MATH 108 Midterm Reference Guide — Page 1

Statements

```
more_than_1 = 2 + 3
```

Name — Any expression

- Statements don't have a value; they perform an action
- An assignment statement changes the meaning of the name to the left of the = symbol
- The name is bound to a value (not an equation).

Comparisons

- < and > mean what you expect (less than, greater than)
- <= means "less than or equal"; likewise for >=
- == means "equal"; != means "not equal"
- Comparing strings compares their alphabetical order

Arrays - sequences of the same type that can be manipulated

- Arithmetic and comparisons are applied to each element of an array individually
  - `make_array(1,2,3) ** 2 # array([1, 4, 9])`
- Elementwise operations can be done on arrays of the same size
  - `make_array(3,2) * make_array(5,4) # array([15,8])`

Defining a Function

```
def function_name(arg1, arg2, ...):
    # Body can contain anything inside of it
    return # a value (the output of the function call)
```

Defining a Function with no arguments

```
def function_name():
    # Body can contain anything inside of it
    return # a value (the output of the function call)
```

- Functions with no arguments can be called by `function_name()`

For Statements

```
total = 0
for i in np.arange(12):
    total = total + i
```

- The body is executed **for** every item in a sequence
- The body of the statement can have multiple lines
- The body should do something: assign, sample, print, etc.

Conditional Statements

```
if <if expression>:
    <if body>
elif <elif expression 0>:
    <elif body 0>
elif <elif expression 1>:
    <elif body 1>
...
else:
    <else body>
```

Operations: addition `2+3=5`; subtraction `4-2=2`; division `9/2=4.5` multiplication `2*3=6`; division remainder `11%3=2`; exponentiation `2**3=8`

Data Types: string "`hello`"; **boolean** `True, False`; **int** `1, -5`; **float** `- 2.3, -52.52, 7.9, 8.0`

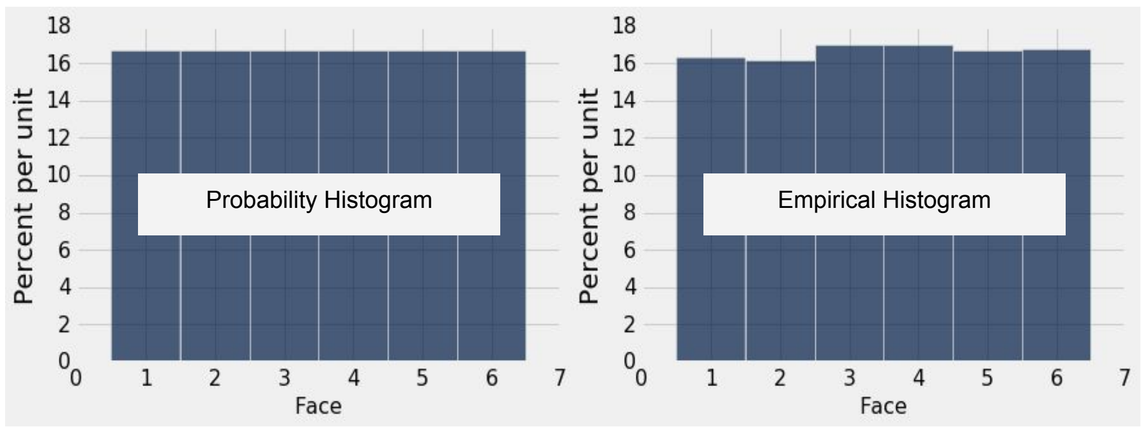
`Table.where` predicates: Any of these predicates can be negated by adding "`not_`" in front of them, e.g. `are.not_equal_to(x)`

- `are.equal_to(x) # val == x`
- `are.above(x) # val > x`
- `are.above_or_equal_to(x) # val >= x`
- `are.below(x) # val < x`
- `are.between(x, y) # x <= val < y`
- `are.containing(s) # contains the string s`

A **histogram** has a few defining properties:

- The bins are continuous (though some might be empty) and are drawn to scale
- The **area** of each bar is equal to the percent of entries in the bin
- The total area is 100%

- The histogram on the left represents the theoretical probabilities in the distribution of the face that appears on one roll of a fair die
- The histogram on the right represents the observed distribution of the faces after rolling the die many times
- If we keep rolling, the right hand histogram is likely to look more like the one on the left



Calculating Probabilities

Complement Rule: P(event does not happen) = 1 - P(event happens)

Multiplication Rule: P(two events both happen) =
P(one happens) * P(the other happens, given that the first happened)

Addition Rule: If an event can happen in ONLY one of two ways:
P(event happens) =
P(first way it can happen) + P(second way it can happen)

Simulating a Statistic:

- Create an empty array in which to collect the simulated values
- For each repetition of the process
  - Simulate one value of the statistic
  - Append this value to the collection array
- At the end, all simulated values will be in the collection array

MATH 108 Midterm Reference Guide — Page 2

In the examples in the left column, `np` refers to the NumPy module, as usual. Everything else is a function, a method, an example of an argument to a function or method, or an example of an object we might call the method on. For example, `tbl` refers to a table, `array` refers to an array, and `num` refers to a number. `array.item(0)` is an example call for the method `item`, and in that example, `array` is the name previously given to some array.

`max(array); min(array)`	Maximum or minimum of an array
`sum(array)`	Sum of all elements in an array; The sum of an array of boolean values is the number of values that are True
`len(array)`	Length (num elements) in an array
`round(num); np.round(array)`	The nearest integer to a single number or each number in an array
`abs(num); np.abs(array)`	The absolute value of a single number or each number in an array
`np.average(array), np.mean(array)`	The average of the values in an array

`np.arange(start, stop, step)`
`np.arange(start, stop)`
`np.arange(stop)`
	An array of numbers starting with `start`, going up in increments of `step`, and going up to but excluding `stop`. When `start` and/or `step` are left out, default values are used in their places. Default `step` is 1; default `start` is 0.

`array.item(index)`	The item in the array at some index. `array.item(0)` is the first item of `array`.
`np.append(array, item)`	A copy of the array with item appended to the end. If item is another array, all of its elements are appended.
`np.random.choice(array)` `np.random.choice(array, n)`	An item selected at random from an array. If `n` is specified, an array of `n` items selected at random with replacement is returned. Default `n` is 1.
`np.ones(n)`	An array of length `n` which consists of all ones.
`np.diff(array)`	An array of length `len(array)-1` which contains the difference between adjacent elements.
`np.count_nonzero(array)`	An integer corresponding to the number of non-zero (or `True`) elements in an array.
`sample_proportions(sample_size, model_proportions)`	An array of proportions that add up to 1. The result of sampling `sample_size` elements from a distribution specified by `model_proportions`, and keeping track of the proportion of each element sampled.
`Table()`	An empty table.
`Table.read_table(filename)`	A table with data from a file.
`tbl.num_rows`	The number of rows in a table.
`tbl.num_columns`	The number of columns in a table.
`tbl.labels`	A list of the column labels of a table.
`tbl.with_column(name, values)` `tbl.with_columns(n1, v1, n2, v2...)`	A table with an additional or replaced column or columns. `name` is a string for the name of a column, `values` is an array.
`tbl.column(column_name_or_index)`	An array containing the values of a column
`tbl.select(col1, col2, ...)`	A table with only the selected columns. (Each argument is the label of a column, or a column index.)
`tbl.drop(col1, col2, ...)`	A table without the dropped columns. (Each argument is the label of a column, or a column index.)
`tbl.relabeled(old_label, new_label)`	A new table with a label changed.
`tbl.take(row_index)` `tbl.take(row_indices)`	A table with only the row(s) at the given index or multiple indices. `row_indices` must be an array of indices.
`tbl.sort(column_name_or_index)`	A table of rows sorted according to the values in a column (specified by name/index). Default order is ascending. For descending order, use argument `descending=True`. For unique values, use `distinct=True`.
`tbl.where(column, predicate)`	A table of the rows for which the column satisfies some predicate. See "`Table.where predicates`" on Page 1.
`tbl.apply(function, column)`	An array of results when a `function` is applied to each item in a `column`.
`tbl.group(column_or_columns)`	A table with the counts of rows grouped by unique values or combinations of values in a column or columns.
`tbl.group(column_or_columns, func)`	A table that groups rows by unique values or combinations of values in a column or columns. The other values are aggregated by `func`. All column names (except the one(s) we group by) will now be `original_name func`. If a column is named 'price', and we group using the `min` function, our new column name will be 'price min'.
`tblA.join(colA, tblB, colB)` `tblA.join(colA, tblB)`	A table with the columns of `tblA` and `tblB`, containing rows for all values of a column that appear in both tables. Default value of `colB` is `colA`. `colA` is a string specifying a column name, as is `colB`.
`tbl.pivot(col1, col2)` `tbl.pivot(col1, col2, vals, collect)`	A pivot table where each unique value in `col1` has its own column and each unique value in `col2` has its own row. The cells of the grid contain row counts (two arguments) or the values from a third column, aggregated by the collect function (four arguments) .
`tbl.sample(n)` `tbl.sample(n, with_replacement)`	A new table where `n` rows are randomly sampled from the original table. Default is with replacement. For sampling without replacement, use argument `with_replacement=False`. If sample size `n` is not specified, the default is the number of rows in the original table.
`tbl.scatter(x_column, y_column)`	Draws a scatter plot consisting of one point for each row of the table.
`tbl.barh(categories)` `tbl.barh(categories, values)`	Displays a bar chart with bars for each category in a column, with length proportional to the corresponding frequency. If `values` is not specified, overlaid bar charts of all the remaining columns are drawn.
`tbl.bin(column, bins)`	A table of how many values in a column fall into each bin. Bins include lower bounds & exclude upper bounds.
`tbl.hist(column, unit, bins, group)`	Displays a histogram of the values in a column. `unit` and `bins` are optional arguments, used to label the axes and group the values into intervals (bins), respectively. Bins include lower bounds & exclude upper bounds. If `group` is specified, the rows are grouped by the values in the column, and histograms for all the groups are overlaid.