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Chapter 1

**Reviewing Basics:**

Measure of central tenancy

**Mean-** Measures of where generally the middle of the data is. Sometimes called the “expected value” E.

**Median-**

**Mode(exactly one mode) || no mode**

**Use these once you have the average**

**Range-**

**Domain-**

**Variance -** how far away a value might be from the mean.

**Standard deviation-** Measures how close the mean values tend to be. Lower means closer to E. Larger means that your distribution is more spread out and unevenly spread out.

**Building Relative Frequency Histogram**

- Open Excel

- Punch in values

- Highlight values

- Insert pivot table

- Drag average wind speeds to rows and sum values

- Right click right column,(not title) value field settings, change to count

- Right click left column group by 2

- Pivot table- ANALYZE TAB – Pivot chart to insert graph

- Right click right column

-Value field settings – show value as % grand total

-Number format, number 3 Decimal Places

-Rename Sheets

**Empirical Rule**

- For normal distribution

- µ ± σ contains 68% of the measurements

- µ ± 2σ contains 95% of the measurements

- µ ± 3σ contains 99.7% of the measurements

**Finding Standard Deviation**

-find the mean

- find each values deviation from the mean

-subtract mean from each value

-square each deviation from the mean

-add up the squares

-find the variance

-divide by 1 less than the number of values

-find square root of the variance

EX:{46,69,32,60,52,41}

**TRIVIA**

- Greek letters means population (all values).

- English letters mean were doing math on sample data within a population

**The Basics of Probability**

Probability- the chance of a particular event occurring, given a particular set of circumstances

probability

Set Theory- A set S is a collection of individual elements such as s. sES

s is an element in the set S.

s may be:

finite if it contains a finite number of elements

countable if it contains a countably infinite number of elements

uncountable if it contains an uncountable infinite number of elements

**Subset**

A is a subset of S if it contains some, all, or none of the elements of S

some: A **c** S some or all: A **c** S

That is A is a subset of S if every element of A is also an element of S

s Ɛ A → s E S

**Ex:**

S = {0,1}; A={0}, or A={1}, or A = {0,1}

S= {‘dog’, ‘cat’, ‘mouse’, ‘elephant’}; A = {‘cat’, mouse}

S = [0,1]; A = (0.25,0.3)

Special case: the empty set ø, is a subset that contains no elements

In probability, it is necessary to think of sets of subsets of S.

Another Example:

S = {1,2,3,4}

Consider all the subsets of S:

- One Element = {1}, {2},{3},{4}

- Two Elements = {1,2}, {1,3}, {1,4}, {2,3}, {2,4}, {3,4}

- Three Elements = {1,2,3}, {1,2,4}, {1,3,4},{2,3,4}

- Four Elements = {1,2,3,4}

- Add to this list is the empty set {zero elements}, ø

There is a collection of 16 subsets of S

**Set Operations**

To manipulate sets we use 3 basic operations: we may focus on the case where two set A and B are subsets of set S.

**Intersection:** the intersection of two sets A and B is the collection of elements that are elements of both A and B.

s E A∩B ← → s E A and s E B

**Intersection Trivia:**

**Union:**

**Union:** the union of two sets A and B is the set of distinct elements that are either in A, or in B, or in both A and B

\*\*enter math eq\*\*\*

**Trivia:**

**Compliment**

**compliment:** the compliment of set A , a subset of S, is the collection of elements of S that are not elements of A.

\*\*enter math eq\*\*

We have that:

A ∩ A’ = ø and A U A’ = S

**Trivia:**

The notations ̅A and A^c are also used for the compliment of A.

We have for any A ͟C S that

(A’)’ = A

**Example:**

page 23 figure 2.2, 2.3, 2.4, 2.5

Example: (Finite Set)

S = {1,2,3,….9,10}

A = {2,4,6}

B ={1,2,5,7,9}

Then

A ∩ B= {2}

A U B= {1,2,4,5,6,7,9}

A’ = {1, 3, 5, 7, 8, 9, 10}

**De Morgan’s Laws**

These two results

A’ ∩ B’ = (A U B)’

A’ U B’ = (A ∩ B)’

are sometime known as de Morgans Laws.

**PRACTICE:**

P.25

Exercises 2.1,2.6,2.7,2.8

2.1 = male and female problem.

**Sample Space and Events**

we now utilize the set theory formula and notation in the probability context

recall the earlier informal definition

by probability , we generally mean the chance of a particular event occurring given a particular set of circumstances. The probability of an event is generally expressed as a quantitative measurement.

We need to carefully define what an ‘event’ is. And what constitutes a ‘particular **set** circumstance’.

**What is an experiment?**

- we consider the general setting of an experiment:

- this can interpreted as any setting in which an uncertain consequence is to arise:

- could involve observing an outcome, Taking a measurement

**Consider the possible outcomes of the experiment:**

make a ‘list’ of the outcomes that can arise, and denote the corresponding set by S.

- S = {0,1};

- S = {‘head’, ‘tails’};

- S = {‘Arts’, ‘Engineering’, ‘Medicine’, ‘Science’};

- S = {1,2,3,4,5,6};

- S = R+

The set S is termed the sample space of the experiment. The individual elements of S are termed sample points (or sample outcomes).

**Events**

**Events:** an event A is a collection of sample outcomes. That is A is a subset of S.

A (C bar under ) S.

for example:

- A = {0};

- A = {‘tail’} ≡(T);

- A = {‘cured’};

- A = {‘Arts’, ‘Engineering’};

- A = {1,3,5};

- A = {2,3};

The individual sample outcomes are termed simple (or elementary) events, and may be denoted

E1,E2….,EK,….

**Terminology**

**Terminology:** we say that event A occurs if the actual outcomes,s, is an element of A.

For two event A and B

- A ∩ B occurs if and only if A occurs and B occurs, that is, s E A ∩ B.

- A U B occurs if A occurs or if B occurs, or if both A and B occur, that is, s E A U B

- if A occurs, then A’ does not occurring

**Back to the Book**

page 28.

figure 2.7 we have a sample Space S, and the possible simple events of a dice roll 1-6

its also discrete sample size, see Definition 2.4

figure 2.8 we can write the events as a subset, or as a collection of unions.

We call those groups, events, instead of Simple Events, (they are subset).

**Definition 2.6**

Axiom 1: P(A) >= 0

- the probability of an event occurring cant be negative

Axiom 2: P(S) = 1

- the probability of an event occurring from the set is always 100%

Axiom 3: The probability of pairwise exclusive events, is the sum of probabilities.

- Consider the dice example, odds of an odds number ?

- P(A) = P(E1 U E3 U E5) = 1/6 + 1/6 + 1/6 = ?

- In English, it would be the probability of E1 OR E2 Or..

- note the or

**Book:**

**P.32**

Exercise 2.10,2.11,2.14,2.18

Pick 2 problems thar have answer in the back of book. Do them. Dealers choice

**Some Immediate corollaries of the axioms:**

if we shuffle variables around from definitions, we can form some potentially useful formulas

- P(A’) = 1 – P(A)

- P(S) = P(A) + P(A’)

- 1 = P(A) + P(A’) and P(A’) = 1 – P(A)

- P(ø) = 0 and P(S) =1

- P(A) ≤ 1

- 1 = P(S) = P(A) + P(A’) ≥P(A)

**Calculating Probability of an Event**

- determine how to write out common events, (when possible…)

- assign probabilities to each event

- pick out which events are interesting. We call this A.

- substitute into probability equation. P(A) = ?

**Flip a coin 3 times. Odds of exactly two heads?**

E1:HHH E2:HHT E3:HTH E4: THH

E5: HTT E6: THT E7: TTH E8:TTT

-There are 8 possible outcomes. So the odds of 1 occurring. Is 1 out of 8. 1/8

- only events 2, 3, 4 have 2 heads

- P(A) = P(E2) + P(E3) + P(E4)

- = 1/8 + 1/8 + 1/8 = 3/8

**Book**

Do these P.39

2.28, 2.33, 2.34

**Note**

sometimes counting the sample space isnt an option… thats when we need some beefier math tools.

We can use permutations and combinations

**Permutations**

An ordered arrangement of r distinct objects is called a permutation. The number of ways of ordering n distinct objects (total) taken r at a time (how many) is denoted , and by the multipication rule we have that

= n!/(n-r)!

Book P.43 Example 2.8

**Multinomial coefficients**

The number of ways partitioning n distinct objects into k disjoint subsets of sizes

n1,n2...nk

where

(ADD EQUATION)

is

(ADD EQUATION)

**Example**

a university department comprises 40 faculty members. Two committees of 12 faculty members, and two committees of 8 faculty members, are needed. The number of distinct committee configurations that can be formed is

(ADD EQUATION)

**Example P.45 2.10 Book**

**Combinations**

The number of combinations n objects taken r at a time is the number of subsets, each of size r, that can be formed from objects. This number is denoted

(ADD EQUATION)

where

(ADD EQUATION)

**Combinatorial Probability Example**

Five cards are selected without replacement from the standard deck (52 cards, no jokers). What is the probability they are all hearts?

Number of elements in S: (ADD EQUATION)

Number of elements in A: (ADD EQUATION)

P(A) = A / S = 0.0004951981

Consider p.43 Theorem 2.2 and p.46 2.4

Book p.46 Example 2.11

**Book**

P.48-51

2.35 – 2.43 odd

2.51,2.54,2.61

Deck of Cards 2.57,2.58,2.59

Dice 2.64, 2.65

**Conditional Probability**

Probability of A given B has occurred

(ADD EQUATION)

**Quick formula word recap**