

# Math 373 Review 1

Exam 1: Fri. Feb. 8

Graded homework is placed in the bin on my office door (PSB 318) and may be picked up after 3:00.

**Material** Lectures: 1-8. Practice Exam Monday. Bring **scratch paper** and your **calculator**. If your calculator doesn't do the normal distribution, bring your text. You may use it's front page and the back page tables.

## Definitions

Median, mode, range, population variance, sample variance, standard deviation, z-score, first and third quartile, interquartile range.

Covariance, correlation coefficient, least-squares line, mutually exclusive.

Conditional probability, independent events, expected value (mean), variance, std. dev. of a random variable.

Binomial experiment.

Normal probability density function.

## Theorems

**EMPIRICAL BELL RULE.** In normal distributions pictured above (bell or mound-shaped curves), about 68% of the data are within 1 std. dev. of the mean. About 95% are within 2 std. dev. About 99% are within 3 std. dev.

**CHEBYSHEV'S THEOREM.** At least  $1 - 1/k^2$  measurements are within  $k$  std. dev. of the mean.

**RANGE APPROXIMATION.** Most of the time, the range  $R$  is about 4 times the std. dev.  $s$ . Thus  $s \approx R/4$ .

The z-score of  $x$  is  $(x - \bar{x})/s$ .

$$P(A^c) = 1 - P(A).$$

$$P(A \cup B) = P(A) + P(B) - P(A \cap B).$$

If  $A$  and  $B$  are *mutually exclusive*, i.e.,  $A \cap B = \emptyset$ , then

$$P(A \cup B) = P(A) + P(B).$$

**THEOREM.**  $P(A \cap B) = P(B)P(A|B) = P(A)P(B|A)$ . If  $A$  and  $B$  are independent,  $P(A \cap B) = P(B)P(A)$ .

**THEOREM.** The probability  $p(k) = P(x=k)$  of  $k$  successes in  $n$  trials of a Binomial experiment is:

$$\binom{n}{k} p^k q^{n-k} = \frac{n!}{k!(n-k)!} p^k q^{n-k}.$$

**THEOREM.** In a binomial experiment with  $n$  trials with probability  $p$  of success, with probability  $q$  of failure, and with  $x$  the number of successes in  $n$  trials:

$$\text{mean} \quad \mu = E(x) = np$$

$$\text{variance} \quad \sigma^2 = npq$$

$$\text{std. dev.} \quad \sigma = \sqrt{npq}.$$

**THEOREM.** If  $x$  is a Poisson random variable measuring the number of occurrences of random independent events in a given period and  $\mu$  is its mean, then

$$P(x = k) = \frac{\mu^k e^{-\mu}}{k!}, \text{ and } \sigma = \sqrt{\mu}.$$

**POISSON THEOREM.** For large  $n$  ( $n > 30$ ) and small  $\mu$  ( $\mu = np < 7$ ), the binomial probabilities are approximately the Poisson probabilities.

$$\frac{n!}{k!(n-k)!} p^k q^{n-k} \approx \frac{\mu^k e^{-\mu}}{k!} \text{ where } \mu = np.$$

**HYPERGEOMETRIC THEOREM.** If a sample of  $n$  items is drawn from a population of  $N$  items of which  $M$  items are labeled "success", then for  $k=0, 1, \dots, n$  and  $x =$  the number of successes in the  $n$  item sample:

$$\mu = n\left(\frac{M}{N}\right) \quad \sigma = \sqrt{n\left(\frac{M}{N}\right)\left(\frac{N-M}{N}\right)\left(\frac{N-n}{N-1}\right)}$$

$$P(x = k) = \frac{\binom{M}{k}\binom{N-M}{n-k}}{\binom{N}{n}}$$

## Main Techniques *Be able to*

Make bar, Pareto, pie charts, time series line charts, dot plots, stem-and-leaf plots, and frequency (relative frequency) histograms.

Calculate range, mode, median, mean, variance, std. dev., z-score, first and third quartile, IQR.

Make stacked and side-by-side histograms for bivariate datasets. Make scatterplots. Calculate covariance and correlation coefficients and least-squares lines.

Draw tree diagrams. Calculate probabilities and conditional probabilities. Calculate the mean, variance and std. dev. for a random variable.

Calculate the mean, std. dev. and probability distributions for binomial, Poisson, and hypergeometric random variables.

Determine which distribution (binomial, Poisson, hypergeometric, normal) should be used.

**Suggested Exercises.** *All homework exercises plus the recommended exercises.*

## Page Problem

14: 1.1, 1.3, 1.5, 1.7, 1.9a-f, 1.11ab.

27: 1.17abc, 1.19, 1.12a.

56: 2.3abc.

63: 2.13abcd.

69: 2.17abc.

80: 2.29, 2.31.

97: 3.1, 106: 3.7.

126: 4.3, 4.5, 4.7.

145: 4.41-4.51.

152: 4.65, 4.67.

161: 4.77, 4.79.

152: 4.69, 4.71.

163: 4.83, 4.85, 4.95.

183: 5.5, 5.7, 5.13.

185: 5.17, 5.19.

190: 5.31, 5.35.

193: 5.41, 5.43, 5.45.

217: 6.3ab, 6.5a, 6.11ab, 6.13.