Probability and Polygraph Outcomes

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My experience in military law enforcement, graduation from the Federal Law Enforcement Academy, work with MCM Security Group and Aegis International in private investigations, and previous coursework in criminal law at Troy State University provide practical context for examining the probability concepts presented in this assignment. In these professional environments, decisions were often made with incomplete information, requiring investigators and security personnel to evaluate evidence carefully rather than rely on impressions. Probability has practical significance. My professional experience also included assignments involving presidential support, highly classified information, nuclear command environments, underground nuclear facilities, and security requirements associated with exceptionally sensitive duties. My professional experience in private investigation and security technology was documented in the security-industry press during my early work with Aegis International (Aegis Security International, n.d.; Ja'Cox, 1991). In such settings, personnel screening and continuing evaluation could be more extensive than in most civilian employment. That distinction matters here.

In investigative and national security contexts, a result that incorrectly identifies a truthful individual as deceptive represents a very different type of error from one that incorrectly identifies a deceptive individual as truthful. Keeping those possible outcomes distinct is a matter of probability and statistical reasoning, not impression. Contemporary research further illustrates the complexity of deception detection, with psychophysiological and neurological responses contributing information that cannot necessarily be reduced to a simple determination of truth or deception (Convertino et al., 2024). These data are from a polygraph (lie detector) "study conducted by Charles R. Honts and Gordon H. Barland" (National University, n.d., para. 1).

Researchers knew whether each participant lied or told the truth, allowing them to compare the resulting data with the polygraph indication. This makes it possible to calculate probabilities and examine how the choice of numerator, denominator, and selection condition changes the meaning of each result.

Table 1

Polygraph Indications and Actual Lying Status

Polygraph indication	Actually did not lie	Actually lied	Total
Subject lied	15	42	57
Subject did not lie	32	9	41
Total	47	51	98

Note. The four original cell counts are reproduced from the assignment handout (National University, n.d.). Row and column totals were calculated for this analysis.

There are 98 subjects. Let L denote lying and $T-$ denote a polygraph indication of not lying. All selections are uniform among the listed subjects. Results are rounded to four decimal places and two percentage decimal places.

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Question 1

If one of the subjects is randomly selected, find the probability of selecting someone who lied. Include both polygraph-result rows: 42 + 9 = 51 subjects lied.

The answer for this study is that a little over half of the participants were in the group that lied. If one person in the study was randomly selected, the probability that they lied is 52.04%.

$$P(L) = \frac{42+9}{98} = \frac{51}{98} \approx .5204 = 52.04\%.$$

Question 2

If one of the subjects is randomly selected, find the probability of selecting someone who did not lie and had a polygraph indication of not lying.

The word "and" identifies the intersection of two conditions. The relevant cell contains 32 subjects, and the selection is still made from all 98 subjects.

$$\text{P (did not lie and T}^{-}) = \frac{32}{98} \approx .3265 = 32.65\%.$$

Table 2

Step-by-Step Probability Table

Step	Description	Calculation	Result
1	Number in joint category (did not lie and T−)	32	32
2	Total number of subjects	98	98
3	Probability (exact fraction)	$\frac{32}{98}$	$\frac{32}{98}$
4	Probability (decimal)	32 ÷ 98	0.3265
5	Probability (percentage)	0.3265 × 100	32.65%

Note: Use the exact fractions for the final answer. Rounded values (0.48 X 0.68) introduce a small rounding difference. This elongated table provides the step-by-step thought process for an average reader.

i This is a joint probability, not the probability of a negative test conditional on being truthful.

Question 3

If one of the subjects is randomly selected, find the probability of selecting someone who lied or had a polygraph indicative of not lying.

The word "or" includes either condition or both. There are 51 subjects who lied and 41 with a negative polygraph indication. Nine subjects satisfy both conditions, so they must be subtracted once to avoid double counting.

$$P(L \text{ or T}-) = \frac{51+41-9}{98} = \frac{83}{98} \approx .8469 = 84.69\%$$

As a check, the only excluded cell contains the 15 truthful subjects whose polygraph indicated lying: 1 − 15/98 = 83/98.

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Question 4

If two different subjects are randomly selected without replacement, find the probability that they both lied.

The first selection has 51 possible subjects who lied out of 98. After selecting one of those subjects without replacement, 50 who lied remain among 97 subjects. The second probability therefore depends on the first outcome.

$$P(\text{both lied}) = \left(\frac{51}{98}\right) \times \left(\frac{50}{97}\right)$$
$$= (.5204) \times (.5155) = .2683$$
$$= 26.83\%$$

Therefore, the probability that both randomly selected subjects lied is approximately 26.83%. Using $(51/98)^2$ would incorrectly treat the selections as if the first subject were replaced.

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Question 5

Use subjective probability to estimate the probability of randomly selecting a subject who did not lie and whose polygraph indicated that he or she did lie.

I would estimate this probability at approximately .15, or 15%. This is a rounded, data-informed judgment: the relevant cell contains 15 of the 98 subjects. The observed joint proportion provides an explicit benchmark for the subjective estimate.

$$\text{Observed benchmark} = 15 \; / \; 98 \approx .1531 = 15.31\%$$

For selection from this fully specified group, 15/98 is the exact probability. The approximately 15% response addresses the requested subjective estimate; it is not a uniquely determined subjective judgment. This cannot be presented as an estimate of a measured rate for a different population.

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Interpretation and Methodological Boundaries

Question 5 is not asking for the false-positive rate conditional on being truthful. That different question would use 47 truthful subjects as its denominator: 15/47 ≈ .3191, or 31.91%. It also does not ask for the probability of being truthful given a positive polygraph result, which would be 15/57 ≈ .2632, or 26.32%. Keeping the selection event and denominator aligned prevents confusion among these three quantities.

The calculations distinguish marginal probability, joint probability, an inclusive union, dependent selections without replacement, and a subjective estimate informed by observed frequency. The assigned textbook is Bennett et al. (2017). The assigned video titles concern the normal distribution (Gibson, 2013a, 2013b); however, these five problems use exact categorical counts. A continuous normal curve, *z*-score, or normal approximation is not needed to answer the supplied questions.

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Interpretation (continued)

Although this assignment relies on categorical counts rather than physiological measurements, contemporary concealed-information research shows that investigators can evaluate several distinct forms of quantitative evidence. For example, researchers have examined skin conductance as a physiological indicator in the Concealed Information Test, while other studies have evaluated behavioral, autonomic, and neuroimaging measures (Takahashi et al., 2024; Wang et al., 2024).

Other research has examined event-related potentials as indicators of concealed information. Lin et al. (2024) found that combining several neural indicators improved discrimination between experimental groups, while a subsequent meta-analysis found substantial P300 effects across Concealed Information Test studies and also demonstrated that outcomes can vary according to the testing paradigm, protocol, and use of countermeasures (Knappe et al., 2025).

The assignment does not provide enough information about recruitment, testing conditions, or a target population to generalize these results into a universal claim about polygraph accuracy. The results describe probabilities derived from the 98 subjects included in the supplied data set. This limitation is particularly important because contemporary research shows that deception and concealed-information detection can be affected by the measurement technique, testing paradigm, protocol, physiological indicator, and use of multiple measures or countermeasures (Knappe et al., 2025; Lin et al., 2024; Takahashi et al., 2024; Wang et al., 2024). Accordingly, the probabilities calculated in this assignment should be interpreted as properties of the supplied data rather than as universal estimates of polygraph performance.

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