ECE 341 - Homework #15

F-Test and ANOVA. Summer 2024

Test of a 3+ Populations

1) The yearly rainfall in Fargo over 20 year spans are: (units: inches per year)

- Source: Hector Airport

		mean	std	n
A	1942-1961	19.6925	3.6771	20
B	1972-1991	19.5740	4.9078	20
C	2002-2021	23.5047	5.3599	19

Determine if the means are the same using an ANOVA test.

Code:

```
Xa = 19.6925;
Sa = 3.6771;
Xb = 19.5740;
Sb = 4.9078;
Xc = 23.5047;
Sc = 5.3999;
Na = 20;
Nb = 20;
Nc = 19;
k = 3;
N = Na + Nb + Nc
G = (Na*Xa + Nb*Xb + Nc*Xc) / N
MSSb = (Na*(Xa-G)^2 + Nb*(Xb-G)^2 + Nc*(Xc-G)^2) / (k-1)
MSSw = ((Na-1)*Sa^2 + (Nb-1)*Sb^2 + (Nc-1)*Sc^2) / (N-k)
F = MSSb / MSSw
```

Reslt

```
N  =     59
G  =    20.8800
MSSb =    96.6039
MSSw =    22.1322
F  =     4.3649
```

Now calculate the probability

- The numerator has (k-1) degrees of freedom
- The denominator has (n-k) degrees of freedom

From StatTrek, p = 0.983

I am 98.3% certain these populations have different means

2) The yearly snowfalll in Fargo over 20 year spanns are: (units: inches per year)

- Source: Hector Airport

		mean	std	n
A	1942-1961	30.0750	15.9243	20
B	1962-1981	38.7700	10.1451	20
C	1982-2001	52.1250	23.4270	20

Determine if the means are the same using an ANOVA test.

Matlab Code:

```
Xa = 30.0750;
Sa = 15.9243;
Xb = 38.7700;
Sb = 10.1451;
Xc = 52.1250;
Sc = 23.4270;
Na = 20;
Nb = 20;
Nc = 20;
k = 3;
N = Na + Nb + Nc
G = (Na*Xa + Nb*Xb + Nc*Xc) / N
MSSb = (Na*(Xa-G)^2 + Nb*(Xb-G)^2 + Nc*(Xc-G)^2) / (k-1)
MSSw = ((Na-1)*Sa^2 + (Nb-1)*Sb^2 + (Nc-1)*Sc^2) / (N-k)
F = MSSb / MSSw
```

Result:

```
N    =    60
G    =    40.3233
MSSb =    2467.2
MSSw =    301.7769
F    =    8.1756
```

From StatTrek, p = 0.999

There is a 99.9% chance the populations have different means

3) Is rainfall on a three-year cycle? The yearly rainfall in years mod 3 are (units: inches per year)

	year mod 3	mean	std	n
A	0	23.4496	5.0424	27
B	1	20.3848	4.5258	26
C	2	19.7235	4.7955	26

Determine if the means are the same using an ANOVA test.

Code:

```
Xa = 23.4496;
Sa = 5.0424;
Xb = 20.3848;
Sb = 4.5258;
Xc = 19.7325;
Sc = 4.7955;
Na = 27;
Nb = 26;
Nc = 26;
k = 3;
N = Na + Nb + Nc
G = (Na*Xa + Nb*Xb + Nc*Xc) / N
MSSb = (Na*(Xa-G)^2 + Nb*(Xb-G)^2 + Nc*(Xc-G)^2) / (k-1)
MSSw = ((Na-1)*Sa^2 + (Nb-1)*Sb^2 + (Nc-1)*Sc^2) / (N-k)
F = MSSb / MSSw
```

Result

```
N    =       79
G    =       21.2176
MSSb =      104.9426
MSSw =       23.0008
F    =        4.5626
```

From StatTrek, this corresponds to a probability of 0.987

I'm 98.7% certain these populations have different means (meaning there is a 3-year cycle)

- Enter values for degrees of freedom (v_1 and v_2).

- Enter a value for one, and only one, of the other textboxes.

- Click **Calculate** to compute a value for the last textbox.

Degrees of freedom (v_1) | 2

Degrees of freedom (v_2) | 76

f Statistic (f) | 4.5626

Probability: $P(F \leq 4.5626)$ | 0.987

Probability: $P(F \geq 4.5626)$ | 0.013

Calculate