0.1 Accuracy Precision and Recall

	Null hypothesis (H_0) true	Null hypothesis (H_0) false
Reject null hypothesis	**Type I error** False positive	**Correct outcome** True positive
Fail to reject null hypothesis	**Correct outcome** True negative	**Type II error** False negative

In the context of a binary classification prediction procedure

	Predicted Negative	Predicted Positive
Observed Negative	True Negative	False Positive
Observed Positive	False Negative	True Positive

Accuracy, Precision and recall are defined as

$$\text{Accuracy} = \frac{tp + tn}{tp + tn + fp + fn}$$

$$\text{Precision} = \frac{tp}{tp + fp}$$

$$\text{Recall} = \frac{tp}{tp + fn}$$

The F measure is computed as

$$F = 2 \cdot \frac{\text{precision} \cdot \text{recall}}{\text{precision} + \text{recall}}$$

Questions

	Predicted Negative	Predicted Positive
Negative Cases	TN: 9,700	FP: 165
Positive Cases	FN: 35	TP: 100

With reference to the table above, compute each of the following appraisal metrics.

a. Accuracy

b. Precision

c. Recall

d. F measure

Question 12 - Classification Metrics

For each of the following classification tables, calculate the following appraisal metrics.

- accuracy
- recall
- precision
- F-measure

	Predict Negative	Predict Positive
Observed Negative	9500	85
Observed Positive	115	300

	Predict Negative	Predict Positive
Observed Negative	9700	140
Observed Positive	60	100

	Predict Negative	Predict Positive
Observed Negative	9530	10
Observed Positive	300	160

0.2 Computer Output

Statistical Procedures were performed using a statistical programming language called R. A brief description of each procedure is provided. For each procedures, identify the null and alternative hypotheses, the $p-$value, and your conclusion for this test.

- If the $p-$value is less than 0.05 : reject the null hypothesis.
- If the $p-$value is greater than 0.05 : fail to reject the null hypothesis.

Test 1. Single Sample Test for Proportions

- Sample size $(n) = 500$
- Number of successes $(x) = 280$
- Expected value under null hypothesis (Usually π, but here as p)

```
> prop.test(x=280,n=500,p=0.60)

1-sample proportions test with continuity correction

data:  280 out of 500, null probability 0.6
X-squared = 3.1688, df = 1, p-value = 0.07506
alternative hypothesis: true p is not equal to 0.6
95 percent confidence interval:
0.5151941 0.6038700
sample estimates:
p
0.56
>
```

Question 11 - Shapiro-Wilk Test

Interpret the output from the three Shapiro-Wilk tests. What is the null and alternative hypotheses? State your conclusion for each of the three tests.

```
> shapiro.test(X)

Shapiro-Wilk normality test

data:  X
W = 0.9001, p-value = 0.113
>
```

```
> shapiro.test(Y)

Shapiro-Wilk normality test

data:  Y
W = 0.8073, p-value = 0.006145
>
```

```
> shapiro.test(Z)

Shapiro-Wilk normality test

data:  Z
W = 0.9292, p-value = 0.372
```

Test 2. F Test for equality of variance

- In this procedure, we determine whether or not two ***populations*** have the same variance.
- The assumption of equal variance of two populations underpins several inference procedures. This assumption is tested by comparing the variance of samples taken from both populations.
- The null and alternative hypotheses are as follows:

$$H_0 : \sigma_1^2 = \sigma_2^2$$
$$H_1 : \sigma_1^2 \neq \sigma_2^2$$

```
> var.test(X,Y)

F test to compare two variances

data:  X and Y
F = 2.5122, num df = 9, denom df = 9, p-value = 0.1862
alternative hypothesis: true ratio of variances
is not equal to 1
95 percent confidence interval:
0.6239986 10.1141624
sample estimates:
ratio of variances
2.512215
```

Test 3. Shapiro Wilk's Test for Normality

- We will often be required to determine whether or not a data set is normally distributed. This assumption underpins many statistical models.
- The null hypothesis is that the data set is normally distributed.
- The alternative hypothesis is that the data set is not normally distributed.
- One procedure for testing these hypotheses is the Shapiro-Wilk test, implemented in `R` using the command `shapiro.test()`.

```
> shapiro.test(X)

Shapiro-Wilk normality test

data:  X
W = 0.9849, p-value = 0.1012
```