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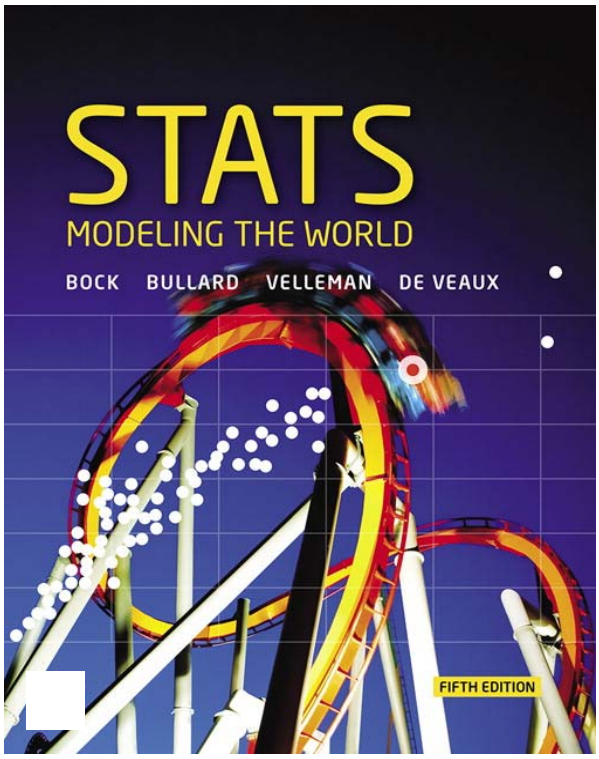

To the

International Baccalaureate
Diploma Programme Mathematics HL
Topic Content - Statistics and Probability

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To the International Baccalaureate Diploma Programme Mathematics HL Topic Content
Statistics and Probability

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Topic 5—Core: Statistics and probability

The aim of this topic is to introduce basic concepts. It may be considered as three parts: manipulation and presentation of statistical data (5.1), the laws of probability (5.2–5.4), and random variables and their probability distributions (5.5–5.7). It is expected that most of the calculations required will be done on a GDC. The emphasis is on understanding and interpreting the results obtained. Statistical tables will no longer be allowed in examinations.

	Content	**Stats, Modeling The World 5th Edition ©2019**
5.1	Concepts of population, sample, random sample and frequency distribution of discrete and continuous data. Grouped data: mid-interval values, interval width, upper and lower interval boundaries. Mean, variance, standard deviation. **Not required:** Estimation of mean and variance of a population from a sample.	**SE/TE:** 4, 15-16, 50-53, 55-56, 58-59, 80-83, 278, 280, 389-390, 392-393, 399-402
5.2	a. Concepts of trial, outcome, equally likely outcomes, sample space (U) and event. b.The probability of an event *A* as $\mathrm{P}(A)=\frac{n(A)}{n(U)}$. The complementary events *A* and *A*' (not *A*). Use of Venn diagrams, tree diagrams, counting principles and tables of outcomes to solve problems.	**SE/TE:** 267, 343, 349, 359, 364-365, 371-374, 376-378, 384-387, 416-417
5.3	Combined events; the formula for P(*A*∪*B*). Mutually exclusive events.	**SE/TE:** 349-350

SE = Student Edition

TE = Teacher's Edition

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5.4	Conditional probability; the definition $P(A \mid B) = \frac{P(A \cap B)}{P(B)}$. Independent events; the definition $P(A \mid B) = P(A) = P(A \mid B')$. Use of Bayes' theorem for a maximum of three events.	**SE/TE:** 366-368, 368-371, 376-378, 380-382
5.5	Concept of discrete and continuous random variables and their probability distributions. Definition and use of probability density functions. Expected value (mean), mode, median, variance and standard deviation. Applications.	**SE/TE:** 389-390, 392-393, 394-399, 400-402, 406-410
5.6	Binomial distribution, its mean and variance. Poisson distribution, its mean and variance. Not required: Formal proof of means and variances.	**SE/TE:** 416-420 For related content please see: **SE/TE:** 394-397
5.7	Normal distribution. Properties of the normal distribution. Standardization of normal variables.	**SE/TE:** 103-105, 107-110, 399-402, 421-423

Topic 7—Option: Statistics and probability

The aims of this option are to allow students the opportunity to approach statistics in a practical way; to demonstrate a good level of statistical understanding; and to understand which situations apply and to interpret the given results. It is expected that GDCs will be used throughout this option, and that the minimum requirement of a GDC will be to find probability distribution function (pdf), cumulative distribution function (cdf), inverse cumulative distribution function, p-values and test statistics, including calculations for the following distributions: binomial, Poisson, normal and t. Students are expected to set up the problem mathematically and then read the answers from the GDC, indicating this within their written answers. Calculator-specific or brand-specific language should not be used within these explanations.

	Content	**Stats Modeling The World, 5th Edition ©2019**
7.1	Cumulative distribution functions for both discrete and continuous distributions. Geometric distribution. Negative binomial distribution. Probability generating functions for discrete Using probability generating functions to find mean, variance and the distribution of the sum of *n* independent random variables.	**SE/TE:** 389-390, 392-393, 399-402, 413-416, 417-419
7.2	Linear transformation of a single random variable. Mean of linear combinations of *n* random variables. Variance of linear combinations of *n* independent random variables. Expectation of the product of independent random variables.	**SE/TE:** 391-397
7.3	Unbiased estimators and estimates. Comparison of unbiased estimators based on variances. $\overline{X}$ as an unbiased estimator for μ . S^2 as an unbiased estimator for σ 2.	This standard is outside the scope of Stats Modeling The World, 5th Edition ©2019

	Content	Stats Modeling The World, 5th Edition ©2019
7.4	A linear combination of independent normal random variables is normally distributed. In particular, $X \sim \mathrm{N}(\mu, \sigma^2) \Rightarrow \overline{X} \sim \mathrm{N}\left(\mu, \frac{\sigma^2}{n}\right)$. The central limit theorem.	**SE/TE:** 443-452, 452-458
7.5	Confidence intervals for the mean of a normal population.	**SE/TE:** 579-580, 591-592
7.6	Null and alternative hypotheses, H_0 and H_1. Significance level. Critical regions, critical values, p-values, one-tailed and two-tailed tests. Type I and II errors, including calculations of their probabilities. Testing hypotheses for the mean of a normal population.	**SE/TE:** 477, 494-495, 496-498, 499-503, 504-510, 519-522, 523-526, 527-529, 530-534

	Content	Stats Modeling The World, 5th Edition ©2019
	Introduction to bivariate distributions. Covariance and (population) product moment correlation coefficient ρ. Proof that $\rho = 0$ in the case of independence and ±1 in the case of a linear relationship between X and Y. Definition of the (sample) product moment correlation coefficient R in terms of n paired observations on X and Y. Its application to the estimation of ρ. Informal interpretation of r, the observed value of R. Scatter diagrams.	
7.7	**The following topics are based on the assumption of bivariate normality.** Use of the t-statistic to test the null hypothesis Knowledge of the facts that the regression of X on Y □E(X |Y □ y)□ and Y on X □E(Y | X □ x)□ are linear. Least-squares estimates of these regression lines (proof not required). The use of these regression lines to predict the value of one of the variables given the value of the other.	**SE/TE:** 148-151, 152-153, 156-159, 171-175, 176-180, 185-187, 188-190, 205-216, 235-238, 704, 712-715