

Tech Talk: Polygraph Decision Rules Included in the LX Score Sheet and ESS-M Interpreter Raymond Nelson

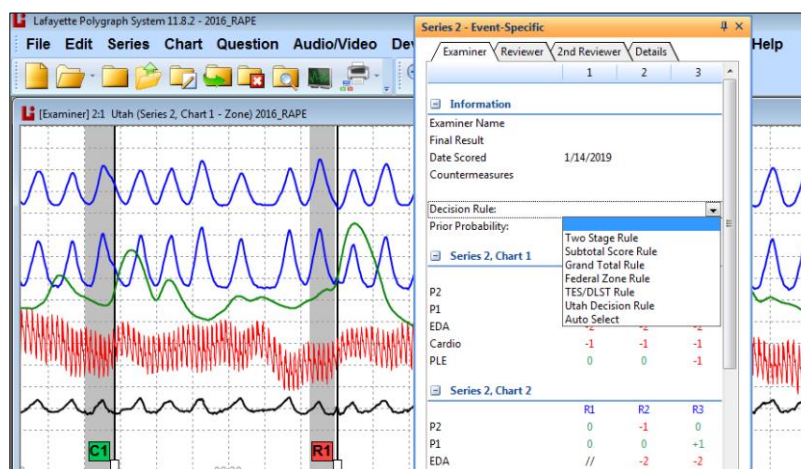
Polygraph test data analysis can be thought of as consisting of four parts.

- **Data extraction:** also referred to as feature extraction
- **Data transformation and reduction:** also discussed as numerical transformations
- **Use of a likelihood function:** a probability reference model or statistical classifier (the most basic form of this a numerical cutscore with known TP, TN, FP and FN rates) to calculate a statistical or probabilistic value for the numerical information
- **Structured decision rules:** determine the categorical test result that is best supported by the numerical data and probabilistic information

Although it is useful to think of these operations as sequential, some decisions about these operations are for scientific and ethical reasons made prior to conducting an examination. The choice of method for numerical transformations, the selection of a likelihood function and associated parameters such as alpha boundaries and cutscores are an example of decisions that should always be made prior to testing. The selection of polygraph decision rules is another choice that should always be made before conducting an examination. As a matter of convenience, the selection of decision rule is most often a function of the type of examination: whether a test is conducted for event-specific diagnostic purposes, in the investigation of a known allegation or incident, or for screening purposes, in the absence of any known allegation or incident.

Polygraph decision rules describe the structured sequence of decisions that are made using the grand total and sub-total scores, and provide a rational and scientific basis for the classification of numerical and probabilistic polygraph data as categorically positive (deceptive) or negative (truthful). Use of structured decision rules increases the reliability and reproducibility of analytic results.

Six different polygraph decision rules can be found in existing publications and are included in the ESS-M Interpreter in LXSoftware versions 11.8 and later. For convenience, all of these decision rules are executed automatically using the ESS-M Interpreter included in the LXSoftware Score Sheet as shown. Select the decision rule and click the link to the ESS-M Report Generator at the bottom of the Score Sheet dialogue.



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The decision rules include:

- Grand Total Rule
- Subtotal Score Rule
- Two-Stage Rule
- Federal Zone Rule
- TES/DLST Rule
- Utah 4-question Rule

Also shown in the graphic, LXSoftware allows users to automatically select the Subtotal Score Rule, Two-Stage Rule using a statistical test to evaluate the similarity or differences of responses to each of the relevant questions. The six decision rules are described below:

Grand Total Rule (GTR)

The GTR (Bell, Raskin, Honts & Kircher, 1999; Kircher and Raskin, 1988; Senter, 2003; Weaver, 1980), involves the calculation and comparison of either the grand total statistic or grand total score with numerical or probability cutscores. A classification is made for the test as a whole if the grand total score or grand total statistic equals or exceeds the numerical cutscore or probability cutscore for deception or truth-telling. If the grand total score or grand total statistic does not equal or exceed the numerical or probability cutscores, a result is inconclusive and no opinion is supported by the test data. Categorical or class results for individual questions are inherited from the test result. The GTR is the simplest and most robust of all decision rules. Studies that make use of the GTR have generally provided the highest rate of accuracy for categorical conclusions.

Subtotal Score Rule (SSR)

The SSR (Department of Defense, 2006a, 2006b; Capps & Ansley 1992; Senter Waller & Krapohl; 2008) is commonly used for polygraph screening examinations that are interpreted with an assumption that the criterion states vary independently for each of the relevant questions. The SSR does not involve the use of the grand total score. Instead, when using the SSR, categorical results are parsed for the individual relevant questions by comparing either the statistical values or numerical scores for question subtotals with the probability cutscores or numerical cutscores for subtotal scores.

When using the SSR, the overall test result is inherited from the results for the individual questions. The overall test result will be classified as deceptive if any of the question subtotals is significant for deception and will be classified as truthful when all of the question subtotals are significant for truth-telling. To prevent the potential for both FP and FN errors within a single exam, conclusions of both deception and truth-telling are not permitted when using the SSR. Numerical and statistical subtotals that are not significant for deception are meaningless and uninterpretable, whenever any question is significant for deception. The SSR is a highly useful rule, providing good test sensitivity for polygraph screening exams, though with reduced precision compared with the GTR. Use of a correction for statistical multiplicity can help to maintain high test specificity levels.

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Two-Stage Rule (TSR)

The TSR, (Senter, 2003; Senter & Dollins, 2003; Handler, Nelson & Blalock, 2008; Krapohl, 2005; Krapohl & Cushman, 2006; Nelson et al., 2011) is sometimes referred to as the Senter-rule. As the name implies, this rule involves two stages. Stage 1 of the TSR is simply the GTR. The TSR terminates at Stage 1 if the result is significant for deception or truth-telling. Stage 2 of the TSR is executed only when the categorical result from Stage 1 is inconclusive. Stage 2 of the TSR is the SSR. In practice, both deceptive and truthful classifications are observed at Stage 1, while only deceptive or inconclusive classifications are observed at Stage 2. This is because cases that would be classified as truthful at Stage 2 are already classified as truthful at Stage 1. Use of the TSR provides some potential increase in test sensitivity and some reduction of inconclusive results. Studies that have used the TSR with statistical correction for multiplicity have shown effect sizes for test accuracy that are similar to the GTR.

Federal Zone Comparison Rules (FZR)

The FZR (Department of Defense, 2006a, 2006b; Light, 1999) involves the simultaneous use of both grand total and subtotal scores. A deceptive classification is made if either the grand total or any subtotal score exceeds a required numerical cutscore. Truthful classifications are made only when the grand total has achieved a specified numerical cutscore with the additional requirement that all subtotal scores must also achieve an additional numerical threshold. The traditional approach has been to use numerical scores, however the FZR can also be executed using probability scores and probability cutscores.

TES/DLST Rules (TES)

The TES decision rules (Department of Defense, 2006a, 2006b; Research Division Staff, 1995a, 199b) are described in research and field practice publications on the Test for Espionage and Sabotage, also known as the Directed Lie Screening Test. Like the FZR, these decision rules involve the simultaneous use of both grand total and subtotal scores. A deceptive classification is made if either the grand total or any subtotal score exceeds a required numerical cutscore. A truthful classification is made by comparing the grand total numerical score with the required numerical cutscore for truth-telling and only when all subtotal scores exceed a required numerical threshold. When applied to the polygraph screening context, TES rules treat the criterion variance of the relevant questions as non-independent (unlike the SSR which is based on an assumption of independent criterion variance).

Utah Four-Question Rules (UT4)

The UT4 rules (Bell, Raskin, Honts & Kircher, 1999; Handler & Nelson 2008) can make use of either the grand total using the GTR or the subtotal scores using the SSR – depending on the variability in responses to relevant and comparison questions. When using the UT4, classifications of deception or truth-telling are made using the SSR whenever the sign values of the subtotal numerical scores are mixed (+ and – within the exam). The UT4 rules allow a classification of deception or truth-telling using the GTR whenever the sign values for subtotal numerical scores are either all + or all –, not including any scores with 0 sign value. Published descriptions of this rule involve the use of numerical scores, however the UT4 can also be executed using probability scores and probability cutscores.

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