# Analysis Techniques: Flood Analysis Example with Instaneous Peak Flow Data (Log-Pearson Type III Distribution)

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**Information to get started:**

- The lesson below contains step-by-step instructions and "snapshots" of what each step looks like when carried out in a Microsoft Excel workbook. Blue shading of information in the Excel illustrations denotes changes made from the previous step. Dots placed in three consecutive rows indicate that a portion of data is hidden from sight.
- You can download an Excel workbook containing the complete data set by clicking on the "Download Data" link below. It contains each calculation step on a separate worksheet. To move between steps, click on the tabs at the bottom of the excel window.
- When you download the file, it may open in your browser window. You may wish to use the "save as" function to save the file to a local drive and then reopen it in Excel. This will make it easier to flip between the online lesson and the example workbook.
- Finally, we want to remind you that the techniques explained on this site are statistically based; therefore results must be viewed as predictions and not as facts. Please use the techniques and the information obtained from them responsibly!

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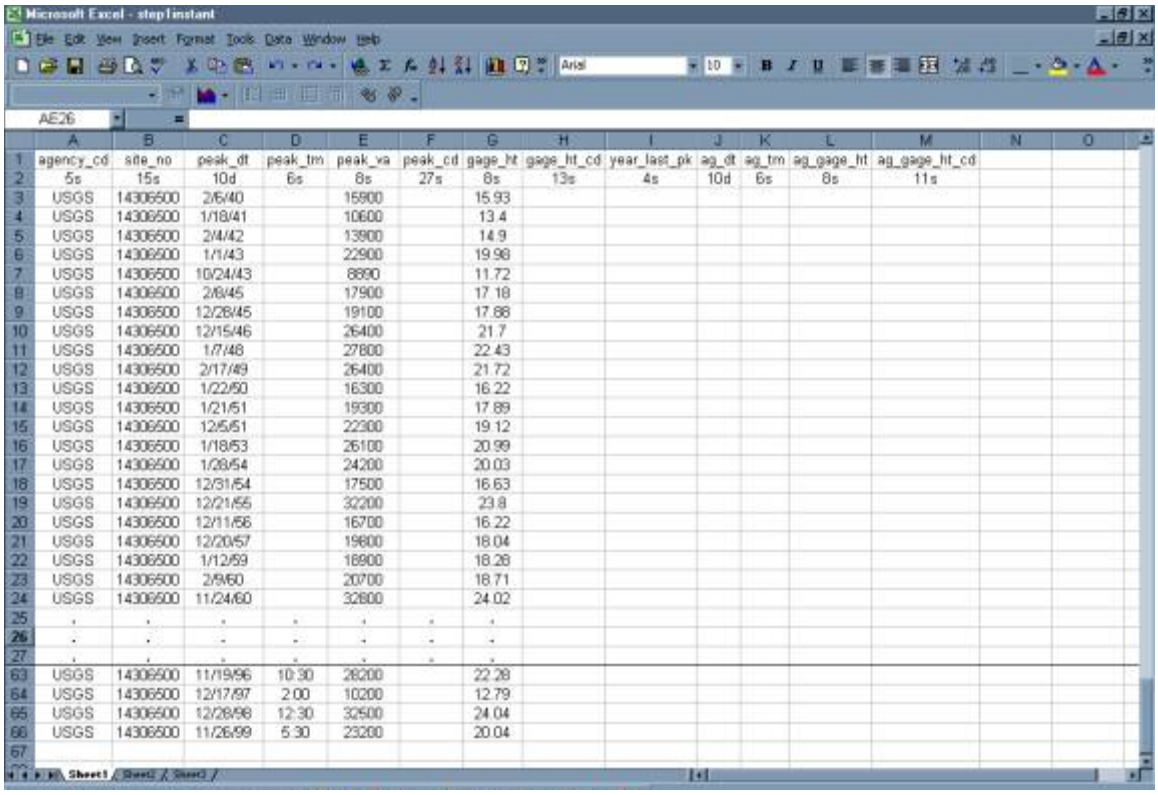
## Download Data

## Step 1: Obtain streamflow data

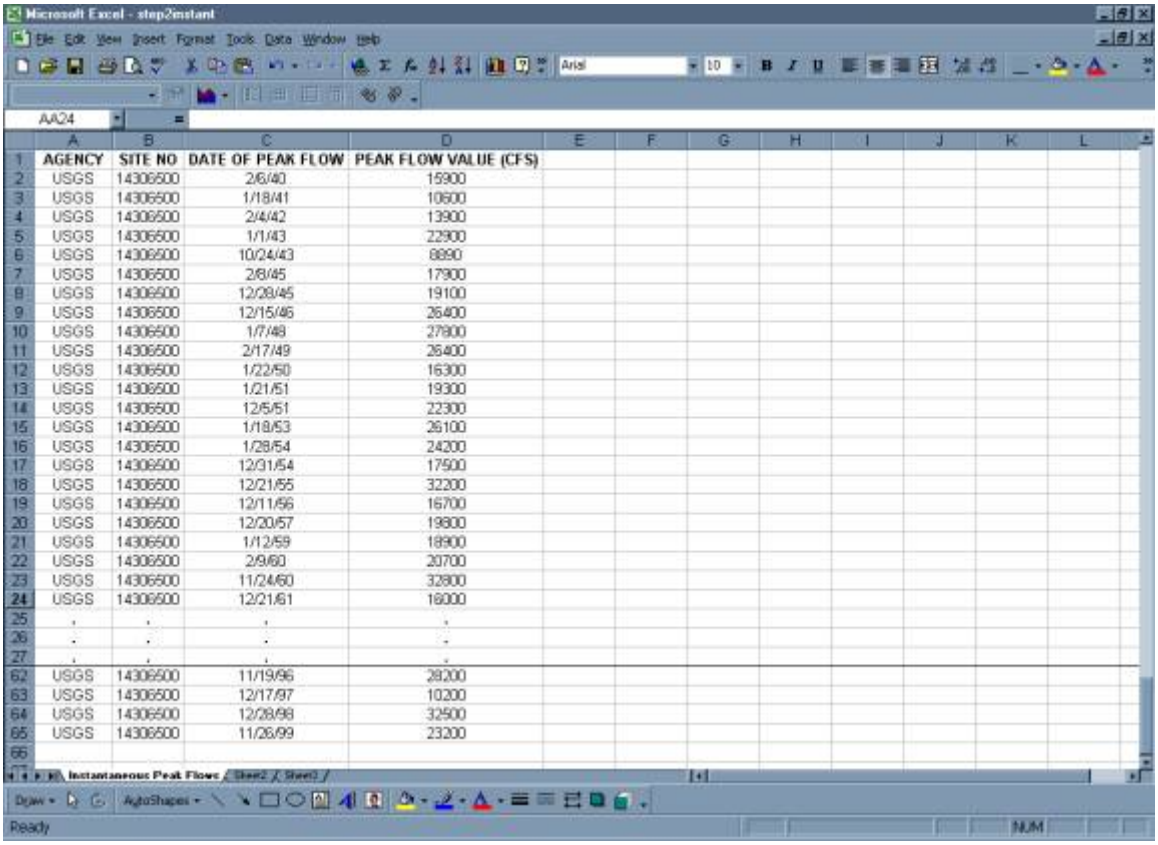
Obtain instantaneous peak streamflow data from the USGS web site.

- Go to **http://oregon.usgs.gov**
- Select Historical Water Data
- Select Surface Water
- Select Peaks
- Check box under Site Identifier for Site Name and Submit
- Type in Alsea under Site Name and select match any part and Submit
- Select gage at TIDEWATER (140306500)
- Select Tab-separated data
- For the example, copy entire data set into Excel worksheet
- Paste special as text (this will separate the data into columns)



| | A | B | C | D | E | F | G | H | I | J | K | L | M | N | O |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | agency_cd | site_no | peak_dt | peak_tm | peak_va | peak_cd | gage_ht | gage_ht_cd | year_last_pk | ag_dt | ag_tm | ag_gage_ht | ag_gage_ht_cd | | |
| 2 | 5s | 15s | 10d | 6s | 8s | 27s | 8s | 13s | 4s | 10d | 6s | 8s | 11s | | |
| 3 | USGS | 14306500 | 2/6/40 | | 15900 | | 15.93 | | | | | | | | |
| 4 | USGS | 14306500 | 1/18/41 | | 10600 | | 13.4 | | | | | | | | |
| 5 | USGS | 14306500 | 2/4/42 | | 13900 | | 14.9 | | | | | | | | |
| 6 | USGS | 14306500 | 1/1/43 | | 22900 | | 19.98 | | | | | | | | |
| 7 | USGS | 14306500 | 10/24/43 | | 8890 | | 11.72 | | | | | | | | |
| 8 | USGS | 14306500 | 2/8/45 | | 17900 | | 17.18 | | | | | | | | |
| 9 | USGS | 14306500 | 12/28/45 | | 19100 | | 17.88 | | | | | | | | |
| 10 | USGS | 14306500 | 12/15/46 | | 26400 | | 21.7 | | | | | | | | |
| 11 | USGS | 14306500 | 1/7/48 | | 27800 | | 22.43 | | | | | | | | |
| 12 | USGS | 14306500 | 2/17/49 | | 26400 | | 21.72 | | | | | | | | |
| 13 | USGS | 14306500 | 1/22/50 | | 16300 | | 16.22 | | | | | | | | |
| 14 | USGS | 14306500 | 1/21/51 | | 19300 | | 17.89 | | | | | | | | |
| 15 | USGS | 14306500 | 12/5/51 | | 22300 | | 19.12 | | | | | | | | |
| 16 | USGS | 14306500 | 1/18/53 | | 26100 | | 20.99 | | | | | | | | |
| 17 | USGS | 14306500 | 1/28/54 | | 24200 | | 20.03 | | | | | | | | |
| 18 | USGS | 14306500 | 12/31/54 | | 17500 | | 16.63 | | | | | | | | |
| 19 | USGS | 14306500 | 12/21/55 | | 32200 | | 23.8 | | | | | | | | |
| 20 | USGS | 14306500 | 12/11/56 | | 16700 | | 16.22 | | | | | | | | |
| 21 | USGS | 14306500 | 12/20/57 | | 19800 | | 18.04 | | | | | | | | |
| 22 | USGS | 14306500 | 1/12/59 | | 18900 | | 18.28 | | | | | | | | |
| 23 | USGS | 14306500 | 2/9/60 | | 20700 | | 18.71 | | | | | | | | |
| 24 | USGS | 14306500 | 11/24/60 | | 32800 | | 24.02 | | | | | | | | |
| 25 | . | . | . | . | . | . | . | | | | | | | | |
| 26 | . | . | . | . | . | . | . | | | | | | | | |
| 27 | . | . | . | . | . | . | . | | | | | | | | |
| 63 | USGS | 14306500 | 11/19/96 | 10:30 | 28200 | | 22.28 | | | | | | | | |
| 64 | USGS | 14306500 | 12/17/97 | 2:00 | 10200 | | 12.79 | | | | | | | | |
| 65 | USGS | 14306500 | 12/28/98 | 12:30 | 32500 | | 24.04 | | | | | | | | |
| 66 | USGS | 14306500 | 11/26/99 | 5:30 | 23200 | | 20.04 | | | | | | | | |
| 67 | | | | | | | | | | | | | | | |

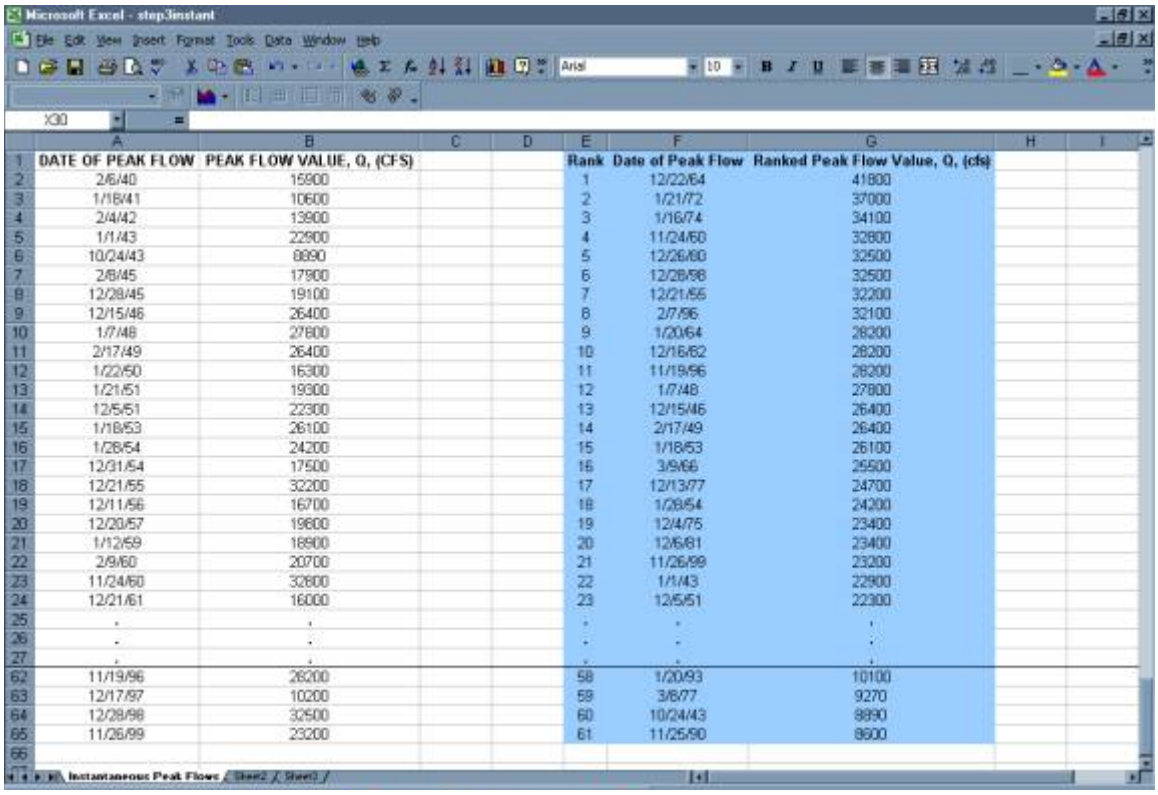
## Step 2: Organize the information in a table.



| | A | B | C | D | E | F | G | H | I | J | K | L |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | AGENCY | SITE NO | DATE OF PEAK FLOW | PEAK FLOW VALUE (CFS) | | | | | | | | |
| 2 | USGS | 14306500 | 2/6/40 | 15900 | | | | | | | | |
| 3 | USGS | 14306500 | 1/18/41 | 10600 | | | | | | | | |
| 4 | USGS | 14306500 | 2/4/42 | 13900 | | | | | | | | |
| 5 | USGS | 14306500 | 1/1/43 | 22900 | | | | | | | | |
| 6 | USGS | 14306500 | 10/24/43 | 8890 | | | | | | | | |
| 7 | USGS | 14306500 | 2/8/45 | 17900 | | | | | | | | |
| 8 | USGS | 14306500 | 12/28/45 | 19100 | | | | | | | | |
| 9 | USGS | 14306500 | 12/15/46 | 26400 | | | | | | | | |
| 10 | USGS | 14306500 | 1/7/48 | 27800 | | | | | | | | |
| 11 | USGS | 14306500 | 2/17/49 | 26400 | | | | | | | | |
| 12 | USGS | 14306500 | 1/22/50 | 16300 | | | | | | | | |
| 13 | USGS | 14306500 | 1/21/51 | 19300 | | | | | | | | |
| 14 | USGS | 14306500 | 12/5/51 | 22300 | | | | | | | | |
| 15 | USGS | 14306500 | 1/18/53 | 26100 | | | | | | | | |
| 16 | USGS | 14306500 | 1/28/54 | 24200 | | | | | | | | |
| 17 | USGS | 14306500 | 12/31/54 | 17500 | | | | | | | | |
| 18 | USGS | 14306500 | 12/21/55 | 32200 | | | | | | | | |
| 19 | USGS | 14306500 | 12/11/56 | 16700 | | | | | | | | |
| 20 | USGS | 14306500 | 12/20/57 | 19800 | | | | | | | | |
| 21 | USGS | 14306500 | 1/12/59 | 18900 | | | | | | | | |
| 22 | USGS | 14306500 | 2/9/60 | 20700 | | | | | | | | |
| 23 | USGS | 14306500 | 11/24/60 | 32800 | | | | | | | | |
| 24 | USGS | 14306500 | 12/21/61 | 18000 | | | | | | | | |
| 25 | . | . | . | . | | | | | | | | |
| 26 | . | . | . | . | | | | | | | | |
| 27 | . | . | . | . | | | | | | | | |
| 62 | USGS | 14306500 | 11/19/96 | 28200 | | | | | | | | |
| 63 | USGS | 14306500 | 12/17/97 | 10200 | | | | | | | | |
| 64 | USGS | 14306500 | 12/28/98 | 32500 | | | | | | | | |
| 65 | USGS | 14306500 | 11/26/99 | 23200 | | | | | | | | |
| 66 | | | | | | | | | | | | |

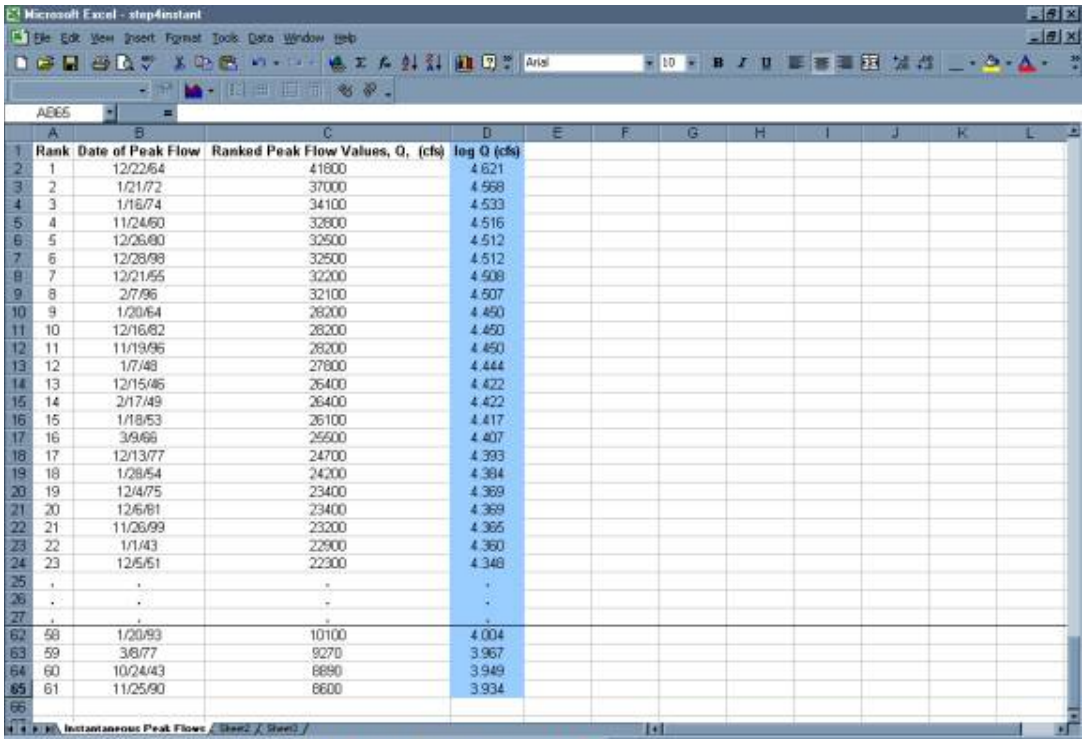
## Step 3: Rank the data from largest discharge to smallest discharge.

- Add a column for Rank and number each streamflow value from 1 to n (the total number of values in your dataset).




| | A | B | C | D | E | F | G | H | I |
|---|---|---|---|---|---|---|---|---|---|
| 1 | DATE OF PEAK FLOW | PEAK FLOW VALUE, Q, (CFS) | | | Rank | Date of Peak Flow | Ranked Peak Flow Value, Q, (cfs) | | |
| 2 | 2/6/40 | 15900 | | | 1 | 12/22/64 | 41800 | | |
| 3 | 1/18/41 | 10600 | | | 2 | 1/21/72 | 37000 | | |
| 4 | 2/4/42 | 13900 | | | 3 | 1/16/74 | 34100 | | |
| 5 | 1/1/43 | 22900 | | | 4 | 11/24/60 | 32800 | | |
| 6 | 10/24/43 | 8890 | | | 5 | 12/26/60 | 32500 | | |
| 7 | 2/6/45 | 17900 | | | 6 | 12/28/98 | 32500 | | |
| 8 | 12/28/45 | 19100 | | | 7 | 12/21/55 | 32200 | | |
| 9 | 12/15/46 | 26400 | | | 8 | 2/7/96 | 32100 | | |
| 10 | 1/7/48 | 27800 | | | 9 | 1/20/64 | 28200 | | |
| 11 | 2/17/49 | 26400 | | | 10 | 12/16/62 | 28200 | | |
| 12 | 1/22/50 | 16300 | | | 11 | 11/19/96 | 28200 | | |
| 13 | 1/21/51 | 19300 | | | 12 | 1/7/48 | 27800 | | |
| 14 | 12/5/51 | 22300 | | | 13 | 12/15/46 | 26400 | | |
| 15 | 1/18/53 | 26100 | | | 14 | 2/17/49 | 26400 | | |
| 16 | 1/28/54 | 24200 | | | 15 | 1/18/53 | 26100 | | |
| 17 | 12/31/54 | 17500 | | | 16 | 3/9/66 | 25500 | | |
| 18 | 12/21/55 | 32200 | | | 17 | 12/13/77 | 24700 | | |
| 19 | 12/11/56 | 16700 | | | 18 | 1/28/54 | 24200 | | |
| 20 | 12/20/57 | 19600 | | | 19 | 12/4/75 | 23400 | | |
| 21 | 1/12/59 | 18900 | | | 20 | 12/6/81 | 23400 | | |
| 22 | 2/9/60 | 20700 | | | 21 | 11/26/99 | 23200 | | |
| 23 | 11/24/60 | 32800 | | | 22 | 1/1/43 | 22900 | | |
| 24 | 12/21/61 | 16000 | | | 23 | 12/5/51 | 22300 | | |
| 25 | . | . | | | . | . | . | | |
| 26 | . | . | | | . | . | . | | |
| 27 | . | . | | | . | . | . | | |
| 62 | 11/19/96 | 26200 | | | 58 | 1/20/93 | 10100 | | |
| 63 | 12/17/97 | 10200 | | | 59 | 3/8/77 | 9270 | | |
| 64 | 12/28/98 | 32500 | | | 60 | 10/24/43 | 8890 | | |
| 65 | 11/26/99 | 23200 | | | 61 | 11/25/90 | 8600 | | |
| 66 | | | | | | | | | |

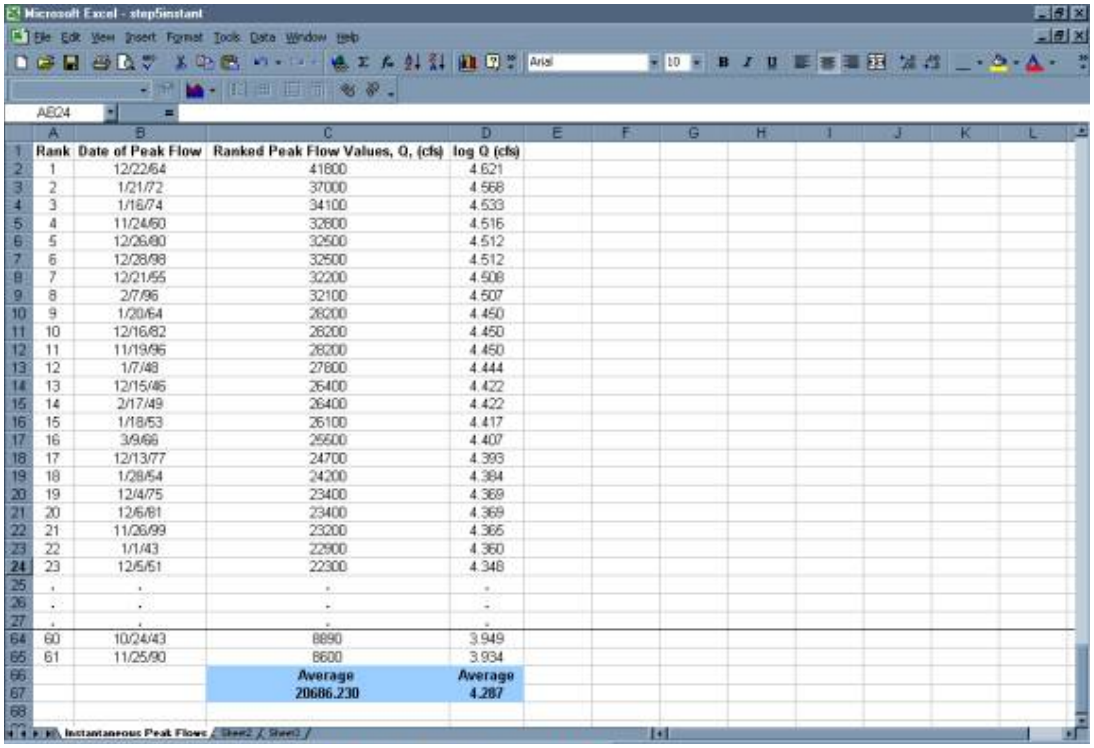
## Step 4: Create a column with the log of each max or peak streamflow using the Excel formula {log (Q)} and copy command.



Microsoft Excel - step4instant

| Rank | Date of Peak Flow | Ranked Peak Flow Values, Q, (cfs) | log Q (cfs) |
|---|---|---|---|
| 1 | 12/22/64 | 41800 | 4.621 |
| 2 | 1/21/72 | 37000 | 4.568 |
| 3 | 1/16/74 | 34100 | 4.533 |
| 4 | 11/24/60 | 32800 | 4.516 |
| 5 | 12/26/80 | 32500 | 4.512 |
| 6 | 12/28/98 | 32500 | 4.512 |
| 7 | 12/21/55 | 32200 | 4.508 |
| 8 | 2/7/96 | 32100 | 4.507 |
| 9 | 1/20/64 | 28200 | 4.450 |
| 10 | 12/16/82 | 28200 | 4.450 |
| 11 | 11/19/96 | 28200 | 4.450 |
| 12 | 1/7/48 | 27800 | 4.444 |
| 13 | 12/15/46 | 26400 | 4.422 |
| 14 | 2/17/49 | 26400 | 4.422 |
| 15 | 1/18/53 | 26100 | 4.417 |
| 16 | 3/9/66 | 25500 | 4.407 |
| 17 | 12/13/77 | 24700 | 4.393 |
| 18 | 1/28/54 | 24200 | 4.384 |
| 19 | 12/4/75 | 23400 | 4.369 |
| 20 | 12/6/81 | 23400 | 4.369 |
| 21 | 11/26/99 | 23200 | 4.365 |
| 22 | 1/1/43 | 22900 | 4.360 |
| 23 | 12/5/51 | 22300 | 4.348 |
| . | . | . | . |
| . | . | . | . |
| . | . | . | . |
| 58 | 1/20/93 | 10100 | 4.004 |
| 59 | 3/8/77 | 9270 | 3.967 |
| 60 | 10/24/43 | 8890 | 3.949 |
| 61 | 11/25/90 | 8600 | 3.934 |

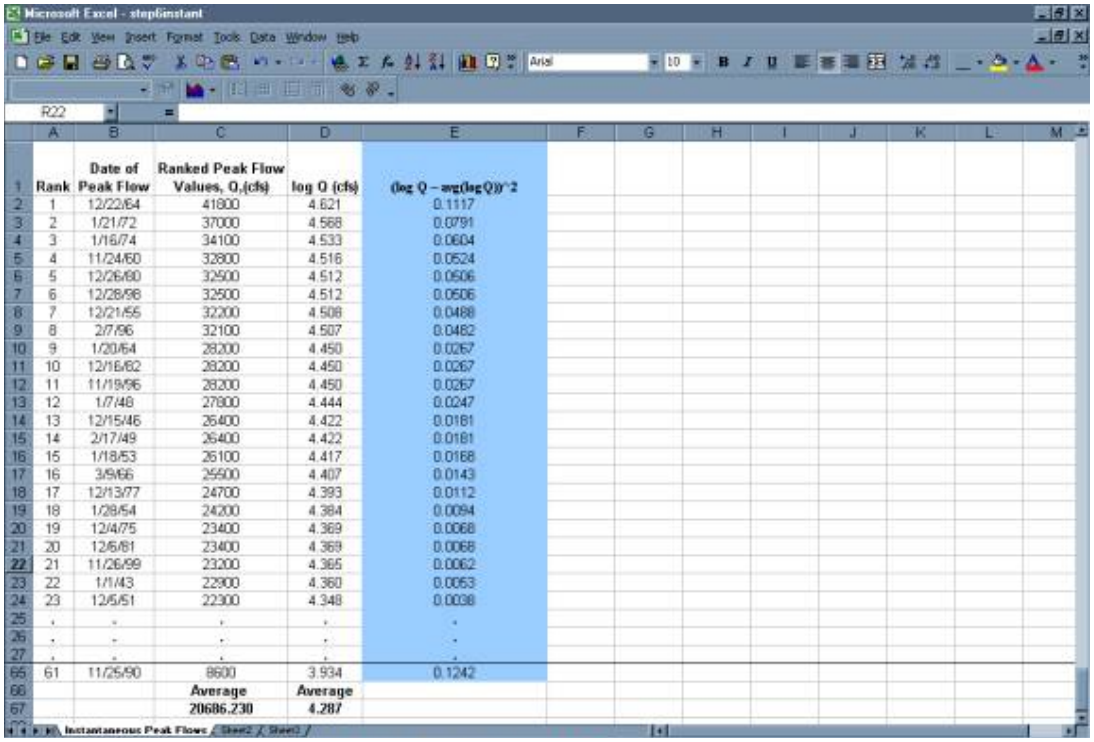
## Step 5: Calculate the Average Max Q or Peak Q and the Average of the log (Q)



Microsoft Excel - step5instant

| Rank | Date of Peak Flow | Ranked Peak Flow Values, Q, (cfs) | log Q (cfs) |
|---|---|---|---|
| 1 | 12/22/64 | 41800 | 4.621 |
| 2 | 1/21/72 | 37000 | 4.568 |
| 3 | 1/16/74 | 34100 | 4.533 |
| 4 | 11/24/60 | 32800 | 4.516 |
| 5 | 12/26/80 | 32500 | 4.512 |
| 6 | 12/28/98 | 32500 | 4.512 |
| 7 | 12/21/55 | 32200 | 4.508 |
| 8 | 2/7/96 | 32100 | 4.507 |
| 9 | 1/20/64 | 28200 | 4.450 |
| 10 | 12/16/82 | 28200 | 4.450 |
| 11 | 11/19/96 | 28200 | 4.450 |
| 12 | 1/7/48 | 27800 | 4.444 |
| 13 | 12/15/46 | 26400 | 4.422 |
| 14 | 2/17/49 | 26400 | 4.422 |
| 15 | 1/18/53 | 26100 | 4.417 |
| 16 | 3/9/66 | 25500 | 4.407 |
| 17 | 12/13/77 | 24700 | 4.393 |
| 18 | 1/28/54 | 24200 | 4.384 |
| 19 | 12/4/75 | 23400 | 4.369 |
| 20 | 12/6/81 | 23400 | 4.369 |
| 21 | 11/26/99 | 23200 | 4.365 |
| 22 | 1/1/43 | 22900 | 4.360 |
| 23 | 12/5/51 | 22300 | 4.348 |
| . | . | . | . |
| . | . | . | . |
| . | . | . | . |
| 60 | 10/24/43 | 8890 | 3.949 |
| 61 | 11/25/90 | 8600 | 3.934 |
| | | Average | Average |
| | | 20686.230 | 4.287 |

## Step 6: Create a column with the excel formula {(log Q – avg(logQ))^2}



Microsoft Excel - step6instant

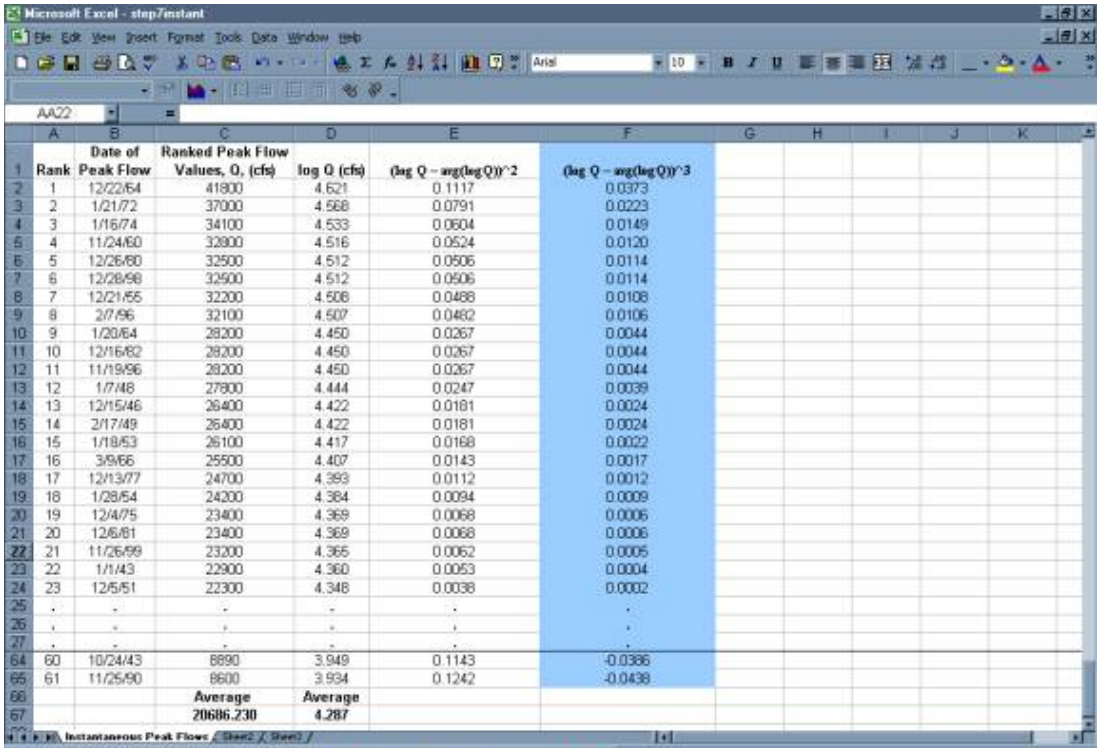
File Edit View Insert Format Tools Data Window Help

R22 =

| | A | B | C | D | E |
|---|---|---|---|---|---|
| 1 | Rank | Date of Peak Flow | Ranked Peak Flow Values, Q, (cfs) | log Q (cfs) | (log Q – avg(logQ))^2 |
| 2 | 1 | 12/22/64 | 41800 | 4.621 | 0.1117 |
| 3 | 2 | 1/21/72 | 37000 | 4.568 | 0.0791 |
| 4 | 3 | 1/16/74 | 34100 | 4.533 | 0.0604 |
| 5 | 4 | 11/24/60 | 32800 | 4.516 | 0.0524 |
| 6 | 5 | 12/26/80 | 32500 | 4.512 | 0.0506 |
| 7 | 6 | 12/28/98 | 32500 | 4.512 | 0.0506 |
| 8 | 7 | 12/21/55 | 32200 | 4.508 | 0.0488 |
| 9 | 8 | 2/7/96 | 32100 | 4.507 | 0.0482 |
| 10 | 9 | 1/20/64 | 28200 | 4.450 | 0.0267 |
| 11 | 10 | 12/16/82 | 28200 | 4.450 | 0.0267 |
| 12 | 11 | 11/19/96 | 28200 | 4.450 | 0.0267 |
| 13 | 12 | 1/7/48 | 27800 | 4.444 | 0.0247 |
| 14 | 13 | 12/15/46 | 26400 | 4.422 | 0.0181 |
| 15 | 14 | 2/17/49 | 26400 | 4.422 | 0.0181 |
| 16 | 15 | 1/18/53 | 26100 | 4.417 | 0.0168 |
| 17 | 16 | 3/9/66 | 25500 | 4.407 | 0.0143 |
| 18 | 17 | 12/13/77 | 24700 | 4.393 | 0.0112 |
| 19 | 18 | 1/28/54 | 24200 | 4.384 | 0.0094 |
| 20 | 19 | 12/4/75 | 23400 | 4.369 | 0.0068 |
| 21 | 20 | 12/6/81 | 23400 | 4.369 | 0.0068 |
| 22 | 21 | 11/26/99 | 23200 | 4.365 | 0.0062 |
| 23 | 22 | 1/1/43 | 22900 | 4.360 | 0.0053 |
| 24 | 23 | 12/5/51 | 22300 | 4.348 | 0.0038 |
| 25 | . | . | . | . | . |
| 26 | . | . | . | . | . |
| 27 | . | . | . | . | . |
| 65 | 61 | 11/25/90 | 8600 | 3.934 | 0.1242 |
| 66 | | | Average | Average | |
| 67 | | | 20686.230 | 4.287 | |

Instantaneous Peak Flows / Sheet2 / Sheet3 /

## Step 7: Create a column with the excel formula {(log Q – avg(logQ))^3



Microsoft Excel - step7instant

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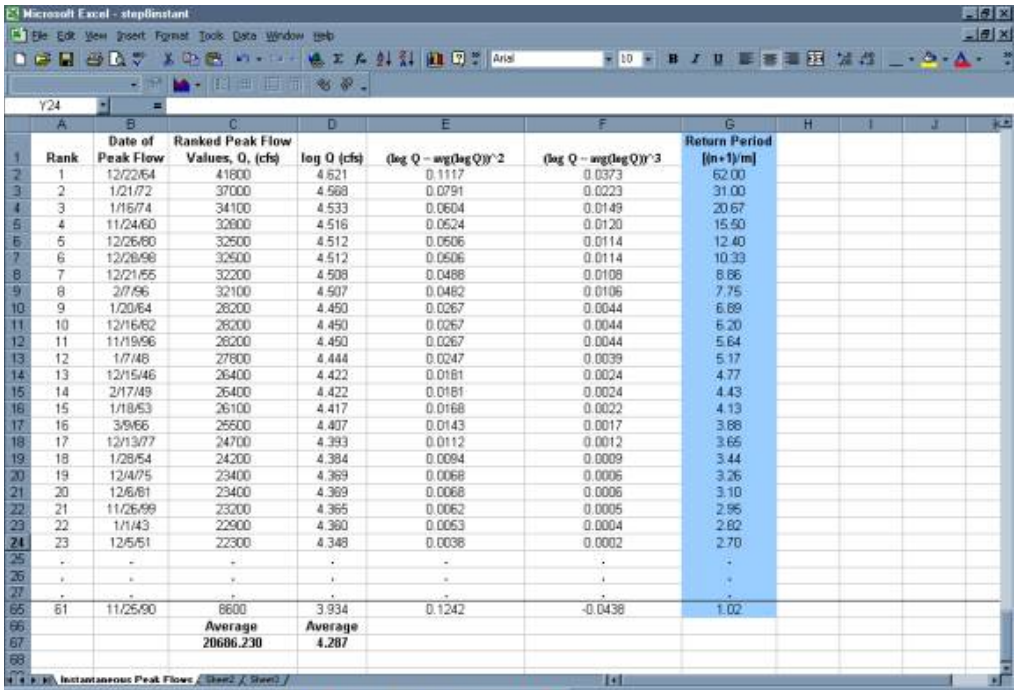
AA22 =

| | A | B | C | D | E | F | G | H | I | J | K |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Rank | Date of Peak Flow | Ranked Peak Flow Values, Q, (cfs) | log Q (cfs) | (log Q – avg(logQ))^2 | (log Q – avg(logQ))^3 | | | | | |
| 2 | 1 | 12/22/64 | 41800 | 4.621 | 0.1117 | 0.0373 | | | | | |
| 3 | 2 | 1/21/72 | 37000 | 4.568 | 0.0791 | 0.0223 | | | | | |
| 4 | 3 | 1/16/74 | 34100 | 4.533 | 0.0604 | 0.0149 | | | | | |
| 5 | 4 | 11/24/60 | 32800 | 4.516 | 0.0524 | 0.0120 | | | | | |
| 6 | 5 | 12/26/80 | 32500 | 4.512 | 0.0506 | 0.0114 | | | | | |
| 7 | 6 | 12/28/98 | 32500 | 4.512 | 0.0506 | 0.0114 | | | | | |
| 8 | 7 | 12/21/55 | 32200 | 4.508 | 0.0488 | 0.0108 | | | | | |
| 9 | 8 | 2/7/96 | 32100 | 4.507 | 0.0482 | 0.0106 | | | | | |
| 10 | 9 | 1/20/64 | 28200 | 4.450 | 0.0267 | 0.0044 | | | | | |
| 11 | 10 | 12/16/82 | 28200 | 4.450 | 0.0267 | 0.0044 | | | | | |
| 12 | 11 | 11/19/96 | 28200 | 4.450 | 0.0267 | 0.0044 | | | | | |
| 13 | 12 | 1/7/48 | 27800 | 4.444 | 0.0247 | 0.0039 | | | | | |
| 14 | 13 | 12/15/46 | 26400 | 4.422 | 0.0181 | 0.0024 | | | | | |
| 15 | 14 | 2/17/49 | 26400 | 4.422 | 0.0181 | 0.0024 | | | | | |
| 16 | 15 | 1/18/53 | 26100 | 4.417 | 0.0168 | 0.0022 | | | | | |
| 17 | 16 | 3/9/66 | 25500 | 4.407 | 0.0143 | 0.0017 | | | | | |
| 18 | 17 | 12/13/77 | 24700 | 4.393 | 0.0112 | 0.0012 | | | | | |
| 19 | 18 | 1/28/54 | 24200 | 4.384 | 0.0094 | 0.0009 | | | | | |
| 20 | 19 | 12/4/75 | 23400 | 4.369 | 0.0068 | 0.0006 | | | | | |
| 21 | 20 | 12/6/81 | 23400 | 4.369 | 0.0068 | 0.0006 | | | | | |
| 22 | 21 | 11/26/99 | 23200 | 4.365 | 0.0062 | 0.0005 | | | | | |
| 23 | 22 | 1/1/43 | 22900 | 4.360 | 0.0053 | 0.0004 | | | | | |
| 24 | 23 | 12/5/51 | 22300 | 4.348 | 0.0038 | 0.0002 | | | | | |
| 25 | . | . | . | . | . | . | | | | | |
| 26 | . | . | . | . | . | . | | | | | |
| 27 | . | . | . | . | . | . | | | | | |
| 64 | 60 | 10/24/43 | 8890 | 3.949 | 0.1143 | -0.0386 | | | | | |
| 65 | 61 | 11/25/90 | 8600 | 3.934 | 0.1242 | -0.0438 | | | | | |
| 66 | | | Average | Average | | | | | | | |
| 67 | | | 20686.230 | 4.287 | | | | | | | |

Instantaneous Peak Flows / Sheet2 / Sheet3 /

**Step 8: Create a column with the return period (Tr) for each discharge using Excel formula {(n+1)/m}. Where n = the number of values in the dataset and m = the rank.**



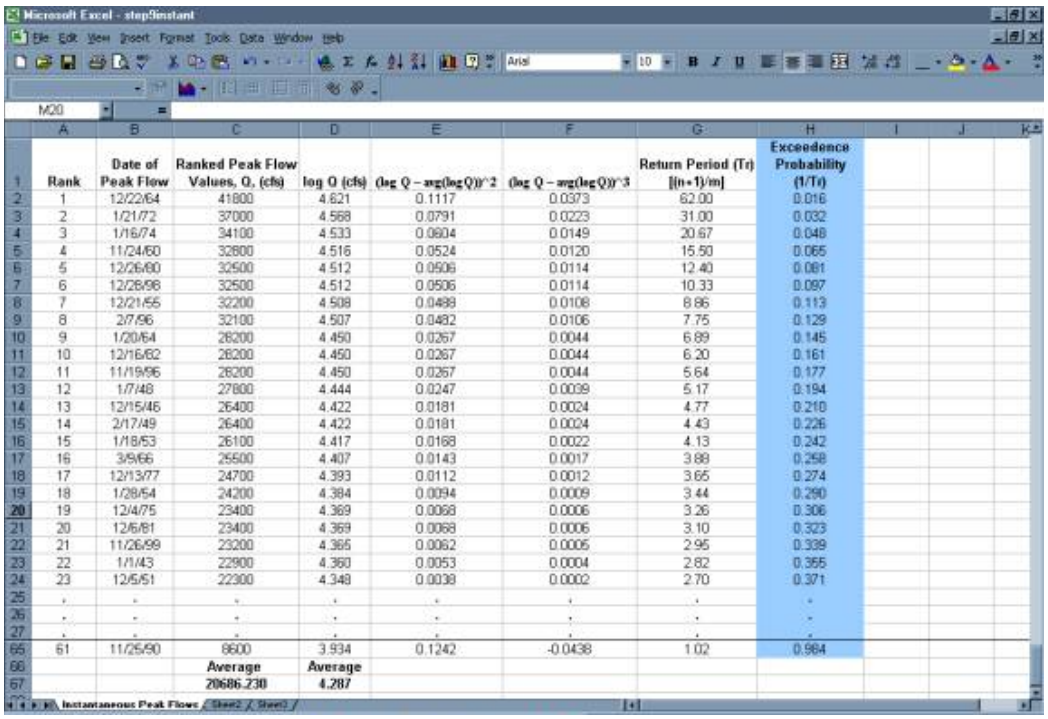
Microsoft Excel - step8instant

Y24 =

| | A | B | C | D | E | F | G | H | I | J |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Rank | Date of Peak Flow | Ranked Peak Flow Values, Q, (cfs) | log Q (cfs) | (log Q – avg(log Q))^2 | (log Q – avg(log Q))^3 | Return Period [(n+1)/m] | | | |
| 2 | 1 | 12/22/64 | 41800 | 4.621 | 0.1117 | 0.0373 | 62.00 | | | |
| 3 | 2 | 1/21/72 | 37000 | 4.568 | 0.0791 | 0.0223 | 31.00 | | | |
| 4 | 3 | 1/16/74 | 34100 | 4.533 | 0.0604 | 0.0149 | 20.67 | | | |
| 5 | 4 | 11/24/60 | 32800 | 4.516 | 0.0524 | 0.0120 | 15.50 | | | |
| 6 | 5 | 12/26/80 | 32500 | 4.512 | 0.0506 | 0.0114 | 12.40 | | | |
| 7 | 6 | 12/28/98 | 32500 | 4.512 | 0.0506 | 0.0114 | 10.33 | | | |
| 8 | 7 | 12/21/55 | 32200 | 4.508 | 0.0488 | 0.0108 | 8.86 | | | |
| 9 | 8 | 2/7/96 | 32100 | 4.507 | 0.0482 | 0.0106 | 7.75 | | | |
| 10 | 9 | 1/20/64 | 28200 | 4.450 | 0.0267 | 0.0044 | 6.89 | | | |
| 11 | 10 | 12/16/62 | 28200 | 4.450 | 0.0267 | 0.0044 | 6.20 | | | |
| 12 | 11 | 11/19/96 | 28200 | 4.450 | 0.0267 | 0.0044 | 5.64 | | | |
| 13 | 12 | 1/7/48 | 27800 | 4.444 | 0.0247 | 0.0039 | 5.17 | | | |
| 14 | 13 | 12/15/46 | 26400 | 4.422 | 0.0181 | 0.0024 | 4.77 | | | |
| 15 | 14 | 2/17/49 | 26400 | 4.422 | 0.0181 | 0.0024 | 4.43 | | | |
| 16 | 15 | 1/18/53 | 26100 | 4.417 | 0.0168 | 0.0022 | 4.13 | | | |
| 17 | 16 | 3/9/66 | 25600 | 4.407 | 0.0143 | 0.0017 | 3.88 | | | |
| 18 | 17 | 12/13/77 | 24700 | 4.393 | 0.0112 | 0.0012 | 3.65 | | | |
| 19 | 18 | 1/28/54 | 24200 | 4.384 | 0.0094 | 0.0009 | 3.44 | | | |
| 20 | 19 | 12/4/75 | 23400 | 4.369 | 0.0068 | 0.0006 | 3.26 | | | |
| 21 | 20 | 12/6/81 | 23400 | 4.369 | 0.0068 | 0.0006 | 3.10 | | | |
| 22 | 21 | 11/26/99 | 23200 | 4.365 | 0.0062 | 0.0005 | 2.95 | | | |
| 23 | 22 | 1/1/43 | 22900 | 4.360 | 0.0053 | 0.0004 | 2.82 | | | |
| 24 | 23 | 12/5/51 | 22300 | 4.348 | 0.0038 | 0.0002 | 2.70 | | | |
| 25 | . | . | . | . | . | . | . | | | |
| 26 | . | . | . | . | . | . | . | | | |
| 27 | . | . | . | . | . | . | . | | | |
| 65 | 61 | 11/25/90 | 8600 | 3.934 | 0.1242 | -0.0438 | 1.02 | | | |
| 66 | | | Average | Average | | | | | | |
| 67 | | | 20686.230 | 4.287 | | | | | | |
| 68 | | | | | | | | | | |

Instantaneous Peak Flows / Sheet2 / Sheet3

**Step 9: Complete the table with a final column showing the exceedence probabilityof each discharge using the excel formula {=1/Return Period or 1/Tr} and the copy command.**



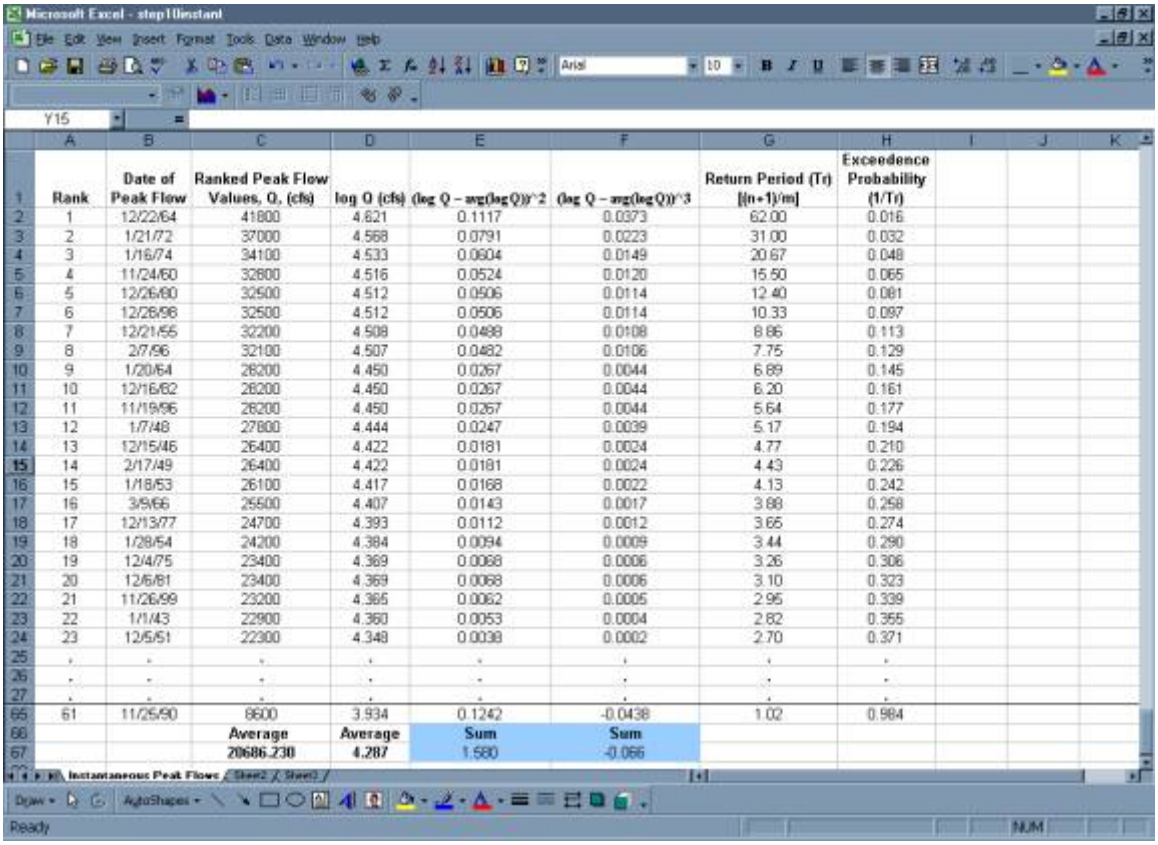
Microsoft Excel - step9instant

M20 =

| | A | B | C | D | E | F | G | H | I | J |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Rank | Date of Peak Flow | Ranked Peak Flow Values, Q, (cfs) | log Q (cfs) | (log Q – avg(log Q))^2 | (log Q – avg(log Q))^3 | Return Period (Tr) [(n+1)/m] | Exceedence Probability (1/Tr) | | |
| 2 | 1 | 12/22/64 | 41800 | 4.621 | 0.1117 | 0.0373 | 62.00 | 0.016 | | |
| 3 | 2 | 1/21/72 | 37000 | 4.568 | 0.0791 | 0.0223 | 31.00 | 0.032 | | |
| 4 | 3 | 1/16/74 | 34100 | 4.533 | 0.0604 | 0.0149 | 20.67 | 0.048 | | |
| 5 | 4 | 11/24/60 | 32800 | 4.516 | 0.0524 | 0.0120 | 15.50 | 0.065 | | |
| 6 | 5 | 12/26/80 | 32500 | 4.512 | 0.0506 | 0.0114 | 12.40 | 0.081 | | |
| 7 | 6 | 12/28/98 | 32500 | 4.512 | 0.0506 | 0.0114 | 10.33 | 0.097 | | |
| 8 | 7 | 12/21/55 | 32200 | 4.508 | 0.0488 | 0.0108 | 8.86 | 0.113 | | |
| 9 | 8 | 2/7/96 | 32100 | 4.507 | 0.0482 | 0.0106 | 7.75 | 0.129 | | |
| 10 | 9 | 1/20/64 | 28200 | 4.450 | 0.0267 | 0.0044 | 6.89 | 0.145 | | |
| 11 | 10 | 12/16/62 | 28200 | 4.450 | 0.0267 | 0.0044 | 6.20 | 0.161 | | |
| 12 | 11 | 11/19/96 | 28200 | 4.450 | 0.0267 | 0.0044 | 5.64 | 0.177 | | |
| 13 | 12 | 1/7/48 | 27800 | 4.444 | 0.0247 | 0.0039 | 5.17 | 0.194 | | |
| 14 | 13 | 12/15/46 | 26400 | 4.422 | 0.0181 | 0.0024 | 4.77 | 0.210 | | |
| 15 | 14 | 2/17/49 | 26400 | 4.422 | 0.0181 | 0.0024 | 4.43 | 0.226 | | |
| 16 | 15 | 1/18/53 | 26100 | 4.417 | 0.0168 | 0.0022 | 4.13 | 0.242 | | |
| 17 | 16 | 3/9/66 | 25600 | 4.407 | 0.0143 | 0.0017 | 3.88 | 0.258 | | |
| 18 | 17 | 12/13/77 | 24700 | 4.393 | 0.0112 | 0.0012 | 3.65 | 0.274 | | |
| 19 | 18 | 1/28/54 | 24200 | 4.384 | 0.0094 | 0.0009 | 3.44 | 0.290 | | |
| 20 | 19 | 12/4/75 | 23400 | 4.369 | 0.0068 | 0.0006 | 3.26 | 0.306 | | |
| 21 | 20 | 12/6/81 | 23400 | 4.369 | 0.0068 | 0.0006 | 3.10 | 0.323 | | |
| 22 | 21 | 11/26/99 | 23200 | 4.365 | 0.0062 | 0.0005 | 2.95 | 0.339 | | |
| 23 | 22 | 1/1/43 | 22900 | 4.360 | 0.0053 | 0.0004 | 2.82 | 0.355 | | |
| 24 | 23 | 12/5/51 | 22300 | 4.348 | 0.0038 | 0.0002 | 2.70 | 0.371 | | |
| 25 | . | . | . | . | . | . | . | . | | |
| 26 | . | . | . | . | . | . | . | . | | |
| 27 | . | . | . | . | . | . | . | . | | |
| 65 | 61 | 11/25/90 | 8600 | 3.934 | 0.1242 | -0.0438 | 1.02 | 0.984 | | |
| 66 | | | Average | Average | | | | | | |
| 67 | | | 20686.230 | 4.287 | | | | | | |
| 68 | | | | | | | | | | |

Instantaneous Peak Flows / Sheet2 / Sheet3

## Step 10: Calculate the Sum for the {(logQ – avg(logQ))^2} and the {(logQ – avg(logQ))^3} columns.



| Rank | Date of Peak Flow | Ranked Peak Flow Values, Q, (cfs) | log Q (cfs) | (log Q – avg(log Q))^2 | (log Q – avg(log Q))^3 | Return Period (Tr) [(n+1)/m] | Exceedence Probability (1/Tr) |
|---|---|---|---|---|---|---|---|
| 1 | 12/22/64 | 41800 | 4.621 | 0.1117 | 0.0373 | 62.00 | 0.016 |
| 2 | 1/21/72 | 37000 | 4.568 | 0.0791 | 0.0223 | 31.00 | 0.032 |
| 3 | 1/16/74 | 34100 | 4.533 | 0.0604 | 0.0149 | 20.67 | 0.048 |
| 4 | 11/24/60 | 32800 | 4.516 | 0.0524 | 0.0120 | 15.50 | 0.065 |
| 5 | 12/26/80 | 32500 | 4.512 | 0.0506 | 0.0114 | 12.40 | 0.081 |
| 6 | 12/26/96 | 32500 | 4.512 | 0.0506 | 0.0114 | 10.33 | 0.097 |
| 7 | 12/21/55 | 32200 | 4.508 | 0.0488 | 0.0108 | 8.86 | 0.113 |
| 8 | 2/7/96 | 32100 | 4.507 | 0.0482 | 0.0106 | 7.75 | 0.129 |
| 9 | 1/20/64 | 28200 | 4.450 | 0.0267 | 0.0044 | 6.89 | 0.145 |
| 10 | 12/16/62 | 28200 | 4.450 | 0.0267 | 0.0044 | 6.20 | 0.161 |
| 11 | 11/19/96 | 28200 | 4.450 | 0.0267 | 0.0044 | 5.64 | 0.177 |
| 12 | 1/7/48 | 27800 | 4.444 | 0.0247 | 0.0039 | 5.17 | 0.194 |
| 13 | 12/15/46 | 26400 | 4.422 | 0.0181 | 0.0024 | 4.77 | 0.210 |
| 14 | 2/17/49 | 26400 | 4.422 | 0.0181 | 0.0024 | 4.43 | 0.226 |
| 15 | 1/18/53 | 26100 | 4.417 | 0.0168 | 0.0022 | 4.13 | 0.242 |
| 16 | 3/9/66 | 25500 | 4.407 | 0.0143 | 0.0017 | 3.88 | 0.258 |
| 17 | 12/13/77 | 24700 | 4.393 | 0.0112 | 0.0012 | 3.65 | 0.274 |
| 18 | 1/28/54 | 24200 | 4.384 | 0.0094 | 0.0009 | 3.44 | 0.290 |
| 19 | 12/4/75 | 23400 | 4.369 | 0.0068 | 0.0006 | 3.26 | 0.306 |
| 20 | 12/6/81 | 23400 | 4.369 | 0.0068 | 0.0006 | 3.10 | 0.323 |
| 21 | 11/26/99 | 23200 | 4.365 | 0.0062 | 0.0005 | 2.95 | 0.339 |
| 22 | 1/1/43 | 22900 | 4.360 | 0.0053 | 0.0004 | 2.82 | 0.355 |
| 23 | 12/5/51 | 22300 | 4.348 | 0.0038 | 0.0002 | 2.70 | 0.371 |
| . | . | . | . | . | . | . | . |
| . | . | . | . | . | . | . | . |
| . | . | . | . | . | . | . | . |
| 61 | 11/25/90 | 8600 | 3.934 | 0.1242 | -0.0438 | 1.02 | 0.984 |
| | | Average | Average | Sum | Sum | | |
| | | 20686.230 | 4.287 | 1.580 | -0.066 | | |

**Step 11: Calculate the variance, standard deviation, and skew coefficient as follows:**

variance =

$$\frac{\sum_{i}^{n}(\log Q - avg(\log Q))^{\wedge}2}{n-1}$$

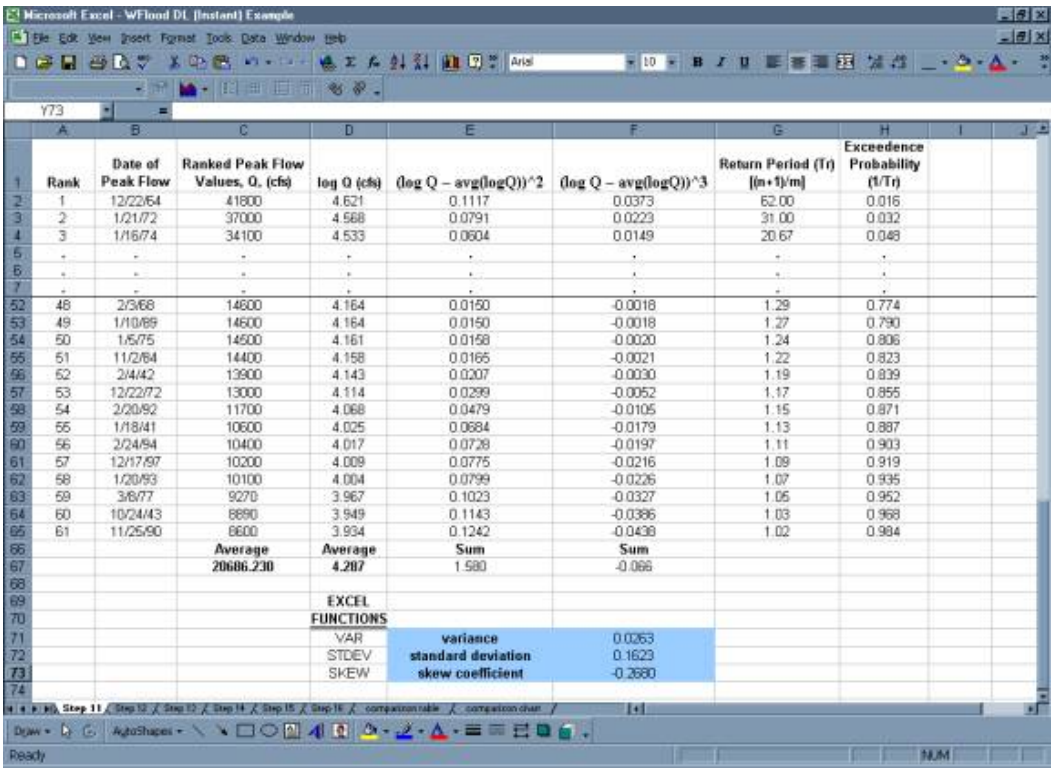
standard deviation =

$$\sigma \log Q = \sqrt{variance}$$

skew coefficient =

$$\frac{n \times \sum_{i}^{n}(\log Q - avg(\log Q))^{\wedge}3}{(n-1)(n-2)(\sigma \log Q)^{\wedge}3}$$

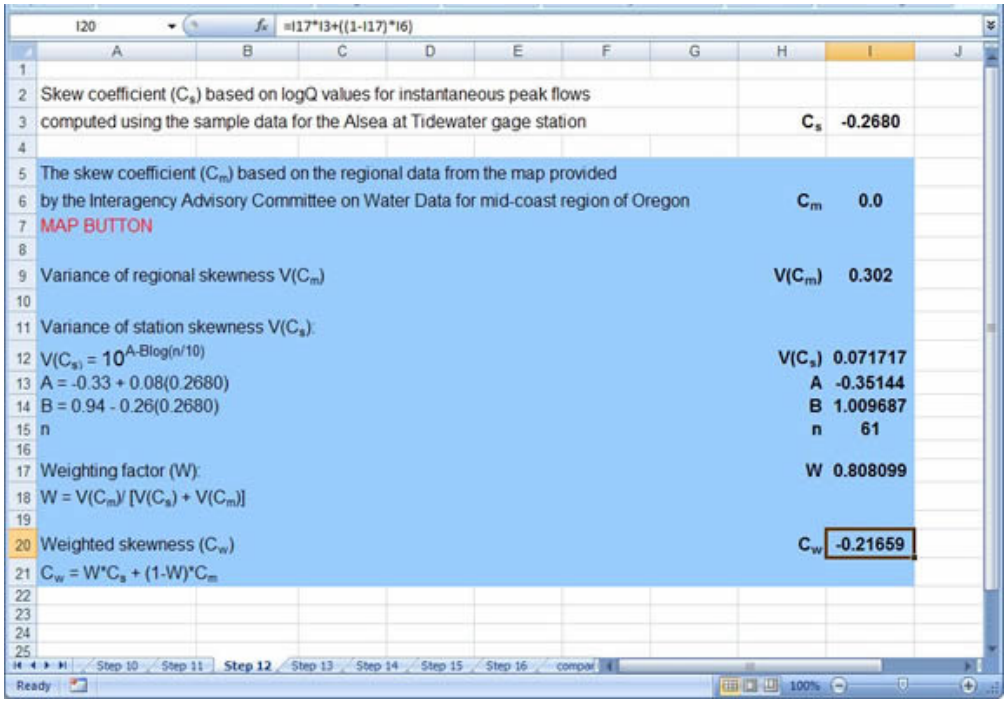
Excel functions can also be used to calculate the variance (=VAR( ) ), standard deviation (=STDEV( ) ), and skewness coefficient (=SKEW( ) ).



| Rank | Date of Peak Flow | Ranked Peak Flow Values, Q, (cfs) | log Q (cfs) | (log Q – avg(logQ))^2 | (log Q – avg(logQ))^3 | Return Period (Tr) [(n+1)/m] | Exceedence Probability (1/Tr) |
|---|---|---|---|---|---|---|---|
| 1 | 12/22/64 | 41800 | 4.621 | 0.1117 | 0.0373 | 62.00 | 0.016 |
| 2 | 1/21/72 | 37000 | 4.568 | 0.0791 | 0.0223 | 31.00 | 0.032 |
| 3 | 1/16/74 | 34100 | 4.533 | 0.0604 | 0.0149 | 20.67 | 0.048 |
| 48 | 2/3/68 | 14600 | 4.164 | 0.0150 | -0.0018 | 1.29 | 0.774 |
| 49 | 1/10/89 | 14600 | 4.164 | 0.0150 | -0.0018 | 1.27 | 0.790 |
| 50 | 1/5/75 | 14500 | 4.161 | 0.0158 | -0.0020 | 1.24 | 0.806 |
| 51 | 11/2/84 | 14400 | 4.158 | 0.0165 | -0.0021 | 1.22 | 0.823 |
| 52 | 2/4/42 | 13900 | 4.143 | 0.0207 | -0.0030 | 1.19 | 0.839 |
| 53 | 12/22/72 | 13000 | 4.114 | 0.0299 | -0.0052 | 1.17 | 0.855 |
| 54 | 2/20/92 | 11700 | 4.068 | 0.0479 | -0.0105 | 1.15 | 0.871 |
| 55 | 1/18/41 | 10600 | 4.025 | 0.0684 | -0.0179 | 1.13 | 0.887 |
| 56 | 2/24/94 | 10400 | 4.017 | 0.0728 | -0.0197 | 1.11 | 0.903 |
| 57 | 12/17/97 | 10200 | 4.009 | 0.0775 | -0.0216 | 1.09 | 0.919 |
| 58 | 1/20/93 | 10100 | 4.004 | 0.0799 | -0.0226 | 1.07 | 0.935 |
| 59 | 3/8/77 | 9270 | 3.967 | 0.1023 | -0.0327 | 1.05 | 0.952 |
| 60 | 10/24/43 | 8890 | 3.949 | 0.1143 | -0.0386 | 1.03 | 0.968 |
| 61 | 11/25/90 | 8600 | 3.934 | 0.1242 | -0.0438 | 1.02 | 0.984 |
| | | Average | Average | Sum | Sum | | |
| | | 20686.230 | 4.287 | 1.580 | -0.066 | | |

| EXCEL FUNCTIONS | | |
|---|---|---|
| VAR | variance | 0.0263 |
| STDEV | standard deviation | 0.1623 |
| SKEW | skew coefficient | -0.2680 |

## Step 12: Calculate weighted skewness



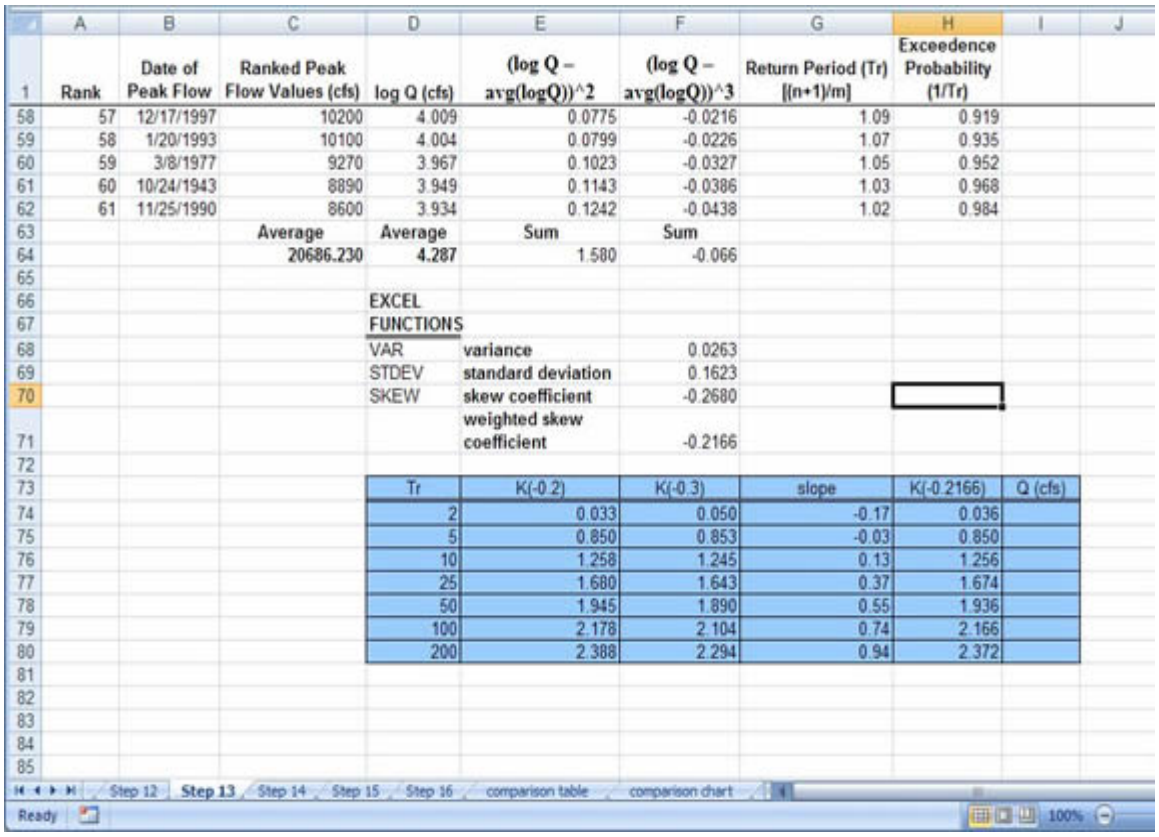
| | | | |
|---|---|---|---|
| Skew coefficient ($C_s$) based on logQ values for instantaneous peak flows | | | |
| computed using the sample data for the Alsea at Tidewater gage station | | $C_s$ | -0.2680 |
| The skew coefficient ($C_m$) based on the regional data from the map provided | | | |
| by the Interagency Advisory Committee on Water Data for mid-coast region of Oregon | | $C_m$ | 0.0 |
| MAP BUTTON | | | |
| Variance of regional skewness $V(C_m)$ | | $V(C_m)$ | 0.302 |
| Variance of station skewness $V(C_s)$: | | | |
| $V(C_s) = 10^{A-B\log(n/10)}$ | | $V(C_s)$ | 0.071717 |
| A = -0.33 + 0.08(0.2680) | | A | -0.35144 |
| B = 0.94 - 0.26(0.2680) | | B | 1.009687 |
| n | | n | 61 |
| Weighting factor (W): | | W | 0.808099 |
| $W = V(C_m)/ [V(C_s) + V(C_m)]$ | | | |
| Weighted skewness ($C_w$) | | $C_w$ | -0.21659 |
| $C_w = W*C_s + (1-W)*C_m$ | | | |

## Show Me

## Step 13: Calculate k values

- Use the **frequency factor table** and the skew coefficient to find the **k values** for the 2,5,10,25,50,100, and 200 **recurrence intervals**.
- If the skew coefficient is between two given skew coefficients in the table than you can linearly extrapolate between the two numbers to get the appropriate k value. To view the frequency factor table click on the "show me" link below.

## Show Me



| | A | B | C | D | E | F | G | H | I | J |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Rank | Date of Peak Flow | Ranked Peak Flow Values (cfs) | log Q (cfs) | (log Q – avg(logQ))^2 | (log Q – avg(logQ))^3 | Return Period (Tr) [(n+1)/m] | Exceedence Probability (1/Tr) | | |
| 58 | 57 | 12/17/1997 | 10200 | 4.009 | 0.0775 | -0.0216 | 1.09 | 0.919 | | |
| 59 | 58 | 1/20/1993 | 10100 | 4.004 | 0.0799 | -0.0226 | 1.07 | 0.935 | | |
| 60 | 59 | 3/8/1977 | 9270 | 3.967 | 0.1023 | -0.0327 | 1.05 | 0.952 | | |
| 61 | 60 | 10/24/1943 | 8890 | 3.949 | 0.1143 | -0.0386 | 1.03 | 0.968 | | |
| 62 | 61 | 11/25/1990 | 8600 | 3.934 | 0.1242 | -0.0438 | 1.02 | 0.984 | | |
| 63 | | | Average | Average | Sum | Sum | | | | |
| 64 | | | 20686.230 | 4.287 | 1.580 | -0.066 | | | | |
| 65 | | | | | | | | | | |
| 66 | | | | EXCEL | | | | | | |
| 67 | | | | FUNCTIONS | | | | | | |
| 68 | | | | VAR | variance | 0.0263 | | | | |
| 69 | | | | STDEV | standard deviation | 0.1623 | | | | |
| 70 | | | | SKEW | skew coefficient | -0.2680 | | | | |
| 71 | | | | | weighted skew coefficient | -0.2166 | | | | |
| 72 | | | | | | | | | | |
| 73 | | | | Tr | K(-0.2) | K(-0.3) | slope | K(-0.2166) | Q (cfs) | |
| 74 | | | | 2 | 0.033 | 0.050 | -0.17 | 0.036 | | |
| 75 | | | | 5 | 0.850 | 0.853 | -0.03 | 0.850 | | |
| 76 | | | | 10 | 1.258 | 1.245 | 0.13 | 1.256 | | |
| 77 | | | | 25 | 1.680 | 1.643 | 0.37 | 1.674 | | |
| 78 | | | | 50 | 1.945 | 1.890 | 0.55 | 1.936 | | |
| 79 | | | | 100 | 2.178 | 2.104 | 0.74 | 2.166 | | |
| 80 | | | | 200 | 2.388 | 2.294 | 0.94 | 2.372 | | |
| 81 | | | | | | | | | | |
| 82 | | | | | | | | | | |
| 83 | | | | | | | | | | |
| 84 | | | | | | | | | | |
| 85 | | | | | | | | | | |

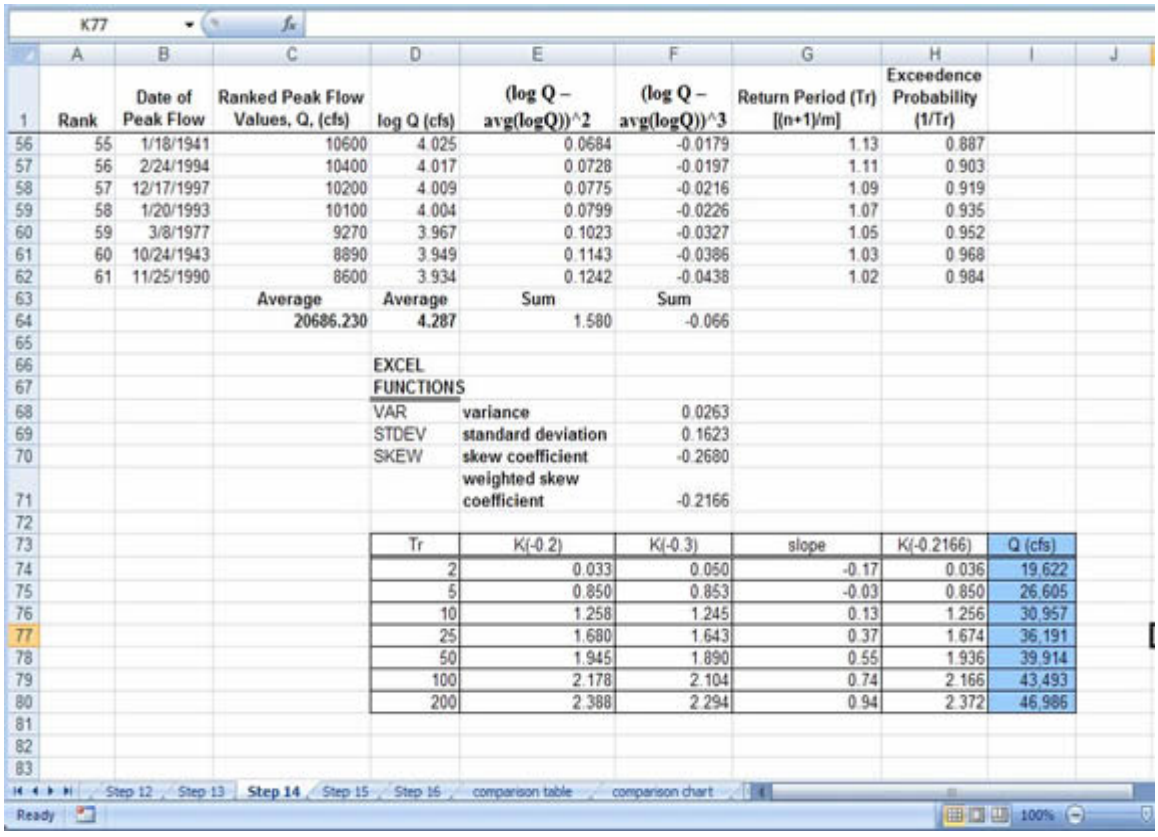
Step 12 | Step 13 | Step 14 | Step 15 | Step 16 | comparison table | comparison chart

Ready 100%

## Step 14: Using the general equation, list the discharges associated with each recurrence interval

general equation =

$$\log Q_{Tr} = \text{avg}(\log Q) + [K(Tr, Cs)] \times \sigma \log Q$$



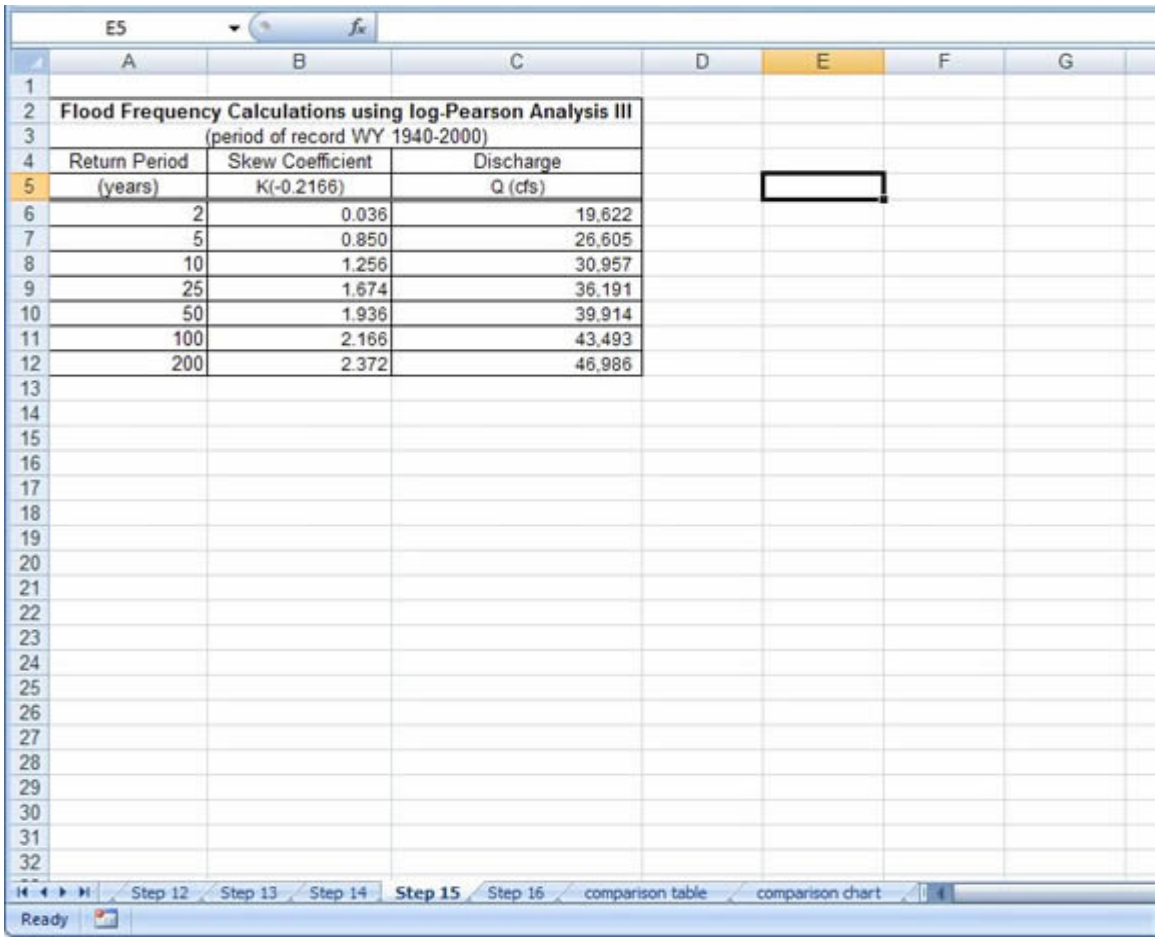
K77

| | A | B | C | D | E | F | G | H | I | J |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Rank | Date of Peak Flow | Ranked Peak Flow Values, Q, (cfs) | log Q (cfs) | (log Q – avg(logQ))^2 | (log Q – avg(logQ))^3 | Return Period (Tr) [(n+1)/m] | Exceedence Probability (1/Tr) | | |
| 56 | 55 | 1/18/1941 | 10600 | 4.025 | 0.0684 | -0.0179 | 1.13 | 0.887 | | |
| 57 | 56 | 2/24/1994 | 10400 | 4.017 | 0.0728 | -0.0197 | 1.11 | 0.903 | | |
| 58 | 57 | 12/17/1997 | 10200 | 4.009 | 0.0775 | -0.0216 | 1.09 | 0.919 | | |
| 59 | 58 | 1/20/1993 | 10100 | 4.004 | 0.0799 | -0.0226 | 1.07 | 0.935 | | |
| 60 | 59 | 3/8/1977 | 9270 | 3.967 | 0.1023 | -0.0327 | 1.05 | 0.952 | | |
| 61 | 60 | 10/24/1943 | 8890 | 3.949 | 0.1143 | -0.0386 | 1.03 | 0.968 | | |
| 62 | 61 | 11/25/1990 | 8600 | 3.934 | 0.1242 | -0.0438 | 1.02 | 0.984 | | |
| 63 | | | Average | Average | Sum | Sum | | | | |
| 64 | | | 20686.230 | 4.287 | 1.580 | -0.066 | | | | |
| 65 | | | | | | | | | | |
| 66 | | | | EXCEL | | | | | | |
| 67 | | | | FUNCTIONS | | | | | | |
| 68 | | | | VAR | variance | 0.0263 | | | | |
| 69 | | | | STDEV | standard deviation | 0.1623 | | | | |
| 70 | | | | SKEW | skew coefficient | -0.2680 | | | | |
| 71 | | | | | weighted skew coefficient | -0.2166 | | | | |
| 72 | | | | | | | | | | |
| 73 | | | | Tr | K(-0.2) | K(-0.3) | slope | K(-0.2166) | Q (cfs) | |
| 74 | | | | 2 | 0.033 | 0.050 | -0.17 | 0.036 | 19,622 | |
| 75 | | | | 5 | 0.850 | 0.853 | -0.03 | 0.850 | 26,605 | |
| 76 | | | | 10 | 1.258 | 1.245 | 0.13 | 1.256 | 30,957 | |
| 77 | | | | 25 | 1.680 | 1.643 | 0.37 | 1.674 | 36,191 | |
| 78 | | | | 50 | 1.945 | 1.890 | 0.55 | 1.936 | 39,914 | |
| 79 | | | | 100 | 2.178 | 2.104 | 0.74 | 2.166 | 43,493 | |
| 80 | | | | 200 | 2.388 | 2.294 | 0.94 | 2.372 | 46,986 | |
| 81 | | | | | | | | | | |
| 82 | | | | | | | | | | |
| 83 | | | | | | | | | | |

Step 12 | Step 13 | Step 14 | Step 15 | Step 16 | comparison table | comparison chart

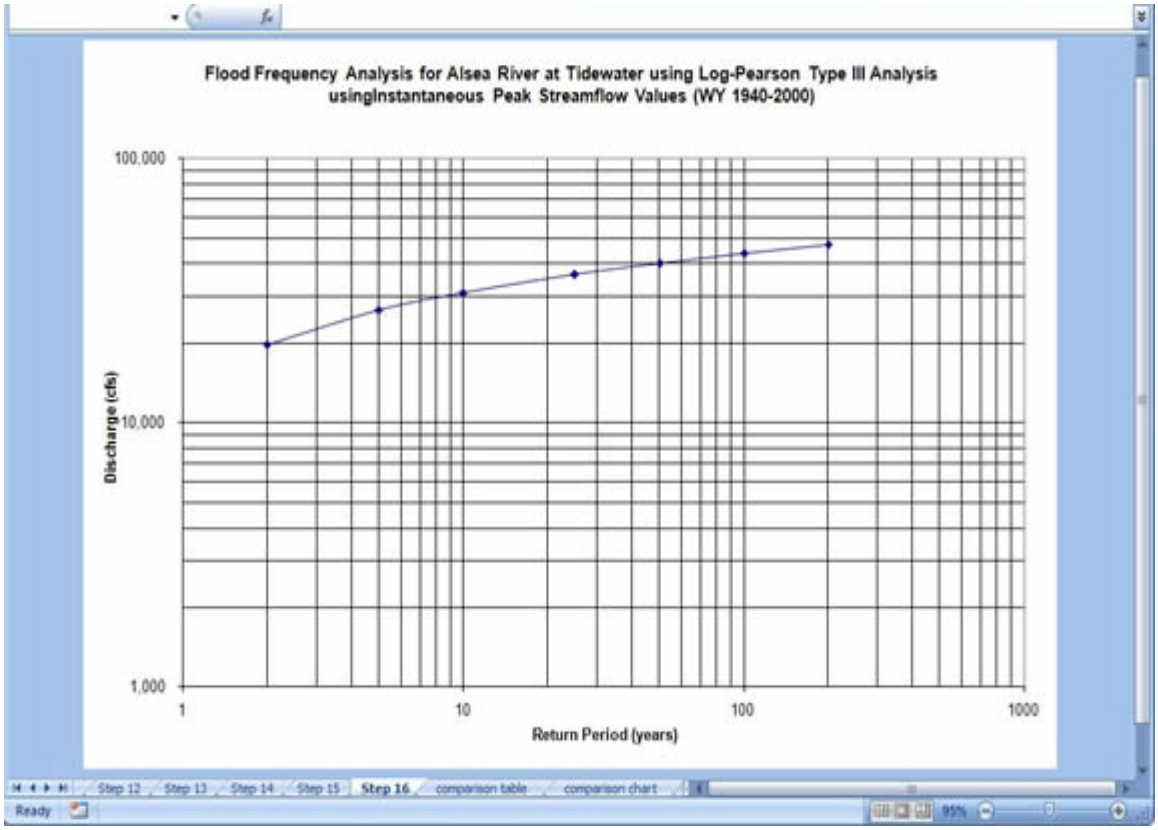
Ready 100%

## Step 15: Create table of Discharge values found using the log – Pearson analysis



| Flood Frequency Calculations using log-Pearson Analysis III (period of record WY 1940-2000) | | |
|---|---|---|
| Return Period (years) | Skew Coefficient K(-0.2166) | Discharge Q (cfs) |
| 2 | 0.036 | 19,622 |
| 5 | 0.850 | 26,605 |
| 10 | 1.256 | 30,957 |
| 25 | 1.674 | 36,191 |
| 50 | 1.936 | 39,914 |
| 100 | 2.166 | 43,493 |
| 200 | 2.372 | 46,986 |

## Step 16: Create Plot



Below is a comparison of flood frequency analysis completed using mean daily data versus instantaneous discharge data. As can be seen, had you completed this analysis using mean daily data, the result would have been an underestimation of the discharges associated with each return period.