

Supplemental Materials for: Agricultural Insurance Loss and Relationships to Climate across the Inland Pacific Northwest Region of the United States

The material contained herein is supplementary to the article named in the title and submitted to the journal, Agriculture, Ecosystems and Environment.

July 2023

These supplemental materials provide exploratory data analyses and principal component analyses (PCA) for the Pacific Northwest (PNW) and the inland Pacific Northwest (iPNW), to better understand the combined effects of differing damage causes, commodities, counties, and years on overall insurance loss.

1. Supplemental Tables List

Table S1. Example of insurance loss records that were acquired from the USDA Risk Management Agency (RMA). Each record represents an individual insurance claim. Full datasets are available at <https://github.com/erichseamon/AGinsurancepaper> as well as via the following DOI:

Table S2. Example of insurance loss records aggregated, which are derived from the original insurance loss files. Here we have summarized claims by year, county, commodity, and damage cause. Full datasets are available at <https://github.com/erichseamon/AGinsurancepaper> as well as via the following DOI:

2. Supplemental Figures List

Pacific Northwest (PNW) Supplemental Figures

Figure S1. Pacific Northwest study area, which includes agricultural regions for the inland Pacific Northwest, the southern Idaho valley, and the Willamette valley.

Figure S2. PNW agricultural insurance loss by year, 1989 to 2015.

Figure S3. PNW agricultural insurance loss by year: 2001 to 2015.

Figure S4. PNW agricultural insurance loss by damage cause: 2001 to 2015.

Figure S5. PNW agricultural insurance loss by commodity: 2001 to 2015

Figure S6. Top panel: biplot of principal components for PNW insurance loss, by county, with commodity as the factor loadings. Bottom panel: Scree plot. Data from 2001 to 2015 is used.

Figure S7. Top panel: biplot of principal components for PNW insurance loss, for all commodities by year, with damage cause as the factor loadings. Bottom panel: Scree plot. Data from 2001 to 2015 is used.

Figure S8. Top panel: biplot of principal components for PNW insurance loss, for all commodities by month, with damage cause as the factor loadings. Bottom panel: Scree plot Data from 2001 to 2015 is used.

Figure S9. Top panel: biplot of principal components for PNW insurance loss, for wheat by year, with damage cause as the factor loadings. Bottom panel: Scree plot. Data from 2001 to 2015 is used.

Figure S10. Top panel: biplot of principal components for PNW insurance loss, for wheat by county, with damage cause as the factor loadings. Bottom panel: Scree plot. Data from 2001 to 2015 is used.

Figure S11. Top panel: biplot of principal components for PNW insurance loss, for apples by county, with damage cause as the factor loadings. Bottom panel: Scree plot. Data from 2001 to 2015 is used.

Figure S12. Top panel: biplot of principal components for PNW insurance loss, for barley by county, with damage cause as the factor loadings. Bottom panel: Scree plot. Data from 2001 to 2015 is used.

Inland Pacific Northwest (iPNW) Supplemental Figures

Figure S13. iPNW agricultural insurance loss by year, 2001 to 2015.

Figure S14. iPNW agricultural insurance loss by commodity, 2001 to 2015.

Figure S15. iPNW agricultural insurance loss by damage cause, 2001 to 2015.

Figure S16. iPNW agricultural insurance loss for apples by county: 2001 to 2015.

Figure S17. iPNW agricultural insurance loss for apples by year: 2001 to 2015.

Figure S18. iPNW agricultural insurance loss for apples by damage cause: 2001 to 2015.

Figure S19. iPNW stacked barplot of annual apples agricultural insurance loss, by top damage causes, 2001 to 2015.

Figure S20. iPNW agricultural insurance loss due to hail, frost, and freeze, for apples, by county, 2001 to 2015.

Figure S21. iPNW agricultural insurance loss due to hail, frost, and freeze, for apples, by county, 2013.

Figure S22. iPNW agricultural insurance loss due to hail, frost, and freeze, for apples, by county, 2012.

Figure S23. iPNW agricultural insurance loss due to hail, frost, and freeze, for apples, by county, 2006.

Figure S24. iPNW agricultural insurance loss due to hail, frost, and freeze, for apples, by county, 2015.

Figure S25. Top panel: biplot of principal components for iPNW insurance loss, for all commodities by county, with damage cause as the factor loadings. Bottom panel: Scree plot. Data from 2001 to 2015 is used

Figure S26. Top panel: biplot of principal components for iPNW insurance loss, for all commodities by month, with damage cause as the factor loadings. Bottom panel: Scree plot. Data from 2001 to 2015 is used

Figure S27. Top panel: biplot of principal components for iPNW insurance loss, for wheat by year, with damage cause as the factor loadings. Bottom panel: Scree plot. Data from 2001 to 2015 is used

Figure S28. Top panel: biplot of principal components for iPNW insurance loss, for wheat by county, with damage cause as the factor loadings. Bottom panel: Scree plot. Data from 2001 to 2015 is used

Figure S29. Top panel: biplot of principal components for iPNW insurance loss, for barley by county, with damage cause as the factor loadings. Bottom panel: Scree plot. Data from 2001 to 2015 is used

Alternative Modeling Supplemental Figures

Figure S30. Top panel: biplot of insurance loss for the PNW, for wheat by county, with damage cause as the factor loadings. Uses a Kmeans technique for grouping. Bottom panel: Scree plot. Data from 2001 to 2015 is used.

Figure S31. Hierarchical clustering dendrogram of iPNW counties, using the first two principal components of the aforementioned dimensionality reduction exercise. This clustering method provides an alternative approach as compared to Kmeans clustering.

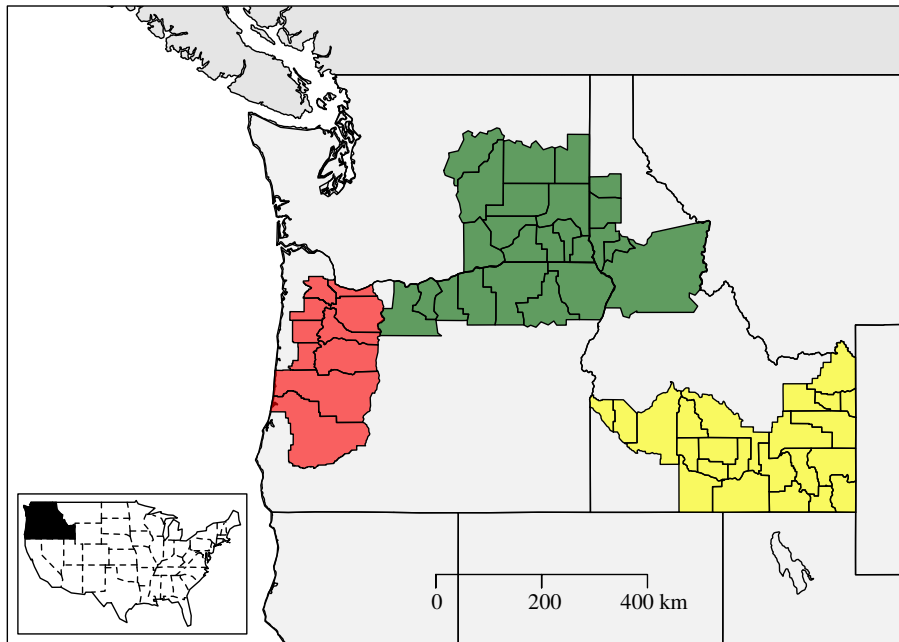


Figure 1: Pacific Northwest study area, which includes agricultural regions for the inland Pacific Northwest, the southern Idaho valley, and the Willamette valley.

Table 1: Example of insurance loss records that were acquired from the USDA Risk Management Agency (RMA). Each record represents an individual insurance claim. Full datasets are available at <https://github.com/erichseamon/AGinsurancepaper> as well as via the following DOI:

year	state	county	commodity	damagecause	month	acres	loss	lossperacre	cropyear
2001	ID	Ada	All Other Crops	Drought	SEP	17.000	153.00	9.000000	2001
2001	ID	Ada	All Other Crops	Heat	AUG	105.200	5249.00	49.895437	2001
2001	ID	Ada	All Other Crops	Freeze	APR	125.000	4500.00	36.000000	2001
2001	ID	Ada	All Other Crops	Wind/Excess Wind	MAY	50.000	1800.00	36.000000	2001
2001	ID	Ada	All Other Crops	Wind/Excess Wind	APR	92.500	3330.00	36.000000	2001
2001	ID	Bannock	WHEAT	Drought	AUG	133.000	1212.00	9.112782	2001
2001	ID	Bannock	WHEAT	Drought	SEP	777.520	24807.00	31.905289	2001
2001	ID	Bannock	WHEAT	Drought	JUL	3529.754	54726.46	15.504327	2001
2001	ID	Bannock	WHEAT	Heat	JUL	19.796	2371.60	119.801980	2001

Table 2: Example of insurance loss records aggregated, which are derived from the original insurance loss files. Here we have summarized claims by year, county, commodity, and damage cause. Full datasets are available at <https://github.com/erichseamon/AGinsurancepaper> as well as via the following DOI:.

year	state	county	commodity	damagecause	loss	count	acres	lossperacre	lossperclaim	acresperclaim
2016	OR	Gilliam	Barley		2913.25	1	0	0	2913.25	0
2017	OR	Gilliam	Barley		4312.60	1	0	0	4312.60	0
2017	OR	Sherman	Barley		6183.40	2	0	0	3091.70	0
2017	ID	Idaho	Canola		8652.00	1	0	0	8652.00	0
2016	OR	Umatilla	Cherries		86425.20	1	0	0	86425.20	0
2017	ID	Latah	Dry Peas		3312.80	1	0	0	3312.80	0
2017	WA	Whitman	Dry Peas		46795.00	2	0	0	23397.50	0
2017	WA	Walla Walla	Grapes		42400.25	2	0	0	21200.12	0
2016	OR	Umatilla	Green Peas		248.20	1	0	0	248.20	0
2017	WA	Adams	Wheat		15215.20	2	0	0	7607.60	0

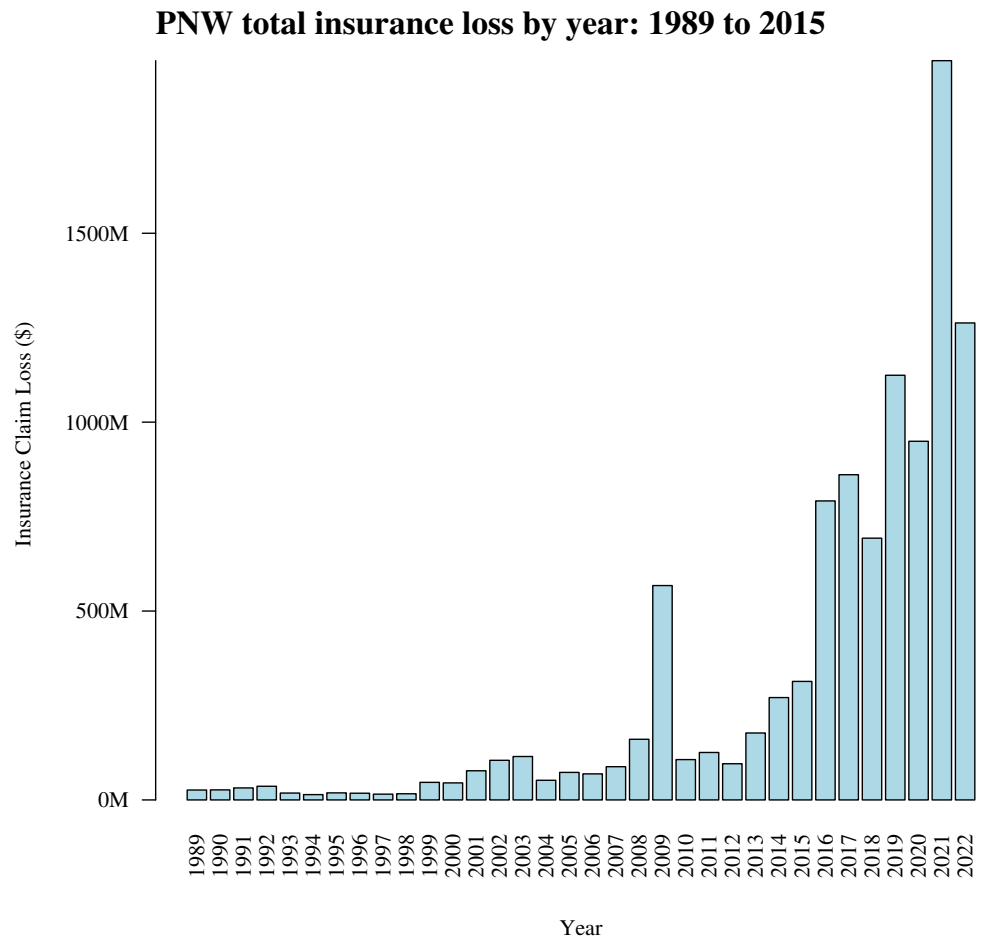


Figure 2: Pacific Northwest agricultural insurance loss by year, 1989 to 2015

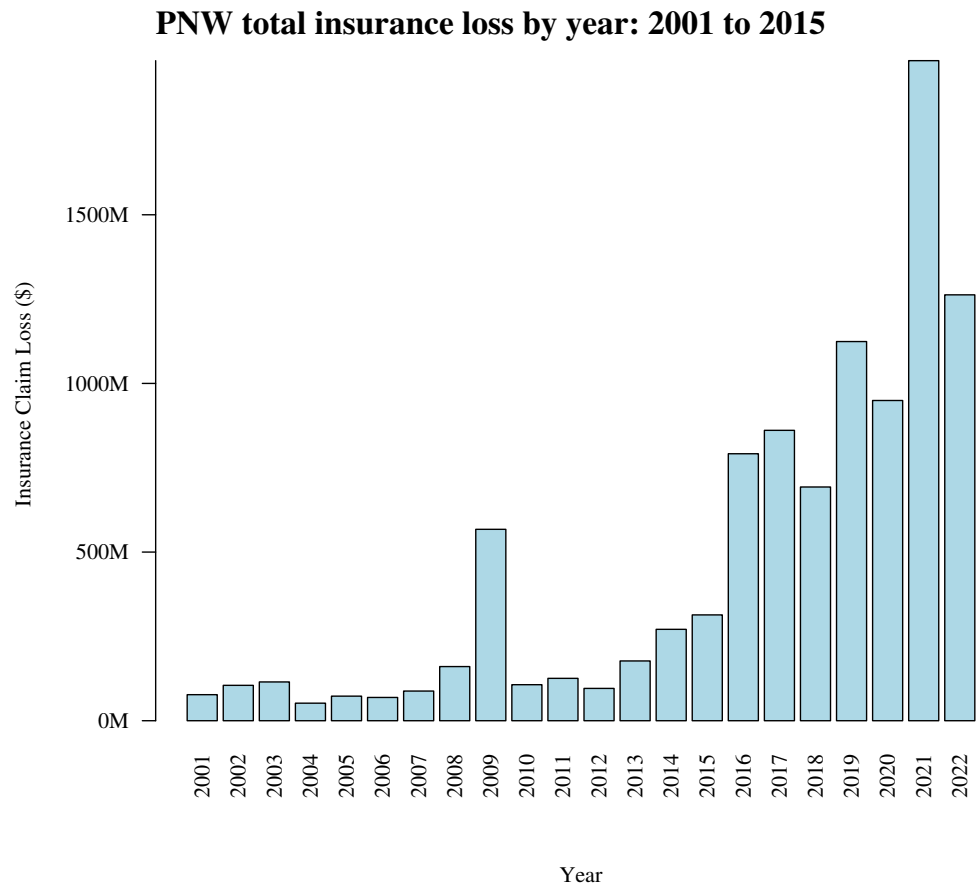


Figure 3: Pacific Northwest agricultural insurance loss by year: 2001 to 2015

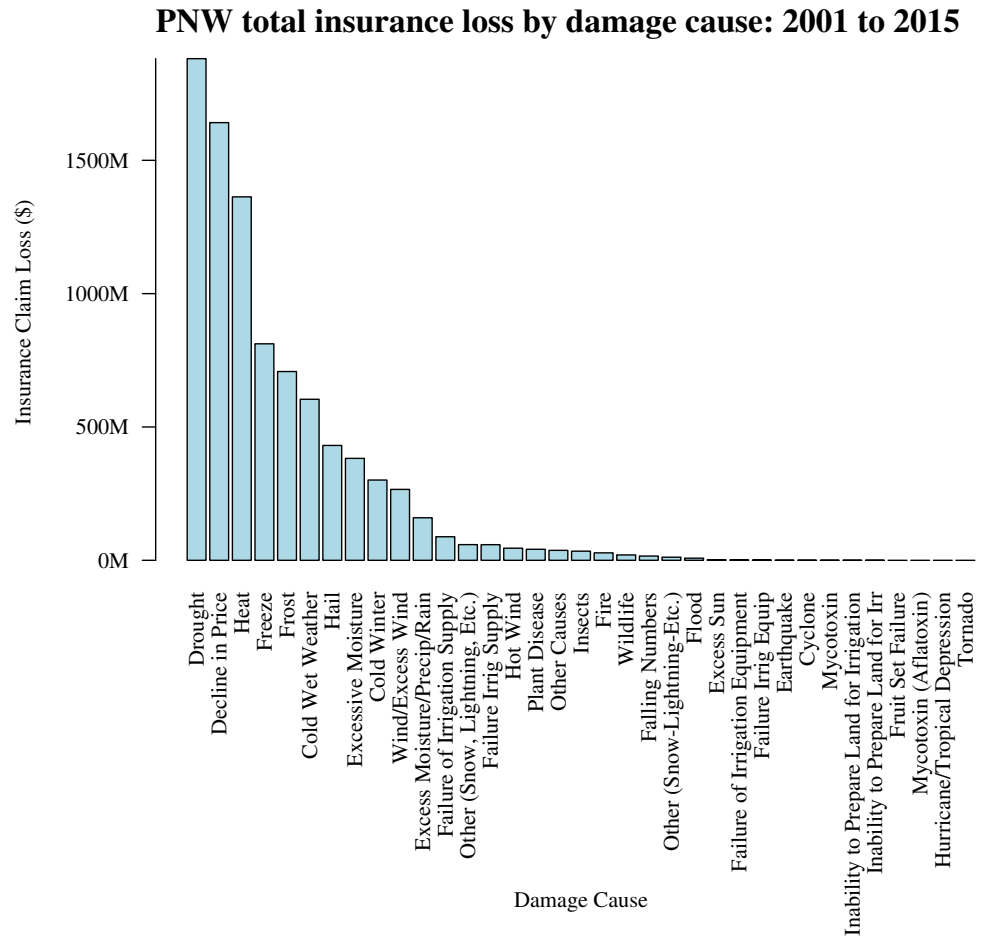


Figure 4: Pacific Northwest agricultural insurance loss by damage cause: 2001 to 2015.

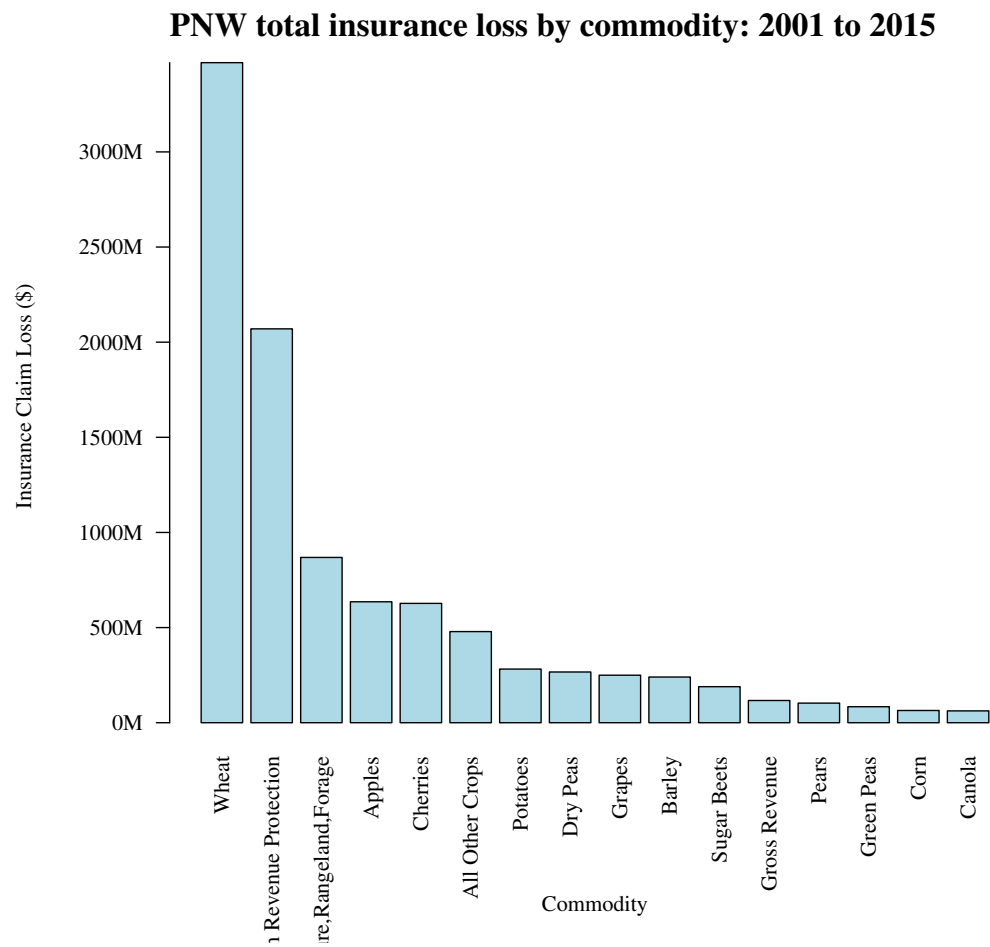


Figure 5: Pacific Northwest agricultural insurance loss by commodity: 2001 to 2015.

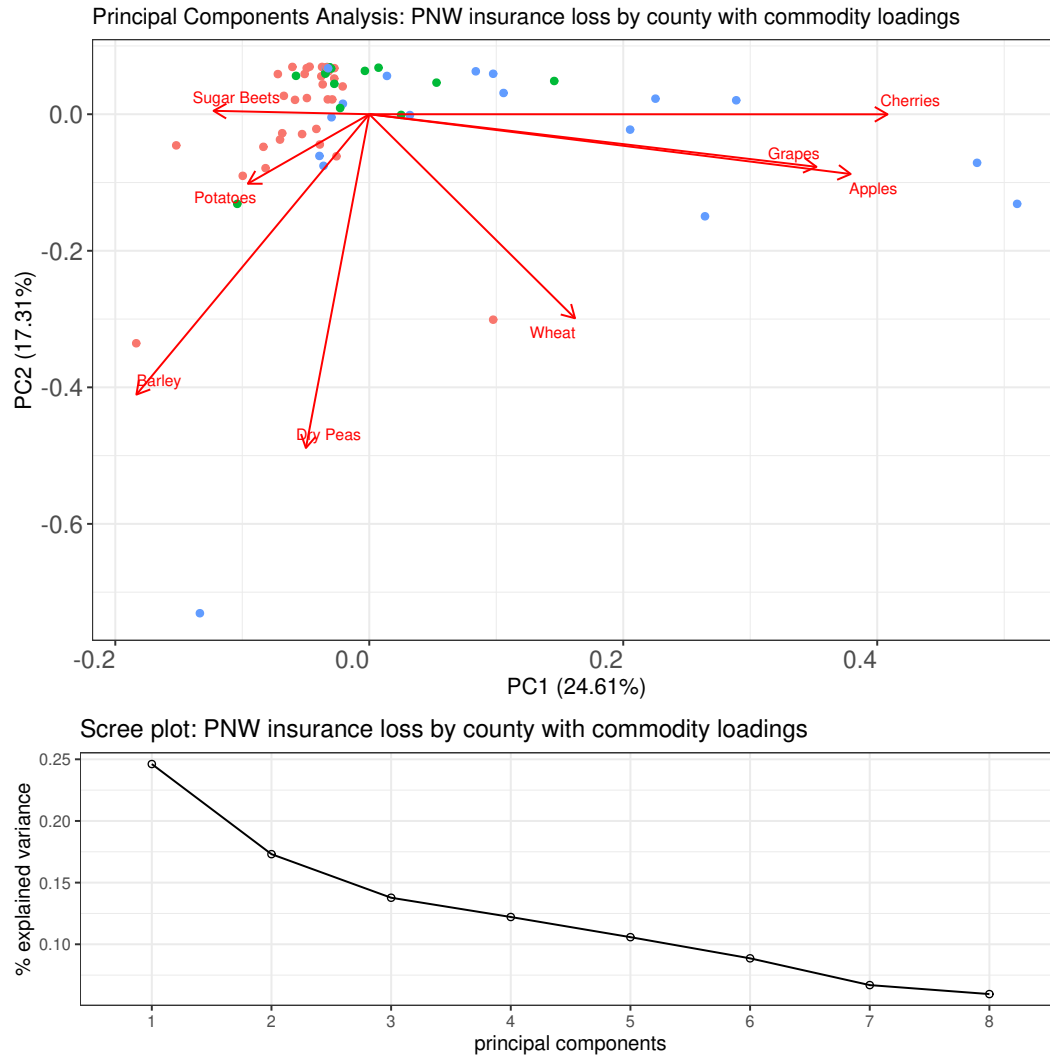


Figure 6: Top panel: Biplot of principal components for insurance loss for the entire PNW, by county, with commodity as the factor loadings. Bottom panel: Scree plot. Data from 2001 to 2015 is used.

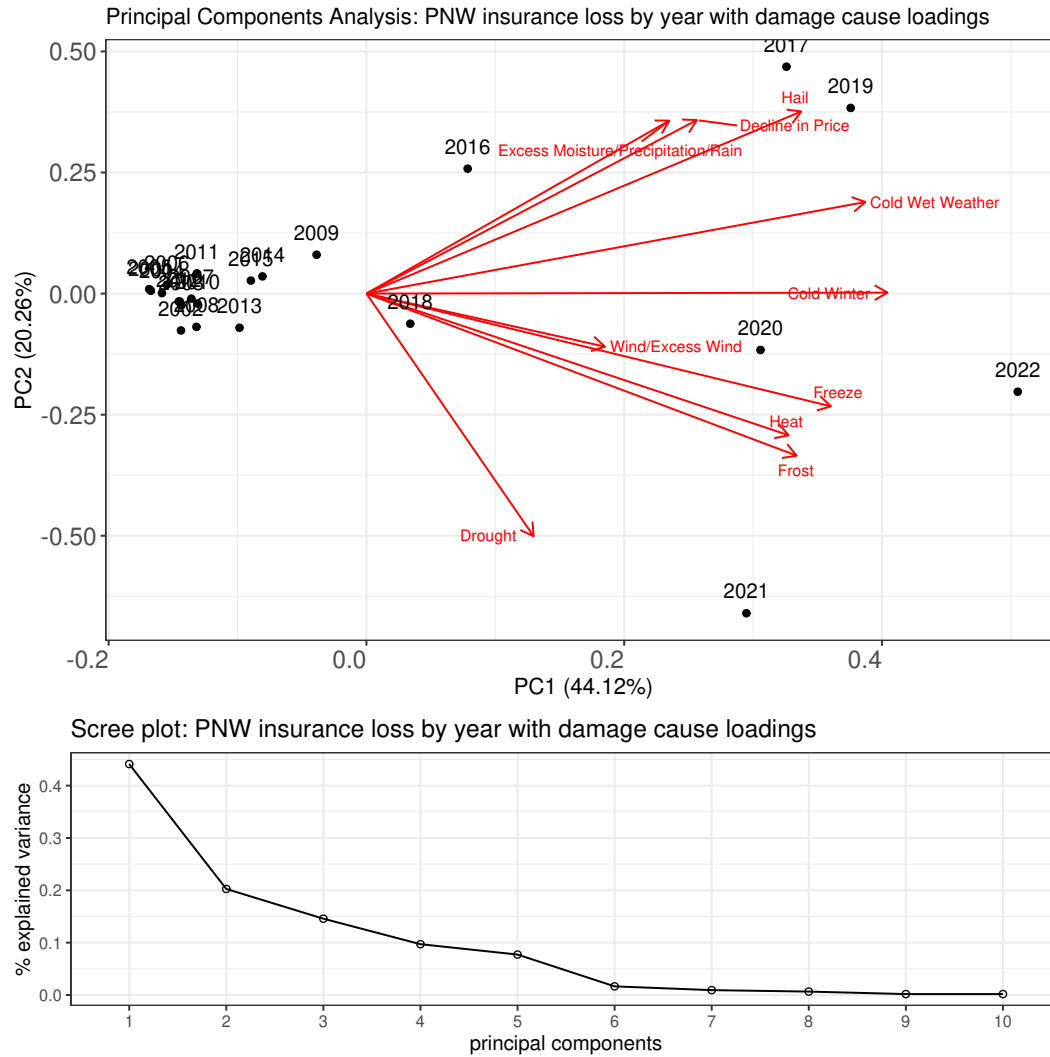


Figure 7: Top panel: biplot of principal components of insurance loss, for the entire PNW, for all commodities by year, with damage cause as the factor loadings. Bottom panel: Scree plot. Data from 2001 to 2015 is used.

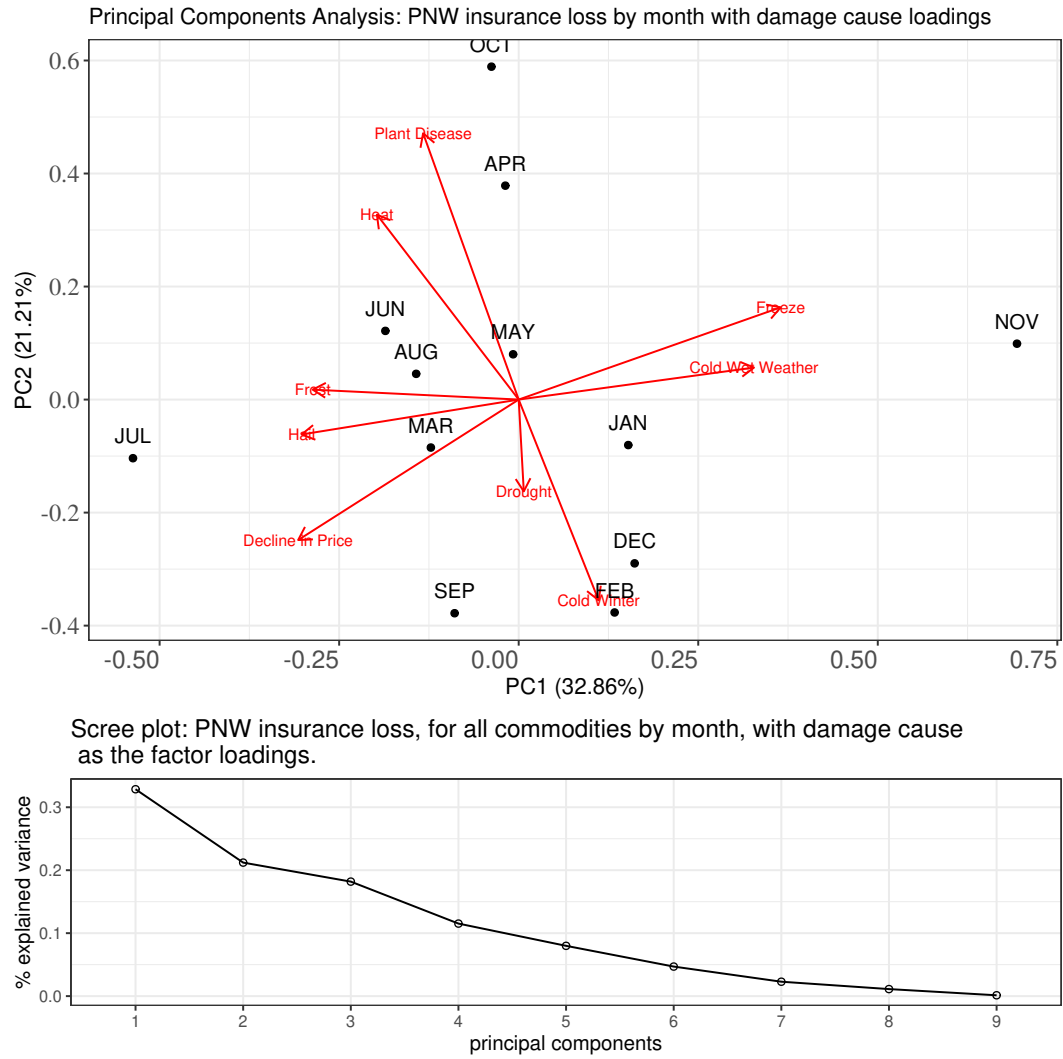


Figure 8: Top panel: biplot of principal components for insurance loss for the entire PNW, for all commodities by month, with damage cause as the factor loadings. Bottom panel: Scree plot Data from 2001 to 2015 is used.

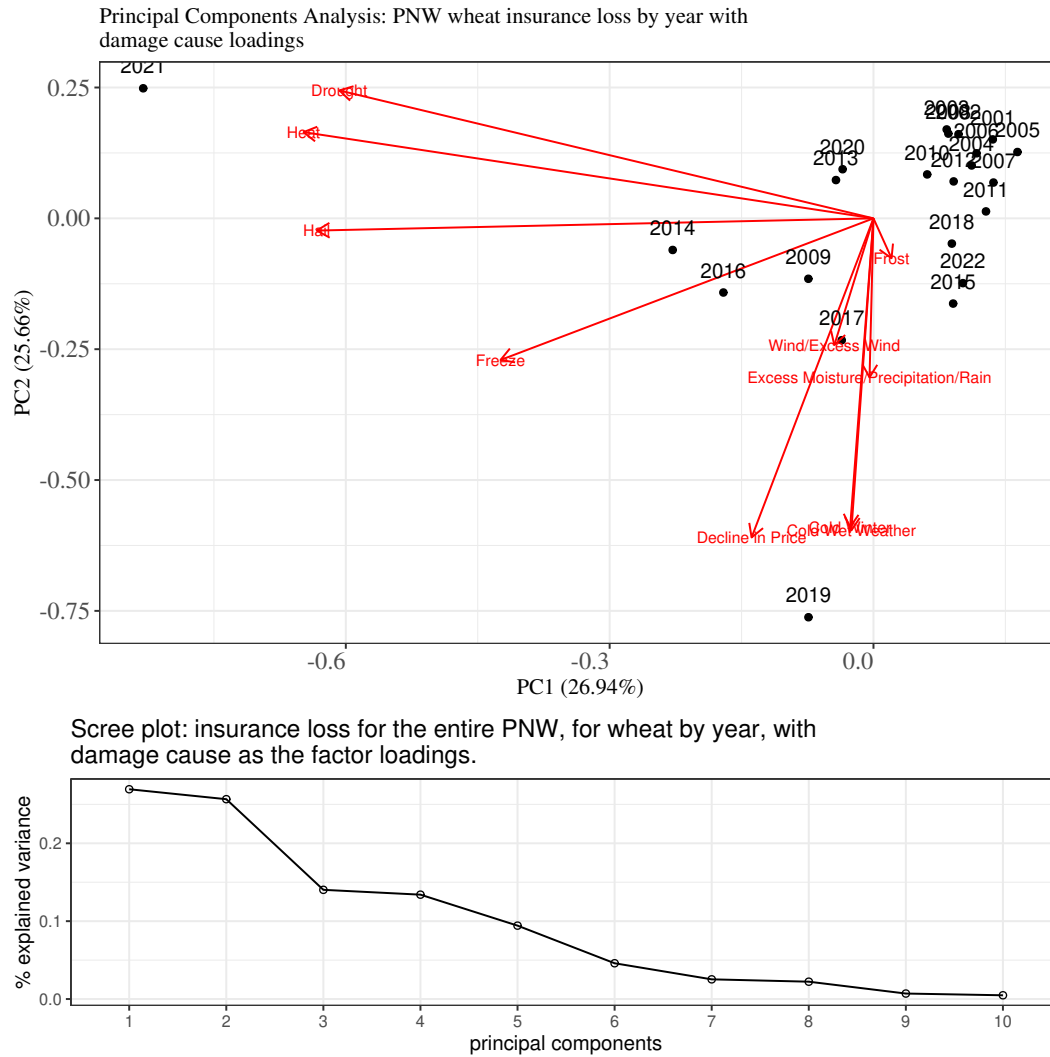


Figure 9: Top panel: biplot of insurance loss for the entire PNW, for wheat by year, with damage cause as the factor loadings. Bottom panel: Scree plot. Data from 2001 to 2015 is used.

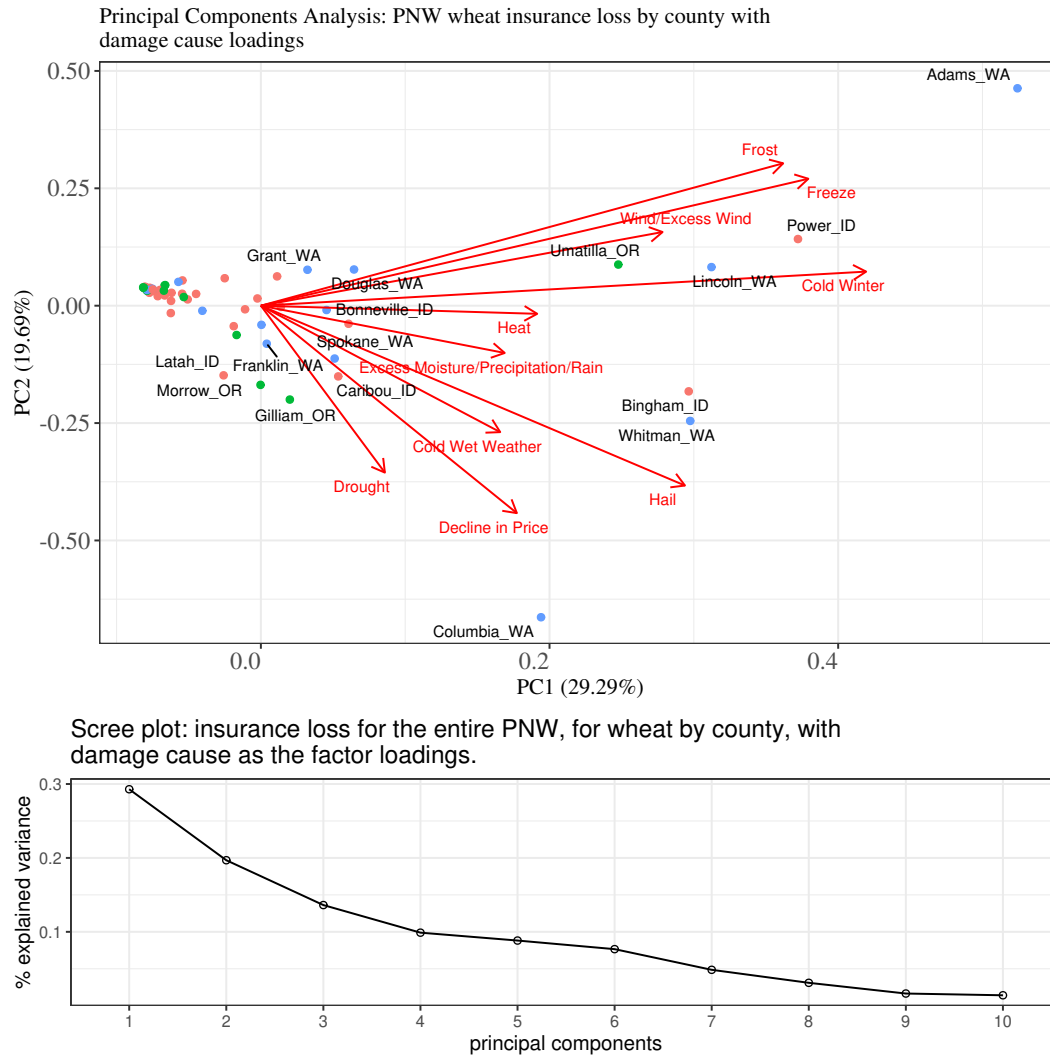


Figure 10: Top panel: biplot of insurance loss for the entire PNW, for wheat by county, with damage cause as the factor loadings. Bottom panel: Scree plot. Data from 2001 to 2015 is used.

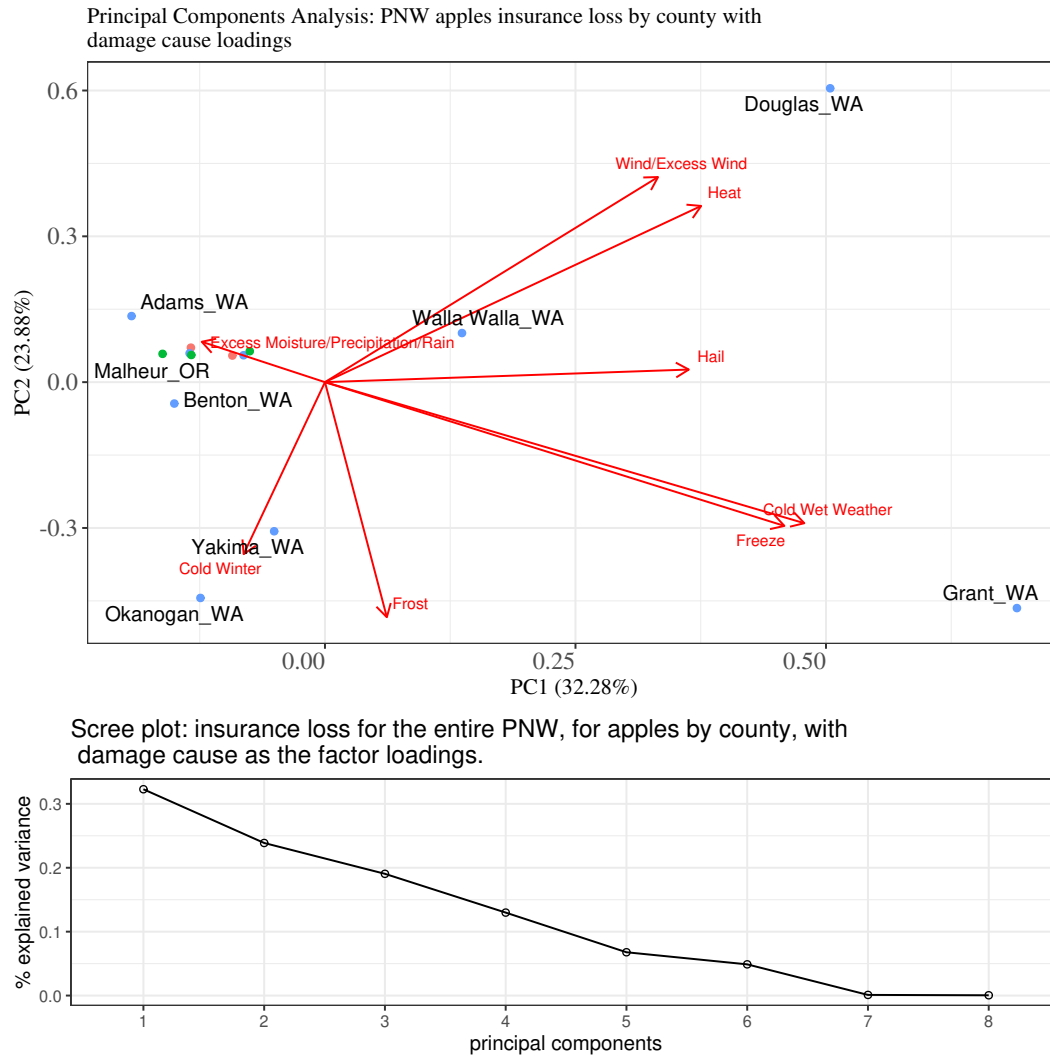


Figure 11: Top panel: biplot of insurance loss for the entire PNW, for apples by county, with damage cause as the factor loadings. Bottom panel: Scree plot. Data from 2001 to 2015 is used.

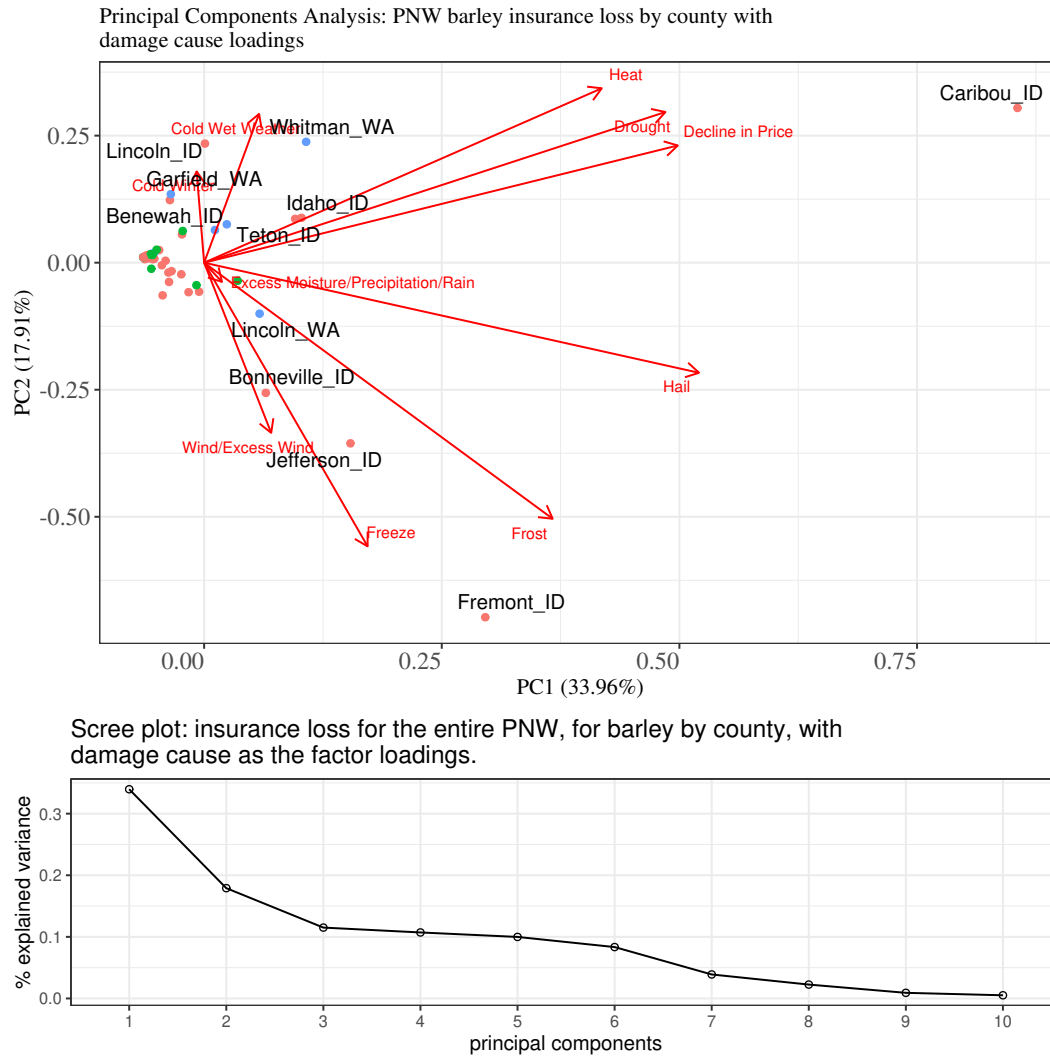


Figure 12: Top panel: biplot of insurance loss for the entire PNW, for barley by county, with damage cause as the factor loadings. Bottom panel: Scree plot. Data from 2001 is 2015 is used.

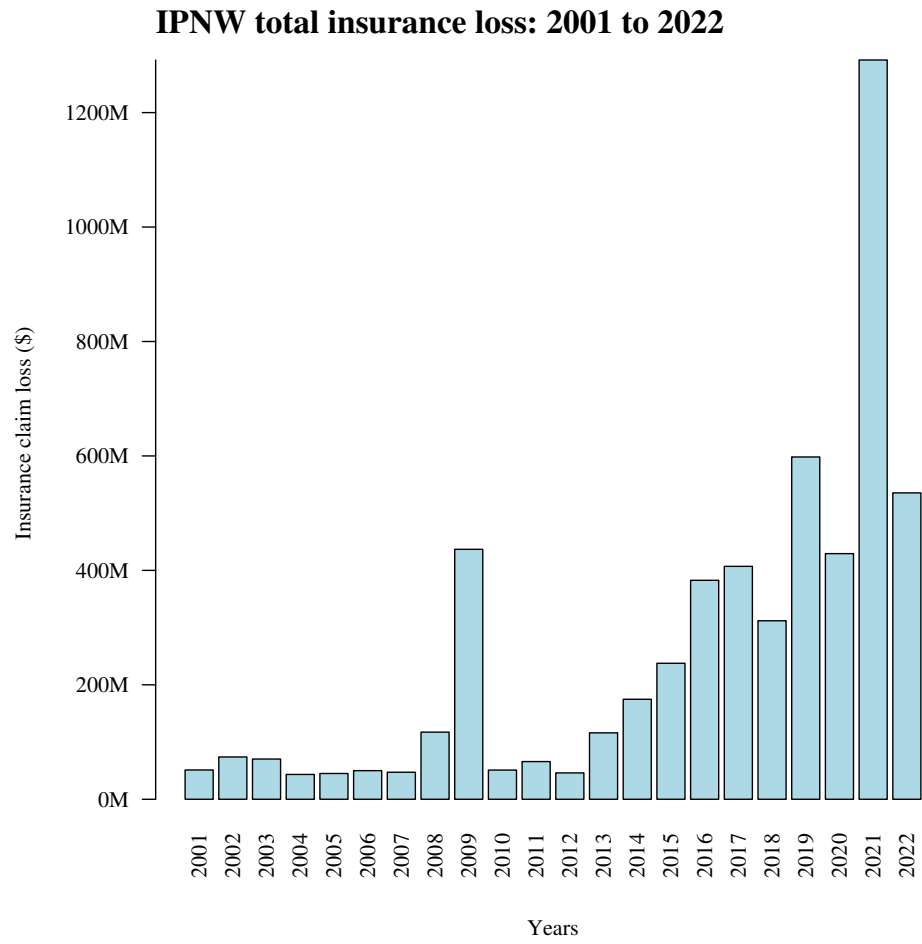


Figure 13: Inland Pacific Northwest agricultural insurance loss by year, 2001 to 2015.

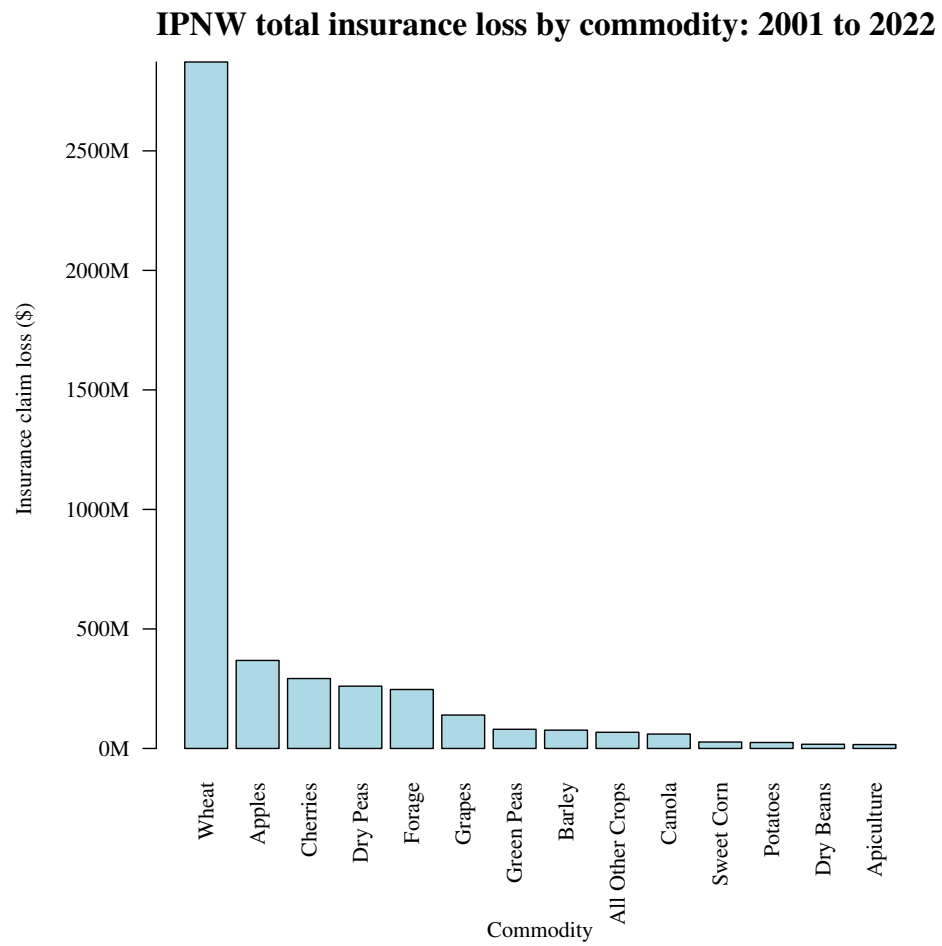


Figure 14: Inland Pacific Northwest agricultural insurance loss by commodity, 2001 to 2015.

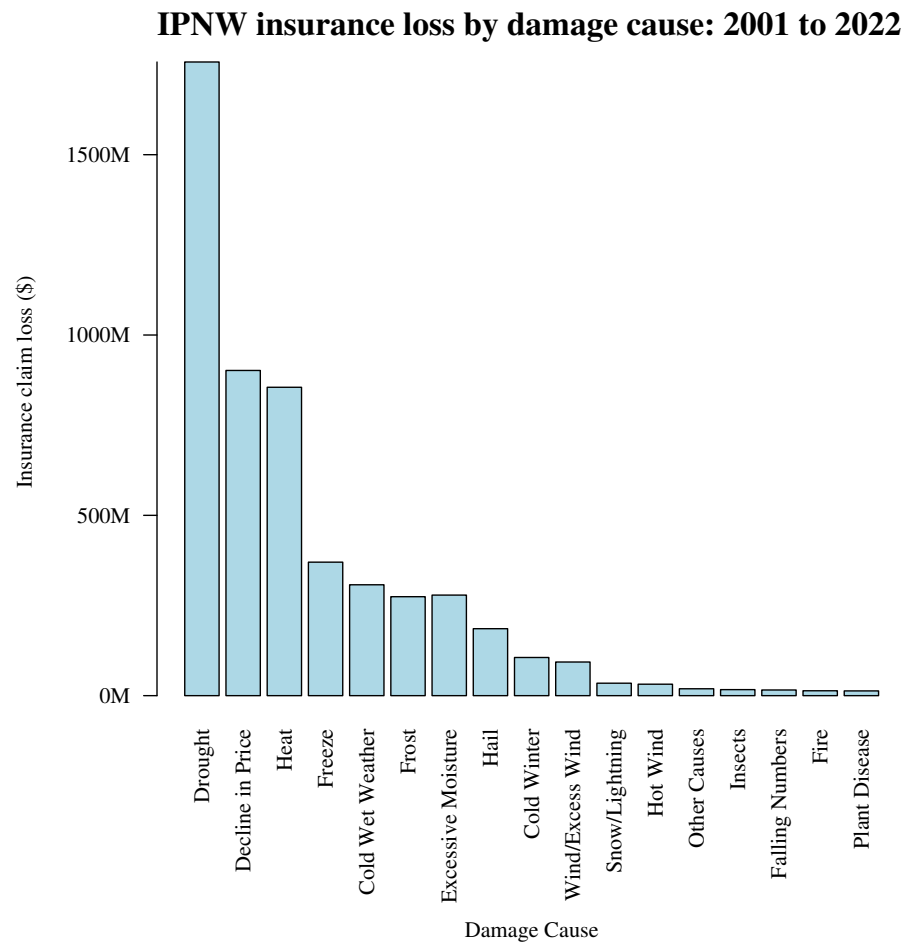


Figure 15: Inland Pacific Northwest agricultural insurance loss by damage cause, 2001 to 2015.

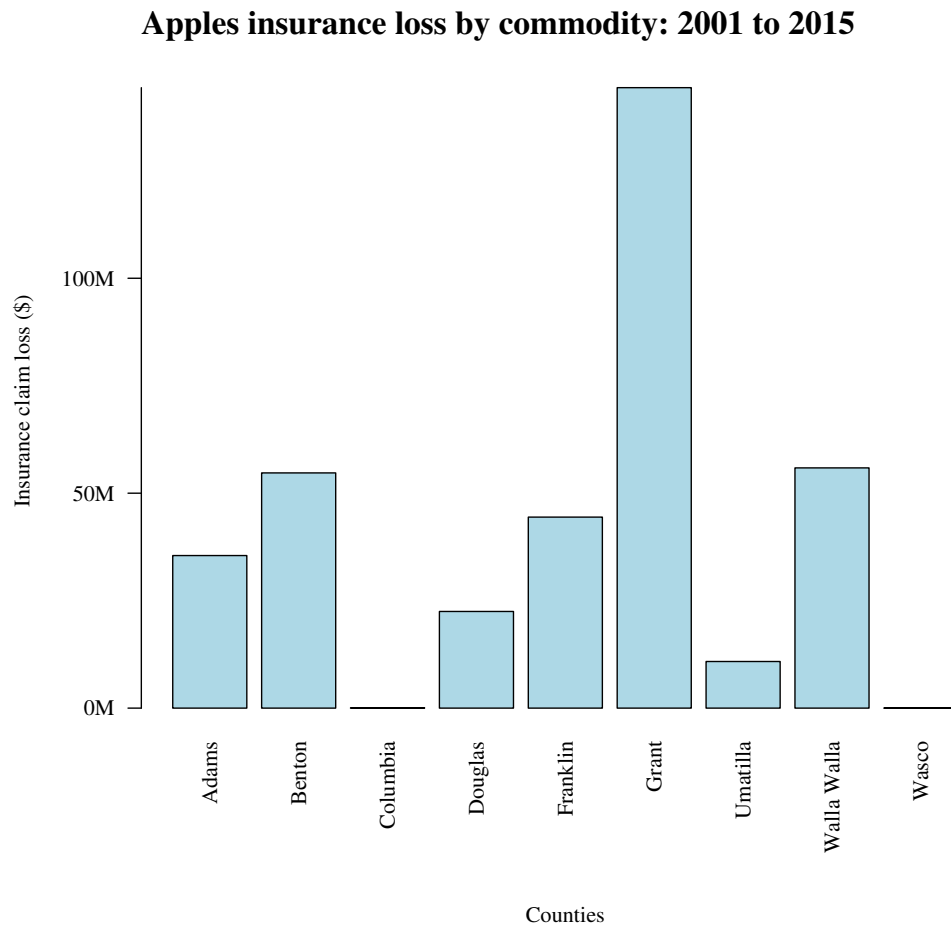


Figure 16: Inland Pacific Northwest agricultural insurance loss for apples, by county, 2001 to 2015.

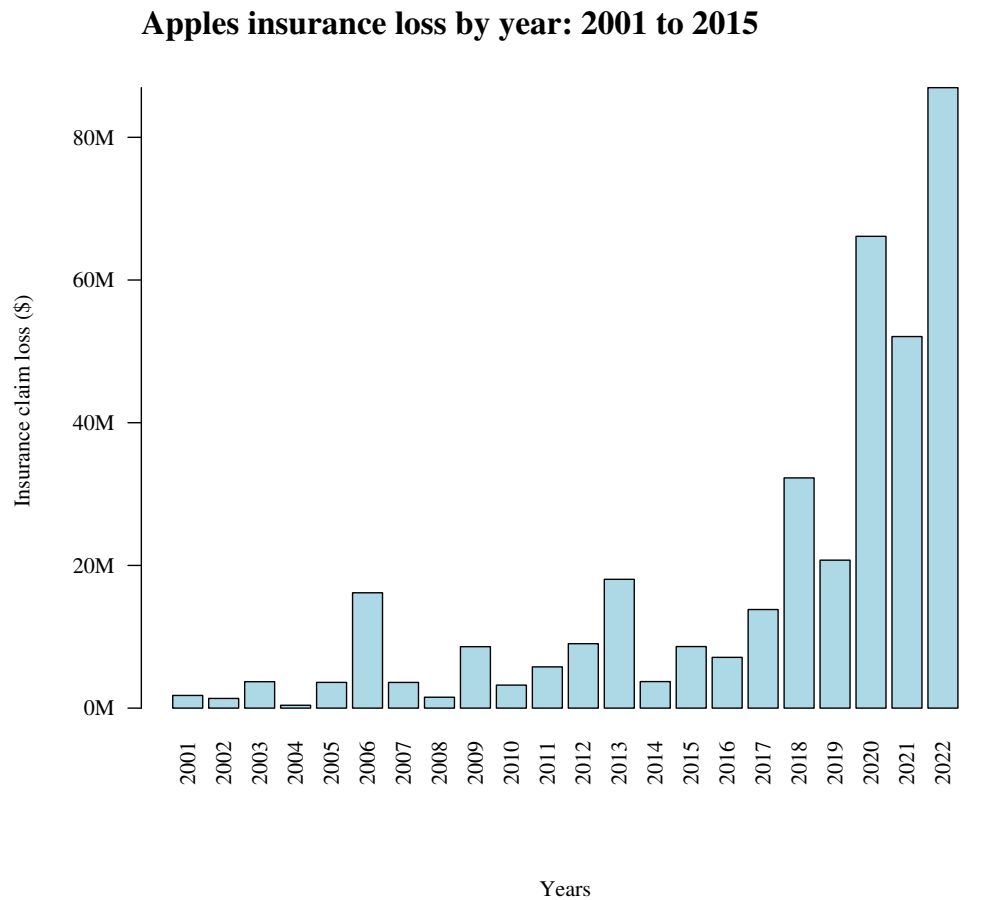


Figure 17: nland Pacific Northwest agricultural insurance loss for apples, by year, 2001 to 2015.

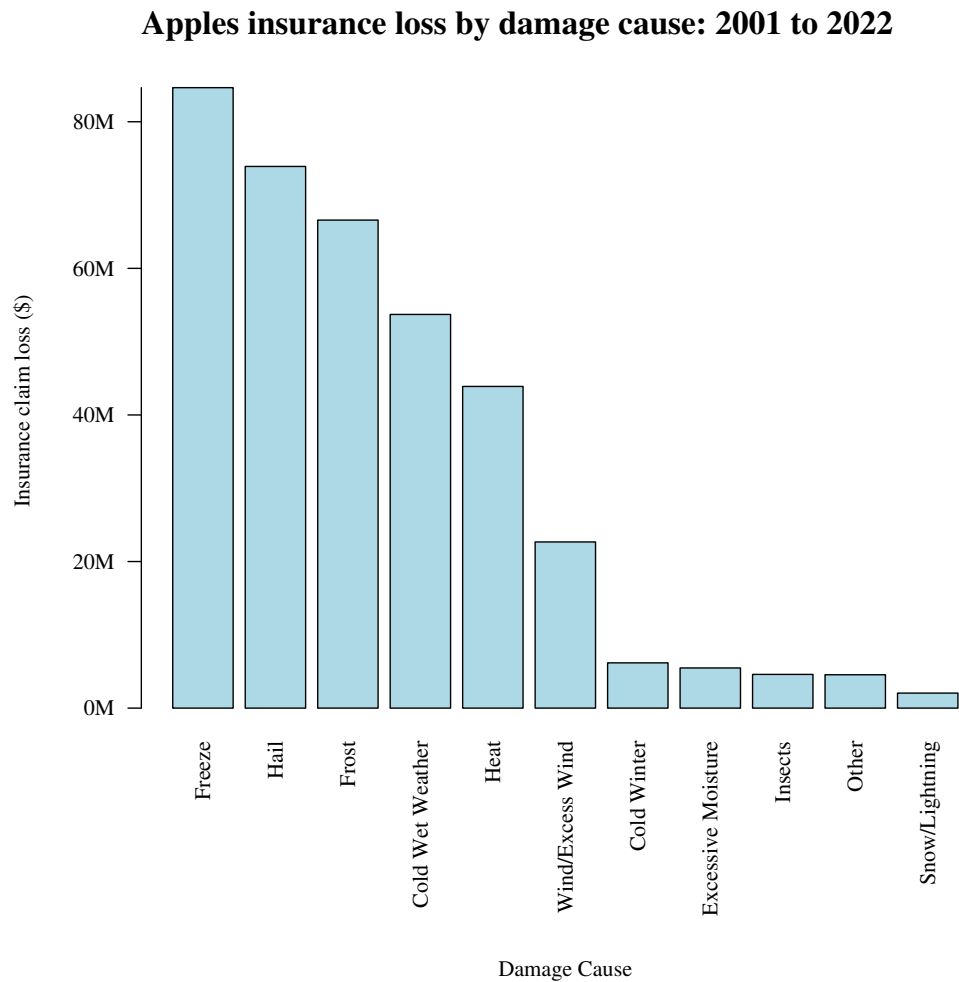


Figure 18: Inland Pacific Northwest agricultural insurance loss for apples, by damage cause, 2001 to 2015.

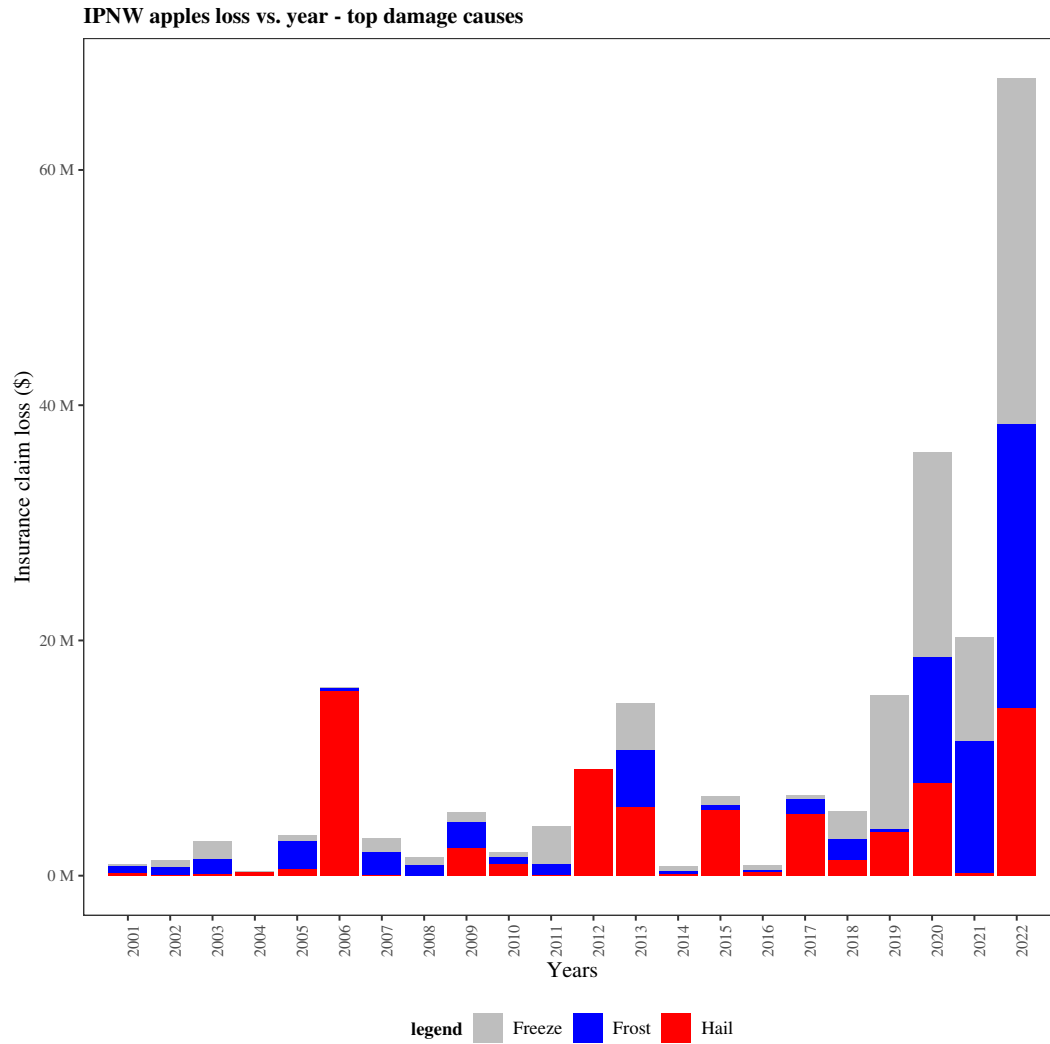


Figure 19: Inland Pacific Northwest stacked barplot of annual apples agricultural insurance loss, by top damage causes, 2001 to 2015.

**IPNW apples insurance loss due to hail, frost, and freeze
2001 to 2015**

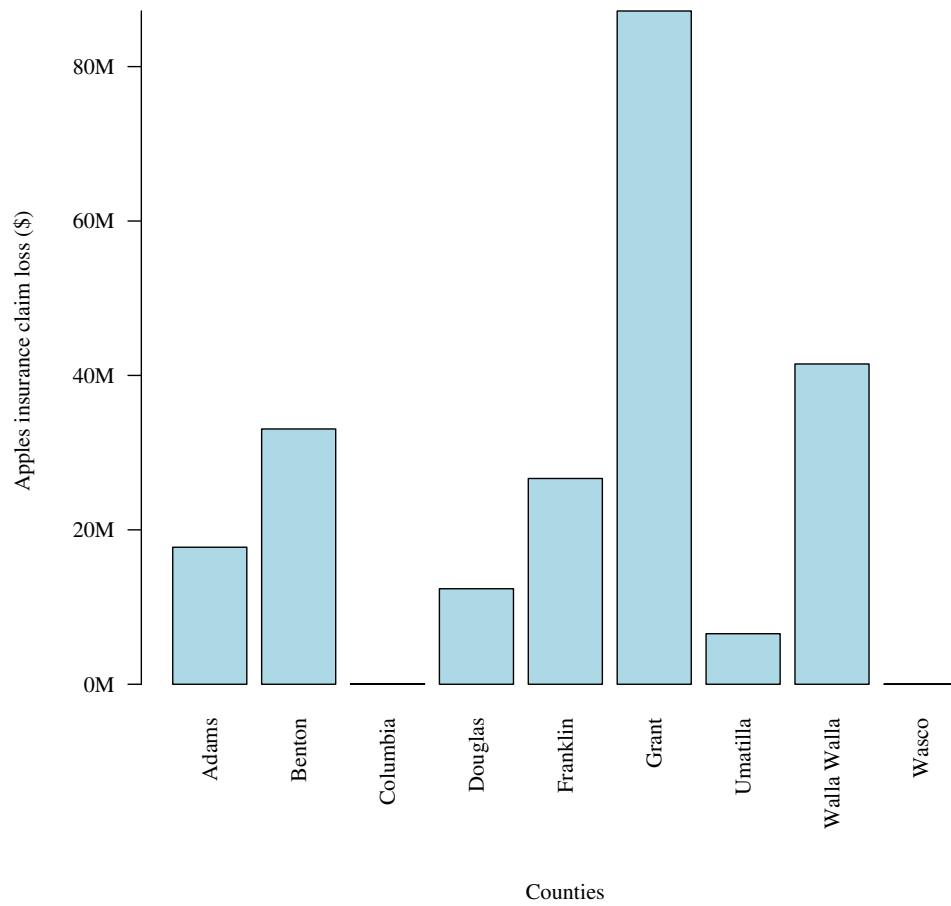


Figure 20: Inland Pacific Northwest agricultural insurance loss due to hail, frost, and freeze, for apples, by county, 2001 to 2015.

IPNW apples insurance loss due to hail, frost, and freeze 2013

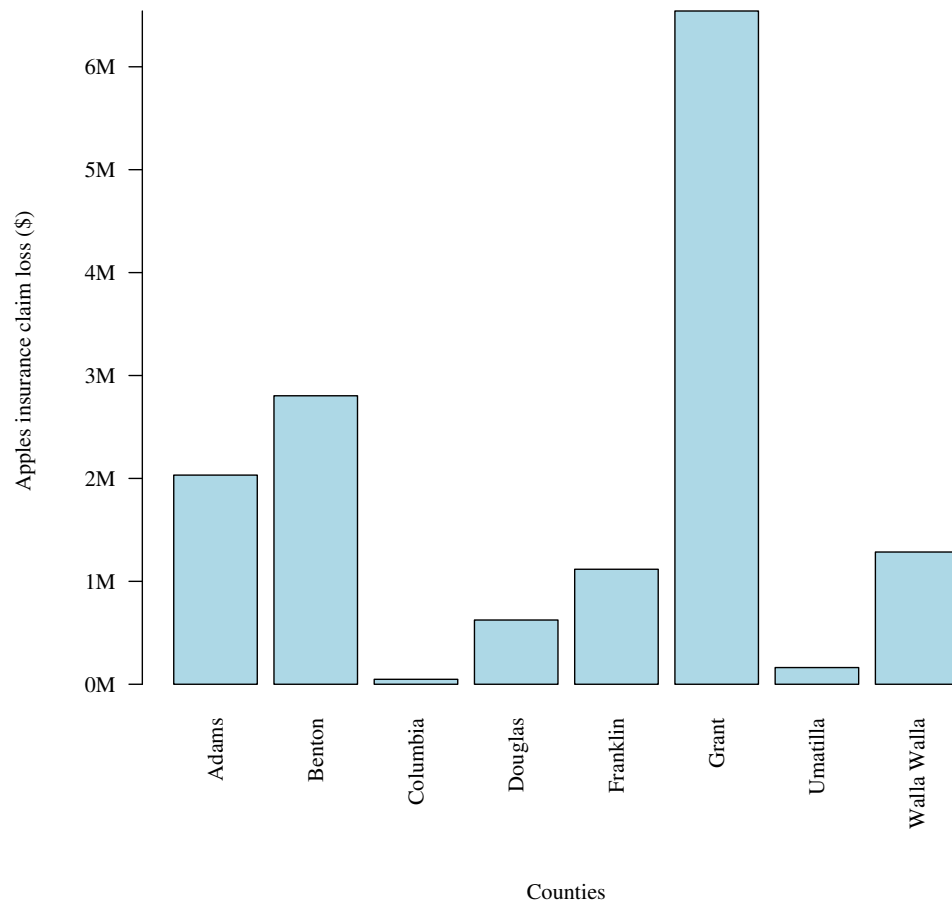


Figure 21: Inland Pacific Northwest agricultural insurance loss due to hail, frost, and freeze, for apples, by county, 2013.

IPNW apples insurance loss due to hail, frost, and freeze 2012

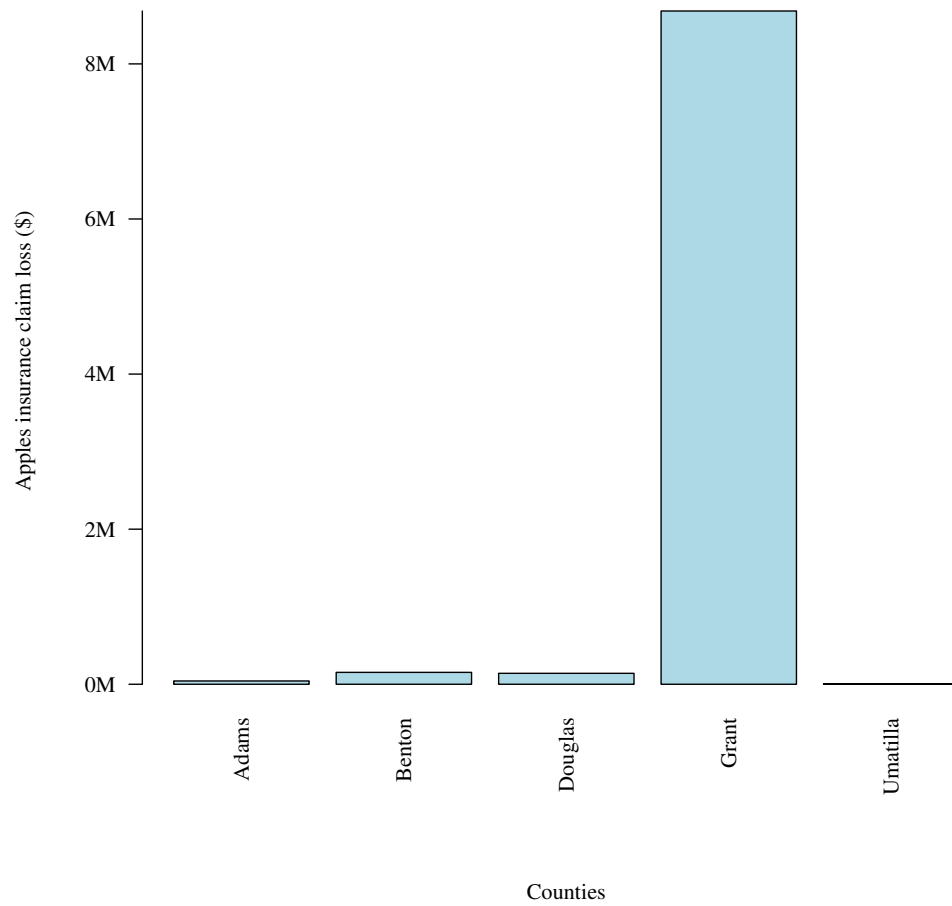


Figure 22: Inland Pacific Northwest agricultural insurance loss due to hail, frost, and freeze, for apples, by county, 2012.

IPNW apples insurance loss due to hail, frost, and freeze 2006

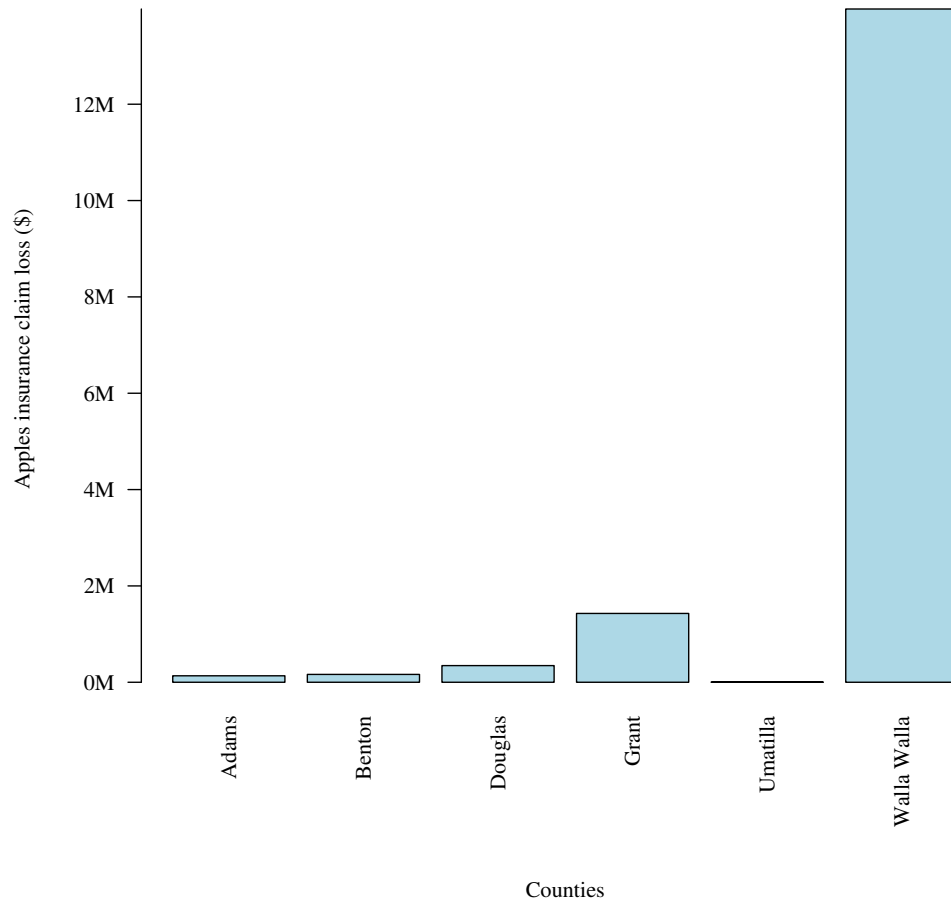


Figure 23: Inland Pacific Northwest agricultural insurance loss due to hail, frost, and freeze, for apples, by county, 2006.

IPNW apples insurance loss due to hail, frost, and freeze 2015

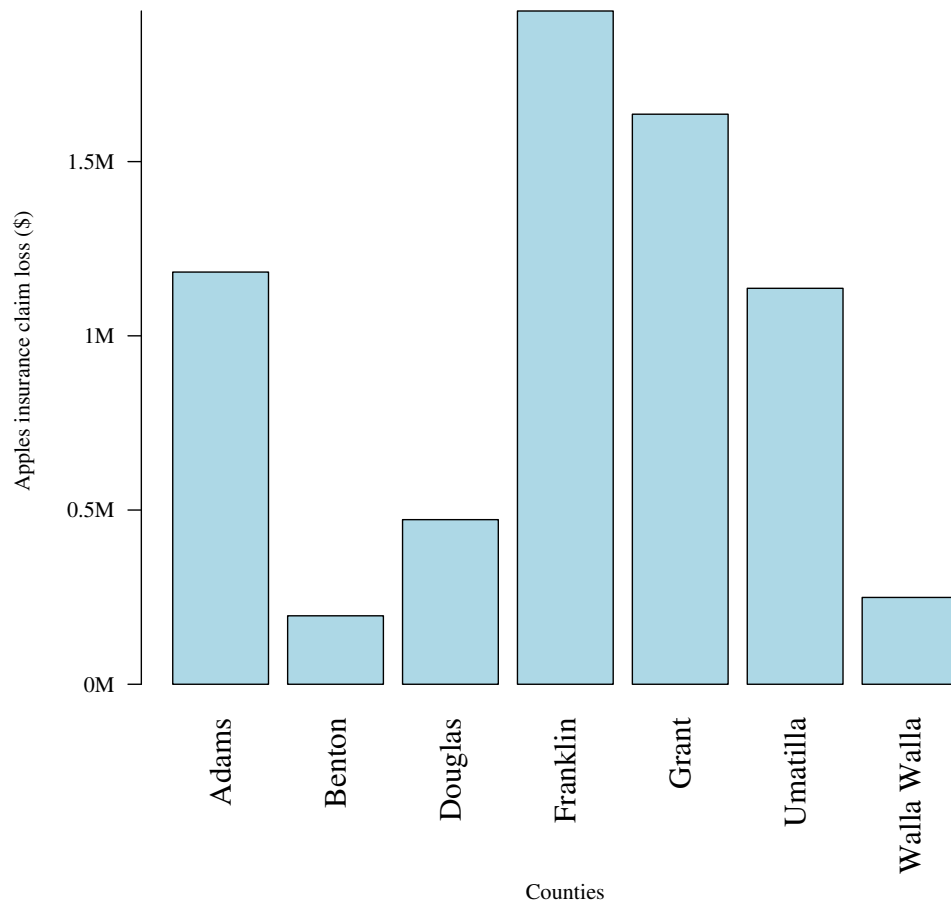


Figure 24: Inland Pacific Northwest agricultural insurance loss due to hail, frost, and freeze, for apples, by county, 2015.

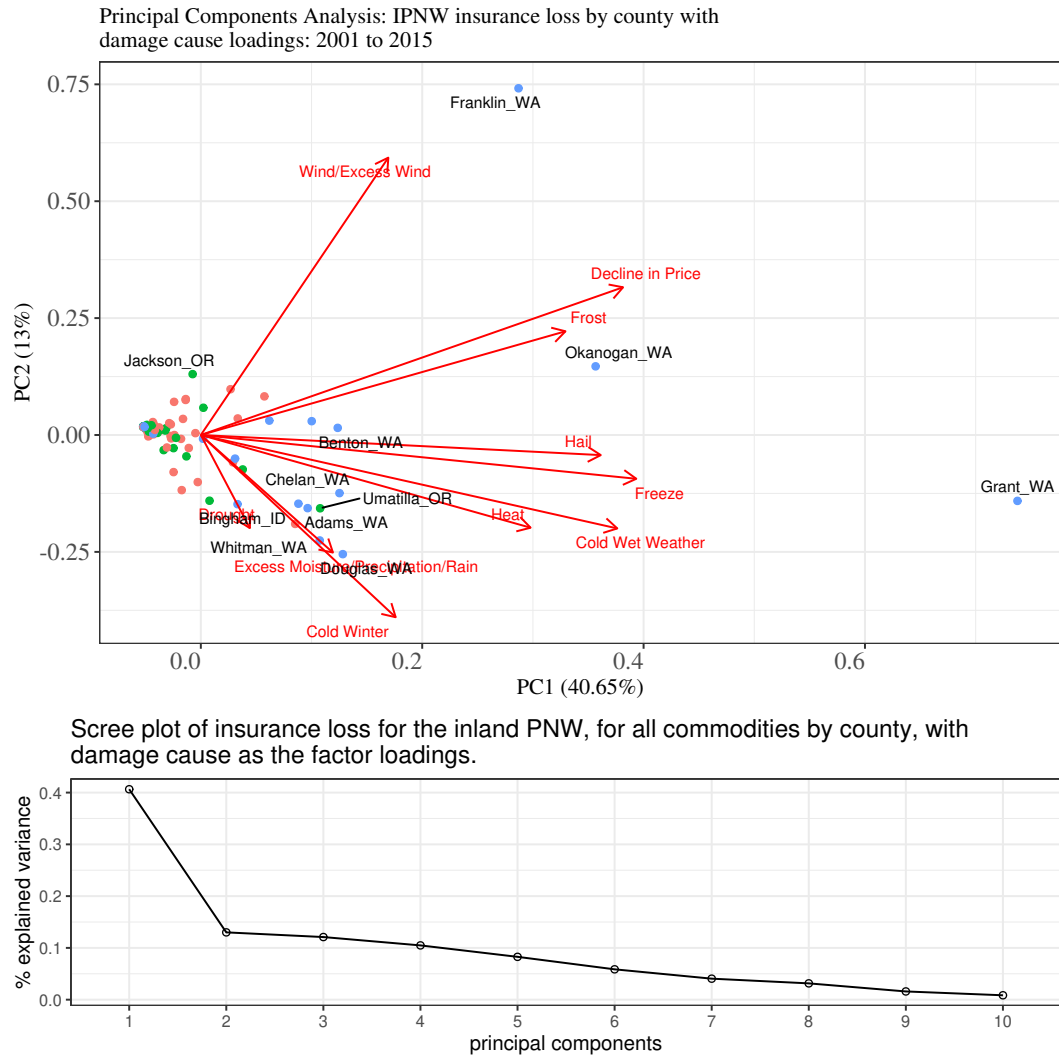


Figure 25: Top panel: biplot of insurance loss for the inland PNW, for all commodities by county, with damage cause as the factor loadings. Bottom panel: Scree plot. Data from 2001 to 2015 is used.

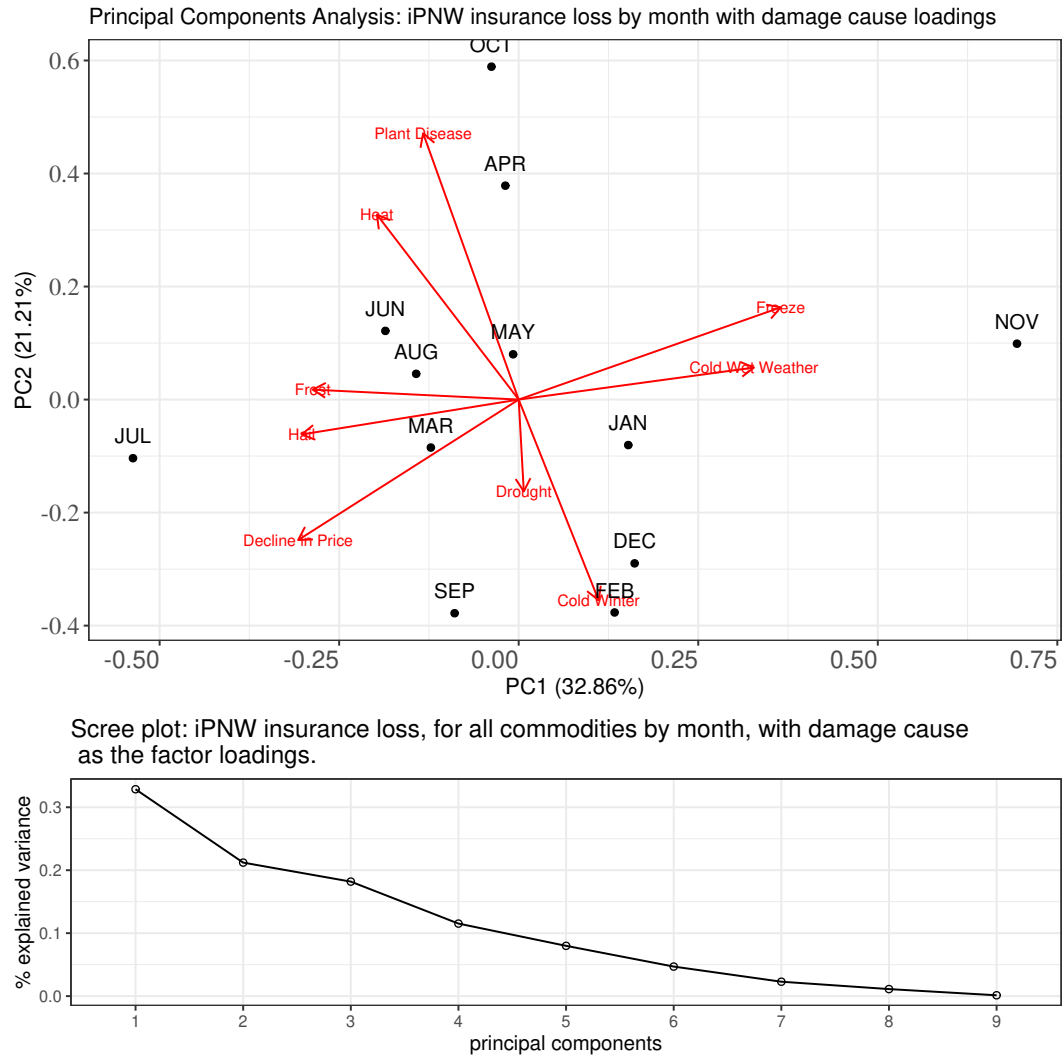


Figure 26: Top panel: biplot of principal components for insurance loss for the entire iPNW, for all commodities by month, with damage cause as the factor loadings. Bottom panel: Scree plot Data from 2001 to 2015 is used.

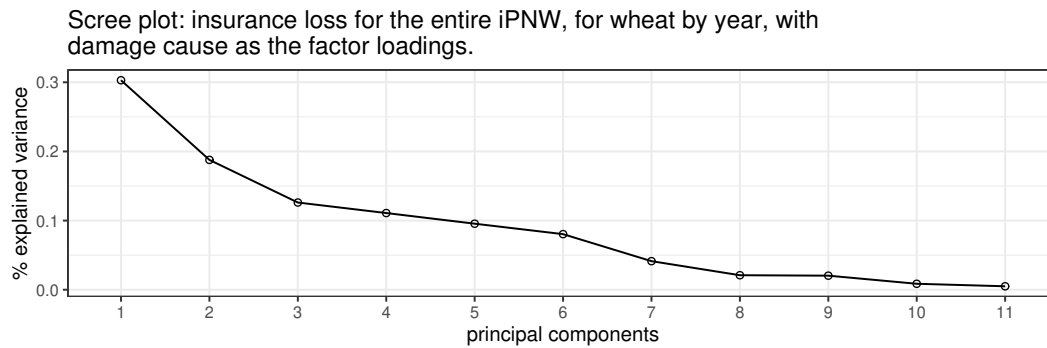
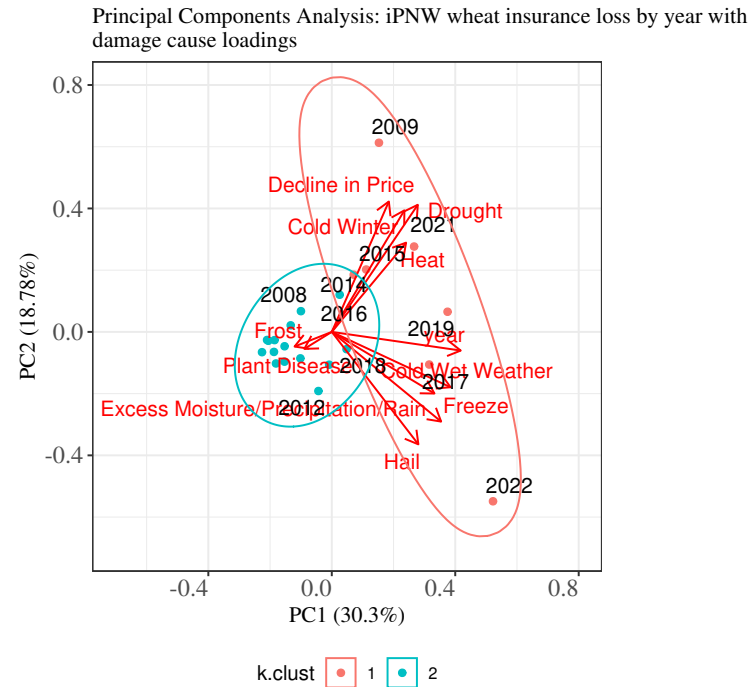


Figure 27: Top panel: biplot of insurance loss for the entire iPNW, for wheat by year, with damage cause as the factor loadings. Bottom panel: Scree plot. Data from 2001 is 2015 is used.

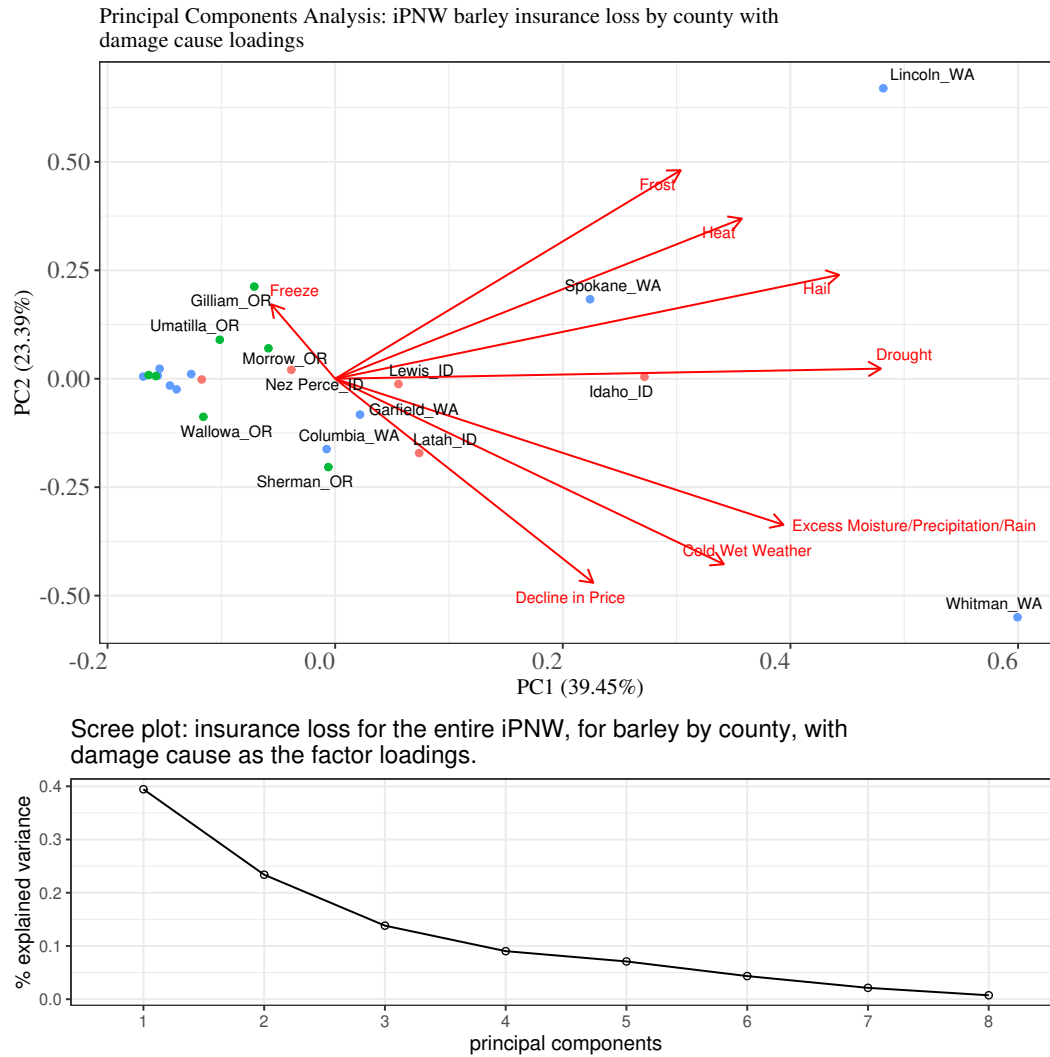


Figure 28: Top panel: biplot of insurance loss for the entire PNW, for barley by county, with damage cause as the factor loadings. Bottom panel: Scree plot. Data from 2001 to 2015 is used.

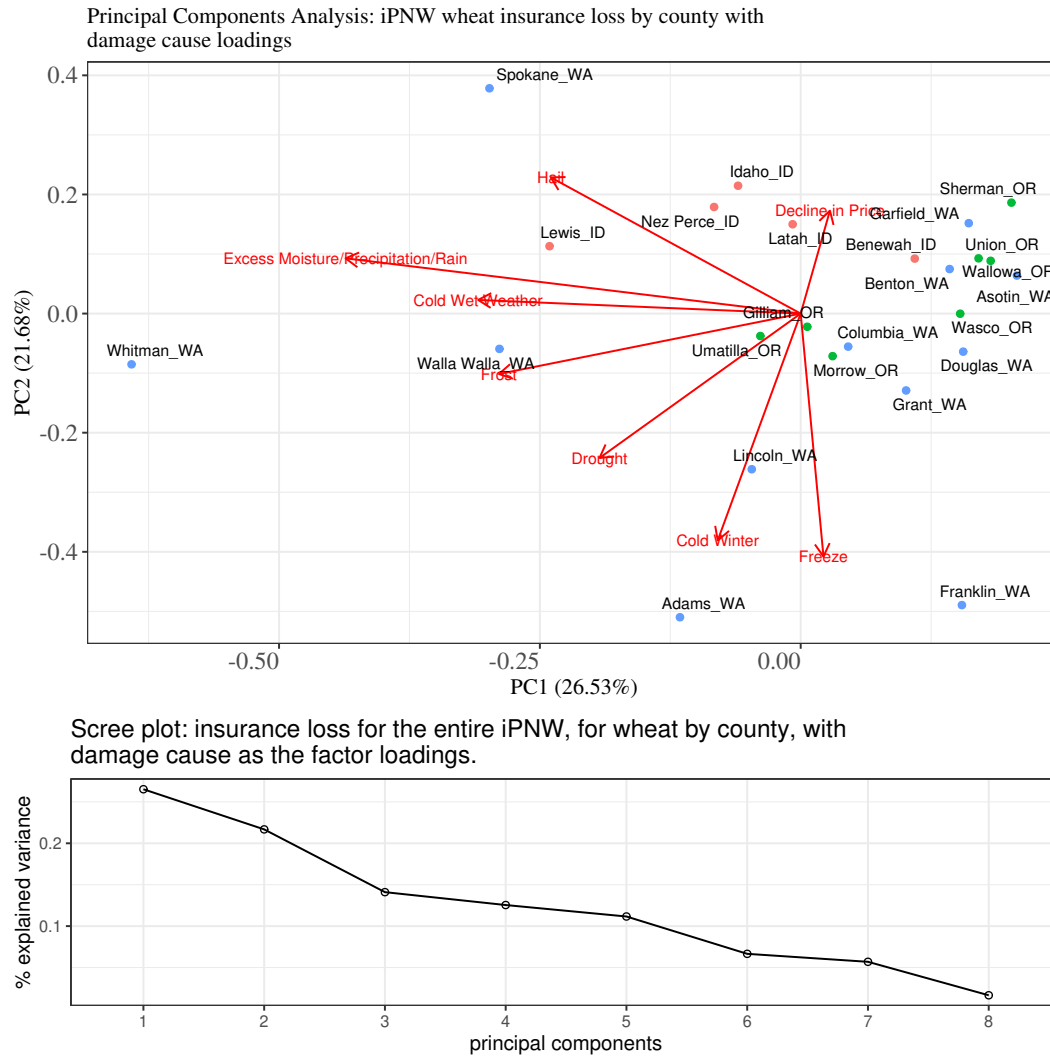


Figure 29: Top panel: biplot of insurance loss for the entire PNW, for wheat by county, with damage cause as the factor loadings. Bottom panel: Scree plot. Data from 2001 to 2015 is used.

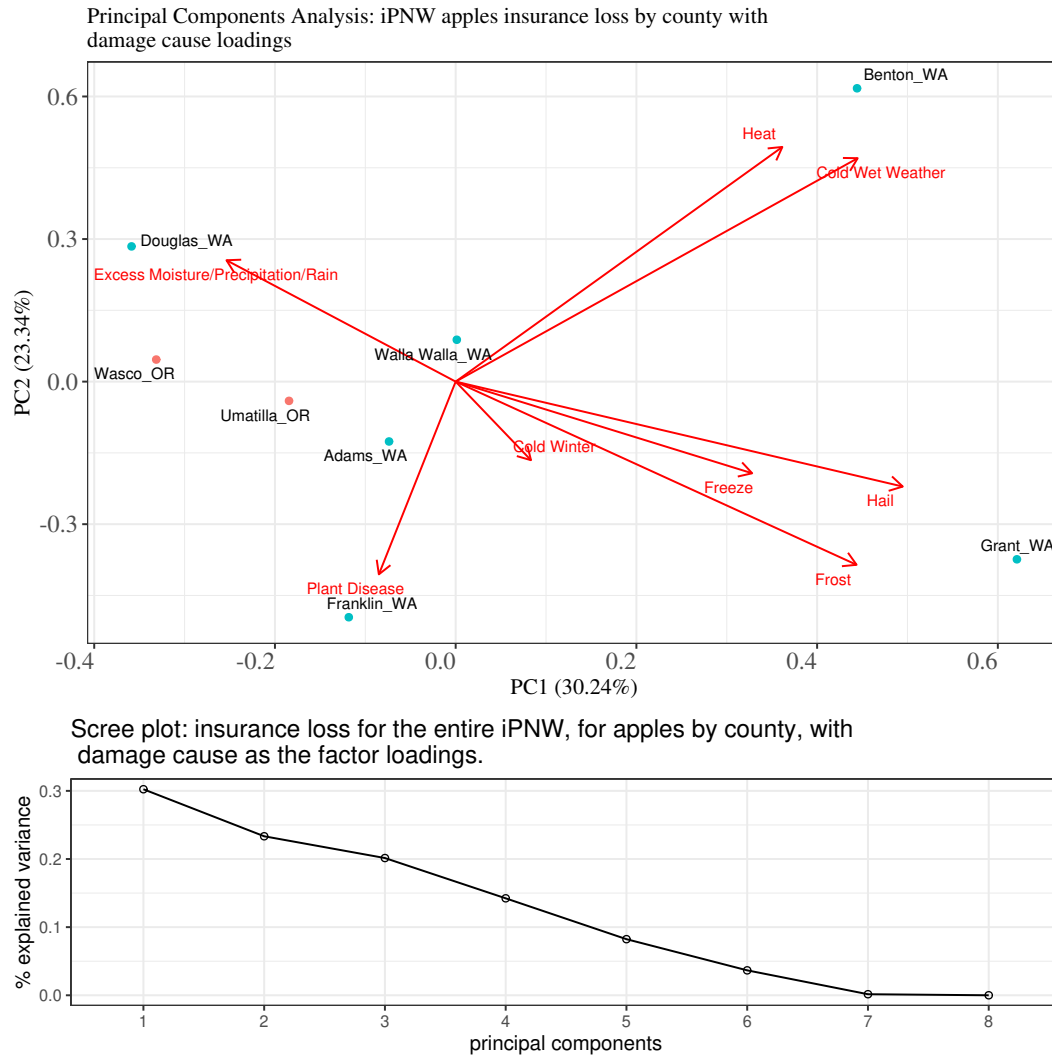


Figure 30: Top panel: biplot of insurance loss for the entire iPNW, for apples by county, with damage cause as the factor loadings. Bottom panel: Scree plot. Data from 2001 is 2015 is used.

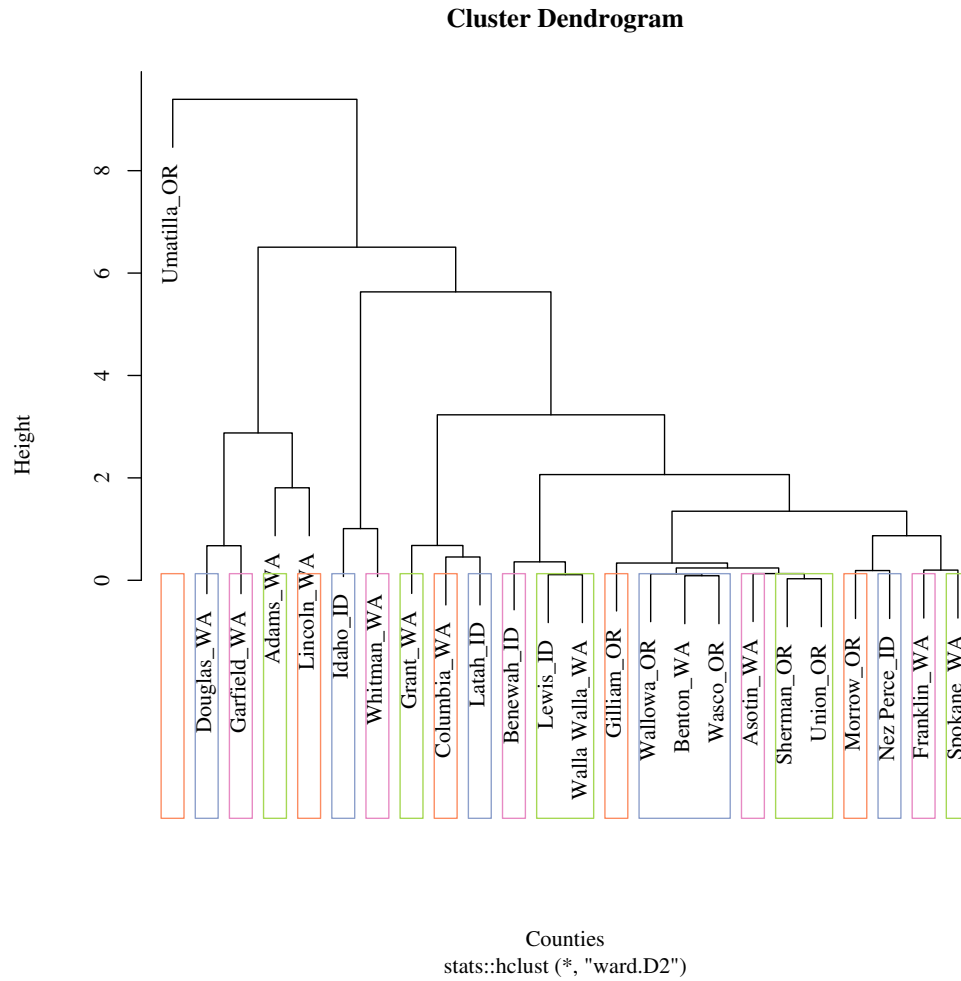


Figure 31: Hierarchical clustering dendrogram of Inland Pacific Northwest counties, using the first two principal components of the aforementioned dimensionality reduction exercise. This clustering method provides an alternative approach as compared to Kmeans clustering.

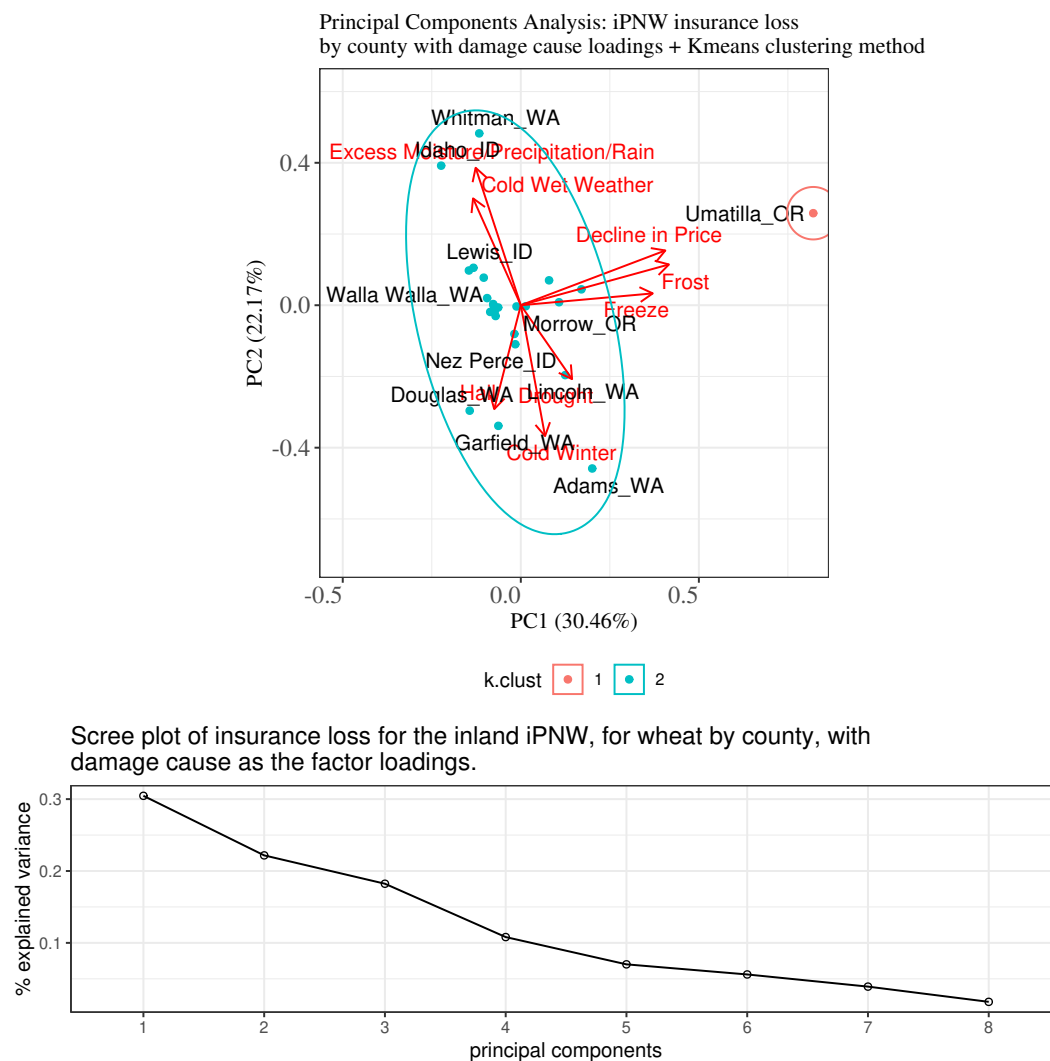


Figure 32: Top panel: biplot of insurance loss for the iPNW, for wheat by county, with damage cause as the factor loadings. Uses a Kmeans technique for grouping. Bottom panel: Scree plot. Data from 2001 is 2015 is used.