											13	4096

- 1)
 - a. Probability refers to the likelihood that an event will occur. Its numeric value ranges from 0 to 1. An event with a probability of 0 will not happen and an event with a probability of 1 will definitely happen.
 - b. Dichotomous Variable is a discrete categorical variable with two possible values. Exs. head/tail, pass/fail, male/female, do or don't do something, have a positive or negative opinion about something.

- 2)
 - a. We never "*accept*" the null or alternative hypotheses. We either: Reject the null and "*assert*" the alternative. We don't accept the alternative because we didn't test it. We tested the null by assuming its truth.
 - b. "*Fail to reject*" the null: We don't accept the null because maybe our test wasn't sensitive enough to detect a bias in the coin.

- 3)
 - a. Different possible outcomes = $N+1 = 7+1 = 8$
 Total number of all possible outcomes = $2^N = 2^7 = 128$
 - b. $N+1 = 15+1 = 16$
 $2^N = 2^{15} = 32,768$

- 4)
 1. Research Question
 2. Hypotheses
 3. Assumptions
 4. Decision Rules
 5. Computations
 6. Decision

5) 1. **Research Question**

Is Chris's cheating?

2. **Hypotheses**

Let s=probability that Sean wins and C=probability that Chris wins

	Symbols	Words
H _O	s=c	Chris is fair.
H _A	s≠c	Chris is cheating.

3. **Assumptions**

1. H_o

4. **Decision Rules**

Alpha = .05, two-tailed test, N=12

If the probability of what we observe ≤ .05, we reject H_o

If the probability of what we observe > .05, we fail to reject H_o

5. **Computation**

In terms of describing the data, Sean got 11/12 or 92% wrong when we would expect something closer to 50% if Chris was fair.

The problem involves a dichotomous variable, so we need Pascal's triangle for N=12 (which was given above) in order to obtain the relevant sampling distribution so we can perform the binomial test.

Possibs	S ¹² C ⁰	S ¹¹ C ¹	S ¹⁰ C ²	S ⁹ C ³	S ⁸ C ⁴	S ⁷ C ⁵	S ⁶ C ⁶	S ⁵ C ⁷	S ⁴ C ⁸	S ³ C ⁹	S ² C ¹⁰	S ¹ C ¹¹	S ⁰ C ¹²
P	1/4096	12	66	220	495	792	924	792	495	220	66	12	1
	.001	.003	.016	.054	.121	.193	.226	.193	.121	.054	.016	.003	.001

Event	Probability
11 Sean Wins	.003
12 Sean Wins	.001
11 Chris Wins	.003
12 Chris Wins	.001
Total	=.008

6. **Decision**

The probability of observing an event as rare as what we obtained = .008. Since this is less than the alpha level of .05, we reject H_o and conclude Chris cheats.

6) 1. **Research Question**

Do people believe the earth is warming?

2. **Hypotheses**

Let a=probability of agreeing and d=probability of disagreeing.

	Symbols	Words
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H_0	$a=d$	People do not have an opinion.
H_A	$a \neq d$	People do have an opinion.

3. Assumptions

1. H_0

4. Decision Rules

Alpha = .05, two-tailed test, N=10

If the probability of what we observe $\leq .05$, we reject H_0 .

If the probability of what we observe $> .05$, we fail to reject H_0 .

Computation

In terms of describing the data, 7/10 or 70% believed the earth is warming when we would expect something like 50% if folks did not have an opinion.

The problem involves a dichotomous variable, so we need Pascal's triangle for N=10 (which was given above) in order to obtain the relevant sampling distribution so we can perform the binomial test.

Possibs	$A^{10}D^0$	A^9D^1	A^8D^2	A^7D^3	A^6D^4	A^5D^5	A^4D^6	A^3D^7	A^2D^8	A^1D^9	A^0D^{10}
P	1/1024	10	45	120	210	252	210	120	45	10	1
	.001	.010	.044	.117	.205	.246	.205	.117	.044	.010	.001

Event	Probability
7 agree	.117
8 agree	.044
9 agree	.010
10 agree	.001
7 disagree	.117
8 disagree	.044
9 disagree	.010
10 disagree	.001
Total	=.344

5. Decision

The probability of observing an event as rare as what we obtained = .344. Since this is greater than the alpha level of .05, we fail to reject the H_0 and conclude that overall, folks do not have an opinion about global warming.