LXSoftware 11.8 - Enhancements to the Lafayette ESS Interpreter (formerly, ESS "Report Generator")

- The Lafayette ESS Interpreter now uses the latest scientific research and advancements to the ESS
    - The ESS interpreter now uses the ESS-Multinomial (ESS-M) reference distributions. The Multinomial reference model is calculated using only facts and information subject to mathematical and logical proof under the basic analytic theory of the polygraph test (i.e., *greater changes in physiological activity are loaded at different types of test stimuli as a function of deception or truth-telling in response to investigation target stimuli*). An important advantage of the multinomial reference model – in addition to the mathematical expression of the test theory – is that it simplifies the generalization of the scientific polygraph testing to diverse groups that may or may not be adequately represented by available empirical reference norms. Multinomial reference distributions permit the generalization of the quantitative and probabilistic ESS method to all groups or individuals for which the basic theory of the polygraph test can be reasonably assumed to be valid. that have been published both with and without the vasomotor sensor. Another important advantage of the multinomial reference model for ESS scores is that it can be calculated using any recording sensors sensor that have been validated as correlated with deception and truth-telling, making it possible to add the vasomotor sensor to the reference distributions and quantitative/probabilistic model.
    - The ESS interpreter now includes the vasomotor sensor. The original ESS, and other algorithms, did not include the vasomotor sensor.
    - The ESS interpreter now uses a Bayesian analytic model. The previous ESS interpreter relied on frequentist analytics for which the test statistic was expressed as a p-value. The American Statistical Association and many areas of science have been moving away from the use of p-values (a statistical estimate of measurement error) as a statistical metric in classification, prediction, and decision models due to their propensity to misunderstanding and misrepresentation. P-values express a probability of error, which is counterintuitive to many people and easily misunderstood because it is not a direct measurement of the effect-size of interest (i.e., the probability of deception or probability of truth-telling. Bayesian analysis uses simple algebra to combine the test data with a prior probability and a likelihood function (i.e., the multinomial reference distribution) to calculate a posterior probability of deception or truth-telling. A posterior probability of deception or posterior probability of truth-telling is a more direct and intuitive expression of the effect-size of practical interest to polygraph examiners and referring professionals. A test result is statistically significant when the lower limit of the credible interval for the posterior odds has exceeded the greater value of the prior odds or the required minimum cut-ratio.
    - The ESS interpreter now provides probability estimates in the form of *odds* (posterior odds of deception and posterior odds of truth-telling) instead of probabilities. Odds are most often expressed in the form "*x-number-of-chances to 1.*" Odds are easily calculated from probabilities [odds = p / (1-p)], and vice-versa [p = odds / (odds + 1)]. The advantage of using odds instead of probabilities is that odds are capable of imparting information that is

more intuitive to more people and more likely to be correctly understood by persons untrained in probabilistic thinking. For this reason, sports statistics, opinion polls, statistical predications in epidemiology, and forensic contexts whenever probabilistic information is to be used by persons with less formal training in statistical concepts. In contrast to the simple intuition provided by statistics in the form of odds, an intuitive understanding of probability values will require the capacity to first map a probability value to an abstracted (imaginary) probability space between 0 and 1 and then interpret the meaning of the statistic. For persons familiar and comfortable with their use, probabilities for deception and truth are shown in parenthesis on the ESS report.

- The ESS interpreter now includes the Test of Proportions for countermeasures or random artifacts. The Test of Proportions was previously only available in the OSS-3 algorithm, and is used to calculate the probability that observed artifacts have occurred due to random chance. When the probability is significantly low that observed artifacts would have occurred due to random chance, the artifact data is a basis of evidence to support a scientific conclusion that the observed artifacts are non-random (i.e., they may be due to systematic, intentional, or strategic effort). By default the level of statistical significance for the Test of Proportions is set to alpha = .05, and this can be adjusted in the user preferences to achieve greater sensitivity or greater precision as desired.

- The ESS interpreter now includes a utility function that can be accessed by advanced users who are able to express their perceived or expected costs association with false-positive (FP) and false-negative (FN) error, or their perceived or expected value associated with true-positive (TP) or true-negative (TN) outcomes. FN and FP costs or TN and TP utility values can be included the Bayesian analytic calculations in order to help achieve desired testing or programmatic goals, associated with FP, FN, TN and FP outcomes.

- The ESS interpreter allows a user or agency to select any desired alpha level for a Bayesian credible interval for a categorical test result (deception or truth-telling). The 1-alpha credible interval can be interpreted as the level of confidence that the posterior odds of deception or truth-telling have exceeded the prior odds of deception or truth-telling. The credible interval is calculated using the Clopper-Pearson method (which has the advantage of always including the desired coverage/confidence area at the lower limit). Default alpha boundaries are .05 and .05 for deception and truth-telling and can be set by the user in the preferences.

- The ESS interpreter allows a user or agency to select any desired minimum odds-ratio for statistical significance. The default configuration is that results are considered significant for deception or truth-telling if the credible interval indicates a 95% confidence level that the posteriors odds of deception or truth-telling have exceeded the prior odds of deception or truth-telling.

- The ESS interpreter allows a user or agency to select any *prior probability* (also referred to more as simply *prior*) of deception that is supported by the case facts and circumstances. The optimal default prior probability for most circumstances is .5 (where the prior odds are 1 to 1). The default prior probability is calculated as 1 / number-of-possible conclusions. The prior probability is also referred to as a *prior probability distribution*, and can be expressed as [.5, .5] because there are two possible conclusions (deceptive or truthful) - where inconclusive/no-opinion is not a conclusion. The prior probability may be adjusted when usable information is available. For most purposes the default prior will be the optimal prior.

◦ The ESS interpreter now includes all polygraph decision rules that are extant in authoritative publications, including: the grand total rule (GTR), subtotal score rules (SSR), two-stage rules (TSR), Federal ZCT rule (FZR), TES/DLST rules (TES), and Utah 4 question rules (UT4). A brief description of the selected decision rule is included in the ESS Report narrative summary.

◦ The ESS interpreter now includes an algorithm to automatically select from the two-stage rules (TSR) and subtotal score rules (SSR) by evaluating the differences in reactions to different relevant questions. The SSR is selected when there are significant differences between relevant questions; under this circumstance the reactions to the relevant questions are assumed to be independent. The TSR is selected when differences are not significant among the relevant questions (reactions appear to be non-independent/dependent).

◦ The ESS interpreter can apply any polygraph decision rules to ESS scores using traditional numerical cutscores as an alternative to cutscores calculated from the multinomial reference model.

◦ The ESS interpreter can calculate the odds (and probability) of deception and truth-telling using 3-position cores instead of ESS scores. Cutscores for 3-position scores are calculated from a complete multinomial reference model for 3-position scores, included in the ESS interpreter. The ESS interpreter can also apply any polygraph decision rule to 3-position scores using traditional numerical cutscores instead of the 3-position multinomial reference model. Statistical values are not included in the ESS report when classification is made using traditional numerical cutscores.

◦ The ESS interpreter can apply any polygraph decision rule to 7-position scores using traditional numerical cutscores. No multinomial reference model exists for 7-position scores, and statistical values are not included in the ESS report when classification is made using 7-position scores with traditional numerical cutscores.

◦ The ESS Report provides detailed information on all analysis parameters and analytic results.

◦ The ESS Report provides a complete written narrative summary that can be copied and pasted into a written report or it can be added to a user's customized report template. The written narrative summary describes the form of analysis, input parameters, decision rules and analytic results.